

Chapter 5

Fundamentals of the Page Typer of the AN/FGC-58

(Model 28 ASR)

Fundamentals of the Page Typer of the AN/FGC-58

DO YOU REMEMBER the first time you watched a Model 28 page typer in action? Can you recall your reaction to the sight of this mass of jumping junk? Didn't you expect it to fly apart—and weren't you disappointed when it didn't? Despite its odd action, we know that the page typer of the AN/FGC-58 is a dependable, trouble-free receiving unit. However, because of its mode of operation, it is much more complicated than the page printer of the M19 we discussed in the earlier chapters of this volume.

2. For those of you who are presently maintaining equipment similar to this—this chapter will serve as a review. On the other hand, there are many of you who have not had the opportunity to service "28" equipment for many months and may have forgotten a large portion of the necessary background required for proper maintenance. For those individuals this chapter will be an aid in recalling the various sequences of mechanical operation of both the page typer and the keyboard which, when combined with the units discussed in the next chapter, become the AN/FGC-58. This set, shown in figure 81, is more commonly known as the Model 28 Automatic Send-Receive (ASR) set. The ASR set can prepare printed and perforated tape for separate transmission with or without simultaneous line transmission and page-printed monitoring. As you can see from the illustration, the ASR set is more modern in design and is able to handle traffic at higher speeds than the Model 19 set it is replacing.

24. The Keyboard of the ASR Set

24-1. The keyboard of the ASR set protrudes through the right front portion of the cabinet, as shown in figure 81. You can see that the keyboard provides mounting space for the typing unit; and, if we disassemble the typer from the keyboard base and then remove the keyboard from the cabinet as shown in figure 82, you will discover that the keyboard base also provides mounting space for additional units. One typing reperforator, known as the keyboard typing reperforator, is mounted on the left side of the base,

and an a.c. motor is mounted on the right rear. This motor drives the keyboard and the page typer. In addition, through shafts with flexible couplings, this same motor also supplies the mechanical power to operate the keyboard typing reperforator and the transmitter distributor. The selector switch, through which the machine is conditioned for different modes of operation, is also mounted on the keyboard base. We will, however, limit our discussion in this section to the mechanical operation of the keyboard.

24-2. General Description of the Keyboard.

The keyboard, shown in figure 83, is equipped with a code bar mechanism, key levers, and a signal generator. A synchronous pulsed transmission control mechanism is furnished to control character transmission, if needed. In addition, the keyboard is equipped with mechanisms for manual control of the following local functions:

- Keyboard lock and unlock mechanisms.
- Repeat operation.
- Margin indicator.
- Local carriage return.
- Local line feed.

These operations can be done in the local machine without placing any signal on the line.

24-3. In addition to these features and the provisions for mounting the keyboard reperforator and selector switch mechanism, the keyboard base mounts:

- A container to hold the tape supply for the typing reperforator.
- An intermediate gear set to drive the typing reperforator.
- A character counter to aid in determining the printed page line equivalent for perforated tape production.
- An electrical keyboard lock mechanism in place of a mechanical keyboard lock mechanism.

24-5. The teletypewriter equipment uses the Baudot code discussed in the previous volume. Polar signals are transmitted, using a 7.00-unit start-stop pattern. Gearing changes can adapt

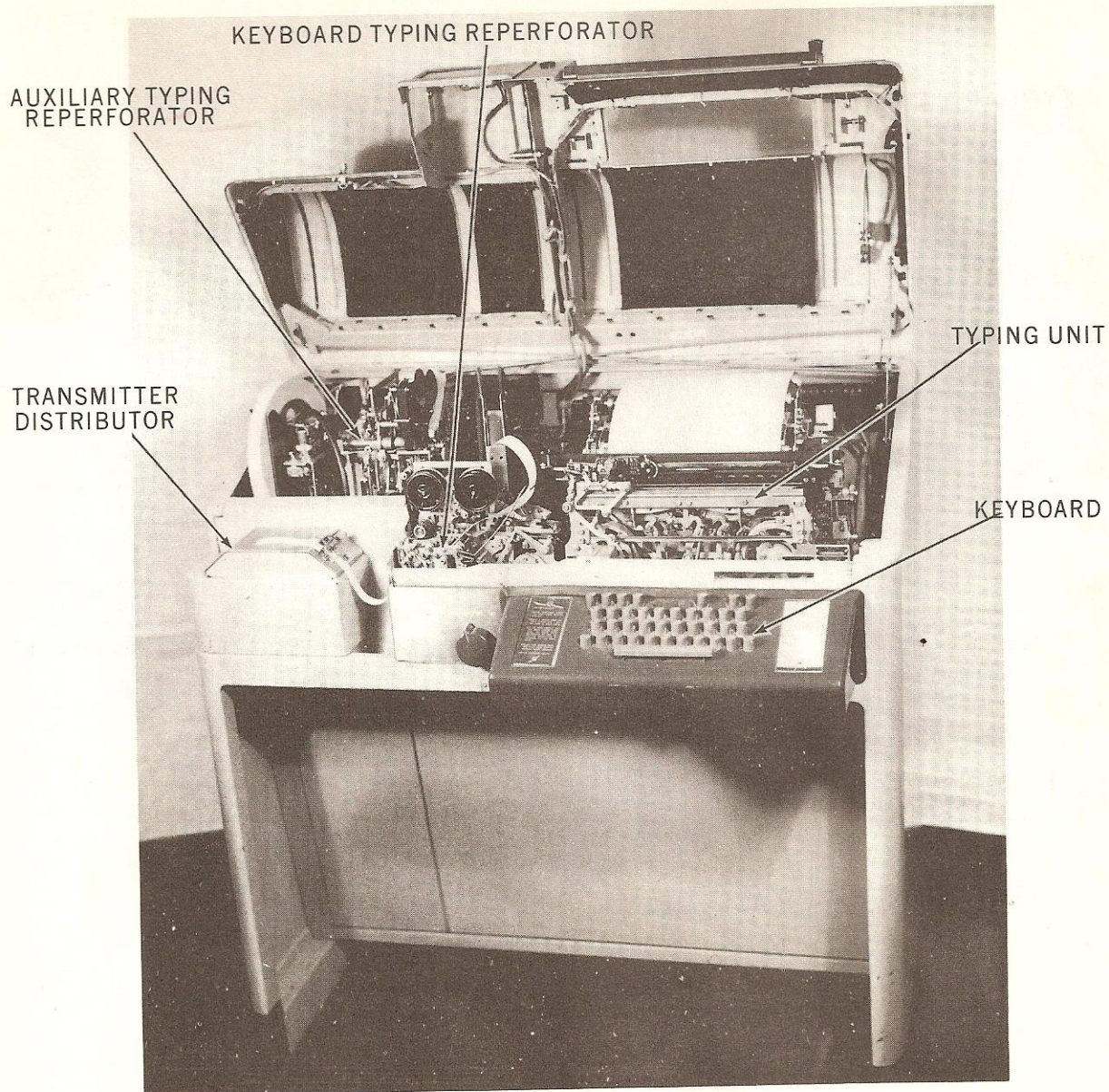


Figure 81. Automatic send-receive (ASR) set.

the equipment to 390 operations per minute (45.5 bauds) or 636 operations per minute (75 bauds). The line signal output is 35 ma of line current. The electrical operation will be covered in the last chapter of this volume. With this in mind, let us now study how the keyboard sets up the code combinations and generates the signal to be transmitted.

24-6. **Code Bar Mechanism.** The code bar mechanism is located in the front underside portion of the keyboard.

24-7. **Key levers.** Each key lever in the lower three rows and the space bar are connected to a code lever; each key lever in the upper row (red) is connected to a function lever. These code and function levers pivot about points near their

midportions, as shown in figure 84. Located above the rear half of the code levers and running parallel with the front of the keyboard are—from rear to front—the code lever universal bail; the clutch trip bar; the No. 1, 2, 3, 4, and 5 code bars; two character counter bars; and the lock bar. The rear portion of each code or function lever normally is held down by a spring so that the front end with its attached key lever is held up.

24-8. **Locking mechanism.** A wedge lock is mounted on the projection of the lower front portion of each code lever, the local line feed function lever, and the local carriage return function lever. If one of these levers is operated, its locking wedge moves downward between the

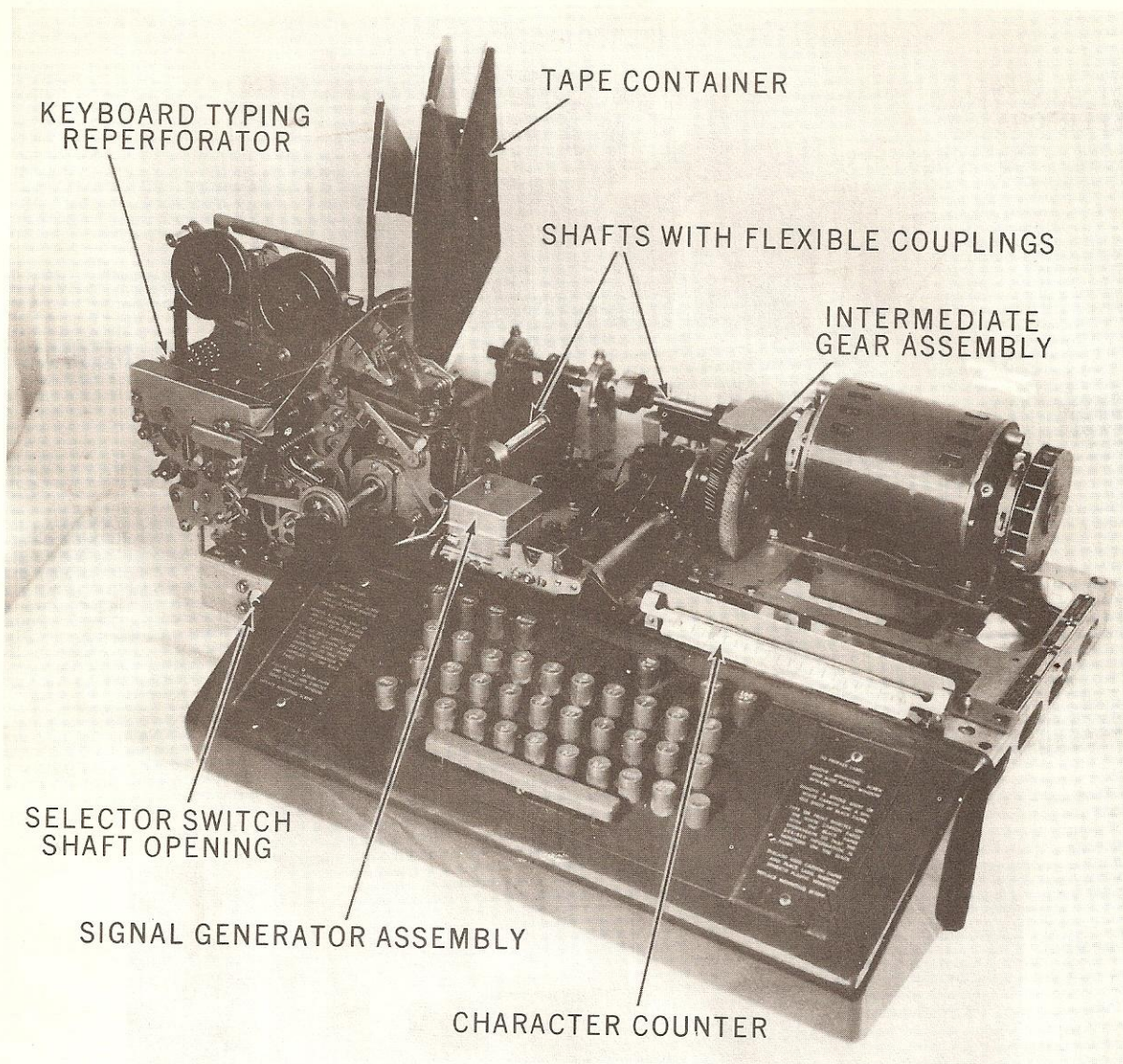


Figure 82. The keyboard of the ASR set.

lock balls in the lock ball channel, as illustrated in figure 85, and crowds them together. This prevents any other lever with a locking wedge from being operated at the same time.

24-9. *Code bars and bail.* With the keyboard shaft in its stop position, the clutch trip bar and the five code bars are held toward the left (as you face the front of the machine). When any green key lever or the space bar is depressed, the rear end of the associated code lever engages and rotates the code lever universal bail counter-clockwise. The extension on the code lever universal bail disengages from the stop at the rear of the universal bail lever. This lever then moves downward under the tension of its spring. As the lever shown to the right of the code bar bail in figure 86 falls, it strikes the code bar bail latch and carries it downward. When the shoulder of

the code bar bail latch is forced below the centerline of the needle bearing (mounted on the code bar bail), the bail is released and the lower portion swings to the right. The code bar bail, the clutch trip bar, and the selected code bars are then pulled to the right by their springs. Unselected code bars are immobilized by the operated key lever (or space bar) which has moved upward and engaged the projections on the underside of the code bars. As demonstrated by figure 87, if the "L" lever is depressed, code bars 1, 3, and 4 are stopped by the code lever engaging teeth on the underside of those bars. There are no teeth in the same relative position on code bars 2 and 5; so, they move to the right when the "L" lever is depressed.

24-10. *Code bar extensions.* Note the vertical extensions on the left ends of the five code

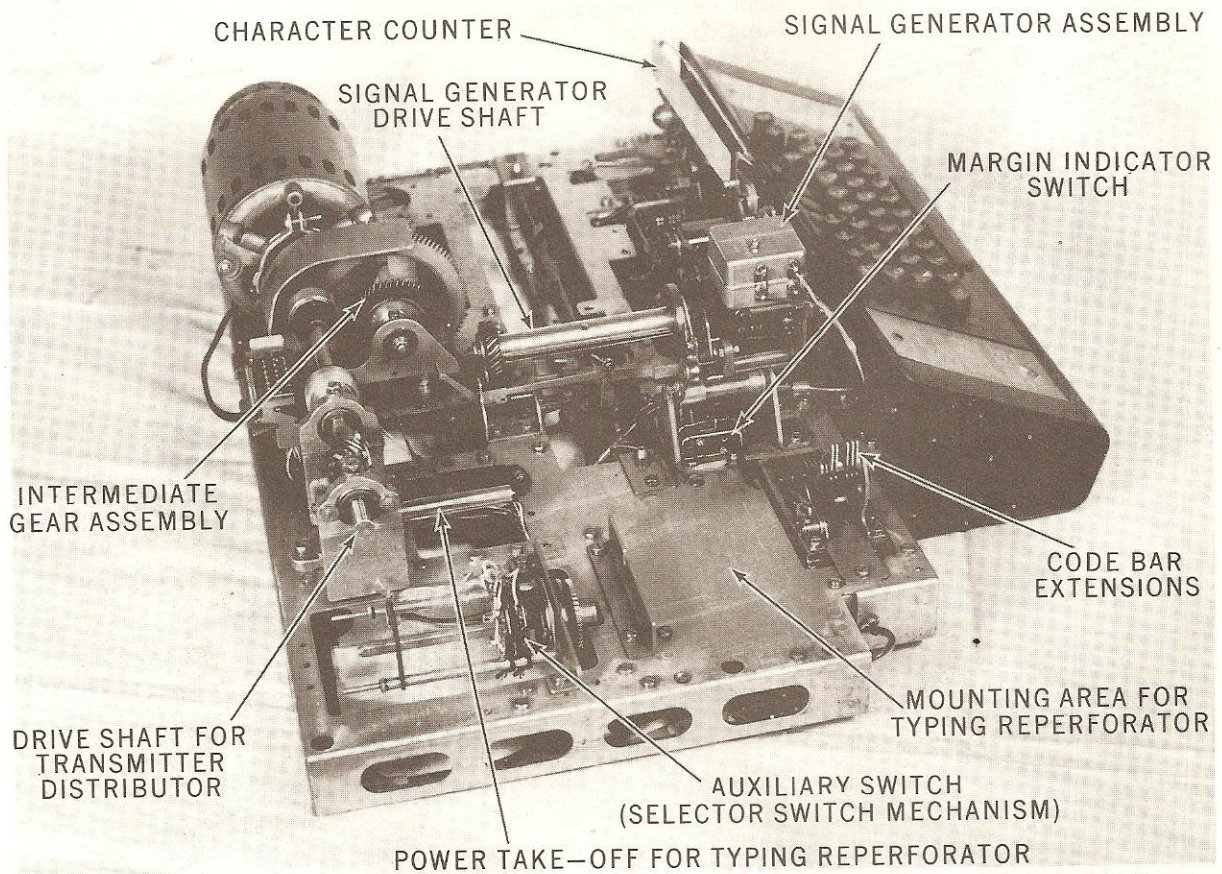


Figure 83. Left view of the keyboard.

bars, as shown in figure 84 and again in figure 88. These vertical extensions engage a curved portion of the signal generator transfer levers. The code bars which are permitted to move to the right carry their respective transfer levers with them. For a mark, the left upper projection of a transfer lever engages the transfer bail and rotates it counterclockwise as the transfer lever is cammed downward. For a space, the right projection of a transfer lever causes a clockwise rotation of the transfer bail as that transfer lever is cammed downward. This positioning of the transfer levers sets up the pattern for the signal to be generated.

24-11. **Signal Generator Mechanism.** If you will turn back and examine figure 83, you'll see that the signal generator mechanism is located on the top front part of the keyboard. A drive shaft geared at the rear to the main shaft of the typing unit, a cam-clutch assembly mounted on the forward end of the shaft, an eccentric follower to operate the code bar mechanism, and a contact box mechanism are the essential features of the signal generator. The purpose of the generator is to convert the mechanical input of the

keyboard to its corresponding electrical signal sequence. Up to the point of tripping the clutch mechanism, operation in response to keyboard input is manually developed through leverage, pivot points, and detents. The clutch-cam applies motor power to the operation through a series of intermediate gears. The signal generator originates an electrical signal pattern of marking and spacing pulses on the signal line, and these pulses correspond to the manual keyboard input.

24-12. *Intermediate gears.* The typing unit intermediate gears, shown in figure 83, are located near the center of the base. Two helical gears are mounted in this assembly. The larger gear engages the motor shaft pinion gear. The gear ratio between the pinion gear and the helical driven gear on the intermediate shaft determines the speed at which the equipment will operate. The normal set allows the equipment to operate at 75 bauds, whereas replaceable gears provide 45.5 bauds operation.

24-13. The smaller gear on the intermediate shaft engages the helical driving gear on the main shaft. This shaft is on a common hub, as shown in figure 89, with the keyboard driving gear.

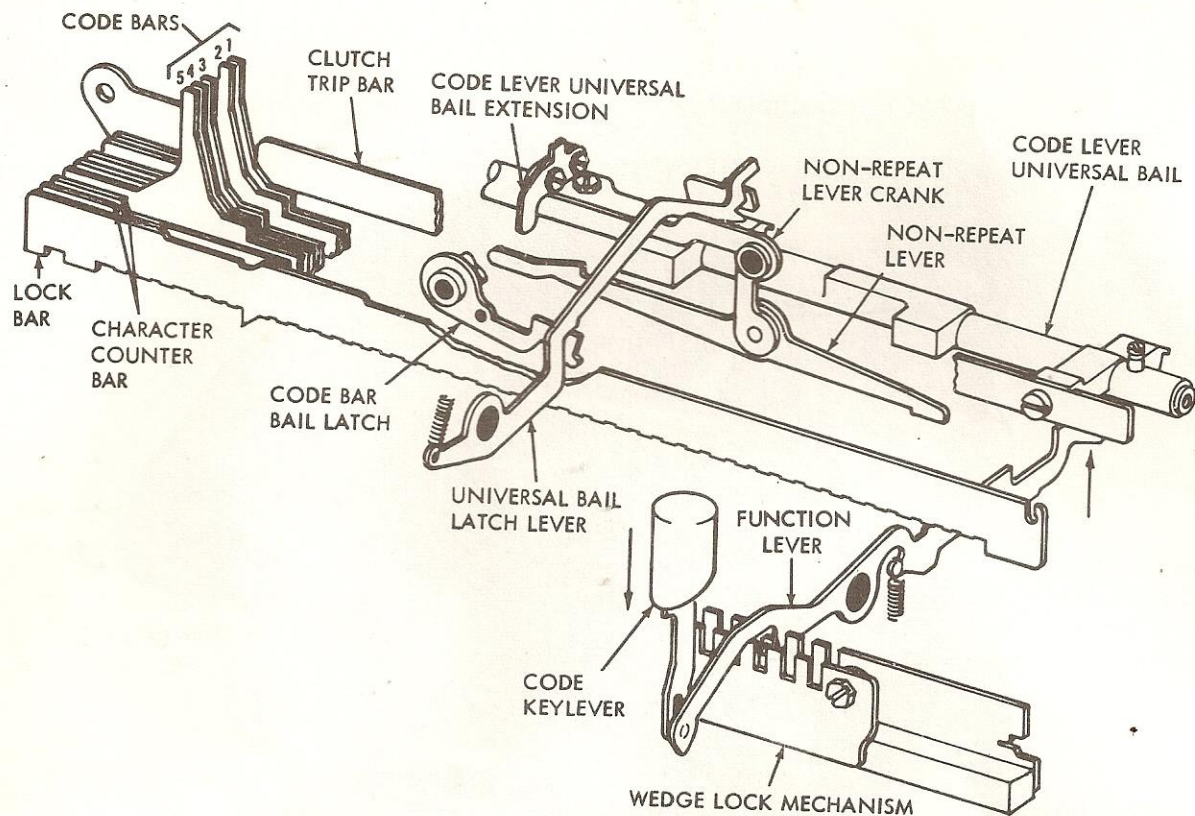


Figure 84. Code bar and code lever universal bail mechanism.

This driving gear then engages the geared end of the signal generator shaft, shown in figure 83. This furnishes the mechanical power to drive the signal generator through the cam clutch.

24-14. *Signal generator clutch.* When the Model 28 ASR set is conditioned for K (keyboard) or K-T (keyboard and tape) operation, a projection on the keyboard control selection lever trips the signal generator stop clutch lever. The clutch then engages and rotates the signal generator cam. When the clutch stop lever is tripped, the clutch shoes engage a serrated surface on the inside of the clutch drum. This serration is illustrated in figure 90. When power is on, the clutch drum rotates continuously in a clockwise direction (viewed from the front) because it is a part of the geared signal generator shaft. Since the clutch shoes, within the clutch drum, are mounted on a plate that is part of the assembly section of the shaft, the cam assembly rotates upon clutch engagement.

24-15. The left-hand portion of figure 90 shows a disengaged clutch. 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.

This occurs each time the clutch stop lever, shown in figure 91, engages lug B in figure 90 (which shows the same clutch engaged). This is done by releasing 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 other 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 lug J on the clutch cam disk to cause it to turn in step with the drum. The cam disk is a part of the signal generator cam assembly, which rotates upon engagement of the clutch. The clutch is allowed to engage by the movement of the clutch stop lever away from the lug on the clutch shoe lever. On the

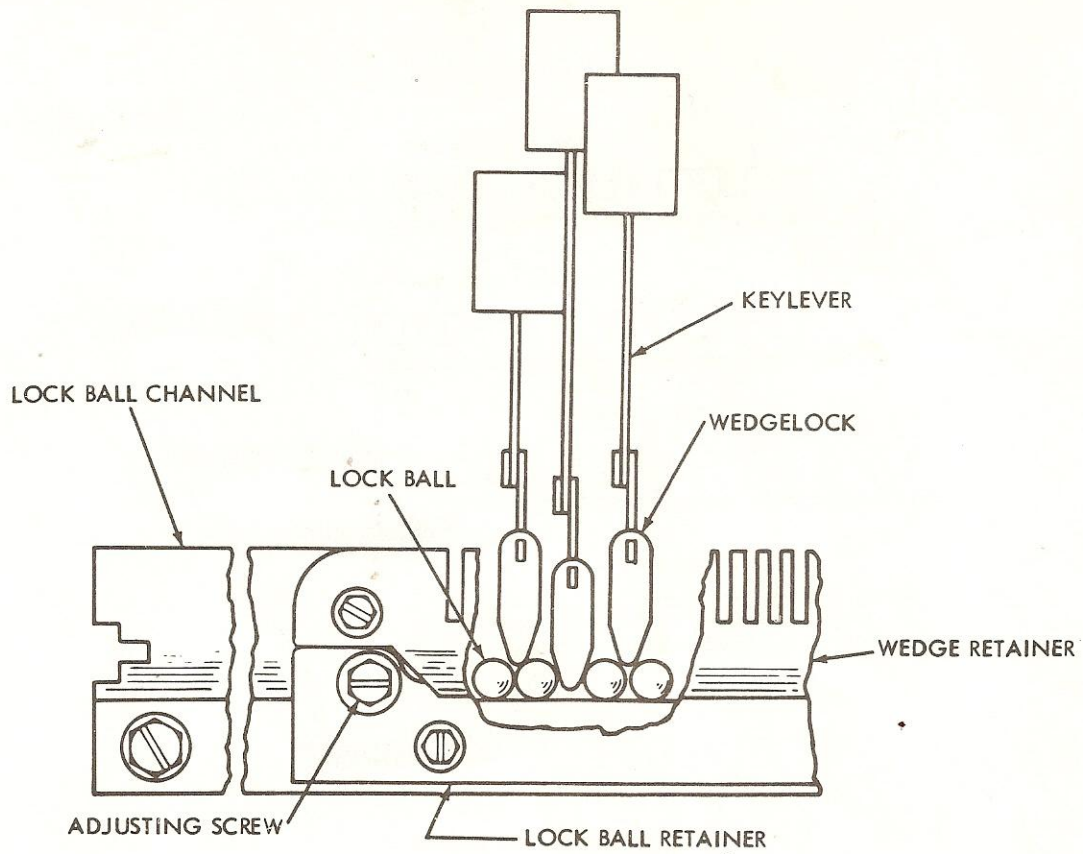


Figure 85. Wedge lock mechanism.

ASR keyboard the clutch is tripped by the clutch trip magnet.

24-16. *Clutch trip operation.* When the selector switch knob is in the K (KEYBOARD) or K-T (KEYBOARD & TAPE) position, the keyboard control selection lever is raised, as shown by the dotted

line in figure 92. Each time the clutch trip magnet is pulsed from an external source, the movement of the armature swings the armature extension towards the front of the keyboard and out of the path of the right end of the clutch trip bar. The clutch trip bar moves to the right under spring

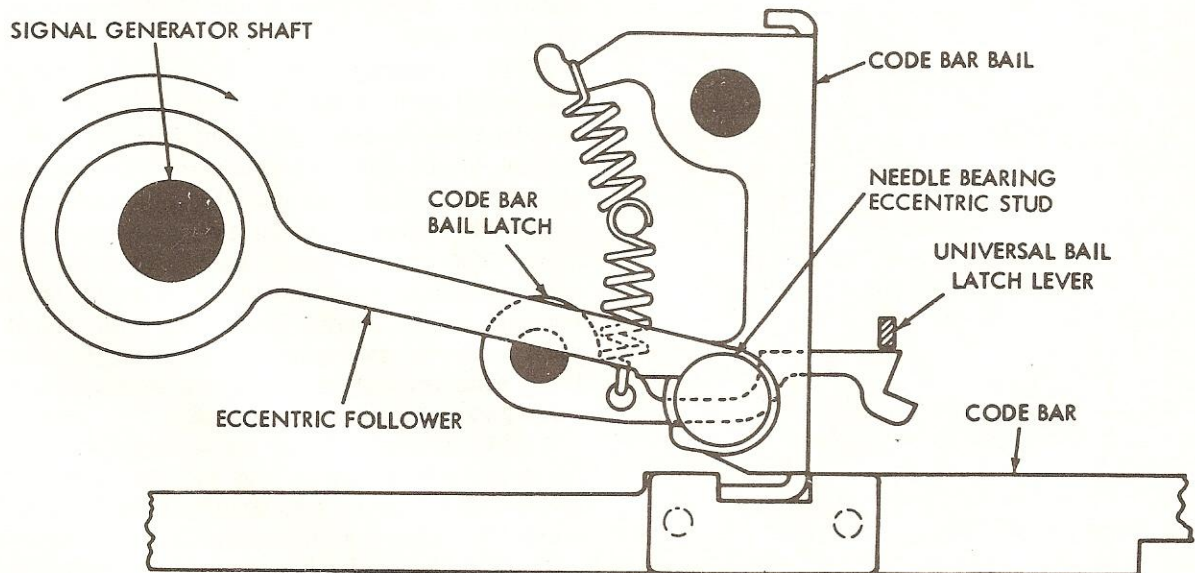


Figure 86. Code bar bail operation.

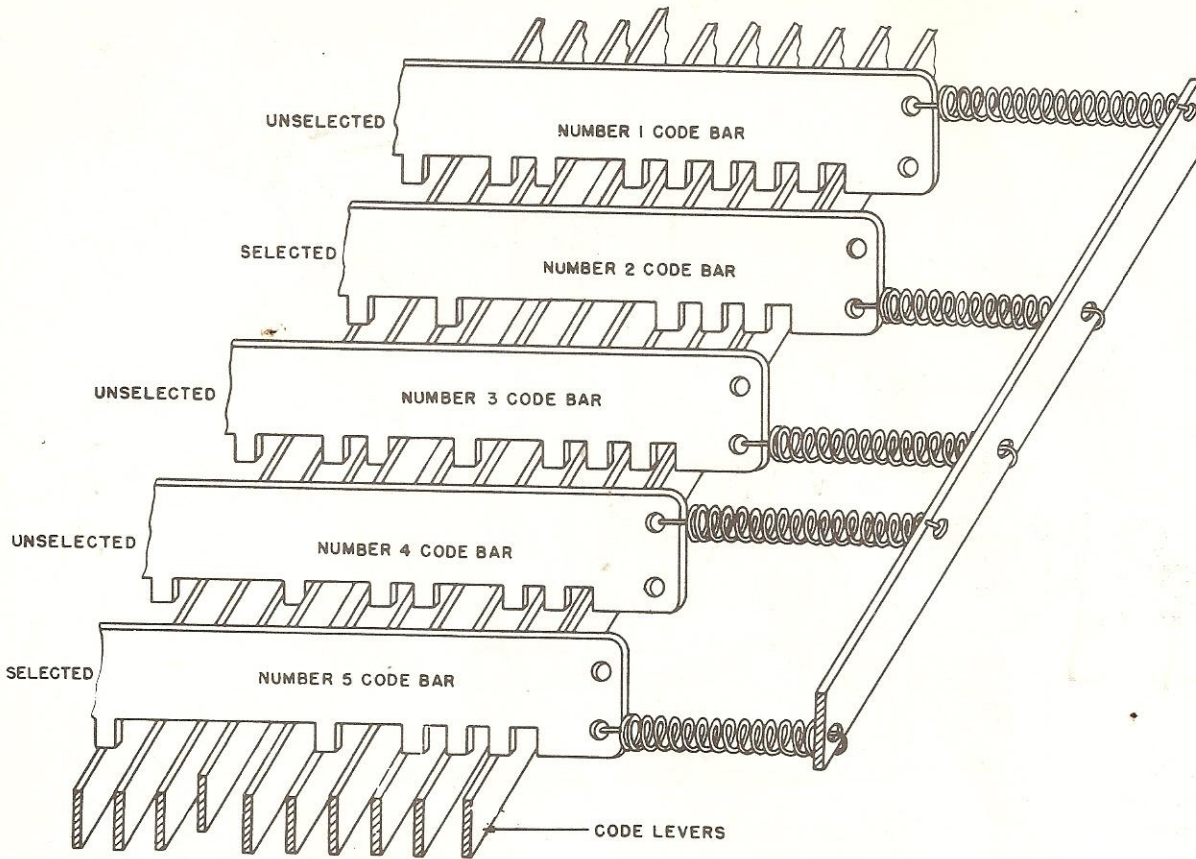


Figure 87. Code bar selection.

tension and takes with it the keyboard control selection lever. The selection lever is in line with the clutch trip lever which, in turn, is connected to the clutch stop lever shown in figure 91. The clutch stop lever lifts away from the lug on the clutch shoe lever, allowing the signal generator clutch to engage.

24-17. *Transfer lever operation.* As stated previously, each of the five code bars positions its own transfer lever. In addition to these five transfer levers, there are two other levers which are not associated with code bars, as shown in figure 88. These originate the start and stop pulse. The cam lobes on the signal generator shaft are numbered 1 through 8, counting from the rear to the front. There are seven signal pulse lobes on the cam, one for each transfer lever, while the eighth lobe is used to actuate the locking bail, also shown in figure 88.

24-18. The cam lobes are so arranged that when the clutch engages and the cam assembly rotates, lobe 3 engages its transfer lever first and moves it. Almost at the same time, the eighth lobe allows the locking bail to move upward under spring tension. The locking bail blade engages on one side or the other of the detents, located

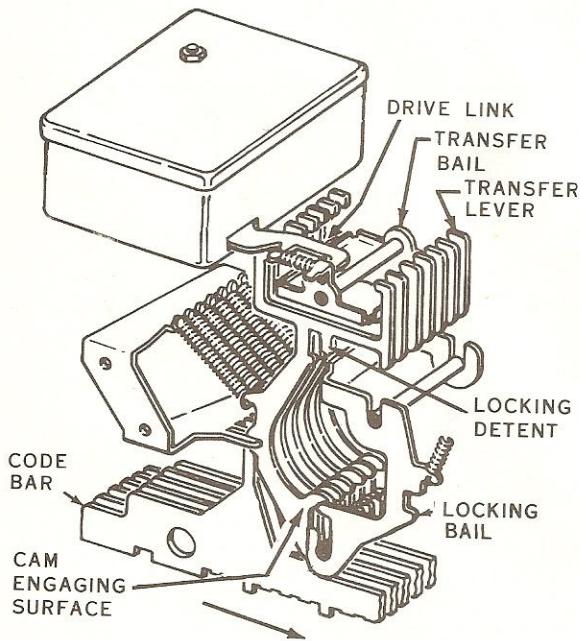


Figure 88. Transfer lever mechanism.

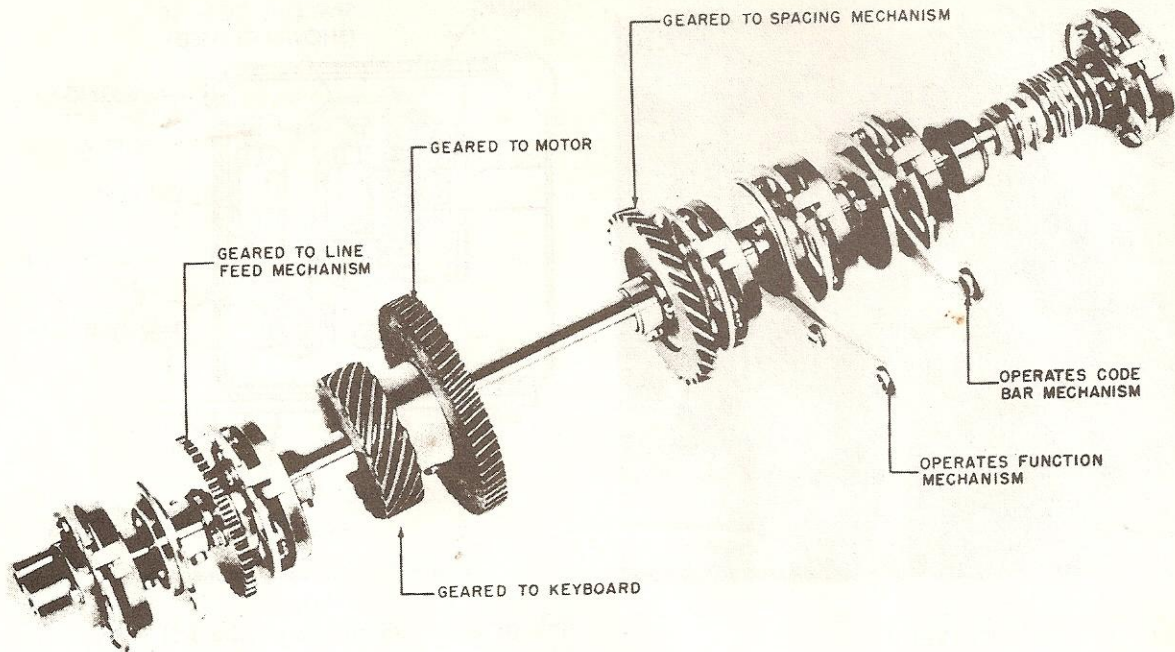


Figure 89. Main shaft of the typing unit.

on the underside of the transfer levers, to lock them in position. Unselected transfer levers are locked in the left (space) position while selected transfer levers are locked in the right (mark) position. Thus, in the first few degrees of cam rotation, the position of the transfer levers is locked, and the code bars are free to be reset in their normal latched positions.

24-19. Transfer lever 3 controls the start pulse. As there is no code bar to engage this transfer lever, it is always held to the left by its

own spring. As cam lobe 3 moves this transfer lever down, the hook on the upper right arm of the transfer lever engages the right-hand side of the transfer bail. The continuing downward movement of the transfer lever trips the transfer bail to the right and pulls the contact drive link, shown in figure 88, to the right. You can also see this drive link in figure 93 and how the movement to the right causes the contact toggle to pivot so that the toggle contact closes to the spacing contact while the marking contact is

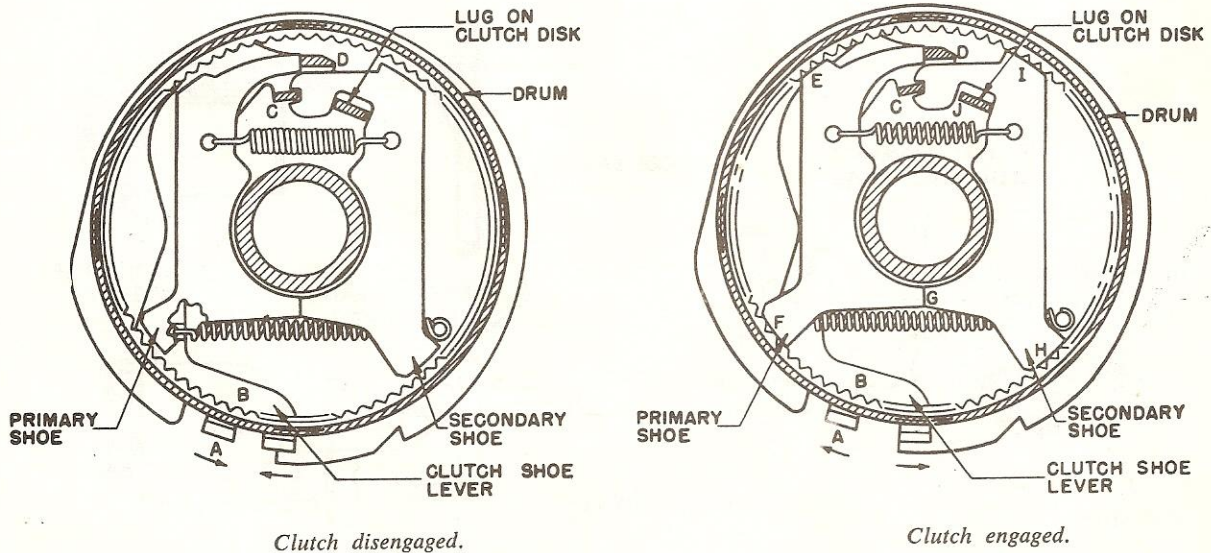
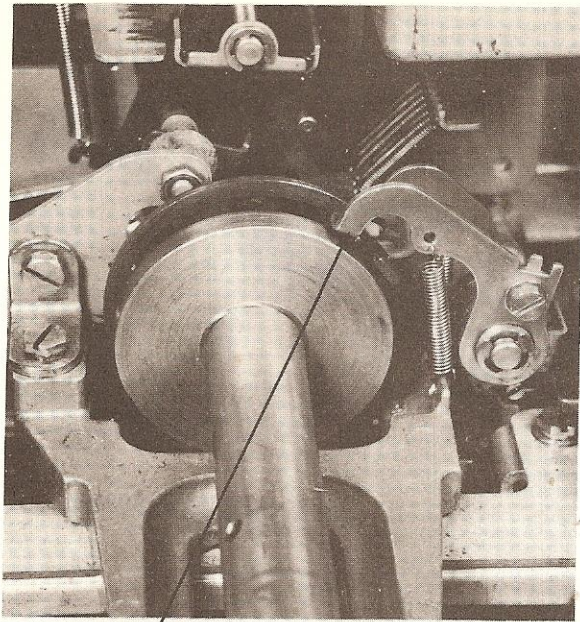


Figure 90. Clutch operation.



CLUTCH STOP LEVER

Figure 91. Clutch stop lever.

opened. This places a start (spacing) pulse on the line.

24-20. In sequential order, lobes 1, 2, 4, 5, and 6 operate their respective transfer levers in a downward direction. The transfer levers which are positioned for spacing pulses cause the transfer bail to pivot clockwise to close the spacing contact. Those transfer levers which are positioned for marking cause the left-hand hook on the lever to engage the left side of the transfer bail and pivot it counterclockwise. The drive

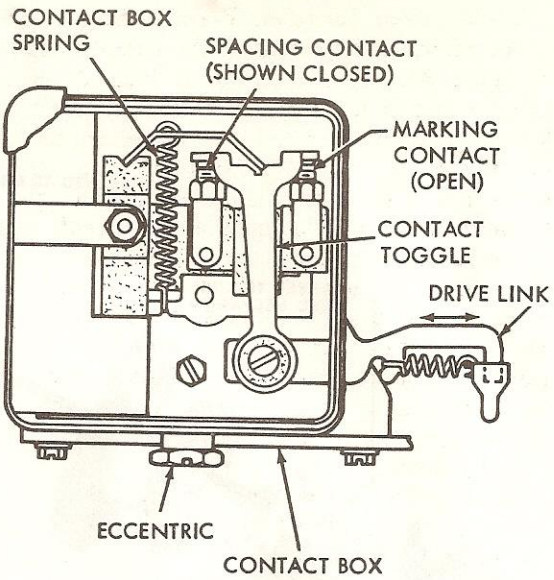


Figure 93. Contact box mechanism.

link in figure 93 moves to the left for marking. This closes the marking contact and opens the spacing contact. Thus the five code pulses are either marking or spacing, depending upon the code combination transmitted.

24-21. Transfer lever 7 is the stop pulse transfer lever. This lever is permanently held to the right by a stop pin; therefore the resulting pulse (stop pulse) is always marking.

24-22. The locking bail holds the transfer levers in their selected positions until after the beginning of the fifth pulse. At this time cam lobe 8 pulls the locking bail down out of the locking position, and all selected code transfer levers are free to return to their left positions.

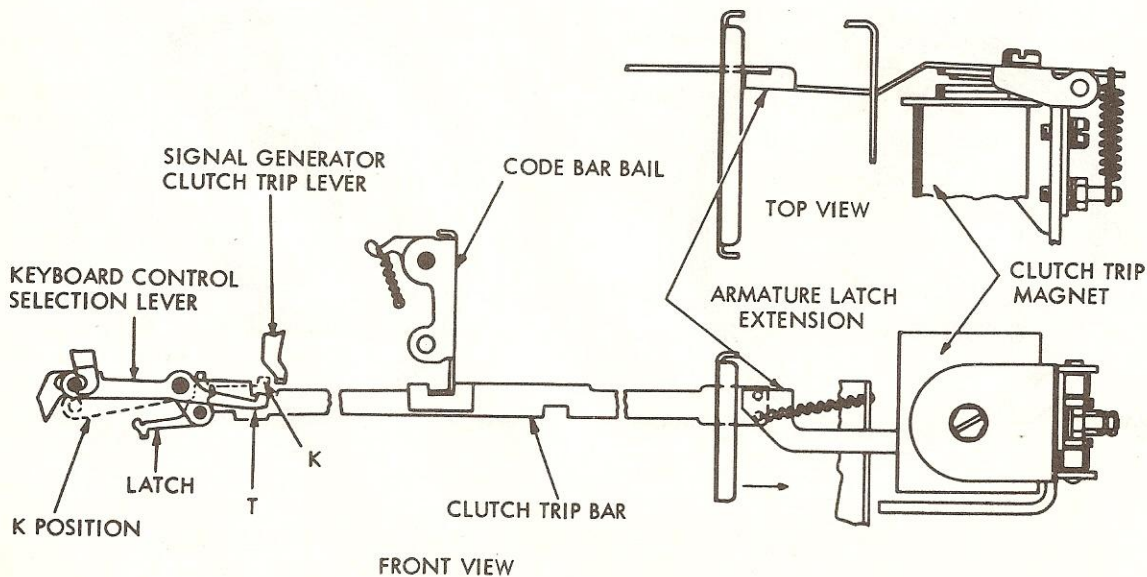


Figure 92. Clutch trip bar mechanism.

24-23. *Code bar reset.* Reset of the code bars is accomplished by means of the eccentric shown in figure 86. This eccentric is located on the front of the cam which drives the eccentric follower. The follower engages an eccentric stud on the side of the code bar bail and pulls the bail to the left as the cam rotates. As the bail moves to the left, the bail latch clears the needle bearing stud and is pulled upward into locking position under tension of the spring to latch, or reset, the code bar bail. As the code bar bail moves into the reset position, it engages projections on the unlatched code bars, clutch trip bar, and a stop on the nonrepeat lever, moving all of these parts to the left, into the latched reset position.

24-24. This covers the main mechanical operations of the keyboard. However, before we go on to the typing unit, there are a number of auxiliary operations which you must study.

24-25. **Auxiliary Operations.** The keyboard of the ASR set, like those you have previously studied, can perform a number of local operations. Most of these operations are controlled through the upper or red row of keys shown in figure 82, which is an illustration of the keyboard. These special keys control local line feed, carriage return, receive, send, and repeat operations. In addition to these local functions we will also discuss the synchronous pulsed transmission mechanism, the margin indicator mechanism, and the character counter mechanism.

24-26. *Local line feed.* Operation of the local line feed key lever (red) causes its function lever to raise the forward end of the local line feed bail, as shown in figure 94. 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 machine is made to operate without disturbing the other typing unit on the same line circuit.

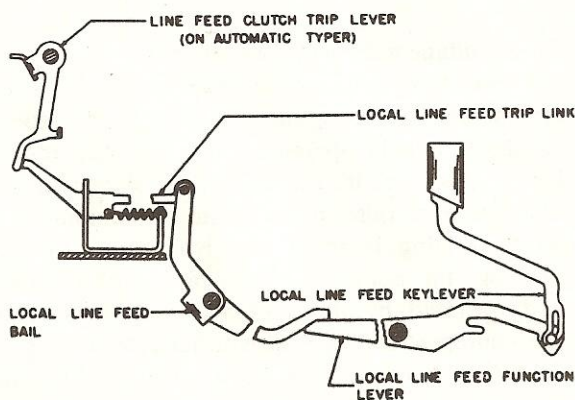


Figure 94. Local line feed mechanism.

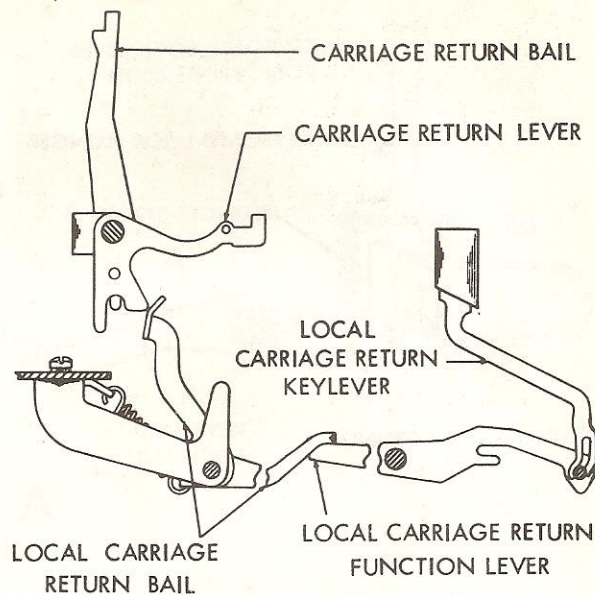


Figure 95. Local carriage return mechanism.

24-27. *Local carriage return.* The local carriage return mechanism enables the operator to trip the carriage return on the local typing unit only, thereby causing the type box carriage to be fully returned to its normal position at the beginning of a line of copy. If you will look at figure 95 as you read, you will get a picture of how this mechanism operates.

24-28. When the LOC CR key lever is depressed, its function lever rises and, in turn, raises the forward end of the carriage return bail. This bail rotates about its pivot point until the upper end engages the carriage return lever on the typer. The carriage return mechanism operates in this manner without an electrical signal that will cause other typing units in the line circuit to function.

24-29. *Receive (keyboard lock).* The Model 28 ASR set contains an electrical keyboard lock mechanism which functions when the REC key lever is depressed. The downward movement of the receive key lever, shown in the upper right of section A, figure 96, raises the rear portion of the keyboard lock function lever which, in turn, raises the lock bar latch. With the lock bar latch disengaged, as in section B of figure 96, the lock bar is free to move to the right under spring tension of the keyboard lock switch contact on the switch lever. The switch lever then pivots, closing the contacts of the switch. The associated circuitry is arranged to shunt the signal generator when the switch is closed. However, since there is no mechanical blocking of the key levers, the typing perforator can still be operated.

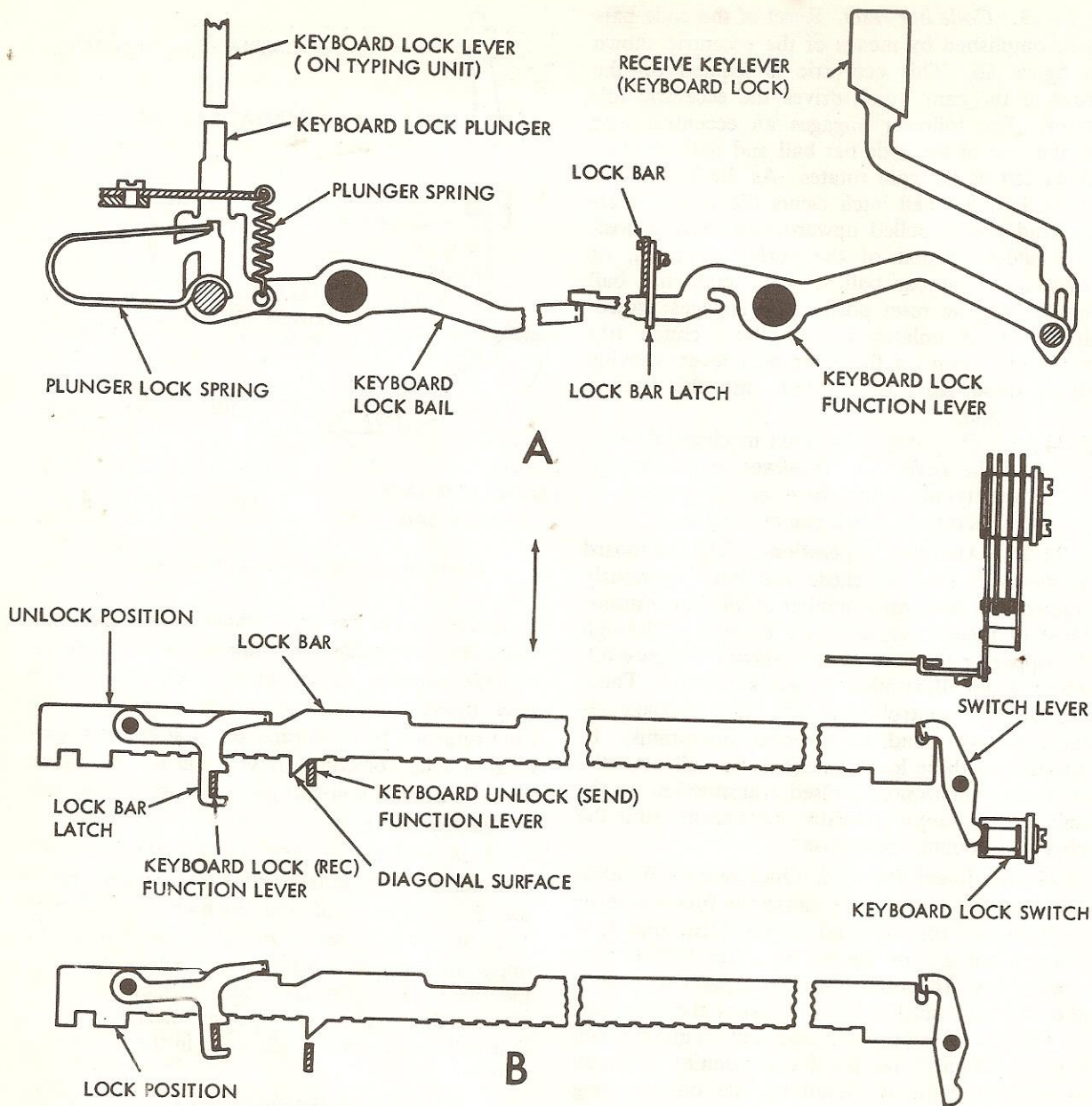


Figure 96. Keyboard lock mechanism.

24-30. *Send (keyboard unlock)*. The keyboard unlock mechanism permits the keyboard signal generator to become operative. When the SEND key lever, shown in figure 96, is depressed, the keyboard unlock function lever rises against a diagonal camming surface, shown in B of figure 96. This moves the lock bar to the left until the lock bar latch falls into the notch on the lock bar. As the lock bar moves to the right, the bottom of the switch lever pivots to the right and opens the shunt circuit around the signal generator to make normal transmission possible.

24-31. *Repeat mechanism*. Through the operation of the repeat mechanism, shown in figure

97, simultaneously with one of the key levers in the lower three rows or the space bar, a character or function will be repeated as long as the repeat key lever is held operated. The operated repeat key lever causes its function lever, shown in the illustration, to raise the right end of the nonrepeat lever, rotating it about its pivot point. In this position, the nonrepeat lever cannot be engaged and operated by the code bar bail. Therefore the nonrepeat lever crank will not reset the operated code bar bail latch. The code bar bail and universal bail latch levers are thus held in their operated positions, and the code bar bail follows

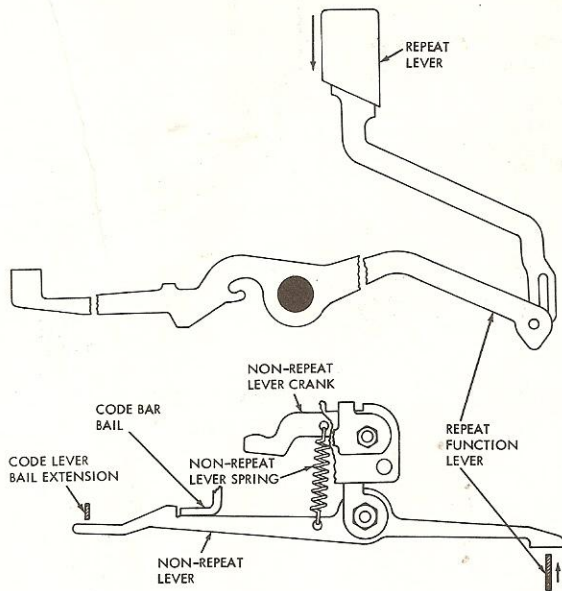


Figure 97. Repeat mechanism.

the eccentric arm movement back and forth until the repeat key lever is released.

24-32. *Synchronous pulsed transmission mechanism.* The synchronous pulsed transmission mechanism provides a means of controlling signal transmission from the keyboard at a predetermined rate, upon reception of a 50-ma external clocking pulse of 20-ms duration. This control pulse is usually supplied through Technical Control Section of the communications center.

24-33. When any green key on the keyboard is depressed, the reset bail moves to the right and releases all selected code bars as previously described. Also released is the universal code bar, located behind the clutch trip bar on the keyboard. When this bar moves to the right, an insulated projection above the bar closes the clutch magnet conditioning contacts, which conditions the clutch trip magnet to receive the external clocking pulse. The clutch magnet is shown in figure 92.

24-34. Upon reception of the external clocking pulse, the clutch trip magnet energizes and unblocks the clutch trip bar. As the clutch trip bar moves to the right, it engages the clutch trip lever extension and trips the signal generator cam shaft to rotate and transmit the proper sequential signal. After one complete revolution of the signal generator camshaft, the reset bail returns to its starting position, resetting all code bars and the clutch trip bar, as previously explained.

24-35. When the keyboard is in the KEYBOARD or KEYBOARD & TAPE position, the signal generator clutch must wait for the clutch trip magnet to receive the external clocking pulse. In the TAPE

ONLY position, the signal generator can still be tripped by the external clocking pulse, unless the clutch trip magnet is held energized by appropriate wiring of the selector switch.

24-36. Some uses of the equipment may not require an external clocking pulse. In this case the clutch trip magnet is removed from the machine and transmission is mechanically controlled by the operation of the key levers.

24-37. *Margin indicator mechanism.* The margin indicator cam disk on the associated typing unit spring drum rotates with the drum as the spacing of characters occurs. As the end of each line is approached, the cam surface of the disk makes contact with the margin indicator contact switch lever, shown in figure 98, and rotates it about its pivot point. When the lever rotates, it releases the margin indicator switch plunger. The normally open contacts are closed, completing the circuit to a margin indicator light in the cabinet. The carriage return cycle returns the cam disk to its starting position which, in turn, opens the margin indicator switch. The margin indicator mechanism does not function in the TAPE ONLY position.

24-38. *Character counter mechanism.* When the Model 28 ASR set is preparing tape without using the page printer for monitoring purposes, a character counter must be used to inform the operator when it is necessary to insert carriage return and line feed combinations into the message being prepared on tape. The character counter mechanism, illustrated in figure 99, serves this purpose. As each character which requires a lateral movement on a page printer is punched in the tape, the counter indicator advances one number. The indicator is attached to the indicator cord which is strung around the pulley and the ratchet drum and attached to the indicator spring. As the ratchet rotates clockwise one notch at a time, due to the reciprocating movement of the drive lever and the holding action of the latch lever, the indicator advances to the right and the spring is stretched. When a carriage return combination is selected, both the drive lever and the latch lever are lifted out of engagement with the ratchet. The indicator is returned to the left by the indicator spring. Let's now look at figure 100 and try to picture how the character counter operates.

24-39. Examine the lower portion of the illustration. This shows the drive lever (behind the latch lever) pinned to the feed lever which is part of the feed bail that bends to the rear and then down to the forked end labeled "1." The drive lever can move to the left and right when activated by the feed bail and also up and down under the influence of the reset lever extension

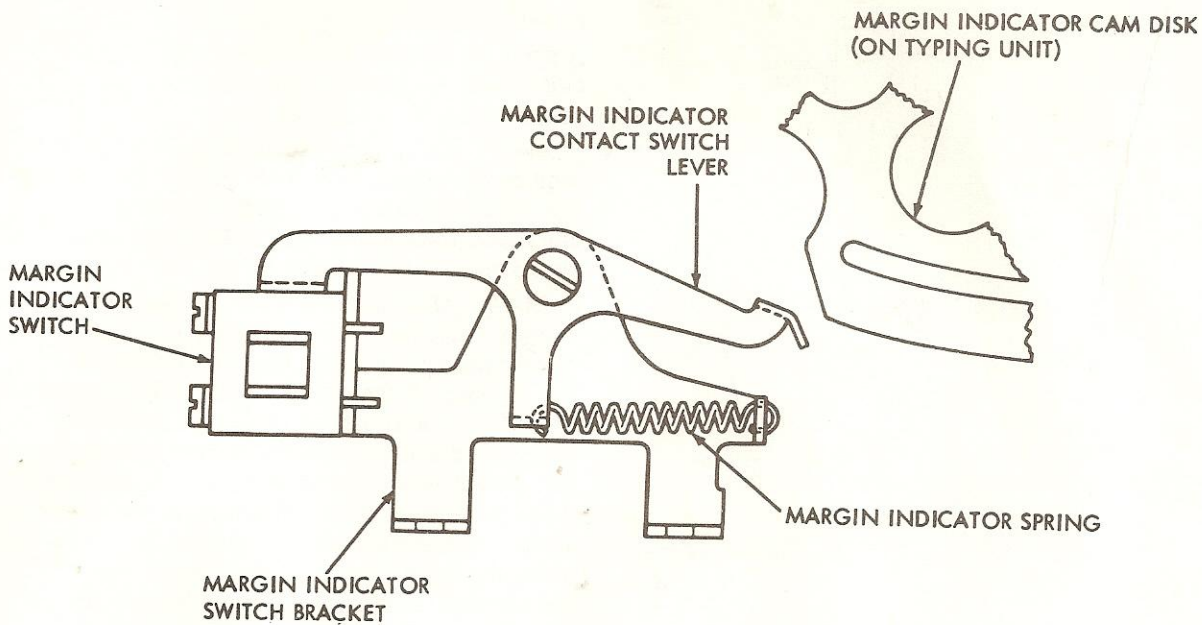


Figure 98. Margin indicator mechanism.

and the reset bail (labeled "2"). The latch lever can only pivot upward when activated by the reset lever extension and then down again under the influence of its spring. The lower fork of the feed lever straddles a projection on the top of the first counter code bar, while the reset bail is positioned in a similar manner over a second code bar (counter reset code bar). These bars are in

front of the No. 5 code bar in the code bar basket. The counter code bar moves to the right each time a key lever—other than a function—is operated. It will be reset, as are the other five code bars, by the code bar bail. On the other hand, the counter reset code bar will operate to the right *only* when the carriage return key lever is depressed. It will then be reset to the left as the

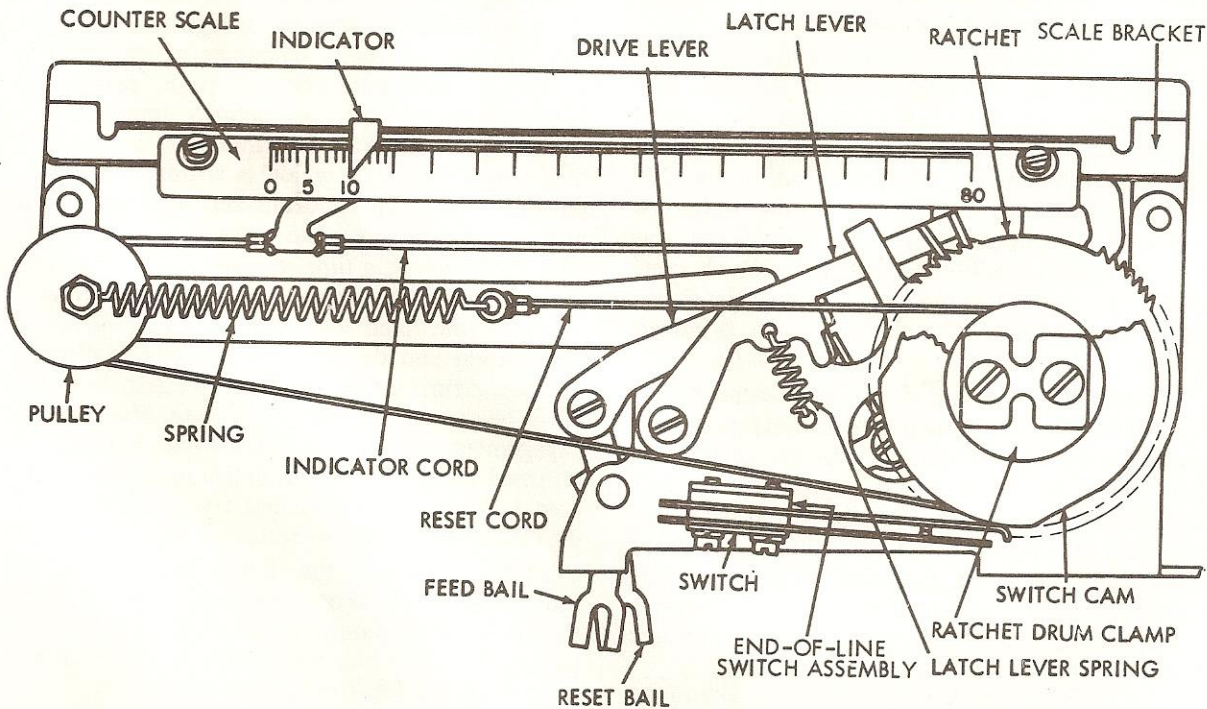


Figure 99. Character counter mechanism.

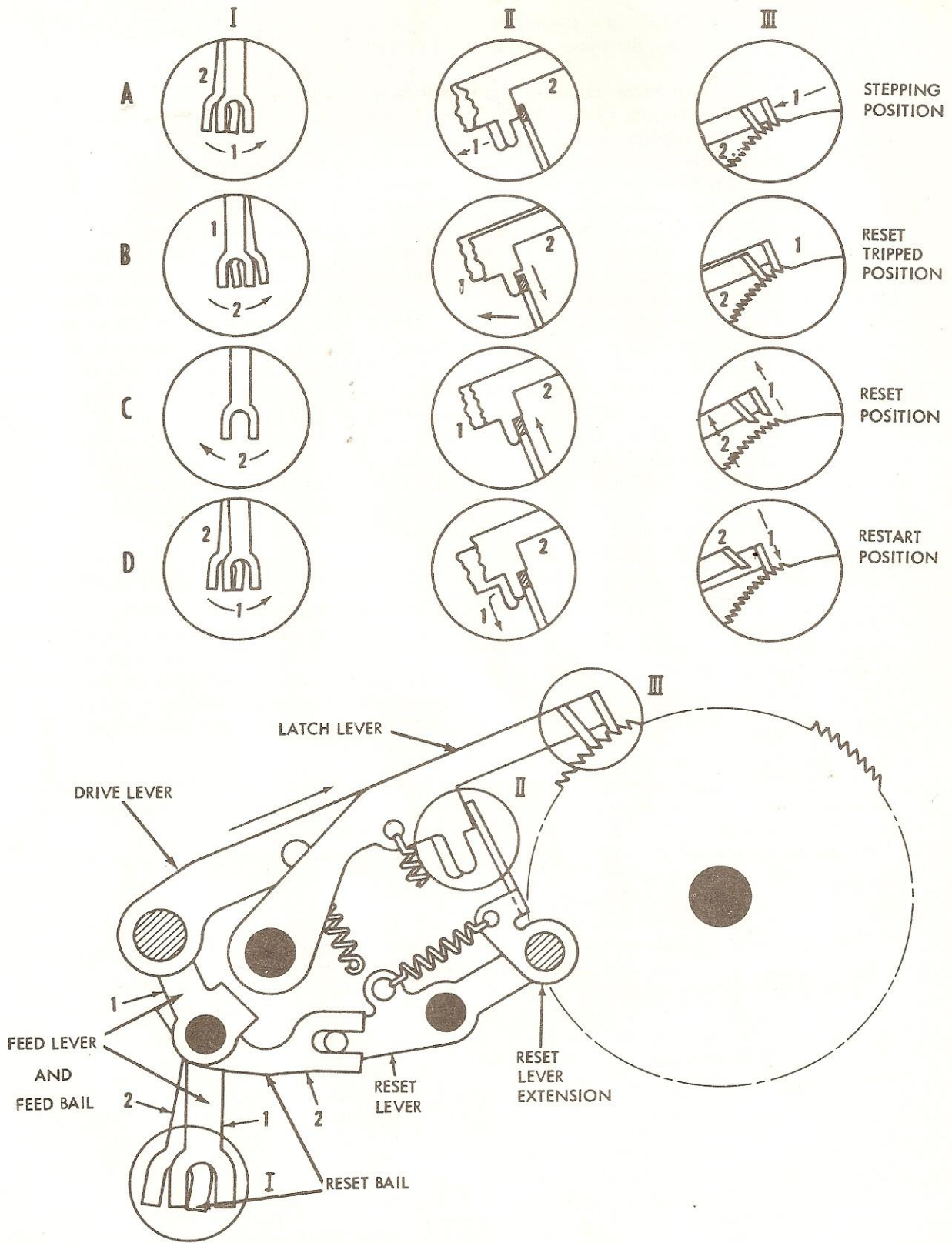


Figure 100. Operation of the character counter.

signal generator shaft completes the revolution. Keeping this in mind, examine the upper portion of figure 100.

24-40. The three circled areas represent the areas circled in the lower portion of the illustration. In A we see the stepping action of the counter as a character key top is depressed. As the counter code bar moves to the right, it causes the forked end of the feed bail to do likewise. The upper end, or feed lever, rotates to the left, causing the drive lever to move to the left. The upper end of the drive lever drags over a tooth on the ratchet and into the next notch. The latch lever prevents the ratchet from turning. When the code bar bail resets the code bars, the counter code bar is also moved to the left. This movement forces the forked end of the feed bail to the left, while the feed lever forces the drive lever to the right. Movement of the drive lever to the right causes the ratchet wheel to rotate clockwise one notch. The latch lever drags over a tooth and into the next notch. Rotation of the ratchet wheel causes the indicator to add another count on the counter scale on figure 99. This action is repeated each time a character, which causes a movement of a typing unit, is punched in the tape of the reperforator.

24-41. Now let us visualize what happens when the carriage return key top is depressed. Movement of the counter reset code bar to the right causes a similar movement by the 2 fork, as shown in B of figure 100. This causes the other end of the reset bail (horizontal fork in the lower section of fig. 100) to move upward, resulting in a clockwise rotation of the reset lever. When the reset lever extension moves below the shoulders of both the drive and latch levers, the spring draws the extension in as shown in BII.

24-42. In C we note what happens as the counter reset code bar is moved to the left by the code bar bail. The reset bail moves to the left, rotating the reset lever counterclockwise. The upward movement of the reset lever extension lifts both the drive lever and the latch lever out of engagement with the ratchet wheel. The ratchet wheel in figure 99 spins counterclockwise, returning the indicator to zero, and the counter is reset.

24-43. In D we see the restart action of the counter. When a character key top is depressed, it results in the action described in A. As the drive lever moves to the left, it drops off the reset lever extension, as shown in DII, and into engagement with a tooth on the ratchet wheel. As the drive lever moves to the right on reset, the ratchet wheel rotates. The dropped drive lever now forces the reset lever extension to rotate out from under the latch lever which then drops into engagement with the ratchet wheel. The mechanism

is now back in the stepping position shown in A of figure 100.

24-44. *End-of-line indicator.* The end-of-line indicator operates instead of the margin indicator whenever the keyboard is used in the TAPE ONLY position. The end-of-line switch, shown in figure 99, operates the margin indicator lamp in the cabinet to signal the end of a typed printed line. Operation of the character counter end-of-line switch is controlled by a switch cam on the ratchet drum. The switch cam rotates with the drum and can be adjusted to close the switch at any typed line length of from 10 to 80 characters.

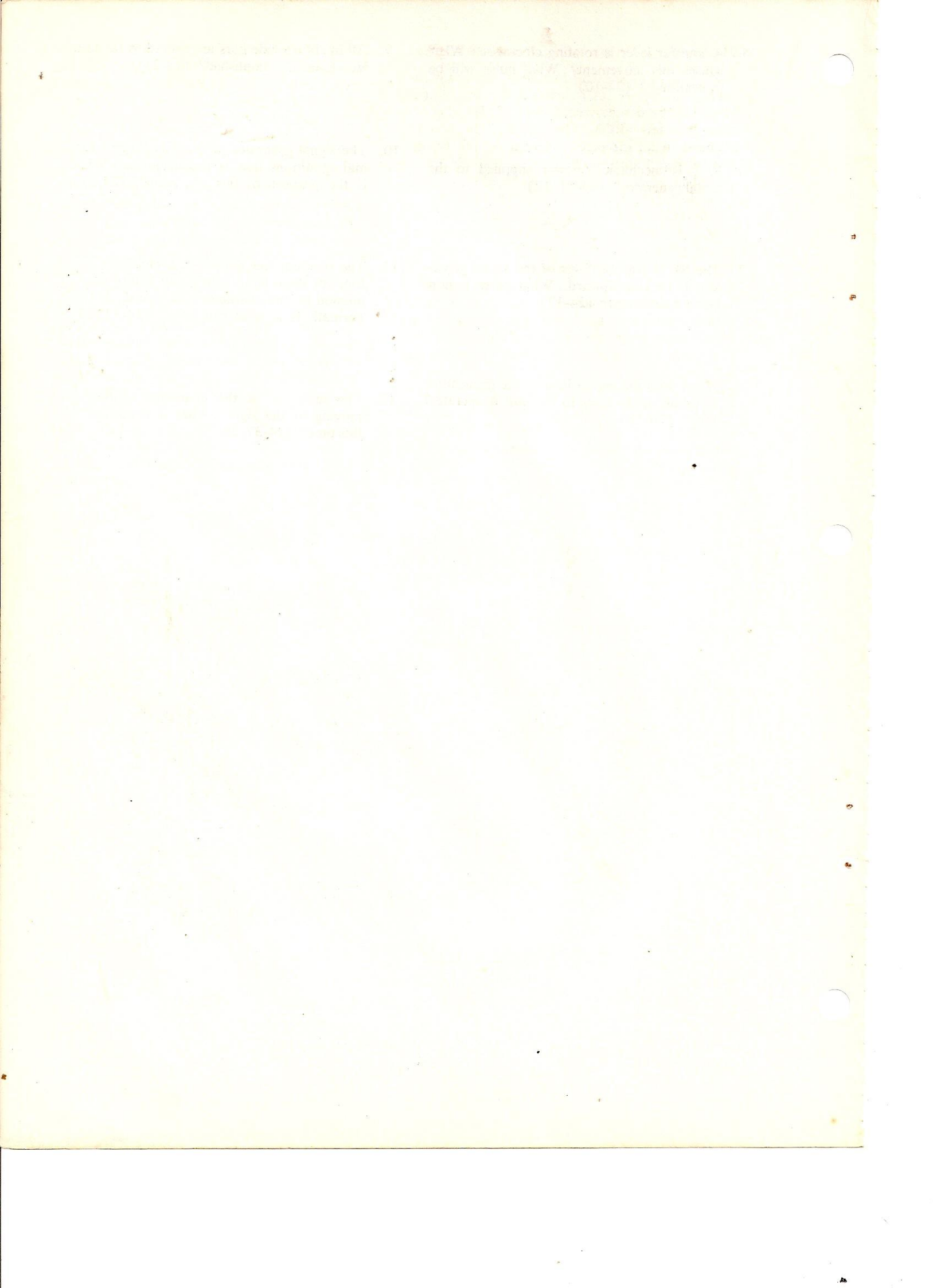
24-45. Well, that is about enough for the keyboard at this time. We will discuss it again, in part, in the next chapter to show the connection between the keyboard and the keyboard typing reperforator; and finally in the last chapter, we will discuss the electrical operation of the keyboard. Right now, before examining the typing unit, we will use some review questions to evaluate your understanding of the mechanical operation of the keyboard.

Review Exercises — Section 24

The following exercises are study aids. Write your answers in pencil in the space provided after each exercise. Use the blank page to record other notes on the chapter content. Immediately check your answers with the key at the end of the text. Do not submit your answers to ECI for grading.

1. List some of the advantages of the ASR set over the TT-7FG discussed earlier in the volume. (Intro.-2; 24-1)
2. A lock ball in the lock ball channel is missing. What effect would this have on the machine? (24-8)
3. The universal bail latch lever spring is stretched and has less tension than required. Will this cause the keyboard to malfunction? If so, why? (24-9)
4. What effect will the loss of the No. 4 code bar spring have on transmissions? Why? (24-9)

5. A transfer lever is rotating clockwise. What causes this movement? What pulse will be transmitted? (24-10)
6. How is mechanical power supplied to the signal generator? (24-11, 12)
7. The No. 3 transfer lever of the signal generator is moving upward. What pulse is now being transmitted? (24-17)
8. When does the eighth lobe of the transmitter camshaft apply force to the unit it operates? Why? (24-18)
9. All operated code bars are moved to the left. How is this accomplished? (24-23)
10. The signal generator is shorted. Under normal conditions how is this achieved? What is the purpose of this operation? (24-29)
11. The operator has depressed a character key top, yet there is a slight delay before transmission of that character is achieved. Is this normal? If so what caused it? (24-32, 33)
12. The indicator of the character counter is moving to the right. What is occurring at this time? (24-37, 38)



25. The Page Printer of the Madel 28 ASR Set

25-1. The typing unit furnished with the automatic send-receive set is identical to those found in all keyboard send-receive sets (KSR) and receive-only sets (RO). Operation of the unit is identical in all instances. A cam on the typing unit carriage return mechanism operates the margin indicator switch. Except for limited local functions, the typing unit operates in response to signal line impulses, and it electromechanically converts these signals to page-printed character form. Operation at either 75 bauds or 45.5 bauds is possible, depending on the gear set used.

25-2. Of course, in this chapter we are only interested in the mechanical operation of the unit. How the electrical signals are received and fed to the selector-magnet circuit will be discussed in the final chapter. Let us concentrate our attention on the sequence of operation from the supplying of the mechanical power to the main shaft through the selecting and printing operation. We will wind up our discussion of the printer with some of the general operations and functions other than printing.

25-3. **Main Shaft.** The main shaft is located in the lower rear portion of the typing unit and extends the full length of the unit, as shown in figure 101. From time to time we will refer to this illustration to show the location of other components of the printer.

25-4. When the typing unit is mounted on the keyboard, the keyboard helical driving gear on the 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 and printer mechanisms.

25-5. The main shaft, shown in figure 102, carries 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.

25-6. Two of the clutches—namely, the line feed and the spacing clutches—have three sets of lugs equally spaced about their periphery

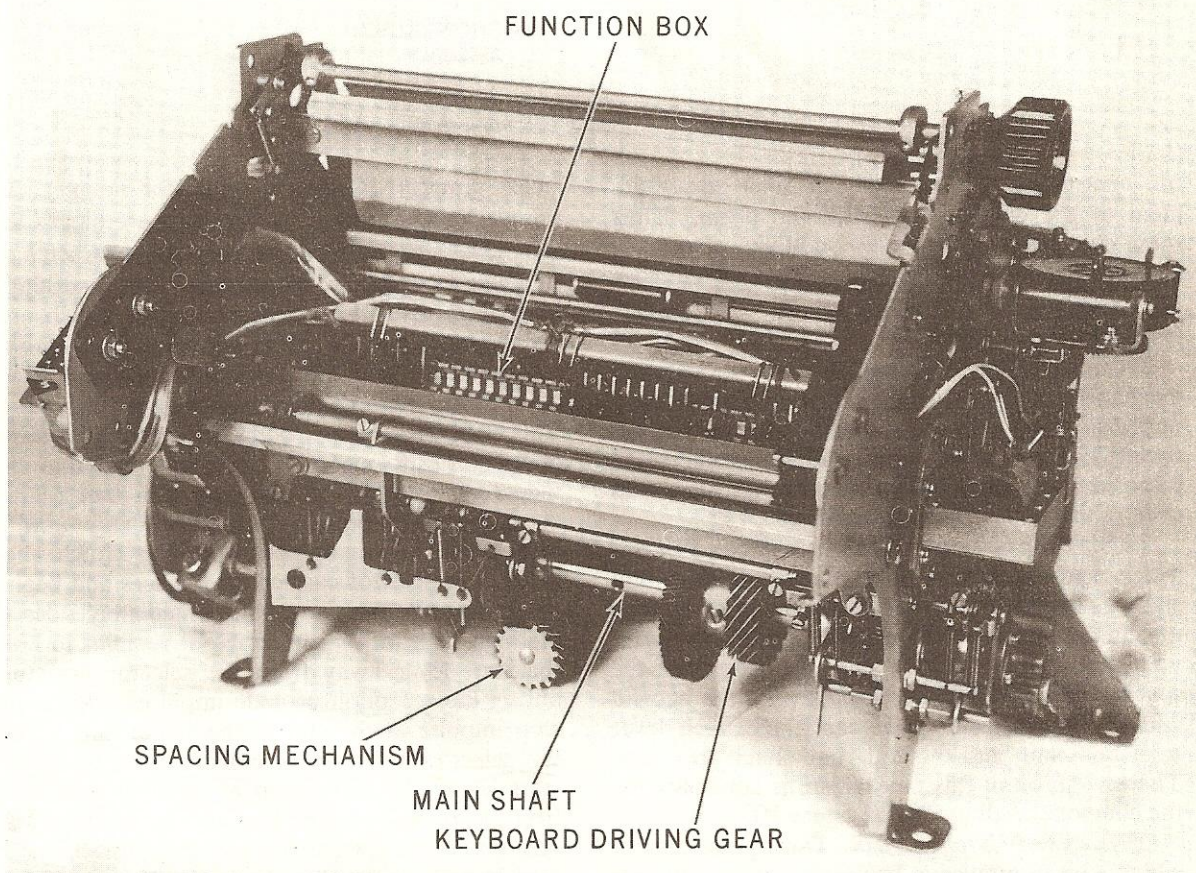


Figure 101. Rear view of the typing unit.

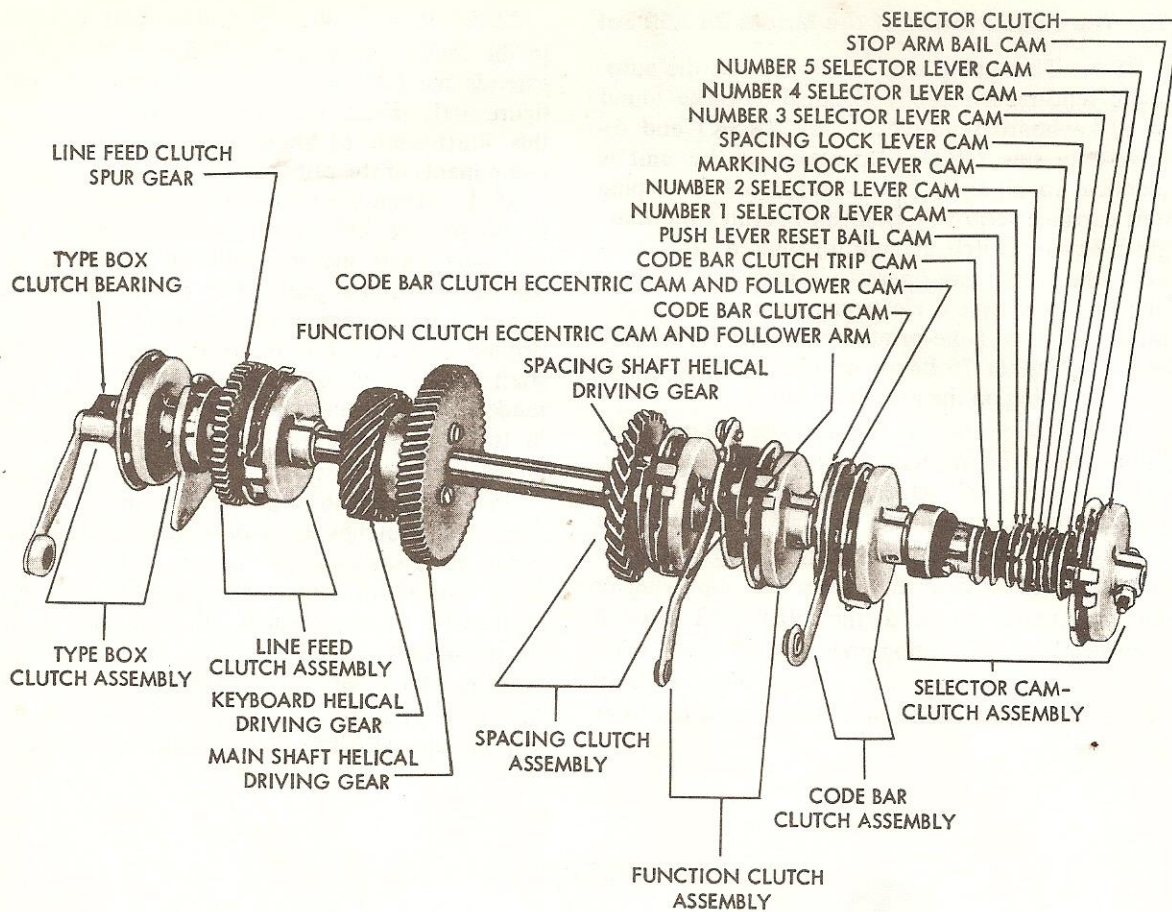


Figure 102. Typing unit main shaft.

for controlling the engagement and disengagement of the clutch shoes with the drum. Thus these clutches may turn only one-third of a revolution when tripped. The remaining four clutches have one set of lugs and must turn a complete revolution when tripped.

25-7. **Selecting Mechanism.** 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 elements of the start-stop code to the mechanical arrangement.

25-8. *Selector cam-clutch assembly.* The selector cam-clutch assembly portion of the main shaft in figure 102 comprises, from right to left: the clutch; the stop arm bail cam; the fifth, fourth, and 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. The revolution of this mechanism is controlled by the components illustrated in figure 103.

25-9. *Cam-clutch control.* During the time in which a stop impulse is being transmitted, the selector-magnet coils are energized and hold the se-

lector armature against the selector magnet. In this stop position, the selector armature blocks the start lever. While the signal for any character or function is being received, the start (spacing) impulse releases the selector armature which, under the tension of its spring, moves away from the magnet cores and thus unlatches the start lever by allowing it to pass over the dropped armature. 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 reception of code impulses. 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 clutch one-stop cam disk, upon which

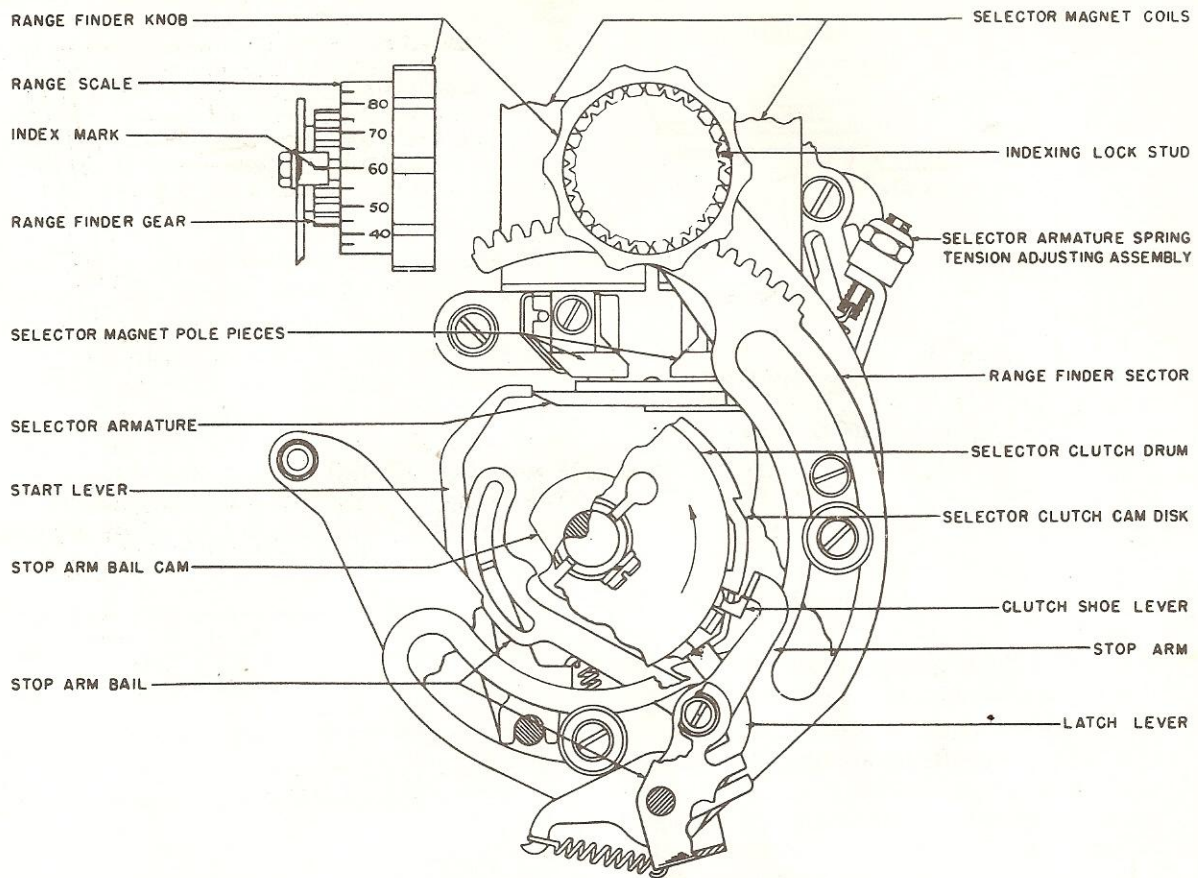


Figure 103. Selector cam-clutch trip mechanism.

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 impulse is received.

25-10. The series of five selecting levers, a marking lock lever, and a spacing lock lever ride their respective cams on the selector cam-clutch assembly. As the marking and spacing code impulses are received in the selector magnet, the selector cam-clutch rotates and actuates the selector levers. When a spacing impulse is received, the marking lock lever is blocked by the knife edge of the armature, and the spacing lock lever swings toward the right (right-end view) above the armature and locks the armature in the spacing position until the next impulse is due. When the marking lock lever is prevented from rotating to the right, in figure 104, the extensions on the marking lock lever prevent the selector levers from following their cams.

25-11. When a marking impulse is received, the spacing lock lever is blocked by the end of the

armature, and the marking lock lever swings to the right below the armature to lock the armature in the marking position until the next impulse is due. During these marking periods, 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 right or selected position momentarily. Each selecting lever has an associated push lever, which drops into a notch (see fig. 104) on the top left side of the selecting lever when it falls into its cam indent. As the selector cam-clutch assembly turns, each selecting lever together with its latched push lever is moved back towards the left and held there until all five code impulses have been received. At that time, all selected push levers are positioned to the left and all unselected (space) push levers are positioned to the right and are held in this position until the next start impulse is received. When the next start impulse 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

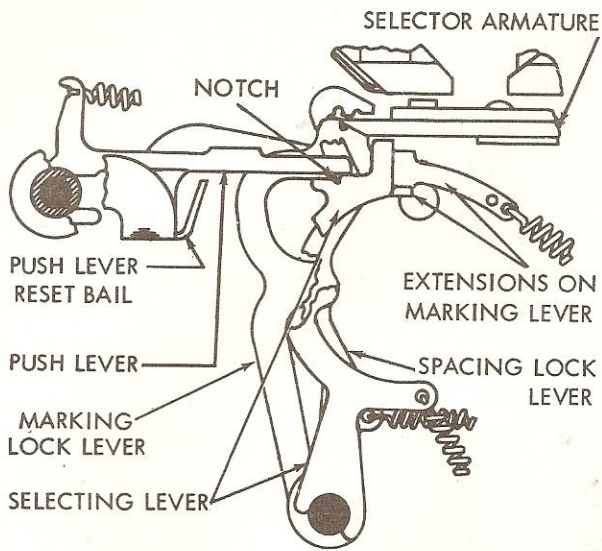


Figure 104. Selector mechanism.

then return to the unselected (right) position under their spring tension.

25-12. **Orientation.** In order to establish operating margins for the typing unit, the sampling of the signal by the selecting mechanism must occur at the most favorable portion of the signal elements. This, as discussed in a previous volume of the course, is referred to as orientation. When the rangefinder knob shown in figure 103 is pushed inward and rotated, its attached rangefinder gear moves the rangefinder sector (which mounts 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 the best setting is obtained, the rangefinder knob is released. Its inner teeth engage the teeth of the indexing lock stud to lock the rangefinder mechanism in position. The setting may be read on the range scale opposite the fixed index mark. Orientation is important because of its effect on printing.

25-13. **Printing.** The process which results in the printing of a character or the performance of a function can be divided in several general areas of operation. These would include the code bar mechanism and the positioning of the code bars, the type box and type box carriage movement, and finally the operation of the printing hammer and the printing carriage which results in the printing of a character on the paper.

25-14. **Code bar mechanism.** 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 thrown toward the front or rear of the typing unit by transfer levers which respond to the 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.

25-15. **Code bar positioning.** Each push lever has an associated intermediate arm, transfer lever, and code bar shift bar. These units can be seen in figure 105. 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 towards each other by a spring. This causes the transfer lever to turn counterclockwise about its pivot point (right-end view) and

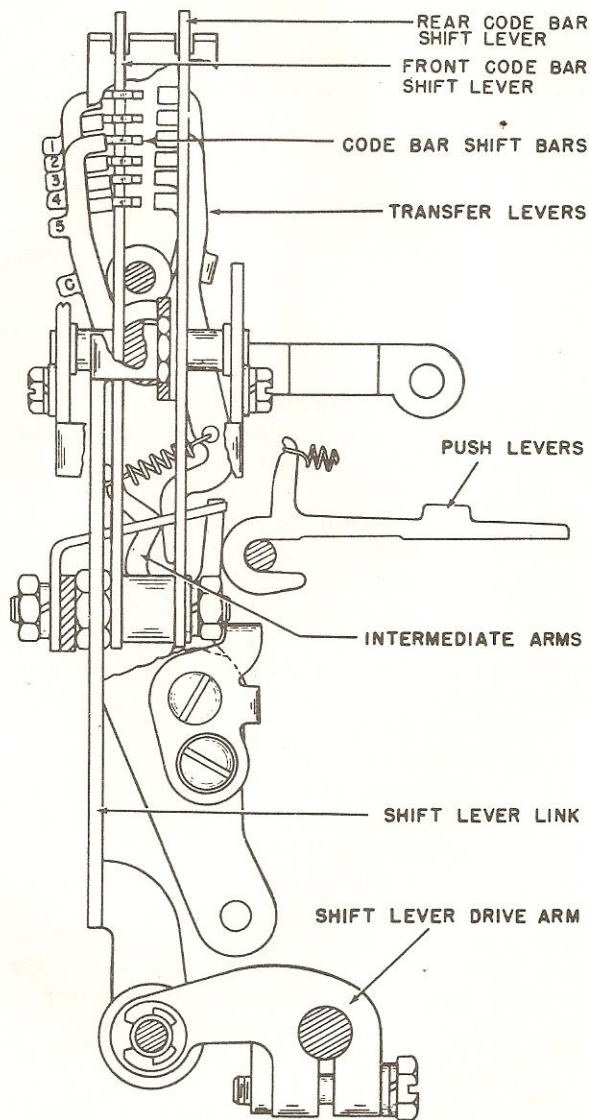


Figure 105. Code bar positioning mechanism.

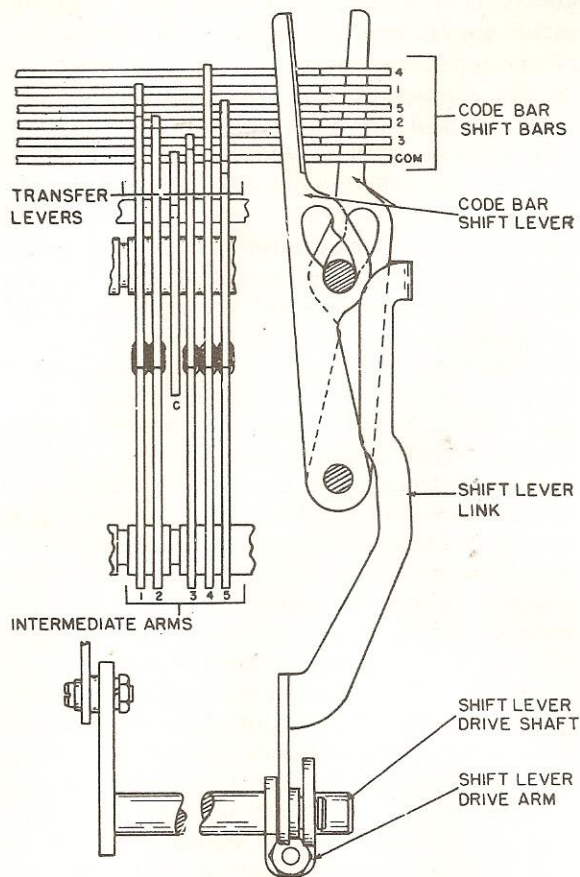


Figure 106. Code bar positioning mechanism, front view.

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), as shown in figure 106, has an extension which passes behind the No. 1 and No. 2 transfer

levers. This can be seen in the top view of the mechanism, shown in figure 107. 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, which can be seen on the main shaft in figure 102. 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 shown in figure 106. 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 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 shifted toward the right. Just how this is accomplished can be easily visualized after you view figure 107. 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, 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.

25-16. *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, No. 4, No. 1, No. 5, No. 2, No. 3, common, automatic carriage return and line feed, and shift-unshift. This arrangement can be seen in figure 108. In the equipment as furnished, the suppression code bar has no

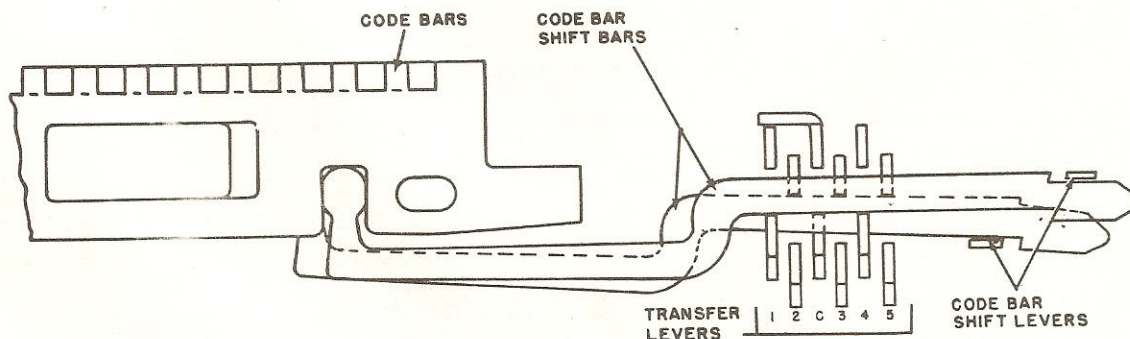


Figure 107. Code bar positioning mechanism, top view.

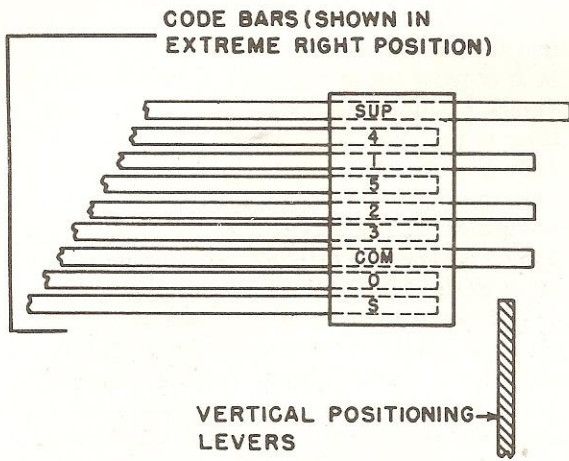


Figure 108. Code bar arrangement.

connection with a shifting mechanism. The automatic carriage return and line feed code bars and the shift-unshift code bar are actuated by mechanisms which we will discuss later in this chapter.

25-17. Type Box and Type Box Carriage. 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 positioned so that the character on the pallet is directly over the correct location on the paper. Since the pallets are arranged in 4 horizontal rows and 16 vertical rows, it is necessary to position the type box carriage both horizontally and vertically for each character. You can see the character arrangement, as viewed from the front of the typing unit, in figure 109.

25-18. Type box movement. 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. Most of these components can be

clearly seen in figure 110. The slide rides the oscillating rail and is clamped to the rear section of the upper draw wire rope. A 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, as shown in figure 111. 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 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. A tensioning pulley rides the underside of the lower draw wire rope to take up any slack which may occur because of the 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 the lower ends. Thus the oscillating rail and 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 to 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 in the chapter, 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.

25-19. Type box positioning. The selection and printing of the various characters from the

LETTERS																FIGURES															
LEFT								RIGHT								LEFT								RIGHT							
MARKING				SPACING				MARKING				SPACING				MARKING				SPACING				MARKING				SPACING			
4	3	2	1	5	4	3	2	5	4	3	2	4	3	2	1	5	4	3	2	4	3	2	1	5	4	3	2	5	4	3	2
TOP	M	N	H	SPACE	BLANK	T	C. R.	O	.	,	SPACE	BLANK	5	C. R.	9	1	2	3	4	BLANK	5	C. R.	9	1	2	3	4	1	2	3	4
2ND	X	F	Y	S	E	Z	D	B	/	!	6	BELL	3	"	\$	?	MARKING	SPACING	L. F.	)	4	&	MARKING	SPACING	MARKING	SPACING	MARKING	SPACING			
3RD	V	C	P	I	L. F.	L	R	G	;	:	Ø	8	L. F.	)	4	&	MARKING	SPACING	-	2	∇	FIGURES	MARKING	SPACING	MARKING	SPACING	MARKING	SPACING			
BOTTOM	LETTERS	K	Q	U	A	W	J	FIGURES	LETTERS	(	1	7	-	2	∇	FIGURES	MARKING	SPACING	1	2	3	4	MARKING	SPACING	MARKING	SPACING	MARKING	SPACING			
4TH	3 MARKING			1ST	1ST	3 SPACING			4TH	3 MARKING			1ST	3 SPACING			4TH	3 MARKING			1ST	3 SPACING			4TH						
ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW	ROW			

Figure 109. Type box arrangement.

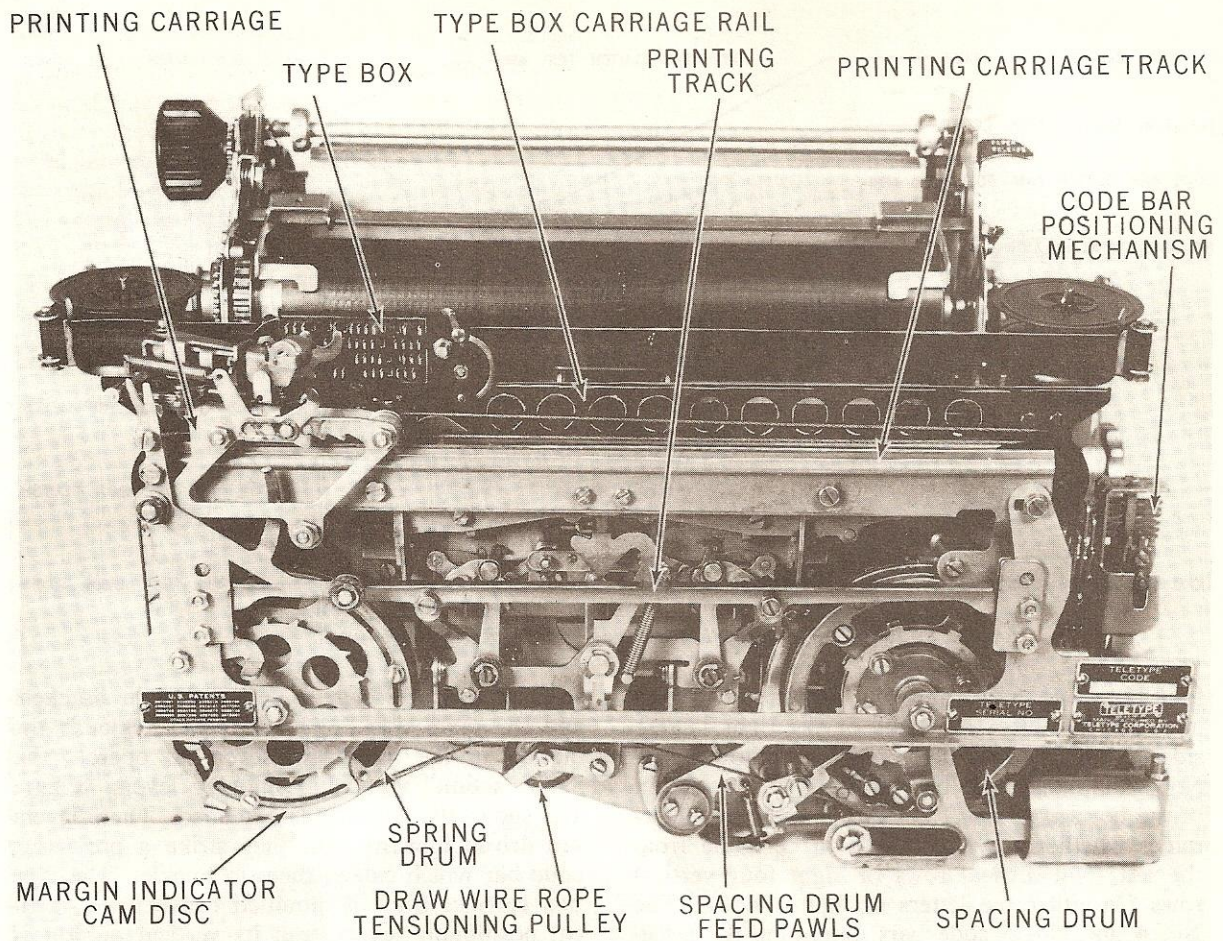


Figure 110. Typing unit, front view.

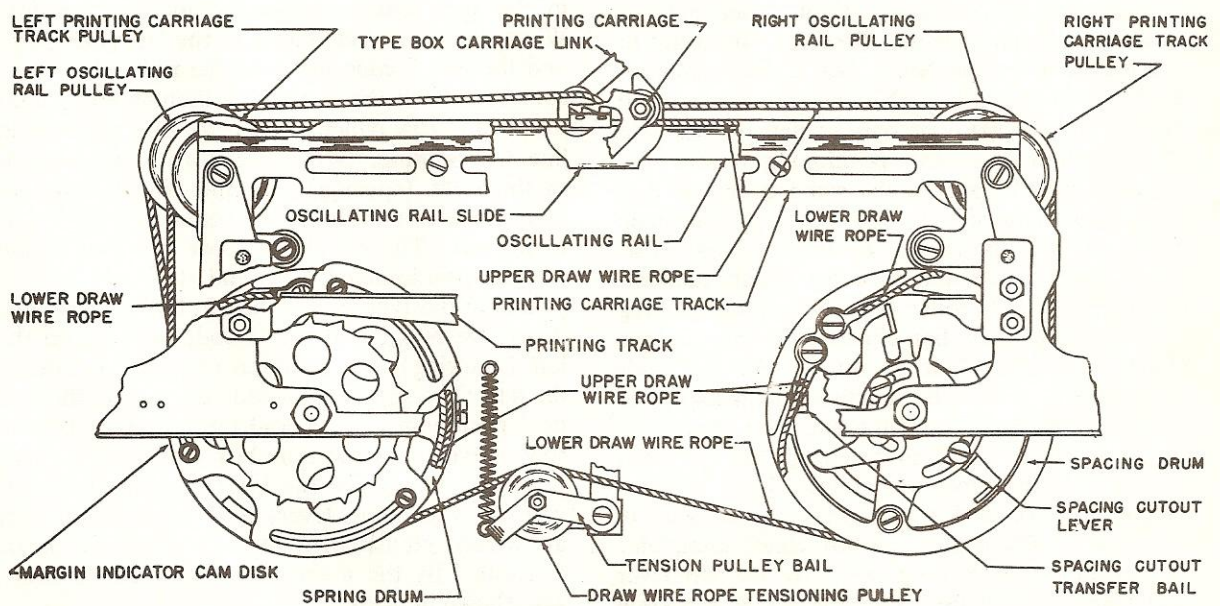


Figure 111. Draw wire rope mechanism.

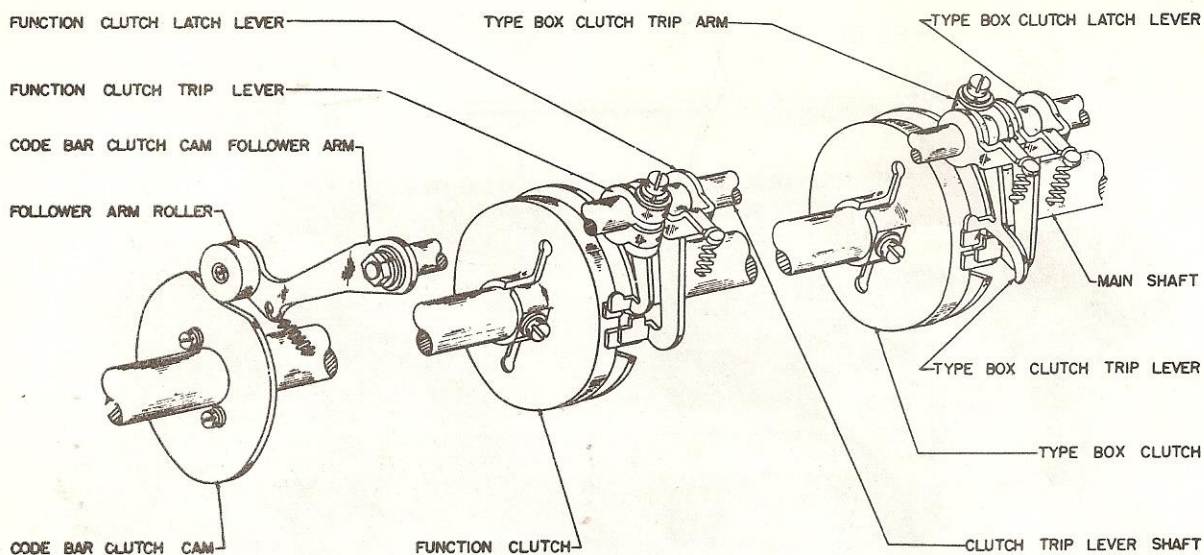


Figure 112. Function and type box clutch trip mechanisms.

four horizontal rows and the eight vertical rows in either the left (LTRS) side or the right (FIGS) side of the type box takes place as follows: The No. 1 and No. 2 code bars determine the selection of the horizontal row. The No. 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 No. 4 and No. 5 code bars determine the selection of one row from the four vertical rows predetermined by the No. 3 code bar.

25-20. 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, No. 1, No. 2, and common, as shown in figure 108. 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 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 move across the sloping indent on the code bar clutch cam, causing the clutch trip lever shaft to rotate. As the shaft turns, it first causes the function clutch trip lever to release the function clutch and then causes the type box clutch trip arm to engage its trip lever and release the type box clutch. Both clutches and their associated components can be seen in figure 112. When the type box clutch completes its revolution, it is disengaged by its trip lever and latch lever in the same manner as the code bar clutch. During its rotation the type box clutch operates a drive link and a bracket, to cause the main rocker shaft to oscillate. The main rocker

shaft 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 113 shows the levers fully extended. 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 No. 1 and No. 2 code bars are to the right (spacing), the common code bar is also to 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 No. 1 code bar is to the left (marking) and the No. 2 code bar is to the right, the No. 2 code bar blocks the vertical positioning levers, and the second row pallets in the type box are then in line for printing. When the No. 1 code bar is to the right (spacing) and the No. 2 code bar is to the left (marking), the common code bar is to the left. The No. 1 code bar then blocks the vertical positioning levers, and the third row of pallets in the type box is then in line for printing. When the No. 1 and No. 2 code bars are to the left (marking), the common code bar is also to the left. The suppression code bar blocks the vertical positioning levers, and the fourth or bottom row of pallets in the type box is 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, also shown in figure 113.

25-21. A bracket attached to the main rocker shaft applies vertical motion to the main bail by means of two main bail links, shown in the bot-

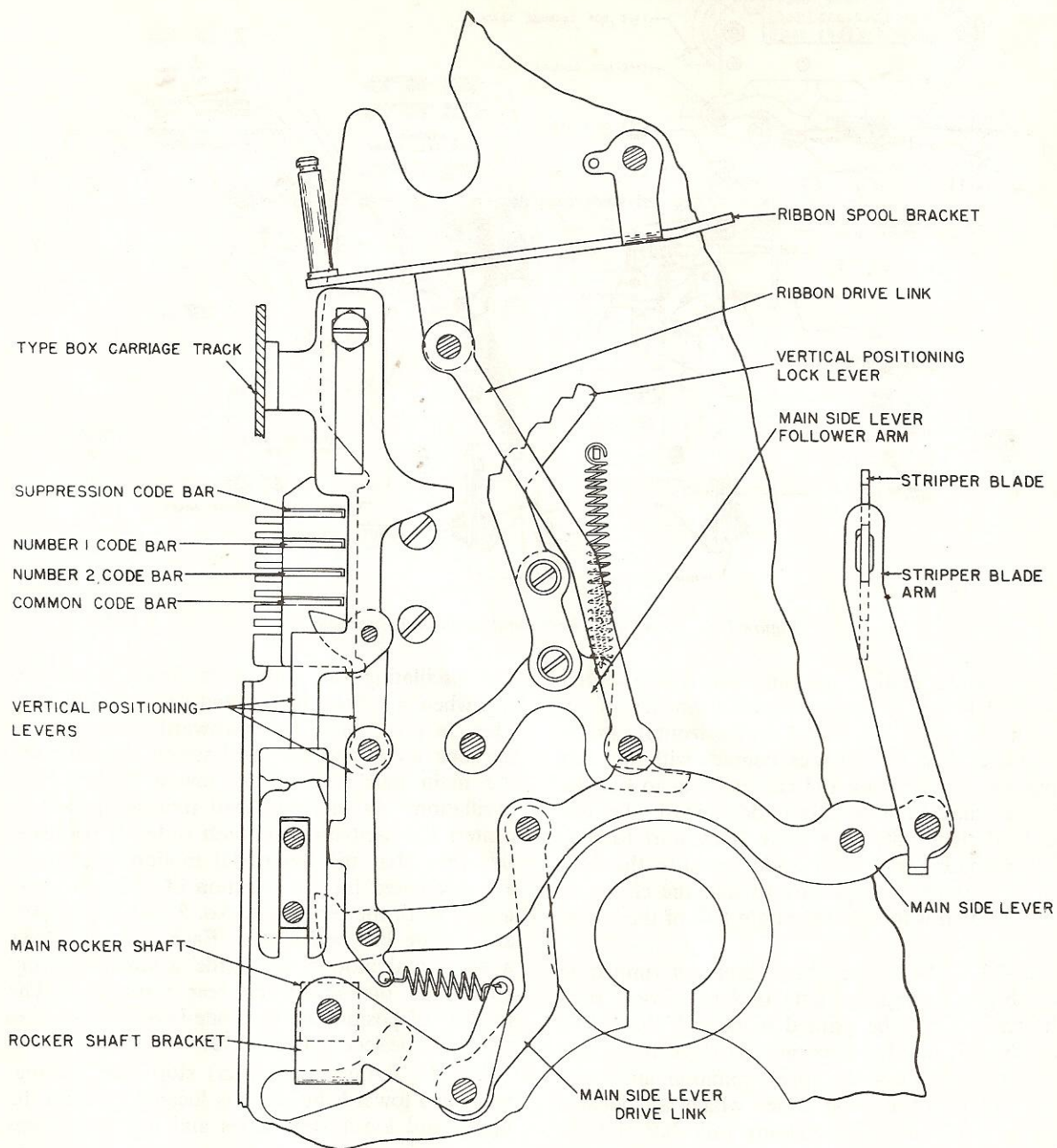


Figure 113. Right side mechanism.

tom center of figure 114. 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; the right shift slide drive links, if not buckled, will try to shift the oscillating rail shift slide toward the left. When the No. 3 code bar is shifted toward the left (marking), the horizontal motion reversing slide, below the type box in figure 114, 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 then makes contact with the right shift slide drive links and causes them to buckle. As the main bail is driven downward, the unbuckled left shift slide drive links start to shift the oscillating rail shift slide towards the right. This positions the type box so that the character to be printed is found in the left half of the letters or figures side.

25-22. In a similar manner, when the No. 3 code bar is shifted toward the right (spacing),

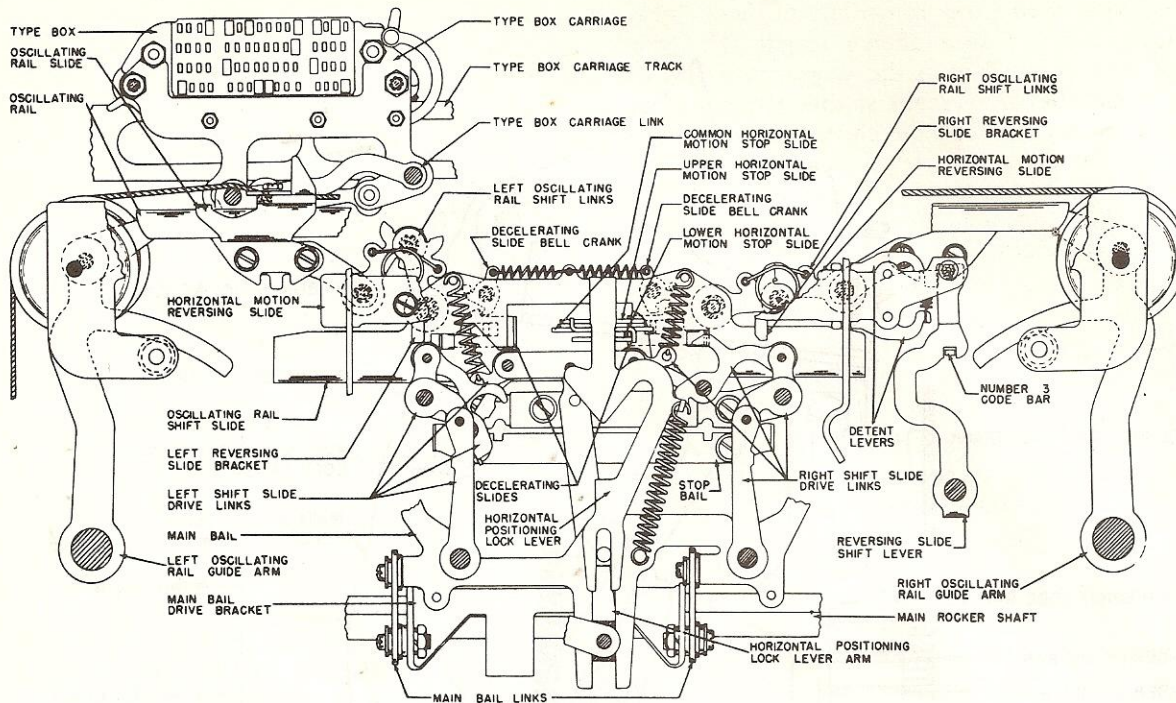


Figure 114. Front plate horizontal positioning mechanism.

the horizontal motion reversing slide is also shifted to the right and held then 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 start to shift the oscillating rail shift slide towards the left. This positions the type box so that the character to be printed is found in the right half of the letters or figures side.

25-23. After it has been thus determined in which group (right or left) of four vertical rows the character to be printed is located, the No. 4 and No. 5 code bars operate the three horizontal motion stop slides—the upper, common, and lower horizontal motion stop slides which are located in the center of the oscillating rail shift slide in figure 114. This determines the row in that group in which the character is to be found. A heart-shaped horizontal positioning lock lever, which is pulled downward by the main bail 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 No. 3 code bar selection) until one of the two decelerating slides (which are mounted on the oscillating rail shift slide) strikes an unselected horizontal motion stop slide. A camming surface on the unbuckled shift slide drive links makes contact with and moves down the face of the decelerating slide causing 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 extends 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. Both the No. 4 and No. 5 code bars operate a code bar bell crank. Each in turn moves a horizontal motion stop slide toward the front (marking) or toward the rear (spacing). The method of positioning the code-bar-operated stop slides can be seen in figure 115.

25-24. A third (common) stop slide (spring-tensioned toward the rear) is located between the upper and lower stop slides and has projections

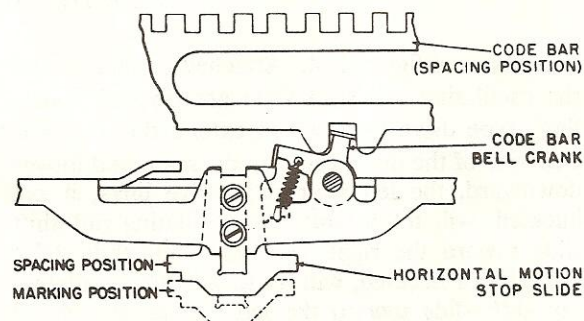


Figure 115. Stop slide positioning.

which pass across the front edges of these slides. Each stop slide is of a different length. The common stop slide, which is 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 No. 4 code bar) is the second longest stop, and the lower slide (operated from the No. 5 code bar) is the third longest stop.

25-25. When both the No. 4 and No. 5 code bars are at the right (spacing), their respective horizontal motion stop slides and the common stop slide are at the rear. The oscillating rail shift slide is moved to the right or left of its central position (determined by the No. 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 No. 4 code bar is at the right (spacing) and the No. 5 code bar is at the left (marking), the lower and the common stop slides are at the front and the upper stop slide is at 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 No. 4 is marking and No. 5 is spacing, the upper and common stop slides are to the front. The lower stop slide, which is to the rear, positions the mechanism so that the third row is in line for printing. When both the No. 4 and No. 5 code bars are to the left (marking), their respective horizontal motion stop slides and the common stop slide are at the front. The oscillating rail shaft slide is moved to the right or left of its central position until it is

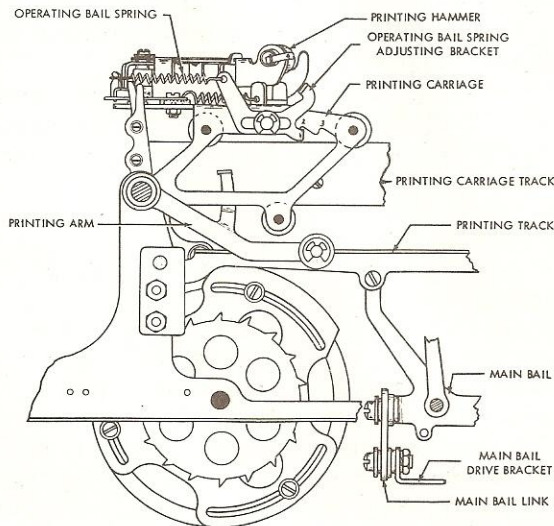


Figure 116. Print hammer mechanism.

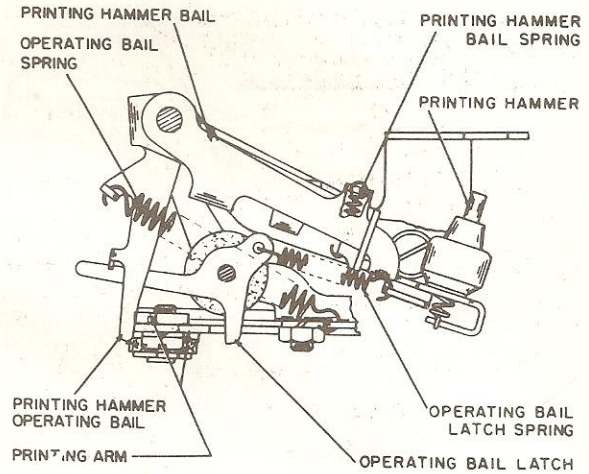


Figure 117. Print hammer mechanism, top view.

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. With the type box properly positioned, let us now discuss the method of printing the character.

25-26. **Printing Hammer and Printing Carriage.** After the type box has been moved so that the selected type pallet is in its proper position, the pallet must be struck by a printing hammer in order to print. This is done by the action of the printing carriage located on the printing carriage track.

25-27. **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.

25-28. **Printing.** The printing track, shown in figure 116, is located on the front of the typing unit and is fastened to an extension at each end of the main bail. As the main bail moves vertically, it extends the motion through 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 to the left and then to the right. When the upper end of the arm moves to the left, it rotates the printing hammer operating bail clockwise against its spring tension until it becomes latched by the operating bail latch, as shown in figure 117. 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 con-

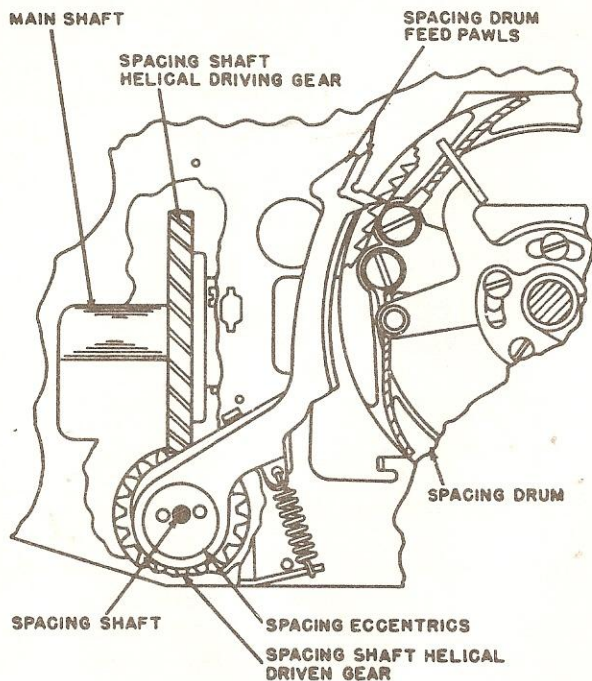


Figure 118. Spacing drum drive mechanism.

tact 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, driven by the operating bail, is also swung toward the type box. When the operating bail is stopped, momentum causes the printing hammer bail to continue its travel until the printing hammer strikes the selected type pallet.

25-29. With the character now in print on the paper, the type box must be advanced to the right to provide space for the next character to be printed.

25-30. **Spacing.** To space the printed character properly, the type box and printing carriages must be advanced with each character printed. To accomplish this, the carriage is 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 similar to the mainspring of a watch, is to tension the draw wire rope and thus pull the carriage to the left.

25-31. About its perimeter the spacing drum has ratchet teeth that are engaged by the eccentric-driven spacing drum feed pawls, which you can see in figure 118. The spacing shaft, which mounts the spacing eccentrics, is operated through the helical gearing. The helical driving gear is 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 the lowest position during the unoperated period. During the time that printing takes 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. The spacing clutch trip lever arm and the spacing trip lever bail can be seen to the right and above the drive gear in figure 119. 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 this spacing clutch trip lever and to 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 the clutch trip lever 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.

25-32. Having completed our discussion of the spacing operation of the typing unit, let us now examine the process which prevents the movement of the type box to the right when spacing is not needed.

25-33. **Spacing Suppression.** When certain functions are selected or when the carriage reaches its extreme right position, it is necessary to suppress spacing. This is done by moving the spacing suppression slide, shown at the top of figure 119, forward. In this position it will hold the upper end of the spacing clutch trip lever forward and prevent it from engaging the spacing clutch trip lever arm. In 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 later in the chapter.

25-34. When the carriage is near its extreme right position, an adjustable cutout lever on the

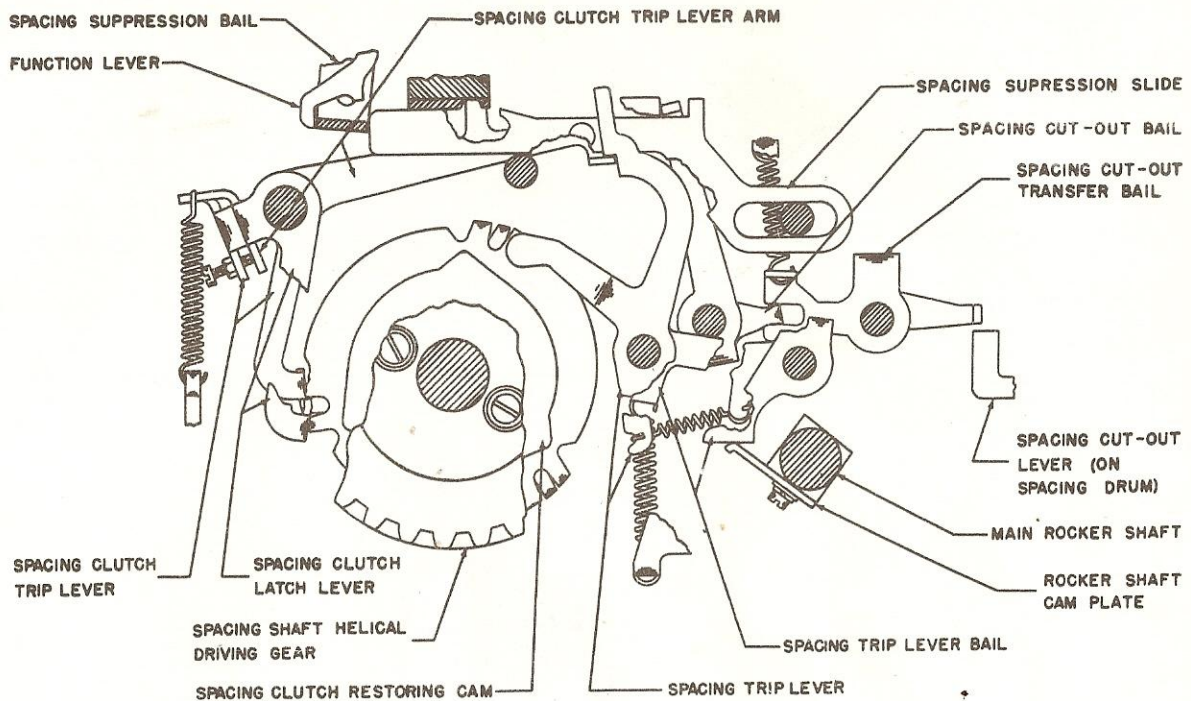


Figure 119. Spacing and spacing suppression mechanism.

spacing drum engages the spacing cutout transfer bail which, in turn, operates the spacing cutout bail. The adjustable spacing cutout lever and the end of the spacing cutout transfer bail are shown in the lower right of figure 111. The spacing cutout bail shifts the spacing suppression slide and prevents spacing until the printing and type box carriages are returned. The maximum number of characters which the typing unit may print on a single line is 85. In order to prevent spacing beyond this point, with subsequent damage to the machine, several teeth are omitted from the spacing drum ratchet wheel.

25-35. 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 actuated by a disk mounted on the spring drum of the typing unit (lower left corner of fig. 111). 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.

25-36. Of course, to print a character there must be an inked ribbon positioned at the proper time between the selected character and the paper. This ribbon is controlled by the ribbon mechanism.

25-37. **Ribbon Mechanism.** 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, as shown in figure 113. A view of the left side ribbon mechanism is also shown in figure 120. As its uppermost position, the ribbon mechanism positions the ribbon relative to the line which is being printed. After each character is printed, the ribbon mechanism is 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.

25-38. **Ribbon Feed.** Each of the ribbon mechanisms consists of a bracket which is hinged at its rear end and upon which a ribbon spool shaft is mounted, as illustrated in figures 113 and 120. A ribbon tension bracket, shown in figure 121, is keyed to the lower end of the ribbon

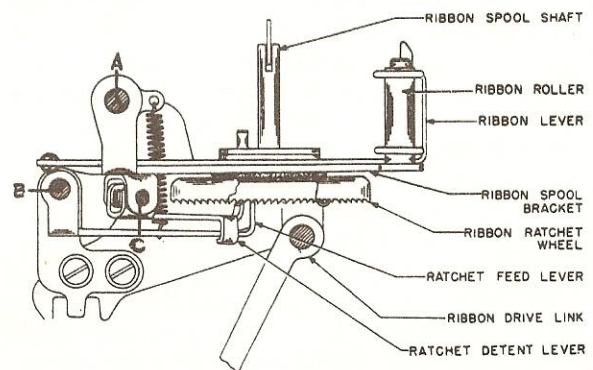


Figure 120. Ribbon mechanism, left side.

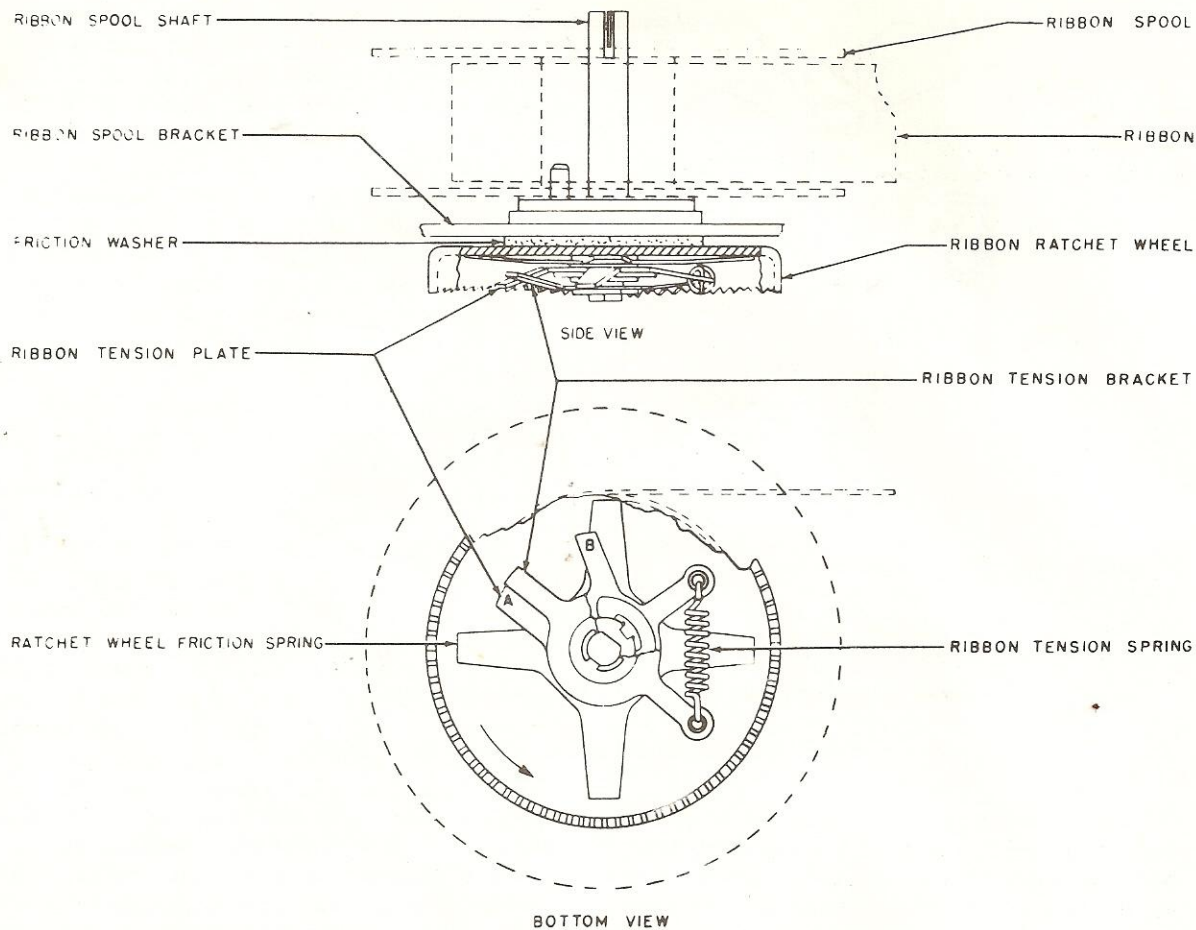


Figure 121. Ribbon tension mechanism.

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 underside of the ribbon ratchet wheel brings the ratchet wheel to bear against the felt friction washer. This applies a constant drag to the ratchet wheel.

25-39. A ribbon tension plate, which is keyed to the hub of the ribbon ratchet wheel, has two projecting lugs (A and B in fig. 121) 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 120. The ratchet feed and ratchet detent levers pivot about points B and C respectively (see fig. 120) and are held against the 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 drives 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 (fig. 121), the ribbon tension plate also turns and extends the ribbon tension spring. When 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 pool.

25-40. **Ribbon Reverse.** When the ribbon has become completely unwound from one spool, it is necessary to reverse its direction so it can re-

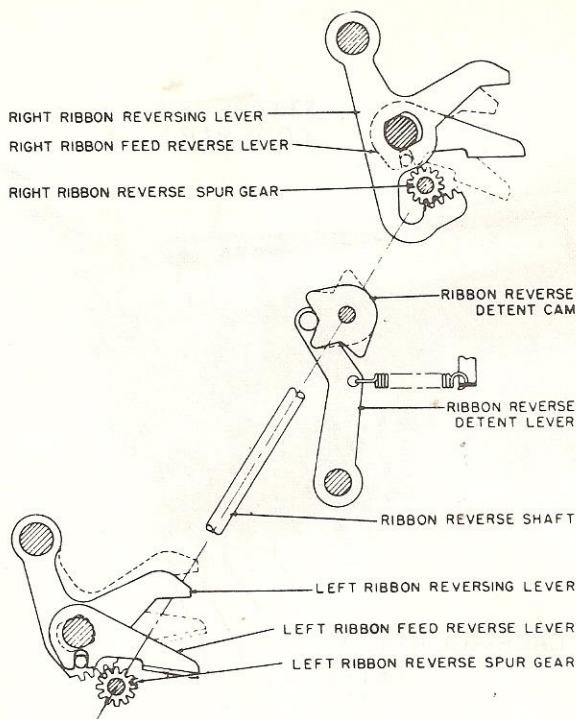


Figure 122. Ribbon reversing mechanism.

wind. This is done 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 is engaged. The left set is held disengaged against the tension of their springs by the left ribbon feed reverse lever, which is in its downward position. (See fig. 122.) The lever is held in this position by means of the ribbon reverse detent lever through the intervening ribbon reverse detent cam, the ribbon reverse shaft, and the ribbon reverse spur gear. As the ribbon unwinds from the ribbon spool, it passes around the ribbon roller and through the slot in the end of the ribbon lever (shown in fig. 123, which is a top view of the unit).

25-41. 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 122. 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 ratchet detent levers from the right ribbon 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 lever 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 kept taut by the previously extended ribbon tension spring.

25-42. There are two types of operations which can be performed by the typing unit. The first are those mechanical actions which are directly necessary to the actual printing of a character, which we have just discussed. The second are the mechanical actions which are supplementary to the printing of a character or which alter the positions of the various mechanisms. These latter actions are known as functions.

25-43. **Functions of the Page Printer.** The page printer, or typing unit, of the ASR set can perform the normal functions of letters and figures shift, carriage return, and line feed. It also can be conditioned to unshift on a spacing signal. In addition, when equipped with switch groups mounted on the function box, the machine can actuate additional equipment or recognize as many as eight character code sequences. We will examine these functions in detail after examining how the typing unit selects a function.

25-44. **Function selection.** As in printing, the reception of function codes results in the positioning of the code bars. Directly behind the code bars is a function box, shown in figure 124, which contains the function bars for the various functions. Figure 124 is a front view of the box, showing the function bars for the more common functions (those located at each end of the box) plus several additional special function bars. Each

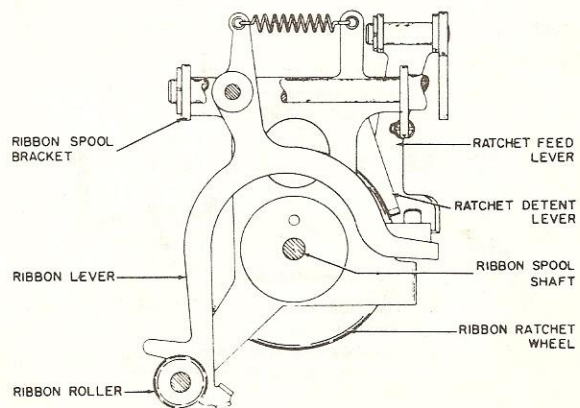


Figure 123. Ribbon mechanism, left top view.

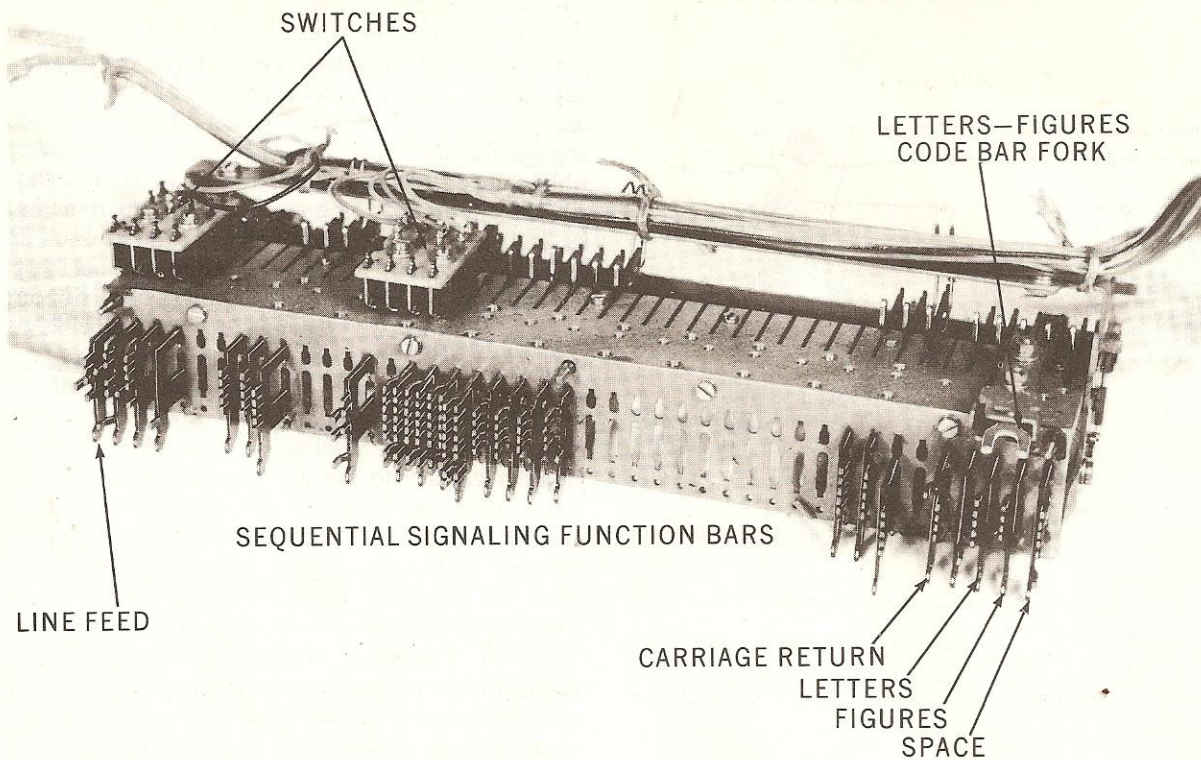


Figure 124. Function box, front view.

function bar has a series of lugs on its ends. You can also see these lugs in figure 125, which shows a cross section through the function box and the allied units. These lugs are offset to one side or the other to correspond with the marking and spacing elements of the particular code to which they are to respond.

25-45. When the function clutch is tripped, it rotates and extends motion to the function bar reset bail (through the intervening cam and follower arm, function rocket 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. As the spring-tensioned function bars are released, they move forward to make contact with the code bars, the back edges of which are notched. 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. This action is clearly shown in figure 126.

25-46. 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 as shown in figure 125. When the function bar reset bail blade releases the function bars, any bar which may be selected will move forward enough (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 of the machine or to the right, as shown in figure 127. 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, and either the upper or lower ends of the levers operate the various

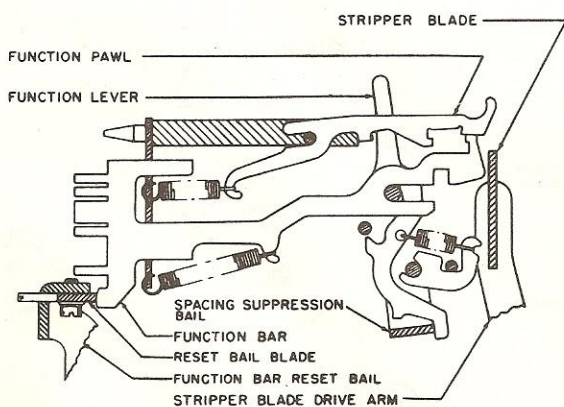


Figure 125. Typical function box mechanism, unselected.

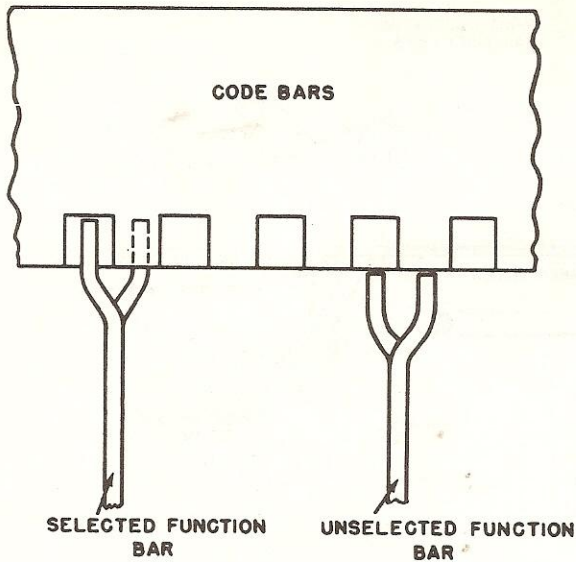


Figure 126. Function selection, top view.

functions. Near the completion of the function cycle a stripper blade (operated by the main side levers through the stripper blade arm) rises to engage any selected function pawl and to strip it from its function bar. This blade can be seen in figure 113. Springs return the released function pawl and function lever to their original positions. To prevent printing during the function cycle, the type box is positioned so that the printing hammer will strike a blank position on the type box. The function clutch cam disk, upon which the latch lever rides, has an indent at the stop position. When the lug 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 drops into the indent in the cam disk, and the clutch is held disengaged until the trip lever is again operated.

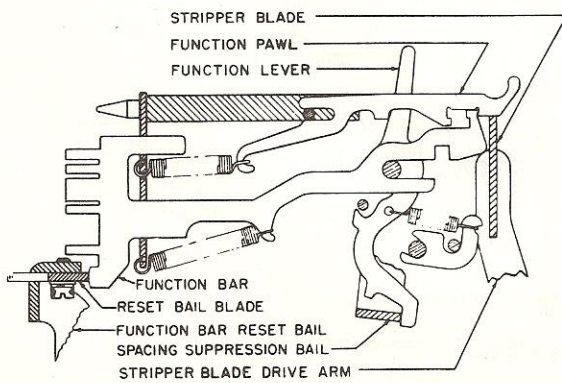


Figure 127. Typical function box mechanism, selected.

REAR OF MACHINE

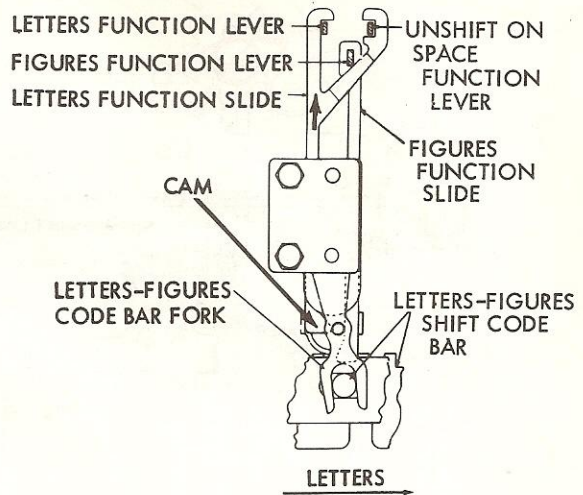


Figure 128. Letters-figures function slides, letters position.

25-47. Letters and figures shift function. 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, as shown in figures 124, 128, and 129, 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, fig. 128) or to the left (figures position, fig. 129). The letters-figures code bar fork engages a pin on the bracket which is fastened to the letters-figures shift code

REAR OF MACHINE

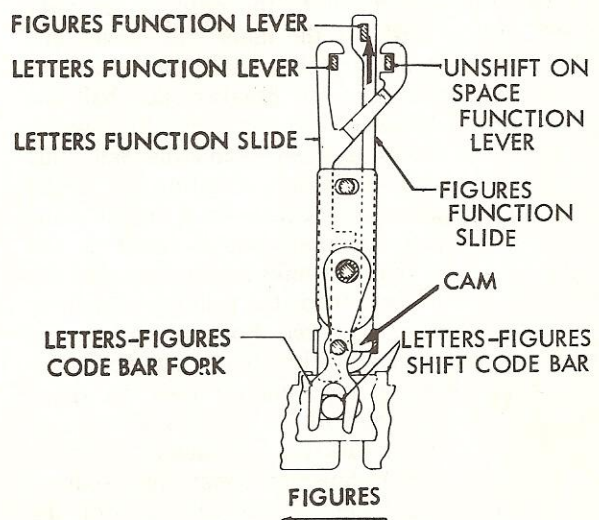


Figure 129. Letters-figures function slides, figures position.

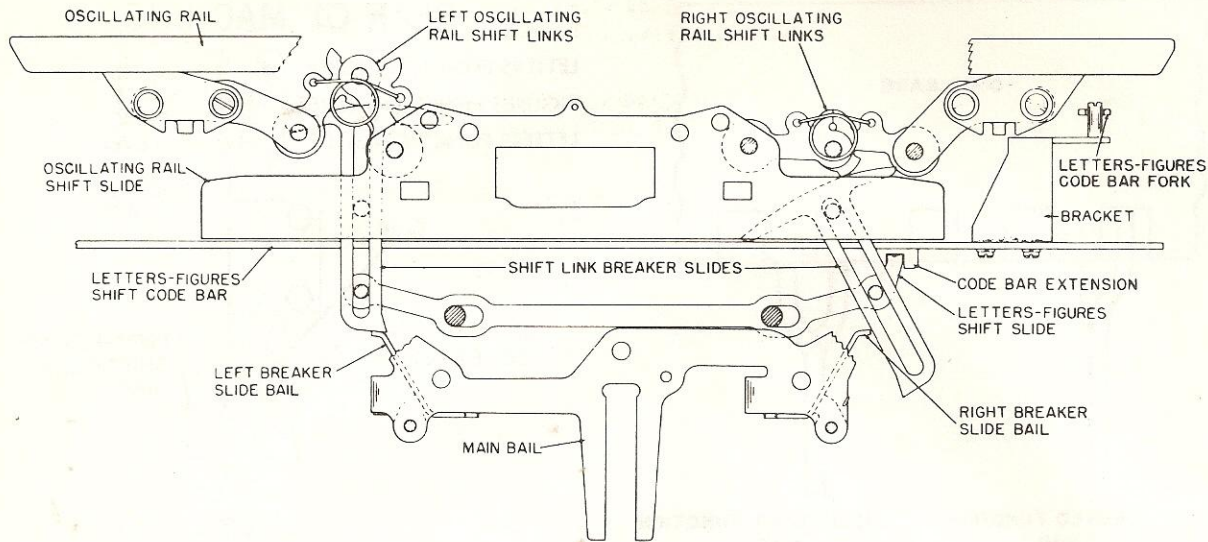


Figure 130. Front view of shift mechanism in letters position.

bar and positions the code bar to the right for letters function or to the left for figures function. This pin can be seen at the far right of figure 130. A slotted extension of the code bar engages a tongue from the right end of the letters-figures shift slide and causes the shift slide to follow the movements of the code bar. Pins at the end of the shift slide serve as lower guides for the right and left shift link breaker slides. Pins which project from the front plate serve as upper guides and pivot points. Mounted on the ends of the main bail are the left and right breaker slide bails. When the letters function code is received, the shift slide is shifted to the right, as shown. This places the left shaft link breaker slide in a vertical position, with its lower end over the left breaker slide bail. The right breaker slide is positioned so 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, and 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 letters. 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 figures.

25-48. *Spacing function.* 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 key lever on the keyboard. The function operates in the manner described under Spacing, which we discussed earlier in the chapter. However, as with the TT-7/FG, printing does not occur for functions.

25-49. *Unshift on space.* There is a function bar which operates on the spacing code combi-

nation located at the right end of the function box. Its associated function lever engages an extension of the letters function slide, as shown in figure 128. Thus, when a spacing function occurs, letters shift will take place in the manner described in the preceding paragraphs. 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, this 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, as shown in figure 131. NOTE: The space function bar must be in

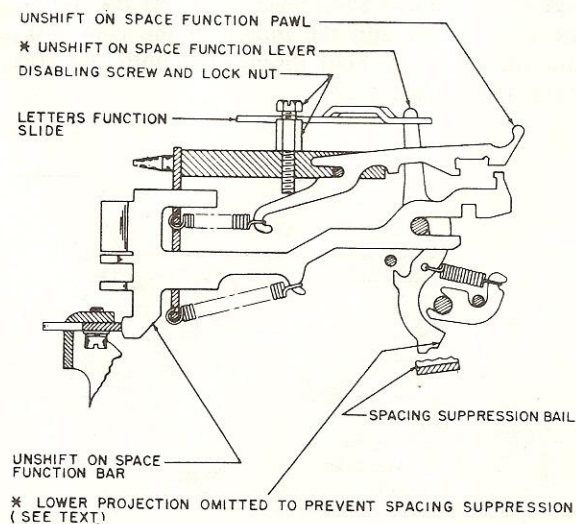


Figure 131. Unshift-on-space mechanism, disabled position.

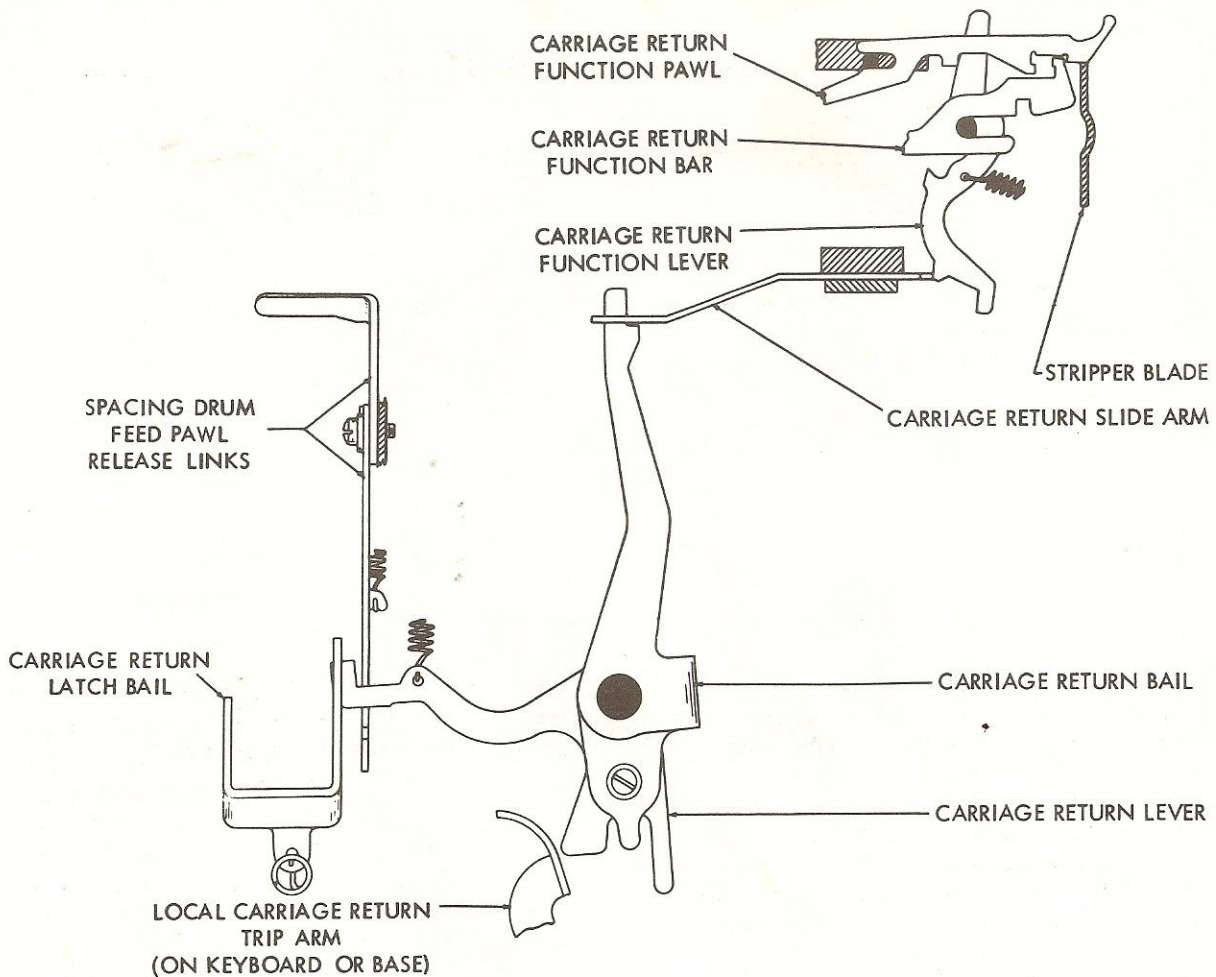


Figure 132. Carriage return function mechanism.

its rearmost position when turning the screw down.

25-50. *Carriage return function.* 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, as shown in figure 132. The lower end of the function lever engages the carriage return slide arm and pushes it forward (toward the left in the illustration). 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, shown in the upper left portion of figure 133. When the carriage return lever reaches the 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 to the left side of the typing unit. As the spacing drum nears

the end of its counterclockwise rotation, the roller on its stop arm comes into contact with the transfer slide, which in turn drives the dashpot piston into the dashpot cylinder. A small passageway with an inlet from 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 setscrew, 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 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.

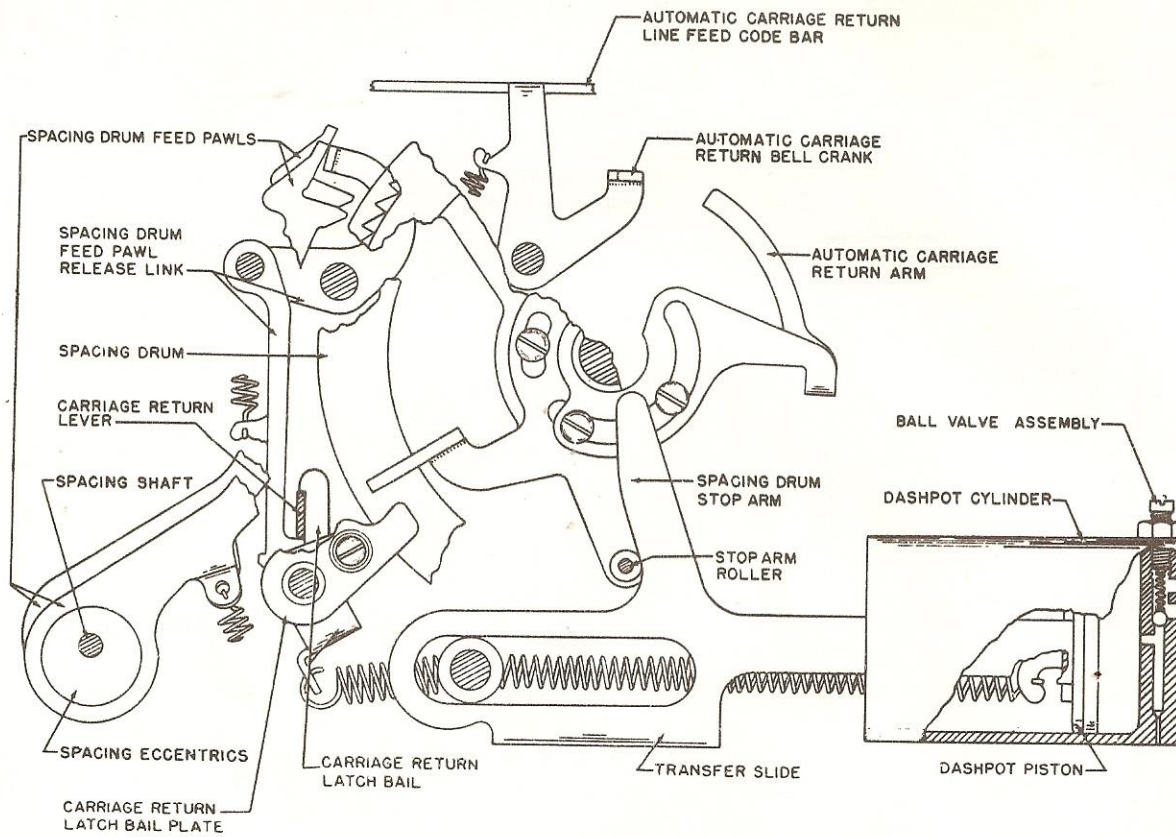


Figure 133. Carriage return mechanism.

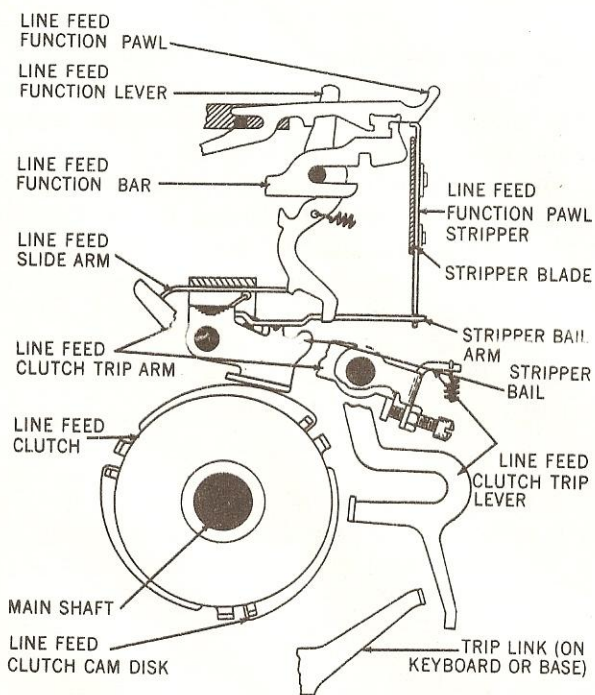


Figure 134. Line feed function and clutch trip mechanism.

25-51. Local (off-line) operation of the carriage return mechanism may be obtained from the keyboard. The keyboard mechanism (described in Section 24) engages a projection of the carriage return lever and causes the operations described in the preceding paragraph to take place.

25-52. *Line feed function.* 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. The lower end of the line feed function lever engages the line feed slide arm and pushes it forward (to the left in fig. 134). The slide arm, in turn, moves the line feed clutch trip arm and the trip lever about their common 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

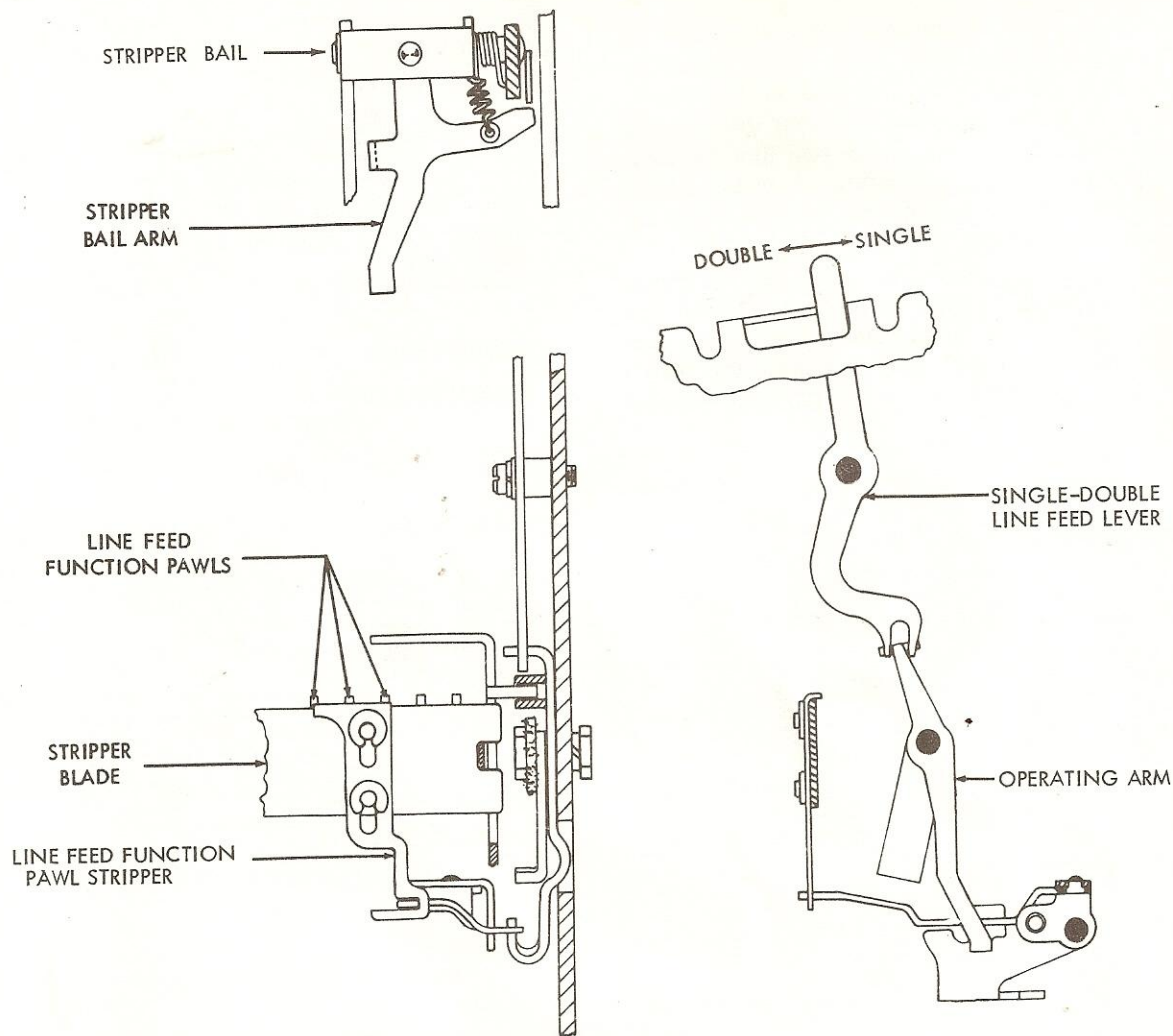


Figure 135. Positioning mechanism for single-double line feed.

lever will stop the clutch after two-thirds of a revolution or double line feed has occurred.

25-52. 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 bail arm, shown in the upper portion of figure 135, extends from the stripper bail and engages the slot at the bottom of the line feed function pawl stripper. The upward movement of the stripper lifts the line feed function pawl, in figure 135, from the line feed function bar in time to prevent more than one line feed. For double line feed, the stripper bail arm is forced to pivot out of the slot in the line feed function pawl stripper by the action of the

single-double line feed lever and the operating arm shown in figure 135.

25-53. When single line feed is 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 left end of the function box, as shown in figure 124, for the sole purpose of suppressing spacing on single line feed function. This mechanism, which always operates on the line feed function code, is released only by the stripper blade and therefore holds the spacing suppression bail operated until the spacing cycle is completed. After the line feed clutch is stopped by its trip lever, it is disengaged by the trip lever and latch lever in the same manner as the three-stop spacing clutch.

25-54. Each one-third revolution of the line feed clutch causes its attached spur gear, shown in figure 136, to rotate the line feed eccentric spur gear and its attached eccentrics one-half of a

revolution. 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.

25-55. When it is desired to position the platen manually, it may be done by pushing 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

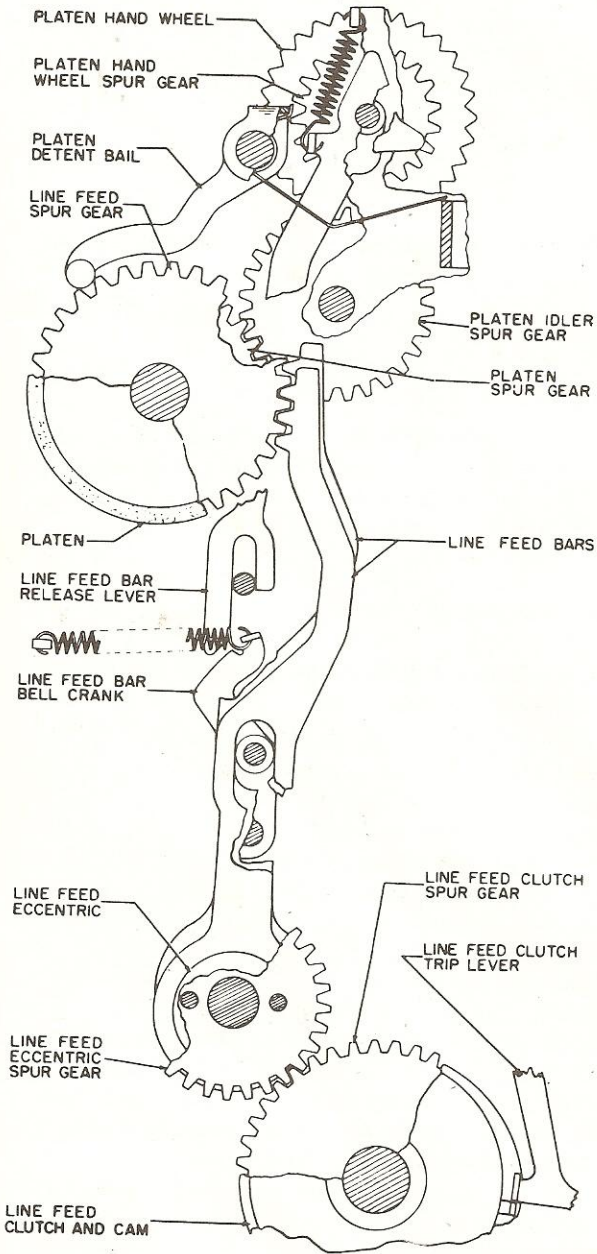


Figure 136. Line feed mechanism.

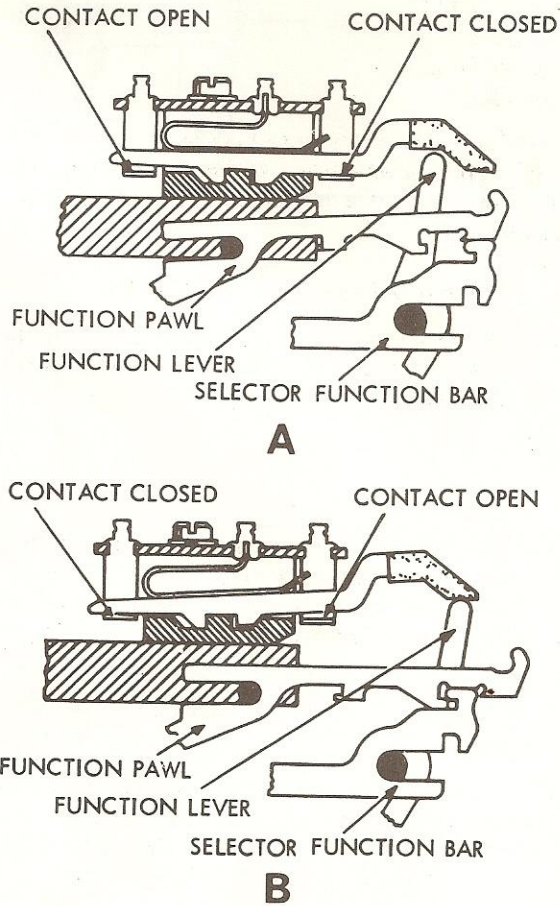


Figure 137. Contact mechanism.

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.

25-56. Local line feed is obtained by depressing the LOC LF key on the keyboard. This causes the trip link shown on figure 134 to hold the line feed clutch trip lever away from the clutch. Line feed will occur as long as the key is held down.

25-57. *Sequential signaling.* The typing unit can be equipped with as many as 32 additional function bars (some of these are shown in fig. 124). These can be so arranged that the reception of a proper code sequence will operate a given series of function bars. Through electrical contacts, such as those shown in figure 137, relays and other electrical components may be arranged to respond only when a proper sequence is received in consecutive order. The typing unit can be conditioned to use the following eight sequences.

- LF, LF, N, N, N, N
- ZYH
- ZYI

- ZYE
- XCRITIC
- ZRJ
- ZEM
- ZCZC

In addition, some machines may be equipped with a signal bell mechanism, automatic carriage return and line feed mechanism, and a blank function mechanism.

Review Exercises – Section 25

1. The start lever is rotating clockwise. What does this indicate? What will occur next? (25-7-9)
2. The selector armature is up in response to a code pulse being received. What effect will this have on the operating selecting lever? How is this achieved? (25-10,11)
3. A push bar is operated by its associated selecting lever. Which code bar shift lever will operate the associated code bar shift bar? In what direction? Why? (25-13-15)
4. The second code bar from the top is positioned to the right. What effect will this have on the vertical positioning levers? Why? (25-19)
5. What moves the common code bar to the rear? What effect will this have on the vertical positioning levers? (25-20)
6. The vertical positioning levers make contact with the suppression code bar. From which horizontal row will the character be selected? Why? (25-20)
7. The number 9 has been selected by the typing unit. What horizontal row has been selected and what halts the type box at this level? (25-20)
8. As the main bail is driven downward, the oscillating rail slide shifts to the left. What signal to the selector magnet causes this? How is it accomplished? (25-21)
9. The oscillating rail shift slide is blocked by the upper horizontal motion shift slide. What code impulses were received in order for this to occur? What vertical row will provide the selection? (25-23,24)
10. What provides the power for cocking the printing hammer of the typing unit? How? (25-28)
11. The spacing trip lever is approaching the high part of the spacing clutch restoring cam. What operation is now taking place? When will it terminate? (25-31)
12. The spacing trip lever is rotated toward the front of the printer. What causes this? What effect will it have on the machine? (25-33,34)
13. You are told to make an adjustment so that the margin indicator lamp lights on the 81st character. What will you adjust? Where is it located? (25-35)
14. When does ribbon feed take place? How is it accomplished? (25-39)

15. What supplies the power to reverse the ribbon feed? How? (25-40)
16. When is the function clutch tripped? What happens when this occurs? (25-45)
17. The letters-figures shift code bar is moving to the left. What causes this? How? (25-47)
18. The main bail is moving upward and the right shift link breaker slide is vertical. What will now occur? Why? (25-47)
19. When the typing unit is in the figures position it will shift to letters when the space combination is received. What could cause this? Why? (25-49)
20. The spacing drum is turning counterclockwise. Why? When will it cease? (25-50)
21. The line feed function pawl stripper is moving upward. What supplies the motive power? What will occur? Why? (25-52)
22. What supplies the power to rotate the platen? How is line feed accomplished? (25-54)
23. How many sequences can the machine be conditioned to recognize? How? (25-57)