

**TYPE 421/421-9 PRINTING MECHANISMS**

Basically Type 421 and 421-9 Accounting Machines use the same printing mechanisms in regard to the mechanical structure. Two different variable speed drives represent the outstanding difference of the two drive units. In this chapter the 421-9 Printing Mechanism will be described. The 421 variable speed drive unit is shown for reference purposes only (Figure 326).

The printing mechanisms of the Types 421 and 421-9 machines represent a completely new design in comparison with the 402 printing mechanism. The zone unit, the magnet unit and the type bar bail assembly have been replaced by printing plates, driving through gears all type bars to print numerical and alphabetical informations. The operation of the printing plates is similar to the counter plates shown in Figure 140. The operation will be described in the following section.

These printing plates permit printing of alphabetical characters to take place from the first or second reading station.

Two numerical or alphabetical printing lines may be printed from one card. In contrary to the Type 402 zoning described earlier under section "Zone Bar and Setup Mechanism", alphabetical printing can be performed from a single reading station.

**Alphamerical and numerical Type Bars**

Each type bar makes a complete unit with four possible different positions of the type bar rack, depending on the printing position of the type bar in the unit.

As shown on the following chart, the arrangement of the characters in the type basket is reversed in respect to the Type 402, i.e., the character 9 is located in the bottom position of the type basket. All alphamerical type bars carry CR or \* characters, selected by a combination of 0- and 1-impulses. If desired, special characters (.) can be used instead.

Characters CR or \* on numerical type bars will be selected by a 0-impulse, due to the identical location of a 0-character in an alphamerical type bar. The appearance

and size of both, numerical and alphamerical type bars is the same. Alphabetic characters are replaced by blank spaces, but as just mentioned, 0 and symbol characters have different positions in comparison with alphamerical bars.

Because of different studs, actuating the latch trip arm, alphamerical type bars can not be interchanged with numerical bars.

**Arrangement of Characters in the Type Bars**

Alphamerical	Numerical
Blank	0 (zero)
0 (zero)	* (or CR)
* (or CR)	
J	
A	
l	1
S	
K	
B	
2	2
T	
L	
C	
3	3
U	
M	
D	
4	4
V	
N	
E	
5	5
W	
O	
F	
6	6
X	
P	
G	
7	7
Y	
Q	
H	
8	8
Z	
R	
I	
9	9

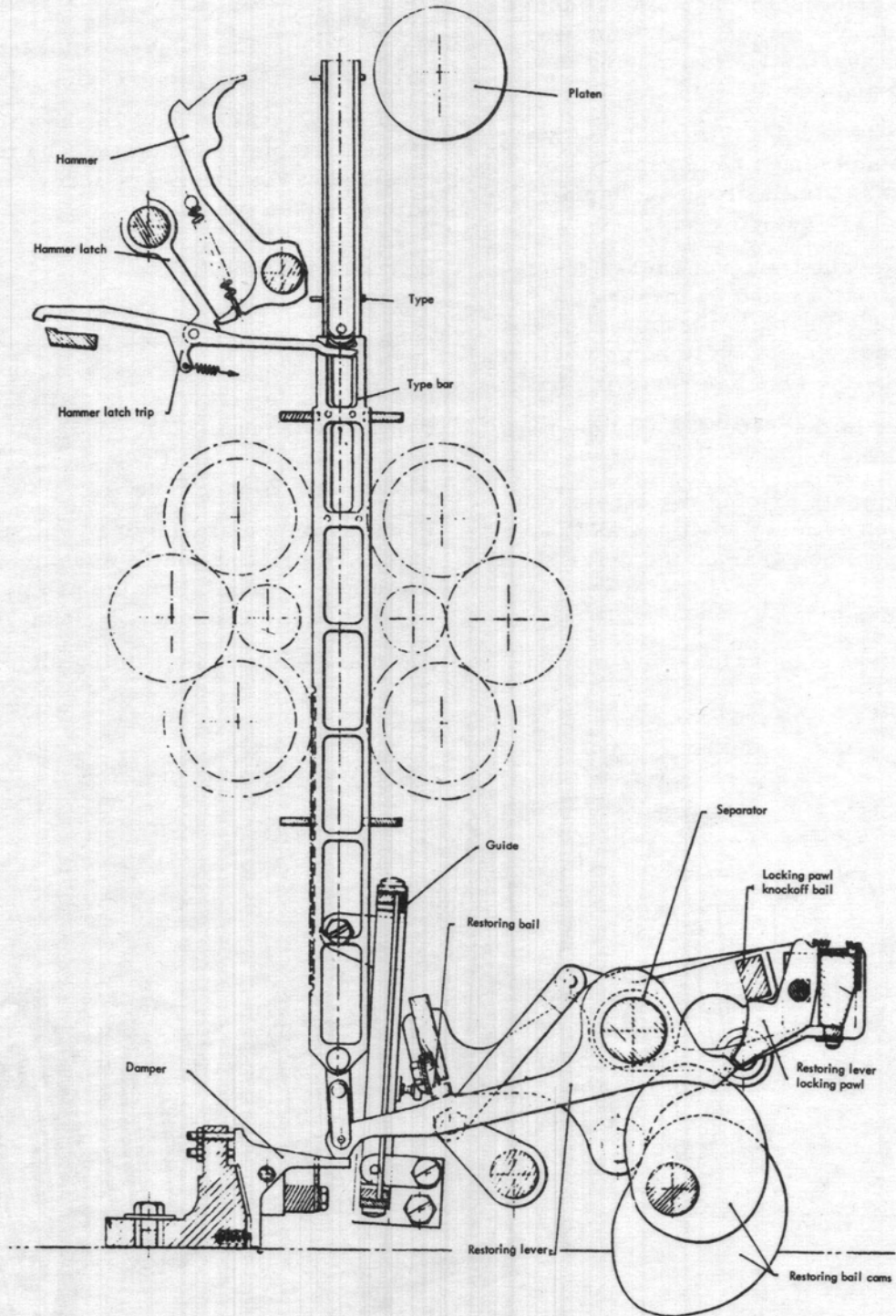


Figure 325. Printing Mechanism Type 421-9

### Printing Mechanism

In the Type 402 Alphabetical Accounting Machine the printing mechanism combines one zone unit, one magnet unit, and two type bar bail assemblies for moving the type bars up and down.

In the Type 421 and 421-9 Accounting Machines these units have been replaced by printing plates, similar to counter plates, and one type bar restoring bail.

Energizing the start magnet causes the respective type bar to rise by means of a gear on the printing plate meshing the rack on the type bar. Restoring to home position is done by the type bar restoring bail.

As a contrary in the Type 402 all type bars rise at the same time.

Each printing plate driving two type bars, represents two printing positions and is driven by a common gear on the drive shaft.

### Variable Speed Unit

The variable speed unit transmits motion

to the printing plates through the printing plate drive shafts.

The drive shafts rotate constantly in synchronism with card reading while reading the positions 9 through 1, allowing the type bars to rise 4 positions each cycle.

Figures 326, 327, and 328 show the design of the variable speed units. The index, mounted to the driving cylinder, is turning with constant speed.

### Horizontal Drive Shafts

Two horizontal drive shafts with 25 gears each are installed. Each gear is driving a single printing plate, which, in turn, moves two type bars, i.e., each shaft actuates 50 type bars (Figure 325).

### Alphamerical Printing Plates

Each printing plate driving two type bars, makes 50 printing plates assembled in each machine. 25 printing plates are positioned in front of the machine, 25 at the rear.

An idler gear on the printing plate transmits

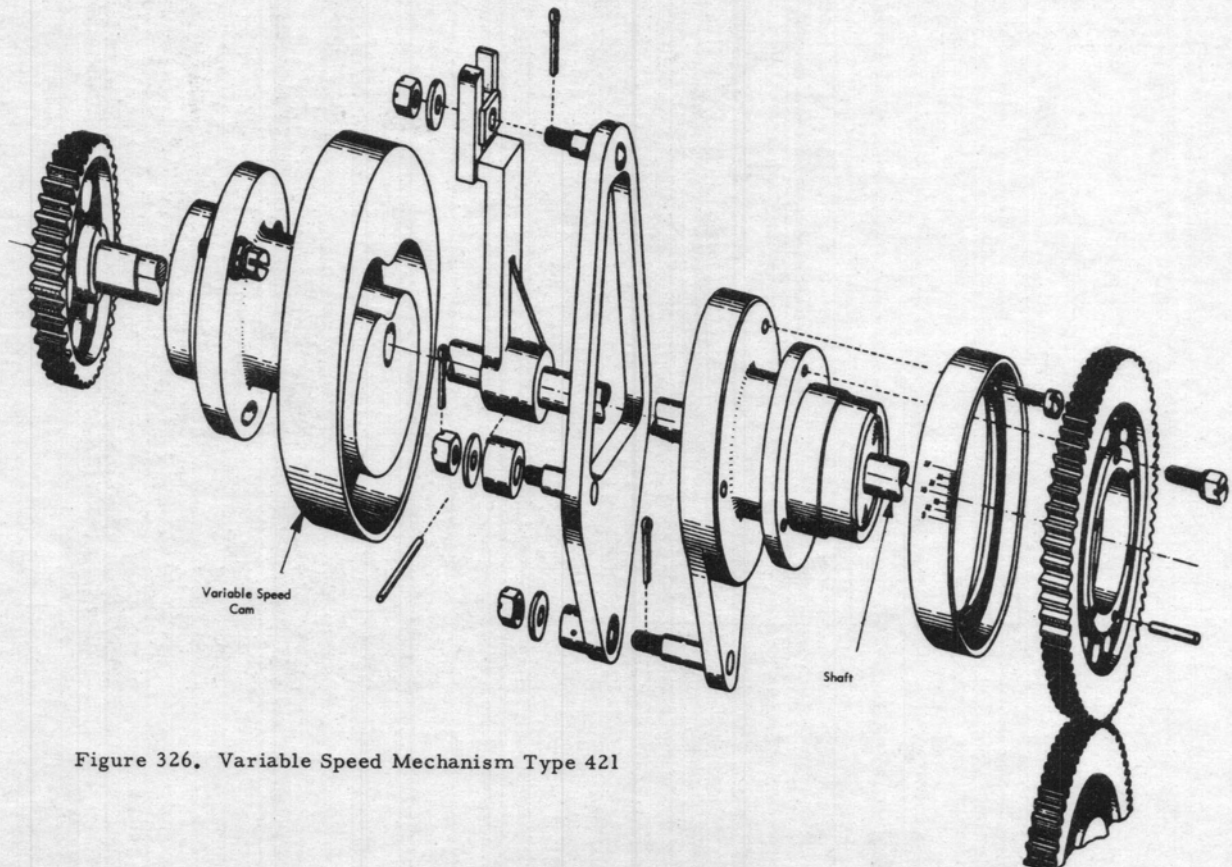


Figure 326. Variable Speed Mechanism Type 421

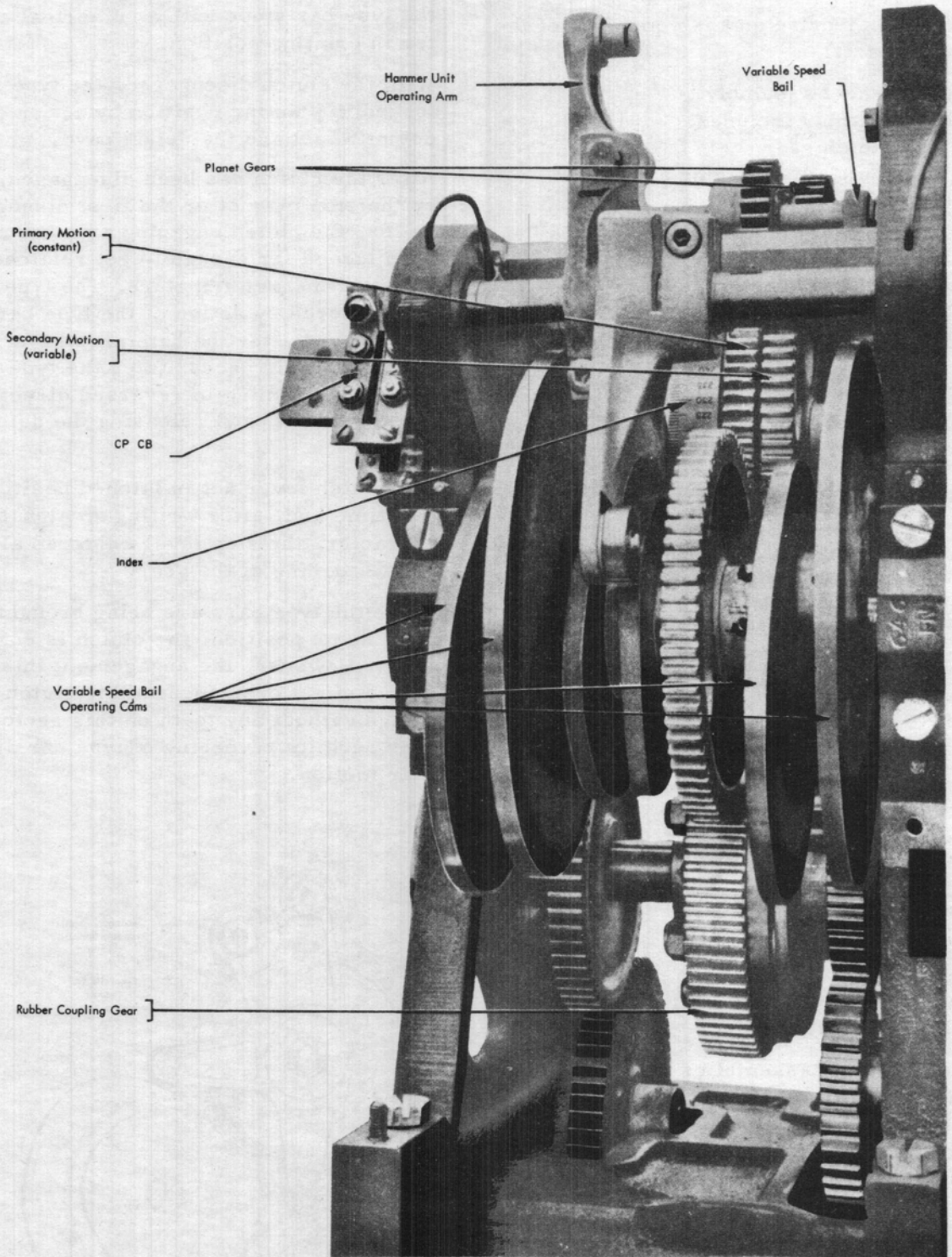


Figure 327. Variable Speed Mechanism Rear View Type 421-9

the motion from the horizontal drive shaft to the two units of the printing plate.

Each type bar drive unit is composed of the following parts:

1. Lower wheel assembly.  
This assembly includes:
  - a) the clutch gear
  - b) the clutch disengaging arm reset roller
  - c) the clutch engaging arm disengaging roller
  - d) the clutch engaging arm reset roller.
2. Drive wheel assembly.  
This assembly consists of:
  - a) the clutch gear
  - b) the brush actuating lever cam
  - c) the detent wheel
  - d) the type bar drive gear.
3. Clutch engaging arm consisting of:
  - a) the clutch engaging cam
  - b) the detent pawl
  - c) the adjustable stop.
4. Start magnet consisting of:
  - a) the armature
  - b) the armature backstop.
5. Stop magnet consisting of:
  - a) the armature
  - b) the armature backstop
  - c) the stop lever
  - d) the armature knockoff
  - e) the transfer brush assembly.

### Alphamerical Printing Plates Functional Principles

Variable speed motion to the printing plates is transmitted by the printing plate horizontal drive shafts.

The lower wheel assemblies make one revolution per cycle. Energizing the start magnet of a printing plate by an impulse 9 - 1 causes the two clutch gears to engage and the respective type bar to rise.

When the stop magnet is energized in the same cycle by reading a 0, 11 or 12 punching in the same column, the type bar is stopped by disengaging the clutch electrically. Thus, an alphabetical character is in printing position.

Did no reading of a 0, 11 or 12 zone occur,

the clutch is disengaged mechanically by means of the first disengaging roller and the type bar stops with a numerical character in printing position.

With the clutch disengaged, the type bar is locked in printing position by action of the detent wheel and the detent pawl.

After the clutch has been disengaged, either by the stop magnet or the first disengaging roller, the clutch engaging arm has not been turned far enough to get relatched on the start magnet armature. The type bars are restored by action of the type bar restoring bail after the hammers have been restored. This necessitates the type bar drive gear turning in reversed direction and the detent pawl releasing the detent gear.

The clutch lever not in latched position at this time and, after writing an alphabetical character, the stop lever restored already allows turning of the gear.

While the type bars are being brought to their home position, the clutch is engaged again. However, the engagement this time has no effect on account of the clutch disc design without any teeth on this sector. This permits reversing of type bar drive gear motion.

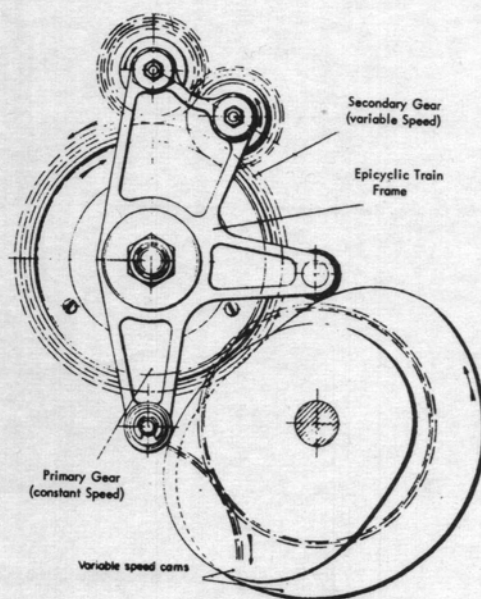


Figure 328. Variable Speed Epicyclic Train

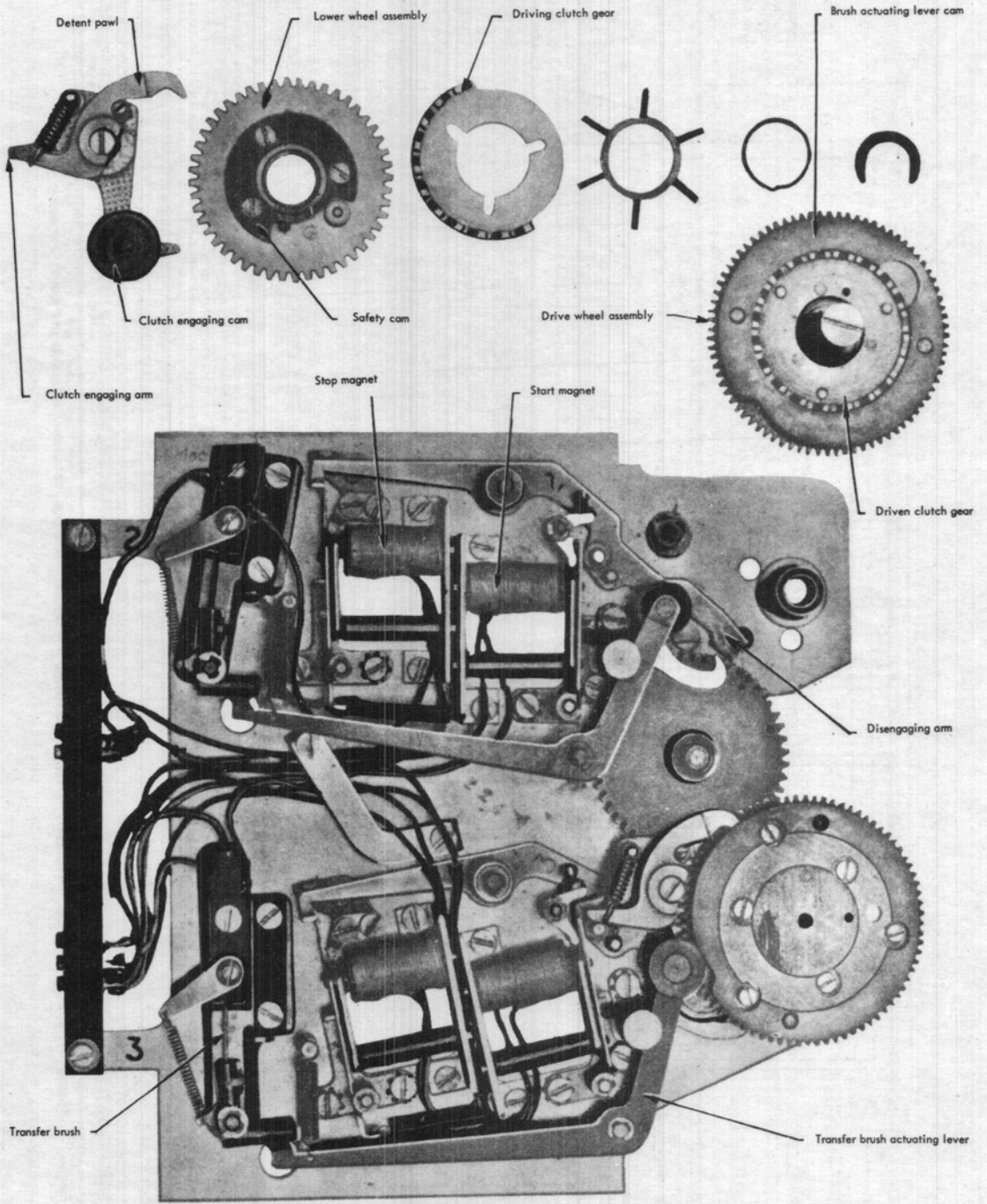


Figure 329. Alphanumeric Printing Plate

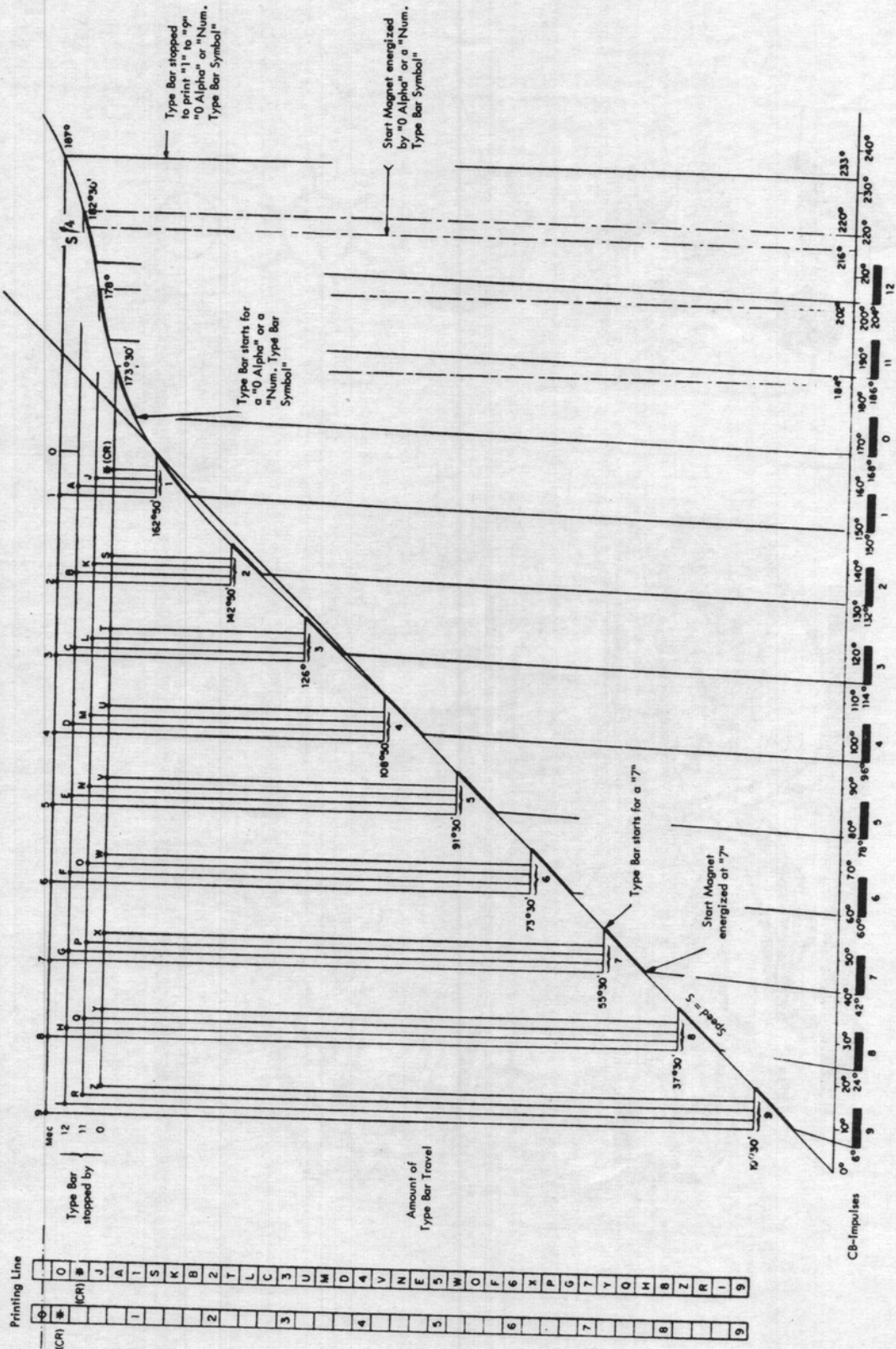


Figure 330. Printing Functional Chart

When the type bar has reached its home position, the clutch lever is relatched on the armature by action of the clutch engaging reset roller.

Using the "Printing Functional Chart" (Figure 330), the movement of the type bar under control of start and stop impulses may be followed up. It can be seen from this chart that the type bar is moving  $18^\circ$  per index point while reading the lines 9 - 4. Then the type bar is accelerated slightly and after reading line 1, the speed drops to  $1/4$ . Between cycle points 0 and 11 speed should theoretically be reduced to  $1/4$ . However, the lack of sufficient time makes this impossible, therefore, speed is raised slightly after 4 to gain time for the changeover to  $S/4$ . Thus, a smooth transfer is obtained.

#### Printing of a Letter by an alphanumerical Type Bar

Through the action of the variable speed unit, the clutch gear attached to the driven gear turns at such a speed that, when the start magnet is energized by any impulse 9 - 1, the type bar upward motion corresponds to four characters per cycle point ( $18^\circ$ ). This results in a type bar motion representing  $4^\circ 30'$  from one character to the next.

However, it will be noticed that the distance from the type bar home position to the first character is  $5^\circ 30'$ .

Owing to the decreasing speed of the variable speed unit during the cycle points corresponding to zone punchings 0, 11, and 12, at this time, the type bar rises one character only per cycle point. This motion represents  $4^\circ 30'$  on the variable speed.

Assume letter "G" (combination of holes 7 and 12) is to be printed.

1. Since a 7 is punched in the card, the clutch gear is ineffective up to the cycle point "7".
2. When hole 7 is sensed, the start magnet is energized at  $42^\circ$ .
3. The type bar starts rising at  $55^\circ 30'$  (see "Timing Chart"). This delay is due to the time required by the start magnet armature to be fully attracted

and by the clutch gears to be fully meshed. The transfer brush is actuated as soon as the type bar is started.

4. At cycle point 12 ( $204^\circ$  on the index), the 12 hole is sensed which causes the stop magnet to be energized. This requires approximately 4 ms and represents a  $4^\circ$  delay, namely  $208^\circ$  on the index.
5. At this time the clutch engaging cam is progressively pulled out from behind the clutch gear while the detent pawl reaches the bottom of the tooth.

The type bar is stopped at  $220^\circ$  on the index (timing chart) which represents  $182^\circ 30'$  of the variable speed.

6. Then the type bar has moved a total of:  $182^\circ 30' - 55^\circ 30' = 127^\circ$ .
7. Since the distance from a character to the next one is  $4^\circ 30'$  (except for the first one), this means the type bar has moved:

$$127^\circ - 5^\circ 30' = 121^\circ 30'$$

$$121^\circ 30' : 4^\circ 30' = 27$$

$$27 + 1 = 28 \text{ characters}$$

and letter "G" is brought in front of the hammer.

8. For a combination of 7 and 11, an 11 impulse (at  $186^\circ$  on the index) energizes the stop magnet and the type bar is stopped at  $202^\circ$  on the index, namely  $178^\circ$  of the variable speed.

Then the type bar has moved a total of:

$$178^\circ - 55^\circ 30' = 122^\circ 30'$$

$$122^\circ 30' - 5^\circ 30' = 117^\circ$$

$$117^\circ : 4^\circ 30' = 26$$

$$26 + 1 = 27 \text{ characters.}$$

In this case, it is letter "P" which is in printing position.

9. For a combination of 7 and 0, a "0" impulse energizes the stop magnet at  $168^\circ$  on the index and the type bar is stopped at  $184^\circ$  on the index, namely  $173^\circ 30'$  of the variable speed.

Then the upward motion of the type bar is equal to:

$$173^\circ 30' - 55^\circ 30' = 118^\circ$$

$$118^\circ - 5^\circ 30' = 112^\circ 30'$$

$$112^\circ 30' : 4^\circ 30' = 25$$

and letter "X" is brought in front of the hammer.



### Printing of a Zero by an alphanumerical Type Bar

To print a zero, the type bar is electrically started and mechanically stopped. The sequence of operation is the following:

1. The start magnet is energized at  $168^{\circ}$  on the index and the armature is fully attracted at  $172^{\circ}$ , which corresponds to  $169^{\circ}$  of the variable speed. The type bar begins to move  $12^{\circ}30'$  later (this delay is due to the time required by the clutch gear teeth to be fully meshed), namely  $181^{\circ}30'$  of the variable speed.
2. The mechanical stopping of the type bar begins at  $214^{\circ}07'$  and ends at  $233^{\circ}$  on the index, namely  $187^{\circ}$  of the variable speed.
3. Then the type bar has moved a total of:  $187^{\circ} - 181^{\circ}30' = 5^{\circ}30'$ , which represents 1 character and brings the zero character in printing position.

### Printing of a Symbol by an alphanumerical Type Bar

The symbol is located just beneath the zero

character, that is, two characters below the blank space. Combination of impulses 1 and 0 is used for symbol printing.

The sequence of operation is the following:

1. At  $150^{\circ}$ , the first impulse energizes the start magnet and the type bar starts rising at  $162^{\circ}47'$  on the index, i. e., at  $163^{\circ}30'$  of the variable speed. At the same time the transfer brush is actuated.
2. At  $168^{\circ}$  the second impulse energizes the stop magnet and the type bar is stopped at  $184^{\circ}$  on the index which corresponds to  $173^{\circ}30'$  on the variable speed.
3. The type bar has been raised:  $173^{\circ}30' - 163^{\circ}30' = 10^{\circ} = 5^{\circ}30' + 4^{\circ}30'$  or two characters, which brings the symbol in front of the hammer.

### Numerical Printing Plate (Fig. 331)

Description: For numerical printing, the type bar starts when 9 - 1 holes are sensed and is mechanically stopped. This explains the absence of stop magnet and transfer brush on numerical printing plates. Save these differences, numerical printing plates

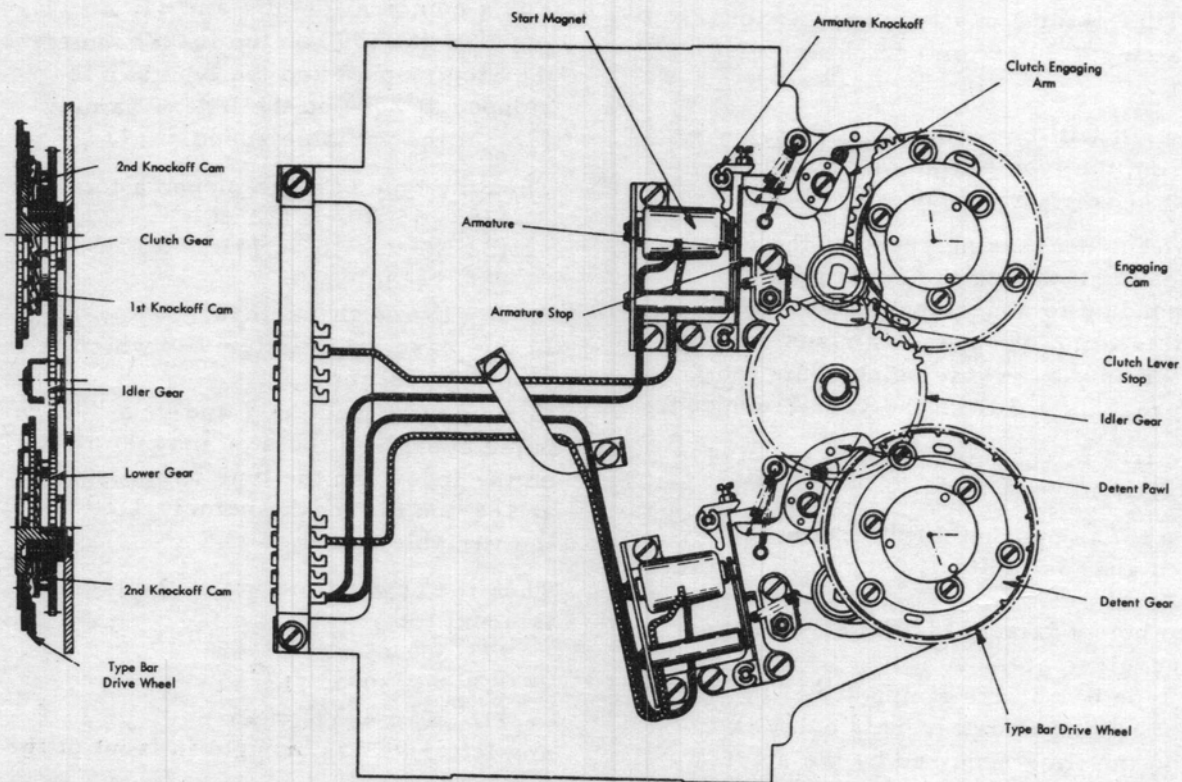


Figure 331. Numerical Printing Plate

are similar to the alphanumerical printing plates.

However, it should be noted that the detent wheel is cut into only 10 teeth corresponding to characters 9 - 1 and the symbol. The zero character is always in printing position when the type bar is at its home position.

Printing of a Figure by a numerical Type Bar

Assume a 9 is to be printed.

1. The start magnet is impulsed at  $6^{\circ}$  and the type bar starts rising at  $19^{\circ}30'$  on the index.
2. Mechanical disengaging takes place from  $214^{\circ}07'$  to  $233^{\circ}$  ( $187^{\circ}$  of the variable speed).
3. Then the upward motion of the type bar is equal to:

$$187^{\circ} - 19^{\circ}30' = 167^{\circ}30'$$

$$167^{\circ}30' - 5^{\circ}30' = 162^{\circ}$$

$$162^{\circ} : 4^{\circ}30' = 36$$

$36 + 1 = 37$  characters and the 9 character is in printing position.

Printing of a Symbol by a numerical Type Bar

The symbol is located just beneath the zero character. Hence, the type bar must rise one character to bring it in printing position. The type bar is started at the 0 cycle point and is mechanically stopped in the normal manner. This is obtained by a special wiring on the control panel.

Printing of a Zero by a numerical Type Bar

As said above, the zero character is always in printing position when the type bar is at its home position. Printing of a zero is un-

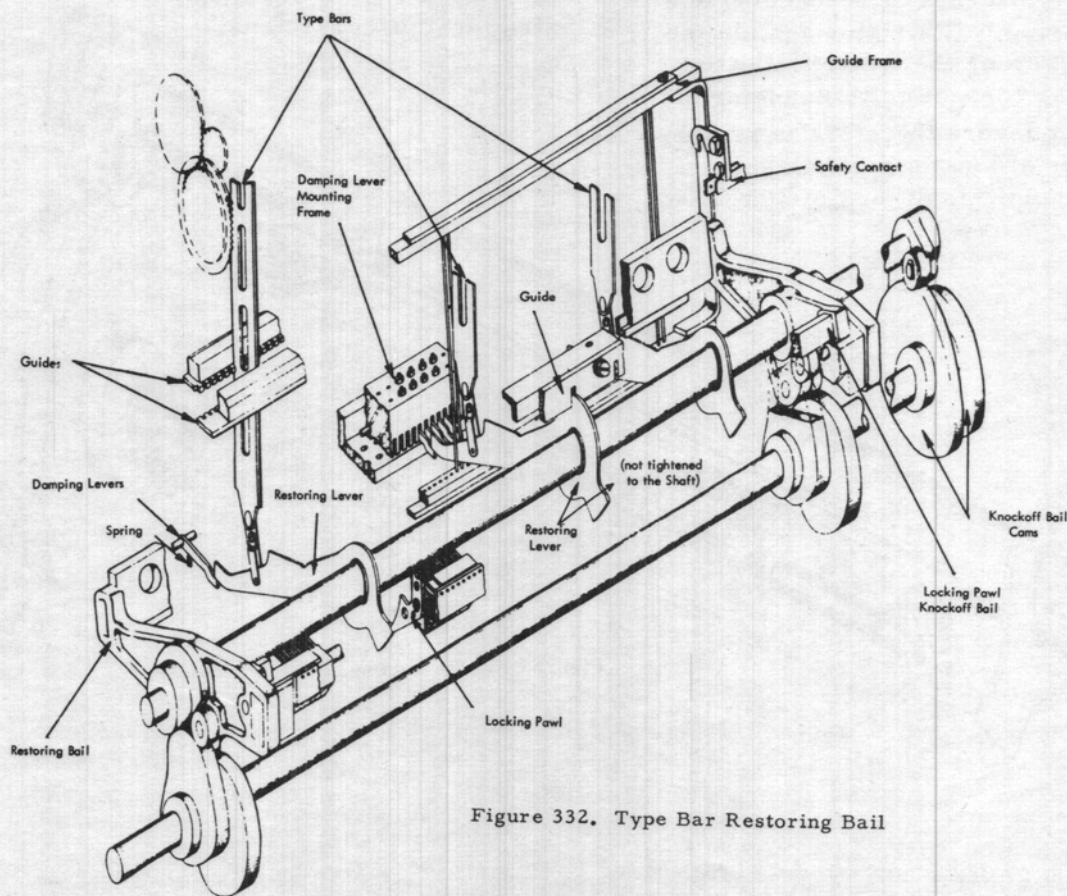


Figure 332. Type Bar Restoring Bail

der the control of the hammer split arm. This will be discussed in the "Hammer Unit" section.

#### Restoring Bail Assembly (Fig. 332)

After the hammers have been tripped at  $229^{\circ}$ , the type bars must be moved down to their home position by the restoring bail.

This unit, located at the rear of the type bars, is operated by 4 cams pinned to each side of the restoring bail shaft. This shaft turns with constant speed.

To avoid interference in type bar upward motion, the bail rises at a higher speed than the type bars (between  $0$  and  $177^{\circ}$ ).

The restoring levers rock freely on the same shaft and are vertically guided in a guide frame.

#### Restoring Lever Locking Unit

The type bars being restored with high speed have a tendency of rebounding due to the restoring bail striking against the restoring lever or the type bars hitting the dampers, respectively. Bouncing of the restoring levers therefore is prohibited by a special locking mechanism. This mechanism, composed of 100

locking pawls rocking individually on a shaft, is operated by cams on the restoring shaft and a bail.

#### Restoring Lever Dampers

These dampers prevent bouncing of the type bars while restoring in home position. The dampers further determine the overlap at starting time between the printing plate clutch wheels and need great care in adjusting.

Zero print positioning of numerical type bars is controlled by the restoring lever dampers, too. This unit is composed of 100 dampers under spring pressure, mounted on the same shaft.

#### Hammer Unit

The hammer unit, composed of 100 hammers, resembles the design of the 402 hammer unit.

Short hammerlock levers mounted on a rigidly fastened bar prevent, in lifted position, the hammers from striking the characters.

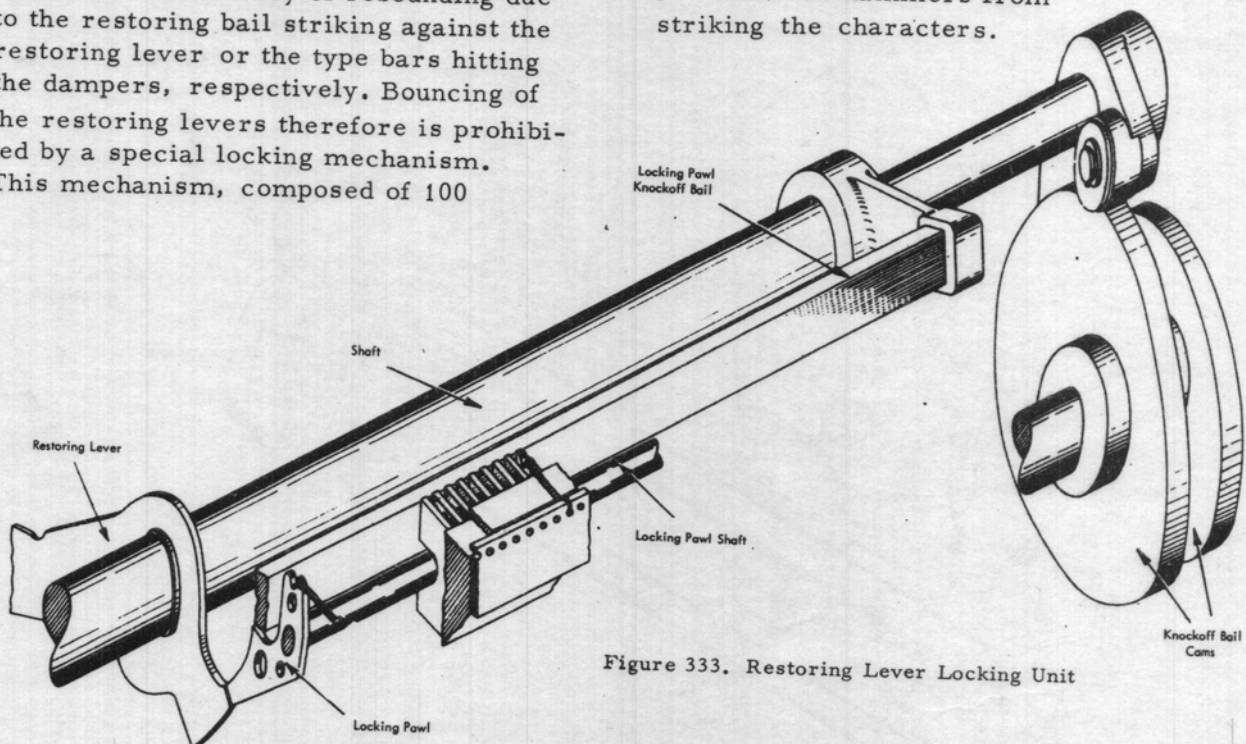


Figure 333. Restoring Lever Locking Unit