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KEYBOARD TAPE PUNCH AND KEYBOARD TYPING TAPE PUNCH (OFF LINE)

DESCRIPTION AND PRINCIPLES OF OPERATION

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Prepared for American Telephone and Telegraph Company by Teletype Corporation

1. GENERAL

1.01 The keyboard tape punch is an electromechanical device for perforating information in paper tape. An operator types the information on a keyboard and the punch converts it to mechanical motions that perforate the tape. The keyboard typing tape punch is similar to the keyboard tape punch except that it also types the information on the tape. The basic function of the units is to prepare perforated tape off-line for later use in teletypewriter communication applications.

1.02 The units consist of a keyboard-base, a motor, a typing or nontyping punch, a drive mechanism, a chad disposal mechanism and a cover. The configuration is shown in Figure 1.

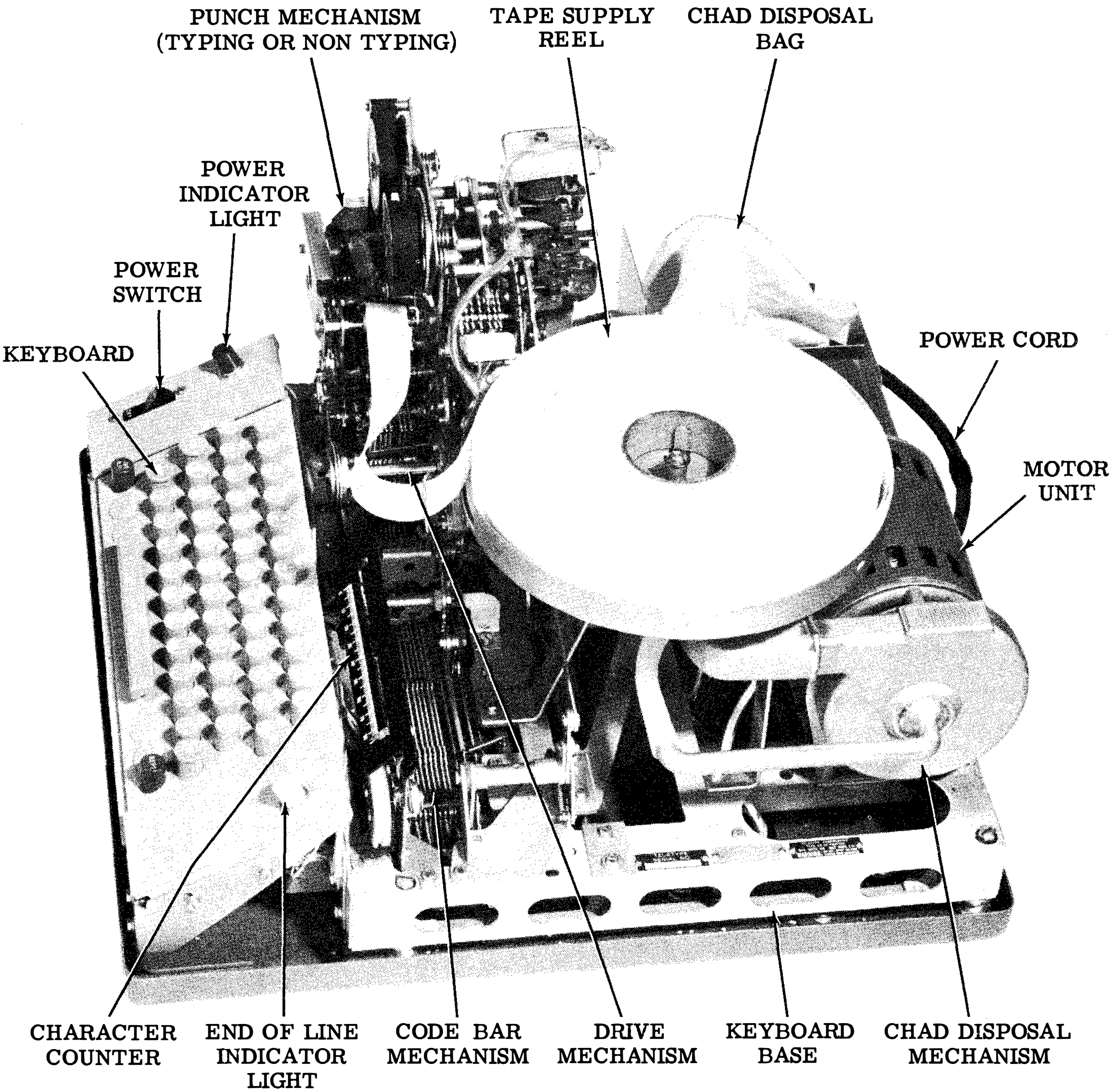


Figure 1 - Keyboard Typing Tape Punch Without Cover

1.03 Variations of the units will produce 5, 6, and 8-level tapes with either in-line or advanced feed holes. The units provide rapid blank tape feed-out, a powered backspace mechanism, a character counter, and an end-of-line indicator.

2. DESCRIPTION

MOTOR AND DRIVE MECHANISM

2.01 Motion for operating the keyboard tape punch and keyboard typing tape punch is supplied by a single-phase synchronous motor which operates from a 115 volt AC source and develops 1/20 hp at 3600 rpm. Mechanical power from the motor is supplied to the mechanisms through suitable shafting, flexible couplings and gearing.

KEYBOARD-BASE ASSEMBLY (Fig. 1)

2.02 The keyboard provides a means for controlling the perforating and typing of tape. It is designed to support a motor and to utilize a typing or nontyping perforator. The major sections of the keyboard are the base assembly, keyboard mechanism, and the character counter mechanism.

A. Base

2.03 The base assembly provides mounting facilities for the keyboard mechanism, the gear shaft assembly, tape container, typing or nontyping perforators, motors, and the character counter mechanism.

2.04 The character counter mechanism contains a scale which records in increments of one character in length up to 72 characters equivalent of a page-printed teletypewriter line. When 66 to 68 characters have been typed, an end-of-line indicator lamp lights. Depressing the return key resets the counter to zero and opens the lamp circuit.

2.05 The tape container stores the tape in a horizontal position above the chad removal apparatus. It is a welded structure fastened to the keyboard base with three brackets.

2.06 Chad is removed from the punch by a vacuum mechanism and is blown into a chad disposal bag. A tube runs from the top of the punch assembly to the center of the motor fan housing. A rotating fan creates a simultaneous sucking and blowing effect which draws the chad from the punch into the chad bag.

B. Keyboard Mechanism

2.07 The keyboard mechanism contains the keytops, keylevers, code bars and levers and other parts necessary to transform the intelligence contained in the manual selection of a keytop into a teletypewriter code combination, represented by code bar positions.

2.08 The keytops are positioned in the conventional three-row arrangement for 5-level units or the new four-row arrangement for the 8-level units. The space bar is located centrally below these keys. A wedge lock assembly prevents the simultaneous depression of more than one keytop.

TAPE PUNCH ASSEMBLY

2.09 The tape punch assembly converts the code combinations set up in the code bars into motions that perforate the combinations into the tape.

A. Drive Mechanism

2.10 Rotary motion from the motor is received by the main shaft and distributed by the clutch assembly. A rocker bail further distributes the motion to the mechanisms involved in printing and perforation.

B. Punch Mechanism

2.11 A perforating mechanism steps the tape, punches feed holes and perforates fully perforated code holes corresponding to the keylevers depressed. The tape is threaded by means of a handwheel.

C. Frame

2.12 A cast frame provides mounting facilities for the various mechanisms of the nontyping perforator.

D. Backspace Mechanism

2.13 The backspace mechanism is used to backspace tape to permit correction of an erroneous character or characters in the tape. The tape is backspaced until the first error is over the punch pins. The letters or rubout keylever is then operated to rub out (that is, to perforate with the letters code combination) the erroneous characters in the tape.

TYPING TAPE PUNCH ASSEMBLY

2.14 The keyboard typing tape punch is similar to the keyboard tape punch but in addition to preparing punched tape, it also types the information that is perforated in the tape.

A. Typing and Positioning Mechanisms

2.15 The characters used in printing are embossed on a bakelite typewheel. The typewheel positioning is controlled by the axial and rotary positioning mechanisms in conjunction with a correcting mechanism. Printing and perforating occur simultaneously at the punch block, but the characters are printed six spaces to the right of the corresponding code combinations. The typewheel is retracted at the end of each operation to make the last printed character visible.

B. Ribbon Mechanism and Function Box

2.16 A ribbon feed mechanism supplies the ink for typing, advances the ribbon, and reverses its direction of feed. A function box enables the unit to perform various auxiliary functions.

3. TECHNICAL DATA

APPROXIMATE DIMENSIONS

Width	16-5/16"
Depth	19"
Height	11"
Weight	43 lbs.

TAPE

Type	Standard Communications
Width	One inch maximum
Perforations	Fully Perforated

MOTOR UNIT

Type	Synchronous
Horsepower	1/20
Input Voltage	115 V AC, ±10%
Phase	Single
Frequency	60 Cycles, ±0.75%
Input Current	
Starting	9 Amperes
Running	1.85 Amperes
Power Factor	
Full Load	30%
Watts Input	
Full Load	65
Start Capacitor	
Rating	43-48 UF
Speed	3600 RPM
Rotation	CCW Viewed from Fan End

KEYBOARD CAPACITY

Keyboard Tape Punch	150 WPM
Keyboard Typing Tape Punch	100 WPM

4. GENERAL OUTLINE OF OPERATION

A. General

4.01 The operation of the keyboard tape punch and the keyboard typing tape punch is essentially the same, except for the addition of a typing mechanism to the keyboard typing tape punch. The sequence of operation to the rocker bail assembly, into the perforating mechanism, is applicable to both units. Motion from the rocker bail assembly to the typing mechanism, applies only to the keyboard typing tape punch. The relationship of the operating mechanisms of the keyboard tape punch and the keyboard typing tape punch are illustrated by the block diagram (Fig. 2).

B. Perforator Mechanism

4.02 AC power is supplied to the motor unit through the power switch. The motor converts electrical energy into rotary mechanical motion, which is geared down and transferred to the main shaft through the jack shaft.

4.03 When a key on the keyboard is depressed, the appropriate code combination is set up in the code bars and in the punch slides. The code bars through the trip assembly, trip the function cam-clutch. From the cam-clutch motion is transferred to the reset mechanism to reset the code bars.

4.04 The function cam-clutch, driven by the main shaft, imparts motion to the rocker bail assembly. The rocker bail transfers motion to the perforator main bail, which distributes it to the punch slides and the tape feed parts. The punch slides having received their arrangement from the code bars, cause the punch pins to perforate code holes in the tape corresponding to the depressed keylevers. Late in the function cycle, the tape feed parts advance the tape one character.

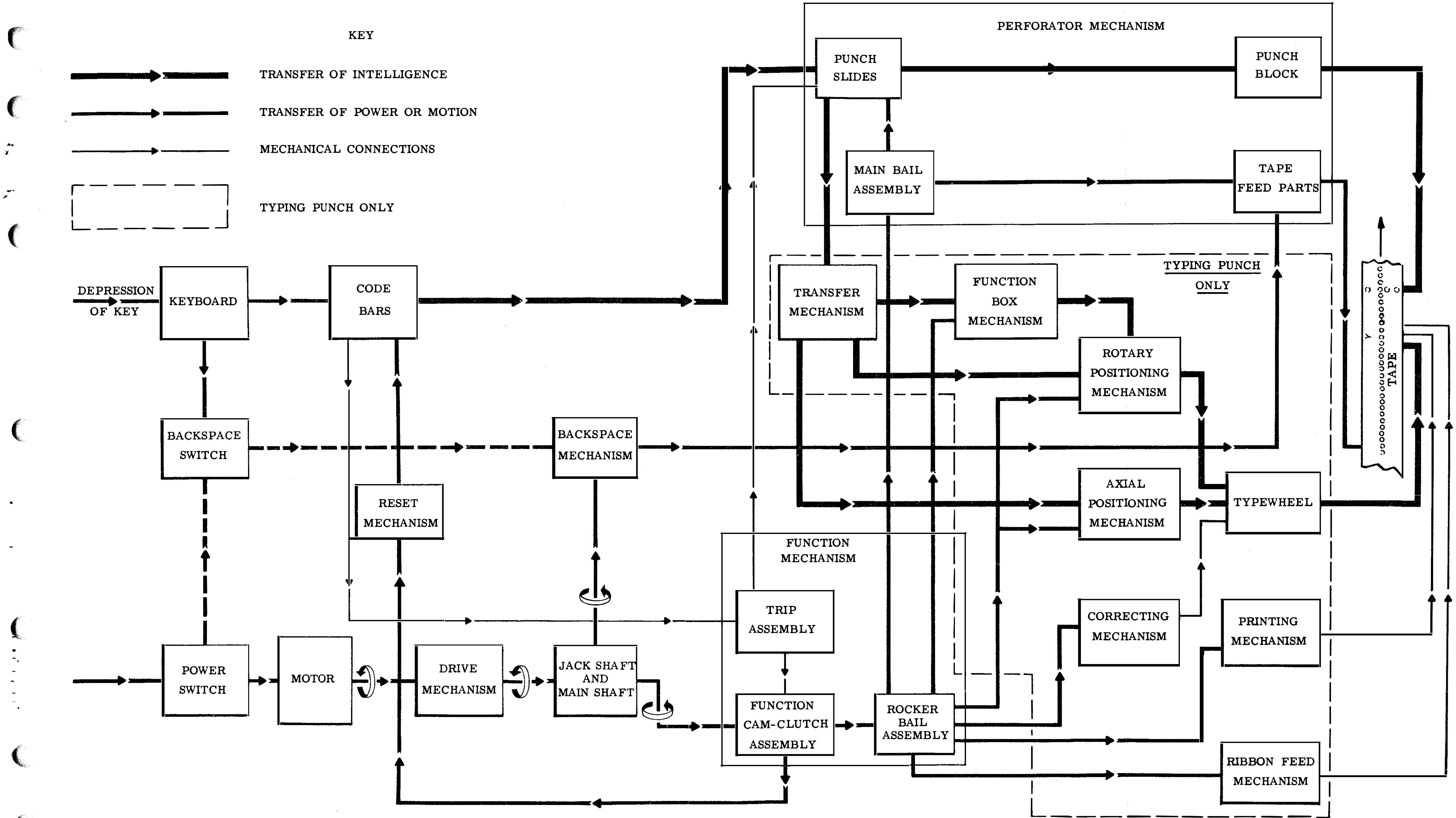


Figure 2 - Block Diagram of the Keyboard Tape Punch and Keyboard Typing Tape Punch

C. Typing Mechanism

4.05 Besides the perforator mechanism, the rocker bail assembly distributes motion to the function box mechanism, the rotary positioning mechanism, the axial positioning mechanism, the correcting mechanism, the printing mechanism and the ribbon feed mechanism.

4.06 The transfer mechanism, having received its arrangement from the punch slides, causes positioning of the axial and rotary positioning mechanisms, which selects the typewheel character to be printed.

4.07 The printing mechanism supplies the force to imprint the selected character, and the ribbon feed mechanism provides ink for printing and advances the ribbon.

4.08 The backspace mechanism receives its motion from the main shaft. When the backspace key is depressed the backspace mechanism moves the perforated tape one code space to the right.

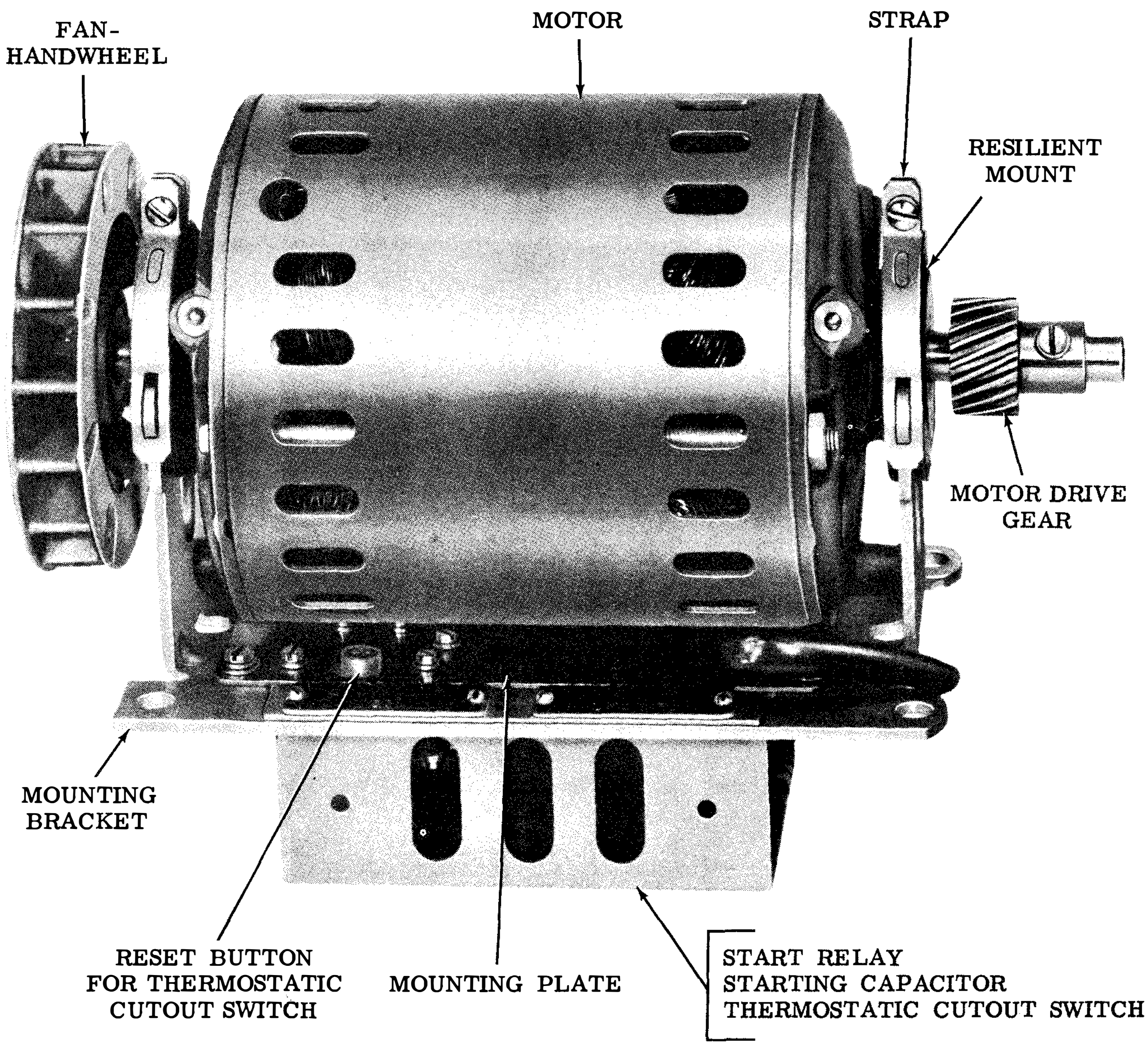


Figure 3 - Synchronous Motor Unit

5. MOTION (Fig. 3)

MOTOR

5.01 A synchronous motor provides rotary motion to the various mechanisms of the tape punches. Mechanical power from the motor is transferred to the various mechanisms through suitable shafting, couplings and gearing. The motor unit mounts on the right rear corner of the keyboard base (Fig. 2).

5.02 The stator of the synchronous motor has two windings: a starting winding and an operating (or run) winding. The start winding, starting capacitor and the normally open contacts of the starting relay are connected in series. The coil of the current-operated starting relay is connected in series with the operating winding. When power is applied, the initial current through the operating winding (and also the starting relay coil) energizes the relay, and its contacts close the circuit to the starting winding. As the speed of the rotor increases, the current in the operating winding decreases and, when the current has decreased to a predetermined magnitude, the starting relay deenergizes. Its contacts open and remove the starting winding from the operating circuit. The rotor continues to accelerate until it reaches the synchronous operating speed (3600 rpm). Rotation is in a counterclockwise direction, as viewed from the fan or short-shaft end of the motor.

5.03 The thermostatic cutout switch is connected in series with both stator windings. This temperature operated device opens the circuit to these windings whenever excessive current is drawn, such as may occur if the motor is stalled, thereby preventing overheating and damage to the motor. The switch may be reset after the unit has cooled by depressing the reset button.

DISTRIBUTION

5.04 Two drive shafts are used: the main shaft which carries the function clutch and cam sleeve assembly, and a lower shaft called the jack shaft, which is geared directly to the motor. The jack shaft on the nontyping perforator is driven at 1,260 rpm. A two cycle clutch and cam sleeve is used to drive the punch at the rate of 1,028 opm. The typing perforator jack shaft is driven at 1,200 rpm. A single cycle clutch and cam sleeve is used to drive the punch at a rate of 685 opm.

6. DEPRESSION OF KEYS (Fig. 4)

6.01 As a key is struck on the keyboard the universal bail rotates back, releasing the universal bail latch lever which in turn strikes the code bar reset bail latch. Thus the reset bail is allowed to fall to the right releasing those code bars which are to be selected. The selected code bars move to the right. As a code bar moves to the right, its left-hand end contacts the latch lever causing it to pivot counterclockwise, unblocking the punch slide which moves to the left under the action of its bias spring when the punch slide reset bail is tripped. As the code bar is reset to the left by the code bar reset bail, the latch lever returns to its normal position. Meanwhile, the punch slide has been reset to the right by its reset bail, returning the system to its normal latched up condition.

6.02 The reset cam follower bracket assembly provides the linkage between the clutch trip bar and the perforator cam assembly, thus permitting the keyboard to be reset by the tape perforator. The assembly consists of a horizontal hollow shaft with internal oilite bearings pivoting on a fixed shaft supported on either end by brackets. To one end of the hollow shaft is welded an arm which terminates in a hook and connects to the clutch trip bar assembly. Screwed to the top of this arm is a link mechanism that follows the reset cam on the main shaft of the perforator. This assembly is mounted on the base to the right of the tape perforator.

6.03 Operation of the REPT key lever simultaneously with one of the other key levers causes the character to be repeated as long as the REPT key lever is held operated (Fig. 5). The operated REPT key lever causes its function lever to raise the right end of the nonrepeat lever and rotates it about its pivot point. In this position, the nonrepeat lever cannot be engaged and operated by the code bar bail, therefore, the nonrepeat lever crank will not reset the operated code bar bail latch. The code bar bail

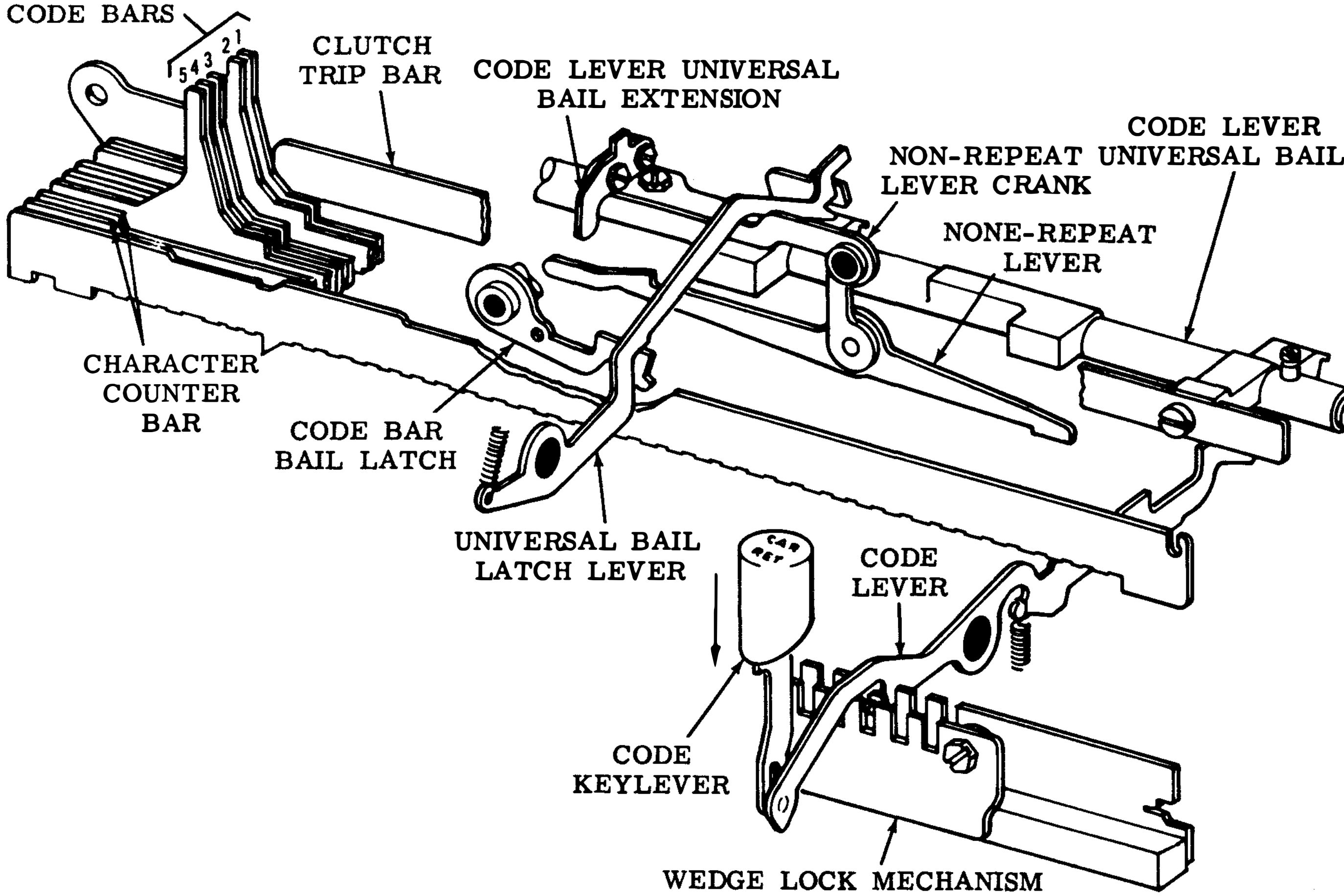


Figure 4 - Code Bar and Code Lever Mechanism

and universal bail latch lever are thus maintained in their operated positions and the code bar bail follows the eccentric arm movement back and forth until the REPT key lever is released.

7. PUNCH TRIPPING AND KEYBOARD RESET

TRIPPING

7.01 The perforator trip system consists of a clutch trip bar and a perforator trip lever. The trip lever operating arm, the trip lever release lug, the main trip lever and the clutch release lever are all mounted on the perforator frame. When a key is depressed, the reset bail is released and moves to the right allowing the clutch trip bar to move to the right. In doing so, it contacts the trip lever operating arm causing it to move counterclockwise. As it moves counterclockwise, it engages the trip lever release lug which engages the main trip lever allowing the clutch release lever to fall, thereby tripping the perforator clutch.

7.02 The fork on the main trip lever engages the punch slide reset bail, releasing the punch slides just before the clutch release lever is released. As the reset cam rotates through its cycle, the clutch release lever is rotated clockwise to its reset position by the operation of the reset lever on the reset pin. This clockwise action draws the trip lever lug up to its reset position due to the connecting spring between the trip lever lug and the clutch release lever. As the clutch release lever continues in its clockwise resetting motion, it allows the main trip lever to be pulled back by spring action to its reset position. The clutch release lever continues its clockwise motion for a few more degrees to assure clearance for the main trip lever and then drops back to its reset position as the reset lever drops over the reset pin. This is a nonrepeating, noninterfering perforator trip system inasmuch as it allows the perforator to be tripped at any keyboard speed without causing interference even though both mechanisms are reset at different speeds.

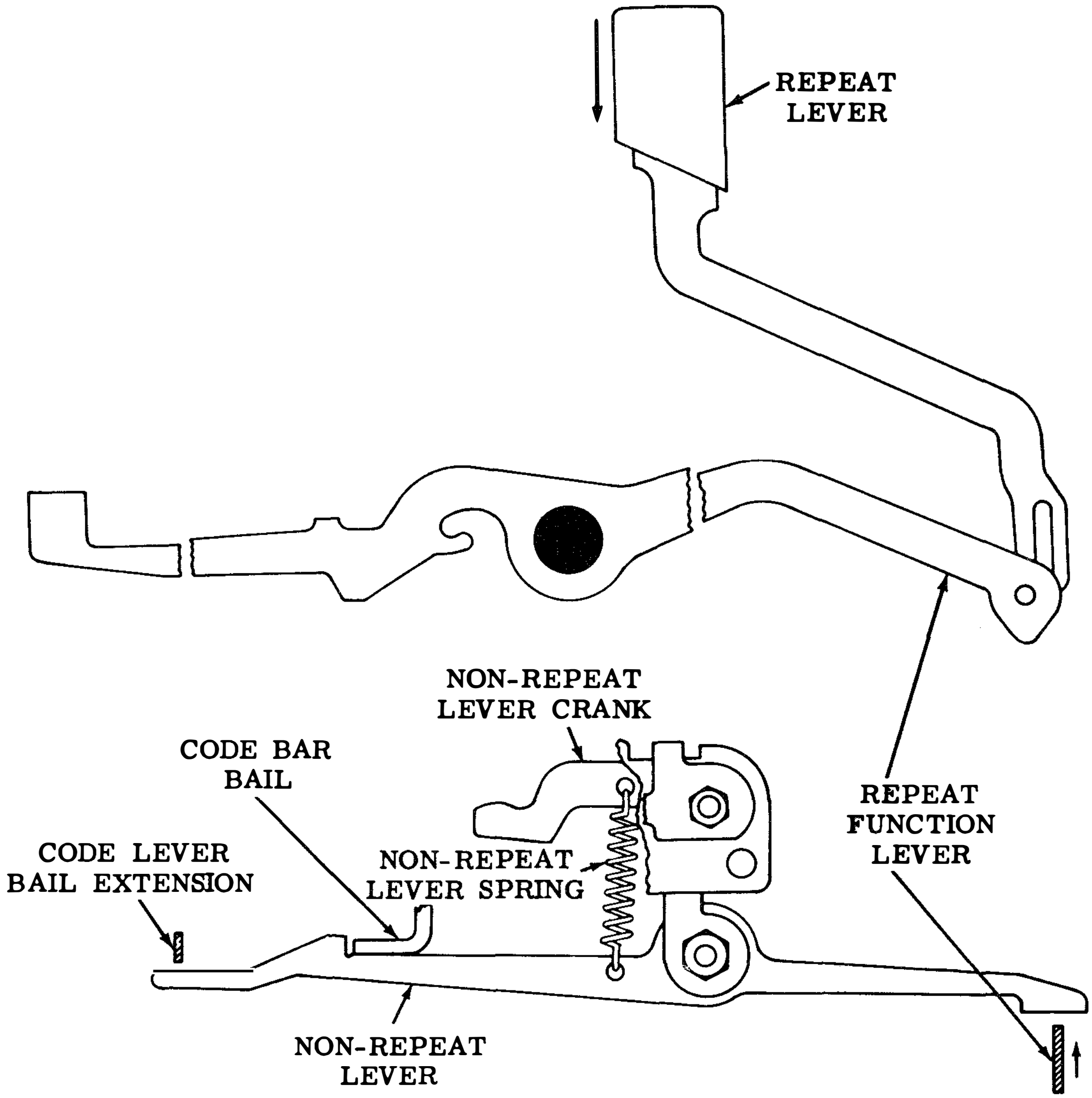


Figure 5 - Repeat Mechanism

RESET

7.03 The code bar reset mechanism operates from the reset cam on the perforators. The nontyping perforator resets the keyboard at approximately 150 wpm, providing the effect of a "free" keyboard. The typing perforator resets the keyboard at approximately 100 wpm.

7.04 When a key is depressed, the code bar reset bail is allowed to fall to the right. The clutch trip bar which is coupled to the code bar reset bail also moves to the right. Near the end of the clutch trip bar's fall to the right, the perforator clutch is tripped. The reset cam begins to rotate counterclockwise and as it does, the reset cam follower arm pivots clockwise to a maximum position following a constant acceleration and deceleration curve. It is then allowed a few degrees and then rapidly, in practically a free fall position, to return to its initial position. In doing this, the clutch trip bar is pushed back to its original position by means of the reset arm mechanism. To be sure that the punch slides are completely reset over the latches by the punch slide reset bail before the reset bail is again tripped for the following character, it is necessary to delay the fall of the clutch trip system to the right. This is accomplished by delaying the return of the reset cam follower arm to its rest (fully counterclockwise) position until the punch slides are fully reset, thereby reducing the time allowed for the cam follower to return to its normal condition after resetting the system. The curve chosen permits a return time which closely approaches the "free-fall" condition, yet allows the roller to follow the cam throughout this fall.

7.05 These features preclude the possibility that the punch slide reset bail will be re-tripped before it has completely reset the punch slides over their latches, causing spurious tape perforation. As the reset cam follower arm pivots clockwise it resets the clutch bar to the left until it reaches a maximum point. At this point the reset bail latch lever is in position to latch the code bar reset bail. As the clutch trip bar moves to the right under the action of the reset cam, the reset bail is latched, preventing any further movement of the clutch trip bar to the right (unless a second key is immediately depressed) as the reset cam follower arm returns to its normal position.

8. TAPE PUNCHING

MOTION (Fig. 7)

8.01 After the function clutch has been tripped the function cam and the rocker bail translate the rotation of the shaft into simple harmonic motion which the rocker bail transfers to the perforating mechanism (Fig. 7). Each function cycle, the function cams bear against the rollers and cause the bail to rock to the left during the first part of the cycle and then back to its home position during the latter part of the cycle.

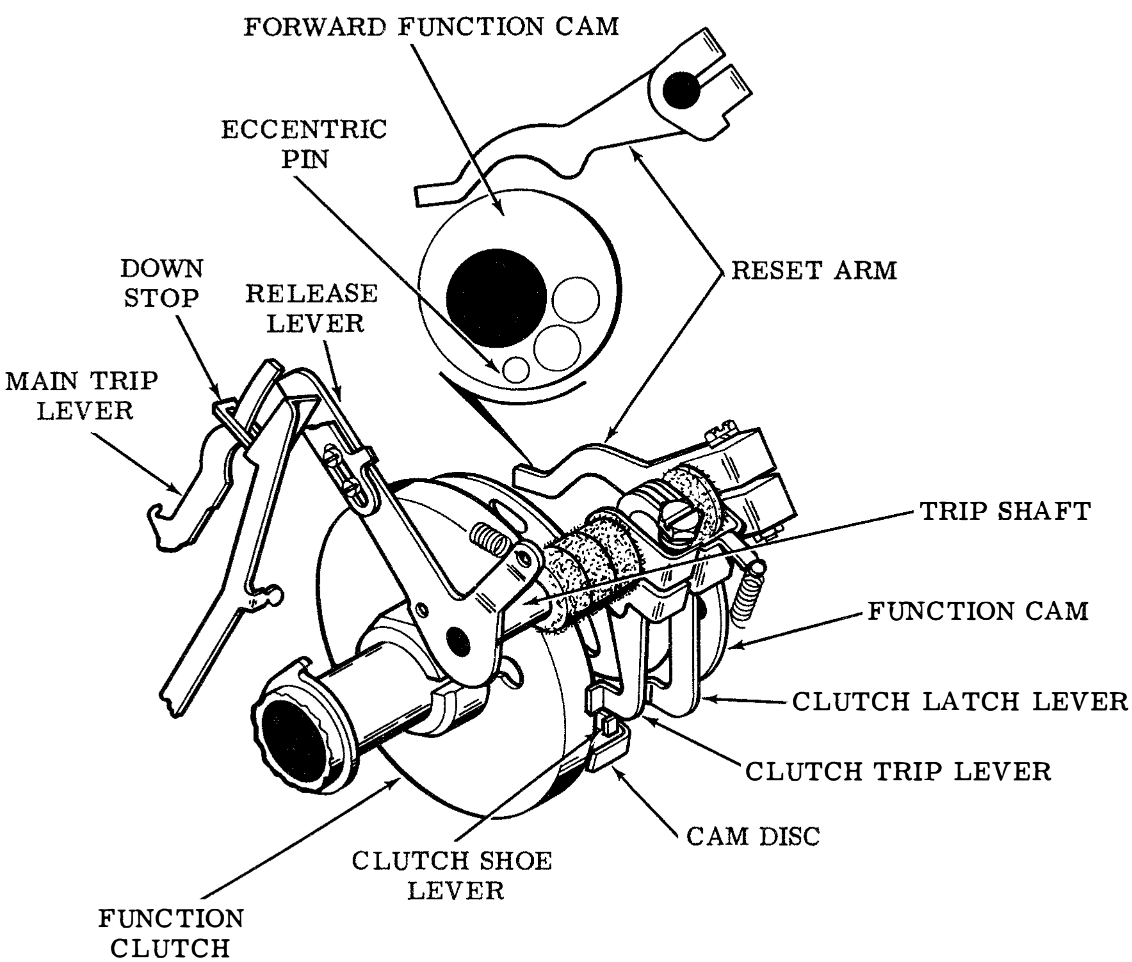


Figure 6 - Function Cam - Clutch and Clutch Trip Assembly

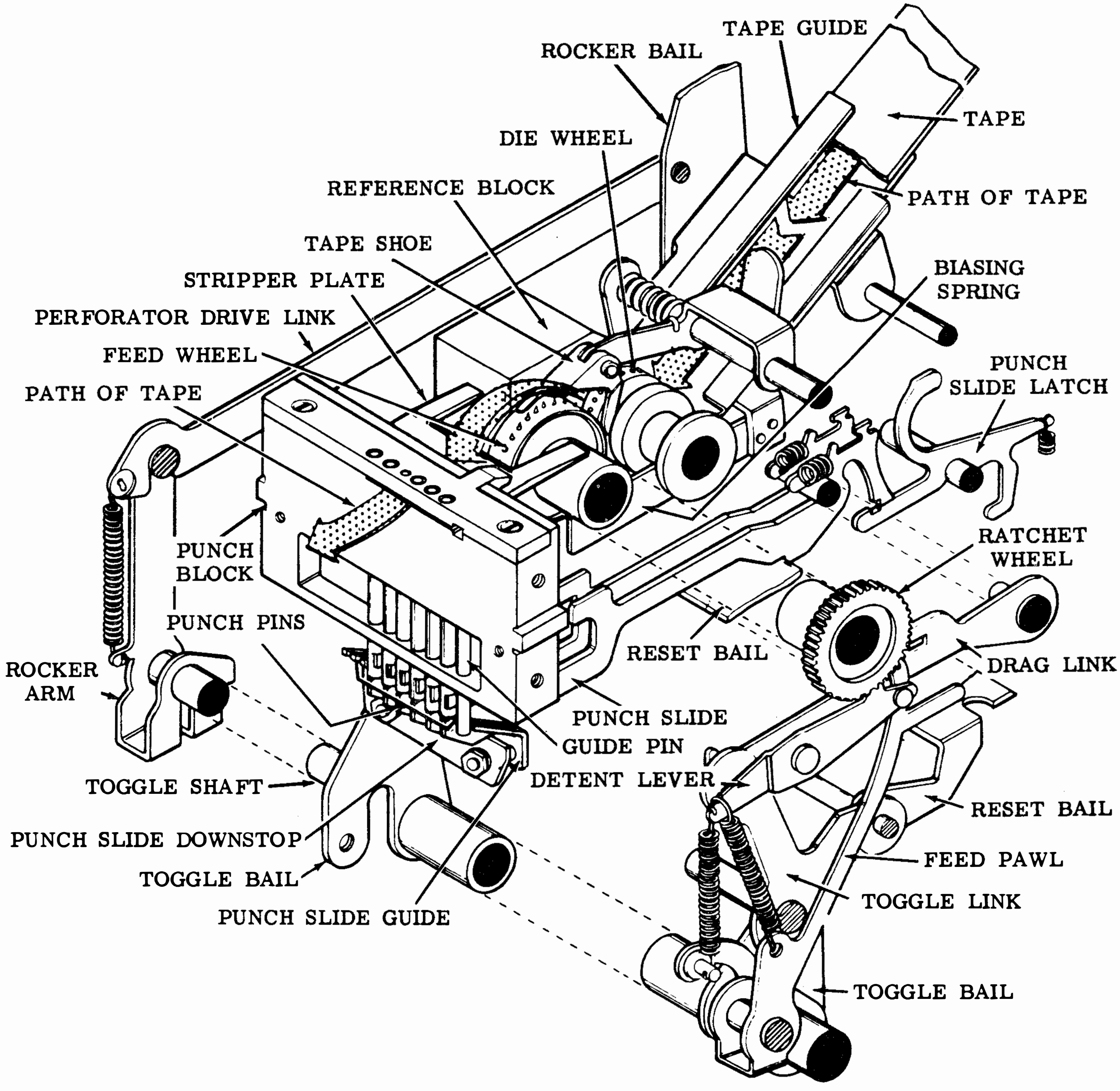


Figure 7 - Perforating Mechanism

PUNCHING AND FEEDING (Fig. 7)

A. General

8.02 The perforating mechanism rolls the tape between a feed wheel and a die wheel, which does not perforate the feed hole but merely regulates the amount of tape feed. The punch perforates round holes corresponding to the keys depressed on the keyboard. It also perforates a smaller feed hole.

B. Perforating

8.03 The selected punch slides move to the left, and the unselected slides are retained to the right by their latches. In the selected position, a projection of each slide extends over the slide post. Since a feed hole is perforated for every operation, the punch slide associated with the feed hole punch pin is designed so that it is always in a selected position. During the first part of the function cycle, the rocker bail moves to the left and, by means of a drive link and rocker arm, rotates the toggle shaft and bail counterclockwise. Toggle links attached to the front and rear of the bail lift the slide post and move the reset bail to the left. The selected slides are carried upward by the post and force their associated pins through the tape. The slides thus become an integral part of the main bail assembly during the perforating stroke. Approximately midway through the function cycle, the function trip assembly lifts the reset bail.

8.04 During the last half of the cycle, the toggle bail is rotated clockwise, pulling the slide post down and lowering the selected punch slides. The punch slides, which engage notches in their respective punch pins, pull the punch pins down below the tape. The main bail assembly and the selected punch slides and their associated punch pins move as a unit during the perforating stroke, both up and down. The punch pins are positively driven and retracted to produce the fully perforated tape.

C. Feeding (Fig. 7)

8.05 Tape feeding is accomplished after perforation during the last half of each function cycle. The tape is threaded down through a tape guide and then up between a feed wheel and die wheel. A feed pawl, driven by the toggle bail, acts upon a ratchet and rotates the feed wheel which, by means of sharp pins and a slot in the die wheel, advances the tape one character at a time. A detent with a roller that rides on the ratchet holds the feed wheel and tape in position during perforation. The detent and feed pawl springs are so positioned that the pressure of the detent on the ratchet is high during the first half of the perforation, but is low during idling and the last half of the cycle to facilitate tape threading and feeding. A tape shoe retains the tape on the feed wheel, a biasing spring holds it back against a reference block so that the feed holes are punched a constant distance from the edge. The tape is stripped from the feed wheel by a stripper plate, passes into the punch block where it is perforated and finally emerges at the left.

9. TYPING (KEYBOARD TYPING TAPE PUNCH ONLY)

GENERAL

9.01 The characters used to type the intelligence - letters, figures and symbols representing the various functions - are embossed on the cylindrical surface of a metal typewheel. During the function cycle, the axial and rotary positioning mechanisms having received the intelligence from the transfer mechanism, position the typewheel so that the character represented by the depressed keylever is selected. Following the typewheel positioning, the correcting mechanism accurately aligns the selected character. Then the printing mechanism by means of a hammer, drives the type and inked ribbon against the wheel and imprints the character. A ribbon feed mechanism advances the ribbon and reverses its direction of feed when one of the two ribbon spools is depleted. Near the end of the function cycle, the axial positioning mechanism retracts the typewheel and the ribbon guide so that the last printed character is visible. The letters or figures code combination sets up an arrangement in the transfer mechanism which permits the function box to operate and cause the rotary positioning mechanism to shift the typewheel.

MOTION

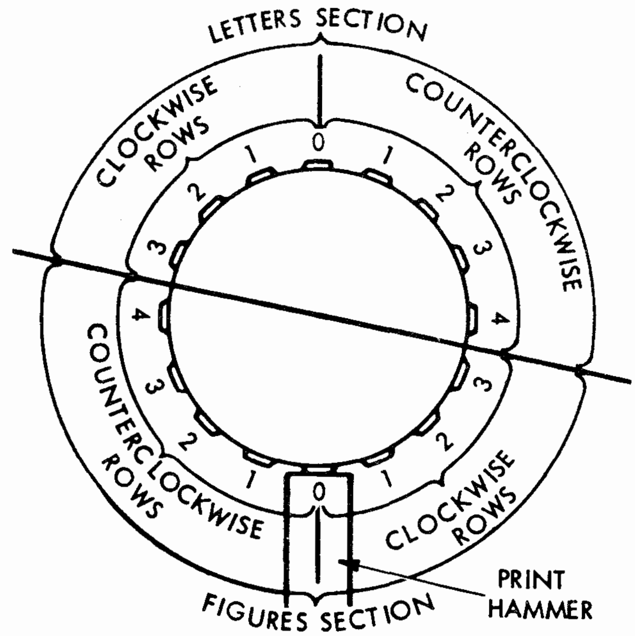
9.02 In addition to the punch mechanism, the rocker bail on the keyboard typing tape punch transfers motion to the correcting mechanism, function box, printing mechanism, oscillating assembly and the push bars of the axial and rotary positioning mechanisms. During each function cycle, the function cams bear against the rollers and cause the bail to rock to the right during the first part of the cycle, and then back to the home position during the latter part of the cycle.

TYPEWHEEL POSITIONING

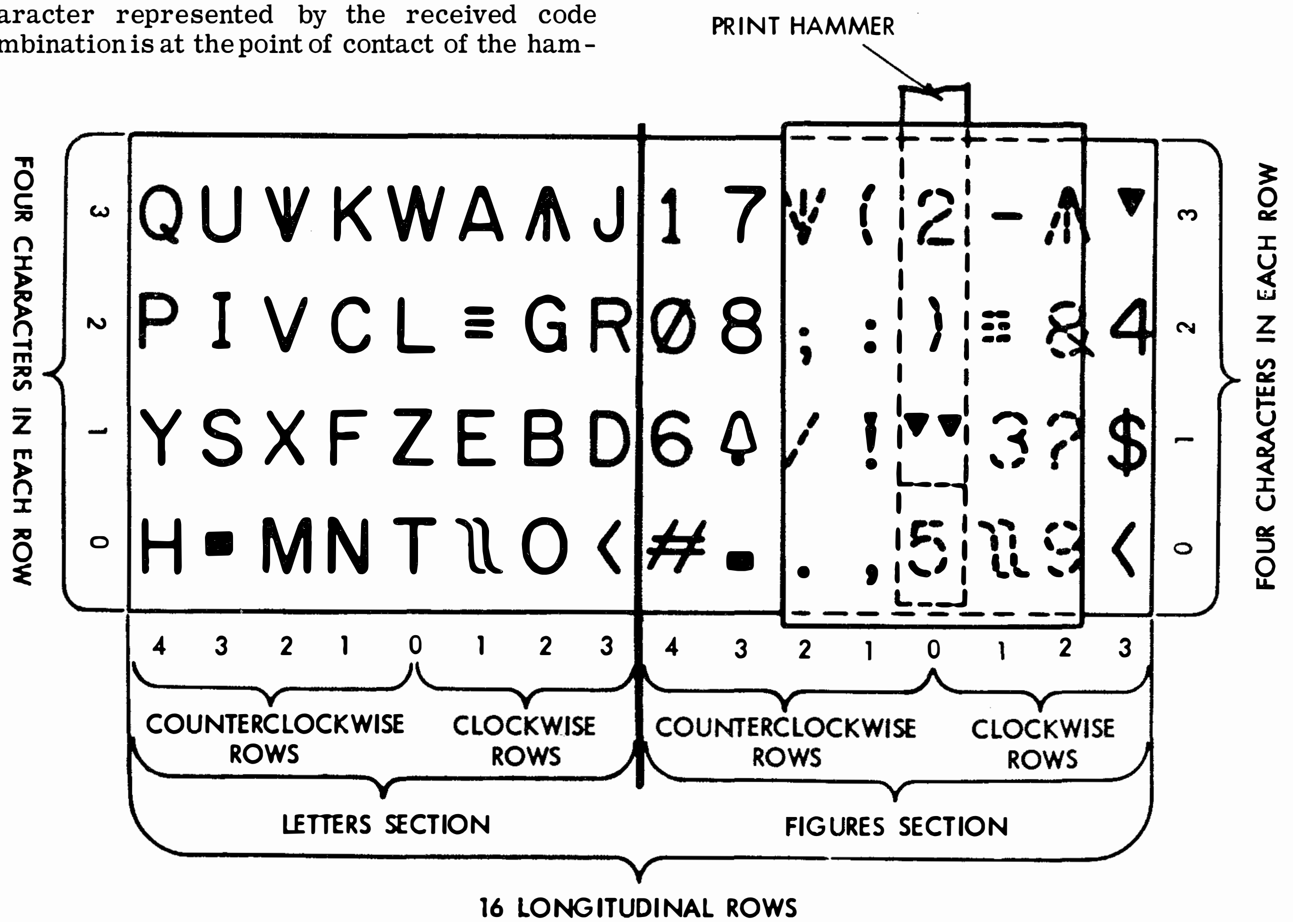
A. General

9.03 A typical typewheel character arrangement is shown in Figure 8 which the wheel's cylindrical surface is shown rolled out into a plane. There are 16 longitudinal rows, each of which is made up of four characters numbered 0 to 4 from front to rear. The surface is divided into two sections, a letters and a figures, each containing eight rows. The fifth row counterclockwise from the division line in both sections is numbered 0, and there are four rows in one direction from 0 numbered 1 to 4 and designated as counterclockwise rows and three rows in the other direction numbered 1 to 3 and designated as clockwise rows. It should be noted that the clockwise and counterclockwise modifiers refer to the direction of rotation of the wheel to select the rows and not to their position on the wheel.

9.04 Each printing operation (excluding those devoted to the letters - figures shift) begins and ends with the typewheel in the home position of the section containing the character to be printed, i.e., with the No. 0 character of the No. 0 row at the point of contact of the print hammer. (Actually, inasmuch as the wheel is retracted to show the last printed character, the No. 0 character is slightly to the rear, but for this discussion it will be assumed that it is at the point of contact.) During the printing operation, the axial and rotary positioning mechanisms transferring separate but simultaneous motions to the wheel, position it so that the character represented by the received code combination is at the point of contact of the ham-



a.
FRONT VIEW SHOWING 16 LONGITUDINAL ROWS



b.
TOP VIEW SHOWING CYLINDRICAL SURFACE IN A PLANE

Figure 8 - Typical Typewheel Character Arrangement

mer at the time of printing. The rotary mechanism, which is controlled by the No. 3, 4 and 5 selecting elements of the code, revolves the wheel so as to select the proper row; and the axial mechanism, which is governed by the No. 1 and 2 elements move it forward and rearward along its axis so as to select the proper character in the row. Rotation of the typewheel to print in either the letters or the figures section is controlled by the No. 7 bit of the code.

9.05 To illustrate the above, if the wheel is in the figures condition and the numeral "0" is to be printed, there is no movement of the wheel during the printing operation, because "0" is already at the point of contact of the hammer. However, if the letter "F" is to be printed, the wheel is first shifted eight rows to the letters home position. Then during the next operation, it is rotated three rows counterclockwise and moved forward two characters so that "F" is at the point of contact of the hammer. Printing takes place and the wheel is then returned to the letters home position.

B. Rotary Positioning

9.06 The rotary positioning mechanism revolves the typewheel so that the row containing the character to be printed is aligned with the print hammer at the time of printing. Mounted on the front plate, the mechanism in-

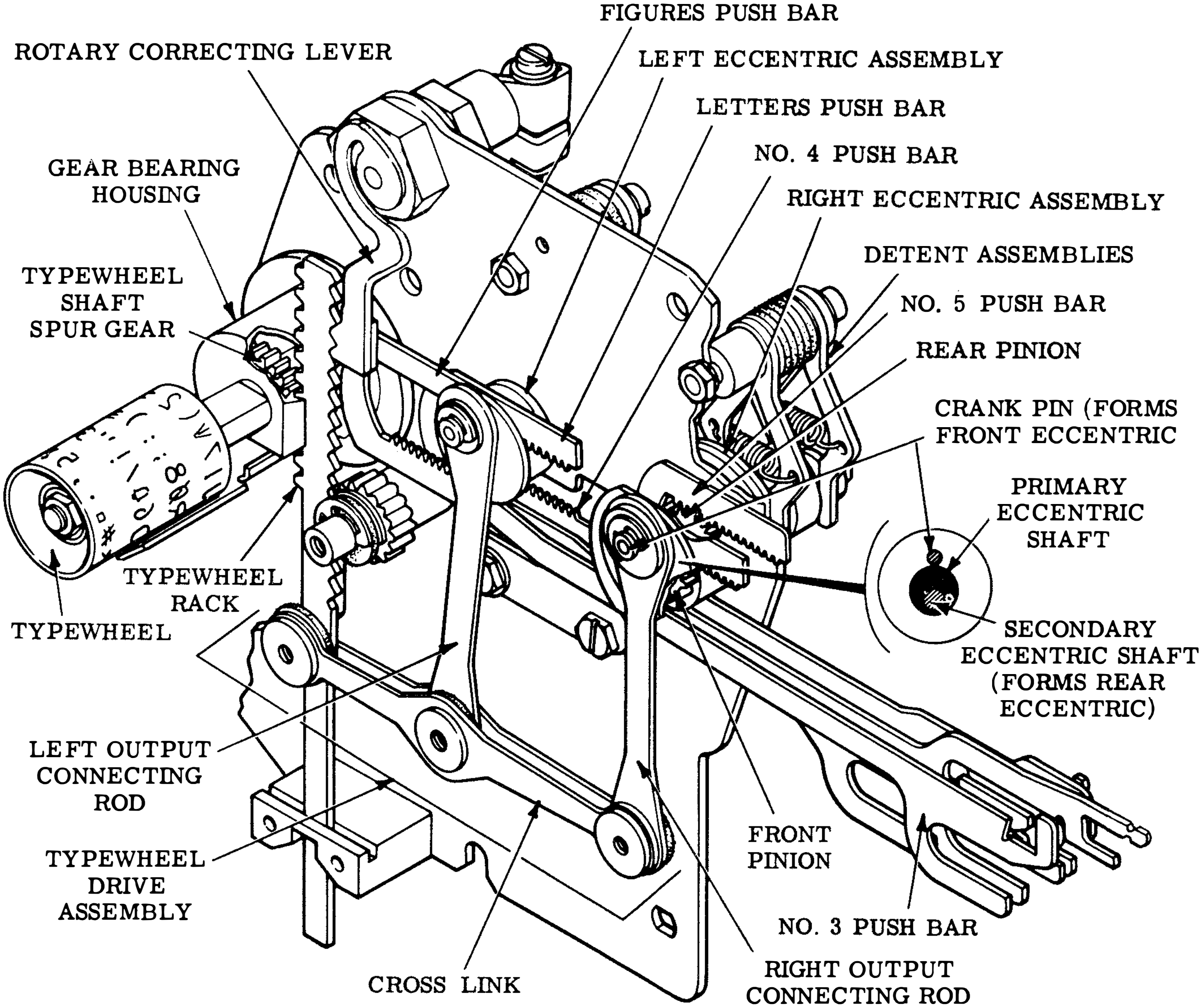


Figure 9 - Rotary Positioning Mechanism

cludes two eccentric assemblies as shown in Figs. 9 and 10. Each assembly includes a primary shaft, a section of which is formed into a pinion. A secondary shaft, mounted in the primary and offset from its center, forms an eccentric, referred to as the rear eccentric. A portion of the secondary shaft is also a pinion, and a crank pin mounted on its disc like forward surface forms a secondary or front eccentric. Each of the four pinions of the two eccentric assemblies is engaged by the rack of a pushbar - the No. 3 bar engages the right front pinion, the No. 4 engages the left rear pinion and the No. 5 engages the right rear pinion. The left front pinion is engaged by both the letters and the figures pushbar.

9.07 The eccentric assemblies are linked to a typewheel shaft by a drive assembly as shown in Fig. 9. The typewheel is secured to the front of the shaft which is supported by a bearing housing mounted at the left rear of the front plate Fig. 11. A spur gear which meshes with the typewheel rack rides on the shaft in a bearing housing. The shaft is free to move axially in the housings and the spur gear, but flats in its circumference which bear against flats in the gear ensure its rotating when the gear rotates.

9.08 When in response to a marking condition a pushbar is lifted by its bell crank, the rocker bail operating blade (see Figures 15 and 18) engages a slot in the bar and moves it to the left during the first part of the function cycle. The bar, by means of its rack and the mating pinion, rotates the associated eccentric one half revolution where it is locked in position by a detent assembly while printing takes place. When the bail rocks back to the right during the latter part of the cycle, it returns the bar and eccentric to their home position where the ec-

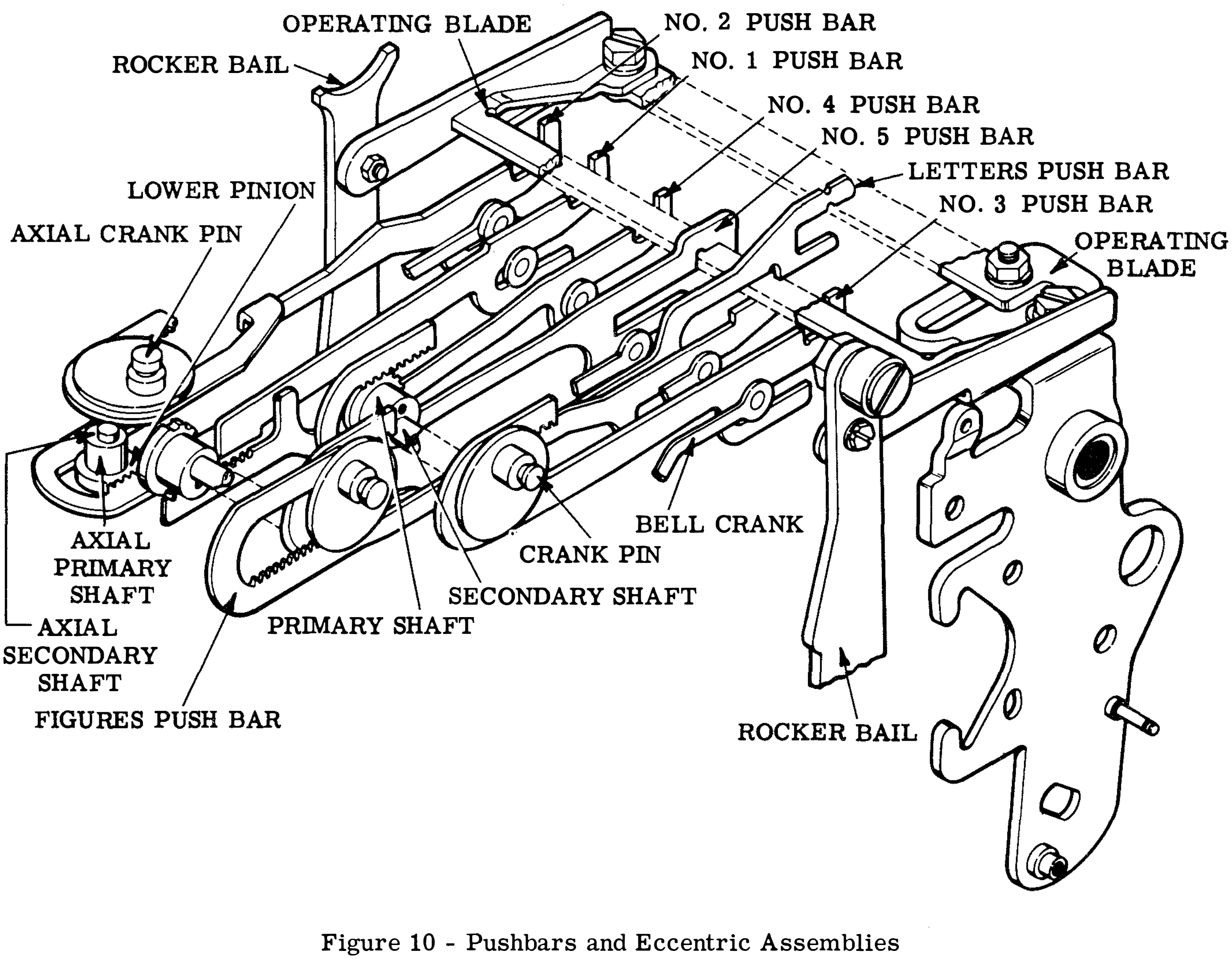


Figure 10 - Pushbars and Eccentric Assemblies

centric is again detented. The preceding does not apply to the No. 7 pushbar. In both assemblies one-half revolution of the rear eccentric results in its maximum vertical displacement which is transferred through the front eccentric to a crank pin. Similarly, one-half revolution of the front eccentric results in its maximum displacement being transferred to the crank pin. If both eccentrics are rotated, the displacement of the crank pin is equal to the algebraic sum of the two displacements which may be in either the same or opposite directions. Both assemblies are so designed that, if the displacement of the rear eccentric is taken to be one unit, the displacement of the front eccentric is four units. Four permutations are thus available: zero (neither eccentric displaced), one unit (rear eccentric displaced), four units (front eccentric displaced) and five or three units depending on how the assembly is set up (both eccentric displaced).

9.09 In the right assembly the home position of the rear eccentric is down and the home position of front eccentric is up (Fig. 10). Thus their displacements are in opposite directions - up for the rear and down for the front - and their aggregate displacement is three units downward. Any displacement occurring in the right assembly is imparted to the typewheel rack in equal quantity but opposite direction. For example, if the No. 5 pushbar is selected, it causes the right rear eccentric to be displaced, and one unit of upward motion is transferred through a right output connecting rod to the right end of a cross link (Fig. 9). The cross link pivots about a left output connecting rod and at its left end imparts one unit of downward displacement to the typewheel rack. The rack rotates the spur gear, shaft and typewheel one row of characters clockwise from the home position, and the No. 1 clockwise row (Fig. 8) is presented to the print hammer at the time of printing. On its right stroke the No. 5 pushbar returns to eccentric and the typewheel to their home positions. In a similar manner, selection of the No. 3 pushbar results in a four-row counterclockwise rotation of the typewheel; and selection of both the three and five bars results in a three-row, counterclockwise rotation of the typewheel.

9.10 The home position of the left rear eccentric is up, and any displacement appearing in the left assembly is transferred to the typewheel rack in double quantity in the same direction. When the No. 4 pushbar is selected, the left rear eccentric is displaced one unit downward. This movement is conveyed through the left output connecting rod to the approximate mid-point of the cross link. The cross link pivots about the right output connecting rod and its left end imparts two units of downward movement to the typewheel rack which rotates the typewheel two rows clockwise from its home position.

9.11 When both eccentric assemblies are displaced, the motion occurring in the typewheel rack is equal to the algebraic sum of the motions resulting from each assembly. For example, if the No. 3, 4 and 5 pushbars are all selected, three units of upward displacement from the right assembly and two units of downward displacement from the left assembly occur as one unit (3-2=1) of upward displacement in the rack and a counterclockwise rotation of one row in the typewheel. If neither the No. 3, 4 nor 5 pushbar is selected, the mechanism remains inactive and printing takes place in the No. 0 row. Excluding the left-front eccentric, which is only used for the letters-figures shift, there are eight permutations available in the other three eccentrics, making it possible to select any of the eight rows in a given section (Fig. 8).

C. Axial Positioning

9.12 The functions of the axial positioning mechanism are to position the typewheel so that the proper character in the selected row is aligned with the hammer at the time of printing and to retract the typewheel and ribbon guide at the end of the function cycle so that the last-typed character is visible. The mechanism mounts on an axial bracket supported by the frame and the front plate and includes an eccentric assembly similar to those of the rotary positioning mechanism (Figs. 10 and 11). Two eccentrics, a lower whose pinion is driven by the No. 1 pushbar and upper whose pinion is driven by the No. 2 pushbar, rotate in a horizontal plane in bearing housings attached to the bracket. The eccentric assembly is linked to the typewheel shaft by an axial output rack and sector as shown in Fig. 11.

9.13 The selection of either the No. 1 or No. 2 pushbar results in the maximum displacement toward the rear of the associated eccentric, and the eccentrics are so designed that, if the displacement of the lower is taken to be one unit, that of the upper is two units. Again four permutations are available at the crank pin: zero (neither eccentric displaced), one unit (lower eccentric displaced), two units (upper eccentric displaced) and three units (both eccentrics displaced).

9.14 If during a function cycle neither pushbar is selected, no motion occurs in the axial positioning mechanism with the exception of that resulting from the oscillating assembly, and the No. 0 character of the selected row is aligned with the hammer at the time of printing (Fig. 8). On the other hand, if the No. 1 pushbar is selected, it causes the lower eccentric to revolve and one unit of displacement to be transferred by the crank pin to the axial output rack. The rack moves to the rear and passes the motion to the axial sector which pivots counterclockwise (as viewed from above). The right end of the sector, by means of a cylindrical rack in the typewheel shaft, moves the typewheel one character forward from its home position. The No. 1 character is printed, and when the pushbar reverts to its unselected position it returns the axial linkage and typewheel to their home position. If the No. 2 pushbar is selected the No. 2 character is printed, and if both pushbars are selected, the No. 3 character is printed. The cylindrical rack has no lead, and the shaft can thus be rotated while being moved axially.

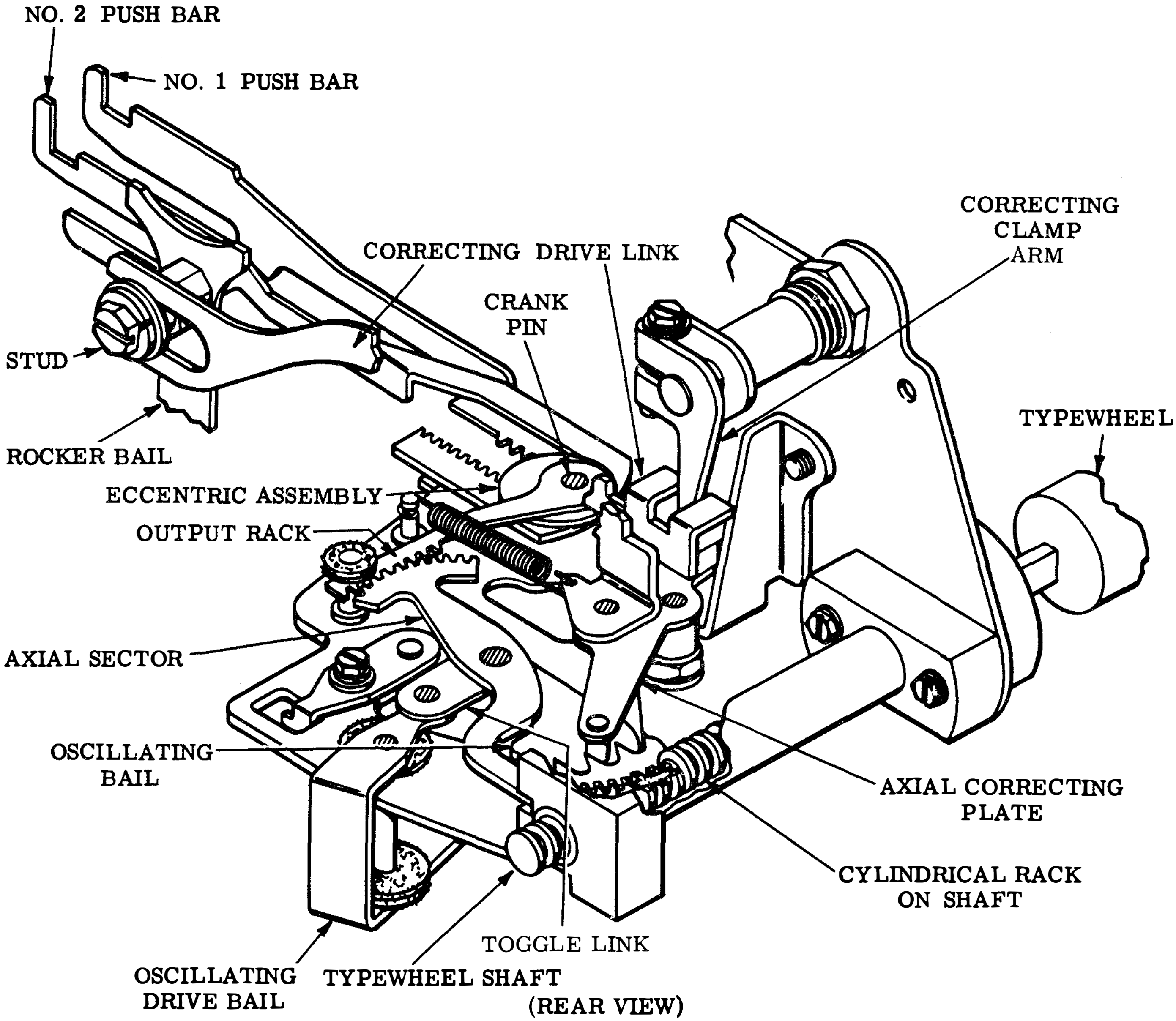


Figure 11 - Axial Positioning Mechanism

9.15 With each cycle of the function clutch, an oscillating drive link transfers from the rocker bail an unselected motion to an oscillating drive bail (Figs. 11 and 12). This movement is passed by toggle links to an oscillating bail and the sector pivot. The effect of this action is to introduce a separate motion to the sector tending to cause it to pivot about the teeth on the output rack. During the fore part of the function cycle, if no axial pushbar is selected, the right end of the sector is moved forward slightly and positions the No. 0 character for printing. At the end of any cycle the sector retracts the typewheel slightly so that the last printed character is visible. Concurrent with the above operation, a ribbon oscillating lever is made to pivot about its left end and with each cycle project and retract the ribbon guide which would obstruct the view of the character (Fig. 12).

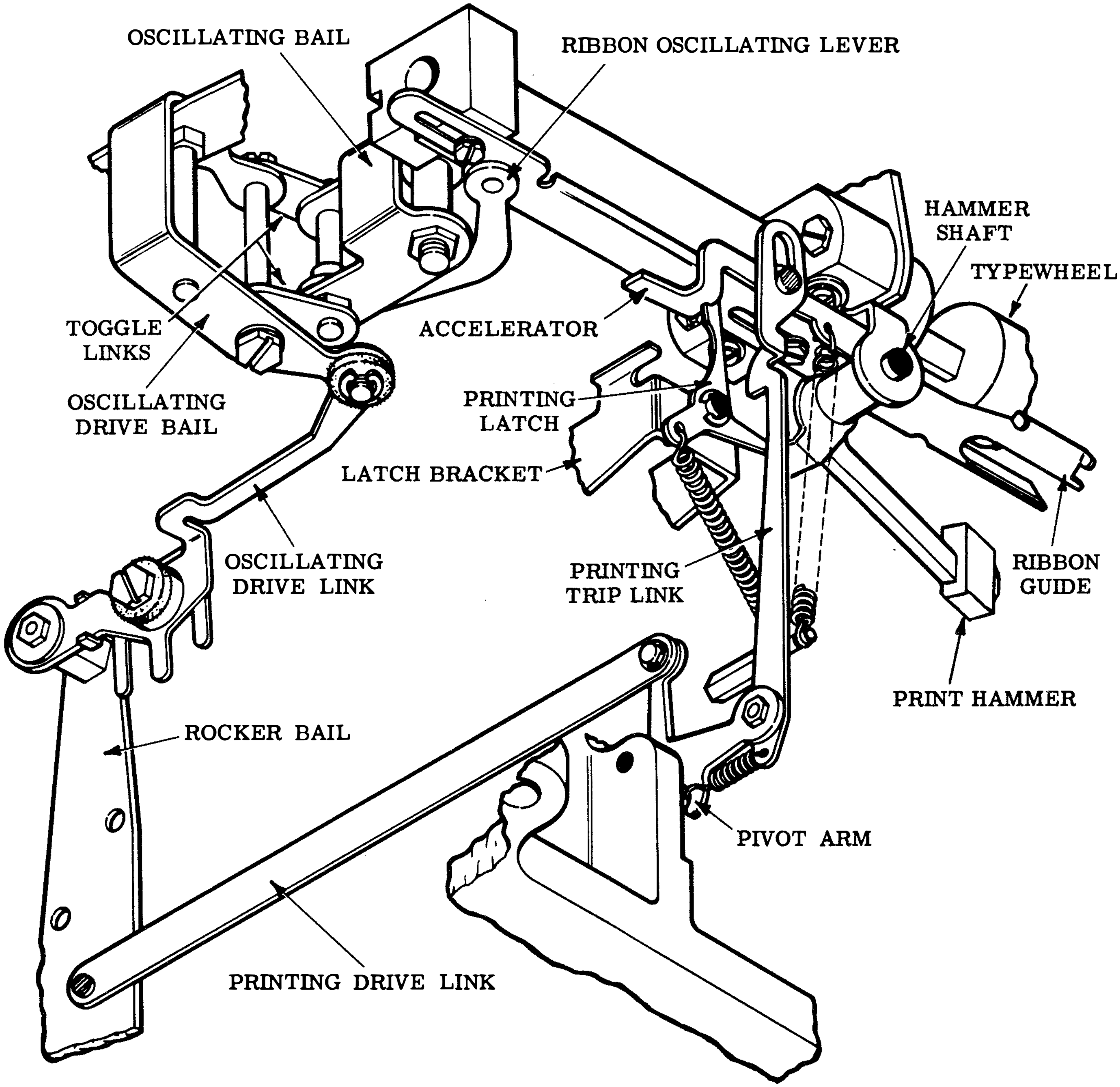


Figure 12 - Printing Mechanism

D. Correction

9.16 After the typewheel has been positioned by the axial and rotary positioning mechanisms, the selected character is more accurately aligned for printing by the correcting mechanism which compensates for any play and backlash in the positioning linkages. Each function cycle the rocker bail transfers motion through a correcting drive link to a correcting clamp and shaft (Fig. 11). The shaft pivots a rotary correcting lever (Fig. 9) which is equipped with an indentation that engages a tooth in the typewheel rack. There is a tooth in the rack for each row of characters (16 in all), and they are so correlated with the typewheel that when a tooth is engaged by the corrector its row is accurately aligned with the print hammer. Axial correction, which is accomplished simultaneously, is similar to rotary correction: the drive link rotates an axial correcting plate counterclockwise (as viewed from above), and a roller mounted on the plate engages a notch in the axial sector (Fig. 11). Thus the typewheel is accurately aligned in both fields of motion just before printing takes place. During the latter part of the function cycle, a correcting drive link spring returns the correcting mechanism to its home position.

9.17 Since the rocker bail is the source of motion for both the pushbars and the positioning mechanisms, correction must take place at a point near enough to the extreme travel of the bail that it does not interfere with the movement of the typewheel rack or axial sector. In addition, because the rocker bail controls the tripping of the print hammer, which occurs very late in the bail's stroke, it becomes necessary to utilize the time between the tripping of the hammer and its striking the paper to accomplish correction. The delay in actuating the correcting mechanism is effected by allowing a drive stud on the rocker bail to slide in an elongated slot in the correcting drive link during the early part of the cycle.

E. Typewheel Shift

Five-Level Units

9.18 The purpose of the letters - figures shift is to rotate the typewheel from the home position of one section to that of the other. It is effected by means of the function box mechanism which is made up of a number of assemblies mounted on two plates located at the upper rear of the typing reperforator. When the unit is in the letters condition, and the figures keylever is depressed, the transfer mechanism sets up the figures arrangement in the bell cranks. Then, as the rocker bail moves from its home position during the first part of the function cycle, a lifter roller under spring pressure follows a camming surface on the rear arm of the bail, and the lifter allows letters and figures function blades to move down and, by means of tines on their lower surface, feel for an opening in the slotted upper arms of the bell cranks.

9.19 The slot arrangement of the No. 1, 2, 4 and 5 bell cranks are identical and permit the entry of both function blades when all are selected. However, when the figures keylever is depressed, the No. 3 bell crank permits entry of the figures blade while blocking the letters blade. In moving all the way down the figures blade encounters a projection of a figures arm assembly and causes the arm assemblies to shift from their letters to figures position. A yield arm extension attached to the figures arm assembly pivots a figures extension arm away from the letters - figures bell crank. A letters extension arm under spring tension rotates the bell crank clockwise and the bell crank lifts the letters and figures pushbars. As the bail reaches its extreme position, the lifter is cammed up and raises the function blades.

9.20 While the letters - figures bell crank is being positioned by the function box, the No. 1, 2 and 4 pushbars are selected, the typewheel is moved two rows clockwise and three characters forward, and the figures symbol is printed. On its return stroke, the rocker bail operating blade encounters a shoulder on the figures pushbar (which was lifted as described above) and moves the bar to the right as viewed from the front in Figs. 9 and 10. The common pinion moves the letters pushbar to the left, and the left-front eccentric shifts from its up to down position. Since the typewheel has been displaced two rows clockwise during the first part of the cycle, it is rotated six more rows to the figures home position. As the bail returns to its home position during the last half of the cycle, a lock lever toggle linkage prevents the lifter roller from following its camming surface, and the lifter holds the function blades up so they do not drop onto the bell cranks. As the bail nears its home position, a trip post riding on the oscillating drive link strikes a lock release arm, buckling the toggle linkage and permitting the lifter roller to again fall on the bail camming surface.

9.21 In a manner similar to that described above, when the letters key is depressed, the function box causes the letters - figures bell crank to lower the letters and figures pushbars. The wheel is rotated two rows counterclockwise during the first part of the cycle and six more rows to the letters home position during the last part of the cycle, and the letters bar is moved to the right. The preliminary two-row rotation of the typewheel, which is made possible by selecting the No. 5 pushbar on spacing rather than marking, provides less throw and smoother operation than would be possible if the complete eight-row displacement were effected during the latter part of the cycle. Each operation the lifter permits the function blades to move down and feel for an opening, but except for the shift operations they are blocked by slotted arms of the bell cranks.

Eight-Level

9.22 The typewheel shift from the letters to the figures printing segment (or figures to letters) is controlled by the No. 7 codebar through an associated train of levers in the transfer mechanism and two pushbars which engage a common pinion. The pushbars are connected to a common bell crank which is in turn, controlled by the No. 7 pulse beam and transfer lever.

9.23 To shift the typewheel from the figures section to the letters section, the No. 7 codebar must be in a marking position (moved to the right). This causes the No. 7 punch slide to move to the left. As the No. 7 punch slide moves left, it rotates its associated transfer lever counterclockwise which, in turn, pivots the No. 7 pulse beam clockwise. This allows the associated bell crank to rotate counterclockwise, under spring tension and lift the letters and figures pushbar until the step on the end of the letters pushbar is raised to a height which will bring it into engagement with the rocker bail operating blade, when the blade moves to the left. The operating blade simultaneously pushes the letters pushbar to the left and the figures pushbar moves to the right, resulting in rotation of the typewheel to the letters section. As long as the No. 7 pulse is marking the letters pushbar will remain in this left-most position.

9.24 When the No. 7 pulse changes from marking to spacing, the punch slide will remain unselected, and the pushbars will not be lifted by the bell crank - transfer lever linkage. The figures pushbar, which is furthest to the right, will then be in such a position that the step on its end extension will be engaged (and pushed) by the rocker bail operating blade as the blade moves to the left, resulting in rotation of the typewheel to the figures position as the figures pushbar moves left, the letters pushbar simultaneously moves to the right.

9.25 As long as the No. 7 pulse is spacing, the letters - figures pushbars will not be lifted and, therefore, the letters pushbar will not be moved to the left (Paragraph 9.23). The typewheel will shift back to the letters section only upon receipt of a No. 7 marking pulse by the reperforator.

F. Printing

9.26 After the typewheel has been positioned and corrected, the printing mechanism supplies the impact which drives the paper and ribbon against the selected character. It effects this operation by means of a print hammer which is mounted on a shaft supported by a bracket attached to the typewheel bearing housing. In its unoperated condition, as illustrated in Fig. 12, the hammer is held against an accelerator by a relatively weak spring. The accelerator is mounted on the hammer shaft and is retained by a printing latch in its upper position against the tension of a relatively strong spring.

9.27 The rocker bail, during the fore part of the function cycle, moves a printing drive link to the right (as viewed from the rear in Fig. 12) and causes a pivot arm to rotate clockwise. The arm lowers a trip link which slides in an elongated slot. Near the end of the rocker bails travel, the trip link pivots the latch which releases the accelerator under the spring tension, the accelerator snaps down and impels the hammer upward. The face of the hammer drives the tape and inked ribbon up against the typewheel and imprints the selected character on the tape. Near the end of its travel, the accelerator encounters a projection on a latch bracket, and inertia carries the hammer the rest of the way. As the rocker bail returns to its home position, it causes the trip link to move up, release the latch and return the accelerator to its latched position.

G. Ribbon Feeding

9.28 The characters are typed in black ink supplied by an inked ribbon which is held between the tape and the typewheel by a guide and advanced by the ribbon feed mechanism (Fig. 13). The path of the ribbon is down to the right off the top of a right spool, under a right roller, through right pins on the reversing arm, through the guide, up through left pins on the reversing arm over a left roller, and to the right over the top of a left spool.

9.29 Each function cycle, as the rocker bail nears the end of its left travel, a roller mounted on its forward arm pivots a drive arm clockwise. The drive arm lifts a feed pawl which advances the ribbon by rotating a ratchet on one of the ribbon spools one tooth. A retaining pawl under spring tension detents the ratchet while the feed pawl, during the latter part of the function cycle, is lowered so as to engage the next tooth. Each operation, the ribbon is advanced in this manner until the ribbon feed mechanism is reversed.

9.30 When a spool is almost depleted, a rivet in the ribbon encounters pins on the reversing arm, and the stress applied through the ribbon as it is rolled on the other spool pivots the arm. As the pawl assembly is lowered at the end of the next operation, an extension strikes the reversing arm, and the pawl is shifted against the other ribbon spool ratchet. The pawl's rounded lower extension pivots a reversing lever which shifts the retaining pawl so that it engages the opposite ratchet. The ribbon will then feed in the opposite direction until again reversed. A detent holds the reversing arm in position until its next reversal.

10. CHARACTER COUNTER (Figs. 14, 15 and 16)

10.01 When tape is being perforated, the character counter indicates the position that the character being perforated will occupy on the typed line of the page printer when receiving from the tape. The counter also operates the end-of-line indicator light to signal the end of a typed page printer line. The end-of-line indicator control is adjustable for a line length of 10 to 80 characters. The counter is driven mechanically from the keyboard perforator by the action of the counter and reset code bars located in the second and third slots of the code bar basket. These bars provide drive projections which engage the forks of the feed and reset bails of the counter. As the code bars fall to the right when a key on the keyboard is struck, the counter mechanism is tripped. As the key-

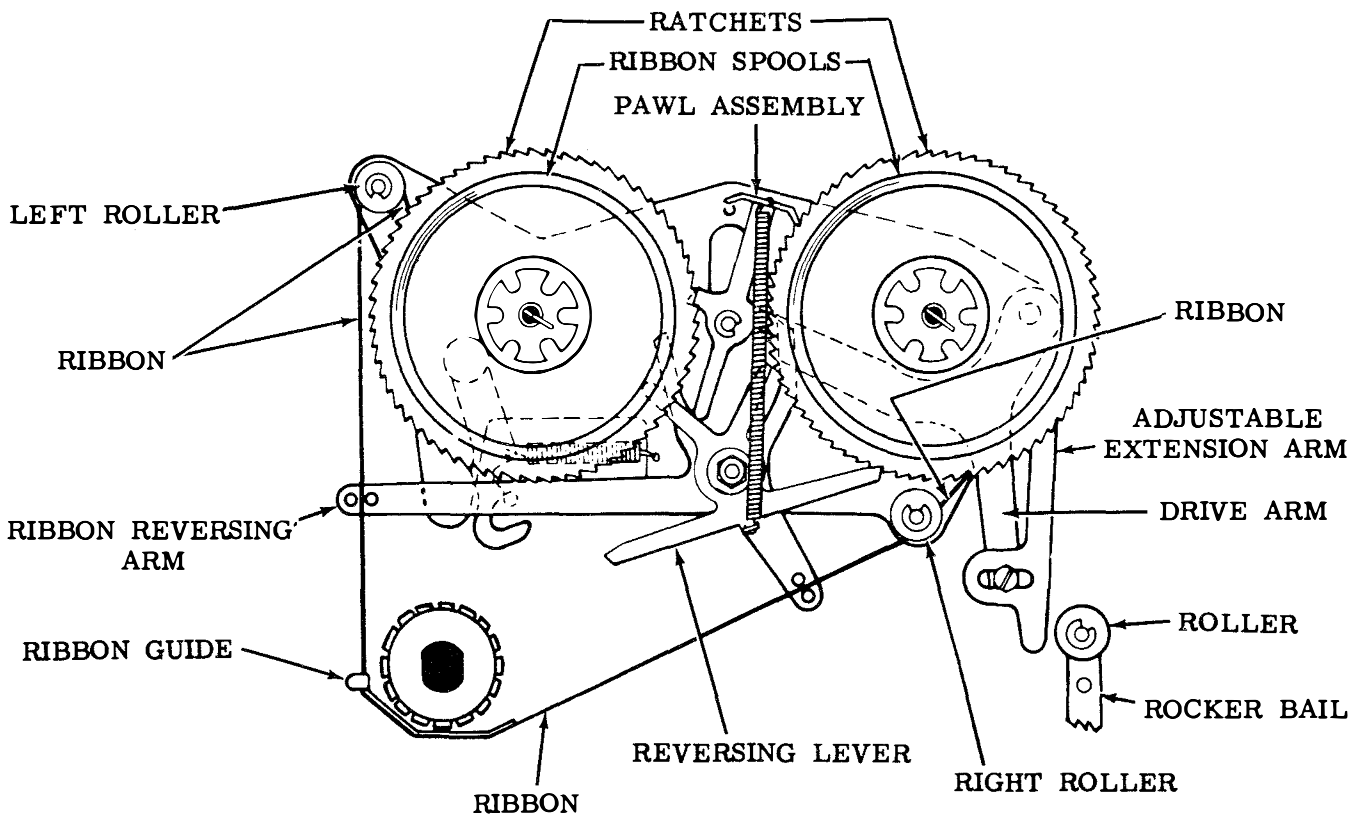


Figure 13 - Ribbon Feed Mechanism

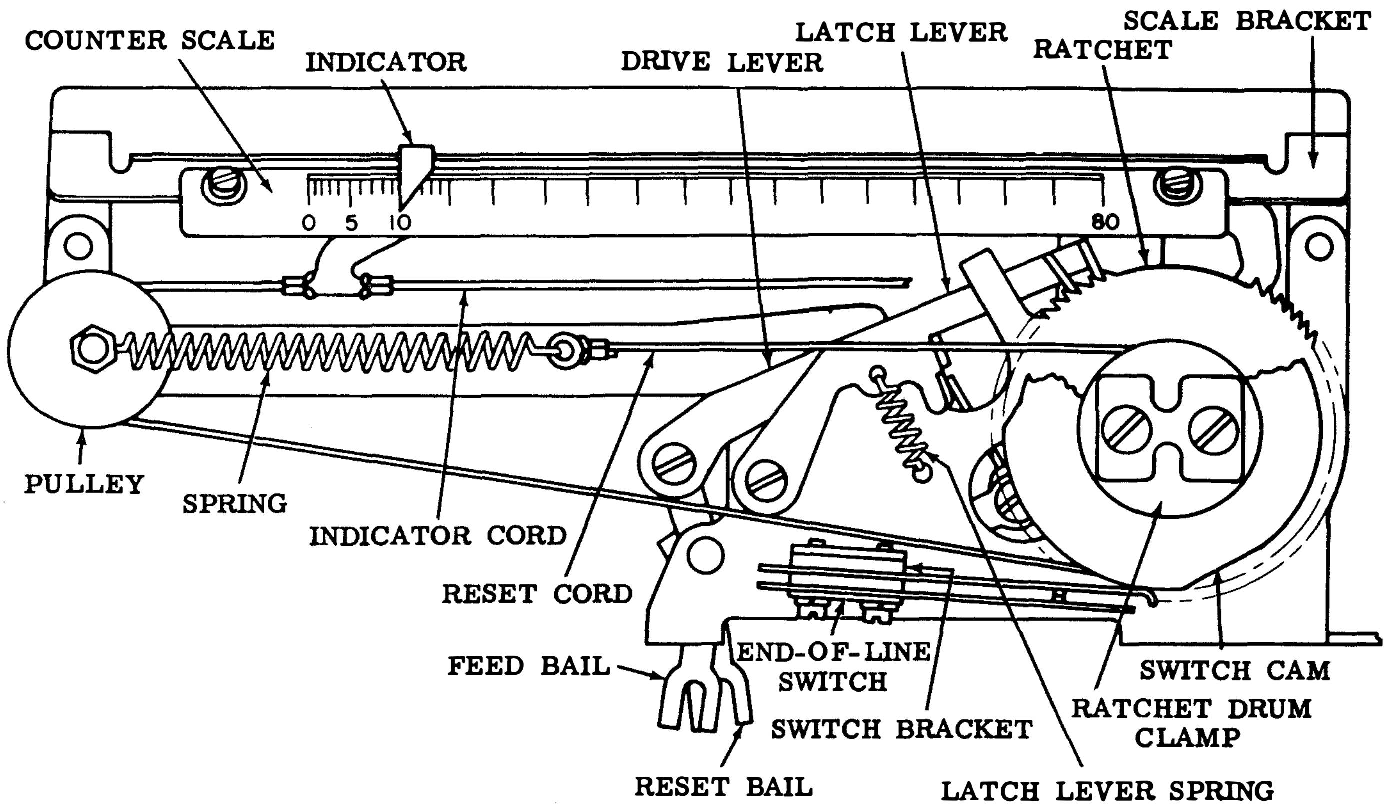


Figure 14 - Character Counter Mechanism (Front View)

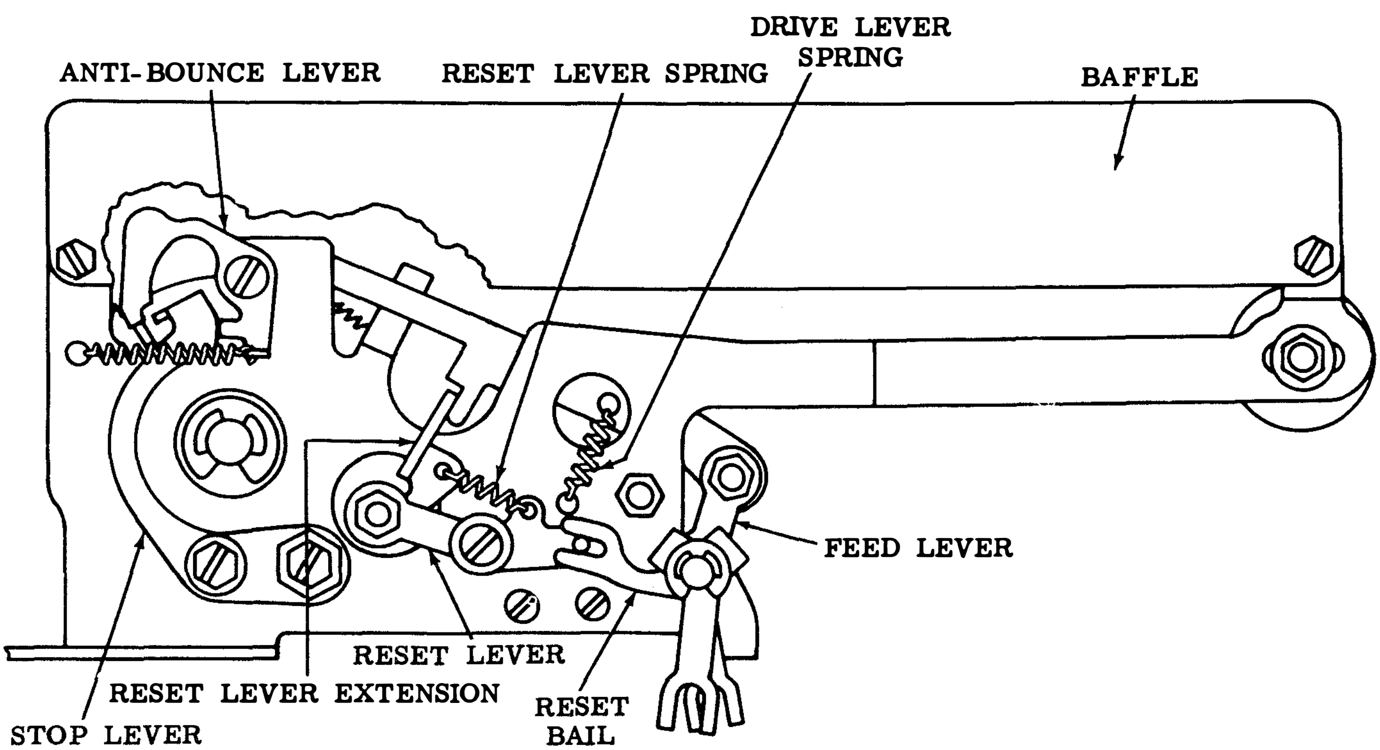


Figure 15 - Character Counter Mechanism (Rear View)

board is reset under power, the counter performs its required functions. These functions may be divided into three distinct phases of operation. Figure 16 illustrates these three phases of operation and also the normal position of the counter mechanism.

A. Stepping

10.02 Referring to sequence A, as a key is struck, (Fig. 16), the code bar falls to the right, carrying with it stepping bail (1). The drive lever which is linked to the stepping bail moves to the left slightly more than one tooth. As the code bars 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 latch lever.

B. Counter Reset

10.03 Sequence B, (Fig. 16), illustrates the tripped position of the counter mechanism for a reset function. Reset bail (2) moves counterclockwise as its code bar 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 latch levers under the action of its spring. When the counter bars are reset as in C, (Fig. 16), the reset bail is rotated clockwise to its original position, causing the reset lever to rotate counterclockwise, carrying the reset lever extension upward, and moving both the drive and latch levers 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.

10.04 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 anti-bounce lever whose lower end is normally in contact with the stop lever. The anti-bounce lever rotates counterclockwise, dropping in behind the ratchet stop. As the ratchet drum rebounds from the stop lever, its stop strikes the anti-bounce lever, preventing further motion and maintaining the anti-bounce lever in its actuated position. The ratchet continues to operate between the stop lever and anti-bounce lever until the energy in the system has been largely dissipated. The ratchet stop then remains in contact with the stop lever, permitting the anti-bounce lever to return to its normal position.

C. Restart

10.05 The restarting action, Sequence D, (Fig. 16), 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 code bar 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 code bars 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 latch lever, which falls into engagement with the ratchet drum. As the drive lever completes its stroke, it steps the ratchet drum one tooth, as in the normal stepping operation.

D. End-of-Line Switch (Fig. 14)

10.06 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.

11. BACKSPACE MECHANISM

11.01 The power drive backspace is a mechanism that reverses the direction of tape feed so that errors appearing in the perforated tape may be deleted. Depressing the backspace key lever causes the perforated tape to move one code space to the right each time the key lever is depressed. The mechanism consists of a magnet, an eccentric drive on the front end of the main shaft and a feed assembly.

11.02 When the magnet is energized, the armature bail is pulled downward. An extension on the bail disengages a drive link latch, which drops, engaging a notch on the eccentric arm. As the main shaft moves the eccentric arm to the left, a bell crank is depressed, contacting the perforator feed pawl and disengaging it. The backspace feed pawl engages the feed wheel ratchet and rotates the feed mechanism counterclockwise. When the magnet is de-energized, the drive link is disengaged from the eccentric arm, which slides freely along the pivot post of the drive link.

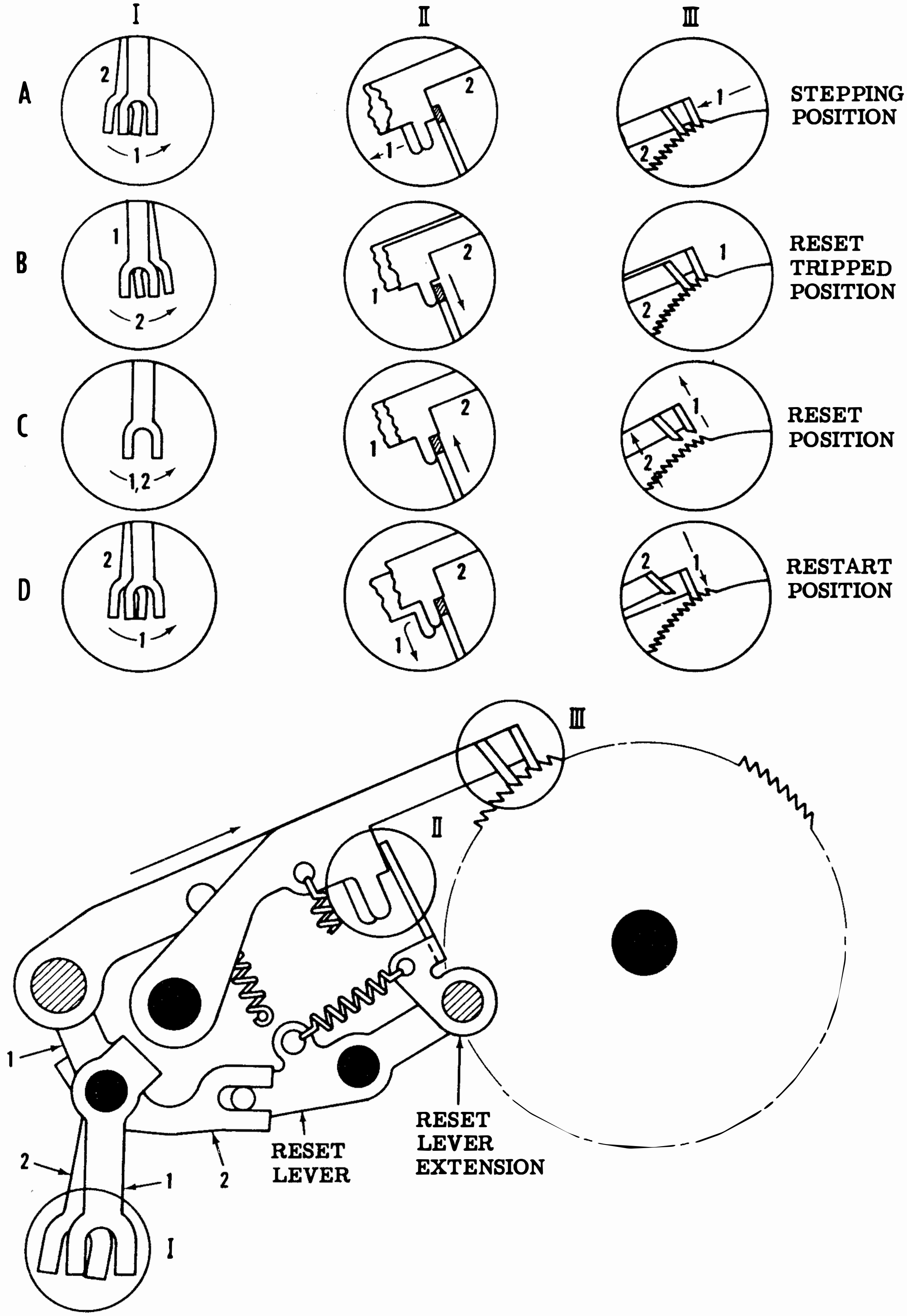


Figure 16 - Operation of Character Counter Mechanism