

TELETYPE

PRINTING TELEGRAPH SYSTEMS

BULLETIN 237B

GENERAL DESCRIPTION

THEORY OF OPERATION

MODEL 28 PRINTER SET

(RACK MOUNTED)



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CORPORATION

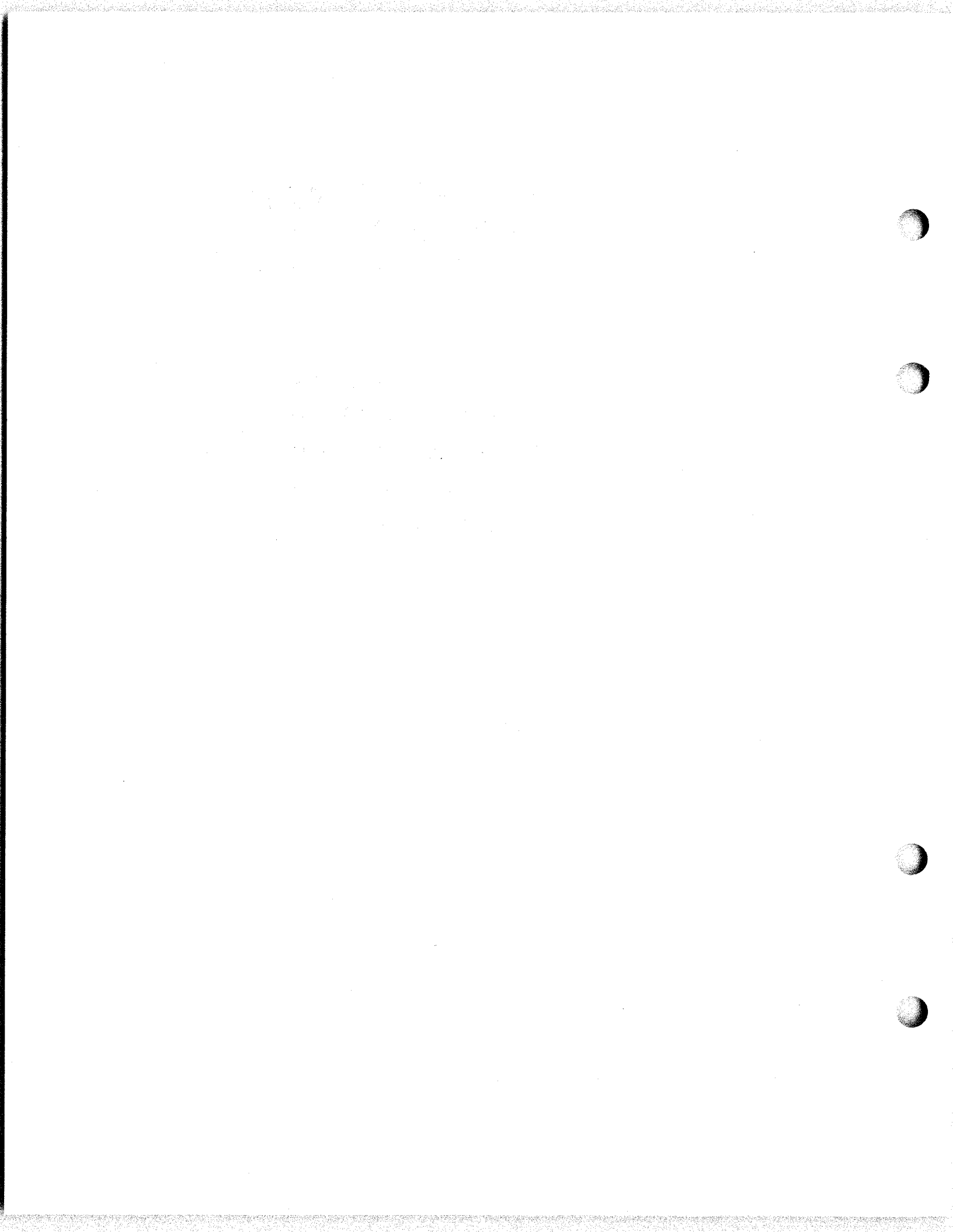
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237B



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SECTION 1

GENERAL DESCRIPTION

1. GENERAL.

a. This section contains a general description of the Teletype Model 28 Printer Set (Rack Mounted). The primary purpose of this equipment is to provide a means of exchanging printed messages between two or more points connected by a telegraph channel. Communication between stations is accomplished by means of an electrical, start-stop, permutation code. Messages are ordinarily printed on single-copy paper eight and one half inches wide, but multiple-copy paper and paper of varying widths may be used. The maximum operating speed is of the order 60 words per minute (368 operations per minute); however, speeds 75 and 100 wpm can be obtained by installing different gear sets which are available as optional components. Electrical requirements include an A.C. power supply of 115 volts and D.C. signal line source of 0.060 ampere. By changes in the wiring, the Sets can be adapted to operate on a line current of 0.020 ampere.

b. The Printer Set is made up of the following basic components: a Keyboard, a Typing Unit, a Motor Unit, a Cover and an Electrical Service Unit. When the Set is assembled, the Keyboard, which incorporates a base and a key arrangement similar to that of a typewriter, is secured to the Cover base plate (Figure 1). The Typing Unit mounts on the central portion of the Keyboard base. The Motor Unit is secured at the right rear of the base behind and partially under the Typing Unit. The Electrical Service Unit mounts on the base plate to the rear of the Keyboard Unit. The Cover encloses all the apparatus except the key arrangement and includes a window through which the printed copy can be viewed (See Frontispiece). In addition to the standard apparatus, certain variable features are furnished with the Set including a motor control mechanism, devices to effect local back space, local reverse line feed and automatic carriage return-line feed, and a time delay mechanism which will stop the motor after a period of signal line idleness. A separate description of each basic component follows.

2. KEYBOARD. (Figure 2.)

a. The Keyboard incorporates a base, message transmitting apparatus and various mechanisms. The base is constructed of formed sheet metal. It serves as foundation for the Motor

and Typing Units as well as the mechanisms integral to the Keyboard itself.

b. The apparatus directly involved in message transmission are a key arrangement, a code bar mechanism and a signal generator mechanism which includes a shaft and a contact box. The code bars (not visible in Figure 2) are located on the front underside of the base. The keys are arranged in four banks (Figure 3). The lower three banks (green) are devoted to characters and standard functions (non-printing operations) in the lower case and numerals, punctuation marks and special symbols in the upper case. The upper bank of keys (red) are consigned to special operations such as local carriage return and reverse line feed.

c. The Keyboard incorporates portions of both the signal line and power line circuits. A connector mounted near the left rear of the base serves to link this circuitry with the Electrical Service Unit. A terminal board, which connects the motor leads to the power line, is located at the right of the connector. An intermediate gear assembly, for transferring mechanical power from the Motor Unit to the Typing Unit, is secured near the center rear of the base. The following mechanisms also mount on the base: time delay, margin indicator, local carriage return, local line feed, local back space and local reverse line feed.

3. TYPING UNIT. (Figures 4 and 5.)

a. The Typing Unit incorporates the necessary mechanical and electrical apparatus for receiving and printing messages. Mounting facilities for the various components of the Unit are provided by a frame made up of a front plate and two side plates. The side plates are braced in the rear by a transverse rod.

b. A main shaft mechanism, which receives mechanical motion from the intermediate gear assembly, is situated across the lower rear of the Unit and supported on bearings in the side plates. Two individual gears (not associated with clutches) and six clutch assemblies ride on the shaft (Figure 6). The steel, internal expansion clutches, which distribute the shaft's mechanical power to the different mechanisms, disengage at the end of each operating cycle and reduce the motor load to a minimum during periods of signal line idleness. Clutch engage-

ment is quick, positive and uniform. Trip assemblies for controlling the clutches mount on a shaft above the main shaft.

c. A selector mechanism, which translates electrical code combinations into corresponding mechanical motions, is mounted on the right side plate. Its basic components are an electromagnet assembly, a selector cam-clutch assembly (Figure 6) and a range finder. The high speed electromagnet operates with low coil current and requires few adjustments. A connector mounted on the right side plate connects the magnet with the Electrical Service Unit. The range setting for optimum response to line signals is obtained by means of direct readings on a self-locking range finder knob.

d. A code bar mechanism continues the selecting operation begun by the selector mechanism. It controls both the printing mechanism and the stunt box (Paragraphs 3.e. and 3.i.). The nine code bars are situated across the front of the Unit behind the Front Plate. They are positioned by a code bar positioning mechanism located at the right of the Unit in front of and linked to the selector mechanism. The positioning mechanism receives its motion from the code bar clutch (Figure 6).

e. The printing mechanism accomplishes the final phase of the operation of selecting and printing a character. It is made up of a type box mechanism and a printing hammer mechanism.

(1) A type box carriage bearing the type box rides on a movable track that extends across the Unit above the front plate. Type box horizontal and vertical positioning assemblies mount on the front plate and side plates. A main rocker shaft, which transfers motion to the positioning assemblies, is mounted between the side plates near the lower rear of the front plate. The type box clutch assembly which drives the rocker shaft rides on the main shaft to left of the left side plate. Type pallets do the actual printing. They are arranged in a compact, light weight box (Figure 52) that can be readily detached for cleaning or replacement.

(2) After a type pallet has been positioned (selected), it is driven against the ribbon and paper by the printing hammer. A printing carriage carrying the hammer rides on a fixed track in front of the type box carriage track. The force of the spring driven hammer can be modified by an adjusting bracket. A printing track which trips the hammer is situated across

the front of the unit and receives motion from the main rocker shaft. In operation, the type box carriage and printing carriage advance together along their tracks with the type box presenting the proper pallets to the hammer. The carriages are so designed that motion is unaffected by non-level positioning of the typing unit. The light weight of these components permit printing at speeds up to 100 words per minute.

f. The type box carriage and printing carriage are moved along the printed line by the spacing mechanism. A spring drum mounts near the left end of the front plate and a spacing drum mounts near the right end. A draw wire rope connected to the two carriages link these drums. Ring type stops on the spacing drum permit the length of the printing line to be adjusted between zero and 85 characters. Feed pawls which rotate the drum are mounted to its left. The spacing clutch (Figure 6) extends motion to these pawls through the spacing shaft located at the lower center of the Unit. A dash pot, which reduces impact when the carriages are returned, mounts at the lower right corner of the front plate.

g. Paper is fed from a roll to the printing mechanism on a platen located behind the type box and supported by bearings in the side plates. Feed pawls for rotating the platen mount inside the left side plate and receive their motion from the line feed clutch assembly. A lever at the top of the left side plate provides a means of obtaining single or double line feed. A hand wheel which permits manual line feed also mounts on the left side plate.

h. Two spools, mounted on hinged brackets near the top front of each side plate, feed inked ribbon to the printing mechanism. A ribbon guide mounts on the type box carriage. The left and right ribbon feed mechanisms retract the ribbon at the end of each printing operation so that the message can be seen. These mechanisms are linked to and receive their motion from the type box positioning assemblies on the side plates.

i. A stunt box located at the rear of the Typing Unit enables the Printer Set to perform functions (non-printing operations). There are 42 slots in the box. Each will accommodate a function bar which is associated with a lever, a pawl and a function mechanism. The slots not used for standard functions are available for special operations. The function bars face the code bars and are selected by them. A function reset assembly, which manipulates the function bars, is situated under the fore part of the stunt

box. A stripper blade, for removing the function pawls from the function bars, mounts across the back of the Unit. These two assemblies receive their motion from the function clutch assembly (Figure 6).

4. MOTOR UNIT. (Figure 7.)

The Motor Unit supplies mechanical motion to the Keyboard and Typing Unit. Its basic component is a two-pole, signal-phase, capacitor-start, synchronous motor. The motor mounts in a cradle and is held in place by a strap at each end. A combination fan and hand-wheel rides one end of the motor shaft and a helical driving gear rides the other end. When the Printer Set is assembled, this gear meshes with the helical driven gear on the intermediate gear assembly. A capacitor, a relay and a manual-reset, thermal-cutout switch are contained in a compartment beneath the motor. Resilient mounts on the motor end bell hubs reduce vibration.

5. ELECTRICAL SERVICE UNIT. (Figure 8.)

The Electrical Service Unit incorporates a number of electrical accessories pertinent to the operation of the Printer Set. The components of the Unit mount on a sheet metal chassis. At the center of this chassis is a motor control mechanism. A power switch mounts near the right end. To the left of the motor control mechanism is a noise suppressor and signal bell assembly. At the extreme right are power fuses and a convenience receptacle. Terminal boards mount within the chassis. Three plastic covered cables with connectors at the end emerge from the left of the Unit; the connectors plug into the Cover, the Keyboard and the Typing Unit respectively. An opening in the Cover makes the power switch accessible.

6. COVER. (Figure 9.)

a. The Cover provides a decorative and protective enclosure for the Printer Set. It is made up of three basic parts: a base plate which serves as a foundation, a section which encloses the Typing Unit and part of the Keyboard, and a section which encloses the Electrical Service Unit. The cover is constructed of light weight metal finished internally and externally in baked enamel. It is approximately 17 inches wide, 24 inches long and 12 inches high.

b. There are two lids in the Cover which provide access to the Typing Unit for changing ribbons and loading paper. The larger lid toward

the rear of the cover may be held in the open position by a pair of nonlocking arms; it is secured in the closed position by overlapping of the front lid. The smaller front lid is opened by sliding two small knobs inward and is independent of the larger lid to permit arranging exit of the paper. A window through which the message may be read while being printed is located in the small lid. This window is in a nearly horizontal position so as to avoid reflection from ceiling lights and is provided with two beveled paper tearing edges so that it may be reversed should one edge become chipped. Two incandescent lamps mounted inside the cover provide copy illumination. An end-of-line indicator lamp is located in the lower left side of the cover where it illuminates a red translucent button. A switch and a connector for the copy lamps are located beneath the rear cover lid. The front of the Cover is equipped with a combination copy line guide and retainer together with a copy tray. The base plate has a latching mechanism for fastening the cover. An opening at the bottom rear of the Cover allows the Electrical Service Unit cables to enter and connect to the Typing Unit, the Keyboard, and the Cover.

7. ELECTRICAL CHARACTERISTICS.

a. SIGNALING CHARACTERISTICS.

(1) The signaling frequency of the output telegraph signal is expressed in maximum dot cycles (one cycle is one current impulse followed by one no-current impulse) per second:

Speed	Frequency
60 words per minute	22.8 cycles
75 words per minute	28.5 cycles
100 words per minute	37.1 cycles

(2) The selector magnet responds to marking and spacing start-stop signals and may be connected for either 0.020 ampere or 0.060 ampere line current.

b. POWER SUPPLY REQUIREMENTS: SYNCHRONOUS MOTOR UNIT.

Input voltage: 115 volts \pm 10 per cent A.C.
 Phase: Single phase.
 Frequency: 60 cycles \pm 0.75 per cent.
 Input current:

Starting	3 amps.
Running	1.85 amps.
Power Factor	0.30
Wattage	65 watts
Heat Dissipation.	50 watts

SECTION 2

THEORY OF OPERATION

1. GENERAL.

a. This section covers the operating principles and circuit descriptions of the Model 28 Printer Set (Rack Mounted). The equipment serves as a transmitting or receiving page printing set when connected to the terminal facilities of a wire or radio telegraph channel, and will operate on signal line current of either 20 or 60 miliamperes without a line relay (direct selector magnet operation). The signals transmitted and received on the local loop are of the neutral type (open and close D.C.) - 7.42 unit start-stop transmission pattern with a speed of 368 operations per minute. The equipment is also adaptable to speeds of 460 or 600 opm by gearing changes. The main transmitting or receiving channel may carry any standard type of 7.42 unit start-stop telegraph signals and may be keyed by any conventional method. Synchronous motors require a power supply of 115 volts (plus or minus 10 per cent) 60 cycle, single phase alternating current. To avoid loss in receiving margin with this type of motor, the frequency regulation must be within ± 0.75 per cent.

b. The general electrical and mechanical relationship of the units which make up the Printer Set are shown in Figure 10.

2. SIGNALING CODE.

a. The signaling code is the START-STOP five element code consisting of current and no-current intervals. Intervals during which the selector magnet is energized are known as marking impulses and those during which the selector magnet is not energized are known as spacing impulses. Each group of five selecting elements is preceded by a START (no-current) interval and followed by a STOP (current) interval. The START and STOP intervals are necessary to maintain synchronism between the transmitting and receiving apparatus.

b. If the period of one selecting interval is defined as being equivalent to one unit, each character, independent of the maximum operating speed, is 7.42 units in length. The START and five selecting impulses are each one unit in length while the STOP impulse is 1.42 units in length (Figure 11).

3. KEYBOARD.

a. GENERAL.

(1) The basic functions of the Keyboard are to provide a rigid base for the Printer Set and to translate selected characters and functions into electrical signaling code. When it is installed in the Cover, a plug on the end of a plastic covered cable that extends from the left end of the Electrical Service Unit (Figure 8), is plugged into a connector mounted at the left rear of the Keyboard (Figure 2). See Figure 12 for schematic wiring. In operation, the motor drives the intermediate shaft assembly which furnishes motive force to the Typing Unit main shaft. This, in turn, drives the signal generator helical driven gear which is connected to the keyboard clutch drum by a sleeve. Thus, the keyboard clutch drum is caused to rotate continually while the motor is running. The transmitting cam-clutch assembly of the signal generator mechanism remains stationary except when motion is extended to it from the keyboard clutch drum. Engagement of the clutch is brought about by the operation of any key in the lower three rows, or the space bar, and a transmitting cycle is then initiated.

(2) The lower three rows of keys across the front of the Keyboard are used to originate messages (Figure 3). By depressing the LTRS key, the letters of the alphabet, as marked on each keytop, will be selected and transmitted when the keys are subsequently depressed. Only capital letters are available. The FIGS key is used to shift and lock the printer set so that the numerals, principal punctuation marks, and special symbols appearing on each Keytop will be selected and transmitted as each key is depressed. When the carriage return and the line feed keys are operated, the corresponding function occurs at both the sending printer set and the receiving printer sets. A fourth row of keys located above the other three actuate such special functions as local reverse line feed and signal line break.

b. INTERMEDIATE GEAR ASSEMBLY. - The intermediate gear assembly, located on the rear central portion of the Keyboard (Figure 2), supports two helical gears and an eccentric cam. When the Motor Unit and the Typing Unit are in place on the Keyboard, the intermediate shaft helical driving gear on the motor engages with and drives the intermediate helical driven gear and its attached intermediate shaft

assembly. This shaft assembly includes the helical gear assembly, which transfers the motive force to the Typing Unit main shaft, and the eccentric bushing which drives the eccentric follower pawl on the time delay mechanism accessory. The gear ratio between the intermediate shaft helical driving gear on the motor and the helical driven gear on the intermediate shaft determines the maximum speed (operations per minute) at which the equipment will operate. These gears are readily replaceable with gears which will furnish other operating speeds.

c. CODE BAR MECHANISM.

(1) The code bar mechanism is located in the front underside portion of the Keyboard. Each keylever in the lower three rows and the space bar is connected to a code lever, and each keylever in the upper row is connected to a function lever. The code and function levers pivot about points near their midportions (Figure 13). Located above the rear half of the code levers and running parallel with the front of the Keyboard are, from rear to front, the clutch trip bar, the upstop bar, the numbers 1, 2, 3, 4, and 5 code bars, and the lock bar. The rear portion of each code or function lever normally is held downward by a spring so that the front end, with its attached keylever, is held upward. A locking wedge is mounted on the projection of the lower front portion of all code levers, the local line feed function lever, and the local carriage return function lever (Figures 13 and 14). If one of these levers is operated, its locking wedge moves downward between the lock balls in the lock ball channel, and crowds them together. This prevents any other lever with a locking wedge from being operated at the same time.

(2) With the Keyboard cam-clutch disengaged, the clutch trip bar and the five code bars are held toward the left, against the tension of their springs, by the latched-up code bar bail (Figure 18). When any keylever in the three lower rows or the space bar is depressed, the rear end of the associated code lever engages and lifts the front edge of the code lever bail (Figure 15). An extension on the code lever bail disengages the code lever bail latch lever and permits it to drop. As the front edge of the code lever bail rises, the back edge rotates around the rear end of the operated code lever and locks it in position. As the code lever bail latch lever drops, it depresses the code bar bail latch lever and releases the code bar bail (Figure 16). Upon being freed, the code bar

bail, the clutch trip bar, and the five code bars are pulled toward the right by their springs, until the code bar bail strikes its bumper. As the five code bars shift, code projections on unselected code bars engage the operated code lever (Figure 17). Code bars which are permitted to move to the extreme right become selected and carry with them their respective transfer levers.

(3) By means of the clutch trip bail and the clutch stop lever, the clutch trip bar releases the keyboard cam-clutch which rotates on the shaft. During the time in which the cam-clutch makes a revolution, an eccentric cam and its follower cause the code bar bail, the five code bars, and the clutch trip bar to be returned to their original positions (Figures 18 and 19).

(4) As the code bar bail moves to the left, it carries with it the non-repeat lever (Figure 36). This in turn rotates the non-repeat bell crank about its pivot point until it lifts the code bail latch lever out of engagement with the code lever bail extension. While a spring then returns the code lever bail to its normal position, the code lever bail extension drops on the non-repeat lever to disengage it from the code bar bail. The spring then resets the non-repeat mechanism. As the code lever bail returns to its normal position, it releases the operated code lever and its keylever.

(5) As the cam-clutch nears the end of its revolution, the clutch shoe lever strikes the stop lever, and the inertia of the cam disk assembly causes it to continue to turn until its lug makes contact with the lug on the clutch shoe lever. At this point the latch lever drops into the indent in the cam disk and the clutch is held disengaged until the stop lever is again operated (Figure 20). For detailed information on the operation of the clutch shoes, see Paragraph 4.b. (3) of this section.

d. SIGNAL GENERATOR MECHANISM.

(1) The signal generator mechanism is located at the front of the Keyboard base. As was shown in Paragraph 3.c. (2) above, each of the five code bars operates its own transfer lever (Figure 21). In addition to these five transfer levers, there are two others which are not associated with code bars and which are used to originate the start and stop pulses. The stop pulse transfer lever (seventh from the rear and located next to the fifth pulse transfer lever) is permanently positioned so that its upper end,

and its associated selector lever are toward the left or selected position. The start pulse transfer lever (third from rear and located between the second and third pulse transfer levers) is permanently positioned so that its upper end and its associated selector lever are to the right or unselected position. When a code bar is unselected, the upper end of its transfer lever and its associated selector lever are positioned toward the right (Figure 21). When a code bar is selected, the upper end of its transfer lever and its associated selector lever are positioned toward the left (Figure 22). After the code bars have positioned their transfer levers and selector levers, the locking bail which is operated by a cam on the keyboard cam-clutch assembly drops downward between the lock projections on the upper ends of the transfer levers (Figure 23). When the selected code bars are reset by the code bar bail, the upper end of their transfer levers are held toward the left by the locking bail. The slotted bearings at their pivot points permit the transfer levers to shift to the left without disturbing the selection set up on the selector levers. Each of the seven selector levers is associated with a cam on the cam-clutch assembly. These cams push the levers upward briefly in the order: start, 1, 2, 3, 4, 5, and stop. A rocker bail is located above the selector levers and is actuated by them. A rocker bail detent holds the bail in either of the two positions it can assume. When a selector lever which is in the unselected position (toward the right) is pushed upward by its cam, it rotates the rocker bail clockwise (Figure 21). When a selector lever which is in the selected position (toward the left) is pushed upward by its cam, it rotates the rocker bail counterclockwise (Figure 23). An extension on the rocker bail is moved downward or upward respectively with clockwise or counterclockwise rotation of the bail.

(2) On the rear side of the signal generator mechanism are located the upper or spacing intermediate lever, the lower or marking intermediate lever, the oscillating lever, the flutter lever, the detent toggle, and the detent lever. In the stop position, the rocker extension holds the marking intermediate lever downward and out of engagement with the flutter lever (Figure 24). As the flutter cam on the keyboard cam-clutch assembly rotates, it moves the flutter lever and the spacing intermediate lever toward the left as viewed from the rear (Figure 25). The spacing intermediate lever bears on the upper part of the oscillating lever and rotates it counterclockwise so that the detent toggle is shifted toward the left where it is held

by the detent lever. The detent toggle moves the toggle extension in the contact assembly (on the top side of the signal generator mechanism) toward the left and causes the contact toggle to pivot on the spacing contact and break the marking contact (Figure 26). This breaks the line circuit which passes through the contact toggle and the marking contact and originates a start or spacing interval of the signaling code. When the rocker extension is in its upward position (Figure 27), it holds the spacing intermediate lever upward out of engagement with the flutter lever. When the flutter lever rides to the high part of its cam, it moves the marking intermediate lever to the left. The marking intermediate lever bears on the lower part of the oscillating lever and rotates it clockwise so that the detent toggle is shifted to the right where again it is held by the detent lever. The detent toggle moves the toggle extension in the contact assembly toward the right and causes the contact toggle to close with the marking contact and pivot on it (Figure 28). This closes the line circuit and originates a marking impulse of the signaling code.

(3) The electrical noise suppressor is in the line circuit to aid in the suppression of undesirable radiation when the circuit is broken.

e. LOCAL CARRIAGE RETURN MECHANISM. — Operation of the local carriage return keylever causes its function lever to raise the forward end of the local carriage return bail (Figure 29). The bail rotates about its pivot point until the upper end engages the carriage return lever on the Typing Unit. Thus, the carriage return mechanism on the local Typing Unit is made to operate without disturbing the other Typing Units in the line circuit. The carriage return mechanism is fully described in paragraph 4.i. (3) of this section.

f. LOCAL LINE FEED MECHANISM. — Operation of the local line feed keylever causes its function lever to raise the forward end of the local line feed bail (Figure 30). The bail rotates about its pivot point and the upper end pushes the trip link until the link engages the line feed clutch trip lever on the Typing Unit. Thus, the line feed mechanism on the local Typing Unit is made to operate without disturbing the other Typing Units on the line circuit. The line feed mechanism is fully described in paragraph 4.i. (4) of this section.

g. LOCAL BACK SPACE MECHANISM. — When no message is being received, the carriage may be back spaced one space at a time without

disturbing the line circuit. Depression of the local back space keylever (Figure 31) causes its associated function lever to lift the front extension of the local back space operating bail. The pin on the gear extension of the bail is moved downward against the camming surface on the lower end of the local back space transfer bail. The upper end of the transfer bail moves toward the rear and engages the lower extension of the back space bail on the typing unit. Refer to paragraph 4.f. (3) of this section for a detailed description of the associated mechanism on the Typing Unit.

h. LOCAL REVERSE LINE FEED MECHANISM. — This mechanism effects reverse line feed without disturbing the other sets on the line. When the local reverse line feed keylever (Figure 32) is depressed, the associated function lever raises the front extension of the local reverse line feed operating bail and moves the attached local reverse line feed trip link to the rear. The upper arm of the transfer bail rides on the slope of the line feed trip link as the link is moved to the rear. The other arm of the transfer bail lifts the link on the typing unit (Figure 81) to its operated position so that the projection is moved in front of the lower end of the line feed bar. The reverse line feed operation will then occur when the line feed clutch trip lever on the typing unit is tripped. Refer to paragraph 4.i. (4) (f) of this section for a detailed description of the associated mechanism on the typing unit.

i. BREAK MECHANISM. — This mechanism provides a means of breaking the signal line. It can be used to start the motors in the circuit. Operation of the break keylever causes its function lever to raise the break rod and shift the break bail (Figure 33). As the break bail moves upward, its lower end engages the lower end of the oscillating lever and rotates the lever counterclockwise as viewed from the rear (Figure 34). The oscillating lever shifts the detent toggle toward the left where it is held by the detent lever. The detent toggle moves the toggle extension in the contact assembly toward the left and causes the contact toggle to pivot on the spacing contact and break the marking contact (Figure 26). This breaks the line circuit until the break keylever is released. When the keylever is released, a spring on the break bail moves it downward. The upper end of the bail engages the upper end of the oscillating lever and rotates it clockwise to close the marking contacts in the contact assembly.

j. REPEAT MECHANISM. — Operation of the

repeat keylever simultaneously with one of the keylevers in the three lower rows or the space bar disables the non-repeat mechanism and causes the character or function selected to be repeated as long as the repeat keylever is held operated. The operated repeat keylever causes its function lever to raise the right end of the non-repeat lever (Figures 35 and 36) and rotate it about its pivot point. In this position, the non-repeat keylever cannot be engaged and operated by the code bar bail. Therefore, the non-repeat bell crank will not reset the operated code lever bail latch which then maintains both the code lever bail and the code bar bail latch lever in their operated positions until the repeat keylever is released.

k. KEYBOARD LOCK MECHANISM.

(1) The Keyboard lock mechanism is used to avoid interruption of message traffic. It may be actuated either by the double blank function (local and remote) or the Keyboard lock keylever (local only). Depression of the Keyboard lock keylever (Figure 37) causes its function lever to raise the Keyboard lock bar pawl. The pawl releases the Keyboard lock bar (Figure 39) and, under tension of its spring, the lock bar moves to the right. In this position, projections on the lower side of the lock bar block the upward movement of any code lever and the repeat function lever.

(2) As described in paragraph 4.i. (7) of this section, the reception of two consecutive blank code signals by the Typing Unit results in its driving its keyboard lock lever downward. The lock lever makes contact with the lock plunger on the Keyboard and pushes it downward (Figure 37). As the plunger moves, it exerts pressure on the yield spring which connects it with the keyboard lock bail. The bail rotates about its pivot point to engage the keyboard lock function lever and causes the lever to raise the lock bar pawl. The lock bar pawl releases the lock bar which disables the Keyboard (Figure 39) as described in the latter part of Paragraph 3.k. (1) above.

l. KEYBOARD UNLOCK MECHANISM. — Operation of the keyboard unlock keylever causes its function lever to rise against a camming surface on the keyboard lock bar and drive the bar toward the left until the lock bar pawl drops into a notch in the lock bar (Figures 38 and 39). In this position, the projections on the lock bar lie between the code levers and offer no interference with their operation.

m. **MARGIN INDICATOR MECHANISM.** — The margin indicator cam disk on the Typing Unit spring drum rotates with the drum as printing or spacing occurs. See paragraph 4.g. of this section. As the end of each line is approached, the cam surface of the disk makes contact with the margin indicator contact lever and rotates it clockwise about its pivot point (Figure 40). When the contact lever leaves the switch plunger, the margin indicator switch operates and closes the circuit to a margin indicator light on the cover (Figure 9). A carriage return cycle returns the cam disk to its starting position and the margin indicator switch opens.

n. **TIME DELAY MECHANISM.**

(1) The time delay mechanism, operating in conjunction with the motor control mechanism on the Electrical Service Unit, automatically stops the motor after an extended period signal line idleness. The mechanism contains two ratchet wheels — one with 27 teeth, and one with 28 teeth. A reciprocating eccentric follower pawl, powered by the intermediate shaft, drives the ratchet wheels one tooth at a time (Figure 41). Therefore, the ratchet wheel with 27 teeth turns a little faster than the one with 28 teeth. The latch pawl rides the inside flanges of the ratchet wheels. The contact pawl is held away from the flanges by the contact pawl latching lever which is controlled by the latch pawl. Each ratchet wheel has an indentation in its inside flange. After a maximum of 756 revolutions of the intermediate shaft, these indentations are adjacent for nearly one revolution. When the adjacent indentations pass over the latch pawl, it drops into them briefly and disengages the contact pawl latching lever from the contact pawl. This allows the contact pawl to ride the flanges of the ratchet wheels until either one of two things occur (Figure 42). If a line signal is received before 756 revolutions of the intermediate shaft have taken place, the main bail drive bracket extension on the Typing Unit engages the upper end of the contact pawl and causes it to again be latched by the contact pawl latching lever. If a line signal is not received before 756 revolutions of the intermediate shaft occur, the indentations in the flanges of the ratchet wheels again become adjacent so as to permit the contact pawl to drop into them briefly and pulse the motor stop switch (Figure 43). This pulse is applied to the electrical motor control mechanism in the Electrical Service Unit to stop the motor. The time lapse between the reception of the last line signal and the stopping of the motor varies from 86 to 172 seconds for 60 words per minute operation.

(2) If it is not desirable to have the motor shut down automatically, the time delay mechanism may be disabled. To accomplish this, loosen the nut on the pilot screw, raise it to the top of its slot, and tighten the nut. When the pilot screw is in this position, the eccentric follower pawl is held out of engagement with the ratchet wheels.

4. **TYPING UNIT. (Figure 63.)**

a. **GENERAL.** — The basic function of the Typing Unit is to convert the code combinations on the signal line into the necessary mechanical motions to print characters or perform functions. A detailed explanation of its operation follows:

b. **MAIN SHAFT. (Figure 6.)**

(1) The main shaft receives mechanical power from the intermediate gear assembly and transfers it to the various mechanisms on the Typing Unit and Keyboard. When the Typing Unit is placed on the Keyboard base, the main shaft helical driven gear meshes with the intermediate helical driving gear, and the main shaft helical driving gear meshes with the helical driven gear on the signal generator shaft (Figure 2). When the motor is running, the main shaft rotates continuously.

(2) Six all-steel internal expansion clutches are mounted on the main shaft. Two of these, the line feed and spacing clutches, each have three sets of trip lever lugs equally spaced about the clutch periphery. Upon engagement, the spacing clutch will rotate one third of a revolution and the line feed clutch will rotate either one-third or two-thirds of a revolution depending upon whether the single-double line feed lever is set for single or double line feed. The four remaining clutches each have one set of trip lever lugs. Upon engagement, they will rotate one complete revolution.

(3) Each clutch has two shoes, primary and secondary, which bear against the inside surface of a serrated drum at four points. The drum is fastened to the main shaft by a set screw. Consequently, the drum rotates continuously when the motor is running. The associated mechanism is attached to the clutch cam disk which rotates upon engagement. The clutches operate as follows:

(a) Figure 44 shows a typical single stop clutch in the disengaged position. Disengagement occurs when lug B on the clutch shoe

lever and lug A on the clutch cam disk are brought close together. The clutch shoe lever pivots clockwise about clutch shoe lever ear C which is pivoted in a notch in the upper end of the secondary shoe. Clutch shoe lever ear D is moved to the right. The clutch shoe spring contracts, pulling the two brake shoes together and away from the serrated drum surface. The drum continues to rotate but the mechanism attached to the clutch cam disk does not.

(b) Figure 45 shows the same clutch in the engaged condition. Engagement occurs when lug A on the clutch cam disk and lug B on the clutch shoe lever are released. The clutch shoe lever spring immediately contracts. The clutch shoe lever pivots counterclockwise about clutch shoe lever ear C, overcoming the clutch shoe spring, moving clutch shoe lever ear D to the left, and forcing the primary shoe against the serrated drum surface at E. The counterclockwise rotation of the drum drives the primary shoe downward and so makes further contact with the drum at F. The movement of the primary shoe in the direction of drum rotation is transferred to the secondary shoe at G which causes the secondary shoe to bear against the drum at H. The revolving drum drives the secondary shoe upward to make contact with the drum at I as well as H. A force component is developed at I in a horizontal direction but is transferred to lug J on the clutch cam disk which causes the cam disk to rotate with the drum. The associated mechanism attached to the cam disk then rotates with the drum.

c. SELECTING MECHANISM.

(1) The selecting mechanism consists of the selector electromagnet and armature, a selector cam-clutch, and the associated levers, arms, bails, and slides necessary to convert the electrical code signals into the mechanical motions which determine the characters printed and the functions performed.

(2) The selector magnet performs the actual transition from electrical code signals to equivalent mechanical motions in the Typing Unit. The magnet consists, essentially, of two 132 ohm coils which are wired to a cable connector mounted on the Typing Unit right side frame. A cable from the Electrical Service Unit, when plugged into this connector, connects the selector magnet coils to the selector magnet terminal board in the Electrical Service Unit. The selector magnet coils are wired in parallel at the factory for 60 milliampere operation.

(3) The selector cam-clutch comprises, from right to left (Figure 6), the clutch, the stop arm bail cam, the fifth, the fourth, and the third selector lever cams, the cams for the spacing and the marking lock levers, the second and the first selector lever cams, the push lever reset bail cam, and the code bar clutch trip cam.

(4) During the time in which a closed line circuit (marking) condition exists, the selector magnet coils are energized and hold the selector armature against the selector magnet pole pieces. In this STOP position, the selector armature blocks the start lever (Figure 46). At the start of a signal for any character or function, the START (spacing) interval releases the selector armature which, under the tension of its spring, moves away from the magnet cores and thus unlatches the start lever. The start lever turns clockwise under the tension of its spring to move the stop arm bail into the indent of its cam. 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 selector cam-clutch engages and begins to rotate. The stop arm bail immediately rides to the high point of its cam where it remains to hold the start lever away from the selector armature during the signaling time. When the STOP impulse at the end of the signal is received, the selector armature is pulled up to block the start lever. Thus, the stop arm bail is prevented from dropping onto the low part of its cam (stop position of cam-clutch), and the attached stop arm is held so as to stop the clutch shoe lever. The selector cam-clutch disk upon which the latch lever follower rides has an indent at its STOP position. When the clutch shoe lever strikes the stop arm, the inertia of the cam disk assembly causes it to continue to turn until its lug makes contact with the lug on the clutch shoe lever. At this point, the latch lever drops into the indent in the cam disk, and the clutch is held disengaged until the next start interval is received.

(5) The series of five selecting levers and a marking lock lever ride their respective cams on the selector cam-clutch. As the marking and spacing signal intervals are applied to the selector magnet, the selector cam-clutch rotates and actuates the selector levers. When a spacing interval is received, the marking lock lever is blocked by the end of the armature and the spacing lock lever swings toward the rear above the armature and locks it in the spacing position until the next signal transition is due. Extensions on the marking lock lever prevent the selector levers from following their cams (Figure 47).

When a marking impulse of the signal is received, the spacing lock lever is blocked by the end of the armature and the marking lock lever swings to the rear below the armature to lock it in the marking position until the next signal transition is due. During this marking condition, the selector levers are not blocked by the marking lock lever extensions but are permitted to move 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 rear or selected position momentarily. Each selecting lever has an associated push lever which drops into a notch on the top of the selecting lever when it falls into its cam indent. As the selector cam-clutch turns, each selecting lever together with its latched push lever is moved toward the front and held there until all five code intervals have been received. At that time, all selected push levers have been positioned to the front and all unselected push levers have been positioned to the rear in which positions they are held until the next start interval is received. When the subsequent start interval again causes the selector cam-clutch to rotate, the push lever reset bail, in following its cam, unlatches the selected push levers. The push levers then return to the unselected (rear) position under their spring tension.

d. ORIENTATION.

(1) In order to establish the operating margins for the Typing Unit, it is necessary that the sampling of the signal by the selecting mechanism occur at the most favorable portion of the signal intervals. This is referred to as orientation.

(2) When the range finder knob (Figure 46) 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 selecting levers. When an optimum setting is obtained, the range finder knob is released. Its inner teeth engage the teeth of the indexing lock stud to lock the range finder mechanism in position. The setting may be read on the range scale opposite the fixed index mark.

e. PRINTING MECHANISM.

(1) CODE BAR MECHANISM

(a) GENERAL.— The character which is to be printed is determined by the combination set up on the six code bars which are operated by the code bar positioning mechanism. In order to position the code bars, their associated shift bars must first be individually positioned toward the front or rear of the Typing Unit by transfer levers which respond to action of the selecting mechanism. While held in these positions, the code bar shift bars are moved either to the left or the right by code bar shift levers which are activated when the code bar clutch trip cam releases the code bar clutch. Detailed functioning of the coordinated mechanism follows:

(b) CODE BAR POSITIONING.— Each push lever (paragraph 4.c. (5) of this section) has an associated intermediate arm, transfer lever, and code bar shift bar (Figure 49). In addition, there is a "common" transfer lever with its code bar shift bar. When a push lever is moved toward the rear (space position) its associated intermediate arm and transfer lever are pulled toward each other by a spring. This causes the transfer lever to turn counterclockwise about its pivot point (Figure 49) and position its code bar shift bar toward the front of the Typing Unit (space position). When a push lever is moved to the front of the Typing Unit (mark position), it moves the intermediate arm toward the left. This causes the transfer lever to turn clockwise about its pivot point and position its code bar shift bar toward the rear of the Typing Unit (mark position). The common transfer lever (Figure 48) has an extension which passes behind the number 1 and number 2 transfer levers (Figures 48 and 50). When either or both of these transfer levers are moved to the rear (mark position), they move the common transfer lever to the rear. This, in turn, moves the common code bar shift bar toward the rear of the Typing Unit (mark position). As the selector cam-clutch completes its revolution, the trip shaft operating lever (fastened to the code bar clutch trip shaft) rides to the peak of the code bar clutch trip cam (Figure 6). This causes the shaft to turn slightly and its attached code bar clutch trip lever releases the code bar clutch. Rotation of the clutch actuates the code bar shift levers through the intervening shift lever drive shaft, drive arm, and shift lever link (Figure 48). Code bar shift bars which have been moved toward the rear position by their transfer levers are engaged by the rear code bar shift lever and are shifted to the left. Code bar shift bars which have been moved toward the front position are engaged by the front code bar shift lever and are shifted toward

the right (Figure 50). Thus, the six code bar shift bars shift their respective code bars toward the right or left where they are retained by a detenting mechanism. The code bar clutch one-stop cam disk, upon which the latch lever rides has an indent at its stop position. When the clutch shoe lever strikes the code bar clutch trip lever, the inertia of the cam disk assembly causes it to continue to turn until its lug makes contact with the lug on the clutch shoe lever. At this point, the latch lever drops into the indent in the cam disk and the clutch is held disengaged until the trip lever is again operated.

(c) ARRANGEMENT OF CODE BARS.

— Three additional code bars bring the total number of code bars to nine. They are arranged from top to bottom as follows: Suppression, number 4, number 1, number 5, number 2, number 3, common, automatic carriage return and line feed, and shift-unshift (Figure 51). The automatic carriage return and line feed code bar and the shift-unshift code bar are actuated by mechanisms which will be discussed under FUNCTIONS.

(2) TYPE BOX MECHANISM.

(a) GENERAL.

1. The various characters and symbols printed by the Typing Unit are embossed on type pallets arranged in a type box (Figure 52). In operation, the type box, mounted on a type box carriage, is positioned both vertically and horizontally by the printing mechanism so that the character to be printed is aligned with the printing space. Five selecting elements of the 7.42 unit code are used to accomplish this alignment.

2. The type box carriage rollers ride on a track which positions the type box vertically. The carriage is positioned horizontally on its track by the oscillating rail slide and type box carriage link. The slide rides the oscillating rail and is clamped to the rear section of the upper draw wire rope. The link provides a flexible connection to permit the type box carriage to follow both the vertical movement of the type box carriage track and the horizontal movement of the oscillating rail slide. The lower right rear end of the upper draw wire rope is fastened to the spacing drum. From this point, it passes part way around the spacing drum, upward and around the right oscillating rail pulley, over to the left oscillating rail pulley, and downward to the spring drum. After passing part way around the spring drum, the

upper draw wire rope is doubled backward around it and passes upward to the left printing carriage rail pulley over to the right printing carriage rail pulley, and downward to the spacing drum to which it is again fastened. The lower draw wire rope is fastened at its left end to the spring drum and, at its right end, to the spacing drum. It acts in opposition to the upper draw wire rope and holds the two drums in phase (Figure 53). A tensioning pulley rides the under side of the lower draw wire rope, to take up any slack which may occur due to stretching of the upper and lower draw wire ropes. The oscillating rail is supported by pivoted arms at each end. These arms which extend downward are pivoted on the typing unit frame at their lower ends. Thus, the oscillating rail and the draw wire rope that it carries may be shifted to the left or right with no change in position relative to each other. The oscillating rail shift slide and the two oscillating rail shift links are used to accomplish the horizontal positioning of the oscillating rail and also connect it with the oscillating rail shift slide. The links are pivoted and are of such a length that only one at a time may be fully extended. As will be shown later under FUNCTIONS, the oscillating rail shift links are used to position the oscillating rail and thus the type box, so that either the left side (letters characters) or the right side (figures characters) of the type box is selected.

(b) TYPE BOX POSITIONING. — The selection of the various characters from the four horizontal rows and the eight vertical rows in either the left (LTRS) side or the right (FIGS) side of the type box and the printing of those characters take place as follows:

1. The left half of the type box, containing the l alphabet, is brought into the printing position by the LETTERS code combination, and the right half, containing the figures and special symbols, is brought into the printing position by the FIGURES code combination. Essentially, the absence or presence of the No. 1 and No. 2 impulses in the selecting code determine which of the four horizontal rows will be positioned for printing; the No. 3 impulse determines which way the type box will be moved from the Figures or Letters centerline (to the left or right); the No. 4 and No. 5 impulses determine which vertical row is selected for printing. (Figure 54).

2. When the No. 1, No. 2, or Common c bar is in the spacing (right) position, it projects slightly beyond the edge of the right code bar bracket into the path of the

right side "knee action" vertical positioning lever thus limiting the total rise of the lever. If none of the code bars are in the spacing position, the lever will be blocked in the topmost position by the suppression code bar. Notches in the left end of each code bar are arranged so that the left side "knee action" vertical positioning levers are in each case blocked by the same code bar that blocks the right side vertical positioning lever.

3. After all the code bars have been shifted to the marking or spacing position corresponding to the line signal variations, the code bar clutch cam follower arm roller in traversing the indent on the cam (Figure 55) causes the clutch trip lever shaft to rotate part of a revolution. As the shaft turns, the function clutch trip lever releases the stop lug on the function clutch. Then the type box clutch trip arm engages its trip lever, releasing the stop lug on the type box clutch. Both clutches engage and commence rotating. By the time each clutch has completed one revolution, the code bar clutch cam follower arm roller has moved to the high portion of the cam, rotating the clutch trip lever shaft in the opposite direction and to its original position, returning the clutch trip levers to the stop position. When each clutch has completed one revolution, it is disengaged by its trip lever and latch lever in the same manner as was the code bar clutch, paragraph 4.e. (1) (b) of this section.

4. During its rotation the type box clutch transfers motion to a drive link and a bracket to cause the main rocker shaft to oscillate. This, in turn, through its left and right brackets and the main side lever drive links, extends the motion to the main side levers to operate the "knee action" vertical positioning levers (Figure 56). These levers are driven upward until they strike a projecting code bar which causes them to buckle. The type box carriage track is mounted between the vertical positioning levers and its vertical motion is controlled by them. When the number 1 and number 2 code bars are toward the right (spacing), the common code bar is also toward the right where it blocks the vertical positioning levers. The top row of pallets in the type box are then in line for printing. When the number 1 code bar is toward the left (marking), and the number 2 code bar is toward the right (spacing), the common code bar is toward the left. The number 2 code bar blocks the vertical positioning levers, and the second row of pallets in the type box are then in line for printing. When the number 1 code bar is toward the right (spacing),

and the number 2 code bar is toward the left (marking), the common code bar is also toward the left. The number 1 code bar blocks the vertical positioning levers and the third row of pallets in the type box are then in line for printing. When the number 1 and number 2 code bars are toward the left (marking), the common code bar is also toward the left. The suppression code bar blocks the vertical positioning levers, and the fourth or bottom row of pallets in the type box are then in line for printing. At each of the four levels at which the vertical positioning levers may be stopped, they are locked momentarily by lock levers which are controlled by the main side lever follower arms (Figure 56).

5. A bracket attached to the main rocker shaft applies vertical motion to the main bail by means of two main bail links (Figure 57). Attached to each end of the oscillating rail shift slide are pivoted, "buckling" type drive links which extend downward to each end of the main bail. As the main bail moves downward, the left shift slide drive links, if not buckled, will try to shift the oscillating rail shift slide toward the right while the right shift slide drive links, if not buckled, will try to shift the oscillating rail shift slide toward the left. When the number 3 code bar is shifted toward the left (marking), the horizontal motion reversing slide is shifted toward the left by the reversing slide shift lever, and is held there by detent levers. A bracket near the right end of the reversing slide will then make contact with the right shift slide drive links and cause them to buckle. As the main bail is driven downward, the unbuckled left shift slide drive links will start to shift the oscillating rail shift slide toward the right. This positions the type box so that the character to be printed will be found in the left half of the LTRS or FIGS side. In a similar manner, when the number 3 code bar is shifted toward the right (spacing) the horizontal motion reversing slide is also shifted toward the right by the shift lever and is held there by the detent levers. A bracket near the left end of the horizontal motion reversing slide then makes contact with the left shift slide drive links and causes them to buckle. As the main bail is driven downward, the unbuckled right shift slide drive links will start to shift the oscillating rail shift slide toward the left. This positions the type box so that the character to be printed will be found in the right half of the LTRS or FIGS side.

6. After it has been thus determined in which group of four vertical rows the character to be printed is located, the number 4 and number 5 code bars operate three horizontal

motion stop slides to determine the row in that group in which the character is to be found (Figure 57). A wedge shaped horizontal positioning lock lever, which is pulled downward by the main bail through a yield spring, bears against the horizontal positioning lock lever arm. This arm drives the oscillating rail shift slide in the direction in which it was started (by the number 3 code bar selection) until one of the two decelerating slides which are mounted on the oscillating rail shift slide strikes an unselected horizontal motion stop slide. A camming surface on the unbuckled shift slide drive links makes contact with and rolls down the face of the decelerating slide and causes the drive links to buckle. The oscillating rail shift slide finally comes to rest when it strikes the blocked decelerating slide. This, in turn, ends the downward movement of the lock lever, and the yield spring is extended until the main bail reaches the lowest point of its oscillation. As the main bail returns upward, it centers the oscillating rail shift slide. It is during this time that the horizontal motion stop slides are positioned for the selection of the next character. The number 4 and number 5 code bars each operate a code bar bell crank. Each, in turn, moves a horizontal motion stop slide toward the front (marking) or toward the rear (spacing) (Figure 58). A third (common) stop slide (spring tensioned toward the rear) is located between the upper and lower stop slides and has projections which pass across the front edges of these slides (Figure 57). Each stop slide is of a different length. The common stop slide, which is in the longest stop, has an additional step on its shank so that it serves as the shortest stop when all the slides are moved forward. The upper slide (operated from the number 4 code bar) is the second longest stop, and the lower slide (operated from the number 5 code bar) is the third longest stop.

7. When both the number 4 and the number 5 code bars are toward the right (spacing), their respective horizontal motion stop slides and the common stop slide are toward the rear. The oscillating rail shift slide is moved to the right or left of its central position (determined by the number 3 code bar) until it is stopped by one end of the common horizontal motion stop slide. This positions the first vertical row (right or left of FIGS center or LTRS center) in line for printing. When the number 4 code bar is toward the right (spacing) and the number 5 code bar is toward the left (marking), the lower and the common stop slides are toward the front and the upper stop slide is toward the rear. The oscillating

rail shift slide is moved to the right or left of its central position until it is stopped by one end of the upper stop slide. This positions the second vertical row (right or left of FIGS center or LTRS center) in line for printing. When the number 4 code bar is toward the left (marking) and the number 5 code bar is toward the right (spacing), the upper and the common stop slides are toward the front and the lower stop slide is toward the rear. The oscillating rail shift slide is moved toward the right or left of its central position until it is stopped by one end of the lower stop slide. This positions the third vertical row (right or left of FIGS center or LTRS center) in line for printing. When both the number 4 and number 5 code bars are toward the left (marking), their respective horizontal motion stop slides and the common stop slide are toward the front. The oscillating rail shift slide is moved toward the right or left of its central position until it is stopped by one side of the shank of the common stop slide. This positions the fourth vertical row (right or left of FIGS center or LTRS center) in line for printing.

(3) PRINTING HAMMER MECHANISM.

(a) GENERAL. — After the type box has been moved so that the selected type pallet is in its proper position, it must be struck by a printing hammer in order to print. This is accomplished by the action of the printing carriage located on the printing carriage track.

(b) PRINTING CARRIAGE POSITIONING. — The printing carriage rides on rollers on the printing carriage track which is rigidly attached to the typing unit front plate. The carriage is clamped to the forward section of the upper draw wire rope. This moves the carriage along its track in such a manner that the hammer advances to the next printing position.

(c) PRINTING. — The printing track which is located on the front of the Typing Unit (Figure 59) is fastened to an extension at each end of the main bail. As the main bail reciprocates vertically, it extends the motion to the printing track which travels in guides located at each end of the track. The printing arm, which extends downward from the printing carriage, rides the printing track. As the arm follows the reciprocating motion of the track, its upper end moves first toward the left and then toward the right. When the upper end of the arm moves toward the left, it rotates the printing hammer operating bail clockwise a-

against its spring tension until it becomes latched by the operating bail latch (Figure 60). The printing hammer operating bail draws the printing hammer bail away from the type box by means of the printing hammer bail spring. When the upper end of the printing arm moves to its extreme right position, it makes contact with the latch and causes it to release the printing hammer operating bail. The operating bail is swung in a counterclockwise direction by the operating bail spring until it strikes its stop. The printing hammer bail, in being driven by the operating bail, is swung toward the type box. When the operating bail is stopped, momentum causes the printing hammer bail to continue its travel against the tension of the printing hammer bail spring until the printing hammer strikes the selected type pallet.

f. SPACING.

(1) GENERAL. — To properly space the printed characters, the type box and printing carriages must be advanced with each character printed. As was shown in paragraph 4.e. (2) (a) 2. of this section and in Figure 53, the carriages are connected to a draw wire rope which, in turn, is fastened to the spring drum and the spacing drum. The purpose of the spring drum, which contains a torsion spring, is to tension the draw wire rope and thus the carriages to the left. The spacing drum has ratchet teeth about its periphery which are engaged by the eccentric driven spacing drum feed pawls (Figure 61). The spacing shaft, on which the spacing eccentrics are mounted, is driven through its helical gear by the helical driving gear attached to the three-stop spacing clutch on the main shaft. The gear ratio of 1-1/2 to 1 causes the spacing shaft to turn one-half of a revolution each time the spacing clutch is tripped. This allows the feed pawls to advance the spacing drum by the amount of one ratchet tooth. As shown previously, each time the Typing Unit operates, the main rocker shaft is made to oscillate about its center. A cam plate which is fastened to the lower side of the rocker shaft is in its lowest position during the rest time. During the time that printing is to take place, the cam plate is moved upward by the shaft and operates the spacing trip lever bail. As this bail is rotated about its pivot point, it raises the spacing trip lever until it latches onto the spacing clutch trip lever arm (Figure 62). As the rocker shaft reverses its direction of rotation, the spacing trip lever bail and the trip lever move downward thus causing the latched-up spacing clutch trip lever arm to operate the spacing clutch trip lever and release the

spacing clutch. Before the spacing clutch completes one-third of a revolution, its restoring cam moves the spacing trip lever about its pivot point until it releases the spacing clutch trip lever arm. This, in turn, releases the spacing clutch trip lever which returns to its normal position in time to stop the spacing clutch after one-third of a revolution. The spacing clutch three-stop cam disk upon which the latch lever rides has an indent at each stop position. When one of the three lugs on the clutch shoe lever disk strikes the spacing clutch trip lever, the inertia of the cam disk assembly causes it to continue to turn until its lugs make contact with the lugs on the clutch shoe lever disk. At this point, the latch lever drops into an indent in the cam disk and the clutch is held disengaged until the trip lever is again operated.

(2) SPACING SUPPRESSION. — When certain functions are selected or when the carriages reach their extreme right positions, it is necessary to suppress spacing. This is accomplished by moving the spacing suppression slide forward. In this position, it will hold the upper end of the spacing trip lever forward and prevent it from engaging the spacing clutch trip lever arm. In the case of spacing suppression on functions, the spacing suppression slide is shifted by means of a spacing suppression bail. The manner in which this bail is operated will be discussed under FUNCTIONS. When the carriages are near their extreme right positions, an adjustable cutout ring on the spacing drum engages the spacing cut-out transfer bail which, in turn, operates the spacing cut-out bail. The adjustable ring and the end of the spacing cut-out transfer bail are shown in Figure 53. The spacing cut-out bail shifts the spacing suppression slide and prevents spacing until the carriages are returned. The maximum number of characters which the Typing Unit may print in one line is eighty-five. In order to prevent spacing beyond this point several teeth are omitted from the spacing drum ratchet wheel. The length of line may be adjusted for any number of characters up to 85.

(3) LOCAL BACK SPACE MECHANISM. — As described in paragraph 3.g. of this section, when the local back space key is depressed, it causes the back space bail to rotate clockwise (Figure 31). The forward extension of the bail bears down against the intermediate arm. The intermediate arm moves down carrying with it the adjusting plate (Figure 91). The right extension of the adjusting plate bears down against the back space camming bail and rotates it

counterclockwise. At the same time, the local back space trip link on the Keyboard (Figure 31) is being moved to the rear by the operating bail. The trip link operates the spacing clutch trip lever which engages the spacing clutch. The clutch operates the spacing mechanism, as described in paragraph 4.f. (1) of this section, except that the back space camming bail does not allow the feed pawl that is moving up to engage the ratchet wheel (Figure 92). The spacing drum, under tension of the spring drum, rotates backward one space following the feed pawl that is moving down. As the spacing clutch continues to rotate, the trip link stripper, riding on the clutch cam disk, disengages the trip link from the clutch trip lever. The trip lever disengages the clutch and the back space camming bail is returned to unoperated position.

g. **MARGIN INDICATOR.** — Before the type box carriage and the printing carriage reach the end of their travel, the margin indicator light in the Cover is illuminated (Figure 9). The contact mechanism which controls the lamp circuit is mounted on the Keyboard and is fully described in paragraph 3.m. of this section. The actuator of this contact mechanism is a disk which is mounted on the spring drum of the Typing Unit (Figure 53). The angular position of this cam disk with respect to the spring drum may be altered to change the point at which the indicator will light.

h. **RIBBON MECHANISM.**

(1) **POSITIONING.** — The left and right ribbon feed mechanisms oscillate in a vertical plane with each revolution of the type box clutch. They are driven by ribbon drive links which are attached to the main side levers (Figure 64). At their uppermost position, the ribbon mechanisms position the ribbon relative to the line which is being printed. After each character is printed, the ribbon mechanisms are dropped downward together with the type box in order that the last character printed may be viewed. The ribbon is held in place at the point of printing by a ribbon guide which is fastened to the rear of the type box carriage.

(2) **FEEDING.** — Each of the ribbon mechanisms includes a bracket which is hinged at its rear end, and upon which a ribbon spool shaft is mounted (Figures 64 and 65). A ribbon tension bracket is keyed to the lower end of the ribbon spool shaft. A ribbon ratchet wheel is mounted freely on the ribbon spool shaft just below the ribbon spool bracket from which it is separated by a friction washer. The ratchet

wheel friction spring on the under side of the ribbon ratchet wheel causes the ratchet wheel to bear against the felt friction washer. This applies a constant drag to the ratchet wheel. A ribbon tension plate which is keyed to the hub of the ribbon ratchet wheel has two projecting lugs (A and B in Figure 65) that straddle the lug on the ribbon tension bracket. A ribbon tension spring tends to maintain the ribbon tension bracket against lug A of the ribbon tension plate. In operation, the ribbon spool bracket, driven by the ribbon drive link, pivots about point A in Figure 64. The ratchet feed and ratchet detent levers pivot about points B and C respectively, and are held against the saw-tooth shaped teeth on the ribbon ratchet wheel by their springs. As the ribbon spool bracket is moved upward, the ratchet wheel feed lever skips over one tooth, while the ratchet detent lever holds the ribbon ratchet wheel from turning backward. When the ribbon spool bracket is moved downward, the ratchet feed lever engages a ratchet tooth and pushes the ratchet wheel. A tooth on the ribbon ratchet wheel then skips over the ratchet detent lever. The teeth on the left and right ribbon ratchet wheels face in opposite directions so that, when their feed levers are engaged, the left ribbon ratchet wheel turns clockwise and the right ribbon ratchet wheel turns counterclockwise (viewed from the top). In order for the ribbon to be pulled from one ribbon spool to the other, only one of the ribbon mechanisms at a time can have its ratchet feed and ratchet detent levers engaged with its ribbon ratchet wheel. As the ribbon ratchet wheel turns (Figure 65), the ribbon tension plate also turns, and extends the ribbon tension spring. When the lug B of the ribbon tension plate makes contact with the ribbon tension bracket, the ribbon spool shaft is made to turn and the ribbon is thus wound on the ribbon spool. When the ribbon has become completely unwound from one spool, it is necessary to reverse its direction so it can rewind. This is accomplished automatically by disengaging one set of ratchet feed and ratchet detent levers and engaging the other set. While the ribbon is passing from the left spool to the right spool, the right set of levers are engaged. The left set are held disengaged against the tension of their springs by the left ribbon feed reverse lever which is in its downward position (Figure 67). The lever is held in this position by means of the ribbon reverse detent lever through the intervening ribbon reverse detent cam, ribbon reverse shaft, and ribbon reverse spur gear. As the ribbon unwinds from the ribbon spool, it passes around the ribbon roller (Figure 66) and through the slot in the end of the ribbon lever. When the

ribbon nears its end on the ribbon spool, an eyelet which is fastened to the ribbon, catches in the ribbon lever slot and pulls the lever toward the right. The next time the ribbon mechanism is moved upward, the displaced ribbon lever engages the end of the left ribbon reversing lever and causes it to move to the dashed position shown in Figure 67. As the lever moves, its teeth rotate the left spur gear which, through the ribbon reverse shaft, turns the detent cam and the right spur gear. As the right spur gear moves the right ribbon reversing lever downward, a pin on the lever drives the right ribbon feed reverse lever downward to disengage the ratchet feed and ratchet detent levers from the right ribbon ratchet wheel. At the same time a pin on the left ribbon reversing lever moves the left ribbon feed reverse lever upward to permit the left ratchet feed and ratchet detent levers to engage the left ribbon ratchet wheel. Thus, the ribbon mechanisms are positioned to rewind the ribbon on the left ribbon spool. When it nears its end on the right ribbon spool, the ribbon is again reversed in a manner similar to that just described. During the reversing cycle the ribbon is maintained taut by the previously extended ribbon tension spring (Figure 65).

i. FUNCTIONS.

(1) GENERAL.

(a) Essentially, the operations performed within the Typing Unit can be divided into two distinct classifications; those which are directly concerned with the actual imprinting of a character and those which result in line feed, carriage return, space, figures - letters shift, etc. The latter operations are known as functions.

(b) As in printing, the reception of a function code combination positions the code bars in accordance with the marking and spacing intervals of the signal. A series of square notches extends across the rear edge of each code bar. The stunt box, containing the function bars, is positioned directly behind the code bars. The front edge of each function bar has a series of tines which are offset to one side or the other. After the code bars have been positioned, the function bars are allowed to bear against the code bars. Only the function bar with the correct arrangement of tines will enter the notches in the code bars. All other function bars will be blocked by one or more code bars.

(c) When the function clutch is trip-

ped, (Figure 55 and paragraph 4.e. (2) (b) 3. of this section) it rotates and imparts motion to the function bar reset bail through the intervening cam and follower arm and function rocker shaft (Figure 68), causing the function bar reset bail with an attached reset bail blade to momentarily release the function bars. As the spring tensioned function bars are released, they move forward to bear against the code bars. If the code bars are positioned for a particular function, each tine on the function bar for that function will be opposite a notch in a code bar. This will permit the selected function bar to enter the code bars while the others are blocked by one or more code bars (Figure 69). A function pawl and function lever are associated with each function bar.

(d) In the unselected position, the function pawl is not engaged by its function bar but is in the forward position where its rear end rests on the function bar tail (Figure 70). When the function bar reset bail blade releases the function bars and the selected function bar moves forward, the function pawl drops off the function bar tail. As the reset bail blade returns the selected function bar to the rear, the engaged function pawl is carried to the rear. The function pawl pivots the function lever clockwise. A projection on the lower end of most function levers engages the space suppression bail and pushes the bail forward to suppress spacing, paragraph 4.f. (2). This extension of the function lever is omitted when spacing on a function is desired. Near the end of the function cycle, the stripper blade, operated by a cam on the function clutch assembly, rises beneath the rear edge of any selected function pawl and strips it from its function bar. Springs return the released function pawl and the function lever to their original positions (Figures 71 and 72). It should be noted here that, to prevent printing during the function cycle, whenever a function selection occurs, the type box is positioned such that the printing hammer will strike where there is no type pallet. The function clutch is disengaged upon completion of one revolution as described in paragraph 4.e. (2) (b) 3.

(2) LETTERS AND FIGURES SHIFT FUNCTION.

(a) The letters and figures function bars, pawls, and levers which are located near the right end of the stunt box operate on letters and figures codes respectively. The upper ends of the function levers engage the letters and figures function slides (Figures 73 and 74). The front ends of these function slides have camming

surfaces which, when a slide is shifted to the rear by its function lever, move the letters-figures code bar fork to the right (letters position - Figure 73) or to the left (figures position - Figure 74). The letters-figures code bar fork engages a pin on the bracket which is fastened to the letters-figures shift code bar, and positions the code bar toward the right for letters function or toward the left for figures function (Figure 75). A slotted extension of the code bar engages a tongue from the right end of the letters-figures shift slide and causes the shift slide to follow the movements of the code bar. Pins at the end of the shift slide serve as lower guides for the right and left shift link breaker slides. Pins which project from the front plate serve as upper guides and pivot points. Mounted on the ends of the main bail are the left and right breaker slide bails. When the letters function code is received, the shift slide is shifted to the right as shown. This places the left shift link breaker slide in a vertical position with its lower end over the left breaker slide bail. The right breaker slide is positioned such that its lower end is to the right of the right breaker slide bail. As the main bail moves upward, the right breaker slide bail clears the right breaker slide while the left breaker slide bail engages the left breaker slide and moves it upward. This action causes the left oscillating rail shift links to break and shift the oscillating rail to the right for the printing of LTRS characters. In a similar manner, when the figures function code is received, the right oscillating rail shift links are broken and the rail is shifted to the left for the printing of FIGS characters.

(3) CARRIAGE RETURN FUNCTION.

(a) The carriage return function mechanism is located in the right end of the Typing Unit. Reception of the carriage return code causes the carriage return function bar, pawl, and lever to operate (Figure 76). The lower end of the function lever engages the carriage return slide arm and pushes it forward (toward the left in the figure). The slide arm, in turn, moves the carriage return bail and its lever about their pivot point. As the front portion of the lever moves downward, it takes with it the lower section of the spacing drum feed pawl release link. This causes the upper portion of the link to turn and disengage the spacing drum feed pawls from the spacing drum (Figure 77). When the carriage return lever reaches its lowest point, the carriage return latch bail locks it there. The disengagement of the spacing drum feed pawls from the spacing drum permits

the spring drum to return the printing and type box carriages toward the left side of the Typing Unit. As the spacing drum nears the end of its counterclockwise rotation, the roller on its stop arm contacts the transfer slide which, in turn, drives the dashpot piston into the dashpot cylinder. A small passageway with an inlet from the inside of the cylinder and three outlets to the outside is incorporated in the end of the cylinder. Two of the openings to the outside are closed by a steel ball which is held in its seat by means of a compression spring. A set screw which may be locked in place with a nut is used to regulate the spring pressure on the ball. The rate of deceleration provided by the cushioning effect of the trapped air is automatically regulated for various lengths of lines by means of the ball valve. This together with the direct opening to the outside, determines the rate at which the air may escape from the cylinder. When the spacing drum reaches its extreme counterclockwise position, an extension on the stop arm trips the carriage return latch bail plate which is fastened to the carriage return latch bail. The latch bail disengages the carriage return lever and the feed pawls are again permitted to engage the spacing drum.

(b) Local operation of the carriage return mechanism may be obtained from the Keyboard. The mechanism described in paragraph 3.e. of this section engages a projection on the carriage return lever and causes the operations described in the preceding paragraph to take place.

(4) LINE FEED FUNCTION.

(a) The line feed function mechanism is located in the left end of the Typing Unit. The reception of the line feed code causes the line feed function bar, pawl, and lever to operate (Figure 78). The lower end of the line feed function lever engages the line feed slide arm and pushes it forward (to the left in the figure). The slide arm, in turn, moves the line feed clutch trip arm and the trip lever about their pivot point until the trip lever releases the three-stop line feed clutch. The line feed gearing is such that each one-third revolution of the clutch will advance the platen by one line. Therefore, the length of time that the line feed clutch trip lever is held away from the clutch will determine the number of line feeds that occur. The timing relationship between the stripper blade cycle and the main shaft rotation is such that the function pawl is not stripped from a function bar by the stripper blade until after more than one-third of a revolution of the clutch has oc-

curred. Thus, the line feed clutch trip lever will stop the clutch after two-thirds of a revolution, or double line feed, has occurred. When single line feed is desired, it is necessary to strip the function pawl from the line feed function bar before the line feed clutch completes one-third of a revolution. This is accomplished by the use of an auxiliary line feed function pawl stripper which is attached to the stripper bail. The stripper bail arm is shifted to the left or to the right by the single-double line feed operating arm (Figure 79). When the lever is in position 1 (toward the front of the Typing Unit) the stripper bail arm is permitted to engage the slot in the auxiliary line feed stripper. When the lever is in position 2 (toward the rear of the Typing Unit) the stripper bail arm is shifted out of the slot in the auxiliary line feed stripper. The cam disk on the three stop line feed clutch operates the auxiliary stripper bail once each one-third revolution of the line feed clutch. If the stripper bail arm is inserted in the auxiliary stripper slot, it will strip the selected line feed function pawl from its respective function bar immediately after the stop lug on the line feed clutch is released. The clutch revolves only one-third of a revolution and is then disengaged by the clutch trip lever.

(b) When single line feed is being used, the line feed function lever is released too soon (by the line feed function pawl stripper) to prevent spacing. Therefore, an additional line feed function bar, pawl, and lever are installed in the extreme left end of the Stunt box for the sole purpose of suppressing spacing on single line feed function. This mechanism, which always operates on the line feed function code, is released only by the stripper blade, and therefore holds the spacing suppression bail operated until the spacing cycle is completed. After the line feed clutch is stopped by its trip lever, it is disengaged by the trip lever and latch lever in the same manner as the three-stop spacing clutch.

(c) Each one-third revolution of the line feed clutch causes its attached spur gear to rotate the line feed eccentric spur gear and its attached eccentrics one-half of a revolution (Figure 80). The eccentrics, which are offset in opposite directions, each carry a line feed bar. These bars, guided by the line feed bar bell crank, alternately engage the line feed spur gear on the platen and advance the platen one line for each one-half turn of the eccentrics. A platen detent bail engages the line feed spur gear to retain the platen at each setting.

(d) When it is desired to manually position the platen, this may be accomplished by bearing down on and turning the platen handwheel. This causes the platen handwheel spur gear to engage the platen idler spur gear which, in turn, is engaged with the platen spur gear on the platen shaft. At the same time, the line feed bar release lever bears on the line feed bar bell crank and causes it to disengage the line feed bars from the line feed spur gear.

(e) Local operation of the line feed mechanism may be obtained from the Keyboard. A mechanism, described in paragraph 3.f. of this section, engages a projection on the line feed clutch trip lever and, when operated, will hold the clutch engaged to provide continuous line feeding (Figure 78).

(f) The reverse line feed feature is an arrangement which will provide an alternate pivot point below the line feed eccentric for reversing the action of the line feed bars. A detailed description of the keyboard linkage which moves the lower pivot into its operated position is contained in paragraph 3.h. of this section. As the reverse line feed trip link continues to move to the rear, it engages and trips the line feed clutch trip lever allowing the clutch to rotate and drive the line feed eccentric assembly. The reverse feeding action of the line feed bars occurs as follows: With the feed bar nearest the left side frame in its up position, the other feed bar is down (Figure 81) and the motion of the lower feed bar at the eccentric assembly is forward (left) and upward. The lower end of the feed bar moves in the same direction as its eccentric and in turn carries the slide link forward. The rear projection on the slide link engages and pushes the intermediate arm against the notched projection on the lower end of the upper feed bar. Therefore, as the lower end of the lower feed bar moves forward, the lower end of the upper feed bar is also moved forward. The motion of the upper bar at its eccentric is to the rear and downward. The resulting motion of the upper feed bar at its upper end is toward the rear and downward which disengages the upper end from the platen gear. The lower bar which remains engaged rotates the platen as the eccentric assembly continues its rotation. When the eccentric completes 180° of rotation, the reverse feeding cycle is completed and the platen is rotated back one line. As the line feed clutch rotates, the trip link stripper lever riding on the clutch cam disk disengages the trip link from the clutch trip lever allowing the trip lever to block further rotation of the clutch. This prevents

more than one line feed operation from occurring each time the reverse line feed keylever is depressed. Continuous reverse line feeding is obtained by depressing both the local reverse line feed and the local (forward) line feed keylevers at the same time. During the forward line feed operation, the slide link (Figure 81) is not operated and the motion of the lower ends of the feed bar is not affected. The bars alternately engaged and disengaged the platen gear due to the action of the eccentric assembly and the bell crank roller which acts as a pivot point for the line feed bars.

(5) **AUTOMATIC CARRIAGE RETURN — LINE FEED FUNCTION.** — If an operator fails to send the carriage return and line feed functions before the carriages are within one character of the right end of the line, the automatic carriage return ring on the spacing drum trips the automatic carriage return bell crank (Figure 77). As the bell crank turns clockwise, it shifts the automatic carriage return-line feed code bar to the right. Located adjacent to the carriage return and line feed function bars in the stunt box are automatic carriage return and line feed function bars. These two function bars are identical and have only one code projection. This projection is located opposite the automatic carriage return-line feed code bar which normally blocks the automatic carriage return and line feed function bars. When the code bar is shifted to the right, these function bars and their associated function pawls and levers are operated. The automatic carriage return and line feed function levers operate the carriage return slide arm and the line feed slide arm respectively and thereby cause the carriage return and line feed functions to occur simultaneously.

(6) **SIGNAL BELL FUNCTION.** — The circuit to the signal bell magnet is controlled by a set of normally open electrical contacts mounted on the stunt box (Figure 82). The signal bell function bar has six code lugs — five for the signal code which is S and one for the letters-figures shift code bar. In order to select the signal bell function, the letters-figures shift code bar must first be shifted to figures position. Then, each time the signal code for the letter S is received, the function lever will pulse the upper signal bell contact once (Figure 83). If the signal code for the letter S is received when the letters-figures shift code bar is in the letters position, the signal bell function bar will be blocked by the shift code bar.

(7) **BLANK FUNCTION.** — Two identical

ORIGINAL

function bars coded to operate when the signal code for blank function is received are installed near the left end of the stunt box. If, at any time, two consecutive blank signal codes are received, the mechanism operated by these two function bars will lock the Keyboard. The single-blank function lever has a projection which reaches over to engage the notch in the keyboard lock function bar and prevent the function bar from moving forward even though a blank signal code is received. Therefore, the first blank signal code received will operate only the blank function bar. This function bar moves its function pawl which, in turn, operates the blank function lever and causes it to move out of engagement with the keyboard lock function bar and to be latched in place by the blank function lever latch (Figure 84). If the next consecutive signal code is not a blank, the keyboard lock function bar will be blocked by the code bars, and the lower edge of the stripper blade will trip the blank function lever latch. The latch will release the blank function lever and permit it to re-engage the Keyboard lock function bar and reset the mechanism. If, however, the next consecutive signal code is a blank, the keyboard lock function bar will move forward before the stripper blade can trip the blank function lever latch and release the blank function lever. The Keyboard lock function bar operates its function pawl which in turn operates the Keyboard lock function lever (Figure 85). The Keyboard lock function lever moves the Keyboard lock slide arm forward (toward the left in the figure). This, in turn, actuates the Keyboard lock levers and causes them to push downward on a plunger (which projects upward from the keyboard) and lock the Keyboard. The operation of the keyboard lock mechanism in the Keyboard is described in paragraph 3.k. of this section.

(8) **SPACING FUNCTION.**

(a) **SPACING.** — For spacing between words or any spacing other than that which accompanies printing, the operator uses the space bar which is attached to the space keylever on the Keyboard. The function operates in the manner described under SPACING, paragraph 4.f. (1) of this section. However, as in all the functions printing does not occur.

(b) **UNSHIFT ON SPACE.** — A function bar which operates on spacing code is located at the right end of the stunt box. Its associated function lever engages an extension of the letters function slide (Figure 89). Thus, when a spacing function occurs, letters shift will take place in the manner described in paragraph 4.i. (2).

The projection at the lower end of the spacing function lever is removed in order not to operate the spacing suppression bail which would suppress spacing. When it is undesirable to use the unshift on space feature, the mechanism may be disabled. This is accomplished by turning a screw (located over the front end of the function pawl) downward until the rear end of the pawl is raised to clear the function bar.

Note

The space function bar must be in its rearmost position when turning the screw down.

5. MOTOR UNIT. (Figure 86.)

a. **GENERAL.** — The Motor Unit is the source of motive power for the Typing Unit.

b. **RATING.** — The synchronous motor is rated:

Single phase; 115 volts; 60 cycle A.C.; *
1/20 H. P.; 3600 RPM

Starting Current: 9.0 AMPS

Running Current: 1.85 AMPS

Power Factor: 0.30; Watts: 65

* To avoid loss of receiving margin, the frequency must be maintained $\pm .75\%$

c. **COMPONENTS.** — The motor is of the capacitor start synchronous type; a two pole wound stator with a squirrel cage rotor. The stator has two windings: a main operating or running winding and an auxiliary or starting winding. A 43 mfd. a.c. electrolytic capacitor and a starting relay are connected in series with the starting winding. Two fans located within the motor frame, one at each end of the rotor, draw cooling air in through the slots in the end bells, and exhaust it through the slots in the stator frame.

d. **STARTING.** — On starting, the initial surge of current causes the starting relay to operate and close the contacts in the starting winding circuit. As the rotor accelerates, the starting current decreases. At approximately 5.7 amperes, the relay armature releases and opens the starting winding circuit. The rotor continues to accelerate until it reaches synchronous speed. Rotation is counterclockwise as viewed from the handwheel end.

e. **OVERLOAD RESET.** — If the motor draws

excessive current for a prolonged period, i.e. a blocked rotor, a thermal cutout switch will open and disconnect the motor from the a.c. supply. This prevents over-heating and possible damage to the motor. The switch can be reset by pressing the manual reset button projecting through the motor mounting plate.

6. ELECTRICAL SERVICE UNIT. (Figure 90.)

a. **GENERAL.** — The Electrical Service Unit is located on the rear portion of the base plate and is secured on its mounting brackets by two studs. It consists of a chassis upon which the electrical noise suppressor, motor control mechanism, signal bell, power switch with line shunt feature, fuses, convenience receptacle, terminal boards and cable assemblies are mounted and interconnected so as to function with the Typing Unit and Keyboard. Plug connectors facilitate the connection of the Unit with the Typing Unit and Keyboard. Provision is made for the installation of a rectifier and resistor assembly to furnish and adjust (20 or 60 MA) a DC voltage for a local loop circuit.

b. **BASIC UNIT.** — The main power switch (3 pole double throw) opens and closes both leads of the power line while the other section of the switch shunts the signal line when the power switch is open. An electrical noise suppressor is connected to the signal line input and an identical suppressor is connected in the power line input to the unit. One container houses both suppressors with a terminal board for connecting the power and line cords. Following the electrical noise suppressor, the power input is fused by two 10 ampere fuses before it reaches the convenience receptacle and the power switch. Power for the series connected (60 volt) copy lamps and the margin indicator lamp (series resistor) is obtained from the common lead through the connector and terminal board. The copy light return lead is energized when the copy light switch, motor control switch and time delay contact (Keyboard) are closed. The return lead from the margin indicator lamp will be energized when the margin indicator switch is closed. The circuit from the signal bell contact in the Typing Unit connects with the circuit to the signal bell magnet which is located on the mounting plate to the left of the motor stop control mechanism. The AC motor circuit connects with the motor power switch in the motor control mechanism. The connectors with their respective cables interconnect the signal line and power line to the associated mechanisms on the Keyboard and Typing Unit. Two strap wires,

which connect the selector magnets in parallel for 0.060 ampere signal line current operation, may be rearranged to connect the magnets in series for 0.020 ampere operation.

c. **MOTOR CONTROL MECHANISM.** — The motor control mechanism is mounted in the center of the Electrical Service Unit. All connections to this mechanism are made through its terminal board. The purpose of the mechanism is to start the motor when the signal line current is interrupted, and, in conjunction with the time delay mechanism on the Keyboard, to stop the Motor if the signal line becomes idle for a period of not longer than approximately two and one half minutes. In the equipment as furnished, the start magnets in the electrical motor control mechanism are wired in parallel for 0.060 ampere signal line current operation. For 0.020 ampere operation, the strap wires on the terminal board may be rearranged to connect the magnets in series. Also, the strap across the line balancing resistor must be removed for 0.020 ampere operation. The resistor is switched into the line circuit when the start magnet coils are switched out in order to compensate for the loss of their resistance and to minimize unbalance in the line circuit. The following paragraphs describe the operation of the motor control mechanism through a complete cycle.

(1) **STOP POSITION.** (Figure 87.) — In this position the Motor is shut down, and the steady signal line current holds the start magnets energized. The start magnet armature is pulled downward and the stop magnet armature is positioned toward the right where it is held by a latch lever. The motor switch, operated by the stop magnet armature, is open and the signal line switch completes the start magnet circuit.

(2) **START POSITION.** (Figure 88.) — In this position the signal line has been opened, the start magnets are de-energized and the start magnet armature is released. When the start magnet armature moved upward, it carried

the latch lever with it. The latch lever in turn released the stop magnet armature. The stop magnet armature swings to the left to close contacts 4 and 6 and contacts 1 and 2. When contacts 4 and 6 are closed the start magnets are shunted from the signal line circuit. If the mechanism is connected for 0.020 ampere operation and contacts 5 and 6 are opened, a 400 ohm resistor is inserted in the line circuit to compensate for the resistance of the start magnets. When contacts 1 and 2 were closed, the power circuit was completed for the starting of the motor.

(3) **STOP POSITION.** (Figure 87.) — In order for the electrical motor control mechanism to return to the stop position and shut down the motor, an electrical impulse is received from the time delay mechanism switch on the keyboard. This pulse energizes the stop magnet briefly and causes the stop magnet armature to swing to the right and again operate the switches to open contacts 4 and 6 and 1 and 2. As the line switch was operated, the start magnet coils were placed in the signal line circuit where they became energized to pull the start magnet armature downward. This allowed the latch lever to engage the stop magnet armature and hold it in the stop position. As the motor switch was operated the circuits to the Motor and copy light lamps were opened.

7. COVER. (Figure 9.)

The principal purpose of the Cover is to house the Keyboard, Typing, Motor and Electrical Service Units. The cover assembly consists of two light weight containers, a base plate and associated hardware. The larger container encloses the Typing Unit including the Keyboard and Motor Unit and is equipped with copy lamps and a margin indicator lamp with its series resistor. The other container houses the Electrical Service Unit. The slot in the top of the container permits the operation of the recessed power switch. Suitable fasteners and a cable connector facilitate the removal of the containers from the base plate for servicing the units.



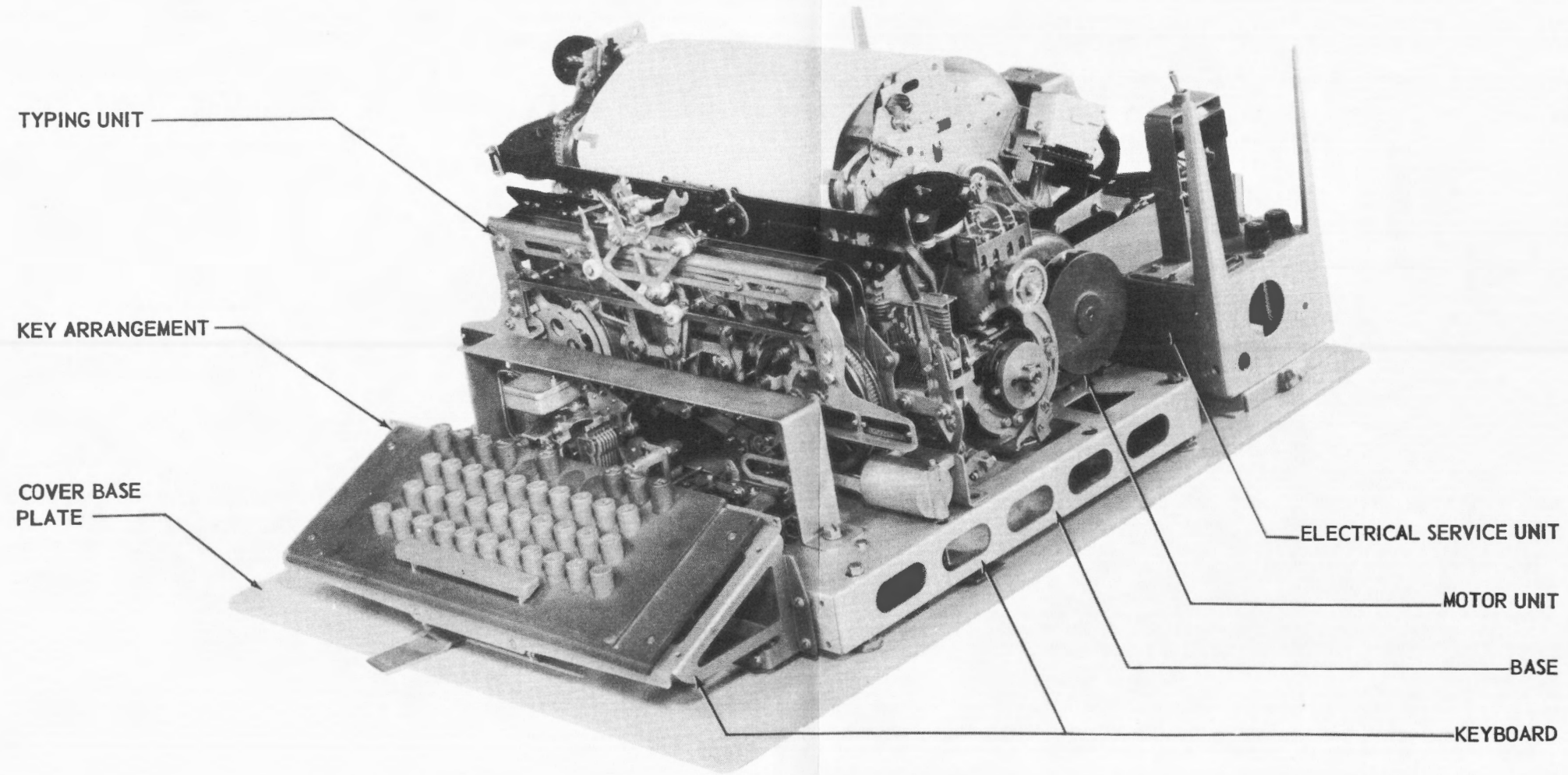


FIGURE 1. MODEL 28 PRINTER SET (RACK MOUNTED) —
COVER REMOVED

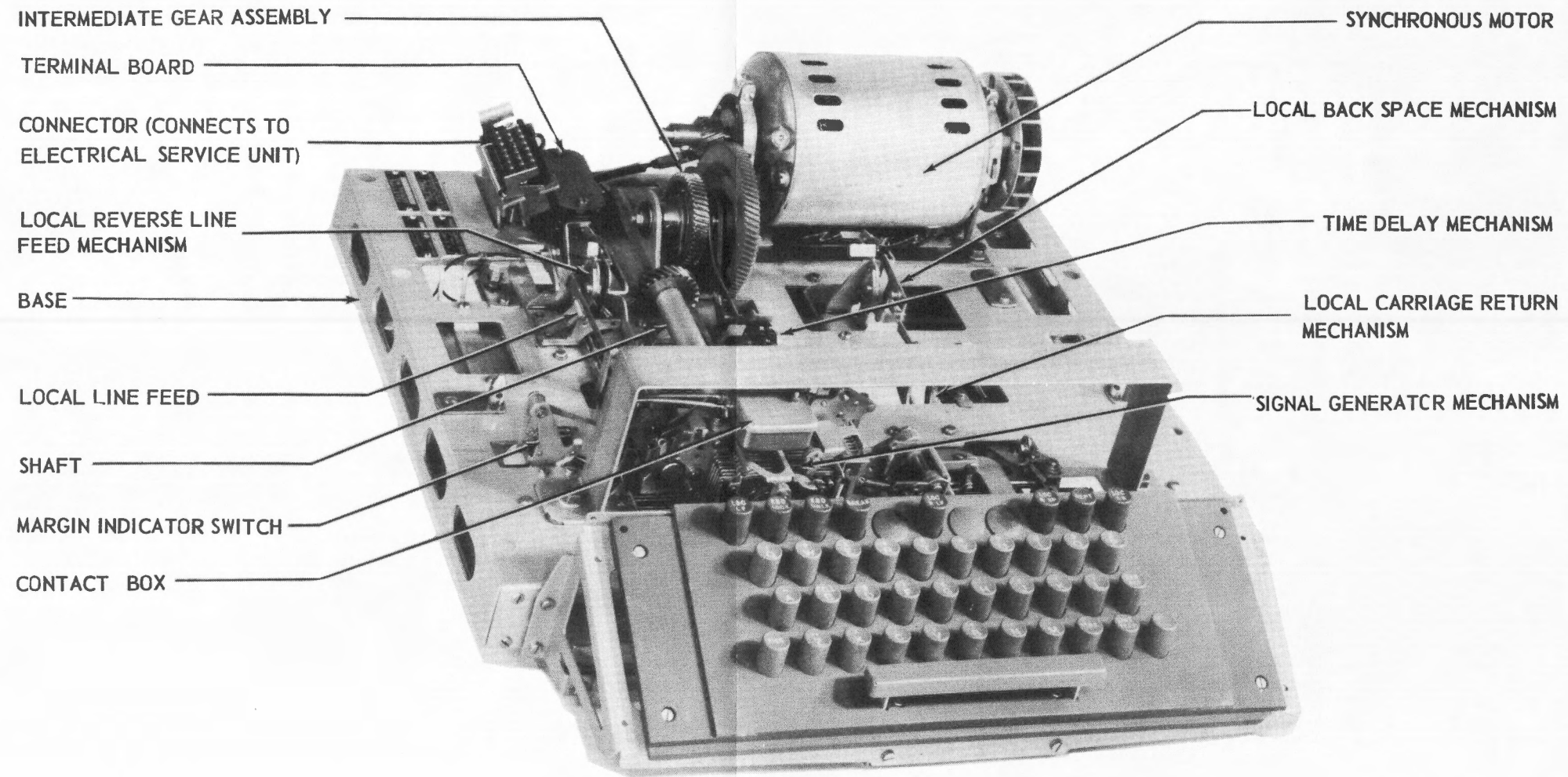


FIGURE 2. KEYBOARD

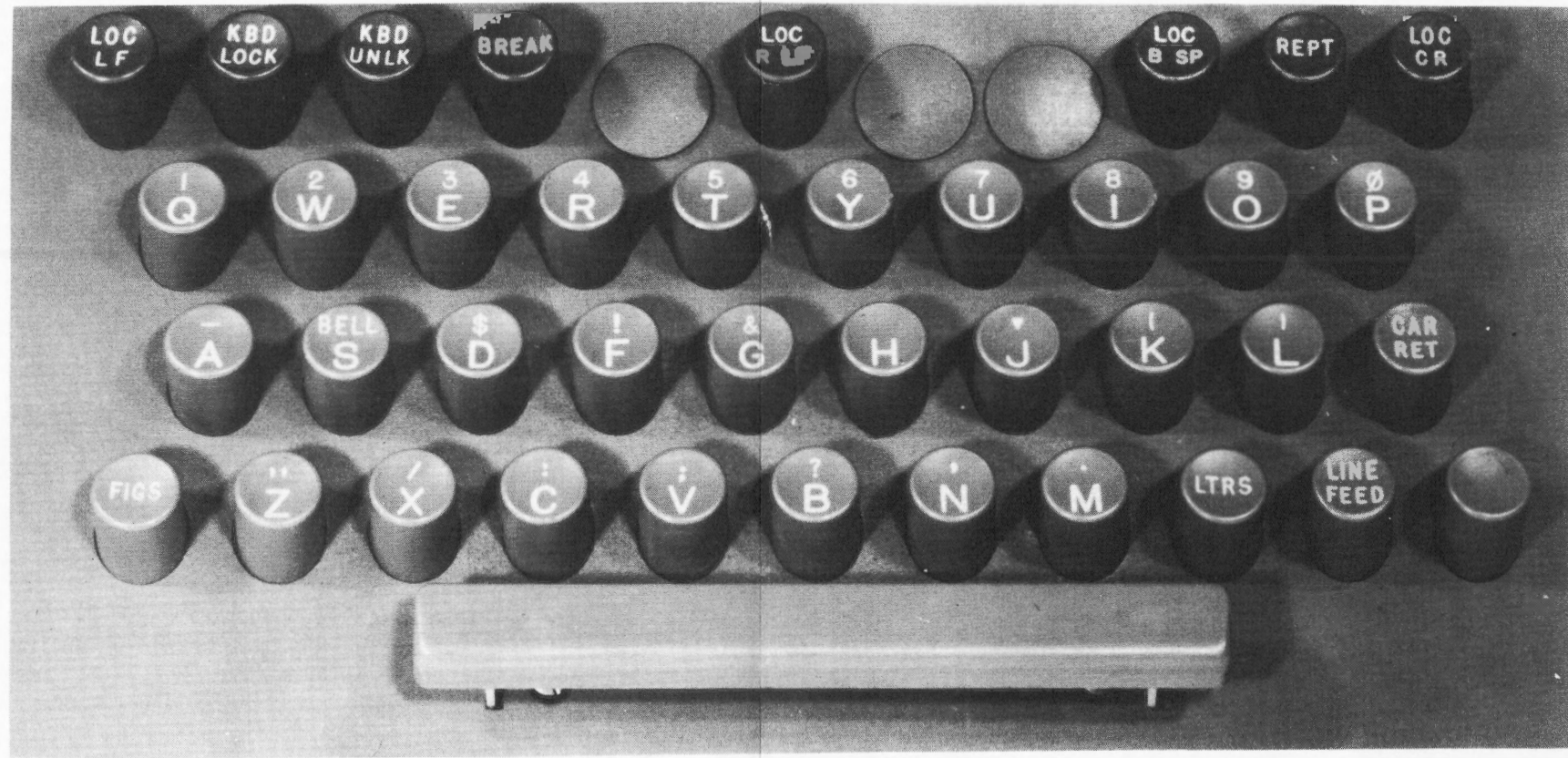


FIGURE 3. KEY ARRANGEMENT

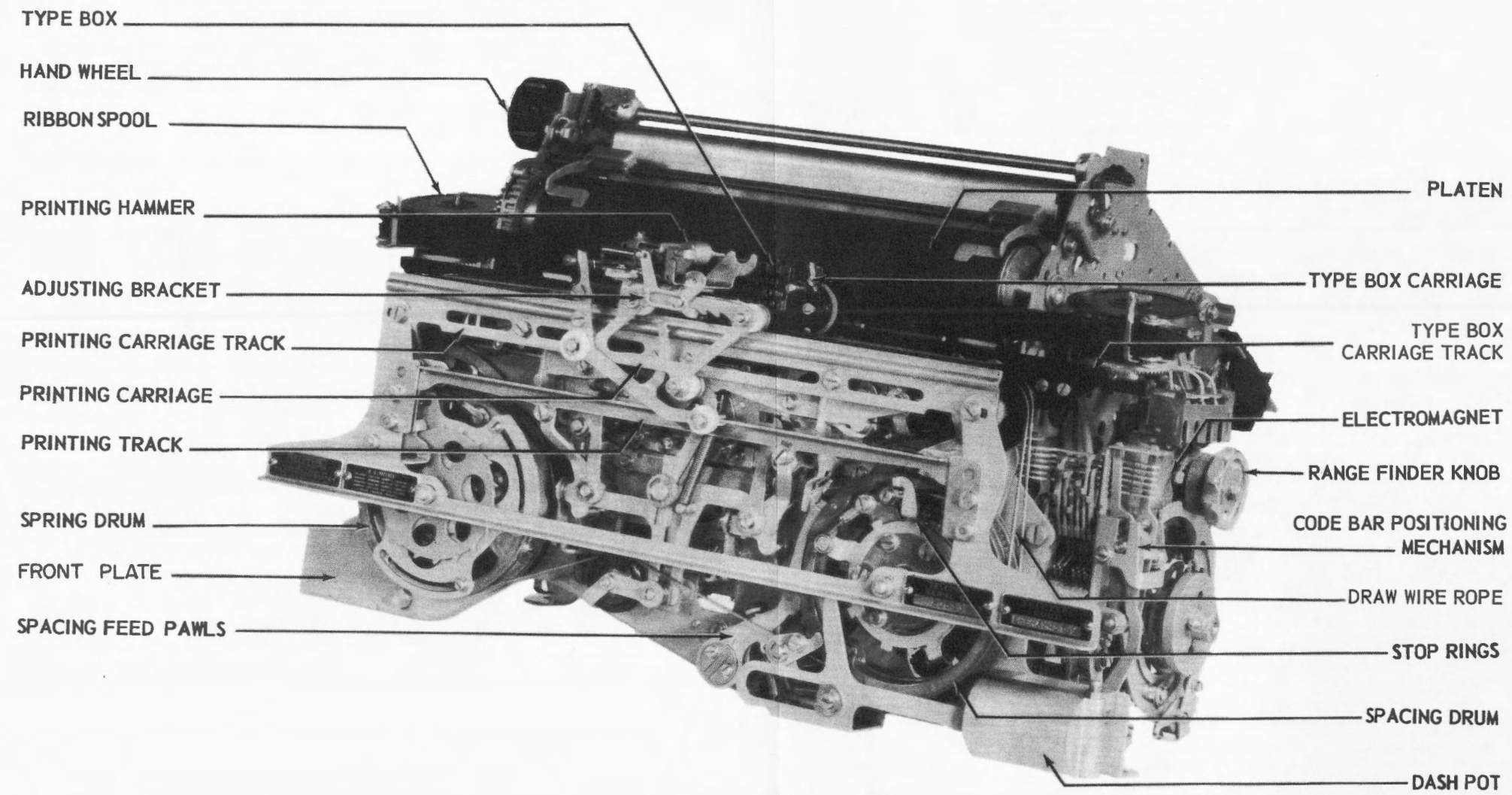


FIGURE 4. TYPING UNIT - FRONT VIEW

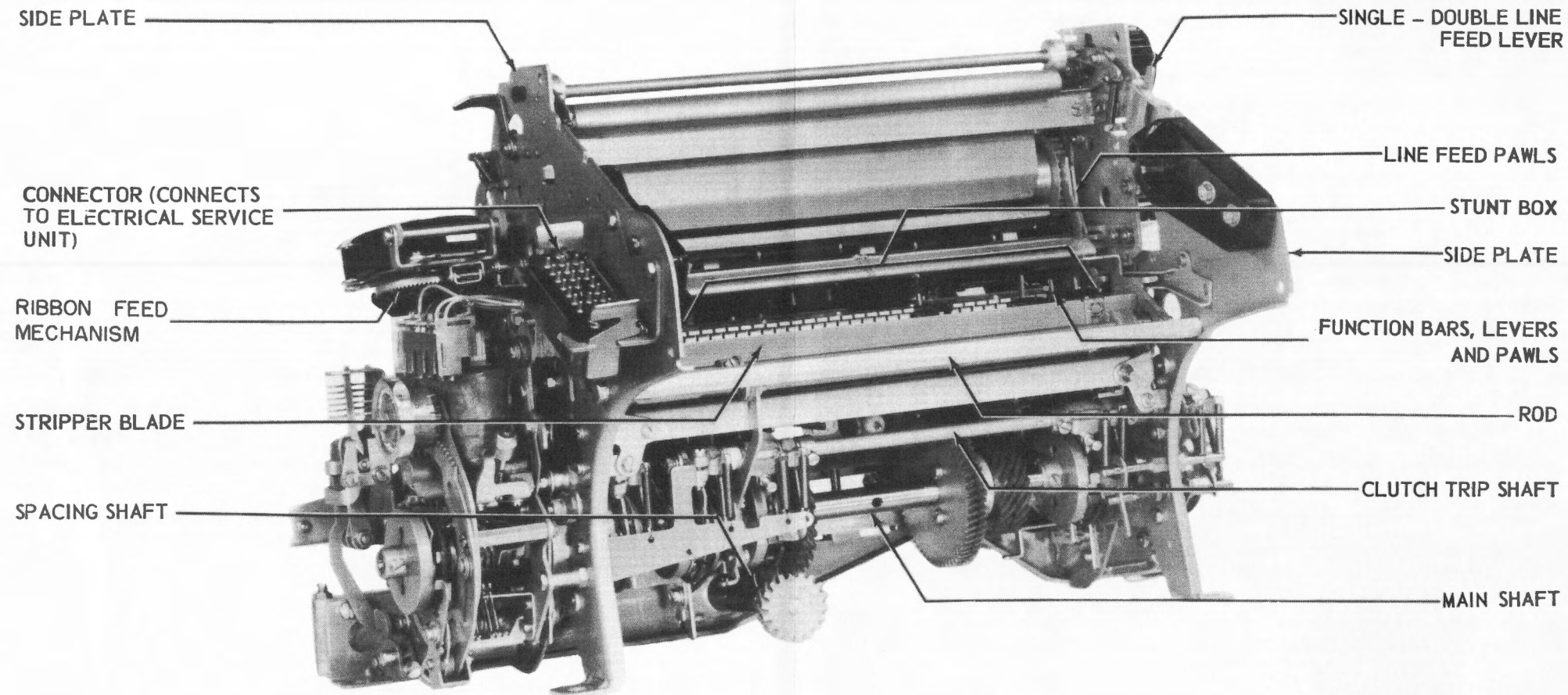


FIGURE 5. TYPING UNIT - REAR VIEW

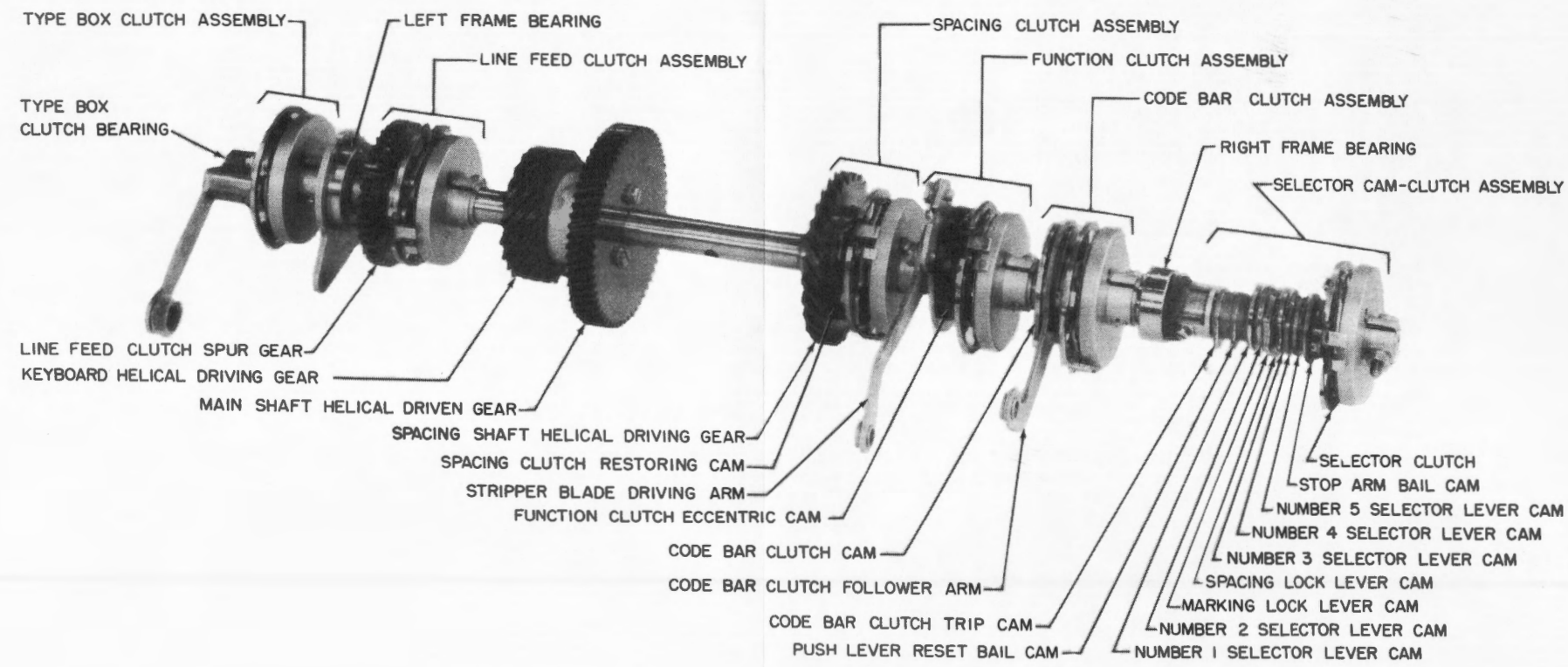


FIGURE 6. MAIN SHAFT

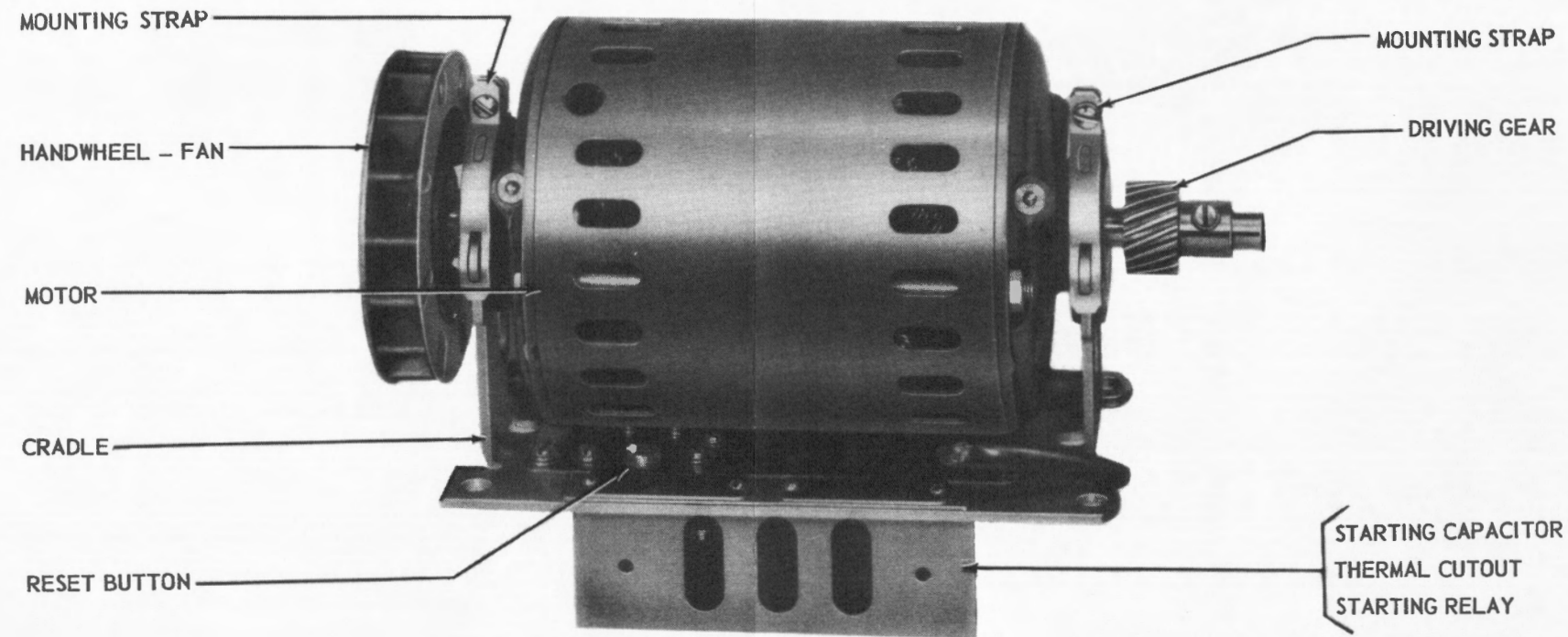


FIGURE 7. SYNCHRONOUS MOTOR UNIT

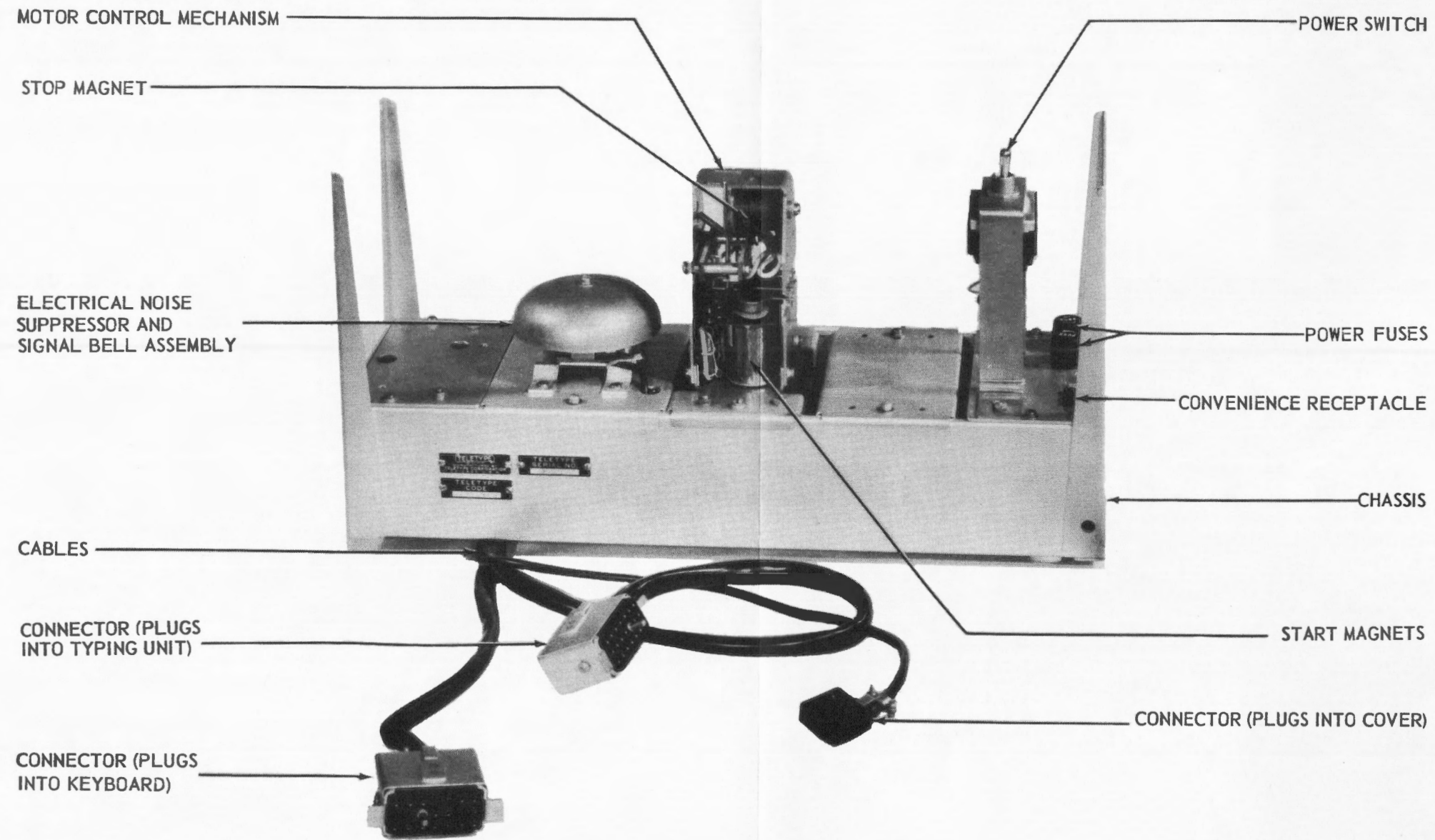


FIGURE 8. ELECTRICAL SERVICE UNIT

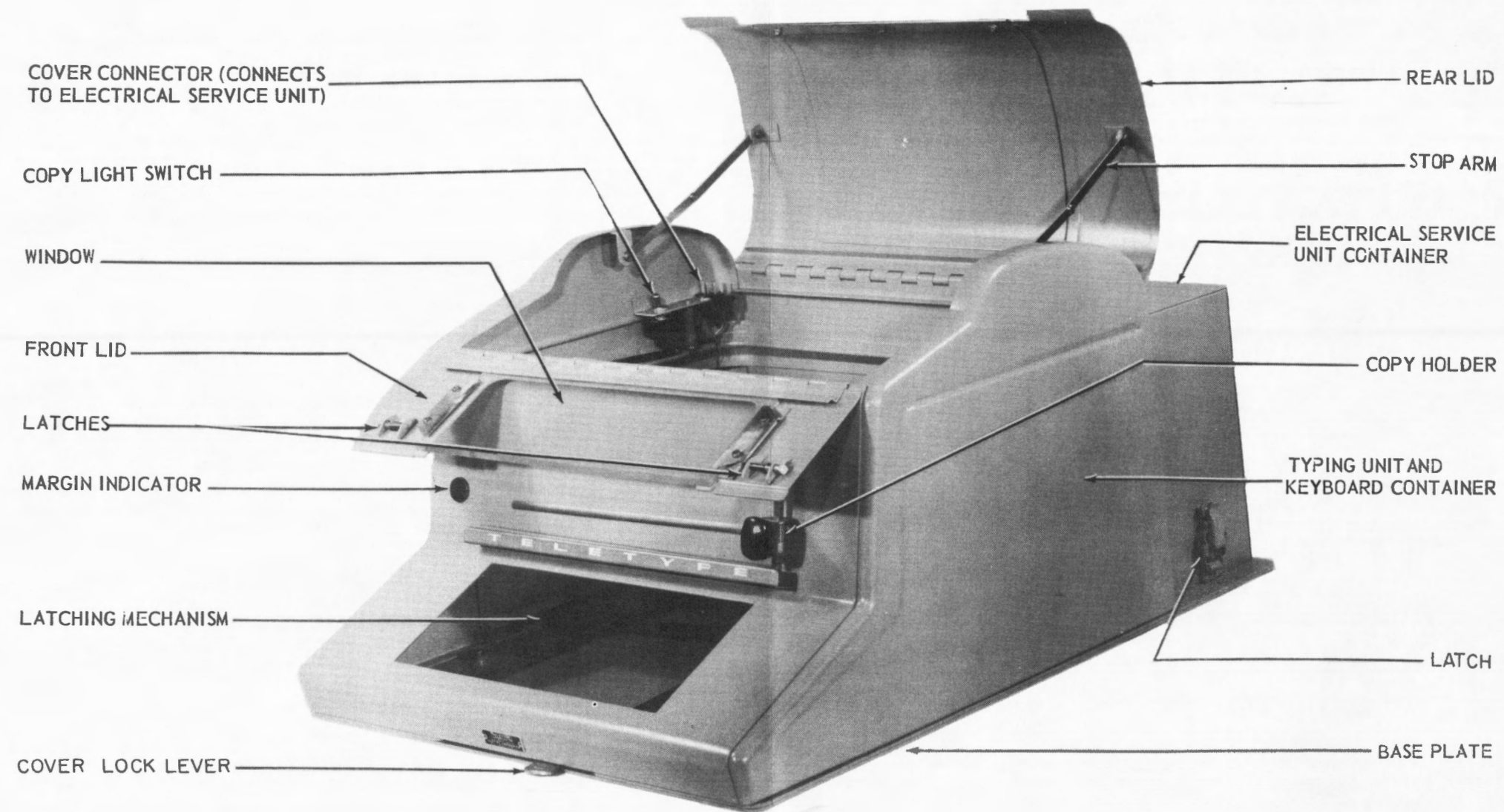


FIGURE 9. COVER

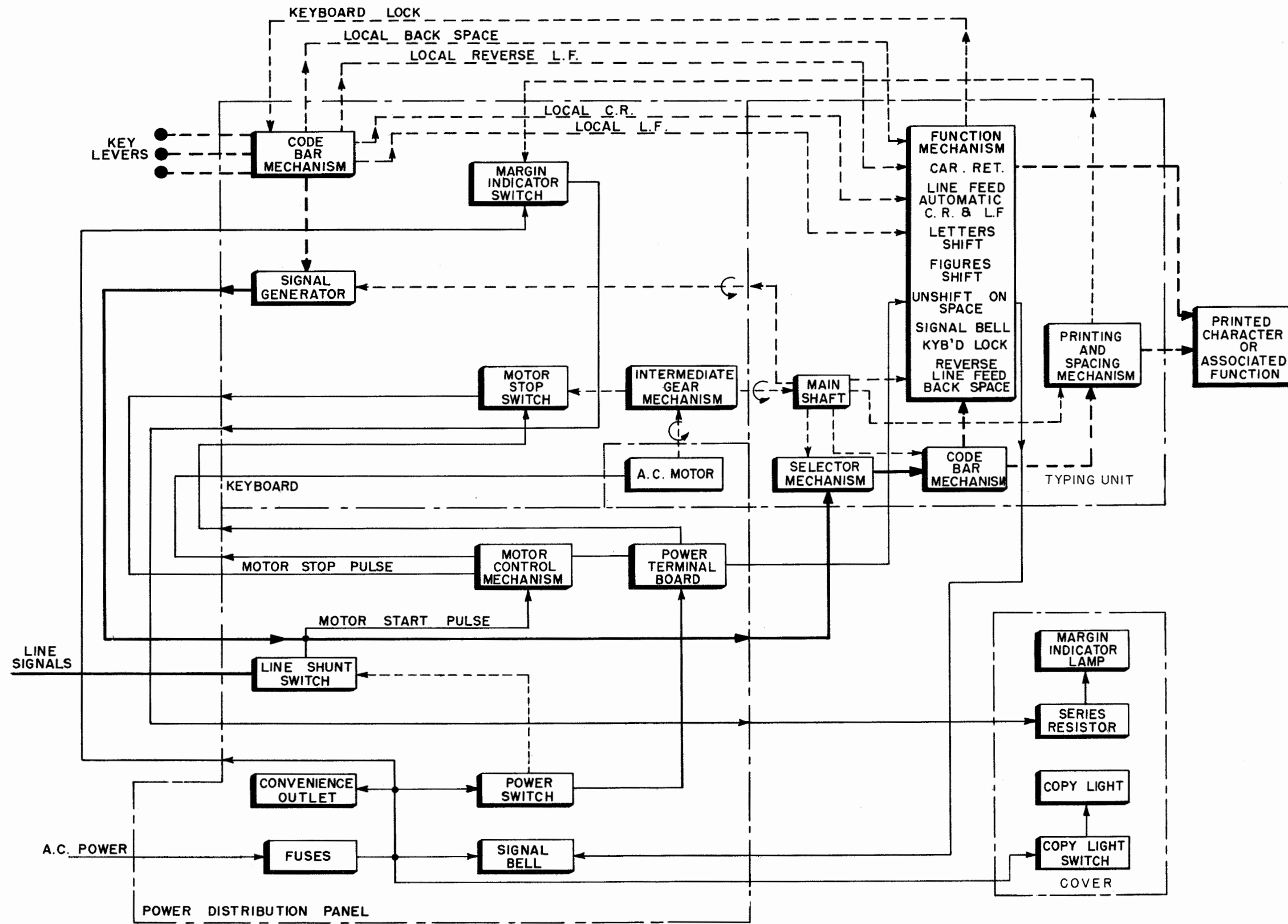


FIGURE 10. FUNCTIONAL BLOCK DIAGRAM

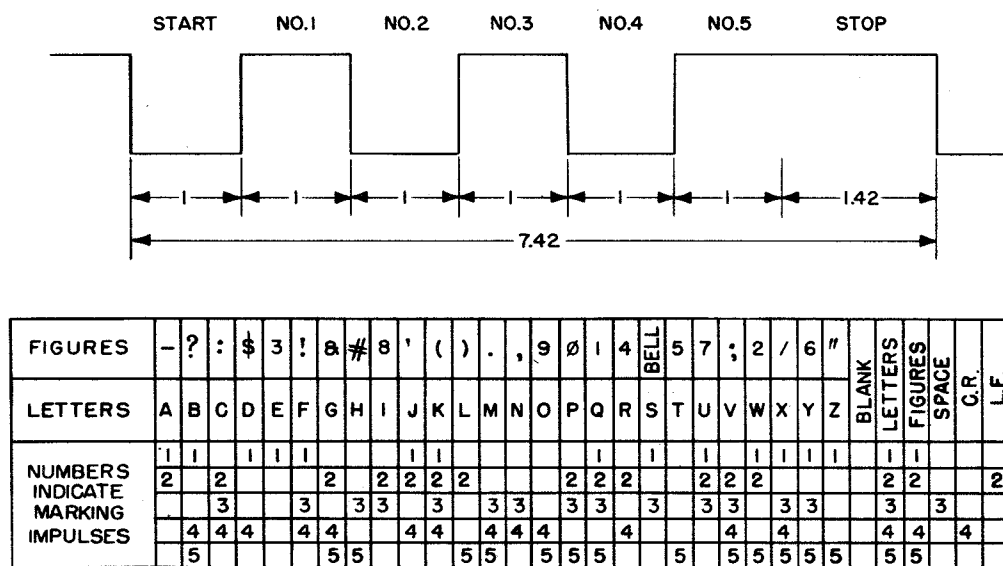


FIGURE 11. SIGNALING CODE

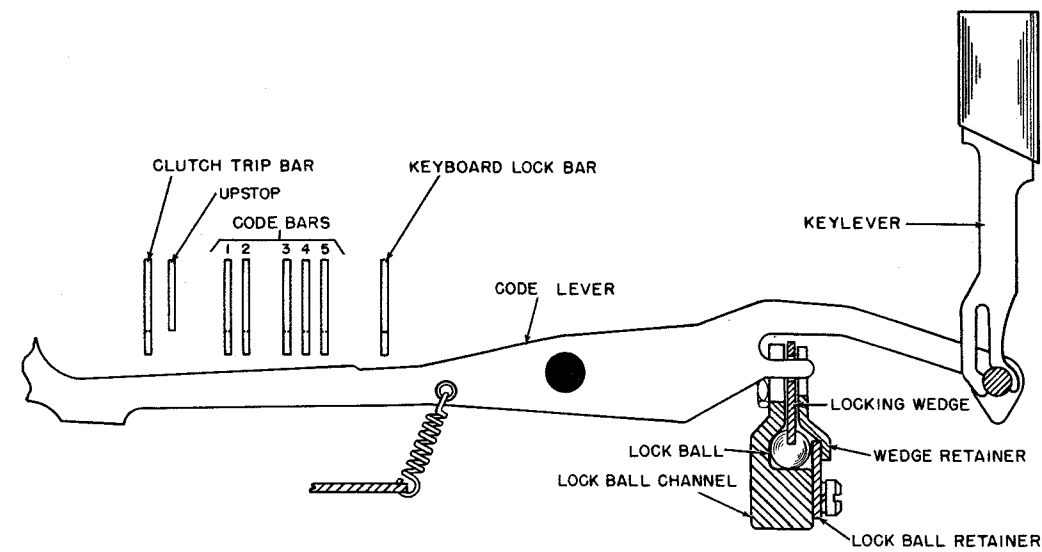


FIGURE 13. CODE BAR ARRANGEMENT

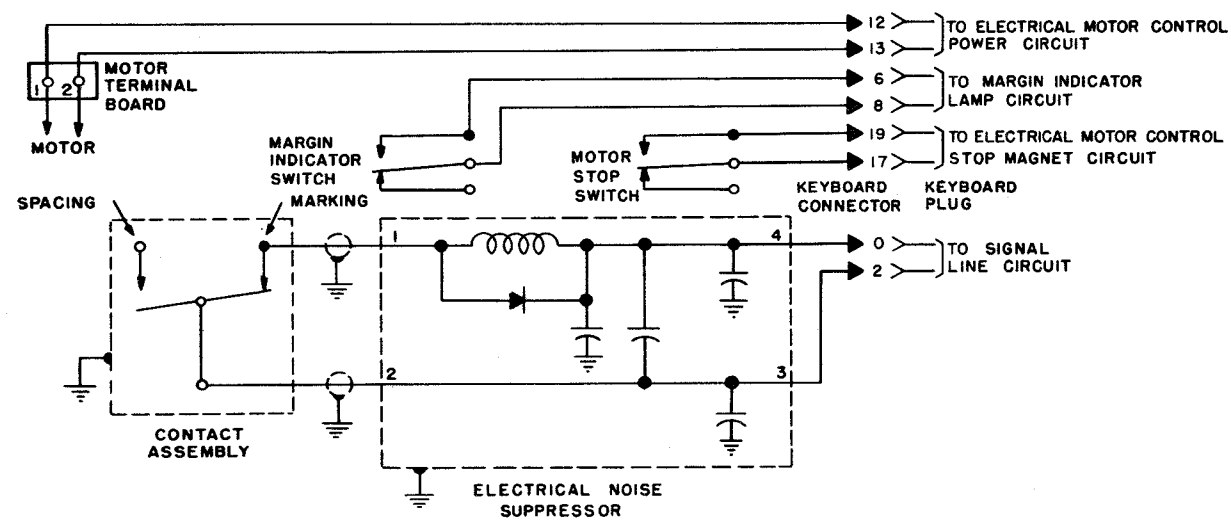


FIGURE 12. KEYBOARD SCHEMATIC WIRING DIAGRAM

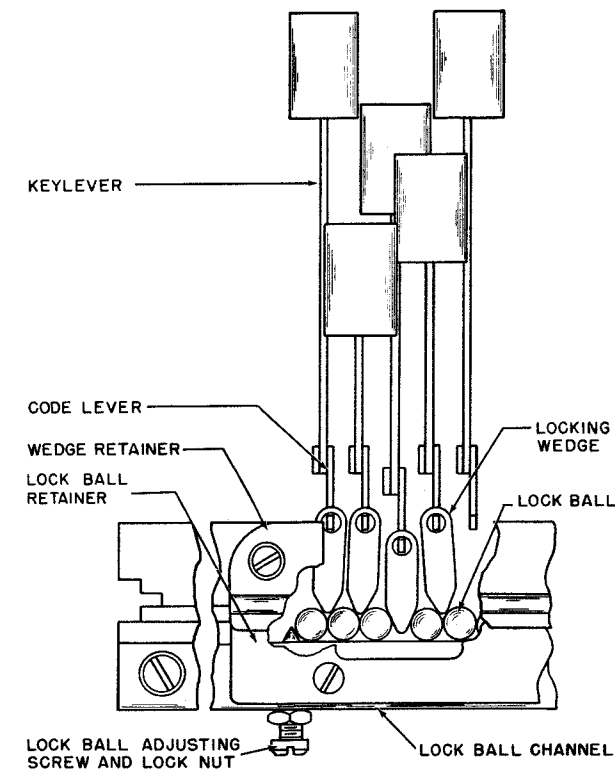


FIGURE 14. LOCK BALL MECHANISM

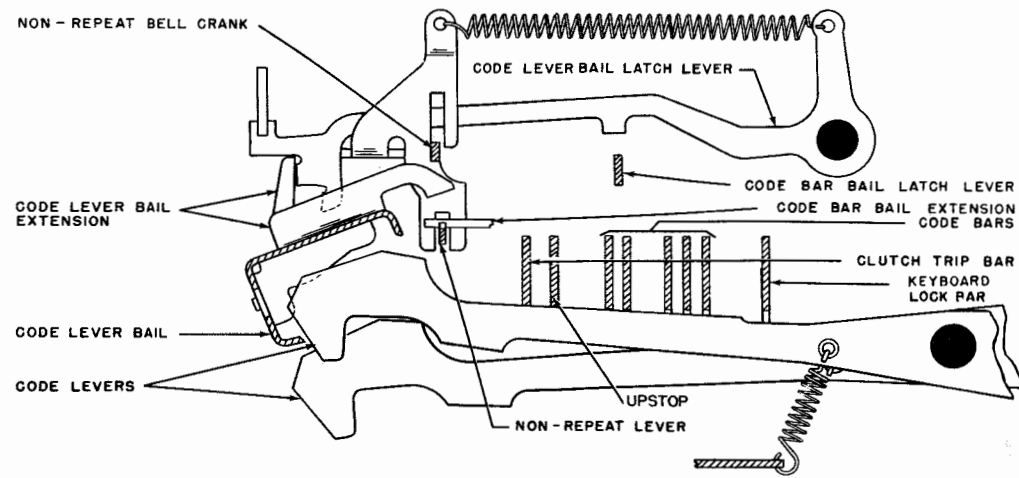


FIGURE 15. KEYLEVER MECHANISM, SELECED POSITION

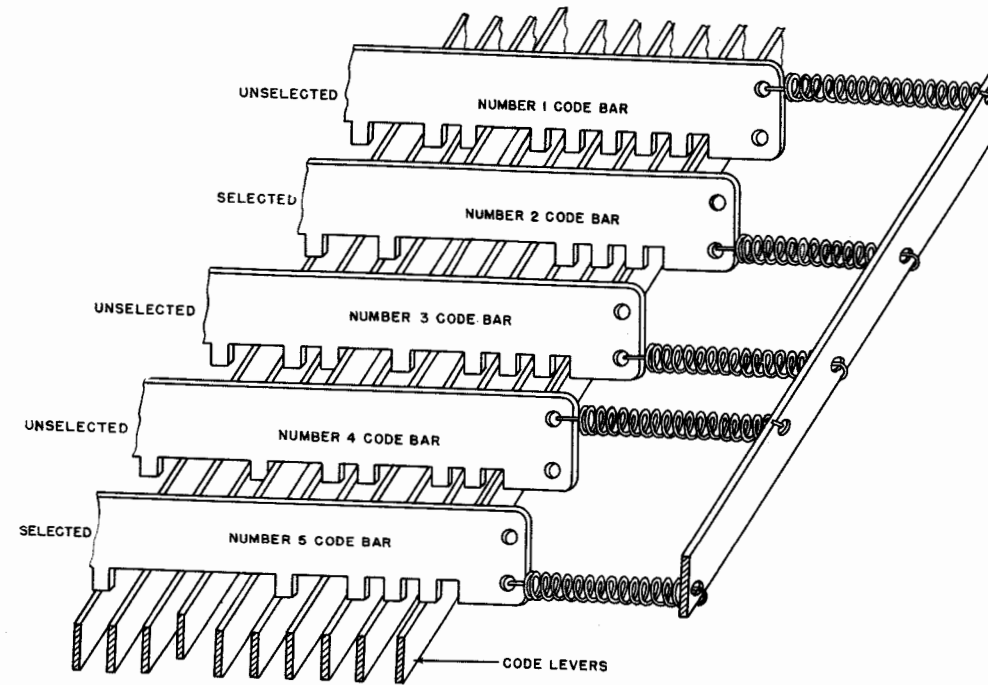


FIGURE 17. CODE BAR SELECTION

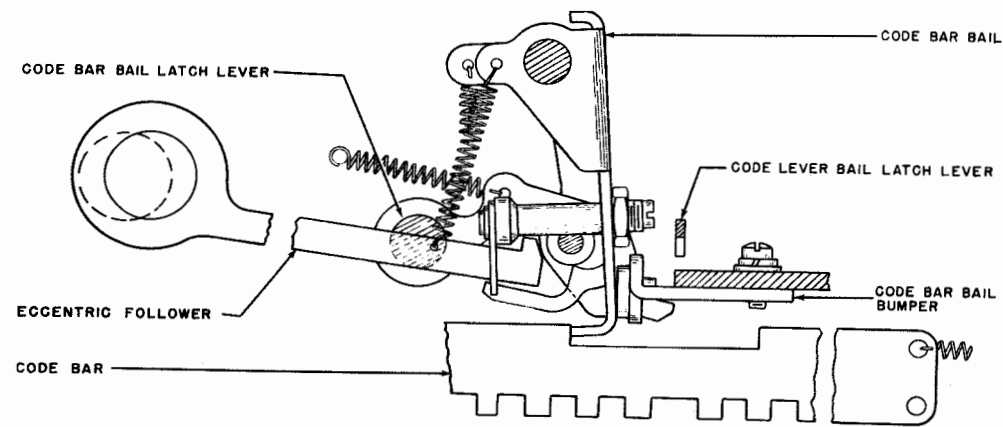


FIGURE 16. CODE BAR BAIL MECHANISM, RELEASED POSITION

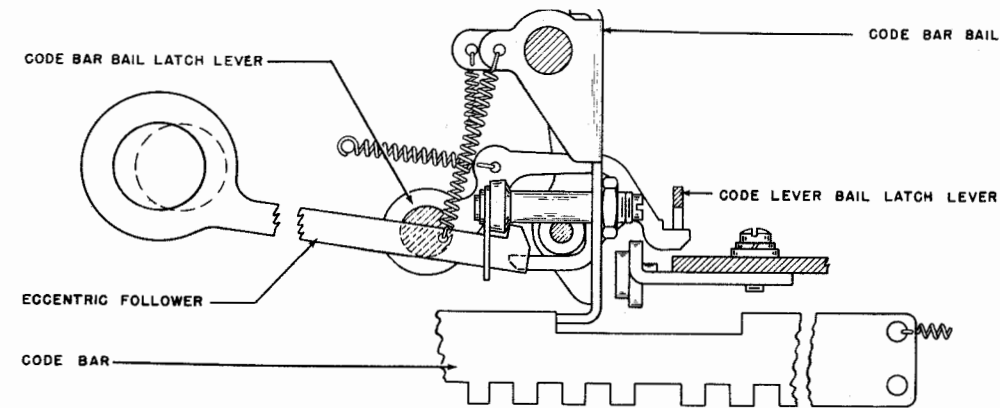


FIGURE 18. CODE BAR BAIL MECHANISM, RESET POSITION

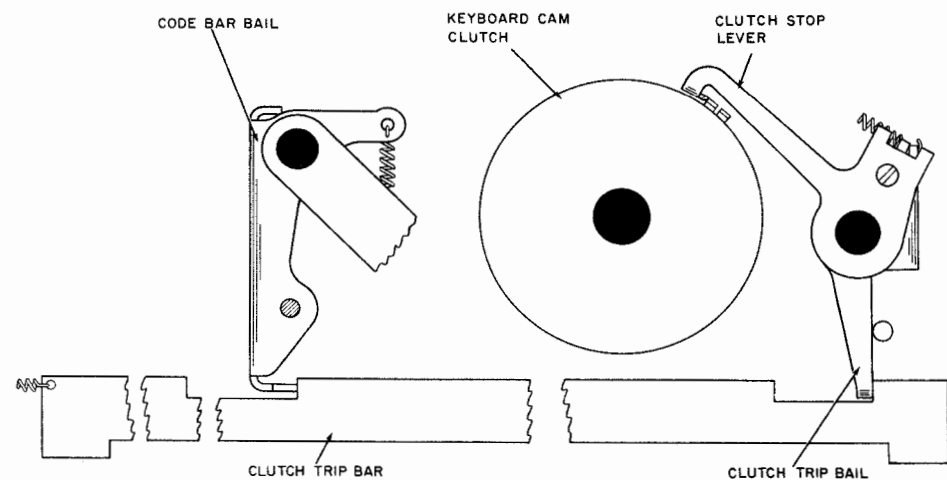


FIGURE 19. CLUTCH TRIP MECHANISM, REAR VIEW

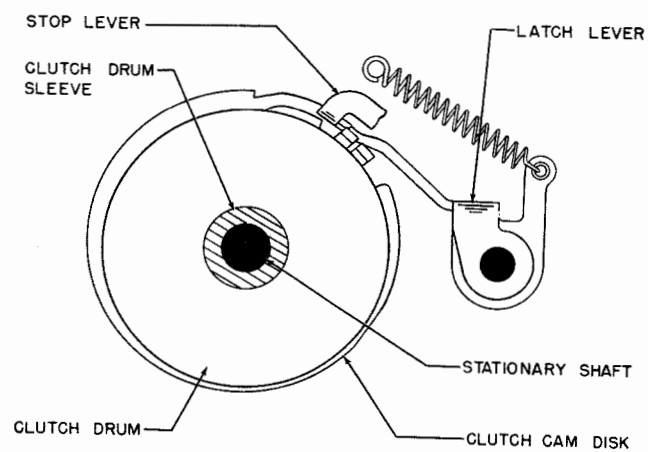


FIGURE 20. KEYBOARD CLUTCH LATCH MECHANISM

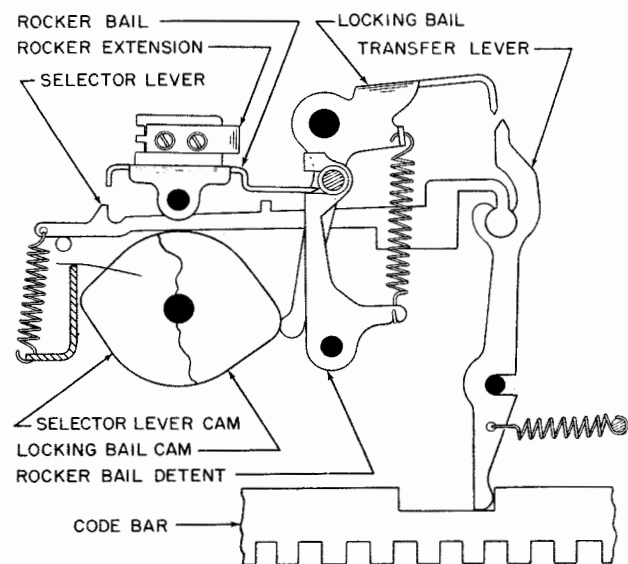


FIGURE 21. SIGNAL GENERATOR MECHANISM (FRONT VIEW)

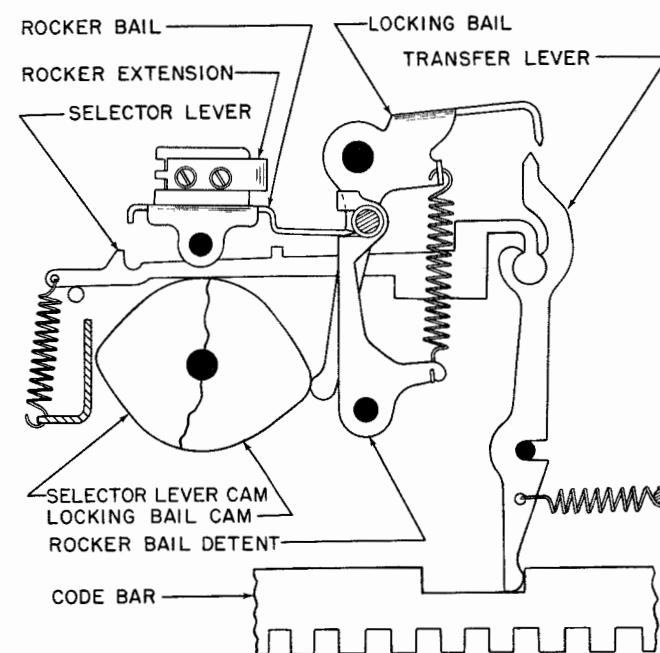


FIGURE 22. SIGNAL GENERATOR MECHANISM (FRONT VIEW)

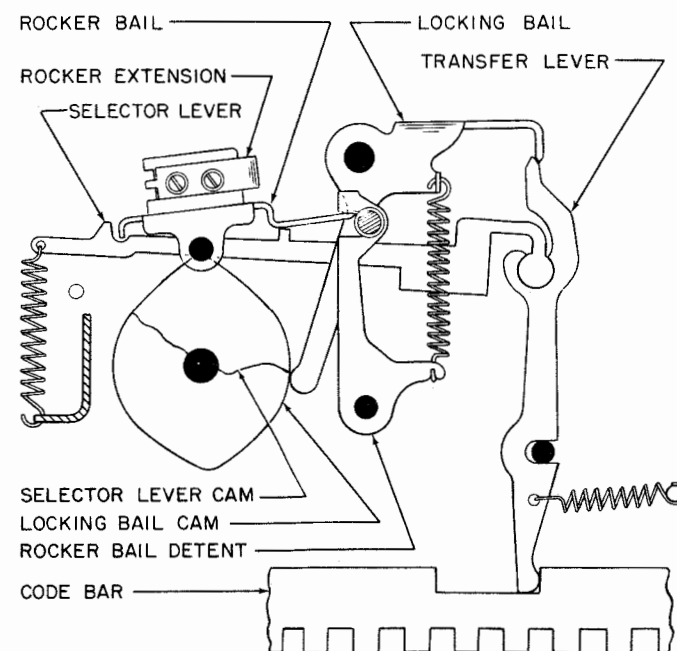


FIGURE 23. SIGNAL GENERATOR MECHANISM (FRONT VIEW)

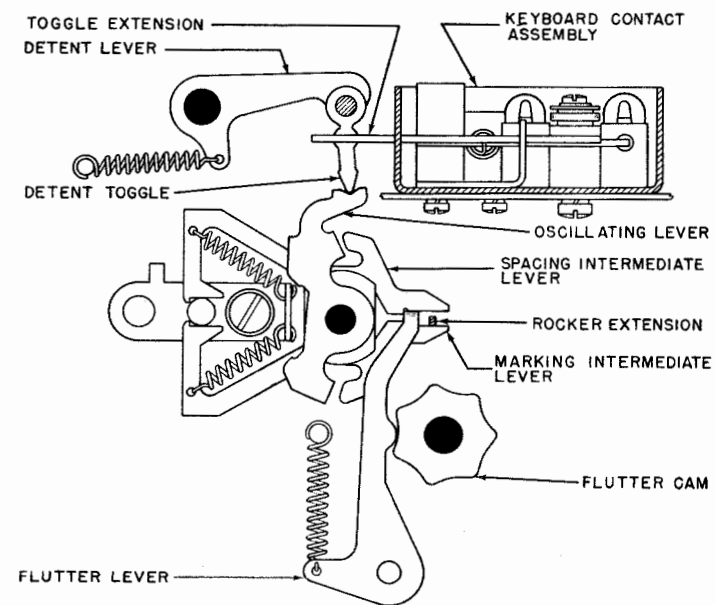


FIGURE 24. SIGNAL GENERATOR MECHANISM (REAR VIEW)—STOP POSITION

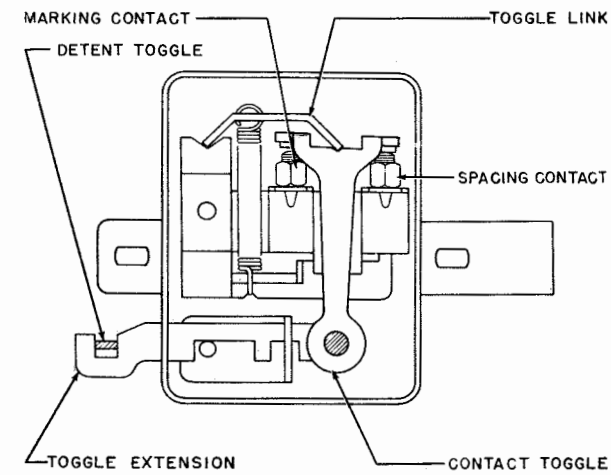


FIGURE 26. CONTACT ASSEMBLY—SPACING POSITION

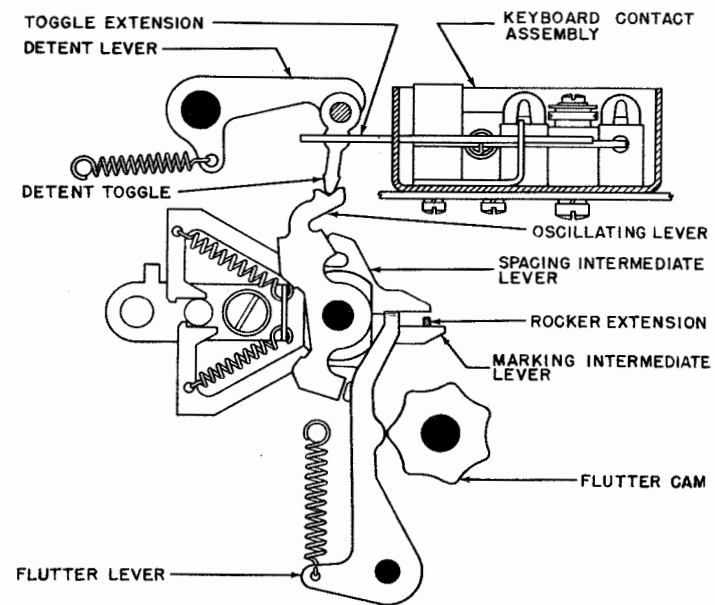


FIGURE 25. SIGNAL GENERATOR (REAR VIEW)—SPACING POSITION

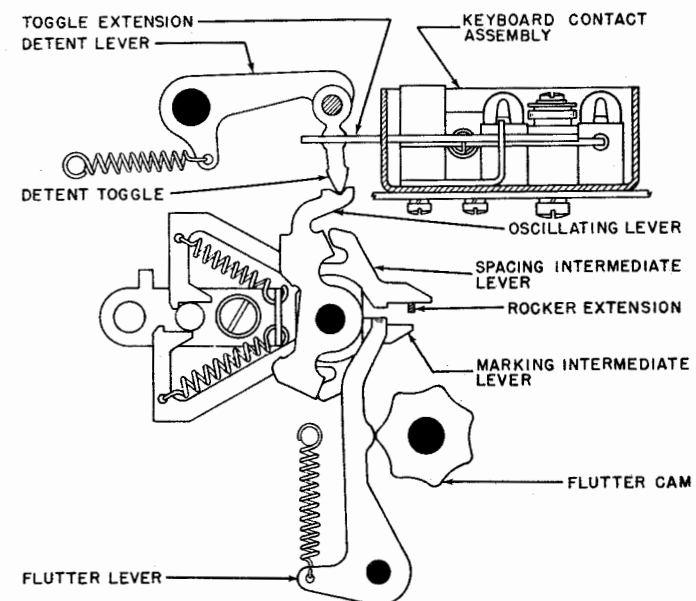


FIGURE 27. SIGNAL GENERATOR (REAR VIEW)—MARKING POSITION

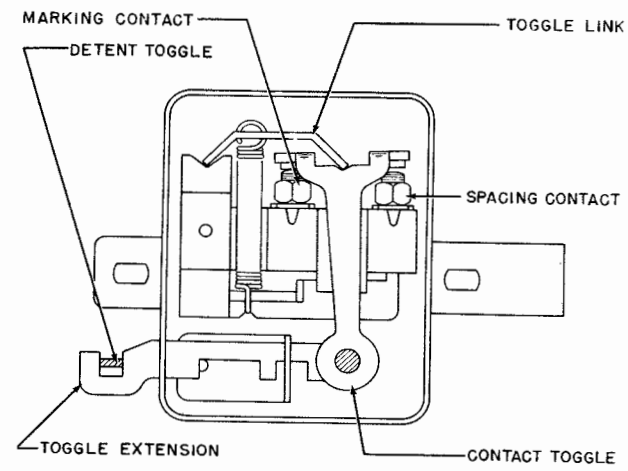


FIGURE 28. CONTACT ASSEMBLY—
MARKING POSITION

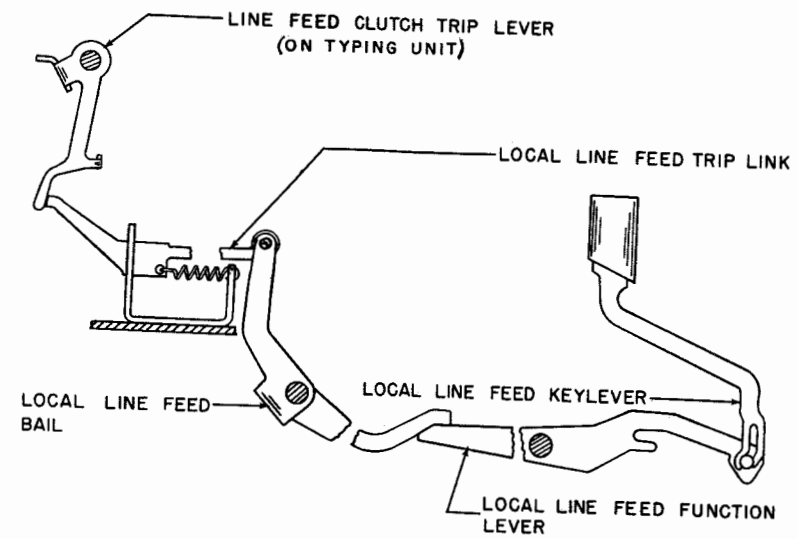


FIGURE 30. LOCAL LINE FEED MECHANISM

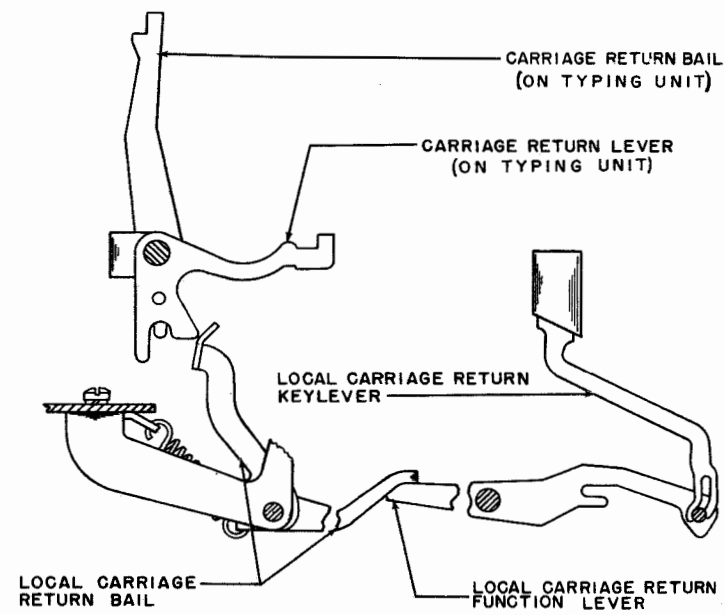


FIGURE 29. LOCAL CARRIAGE RETURN MECHANISM

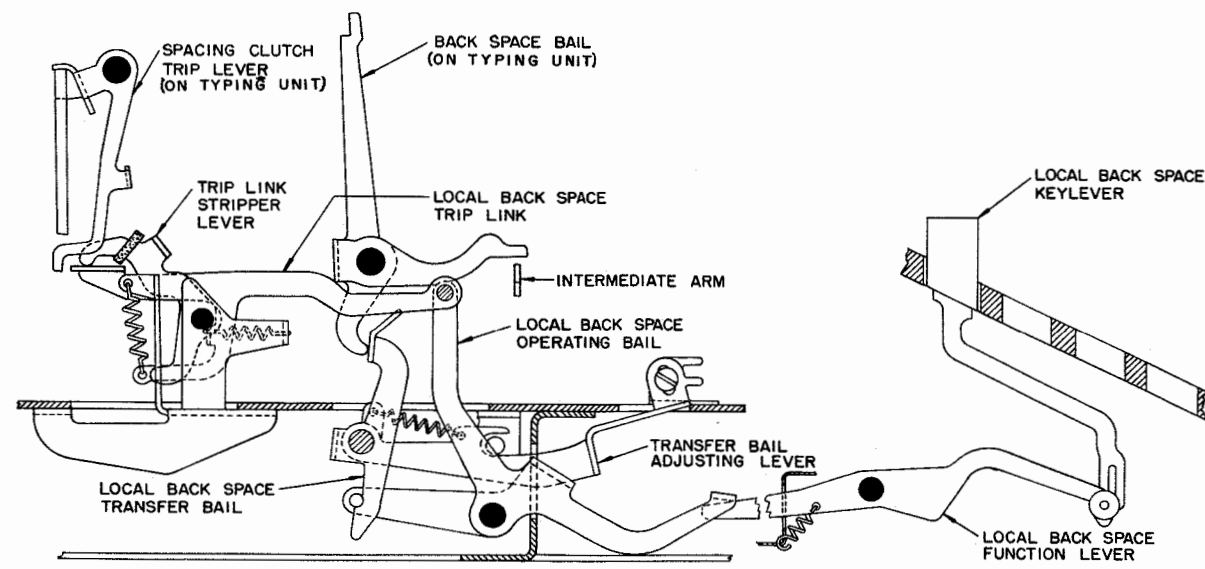


FIGURE 31. LOCAL BACK SPACE MECHANISM

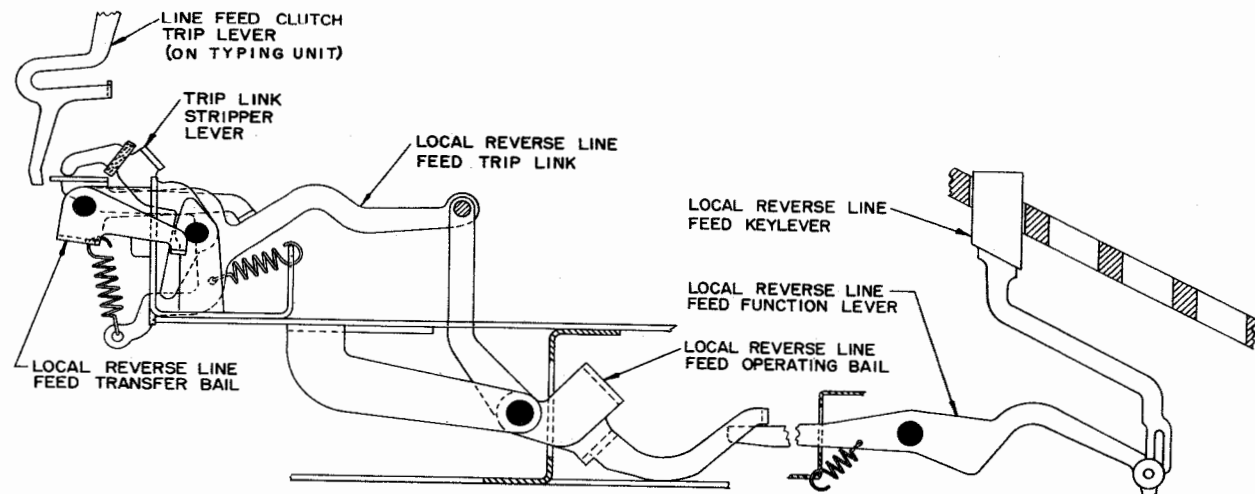


FIGURE 32. LOCAL REVERSE LINE FEED MECHANISM

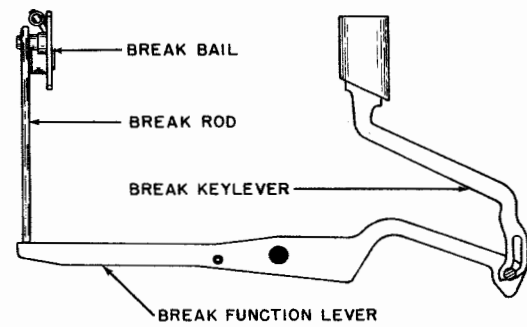


FIGURE 33. BREAK MECHANISM

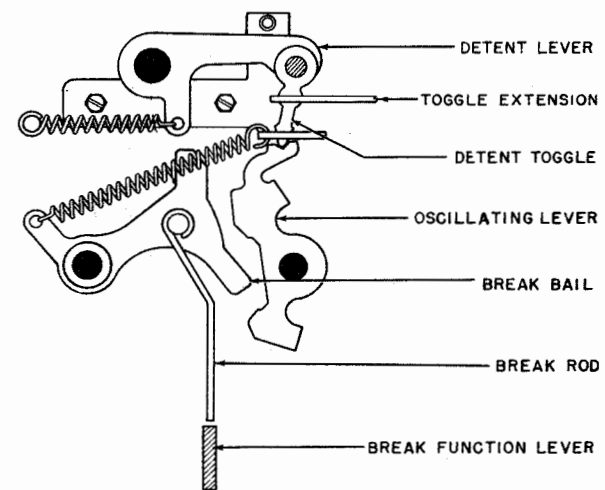


FIGURE 34. BREAK MECHANISM

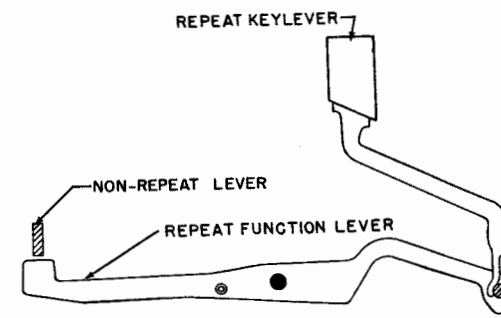


FIGURE 35. REPEAT MECHANISM

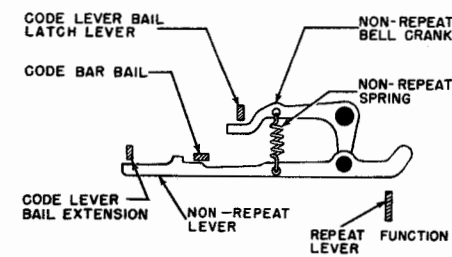


FIGURE 36. NON-REPEAT MECHANISM

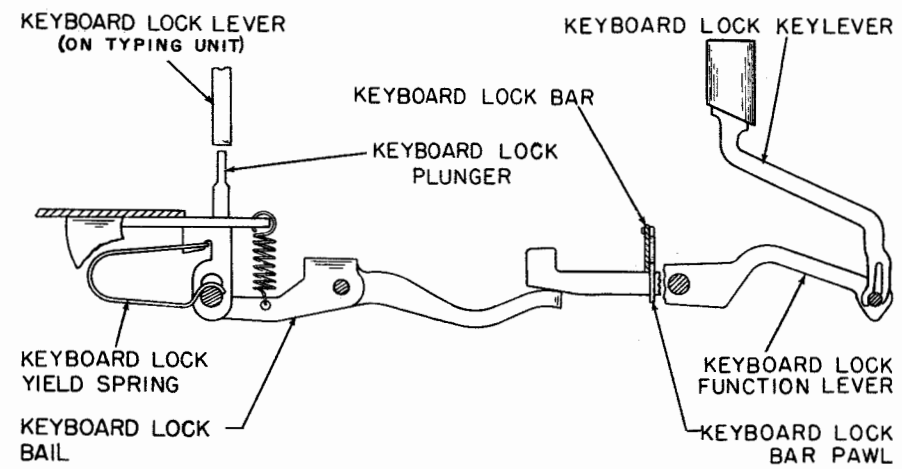


FIGURE 37. KEYBOARD LOCK MECHANISM

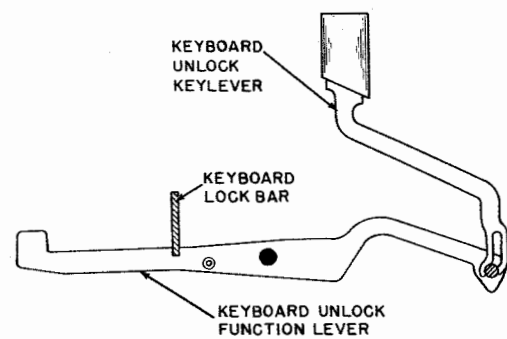


FIGURE 38. KEYBOARD UNLOCK MECHANISM

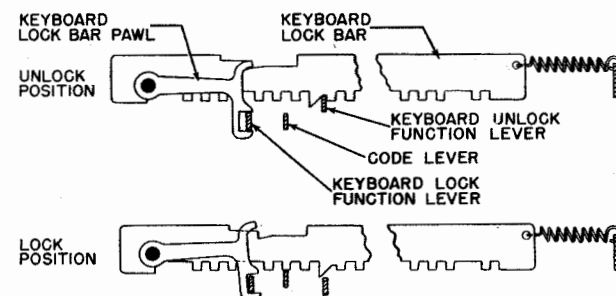


FIGURE 39. KEYBOARD LOCK MECHANISM

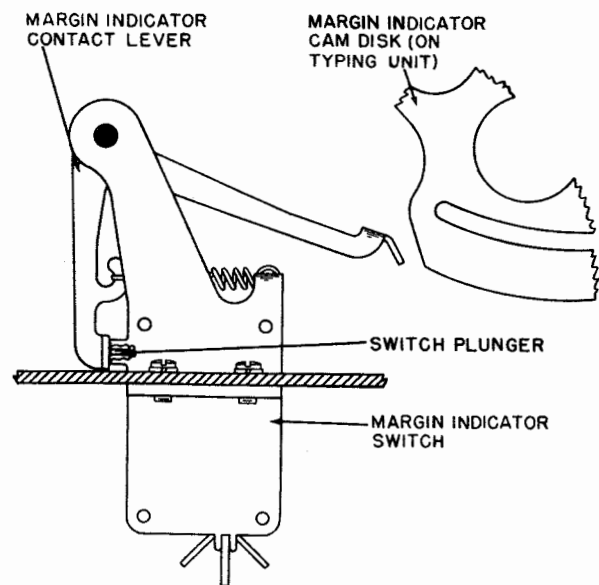


FIGURE 40. MARGIN INDICATOR MECHANISM

ORIGINAL

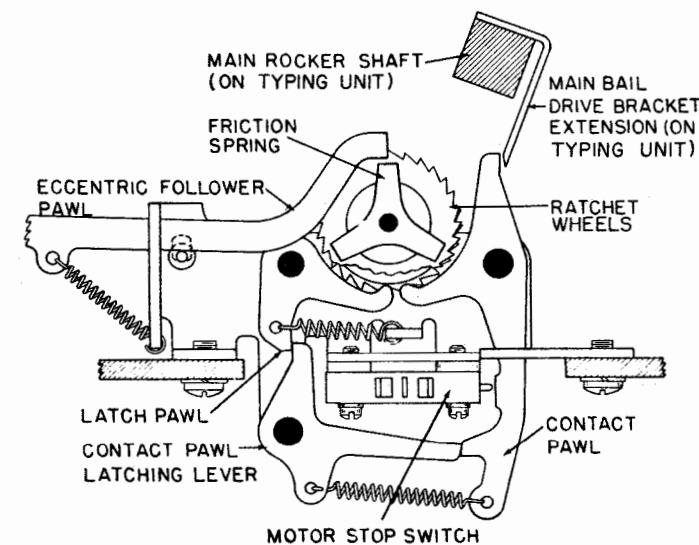


FIGURE 41. TIME DELAY MECHANISM

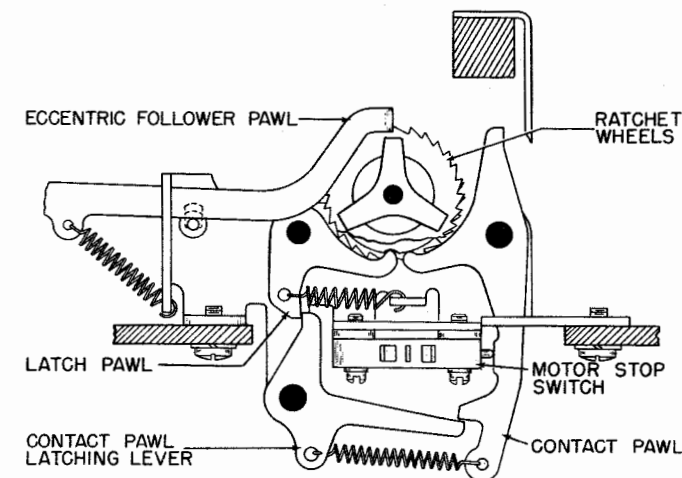


FIGURE 42. TIME DELAY MECHANISM

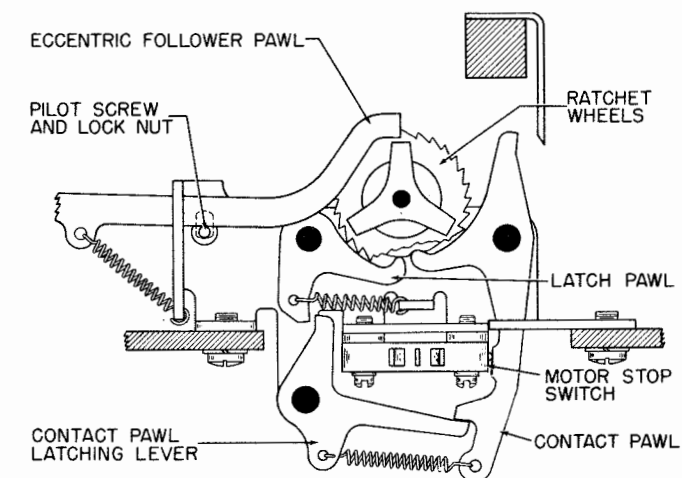


FIGURE 43. TIME DELAY MECHANISM

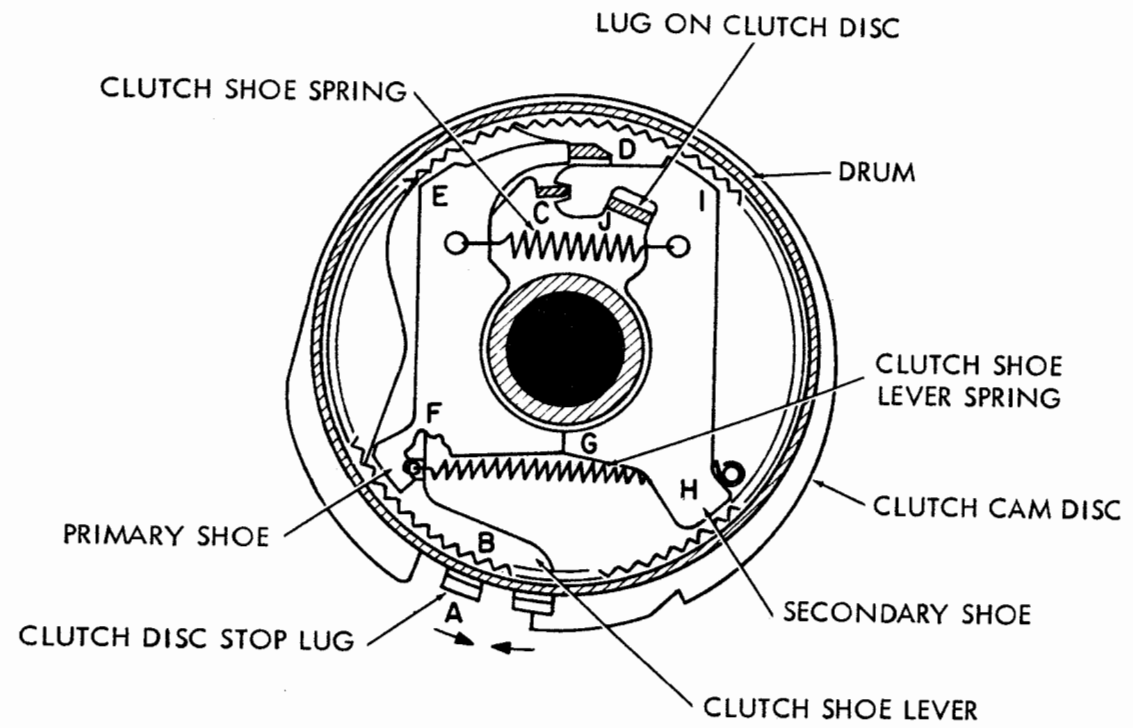


FIGURE 44. CLUTCH-DISENGAGED

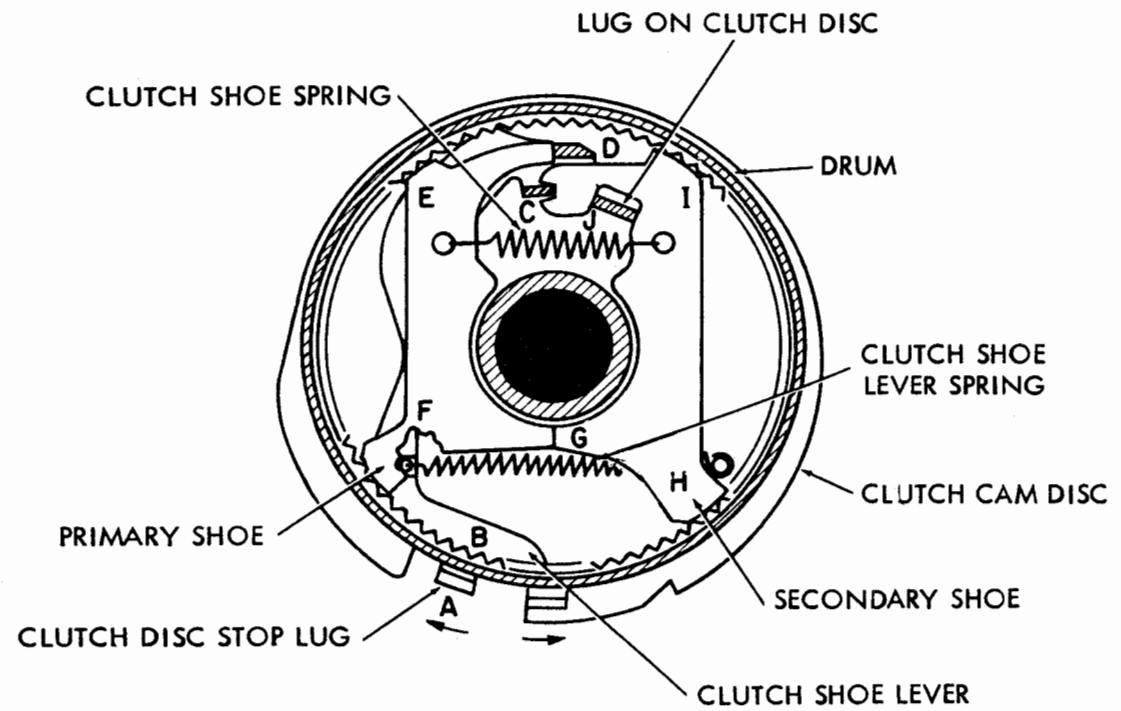


FIGURE 45. CLUTCH-ENGAGED

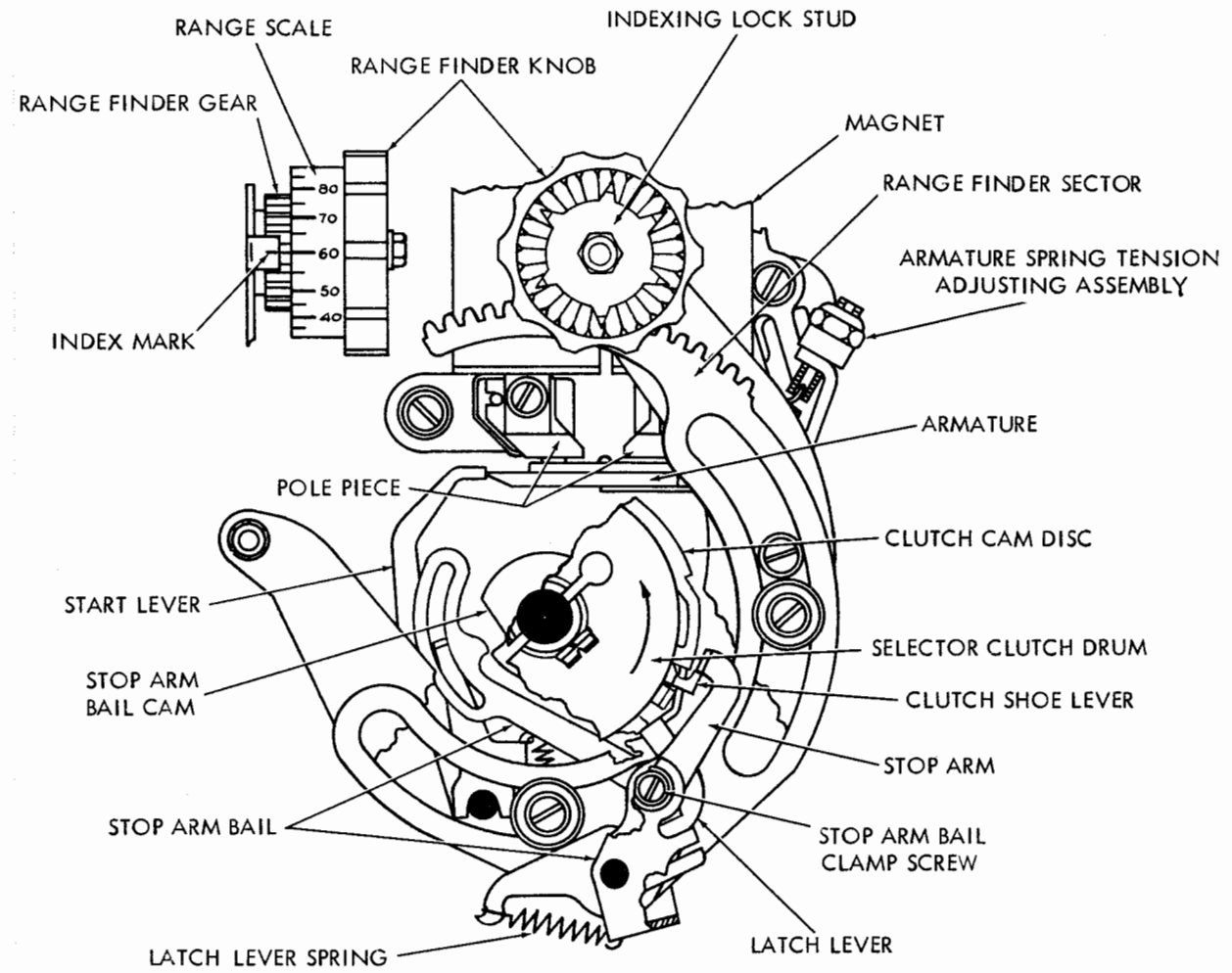


FIGURE 46. SELECTOR MECHANISM

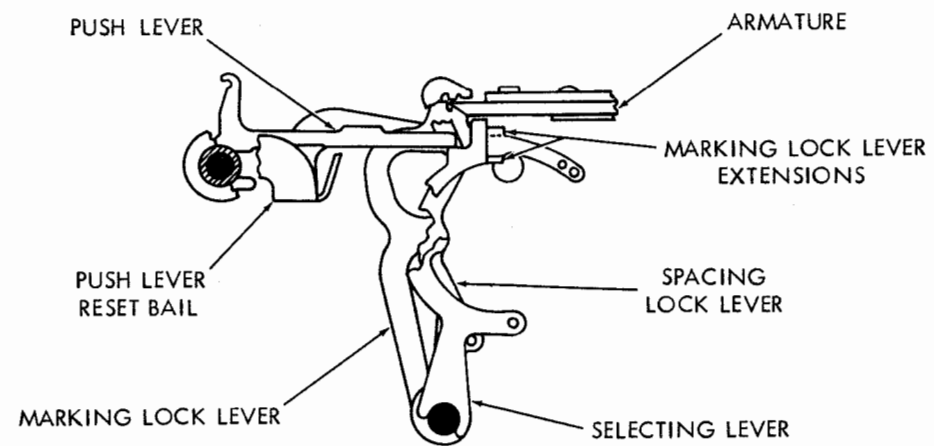


FIGURE 47. SELECTOR MECHANISM

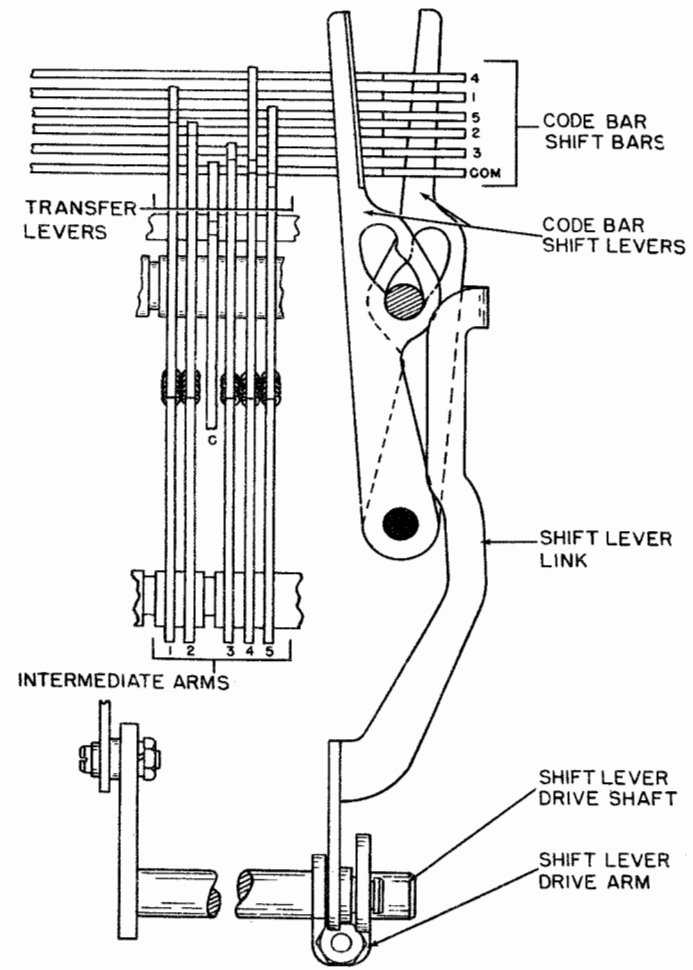


FIGURE 48 CODE BAR POSITIONING MECHANISM

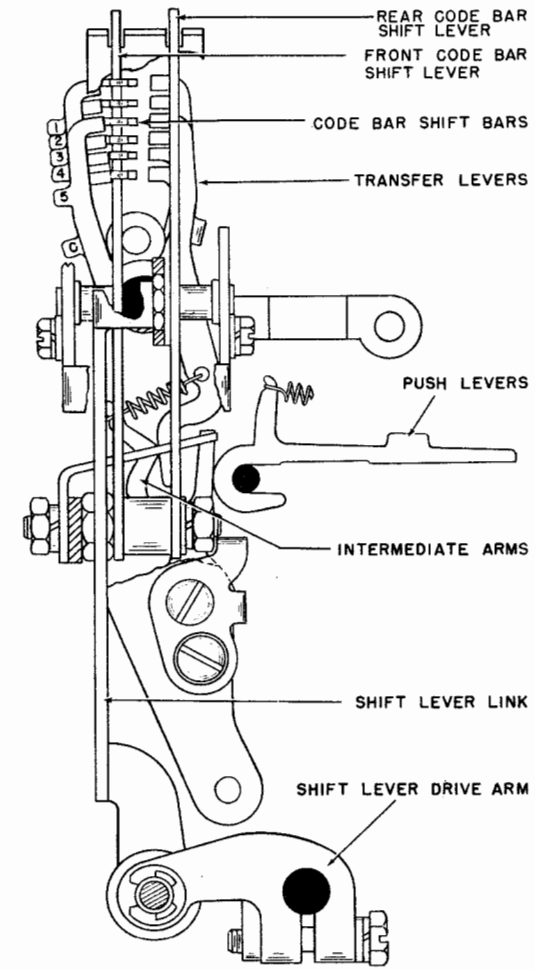


FIGURE 49. CODE BAR POSITIONING MECHANISM

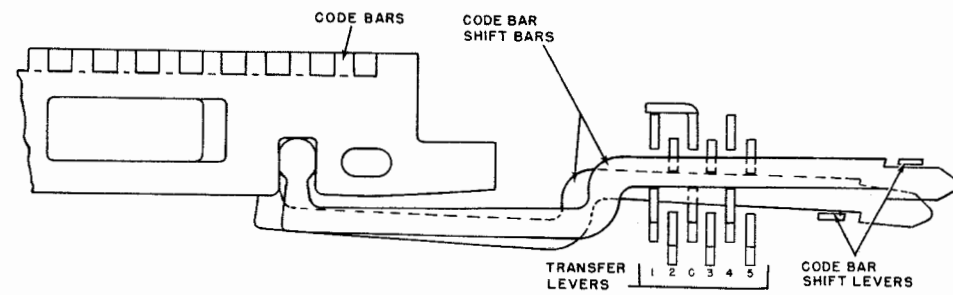


FIGURE 50. CODE BAR MECHANISM (TOP VIEW)

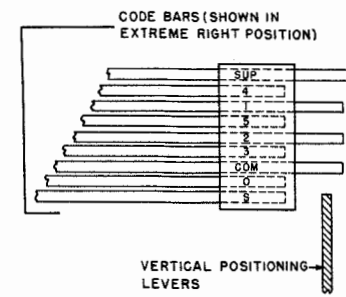


FIGURE 51. CODE BAR MECHANISM

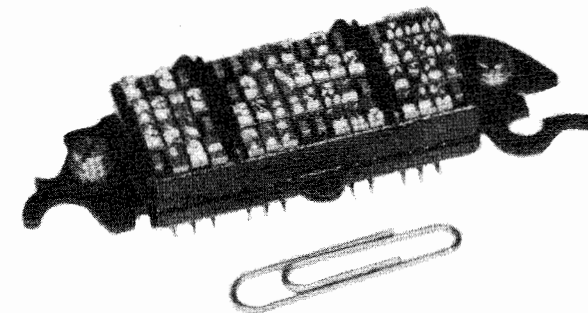


FIGURE 52. TYPE BOX

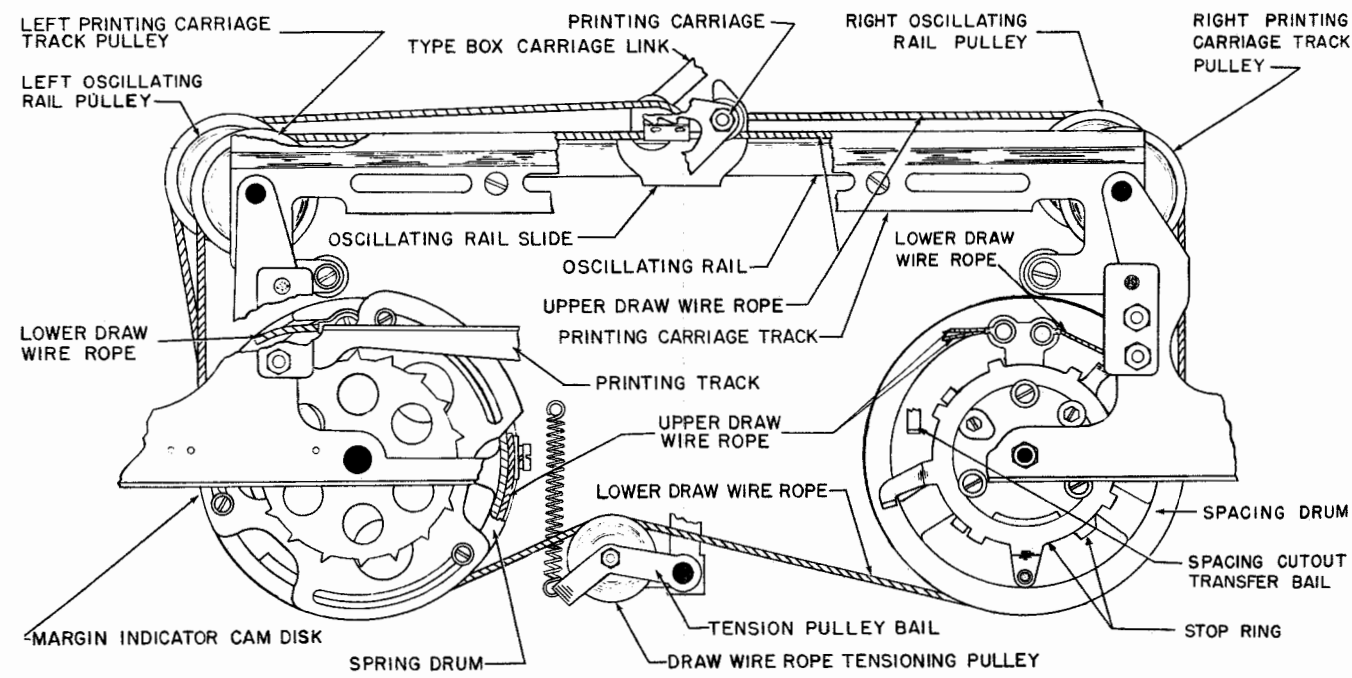


FIGURE 53. DRAW WIRE ROPE MECHANISM

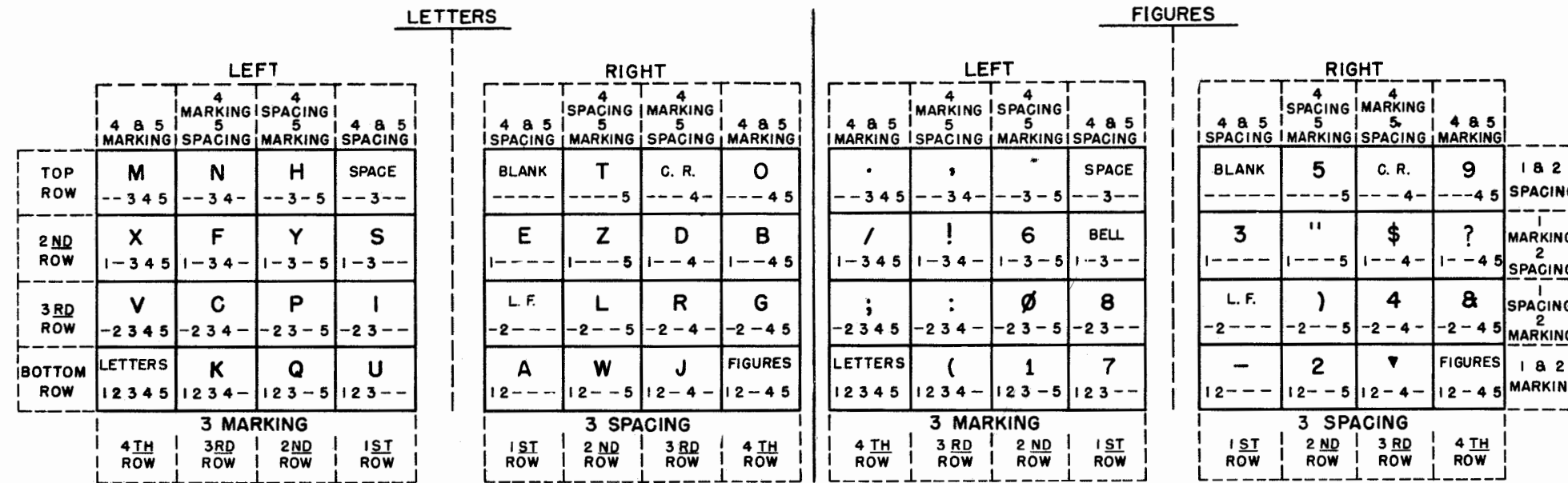


FIGURE 54. TYPE BOX ARRANGEMENT (VIEWED FROM FRONT OF TYPING UNIT)

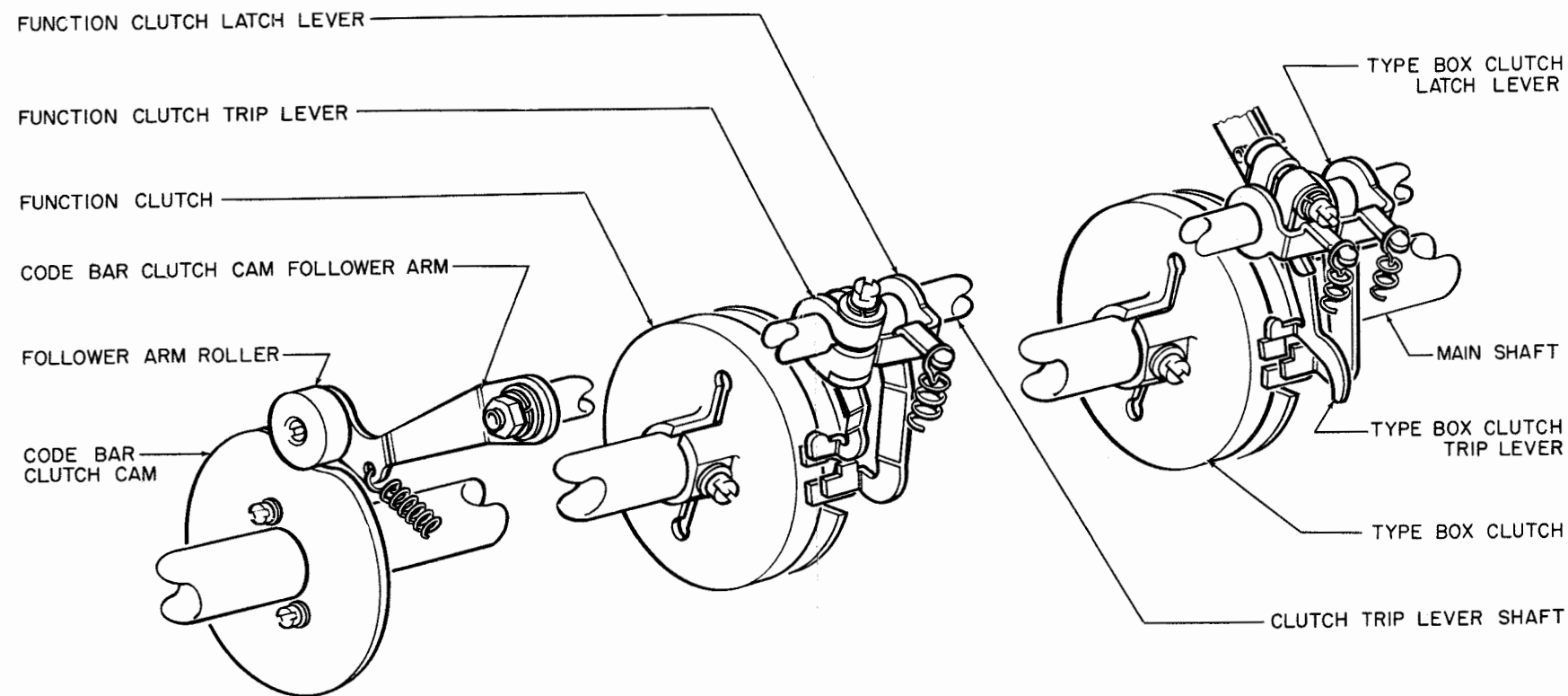


FIGURE 55. TRIP MECHANISM FOR FUNCTION AND TYPE BOX CLUTCHES

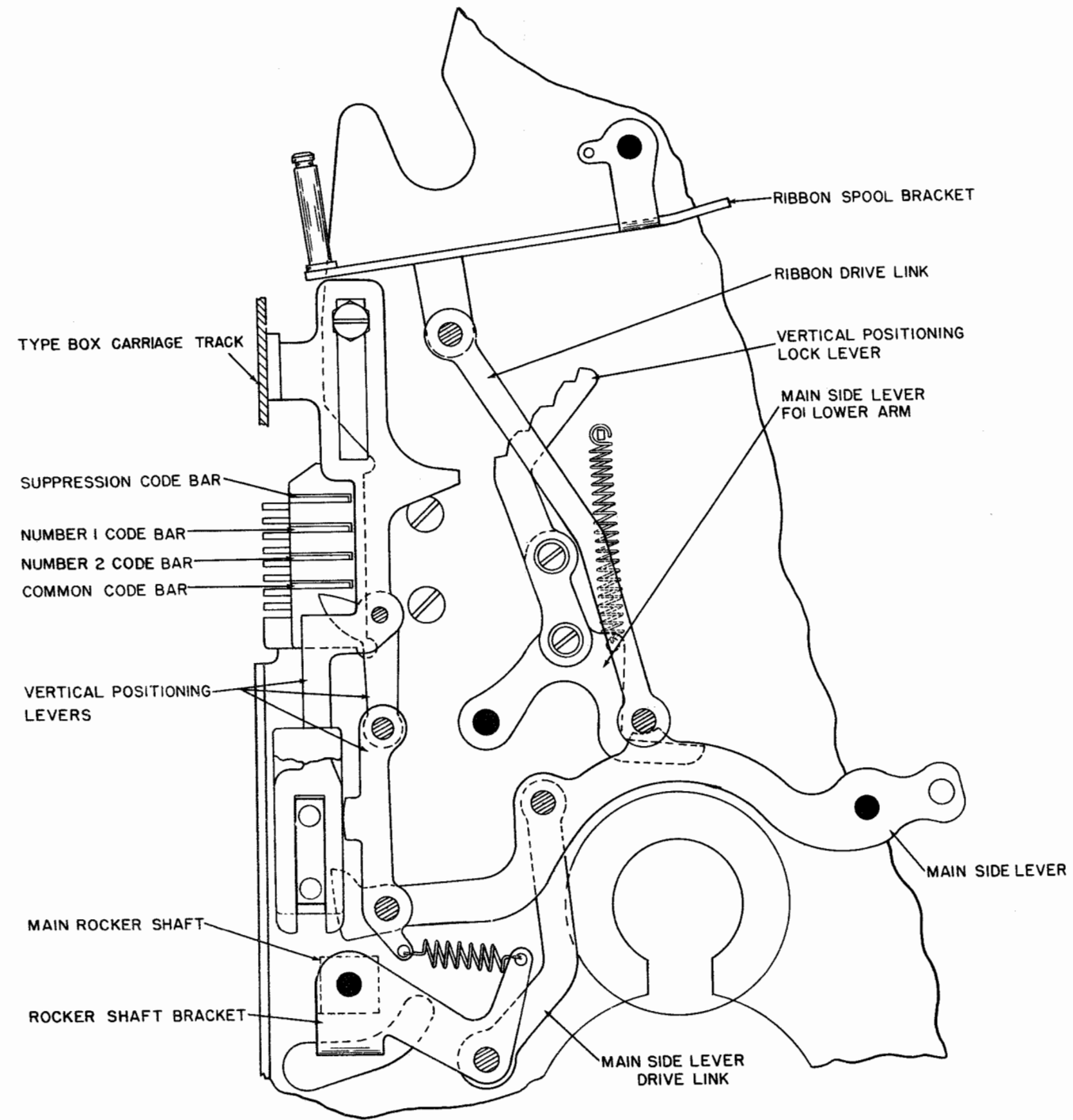


FIGURE 56. RIGHT SIDE MECHANISM

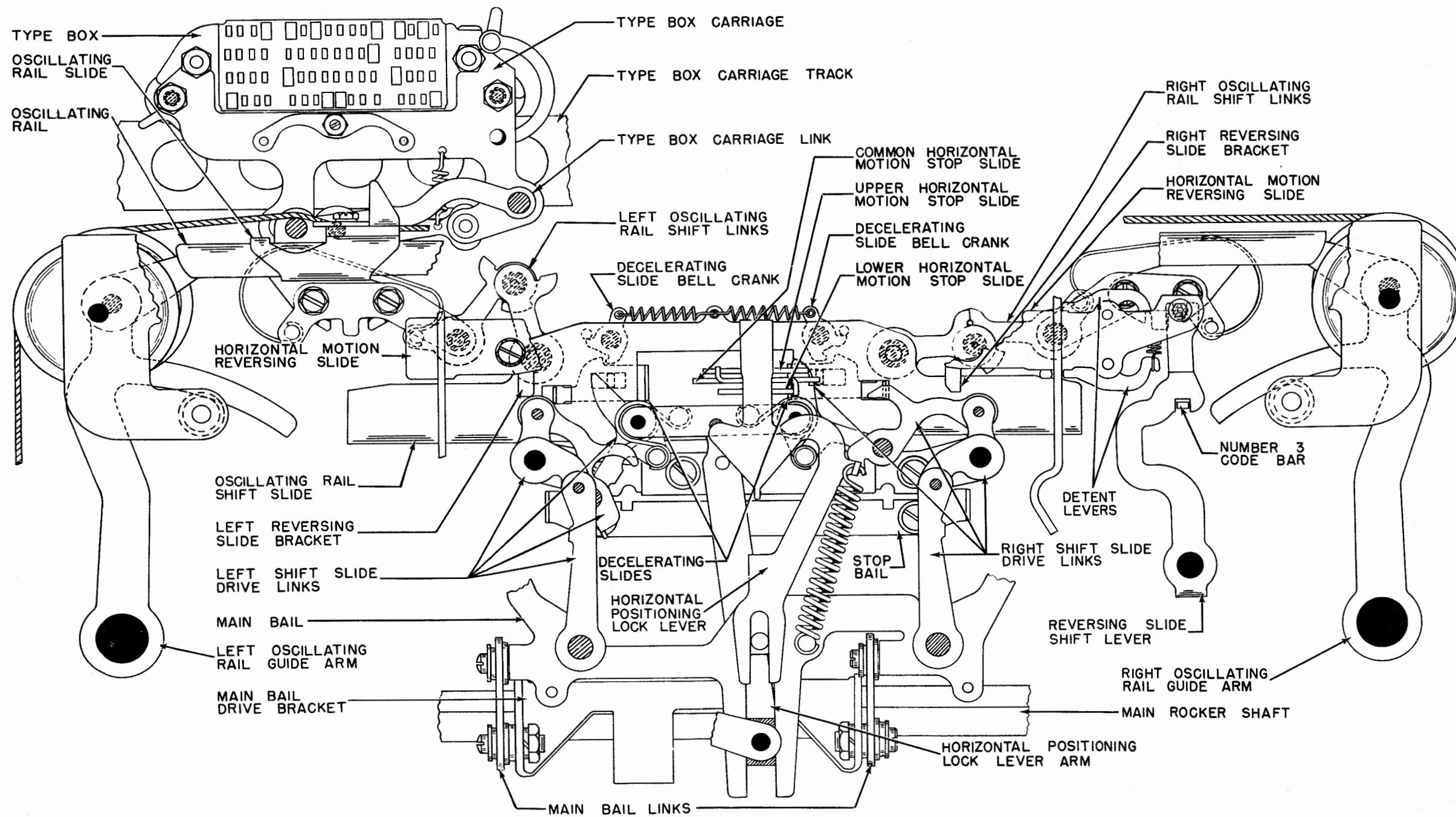


FIGURE 57.
FRONT PLATE HORIZONTAL POSITIONING MECHANISM

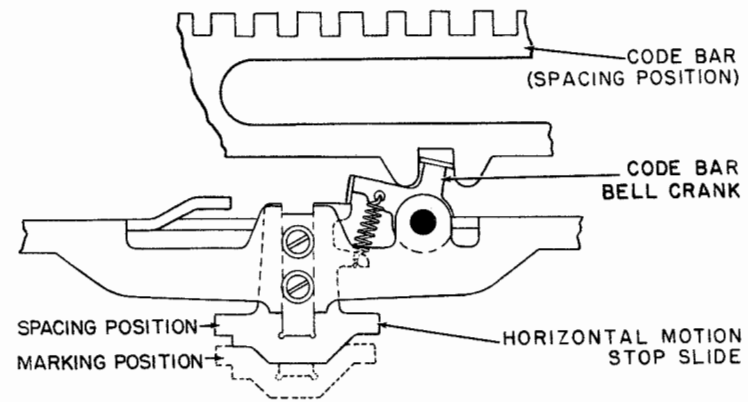


FIGURE 58. STOP SLIDE POSITIONING

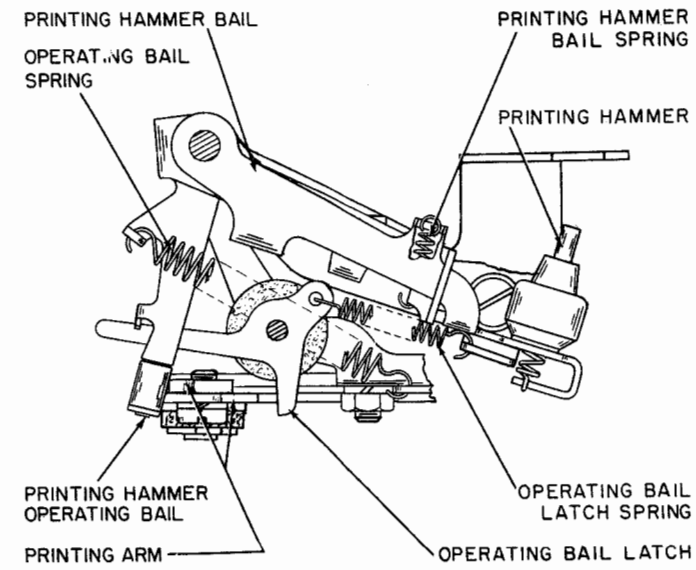


FIGURE 60. PRINTING HAMMER MECHANISM

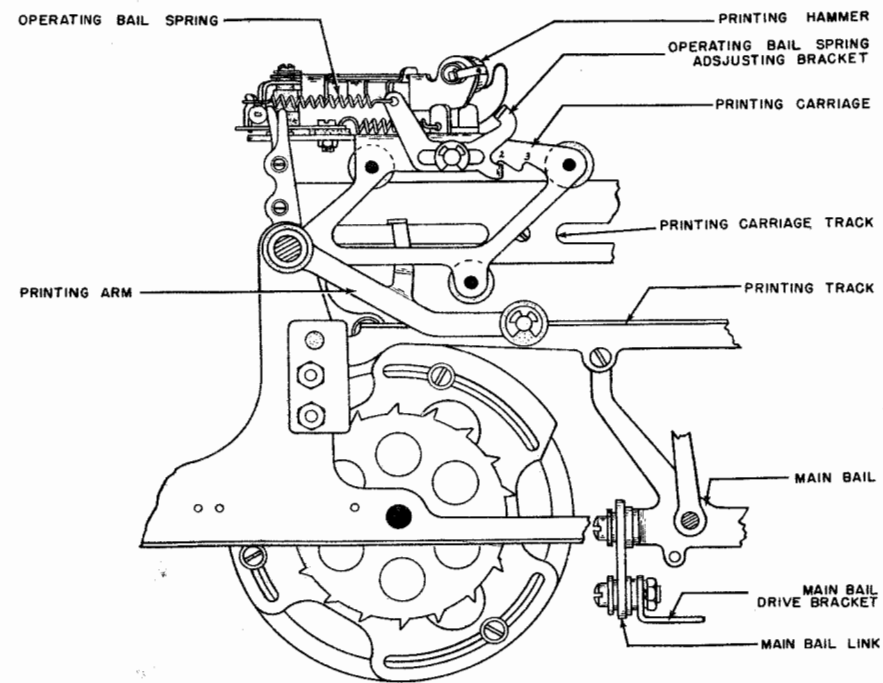


FIGURE 59. SPRING DRUM AND PRINTING HAMMER MECHANISM

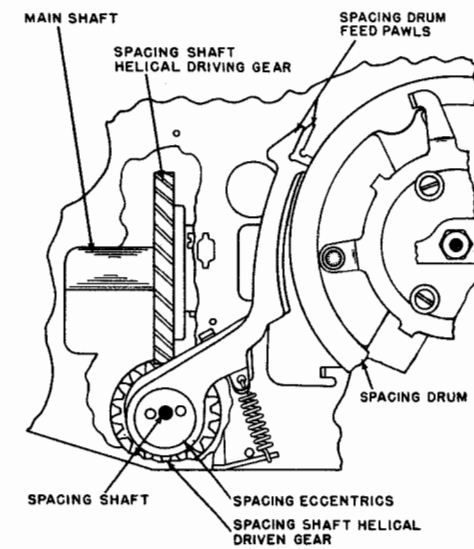


FIGURE 61. SPACING MECHANISM

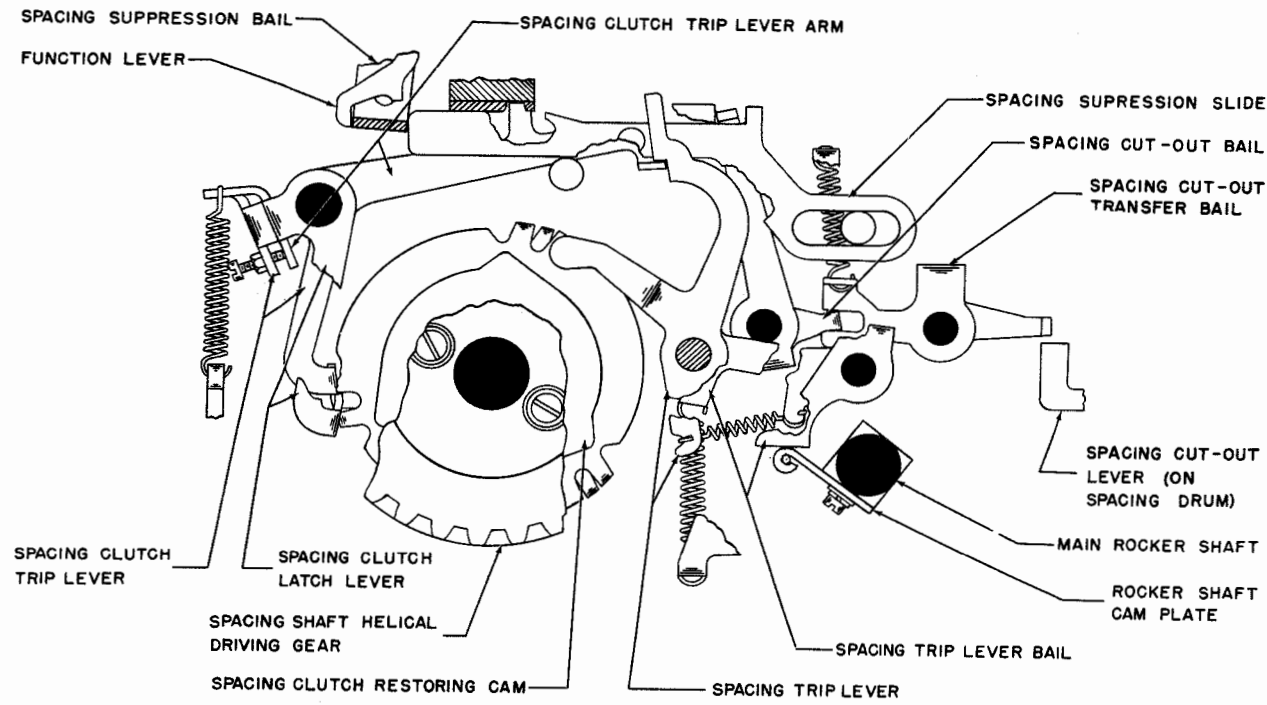


FIGURE 62. SPACING MECHANISM

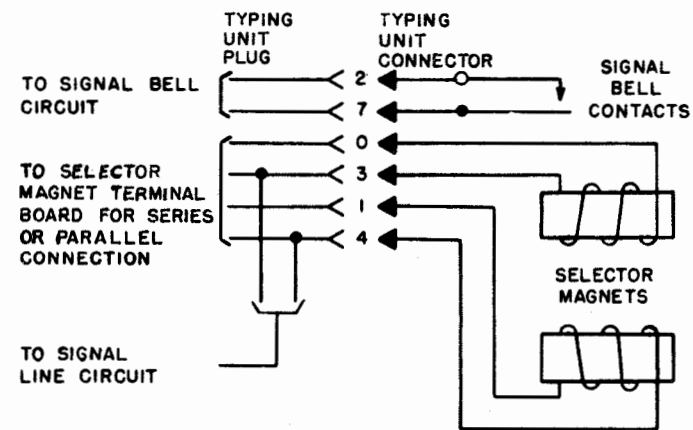


FIGURE 63. TYPING UNIT SCHEMATIC WIRING DIAGRAM.

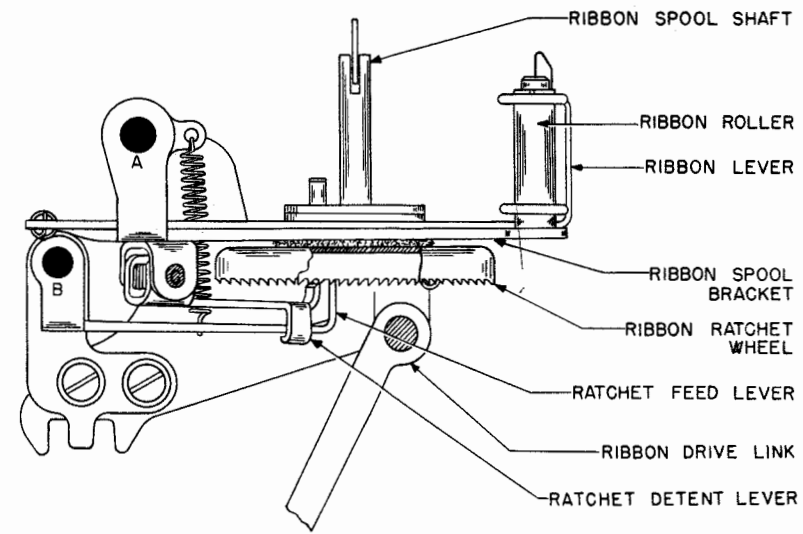


FIGURE 64. RIBBON MECHANISM

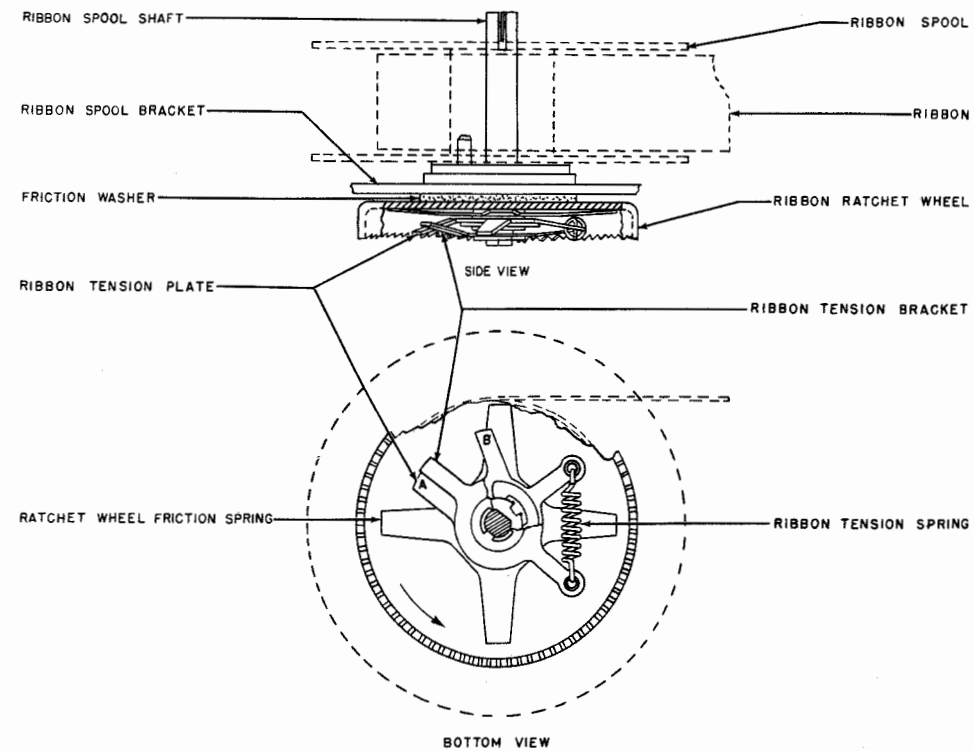


FIGURE 65. RIBBON MECHANISM

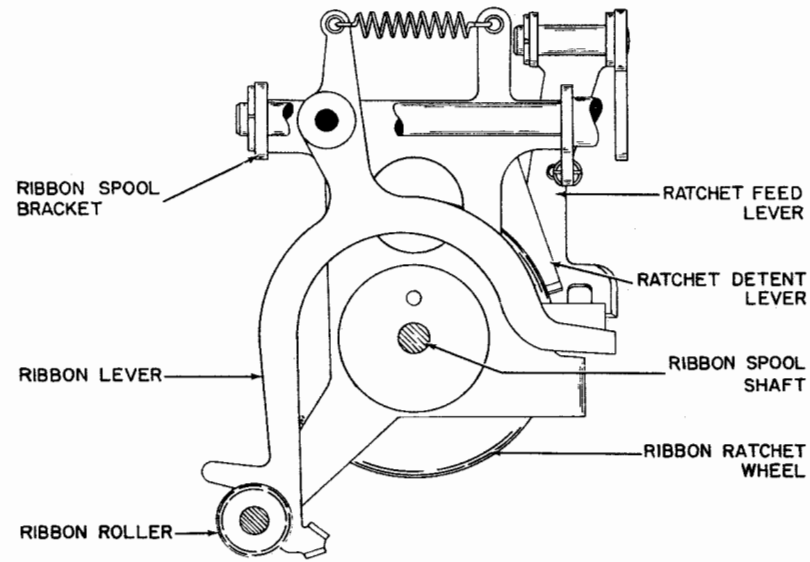


FIGURE 66. RIBBON MECHANISM

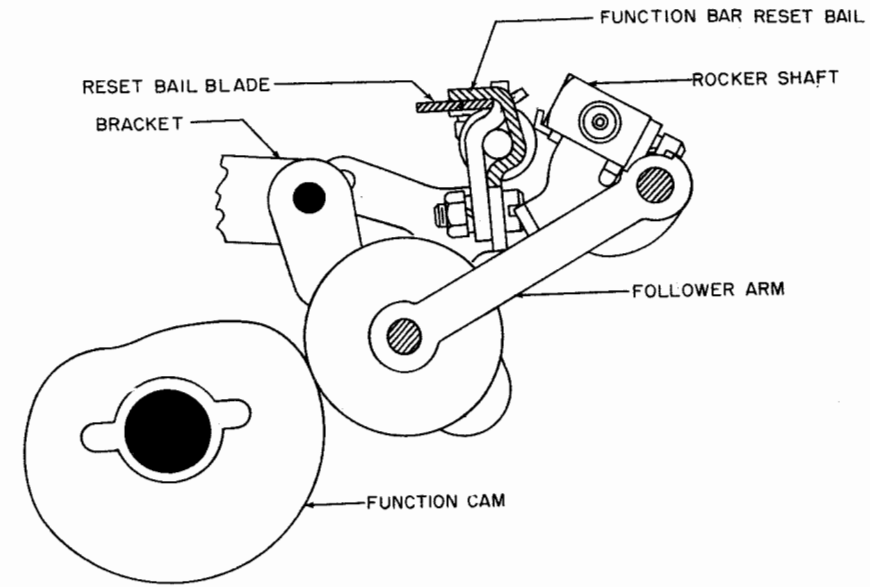


FIGURE 68. FUNCTION RESET BAIL MECHANISM

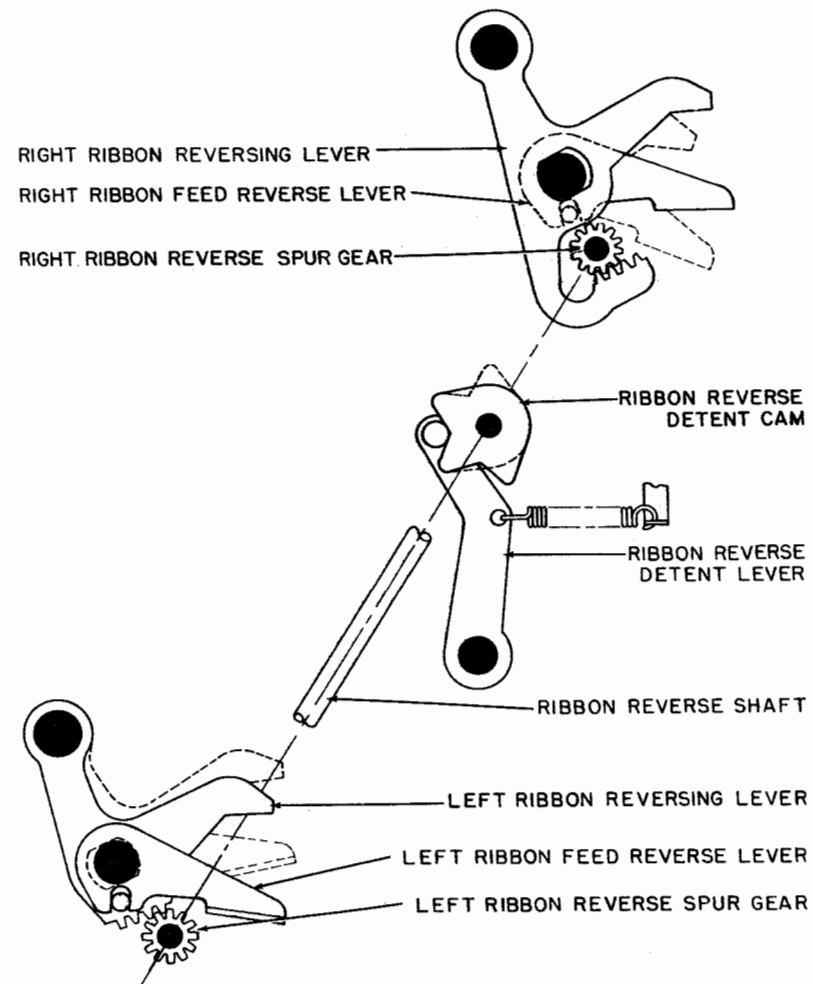


FIGURE 67. RIBBON REVERSING MECHANISM

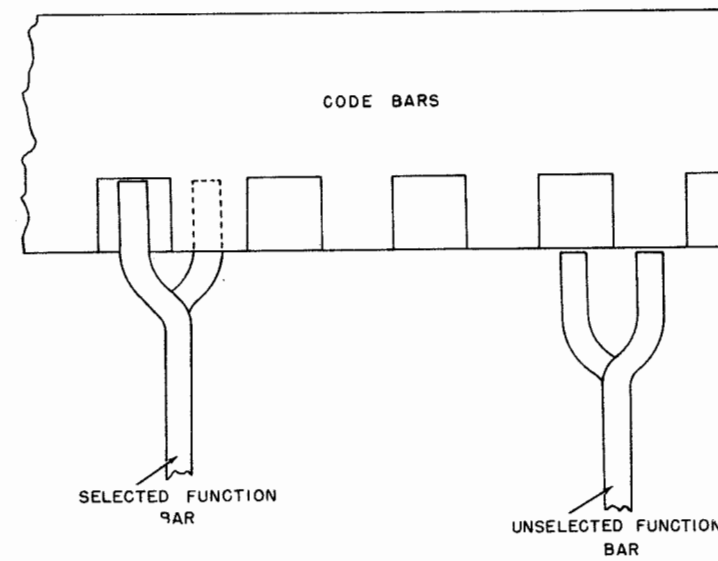


FIGURE 69. FUNCTION SELECTION (TOP VIEW)

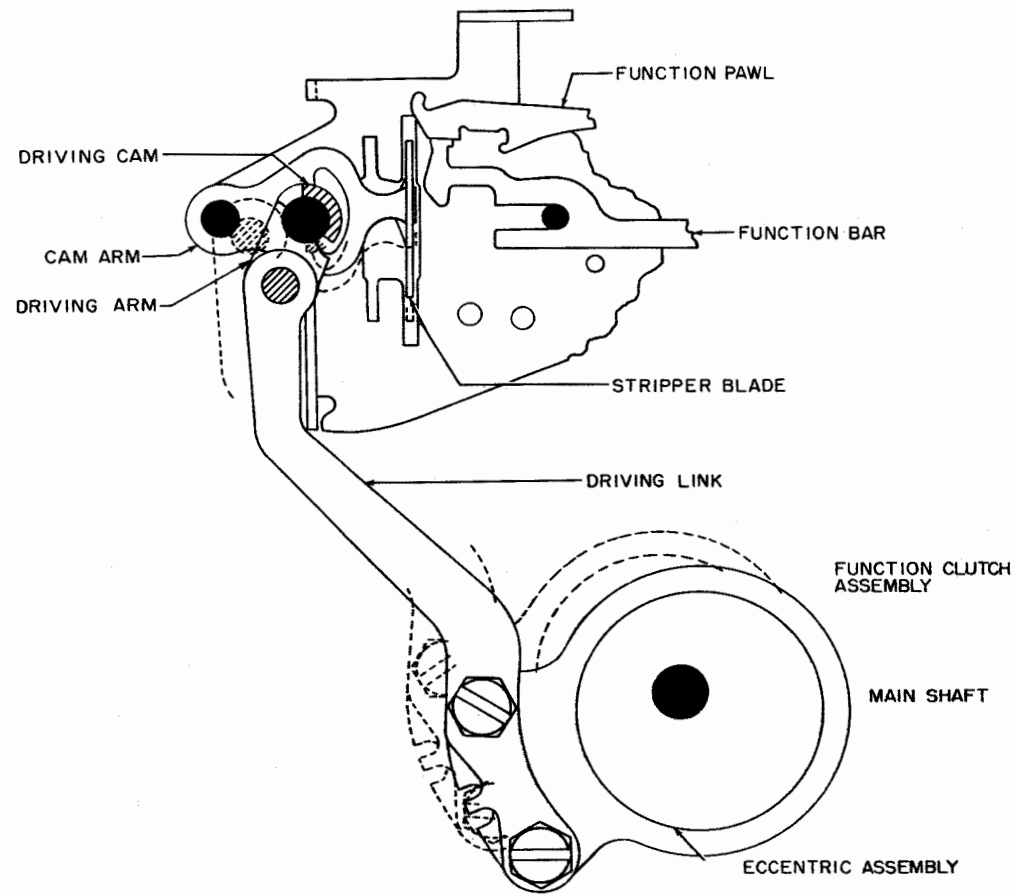


FIGURE 70. STRIPPER BLADE MECHANISM

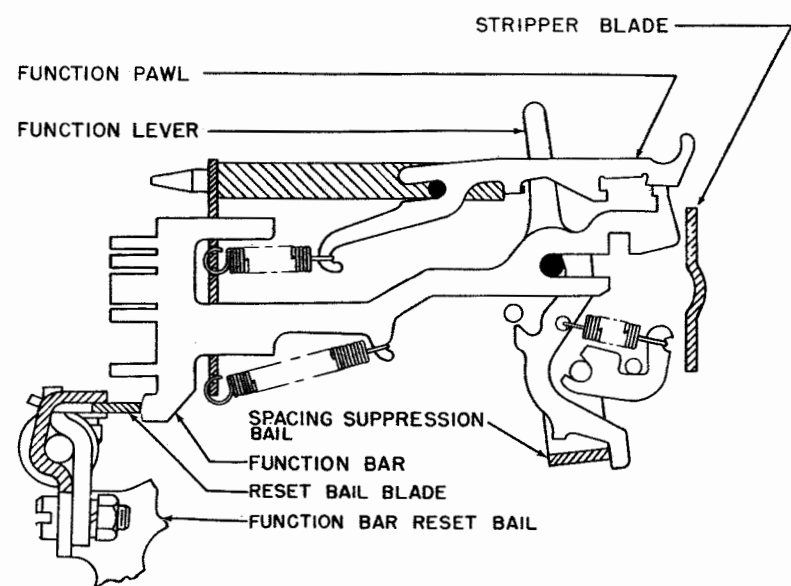


FIGURE 71. STUNT BOX-FUNCTION BAR UNSELECTED

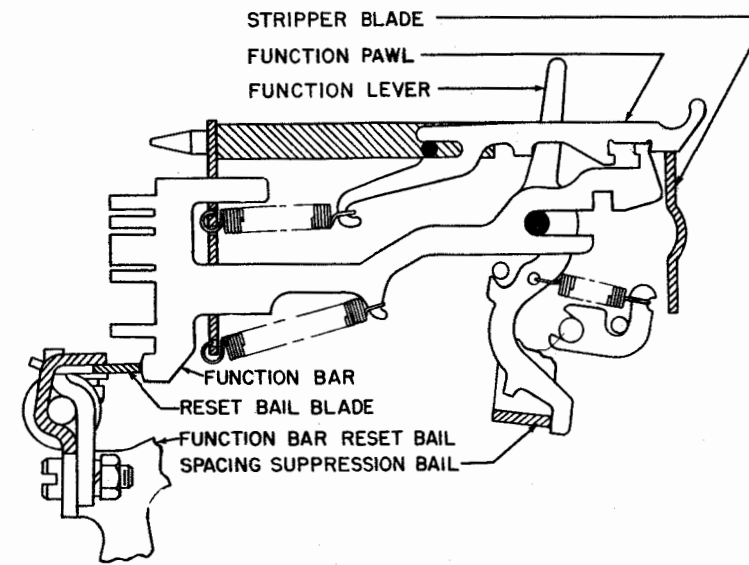


FIGURE 72. STUNT BOX-FUNCTION BAR SELECTED

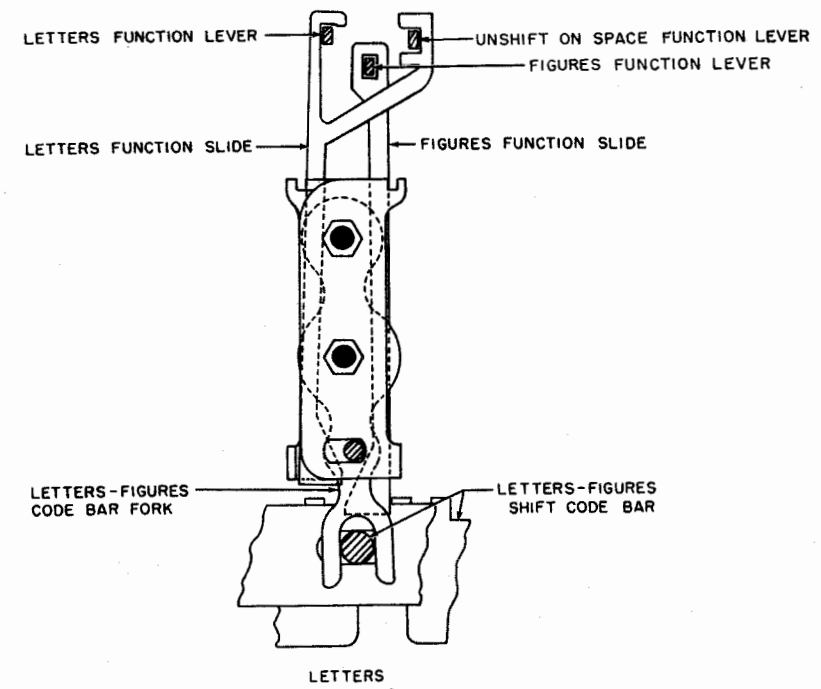


FIGURE 73. LETTERS-FIGURES FUNCTION SLIDE - LETTERS POSITION

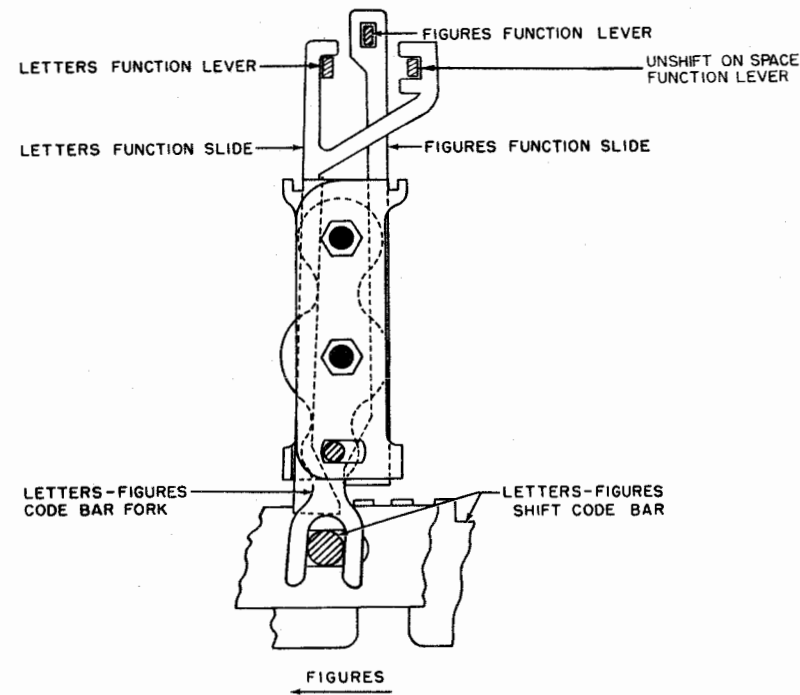


FIGURE 74. LETTERS-FIGURES FUNCTION SLIDES - FIGURES POSITION

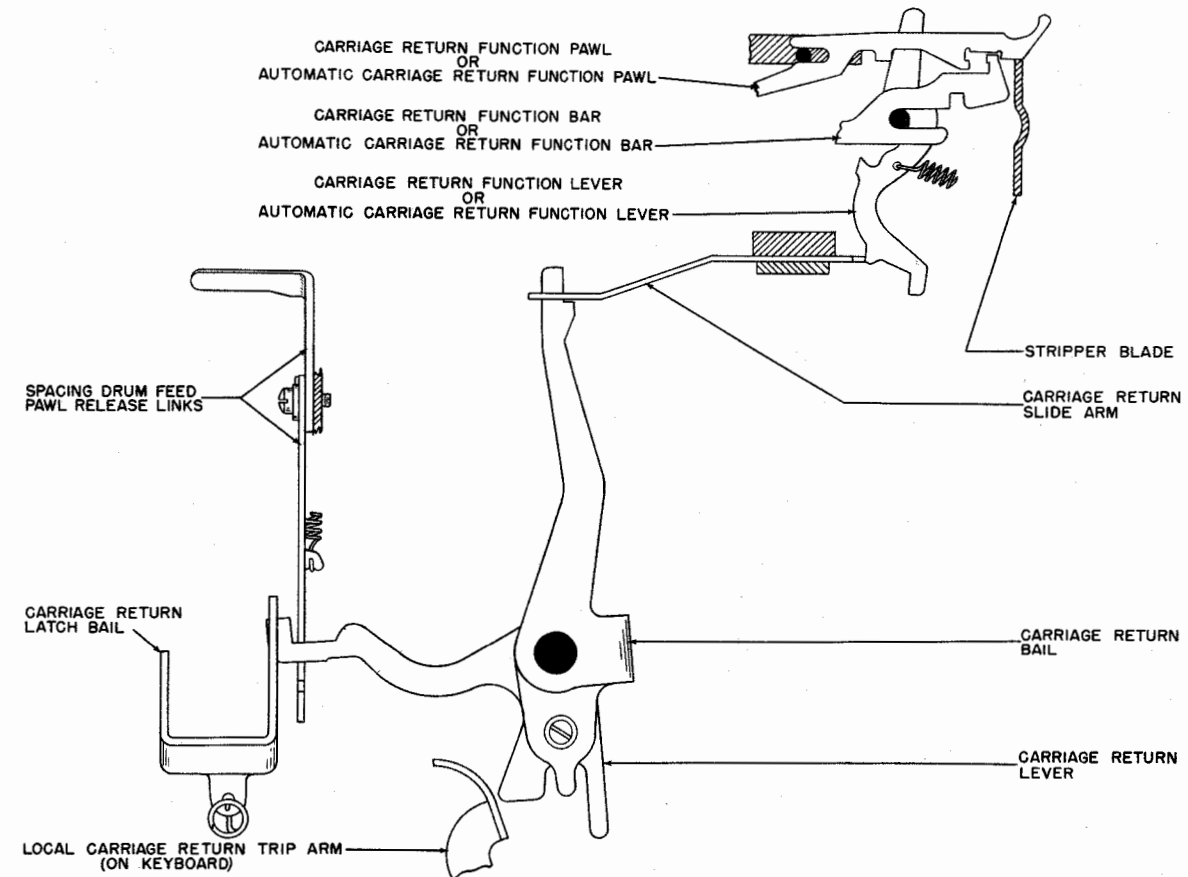


FIGURE 76. CARRIAGE RETURN FUNCTION MECHANISM

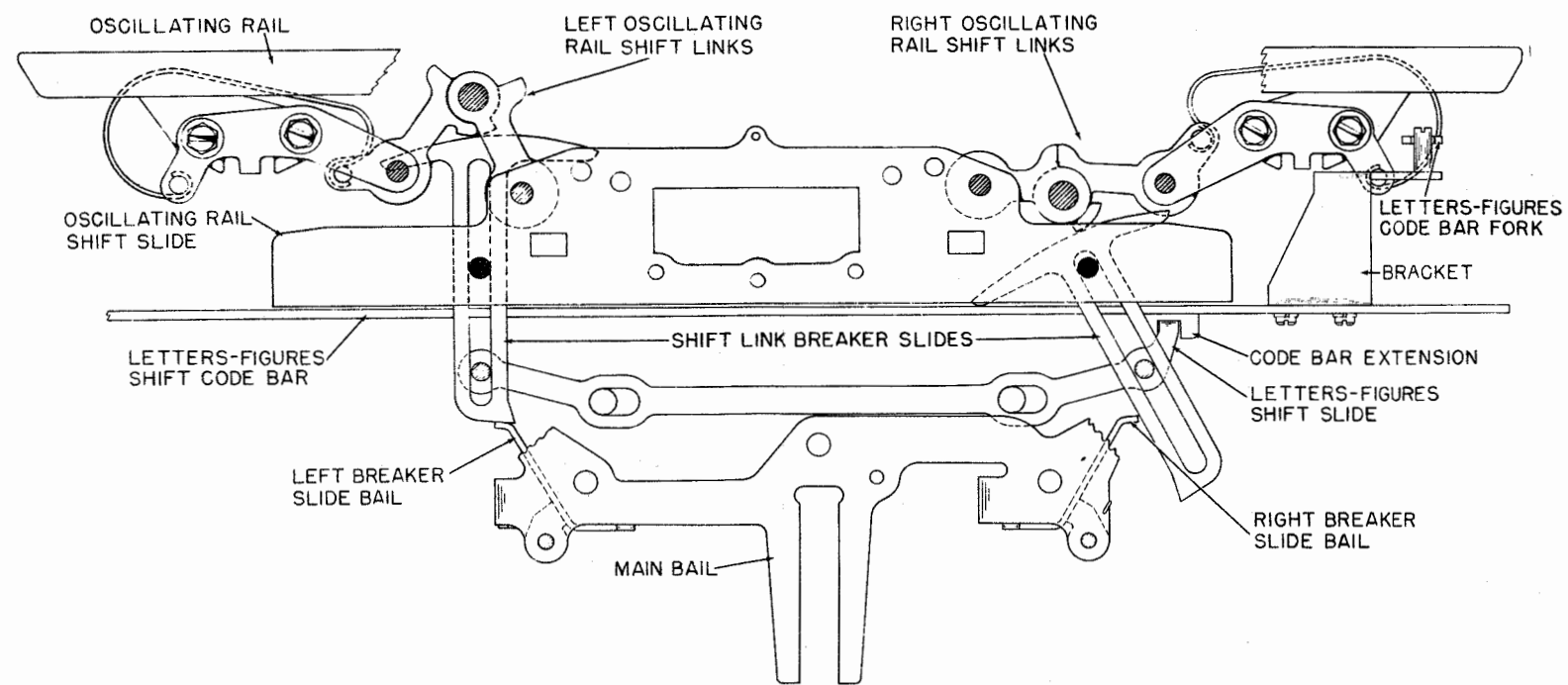


FIGURE 75. LETTERS-FIGURES SHIFT MECHANISM. LETTERS POSITION

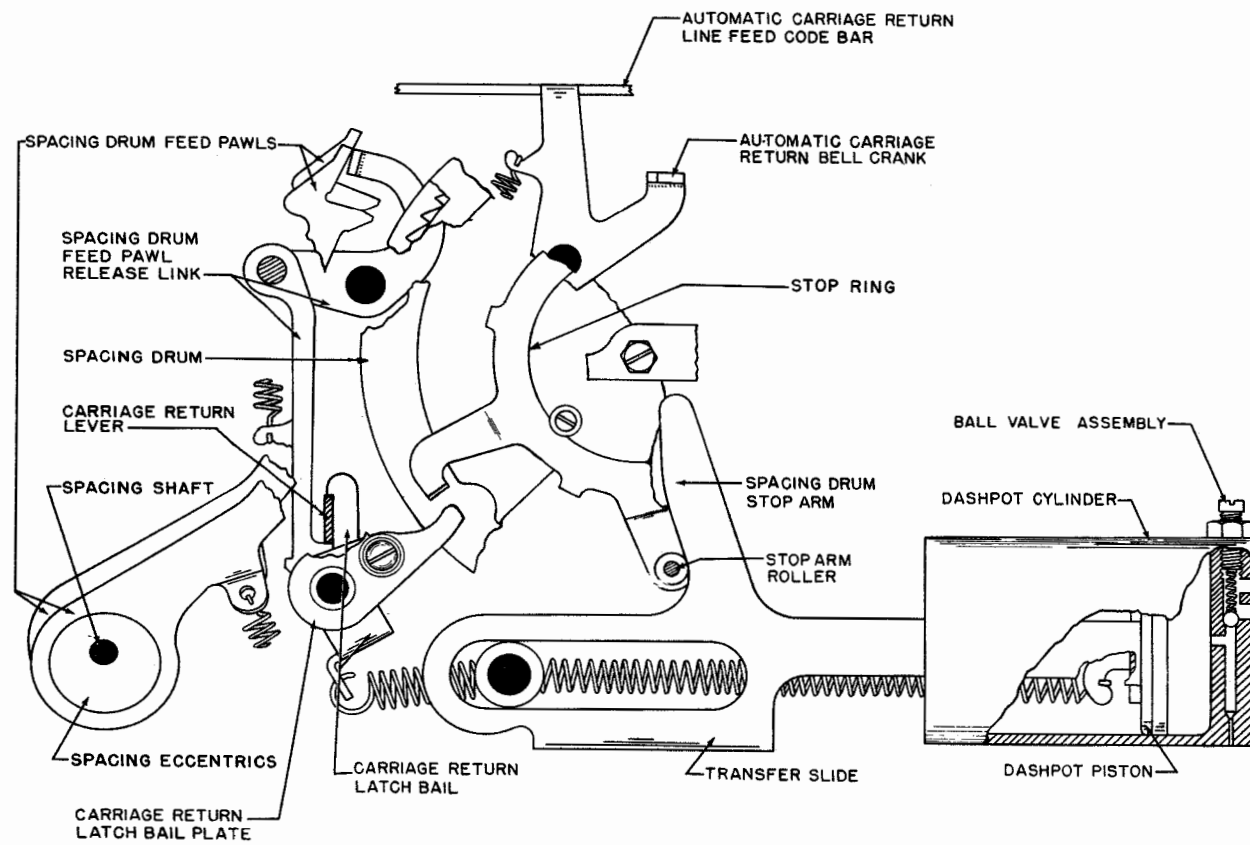


FIGURE 77. CARRIAGE RETURN MECHANISM

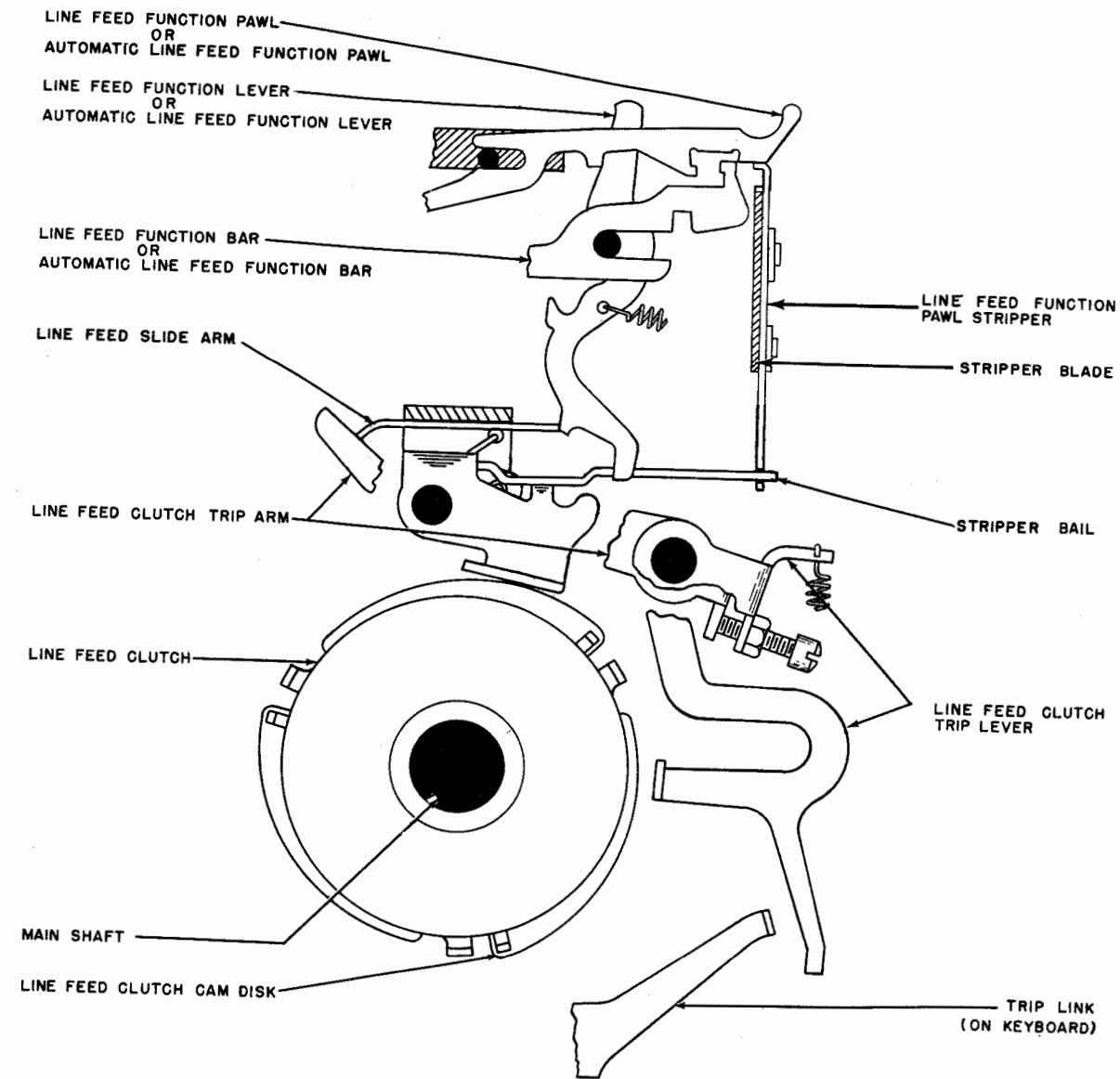


FIGURE 78. LINE FEED MECHANISM

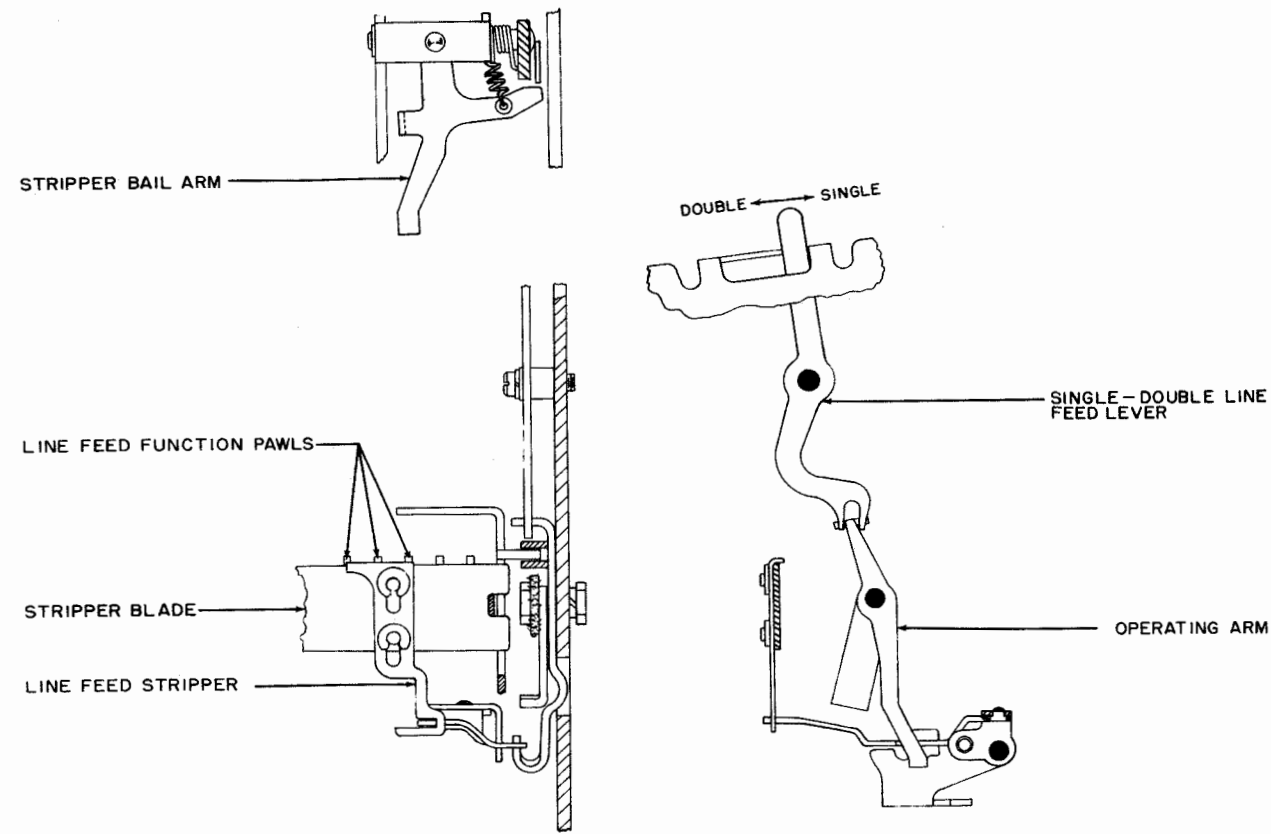


FIGURE 79. LINE FEED MECHANISM

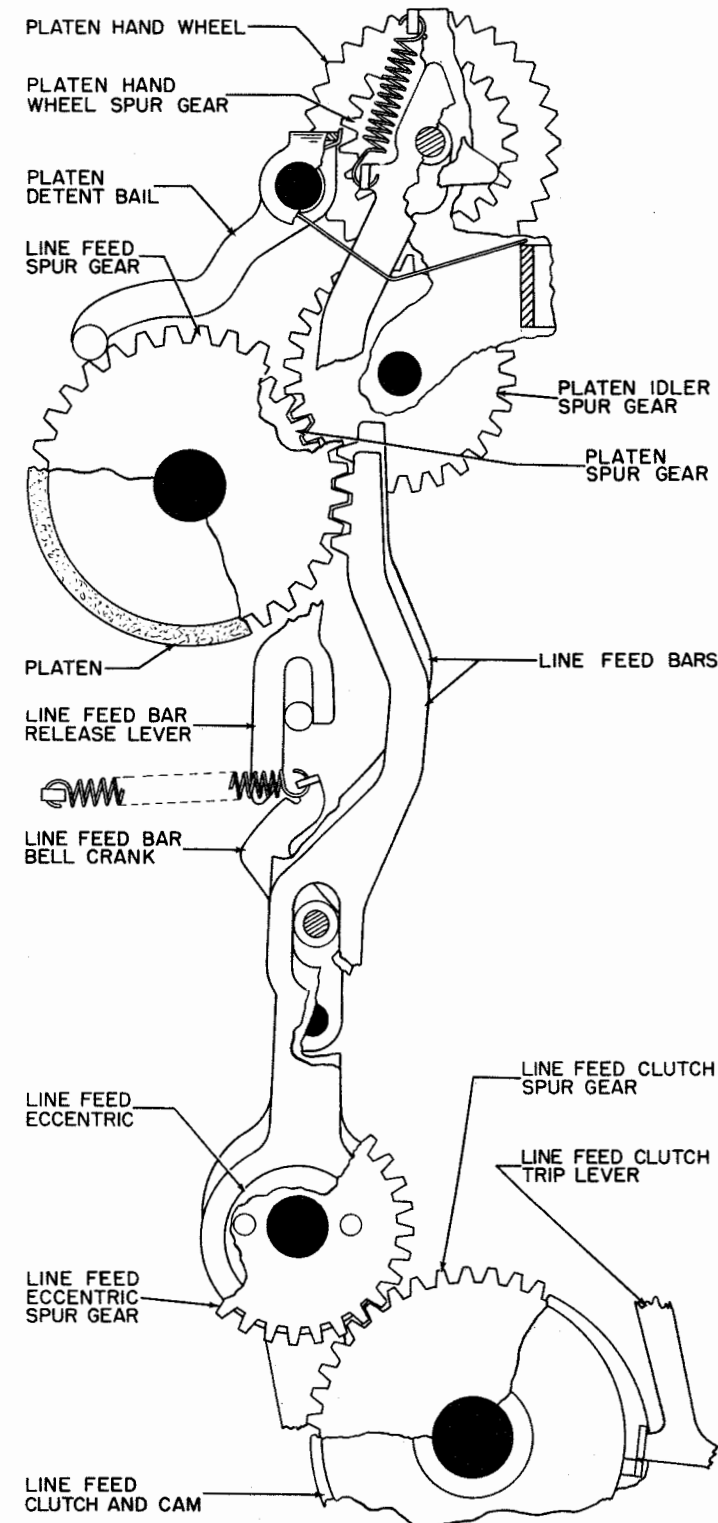


FIGURE 80. LINE FEED MECHANISM

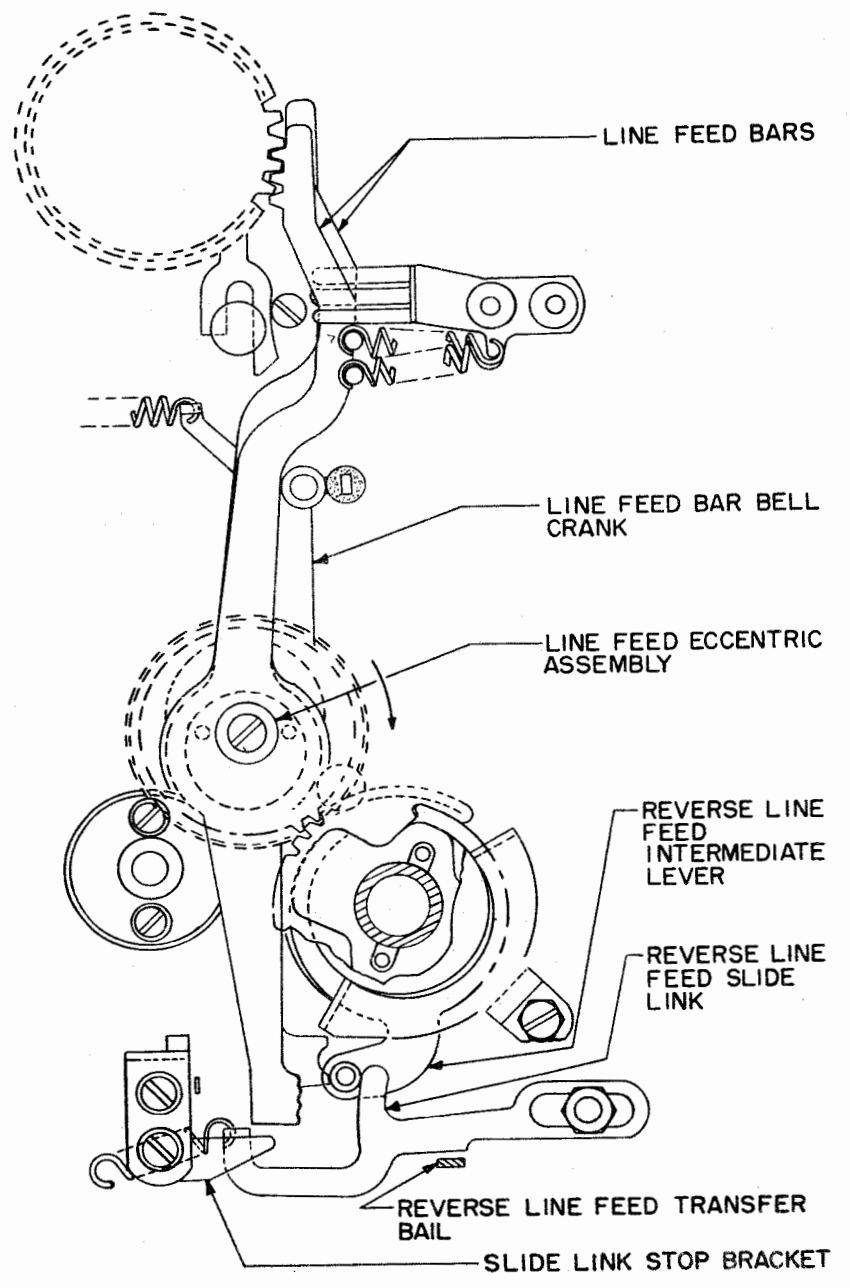


FIGURE 81. REVERSE LINE FEED MECHANISM

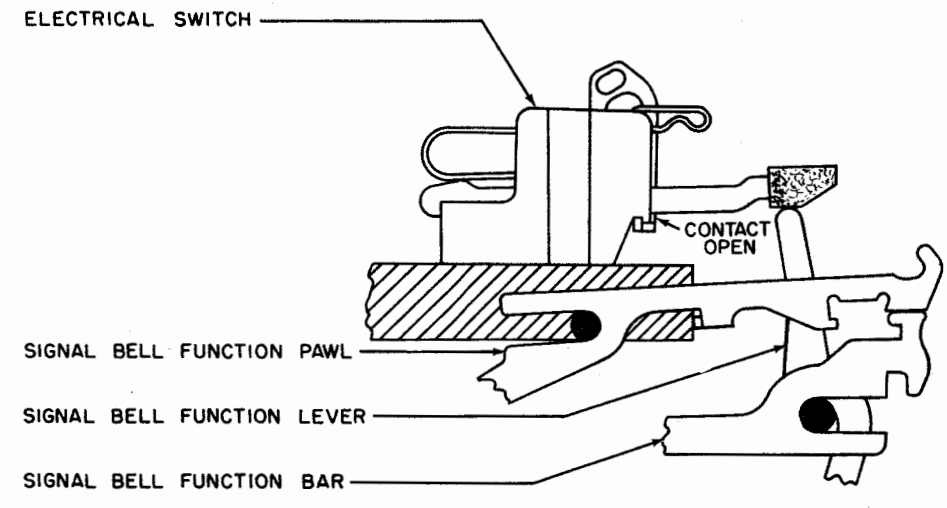


FIGURE 82. SIGNAL BELL CONTACT MECHANISM—UNSELECTED

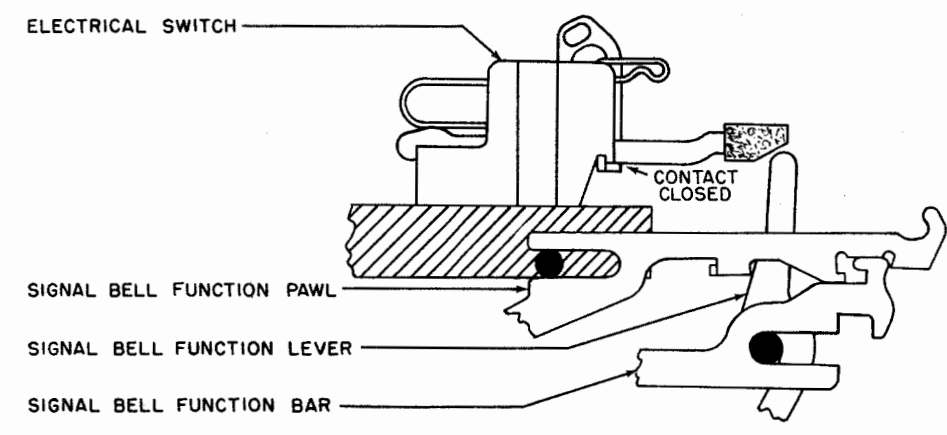


FIGURE 83. SIGNAL BELL CONTACT MECHANISM—SELECTED

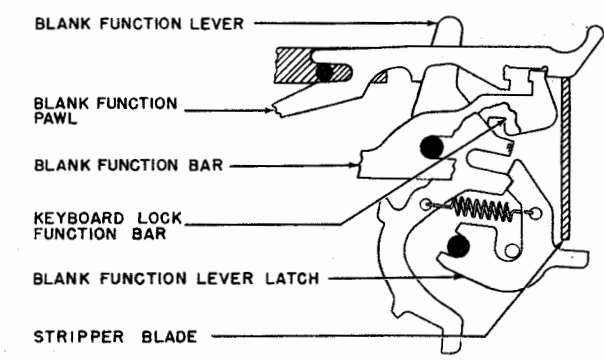


FIGURE 84. KEYBOARD LOCK PRIMING MECHANISM

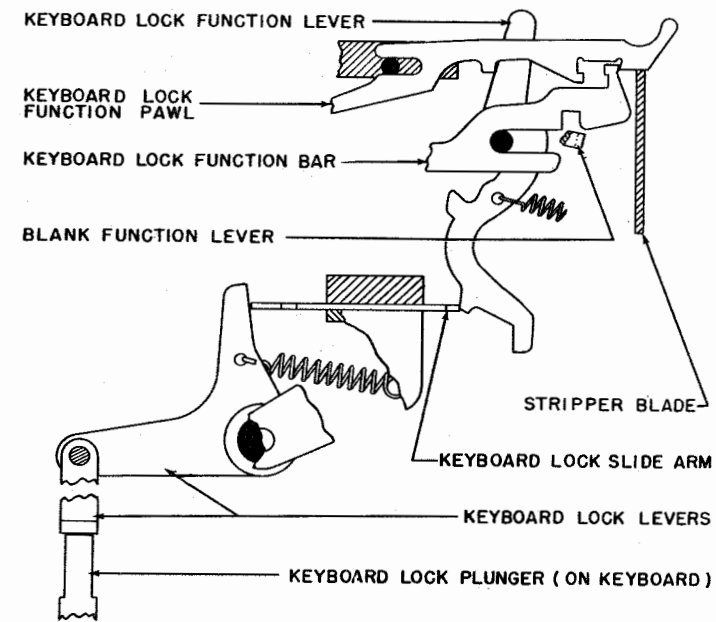


FIGURE 85. KEYBOARD LOCK MECHANISM

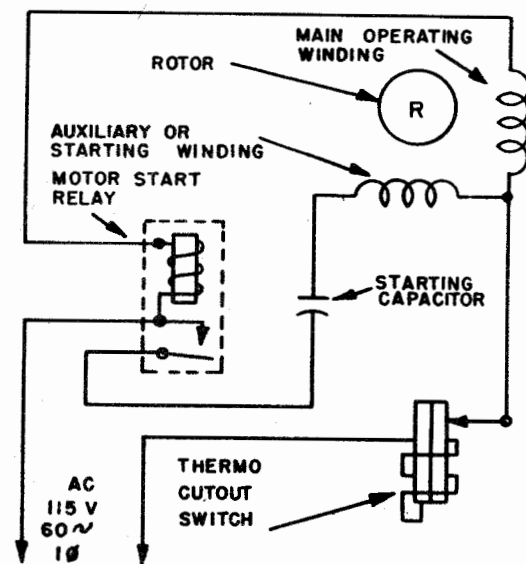


FIGURE 86. SYNCHRONOUS MOTOR UNIT SCHEMATIC WIRING DIAGRAM

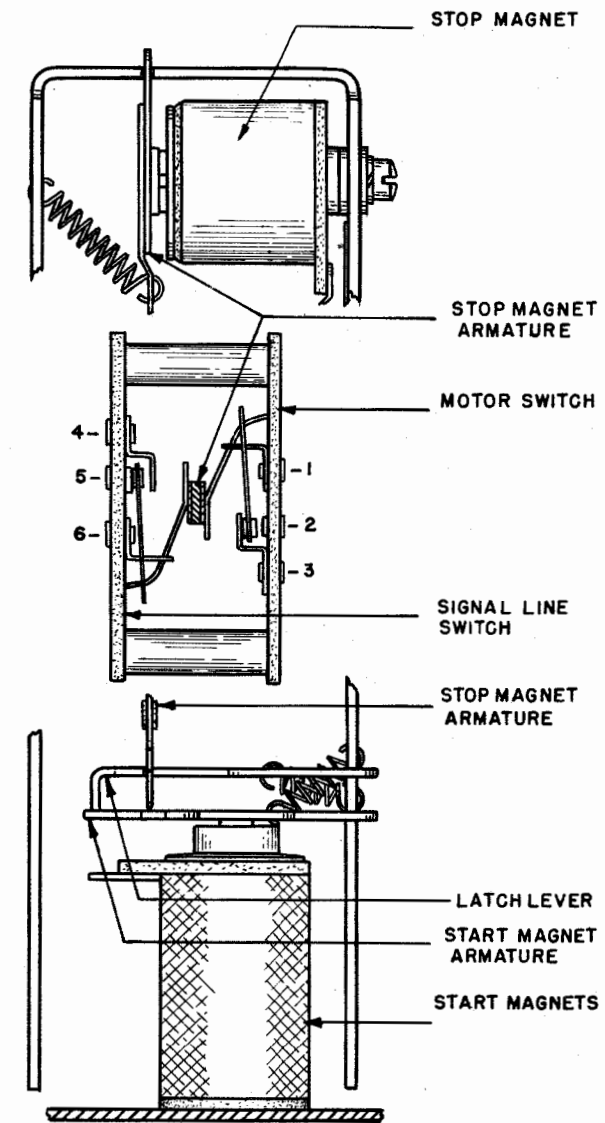


FIGURE 87. MOTOR CONTROL MECHANISM - STOP POSITION

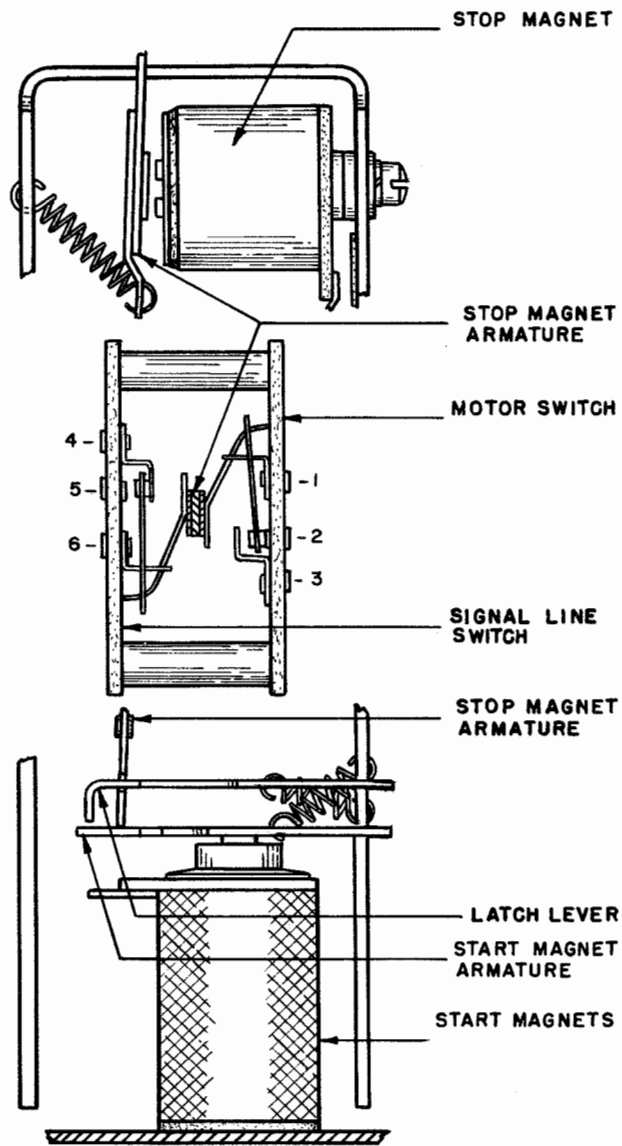


FIGURE 88. MOTOR CONTROL MECHANISM - START POSITION

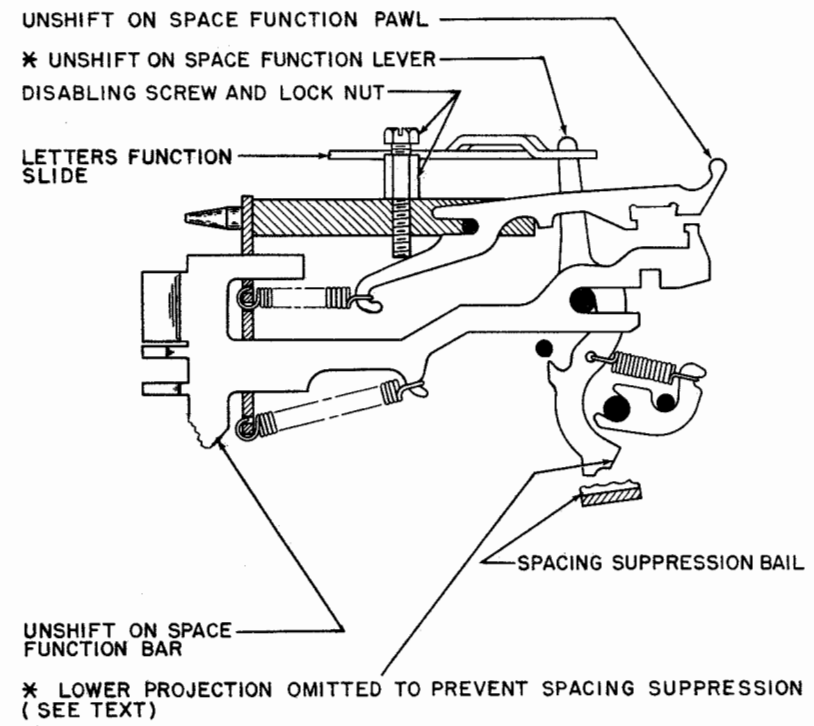


FIGURE 89. UNSHIFT ON SPACE FUNCTION MECHANISM

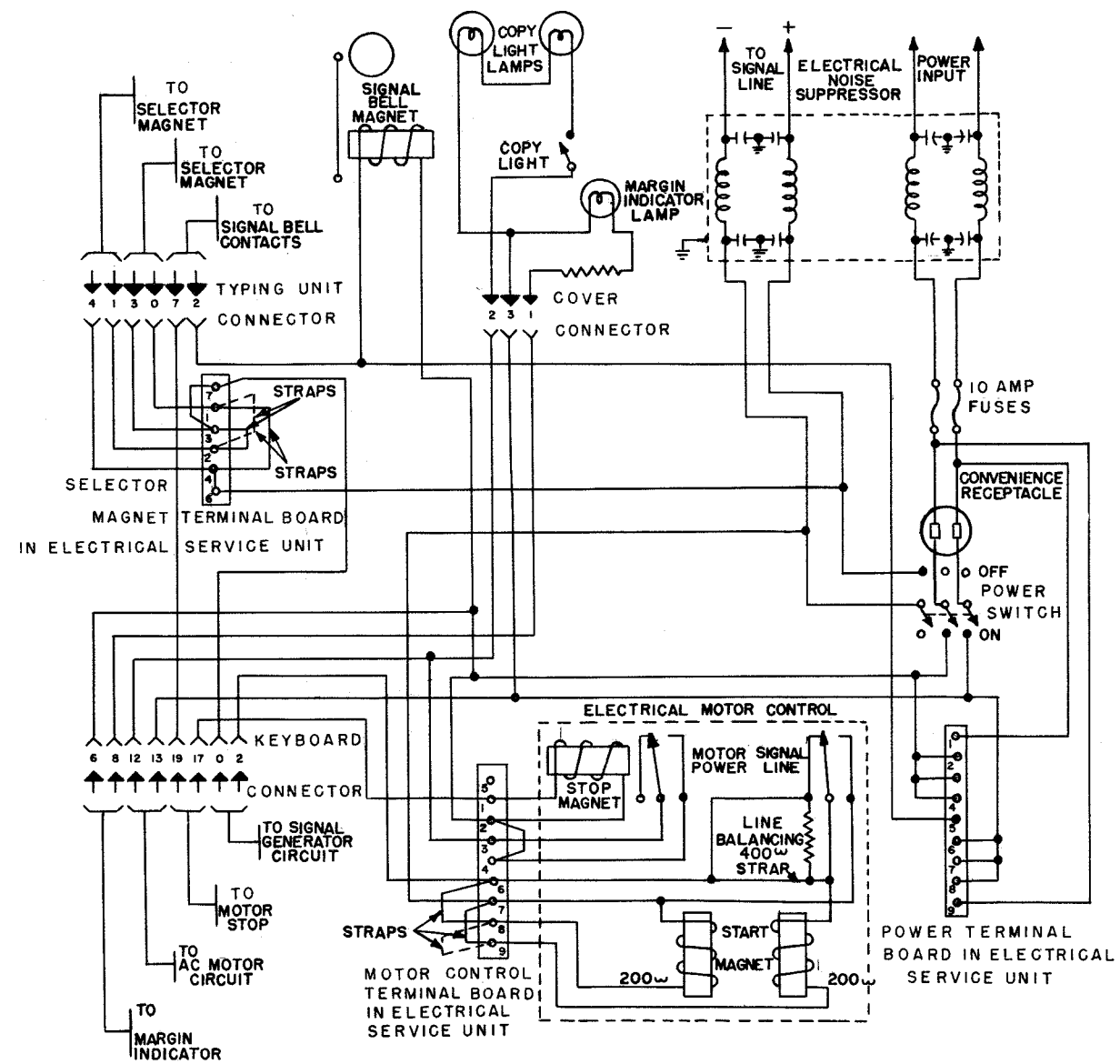


FIGURE 90. ELECTRICAL SERVICE UNIT SCHEMATIC WIRING DIAGRAM

ORIGINAL

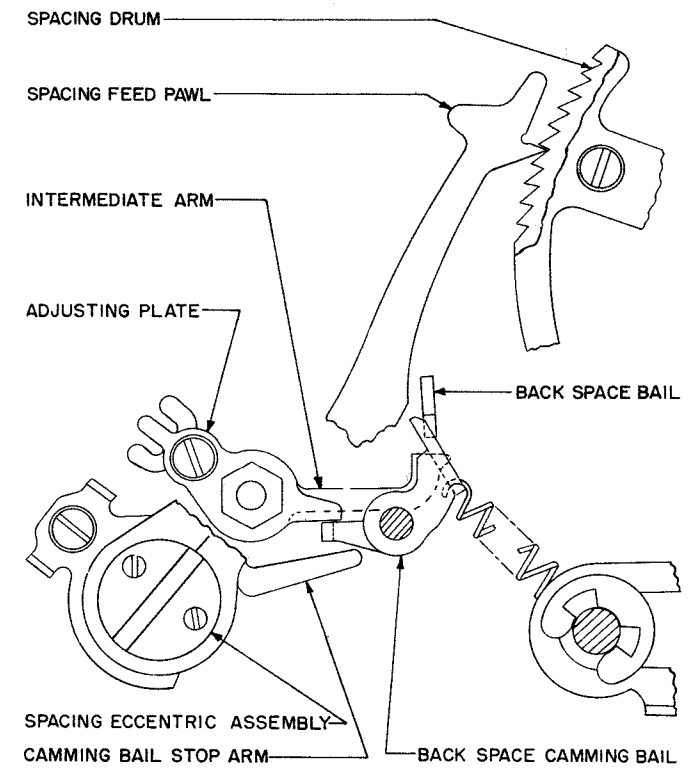


FIGURE 91. LOCAL BACK SPACE MECHANISM

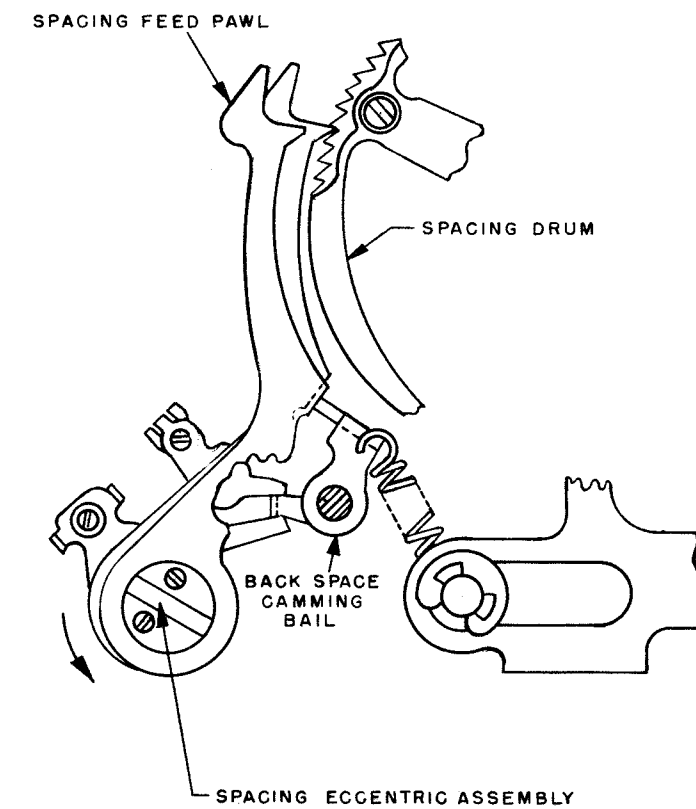


FIGURE 92. LOCAL BACK SPACE MECHANISM