PRINTING MECHANISMS

PRINTING is one of the most important functions of IBM Data Processing Machines. It is through the medium of printing that the finished products of the Data Processing Method of Accounting are produced. These products are printed reports and document forms which are required by the customer for the efficient operation of his business. He is vitally interested in the quality and legibility of the printing on these forms because many of them, such as statements, invoices and shipping notices are placed in the hands of his own customers.

The Data Processing Machines provide the quality and legibility desired. There are many factors which contribute to satisfactory printing results. A number of these are listed below:

1. Paper — its texture and ability to receive the inked type impression clearly and sharply.
2. Ribbon — affects the clearness of printing.
3. Carbon paper — determines legibility of carbon copies and is particularly important when numerous copies are required.
4. Impression — affects the quality and legibility of the printed character. Impression is affected by the impact or pressure of the type against the paper, and also by the hardness of the platen.

In addition to the above, an important factor is the design and type of the printing mechanism. It is with this principle that this chapter will deal primarily.

Printing Systems

Books, magazines and newspapers are commonly produced by letterpress printing, in which the ink is carried by the raised portions of type. Similarly, typewriters and accounting machines produce their results by pressure from the raised surfaces of type. In the printing of books, the individual type pieces required to make up each page are usually set up in a form. These forms are placed in a printing press which produces the desired quantity of printed pages. In the adaptation of printing to typewriters, adding machines, desk calculators, electric accounting machines, etc., the methods differ because the setup changes with each printing operation. A selecting mechanism is provided to select the individual type characters which are to be printed. To accomplish this, two distinct systems are employed; serial and parallel printing.

Serial Printing

The typewriter is an example of the serial printing system. The characters are individually selected and printed one character at a time, on the printing line. Immediately following the printing of each character, the paper is moved to the left by a carriage, positioning the paper to receive the printing of the next character.

Parallel Printing

This method of printing is used generally on desk calculators, adding machines and IBM Data Processing Machines. The mechanism used consists of groups or banks of type bars, wheels or sectors, in parallel arrangement. Each of these carries a full complement of numerical characters, or numerical and alphabetical characters. During the selection or setup portion of the operation, the desired character in each type bar or wheel is selected and positioned at the printing line. At a definite time later in the cycle of operation all of the type characters are pressed against the paper simultaneously. Thus an entire line is printed at the

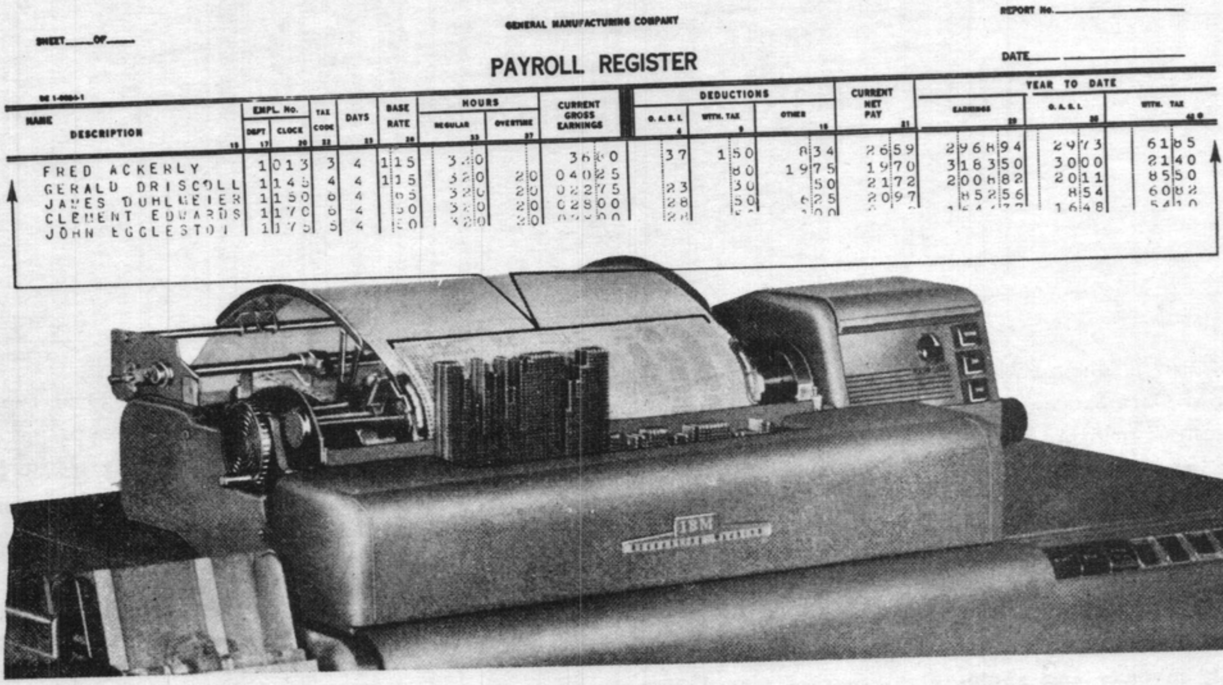

Figure 184. Parallel Printing

same time, as seen in Figure 184. The chief advantage of the Parallel System is the printing speed factor. Because it prints a complete line at once, it is capable of a greater output than the series system.

Components of an IBM Printing Mechanism

Figure 185 shows the basic components of an IBM printing mechanism combined to perform a printing operation. The type, hammer and control mechanism may vary and differ in size, shape, and design as they are adapted to a machine to form a specific printing mechanism, but they will perform the same function in all units.

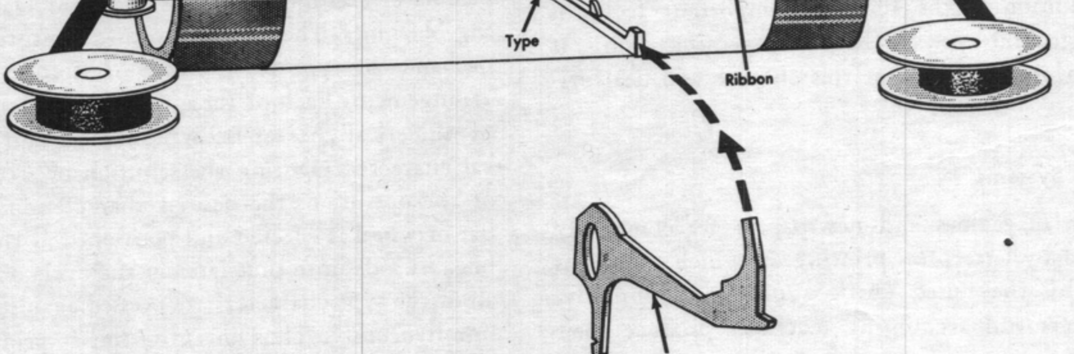

Figure 185. Basic Components of an IBM Printing Mechanism

TYPE 402 PRINTING MECHANISM

Numerical Type Bar

Some knowledge of the construction of a type bar is necessary before the operation of the type bar can be fully understood. The Type 402 Machine has two different kinds of type bars; numerical and alphamerical.

Figure 186 shows the numerical type bar found in the type 402 machine. The type bar holds 11 pieces of type. The piece of type in the top position can be one of two characters, either a credit symbol (CR) or an asterisk (*): These two pieces of type are used

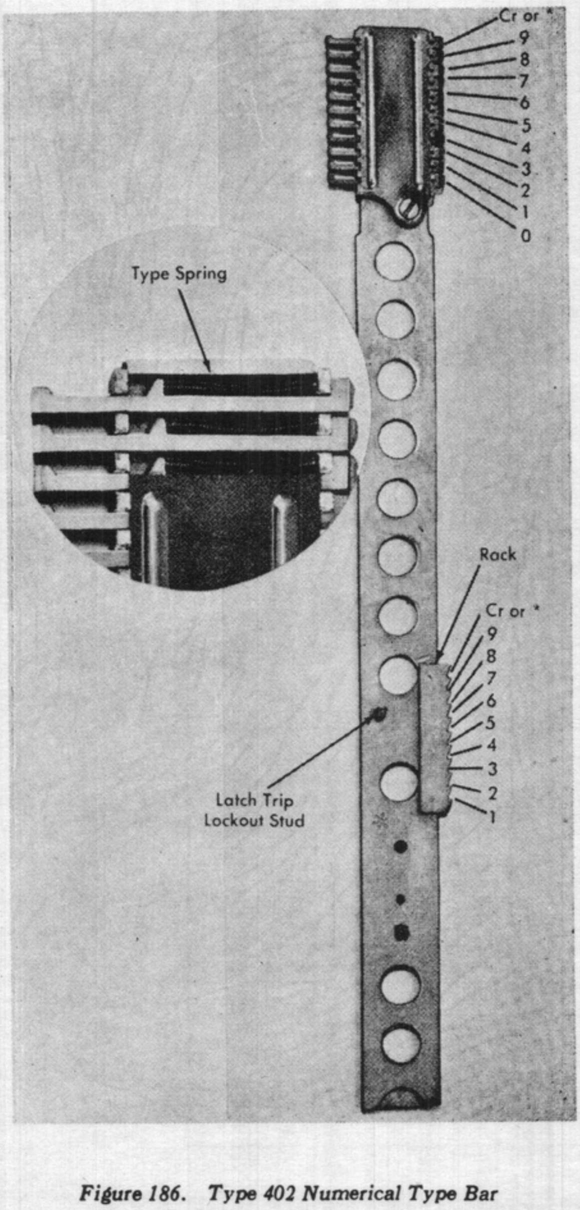

Figure 186. Type 402 Numerical Type Bar

to identify totals, and are located in alternate type bars (for example, all even numbered type bars will have a CR symbol while all odd numbered type bars will have an *). The other ten pieces of type are the ten numerical digits (9 through 0). Each piece of type is free to move independently and each has its own spring to return it after the hammer strikes it.

There are ten teeth on the numerical type bar, one for each piece of type except zero. The type bar will be stopped by the tooth corresponding to the digit to be printed. If it is not stopped by a tooth, it will be stopped in the zero position. The distance between the lands of the teeth is equal to the distance between centers of adjacent pieces of type.

Type Bar Synchronism

As the type bar moves up to print, it is stopped by a stop pawl which is under the control of a magnet (print magnet). The print magnet is generally impulsed as a result of a brush sensing a hole in a card. The type bar must move in synchronism with the card so that the type bar will be accurately stopped in a predetermined position. Figure 187 shows a numerical type bar being set up to print a 5.

The 402 and 405 machines, which use this type bar, are both 20 cycle point machines. This results in 18° per cycle point which signifies that the card requires 18° to move from one position on the card to the next. It also indicates that the type bar must move a distance equal to the distance between lands in 18°. Both machines feed a card 9-edge first, so the 9-type is located above the other numbers on the bar. In Figure 187, the type bar and card are shown at 81° on the index when the brush is reading a 5-hole. The hole is sensed and the print magnet is energized to release the stop pawl. The stop pawl is not directly opposite the land of the 5 tooth. Actually the type bar has moved so that the land of the 6 tooth is 3° past the stop pawl; thus the type bar must move 15 more degrees before being stopped by the 5 tooth. This arrangement is necessary to allow the pawl time to swing in to engage the tooth. It can be seen that the next tooth that can engage the stop pawl is the 5 tooth and a 5 will be positioned to print. However, to be sure the pawl does not engage the 6 tooth, the print magnet is not energized until after the stop pawl is beyond the 6 tooth. The distance (3°) that the stop pawl overlaps the 6 tooth is called list lap.

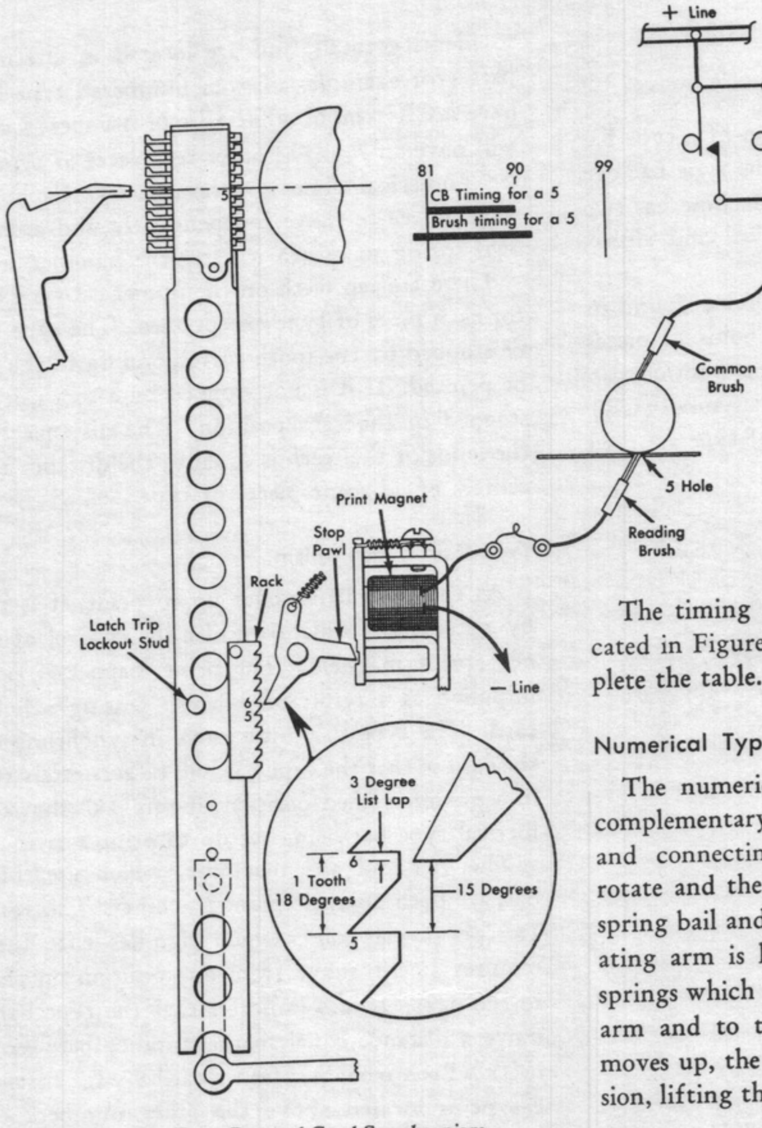

Figure 187. Type Bar and Card Synchronism

The timing for a CR or * and a 5-hole are indicated in Figure 188. Fill in the other spaces to complete the table.

Numerical Type Bar Bail Assembly

The numerical type bar bail is operated by two complementary cams through a forked cam follower and connecting link (Figure 189). As the cams rotate and the connecting link is raised, it raises the spring bail and the restoring bail. The type bar operating arm is held against the restoring bail by the springs which are connected to the type bar operating arm and to the spring bail. As the restoring bail moves up, the type bars are raised by the spring tension, lifting the operating arm. Note that as the type

Hole in card	Brush makes at	CB's makes at	CB's breaks at	TB stop at
Cr or *		351 degrees	360 degrees	6 degrees
9				
8				
7				
6				
5	77-78½ degrees	81 degrees	90 degrees	96 degrees
4				
3				
2				
1				
0				

Figure 188. Type Bar Table

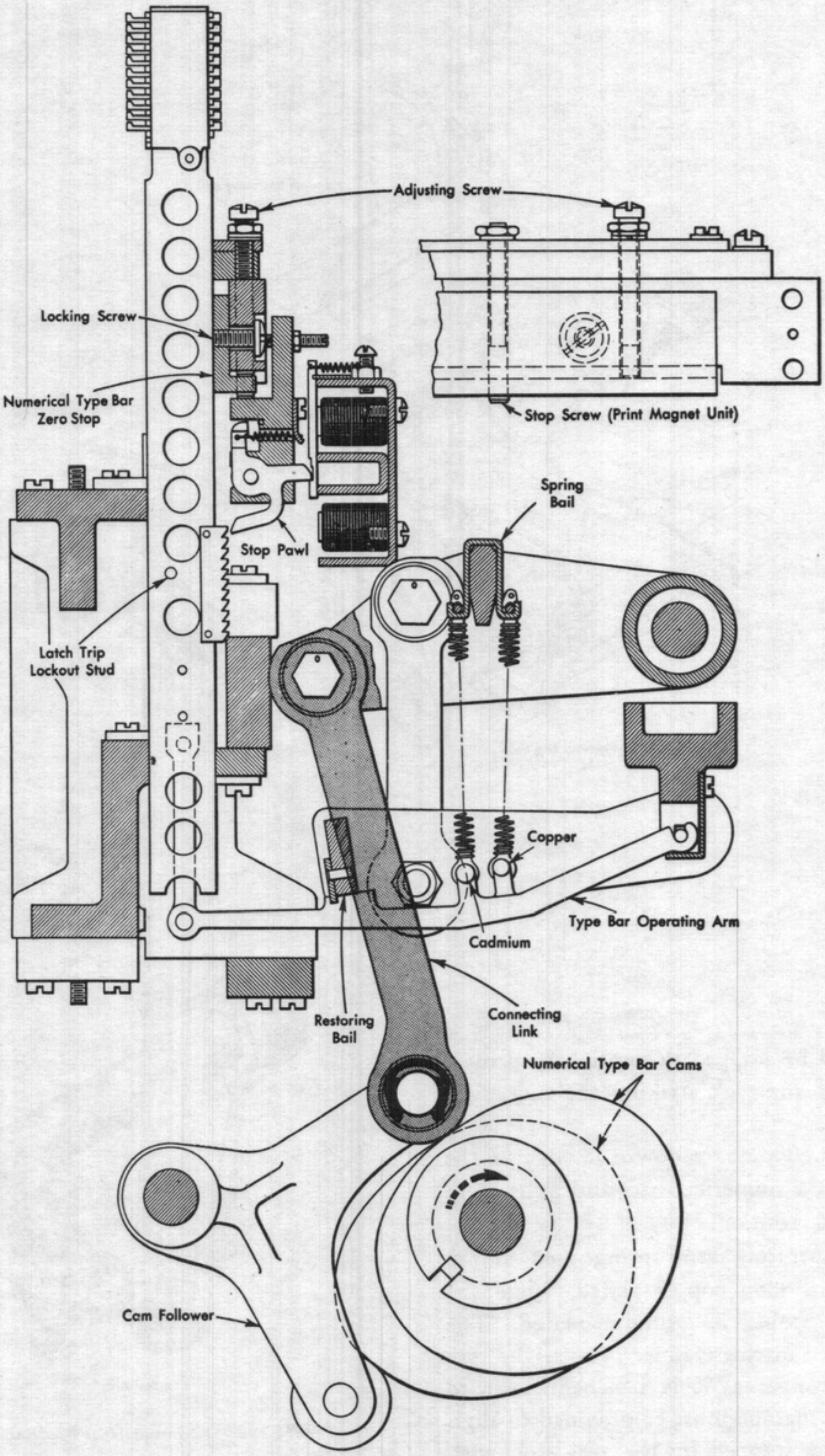

Figure 189. Numerical Type Bar Bail Assembly

bars move up, the spring bail also moves up so that the spring tension is not lost. If the type bar is stopped by a stop pawl, it will be held against the stop pawl by the spring tension which will increase as the restoring bail and spring bail continue to move upward. If, however, the type bar is not stopped by

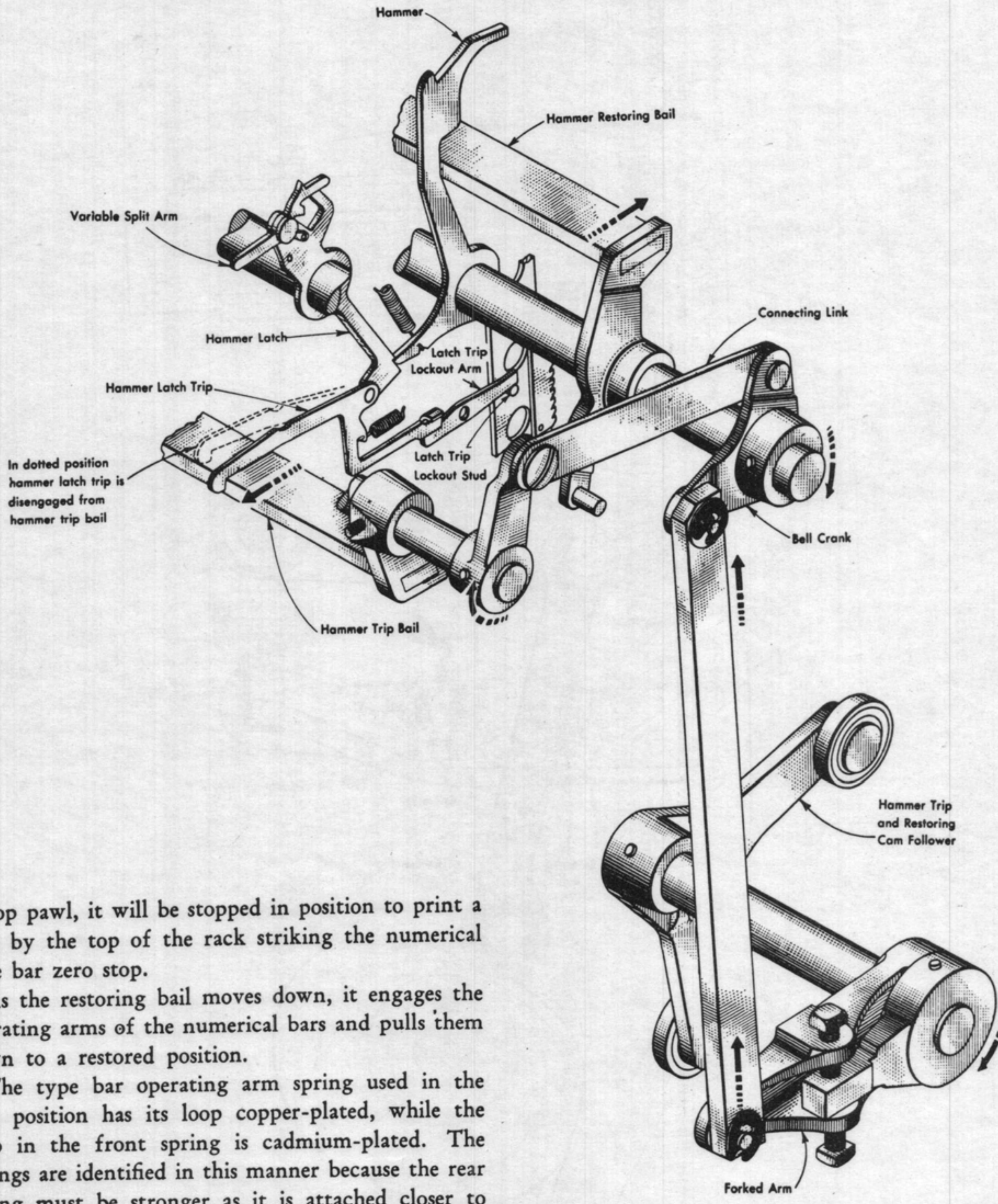

Figure 190. Hammer Unit Mechanism

a stop pawl, it will be stopped in position to print a zero by the top of the rack striking the numerical type bar zero stop.

As the restoring bail moves down, it engages the operating arms of the numerical bars and pulls them down to a restored position.

The type bar operating arm spring used in the rear position has its loop copper-plated, while the loop in the front spring is cadmium-plated. The springs are identified in this manner because the rear spring must be stronger as it is attached closer to the pivot point. A method must be provided to align the type in the bars stopped by the zero stop with that in the bars stopped by the stop pawls. The print magnet and stop pawl position is fixed so the numerical type bar zero stop is made adjustable up and down to align the top and bottom of the zeros with the other characters (Figure 189). A good test for this alignment is to have zeros and eights in alternate type bars (8080808), although any character, such as CR or 1, that can be aligned both top and bottom with the zero will be satisfactory.

Hammer Unit Assembly

The hammer unit assembly is designed to print the information which is set up in the type bars. The hammers are released at approximately 196°, after all type bars have been correctly positioned for printing. The hammer unit assembly also restores the hammers so that they are clear of the type before the bars begin to move down.

Figure 190 shows the hammer unit mechanism. The hammer is being held by a latch while the hammer spring is attempting to rotate the hammer in a clockwise direction. The hammer will be held by the latch until 196° when the latch is pulled away. Then the hammer is free to rotate and strike the tail of a piece of type.

The hammer unit mechanism is operated by two complementary cams and cam followers which cause the forked arm and the bell crank to operate. The arrows in the figure show the direction of movement as it approaches 196° (hammer firing time). The hammer restoring bail is moving away from the hammers so the hammers will be free to fire. The hammer trip bail is moving to the left pulling the hammer latch trip with it. The hammer latch trip is connected to the hammer latch which is pulled clear of the hammer permitting the hammer to fire.

The mechanism is then restored and the direction of movement is opposite the direction indicated by the arrows. The restoring bail pulls the hammer back and the hammer trip bail permits the latch to snap over the hammer, relatching it.

The procedure described above is the same for all positions set up to print anything other than a zero. If a type bar rises until stopped by the zero stop, the latch trip lockout stud strikes the latch trip lockout arm. The turned over ear on the latch trip lockout arm will pull down on the hammer latch trip. This will lift the end which is hooked over the hammer trip bail clear of the bail (Figure 191). The hammer trip bail will not pull the hammer latch trip to

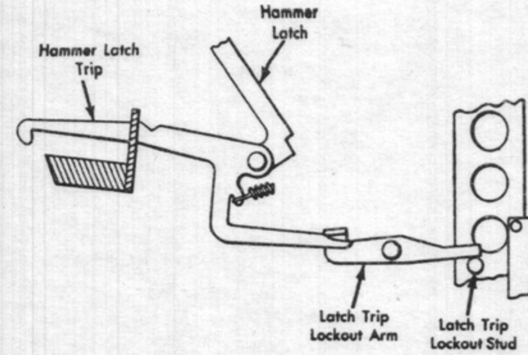

Figure 191. Hammer Latch Trip Locked Out

free the hammer as it moves to the left. As a result, the hammer in that position will not be tripped in the normal manner.

It is desirable not to automatically fire hammers in positions which have zeros set up, because it would result in all numerical type bars printing zeros. As a result, the report printed would be hard to read. Figure 192 shows what a numerical report would look like if zeros printed automatically. It is important, however, to print zeros which are to the right of a significant digit; for example, in the number 1001 the zeros should print. Variable split arms are provided to control the printing of zeros to the right of significant digits.

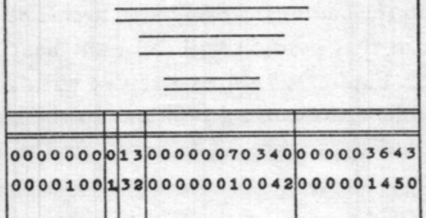

Figure 192. Report Showing All Zeros Printing

Variable Split Arm

In Figure 190, note that anything which causes the hammer latch to pivot in a clockwise direction will cause the hammer in that position to fire. From Figure 193 it can be seen that at the top of the hammer

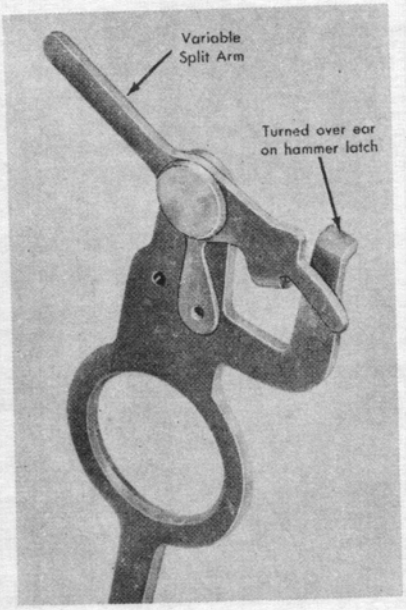

Figure 193. Hammer Latch and Variable Split Arm

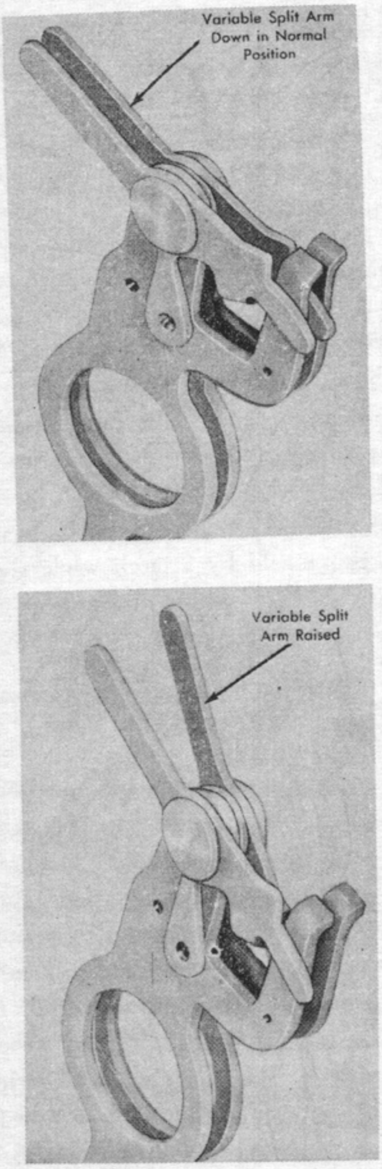

Figure 194. Two Variable Split Arms — Lowered and Raised

latch a variable split arm is attached and the hammer latch forms another arm with a turned-over ear. It should also be noted that there is a projection on the variable split arm. When the hammer latches are placed side by side, the turned-over ear on the latch is directly in front of the projection on the variable split arm in the adjacent position (Figure 194). If the hammer latch in the back is rotated to release its hammer, the variable split arm moves forward. The projection on the variable split arm strikes the turned-over ear on the hammer latch in the front causing it to move forward. The latching portion will be moved away from the hammer causing it to fire. The variable split arm in that position will cause the next position to fire, etc. Figure 195 shows a report with all of the variable split arms causing positions to the right of a significant digit to fire. The zeros on the extreme left side of the page did not print but all others did. However, this is not completely satisfactory because in all fields, except the first, zeros were still printed to the left of a significant digit. The variable split arms are made so that the tail of the arm can be raised by the operator. This lowers the projection so that it will pass under the turned over ear and not fire the adjacent hammer (Figure 194). If the variable split arm is raised in the units position of each field, it will not fire hammers in the field to the right. The same report shown previously is repeated in Figure 196 with the variable split arms raised in the units position of each field.

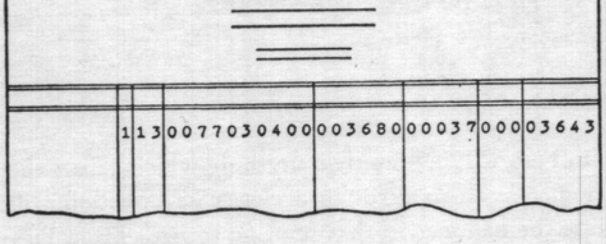

Figure 195. Report Showing All Zeros Printing After the First Significant Digit

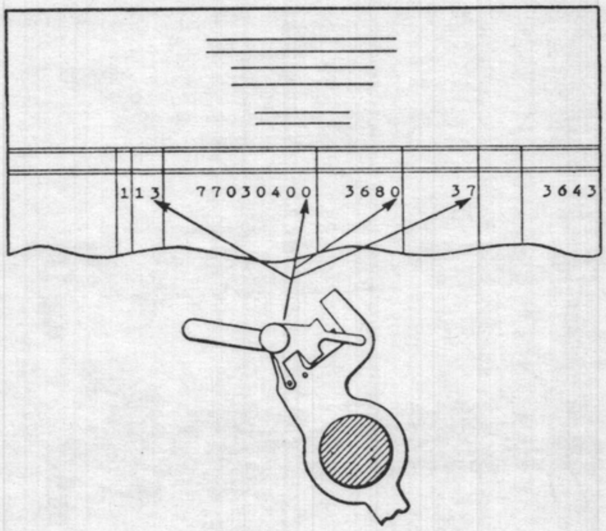

Figure 196. Report Showing Zeros Printing Only After the First, Significant Digit in Each Field

Hammerlock Assembly

The hammers can be prevented from firing in another manner, even though a significant digit might be set up to print. Hammers may be controlled by a hammerlock assembly, which is located on top of the hammer unit. For each hammer there is a hammerlock spring, short hammerlock lever, and a long hammerlock lever. All of these parts are mounted on a hammerlock bar. Figure 197 shows the position of the hammerlock spring in relation to the hammer when either of the hammerlock levers is raised.

The hammerlock spring is a leaf spring which prevents the hammer from firing when it is down far enough to engage the notch in the top of the hammer. The hammer will be prevented from firing anytime the short hammerlock lever is raised. If the long

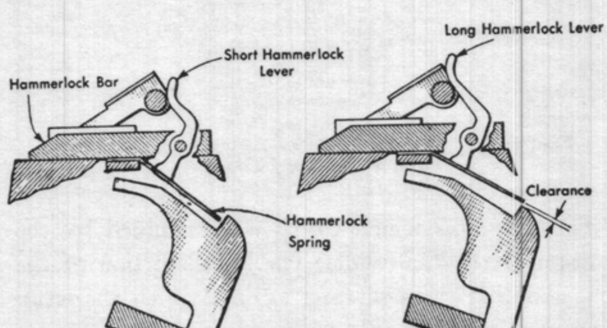

Figure 197. Hammerlock Assembly

hammerlock lever is raised, it can be seen from Figure 197 that the hammerlock spring does not move down far enough to prevent the hammer from firing. However, the hammerlock bar to which all the hammerlock springs are attached, is supported by a hammerlock magnet armature through a link and armature arm. When the hammerlock magnet is energized, the hammerlock bar will be lowered. The positions where the long hammerlocks are raised will have the hammers blocked. The magnet is controlled by control panel wiring to suppress printing certain information or all except certain information.

The hammer will be released by the latch to fire regardless of the hammerlock springs. The springs only prevent the hammer from continuing forward to strike the type.

Alphamerical Type Bar

The alphamerical type bar is designed to print both alphabetical and numerical characters. Figure 198 shows the construction and nomenclature of an alphamerical type bar. There are 38 pieces of type, 26 alphabetical characters, 10 numerical characters, one special character (&), and one extra zero. There are ten lands on the lower section (one for each numerical character). The type bar is stopped in the same manner as the numerical bar. When a hole is read, the print magnet is energized and the stop pawl swings in to engage one of the ten teeth and stop the type bar. In this manner the type bar will print numerical information just as the numerical type bar did. However, it is also desired to print alphabetical information from the same type bar.

An alphabetical character is a combination of two punches, a zone punch and a numerical punch, in the same column. All characters which can be printed by the type bar are divided into four zones: numerical zone, 12 zone, 11 zone, and 0 zone, as follows:

Numerical Zone	12 Zone	11 Zone	0 Zone
1	A	J	
2	B	K	S
3	C	L	T
4	D	M	U
5	E	N	V
6	F	O	W
7	G	P	X
8	H	Q	Y
9	I	R	Z

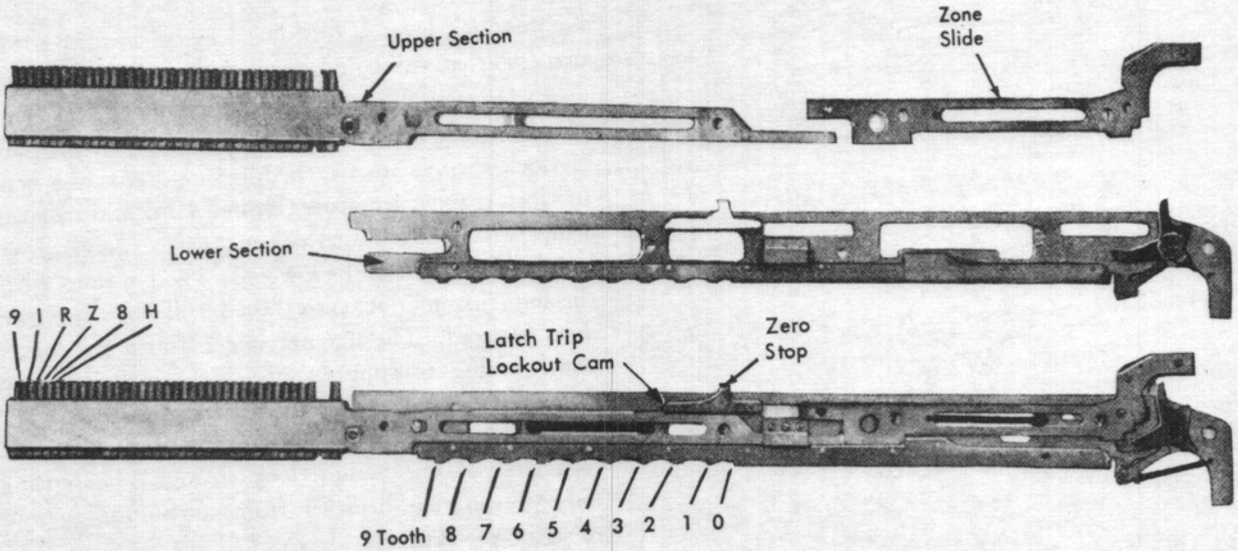

Figure 198. Type 402 Alphamerical Type Bar

Note that there is no 0-1 combination; with 26 letters in the alphabet, this combination was not required and for circuit reasons it is desirable to eliminate this combination.

The zone information must be mechanically combined with the numerical to set up the type bar properly. The spaces between the lands of the teeth are more widely spaced than those on the numerical type bar. This is because, for the numercial portion of an alphabetical character, one of these teeth will stop the type bar, but when zones are combined there are generally three more characters possible and space must be allowed for them between the numerical type. The type is grouped according to the numerical portion of the character. Starting at the top of the type bar, the first type is a nine, because the card is fed 9-edge first, and the type bar moves in synchronism with the card. The character directly beneath a numerical character is that number combined with the 12 zone, in this case an I. The next character will be that number combined with an 11 zone, or in this case an R. Then the Z type which is a 9 combined with a 0 zone. Sequence of remaining type can be determined using the same sequence and the combinations shown above.

The type bar is composed of three major parts: the upper section, the lower section and the zone slide. The upper section is held down against the zone slide by spring tension. When the type bar is not zoned, the zone slide rests against a shoulder on the lower section. With the zone slide and upper section in this position, if the type bar is stopped by the five tooth, a numerical 5 will be positioned to print. However, if a type bar is stopped by the five tooth, there are four possible characters which may be printed: 5, E, N, or V (Figure 199).

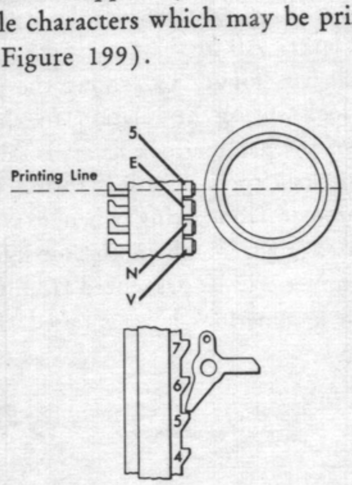

Figure 199. Four Characters Possible with Type Bar Stopped by the 5 Tooth

The character which prints is determined by the position of the zone slide. The lower portion of the zone slide has three surfaces against which the setup pawl may rest. These correspond to the three zones which can be read from the card. If the type bar zone slide and upper section is raised so that the setup pawl rests in the first notch, or 12 zone, it will print

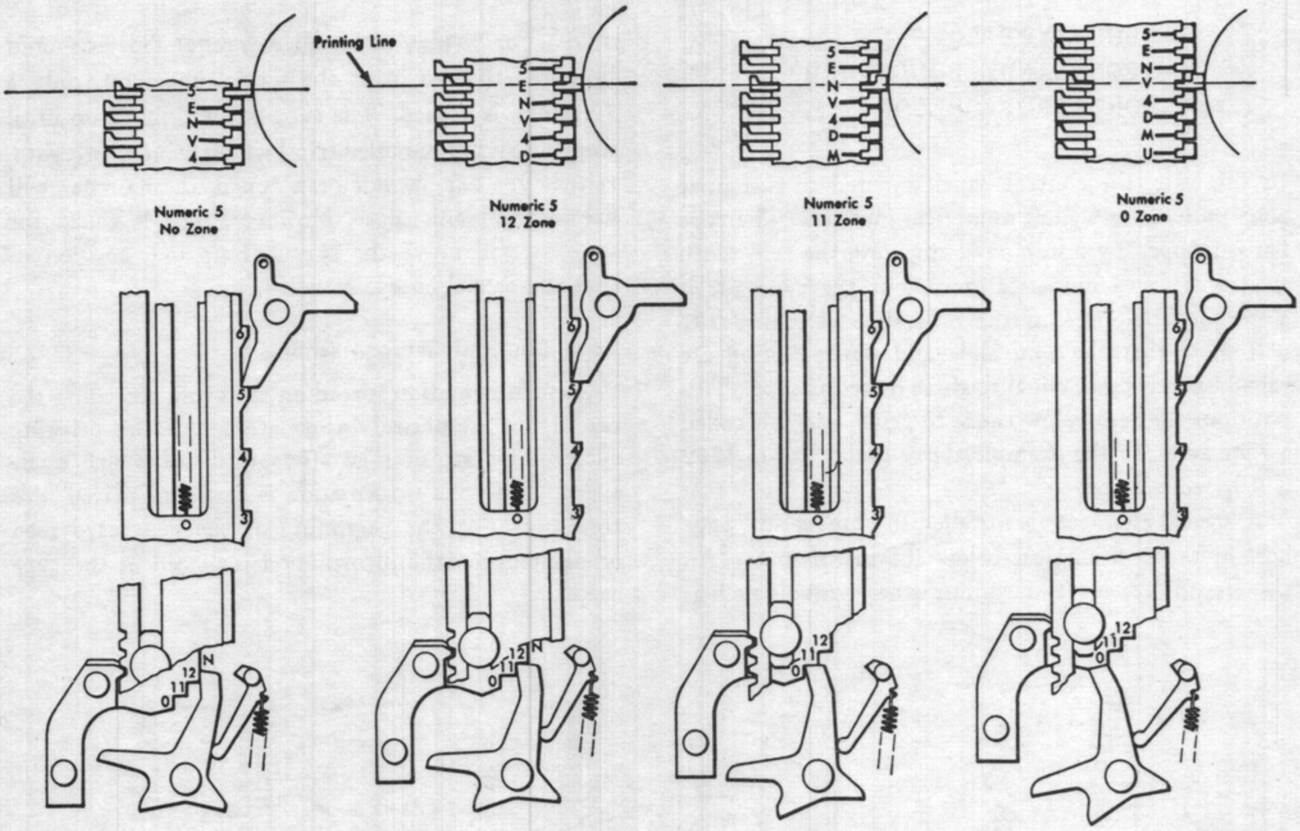

Figure 200. How the 5, E, N, and V Are Each Positioned to Print

an E rather than a 5. The movement of the zone slide from one step to the next moves the upper section a distance equal to the distance between centers of adjacent pieces of type. Figure 200 shows the position of the setup pawl, zone slide, lower section, and upper section for a 5, E, N and V.

The distance between the one tooth and the zero tooth is less than the distance between the other teeth. This is because there is no 0-1 combination and a space is not required there. Since the zero was placed directly beneath the J, the land was moved up the distance equal to one type position, to properly position the zero to print.

If an alphamerical type bar is permitted to rise to the limit of its travel (not stopped by a stop pawl), it will be stopped by the latch trip lockout cam—zero stop. The blank position will be on the printing line in this case. The alphamerical type bar does not stop at zero as the numerical bar does because in printing names, addresses, and other alphabetic data, spaces occur between words, and the columns in which this occurs vary from line to line. The hammers will be fired in columns where the spaces occur because of the variable split arms causing hammers to the right of significant information to fire. If a zero, rather than a blank is set up, a zero will print instead of leaving a space. It is not practical to raise the variable split arm to prevent this, because on subsequent lines a zero may be in that column, and the hammer must be fired by the position to the left.

A zero punched in a card is unique in that it can represent either a number (zero) or a zone (zero zone). If the control panel is wired for numerical information only, and a zero is read from a card, the type bar will be positioned as shown in Figure 201. The type bar is stopped by a stop pawl engaging the zero tooth; the type bar will not be zoned because the control panel is not wired to recognize zones. A zero will be positioned to print; this is called a numerical zero (the zero directly beneath the J).

There are many occasions when an alphamerical type bar will print both numerical and alphabetical information, as in printing a name and address:

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SLUG TYPE COMPANY
1200 SANDY BOULEVARD
PORTLAND, OREGON
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In this case, the control panel is wired to recognize zone punches as well as numerical punches. The type bar is stopped by a stop pawl engaging the zero tooth as it was for a numerical zero, but the type bar is also zoned. A check of the zone slide in Figure 201 will show that the zone slide and upper section are raised by a distance equal to three pieces of type. This positions the zero below the & to print, and it is called a zone zero. In the example above both zeros in 1200 will be zone zeros.

A special character is installed in alphabetical type bars in the position just below the blank space. An ampersand (&) is standard, but other symbols such as $, @, –, or % may be installed as requested. It should be noted that to print the special character, only a 12 punch is needed. The type bar will move up until stopped by the hammer trip lockout cam—zero stop. If the type bar has not been zoned, the hammer will fire in the blank space. However, if it is zoned for a 12, it will move the type bar up one position so that the special character will print.

Zone Bar and Setup Mechanism

Zone information is read on the cycle preceding the reading of numerical information and the printing cycle. This requires two sets of brushes one cycle apart. The zone information is read and placed in a zone unit. At the beginning of the next card feed or print cycle, the information is placed in the type bar.

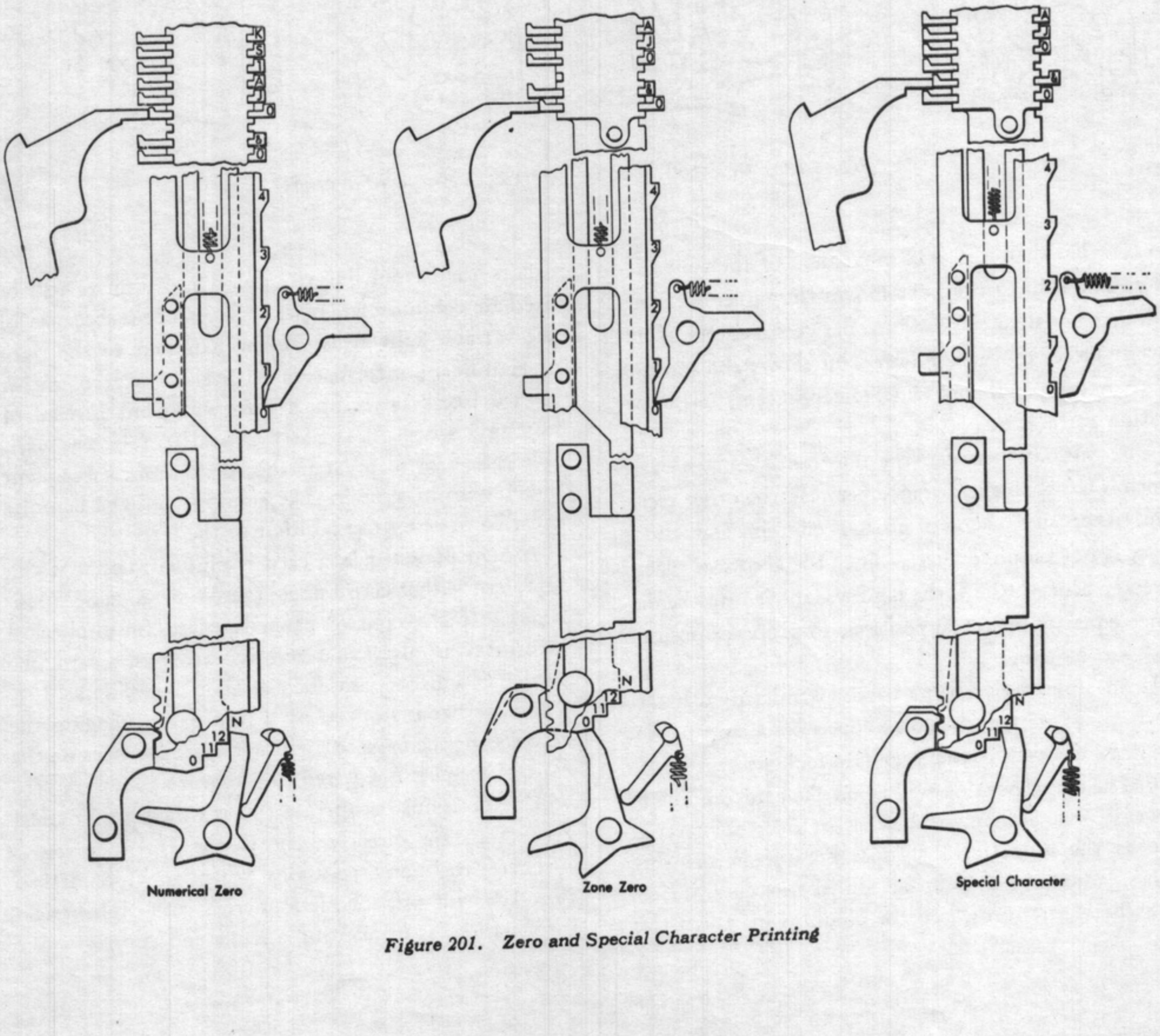

Figure 201. Zero and Special Character Printing

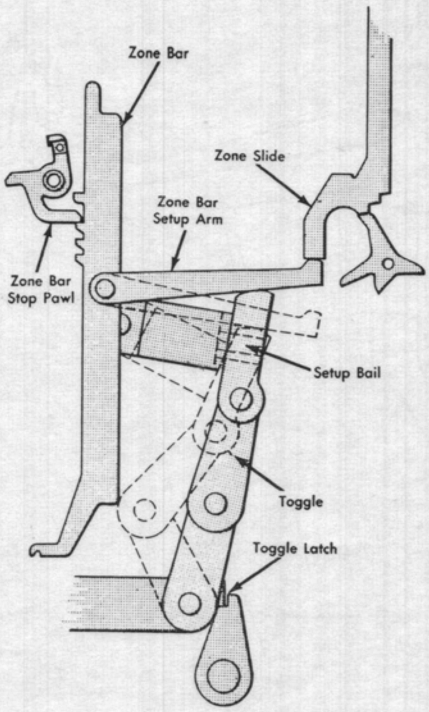

Figure 202. Zone Bar and Setup

The zone bars in the zone unit move in synchronism with the card, as do type bars. The zone bar only moves during the time that zones are sensed, and is capable of setting up a numerical, 12, 11, or 0 zone.

The elements of the setup mechanism are shown in Figure 202. The zone bar setup arm is the medium through which the zone is actually transferred into the type bar. The zone bar setup arm pivots on a stud on the zone bar and rests on the setup bail by its own weight. This figure shows both positions of the toggle, i. e. collapsed and straightened. When the toggle is straightened, the toggle latch will support the lower end of the toggle if the type bars are to be zoned.

The setup bail always rises to the same point when the toggle is straightened. If the setup bail was stationary while the zone bar moved up and down, the position of the zone bar setup arm against the zone slide would depend on the position of the zone bar. In that case, the setup bail would merely act as a fulcrum. The same effect is achieved by positioning the zone bar and then straightening the toggle. When the toggle is straightened, the position of the zone slide will be determined by the position of the zone bar.

The lower the position of the zone bar, the higher the zone slide on the type bar will be lifted. Because the zero zone is the first zone to be read, the first tooth that can engage the zone bar stop pawl represents a zero. This is the *lowest* position the zone bar can stop in. This also results in lifting the zone slide on the type bar to its *highest* position. Figure 203 shows the four possible positions of the zone bar and zone slide. It is obvious from this figure why the type was arranged as it was with the 12 zone type immediately under the numerical, etc.

Zone Control Drive Unit

The zone control drive unit is the mechanism which operates and controls the zone unit assembly. It consists of an assembly of 4 cams (Figure 204), which is driven by the card feed mechanism and operates only when the card feed clutch is engaged. The cams operate bails in the zone unit assembly so that it may accept the 0-11-12 information punched in the card and place this information in the corresponding type bar zone slide position.

Zone Unit Assembly

The zone unit assembly has 43 zone bars and zone bar setup arms, one for each alphamerical type bar (Figure 205). The zone bar is raised by spring tension and its position and operation are controlled by the cams of the zone control drive unit.

Zone Cam 1 — Figures 206 and 207

Cam 1 in the zone control drive unit, through arms and cam followers, operates the zone bar restoring bail. The main purpose of the bail is to control the rate at which the zone bar will rise in relation to the stop pawl. This relation of the 0, 11, and 12 teeth to the stop pawl is called zone lap and corresponds to list lap when speaking of the type bars. Zone lap is the overlap of the zone unit stop pawl on a tooth of the zone bar at the time the circuit breaker impulse is made for a 0, 11, or 12-hole, no time being allowed for slowness or delay in the action of the stop pawl or zone bar.

The time required to raise the zone bar from the 0 to the 11 tooth, or one unit, is 18° which corresponds to the distance between the 0 and 11 punches in the card. Therefore, if an impulse for an 11-hole is completed by the circuit breakers at 189° and the stop pawl brings the zone bar to rest at 204°, the

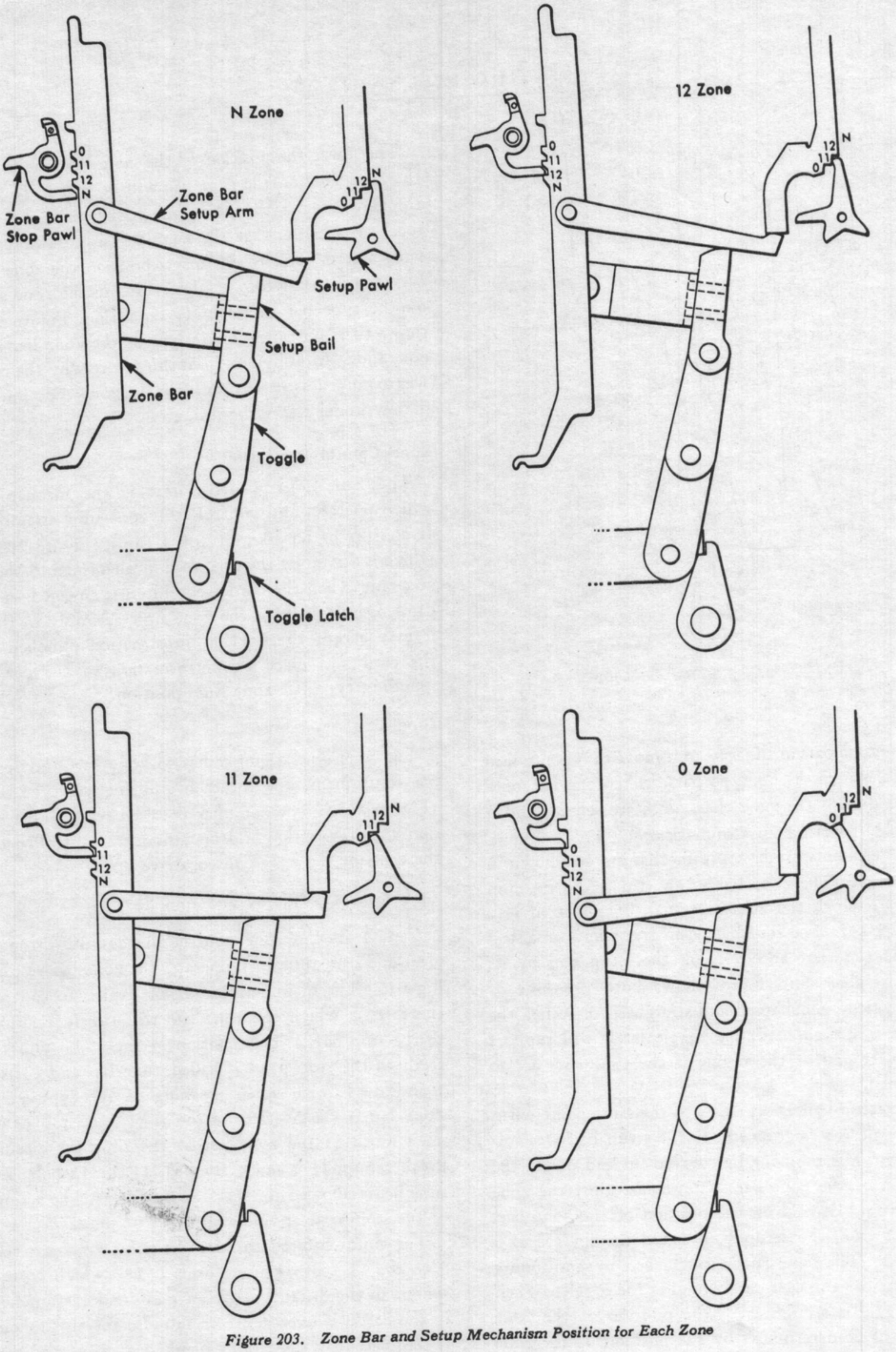

Figure 203. Zone Bar and Setup Mechanism Position for Each Zone

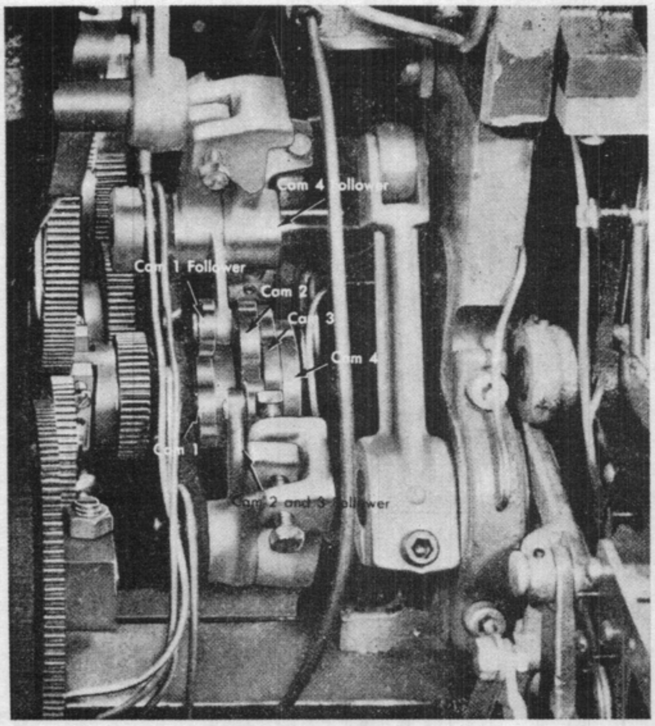

Figure 204. Zone Control Drive Unit

zone bar will rise that distance in 15°. This will allow 3° zone lap or overlap of the stop pawl on the 0 tooth at the time the stop pawl zone magnet is energized. The 15° safety factor will give the stop pawl time to swing into position to stop the zone bar before it comes to rest on the 11 tooth.

The restoring bail on the down movement causes the stop pawls to be restored back upon the latches. Additional linkage performs other functions; it operates the latch restoring bail and the toggle latch restoring link, and causes the toggle armature latch to be restored back upon its armature.

The forked arm on the cam 1 follower is adjusted so that the zero tooth of the zone bar will come to rest against the stop pawl when the machine index is at 186°. A similar condition is also true for the 11 tooth and the 12 tooth of the zone bar at the correct time shown on the mechanical timing chart.

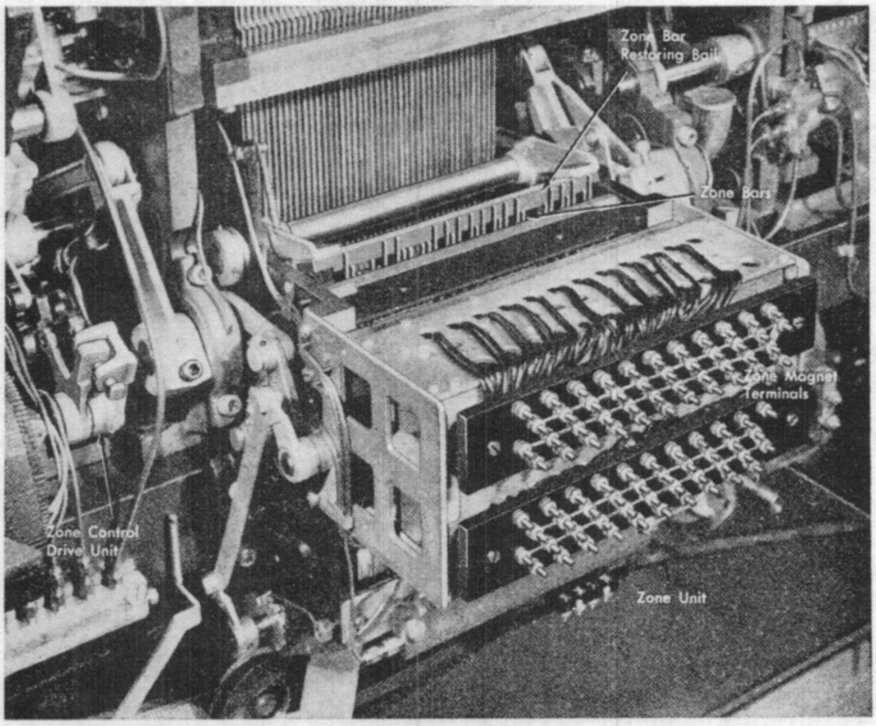

Figure 205. Zone Unit

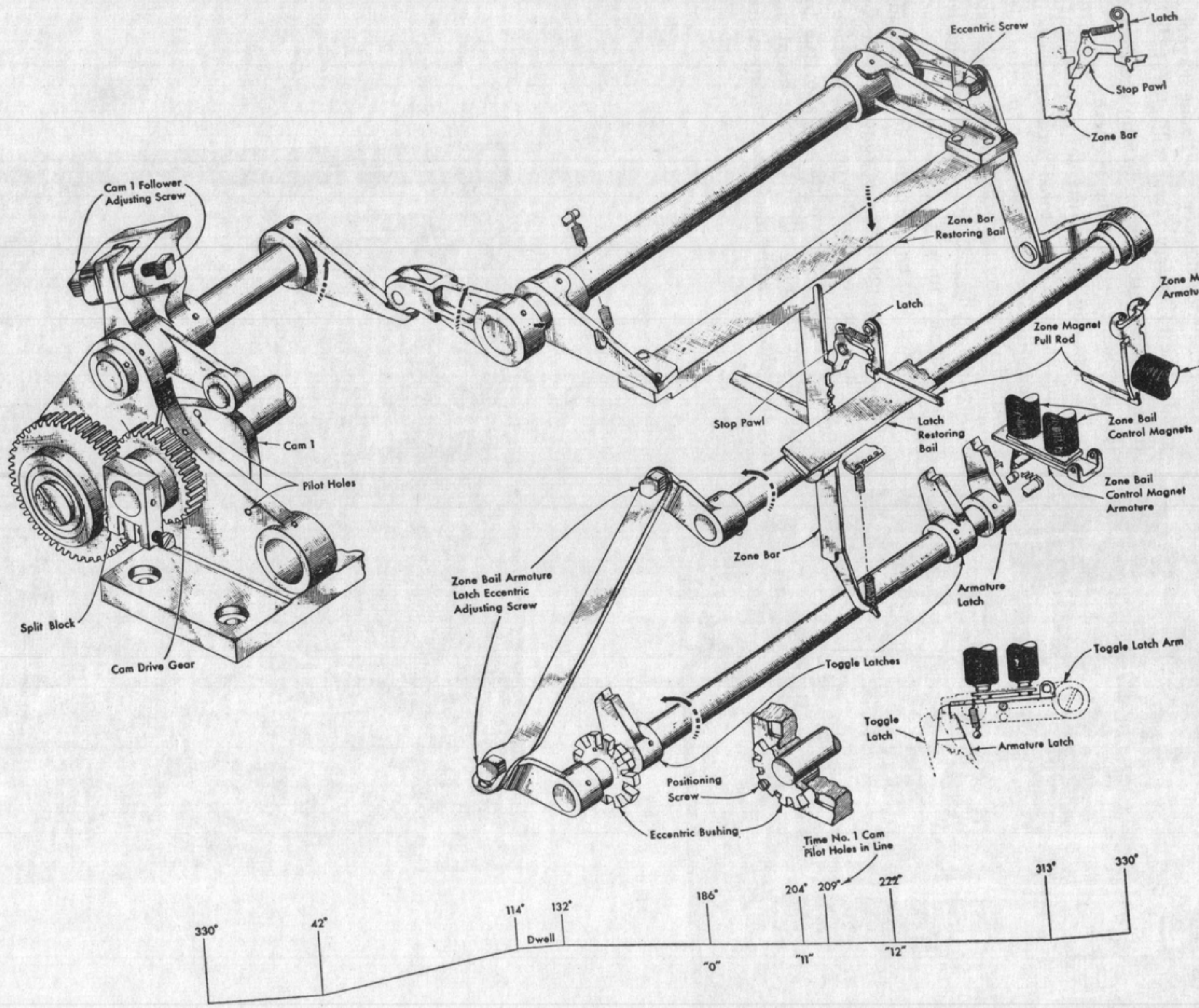

Figure 206. Cam 1 Operation

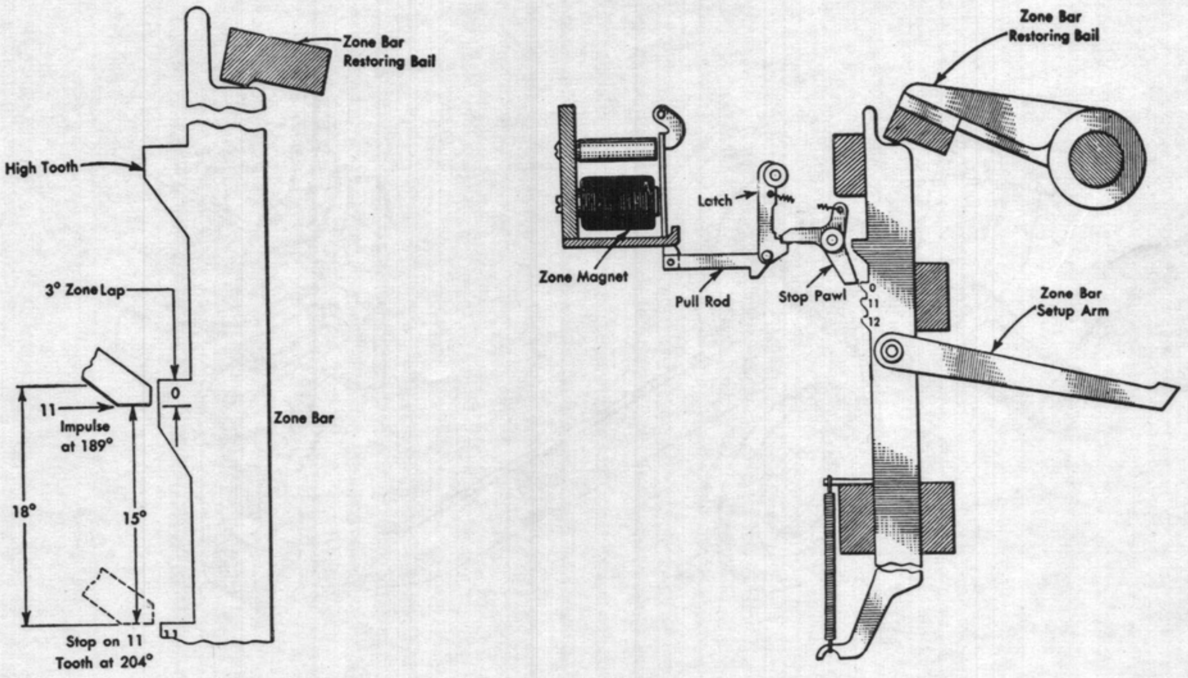

Figure 207. ›ne Bar Zone Lap

Zone Cam 2 — Figure 208

Cam 2 through connecting linkage causes the toggles, when resting on their latches, to straighten out. This in turn raises the setup bail and causes the zone bar setup arm to raise the type bar zone slide so that the setup pawl may fall into the correct zone position. This places the zoning originally read from the card by the reading brushes in the type bar.

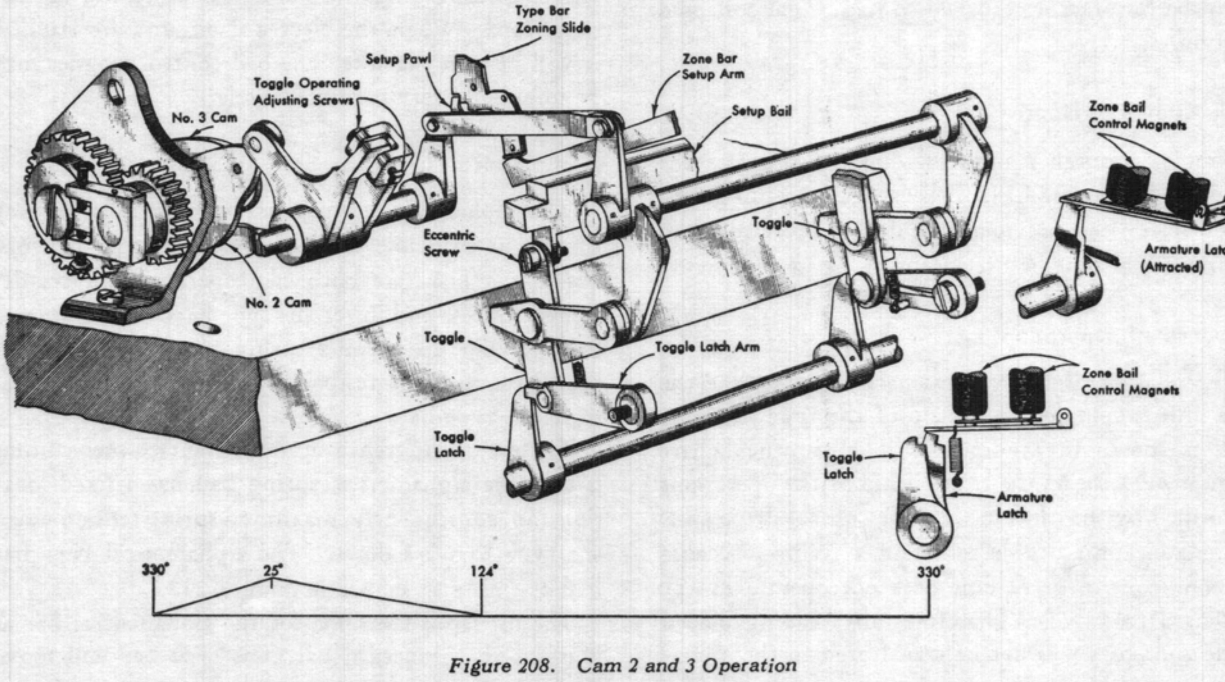

Figure 208. Cam 2 and 3 Operation

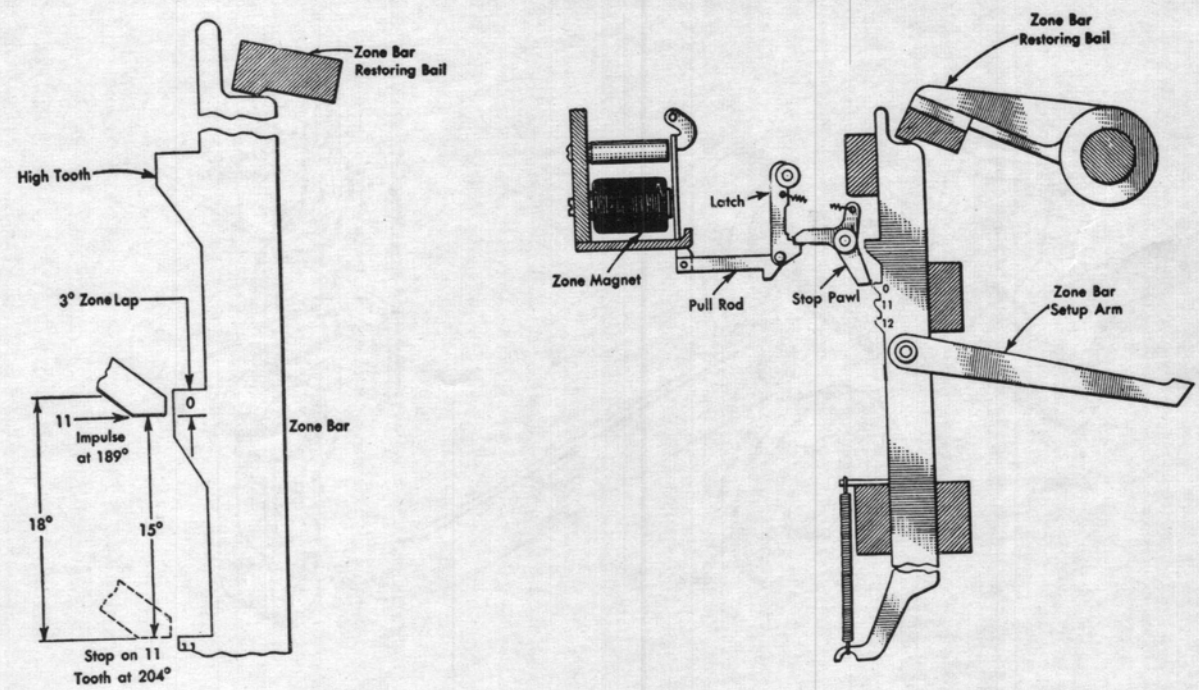

Figure 207. ›ne Bar Zone Lap

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Cam 2 through connecting linkage causes the toggles, when resting on their latches, to straighten out. This in turn raises the setup bail and causes the zone bar setup arm to raise the type bar zone slide so that the setup pawl may fall into the correct zone position. This places the zoning originally read from the card by the reading brushes in the type bar.

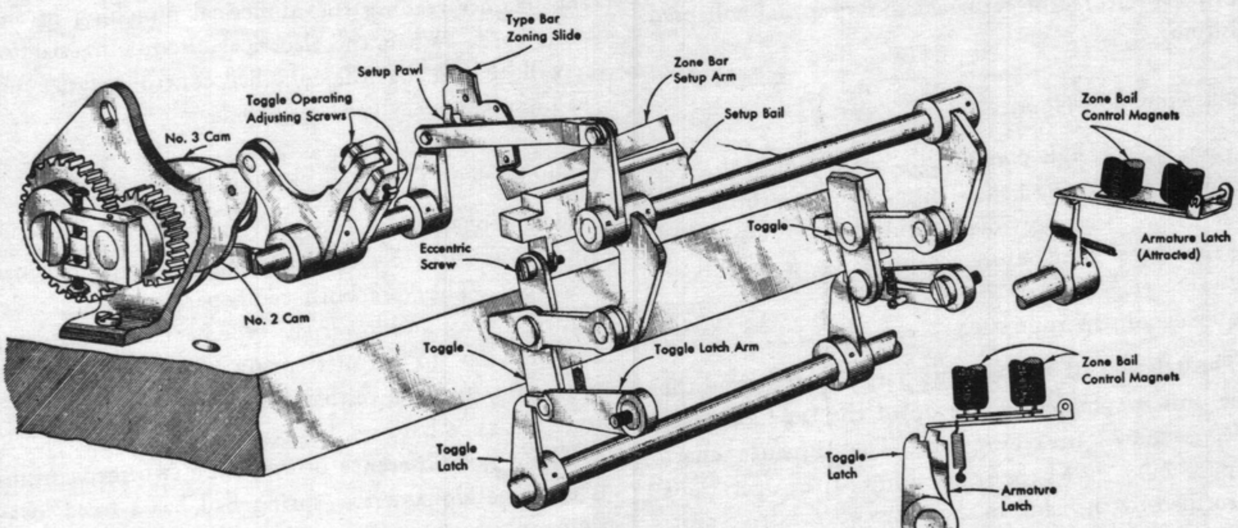


Figure 208. Cam 2 and 3 Operation

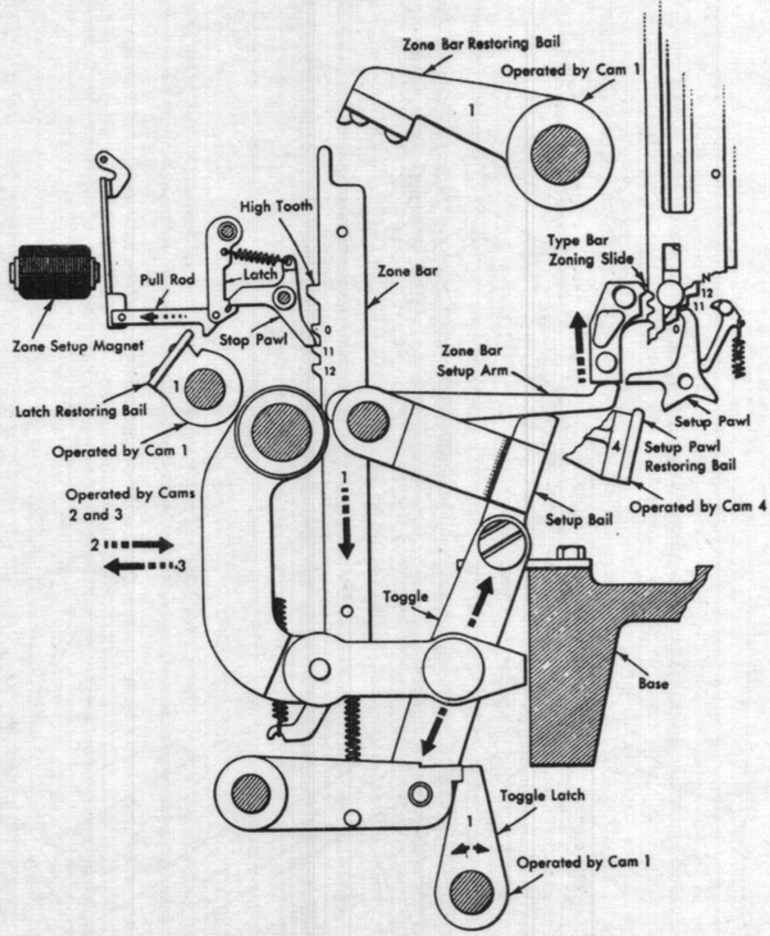


Figure 210. Zone Unit Operation

in synchronism with the card so that it requires 18° on the index to move from one tooth to the next. The list lap is 3° leaving 15° of type bar movement after the stop pawl magnet is energized, before being stopped by the stop pawl.

Hammer Unit

The hammer unit and hammerlock assembly is the same mechanism previously described. The alphamerical type bar has a hammer latch trip lockout cam instead of the stud on the numerical bar, but it serves the same function.

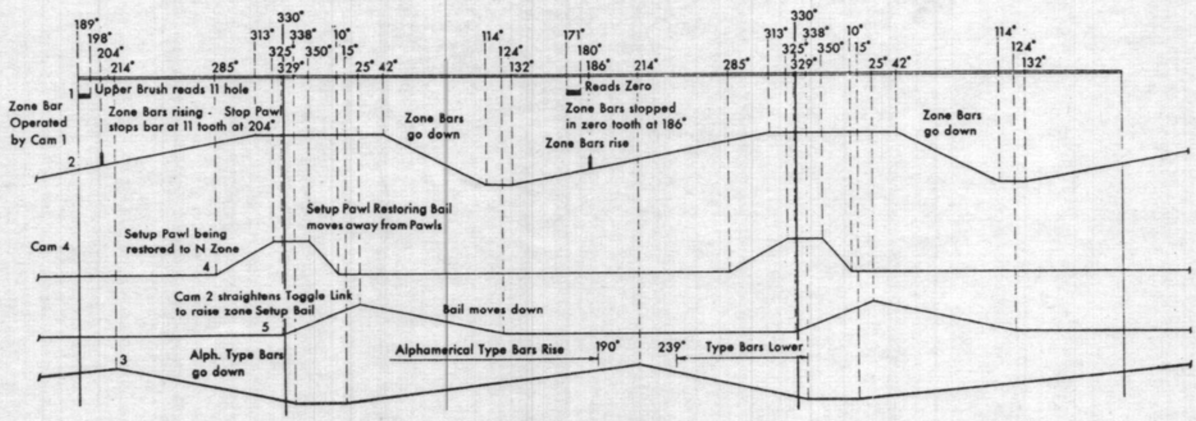


Figure 211. Sequence of Operation

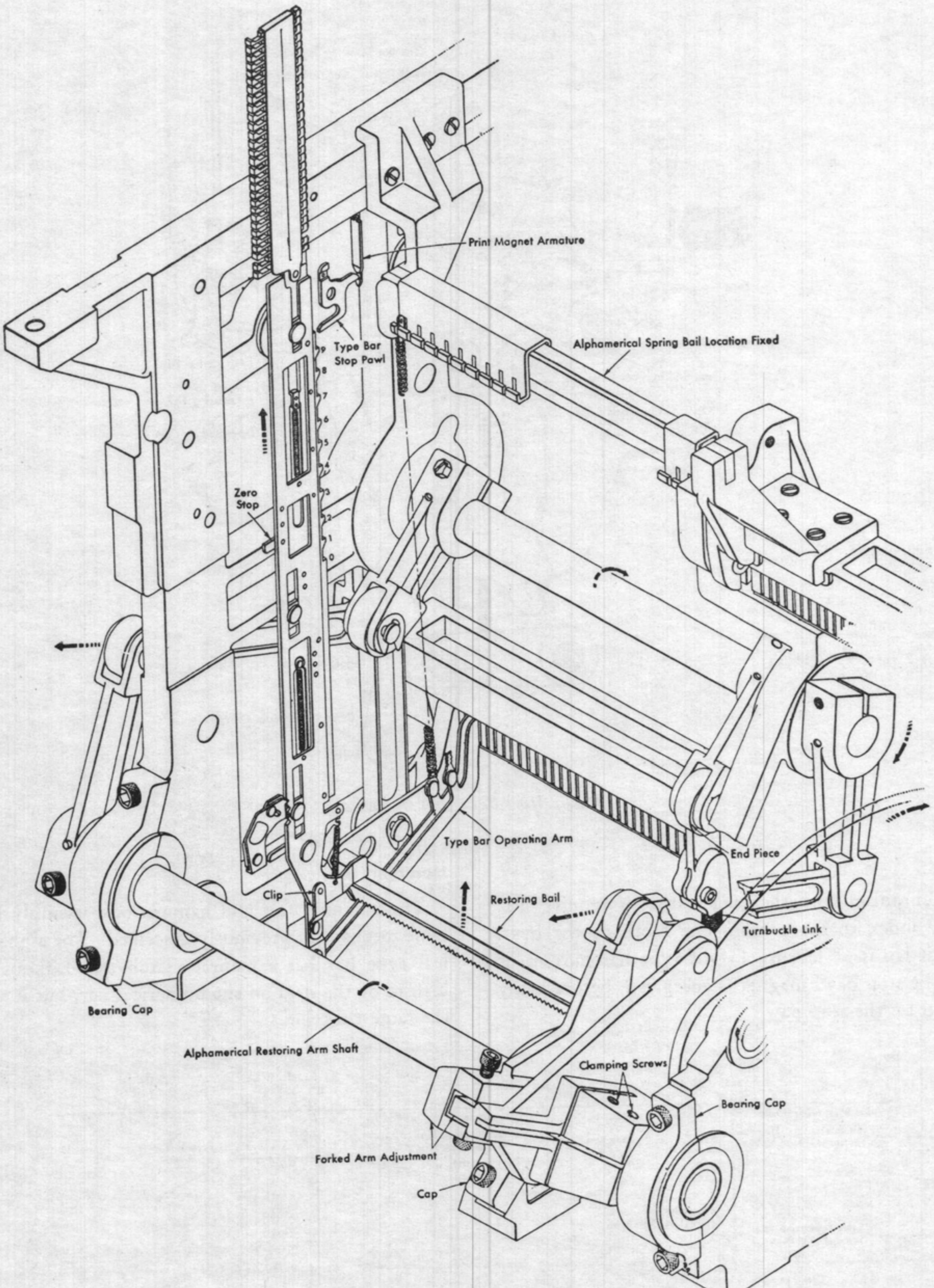
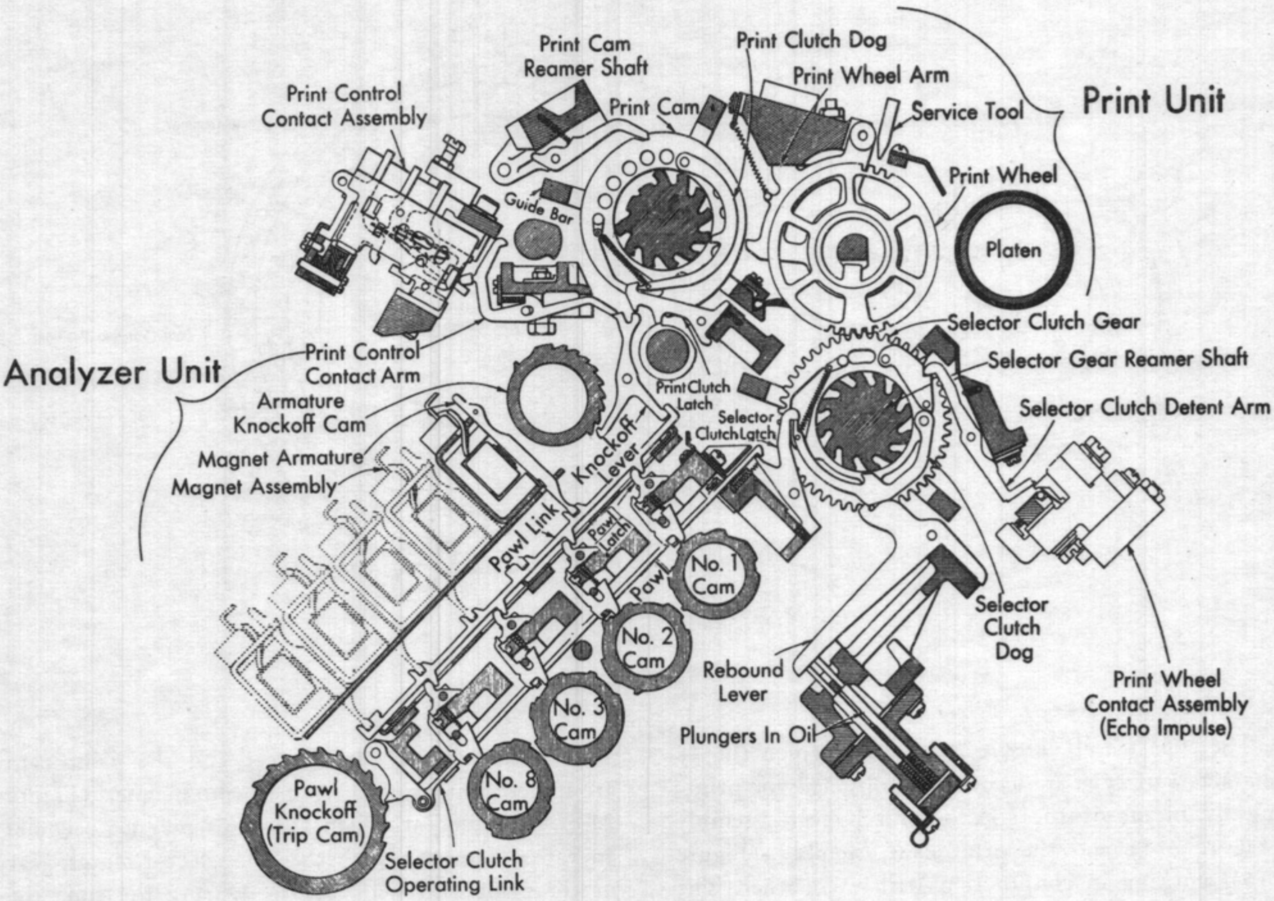


Figure 212. Alphamerical Type Bar Bail Assembly



407 Printing Mechanism

Figure 213. Printing Mechanism

TYPE 407 PRINTING MECHANISM

THE OVER-ALL operation of the print unit will be discussed first and will be followed by a description of the units in detail.

The printing of this machine is performed by the type wheel print mechanism. The print mechanism (Figure 213) will print 120 alphabetic or numerical characters at the rate of 150 operations per minute. The type wheels are positioned to print ten characters per lateral inch. Each of the 120 printing positions is capable of printing forty-eight characters; ten numerical characters, twenty-six alphabetic characters and twelve special symbols. The numerical and alphabetic characters are selected by the holes in the card in the usual manner, a lower punch alone for the digit and the lower and upper combined for alphabetic. Both the upper and lower impulses are received during the same cycle from the same card to print the alphabetic characters. It is not necessary to read the zone impulse a cycle early as in previous accounting machines. The twelve special symbols are selected by various combinations of holes in the card or by impulses from the character emitter. An 8 and a 4 impulse or an 8 and a 4 in combination with each of the zone impulses 0, 11, and 12 will provide four different symbols. An 8 and a 3 alone or in combination with each of the zone impulses 0, 11, and 12 will provide four more symbols. A zero and 1 will provide one more symbol. By using the 11 and 12 impulses alone, two more symbols can be obtained; by using the N impulse (no zone impulse, available on each machine cycle) one more symbol can be obtained, making twelve in all. See Figure 214 for the individual codes. The character emitter may be used to print any of the 48 characters without any punching in the card. Several other entry and exit hubs may be used to print certain symbols as covered in the *Circuits* section.

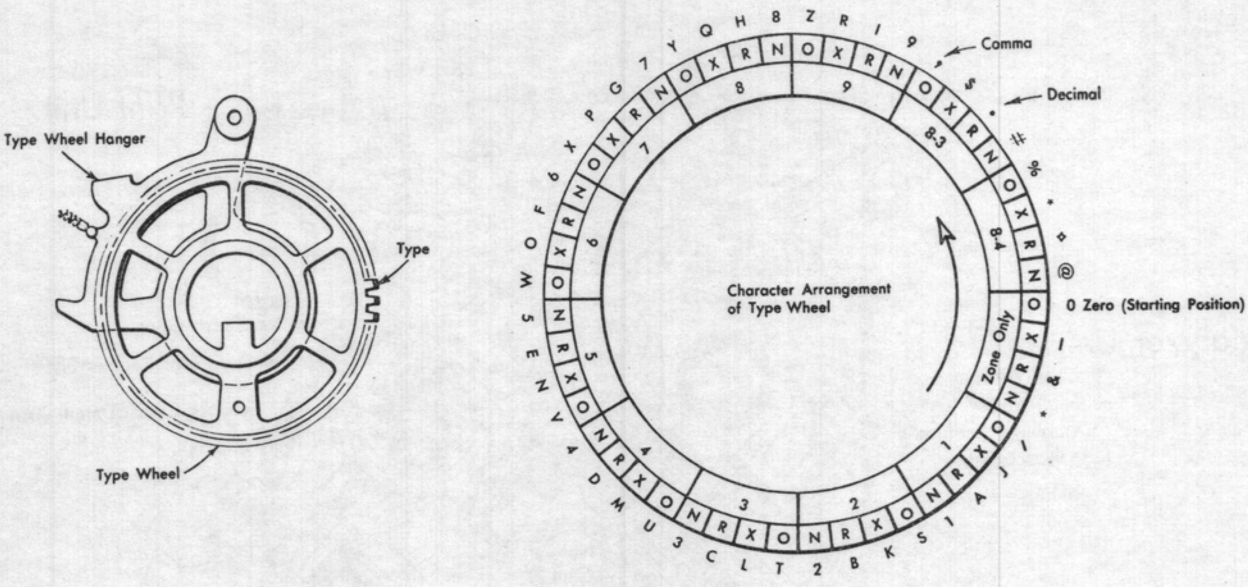


Figure 214. Type Wheel

Type Wheel

The type wheel (Figure 214) upon which the 48 characters of type are located is positioned for printing by means of the selector clutch gear assembly (Figure 215) and the print cam assembly (Figure 216) working in conjunction with each other. The selector clutch gear is controlled by the lower readings (1-9) of the card, counter, emitter, storage or N impulse, whereas the print cam is controlled by the 0, 11, 12, or N impulse.

Print Magnet

Both the selector clutch gear and the print cam are under control of the same print magnet (Figure 213). The time at which the print magnet becomes energized determines whether the selector clutch gear or the print cam will operate. During the time the 9 through 1 impulses are received from the card, counter, emitter, or storage units, the print magnet is energized; this later causes the selector clutch dog to be released and in turn causes the selector clutch

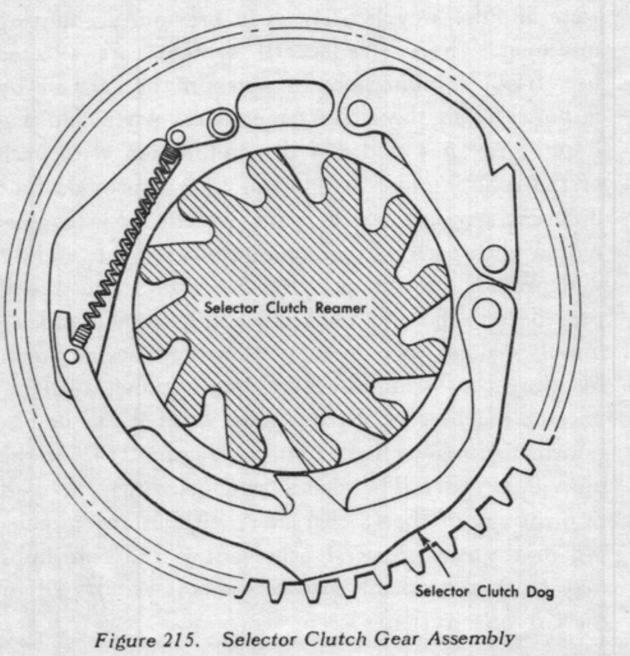


Figure 215. Selector Clutch Gear Assembly

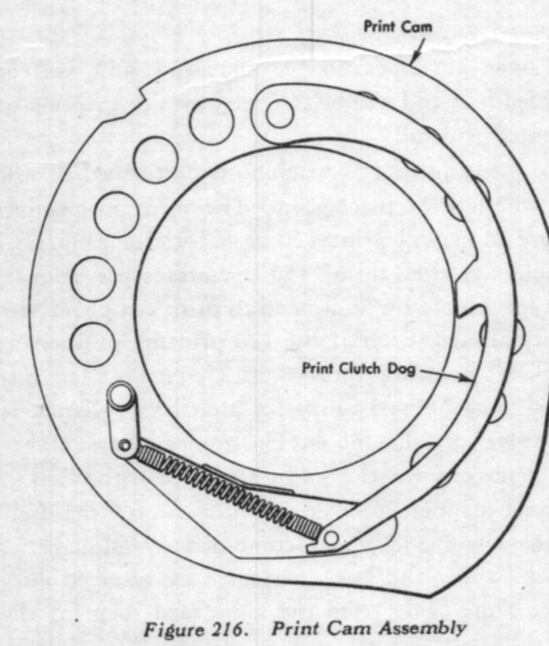


Figure 216. Print Cam Assembly

gear to operate. The N impulse, an automatic machine impulse coming through at 187°, may also cause the selector clutch gear to operate if the print magnet has not previously been energized. This depends upon the control panel wiring and the condition of adjacent positions. When the selector clutch gear operates, the type wheel also operates since they are geared together.

It should be noted here that the surfaces of contact of the clutch dogs and the clutch reamer flutes are 90° to a line drawn through the surface and through the pivot point of the clutch dog which assures positive operation of the clutch in spite of the appearance which tends to give the indication that the clutch might slip. This type of clutch is most satisfactory for the operations involved.

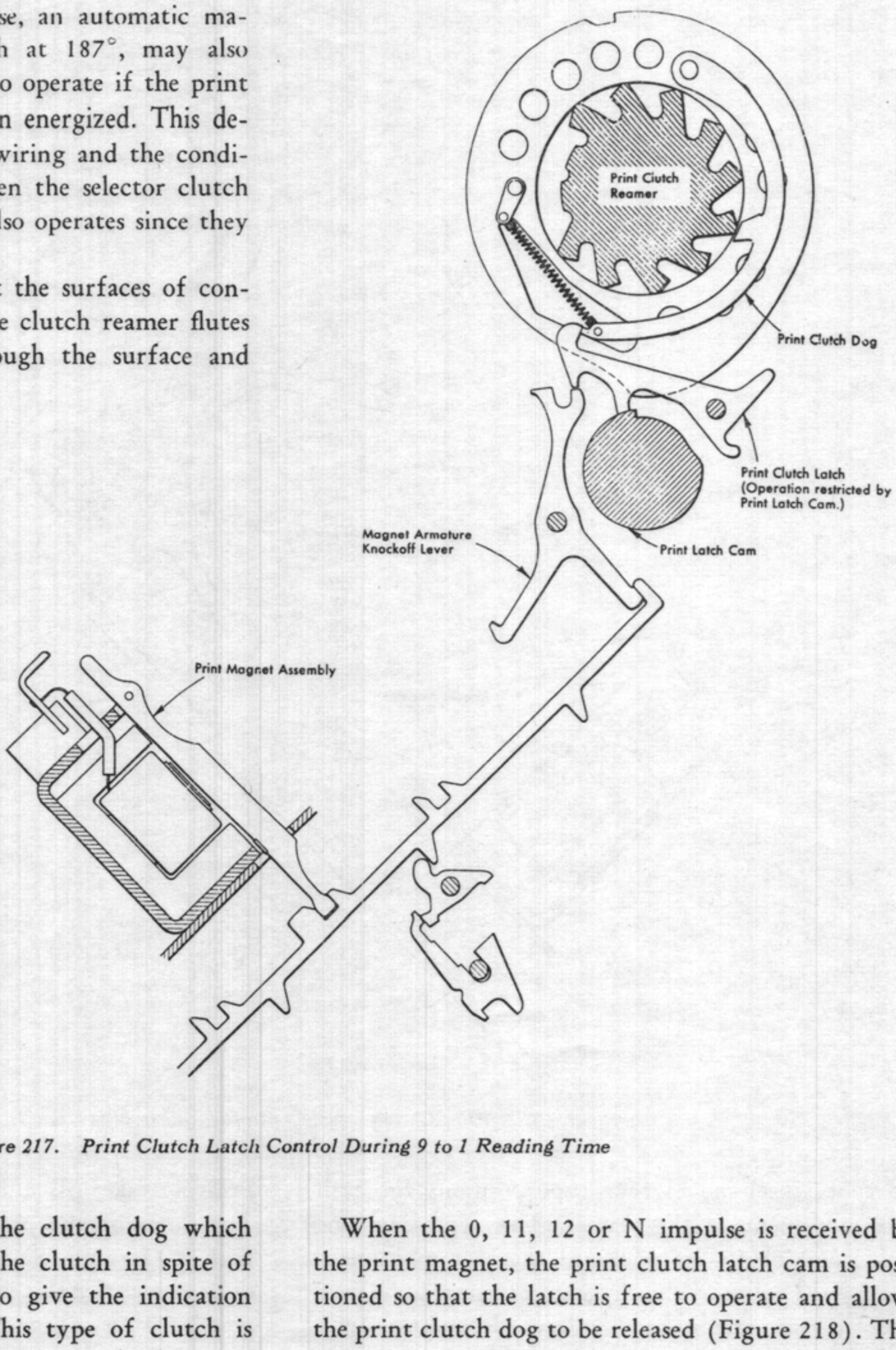


Figure 217. Print Clutch Latch Control During 9 to 1 Reading Time

Print Clutch Latch

During the 9 through 1 impulses the print clutch latch is not affected because the print latch cam prevents the print clutch latch from being released (Figure 217). Consequently, the print cam does not operate as a result of a 9 through 1 impulse from any source.

When the 0, 11, 12 or N impulse is received by the print magnet, the print clutch latch cam is positioned so that the latch is free to operate and allows the print clutch dog to be released (Figure 218). This in turn causes the print cam to operate.

Variable Speed

At the time the selector clutch dog is engaged in the selector clutch reamer, the reamer is turning at the rate of 300 RPM. The movement between each flute on the selector clutch reamer is equal to a movement of four teeth on the selector clutch gear. Since the selector clutch gear is geared to the type wheel,

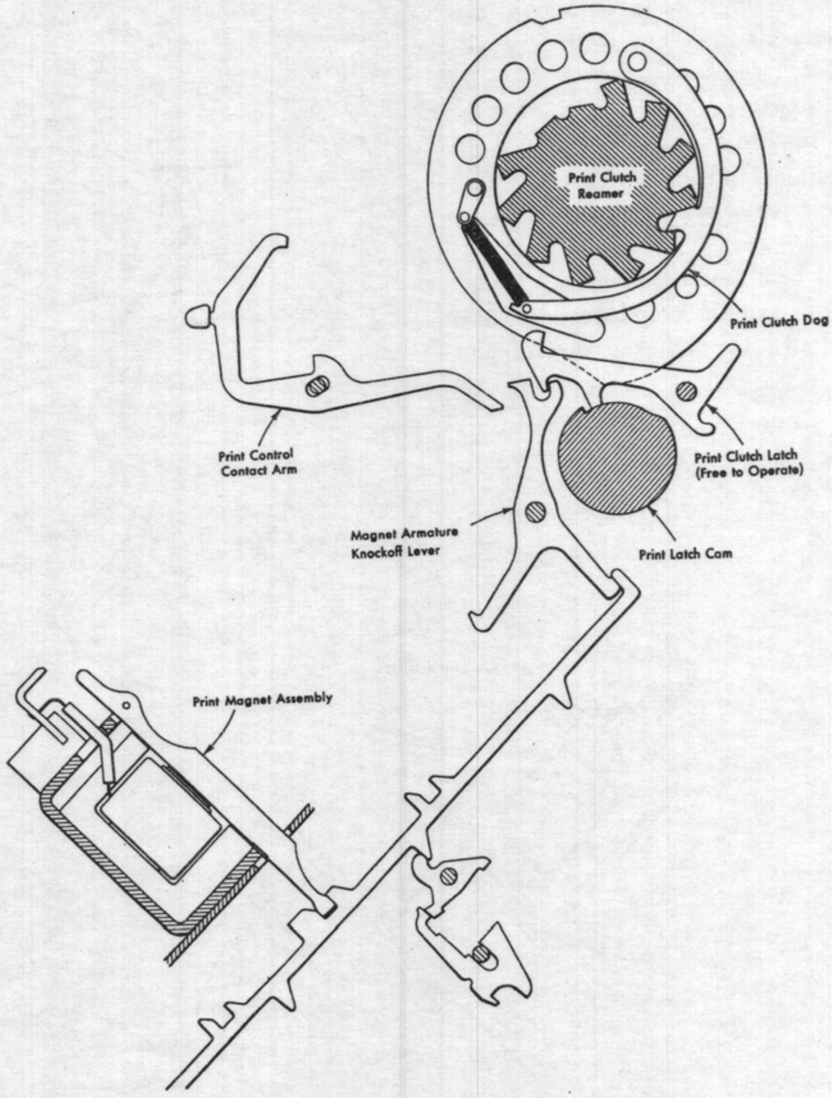


Figure 218. Print Clutch Latch Control During 0, 11, 12, and N Time

the type wheel moves four type positions for each flute movement of the reamer. This represents one cycle point or 15°. This means that for each selection of the selector clutch gear, printing may take place in any one of four places depending upon whether the character to be printed has a 0, 11, or 12 zone or whether it is a numerical character with an N impulse. This also makes it necessary to print at four different times in one machine cycle. Unlike former machines, all printing is not done at the same instant. The time of printing depends upon the time that the print cam starts to operate and that may be at any one of four different times (0, 11, 12, or N). Printing takes place at 300°, 315°, 330°, and 345°. The flutes of the print reamer shaft are machined with a 7° spiral. Since the shaft turns two revolutions per cycle, this causes the print clutch dog for position 1 to engage 3½° earlier than position 120.

Type Wheel Selection

The selection between the four type positions is accomplished by controlling the printing time which depends upon the zone of the character to be printed. The type wheel turns up to the time that the printing is performed. The printing actually takes place when the type wheel is cammed toward the platen. The print cam does not cam the type wheel fully against the platen by positive action. The type wheel is cammed to within approximately 1/16″ of the platen and is forced against the platen by its own momentum.

The print clutch dog (Figure 218) is released when the print magnet is energized by a 0, 11, 12 or N impulse, allowing the dog to become engaged in the continuously running print clutch reamer. This revolves the print cam, the high lobe of the print cam comes in contact with the type wheel hanger, the type wheel is rocked toward the platen, and printing takes place.

Since the type wheel is turning at the time the print cam forces the wheel against the platen, the character to be printed can be controlled by timing the camming action. The selector clutch gear has been set up to position the type wheel so that any one of four positions may print. If the lower impulse which controls the operation of the selector is a 5, the selector clutch dog will become engaged with the proper reamer flute to print a V, N, E or 5. The one flute will position the selector gear for printing all

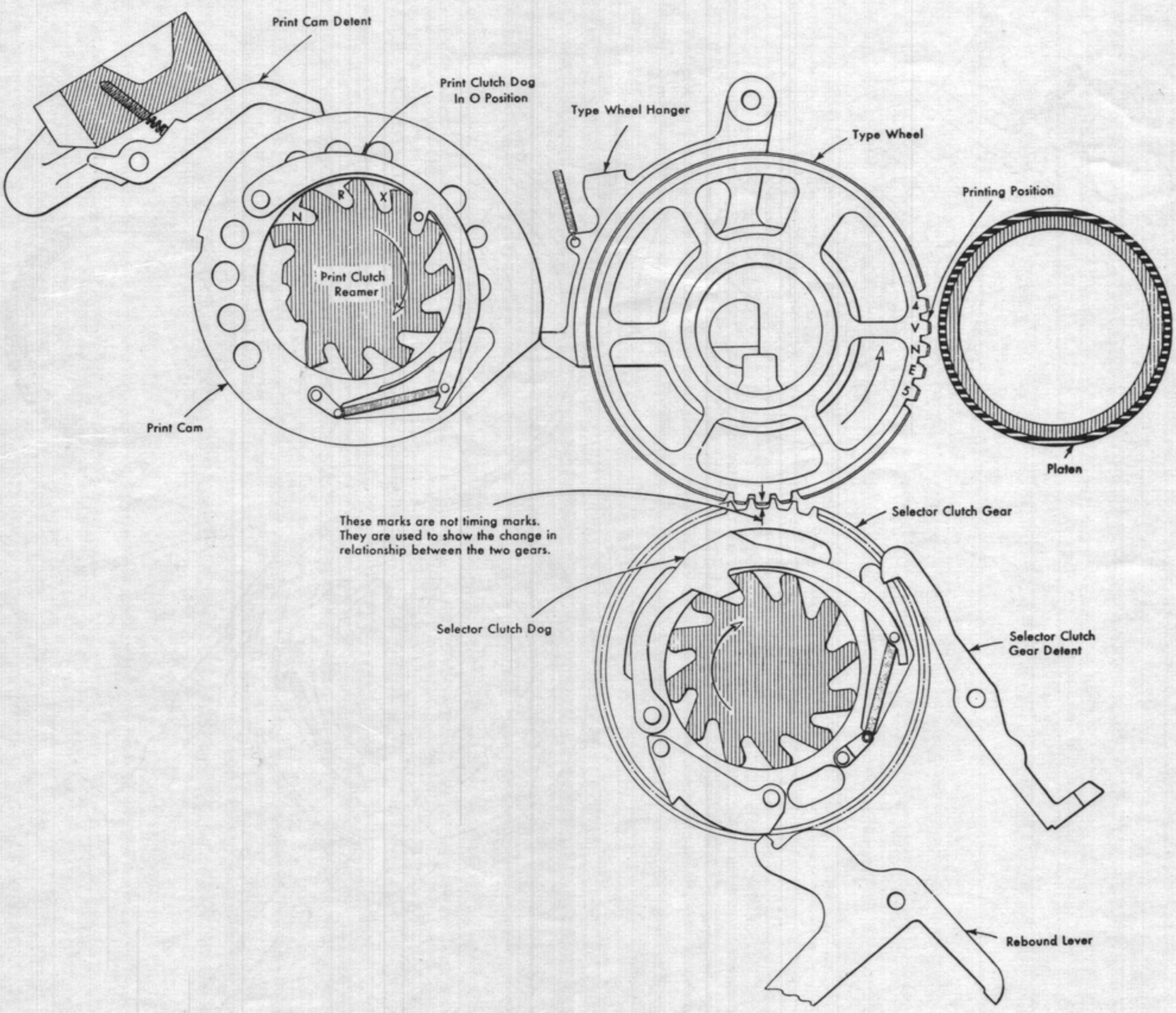


Figure 219. Printing Mechanism Positioned for Printing V

four of these characters. The character that is printed is dependent upon the zone impulse that is received by the print magnet the second time. As mentioned previously, printing takes place when the print cam operates against the type wheel hanger and forces the type wheel against the platen. If a zero (0) impulse is received by the print magnet, causing the print cam to start operating at 155°, the V which is the first character of the group will be printed at 300°, since this is the time when the highest point of the print cam comes in contact with the type wheel hanger assembly. (Refer to Figure 219 for the operation of the print cam and selector clutch gear.) If an 11 impulse is received by the print magnet causing the print cam to start operating at 170°, the N, which is the second character of the group, will be printed at 315°. (Figure 220 shows the relative position of the print cam and selector clutch gear when printing an N.) If a 12 impulse is received by the print magnet causing the print cam to start operating at 185°, the E, which is the third character of the group, will be printed at 330° (Figure 221). If no zone impulse is received, the character printed will be a number, in this case a 5. As previously mentioned the print cam must operate for printing to take place. Therefore an impulse is needed to engage the print clutch. The N impulse, which is an automatic machine impulse coming through at 187°, energizes the print

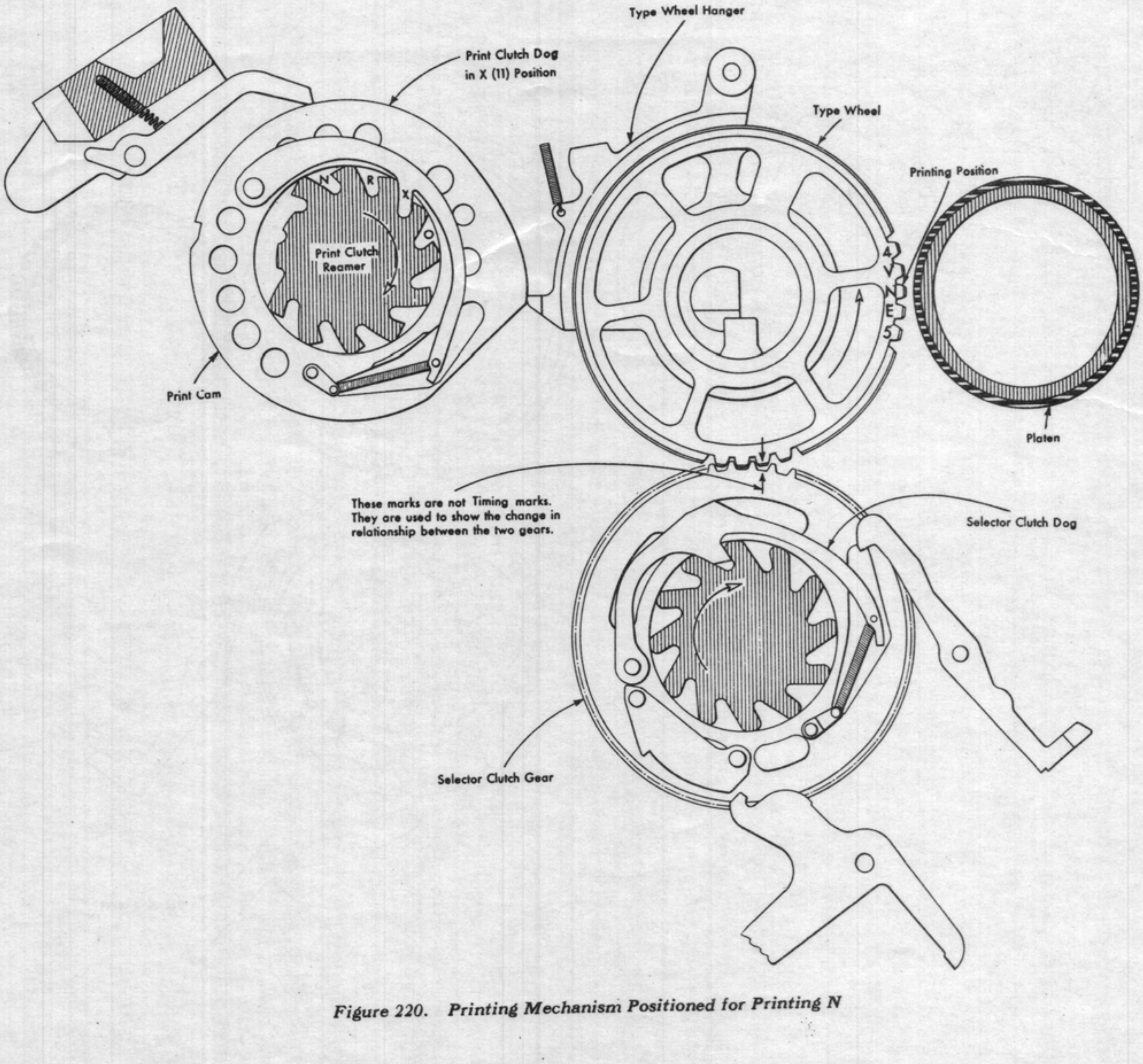


Figure 220. Printing Mechanism Positioned for Printing N

magnet and causes the print cam to start operating at 200° and the 5 to be printed at 345° (Figure 222).

The N impulse is also received on the three preceding conditions but, since the print magnet had previously been energized by zone impulses, no other effect is caused by the N impulse because the zone impulses take preference.

When the selector clutch gear is set up, the selector clutch reamer from one flute to the next moves the selector clutch gear the distance of four teeth in 15°. Since the selector clutch gear has 48 teeth and is meshed with the type wheel which also has 48 character positions, the type wheel must move four character positions for each flute of the selector clutch reamer.

At the time of printing one of the four characters must be selected. As mentioned above, the particular character to be printed is determined by the time at which the print cam operates against the type wheel hanger. Since the flutes on the print clutch reamer operate at the rate of one for each 15°, the selector clutch reamer must be slowed down to one-quarter the normal speed at printing time so that one flute of the print clutch reamer will correspond to one type position on the type wheel instead of the usual four positions. Therefore, the speed of the selector clutch

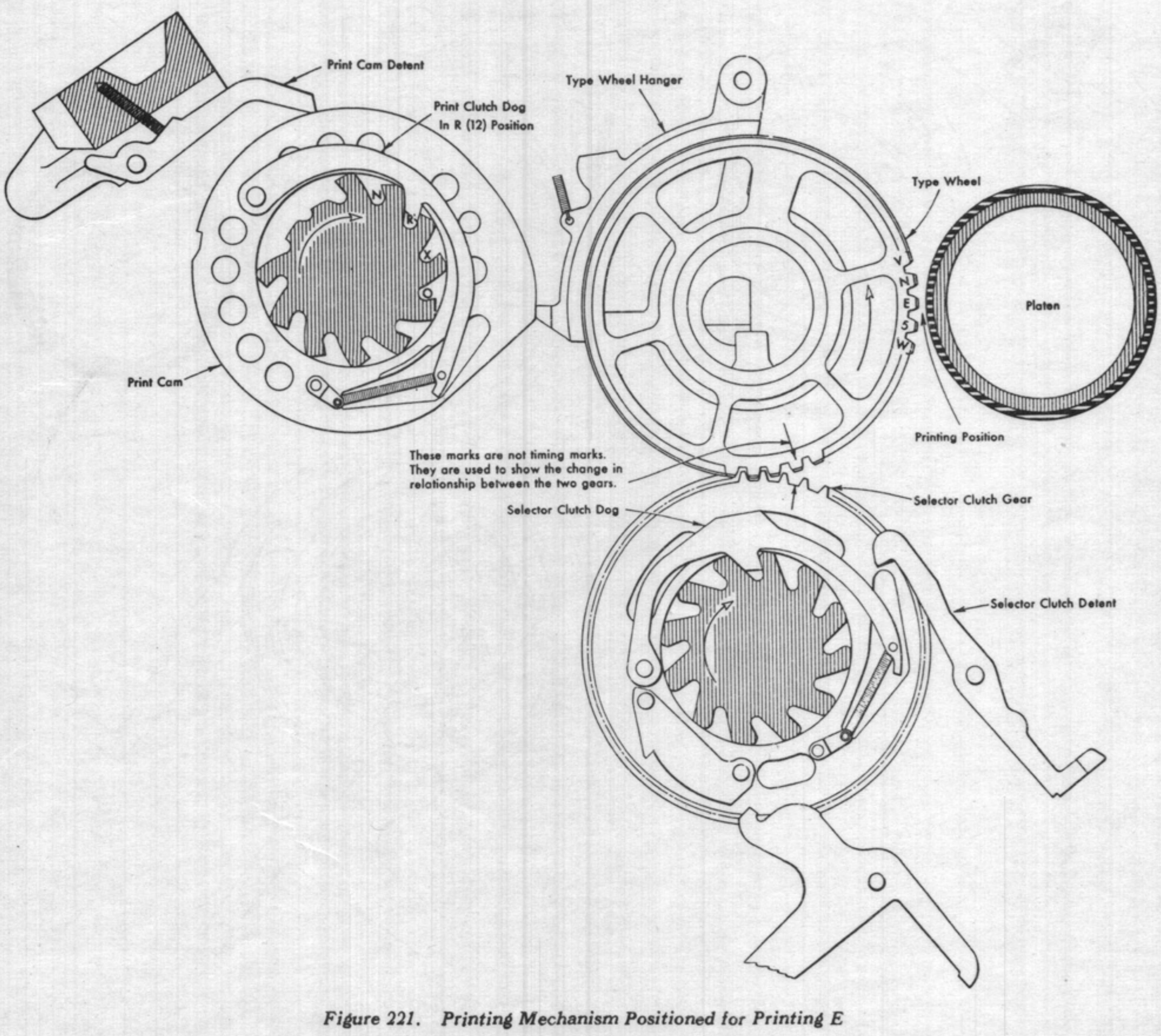


Figure 221. Printing Mechanism Positioned for Printing E

reamer at printing time (300°-345°) is 75 RPM. The speed of the print clutch reamer remains constant (300 RPM). Consequently, the movement of the four flutes of the print clutch reamer at printing time corresponds with the movement of one flute of the selector clutch reamer which is four character positions. Thus each flute of the print clutch reamer moves the distance of one character position during printing time.

The change in speed is accomplished by a variable speed drive.

The selector clutch gear drives the type wheel in a counterclockwise direction. When the print cam operates against the type wheel hanger, the type wheel tends to turn in a clockwise direction because of the pivoting action. The result of these two actions at printing time keeps the type wheel stationary for the printing operation.

The following sections cover the individual units in more detail.

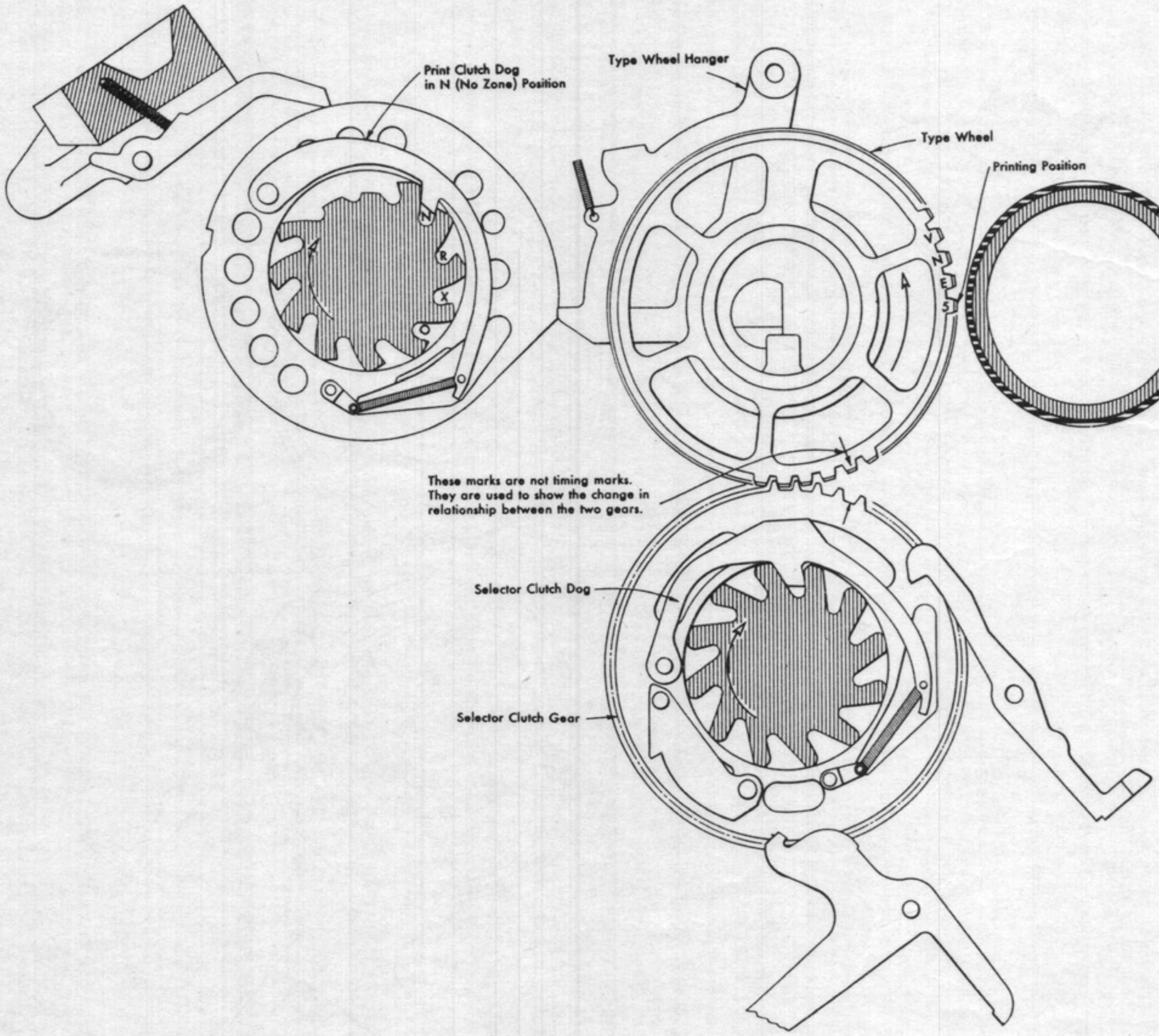


Figure 222. Printing Mechanism Positioned for Printing 5

Analyzer (Mechanical Delay) Unit

The selector clutch reamer, which operates the selector clutch gear through the selector clutch dog, has twelve flutes into which the clutch dog may fall. Selection of the proper flute must be made according to the impulse received. However, the engaging of the selector clutch dog with the reamer must be delayed beyond the time of receiving the impulse from the card or counter. This is accomplished through the mechanical delay operations of the analyzer unit. The delayed action is necessary to delay releasing the selector clutch dog until sufficient time has elapsed for sensing both impulses in one position if a special character is to print. Special characters use an 8-3 and an 8-4 combination in conjunction with zone punches. Consequently, time must be allowed to read a 3 hole before the type wheel is set up.

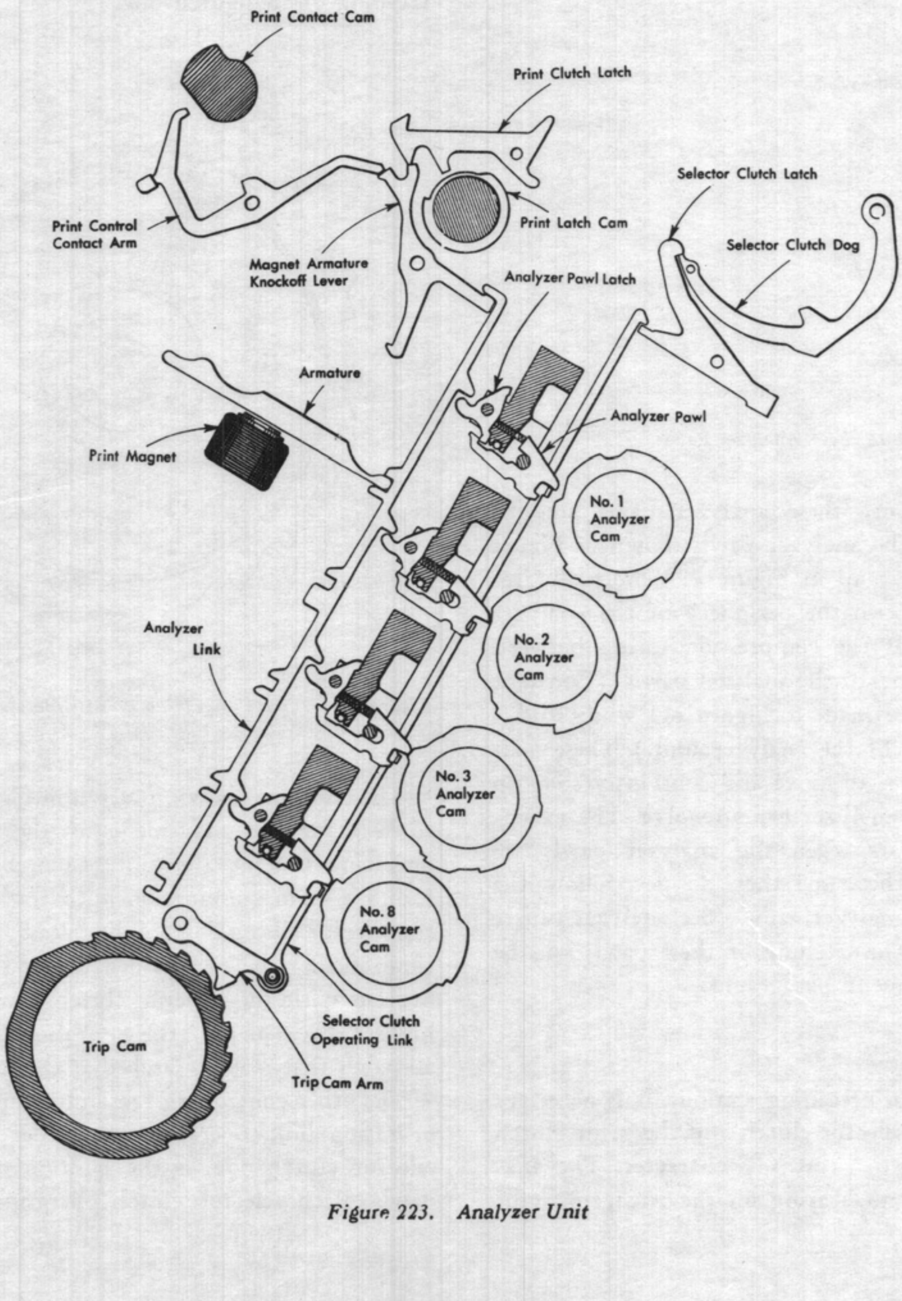


Figure 223. Analyzer Unit

Analyzer Cams and Pawls

Among the various parts of this unit are the four analyzer cams which operate the four analyzer pawls for each type wheel position. These analyzer cams extend over the length of the analyzer unit, therefore, each printing position is under control of all four analyzer cams. Each of the four analyzer cams has a different peripheral surface. The surfaces of these cams provide for three distinct heights — low, intermediate and high. The chart shown in Figure 227 gives the relative peripheries of these cams.

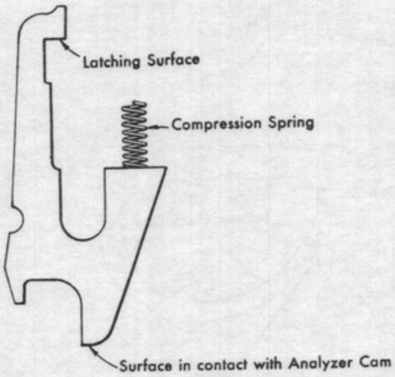


Figure 224. Analyzer Pawl

Operating against these analyzer cams are the analyzer pawls. The analyzer pawls shown in Figure 223, and as a close-up in Figure 224, normally remain in contact with the periphery of the analyzer cams by means of the compression spring between them and the latches of the analyzer pawls. (Constant reference should be made to Figure 213 while studying the operation of the analyzer unit.) These analyzer pawls are free to move and constantly slide up and down as the analyzer cams revolve. The exception to this occurs when the analyzer pawls are latched; during this time they do not follow the periphery of the analyzer cams. (See analyzer cam 1 in Figure 223.) The latching of these pawls will be covered in subsequent paragraphs.

Selector Clutch

As mentioned in preceding sections, it is necessary to have both the selector clutch and the print clutch engaged in order to print any character. The analyzer pawls have no bearing on the engagement of the print clutch but definitely control the operation of the selector clutch. Therefore, for the time being, the operation of the selector clutch gear will be considered.

By referring to Figure 213, it can be seen that to operate the selector clutch gear the selector clutch dog must be released to become engaged with the selector clutch reamer. The selector clutch dog is held in the latched or disengaged position by the selector clutch latch which in turn is operated by the selector clutch operating link. The selector clutch operating link is under control of the analyzer pawls and the trip cam which controls the actual time of tripping of the clutch dog.

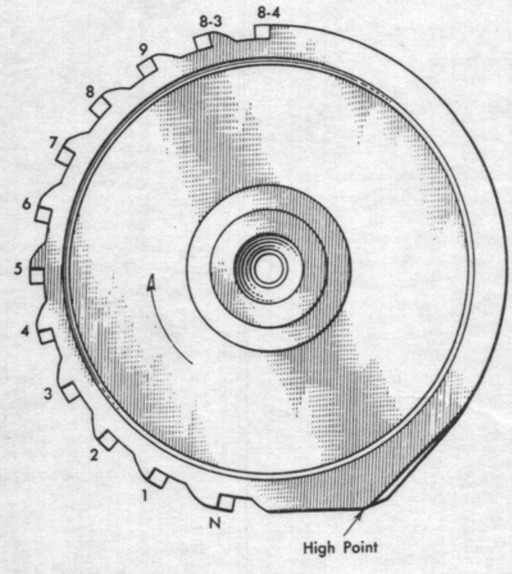


Figure 225. Trip Cam (High Point Unlatches Analyzer Pawls)

The trip cam, shown in detail in Figure 225, is used to test for the movement of the selector clutch operating link at a definite time. Because the trip cam works in conjunction with the analyzer pawls, the selector clutch dog will be released only at definite times during the cycle when the dog has the proper overlap with the selector clutch reamer flutes. The highest dwell of the trip cam also serves to unlatch all pawls that may be latched at the end of the cycle.

The other controlling factor for the selector clutch operating link, operating to the left to release the selector clutch dog, is the position of the analyzer pawls. Each selector clutch operating link (Figure

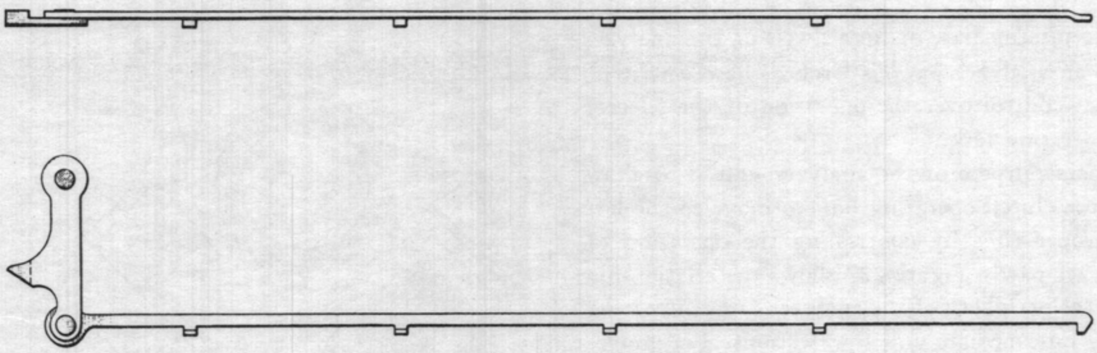


Figure 226. Selector Clutch Operating Link

226) has four turned-over ears which may or may not be in contact with the corresponding analyzer pawl. Whether or not the turned-over ears are in contact with the analyzer pawls depends upon the position of the analyzer pawls which are under control of the analyzer cams and the analyzer pawl latches. As can be seen from Figures 213 and 223, when an analyzer pawl is operating against the low dwell of the analyzer cam, the analyzer pawl comes in contact with the turned-over ear of the selector clutch operating link and prevents any movement to the left. Because of spring action, the selector clutch operating link tends to move to the left and release the selector clutch dog. Any one of the analyzer pawls in the lowest position is sufficient to keep the selector clutch operating link from moving to the left. In order to have the selector clutch operating link operate to the left, all four analyzer pawls must

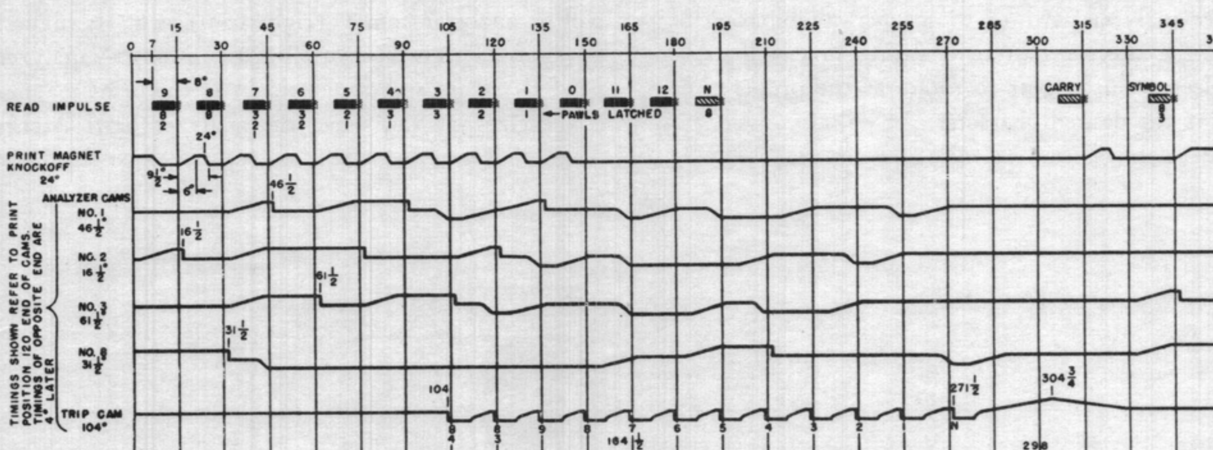


Figure 227. Mechanical Timing Chart — Analyzer Unit and Print Cam Control

be on the intermediate or high dwell of the analyzer cams. If an analyzer pawl is latched, however, it no longer has control over the operation of the selector clutch operating link.

The main purpose of the analyzer unit is to allow the selector clutch operating link to move to the left at the proper time by controlling the operation of the analyzer pawls. Figure 227 shows the relationship between the periphery of the analyzer cams indicating the high, intermediate and low sections. The movement of the selector clutch operating link is controlled by both the analyzer pawls and the trip cam; the chart in Figure 227 shows that at all testing positions of the trip cam, at least one of the analyzer pawls is located at the lowest level of one of the analyzer cams. With all pawls operating normally (none latched) the selector clutch operating link will not move to the left and, consequently, the selector clutch dog will not be released and no printing will take place.

If one or more of the analyzer pawls are latched in a position where they will not interfere with the movement of the selector clutch operating link, however, the selector clutch dog will be released and operate the selector clutch gear. Thus the main purpose of the analyzer unit is seen. By latching the proper analyzer pawl, or the proper combination of pawls, the selector clutch operating link will cause the selector clutch gear to rotate at the proper time to print the desired character.

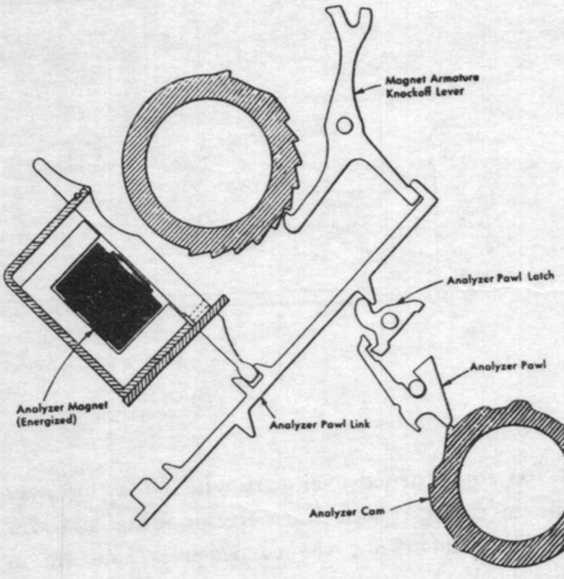


Figure 229. Analyzer Pawl Latching Position

Analyzer Operation for Printing a 1

Assume that a 1 is to be printed. Figure 227 shows that at read impulse 1 time (127°-135°) analyzer cam 1 has its highest surface against the analyzer pawl. This means that the analyzer pawl under control of analyzer cam 1 (right cam) is at its highest position. (This is true for all 120 positions — analyzer pawl 1 is at its highest position.) If the print magnet is energized at this time, the analyzer pawl latches

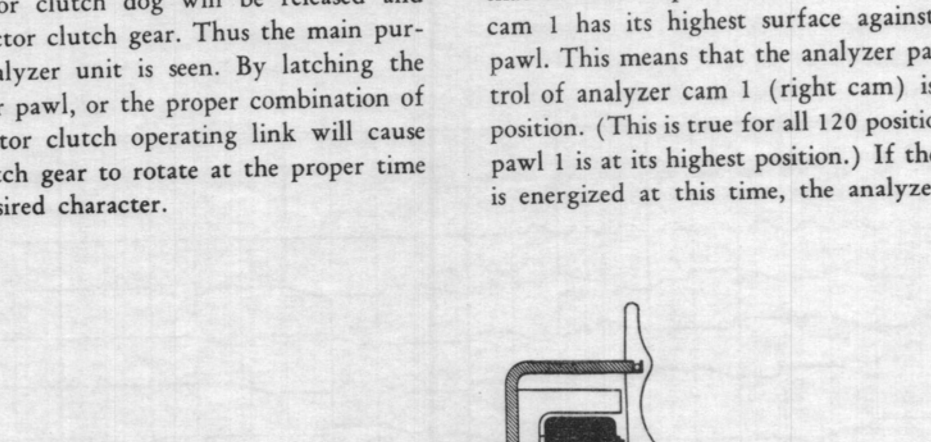


Figure 228. Analyzer Pawl Link and Analyzer Pawl Latches

of all four pawls of each position in which the print magnet is energized will be pivoted in a counterclockwise direction by the analyzer pawl link being operated. Each analyzer pawl link has four projections which operate against the analyzer pawl latches whenever the analyzer pawl link is moved (Figure 228). Since the analyzer pawl for the analyzer cam 1 is at its highest position at this time, the analyzer pawl latch will pivot below the latching surface of the analyzer pawl 1 (Figure 229). The remaining three analyzer pawls for this particular printing position will not become latched on the pawl latch since these analyzer pawls are not at their highest position at 1 time (chart, Figure 227).

As the machine continues to operate, analyzer cam 1 will move its high point of the cam away from the analyzer pawl but, since the pawl latch is positioned under the latching surface, the analyzer pawl will remain latched. When the analyzer pawl is latched, it has no control over the selector clutch operating link. Consequently, the selector cutch operating link is under control of only three analyzer pawls (2, 3, and 8) and the trip cam. The analyzer cams are numbered 1, 2, 3, and 8, from right to left (Figure 223). They are numbered this way since a 1 impulse will latch the analyzer pawl 1 only, a 2 impulse will latch analyzer pawl 2 only, a 3 impulse will latch the analyzer pawl 3 only, and an 8 impulse will latch the analyzer pawl 8 (extreme left) only. All other impulses 4, 5, 6, 7, and 9 will latch a combination of pawls while 0, 11, and 12 will not latch any pawls.

Refer at this time to Figure 227 and disregard the position of analyzer cam 1 since the cam has no effect as long as its corresponding pawl is latched. Under these conditions it will be found that the first time that the selector clutch operating link is not held by at least one analyzer pawl the trip cam is at 254° which is test time for 1. This means that the selector clutch dog is released at 254°. The clutch dog becomes fully engaged and the selector clutch gear starts to operate at 271°.

The type characters are positioned on the type wheel in such a manner that, when the selector clutch gear starts operating at 271°, the type wheel will be in position to print /, J, A, or 1 depending upon whether the print magnet receives a 0, 11, 12, or N impulse at the second energization (Figure 214).

According to machine operation the print clutch becomes engaged and causes the printing to take place as a continuation of the above operations. For the time being, however, discussion will include only the operation of the selector clutch gear.

Operation for Printing a 7

Referring again to the chart (Figure 227) it can be seen that when a 7 impulse is received by the print magnet, the number 1, 2, and 3 analyzer pawls are at their highest position because of the position and contour of their corresponding analyzer cams. When the analyzer pawl link operates and pivots the analyzer pawl latches, the latches for analyzer pawls 1, 2, and 3 will latch the corresponding pawls. Thus, as a result of a seven impulse to the print magnet, analyzer pawls 1, 2, and 3 are latched. The selector clutch operating link is under control of the trip cam and analyzer pawl 8 only. According to the chart (Figure 227) analyzer pawl 8 does not reach an intermediate or high position after the trip cam is in position for testing until 164°. This is the time for testing for a 7. In other words if a 7 is to be printed, the selector clutch dog must be released at this time. Since analyzer pawl 8 is the lone controlling pawl, as soon as the intermediate position of this pawl is reached, the selector clutch operating link will operate in conjunction with the trip cam and cause the selector clutch dog to become engaged. The usual overlap of the clutch dog to the reamer flutes is necessary as in any clutch mechanism at engagement time. Consequently, it is not until 179½° that the selector clutch dog has come face to face with the reamer flutes to actually operate the selector clutch gear.

With the selector clutch gear starting to operate at 179½°, the type wheel, which is geared to the selector clutch gear, will be in position to print an X, P, G or 7 at printing time depending upon the second impulse to the print magnet (Figure 230). This second impulse (0, 11, 12 or N) to the print magnet causes the print clutch to become engaged and complete the printing operation.

From the above it is apparent that 1-9 impulses to the print magnets, whether from the card, counter, storage unit or emitter, will cause one or more analyzer pawls to be latched. The remaining analyzer pawls, working in conjunction with each other and the trip cam, will cause the selector clutch operating link to release the selector clutch dog at the proper time for the selector clutch gear to position the type wheel for the desired character.

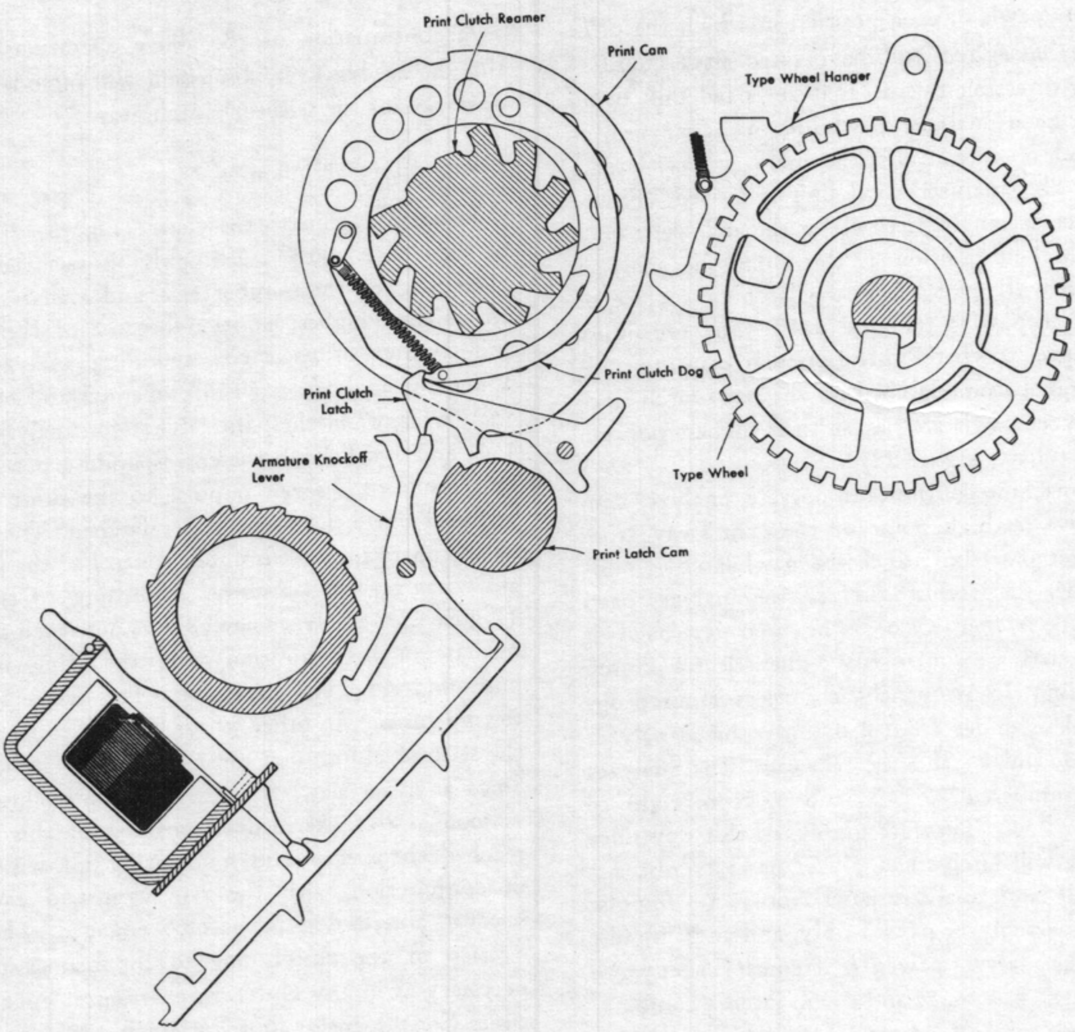


Figure 230. Print Cam Operation

It should be noted from the chart (Figure 227) that the trip cam does not start to test until after the 4 impulse has had time to be effective, because of the special character combinations using 8 and 4, with or without zone impulses. Consequently, both the 8 and 4 impulses must have ample time to set up the analyzer unit before any testing is done. In the meantime the 3 impulse is in the process of setting up the analyzer unit. As mentioned before, testing is the process of determining when the selector clutch operating link should operate and in turn cause the selector clutch dog to be engaged. For example, when testing for a 9, the trip cam, in conjunction with the four analyzer pawls, checks whether the pawls are in position to allow the selector clutch operating link to operate at 134°. If the type wheel is to print a 9, or a letter using 9 as the lower punch, the selector clutch dog must be released at 134° which is 9 testing time. Releasing the selector clutch dog at 134° causes the selector clutch gear to operate at 149½°. Remember that the selector clutch gear must position the type wheel to print in one of four places. It is the function of the print cams to pick up the individual position. This operation is described in the next section.

Print Cam Operation (Figure 230)

While the analyzer unit delays the release of the selector clutch dog until the proper test has been made, the 0, 11, 12 or N impulse is received by the print magnet.

The energization of the print magnet causes the print magnet armature to operate the analyzer pawl link. The analyzer pawl link pivots the armature knockoff lever which also operates as a stop for the print clutch latch. This causes the print clutch latch to release the print clutch dog and allow it to become engaged with the print clutch reamer. There is no delay here except for the time needed to have the clutch dog come face to face with the reamer flutes as a result of the overlap at the time the impulse is received.

The print cam may begin to rotate at 155°, 170°, 185°, or 200°, depending upon when the impulse is received (Figure 227). The N (machine) impulse comes through to the print magnet on every cycle that a previous impulse has been received by the print magnet. However, if the 0, 11, or 12 impulse is received, the N impulse will have no effect on machine operation as the zone impulses come through first.

Since the print cam may start turning at four different times, the high point of the cam can come in contact with the type wheel hanger at four different times, namely, 300°, 315°, 330°, and 345°.

At the time the selector clutch dog is engaged with the selector clutch reamer, the movement of one flute of the reamer moves the type wheel through four character positions. The movement of one flute at this time equals 15°. The movement of one flute of the print clutch reamer also equals 15°. If these speeds remained the same through printing time, only one of the four characters could ever be printed, and even that would be a poor specimen. Therefore, the type wheel must be slowed down at printing time to allow the print cam to operate against the type wheel hanger at any one of four times while the type wheel is moving four character positions; this is equivalent to the movement of one flute. This is accomplished by a variable speed drive which reduces the speed of the selector clutch gear and the type wheel to one-quarter the speed when selecting; this is also one-quarter of the speed of the print cam reamer. Consequently, the print cam reamer will travel four flutes in the same length of time that it takes one flute of the selector clutch reamer to move during printing time. Thus, one flute of the print clutch reamer will move for each individual character position of the typewheel.

When the print cam starts operating at the earliest time, the type wheel is cammed against the platen when the first character of the group is in line with the platen. If the print cam starts turning at the next starting time (when the dog is engaged with the second flute of the print clutch reamer), the print cam will operate against the type wheel hanger when the second character of the group is opposite the platen. Because of the reduction in the speed of the selector clutch gear, the type wheel moves only one character position for each flute movement of the print clutch reamer and print cam.

Operation for Printing a G

By referring to Figure 213 and the chart in Figure 227, the sequence of operation for printing the letter G (as an example) can be followed.

At 37° the print magnet receives the 7 impulse which is the lower value of the letter G. The chart (Figure 227) indicates that the analyzer cams are holding the analyzer pawls 1, 2 and 3 in their highest position at the time the print magnet receives the impulse at 37°. The operation of the analyzer pawl link will cause the analyzer pawl latches to pivot. Since analyzer pawls 1, 2 and 3 are at their highest position, the analyzer pawl latches for those positions will pivot below the latching surface of the analyzer pawls. As the machine continues in operation and the analyzer cams change their position, analyzer pawls 1, 2, and 3 will remain in the upper or latched position because of the analyzer pawl latches. This means that analyzer pawls 1, 2, and 3 will not follow the contour of their respective analyzer cams. However, analyzer pawl 8 will be free to follow the contour of analyzer 8 cam. Thus with analyzer pawls 1, 2 and 3 latched, it only remains for the analyzer pawl 8 to be moved to its intermediate position by the analyzer cam to allow the selector clutch operating link to move to the left in conjunction with the trip cam. Moving the selector clutch operating link to the left releases selector clutch dog. As shown by Figure 227, analyzer pawl 8 does not reach the intermediate level until 164° which means that the selector clutch operating link will not release the selector clutch dog until that time. This will allow the clutch dog to be engaged with the selector clutch reamer and start the selector clutch gear and type wheel turning at 179°. When the clutch dog drops in the reamer at that time, it causes the type wheel to be in position to print an X, P, G or 7 depending upon whether a 0, 11, 12 or N impulse is received.

In the meantime, since it is assumed that a G is to be printed, the second impulse to the print magnet is a 12 impulse. This impulse energizes the print magnet at 172°. This will have no effect on the selector clutch since none of the analyzer pawls are at their highest position. In this specific case, the clutch is engaged at this time and would have no effect, regardless of the position of the analyzer pawls. However, the print clutch dog for the print cam will be tripped at this time and engaged with the print clutch reamer, causing the print cam to start operating at 185°. As the high point of the print cam strikes the type wheel hanger, the type wheel is forced against the platen by the momentum of the assembly.

As the high point of the cam approaches the type wheel hanger, the speed of the selector clutch gear and the type wheel is reduced to one-quarter speed. This allows the print cam to operate against the type wheel hanger at a time when the proper character is lined up with the platen. In this assumption, a G is lined up with the platen at the time the type wheel hanger is cammed by the print cam. The reduction in speed of the selector clutch gear allows the movement of one character for each 15° of the index which also corresponds to one flute movement of the print cam reamer.

As the type wheel hanger is rocked toward the platen, the type wheel tends to rotate in a clockwise direction since the type wheel is meshed with the selector clutch gear. At the same time the selector clutch gear tends to turn the type wheel in a counterclockwise direction. At printing time the movement of each is equal and, since one is acting against the other, the type wheel movement is lateral. Thus, at printing time the type wheel is stationary.

Print Clutch Latch Cam

By referring to Figure 230 and to the chart (Figure 227) it can be seen why the print clutch dog is not released while the 9 through 1 impulses energize the print magnets. The analyzer pawl link operates the armature knockoff lever which also acts as a stop for the print clutch latch, but the print clutch latch cam is positioned at this time to prevent the print clutch latch from releasing the print clutch dog. It is not until 149° (after the 1 impulse has been received) that the print clutch latch cam is positioned to allow the print clutch dog latch to operate.

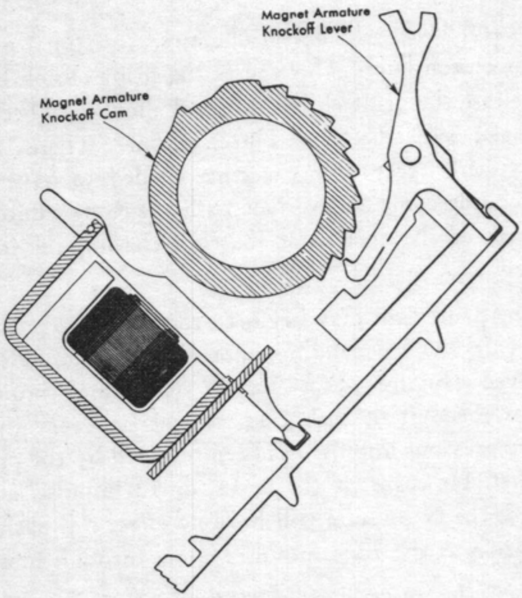


Figure 231. Print Magnet Armature Knockoff

Magnet Armature Knockoff Cam (Figure 231)

It is very necessary that the print magnet armature be attracted only for the duration of one impulse. Otherwise improper analyzer slides will be latched and the wrong character will be printed. The magnet armature knockoff cam is provided to prevent this. Figure 227 shows the time of the operation of the cam. The cam operates to force the armature away from the print magnet core after each lower reading (9 through 1) and before the 9 impulse. The knockoff is not necessary after zone impulses since they do not affect the analyzer slides. There is one more knockoff operation which takes place after a carry impulse. As will be noted in the circuit section, during a carry operation it is possible to energize the print magnet, depending upon the control panel wiring. This impulse at carry time (307°) does not affect the print unit. If the print magnet armature were not restored, the 3 and 8 analyzer slides might become latched at 337° which is the special symbol impulse time. The knockoff operation before 9 time is necessary because of the special symbol impulse coming through at 337° when printing the special dollar, decimal and comma symbols.

Trip Cam

The trip cam is used to test for the operating time of the selector clutch operating link. The trip cam arm follows the contour of the trip cam. At twelve definite positions the trip cam arm tests to see if the analyzer pawls are in position to allow the selector clutch operating link to move to the left. The trip cam controls the time that the selector clutch operating link is allowed to move. The selector clutch operating link must move to unlatch the selector clutch dog at the proper time to allow the selector clutch dog to engage with the proper flute to print the character for which the print magnet is impulsed.

The trip cam and the analyzer pawls operate in conjunction with each other. All pawls must be clear

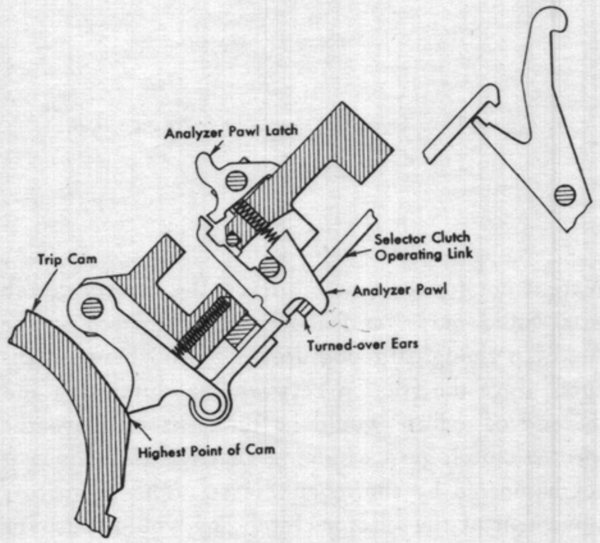


Figure 232. Unlatching Analyzer Pawl

of the selector clutch operating link when the trip cam arm reaches a test position if the selector clutch dog is to be unlatched at that time. In this way the trip cam arm holds the selector clutch operating link in such a position that the turned-over ears are not in contact with the analyzer pawls while the pawls are operating. This leaves the pawls free to slide up or down. If the pressure of the selector clutch operating link were operating against the analyzer pawls, the pawls would not be free to operate.

The trip cam also has the function of unlatching all pawls that have been latched during the cycle. This unlatching time takes place at the highest point of the trip cam at 304°. As the trip cam arm operates

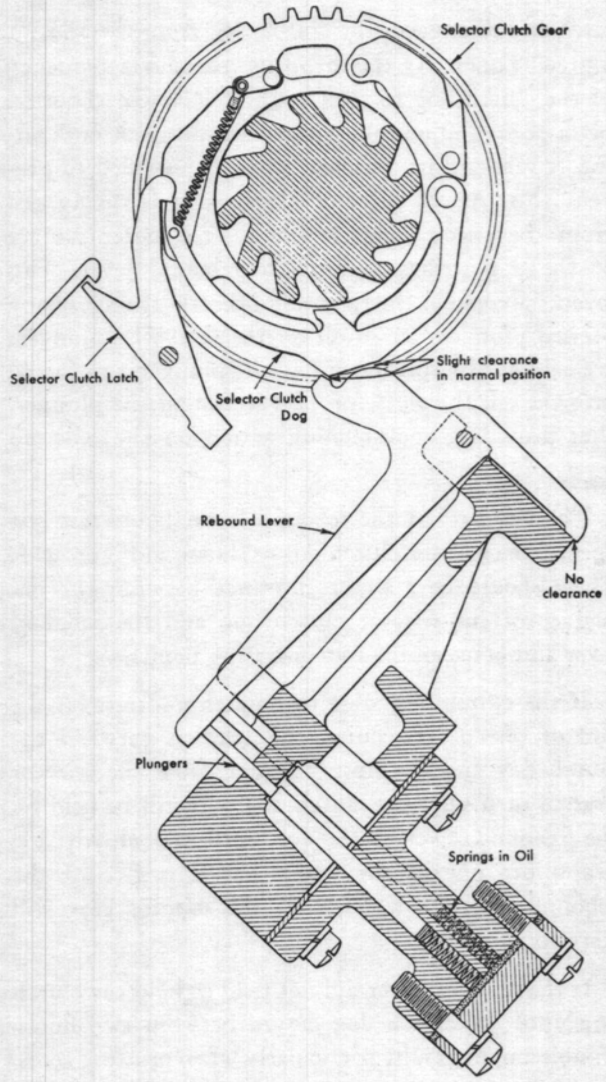


Figure 233. Selector Clutch Gear Rebound Lever

against the high point of the trip cam, the selector clutch operating link is forced to the right. The turned-over ears of the selector clutch operating link operate against the analyzer pawls in the reverse direction and cause them to pivot so that the analyzer pawl latches return to normal (Figure 232).

Rebound Lever (Figure 233)

One complete cycle from the point where the clutch became engaged it becomes disengaged. This is not a complete machine cycle but is one revolution of the selector clutch reamer and selector clutch gear. As the selector clutch gear completes its cycle, the selector clutch dog comes in contact with the clutch latch and disengages the clutch dog from the selector clutch reamer. As this happens, there is a tendency of the clutch dog to rock counterclockwise about its pivot point and unduly stretch the spring. A cushioning or rebound mechanism has been provided to prevent this. As the selector clutch dog is disengaged from the selector clutch reamer, the outer surface of the dog strikes against the rebound lever. This lever is pivoted at the right and operates against spring pressed plungers set in oil on the left. The plungers are held out by springs and, as the plungers are forced into the oil, the oil is forced out around the plunger, thus providing a cushioning action on the rebound lever and dog.

The left part of the rebound lever should not rest against the selector clutch dog as shown in Figure 233. There should be a slight clearance between the flat surface of the selector clutch dog and the rebound lever and between the two operating points.

If the clutch dog were to unlatch and rest on the end of one of the flutes, the friction between the clutch dog and the flute will not cause the selector gear to turn since the clutch dog will still be held by the rebound lever. It is not until the clutch dog drops into one of the flutes that it is free of the rebound lever, at which time the selector gear will start to turn.

If the rebound lever did not tend to hold the clutch dog until the clutch dog moved between two flutes, trouble might result, particularly when printing zeros.

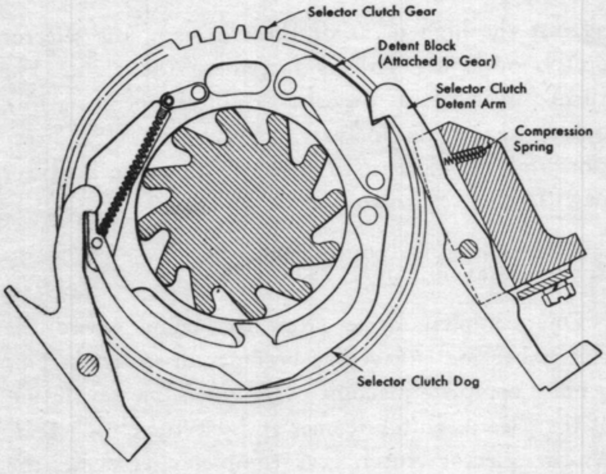


Figure 234. Selector Clutch Gear Detent

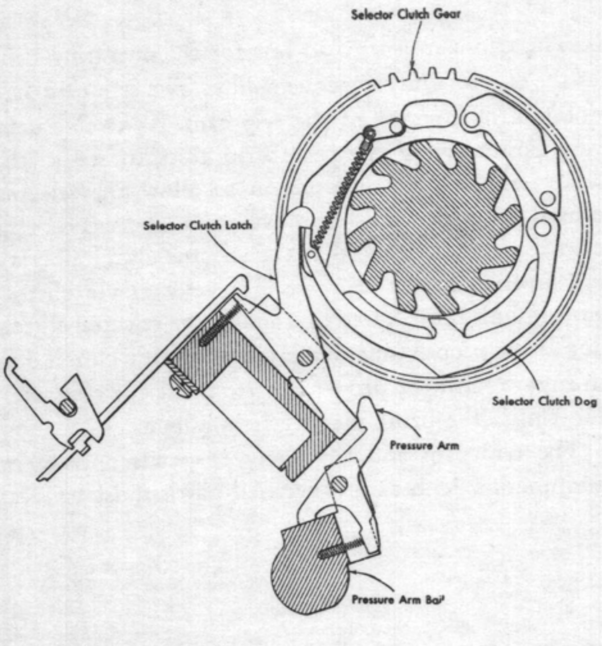


Figure 235. Selector Clutch Latch Pressure Bail

Were it not for the rebound lever, the selector clutch gear would move immediately upon unlatching the dog even though the dog does not drop between the flutes, since the friction between the clutch dog and the end of a flute would be sufficient to move the selector clutch gear, assuming that the clutch dog is not hampered by the rebound lever. This premature movement of the selector clutch dog would cause the type wheel to move too much and the printing would be out of alignment, particularly in instances where the type wheel moves very little before the printing takes place, as when printing zeros.

Selector Clutch Gear Detent (Figure 234)

As the selector clutch gear is stopped, there is a tendency for the gear to rebound counterclockwise. This action is prevented by the operation of a spring pressed detent into the detent block which is secured to each gear. This detented position also holds the selector clutch gear in such a position that the clutch dog is held clear of the selector clutch reamer which prevents the dog from riding on the reamer flutes and causing a nipping action.

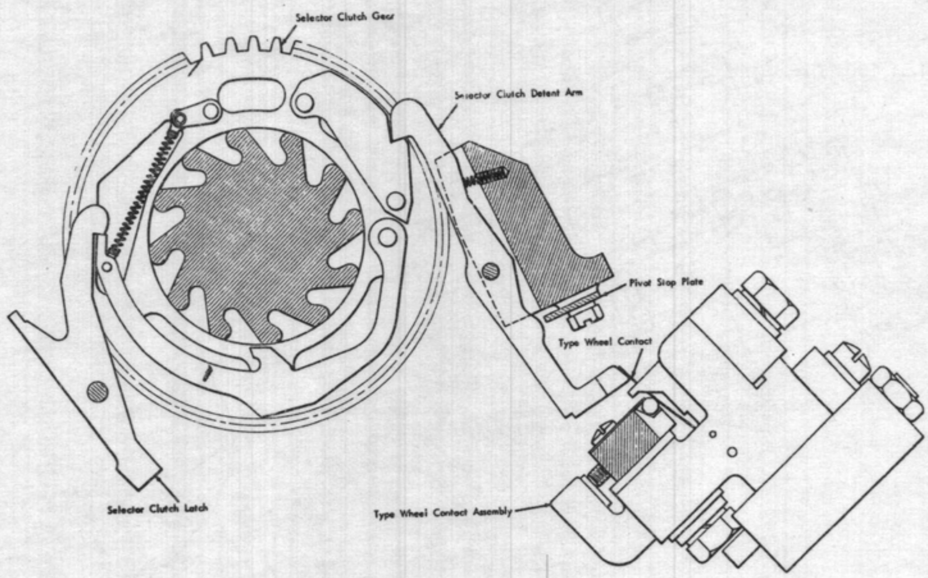


Figure 236. Type Wheel Contact Assembly

Selector Clutch Latch Pressure Bail (Figure 235)

In order to insure that the selector clutch latches are in the path of the free end of the clutch dog as the selector clutch gear completes its cycle, the selector clutch latch pressure bail has been installed. The purpose of this bail, which has pressure arms under spring tension operating against the clutch latches, is to keep constant pressure on the clutch latches after the trip cam has unlatched the analyzer pawls. This takes place from 315° to 107°. During the tripping time of the selector clutch dog, the bail is not effective since it would tend to prevent the selector clutch dog latch from operating. This bail is cammed to give pressure at the proper time and to be ineffective at other times.

The pressure arms are spring loaded to allow the high center portion of the selector clutch dogs to pass. Since the selector gears can be started at so many different times in the cycle, it follows that they will be latched at various times in the cycle. The pressure arms must be in position for latching some selector clutch dogs while the high section of other selector clutch dogs will be passing the pressure arms.

Type Wheel Contact (Figure 236)

The type wheel contacts, one for each type wheel are normally open points which are closed as the selector clutch gear starts to revolve. These contacts are operated by the selector clutch detent arm of each printing position. As the selector clutch gear revolves, the detent arm moves out of position and allows the contact to close.

These contacts complete a circuit for each lower punch impulse (9-1) at 150° *after* the original impulse is received from the card, counter, storage unit or emitter. For example, a 6 impulse at 52° to the print magnet will cause the type wheel contact to emit a 6 impulse at 202° (52° + 150°). This delayed impulse may be used to add into the counter since the counter has two distinct adding periods within one machine cycle.

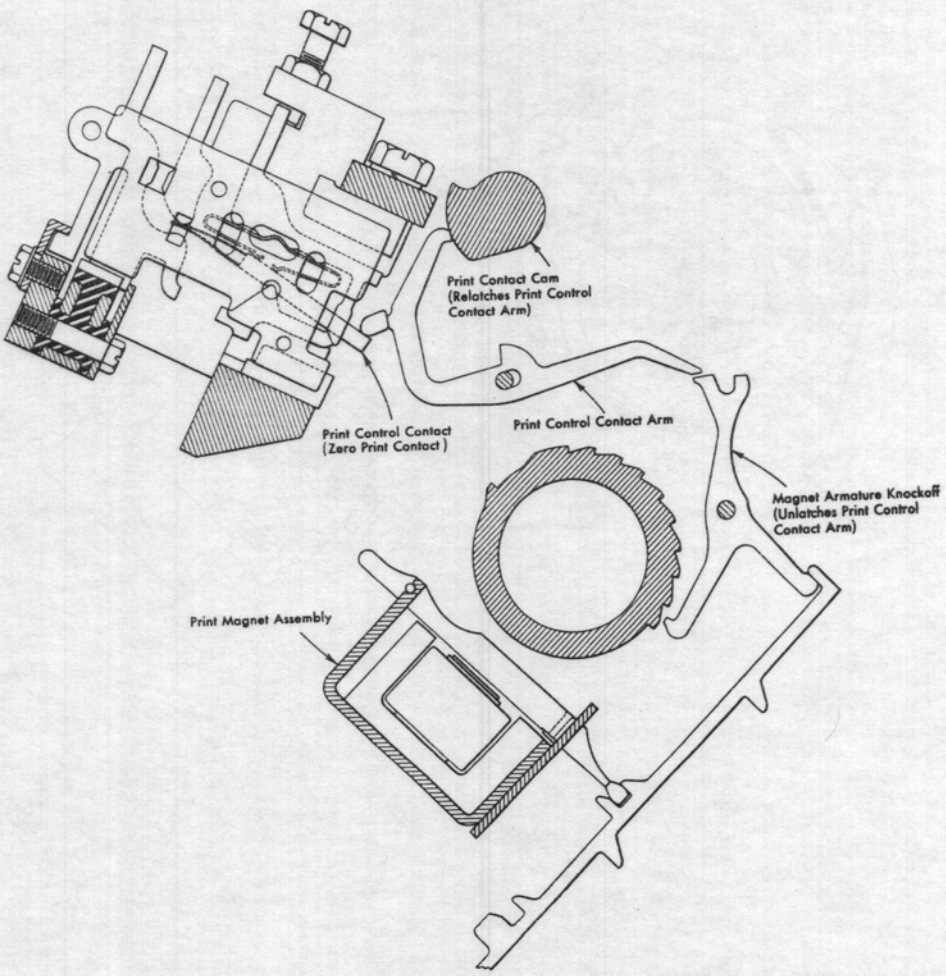


Figure 237. Zero Print Control Contact Assembly

Zero Print Control Contacts (Figure 237)

There are 120 zero print control contacts, one for each type wheel position. The zero print control contacts are transfer contacts which operate as a result of the energization of the print magnet. The purpose of these contacts is to control zero printing to the right and left of significant figures as well as special characters, such as asterisks (*), decimals, and commas. When the print magnet is energized in the usual manner, the contacts are transferred. This signals the adjacent positions that something is about to be printed in the position where the zero print contact transferred. These contacts in conjunction with the ZERO PRINT CONTROL hubs are used to control printing as desired.

These contacts are adjusted so that the normally open side closes before the normally closed side opens. This is done to prevent breaking the circuit to the print magnet during its normal energization.

One exception to the above statement, that the zero print contacts transfer whenever the print magnet is energized, occurs when the print magnet is energized at 337° for special symbol printing. The zero print contacts do not transfer at this time because the print contact cam prevents the print control contact arm from operating and transferring the contacts. This is done to prevent printing certain symbols when no other figures are being printed.