

# TELETYPE

## PRINTING TELEGRAPH SYSTEMS

BULLETIN NO. 216B

GENERAL DESCRIPTION  
AND  
THEORY OF OPERATION  
MODEL 28 PRINTER



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JUNE, 1953

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
A TO C	ORIGINAL		
1-1 TO 1-3	ORIGINAL		
2-0 TO 2-17	ORIGINAL		
3-0 TO 3-65	ORIGINAL		

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## SECTION 1

## GENERAL DESCRIPTION

## 1. GENERAL

a. The Model 28 Printer described herein is used to exchange typewritten page messages between two or more distant points when connected by a telegraph channel. The operating speeds are in the order of 368 opm (60 wpm), 460 opm (75 wpm), and 600 opm (100 wpm) as desired. Sets of gears for the various speeds are supplied as optional components. Signaling between stations is accomplished electrically by use of the five-unit start-stop permutation code.

b. The equipment is wired at the factory for operation on 0.060 ampere signal line current but, by making a convenient wiring change in the Electrical Service Unit and readjusting the selector armature spring, it may be adapted for operation on 0.020 ampere signal line current.

c. Messages are ordinarily typed on single-copy paper eight and one-half inches wide. However, multiple copy paper or paper of lesser varying widths (minimum three inches) may be used.

## 2. DESCRIPTION OF COMPONENTS

a. **KEYBOARD.** (See figure 1-2.)- The Keyboard supports the Motor Unit and the Typing Unit and incorporates code selecting and signal generating mechanisms. Signal line and power line circuits are also included. A time delay mechanism which (when used in conjunction with a motor control mechanism in the Electrical Service Unit) will stop the Motor on extended idle periods of the signal line may be supplied as an optional feature. The keys are positioned in the conventional three-bank arrangement with numerals, punctuation marks, and special symbols available in upper case positions (figure 1-2). Special keys for line break, keyboard lock and unlock, repeat operation, and local carriage return and line feed are located directly above the lower three rows of standard keys for facility of operation. A repeat-on-space mechanism is included when required. The Keyboard with the Typing Unit and Motor Unit mounted in position is placed upon a cradle within the Cabinet. The front of the Keyboard protrudes beyond the Cabinet and is fitted with a rubber pad that seals the edges of the aperture for a silencing effect. Motive force for activating the Keyboard is derived from the Motor by way of the Typing Unit.

b. **RECEIVING-ONLY BASE.** (See Figure 1-3.) - The Receiving-Only Base is used in place of the Keyboard when receiving facilities only are required. It supports the Motor Unit and the

Typing Unit and provides for local carriage return and local line feed operation of the Typing Unit. It does not incorporate code selecting and signal generating mechanisms. A time delay mechanism may be included if required.

c. **TYPING UNIT.** (See figures 1-4 and 1-5.)

(1) The Typing Unit incorporates the necessary electrical and mechanical features for translating the code signals into mechanical action in order to record the message and perform the usual functions incident thereto.

(2) Code signals are applied to a two-coil magnet associated with a selecting mechanism which interprets the signals and controls the motions involved in typing a character or performing a required function. Means are provided for orienting the selector to the received signal. The Motor is geared to the main shaft of the Typing Unit which, in turn, extends motion to the keyboard mechanism. The typing and various functional sections of the Typing Unit are activated by individual clutches that completely disengage at the termination of each operating cycle and thus reduce the motor load to the minimum when idling.

(3) For friction feeding, the paper feeds from a five inch diameter roll mounted on the Typing Unit and passes around a stationary platen. However, the Typing Unit may be equipped with a sprocket feed mechanism to accommodate fan-fold forms. Paper spindle latches may be provided as an optional feature. Interchanging of Typing Unit sub-assemblies involves the minimum in readjusting procedure (figures 1-6, 1-7 and 1-8). Type pallets are arranged in a compact, lightweight type box which may be readily detached for cleaning or for replacement by another type box. In operation, the type box keeps step with a printing carriage and presents the proper type pallets to the printing hammer to receive its strokes as the printing carriage advances along the line. Combined automatic carriage return and line feed functions operate to return the carriages and advance the paper to prevent overprinting at the end of a line should the carriage return combination not be received in time. Motor stop contacts may be provided as an optional feature.

(4) In addition to the conventional functions common to printing telegraph equipment, built-in facilities permit the addition of selective station call or recognition functions with electrical circuits associated therewith available for remote extension. In such applications the Typing Unit may be

stripped of all typing and paper feeding mechanisms and utilized for circuit switching or similar applications.

(5) The type box and function box are features that will vary with the type and function arrangements desired.

d. **MOTOR UNITS.** - The Motor Units are self-contained components that mount on the rear of the Keyboard or Receiving-Only Base and have characteristics adaptable to standard power supplies.

(1) **SYNCHRONOUS MOTOR UNIT.** (See figure 1-9.)

(a) The Synchronous Motor Unit contains a wound stator, two pole, single phase, capacitor start, motor. A combination hand-wheel and fan is mounted on one end of the motor shaft. A motor-starting relay and capacitor, together with a thermal cutout switch, are mounted in a compartment on the underside of the Motor Unit. The thermal cutout switch (manually reset) serves to protect the motor windings from excessive heating.

(b) The motor proper is supported by a cradle to which it is held by straps at each end. Resilient mounts on the hubs of the motor end bells reduce transmission of vibration to the Keyboard or Receiving-Only Base.

(2) **GOVERNED MOTOR UNIT.** (See figure 1-10.)

(a) The governed motor is series wound and is similar to the synchronous motor in its mounting arrangement.

(b) A combined governor and fan are positioned on the motor shaft extension. The fan draws cooling air through the motor as an aid in controlling the temperature rise. A target for speed-checking purposes is painted on the governor cover. The cover also serves to protect the governor mechanism. A screw-driver opening is provided in the cover to facilitate speed adjustment. Brush filter capacitors are provided within the motor end bells. A compartment on the underside of the motor unit houses the governor resistor and capacitor, as well as a power leads electrical noise suppressor.

e. **CABINET.** (See figure 1-1.)

(1) **GENERAL.** The cabinet is of sheet metal construction and is finished internally and externally in baked enamel. It is approximately 40 inches high, 20½ inches wide, and 18½ inches deep. The upper portion forms a compartment for housing the mechanical units and the Electrical Service Unit. A shelf

located in the lower section may be used to support a Rectifier (not furnished as part of the Model 28 Printer). The top of the Cabinet forms a dome that is hinged at the rear. The dome is unlatched by a push button and is counterbalanced by a mechanism that aids in raising it and then supports it in the open position. A copyholder is attached to the front of the dome. A window through which the message may be read while being printed is located in the upper portion of the dome. This window is in a nearly horizontal position to avoid reflection from ceiling lights. A hinged door in the dome is unlatched by a push button to permit access to the printed copy. The copy is illuminated by a copy light located under the dome. Rubber sealing strips are applied to the edges of both the dome and the door for silencing purposes. A rubber mounted cradle includes a tilting arrangement which permits the assembled Keyboard, Motor, and Typing Units to be tilted forward and supported when the dome is open (figure 1-11). This provides maximum accessibility to the mechanism while servicing. Terminal boards for power and signal line connections are located on the inner rear wall (figure 1-12). The Electrical Service Unit is located to the rear of the Keyboard. Its power switch is controllable from a switch lever at the front of the Cabinet. The Cabinet may be equipped with the following features to meet the customers requirements.

(a) A signal bell.

(b) A margin indicator lamp.

(c) Two electrical noise suppressors which minimize electromagnetic radiation from the power and signal lines external to the Cabinet.

(d) A combination lower compartment cover panel and maintenance plate. This panel, which normally is snapped in place in front of the rectifier shelf in the lower portion of the Cabinet, may be installed horizontally in the upper part of the Cabinet with its inside surface facing upward. In this position the panel serves as a work shelf upon which the Typing Unit may be placed for servicing.

f. **ELECTRICAL SERVICE UNIT.** (See figure 1-13.) - The Electrical Service Unit is located in the upper compartment of the Cabinet. It incorporates receptacles, fuses, switches, etc., which are associated with the power and signal line circuits. The unit may include any of the following optional features:

(1) Motor control mechanism.

(2) Signal line relay mounting assembly.

(3) 0.100 ampere rectifier assembly.

(4) Current limiting resistors for operation of the Model 28 Printer on DC.

(5) Line test key assembly.

**3. ELECTRICAL CHARACTERISTICS.**

a. 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

b. 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.

**Note**

The rectifier, when incorporated in the Electrical Service Unit, has sufficient output (0.100 ampere, 115 VDC) to supply the selector magnet and the relay bias winding circuits. However, this rectifier does not have sufficient output to also supply the signal line current.

**c. POWER SUPPLY REQUIREMENTS.**

**(1) SYNCHRONOUS MOTOR UNIT.**

(a) Input voltage: 115 volts  $\pm$  10 per cent a-c.

(b) Phase: Single phase.

(c) Frequency: 60 cycles  $\pm$  0.75 per cent.

(d) Input current:

Starting . . . . . .9 amps.

Running . . . . . 1.85 amps.

(e) Power Factor . . . . . 0.30

(f) Wattage . . . . . 65 watts

(g) Heat Dissipation . . . . . 50 watts

**(2) GOVERNED MOTOR UNIT.** - This data for Governed Motor Unit used without current limiting resistors in Electrical Service Unit.

(a) Input voltage: 115 volts  $\pm$  10 per cent a-c.

(b) Phase: Single phase.

(c) Frequency: 50 to 60 cycles.

(d) Input current:

Starting . . . . . 1.75 amps.

Running . . . . . 1 amp.

(e) Power Factor . . . . . 0.83

(f) Wattage . . . . . 95 watts

(g) Heat Dissipation . . . . . 75 watts

## SECTION 2

## THEORY OF OPERATION

## 1. GENERAL.

a. This section covers the operating principles and circuit descriptions of the Model 28 Printer. This equipment serves as a sending and receiving (or receiving only) page-type printing telegraph set when connected to the terminal facilities of a wire or radio telegraph circuit, and will operate on signal line current of either 20 or 60 milliamperes without a line relay. The signals received by the Model 28 Printer are of the start-stop type. The equipment is wired at the factory to transmit neutral signals but is readily adaptable to transmit polar signals by wiring changes. The equipment is designed to operate at speeds of 368, 460, or 600 operations per minute (opm). Conversion from one speed to another is made by changing gears. 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 plus or minus 0.75 per cent. Governed motors require a like power supply except that the frequency may be from 50 to 60 cycles.

b. The electrical and mechanical relationships of the units which make up the Model 28 Printer, when equipped with a motor control mechanism as an accessory, are shown in a functional block diagram (figure 2-1).

## 2. SIGNALING CODE.

The signaling code is a five unit start-stop code of current and no-current intervals. Intervals during which the selector magnet is energized are known as marking impulses, and those during which the magnet is not energized are known as spacing intervals. Each group of five selecting intervals is preceded by a start interval (no-current) and is followed by a stop impulse (current) both of which are used to maintain synchronism between the transmitting and receiving apparatus. Figure 2-2 shows, graphically, the code used.

## 3. KEYBOARD.

a. GENERAL. - The Keyboard embodies a sheet metal structure on which an intermediate shaft assembly, a code bar mechanism with keylevers, and a signal generator mechanism are mounted. It also contains a margin indicator switch mechanism, and provides mounting facilities for a Typing Unit and a Motor Unit. At the time a Keyboard is installed in its Cabinet, a plug on the end of a plastic covered cable that extends from the left end of the Electrical Service

Unit (figure 1-13), is plugged into a connector mounted on the top left rear corner of the Keyboard (figures 1-2 and 1-11). See figure 2-3 for schematic wiring. In operation, the motor drives the intermediate shaft assembly which furnishes motive force to the typing unit main shaft (figures 1-5 and 1-7). 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.

b. INTERMEDIATE SHAFT ASSEMBLY. - The intermediate shaft assembly, located in the rear central portion of the Keyboard (figure 1-2), supports two helical gears (one with an overload clutch) 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 overload clutch and helical gear assembly which transfers the motive force to the typing unit main shaft, and when required, 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. The overload clutch lever disengages its notch in the main shaft helical driving gear if the Typing Unit or the Keyboard become jammed. This removes all driving torque from these units to prevent damage to the equipment. The clacking sound made by the overload clutch lever as it strikes its notch with each revolution of the intermediate shaft serves as an audible alarm. To re-engage the overload clutch, the power must be removed from the Motor Unit and the motor must be turned over by hand until the overload clutch lever falls into its notch. If the trouble in the equipment is not cleared before the Motor Unit is re-energized, the clutch will immediately disengage again.

c. CODE BAR MECHANISM. - 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 2-4). 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 2-4 and 2-5). 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. With the keyboard shaft in its stop position, the clutch trip bar and the five code bars are held toward the left (front view), against the tension of their springs, by the latched-up code bar bail. 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 2-6). 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 2-7). 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 2-8). Code bars which are permitted to move to the extreme right become selected and carry with them their respective transfer levers. 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 2-9 and 2-10). As the code bar bail moves to the left, it carries with it the non-repeat lever (figure 2-11). This in turn rotates the non-repeat bell crank about its pivot point until it lifts the code lever 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.

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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. 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 2-12). For detailed information on the operation of the clutch shoes, see paragraph 5.b.(3) of this section.

d. SIGNAL GENERATOR MECHANISM. - The signal generator mechanism is located on the top front part of the keyboard base. As was shown in paragraph 3.c., each of the five code bars operates its own transfer lever (figure 2-13). 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 2-13). When a code bar is selected, the upper end of its transfer lever and its associated selector lever are positioned toward the left (figure 2-14). 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 2-15). 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 2-13). 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 2-15). An extension on the rocker bail is moved downward or upward respectively with clockwise or counterclockwise rotation of the bail. 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 2-16). 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 2-17). 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 2-18). 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, it holds the spacing intermediate lever upward out of engagement with the flutter lever and the marking intermediate lever toward 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 2-20). This closes the line circuit and originates a marking impulse of the signaling code. 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 2-21). 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 on the same line circuit. The carriage return mechanism is fully described in paragraph 5.i. (4) of this section.

f. **LOCAL LINE FEED.** - Operation of the local line feed keylever causes its function lever to

raise the forward end of the local line feed bail (figure 2-22). 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 same line circuit. The line feed mechanism is fully described in paragraph 5.i. (5) of this section.

g. **BREAK MECHANISM.** - Operation of the break keylever causes its function lever to raise the break rod and shift the break bail (figure 2-23). As the break bail moves upward, its lower end engages the lower end of the oscillating lever to rotate the lever counterclockwise as viewed from the rear (figure 2-24). 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 2-18). 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 to rotate it clockwise and close the marking contacts in the contact assembly.

h. **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 2-11 and 2-25), 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 lever 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.

i. **KEYBOARD LOCK MECHANISM.** - Operation of the keyboard lock keylever causes its function lever to raise the keyboard lock bar pawl (figure 2-26). As described in paragraph 5.i. (8) 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 also pushes it downward. 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. Thus, the pawl may be raised either by local operation of the keyboard lock keylever, or by operation of the blank or break keylevers, on any Keyboard in the line circuit. In its upper position, the pawl releases the keyboard lock bar and a spring pulls the bar toward the right (figure 2-28). In this position, projections on the lower side of the bar block the upward movement of any code lever and the repeat function lever.

**j. 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 2-27 and 2-28). In this position, the projections on the lock bar lie between the code levers and offer no interference with their operation.

**k. 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 5.g. (1) 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 2-29). When the contact lever leaves the switch plunger, the margin indicator switch operates and closes the circuit to a margin indicator light in the Cabinet (figures 2-3 and 2-79). A carriage return cycle returns the cam disk to its starting position and the margin indicator switch opens.

**l. TIME DELAY MECHANISM** - As shown in paragraph 7.c. of this section if an electrical motor control mechanism is furnished with the Electrical Service Unit, it must receive an electrical pulse to stop the motor. Such a pulse may be supplied by a time delay mechanism on the Keyboard. This 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 2-30). 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 2-31). 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 2-32). This pulse is applied to the electrical motor control mechanism in the Electrical Service Unit to shut down 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, and from 53 to 106 seconds for 100 words per minute operation. 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.

**m. REPEAT-ON-SPACE MECHANISM.** - When a Keyboard is equipped with a repeat-on-space mechanism (dashed outline, figures 2-7 and 2-9), it will automatically transmit the space function as long as the space bar is held operated. When the space bar is depressed, the rear portion of the space code lever engages and lifts the lower end of the space repeat lever. As the space repeat lever turns clockwise (viewed from front of Keyboard) its frontward projection engages the lower projection on the code bar bail latch lever. Thus, the code bar bail latch lever is made to drop downward (figure 2-7) in which position it is held until the space bar is released.

#### 4. RECEIVING-ONLY BASE. (See figure 1-3.)

The Receiving-Only Base is a sheet metal structure which supports an intermediate shaft assembly (paragraph 3.b.) and provides mounting facilities for a Typing Unit and a Motor Unit. On the front of the base two off-line function keylevers, local carriage return and local line feed (paragraphs 3.e. and 3.f.), are mounted. At the time a Receiving-Only Base is installed in its Cabinet, a plug on the end of a plastic covered cable that extends from the left end of the Electrical Service Unit (figure 1-13) is plugged into a connector mounted on the top left rear corner of the Receiving-Only Base.

## 5. TYPING UNIT.

### a. GENERAL.

(1) The receiving circuit of the Typing Unit (figure 2-33) consists of two 132 ohm selector magnet coils wired to a connector which is mounted on the typing unit right frame (figure 1-4). At the time the Typing Unit is installed in its Cabinet, a plug on the end of a plastic covered cable that extends from the right end of the Electrical Service Unit (figure 1-13) is plugged into this connector. A selector magnet terminal board in the Electrical Service Unit provides for the connection of the selector magnet coils in series for 0.020 ampere line current operation, or in parallel for 0.060 ampere line current operation.

(2) The Typing Unit also has a set of electrical contacts which are wired to the connector on its right frame. These contacts are used to pulse a signal bell when it is installed in the Cabinet and are operated by a mechanism described in paragraph 5.i.(7).

### b. MAIN SHAFT. (See figure 2-34.)

(1) The main shaft is located in the lower rear portion of the Typing Unit and extends the full length of the unit. It is supported by ball type bearings mounted in each side frame.

(2) At the time the Typing Unit is mounted on a Keyboard, the keyboard helical driving gear on its main shaft meshes with the signal generator helical driven gear. The main shaft helical driven gear meshes with the main shaft helical driving gear on the motor driven intermediate shaft on the Keyboard. Thus, motive force is extended from the motor to the main shaft which in turn drives the keyboard mechanism.

(3) The main shaft includes six clutches each of which, when tripped, drives its associated mechanism. These clutches have two shoes which bear against the inside surface of a drum which, in turn, is keyed to the main shaft. They operate as follows:

(a) Figure 2-35 shows a clutch disengaged. Disengagement is accomplished by bringing together lug A on the clutch cam disk, and the lower end of clutch shoe lever B. The upper end of lever B pivots about its ear C and allows its other ear D to move toward the right. The upper spring then pulls the two shoes together and away from the drum.

(b) Figure 2-36 shows the same clutch engaged. This is accomplished by releasing lug A and the lower end of lever B. The upper end of lever B pivots about its ear C

(which bears against the upper end of the secondary shoe) and moves its ear D, and the upper end of the primary shoe, toward the left until the shoe makes contact with the drum at point E. As the drum turns counterclockwise, it drives the primary shoe downward so that it again makes contact with the drum, this time at point F. There, the combined forces acting on the primary shoe cause it to push against the secondary shoe at point G. The lower end of the secondary shoe then bears against the drum at point H. The revolving drum acts to drive this shoe upward so that it again makes contact with the drum at point I. Since the forces involved are multiplied at each of the preceding steps, the final force developed at point I is very great. This force is applied to the lug J on the clutch cam disk to cause it to turn in step with the drum. The cam disk on each clutch is connected with the particular mechanism involved.

(c) Two of the clutches (namely the line feed and the spacing clutches) have three sets of lugs equally spaced about their periphery for controlling the engagement and disengagement of the clutch shoes with the drum. Thus, these clutches will turn only one-third of a revolution when tripped, except when a single-double line feed lever (paragraph 5.i.(5) (a) of this section) is set for double line feed in which case the line feed clutch will turn two-thirds of a revolution. The function clutch has two sets of lugs diametrically opposite of each other and will turn only one-half of a revolution when tripped. The remaining clutches have one set of lugs and will turn a complete revolution when tripped.

### c. SELECTING MECHANISM.

(1) The selecting mechanism consists of the selector magnet coils and armature, a selector cam-clutch, and the associated levers, arms, bails, and slides necessary to convert the electrical intervals of the start-stop code to the mechanical arrangements which govern the characters to be printed and the functions to be performed.

(2) The selector cam-clutch comprises, from right to left (figure 2-34), 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.

(3) 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 2-37). 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 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.

(4) 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 2-38). 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 Units, 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 2-37) 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 basically 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 acted upon by code bar shift levers to which motion is extended from the code bar clutch when activated by the code bar clutch trip cam. Detailed functioning of the coordinated mechanism follows:

(b) CODE BAR POSITIONING. - Each push lever (paragraph 5.c. (4) of this section) has an associated intermediate arm, transfer lever, and code bar shift bar (figure 2-39). In addition, there is a "common" transfer lever with its code bar shift bar. When a push lever is toward the right (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 (right end view) and position its code bar shift bar toward the front of the Typing Unit (space position). When a push lever is to the left (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 (front view - third from the left) has an extension which passes behind the number 1 and number 2 transfer levers (figures 2-40 and 2-41). 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 2-34). 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 2-40). 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 2-41). 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 2-42). In the equipment as furnished, the suppression code bar has no connection with a shifting mechanism. 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 AND TYPE BOX CARRIAGE.

(a) GENERAL. - All of the characters that may be printed by the Typing Unit are formed by type pallets which are arranged in a type box. The type box is mounted in a carriage from which it may be removed for cleaning or replacement. In order to print any selected character, the type box carriage is so positioned that the character on the pallet is directly over the required location on the paper. Since the pallets are arranged in four horizontal rows and sixteen vertical rows, it is necessary to position the type box carriage both horizontally and vertically. See figure 2-43 for character arrangement. The type box carriage rides on rollers over a track which is moved vertically for positioning in that particular plane. 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 2-44). 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) 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. Briefly, the number 1 and number 2 code bars determine the selection of the horizontal row. The number 3 code bar determines whether the selection is to be made from the left four vertical rows or right four vertical rows (in either the letters or figures side). The number 4 and number 5 code bars determine the selection of one row from the four vertical rows predetermined by the number 3 code bar.

2. Four code bars (longer than the others), extend through the right code bar bracket and serve as stops for the right "knee action" vertical positioning levers. They are (from top to bottom), suppression, number 1, number 2, and common (figure 2-42). Notches are arranged in the left ends of the code bars so that the left side "knee action" vertical positioning levers are stopped, in each case, by the same code bar that blocks the right side vertical positioning levers. After all the code bars have been positioned by the code bar positioning mechanism, the code bar clutch cam follower arm and its roller, in traversing the sloping indent on the code bar clutch cam, rotates the clutch trip lever shaft. As the shaft turns, it first causes the function clutch trip lever to release the function clutch (figure 2-45) and then causes the type box clutch trip arm to engage its trip lever and release the type box clutch. When the type box clutch completes its revolution, it is disengaged by its trip lever and latch lever in the same manner as was the code bar clutch, described in paragraph 5.e.(1) (b) of this section. During its rotation, the type box clutch operates 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 2-46). 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 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.

3. A bracket attached to the main rocker shaft applies vertical motion to the main bail by means of two main bail links (figure 2-47). 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.

4. 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 2-47). 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 make 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 2-48). 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 2-47). 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.

5. When both the number 4 and 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 AND PRINTING CARRIAGE.

(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) **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 2-49) 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 against



its spring tension until it becomes latched by the operating bail latch (figure 2-50). 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 5.e.(2) (a) of this section and in figure 2-44, 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 2-51). 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  $1\frac{1}{2}$  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 earlier, 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 2-52). 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 the 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 lever on the spacing drum engages the spacing cut-out transfer bail which, in turn, operates the spacing cut-out bail. The adjustable spacing cut-out lever and the end of the spacing cut-out transfer bail are shown in figure 2-44. 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.

g. MARGIN INDICATOR. - Before the type box carriage and the printing carriage reach the end of their travel, the margin indicator light in the Cabinet is illuminated. The contact mechanism which controls the lamp circuit is mounted on the Keyboard and is fully described in paragraph 3.k. of this section. The actuator of this contact mechanism is a disk which is mounted on the spring drum of the Typing Unit (figure 2-44). 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 2-54). 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 2-53 and 2-54). 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 2-53) 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 2-54. 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 can have its ratchet feed and ratchet detent levers engaged with its ribbon ratchet wheel at a time. As the ribbon ratchet wheel turns (figure 2-53), 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 2-56). 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 2-55) 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 2-56. 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 2-53).

#### i. FUNCTIONS.

##### (1) GENERAL.

(a) There are two types of operations which are performed by the Typing Unit. The first embodies those mechanical actions which are directly necessary to the actual printing of a character. The second embodies mechanical action which alters the positions of the various mechanisms and is known as a function.

(b) As in printing, the reception of function codes results in the positioning of the code bars. The back edges of the code bars are notched. Positioned directly behind the

code bars is a function box which contains the function bars for the various functions (figure 2-57). Each function bar has a series of lugs on its end which are offset to one side or the other to correspond with the marking and spacing intervals of the particular code to which it is to respond. When the two-stop function clutch is tripped (paragraph 5.e.(2) (b) 2. of this section, and figure 2-45), it rotates one-half of a revolution. During this time it extends motion to the function bar reset bail (through the intervening cam and follower arm, function rocker shaft, and reset bail drive links) to cause the function bar reset bail with its attached reset bail blade to release the function bars momentarily (figure 2-59). As the spring tensioned function bars are released, they move forward to make contact with the code bars. If the code bars are positioned for a function, each lug on the function bar for that function will be opposite a slot in a code bar. This will permit the selected function bar to move forward into the code bars while the other function bars are blocked by one or more code bars (figure 2-60). Associated with each function bar in the function box is a function pawl and a function lever. In the unselected position, the function bar is not latched with its function pawl (figure 2-61). When the function bar reset bail blade releases the function bars, any bar which may be selected will move sufficiently far forward (to the left in the figure) to permit it to engage its function pawl. Then, as the reset bail blade returns the function bar to its initial position, the function bar carries the function pawl to the rear (to the right in figure 2-62). The function pawl, in turn, moves the function lever clockwise about its pivot point. A projection at the lower end of most function levers operates the spacing suppression bail (paragraph 5.f. (2) of this section) and either the upper or lower ends of the levers operate the various functions. Near the completion of the function cycle, a stripper blade (operated by the main side levers through the stripper blade arm, figure 2-46) rises to engage any selected function pawl and strip it from its function bar. Springs return the released function pawl and the function lever to their original positions (figure 2-61). 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 two-stop cam disk upon which the latch lever rides has an indent at each stop position. When one of the two lugs on the clutch shoe lever disk strikes the function 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) LETTERS AND FIGURES SHIFT FUNCTION.

(a) The letters and figures function bars, pawls, and levers which are located near the right end of the function box operate on letters and figures codes respectively. The upper ends of the function levers engage the letters and figures function slides (figures 2-63 and 2-64). 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 2-63) or to the left (figures position - figure 2-64). 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 2-65). 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 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 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) 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 5.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 function box. Its associated function lever engages an extension of the letters function slide (figure 2-66). Thus, when a spacing function occurs, letters shift will take place in the manner described in paragraph 5.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.

**(4) 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 2-67). 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 2-68). 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 (off-line) operation of the carriage return mechanism may be obtained from the Keyboard. The Keyboard 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.

**(5) 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 2-69). 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 until after more than one-third of a revolution of the clutch has occurred. 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 driven by a stripper bail. The cam disk on the three-stop line feed clutch furnishes the motive force to operate the stripper bail once each one-third revolution of the line feed clutch. The stripper blade on which the slotted line feed function pawl stripper rides may be shifted toward the right or left by the camming action of the single or double line feed lever (figure 2-70). The upper end of the pivoted single or double line feed lever protrudes from the upper left rear portion of the Typing Unit where it rides in the two position side frame detent extension. When the lever is in position 1 (toward the front of the Typing Unit), the stripper blade is positioned such that the

two ears at the upper end of the line feed function pawl stripper are under the line feed and automatic line feed function pawls. When the lever is in position 2 (toward the rear of the Typing Unit), the stripper blade is positioned such that the ears on the line feed function pawl stripper are between the function pawls. All the other function pawls are stripped with the stripper blade in either position. 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 function box for the sole purpose of suppressing spacing on single line feed function (figure 2-57). 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.

(b) 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 2-71). 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.

(c) 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.

(d) Local (off-line) operation of the line feed mechanism may be obtained from the Keyboard. A keyboard 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 2-69).

#### (6) AUTOMATIC CARRIAGE RETURN - LINE FEED FUNCTION.

(a) 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 arm on the spacing drum trips the automatic carriage return bell crank (figure 2-68). 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 function box are automatic carriage return and line feed function bars (figure 2-57). 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.

#### (7) SIGNAL BELL FUNCTION.

(a) The circuit to the signal bell magnet is controlled by a set of normally open electrical contacts mounted on the function box (figures 2-33 and 2-72). The signal bell function bar has six code lugs - five for the signal code which may be either S or J and one for the letters-figures shift code bar (figure 2-57). 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 (or J) is received, the function lever will pulse the upper signal bell contact once (figure 2-73). If the signal code for the letter S (or J) 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.

#### (8) BLANK FUNCTION.

(a) Two identical function bars coded to operate when the signal code for blank function is received may be installed near the left end of the function box (figure 2-57). 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 (figure 2-58).

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 2-74). 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 2-75). 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.i. of this section.

(b) The function box may be equipped with a clip mounted adjacent to the blank function lever. When the function box is so equipped, the blank function may be disabled, operated by a single blank, or operated by a double blank depending on whether the clip is positioned to the center, left, or right respectively. In the center position, an extension of the clip extends beneath the blank function pawl and prevents the pawl from being engaged by the function bar when the blank function bar is selected. In the left position, the extension of the clip also extends in front of the blank function lever and holds it to the rear in its operated position. With the blank function lever in its operated position, the keyboard lock function bar is free to be selected when a blank signal code is received. In the right position, the extension of the clip is clear of both the blank function pawl and blank function lever, and double-blank operation is brought about as described in paragraph 5.i.(8) (a) of this section. An extra blank function bar, pawl, and lever is provided to suppress printing and spacing on blank since the blank and keyboard lock function levers just described do not have the extension on their lower ends for operating the space suppression bail.

#### (9) MOTOR STOP FUNCTION.

(a) As shown in paragraph 7.c. of this section, if an electrical motor control

mechanism is furnished with an Electrical Service Unit, it must receive an electrical pulse to stop the motor. This pulse may be supplied by a pair of electrical contacts in the stop magnet circuit which are operated by an associated mechanism that functions only upon the reception of the signal code for upper case H or, if preferred, for upper case M. In Typing Units so equipped, the motor stop function mechanism is mounted on the function box. The mechanism is similar to the signal bell function mechanism described in paragraph 5.i. (7) (a) of this section, except that the function bar is coded for upper case H or M as the case may be.

(b) When it is desired to operate the motor stop on a shift-blank-stop sequence, an upper case blank function bar with its associated function pawl and function lever is provided next to the upper case H or M function bar and a clip is mounted adjacent to the upper case blank function lever. The upper case blank function lever has a projection which reaches over and engages the notch in the upper case H or M function bar and prevents it from being selected upon reception of FIGURES and H or M signal codes. Operation of the two function bars, pawls, and levers is the same as the operation of the blank and keyboard lock function bars, pawls, and levers described in paragraph 5.i.(8) (a) of this section except for the different codes on which they operate. When the function box is so equipped, the motor stop function may be disabled, operated by FIGURES H or M, or operated by FIGURES BLANK H or M depending, on whether the clip is positioned to the center, left, or right respectively. The various settings of the clip control the movements of the function bars, pawls, and levers in the same manner as described for the BLANK function in paragraph 5.i.(8) (b) of this section.

## 6. MOTOR UNITS.

a. SYNCHRONOUS MOTOR UNIT. (See figures 1-9 and 2-76.) - The synchronous motor is for use with single phase, 115 volt (plus or minus 10 per cent) alternating current, at a frequency of 60 cycle per second (plus or minus 0.5 cycle). It is a 1/20 horsepower, 3600 rpm, two pole, wound stator, ball bearing motor, with a squirrel cage type rotor. The stator has two windings; a main operating winding and an auxiliary winding. The auxiliary winding is in series with a 43 mf a.c. electrolytic capacitor and with a current-operated motor-starting relay. The initial starting current causes the relay to pull up and its contacts close the auxiliary winding circuit. As the rotor gains speed, the current flowing through the motor (and also the relay coil) decreases. When a predetermined current value is reached, the relay armature is released, the relay contacts are opened, and the auxiliary winding

circuit is disconnected from the line. The rotor continues to accelerate until it reaches synchronous speed (3600 rpm.) The motor is wired in such a manner that the rotor rotates counterclockwise when viewed from the fan end. The starting relay and capacitor together with a thermal cutout switch are mounted in a compartment on the underside of the motor. The thermal cutout switch is in series with both the main and auxiliary motor windings, and if excessive current is drawn by the motor due, for example, to a blocked rotor) the switch will open the circuit. This is to prevent overheating and possible damage to the motor if it is stalled. The switch may be manually reset, if tripped, by depressing its red button which projects upward through the motor mounting plate. There are two fans located within the motor housing, one at each end of the rotor. These draw cooling air in through the slots in the end bells and exhaust it through the slots in the motor housing. The end bells have rubber vibration mounts by means of which the motor sets in the ends of its mounting bracket. The rubber mounts are held in the bracket by means of mounting straps. The motor shaft has a tapped hole for use in fastening the intermediate shaft driving helical gear. All end play is taken up by means of a conical shaped spring which bears against the outer race of one of the ball bearings. The motor mounting bracket is fastened to the Keyboard by means of four screws and lockwashers.

b. **GOVERNED MOTOR UNIT.** (See figures 1-10 and 2-77.) - The governed motor is for use with either single phase, 115 volt (plus or minus 10 per cent) alternating current, at a frequency of 50 to 60 cycles per second, or 115 volt direct current. (Direct current operation requires that external current limiting resistors be supplied. See paragraph 7.f. of this section.) It is a 1/20 horsepower, 3600 rpm, ball bearing motor which depends on an electromechanical governor for its speed regulation. The armature, which has a 48 segment commutator, is wired in series with the two field windings and the governor contacts. A 250 ohm, 40 watt resistor and a 0.5 mf capacitor are connected in parallel with the governor contacts. When the contacts are closed the resistor is shorted out. When the contacts are open the resistor is in series with the motor, to limit its operating current, and thus reduce its speed. The capacitor serves as a spark suppressor for the governor contacts. The combination fan and governor is mounted on one end of the motor shaft. The fan draws cooling air through the motor housing, and also serves as a mounting plate for the governor slip rings and for the governor contact mechanism (mounted on opposite sides of the fan). Connections to the two slip rings, which are wired to the governor contacts, are made by means of two brushes mounted on the ends of the motor housing. Normally the

governor contact spring holds the governor contact against the contact screw (figure 2-78). When the motor shaft exceeds a predetermined speed, the centrifugal force developed on the governor contact overcomes briefly the pull of the governor spring, and the governor contact leaves the contact screw until the motor slows down. The tension on the contact spring may be adjusted to maintain the motor speed at 3600 rpm. In order to make this adjustment, means are provided to compare the motor speed with a standard. An aluminum cover fits against the side of the fan and encloses the governor contact mechanism. The outside of the cover is finished in white with three rows of black spots equally spaced about its periphery. The outer, center, and inner rows contain four, six, and thirty-five spots respectively. The four spot row serves as a target which should stand approximately still at 3600 rpm when viewed through the moving shutter of a 120 vibration per second (vps) tuning fork. The six spot and thirty-five spot rows serve as targets when using an 87.6 vps tuning fork. The six spot target is used to approach an on-speed setting and the thirty-five spot is used to arrive at an accurate setting. The two motor brushes are protected by 8000 mmf capacitors which are connected between the brushes and the grounded frame of the motor. These tend to bypass any electrical noise created by the brushes as they make and break contact with the various segments of the armature commutator. The motor is wired in such a manner that the armature rotates counterclockwise when viewed from the governor end. The method of mounting the series motor is similar to the method of mounting the synchronous motor. The housing provided on the underside of the mounting bracket contains both the 250 ohm resistor and 0.5 mf capacitor in the governor circuit as well as an electrical noise suppressor. The purpose of the electrical noise suppressor in the motor power input circuit is to prevent any radio interference which may be generated by the motor from being radiated by the motor power leads.

7. **CABINET, AND ELECTRICAL SERVICE UNIT.** (See figures 1-12, 1-13 and 2-79.)

a. **GENERAL.** - The Cabinet houses the Keyboard (or Receiving-Only Base), the Motor Unit, the Typing Unit and the Electrical Service Unit. In addition, the Cabinet contains certain electrical features. Three terminal boards, mounted end to end in the upper rear portion of the Cabinet, make up the cabinet terminal board. The signal bell is located on the underside of the Cabinet and its magnet connects to the cabinet terminal board. The copy light lamp, with its switch and ballast, and the margin indicator lamp (controlled by the margin indicator switch in the Keyboard) are located in the cabinet dome and connect with

the cabinet terminal board. The power input and the signal line are also brought to the cabinet terminal board. The Electrical Service Unit is located behind the Keyboard inside the Cabinet and is held in place by two studs. The power switch, located in the lower front corner of the right end of the service unit, is engaged by the fork on the power switch extension shaft. This shaft extends through the front of the Cabinet below the right end of the Keyboard and is equipped with a knob so that the Printer may be turned ON or OFF from outside the Cabinet. Four legs on the unit project upward from the corners for use when the Electrical Service Unit is turned upside down for servicing. The complete Electrical Service Unit is composed of the basic Electrical Service Unit plus any of various optional features.

b. **BASIC ELECTRICAL SERVICE UNIT.** - The basic part of the Electrical Service Unit consists of a sheet metal structure upon which is mounted all of the cabling which interconnects the Keyboard, the Typing Unit, and the Cabinet together with the necessary plug connectors, fuses, switches, terminal boards, convenience receptacle, and line shunt relay. The plug connector and cable assemblies which go to the Keyboard and to the Typing Unit pass through holes in the top mounting plates which are located at the left and right ends respectively of the unit. The cable with lug terminations which extends from the left side of the unit connects with the left half of the cabinet terminal board to bring all signal line circuits into the service unit. The cable with lug terminations which extends from the right side of the unit connects with the right half of the cabinet terminal board. This cable brings power into the unit and completes the circuits to the various electrical components in the Cabinet. Upon entering the unit, the power input is fused by two 10 ampere fuses before it reaches the convenience receptacle, the power switch, and the three position lamp switch. In the center or OFF position of the lamp switch (which connects with the copy light lamp circuit at the cabinet terminal board), the lamp in the Cabinet is completely disconnected from any power circuit. With the power switch OFF, the copy light lamp in the Cabinet may be turned ON by throwing the lamp switch to the MAINT ON position. When the power switch is ON, the power input is applied to the power distribution terminal board, and to the magnet coil of the signal line shunt relay. In the de-energized condition of the line shunt relay, its contacts shunt the signal line at the cabinet terminal board. When the relay is energized by operation of the power switch, the contacts open to remove the shunt. In the left or ON position of the lamp switch, power for the copy light lamp circuit in the Cabinet is taken from the power distribution terminal board and passes through the motor control

terminal board where it may be controlled by the motor switch in the electrical motor control mechanism if this feature is supplied. See paragraph 7.c. of this section. The circuit from the margin indicator switch in the Keyboard connects with the margin indicator lamp circuit in the Cabinet at the cabinet terminal board. The circuit from the signal bell contacts in the Typing Unit picks up power at the power distribution terminal board and connects with the circuit to the signal bell magnet in the Cabinet. Wiring is provided to bring the circuits from the upper case "H" or "M" motor stop contacts in the Typing Unit or from a time delay mechanism motor stop switch in the Keyboard to the motor control terminal board. The motor circuit from the Keyboard picks up power at the power distribution terminal board, and connects with the motor control terminal board. Here it may be interrupted by the motor power switch in the electrical motor control mechanism when the equipment is furnished with this feature. The signal line circuits from both the Keyboard and the Typing Unit connect with the cabinet terminal board, where they may be arranged for either single loop or double loop operation. In addition, wires from the selector magnets in the Typing Unit connect with the selector magnet terminal board in the Electrical Service Unit. Two strap wires on this terminal board which connect the selector magnets in "parallel" for 0.060 ampere signal line current operation may be re-arranged (dashed lines in figure 2-83) to connect the magnets in "series" for 0.020 ampere operation.

c. **ELECTRICAL MOTOR CONTROL MECHANISM.** - When an electrical motor control mechanism is provided, it is mounted in the center of the Electrical Service Unit. All connections to this mechanism are made through the motor control terminal board. The purpose of the mechanism is to stop the motor when used in conjunction with a time delay mechanism on the Keyboard or a set of upper case "H" or "M" motor stop contacts on the Typing Unit, and to start the motor when the signal line current is interrupted. When used with the time delay mechanism, the motor control mechanism will stop the motor after the signal line has been idle for a period of approximately two minutes. In the mechanism as furnished, the start magnets are wired in "Parallel" for 0.060 ampere signal line current operation. For 0.020 ampere operation, the strap wires on the motor control terminal board may be re-arranged (dashed lines in figure 2-83) to connect the start magnets in "series". When the electrical motor control mechanism is used, the wiring of the Electrical Service Unit is such that the circuit through the line shunt relay is under the control of the motor power switch in the motor control mechanism. Also the Cabinet wiring is such that the contacts of the line



shunt relay will shunt the selector magnets instead of the signal line. When the motor is de-energized by the electrical motor control mechanism, the line shunt relay is de-energized and its contacts shunt the selector magnets. This automatically sets up the double blank function in the printer and locks the keyboard. The following paragraphs describe the operation of the electrical motor control mechanism through a complete cycle.

(1) STOP POSITION. (See figure 2-80.) - In this position the motor is shut down, the line shunt relay is de-energized, the selector magnets are shunted, 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 the latch lever. The motor power switch, operated by the stop magnet armature, is open and the signal line switch completes the start magnet circuit.

(2) OPEN LINE POSITION. (See figure 2-81.) - In this position, the signal line has just 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 released the stop magnet armature which started to swing toward the left. However, the stop magnet armature was immediately blocked by the start magnet armature. The slight movement of the stop magnet armature was not sufficient to change the positions of the motor power and signal line switches.

(3) START POSITION. (See figure 2-82.) - In this position, the signal line has just been closed, and the start magnets have been energized to pull the start magnet armature downward and release the stop magnet armature. The stop magnet armature has swung to the left and has operated the motor power and signal line switches. When the signal line switch was operated, it shunted the start magnets from the signal line circuit so that their armature would not vibrate with the line signals. When the motor power switch was operated, it completed the circuit through the line shunt relay and thereby removed the shunt from the selector magnets, and it completed the circuit to the motor and to the copy light lamp.

(4) STOP POSITION. (See figure 2-80.) - In order for the electrical motor control mechanism to return to this position and stop the motor, a pulse was received from either the Keyboard or the Typing Unit. This pulse energized the stop magnet briefly and caused the stop magnet armature to swing to the right and again operate the motor power and signal line switches. As the signal line switch was operated, it placed the start magnet coils back in the signal line circuit where they became energized and pulled 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 power switch was operated, it opened the circuit through the line shunt relay, and thereby shunted the selector magnets, and it opened the circuit to the motor and to the copy light lamp.

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**SECTION 3**  
**FIGURES**  
**FOR**  
**SECTIONS 1 AND 2**

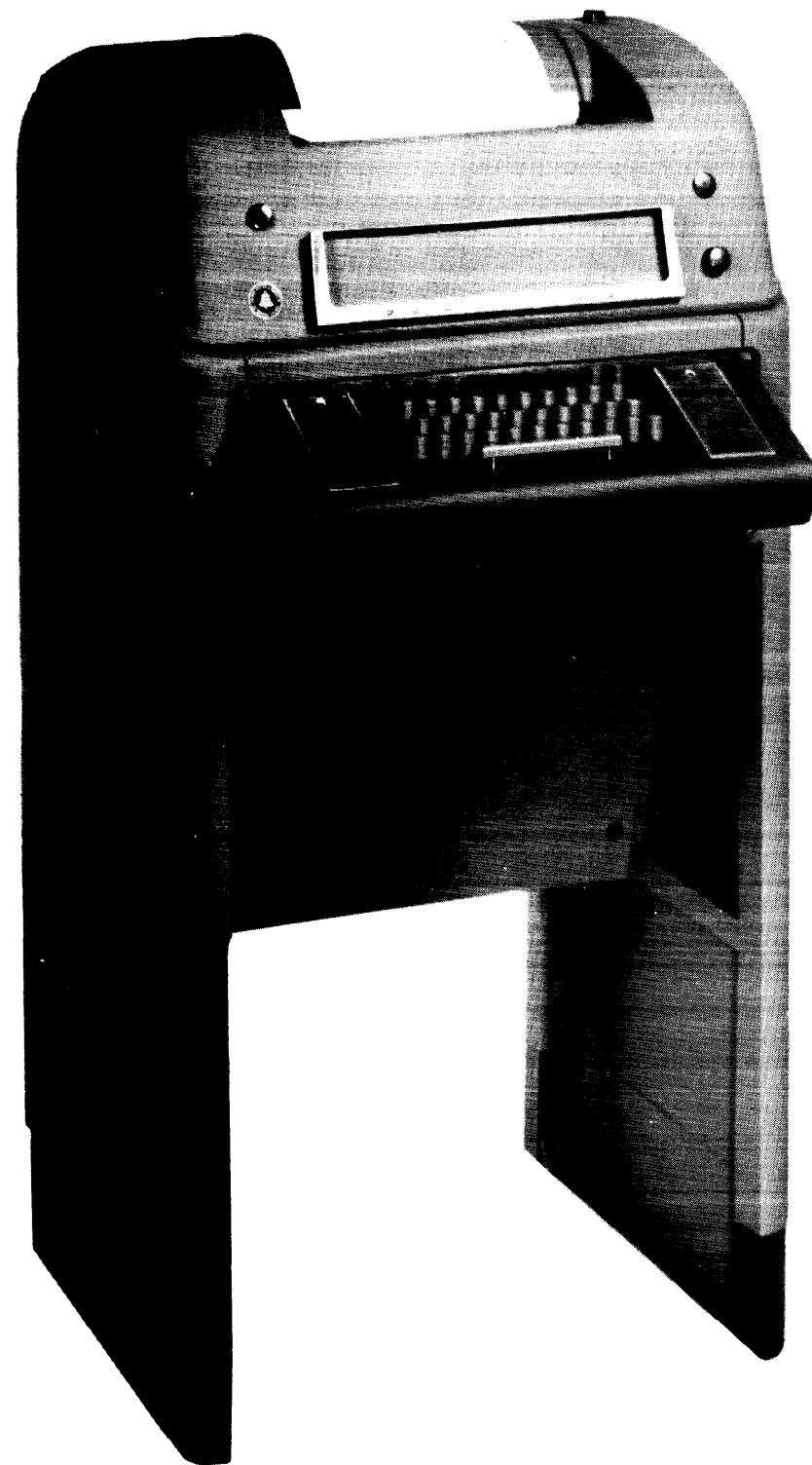


FIGURE 1-1. MODEL 28 PRINTER COMPLETE

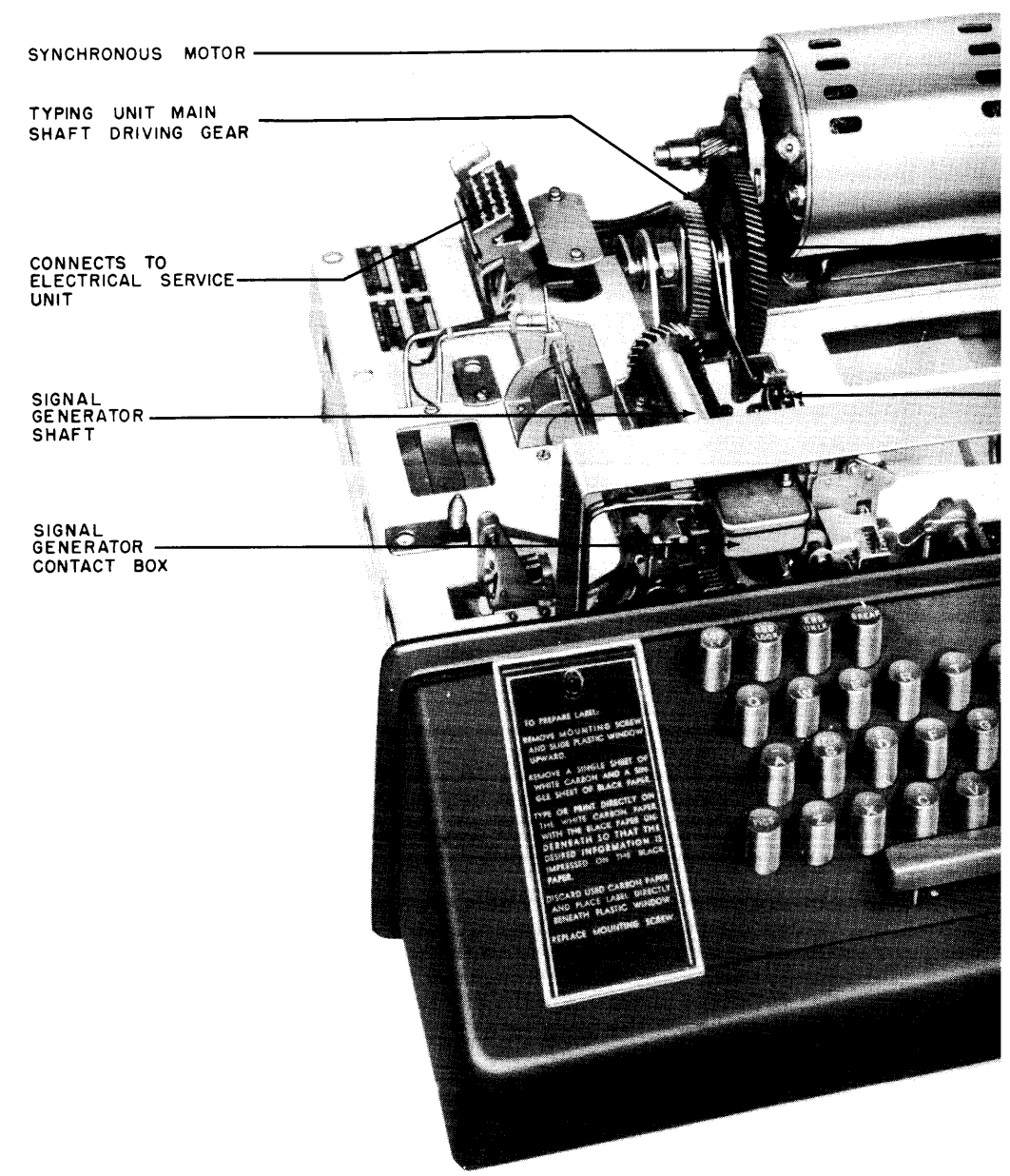


FIGURE 1-2. KEYBOARD

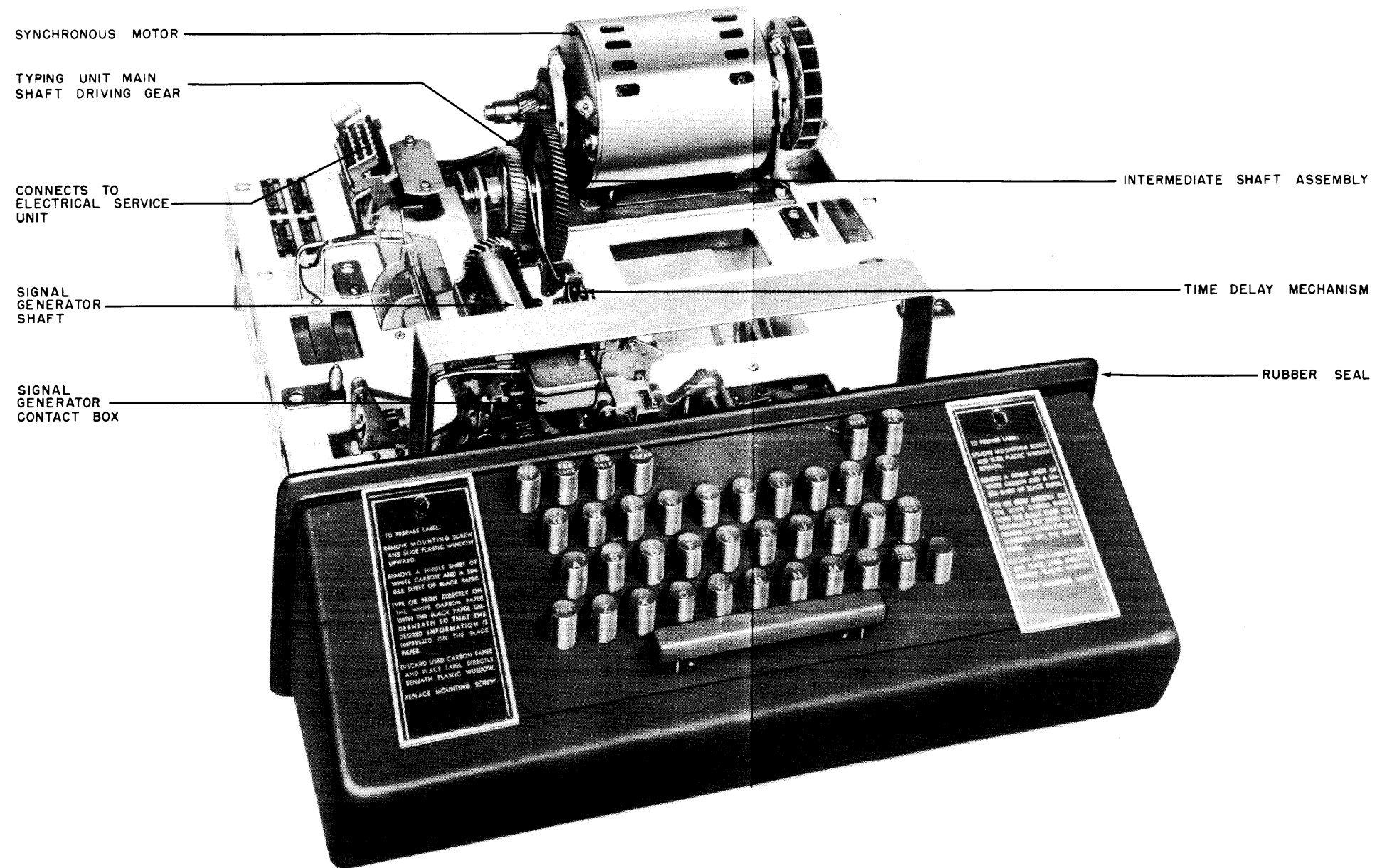
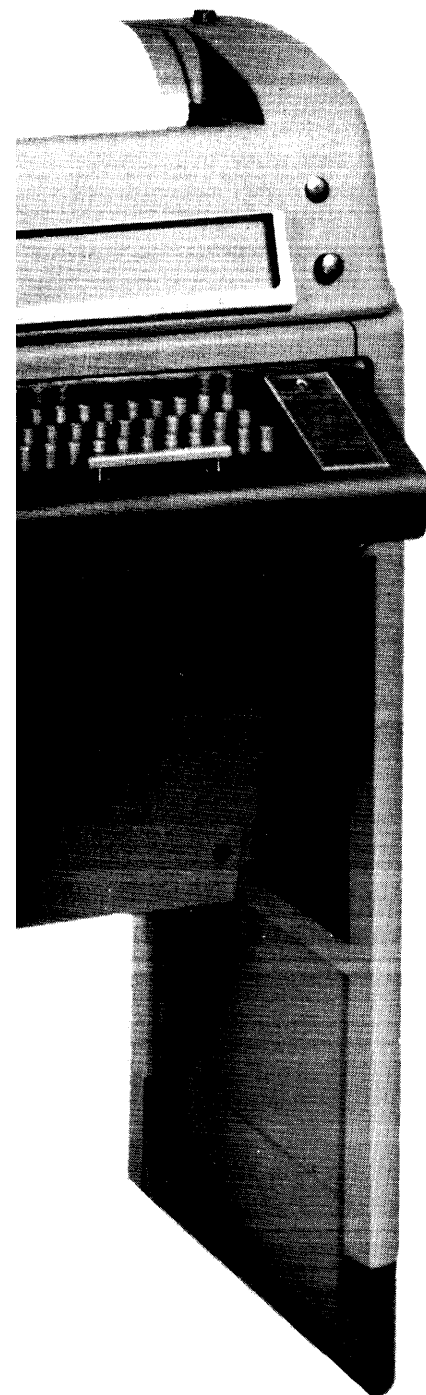


FIGURE 1-2. KEYBOARD, WITH MOTOR

3 PRINTER COMPLETE

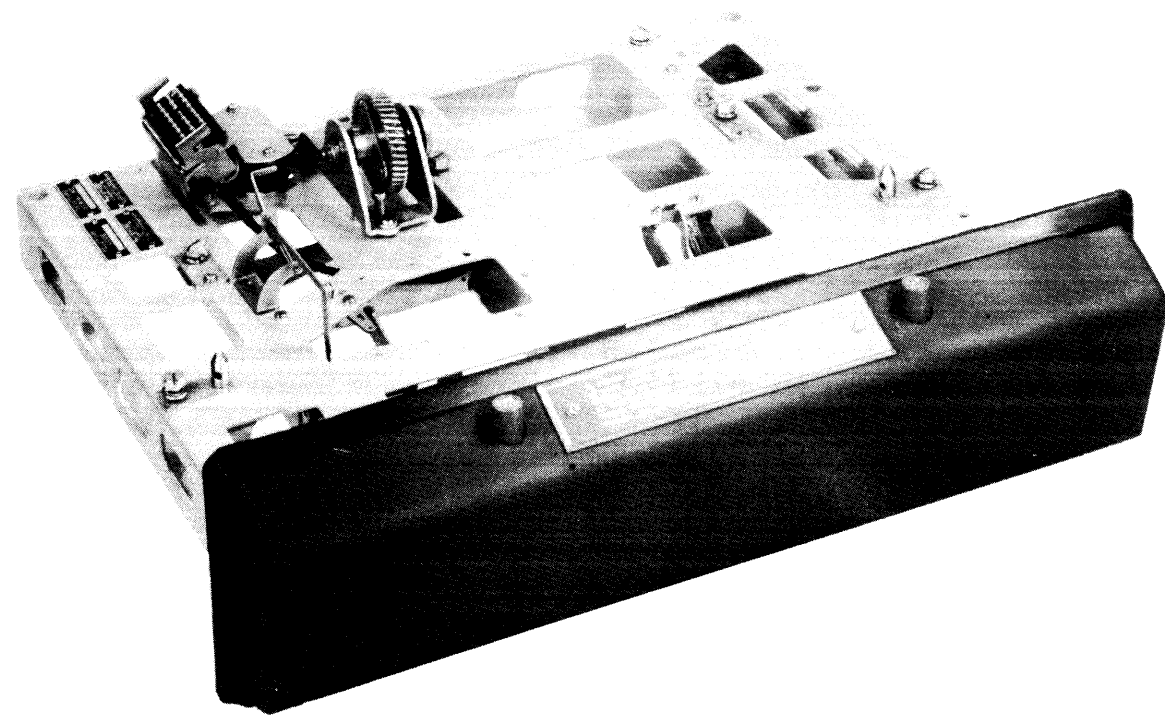


FIGURE 1-3. RECEIVING-ONLY BASE

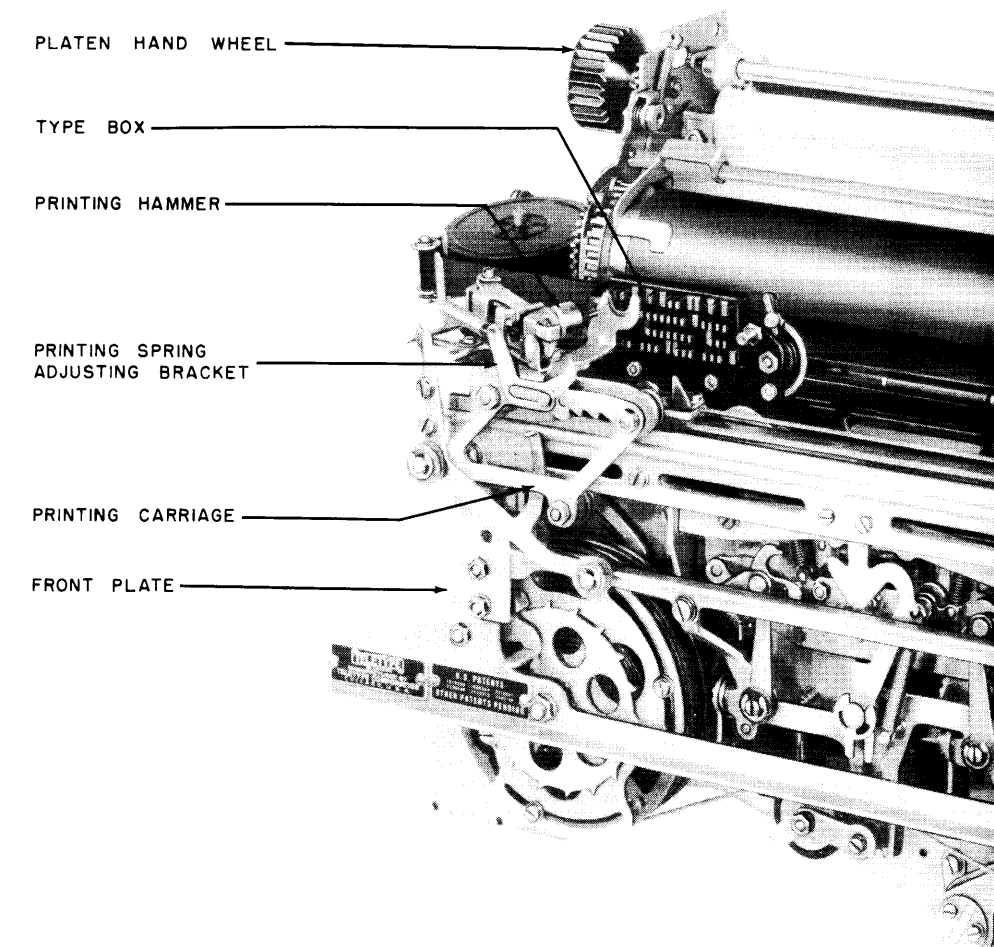
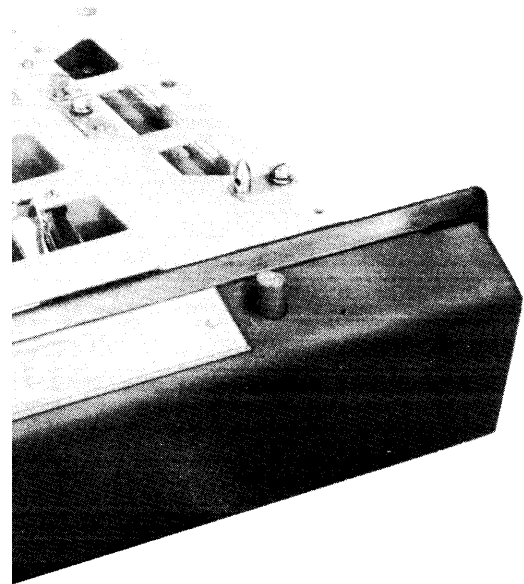


FIGURE 1-4. TYPING MECHANISM



NG-ONLY BASE

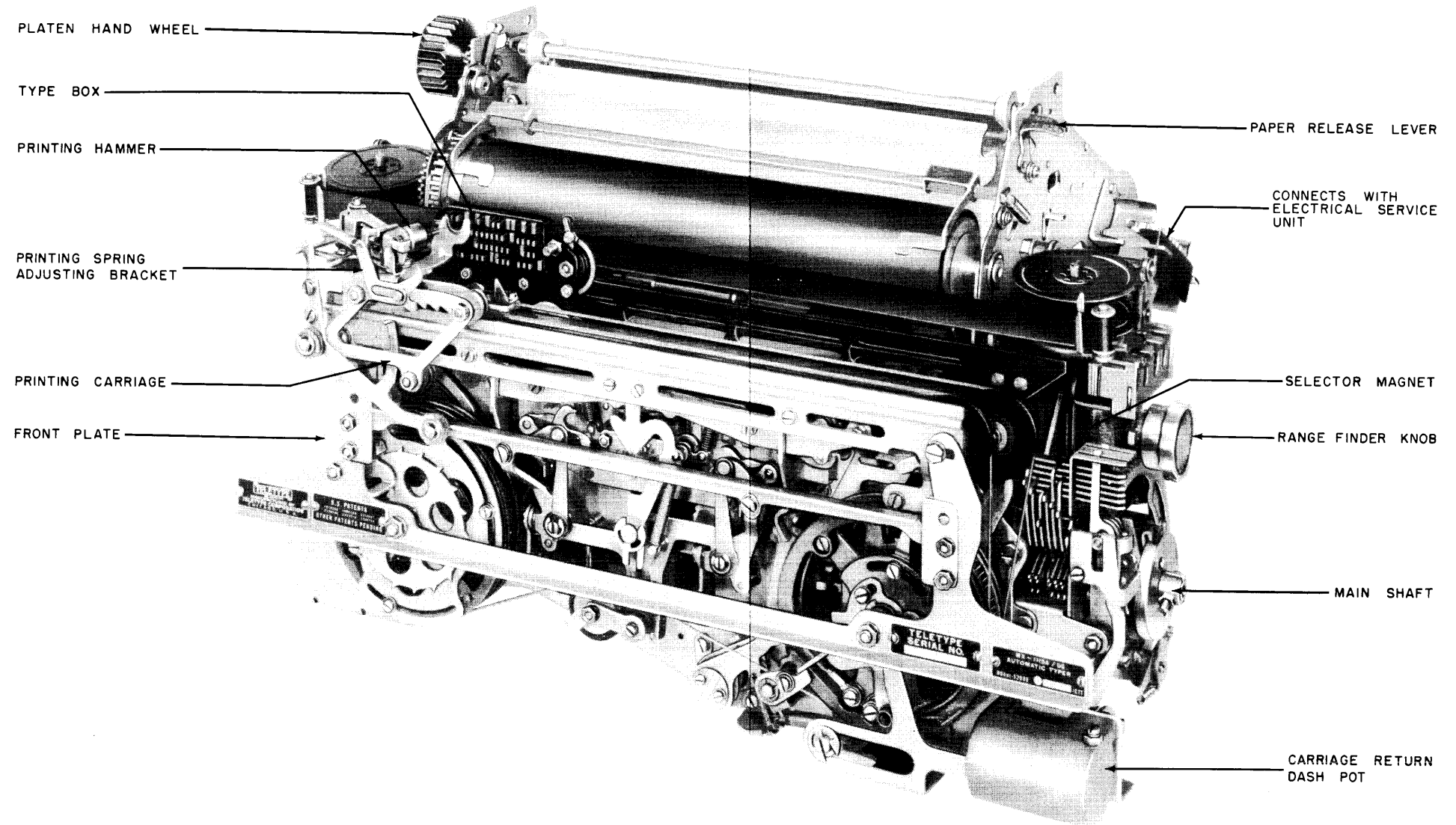


FIGURE I-4. TYPING UNIT, FRONT VIEW

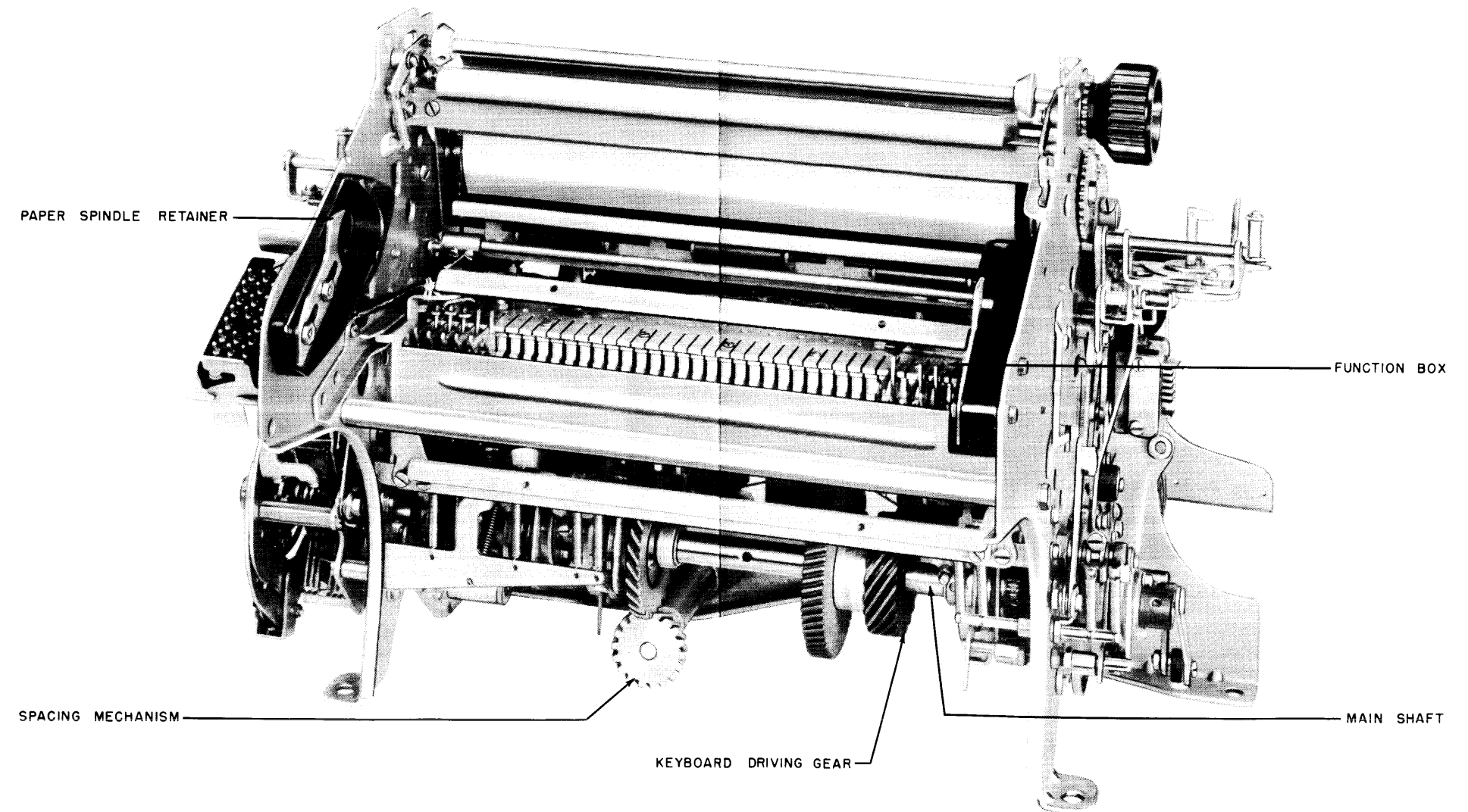


FIGURE 1-5. TYPING UNIT, REAR VIEW

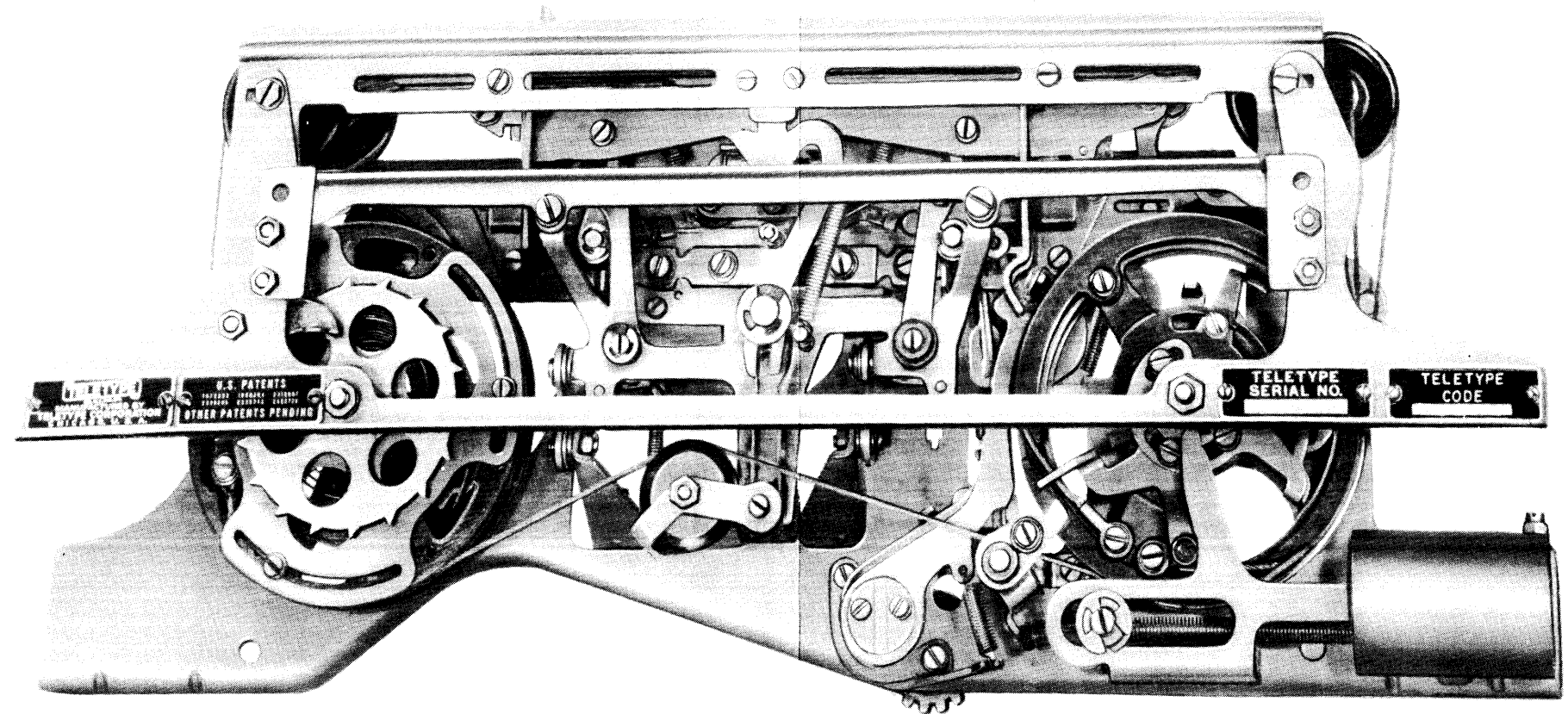


FIGURE I-6. TYPING UNIT FRONT PLATE



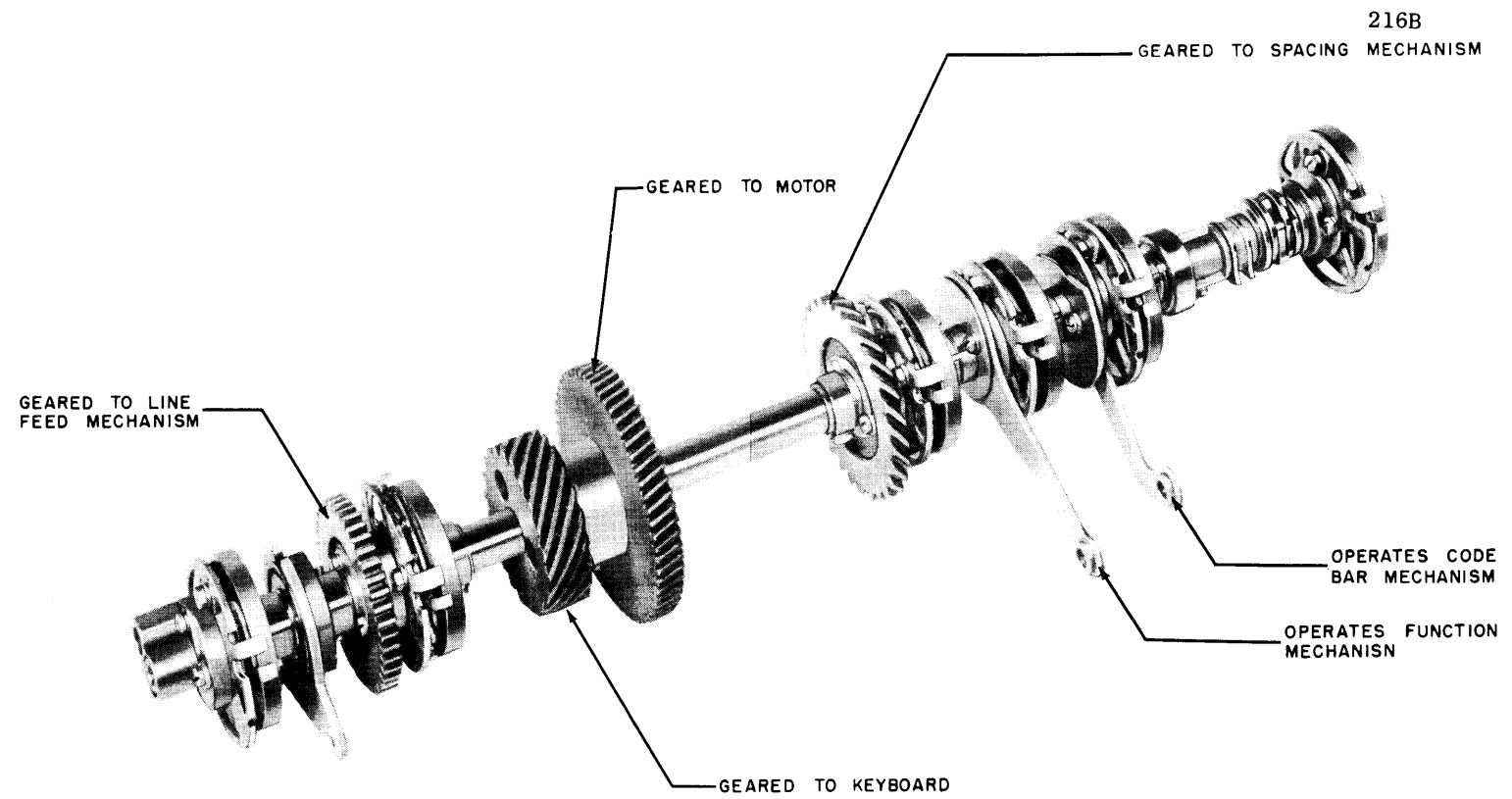


FIGURE I-7. TYPING UNIT MAIN SHAFT

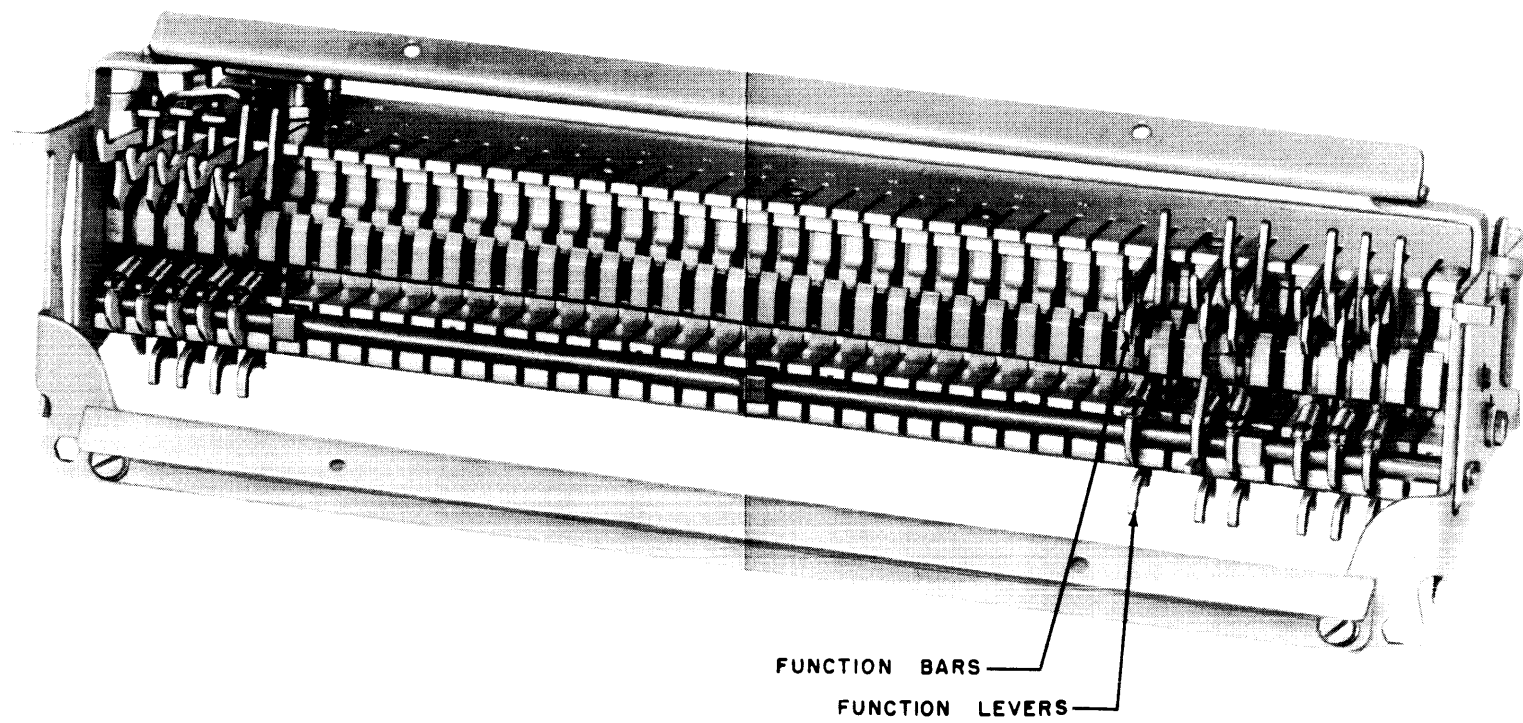


FIGURE I-8. TYPING UNIT FUNCTION BOX

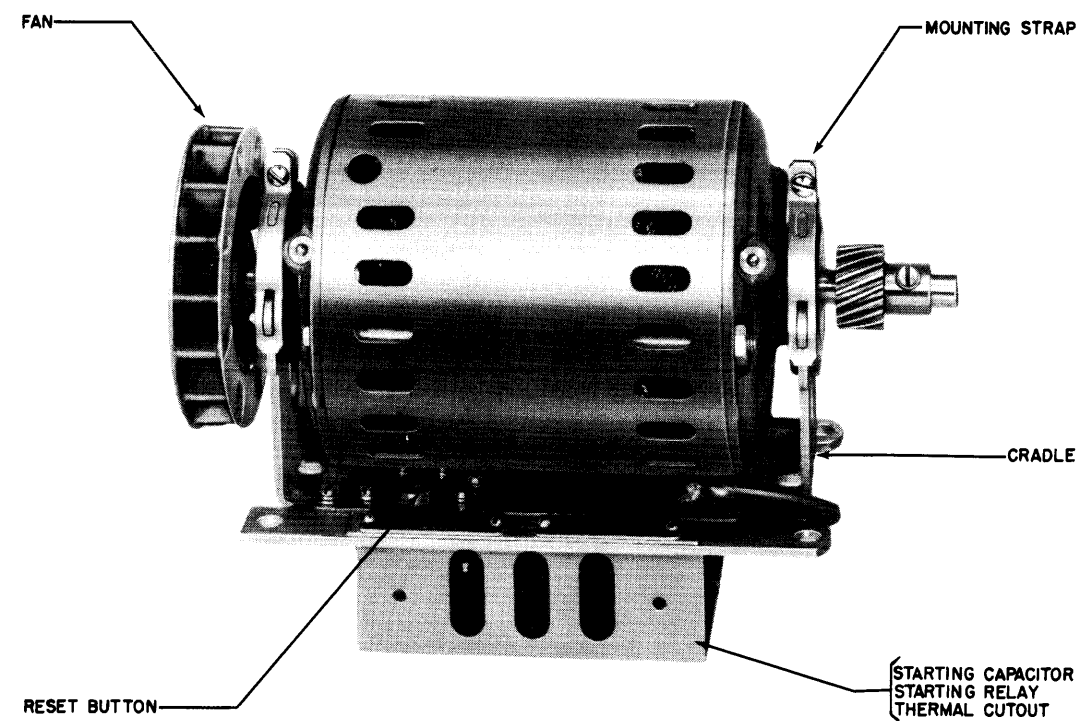


FIGURE I-9. MOTOR, SYNCHRONOUS

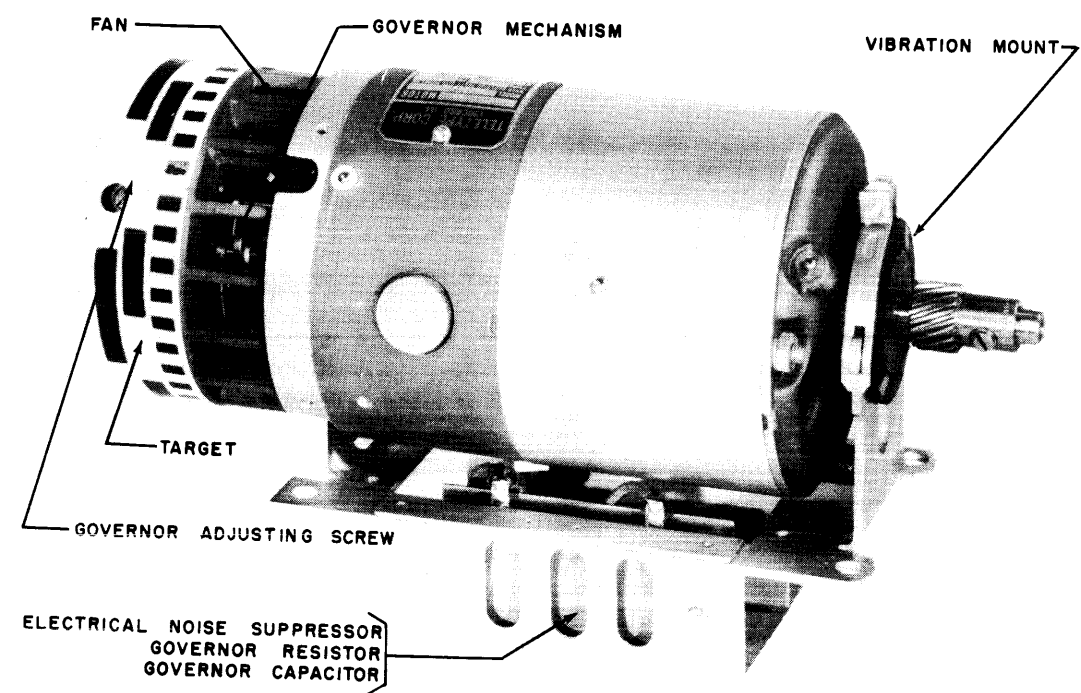


FIGURE I-10. MOTOR, GOVERNED

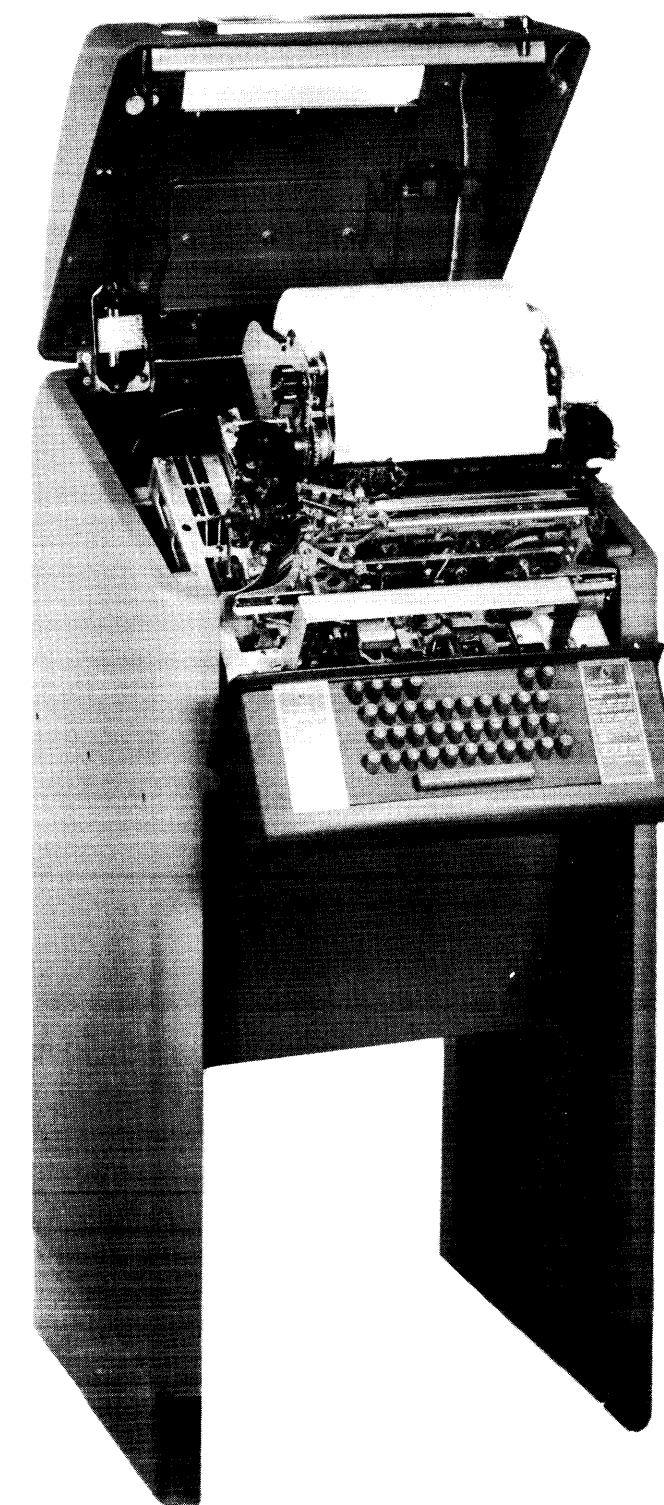


FIGURE I-11. TILTING ARRANGEMENT

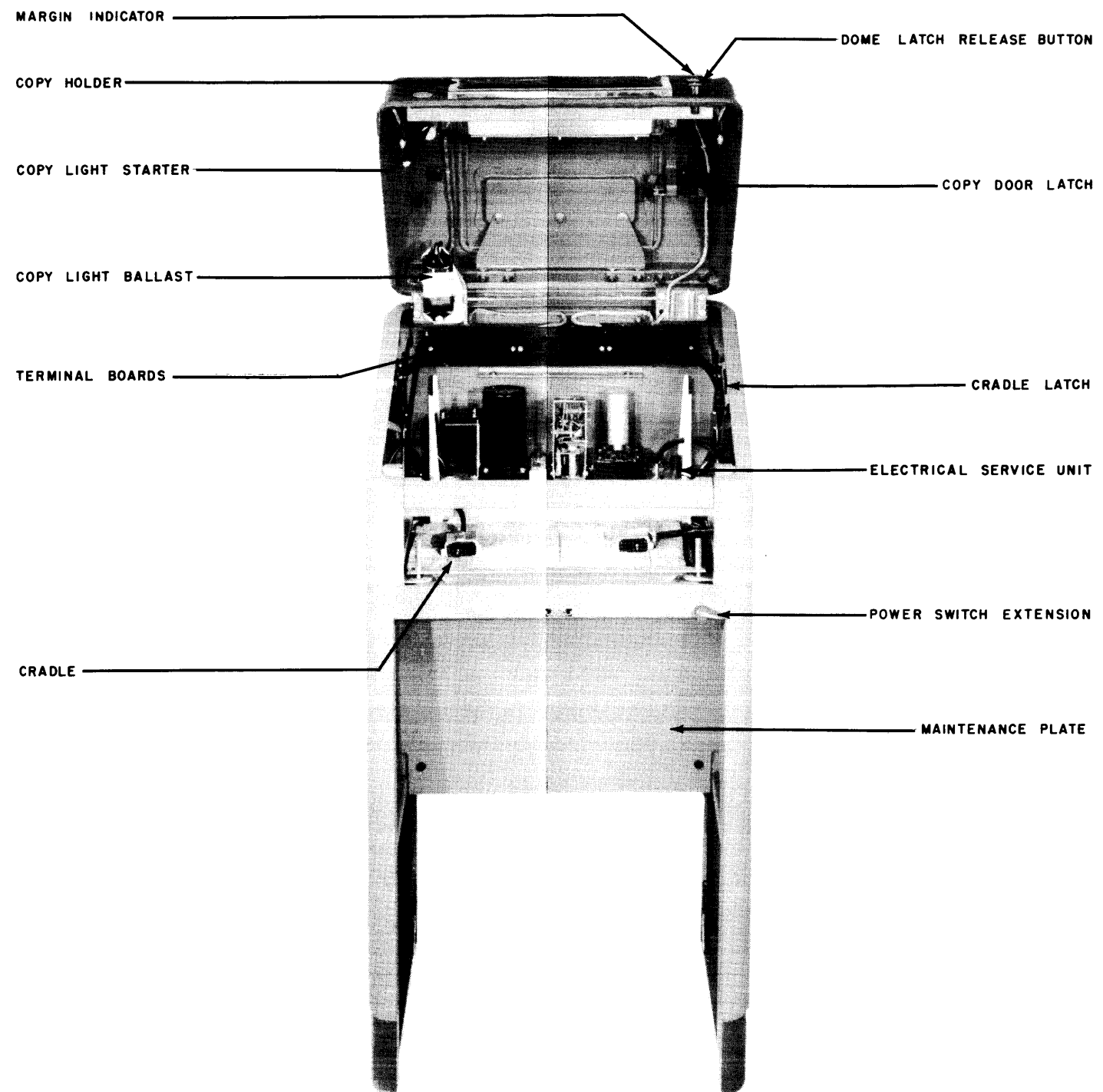


FIGURE 1-12. CABINET, WITH ELECTRICAL SERVICE UNIT

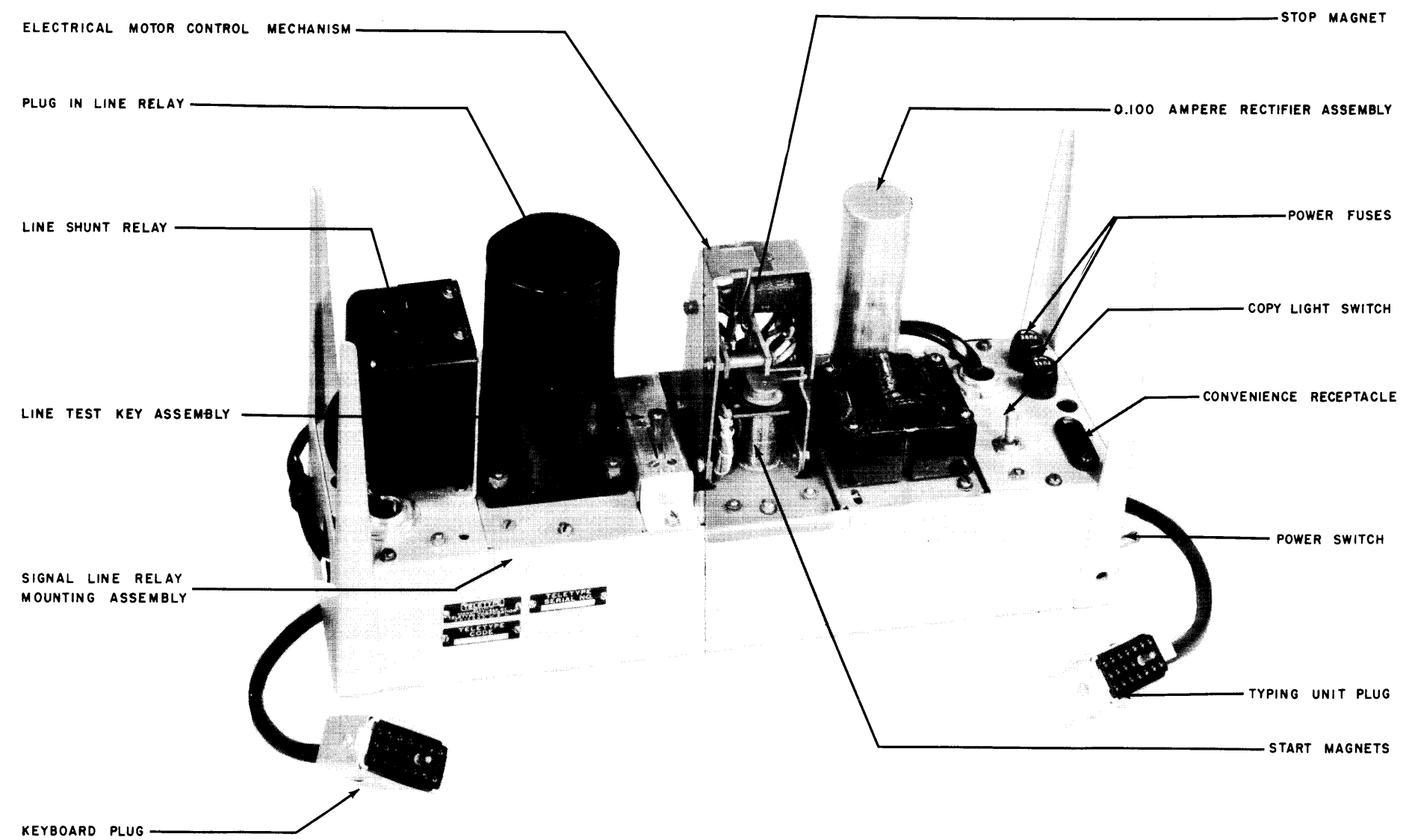


FIGURE I-13. ELECTRICAL SERVICE UNIT

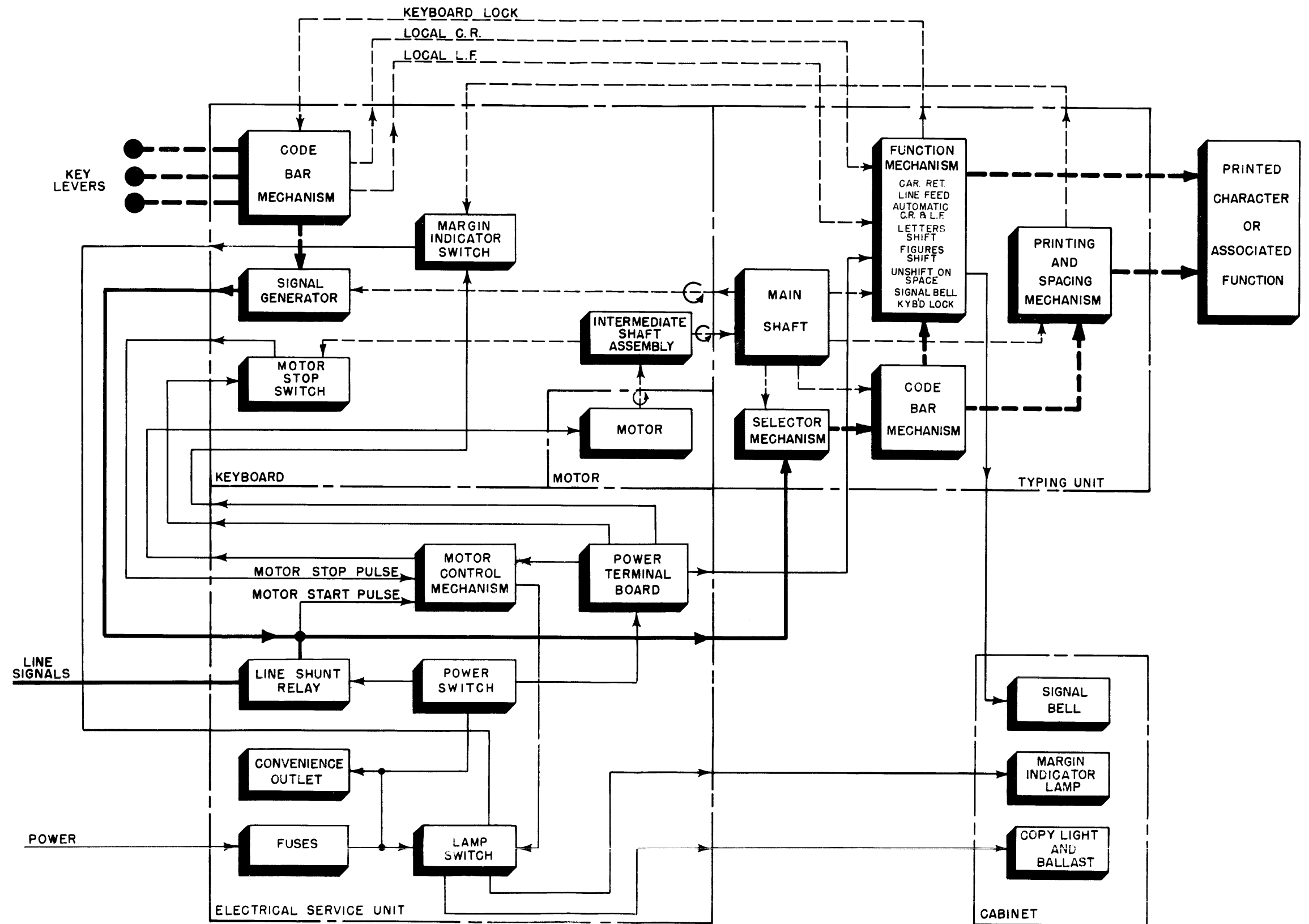


FIGURE 2-1. MODEL 28 PRINTER, FUNCTIONAL BLOCK DIAGRAM

FIGURES	-	?	:	\$	3	!	&	£	8	'	(	)	,	9	0	1	4	BELL	5	7	;	2	/	6	"	BLANK	LETTERS	FIGURES	SPACE	C.R.	L.F.	
LETTERS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z						
NUMBERS INDICATE MARKING IMPULSES	1	1		1	1	1				1	1					1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	2	2				2	2	2	2	2					2	2	2				2	2				2	2				2	
			3			3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	4	4	4			4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
					5	5				5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	

FIGURE 2-2. SIGNAL CODE

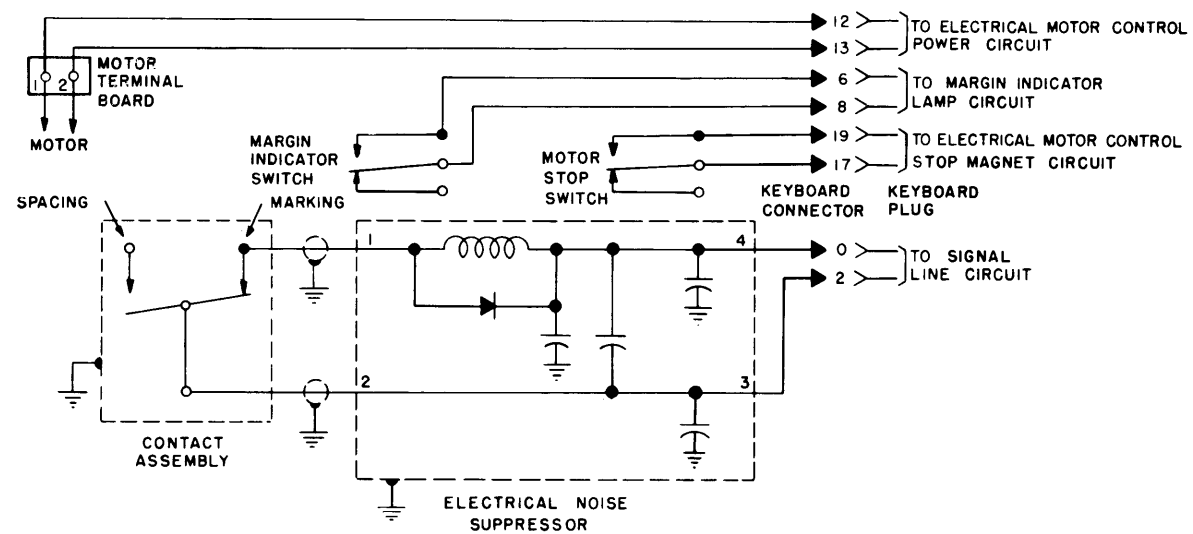


FIGURE 2-3. KEYBOARD, SCHEMATIC WIRING DIAGRAM

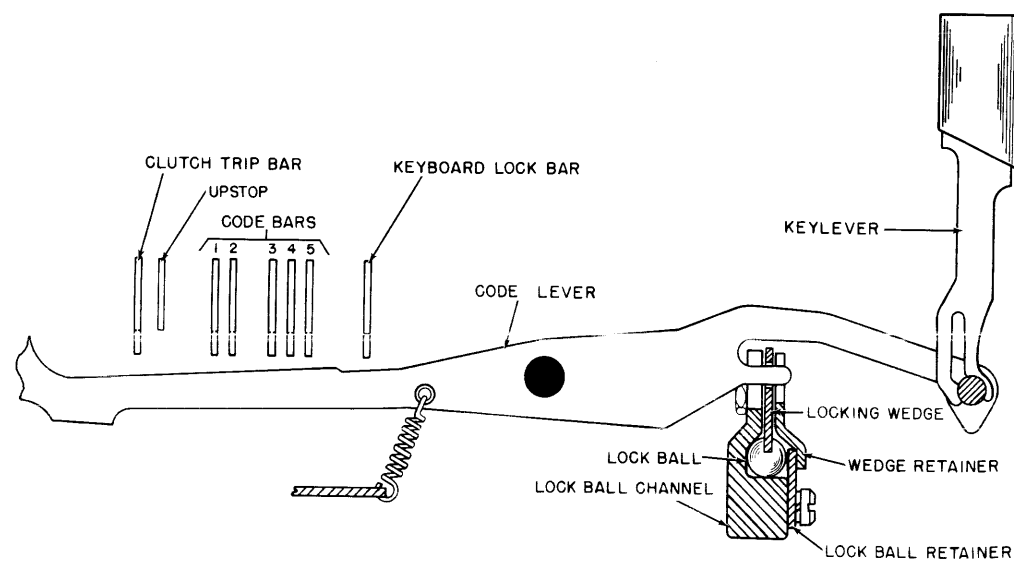


FIGURE 2-4. CODE BAR ARRANGEMENT

ORIGINAL

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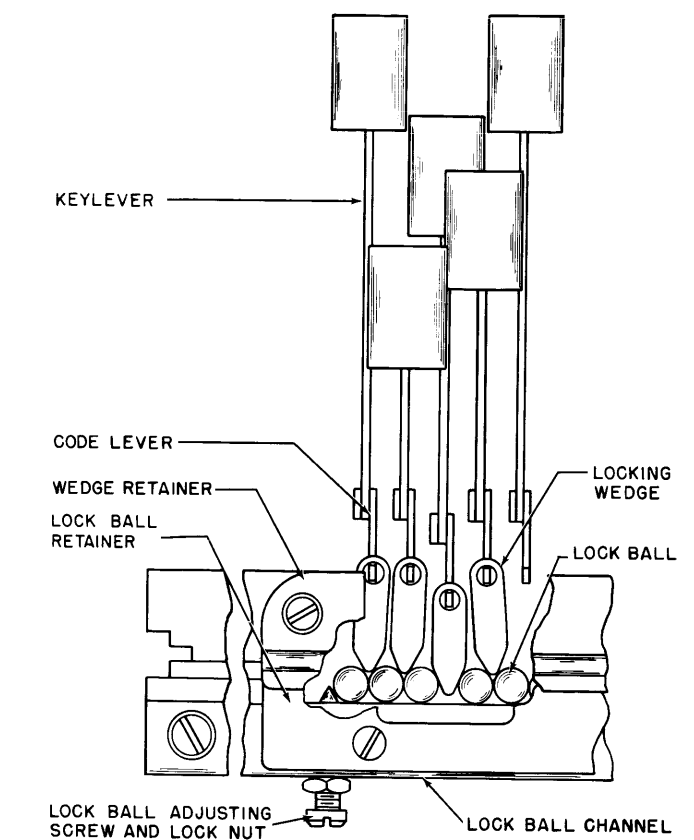


FIGURE 2-5. KEYLEVER LOCK BALL MECHANISM

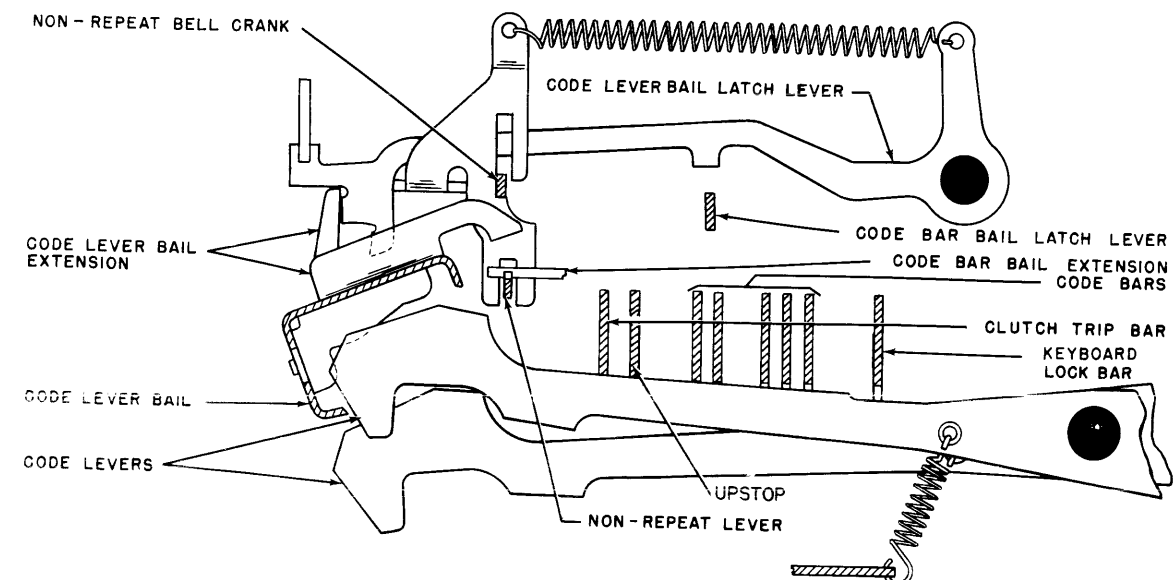


FIGURE 2-6. KEYLEVER MECHANISM, SELECTED POSITION

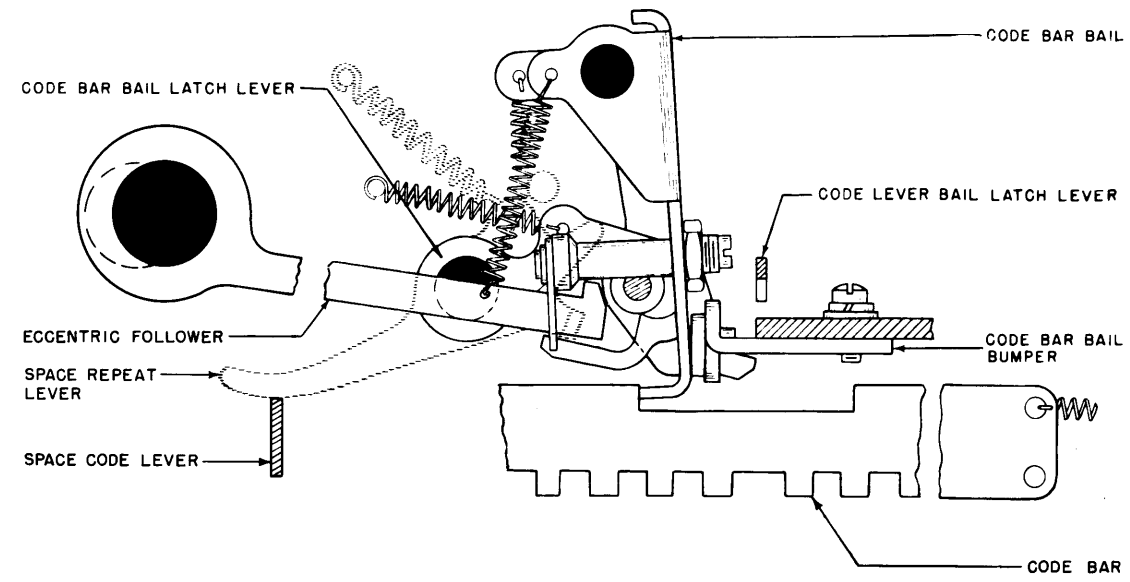


FIGURE 2-7. CODE BAR BAIL MECHANISM, RELEASED POSITION

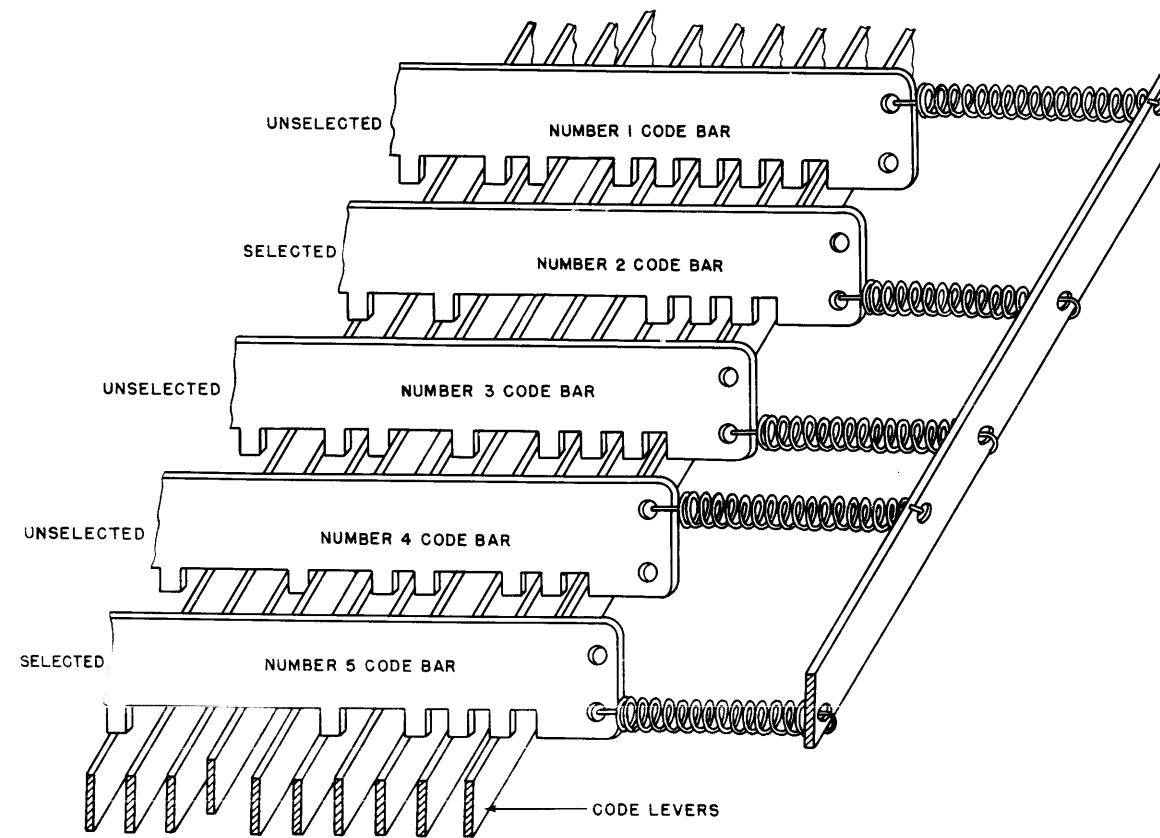


FIGURE 2-8. CODE BAR SELECTION

ORIGINAL

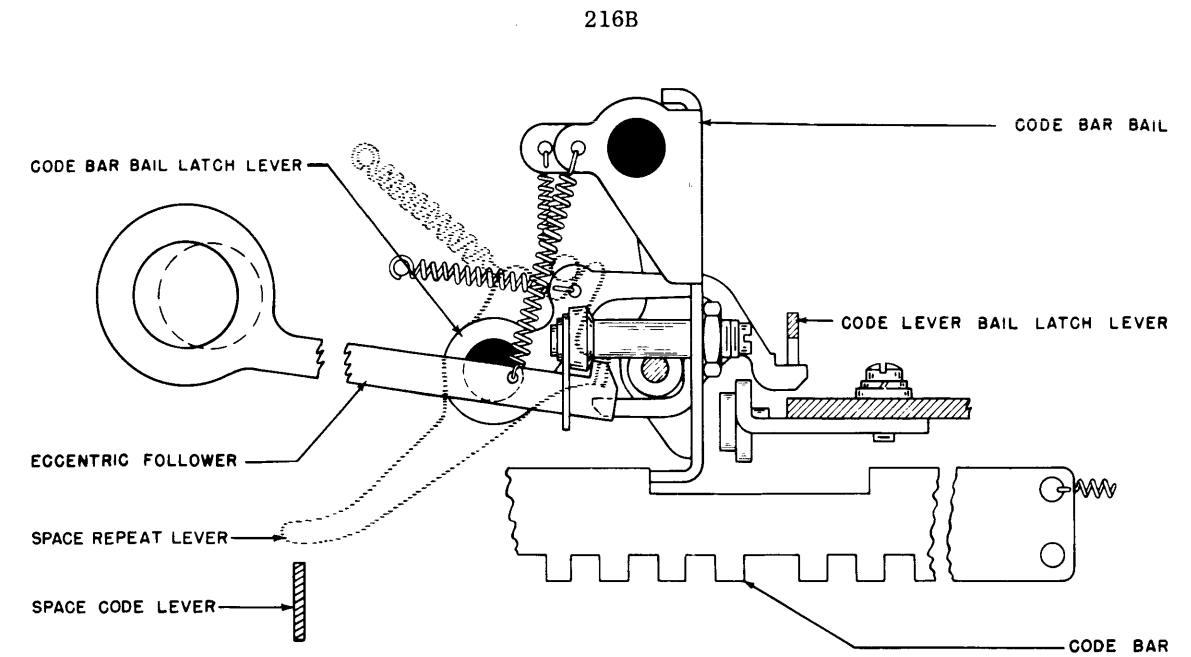


FIGURE 2-9. CODE BAR BAIL MECHANISM, RESET POSITION

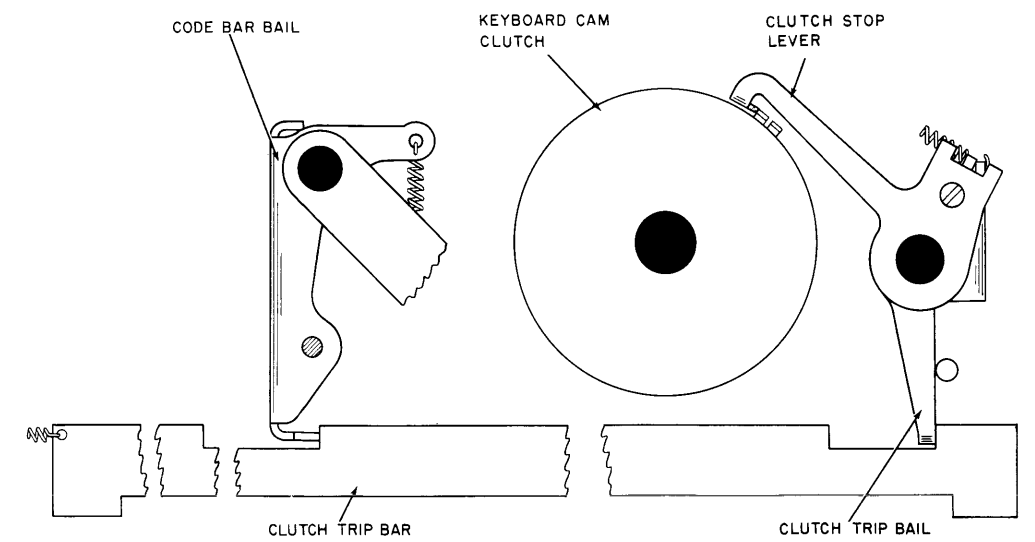


FIGURE 2-10. CLUTCH TRIP MECHANISM, REAR VIEW

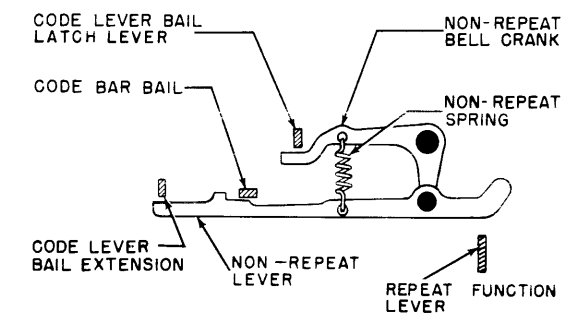


FIGURE 2-11. NON-REPEAT LEVER MECHANISM

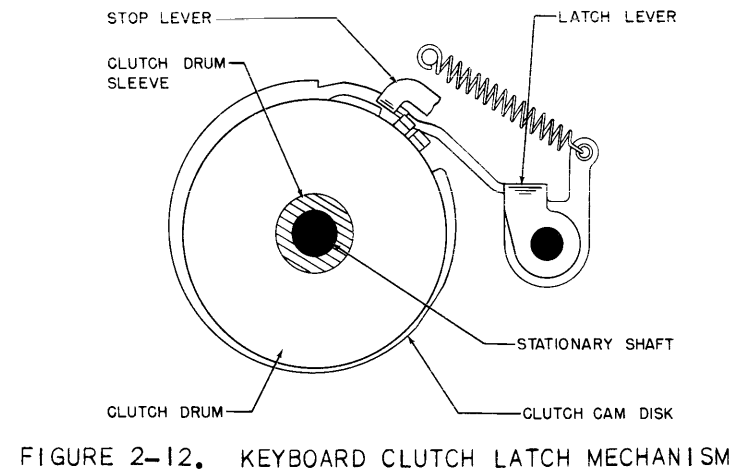


FIGURE 2-12. KEYBOARD CLUTCH LATCH MECHANISM

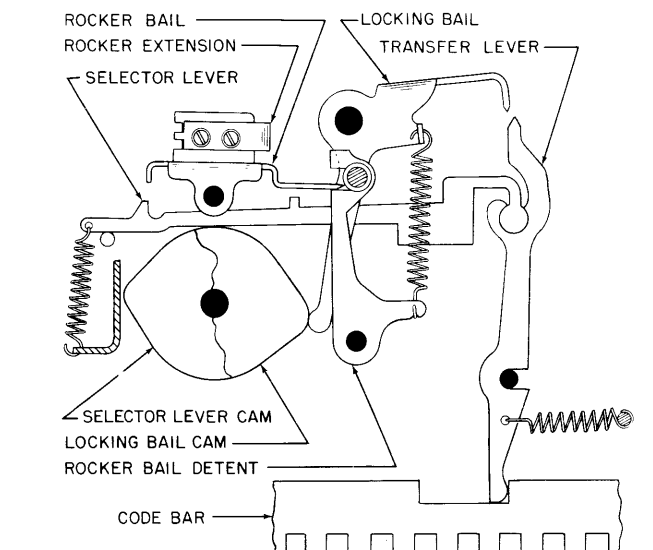


FIGURE 2-13. SIGNAL GENERATOR MECHANISM, FRONT VIEW

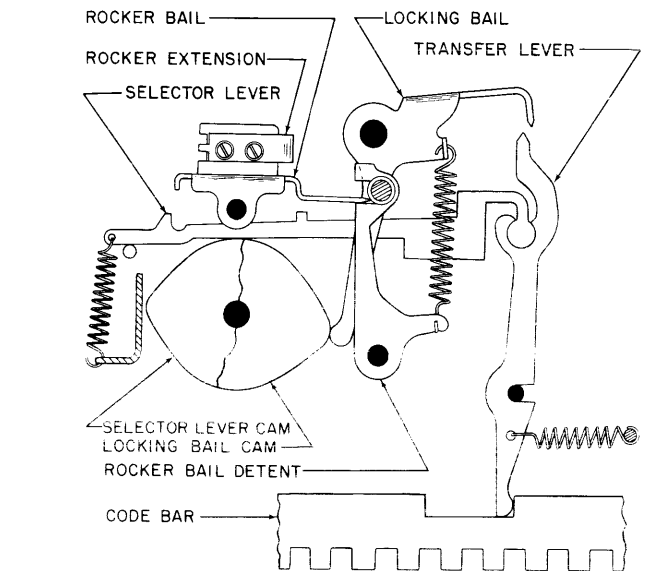


FIGURE 2-14. SIGNAL GENERATOR MECHANISM, FRONT VIEW

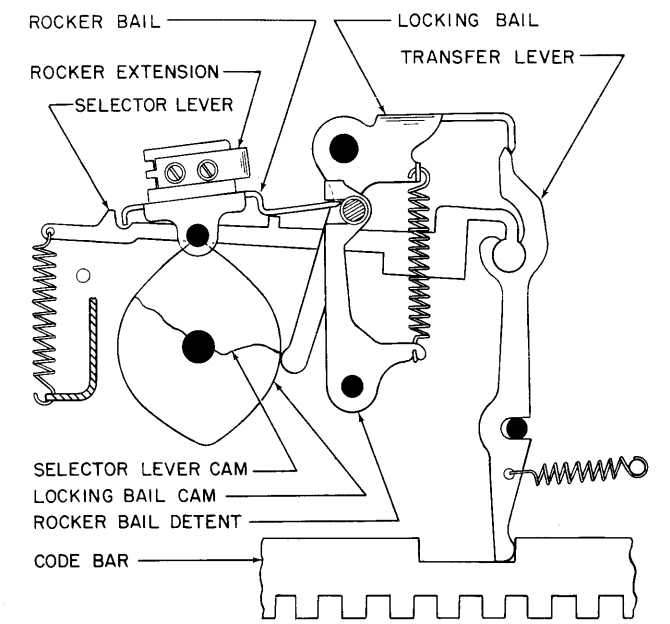


FIGURE 2-15. SIGNAL GENERATOR MECHANISM, FRONT VIEW

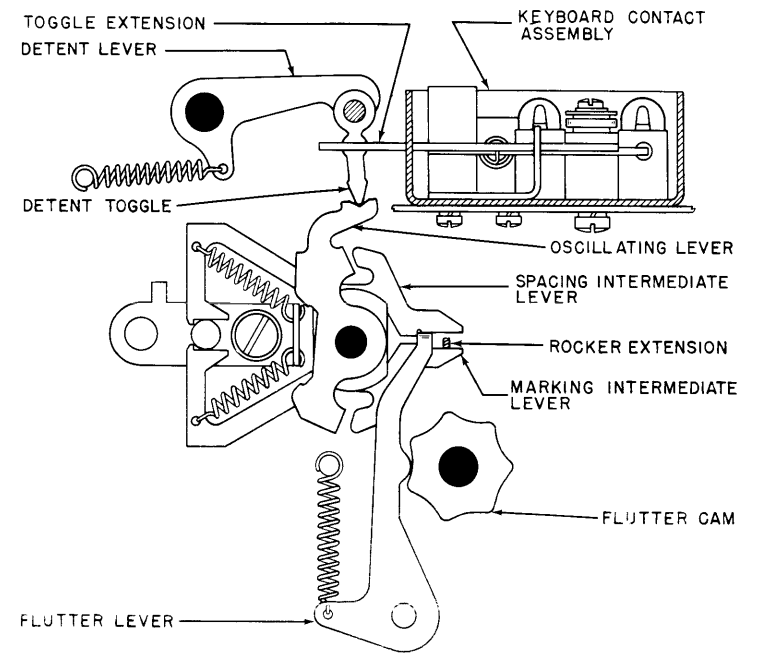


FIGURE 2-16. SIGNAL GENERATOR, REAR VIEW, STOP POSITION



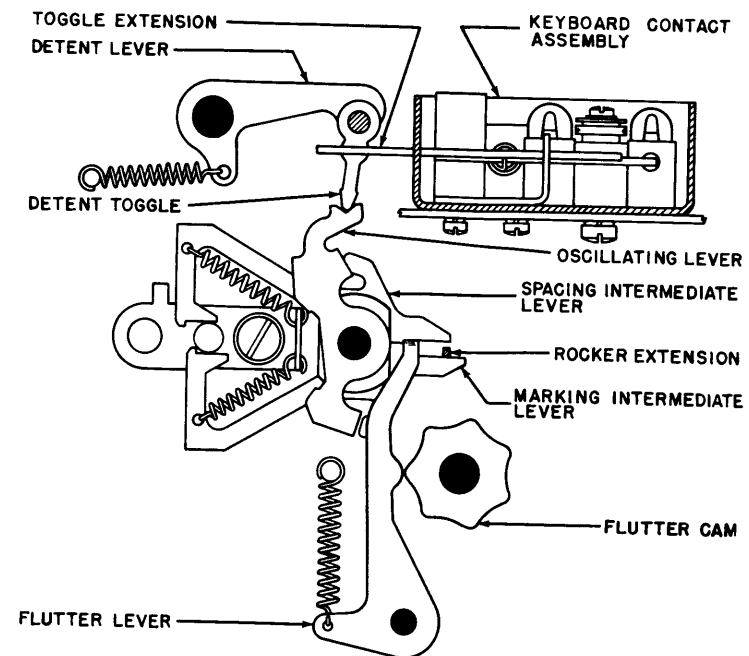


FIGURE 2-17. SIGNAL GENERATOR, REAR VIEW, SPACING POSITION

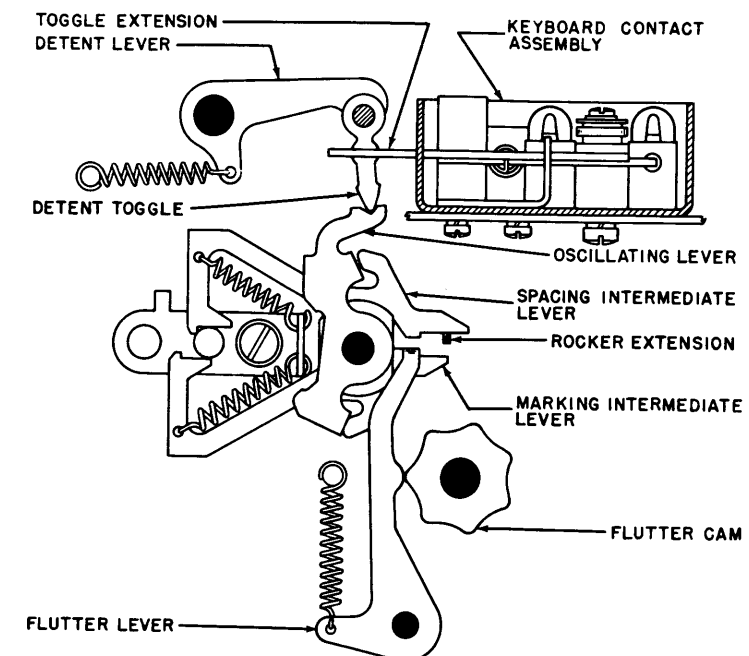


FIGURE 2-19. SIGNAL GENERATOR, REAR VIEW, MARKING POSITION

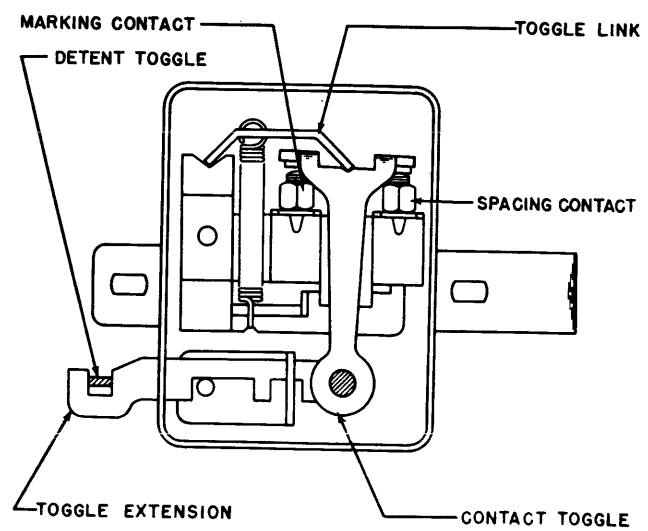


FIGURE 2-18. CONTACT ASSEMBLY, SPACING POSITION

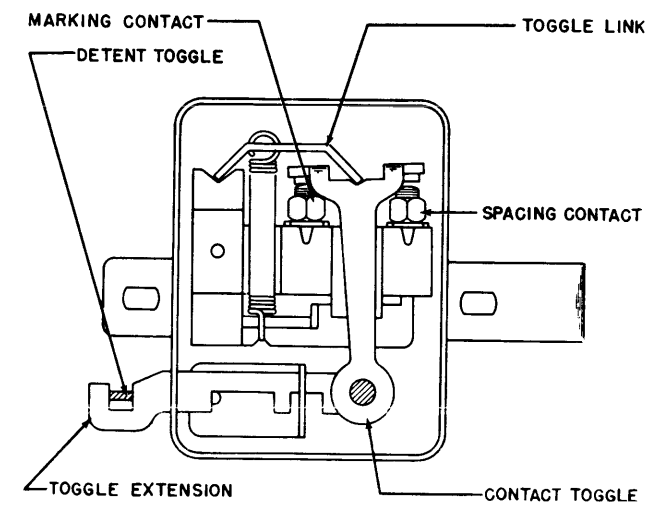


FIGURE 2-20. CONTACT ASSEMBLY, MARKING POSITION

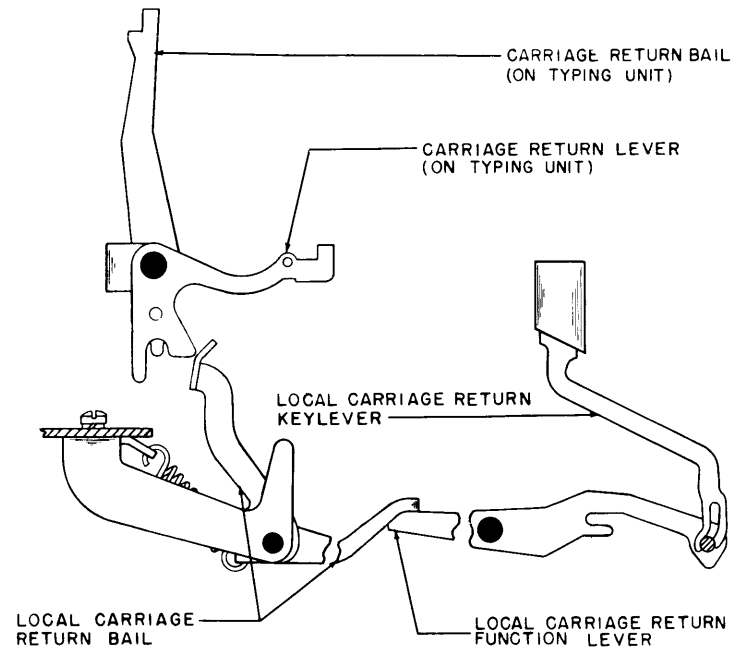


FIGURE 2-21. LOCAL CARRIAGE RETURN MECHANISM

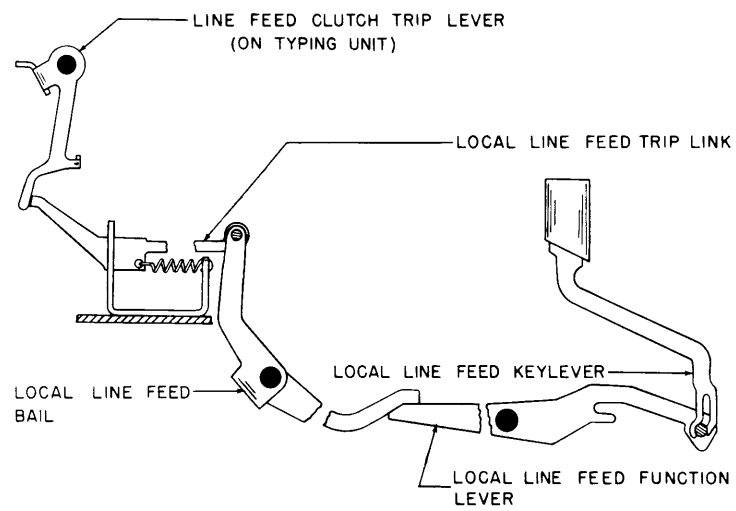


FIGURE 2-22. LOCAL LINE FEED MECHANISM

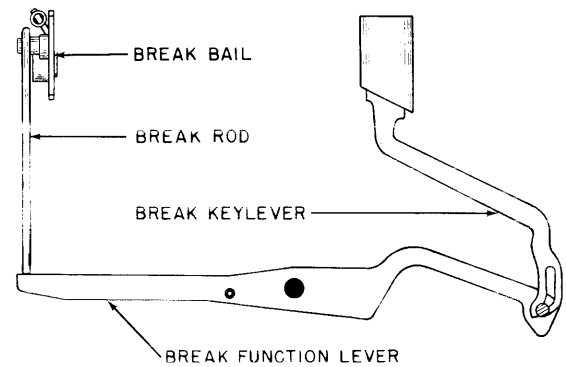


FIGURE 2-23. BREAK MECHANISM

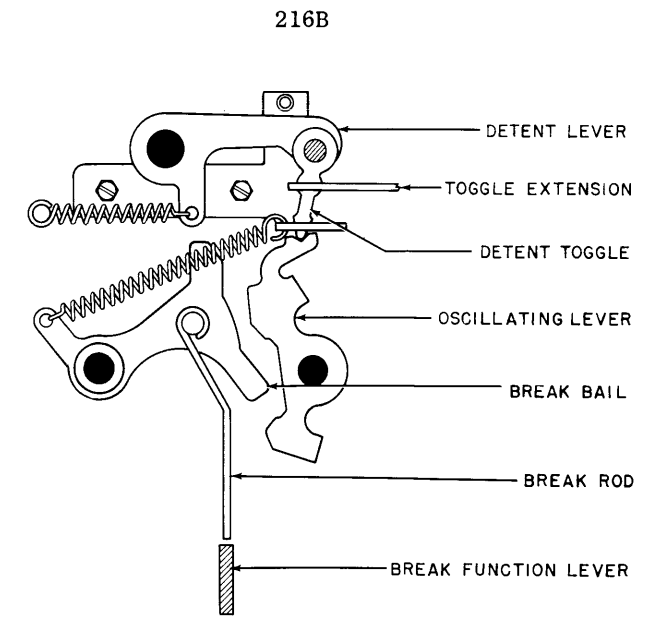


FIGURE 2-24. BREAK MECHANISM

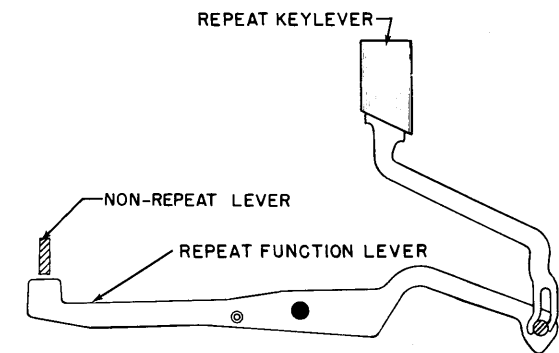


FIGURE 2-25. REPEAT MECHANISM

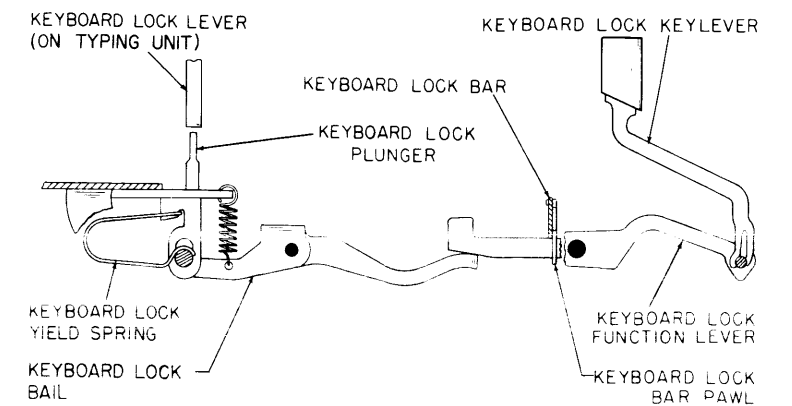


FIGURE 2-26. KEYBOARD LOCK MECHANISM

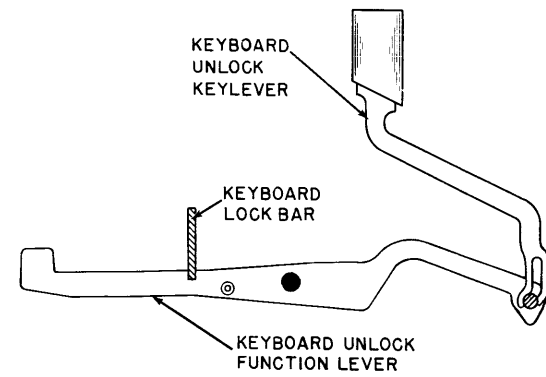


FIGURE 2-27. KEYBOARD UNLOCK MECHANISM

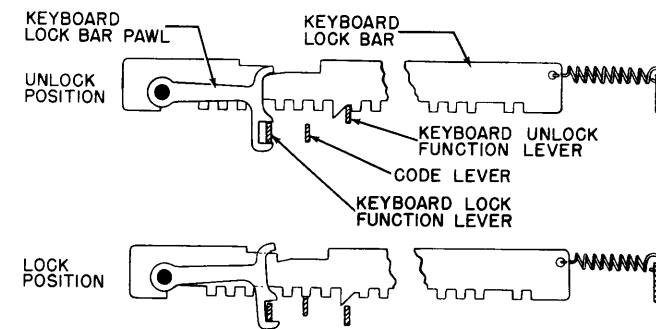


FIGURE 2-28. KEYBOARD LOCK MECHANISM

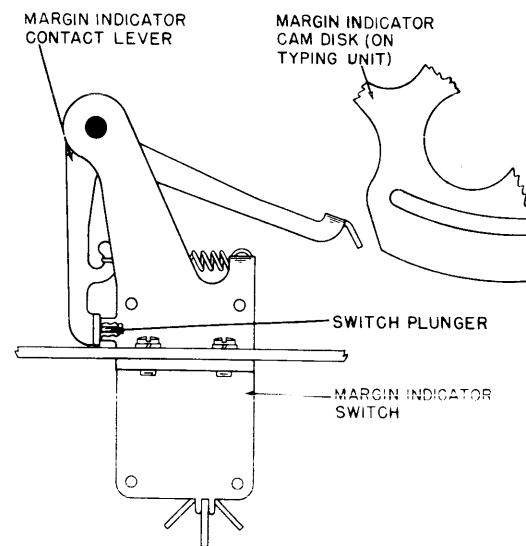


FIGURE 2-29. MARGIN INDICATOR MECHANISM

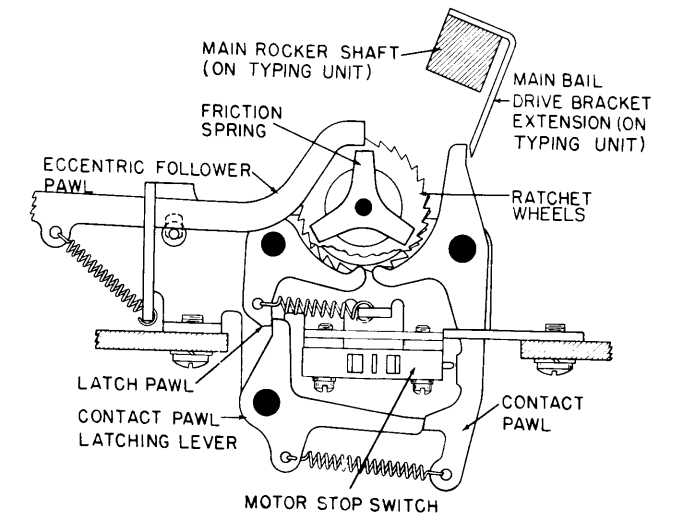


FIGURE 2-30. TIME DELAY MECHANISM

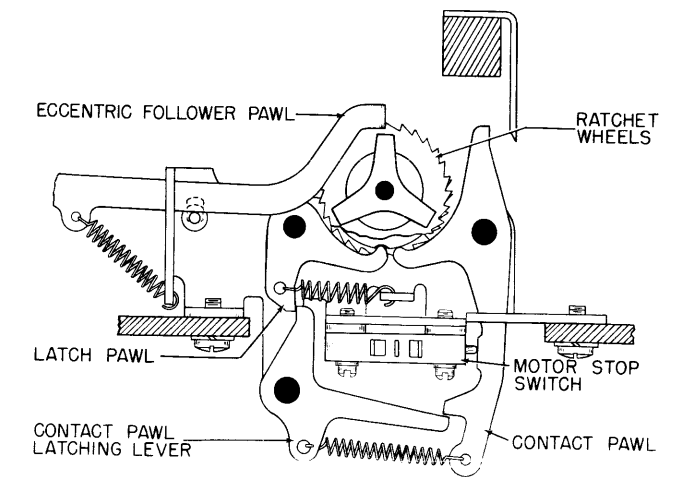


FIGURE 2-31. TIME DELAY MECHANISM

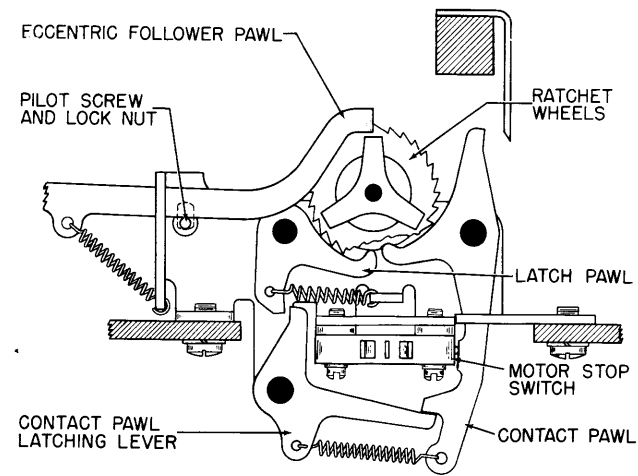


FIGURE 2-32. TIME DELAY MECHANISM

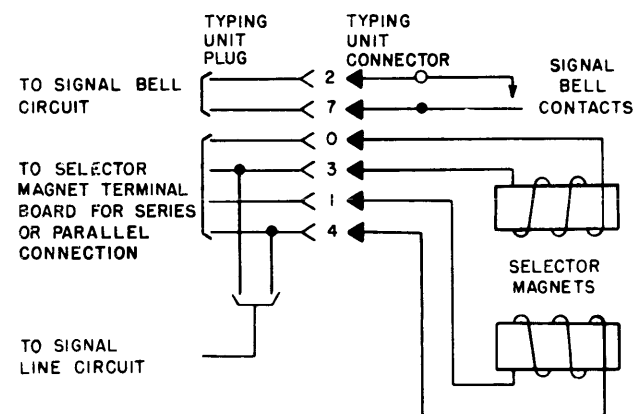


FIGURE 2-33. TYPING UNIT, SCHEMATIC WIRING DIAGRAM

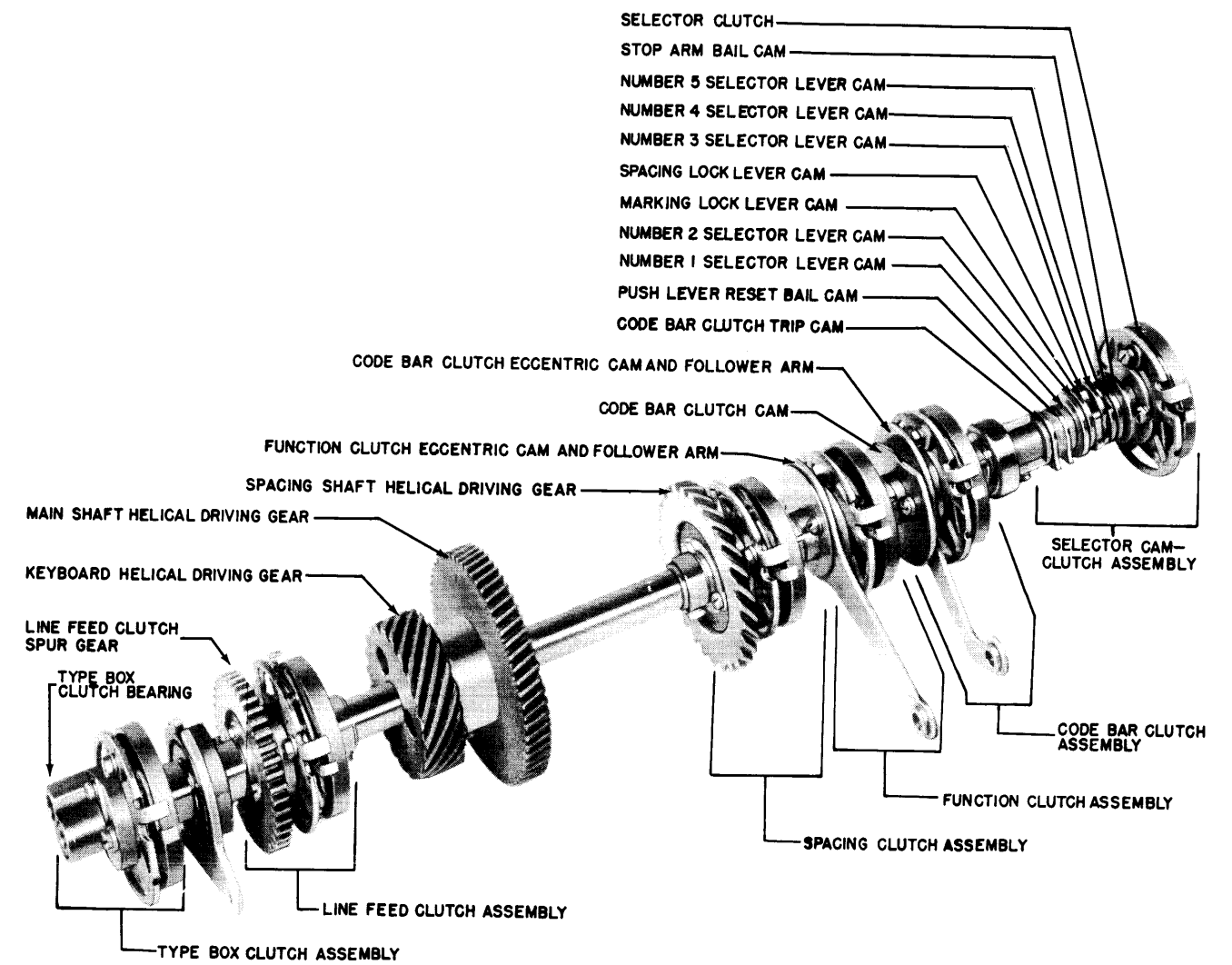


FIGURE 2-34. TYPING UNIT MAIN SHAFT

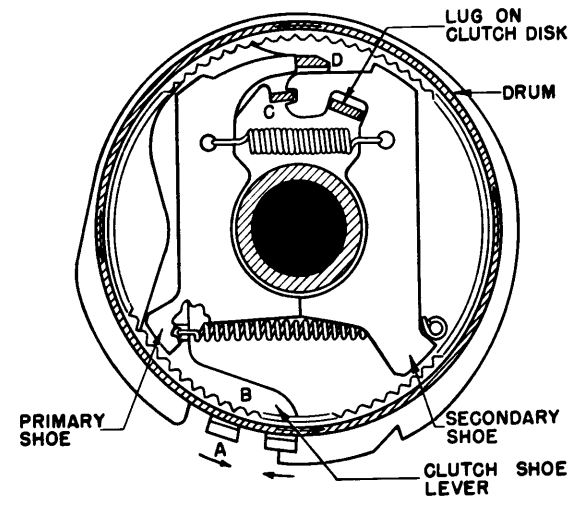


FIGURE 2-35. CLUTCH, DISENGAGED

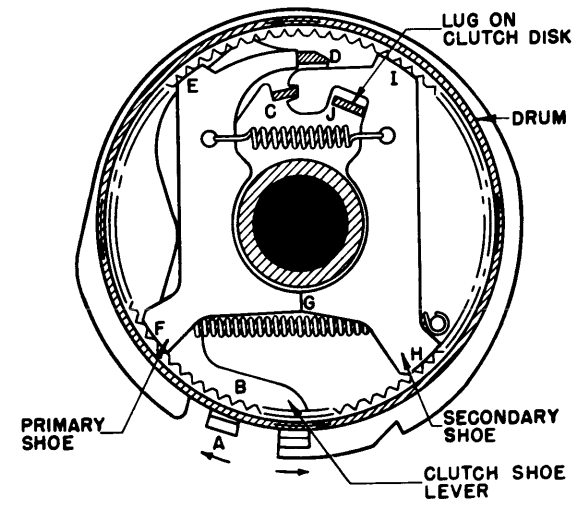


FIGURE 2-36. CLUTCH, ENGAGED

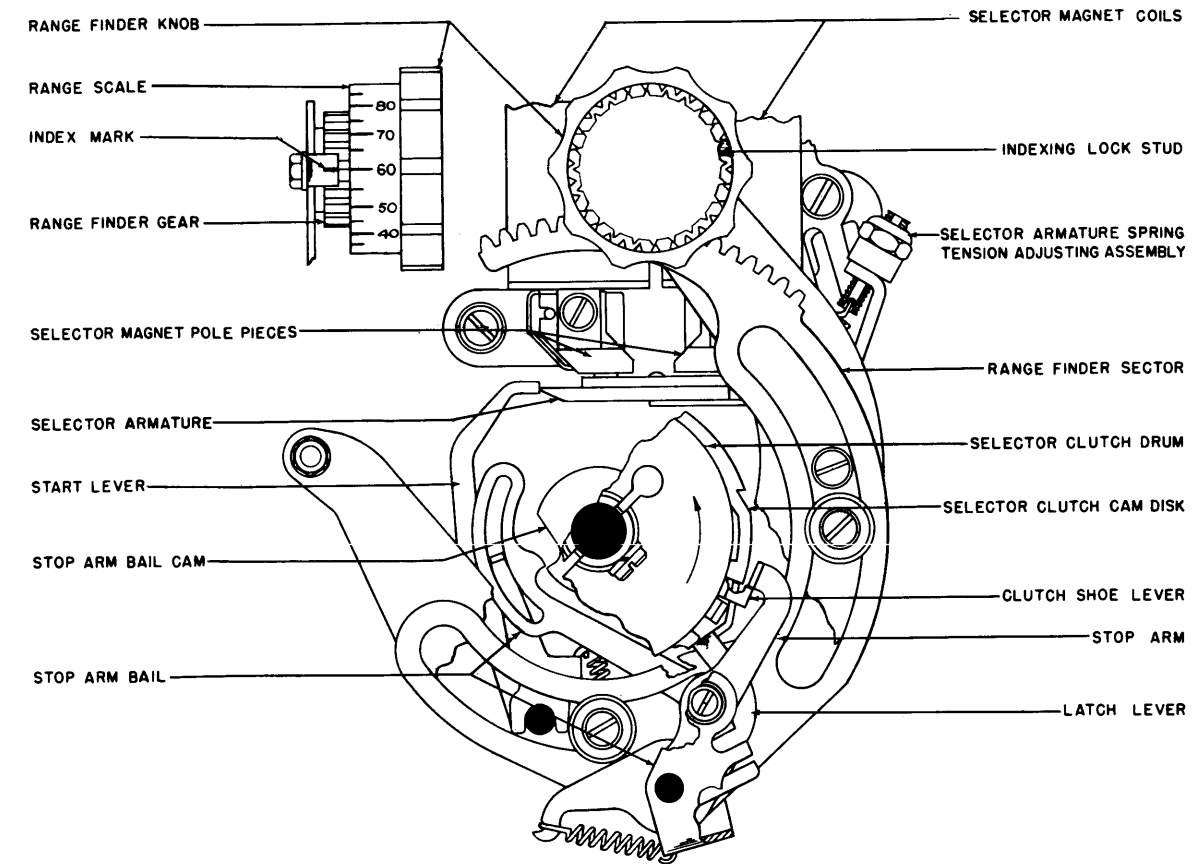


FIGURE 2-37. SELECTOR CAM-CLUTCH TRIP MECHANISM

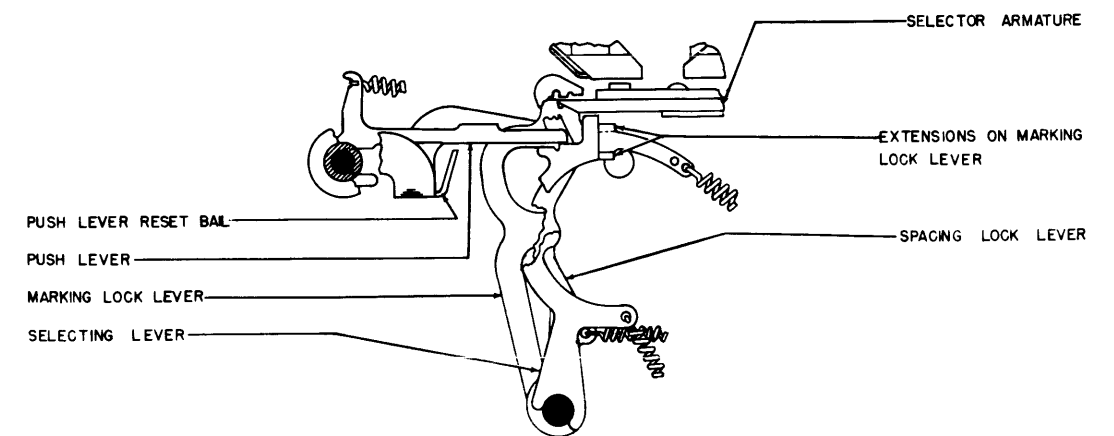


FIGURE 2-38. SELECTING MECHANISM, RIGHT END VIEW

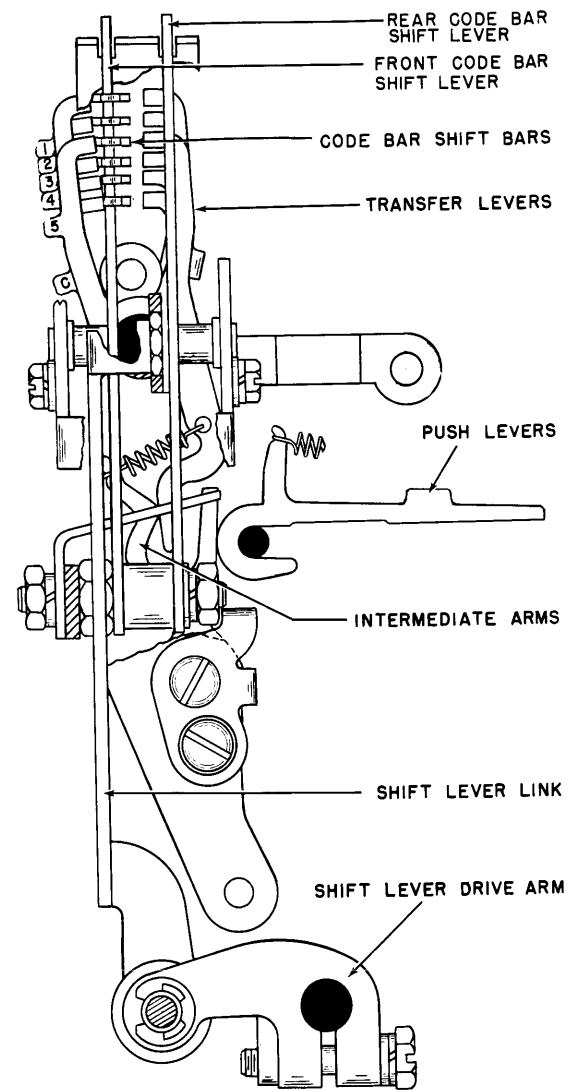


FIGURE 2-39. CODE BAR POSITIONING MECHANISM

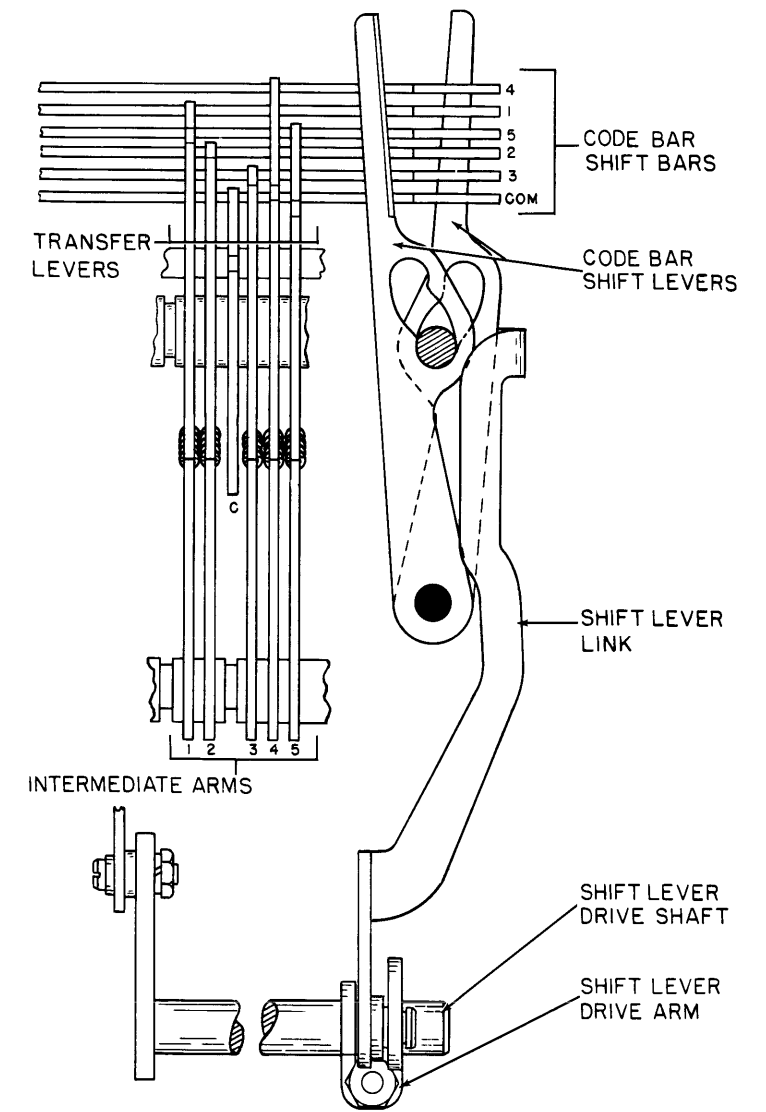


FIGURE 2-40. CODE BAR POSITIONING MECHANISM, FRONT VIEW

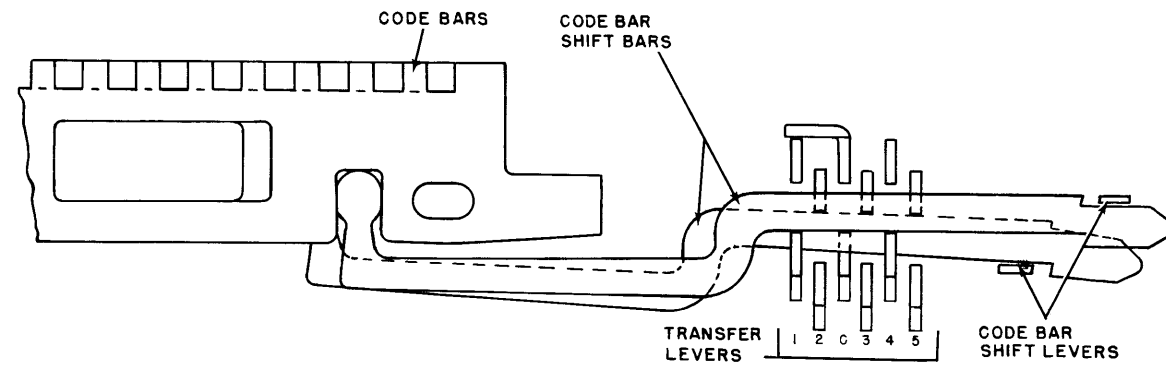


FIGURE 2-41. CODE BAR POSITIONING MECHANISM, TOP VIEW

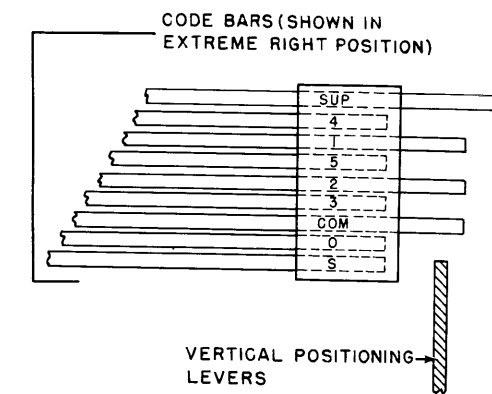


FIGURE 2-42. CODE BAR ARRANGEMENT

		LETTERS				FIGURES				
		LEFT		RIGHT		LEFT		RIGHT		
		4 8 5 MARKING	4 MARKING	4 SPACING	4 8 5 MARKING	4 8 5 MARKING	4 MARKING	4 SPACING	4 8 5 MARKING	
		5 SPACING	5 MARKING	5 SPACING	5 MARKING	5 SPACING	5 MARKING	5 SPACING	5 MARKING	
TOP ROW		M	N	H	SPACE	BLANK	T	C. R.	O	
		--3 4 5	--3 4--	--3-5	--3--	----	-----5	----4-	---4 5	
2ND ROW		X	F	Y	S	E	Z	D	B	
		1-3 4 5	1-3 4-	1-3-5	1-3--	1-----	1-----5	1--4-	1--4 5	
3RD ROW		V	C	P	I	L. F.	L	R	G	
		-2 3 4 5	-2 3 4-	-2 3-5	-2 3--	-2-----	-2-----5	-2-4-	-2-4 5	
BOTTOM ROW		LETTERS	K	Q	U	A	W	J	FIGURES	
		1 2 3 4 5	1 2 3 4-	1 2 3-5	1 2 3--	1 2-----	1 2-----5	1 2-4-	1 2-4 5	
		3 MARKING				3 SPACING				
		4TH ROW	3RD ROW	2ND ROW	1ST ROW	1ST ROW	2ND ROW	3RD ROW	4TH ROW	

		LETTERS				FIGURES				
		LEFT		RIGHT		LEFT		RIGHT		
		4 8 5 MARKING	4 MARKING	4 SPACING	4 8 5 MARKING	4 8 5 MARKING	4 MARKING	4 SPACING	4 8 5 MARKING	
		5 SPACING	5 MARKING	5 SPACING	5 MARKING	5 SPACING	5 MARKING	5 SPACING	5 MARKING	
TOP ROW		.	,	#	SPACE	BLANK	5	C. R.	9	1 8 2
		--3 4 5	--3 4-	--3-5	--3--	----	-----5	----4-	---4 5	SPACING
2ND ROW		/	!	6	BELL	3	"	\$	?	MARKING
		1-3 4 5	1-3 4-	1-3-5	1-3--	1-----	1-----5	1--4-	1--4 5	2 SPACING
3RD ROW		;	:	0	8	L. F.	)	4	&	SPACING
		-2 3 4 5	-2 3 4-	-2 3-5	-2 3--	-2-----	-2-----5	-2-4-	-2-4 5	2 MARKING
BOTTOM ROW		LETTERS	(	1	7	-	2	▼	FIGURES	1 8 2
		1 2 3 4 5	1 2 3 4-	1 2 3-5	1 2 3--	1 2-----	1 2-----5	1 2-4-	1 2-4 5	MARKING
		3 MARKING				3 SPACING				
		4TH ROW	3RD ROW	2ND ROW	1ST ROW	1ST ROW	2ND ROW	3RD ROW	4TH ROW	

FIGURE 2-43. TYPE BOX ARRANGEMENT, VIEWED FROM FRONT OF TYPING UNIT

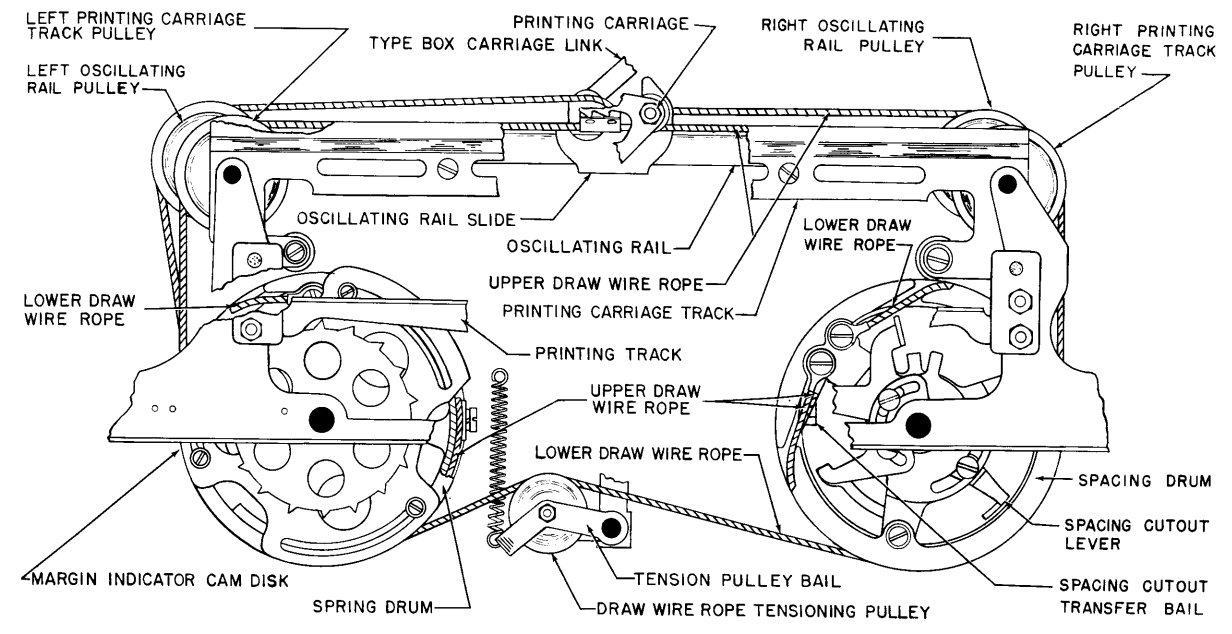


FIGURE 2-44. DRAW WIRE ROPE MECHANISM

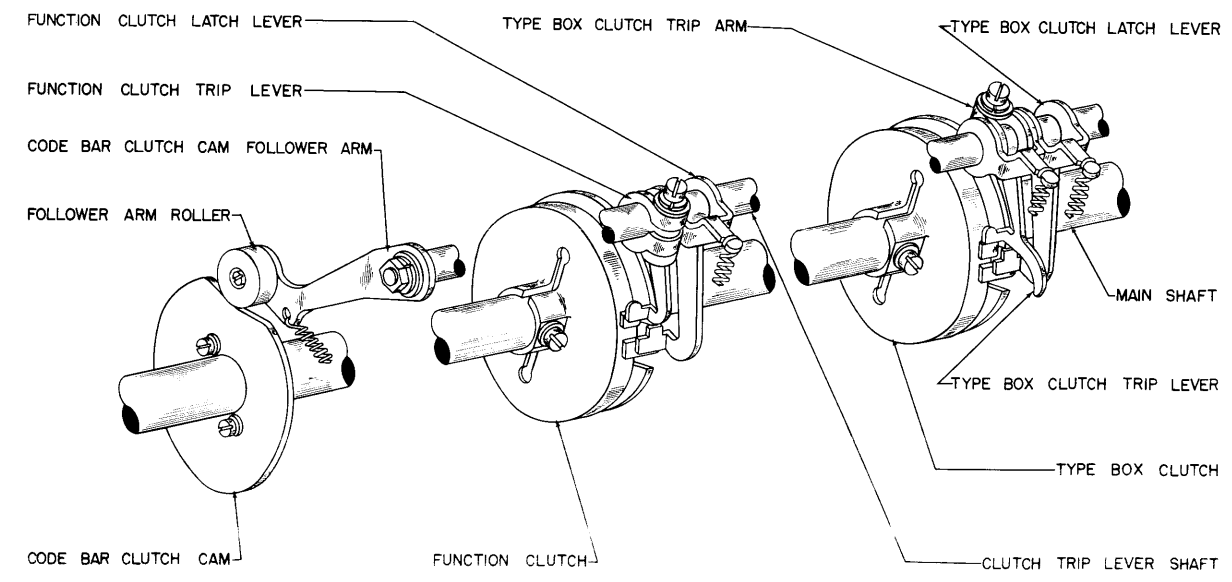


FIGURE 2-45. TRIP MECHANISM FOR FUNCTION AND TYPE BOX CLUTCHES

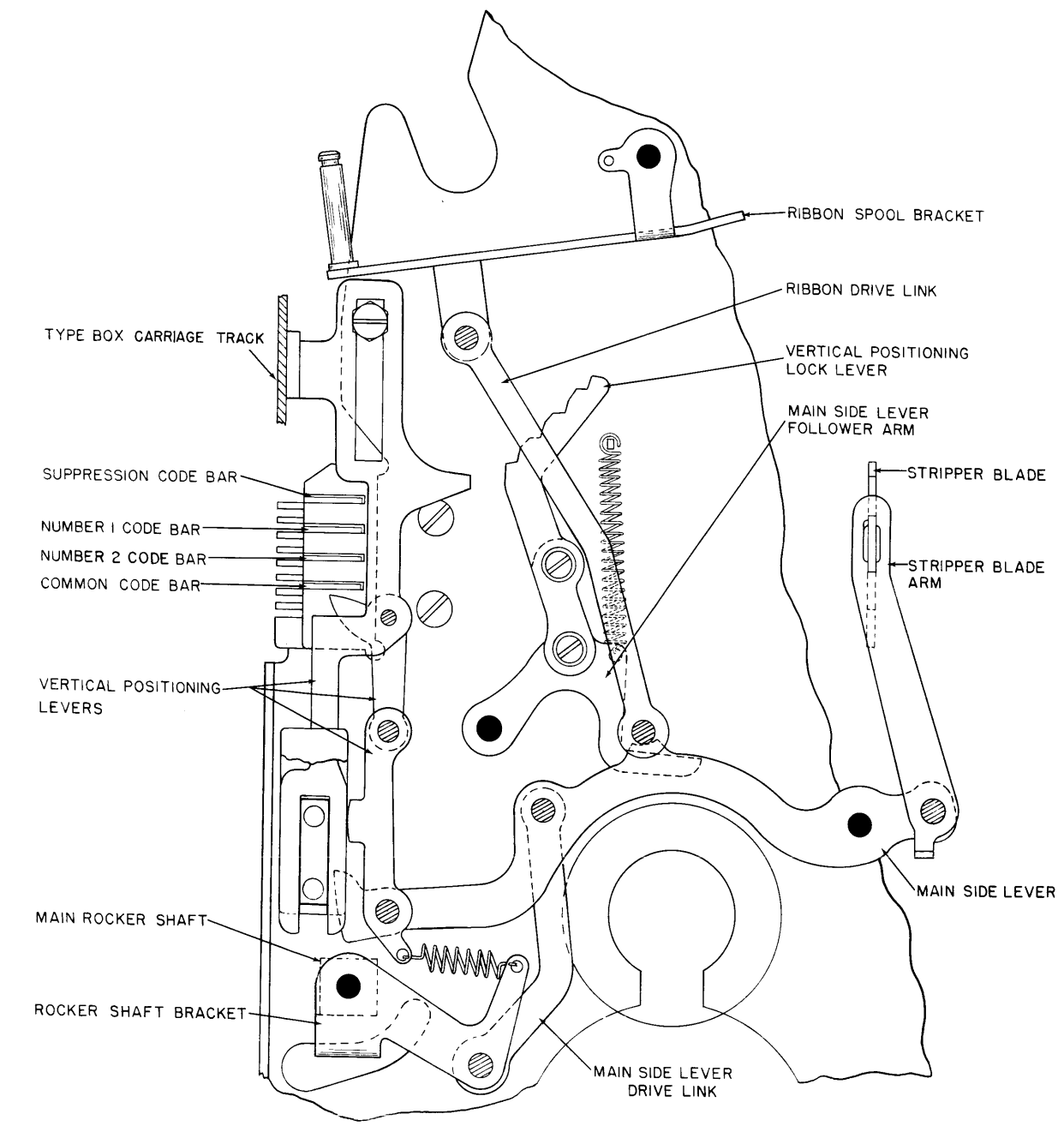


FIGURE 2-46. RIGHT SIDE MECHANISM



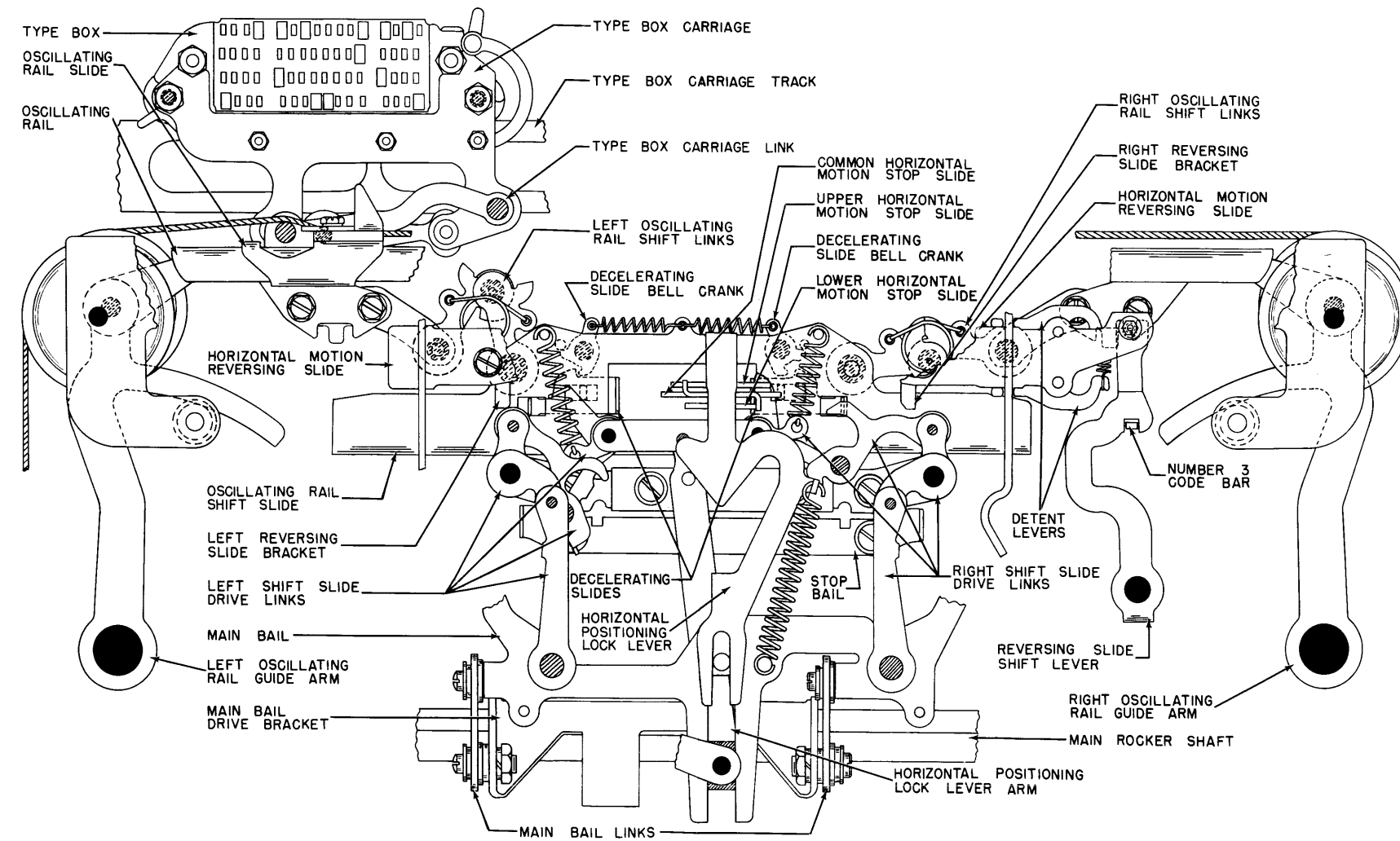


FIGURE 2-47. FRONT PLATE HORIZONTAL POSITIONING MECHANISM

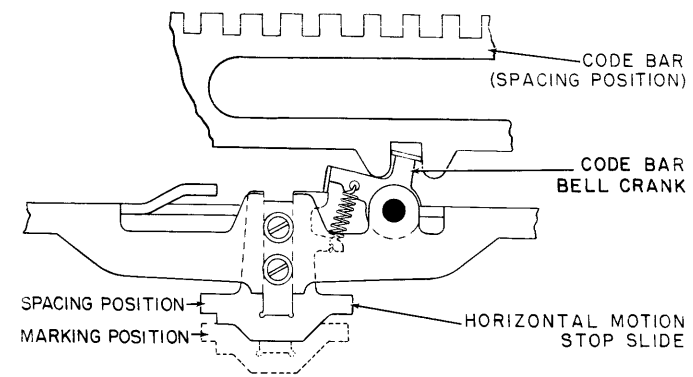


FIGURE 2-48. STOP SLIDE POSITIONING

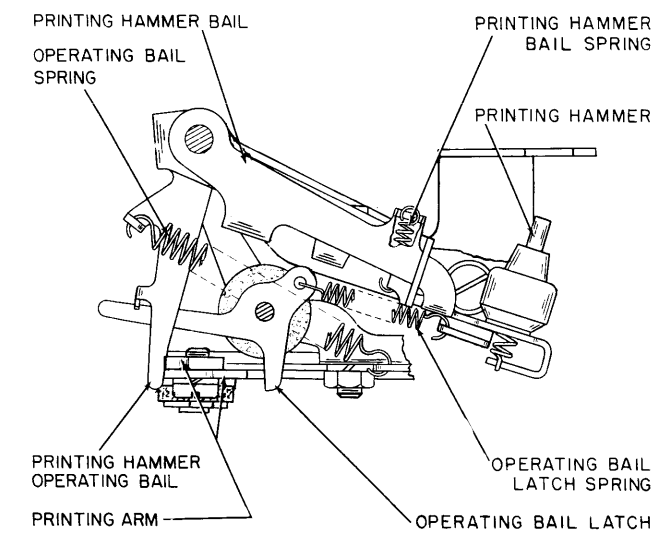


FIGURE 2-50. PRINTING HAMMER MECHANISM, TOP VIEW

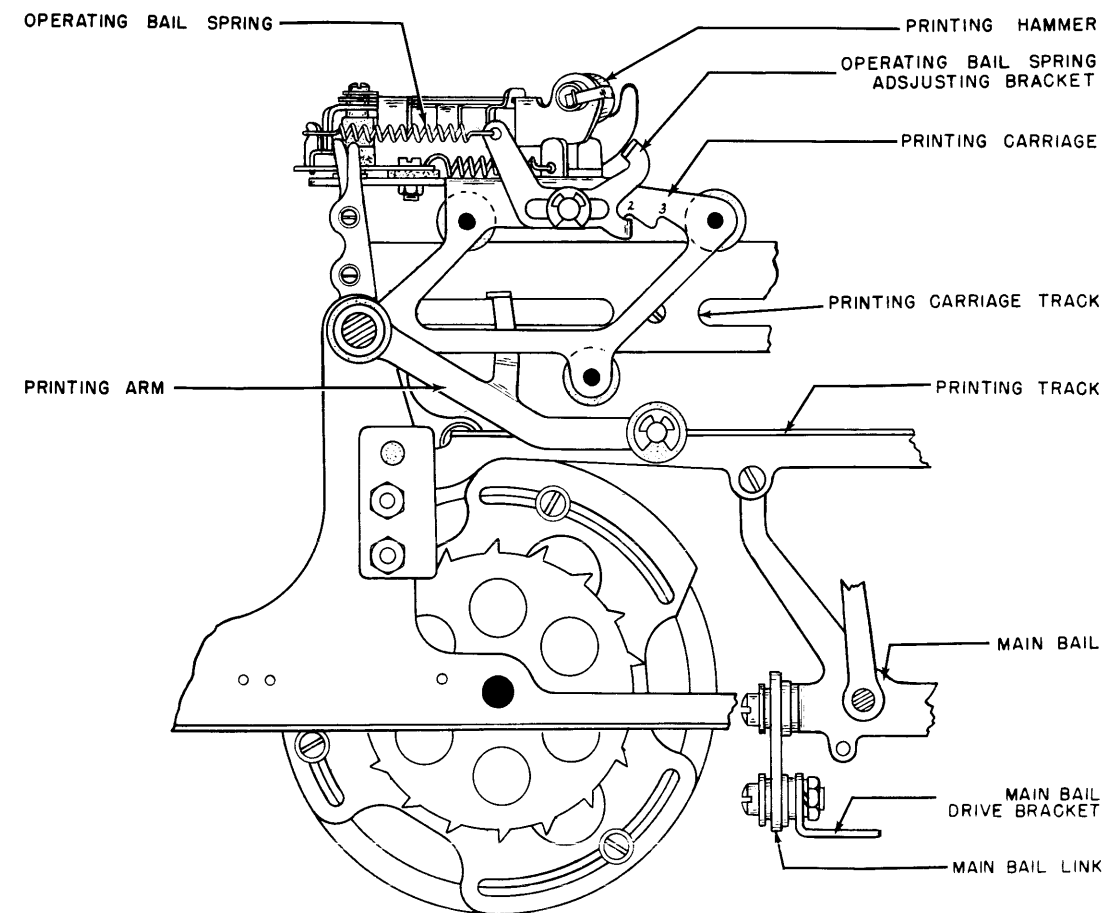


FIGURE 2-49. PRINTING HAMMER MECHANISM, FRONT VIEW

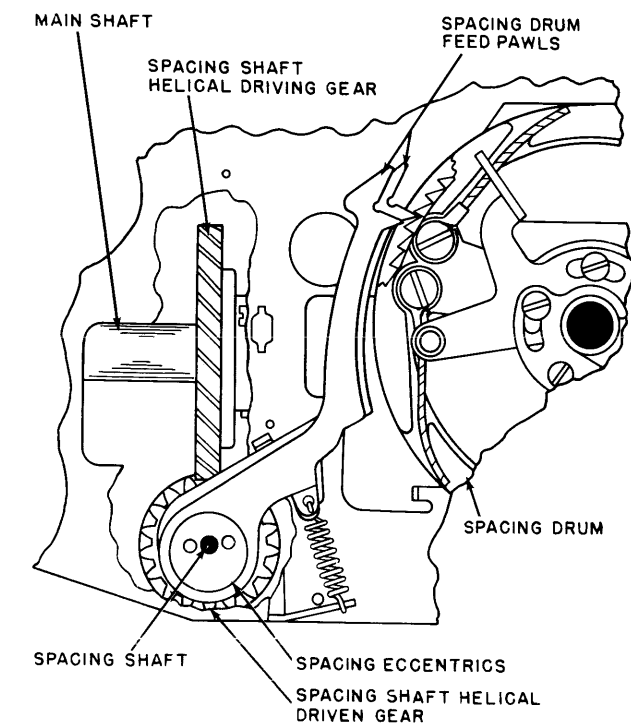


FIGURE 2-51. SPACING DRUM DRIVE MECHANISM

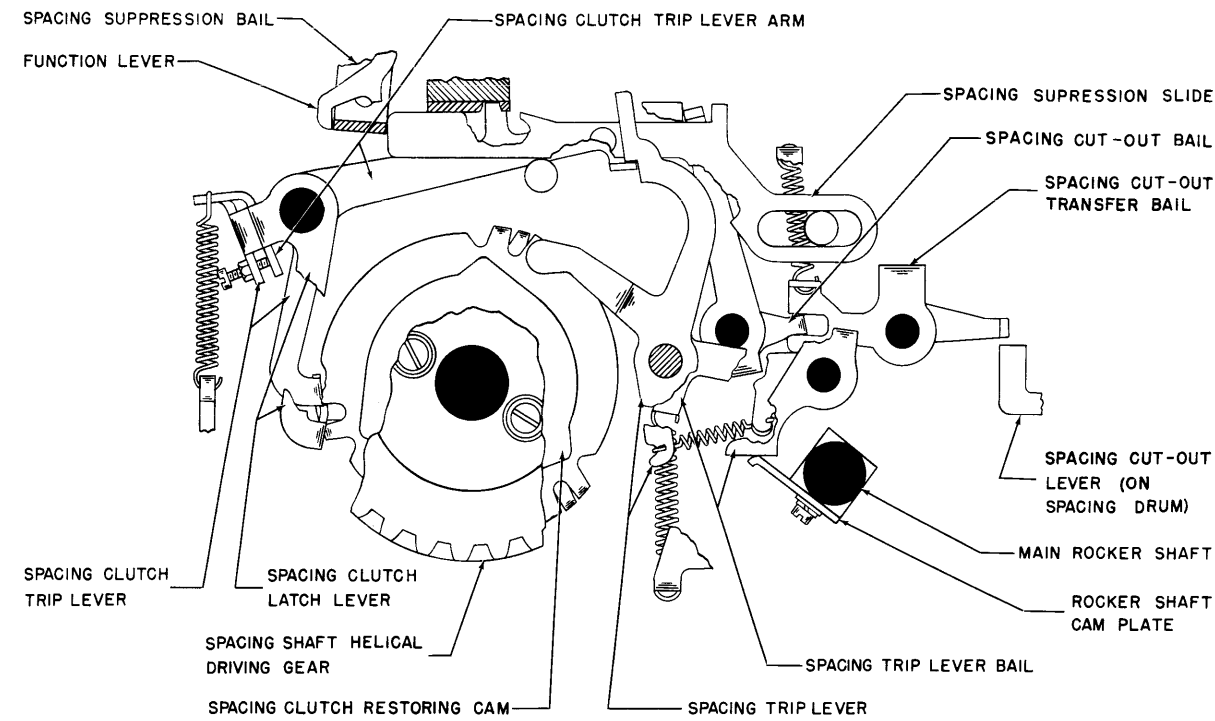


FIGURE 2-52. SPACING AND SPACING SUPPRESSION MECHANISM

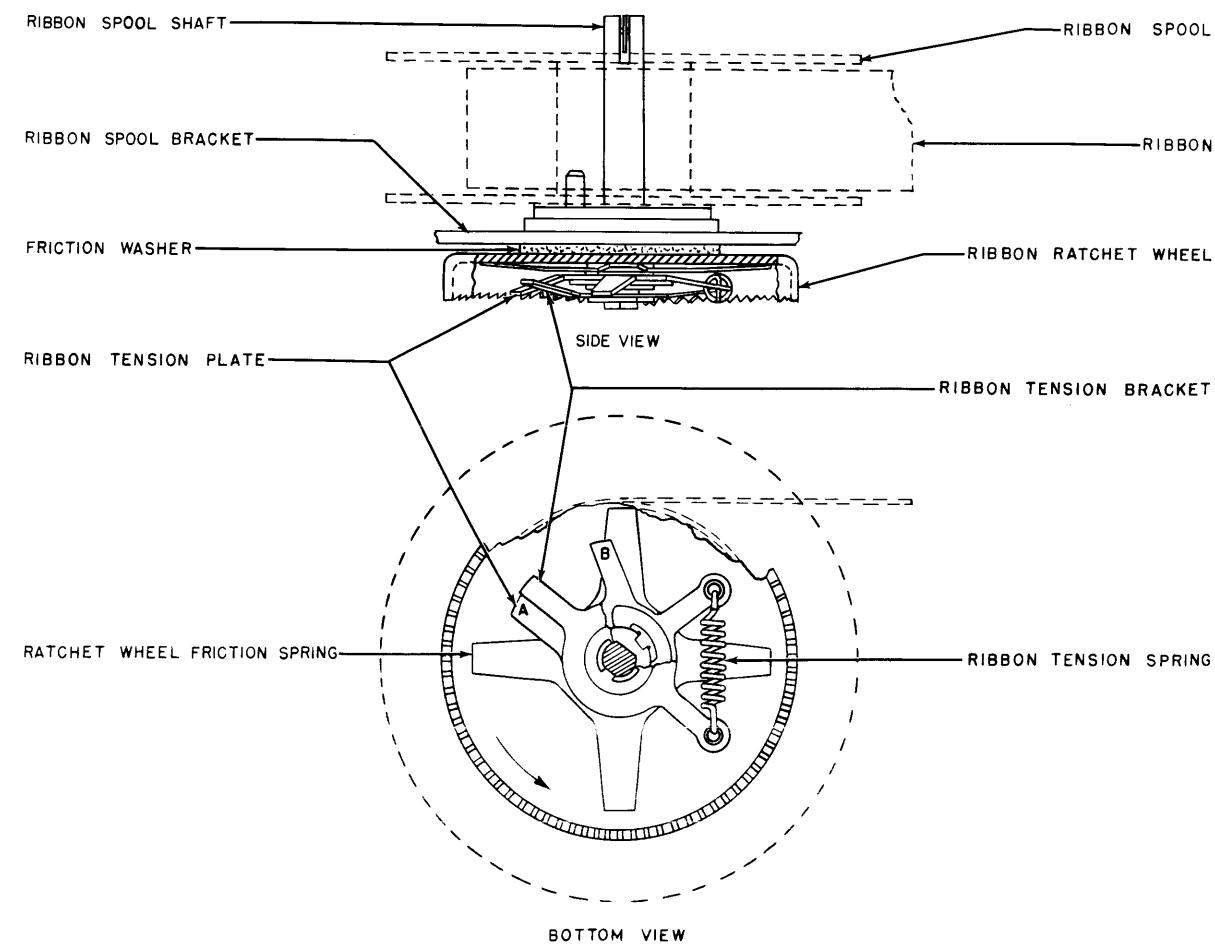


FIGURE 2-53. RIBBON TENSION MECHANISM

ORIGINAL

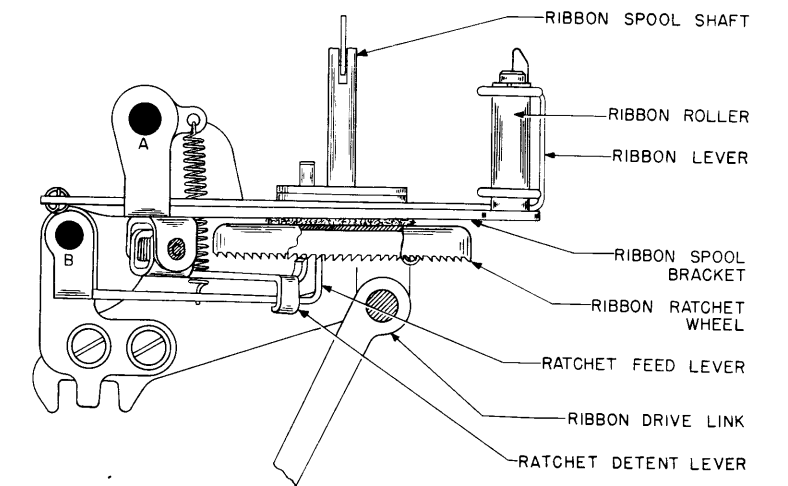


FIGURE 2-54. RIBBON MECHANISM, LEFT SIDE

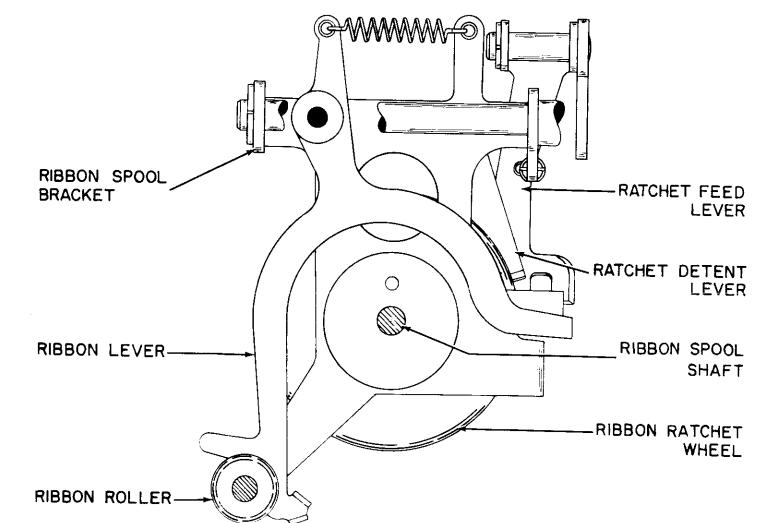


FIGURE 2-55. RIBBON MECHANISM, LEFT TOP VIEW

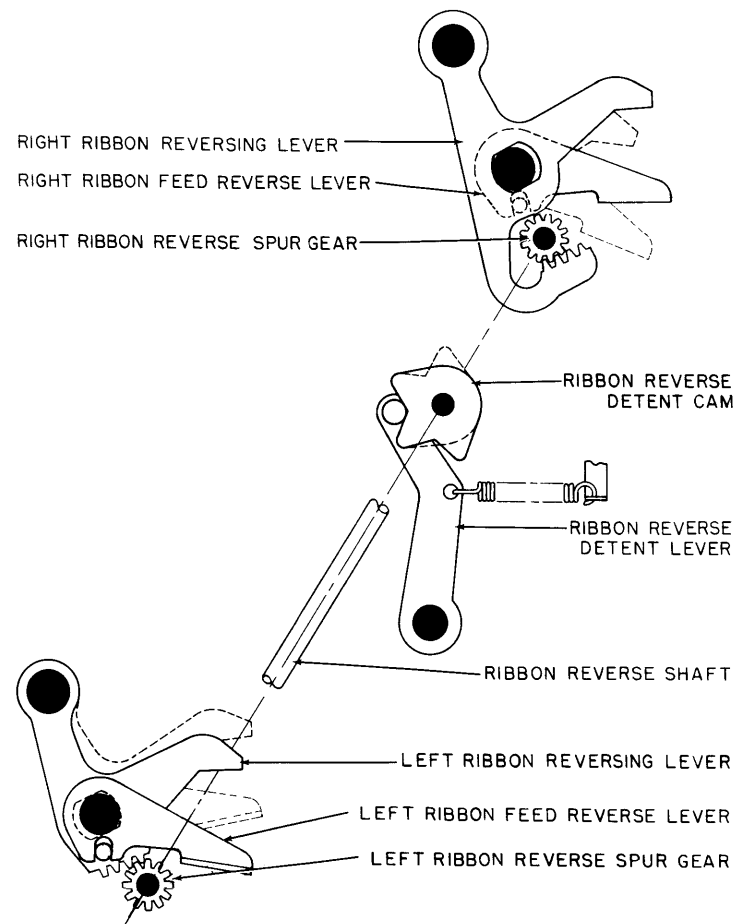


FIGURE 2-56. RIBBON REVERSING MECHANISM

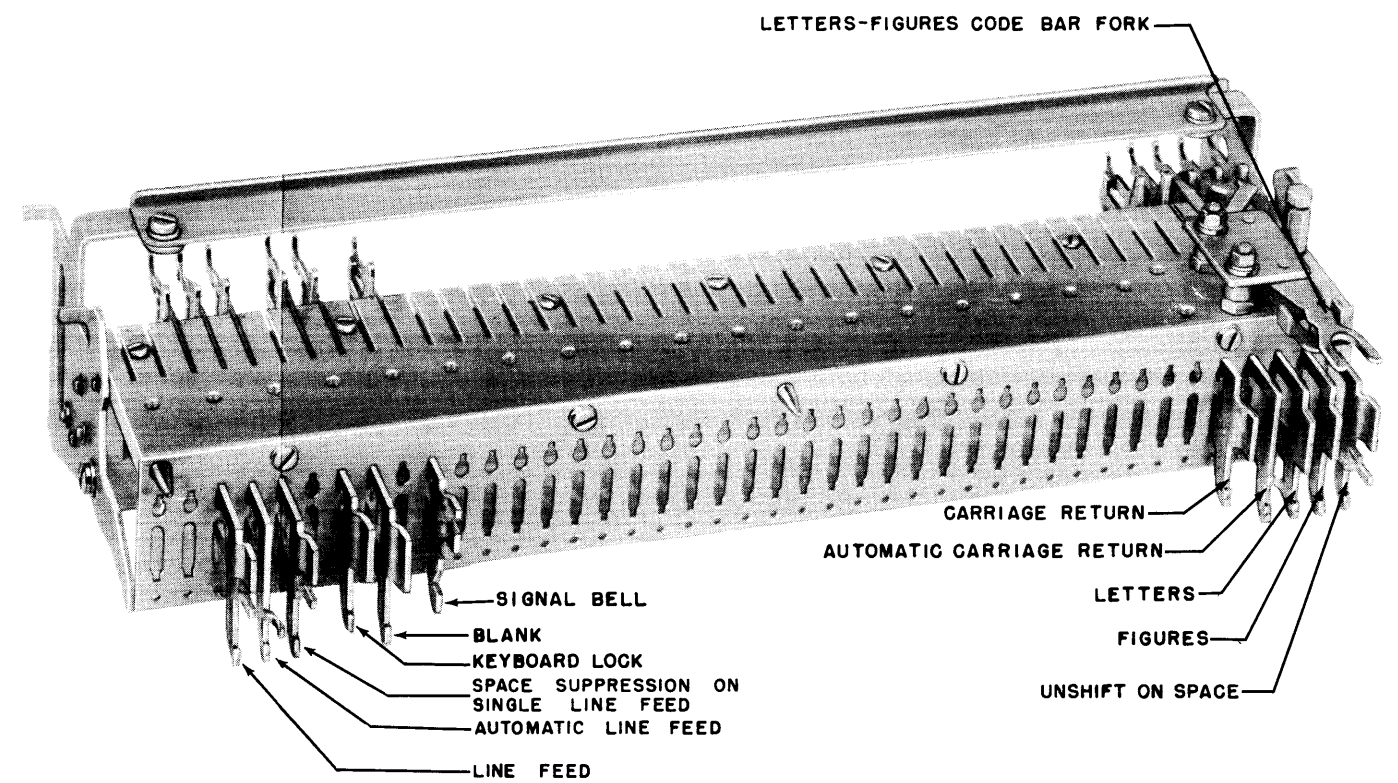


FIGURE 2-57. FUNCTION BOX, FRONT VIEW SHOWING FUNCTION BARS

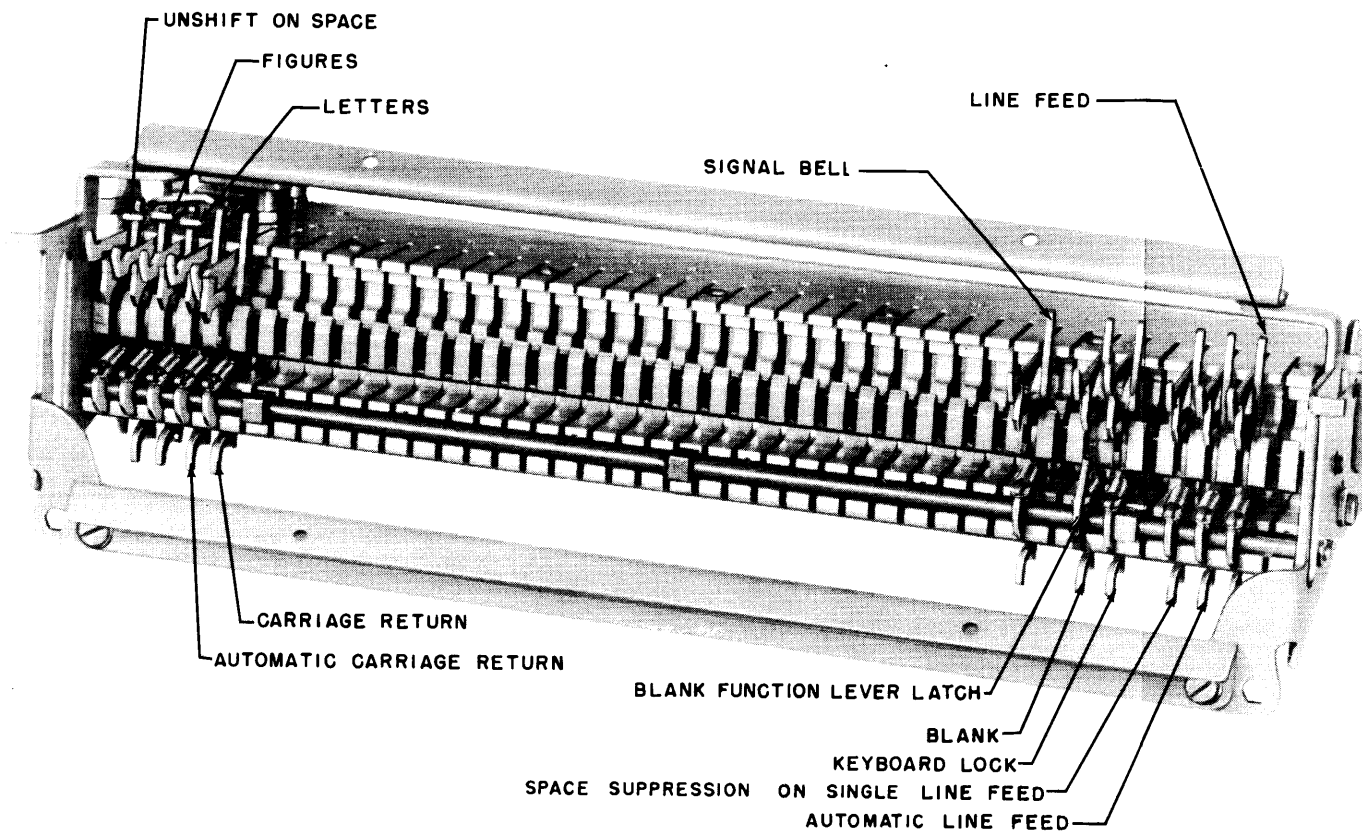


FIGURE 2-58. FUNCTION BOX, REAR VIEW SHOWING FUNCTION LEVERS

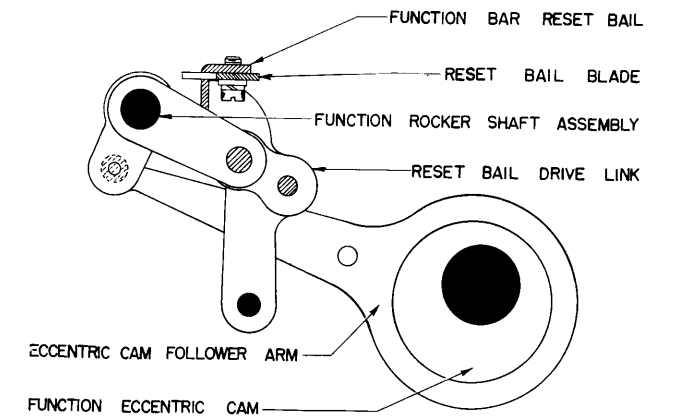


FIGURE 2-59. FUNCTION RESET BAIL MECHANISM

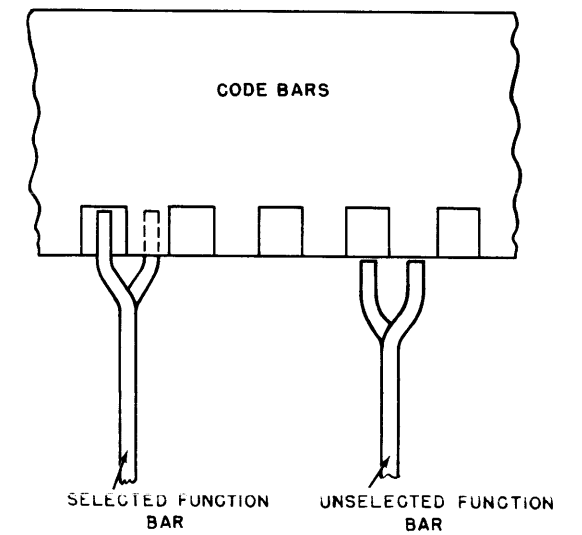


FIGURE 2-60. FUNCTION SELECTION, TOP VIEW

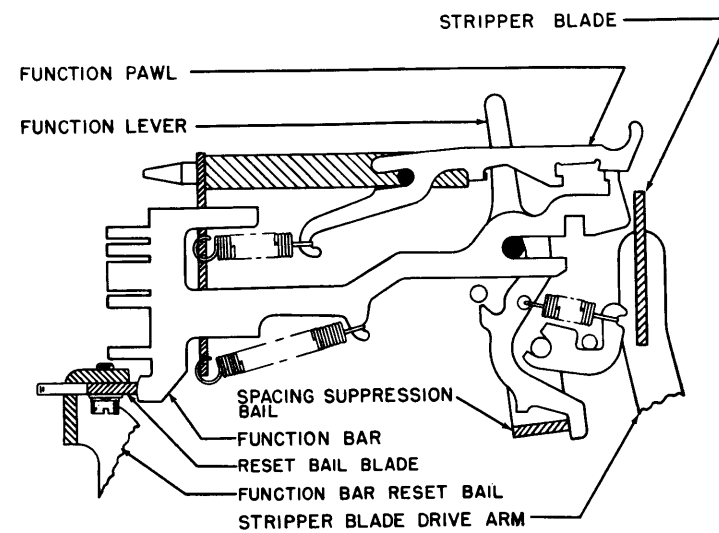


FIGURE 2-61. TYPICAL FUNCTION BOX MECHANISM, UNSELECTED

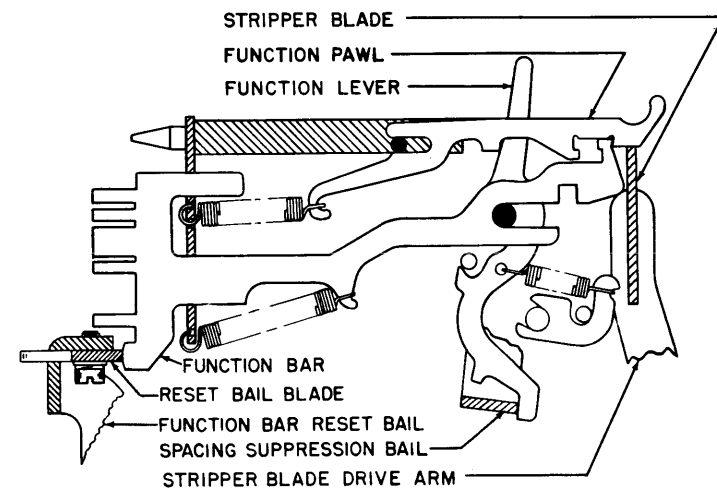


FIGURE 2-62. TYPICAL FUNCTION BOX MECHANISM, SELECTED

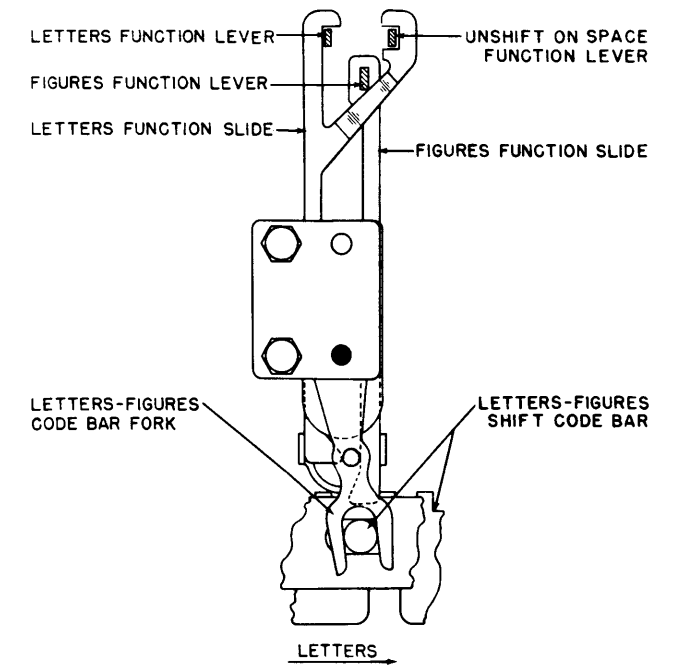


FIGURE 2-63. LETTERS-FIGURES FUNCTION SLIDES, LETTERS POSITION

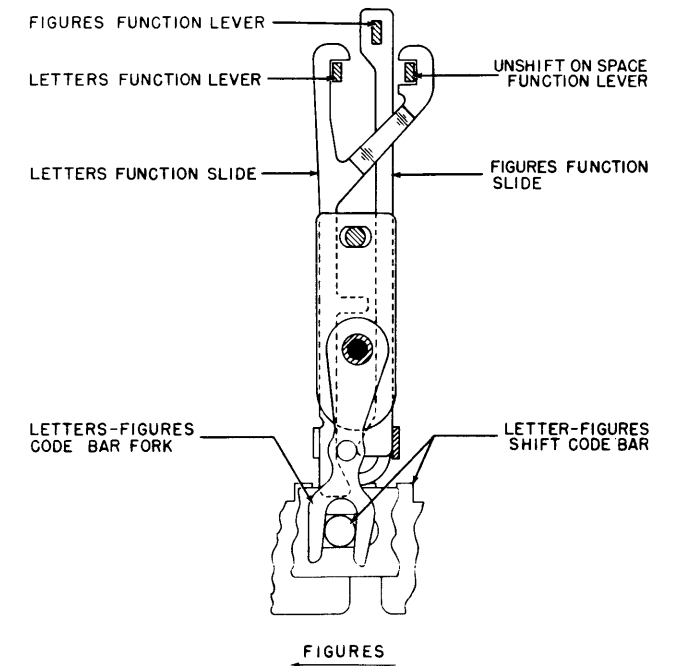


FIGURE 2-64. LETTERS-FIGURES FUNCTION SLIDES, FIGURES POSITION

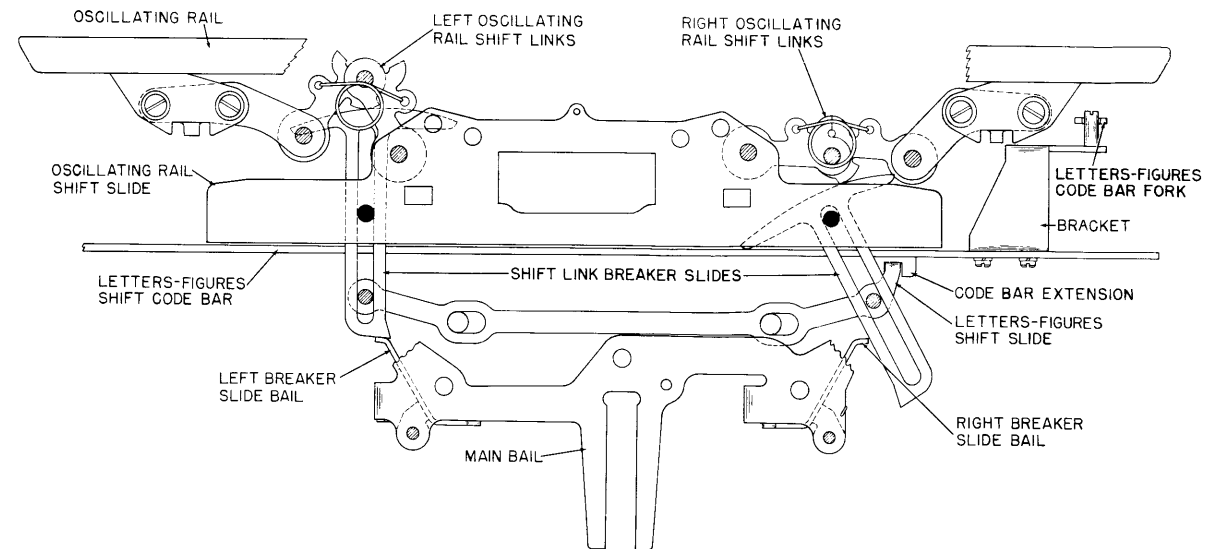


FIGURE 2-65. LETTERS-FIGURES SHIFT MECHANISM, LETTERS POSITION

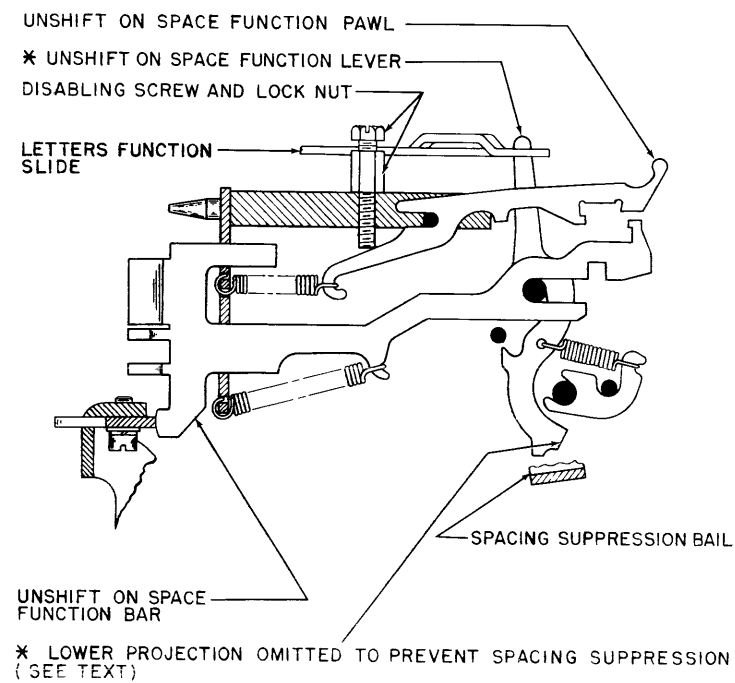


FIGURE 2-66. UNSHIFT ON SPACE FUNCTION MECHANISM, DISABLED POSITION

ORIGINAL

216B

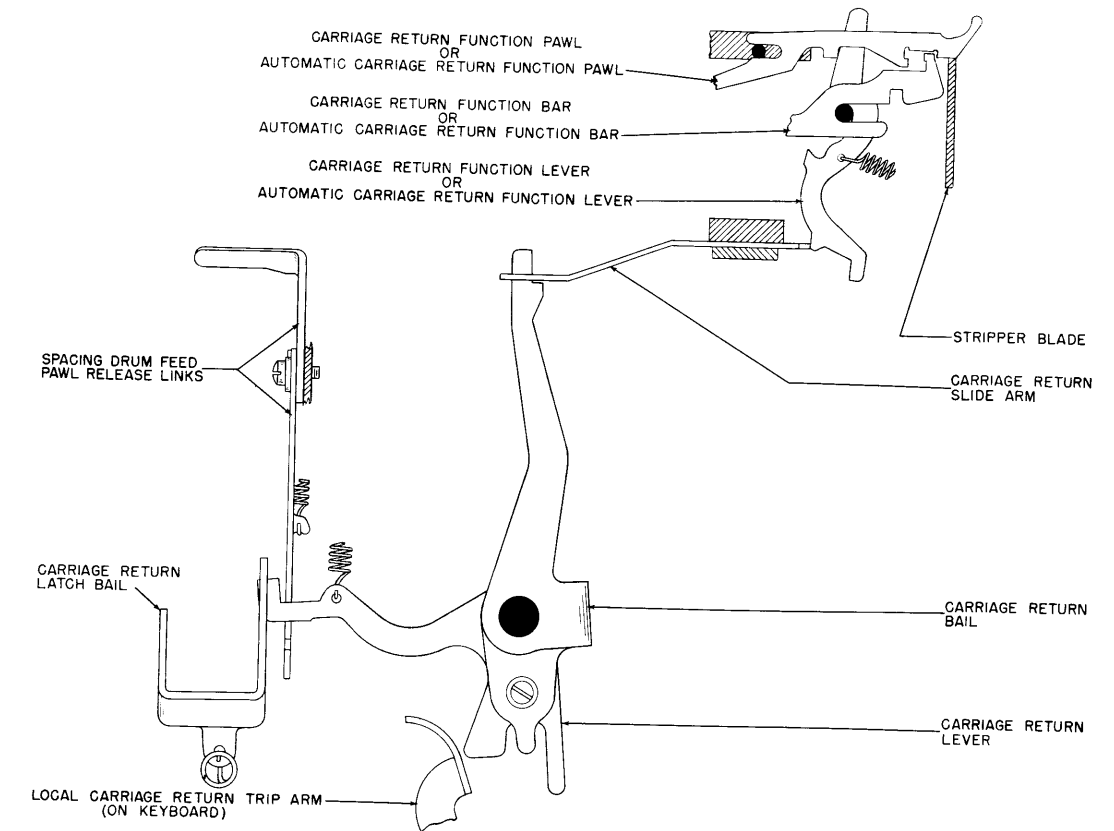


FIGURE 2-67. CARRIAGE RETURN FUNCTION MECHANISM

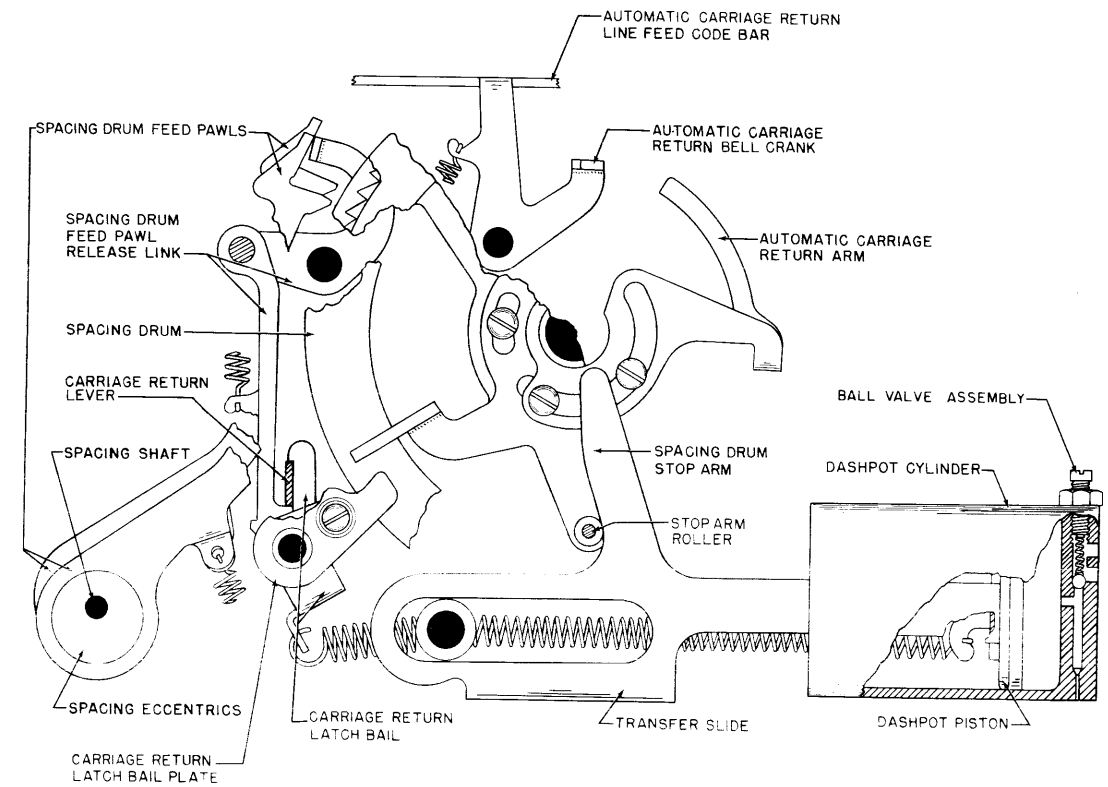


FIGURE 2-68. CARRIAGE RETURN MECHANISM

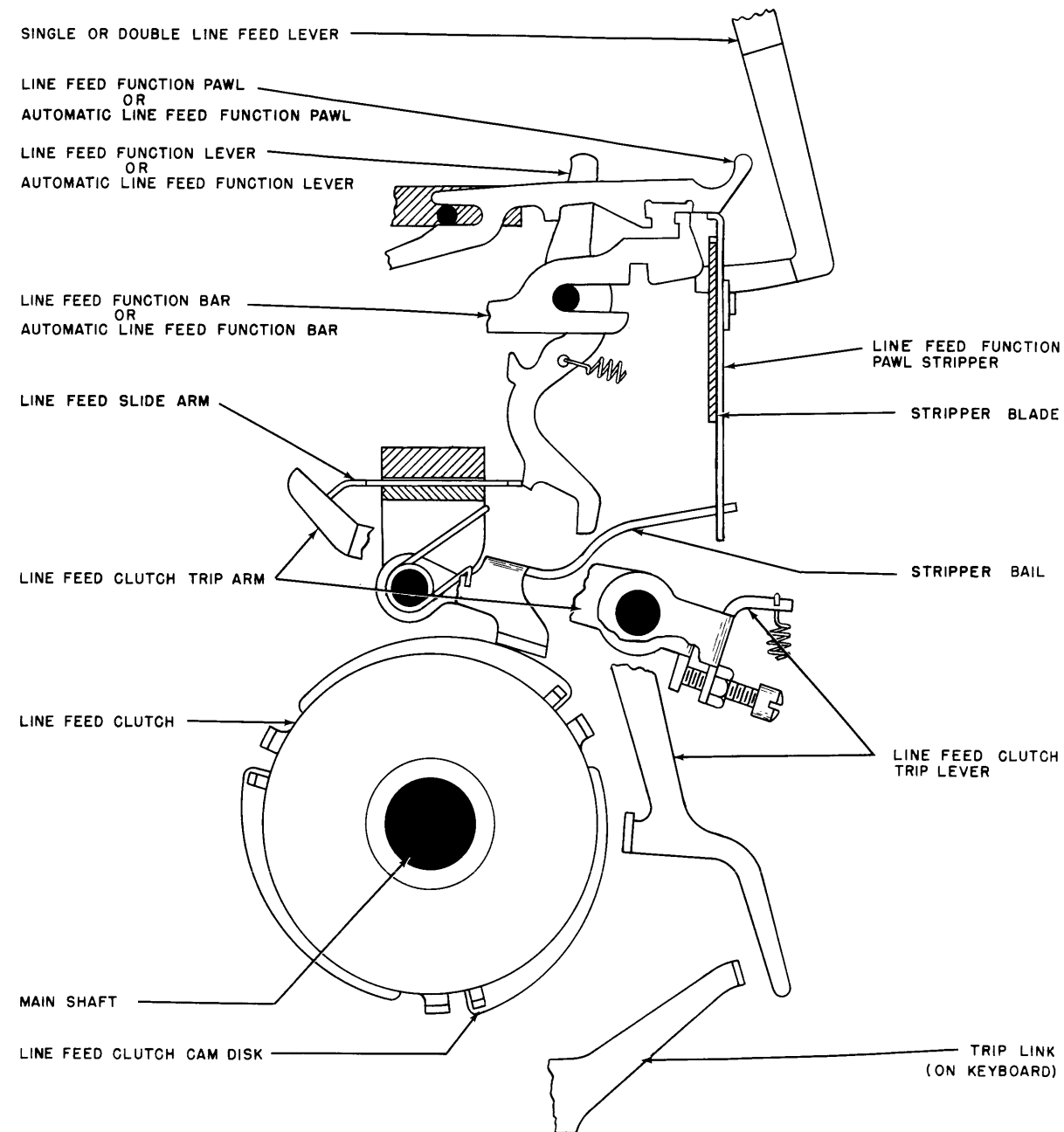


FIGURE 2-69. LINE FEED FUNCTION AND CLUTCH TRIP MECHANISM

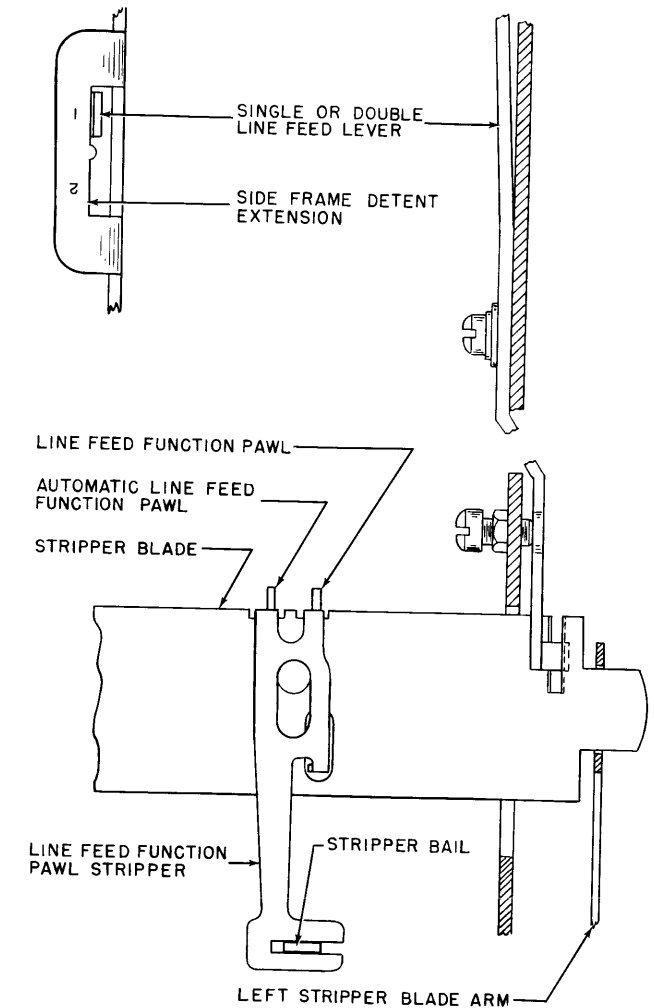


FIGURE 2-70. POSITIONING MECHANISM FOR SINGLE OR DOUBLE LINE FEED



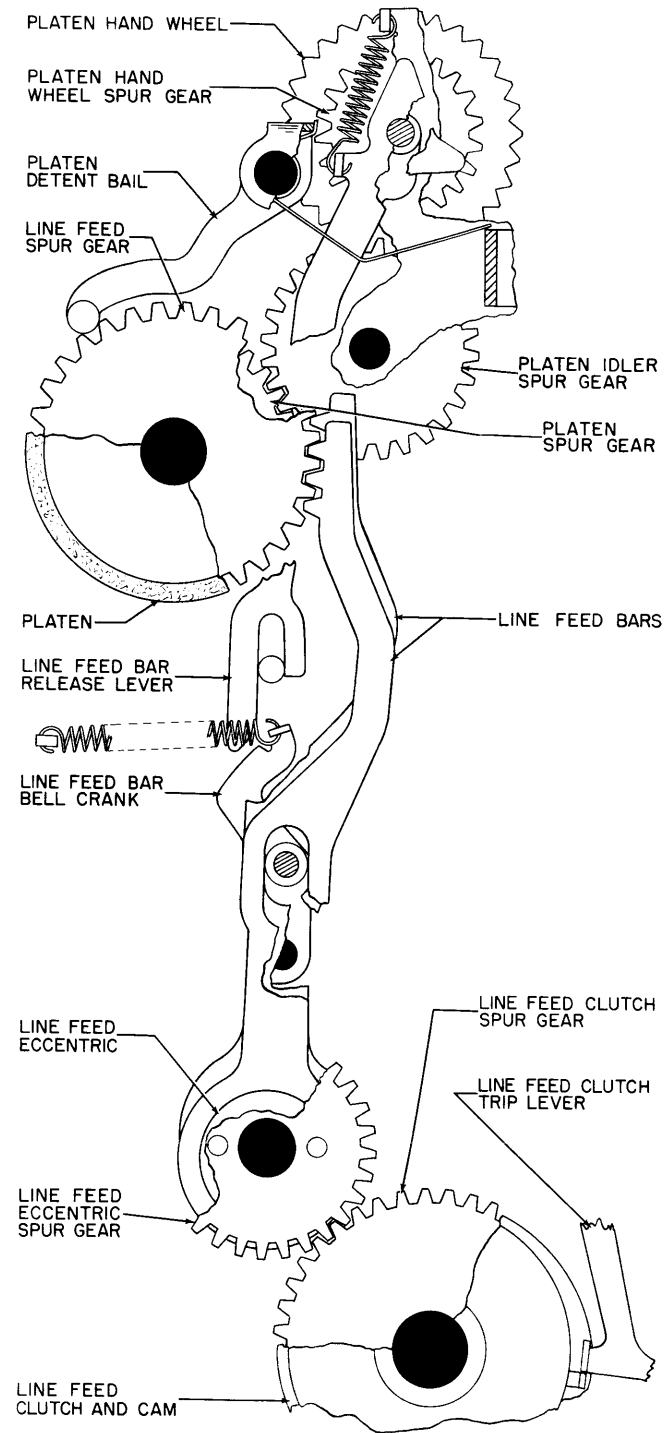


FIGURE 2-71. LINE FEED MECHANISM

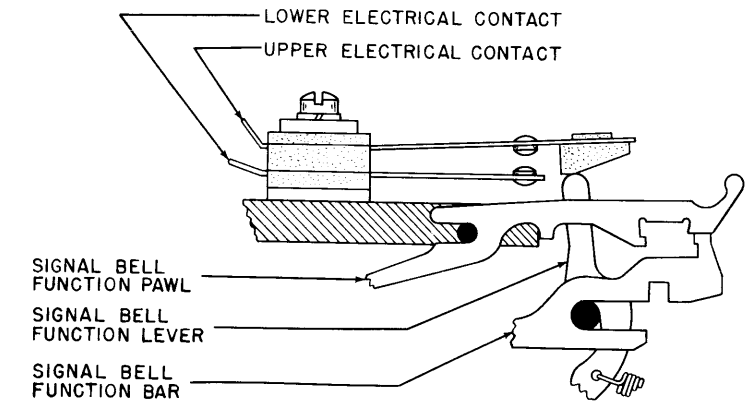


FIGURE 2-72. SIGNAL BELL CONTACT MECHANISM, UNSELECTED

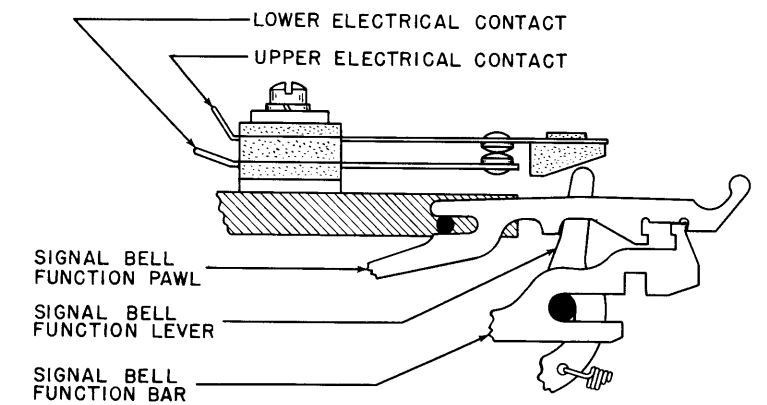


FIGURE 2-73. SIGNAL BELL CONTACT MECHANISM, SELECTED

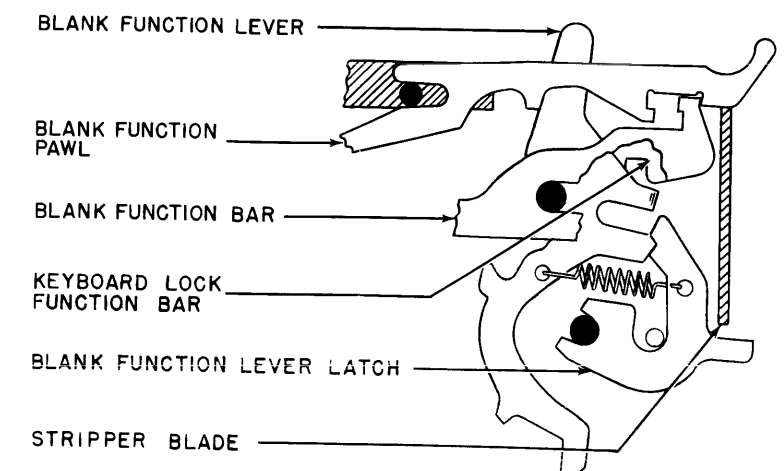


FIGURE 2-74. KEYBOARD LOCK PRIMING MECHANISM

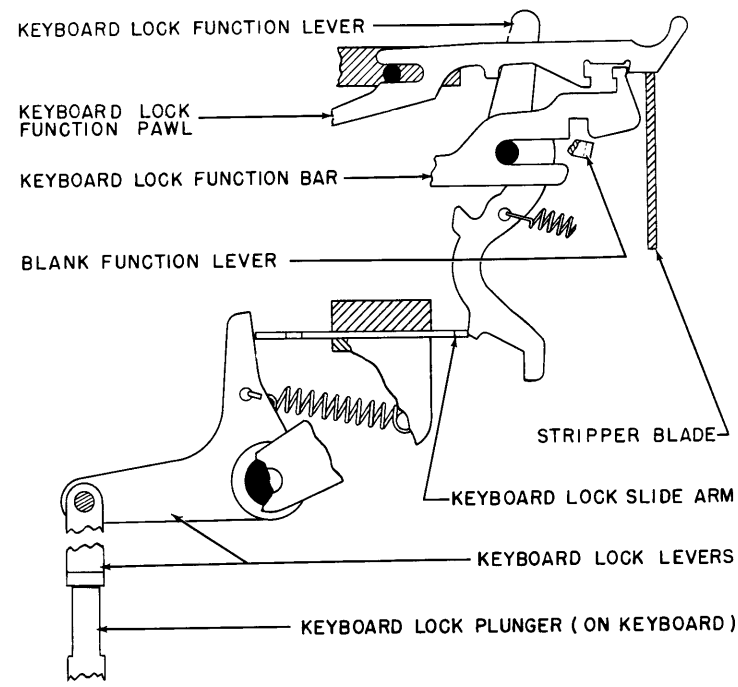


FIGURE 2-75. KEYBOARD LOCK MECHANISM

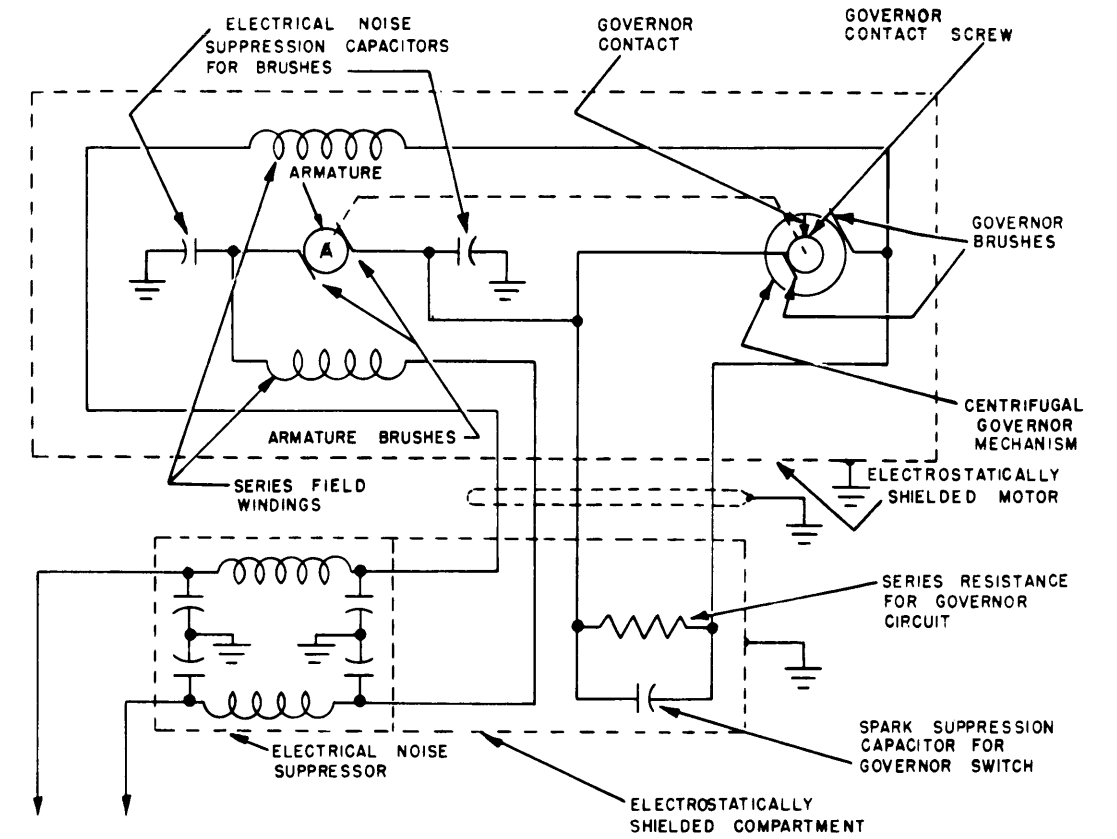


FIGURE 2-77. GOVERNED MOTOR UNIT, SCHEMATIC WIRING DIAGRAM

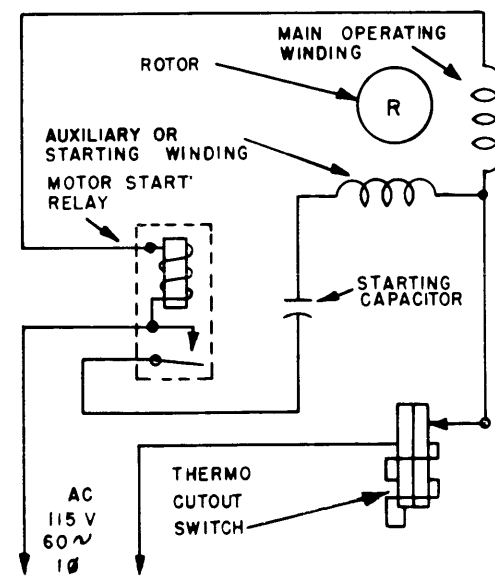


FIGURE 2-76. SYNCHRONOUS MOTOR UNIT, SCHEMATIC WIRING DIAGRAM

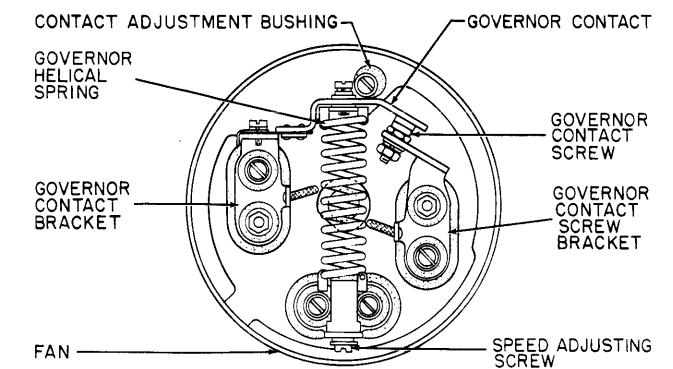


FIGURE 2-78. MOTOR GOVERNOR

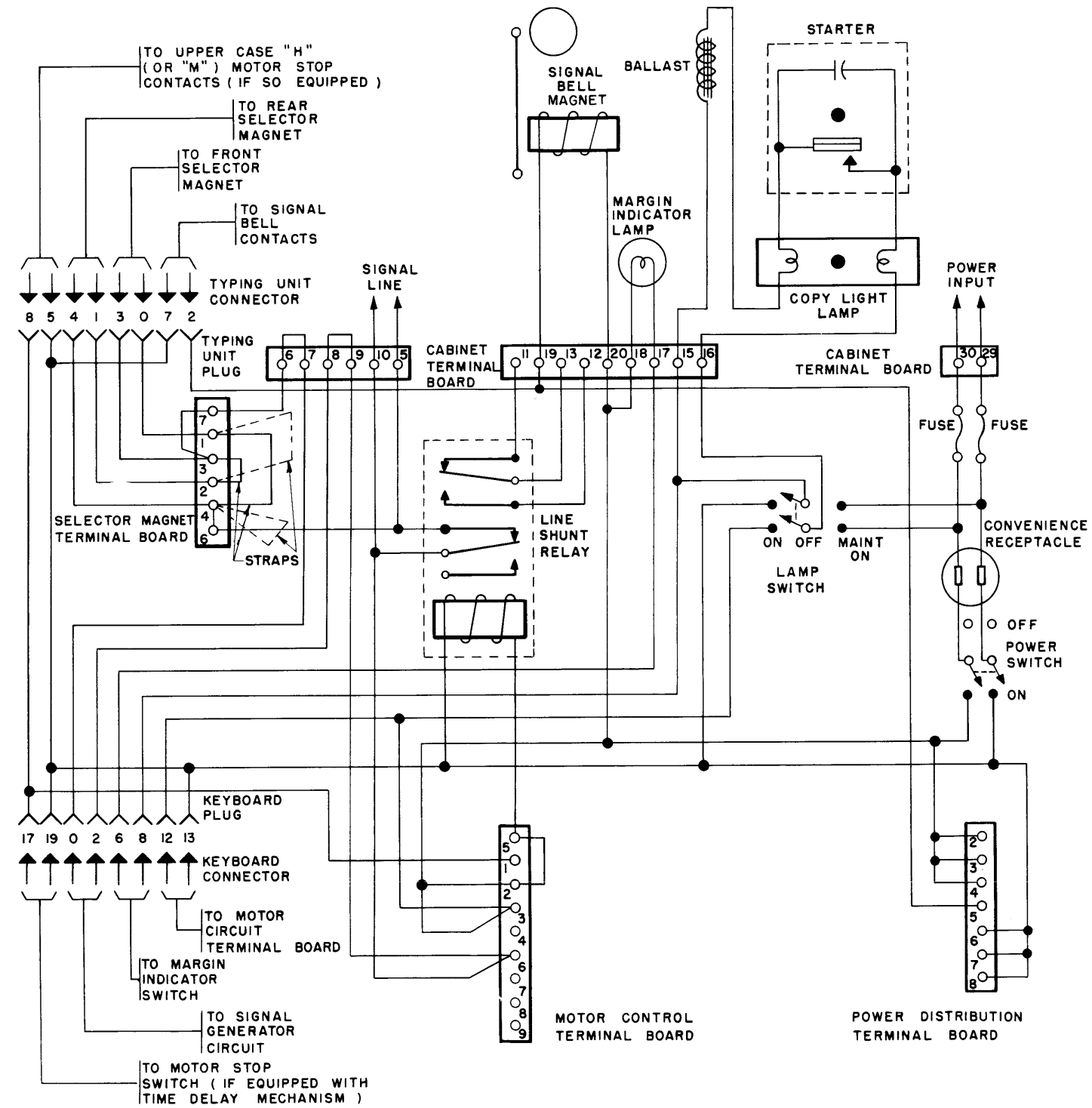


FIGURE 2-79. ELECTRICAL SERVICE UNIT AND CABINET, SCHEMATIC WIRING DIAGRAM

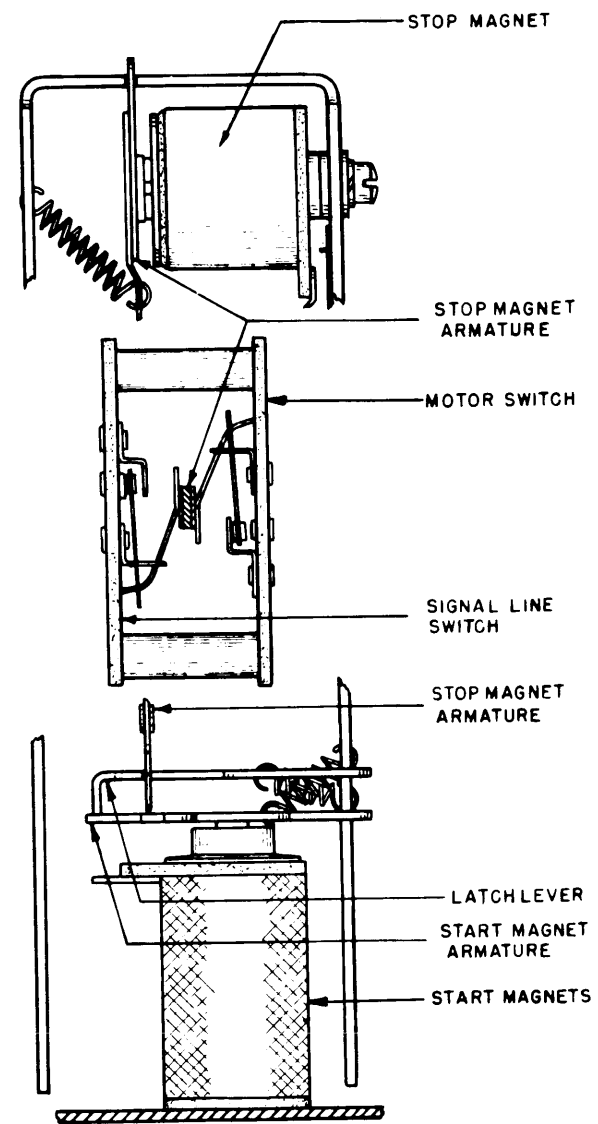


FIGURE 2-80. ELECTRICAL MOTOR CONTROL MECHANISM, STOP POSITION

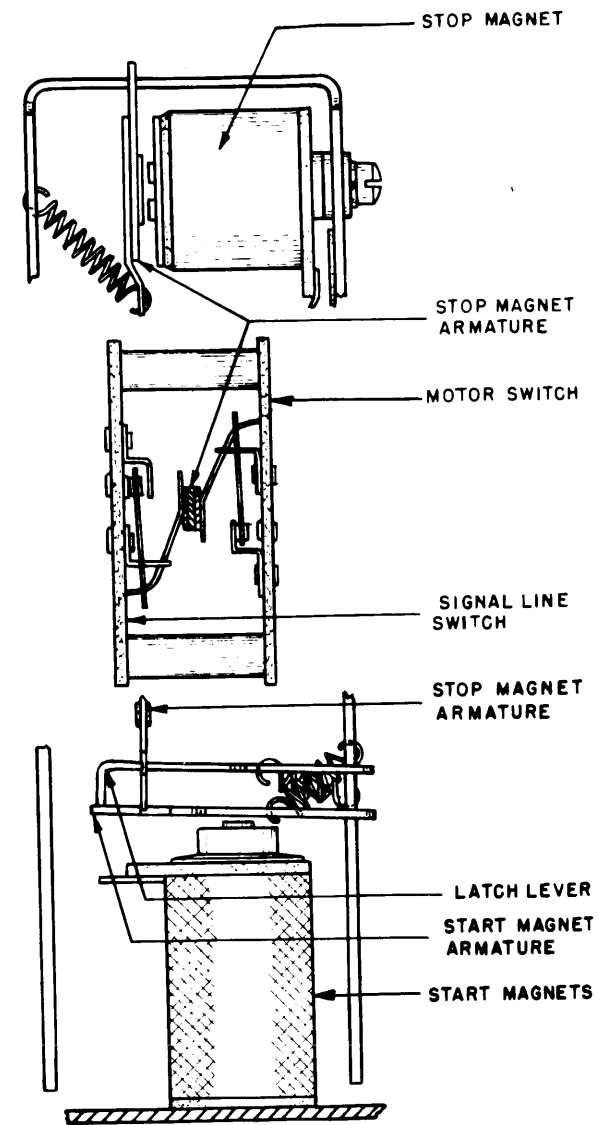


FIGURE 2-81. ELECTRICAL MOTOR CONTROL MECHANISM, OPEN LINE POSITION

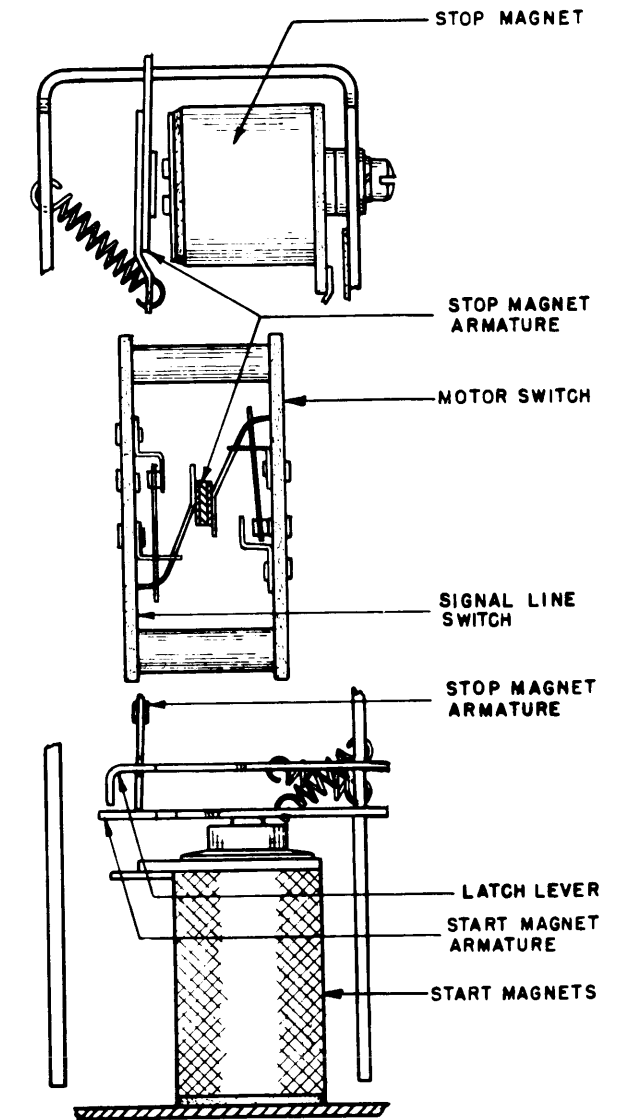


FIGURE 2-82. ELECTRICAL MOTOR CONTROL MECHANISM, START POSITION

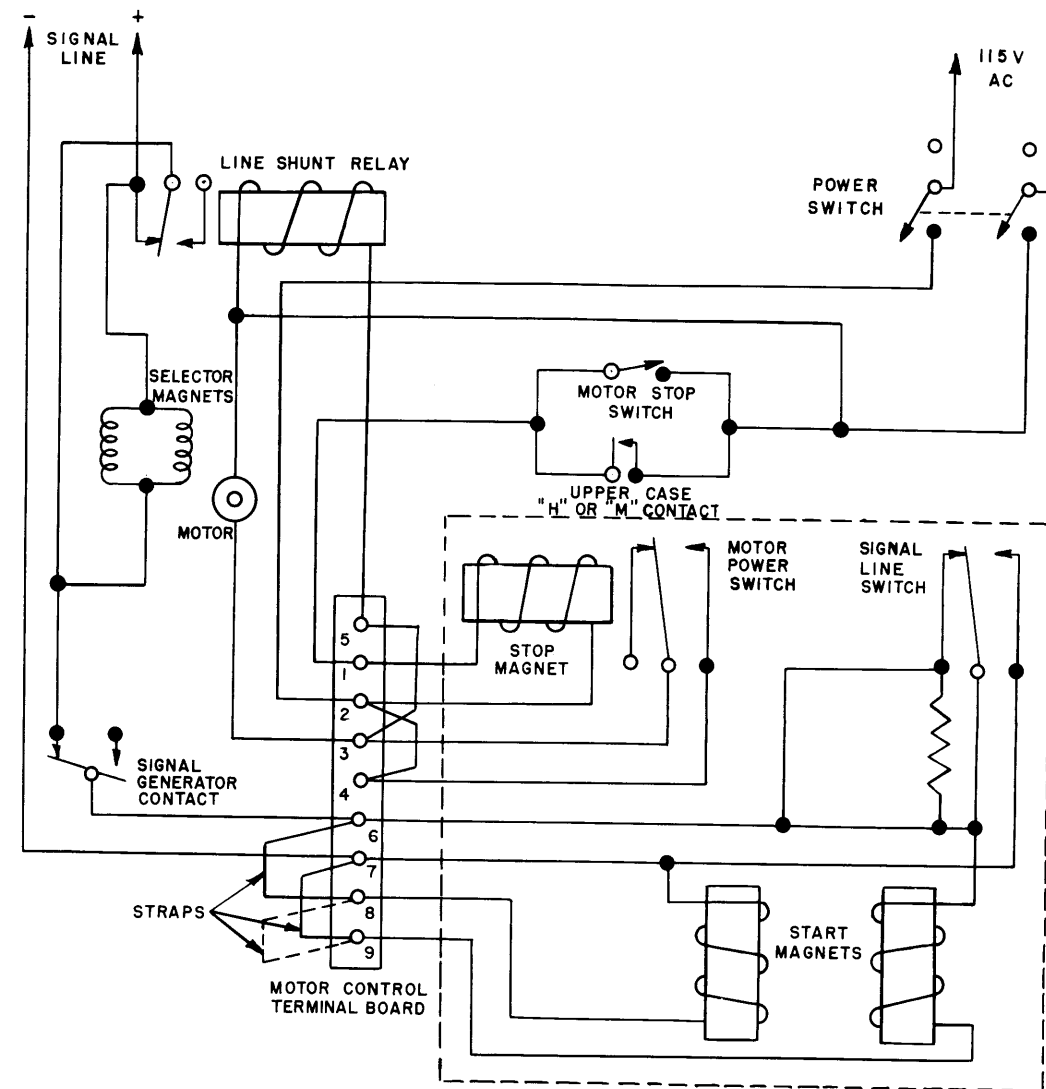


FIGURE 2-83. ELECTRICAL MOTOR CONTROL MECHANISM, SCHEMATIC WIRING DIAGRAM