

Area Code 312
Phone 346-0585

1.

TELETYPE CORPORATION

SCHOOL OF MAINTENANCE TRAINING

201 NORTH WELLS STREET

Chicago 6, Illinois

M-28 ASR TAPE LINE EQUIPMENT

TRAINING COURSE

STUDENT'S GUIDE

FOR INSTRUCTION PURPOSES ONLY

SCHOOL INFORMATION

The Customer Service School provides, tuition-free, training for the maintenance personnel of Teletype's customers. As the School of Training is maintained for the customer, it is under the supervision of the Sales organization.

As there is no charge for the training provided, the Teletype Corporation will not assume the responsibility for making student's hotel reservations. For military personnel the School will, upon request, issue a form indicating time of arrival and departure. No certificate of non-availability of aircraft, rations or quarters will be issued.

Class hours are from 8 A. M. to 4:30 P. M. Monday through Friday, with a fifteen minute break in A. M. and P. M. and 3/4 hour lunch period. Classes will terminate during A. M. of last day. There are no classes scheduled for Saturdays. Students may bring their lunch or eat at any of the numerous restaurants in the area.

Students are requested to observe the hours of the class and to be on time following each break. No extra training will be given students who come in late. Students who are repeatedly late will be asked to leave.

All text materials such as bulletins, charts and rulers may be retained by the student. Students are required to have a pen and/or pencil.

Although the classes are scheduled to end during A.M. of the final day, some students may wish to stay later and are welcome to do so. Those who finish early may leave but no student may leave without completing the course unless he has special permission. Teletype personnel may not leave the School at any time unless they have the permission of their supervisor, lunch and break periods excepted.

The school's telephone may be used ONLY by instructors and Teletype personnel on company business.

The address and telephone number of the school is:

ADDRESS 201 N. Wells Street

PHONE Area Code 312
346-0585

Your instructors will be:

MODEL 28 AUTOMATIC SENDING AND
RECEIVING SET COURSE OF INSTRUCTION

Description of the Course

The purpose of this course is to train personnel in the maintenance of the Model 28 Automatic Sending and Receiving Set.

The course is scheduled for a 3 week period and will cover theory, disassembly, adjustments of principle components, also testing and operation of complete set.

The student is urged to take notes for future reference and to ask questions so that he may derive the maximum benefit from the course.

Literature

Literature in the form of Teletype bulletins, specifications and wiring diagrams will be furnished each student.

List of Literature

	<u>Bulletins</u>	<u>Teletype Code</u>
235B	Adj. Single Contact Transmitter Distributor	LXD
258B	Theory Single Contact Transmitter Distributor	LXD
1161B	Parts Single Contact Transmitter Distributor	LXD
242B	Theory Two Shaft Transmitter Distributor	LBXD
243B	Adj. Two Shaft Transmitter Distributor	LBXD
1165B	Parts Two Shaft Transmitter Distributor	LBXD
246B	Theory Typing Reperforator	LPR
247B	Adj. Typing Reperforator	LPR
1167B	Parts Typing Reperforator	LPR
248B	Adj. Tape Handling Stand (RT Set)	RT
1168B	Parts Tape Handling Stand (RT Set)	RT
249B	Theory Perforator Transmitter	LAK
250B	Adj. Perforator Transmitter	LAK
1169B	Parts Perforator Transmitter	LAK
251B	Theory Pivoted Head Transmitter Distributor	LAXD
252B	Adj. Pivoted Head Transmitter Distributor	LAXD
1170B	Parts Pivoted Head Transmitter Distributor	LAXD
253B	Theory Fixed & Pivoted Head Trans. Dist.	LCXD
254B	Adj. Fixed & Pivoted Head Trans. Dist.	LCXD
1171B	Parts Fixed & Pivoted Head Trans. Dist.	LCXD
255B	Theory Non-Typing Reperforator	LRPE
256B	Adj. Non-Typing Reperforator	LRPE
1172B	Parts Non-Typing Reperforator	LRPE
1124B	Tool Bulletin	

In addition to the above, Western Union trainees receive:

244B	Theory Multimagnet Reperforator	LARP
245B	Adj. Multimagnet Reperforator	LARP
1166B	Parts Multimagnet Reperforator	LARP

A.T. & T. Co. and all Telephone Co. trainees will also receive:

234B	Theory, Adj. & Lub. Multiple Wire Distributor	LD
1159B	Parts Multiple Wire Distributor	LD

In ordinary telegraph transmission, intelligence is relayed from one point to another by the making and breaking of the signal line. An operator at one end would open or close a telegraph key and cause a sounder at the receiving end to emit pulses of sound which could then be translated into characters by the other operator, trained to recognize the various code combinations. During the latter part of the nineteenth century, telegraphy took a step forward by substituting a mechanical sending mechanism for the old telegraph key, and a printer for the receiving station.

The new method of printing telegraphy, however, required modification of the old signaling method. The primary change has been in time control of the transmitted pulses. Specified time intervals or pulse lengths have replaced the, somewhat arbitrary, dot-dash system.

As devised by Jean Baudot, a French Signal Officer, the newer code requires that each character have a certain number of current and no-current time intervals (MARK or SPACE pulses) to indicate a particular code combination. It was decided that the intelligence portion of each complete character should have five of these time intervals. It may be seen that with two possibilities (MARK or SPACE) for five pulses:

$$2^5 = 32 \text{ possible code combinations}$$

Therefore, with the addition of an upper case, (figures) the Teletype Printer is capable of performing twice as many operations (printing or performing a function) as the number of available code combinations.

In the lower case, or letters, we have the 26 letters of the alphabet plus 6, so-called, "functions". These functions are mechanical operations of the printer as opposed to the actual printing of a character.

They include:

Letters (LTRS) = Either shifting the typebox to the letters segment or, as in the M15, shifting the platen down.

Figures (FIGS) = Just the opposite of letters

Space = Moving the printing mechanism to leave a blank between words.

Carriage Return (C.R.) = Returning the printing mechanism to the left margin.

Line Feed (L.F.) = Feeding the paper out of the printer.

Blank = All pulses 'spacing -- used for various operations

The length or time duration of the individual pulses is determined by the operating period of the various cams and levers that cause the signal line contacts to open and close. It may be seen, then, that as the operating speed increases, the pulse length decreases.

At this time three basic speeds are in popular usage. They are: 368rpm; 460rpm; and 600rpm. An expression, of these speeds, in "words-per-minute" has been roughly approximated by dividing each figure by 6. (This assumes that a "word" is composed of five characters and a space). Thus, 368 becomes 60 words-per-minute, 460 becomes 75 words-per-minute and 600 becomes 100 words-per-minute. For maintenance or other technical purposes, however, it is far more accurate to deal only with actual shaft speeds.

If, for every revolution of the transmitting shaft, a complete character is transmitted, we may refer to 368 characters or 368 operations-per-minute (opm). This breaks down:

(a) $\frac{368}{60} = \text{operations-per-second} = 6.13$ (b) $\frac{1 \text{ second}}{6.13} = \text{length of one operation} = .163 \text{ sec.}$

$= 10$ $.10$

(c) At 368opm, then, one operation take .163 seconds or: 163 milliseconds (ms.)

To maintain synchronism between the sender and the receiver, it is necessary to establish a starting point and a stoping point. Consequently, to our character combination of five pulses there has been added a START pulse and a STOP pulse. These pulses are not considered information pulses. In the systems used by most companies, the START pulse is the same length as an information pulse while the STOP pulse is somewhat longer. The STOP pulse is longer to insure that the receiving machine has time to complete detection of the last information pulse before the transmitter begins a new character. The STOP pulse, in most cases, is 1.42 (or 142%) times as long as the START or information pulse. If we designate the START (or standard pulse length) as 1 unit, we have:

(d)

START	=	1 Unit
Information pulse	=	5 Units
STOP	=	<u>1.42 Units</u>

7.42

(e) 7.42 is known as the UNIT CODE

Western Union, as an alternate example, has a STOP pulse the same length as the START or information pulse. With all seven pulses the same duration, Western Union would be operating with a 7.00 Unit Code.

To determine the time duration of any pulse:

(f) $\frac{.163 \text{ sec (time for one complete operation)}}{7.42 \text{ (units)}} = 21.96 \text{ or } 22\text{ms.} = 1 \text{ Unit}$

$\frac{100}{742} = 134.9\text{ms}$

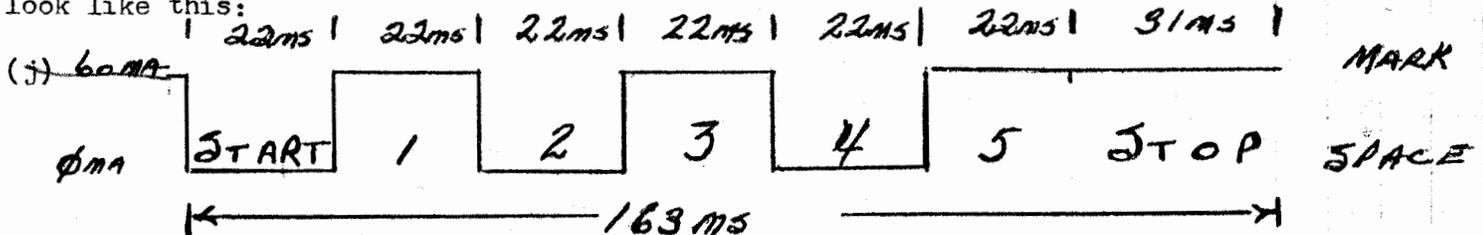
(g) $21.96 \times 1.42 = 31.18\text{ms}$ or 31ms. $13.5 \times 1.42 = 19.2\text{ms}$

(h) The START or information pulse (1 Unit) = 22ms.

(i) The STOP pulse (1.42 Units) = 31ms.

$19.155 \text{ ms for } 100\text{WPM}$

The normal, or "rest" condition of the signal line is closed, that is, with current on the line. If the normal condition is closed, the beginning or START pulse must alter that condition. Obviously, then, the START pulse must be no-current or SPACING. The end of the transmission must return the signal line to its normal condition so the STOP pulse must be current or MARKING. As seen on an oscilloscope and assuming no distortion, the character 'Y' would look like this:



The character 'Y' is most often used for illustration and test purposes because every other pulse is different. As indicated on the rulers, however, the information pulses (between the START and STOP pulses) may vary according to the character selected. It has been noted that the STOP pulse is 1.42 times as long as the START or information pulse. This, of course, assumes continuous operation. Otherwise the STOP pulse might be 31ms, 31 minutes or ten days -- depending upon when the next character was transmitted.

POLAR OPERATION: Up until now, only NEUTRAL operation has been considered. In Neutral operation, a SPACE is when there is no-current on the line and a MARK is when there is current on the line (60ma or 70ma). In Polar operation, there is current on the line at all times and it is the difference between the current polarity that determines whether a MARK (+) or a SPACE (-) is being transmitted. Obviously the printer could not be hooked, directly, to a polar signal because current, no matter what polarity, would energize the selector magnets.

BAUD (from Baudot): An expression which combines shaft speed (operations-per-second) and unit code into one usable term or figure. It also indicates the maximum number of pulses-per-second. It is derived by multiplying the operations-per-second by the unit code:

$$(k) \quad \frac{368 \text{ opm}}{60} = 6.13 \text{ ops/sec} \times 7.42 \text{ (Unit Code)} = 45.5 = \text{Baud}$$

In the case of Western Union, both the operations-per-second and shaft speed differ:

$$(l) \quad \frac{390 \text{ opm}}{60} = 6.5 \text{ ops/sec} \times 7.00 \text{ (Unit Code)} = 45.5 = \text{Baud}$$

It may be seen, in the above illustrations, that although both shaft speed and unit code differ, and Western Union machine may operate with any Teletype product because their BAUD is the same.

DOT CYCLE FREQUENCY: Each MARK-to-SPACE transition comprises a rectangular wave. Any rectangular wave is made-up of a fundamental sine wave plus a number of sub harmonic frequencies. This fundamental, or Dot Cycle Frequency of any character may be determined by dividing the length of one MARK-to-SPACE transition into one. Inasmuch as the character 'Y' changes from MARK to SPACE every other pulse, one MARK-to-SPACE transition would be equal to the length of two pulses or .044sec.

$$(m) \frac{1}{.044} = \text{approx. } 23\text{cps} = \text{Dot Cycle Frequency of character 'Y'}$$

$\frac{1}{.027} = 37\text{cps}$

The character 'M' (3,4 & 5 MARK) does not have as many transitions as 'Y'. For 'M', the START, first and second pulse would be one part, while the third, fourth and fifth pulses would be the other part of its rectangular wave form.

$$(n) \begin{array}{l} \text{START + First + Second} = 66\text{ms.} \\ \text{Third + Fourth + Fifth} = \underline{66\text{ms.}} \\ \hline 132\text{ms.} \end{array}$$

$\frac{1}{40.5} = 24.7\text{cps}$
 $\frac{1}{81} = 12.4\text{cps}$

$$\frac{1}{.132} = \text{approx. } 8\text{cps} = \text{Dot Cycle Frequency of character 'M'}$$

$\frac{1}{.081} = 12.4\text{cps}$

The Dot Cycle Frequency is important in determining the necessary bandpass for Teletype transmission. If the highest frequency can get through, all others may. Consequently, the character 'Y', with the maximum number of transitions, provides this maximum or reference frequency. It has been found that the fundamental frequency plus the next ten or eleven harmonics provides a good signal. The BELL system, however uses only the third or fourth (around 89cycles) for their bandpass.

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SIGNAL DISTORTION

For purposes of illustration Teletype pulses are shown as perfect rectangular waveshapes with sharp transitions and precise timing. This optimum condition is seldom, if ever, found in actual practice.

The modification of the original, rectangular waveshape is called Distortion. The Total Distortion to any signal is broken-down into three categories for purposes of classification but it is important to note that any signal may contain all three components of distortion. The three components of distortion are:

Bias Distortion
Characteristic Distortion

Fortuitous Distortion

Bias and Characteristic Distortion are combined in the term Systematic Distortion because both occur in response to natural law and, consequently, either is roughly predictable. With the third element, Fortuitous Distortion, every possible modification is accounted for -- and labeled Total Distortion.

Bias Distortion

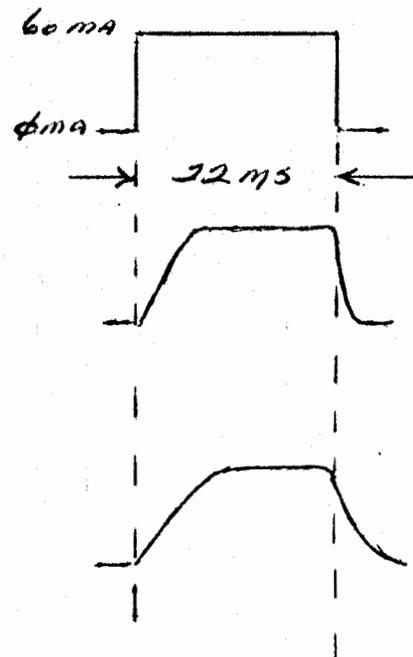
Bias Distortion effects all pulses uniformly and its effect upon a MARK is opposite to its effect upon a SPACE. Bias may effect either the beginning or the end of an impulse but inasmuch as the selector always begins with the MARK-to-SPACE transition of the Start pulse, the total effect of bias is to advance or retard the leading edge of any impulse with respect to the Start pulse.

Before illustrating Bias, it will be necessary to indicate the effect, upon a signal pulse, by the resistive, inductive and capacitive elements in the signal line.

1. Perfect MARK impulse

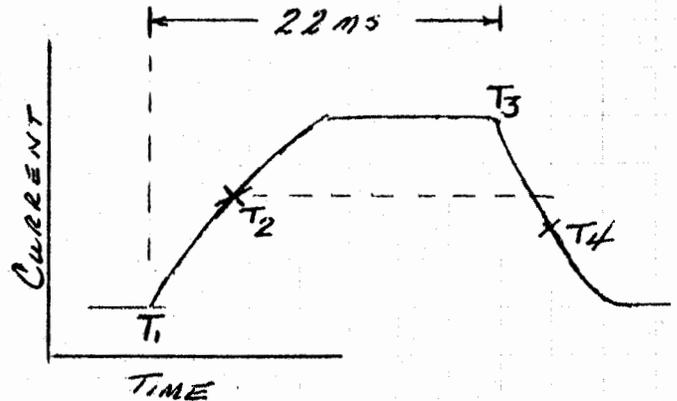
2. Line INDUCTANCE opposes sudden transitions of current. Inductance from Line Relays and/or selector magnet coils.

3. Line CAPACITANCE shunts the signal line preventing rapid current build-up and, thus, further sloping the edges of the wave.



The impulse in figure 3 is more likely to be found at the receiving printer than the one (figure 1) impressed at the transmitter. The impulse seen in figure 3, as applied to the selector magnets of the printer, will be used to illustrate Bias Distortion. It will be noted that this waveshape builds up to its 60ma level gradually -- due to the reactive elements of the signal line.

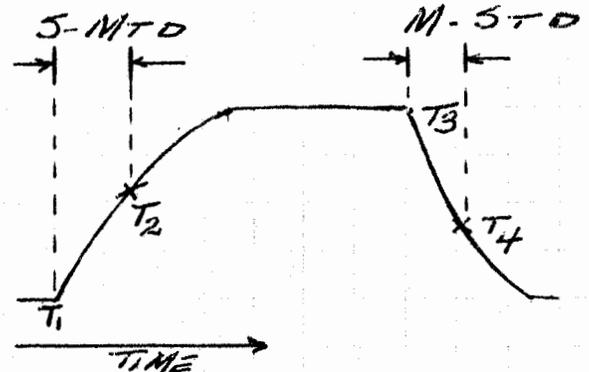
Instead of picking-up at the leading edge of the pulse (T1), the selector magnet will energize at a somewhat later time -- say, for example, at T2 -- or whenever the current has reached a level where it generates sufficient magnetic attraction. This point, T2, would be the beginning of the MARK impulse as far as the selector was concerned.



When, at the end of the transmitted pulse, the current again starts towards 0ma., the selector armature should, theoretically, fall away at T3. The trailing edge of the impulse, however, also slopes and, consequently, a definite time will have elapsed before the armature will drop away (T4). Notice that T2 and T4 are not identical current values. The de-energization point will be a lower value due to residual magnetism in the coils and, conceivably, to weak spring tension.

The time between when the armature should attract (T1) and when it does attract (T2) is known as SPACE-to-MARK TRANSITION DELAY. (abbreviated S-MTD)

The time between when the armature should drop away (T3) and when it does drop away (T4) is known as MARK-to-SPACE TRANSITION DELAY (M-STD).



If the S-MTD is equal to the M-STD, the pulse as seen by the selector would be undistorted.

If the S-MTD is greater than the M-STD the pulse has been shortened and the condition is known as SPACING BIAS

If the M-STD is greater than the S-MTD the pulse has been lengthened and the condition is known as MARKING BIAS

The BELL System uses the following formula to determine the actual Bias condition in milliseconds (ms.). The sign of the result indicates whether the Bias is MARKING (+) or SPACING (-).

$$M-STD - S-MTD = \text{ms. Bias}$$

This example of Bias Distortion illustrates that although the M-STD may not equal the S-MTD, the two will be consistent for any given circuit and/or adjustment. It will be noted, also, that the effect of Bias will:

- a) Be the opposite to a SPACE from its effect upon a MARK.
- b) Be consistent for any character combination.

Characteristic Distortion

Characteristic Distortion, as the name implies, is determined by the signal line characteristics. That is, the resistance, capacitance and inductance. This type of distortion will effect different characters in different ways but it will always be consistent for the same character. In neutral operation, Characteristic Distortion will effect Bias.

Characteristic Distortion has varying effects upon different characters because the circuit's reactance will have less chance to become stabilized when characters with many current transitions are applied ('Y', for example) than when characters with few transitions are applied ('M', for example). It may be said that the effect of Characteristic Distortion is proportional to the Dot Cycle Frequency of the character transmitted.

The contrasts between Characteristic Distortion and Bias may be summarized as follows:

1. The effect of Characteristic Distortion depends upon the length of the impulse transmitted. The effect of Bias is independent of the length of the impulses.
2. For a given length of impulse, the effect of Characteristic Distortion is independent of whether it is a marking or spacing impulse. The effect of Bias is always opposite on a mark to what it is on a space.
3. Characteristic Distortion is related to the amount and arrangement of the capacitance, inductance and resistance of a circuit. Except in neutral operation, these factors do not effect Bias.
4. Bias is caused by unequal marking and spacing line current, biased relays etc., conditions which do not effect Characteristic Distortion.
5. Characteristic Distortion, because it is due to the capacitance, inductance and resistance of a circuit, which, except for the resistance, are unchanging in value, varies only a small amount from day to day. Bias, because it is caused by uneven potentials, relays losing adjustment etc., may vary from hour to hour.

Fortuitous Distortion

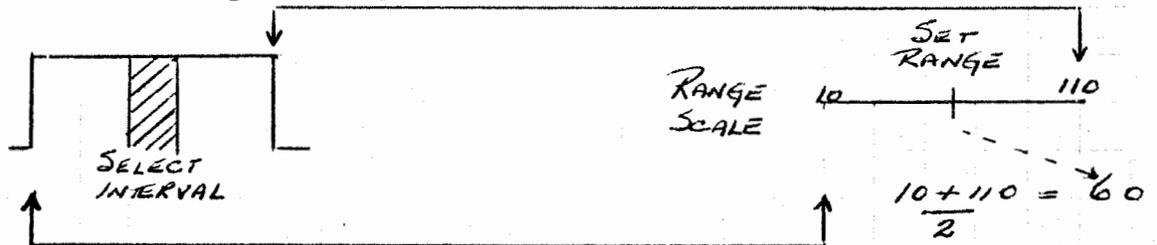
This form of distortion covers such unpredictable occurrences as sudden battery fluctuations or loose ground connections. This distortion may effect any portion of any character and little or no compensation may be made for it.

RANGE

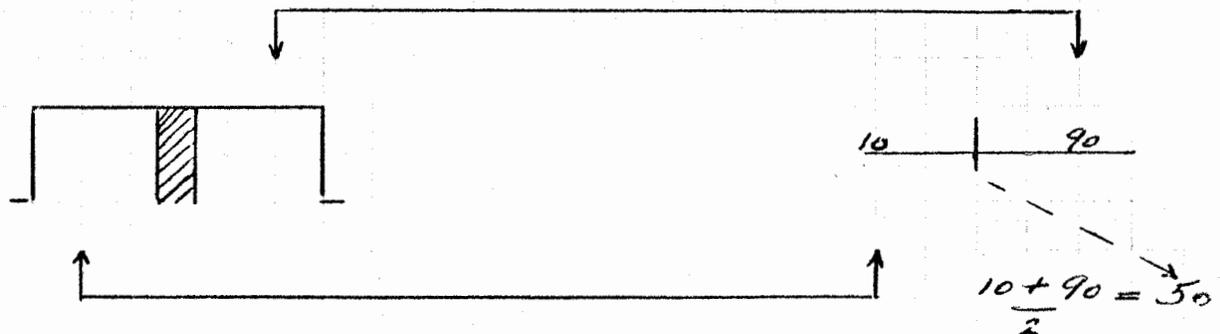
All Teletype receivers (i.e. printers, perforators etc.) are equipped with a range scale. In every case, the function of the range scale is to orient the mechanical selector to the electrical signal to obtain maximum selecting margins.

The selecting interval of the impulse (i.e. when the actual selection is made) is only 20% of the pulse width or 4.4ms. Consequently a perfect selector should be able to tolerate 40% distortion of both leading and trailing portions of an impulse. $13.5 \times 20\% = 2.7 \text{ms}$

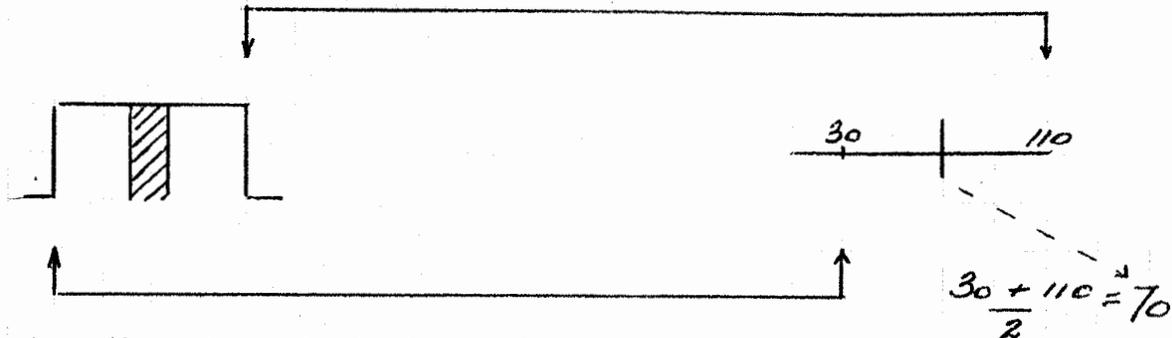
In a perfect impulse of 22ms duration, the necessary 20% selecting interval would be in the center with a range reading of 10 to 110:



If 20% MARKING END DISTORTION (an artificially produced characteristic distortion used to test acceptance -- in this case it would extend the leading edge of the pulse) were introduced, the range would shift in order to maintain the selecting interval in the middle of the pulse:



If 20% SPACING END DISTORTION were introduced the range would shift in an opposite direction;

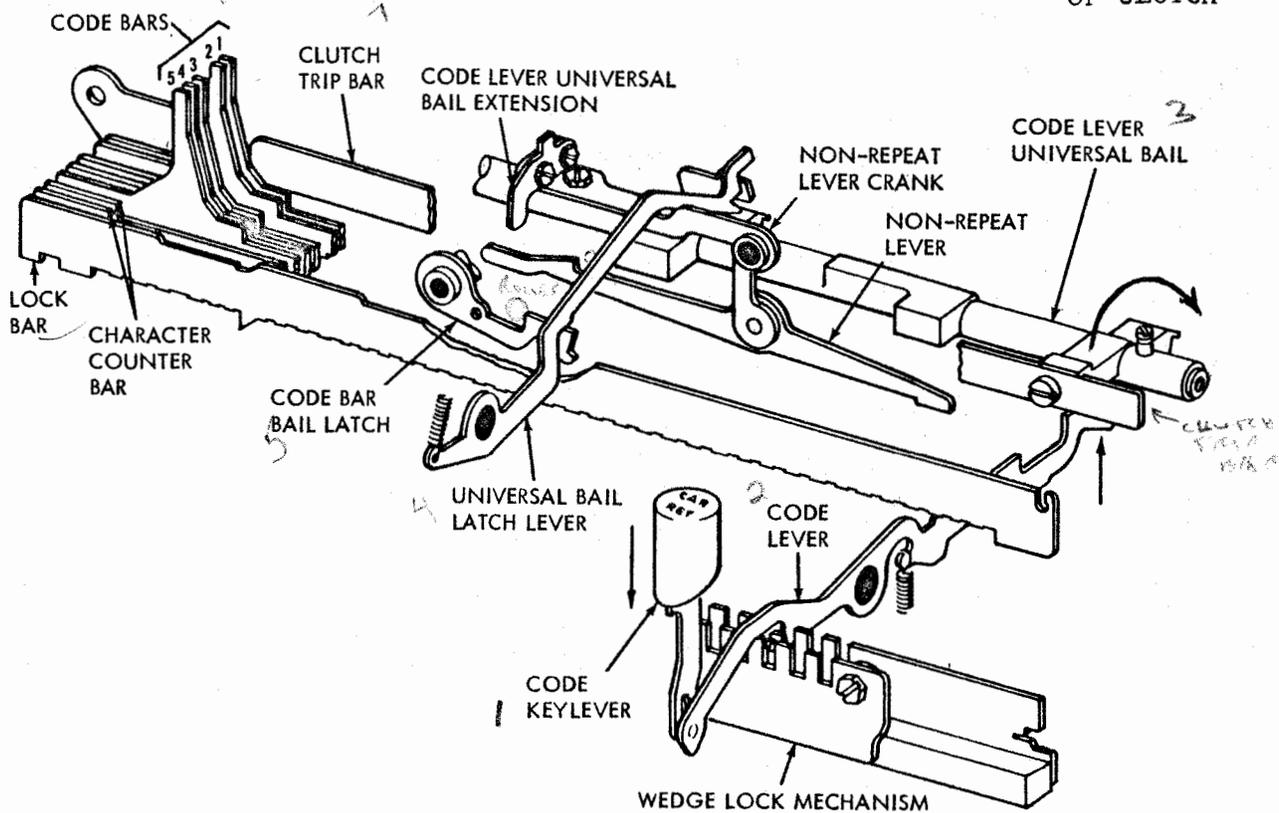


In any situation there is a standard procedure for determining the proper setting for the range scale:

- a) Determine the high and low points on the range scale by observing errors in copy.
- b) Add the high point to the low point and divide by two. (See examples in range illustrations)

ASR SET OF TOOLS

1. 8 oz. scale
2. 32 oz. scale
3. 64 oz. scale
4. set of gauges (#117781)
5. (2) off set screwdrivers (90°) (30°)
6. screwdriver (large)
7. screwdriver (small)
8. #8 crochet hook
9. #12 crochet hook
10. spring hook (push)
11. spring hook (pull)
12. screw holder with blades
13. armature clip
14. hand wheel
15. wrench - 3/16" - 1/4"
16. wrench - 5/16" - 3/8"
17. wrench - 9/16" - 3/4"
18. tommy wrench
19. contact adjusting tool (#156170)
20. tape lid gauge (#156743)
21. top plate adjusting gauge (#159133)
22. punch bail arm gauge w/pin (#159926)
23. tape gauge w/pins (#156011)
24. hexagon key wrench (#104457)
25. " " " (#159841)
26. " " " (#124682)
27. key lever remover
28. tweezers
29. wrench #129534 - 3/16" - 1/4"



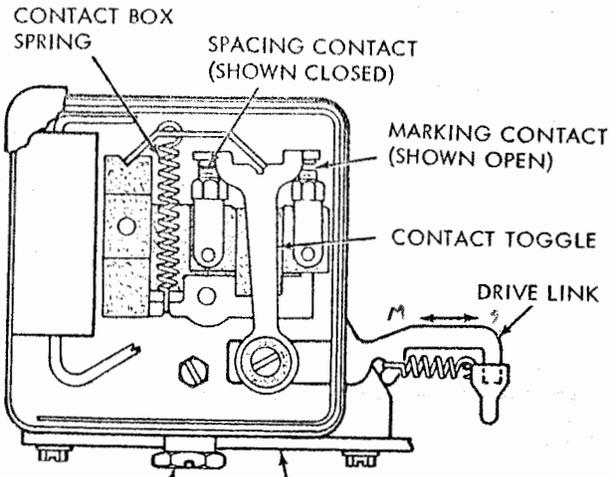
- 1 Depressing KEYLEVER operates
- 2 CODE LEVER rotates
- 3 UNIVERSAL BAIL rotates and allows
- 4 UNIVERSAL BAIL LATCH LEVER to move down
- 5 and release CODE BAR BAIL LATCH allows
- 6 CODE BAR BAIL to move to right.
- 7 CLUTCH TRIP BAR and all selected
- 8 CODE BARS move to right
- 9 CLUTCH STOP LEVER trips
- 10 CLUTCH and CAM SLEEVE rotates.

CODE BARS

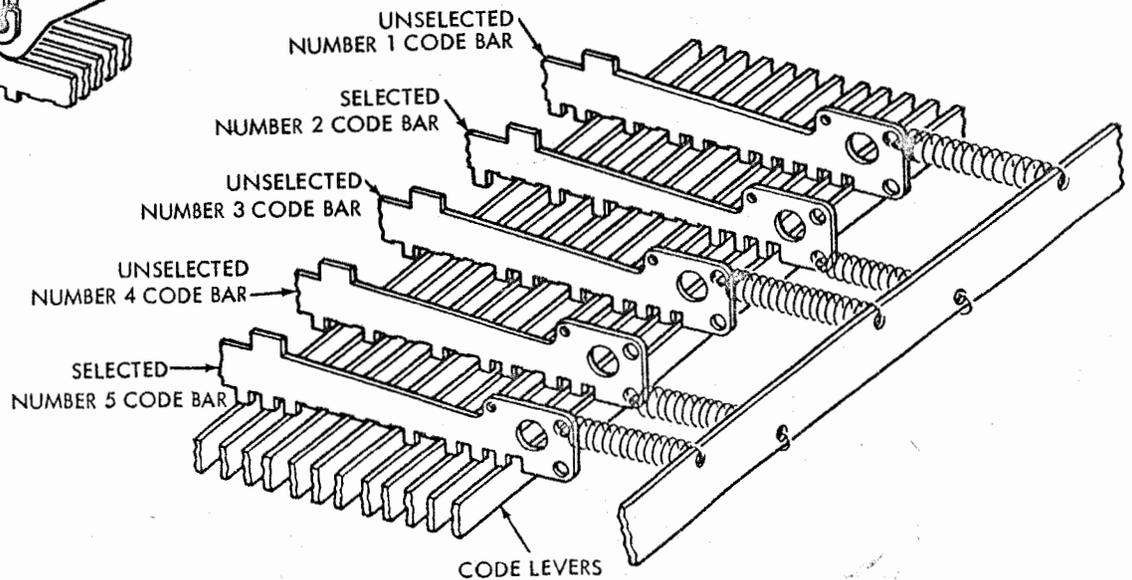
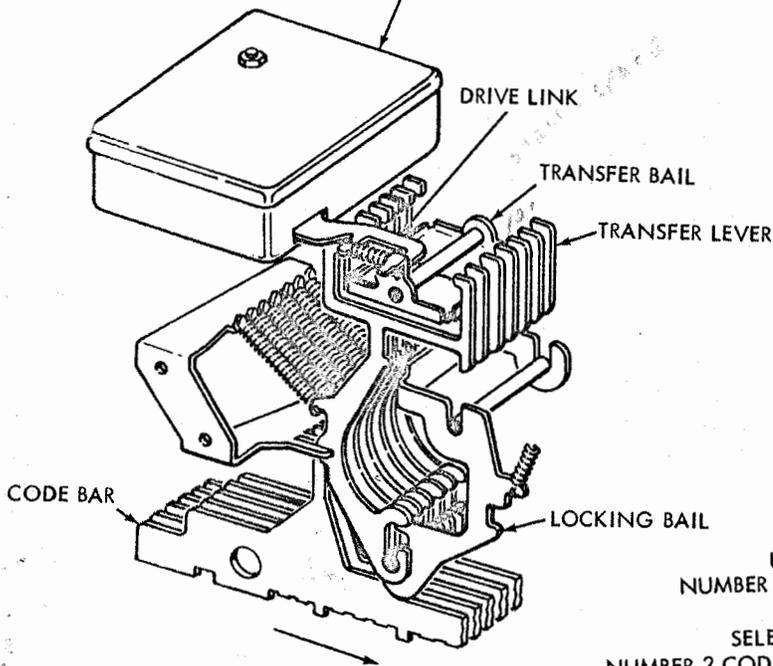
(unselected code bars are
blocked by the operated
code lever)

FROM TRIPPING OF CLUTCH
TO OPERATION OF CONTACTS

(ASR KYBRD.)

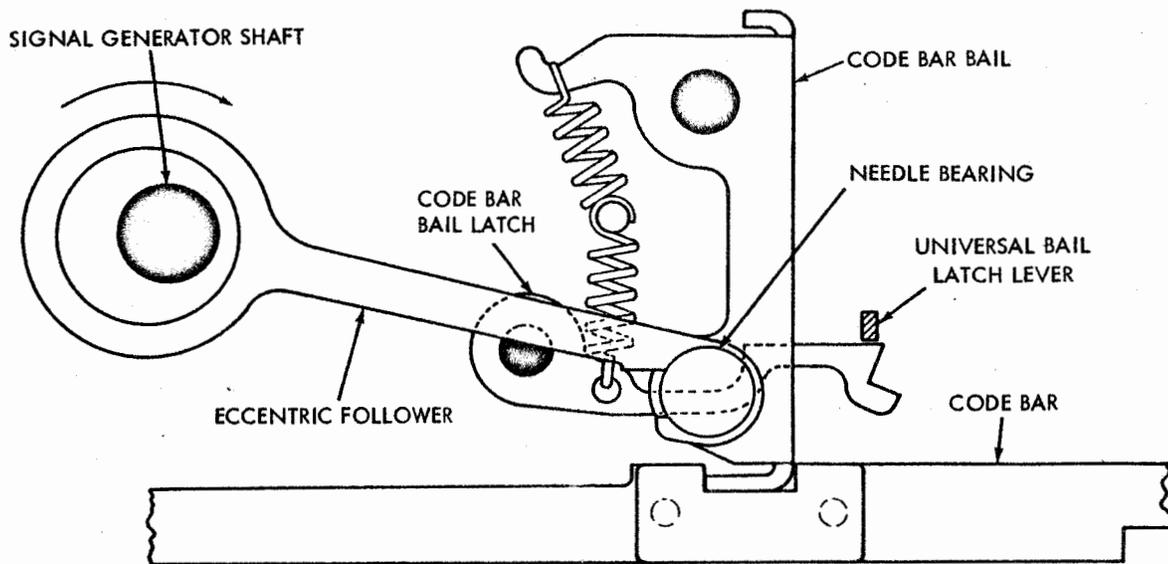


ECCENTRIC
CONTACT BOX



selected CODE BARS move
code bar VERTICAL EXTENSION
engage TRANSFER LEVER
rotate TRANSFER BAIL
operates DRIVE LINK
operates CONTACT TOGGLE
actuates CONTACTS

(ASR KYBRD.)

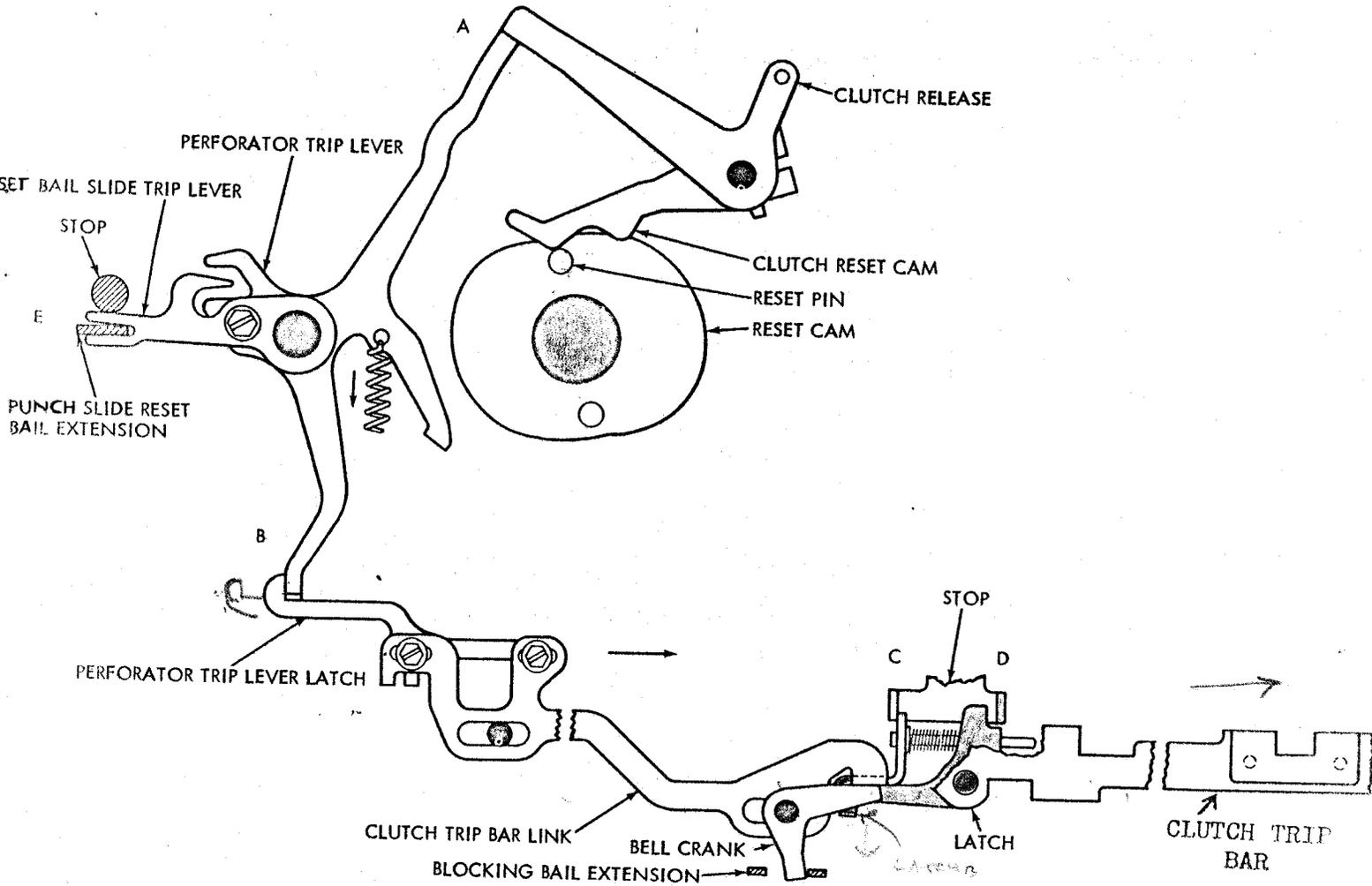


SIGNAL GENERATOR SHAFT rotates
ECCENTRIC FOLLOWER and
CODE BAR BAIL moves to left, allowing
CODE BAR BAIL LATCH to move up, latching
NEEDLE BEARING STUD.

CODE BAR BAIL moving left engages
permutated CODE BARS
CLUTCH TRIP BAR
NON-REPEAT LEVER

TRIPPING PERFORATOR CLUTCH

(ASR KYBRD.)



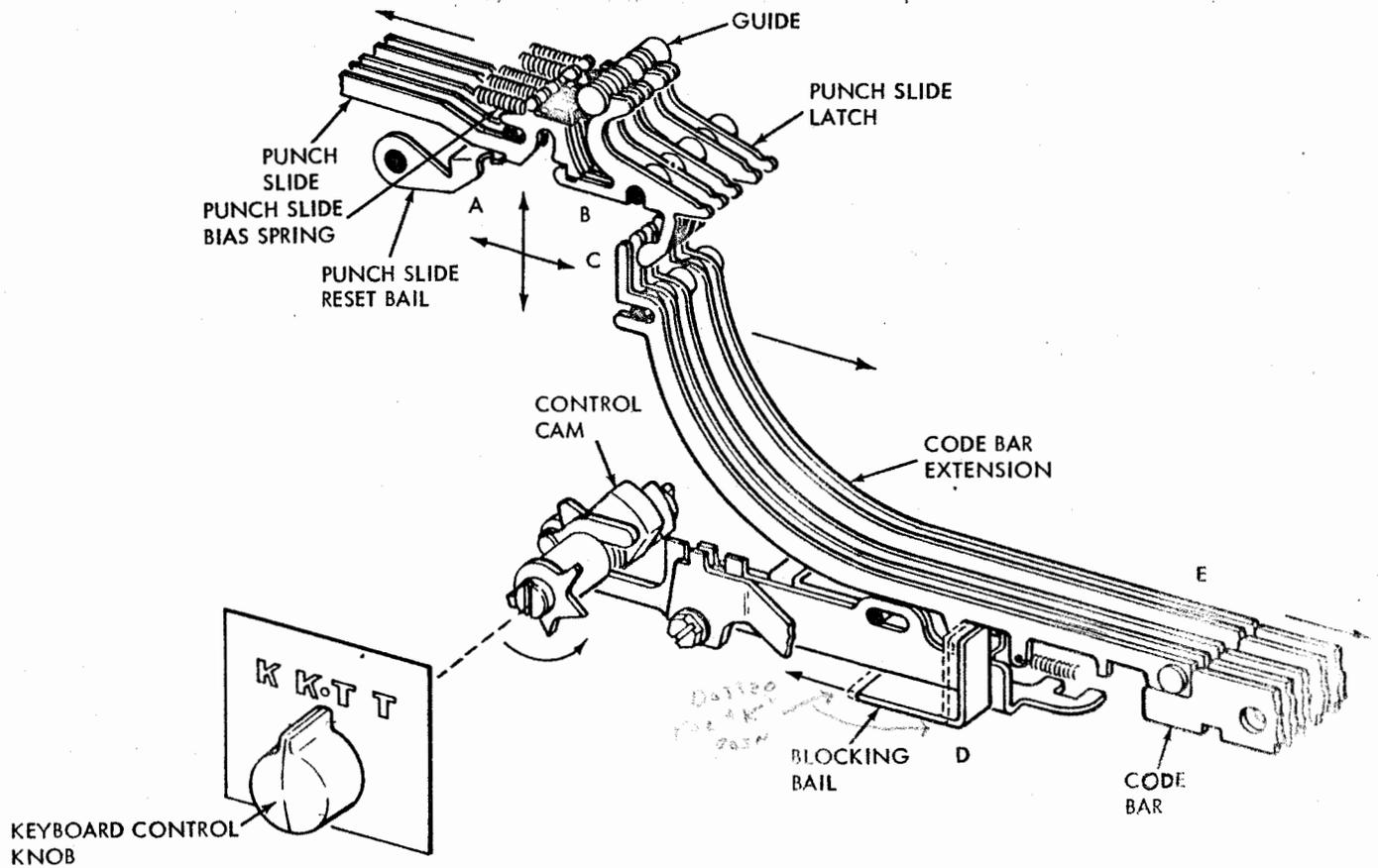
IN K-T POSITION

- CLUTCH TRIP BAR moves to right
- LATCH engages
- CLUTCH TRIP BAR LINK
- PERFORATOR TRIP LEVER LATCH operates
- PERFORATOR TRIP LEVER releases
- CLUTCH RELEASE and
- FUNCTION CLUTCH TRIP LEVER (not shown)

CLUTCH IS DISENGAGED
 WHEN CLUTCH RESET CAM
 RIDES HIGH PART OF RESET
 PIN.

K 1/2
 Blocking bail 2nd 3rd
 moves left
 Bell crank
 C.W. Latch
 disengages
 LINK + BAIL TRIP
 not shown

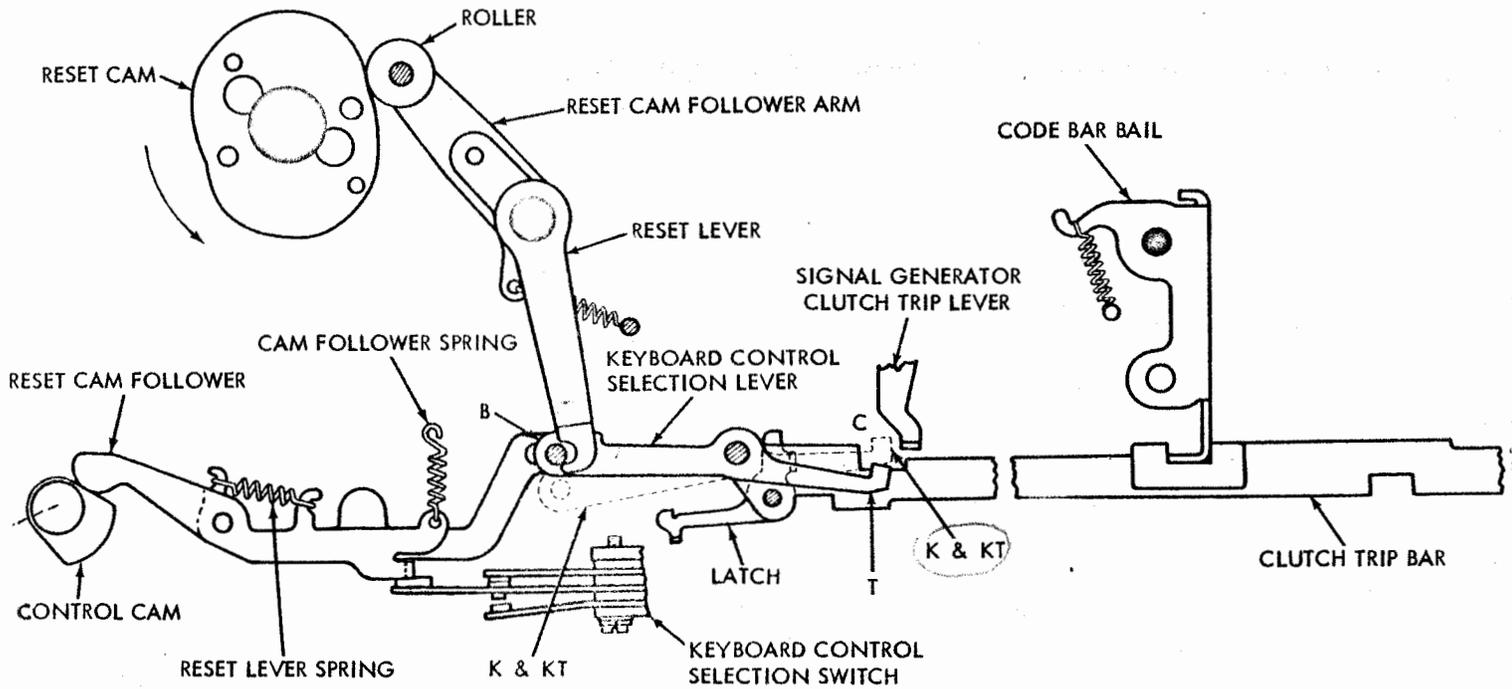
OPERATION OF
PUNCH SLIDES
(ASR KYBRD.)



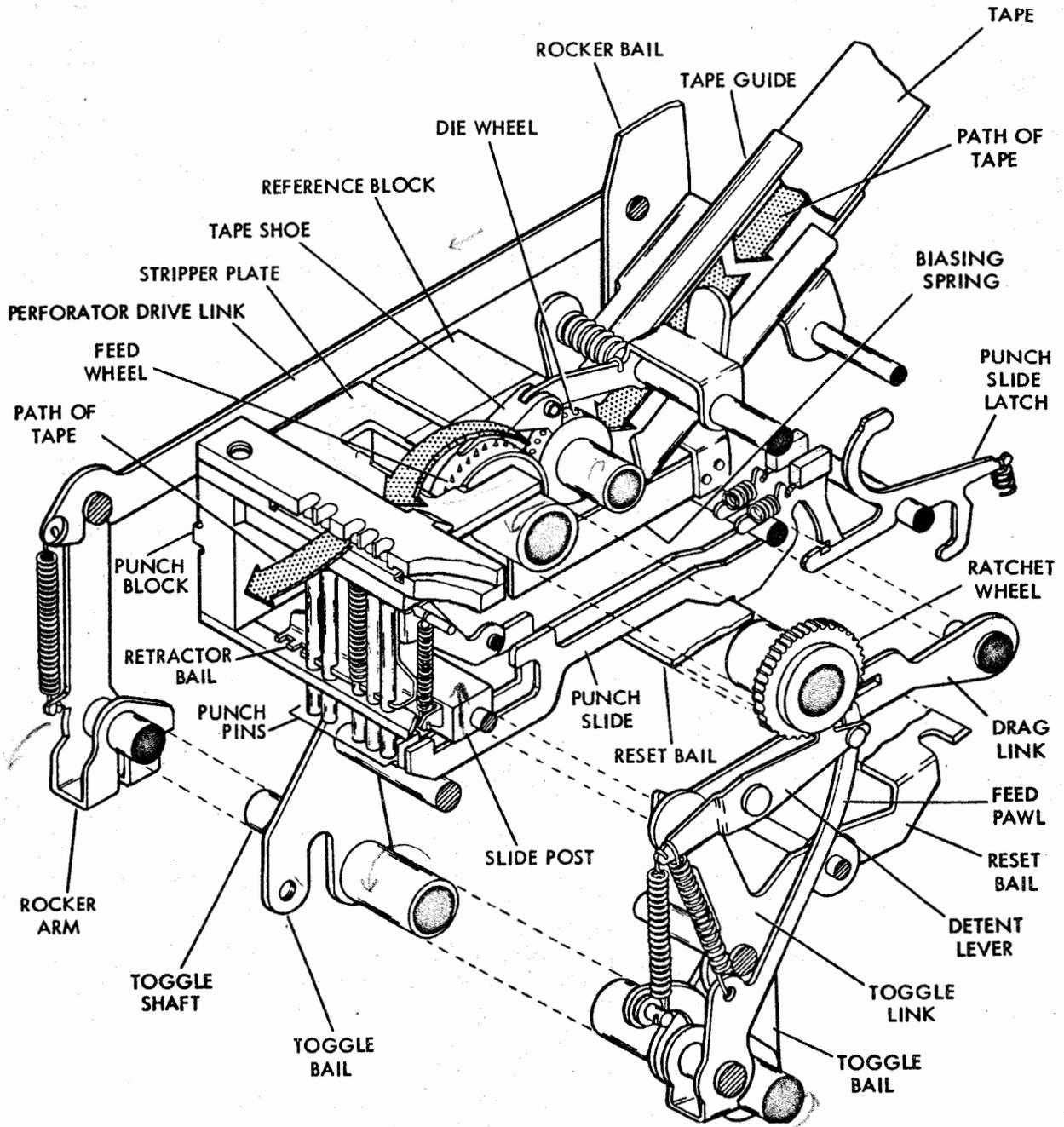
selected CODE BARS operate allowing
CODE BAR EXTENSIONS to move to right
rotating PUNCH SLIDE LATCH freeing selected
PUNCH SLIDES
(PUNCH SLIDE BIAS SPRING operates PUNCH SLIDES)

BLOCKING BAIL to right freeing CODE BAR EXTENSIONS
in K-T and T position, to left, blocking CODE BAR
EXTENSIONS in K position

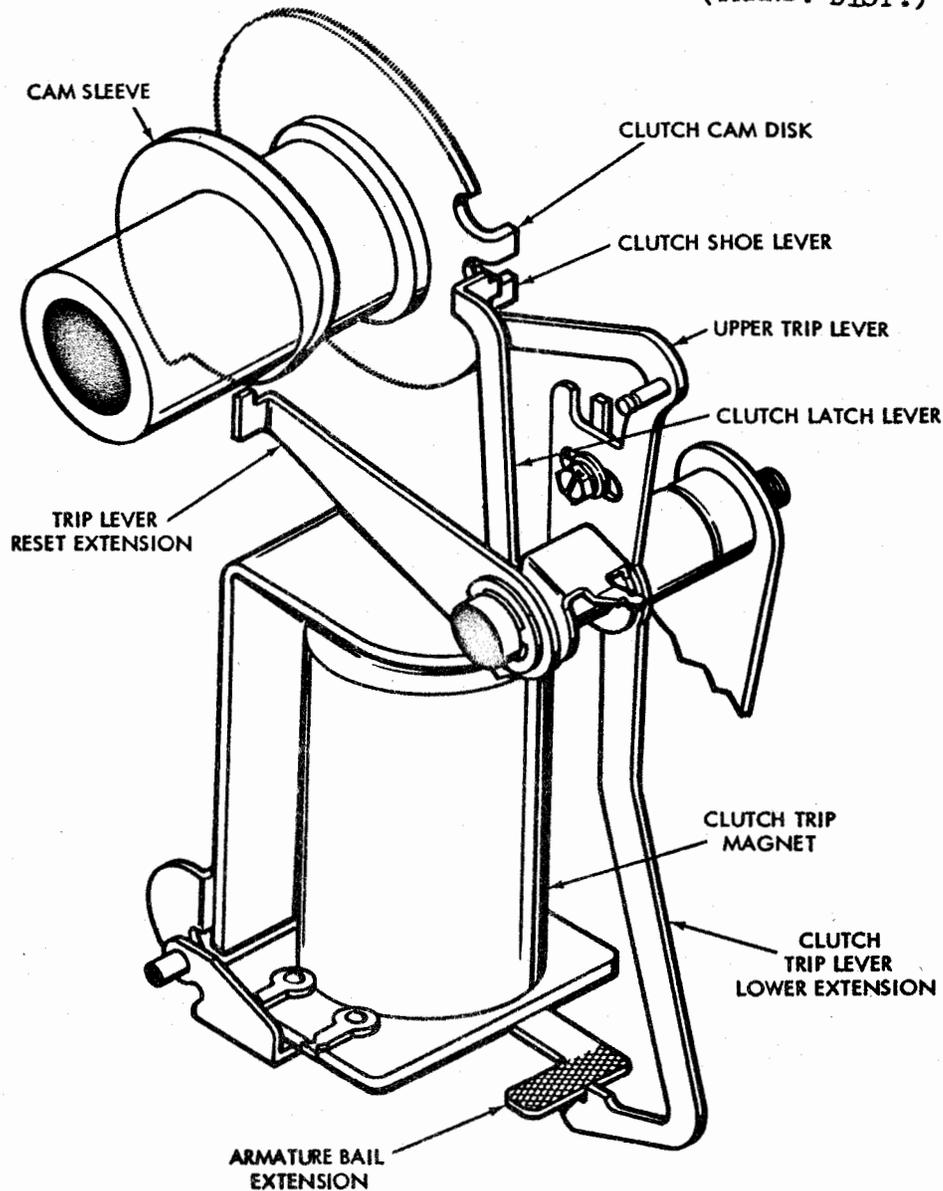
RESET OF CODE BARS
IN TAPE POSITION
(ASR KYBRD.)



RESET CAM revolves
 RESET CAM FOLLOWER ARM operates
 RESET LEVER actuates
 KEYBOARD CONTROL SELECTION LEVER moves left operating
 CLUTCH TRIP BAR resetting
 CODE BAR BAIL
 CODE BARS
 NON-REPEAT LEVER

PERFORATOR MECHANISM
(ASR KYBRD.)

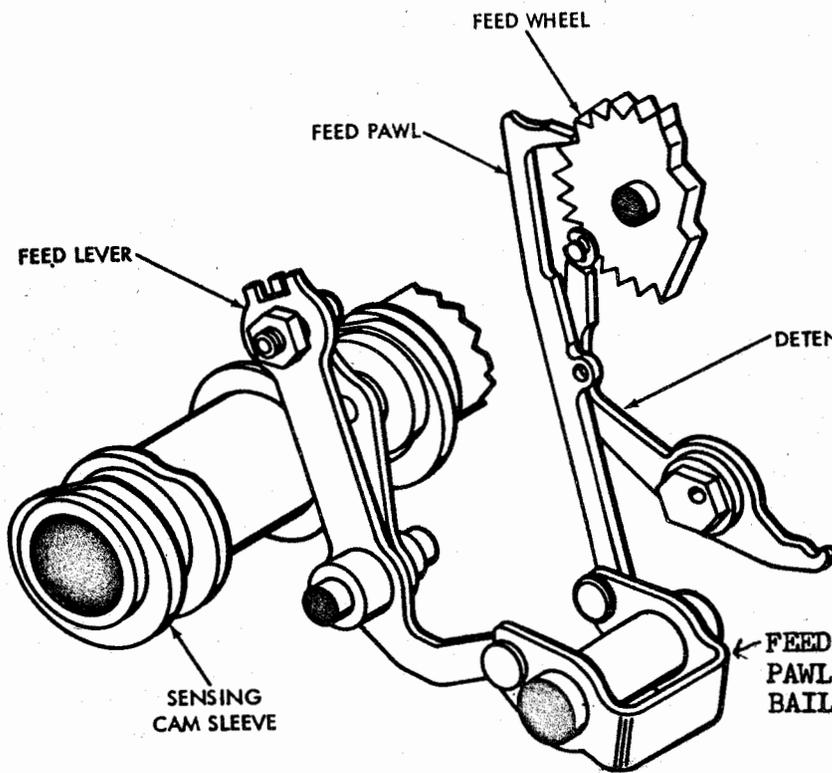
ROCKER BAIL operates (after function clutch trips)
 PERFORATOR DRIVE LINK actuates
 ROCKER ARM rotates
 TOGGLE SHAFT operates
 TOGGLE BAIL counterclockwise
 SLIDE POST moves up driving the selected
 PUNCH SLIDES up striking
 PUNCH PINS driving PINS through the tape

CLUTCH TRIP MECHANISM
(TRANS. DIST.)

current applied to the CLUTCH MAGNET causes the ARMATURE BAIL EXTENSION to rise and free CLUTCH TRIP LEVER LOWER EXTENSION which rotates UPPER TRIP LEVER moves away from CLUTCH SHOE LEVER allowing the CLUTCH to become engaged and the CAM SLEEVE comences to rotate

resetting occurs as the RESET CAM rotates TRIP LEVER RESET EXTENSION which rotates shaft and presents UPPER TRIP LEVER in path of CLUTCH SHOE LEVER thus disengaging CLUTCH

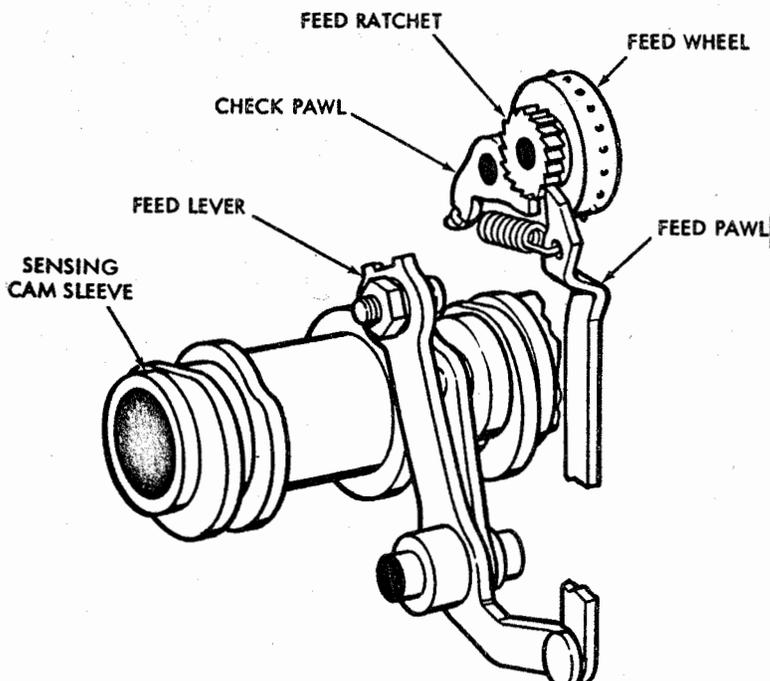
(TRANS. DIST.)



FIXED READER

SENSING CAM SLEEVE rotates
FEED LEVER operates
FEED PAWL BAIL moves
FEED PAWL down rotating
FEED WHEEL one space

* CAM FED SPRING RETURNED



PIVOTED READER

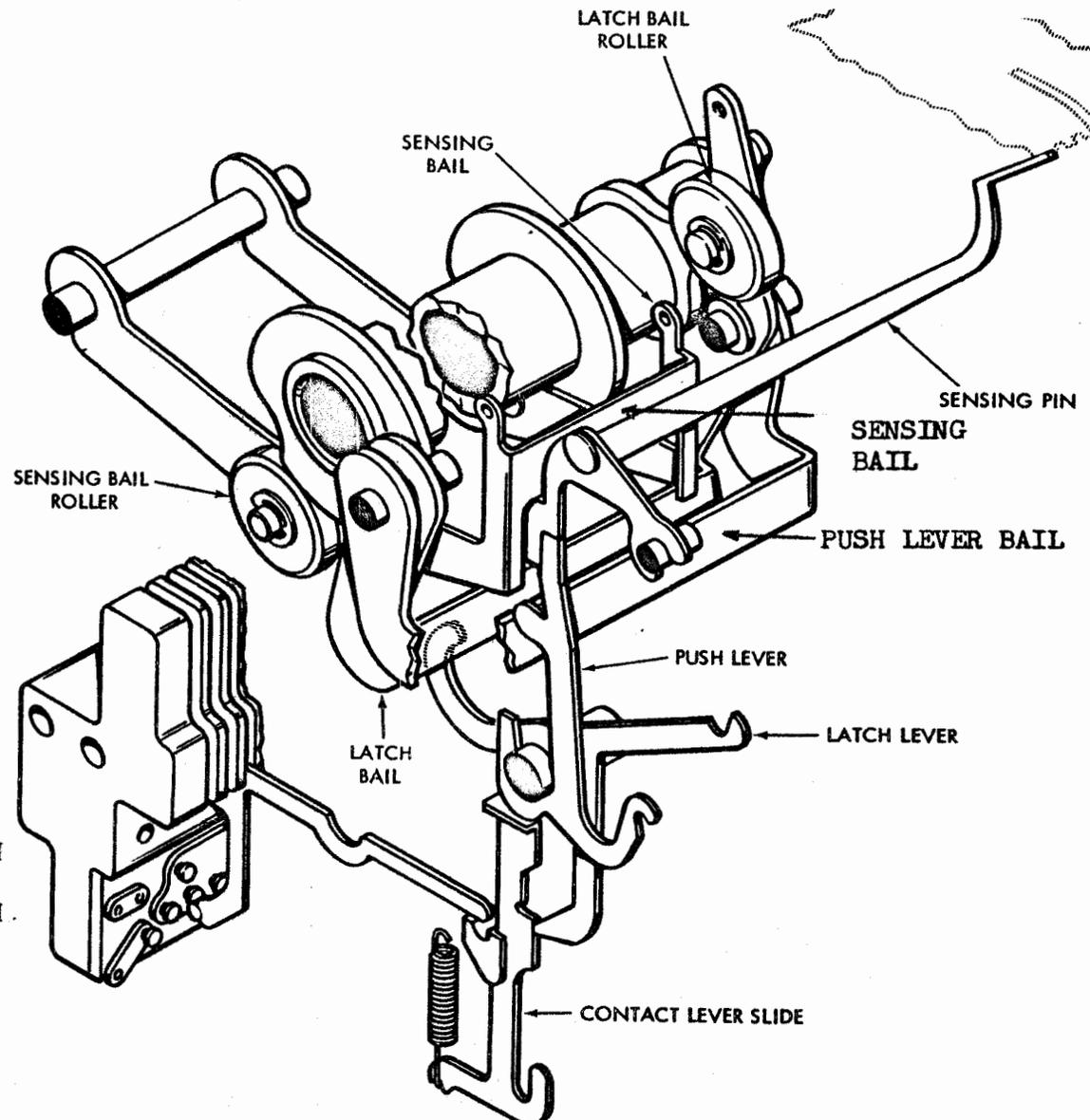
SENSING CAM SLEEVE rotates allowing
FEED LEVER SPRING (not shown) to
operate
FEED LEVER moves
FEED PAWL up rotating
FEED WHEEL one space

* SPRING FED CAM RETURNED

SENSING MECHANISM
(TRANS. DIST.)

STRIPPING

SENSING CLUTCH trips
permitting SENSING CAM
SLEEVE to rotate PUSH
LEVER BAIL strips PUSH
LEVERS from SENSING
PINS



SENSING

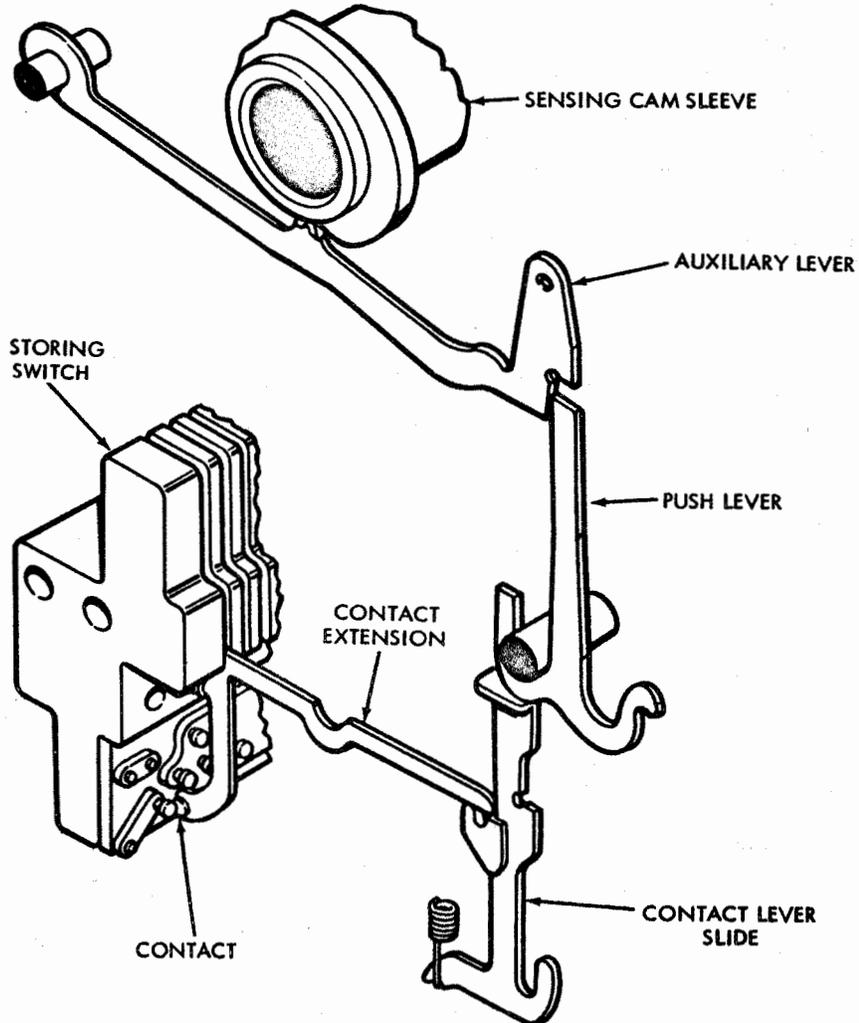
SENSING BAIL CAMS (2) allow
SENSING BAIL and
SENSING PINS to rise & sense tape.

PUSH LEVERS fall under selected sensing pins
LATCH BAIL strips off
LATCH LEVERS from
CONTACT LEVER SLIDE allowing
CONTACTS to open, erasing last character in
STORING BLOCK

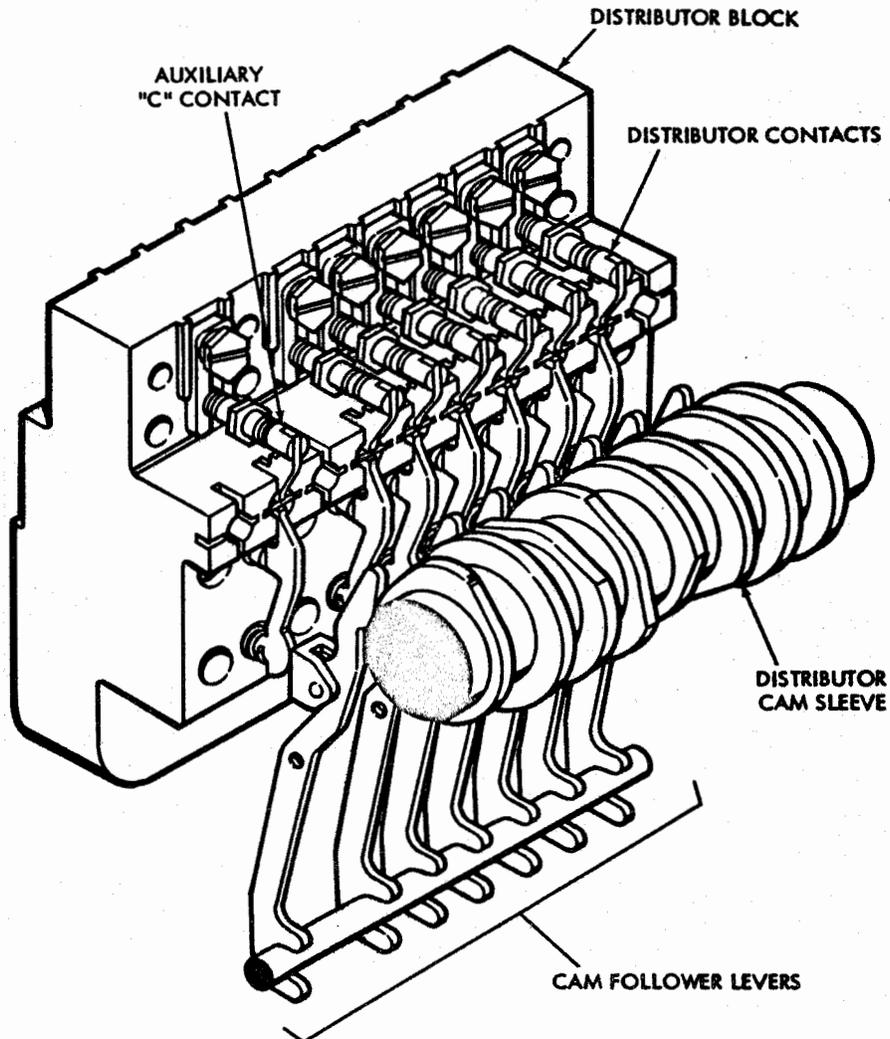
CONTACTS OPERATING

SENSING BAIL operates
SENSING PINS moving selected
PUSH LEVERS moving
CONTACT LEVER SLIDES down allowing
CONTACT to close

AUXILIARY CONTACTS
 (IN SENSING MECHANISM)
 (TRANS. DIST.)

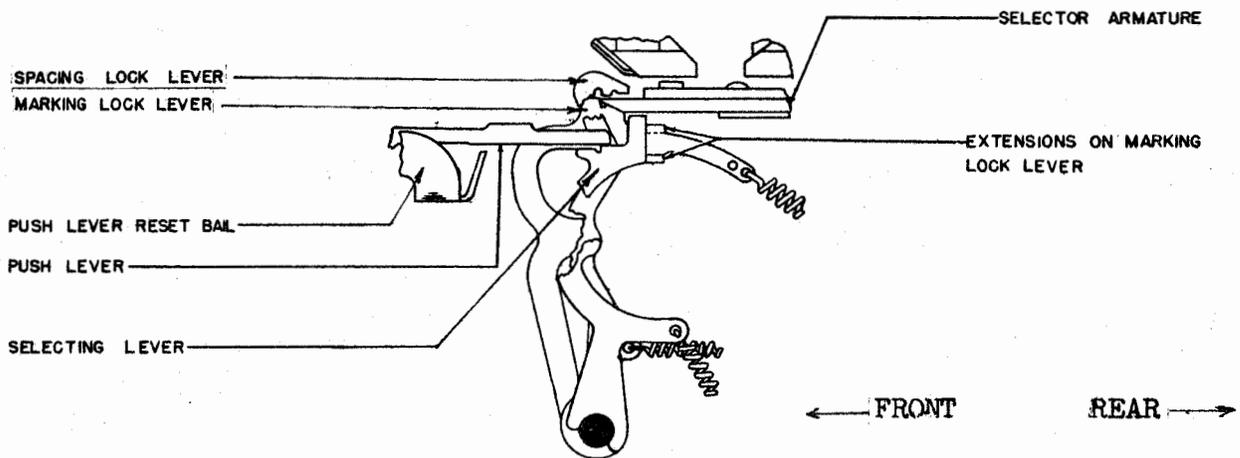
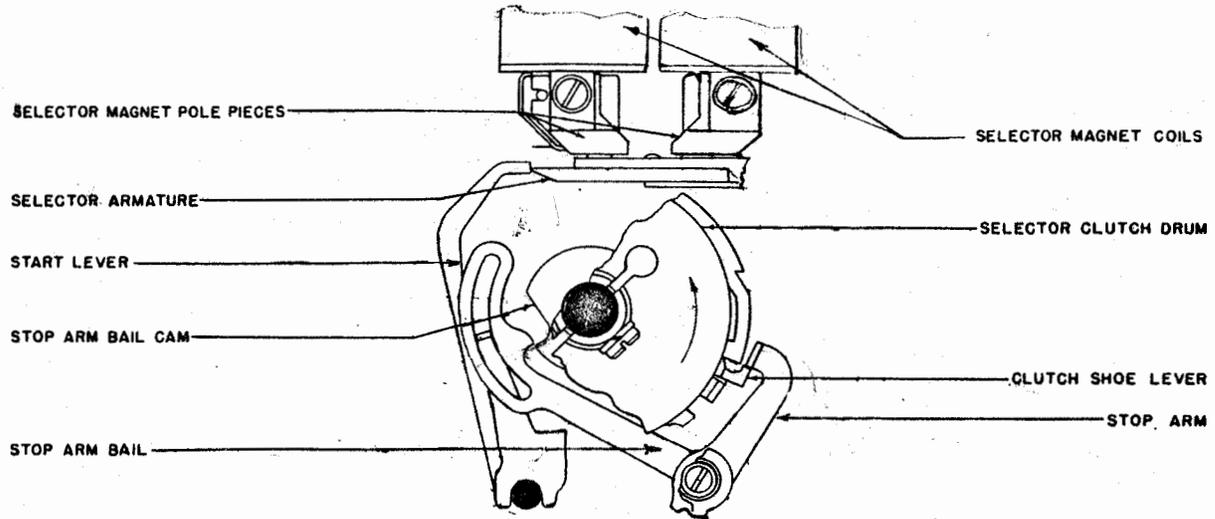


SENSING CAM SLEEVE rotating causes
 AUXILIARY LEVER to move down against
 PUSH LEVER moving
 CONTACT LEVER SLIDE down permitting
 CONTACT LEVER EXTENSION to drop allowing
 CONTACT to close

DISTRIBUTOR BLOCK
(TRANS. DIST.)

closing auxiliary contact on pivoted or fixed sensing mechanism causes DISTRIBUTOR CLUTCH to become energized allowing DISTRIBUTOR CAM SLEEVE to rotate permitting CAM FOLLOWER LEVERS to fall into low part of cam (sequentially) permitting DISTRIBUTOR CONTACTS to close generating a TELETYPE signal.

SELECTION



Start pulse received in SELECTOR MAGNET COILS releases

ARMATURE unblocks

START LEVER releases

STOP ARM BAIL and STOP ARM

CLUTCH trips and SELECTOR CAM SLEEVE rotates

PUSH LEVER RESET BAIL resets

PUSH LEVERS to the rear (spacing) position

ARMATURE attracted (marking) permits

SELECTING LEVER to move behind

PUSH LEVER drops down

SELECTING LEVER moves

PUSH LEVER forward to its marking position

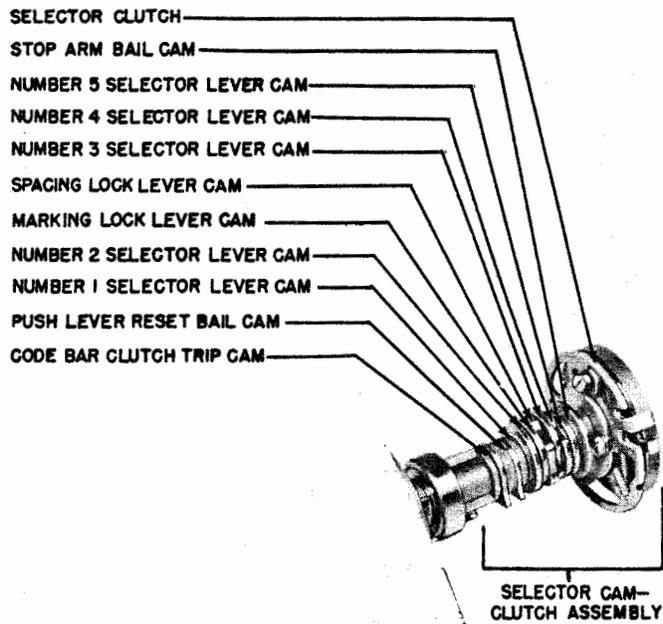
ARMATURE unattracted (spacing) blocks

MARKING LOCK LEVER

MARKING LOCK LEVER EXTENSIONS block

SELECTING LEVER causing PUSH LEVER to remain on top of SELECTING LEVER and to the rear in its spacing position

MOVEMENT OF THE START LEVER

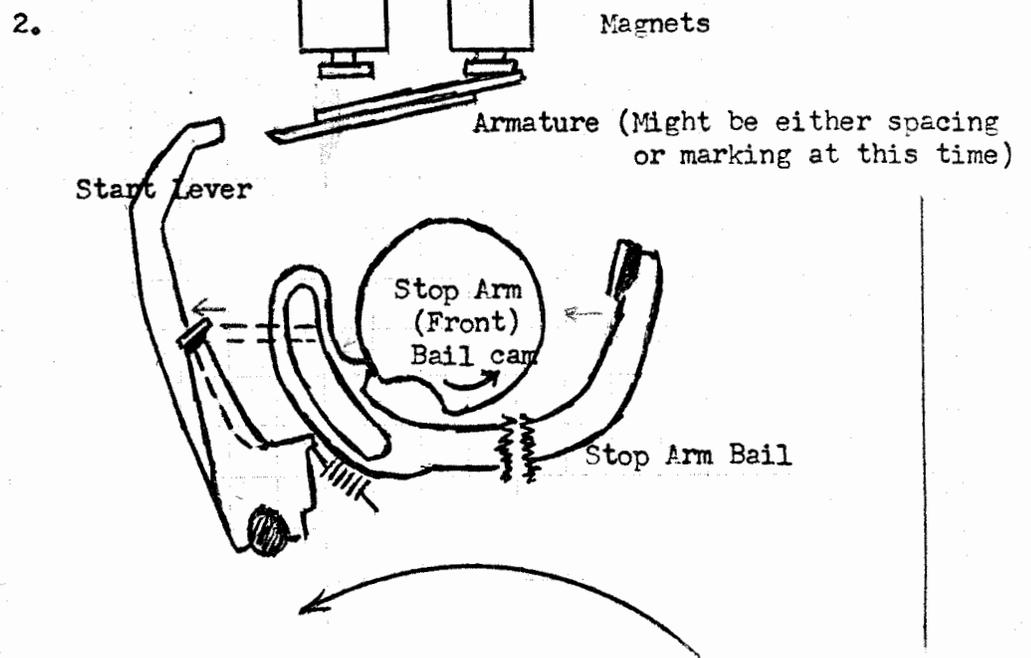
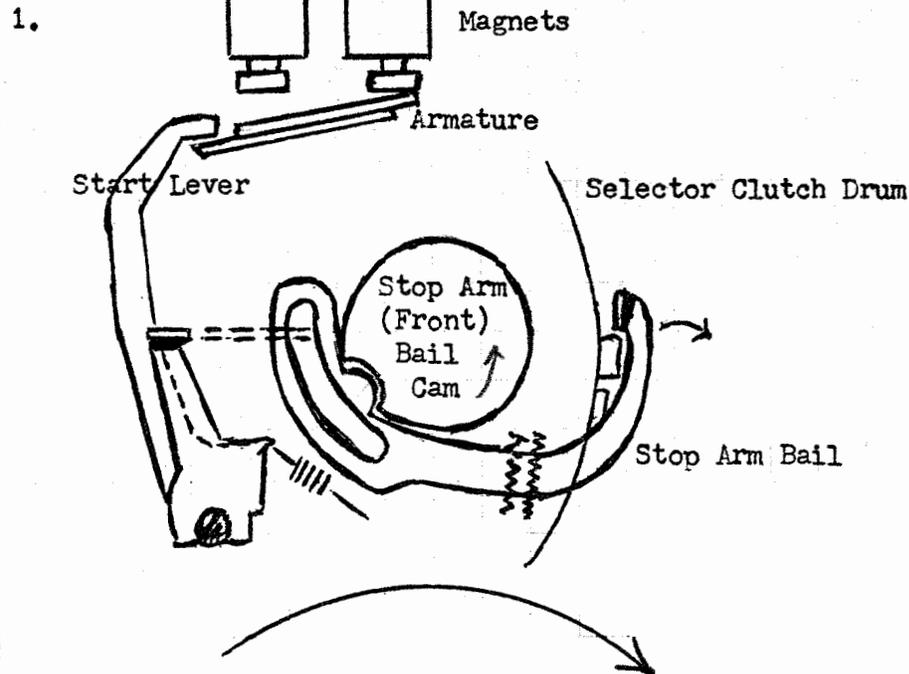


1. The armature drops down for the first pulse, the START pulse, which is always SPACING. The Start lever drops over the armature extension, holding the armature spacing. The Start lever is connected to the Stop Arm Bail -- as the Start Lever moves over the armature extension, the Stop Arm Bail is forced into the indent of its cam -- causing the Selector Clutch Stop Arm (shown as one piece with the Bail, for illustration purposes) to fall away and allow the clutch to engage and begin rotating.

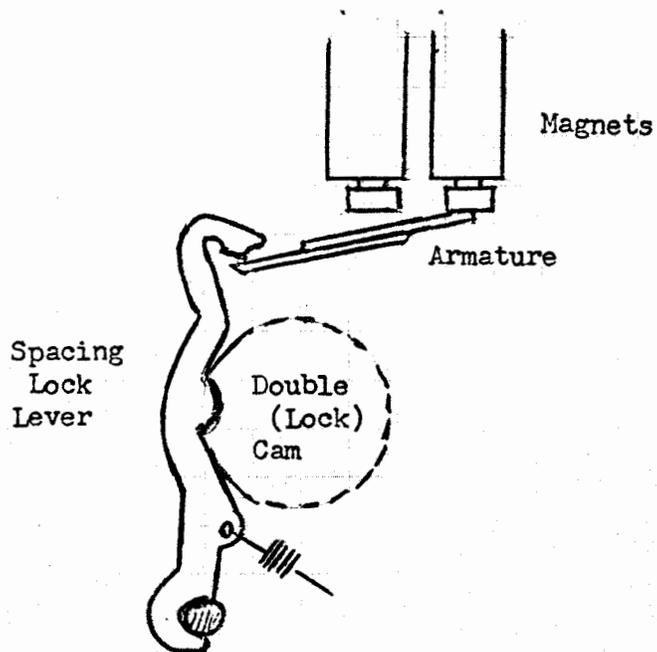
2. As the Selector cam begins rotating, the reverse action takes place. The Stop Arm Bail extension rides to the high part of the front cam, forcing the Start Lever clear of the armature extension and pulling the Selector Clutch Stop Arm back against the clutch drum where it will be in position to stop the Selector clutch after one revolution.

NOTE: Because the Stop Arm Bail Cam (Front Cam) has only one indent, the Start Lever may not fall over the armature again during the cycle.

28.



1.

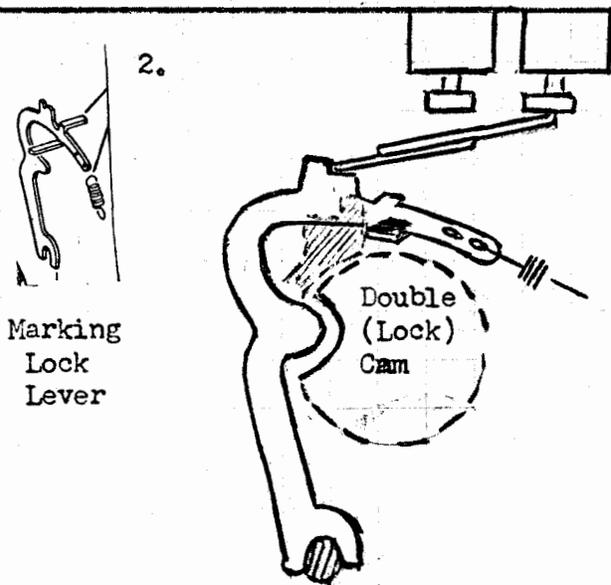


SELECTOR MECHANISM DURING SPACING IMPULSE

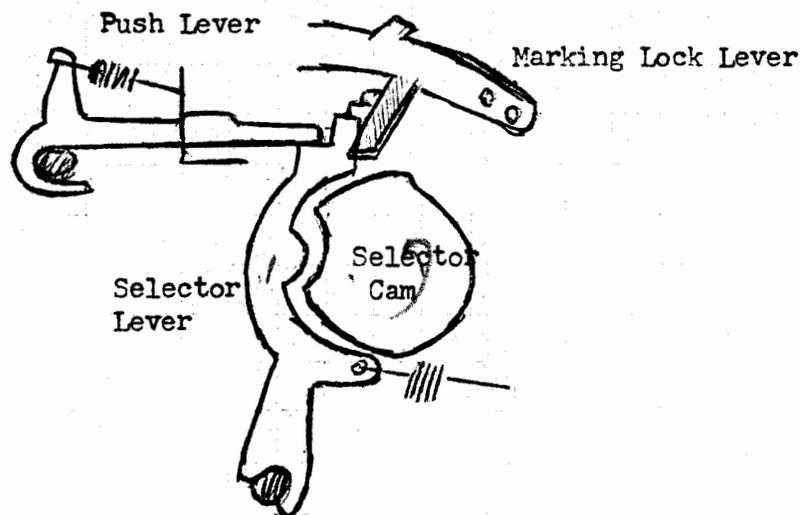
1. Magnets are de-energized and armature drops down. Spacing Lock Lever falls over top of armature, holding it spacing. Spacing Lock Lever rides into indent of double (LOCK) cam.
2. With the armature down (Spacing), the Marking Lock Lever is blocked. The projection on the Marking Lock Lever rides in the air over the indent in the double cam.
3. As the Selector cam indent comes into line, the Selector Lever attempts to move back into the indent. Because the Marking Lock Lever is being blocked by the armature extension (2), the Selector Lever is blocked by the arm on the Marking Lock Lever. The Selector Lever moves to the rear slightly but not far enough to allow the Push Lever to drop down on to the Selector Lever Guide.

NOTE: BETWEEN EACH PULSE, THE MARKING AND SPACING LOCK LEVERS RIDE TO A HIGH PART OF THE DOUBLE CAM AND MOVE CLEAR OF THE ARMATURE.

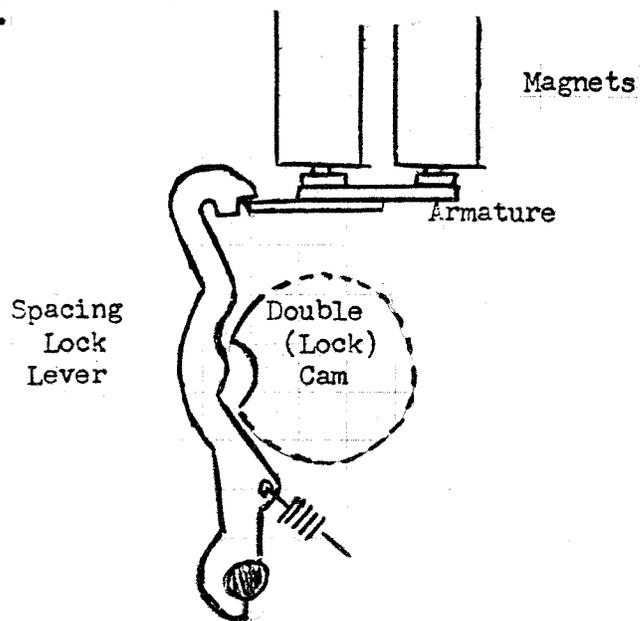
2.



3.



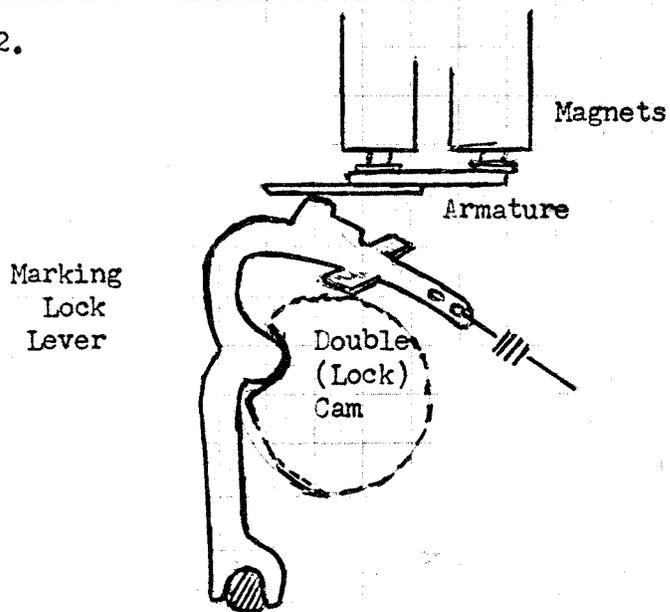
1.



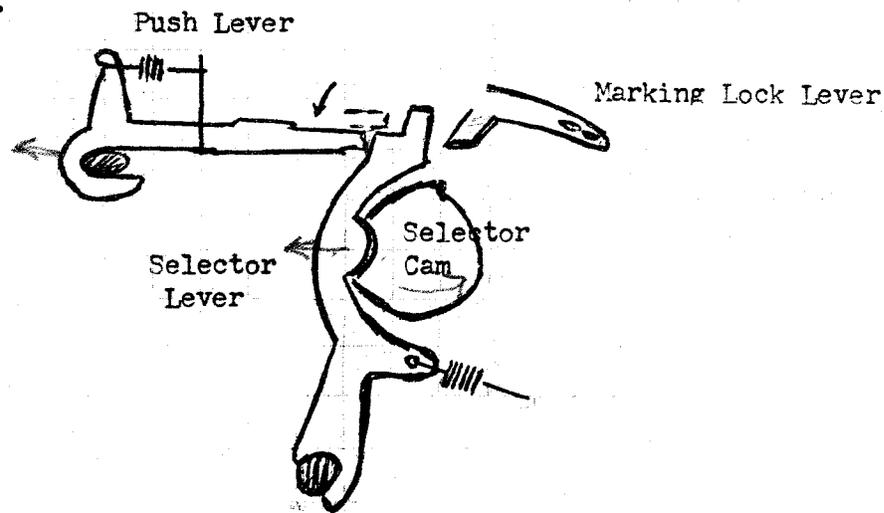
SELECTOR MECHANISM DURING MARKING IMPULSE

1. Magnets are energized and armature is pulled up. The Spacing Lock Lever attempts to move to the rear but is now blocked by the armature extension.
 2. With the armature up (Marking), the Marking Lock Lever is free to be pulled to the rear by its spring. As it moves to the rear, it braces the armature against the pole pieces and rides into the indent of the double (Lock) cam. (The Spacing Lock Lever is, at this period, riding in the air above that same cam indent.)
 3. The Marking Lock Lever is now out of the way so the Selector Lever, which has the indent of its cam available, may fall in. The indents of the other Selector cams have either passed or not yet arrived, consequently only one Selector may fall in during any given pulse. Moving to the rear, the Selector Lever can no longer support the Push Lever and, consequently, the Push Lever drops down onto the Selector Lever Guide. As the Selector rides out of its indent it will move forward which, in turn, will cause the Push Lever to be moved forward.
- Note:** BETWEEN EACH PULSE, THE MARKING AND SPACING LOCK LEVERS RIDE TO A HIGH PART OF THE DOUBLE CAM AND MOVE CLEAR OF THE ARMATURE EXTENSION.

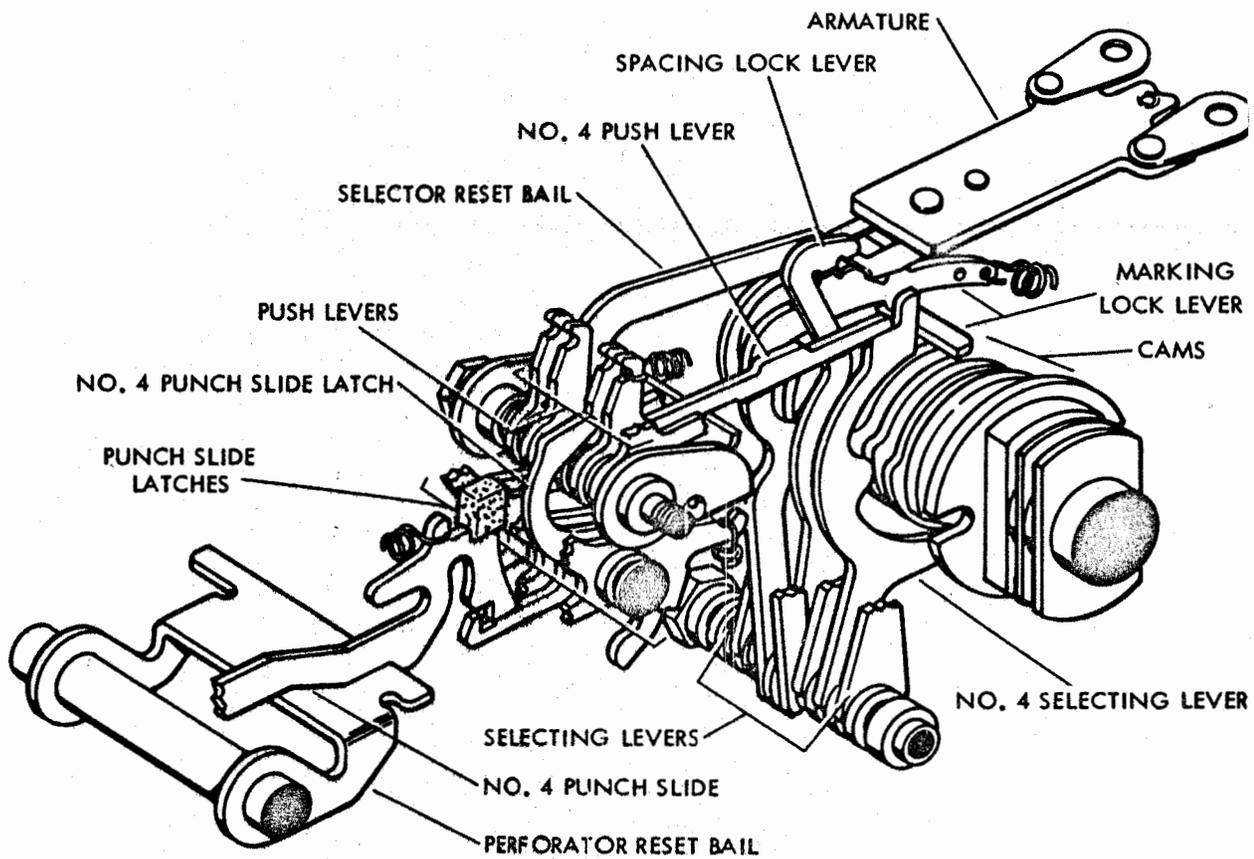
2.



3.

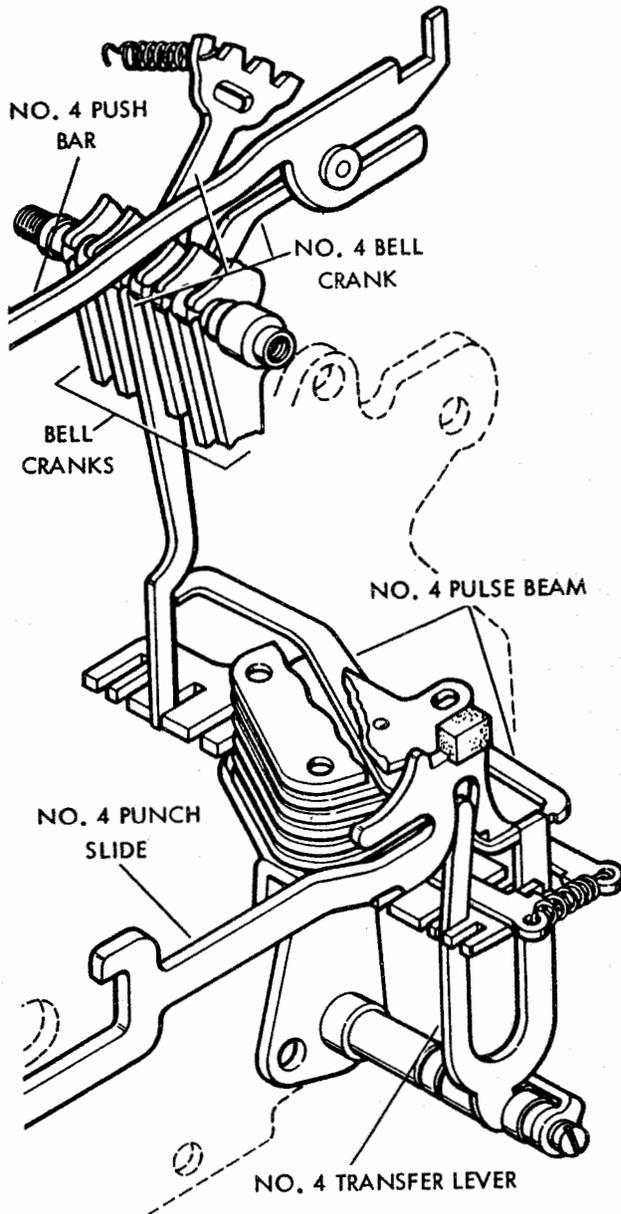


30.



MARKING SELECTOR LEVER moves to left operating PUNCH SLIDE LATCH counterclockwise permitting PUNCH SLIDE BIAS SPRING to operate the PUNCH SLIDE to a marking position

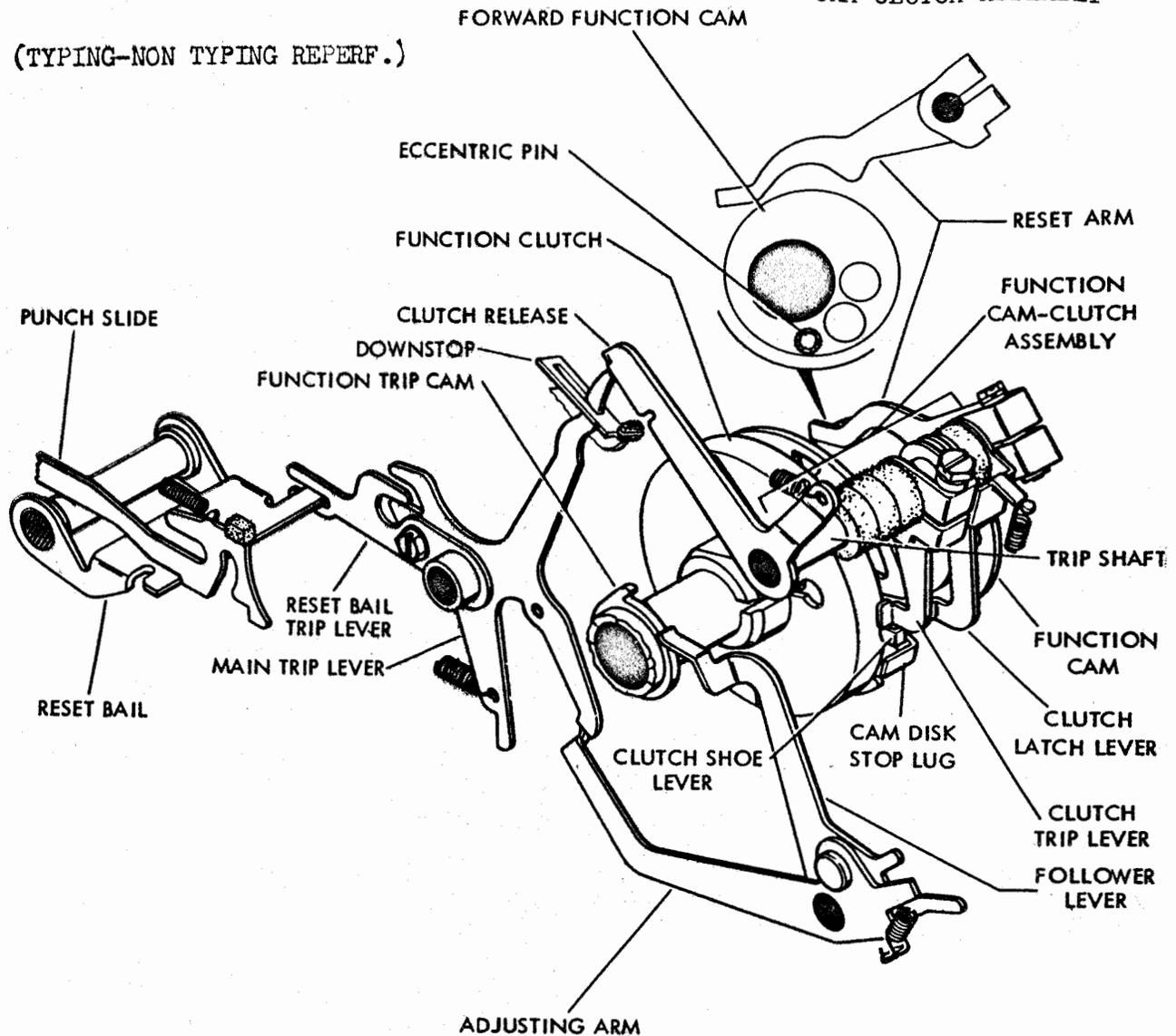
(SPACING SELECTOR LEVER causes PUNCH SLIDE LATCH and PUNCH SLIDE to remain stationary)



PUNCH SLIDE marking (to left) moves
TRANSFER LEVER left rotating rear of
PULSE BEAM to right allowing
BELL CRANK to rotate counterclockwise
positioning PUSH BAR up MARKING

PUNCH SLIDE spacing
all parts would remain stationary
PUSH BAR would remain down
SPACING

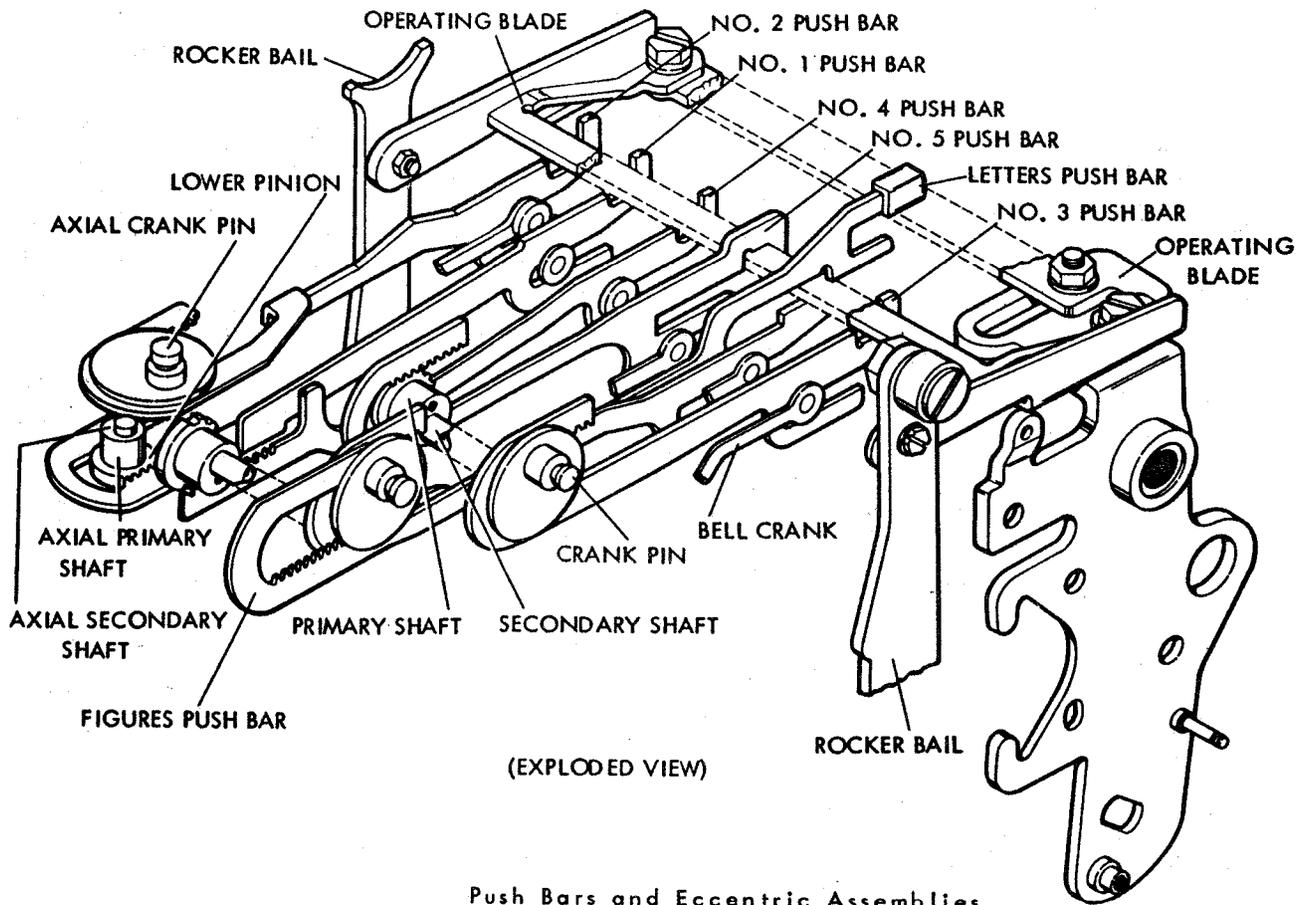
(TYPING-NON TYPING REPERF.)



SELECTOR CAM SLEEVE rotating causes
 FUNCTION TRIP CAM to operate
 FOLLOWER LEVER moving
 ADJUSTING ARM up rotating
 MAIN TRIP LEVER counterclockwise permitting
 CLUTCH RELEASE to drop rotating
 TRIP SHAFT moving
 CLUTCH TRIP LEVER free of
 CLUTCH SHOE LEVER permitting
 CLUTCH ENGAGEMENT and rotation of
 FUNCTION CAMS.

resetting occurs as
 ECCENTRIC PIN moves
 RESET ARM rotates
 TRIP SHAFT presenting
 CLUTCH TRIP LEVER into path of
 CLUTCH SHOE LEVER disengaging
 FUNCTION CLUTCH

PUSH BAR OPERATION
(TYPING REPERF.)

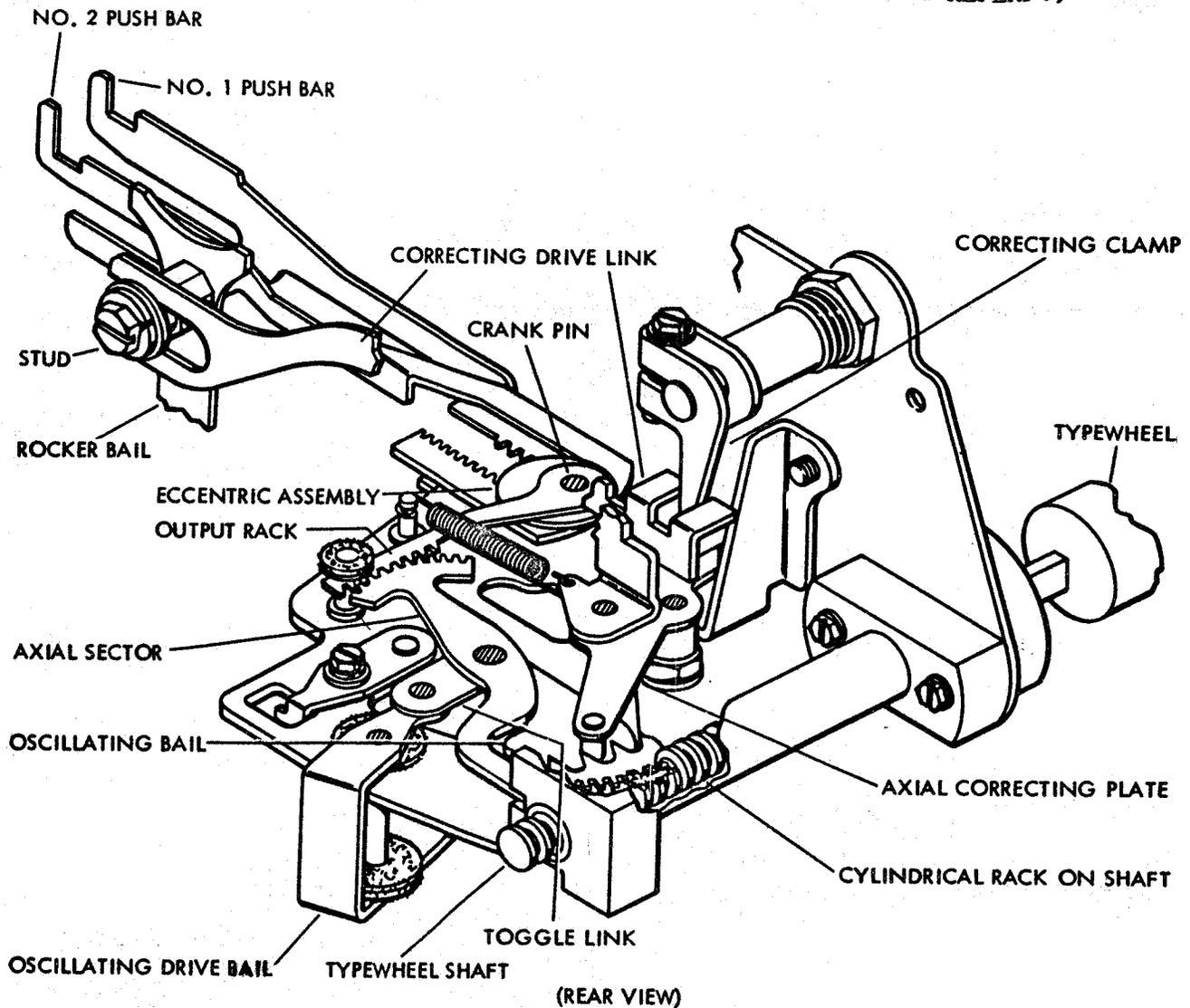


OPERATING BLADE moving to left will operate selected* PUSH BARS which, through rack & gear arrangement, will operate ECCENTRIC ASSEMBLIES (3)

PUSH BARS #3,4,& 5 control ECCENTRIC ASSEMBLIES on front of unit and provide rotary positioning of TYPE WHEEL

PUSH BARS #1 & 2 control rear ECCENTRIC ASSEMBLY and provide axial positioning of TYPE WHEEL.

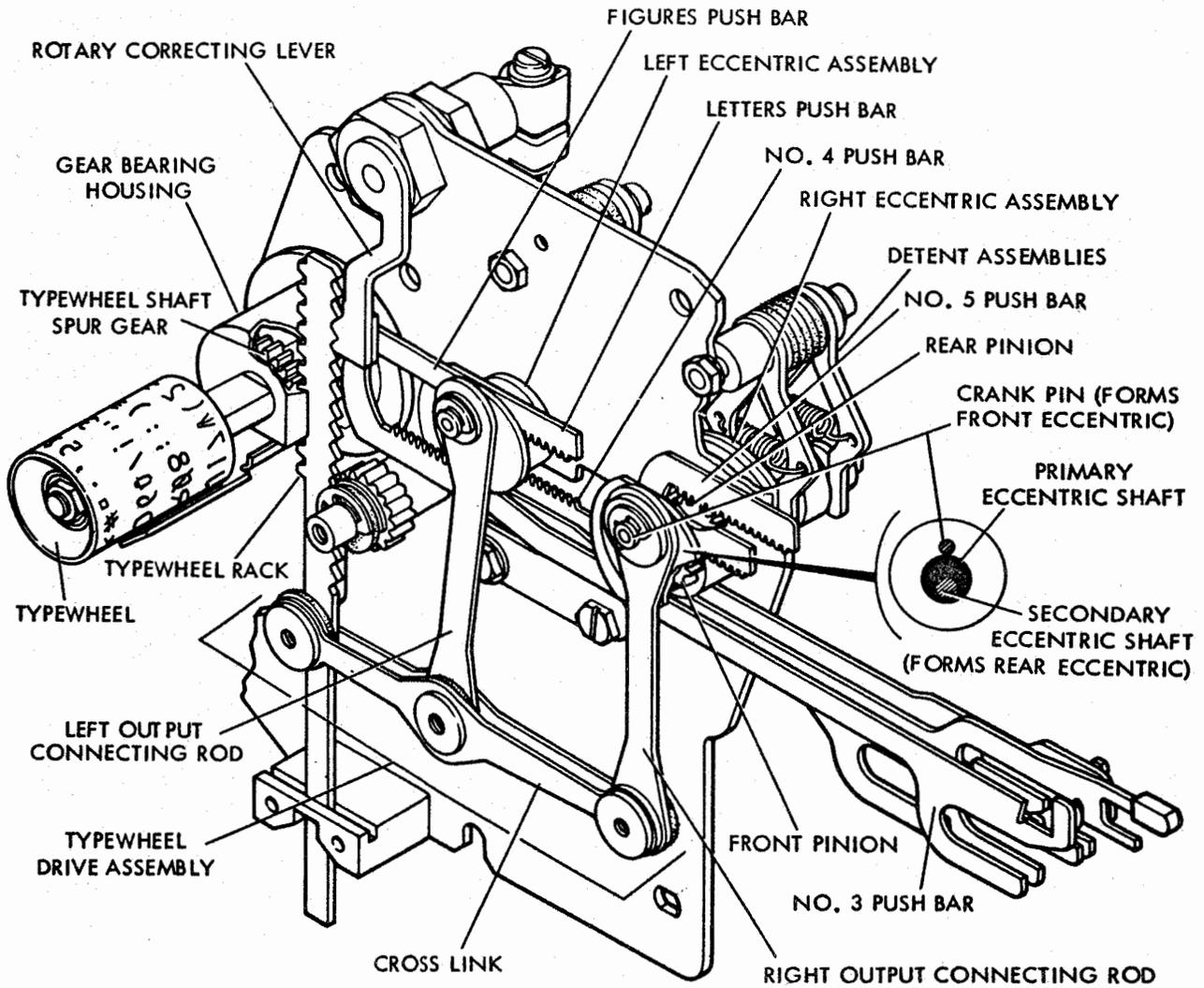
* Selected PUSH BARS - 1,2,3 & 4 on mark (up)
5 on space (down) note construction #5

AXIAL POSITIONING MECHANISM
 (TYPING REPERF.)


movement of #1 and/or 2
 PUSH BAR causes
 ECCENTRIC ASSEMBLY to rotate causing
 CRANK PIN to move
 OUTPUT RACK rotating
 AXIAL SECTOR moving
 CYLINDRICAL RACK and
 TYPEWHEEL forward into one of 3 stops

ROTARY POSITIONING
(TYPING REPERF.)

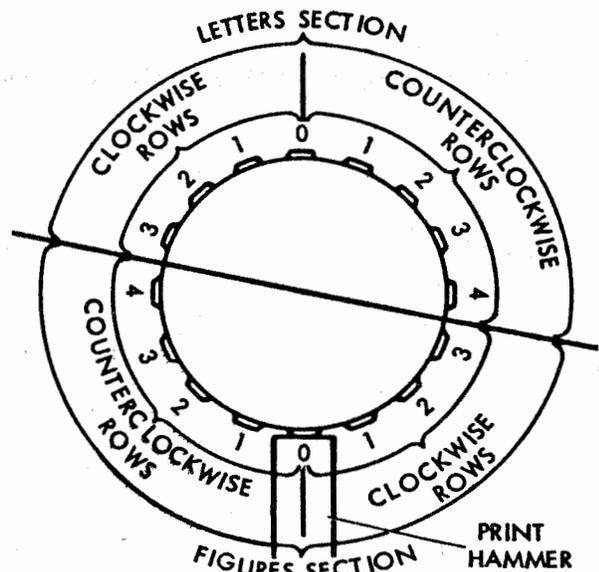
37.



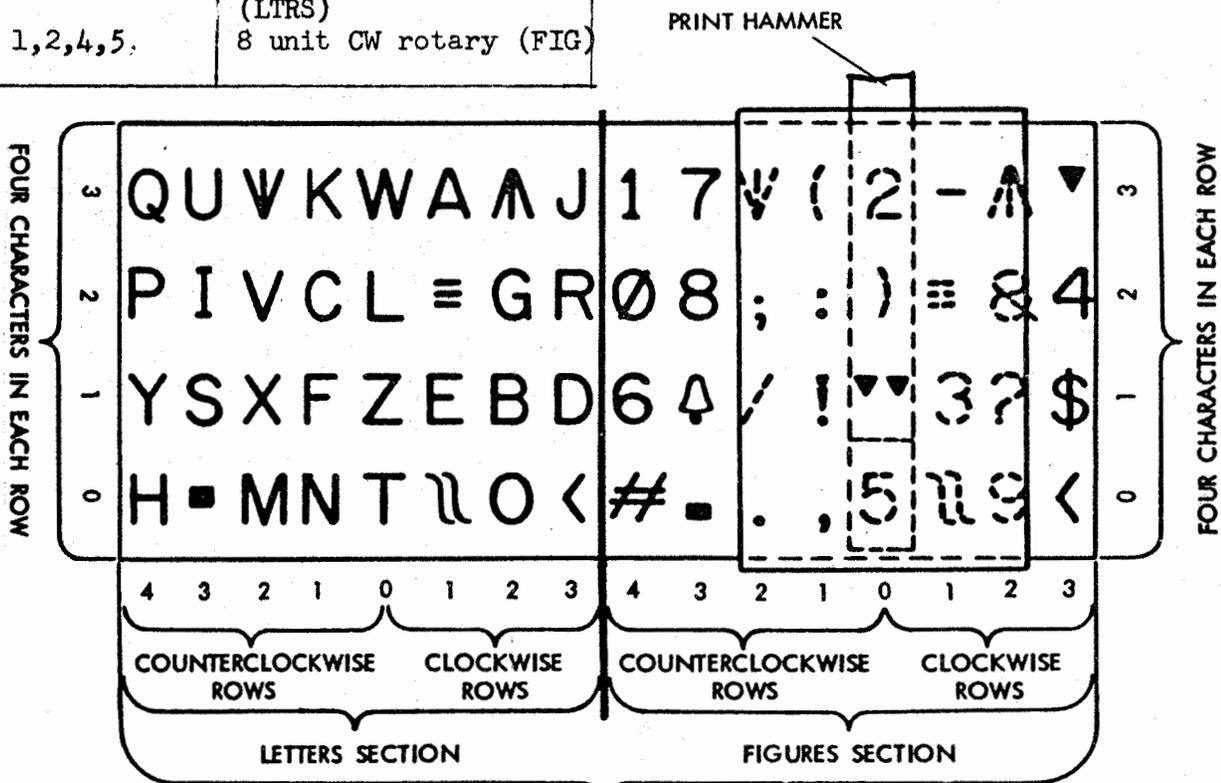
The various selection of #3,4,& 5
PUSH BARS to operate the right and/or left
ECCENTRIC ASSEMBLIES operating the
OUTPUT CONNECTING RODS moving the
CROSS LINK operating
TYPEWHEEL RACK rotating
TYPEWHEEL SHAFT SPUR GEAR rotating the
TYPEWHEEL into one of eight stops

LETTERS-FIGURES shift gives eight additional stops
for a total of sixteen.

CODE		Displacement Produced
Spacing	Marking	
1,2	- -	0 units axial
2	1	1 unit axial
1	2	2 unit axial
- -	1,2	3 unit axial
3,5	4	3 unit CW rotary
3	4,5	2 unit CW rotary
3,4,5	- -	1 unit CW rotary
3,4	5	0 units rotary
5	3,4	1 unit CCW rotary
- -	3,4,5	2 unit CCW rotary
4,5	3	3 unit CCW rotary
4	3,5	4 unit CCW rotary
- -	1,2,3,4,5	8 unit CCW rotary (LTRS)
3	1,2,4,5	8 unit CW rotary (FIG)

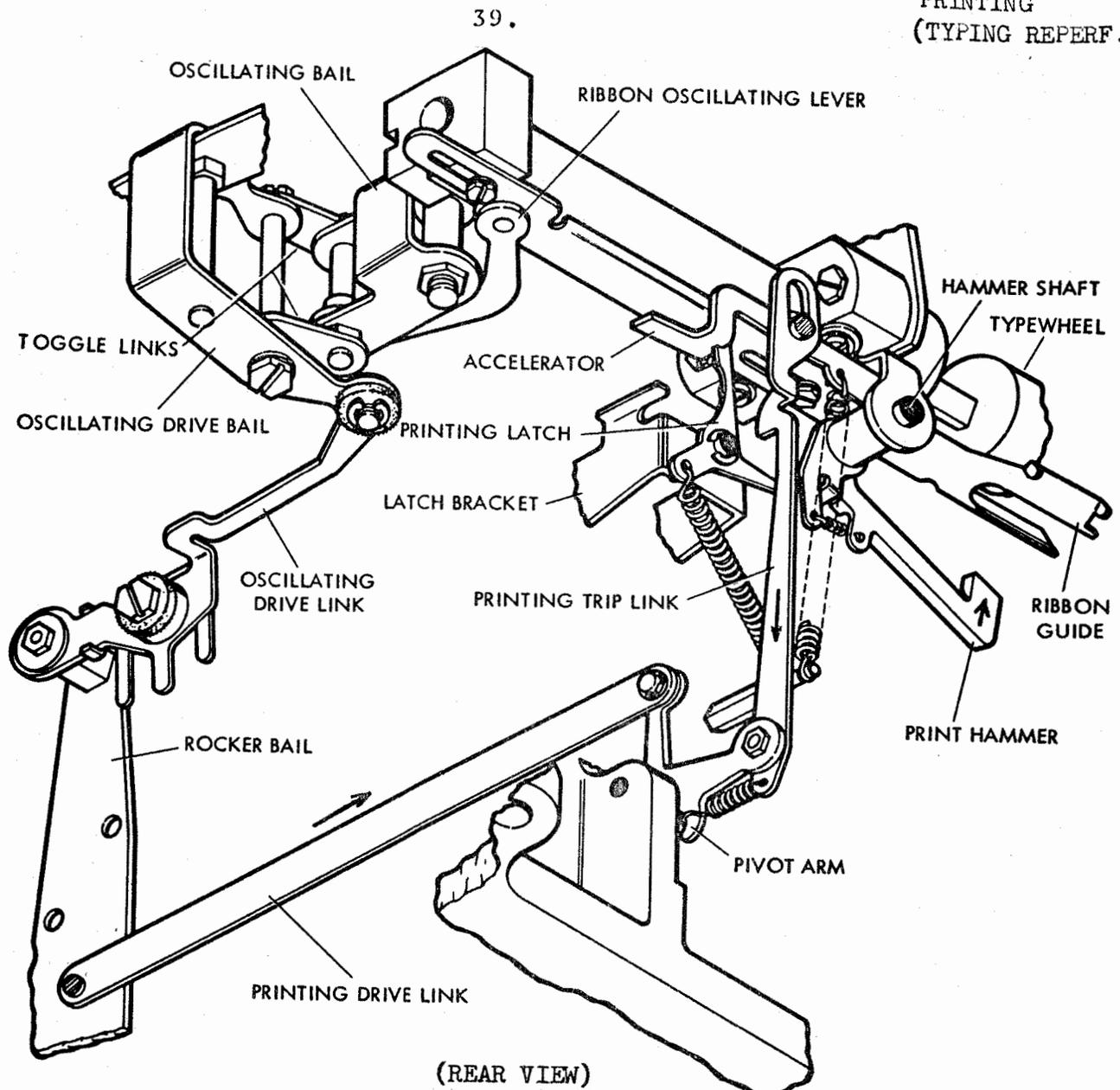


a. FRONT VIEW SHOWING 16 LONGITUDINAL ROWS



b. 16 LONGITUDINAL ROWS

TOP VIEW SHOWING CYLINDRICAL SURFACE IN A PLANE



PRINT

ROCKER BAIL operates
PRINTING DRIVE LINK rotating
PIVOT ARM pulling down
PRINTING TRIP LINK rotating
PRINTING LATCH permitting
ACCELERATOR SPRING to pull down
ACCELERATOR driving
PRINT HAMMER up against
RIBBON

RESET

ROCKER BAIL, PRINTING DRIVE LINK, PIVOT ARM & PRINTING
TRIP LINK reverse their previous movements operating
ACCELERATOR, PRINT HAMMER down allowing PRINTING LATCH
to relatch