BULLETIN 246B

DESCRIPTION AND PRINCIPLES OF OPERATION

MODEL 28 TYPING REPERFORATOR SET (LPR, LRB, LRC, LT)

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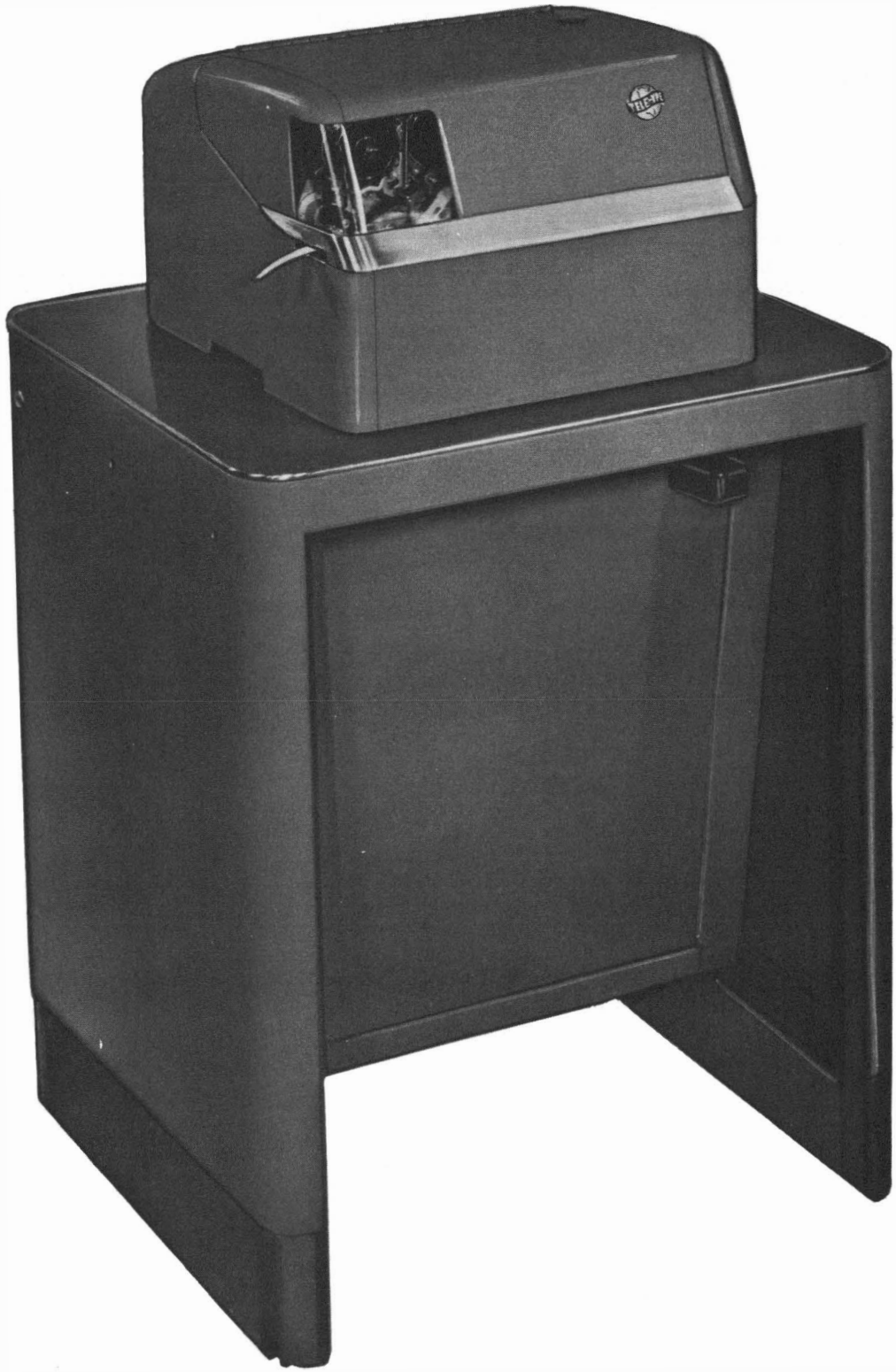

Model 28 Typing Reperforator Set

consists of

Typing Reperforator Unit (LPR), Reperforator Base (LRB), Motor Unit (LMU), Reperforator Cover (LRC), Reperforator Table (LT) and Electrical Service Unit (LESU)

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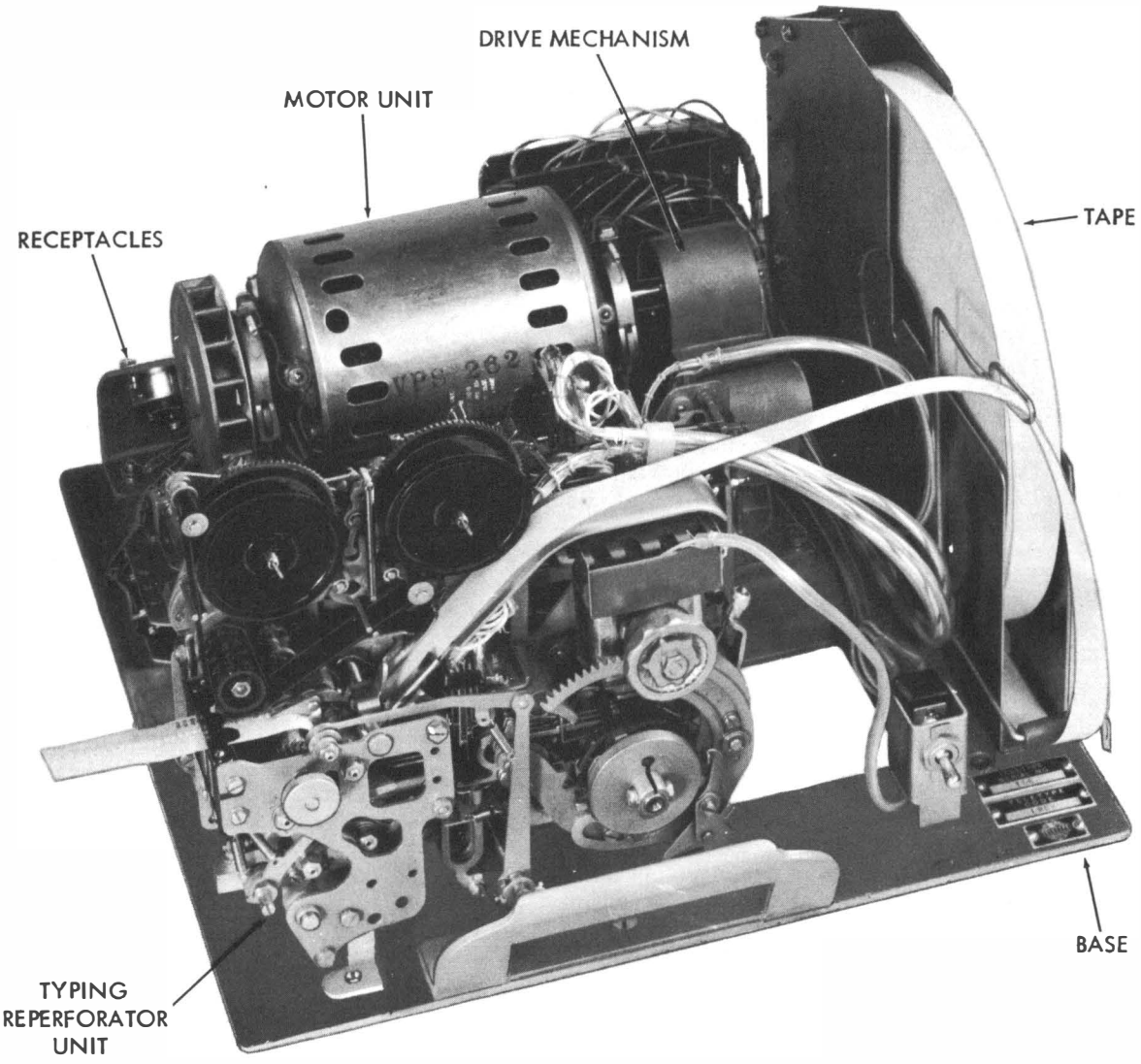


Figure 1-1. Typing Reperforator Set - For Rack or Cabinet Mounting

SECTION 1

DESCRIPTION

1. INTRODUCTION

1.a. This bulletin describes and explains the operation of the Teletype Model 28 Typing Reperforator Set. Section 1 presents a physical description of the equipment and provides a summary of its technical data. Section 2 covers in detail its principles of operation.

1.b. Unless stated to the contrary, references in the text to "left" or "right" indicate the viewer's left or right as he faces the front of the Set. In the illustrations, unless they are specifically labeled otherwise, it is assumed that the equipment is being viewed from the front. Pivot points are shown in the drawings by circles or ellipses which are solid black to indicate fixed points and cross-hatched to indicate floating points.

2. GENERAL (Figures 1-1 and 1-2)

2.a. The Model 28 Typing Reperforator Set is an electro-mechanical apparatus which records messages on standard paper tape, both as printed characters and as combinations of chadless code perforations. The messages are received from a signal line in the form of an electrical signaling code which is translated into the necessary mechanical motions to type and perforate the information. The printed characters simplify tape handling by eliminating the necessity of reading the code perforations.

2.b. The basic components of the Set are a base, a motor unit and a typing reperforator unit (Figure 1-1). The motor and typing reperforator units are mounted on the base and are connected by either a single-speed or a variable-speed drive mechanism. Power and signal-line current are led to the Set through two receptacles at the rear. Tape unwinds off a roll at the right, passes across the front and is printed and perforated at the left. In addition to the above-mentioned components, the Set may also include a table, a cover and an electrical service unit (Figure 1-2). The base, with the motor unit, cover and typing reperforator unit, rests on the top of the table, and the electrical service unit is supported by a shelf in a lower compartment. The power line connects to a receptacle on the base and the signal line to a terminal board on the electrical service unit. The components are interconnected by a control cable which passes from the electrical service unit up through a hole in the table top to a receptacle on the base. A number of variable features are available with the Set (see Subdivision 5. of this section).

2.c. The Typing Reperforator Set operates on a d.c. signal line current of either 0.020 or 0.060 ampere and an a.c. power supply of 115 volts, single-phase, 60 cycles. It accommodates standard-width paper tape and produces five-level, chadless code perforations; i.e., the perforated portions, or chads, are not completely

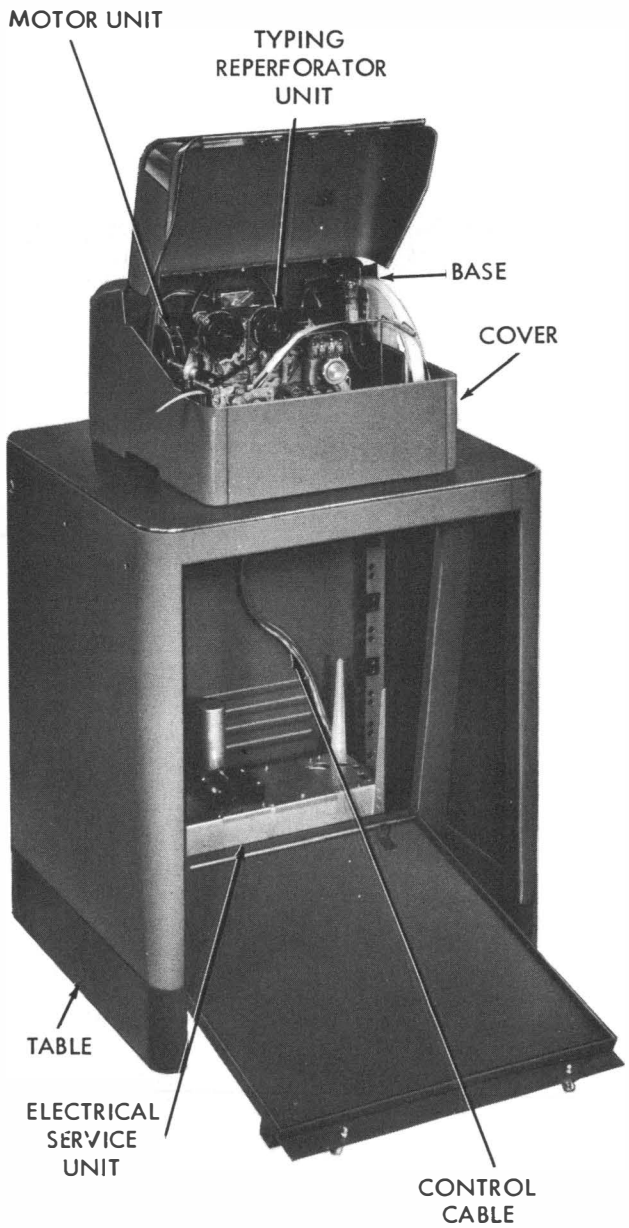


Figure 1-2. Typing Reperforator Set

severed, but remain attached at their leading edges. Thus chad disposal is eliminated, and the characters can occupy the same space as the holes without legibility being impaired. The Set will operate at speeds ranging from approximately 60 to 100 words per minute.

3. DESCRIPTION OF COMPONENTS

3.a. BASE

3.a.(1) The base provides a foundation for the motor unit and typing reperforator unit and incorporates a number of electrical and mechanical accessories. Two typical models are described below.

3.a.(2) Single-Plate Base (Figure 1-3) — A plate rests on four metal feet and serves as a foundation for the other elements. Wiring, a power switch, a four-point terminal board and a three-point power connector are part of the power circuitry. All other wiring terminates in a 32-point connector mounted by a bracket at the rear of the plate. Three nine-point terminal boards provide intermediate connecting points for this wiring which includes two selector magnet leads. The typing reperforator unit is mounted by four tapped holes at the left front of the plate. The motor unit is supported by three posts and an adjusting plate. A tape container with a roller, a wire guide and a wooden filler for a tape roll is attached to the extreme right of the pl ate. A low tape mechanism incor-

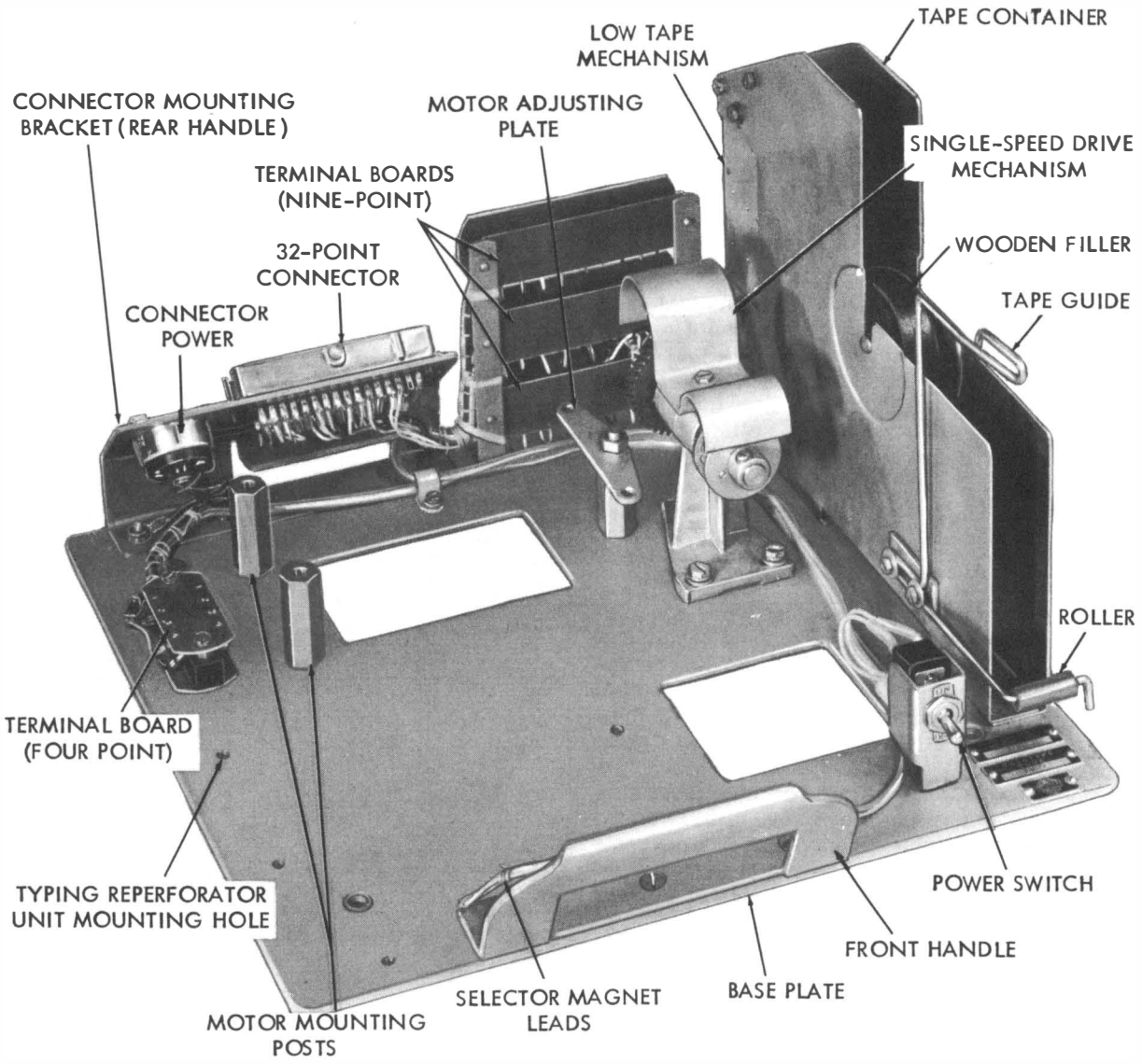


Figure 1-3. Base (Single Plate)

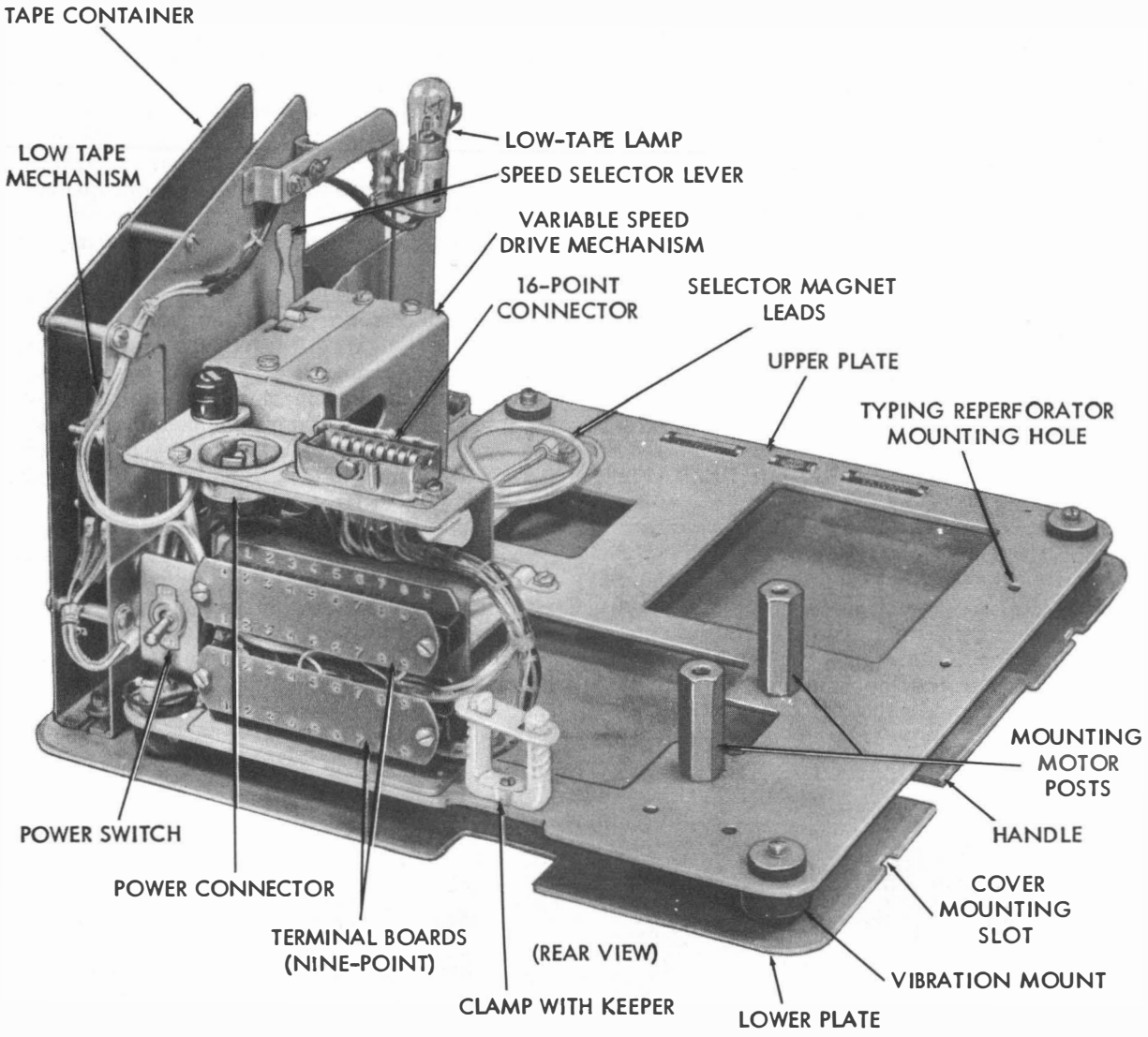


Figure 1-4. Base (Double Plate)

porating two switches which may be connected to visual or audible alarms is located in the rear of the container. The base may be carried by a front handle and the connector mounting bracket which serves as a rear handie.

3.a.(3) Double-Plate Base (Figure 1-4) — An upper plate is separated from a somewhat larger lower plate by rubber vibration mounts. The lower plate rests on four leather feet and has two handles and four slots for mounting a cover. Wiring, a power switch and a three-point power connector are part of the power circuitry. All other wiring terminates in a 16-point connector. Two nine-point terminal boards provide intermediate connecting points for all wiring except two selector magnet leads. A clamp with keeper secures cables where they leave the base. The tape container and the mounting facilities for the motor and typing reperforator unit are identical with those on the single-plate base (see above). A low-tape lamp is mounted by a bracket on the tape container.

3.a.(4) Motion can be transferred from the motor unit to the typing reperforator unit by either a single-speed drive mechanism (Figure 1-3) or a variable-speed drive mechanism (Figure 1-4). Gear sets of the single-speed drive mechanism may be interchanged if different operating speeds are desired. If the variable speed mechanism is used, the speed may be changed by manually positioning a speed selector lever.

3.b. MOTOR UNIT (Figure 1-5) — Mechanical motion to operate the Typing Reperforator Set is produced by a two-pole, single-phase, synchronous motor unit which develops 1/20 horsepower at 3600 revolutions per minute. The motor rests in the cradle of a mounting bracket and is held in place by a strap at each end. The cradle is isolated from the motor by resilient mounts which reduce vibration. Two fans are mounted at each end of a rotor within the end bells, and a combination fan and handwheel rides on the left end of the shaft. A start relay, a starting capacitor and a thermal-cutout switch are contained in a lower compartment. The switch will turn off the motor if an overload should exist long enough to overheat the winding. The switch may be closed by pushing a reset button. A governed motor is also available.

3.c. TYPING REPERFORATOR UNIT (Figures 1-6 and 1-7)

3.c.(1) The typing reperforator unit incorporates the necessary electrical and mechanical elements to translate the code pulses into motions which perforate and print the information on the tape. A cast frame provides mounting facilities for the mechanisms which make up the unit. Mechanical motion from an external source is received by a main shaft and distributed by two cam-clutch assemblies. A rocker bail further distributes the motion to the mechanisms involved in printing and perforation. A selecting mechanism, which includes a two-coil magnet wired to the signal line, converts the electrical code combinations into mechanical arrangements which govern the printing and perforation. The magnet may be wired in series for 0.020 ampere operation or in parallel for 0.060 ampere operation. By means of a range finder the selector can be adjusted in relation to the signaling code.

3.c.(2) The characters used in printing are embossed on a bakelite typewheel which may be replaced to obtain different type faces and character arrangements. Controlled by the selecting and transfer mechanisms, axial and rotary positioning mechanisms in conjunction with a correcting mechanism select the proper characters by moving the type-wheel. A printing mechanism utilizes a hammer to drive the tape and inked ribbon against the typewheel and imprint the selected characters. The ribbon is advanced by a ribbon-feed mechanism. A perforating mechanism steps the tape, punches feed holes and perforates chadless code holes corresponding to the code pulses received by the selecting mechanism. The tape is threaded by means of a handwheel. A function box enables the unit to perform certain auxiliary functions including the letters-figures shift. Printing and

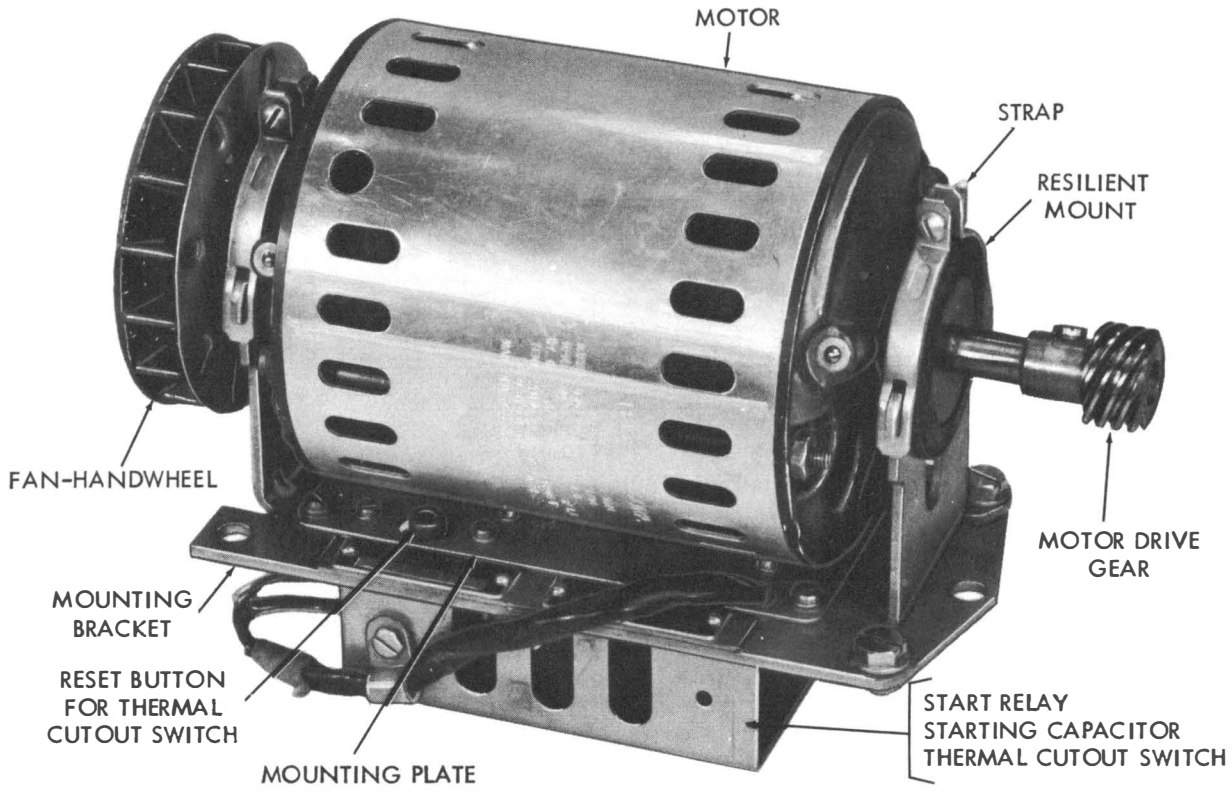


Figure 1-5. Motor Unit

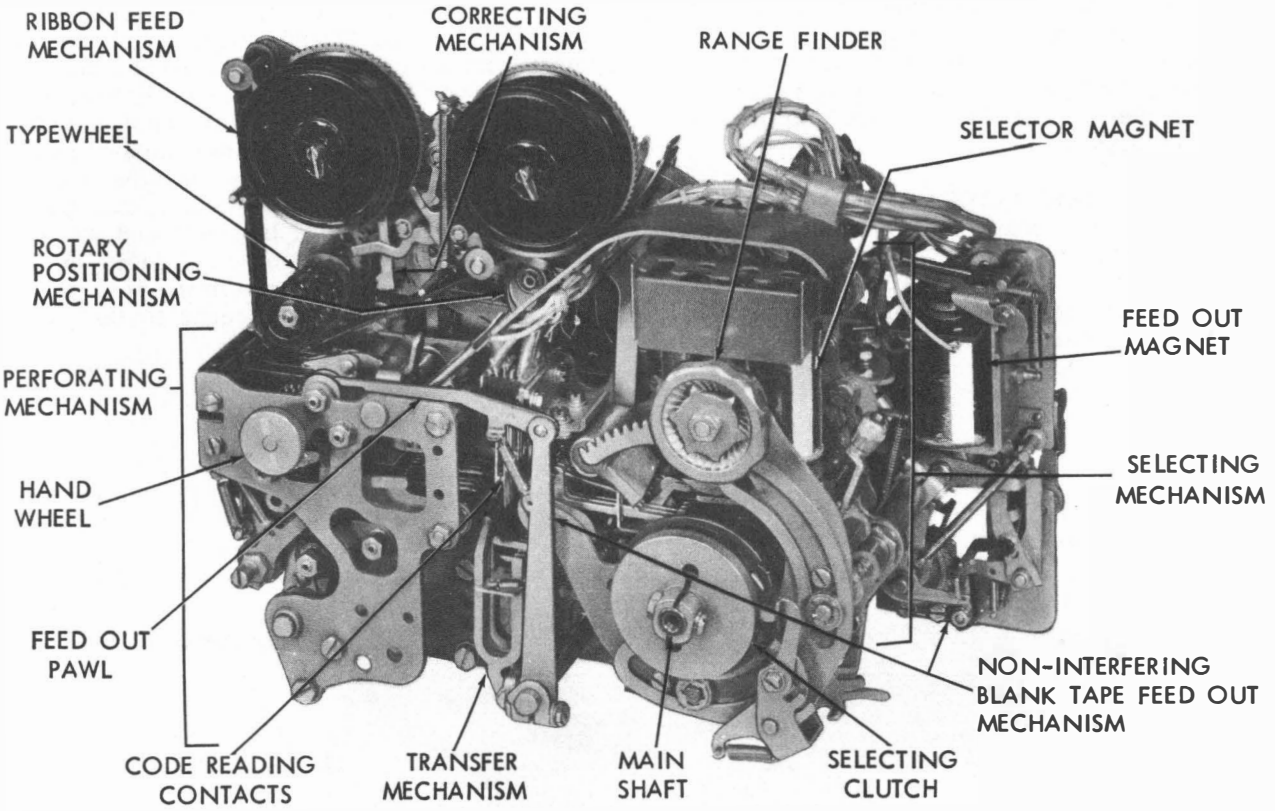


Figure 1-6. Typing Reperforator Unit

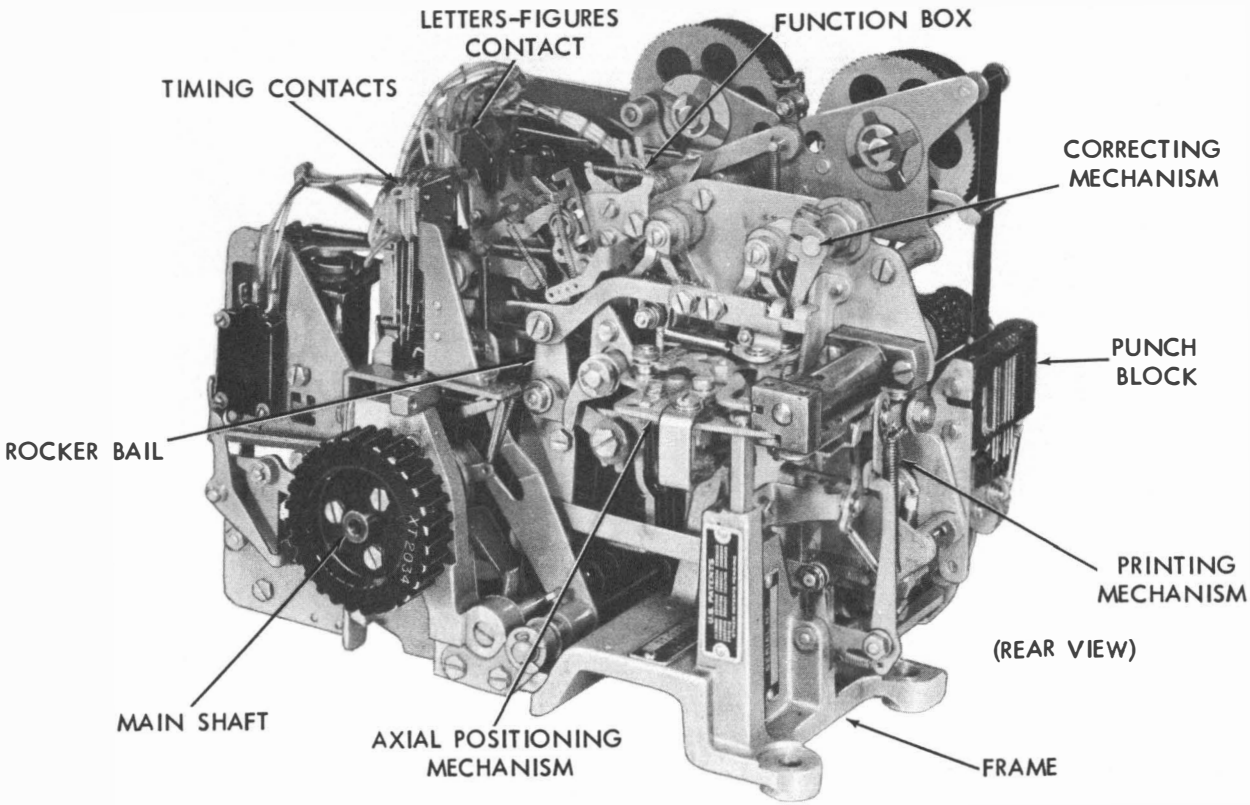


Figure 1-7. Typing Reperforator Unit (Rear View)

perforating occur simultaneously at a 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 so that the last printed character is visible.

3.d. REPERFORATOR COVER (Figure 1-8) — The reperforator cover provides a protective enclosure for the base, motor unit and typing reperforator unit. It is made of lightweight sheet steel and is available in a number of finishes. The cover fits closely around the typing reperforator unit and rests on the lower plate of the base (Figure 1-4). A lid, which is held in its open position by a friction arm, permits access to the reperforator to load tape and change ribbons. The lid is equipped with a paper-emission slot, a chrome-finished handle and a window through which the tape printing and perforating may be viewed. A red translucent button on the lid is positioned so as to be illuminated by the low-tape lamp on the base (Figure 1-4). Openings in the rear permit admission of cables and access to the power switch (Figure 1-4).

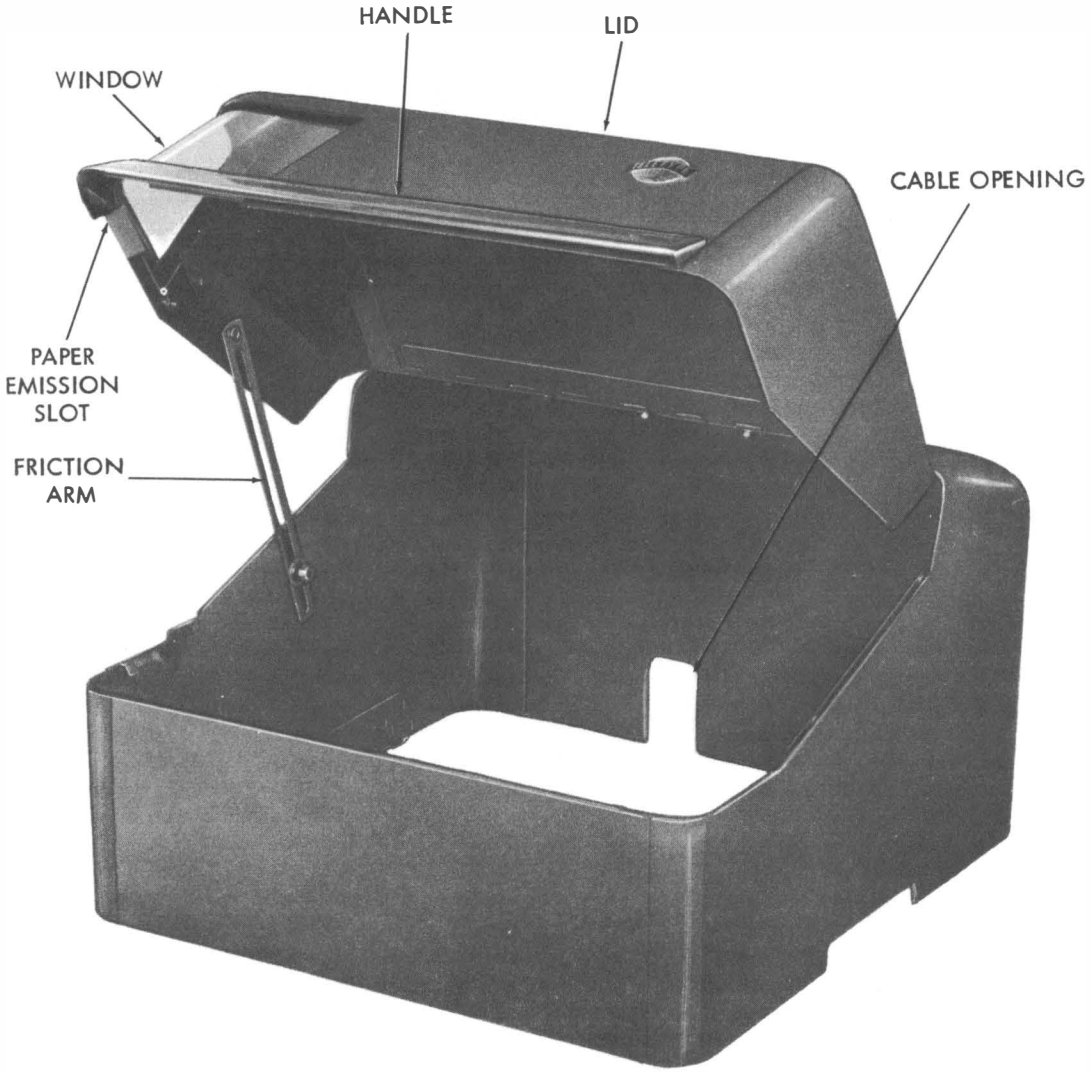


Figure 1-8. Reperforator Cover

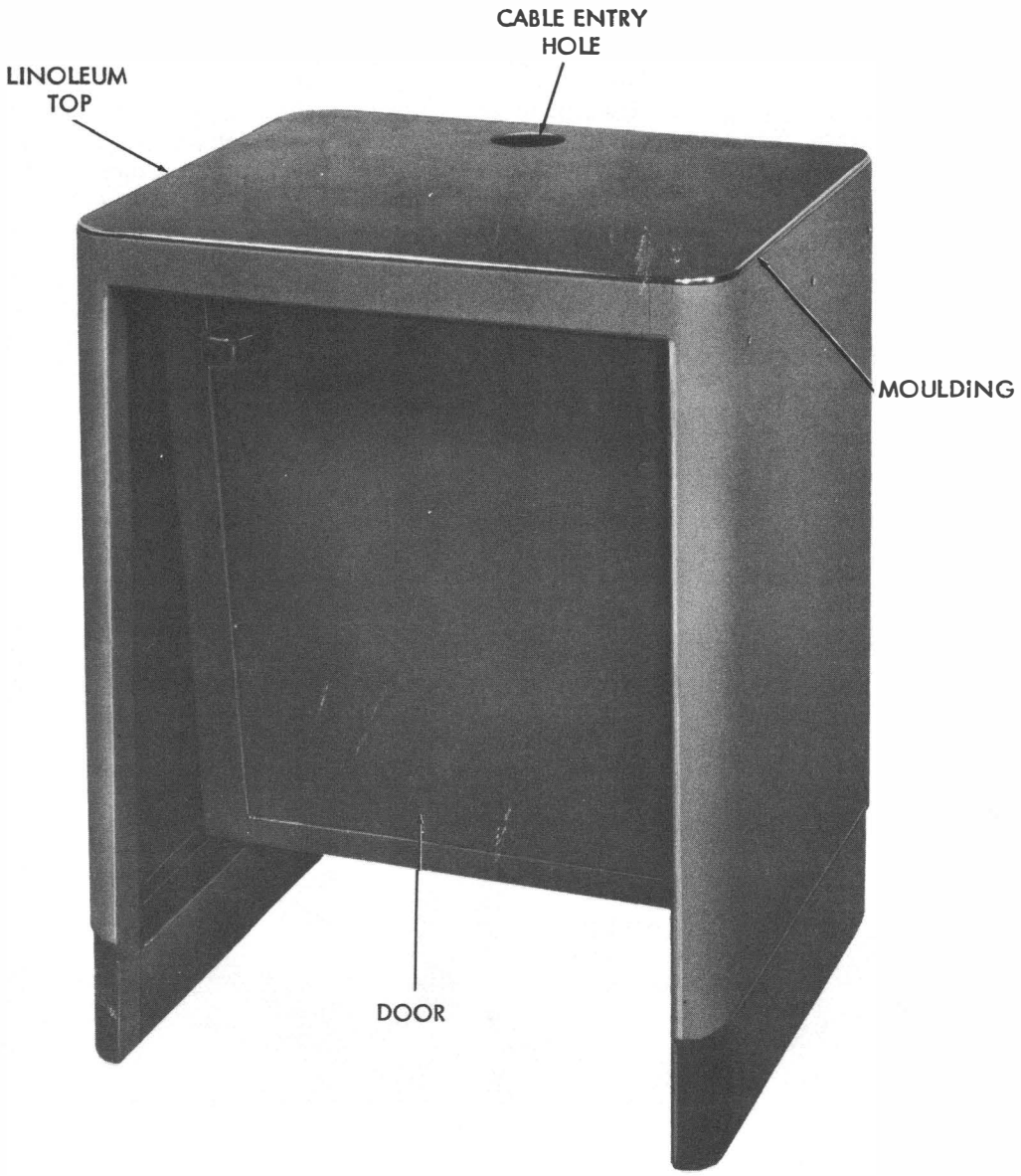


Figure 1-9. Reperforator Table

3.e. REPERFORATOR TABLE (Figure 1-9) — The reperforator table provides mounting facilities for the Typing Reperforator Set. It is constructed basically of sheet steel and is available in a number of finishes. The top on which the base rests is gray, desk-top linoleum cemented to a sound-deadened steel subtop. The edges of the linoleum are protected by stainless-steel moulding. A 2-1/2-inch cable-entry hole is located at the rear center of the top. A lower compartment accommodates the electrical service unit (Figure 1-2). A nine-point terminal board for external electrical connections is mounted on the rear panel inside the compartment. A door covers the compartment and is held in its closed position by quarter-turn fasteners. The table may rest on adjustable feet which permit leveling and varying the height; it may be bolted directly to the floor by tapped holes in the bottom; or it may be supported by shock mounts.

3.f. ELECTRICAL SERVICE UNIT (Figure 1-10) — The electrical service unit serves as

a point of concentration for the circuitry associated with the Typing Reperforator Set. A typical unit is shown in Figure 1-10. A sheet aluminum chassis provides mounting facilities. Four feet on the chassis permit the unit to be turned upside down for servicing. Terminal boards mounted within the chassis furnish intermediate connecting points for the wiring. Straps on the terminal boards (and on the selecting mechanism of the typing reperforator unit) may be positioned so that the Set will operate on a signal-line current of either 0.020 or 0.060 ampere. A control cable terminates in a connector which plugs into the 16-point connector on the base (Figure 1-4). Electrical interlocks will de-energize a line shunt relay if either the power or control connector is accidentally removed from its receptacle. The line shunt relay, when de-energized, shunts out the signal line to prevent an open line condition. A signal bell, which may be connected to a contact on the typing reperforator unit (Figure 1-10), provides an audible alarm. A mounting assembly furnishes facilities for installing a line relay which will repeat the line code pulses for the selector magnets. A rectifier serves as a source of direct current to actuate local selector magnets and bias windings of the line relay.

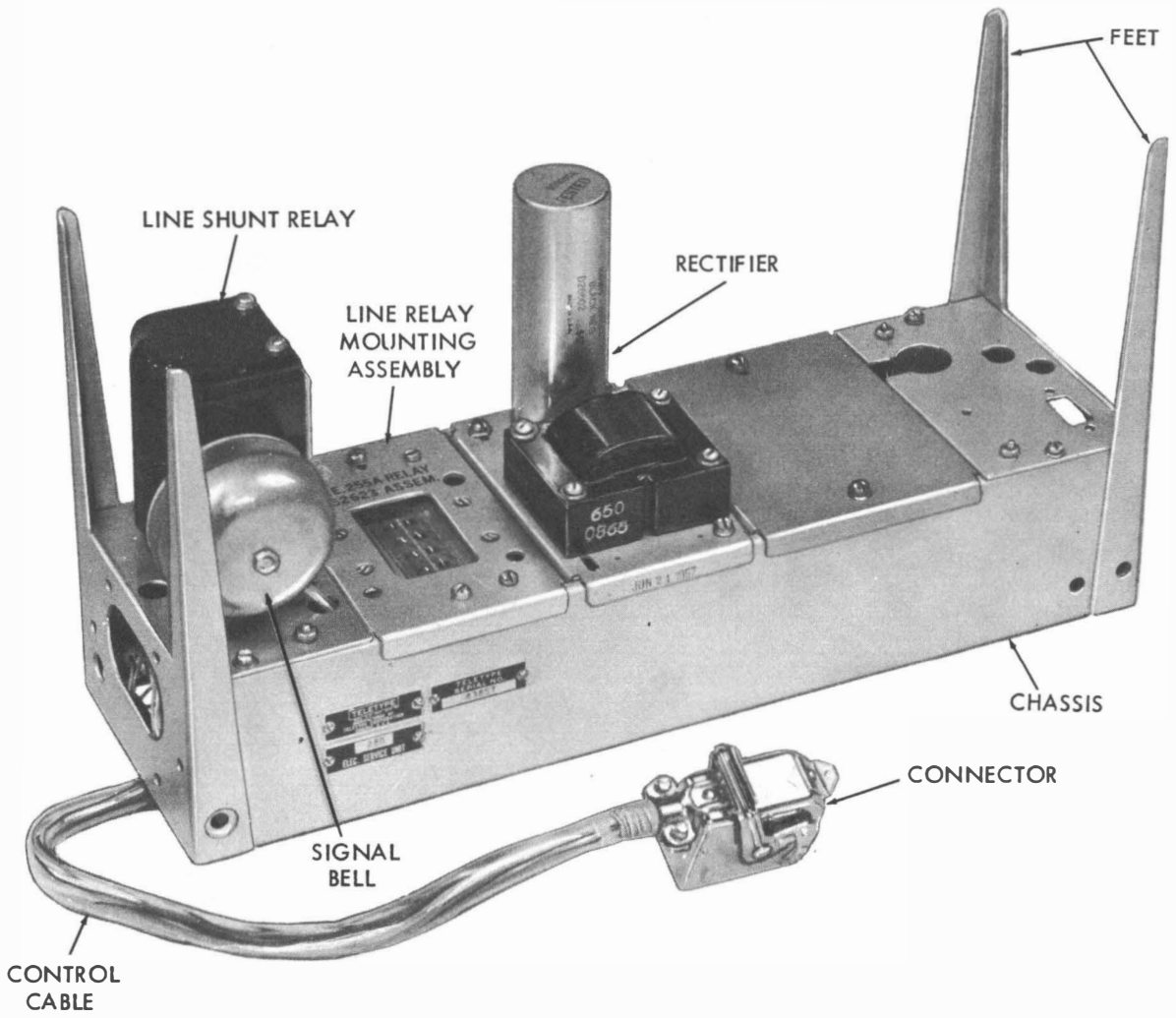


Figure 1-10. Elecrrical Service Unit

4. TECHNICAL DATA

WEIGHTS AND DIMENSIONS (Typical Set and Components)

COMPONENT	APPROX. DIMENSIONS IN INCHES WIDTH	DEPTH	HEIGHT	APPROX. WEIGHT IN POUNDS
Typing Reperforator Unit	7-1/2	6-1/2	8	7-1/2
Reperforator Base	13	13-1/2	9	12
Motor Unit	9	4	4-1/2	10
Electrical Service Unit	15-1/2	5	8-1/2	9
Reperforator Cover	13	14-1/2	9-1/2	9-1/2
Reperforator Table	20-1/2	18-1/2	25-1/2	50
Typing Reperforator Set	20-1/2	18-1/2	35	98

SIGNALING CODE . . . . . Sequential five-unit start-stop (See Figure 2-1 and Subdivision 2. of Section 2)

LINE CURRENT . . . . . 0.020 or 0.060 ampere

SPEED (operations per minute and words per minute) . . . . . 368 opm (60 wpm), 404 opm (67 wpm or 50 baud), 460 opm (75 wpm) or 600 opm (100 wpm)
(Other speeds are also available — See Teletype Bulletin 1167B.)

TAPE . . . . . Standard
Width . . . . . 11/16 inch
Maximum Diameter of Roll . . . . . 9 inches
Code Perforations . . . . . Five-level chadless
Characters or feed holes per inch 10

PRINTED CHARACTERS . . . . . English
Height
Standard . . . . . 0.120 inch
Maximum . . . . . 0.193 inch
Width
Standard . . . . . 0.075 inch
Maximum . . . . . 0.085 inch

MOTOR UNIT . . . . . Synchronous*
Output . . . . . 1/20 horse power
Speed . . . . . 3600 rpm
Input voltage . . . . . 115 volts ± 10 per cent a.c.
Phase . . . . . Single
Frequency . . . . . 60 cycles ± 0.75 per cent
Input Current
Starting . . . . . 9.00 amps
Running . . . . . 1.85 amps
Power Factor 0.30
Wattage . . . . . 65 watts
Heat Dissipation . . . . . 50 watts

* Governed motors are also available.

5. VARIABLE FEATURES

5.a. GENERAL — A number of variable features are available with the Typing Reperforator Set. These features, which are described below, enable the Set to perform special operations and may be installed either at the factory or in the field.

5.b. NON-INTERFERING BLANK TAPE FEED-OUT MECHANISM (Figures 1-6 and 1-7) — Provides a means for the typing reperforator unit to feed-out a predetermined length of blank tape to facilitate tape handling. The feed-out operation, which is initiated by a pulse from an external source applied to a feed-out magnet, is accomplished by an auxiliary feed pawl that

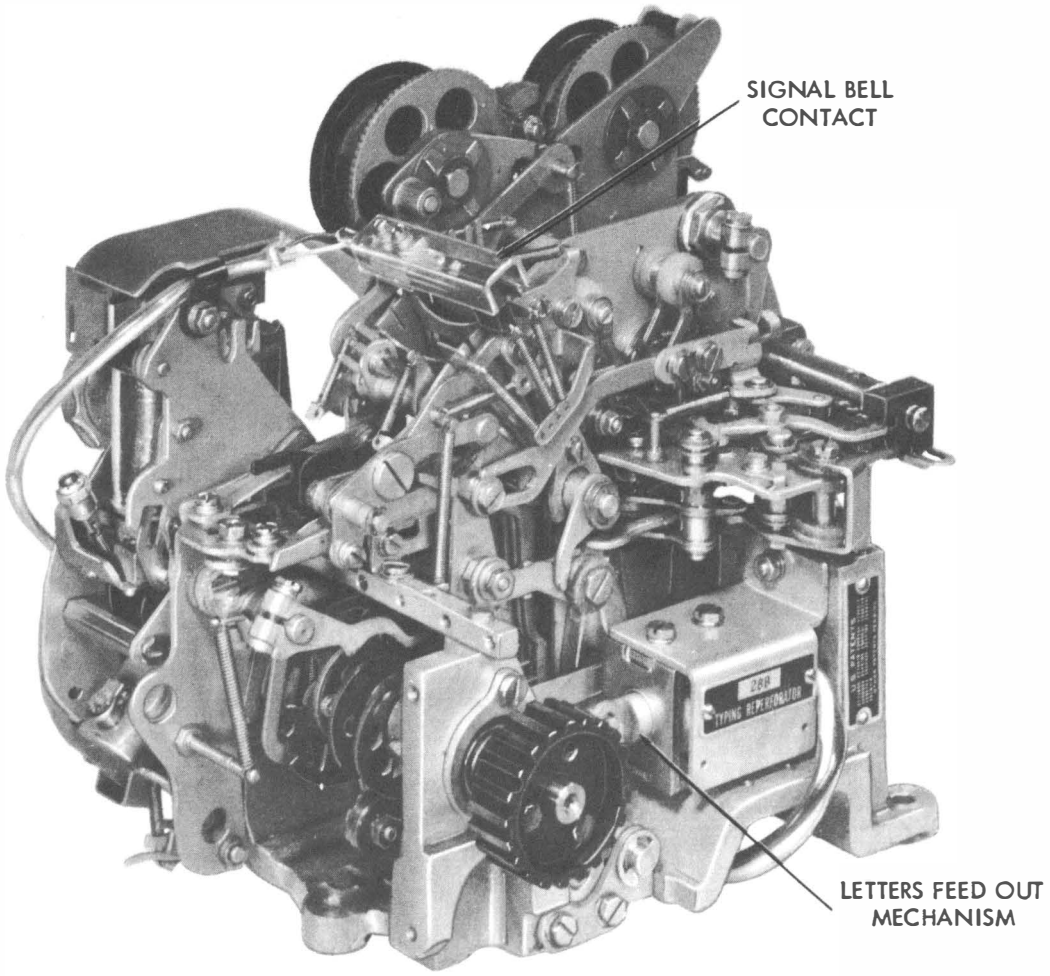


Figure 1-11. Typing Reperforator Unit

receives motion from an eccentric on the main shaft. The mechanism may be adjusted to feed-out any length of tape up to 17 inches. Should the operation be interrupted by an incoming message, feed-out automatically stops and the message is printed and perforated without error.

5.c. INTERFERING LETTERS TAPE FEED-OUT MECHANISM (Figure 1-11) — Enables the typing reperforator unit to step out tape containing successive letters code combinations. The feed-out operation may be actuated locally by a hand lever; or, with the addition of a separate set of parts, it may be controlled remotely by energizing a solenoid. Letters feed-out will continue as long as either the hand lever or solenoid is actuated. The mechanism's principle of operation involves tripping the selector clutch while retaining the armature in its marking position.

5.d. CODE READING CONTACT MECHANISM (Figure 1-6) — Reads the code combinations being perforated by the typing reperforator unit and establishes circuits corresponding to the five code elements. The mechanism consists of a bank of five contacts, each of which is actuated by a punch slide. Either transfer (break-before-make) or make contacts are manufactured. Applications of the mechanism include error checking and parallel code output.

5.e. TIMING CONTACT MECHANISM (Figure 1-7) — When connected to external circuits, provides electrical pulses which may be synchronized with the code reading contacts for circuitry control purposes. Either single- or double-contact mechanisms are available. The contacts, which are of the transfer type, are

actuated by bails which receive motion from the function cam of the typing reperforator unit.

5.f. LETTERS-FIGURES CONTACT MECHANISM (Figure 1-7) — Furnishes a remote signal to indicate whether the typing reperforator unit is in the letters or figures condition. The mechanism is mounted on the rear of the selector and is actuated by the letters pushbar.

5.g. SIGNAL BELL CONTACT MECHANISM (Figure 1-11) — Provides an electrical pulse to actuate an audible alarm when the typing reperforator unit receives the "S" code combination in the figures condition. The mechanism is mounted on and controlled by the function box.

6. TWO-SHAFT TYPING REPERFORATOR UNIT (Figure 1-12) — Used on ASR Set.

The two-shaft typing reperforator unit is designed to be mounted on the automatic send-receive keyboard (see Teletype Bulletin 249B). It may be operated either from signal line pulses or by direct mechanical action from the keys of the keyboard. It differs from the basic unit (see paragraph 3.c.) primarily in the method of driving the cam-clutches. An extra shaft, the jack shaft (Figure 1-12), enables the perforator and typing mechanism to be operated at a different speed from that of the selecting mechanism. Thus the speed of the selecting mechanism may be adjusted to line conditions (up to approximately 100 words per minute), while the speed of the perforator and typing mechanism remains constant. An optional feature with the two-shaft unit is a backspace mechanism (Figure 1-12) which will delete an erroneously perforated code combination by replacing it with a letters combination (see Bulletin 249B).

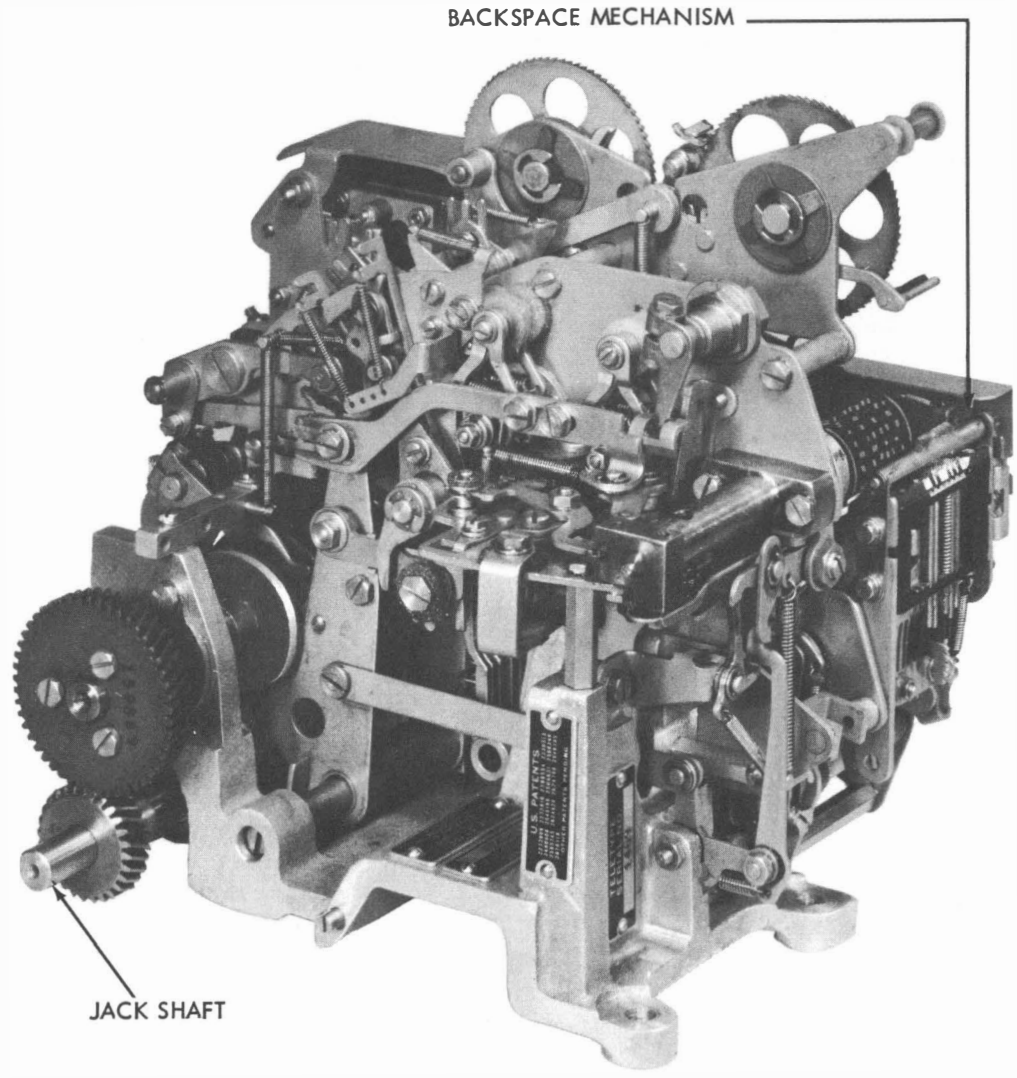


Figure 1-12. Two-Shaft Typing Reperforator Unit (Used with ASR Set)

SECTION 2

PRINCIPLES OF OPERATION

1. GENERAL

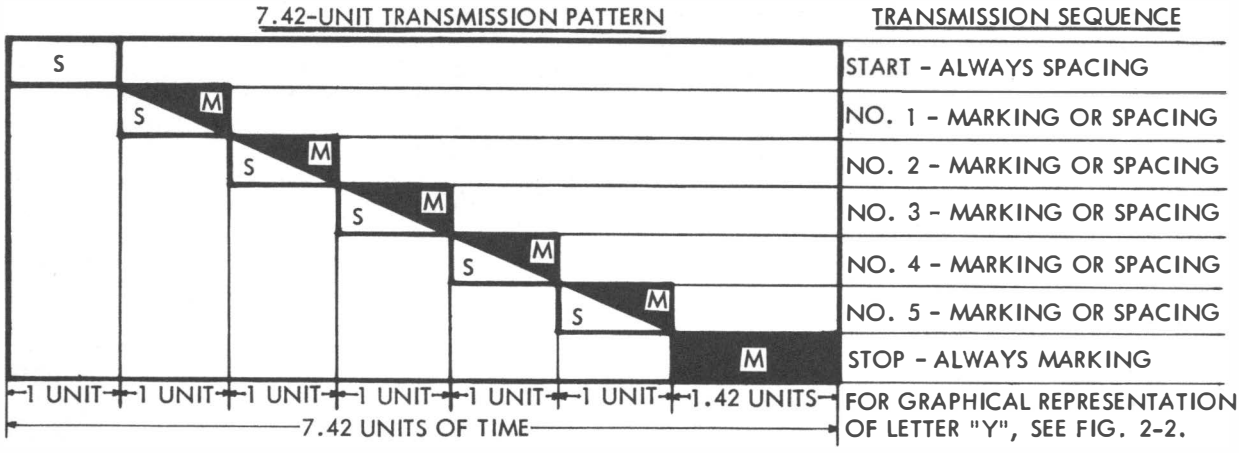
1.a. This section explains the operation of the Model 28 Typing Reperforator Set. The basic function of this equipment is to record messages on paper tape both as printed characters and chadless code perforations. The messages are received from a signal line in the form of signaling code combinations which represent characters and functions. The Set translates these combinations into mechanical motions which print the characters and perforate corresponding combinations of code holes in the tape.

1.b. Functions are operations auxiliary to typing, such as "carriage return," "line feed," "letters," "figures," etc. The Set is referred to as being in the idling condition when the motor is running, the signal circuit is closed and no message is being received. The operating speed of the equipment is usually given in operations per minute. Each operation includes the receiving of a signaling code combination, the cycling of the two cam-clutches, the printing and perforating of a character and the advancing of the tape.

1.c. The signaling code is described in Subdivision 2. of this section. Subdivision 3. presents a general outline of the overall operation of the equipment. Subdivisions 4. through 10. cover in detail the functioning of the individual mechanisms. A schematic wiring diagram of a typical Set is shown in Figure 2-25.

2. SIGNALING CODE (Figure 2-1)

2.a. Messages are received by the Typing Reperforator Set in the form of a five-unit, start-stop signaling code in which each character or function is represented by a combination of current and no-current time intervals. Intervals during which current flows in the signal circuit is referred to as marking elements and during which no current flows as spacing elements. Every combination includes five elements that carry the intelligence, each of which may be either marking or spacing (Figure 2-1). The intelligence elements are preceded by a start element (always spacing) and are followed by a stop element (always marking) which is 1.42 times as long as each of the other elements. Thus each combination consists of 7.42 units of time (referred to as a 7.42 unit trans-



a.

	FIGURES	–	?	:	$	3	!	&	#	8	'	(	)	.	,	9	0	1	4	Δ	5	7	;	2	/	6	"	≈	<	≡	■	¥	↑
	LETTERS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	BLANK	C.R.	L.F.	SPACE	LTR.	FIG.
	1	●	●		●	●	●				●	●						●		●		●		●	●	●	●					●	●
	2	●		●				●		●	●	●	●				●	●	●			●	●	●						●		●	●
	FEED HOLES	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
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	5		●					●	●				●	●		●	●	●			●		●	●	●	●	●					●	●

(TYPICAL CHARACTER ARRANGEMENT)

b.

Figure 2-1. Signaling Code

mission pattern). The start and stop elements ensure synchronism between the transmitting and receiving equipment. The various code combinations as they appear in tape form are shown in Figure 2-1b.

2.b. The total number of permutations of a five unit code is two to fifth power, or 32. In order to transmit more than 32 characters and functions, a letters-figures shift operation is designed into the equipment. Thus each permutation, excluding those used to shift and unshift the apparatus, may represent two characters and functions.

2.c. Some telegraph systems employ a 7.00-unit transmission pattern in which the stop element is equal to each of the other elements (see paragraph 2.a. above). Interoperation between 7.42 and 7.00 apparatus is satisfactory providing the operating speeds selected yield identical unit pulse lengths. The signaling frequency is expressed in dot cycles per second. One cycle consists of one current pulse followed by a no-current pulse. The equipment speed in baud (common in international usage) is equal to twice the frequency. The following chart shows the relationships between the transmission patterns, frequency, pulse lengths and operating speed (in operations per minute, baud and characters per second). Speed in words per minute is roughly equivalent to one-sixth the operations per minute.

Transmission Pattern	7.42	7.00	7.42	7.00	7.42	7.42	7.00
Operations per Minute	368	390	404	428.6	460	600	636
Baud	45.5	45.5	50	50	56.9	74.2	74.2
Pulse Length (Seconds)	0.022	0.022	0.020	0.020	0.0175	0.0135	0.0135
Frequency (Cycles per Second)	22.75	22.75	25	25	28.45	37.1	37.1
Characters per Second	6	6.5	6.7	7.1	7.7	10	10.6

3. GENERAL OUTLINE OF OPERATION (Figure 2-2)

3.a. A-C power is fed to the motor unit through the power switch. The motor converts this electrical energy into rotary mechanical motion which is geared down and transferred to the main shaft of the typing reperforator unit by the drive mechanism. The main shaft rotates as long as the power switch is in the "on" position.

3.b. The signaling code combinations — e.g., the combination representing the letter "Y" plotted at the left of Figure 2-2 — are applied to the selecting mechanism. The start pulse of each code combination causes the selector through a trip assembly to trip the selecting cam-clutch. Driven by the main shaft, the cam-clutch begins its cycle and imparts timed motion to the selector which converts the code combinations into corresponding mechanical arrangements. Near the end of each selecting cycle, the selecting cam-clutch by means of a trip assembly trips the function cam-clutch and permits the punch slides of the perforator to receive the arrangements from the selector. The selecting cam-clutch is then disengaged by the stop pulse of the code and remains inoperative until the next combination is received.

3.c. The function cam-clutch operates approximately one cycle behind the selecting cam-clutch and drives the rocker bail. The latter distributes motion to the various mechanisms that effect typing and perforation.

3.d. The punch slides distribute the intelligence in the form of mechanical arrangements to the transfer mechanism and the punch block. The transfer mechanism, in turn, carries the information to the function box and the axial and rotary positioning mechanisms. At the receipt of the letters or the figures code combination, the function box causes the rotary mechanism to shift the typewheel. The positioning mechanisms in conjunction with the correcting mechanism position the typewheel so that the proper characters are selected. The ribbon feed mechanism supplies the ink and the printing mechanism provides the impact to imprint the selected characters.

3.e. The perforator main bail assembly, driven by the rocker bail, imparts motion to the tape feed parts and the punch slides. The feed parts punch feed holes and advance the tape. The punch slides, having received the intelligence from the selector, cause pins in the punch block to perforate combinations of holes corresponding to the incoming code combinations.

4. MOTION

4.a. MOTOR UNIT (Figure 2-3)

4.a.(1) Mechanical motion for the Typing Reperforator Set is supplied by a synchronous motor unit. The motor is comprised of a two-pole, wound stator and a squirrel-cage rotor. The stator includes a main operating winding and a starting winding connected in parallel (Figure 2-3). A 43-microfarad, electrolytic

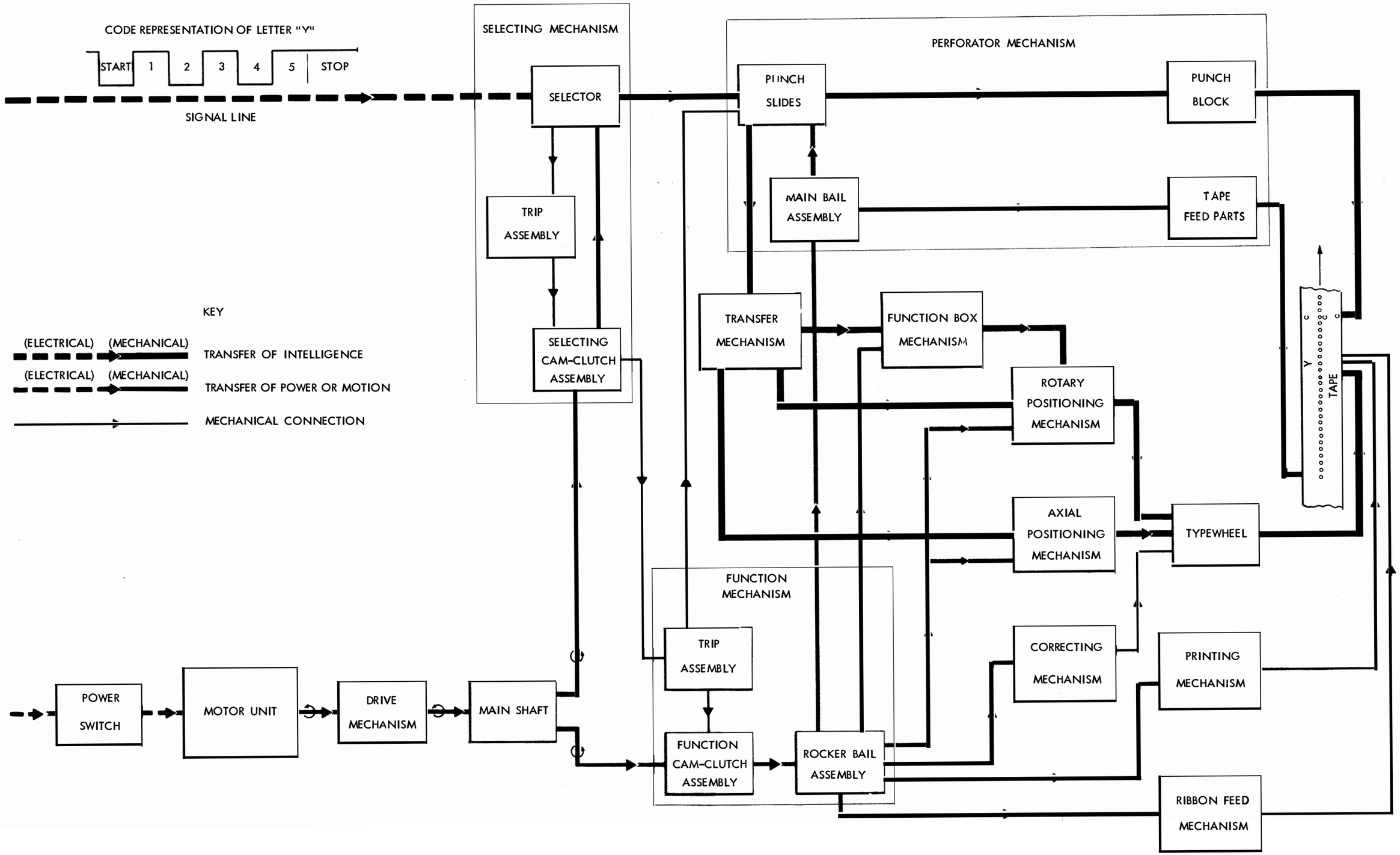


Figure 2-2. Block Diagram Of Typing Reperforator Set

starting capacitor and the switch of a start relay are in series with the starting winding, and the coil of the start relay and a thermal-cutout switch are in series with the main operating winding.

4.a.(2) When the power switch (Figure 2-25) is closed, the initial surge of current (approximately 9 amperes) energizes the starting relay coil which closes the relay contacts. The magnetic flux produced by the main operating and starting windings causes the rotor to turn. As the rotor accelerates the current through the motor-start relay, main operating winding and thermal-cutout switch decreases; and at approximately 5.7 amperes the relay coil permits its contact to open and remove the starting winding from the circuit. The rotor continues to accelerate until it reaches synchronous speed. The thermal-cutout switch is placed in the circuit to prevent damage that might be caused by an overload. Should the unit draw excessive current — because of a blocked rotor, for example — heat generated in the coils will cause the switch to open and remove power from the motor. The switch can be closed by pressing the red reset button that projects through the motor mounting plate.

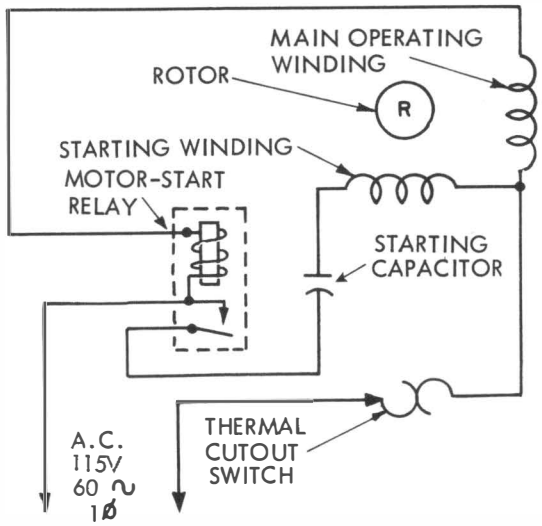


Figure 2-3. Schematic Wiring Diagram of Motor Unit

4.a.(3) Two fans mounted at each end of the rotor within the frame draw cooling air through slots in the end bell and exhaust it through slots in the stator frame. Additional cooling is provided by a combination fan-handwheel mounted at the left end of the shaft. The motor's rotation is counterclockwise as viewed from the handwheel end.

4.b. TRANSFER

4.b.(1) Single-Speed Drive Mechanism (Figure 2-4) — The rotary motion produced by the motor unit is geared down and transferred

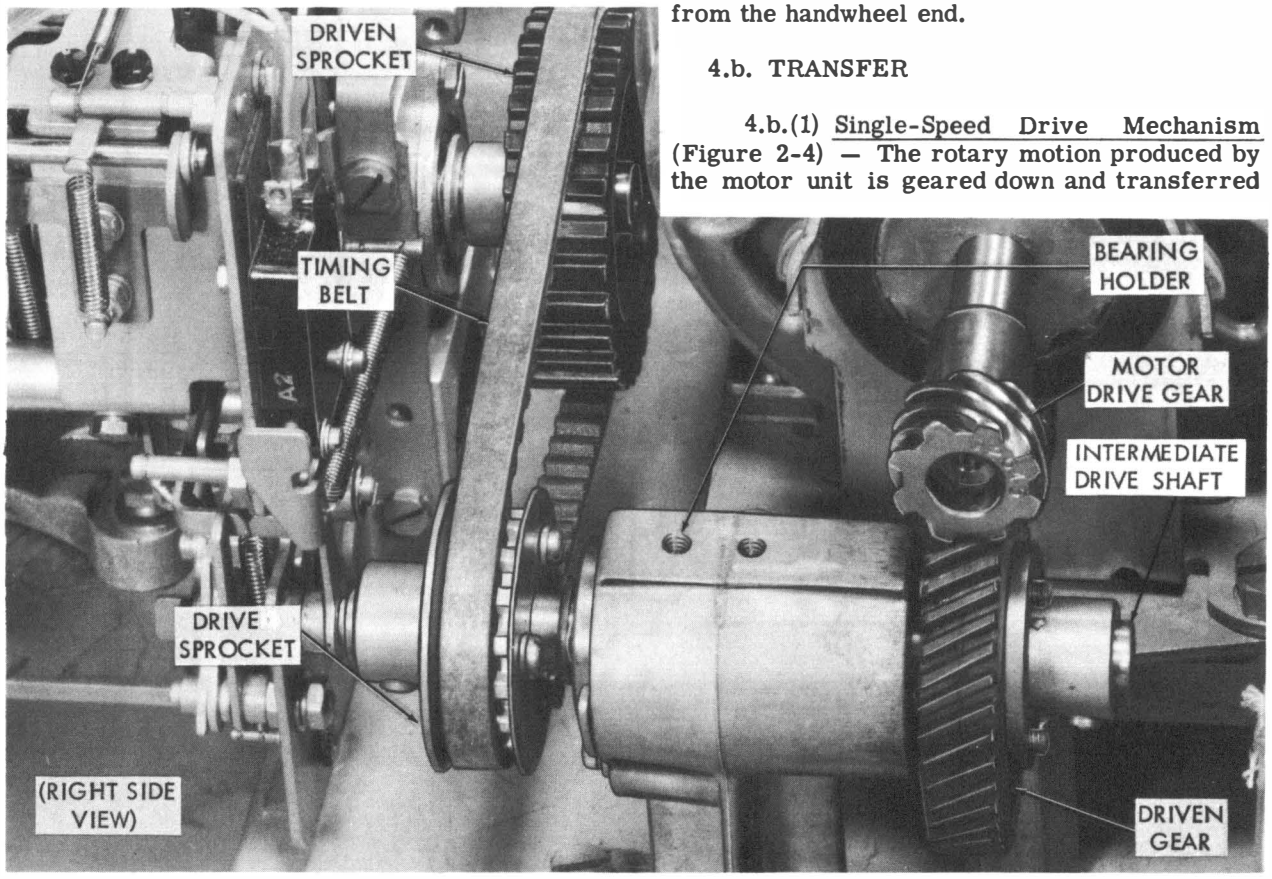


Figure 2-4. Single - Speed Drive Mechanism (Guard Removed)

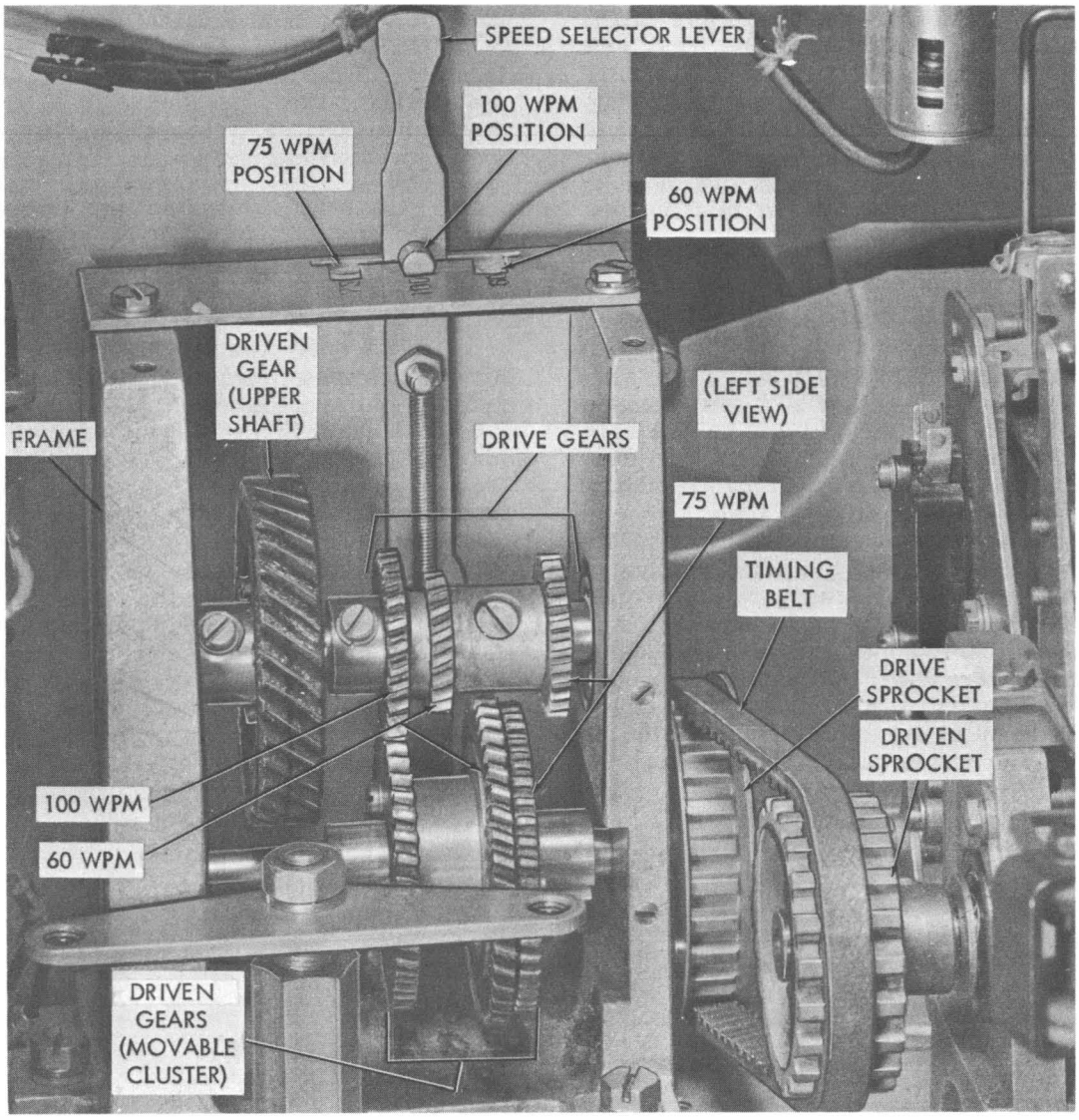


Figure 2-5. Variable - Speed Drive Mechanism

to the main shaft of the typing reperforator unit by a drive mechanism. If the single-speed drive mechanism is used, the path of the motion is as follows: from the motor shaft through a motor drive gear to a driven gear at the rear of an intermediate drive shaft which rotates in a bearing holder; from a drive sprocket at the forward end of the drive shaft through a toothed timing belt to a driven sprocket at the rear end of the main shaft of the typing reperforator unit.

4.b.(2) Variable-Speed Drive Mechanism (Figure 2-5)

4.b.(2)(a) If the variable-speed drive mechanism is used, the motion is transferred from the motor shaft through a motor drive gear (Figure 1-5) to a driven gear at the rear of an upper drive shaft which rotates in a cast frame; from the upper shaft through a drive gear to a corresponding driven gear on a lower drive shaft; from a drive sprocket at the forward end of the lower shaft through a toothed timing belt to a driven sprocket at rear end of the main shaft of the typing reperforator unit.

4.b.(2)(b) The three drive gears (Figure 2-5) are rigidly attached to the upper shaft which always rotates at the same speed. The cluster of three driven gears are free to move axially along the lower shaft, but are keyed to the shaft by a square bar, so that the shaft rotates in unison with the cluster. A selector lever is connected to the movable cluster by a roller and groove arrangement. When the selector lever is manually placed in any one of three positions (for 60, 75 or 100 words per minute), a drive gear meshes with a corresponding driven gear and rotates the cluster and shaft at the proper speed to produce the desired revolutions per minute at the main shaft of the typing reperforator unit.

4.b.(3) Main Shaft (Figure 2-6) — The main shaft, which is mounted on bearings in the frame of the typing reperforator unit, rotates continuously as long as the motor is running. Selecting and function cam-clutches on the shaft distribute its motion to the selecting and function mechanisms respectively as described in paragraphs 5.b.(1) and 6.b. of this section.

5. SELECTION

5.a. GENERAL — The selecting mechanism — made up primarily of a selector (Figure 2-10) a clutch trip assembly (Figure 2-7) and a cam-clutch (Figure 2-6) — translates the signaling code into mechanical arrangements which govern printing and perforation of the tape. The electrical pulses comprising each code combination are applied to a magnet of the selector. The magnet through an armature controls the clutch trip assembly and the parts associated with translation. The cam-clutch transfers timed motion to the selector and also trips the function cam-clutch. By means of a range finder assembly (Figure 2-7), the selecting mechanism can be adjusted to sample the code elements at the most favorable time for optimum operation. The mechanical arrangements produced by the selecting mechanism are passed on to the punch slides which control the perforator and the transfer mechanism (Figure 2-11). The latter, consisting of a group of mechanical linkages, transfers the arrangements to the function box and positioning mechanisms.

5.b. RECEPTION AND TRANSLATION

5.b.(1) Selecting Cam Clutch and Clutch Trip Assembly (Figures 2-6 and 2-7)

5.b.(1)(a) The selecting cam-clutch assembly includes (from right to left in Figure 2-6) the clutch, the stop arm bail cam, the fifth, the fourth and the third selector cams, the cams for the spacing and the marking lock levers, the second and the first selector cams, the selector reset bail cam and the function trip cam. The cam-clutch is controlled by the selector through the clutch trip assembly (Figure 2-7). During the time in which the signal circuit is closed (marking), the selector magnet coils are energized and hold the selector armature up against the magnet pole pieces. In this position, the armature blocks the start lever, and the cam-clutch is held stationary between the stop arm and latch lever.

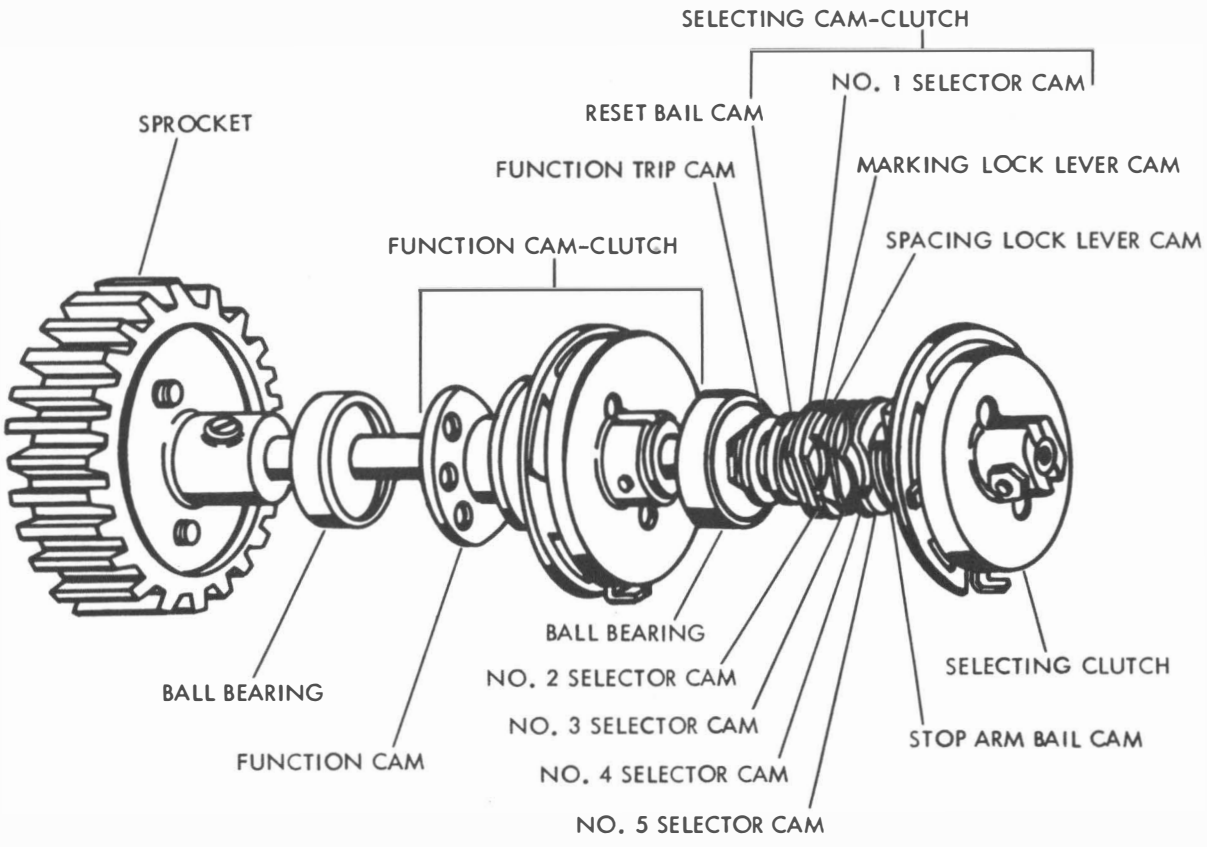


Figure 2-6. Main Shaft

5.b.(1)(b) When a code combination is received, the start (spacing) element de-energizes the magnet, and the selector armature under tension of its spring moves down out of the way of the start lever. The start lever turns clockwise under spring pressure and moves the stop arm bail into the indent of its cam (Figure 2-7). As the stop arm bail rotates about its pivot point, the attached stop arm is moved out of engagement with the clutch shoe lever. The selecting cam-clutch engages and begins to rotate counterclockwise. The stop arm bail immediately rides to the high part of its cam where it remains to hold the start lever away from the armature while the selecting elements of the code are received and processed by the selector (paragraph 5.b.(3) below).

5.b.(1)(c) When the stop element at the end of the code combination is received, the armature is pulled up and blocks the start lever. Thus the stop arm bail is prevented from dropping onto the low part of its cam, and the attached stop arm is held in position to stop the clutch shoe lever. When the clutch shoe lever strikes the stop arm, the inertia of a cam disk causes it to continue to turn until its lug makes contact with the clutch shoe lever. At this point a latch lever drops into an indent in the cam disk, and the clutch is held disengaged until

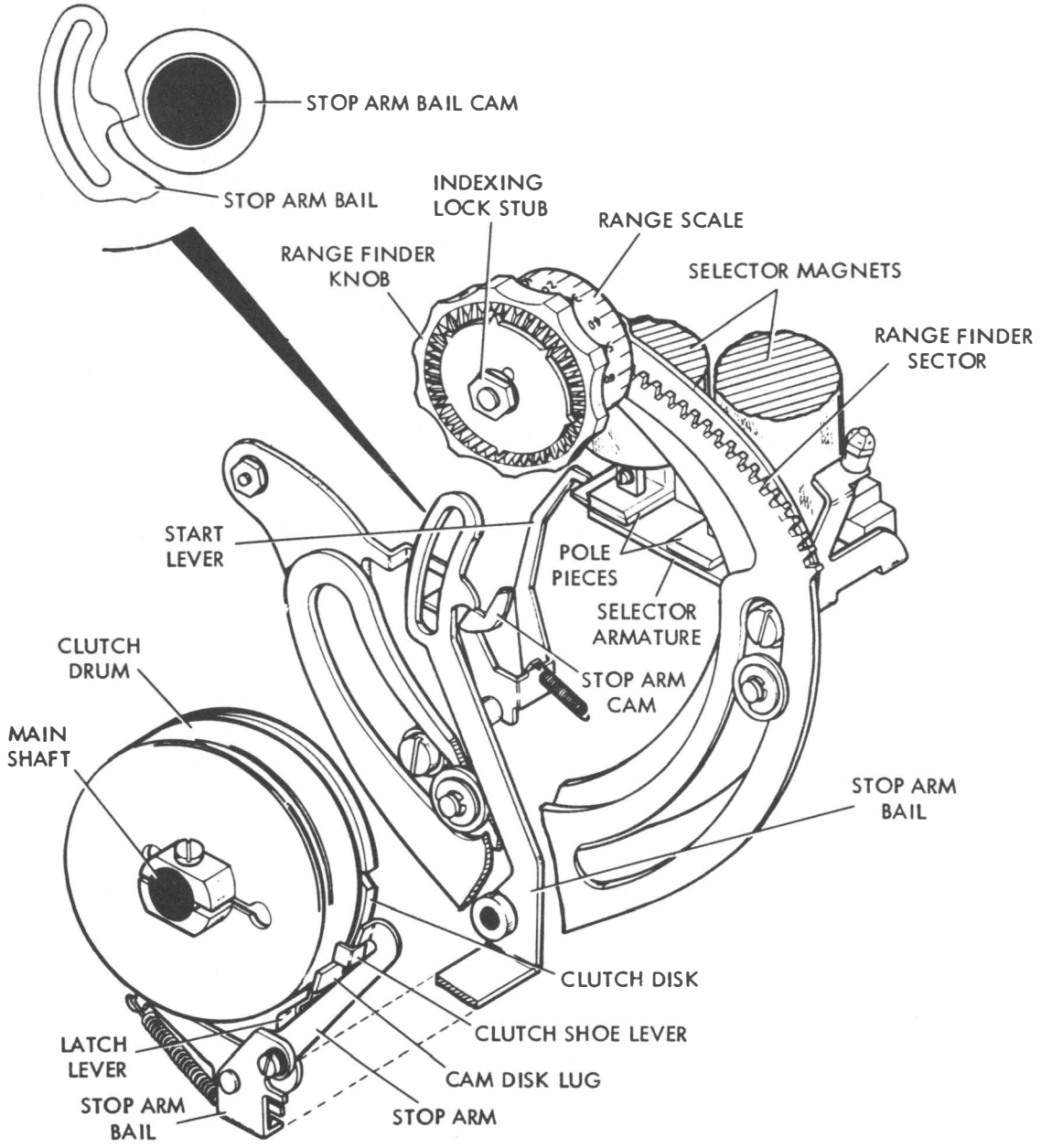


Figure 2-7. Range Finder and Selecting Cam Clutch Trip Assembly

the next code combination is received.

5.b.(2) Clutch Operation (Figures 2-8 and 2-9)

5.b.(2)(a) The clutch drum is attached to and rotates in unison with the main shaft

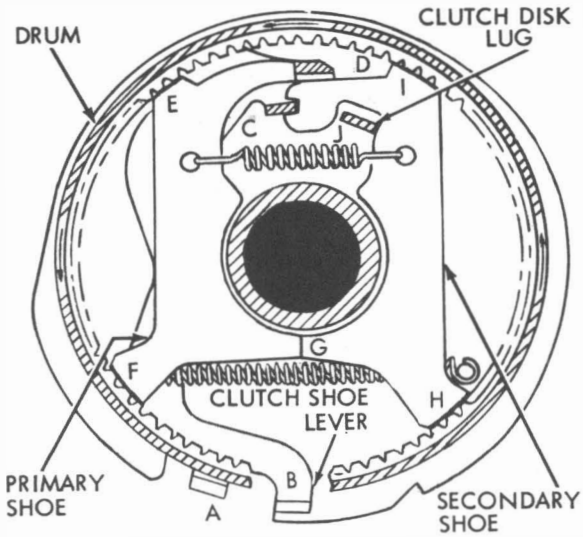


Figure 2-8. Clutch-Engaged

(Figure 2-7). In the disengaged position, as shown in Figure 2-9, the clutch shoes do not contact the drum, and the shoes and cam disk are held stationary. Engagement is accomplished by moving the stop arm (Figure 2-7) away from the clutch and thus releasing stop lug A and the lower end of shoe lever B (Figure 2-8). The upper end of lever B pivots about its ear C, which bears against the upper end of the secondary shoe, and moves its ear D and the upper end of the primary shoe toward the left until the shoe makes contact with the notched inner surface of the rotating drum at point E. As the drum turns counterclockwise, it drives the primary shoe downward so that it again makes contact with the drum at point F. There, the combined forces acting on the primary shoe cause it to push against the secondary shoe at point G. The lower end of the secondary shoe then bears against the drum at point H. The drum drives this shoe upward so that it again makes contact with the drum at point I. The forces involved are multiplied at each of the preceeding steps. The aggregate force is applied through the shoes to the lug J on the clutch cam disk, and the disk and attached cam turn in unison with the drum.

5.b.(2)(b) Disengagement is effected when the lower end of shoe lever B strikes the stop arm (see Figure 2-7). Lug A and the lower end of the shoe lever are brought together (Figure 2-9), and the upper end of lever B pivots about its ear C and allows its other ear D to move toward the right. The upper spring then pulls the two shoes together and away from the drum. The latch lever seats in the indent in the cam disk (paragraph 5.b.(1)(c)) and the cam is held in its stop position until the clutch is again engaged.

5.b.(3) Selector (Figures 2-6, 2-7 and 2-10)

5.b.(3)(a) The selector assembly consists primarily of two magnet coils (Figure 2-7), an armature and associated arms, bails, levers and latches (Figure 2-10). Five linkages, each of which consists of a selecting lever, a push lever and a punch slide latch, link the selector cam with the punch slides. Since the linkages are identical, only the no. 4 is shown in its entirety in Figure 2-10. As the selecting elements of the code combination are applied to the magnet, the cam actuates the selecting levers. When a spacing element is received, a marking lock lever is blocked by the end of the armature and a spacing lock lever swings to the right above the armature and locks it in the spacing position until the next signal transition occurs. Extensions on the marking lock lever prevent the selecting levers from following their cams. When a marking element is received, the spacing lock lever is blocked by the end of the armature and the marking lock lever swings to the right below the armature and locks it in the marking position until the next signal transition occurs. During this marking condition, the selecting levers are not blocked by the marking lock lever extensions, but are permitted to move

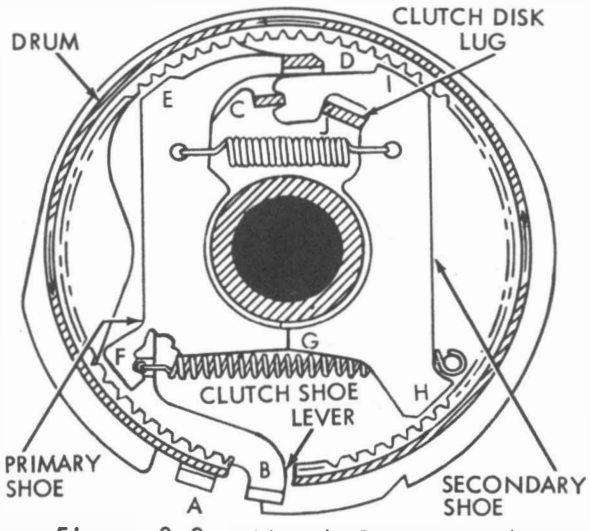


Figure 2-9. Clutch-Disengaged

against their respective cams. The selecting lever that is opposite the indent in its cam, while the armature maintains a marking condition, swings to the right, or selected, position and an associated push lever falls to its left.

5.b.(3)(b) As the cam rotates, the se-

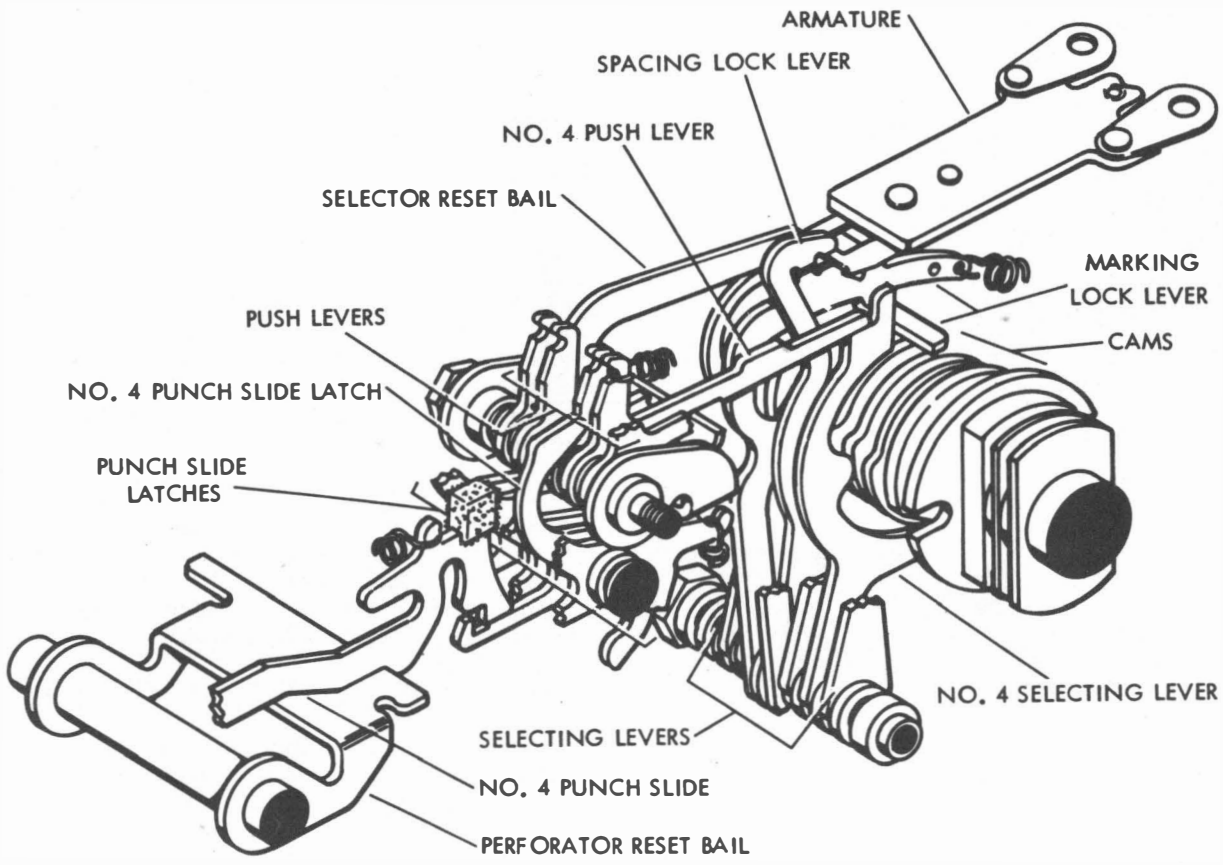


Figure 2-10. Selector

lecting levers, together with any selected push levers, are moved to the right by the high part of their respective cams where they remain until the next code combination is received. The unselected push levers remain to the right. When the next code combination is received, a selector reset bail, lifted by its cam (Figure 2-6), strips the selected push levers from the selecting levers, and the push levers are returned to the right by their springs.

5.b.(3)(c) The selected push levers in moving to the left rotate associated punch slide latches counterclockwise (Figure 2-10). Just before the fifth push lever is selected, the selecting cam through the function trip assembly causes the perforator reset bail to release the punch slides (paragraph 6.b.). The unselected latches retain their associated slides to the right while the selected latches permit their slides to move to the left under spring tension. During the latter part of the function cycle the reset bail returns the punch slides to their unselected position (see paragraph 8.b.(2)). The latches under spring tension return to their unselected position when the selected push levers are repositioned at the beginning of the next selecting cycle.

5.c. ORIENTATION (Figure 2-7)

5.c.(1) For optimum performance, the selecting mechanism should be adjusted to sample the signaling code elements at the most favorable time. To determine this adjustment, the operating margins are established through the range finder which provides a means of varying the time of sampling. The obtaining of this optimum setting is referred to as orientation.

5.c.(2) When the range finder knob (Figure 2-7) is pushed inward and rotated, its attached range finder gear moves the range finder sector (which supports the stop arm bail, stop arm and latch lever) either clockwise or counterclockwise about the selector cam-clutch. This changes the angular position at which the selector cam-clutch stops with respect to the marking and spacing lock levers. When an optimum setting is obtained, the range finder knob is released. Its inner teeth engage the teeth of

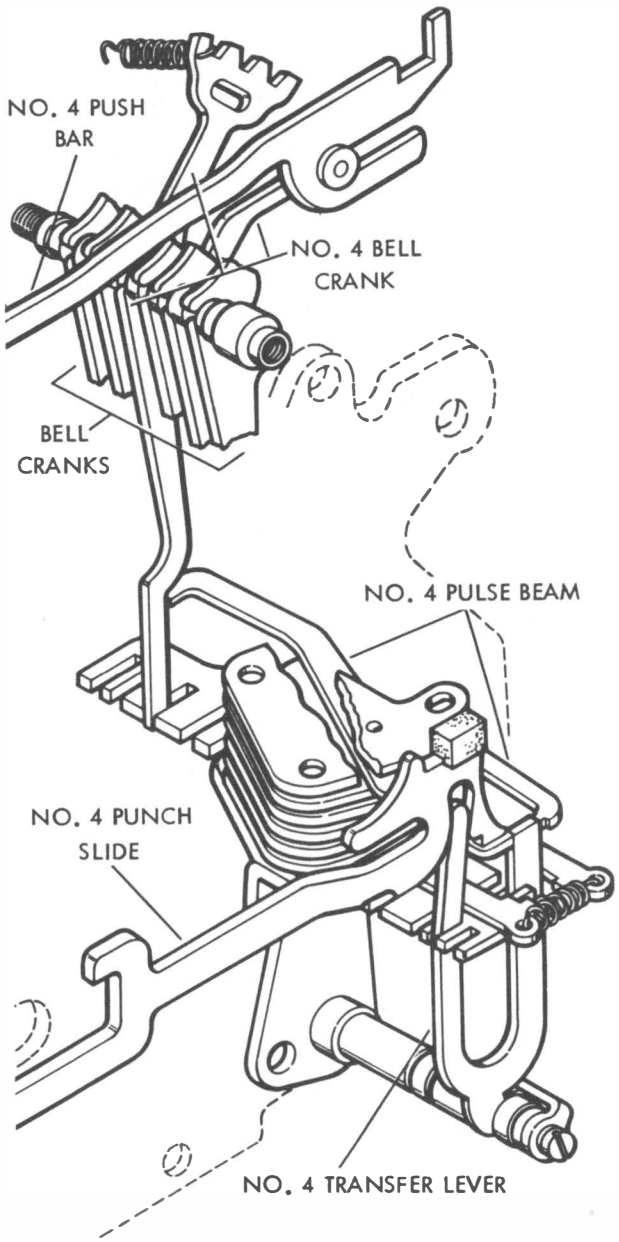


Figure 2-11. Transfer Mechanism

the indexing lock stud to hold the range finder mechanism in position. The setting may be read on the range scale opposite a fixed index mark.

5.d. TRANSFER (Figure 2-11)

5.d.(1) Near the end of each selecting cycle the transfer mechanism moves the intelligence in the form of a mechanical arrangement from the punch slides to the function box and positioning mechanisms. Included in the mechanism are five linkages, each of which is associated with a punch slide. A linkage consists of a transfer lever, a pulse beam and a bell crank. Since the linkages are similar only the no. 4 is shown in its entirety in Figure 2-11.

5.d.(2) The linkages associated with the unselected punch slides (paragraph 5.b.(3)(c)) remain in their unselected position as shown in Figure 2-11. However, the selected slides in moving to the left pivot the associated transfer levers which, in turn, move corresponding pulse beams clockwise (as viewed from above). The selected beams allow assocated bell cranks under spring tension to pivot counterclockwise and lift attached push bars. The push bars, in turn, control the positioning mechanisms. In the period of the last half of the function cycle, the selected slides are moved back to the right (paragraph 8.b.(2)) and return the linkages to their unselected position.

5.d.(3) Slotted upper arms of the bell cranks extend up into the function box and control its operation as described in paragraph 7.b.(5). An additional bell crank, not associated with a transfer linkage, is specifically concerned with the letters-figures shift.

6. MOTION FOR TYPING AND PERFORATING

6.a. GENERAL — The main shaft's motion is distributed to the mechanisms concerned with typing and perforation by the function mechanism which is comprised of a cam-clutch (Figure 2-6), a rocker bail (Figure 2-13) and a clutch trip assembly (Figure 2-12).

6.b. FUNCTION CAM CLUTCH AND CLUTCH TRIP ASSEMBLY (Figure 2-12).

6.b.(1) The trip assembly is shown in its unoperated condition in Figure 2-12. A follower lever rides on a function trip cam which is part of the selecting cam-clutch. Near the end of the selecting cycle, as the main shaft rotates counterclockwise, the high part of the cam pivots the follower lever which through an attached adjusting arm rotates a main trip lever counterclockwise. A reset bail trip lever attached to the main trip lever lowers the perforator reset bail and releases the punch slides (paragraph 8.b.(1)); and an upper arm of the main trip lever moves out of the way of a clutch release which falls against a downstop and rotates a trip shaft counterclockwise. Immediately, the low part of the trip cam allows the follower lever to return to its unoperated position, and the upper arm of the main trip lever moves down against the release. When the trip shaft is rotated by the release, it moves an attached clutch trip lever out of engagement with the clutch shoe lever. The clutch engages and the cam-clutch assembly begins its cycle. The internal operation of the clutch is the same as that of the selector clutch described in para-

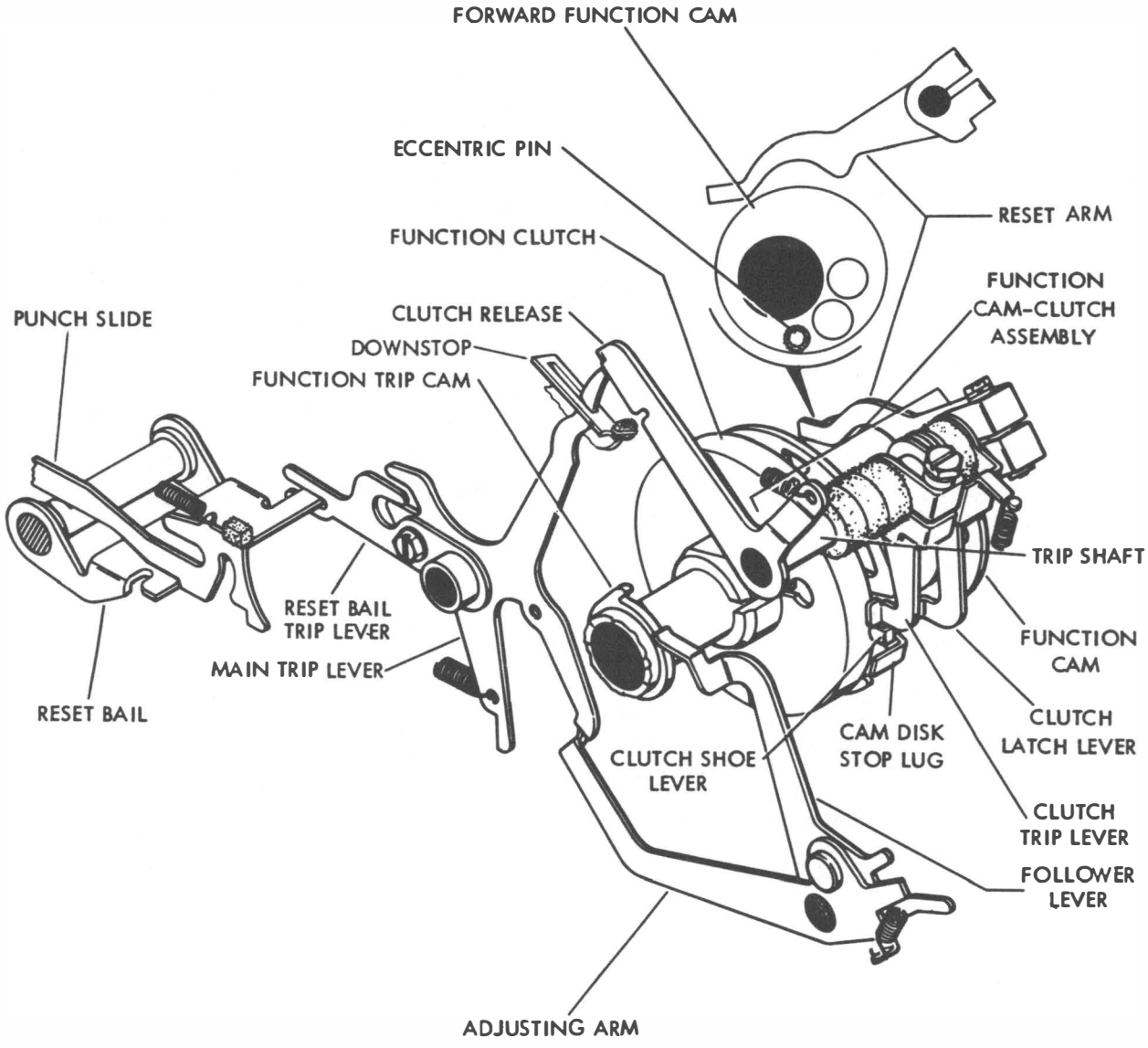


Figure 2-12. Function Cam-Clutch and Clutch Trip Assembly

graph 5.b.(2) of this section.

6.b.(2) About midway through the function cycle, an eccentric pin on the function cam lifts a reset arm which rotates the trip shaft clockwise. The release is moved up and allows the main trip lever to fall against the adjusting arm and raise the reset bail. The eccentric pin then moves out from under the reset arm and the release is permitted to return to its unoperated position against the main trip lever. When the cam-clutch assembly completes its cycle, the clutch shoe lever strikes the trip lever and the clutch is disengaged.

6.c. ROCKER BAIL ASSEMBLY (Figure 2-13) — The rocker bail distributes motion received from the function cam-clutch to the following: the ribbon feed mechanism, the perforator, the correcting mechanism, the function box, the printing mechanism, the oscillating assembly and the push bars of the axial and rotary positioning mechanisms. The bail is shown in its home position in Figure 2-13. Each function

cycle the function cams bear against rollers and cause the bail to rock the right (as viewed from the rear in Figure 2-13) during the first part of the cycle and then back to the home position during the latter part of the cycle.

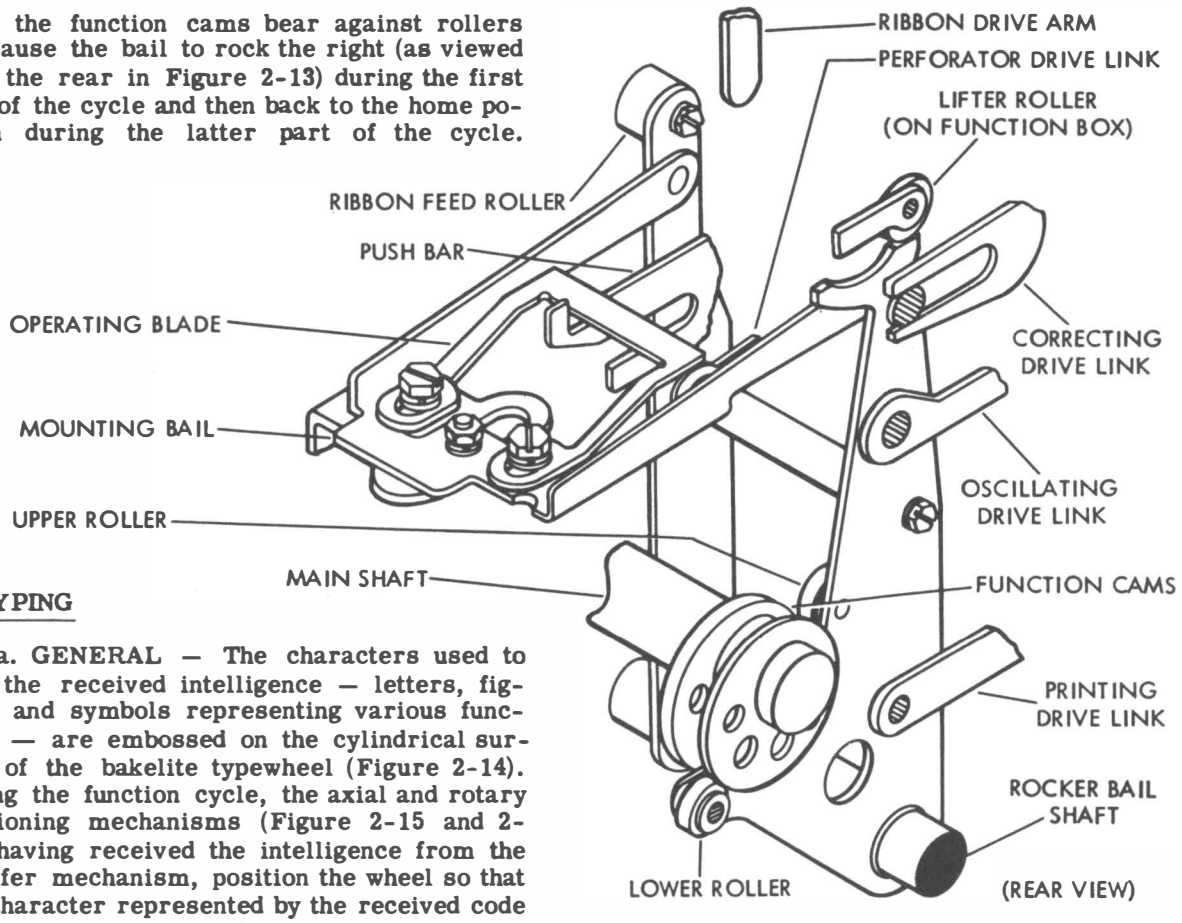


Figure 2-13. Rocker Bail Assembly

7. TYPING

7.a. GENERAL — The characters used to type the received intelligence — letters, figures, and symbols representing various functions — are embossed on the cylindrical surface of the bakelite typewheel (Figure 2-14). During the function cycle, the axial and rotary positioning mechanisms (Figure 2-15 and 2-17), having received the intelligence from the transfer mechanism, position the wheel so that the character represented by the received code combination is selected. Following typewheel positioning the correcting mechanism (Figures 2-15 and 2-17) accurately aligns the selected character. Then the printing mechanism (Figure 2-19), by means of a hammer, drives the tape and inked ribbon against the wheel and imprints the character. A ribbon feed mechanism (Figure 2-20) advances the ribbon and reverses its direction of feed when one of two ribbon spools is depleted. Near the end of the function cycle the axial positioning mechanism retracts the typewheel and a ribbon guide so that the last printed character is visible. The letters or the figures code combination sets up an arrangement in the transfer mechanism which permits the function box (Figure 2-18) to operate and cause the rotary positioning mechanism to shift the typewheel.

7.b. TYPEWHEEL POSITIONING

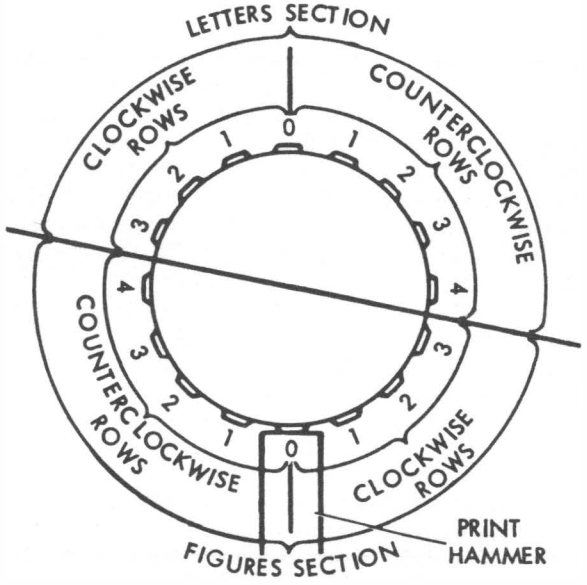
7.b.(1) General

7.b.(1)(a) A typical typewheel character arrangement is shown in Figure 2-14b. in 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.

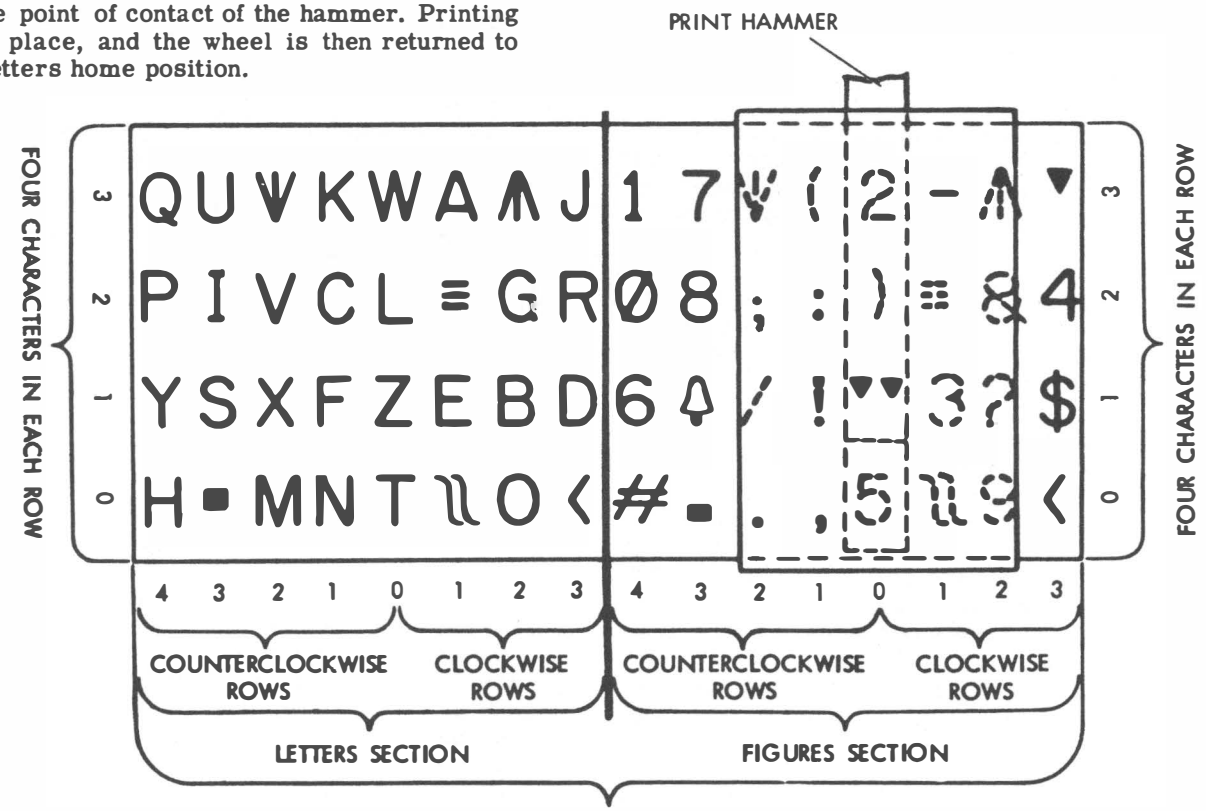
7.b.(1)(b) Each printing operation (excluding those devoted to the letters-figures shift) begins and ends with the typewheel in the home position of the section containing the character to be printed, i.e., with the no. 0 character of the no. 0 row at the point of contact of the print hammer. (Actually, inasmuch as the wheel is retracted to show the last printed character (paragraph 7.b.(3)(d)), 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 hammer 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, moves it forward and rearward along its axis so as to select the proper character in the row. The letters-figures shift, which consists of rotating the wheel eight rows from the home position of one section to that of the other, requires a separate operation of the equipment and results in the printing of the letters or figures symbol.

7.b.(1)(c) To illustrate the above, if the wheel is in the figures condition, as shown in Figure 2-14, and the numeral "5" is to be printed, there is no movement of the wheel during the printing operation, because "5" is already at the point of contact of the hammer. However, if the letter "I" 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 "I" is at the point of contact of the hammer. Printing takes place, and the wheel is then returned to the letters home position.



a.
FRONT VIEW SHOWING 16 LONGITUDINAL ROWS



b.
TOP VIEW SHOWING CYLINDRICAL SURFACE IN A PLANE

Figure 2-14. Typical Typewheel Character Arrangement

7.b.(2) Rotary Positioning (Figures 2-15 and 2-16)

7.b.(2)(a) 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 includes two eccentric assemblies as shown in Figures 2-15 and 2-16. 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 push bar: 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 push bar.

7.b.(2)(b) The eccentric assemblies are linked to a typewheel shaft by a drive assembly as shown in Figure 2-15. 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 (Figure 2-17). A spur gear which meshes with a 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.

7.b.(2)(c) When in response to a marking pulse a push bar is lifted by its bell crank, as described in paragraph 5.d.(2) of this section, the rocker bail operating blade (see Figures 2-13 and 2-16) 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 eccentric is again detented. The preceding does not apply to the no. 5 push bar which is designed so that it is selected (moved to the left) on spacing rather than marking, nor the left-front eccentric which effects the letters-figures shift and whose operation is covered in paragraph 7.b.(5). 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 eccentrics displaced).

7.b.(2)(d) In the right assembly the home position of the rear eccentric is down and the home position of front eccentric is up (Figure 2-16). 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 push bar 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 (Figure 2-15). 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 (Figure 2-14) is presented to the print hammer at the time of printing. On its right stroke the no. 5 push bar returns the eccentric and the typewheel to their home positions. In a similar manner, selection of the no. 3 push bar results in a four unit downward displacement of the right front eccentric and 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.

7.b.(2)(e) 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 push bar 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.

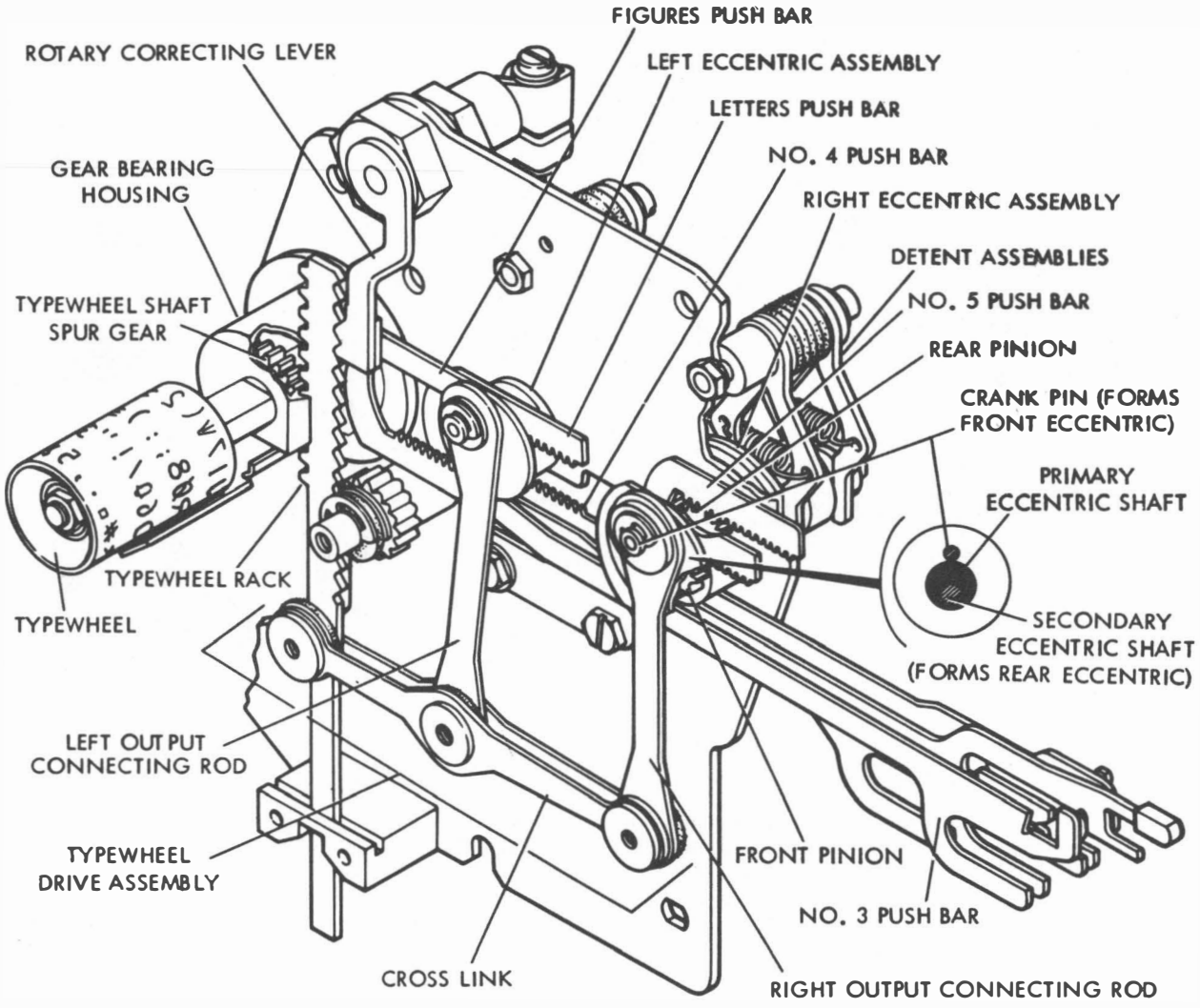


Figure 2-15. Rotary Positioning Mechanism

7.b.(2)(f) 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 push bars 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 push bar 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 (Figure 2-14).

7.b.(3) Axial Positioning (Figures 2-16, 2-17 and 2-19)

7.b.(3)(a) 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

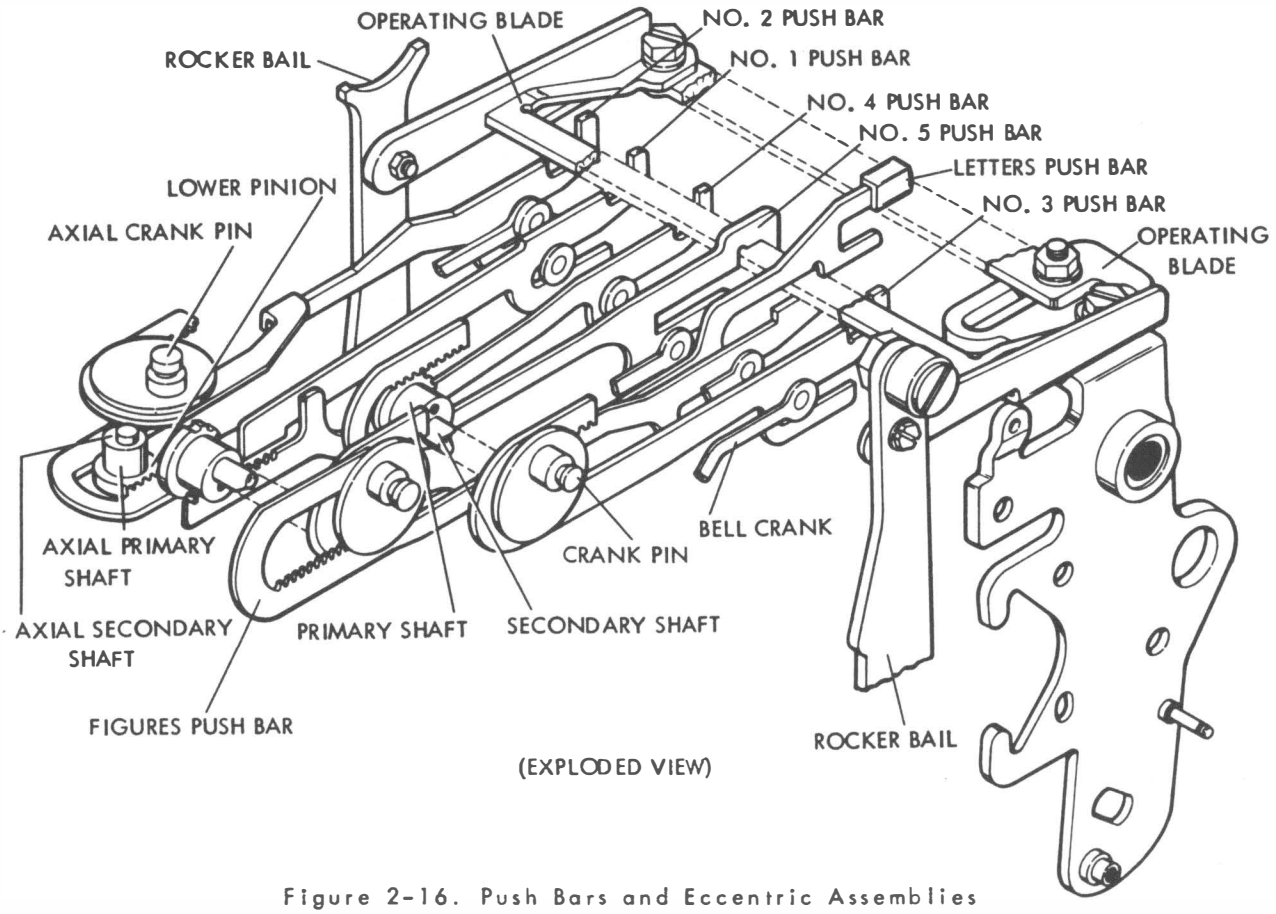


Figure 2-16. Push Bars and Eccentric Assemblies

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 (Figure 2-16 and 2-17). Two eccentrics, a lower whose pinion is driven by the no. 1 push bar and upper whose pinion is driven by the no. 2 push bar, 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 Figure 2-17.

7.b.(3)(b) The selection of either the no. 1 or no. 2 push bar 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).

7.b.(3)(c) If during a function cycle neither push bar is selected, no motion occurs in the axial positioning mechanism with the exception of that resulting from the oscillating assembly (paragraph 7.b.(3)(d) below), and the no. 0 character of the selected row is aligned with the hammer at the time of printing (Figure 2-14). On the other hand, if the no. 1 push bar 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 push bar reverts to its unselected position it returns the axial linkage and typewheel to their home position. If the no. 2 push bar is selected the no. 2 character is printed, and if both push bars 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.

7.b.(3)(d) With each cycle of the function clutch, an oscillating drive link transfers from the rocker bail an unselected motion to an oscillating drive bail (Figures 2-17 and 2-19). 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 push bar 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 (Figure 2-19).

7.b.(4) Correction (Figures 2-15 and 2-17)

7.b.(4)(a) 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 (Figure 2-17). The shaft pivots a rotary correcting lever (Figure 2-15) which is equipped with an indentation that engages a tooth in a 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 the

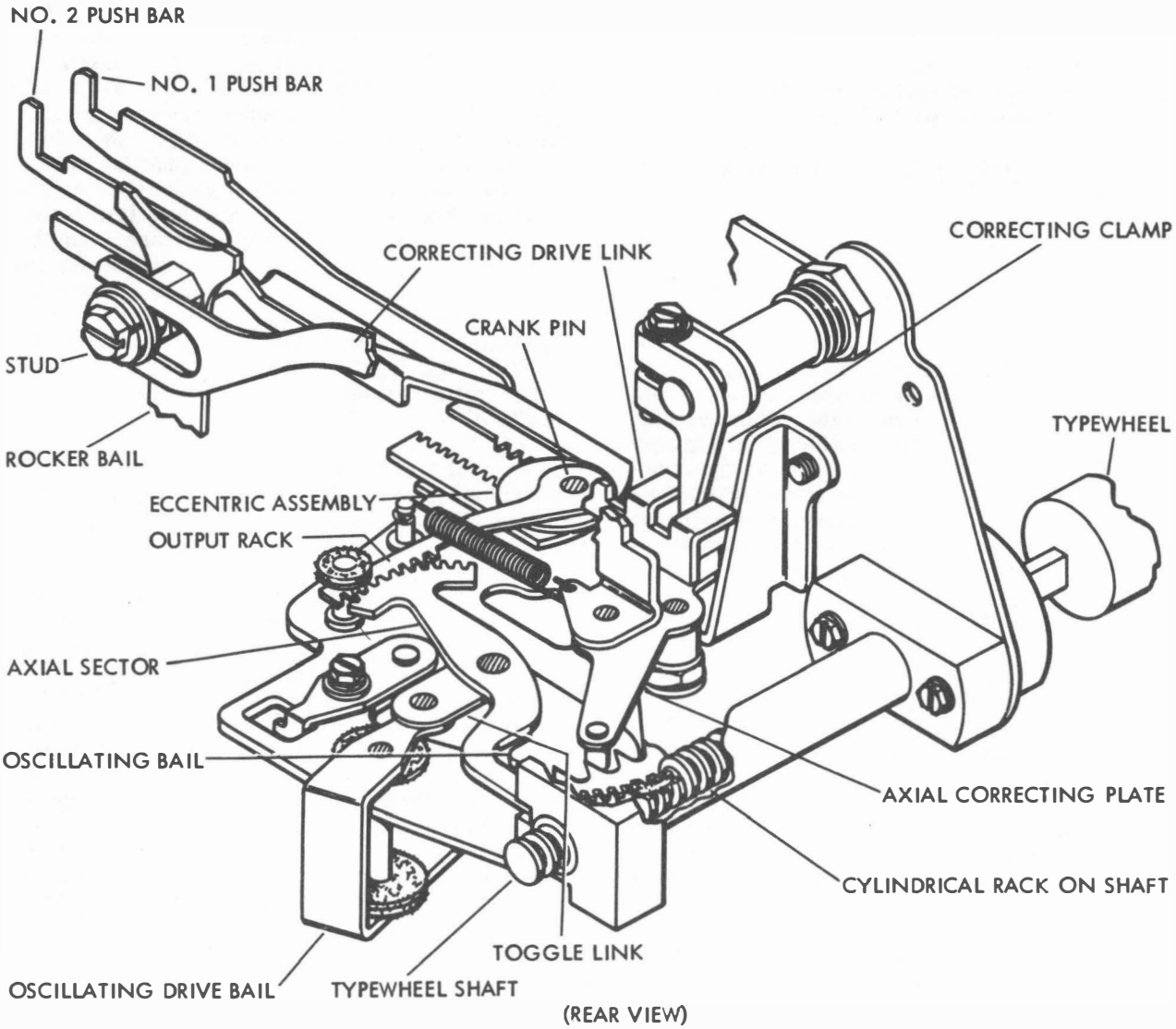


Figure 2-17. Axial Positioning Mechanism

above), and a roller mounted on the plate engages a notch in the axial sector (Figure 2-17). 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.

7.b.(4)(b) Since the rocker bail is the source of motion for both the push bars 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.

7.b.(5) Letters-Figures Shift (Figures 2-15 and 2-18)

7.b.(5)(a) The purpose of the letters-figures shift is to rotate the typewheel from the home position of one section to that of the other (Figure 2-14). It is effected by means of the function box mechanism which is made up of a number of parts assemblies mounted on two plates located at the upper rear of the typing reperforator unit (Figure 2-18). When the unit is in the letters condition, as shown in Figures 2-15 and 2-18, and the figures code combination (12-45) is received, the transfer mechanism sets up the figures arrangement in the bell cranks during the selecting cycle (paragraph 5.d.). 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 (Figure 2-18), 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.

7.b.(5)(b) 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, on receipt of the figures code combination, 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 arr ssembly pivots a figures extension arm away from the letters-figures bell crank. A letters extension arm under spring tension rotates the bell crank clockwise (Figure 2-18), and the bell crank lifts the letters and figures push bars. As the bail reaches its extreme position, the lifter is cammed up and raises the function blades.

7.b.(5)(c) While the letters-figures bell crank is being positioned by the function box, the no. 1, 2 and 4 push bars are selected, the typewheel is moved two rows clockwise and three characters forward, and the figures symbol is printed (paragraphs 7.b.(2) and (3)). On its return stroke, the rocker bail operating blade encounters a shoulder on the figures push bar (which was lifted as described above) and moves the bar to the right as viewed from the front in Figures 2-15 and 2-16. The common pinion moves the letters push bar 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 (see paragraph 7.b.(2)(e)). As the bail returns to its home position during the last half at the cycle, a lock lever toggle linkage (Figure 2-18) 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.

7.b.(5)(d) In a manner similar to that described above, when the letters code combination (12345) is received, the function box causes the letters-figures bell crank to lower the letters and figures push bars. 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 push bar 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.

7.c. PRINTING (Figure 2-19)

7.c.(1) After the typewheel has been positioned and corrected, the printing mechanism supplies the impact which drives the paper and

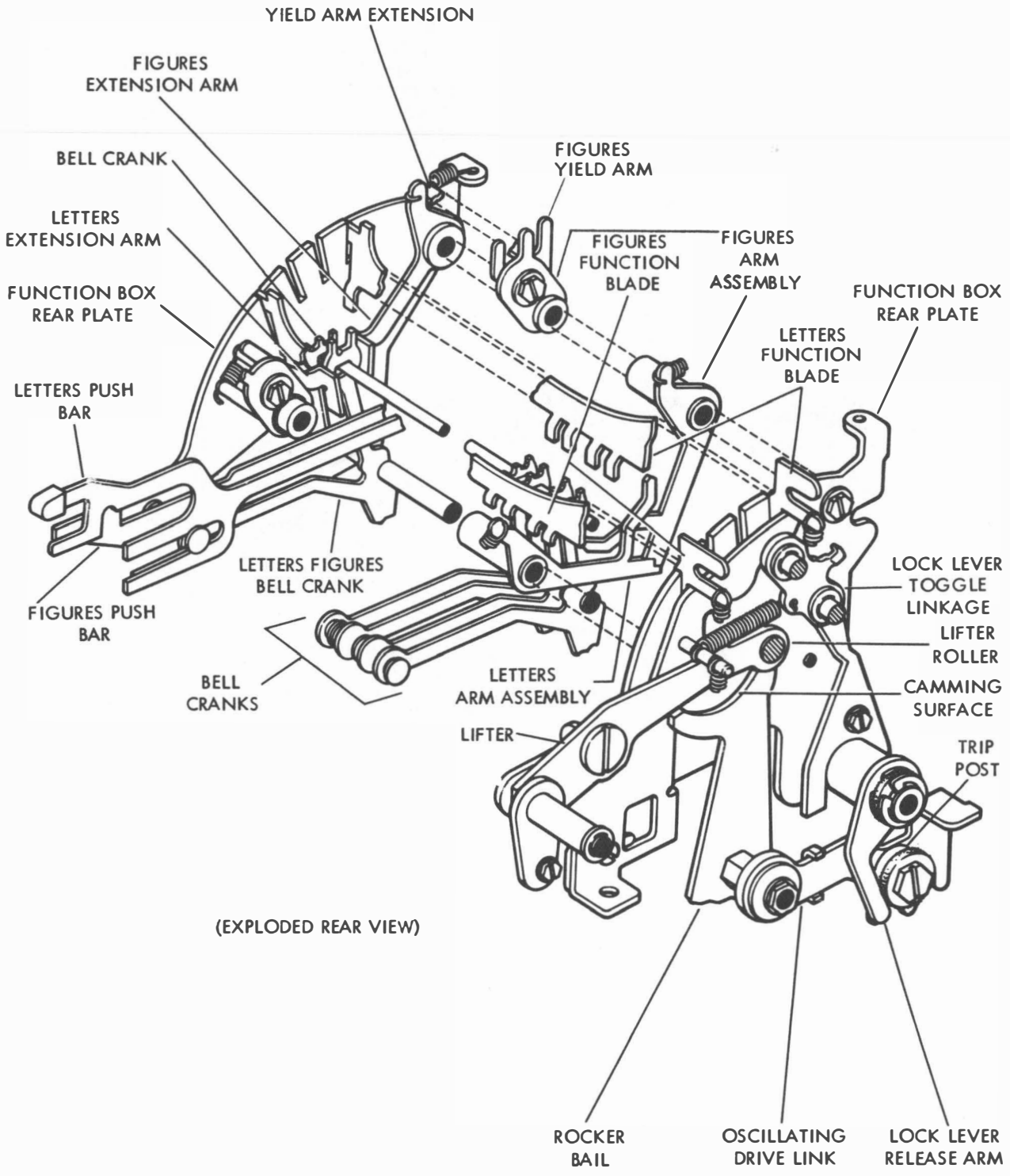


Figure 2-18. Function Box

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 Figure 2-19, 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.

7.c.(2) 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 Figure 2-19) 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 bail's 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. The accelerator does not follow the hammer through the complete printing stroke. Near the end of its travel, the accelerator encounters a projection on a latch

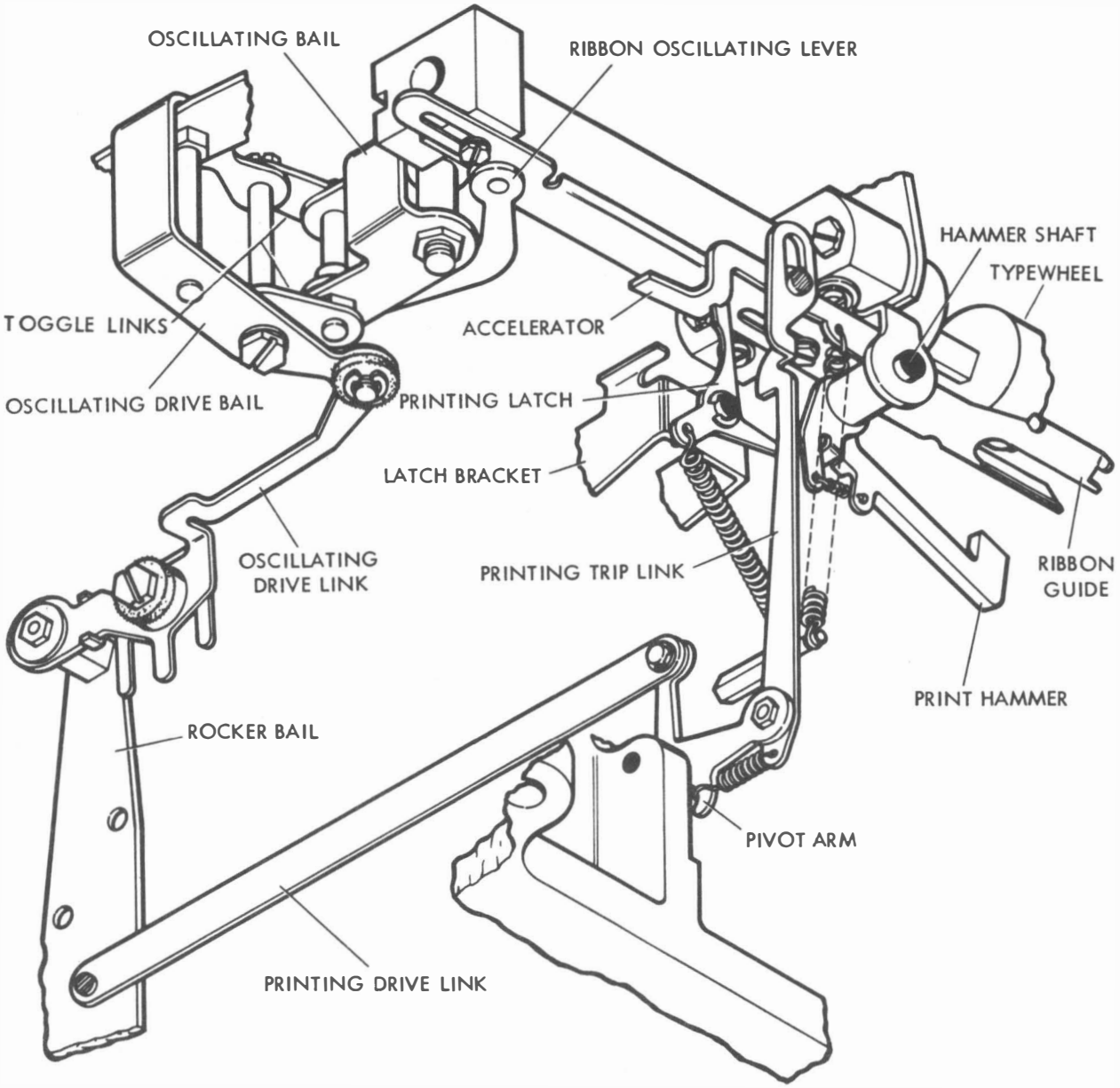


Figure 2-19. Printing Mechanism

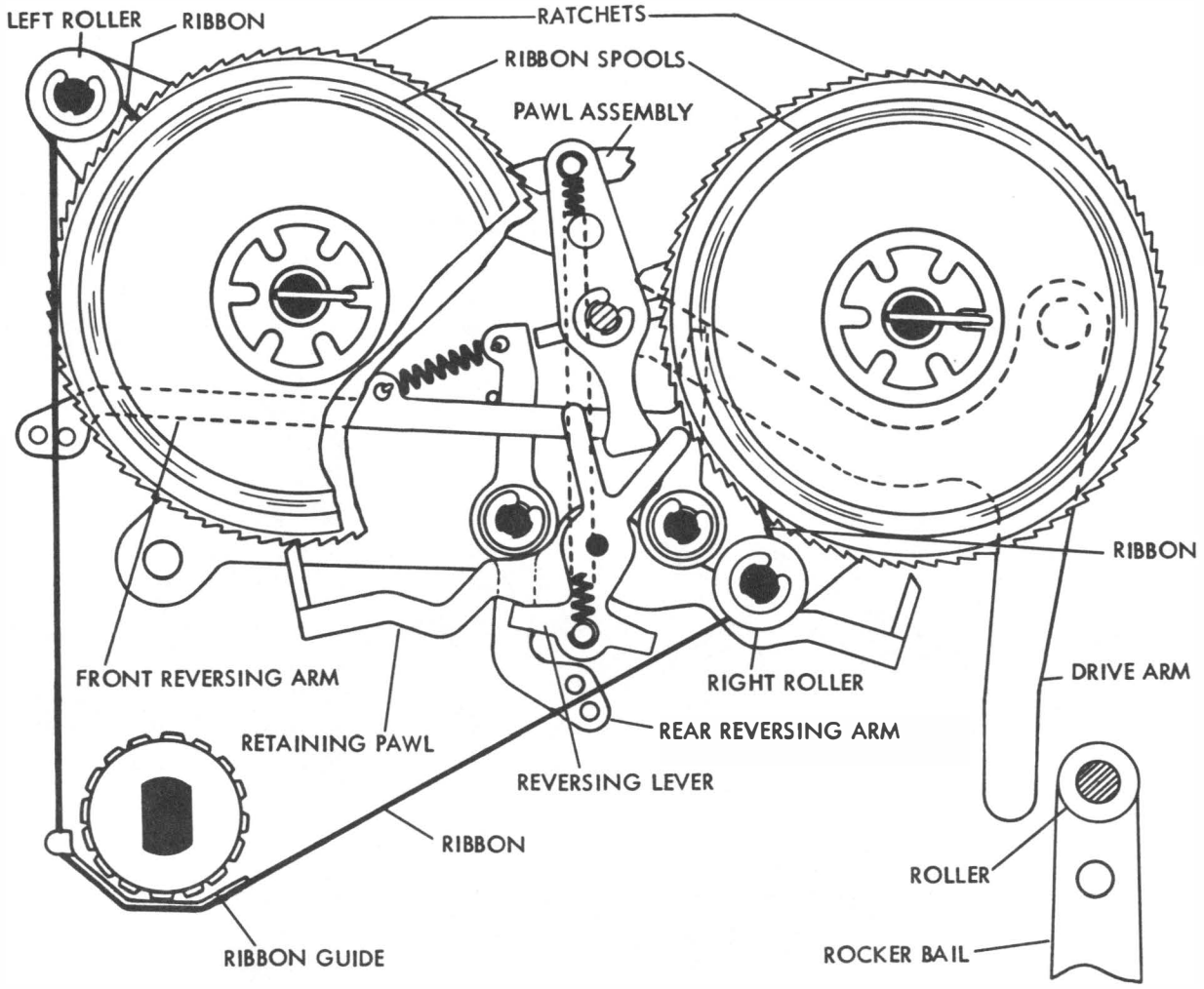


Figure 2-20. Ribbon Feed Mechanism

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.

7.d. RIBBON FEEDING (Figure 2-20)

7.d.(1) The characters are typed in 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 (Figure 2-20). The path of the ribbon is down to the left off the top of a right spool, under a right roller, to the left through pins on a rear reversing arm, through the guide, up through pins on a front reversing arm, over a left roller and down to the right onto the bottom of a left spool.

7.d.(2) 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 and ribbon spool 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.

7.d.(3) When a spool is almost depleted, a rivet in the ribbon encounters pins on a 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 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.

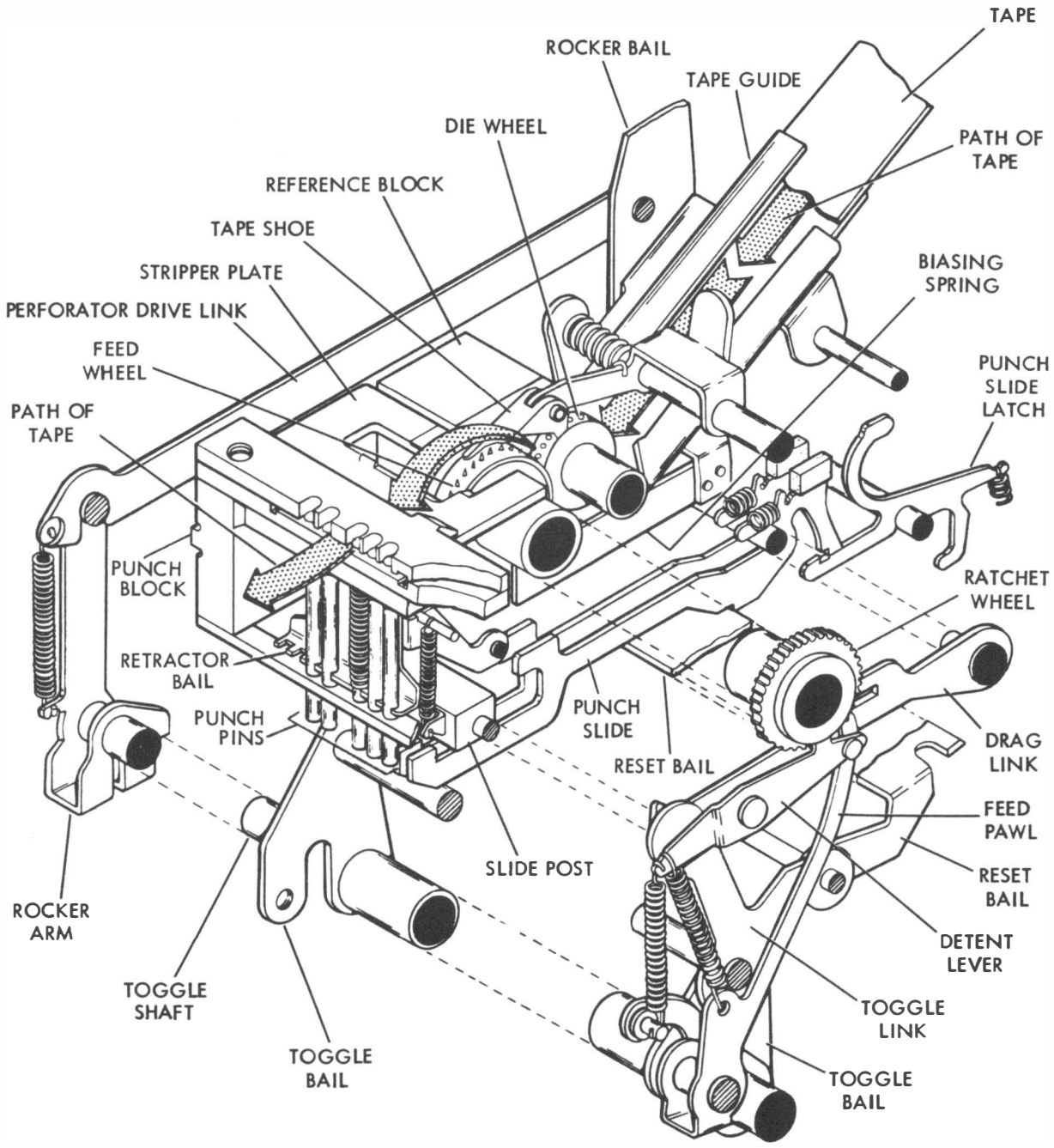


Figure 2-21. Perforator Mechanism

8. TAPE PERFORATING AND FEEDING

8.a. GENERAL — The perforator mechanism punches feed holes, advances the tape and perforates combinations of chadless code holes corresponding to the code combinations received from the signal line. Intelligence is received from the selecting mechanism by the punch slides which select proper punch pins in a punch block assembly (Figure 2-21). Motion from the rocker bail is distributed to the pins and the tape feeding parts by a main bail assembly, which includes a toggle bail, a toggle shaft, a slide post, toggle links, drag links and the punch slide reset bail.

8.b. PERFORATING

8.b.(1) As described in paragraph 6.b.(1), near the end of the selecting cycle the reset bail is lowered and releases the five punch slides (Figure 2-21). The selected slides move to the left and the unselected slides are retained to the right by their latches (paragraph 5.b.(3)(c)). In the selected position a projection of each slide extends over the slide post. 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 the associated punch pins through the tape. The slides pivot about the same point as drag links and thus become an integral part of the main bail assembly during the perforating stroke. A retractor bail, which engages notches in the punch pins, is pivoted clockwise as the pins move up through the tape. Approximately midway through the function cycle, the function clutch trip assembly lifts the reset bail as described in paragraph 6.b.(2).

8.b.(2) During the last half of the cycle the toggle bail is rotated clockwise and lowers the punch slides. The reset bail, moved to the right by the toggle links, drives the slides back to their unselected position where it holds them until the next operation. The retractor bail under spring pressure holds the punch pins down against the slides until the pins are retracted below the tape. The notches in the pins are long enough to allow the retractor bail to pivot its full amount without lifting the unselected pins against the tape, but are short enough to permit the bail to serve as a downstop for the pins and thus hold them in the block. A compression spring is mounted on the no. 3 punch pin, and four tension springs are hooked to the slide post and the retractor bail. The main bail assembly, the retractor bail and the selected slides and pins move as a unit during the perforating stroke, and the retractor bail tension springs are not part of the load on the toggle bail shaft. The openings in the block above the tape through which the selected pins protrude are semi-circular so that only the rear portion of the hole is severed.

8.c. FEEDING — 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 (Figure 2-21). A feed pawl, driven by the toggle bail, acts upon a ratchet and rotates the feed wheel which, by means of sharp pins and holes in the die wheel, rolls feed holes into the tape and advances it 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 cycle so as to hold the tape in position during 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, and 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 printed and perforated and finally emerges at the left. A biasing spring, by holding the tape back against a reference surface on the block, maintains a constant relationship between the code perforations and the edge of the tape.

9. VARIABLE FEATURES

9.a. NON-INTERFERING BLANK TAPE FEED-OUT (Figure 2-22)

9.a.(1) GENERAL — The non-interfering blank tape feed-out mechanism provides a means of feeding out a predetermined length of blank tape (see paragraph 5.b. of Section 1). The mechanism is shown in its unoperated condition in Figure 2-22.

9.a.(2) INITIATION AND FEEDING — The feed-out operation is initiated by a pulse applied to a feed-out magnet when the Typing Reperforator Set is in the idling condition. The magnet pulls an armature down, and an armature bail through a roller and lock lever rotates a release arm counterclockwise. The release arm unlatches a drive arm which under spring tension falls against an eccentric collar on the main shaft. A latch engages the release arm at its right end and thus holds the mechanism in its operated condition. As the eccentric collar is rotated by the main shaft, it imparts an oscillating motion through the drive arm, a drive

shaft, and a feed pawl arm to a feed pawl which acts on a ratchet to rotate the perforator feed wheel and advance the tape.

9.a.(3) METERING AND TERMINATION

9.a.(3)(a) When in response to the initiating pulse the release arm rotates counterclockwise, it permits a lifter lever to lower a metering feed pawl and an outer ratchet check pawl onto two metering ratchets. Every sixth tooth of these ratchets is deeper than the others. An eccentric riding on the main shaft transfers an oscillating motion to the metering feed pawl which advances the inner ratchet one tooth counterclockwise each revolution of the shaft. As long as it is engaging the shallow teeth of the inner ratchet, the feed pawl is prevented from engaging the outer ratchet. However, when a deep tooth comes up, the pawl engages and advances both ratchets. Thus a six to one reduction ratio is designed into the mechanism. Check pawls prevent the ratchets from rotating clockwise.

9.a.(3)(b) As the ratchets are revolved in the manner described above, at a predetermined time, an extension of an adjusting plate (adjustable for different lengths of tape) riding on the front ratchet moves up and rotates a latch arm and attached kickout arm clockwise. If at this time the armature is in the attracted position, a roller on the kickout arm acts on a camming surface of the lock lever to cause the roller on the lock lever to be disengaged from the armature bail. If the armature is not attracted, the lock lever is not disturbed. As the latch arm continues to pivot, an extension carries the latch with it, thus unlatching the release arm. The release arm under spring tension pivots clockwise, latches the drive arm and causes the lifter lever to lift the metering pawls off the ratchets. Feed-out terminates since the drive arm no longer receives motion from the eccentric collar. A spring returns the forward ratchet and the adjusting plate to their start position. As the extension on the adjusting plate moves up and engages the latch arm, it also pivots a switch lever which actuates a switch mounted on the rear of the tape-out frame. The switch is momentarily opened or closed depending on the choice of contacts.

9.a.(4) NON-INTERFERENCE — If a code combination is received during the feed-out interval, the selector reset bail rises (paragraph 5.b.(3)(b)) and pivots a non-interfering lever. Motion is conveyed through a shaft and clamp arm to an intermediate lever. The intermediate lever rotates the latch arm clockwise, and the feed-out operation is terminated as described in paragraph 9.a.(3)(b) above.

9.b. INTERFERING LETTERS TAPE FEED-OUT (Figure 2-23)

9.b.(1) GENERAL — The interfering let-

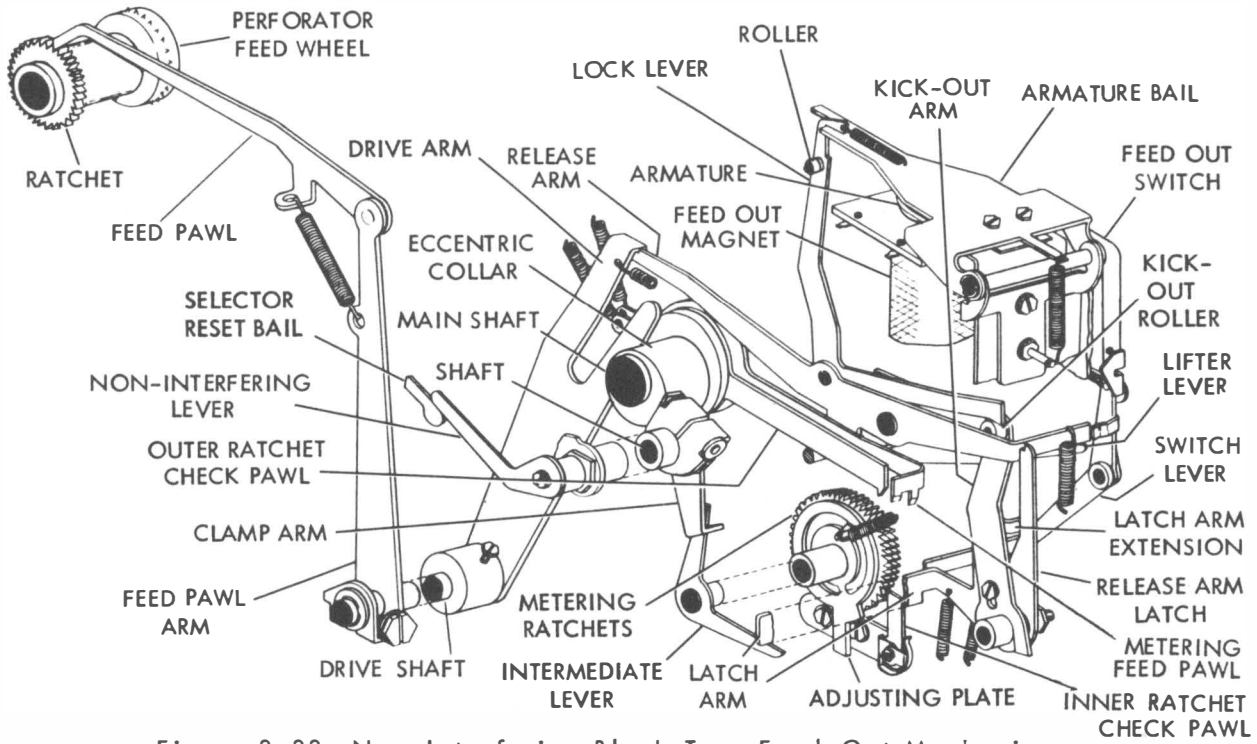


Figure 2-22. Non-Interfering Blank Tape Feed-Out Mechanism

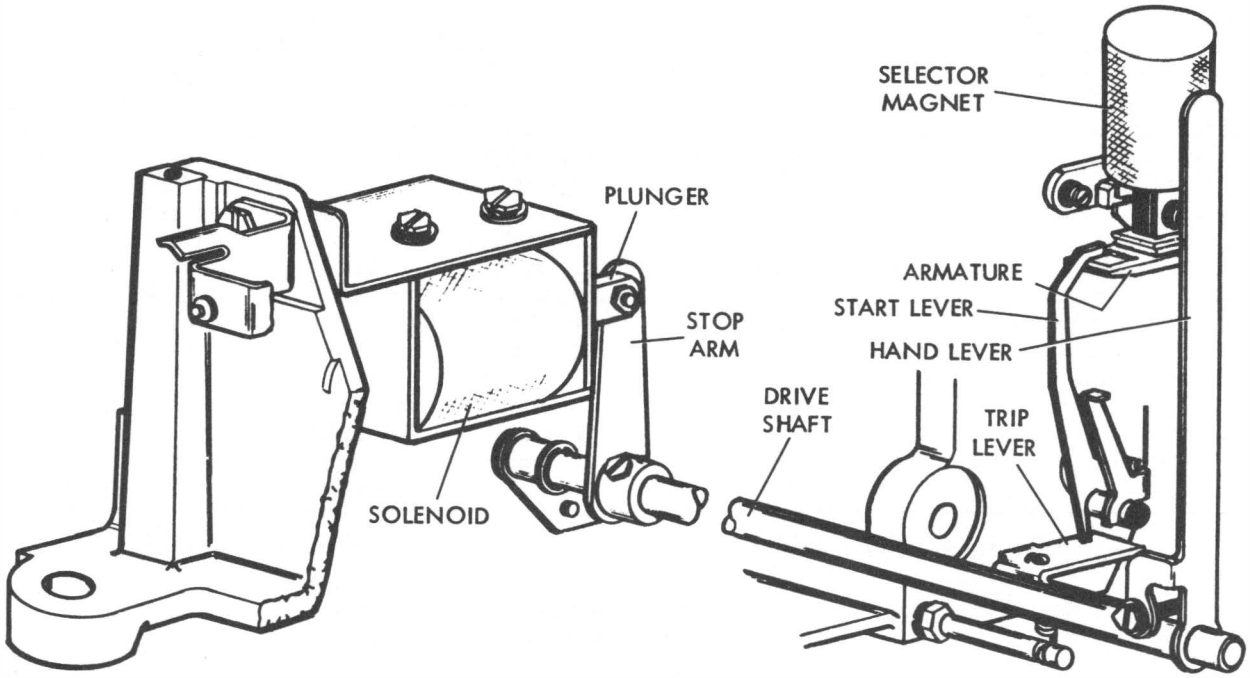


Figure 2-23. Interfering Letters Tape Feed Out Mechanism

ters tape feed-out mechanism provides a means of feeding out tape containing successive letters code combinations (see paragraph 5.c. of Section 1). The mechanism is shown in its operated condition in Figure 2-23.

9.b.(2) INITIATION — When the Set is in the idling condition, the selector magnet is energized and the start lever is blocked by the selector armature as shown in Figure 2-7. Feed-out is initiated by moving a feed-out hand lever to the left (Figure 2-23). A drive shaft affixed to the hand lever rotates a trip lever which lifts the start lever. The latter clears the armature and under spring tension rotates clockwise. The selecting cam-clutch engages, as described in paragraph 5.b.(1), and the unit undergoes a complete operation. Since the selector magnet remains energized, it is equivalent to all intelligence elements of the signaling code being marking; and the letters symbol is printed, the letters code combination (12345) is perforated and the tape is advanced one feed hole. As long as the hand lever is retained to the left, the start lever will trip the selecting cam-clutch and feed-out will continue.

9.b.(3) TERMINATION — Feed-out is terminated by releasing the hand lever. The drive shaft and trip lever rotate clockwise under spring tension and lower the start lever. When the stop arm bail and start lever are moved to the left by the stop arm bail cam (paragraph 5.b.(1)(b)), the start lever is blocked by the armature, the selecting cam-clutch is disengaged and the Set is returned to its idling condition. A message received during feed-out will be garbled.

9.b.(4) SOLENOID OPERATION — By the use of an additional set of parts, the letters feed-out operation can be initiated by a pulse from an external source. When the solenoid (Figure 2-23) is energized by the pulse, it pulls a plunger to the left. The plunger through a stop arm and the drive shaft causes the trip lever to lift the start lever, and feed-out is effected as described in paragraph 9.b.(2) preceding. Feed-out will continue until the solenoid is de-energized at which time the plunger moves back to the right, the start lever is lowered and feed-out is terminated as described in paragraph 9.b.(3) preceding.

10. TWO-SHAFT TYPING REPERFORATOR UNIT (Figure 2-24)

10.a. The jack shaft of the two-shaft typing reperforator unit is coupled directly to the driving shaft of the automatic send-receive keyboard (see Bulletin 249B). A set of gears at the rear of the unit (Figure 2-24), which

may be replaced to obtain different selecting speeds, transfers motion from the jack shaft to the main shaft. Another set of gears, positioned toward the forward ends of the shafts, convey motion from the jack shaft to the drum of the function cam-clutch which rides freely on the main shaft. Thus the selecting cam-clutch and the function cam-clutch can rotate at different speeds. The main shaft and the drum of the function cam-clutch rotate continuously as long as the unit is under power.

10.b. When the control knob of the automatic send-receive keyboard is in the Keyboard (K) position (see Bulletin 249B), the unit operates from the signal line in essentially the same manner as the basic unit; i.e., the selecting mechanism receives the code combinations, trips the function cam-clutch and controls printing and perforating. When the control knob is turned from the K position to the Keyboard-Tape (K-T) or the Tape (T) position (Figure 2-24), a reset slide actuated by the control cam lifts the selector reset bail which strips the selected push levers and permits the selected punch slide latches to return to their unselected positions (see Figure 2-10). Since the selecting mechanism does not operate in the K-T and T positions, a means must be provided to keep the selector armature in its marking position; e.g., by energizing the selector magnets locally. When a key is manually depressed, it initiates a series of actions which culminate in selecting the proper combination of latches and tripping the function cam-clutch as described in Bulletin 249B. The character or function on the selected key is then printed and perforated during the function cycle as in the basic unit.

10.c. The function cam of the two-shaft unit (Figure 2-24), has an additional camming surface on which rides a roller mounted on the keyboard reset cam follower arm. When the control knob is in the T position, this arm resets the keyboard as outlined in Bulletin 249B.

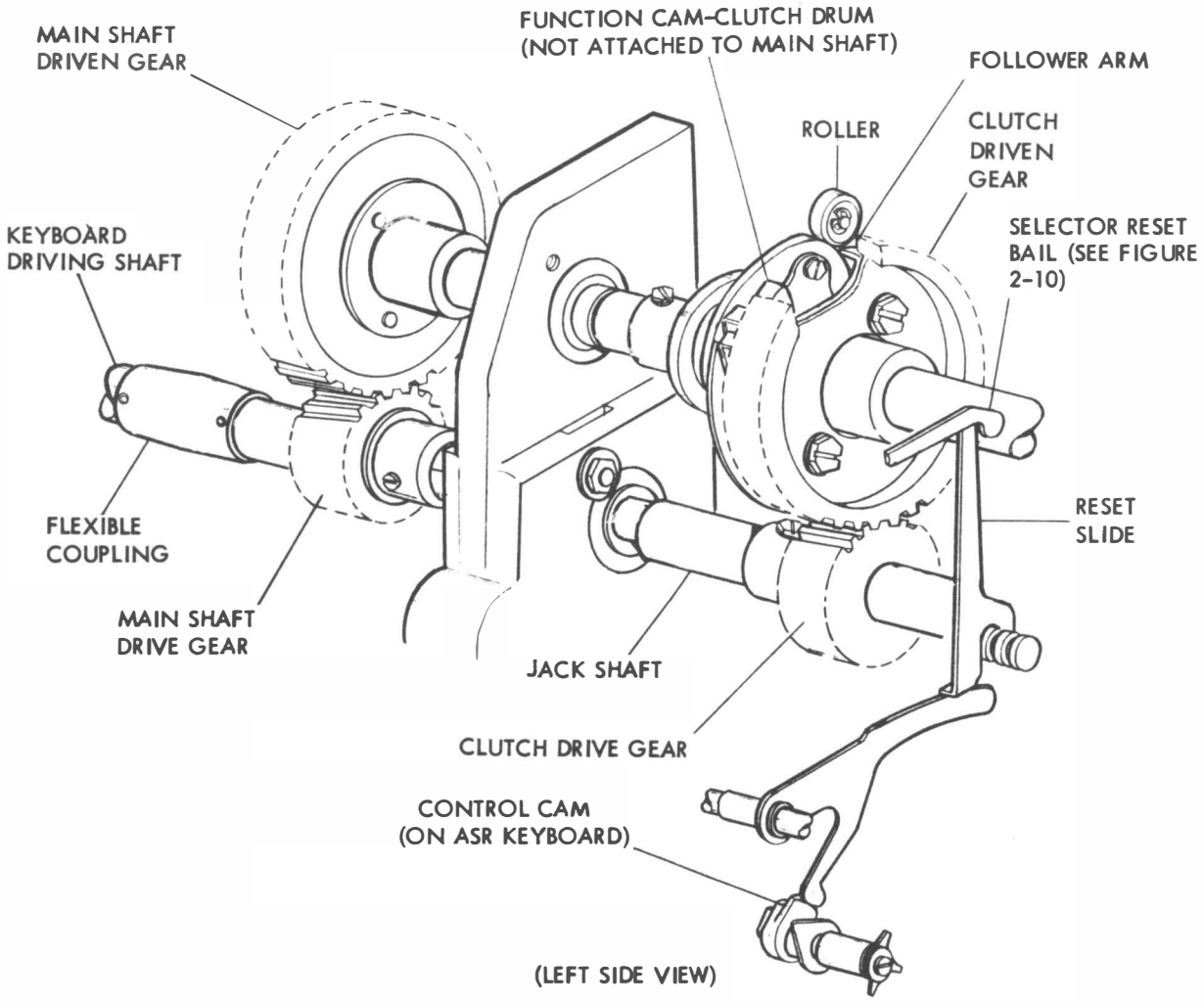


Figure 2-24. Shafts (Two-Shaft Typing Reperforator Unit)

GROUNDED SIDE
AC
G2
POWER INPUT
115 VOLTS A.C.
POWER SWITCH
G1
DH1
4 AMP TIME DELAY FUSE
DH 2
F11
E1
OUTER TAPE OUT CONTACTS (ON TAPE CONTAINER)
DH4
TAPE OUT LAMP (ON TAPE CONTAINER)
DH8
DH7
F2
E8
E9
F4
E7
BELL ASSEMBLY (IN LESU)
PM
160 Ω
240Ω
SIGNAL BELL CONTACTS (ON TYPING REPER. UNIT)
DG1
FI0
E5
F9
E2
E3
DH3
4
AC
3
0.1 Ω
2
MOTOR START RELAY
OPERATING WINDING
R
START WINDING
THERMAL CUT OUT AC MOTOR SYNCHRONOUS
4.3 MFD
STARTING CAPACITOR
E2
E2
E4
AC
LINE SHUNT RELAY
1250 Ω
RECTIFIER SHOWN CONTROLLED BY POWER SWITCH. FOR CONTINUOUS OPERATION MOVE PRIMARY (INPUT) LEAD FROM TERMINAL E2 TO TERMINAL E1.
DG8
FI3
DI
D2
RECTIFIER
120 MA (MAX)
115 V DC OUTPUT
220 MFD
56.5 Ω
26.0 Ω

DC-
2,000 Ω
J 3 1
0.25 MFD
0.1 MFD
0.1 MFD
400 Ω
J 2 5
SPACING
J 2 1
J 1 1
J 3 4
J 2 4
400 Ω
MARKING
A3
600 Ω
J 2 10
J 3 2
J 3 5
2,750 Ω
A9
.01MFD
DOT - DASH(– – –) LINES INDICATE FILTERING, SHIELDING AND SUPPRESSION NETWORKS.
F8
132 Ω
SELECTOR MAGNETS (ON TYPING REPER. UNIT)
132 Ω
A8
FI6
A7
DC+
810 Ω
2000 Ω
J 2 9
J 2 7
LINE RELAY
136 Ω
4000 Ω
J 1 3
J 2 2
1800 Ω
4000 Ω
J 1 4
J 3 6
J 2 3
136 Ω
J 2 6
0.1 MFD
P
CIRCUITS SHOWN FOR .060 AMP NEUTRAL SIGNAL LINE OPERATION. FOR .020 AMP LINE CURRENT, ADD DASH LINE (----) CONNECTION AND OMIT CONNECTION MARKED (–×–).
LINE RELAY ASSEMBLY
A6
LINE SHUNT CONTACTS
(IN LINE SHUNT RELAY)
AUX CONTACTS
A1
+
SIGNAL LINE
–
A5
D4
A8
A2
DH6
F5
B7
DH5
FI5
B6
INNER TAPE—OUT CONTACTS (ON TAPE CONTAINER)
DG2
FI2
B2
DG3
F6
B3
DG4
FI4
B4
DG5
F7
B5

LEGEND
AC
- G 3 - POINT CONNECTOR (ON BASE)
- DG TERMINAL BLOCK (ON BASE)
- DH TERMINAL BLOCK (ON BASE)
- F 16 - POINT CONNECTOR
- A TERMINAL BLOCK (ON ELEC. SER. UNIT)
- B TERMINAL BLOCK (ON ELEC. SER. UNIT)
- D TERMINAL BLOCK (ON ELEC. SER. UNIT)
- E TERMINAL BLOCK (ON ELEC. SER. UNIT)
- J ① TERMINAL STRIP ON LINE RELAY (ON ELEC. SER. UNIT)
- J ② LINE RELAY CONNECTOR (ON ELEC. SER. UNIT)
- J ③ LINE RELAY FILTER (ON ELEC. SER. UNIT)

G3
DG9
F3
GROUND SCREW (ON LE SU CONTAINER)
GROUND SCREW (ON POWER SWITCH BRACKET)
GROUND SCREW (ON ISOLATION MOUNTING SCREW)

RESISTANCE VALUES IN OHMS (Ω)
INDUCTANCE VALUES IN MICROHENRIES (MH)
CAPACITANCE VALUES IN MICROFARADS (MFD)

ALL APPARATUS IS SHOWN IN UNOPERATED OR DE-ENERGIZED POSITIONS.

Figure 2-25. Schematic Wiring Diagram of Typical Typing Reperforator Set