

## PUNCHING MECHANISMS

A PUNCHING mechanism is designed to cut a hole in some material such as paper, metal, or, as in IBM machines, card stock. A common and typical punching device is a conductor's hand punch; another would be a three-hole paper punch.

There are three basic elements of any punching device: a punch, a die, and a stripper. These three elements are also present in IBM punches. The punch is the piece which is driven through the card and cuts the hole. The die serves as a base, supports the card while it is being cut, and helps to determine the shape and size of the hole. The stripper serves as a guide for the punch and as a means of stripping the card from the punch after the latter has cut the card. Figure 62 shows the components of a punching mechanism.

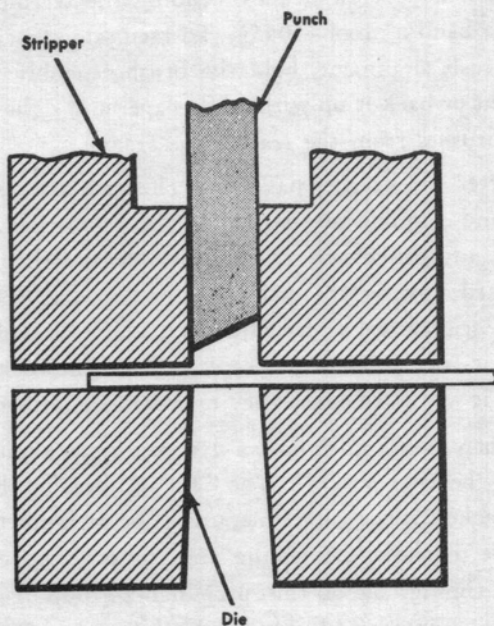


Figure 62. Elements of a Punching Device

### Punch Control

Power must be applied to the punch so that it will cut the hole in the card. The hand provides the driving force in the case of the conductor's hand punch. Punches are driven automatically by a mechanical

means in IBM machines. It is necessary that punching be controlled to punch the correct information at the proper time. The control may be either electrical or mechanical. The impulses which are available as a result of sensing holes in a card may control punching mechanisms. The punching mechanisms can also be controlled by an operator depressing a key on a key-driven card punch.

### Punch Requirements

There are three main requirements of IBM punching mechanisms: first, the mechanism must cut clean holes in the card; second, the holes are to represent transcribed data and, third, the hole must be cut in accurate registration.

### Punching Sequence

The punching of the card can occur in one of two sequences depending on the type of feed used. The cards can be punched in a column-by-column sequence which requires 12 punches, one for each punching position in a column. The cards can also be punched in a digit-by-digit sequence which requires 80 punches, one for each column.

### COLUMN-BY-COLUMN PUNCHING

IN A COLUMN-BY-COLUMN punching sequence, the machine has 12 punches mounted in a row to correspond to the 12 punching positions on the card (Figure 63).

### Type 31 Punch Selection

The method of selecting the proper punch is also illustrated in Figure 63. Assume that the motor plate, which is normally in a position  $1/2''$  above the tops of the punches, has a stroke of  $1/4''$ . None of the punches will be struck by the plate when it descends; however, if an interposer  $3/8''$  thick is moved into position over the top of any of these punches, it will depress that particular punch without disturbing the others when the plate descends (Figure 64). This interposer principle of selecting the punch to be operated is generally applied in all IBM card-punching machines in one form or another.

Type 31 Punch Operation

On some key-driven card punch machines there are 12 interposers, each individually operated by a key on the keyboard. The sketch in Figure 65 represents one such position.

As the key is depressed, it operates the bell crank to move the interposer to the left under the motor plate. When the motor plate descends, the punch corresponding to the key depressed will be forced through the card. Similarly, if any other key is depressed, its interposer moves forward to be depressed by the motor plate, and a hole will be punched in the card corresponding to the key selected. Note the felt pad through which the punches are inserted just above the stripper. This provides a means of lubricating the punches, as this pad can be kept saturated with light oil.

The motor plate is operated through a linkage by a two-coil punch magnet mounted under the base. As the key is depressed and the corresponding interposer moves forward, the interposer pushes the con-

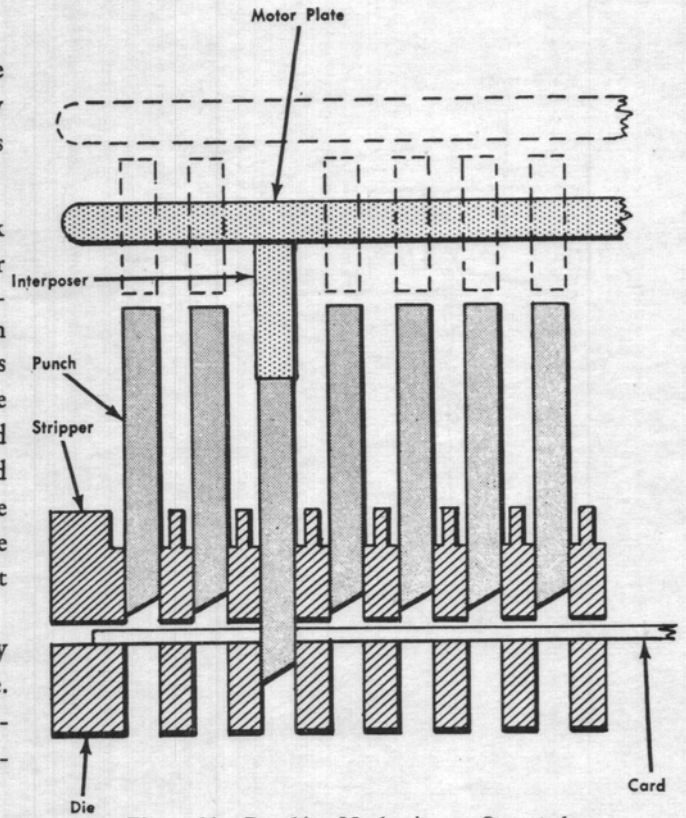


Figure 64. Punching Mechanism — Operated

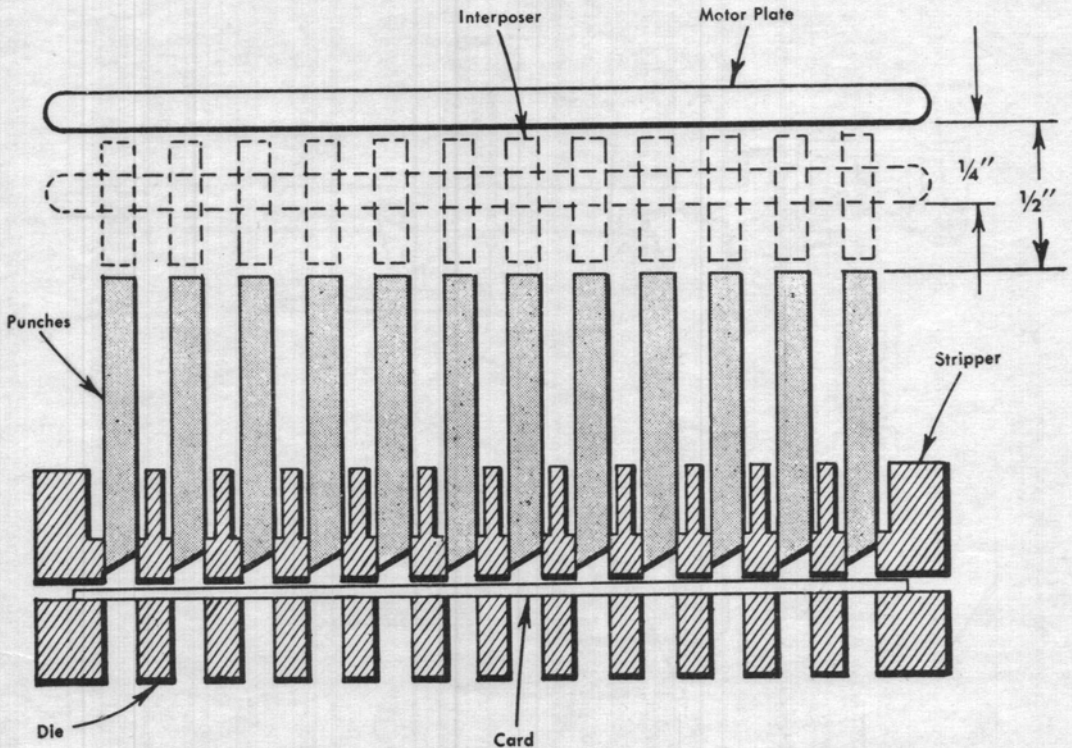


Figure 63. Punching Mechanism — Normal



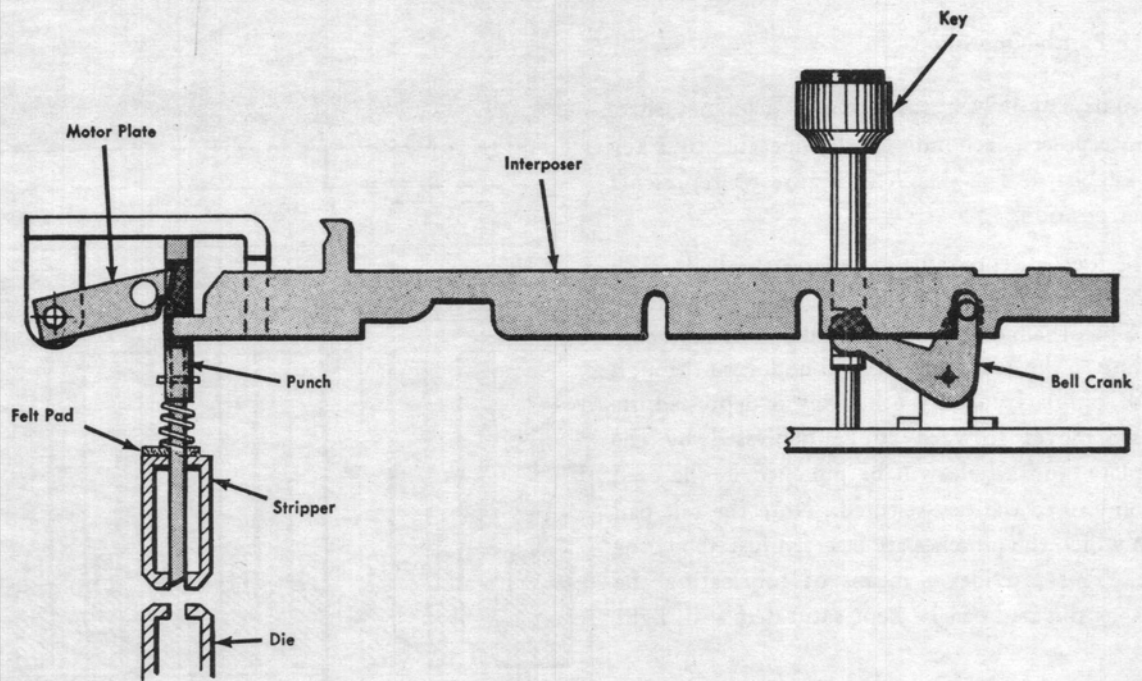


Figure 65. Interposer Operation

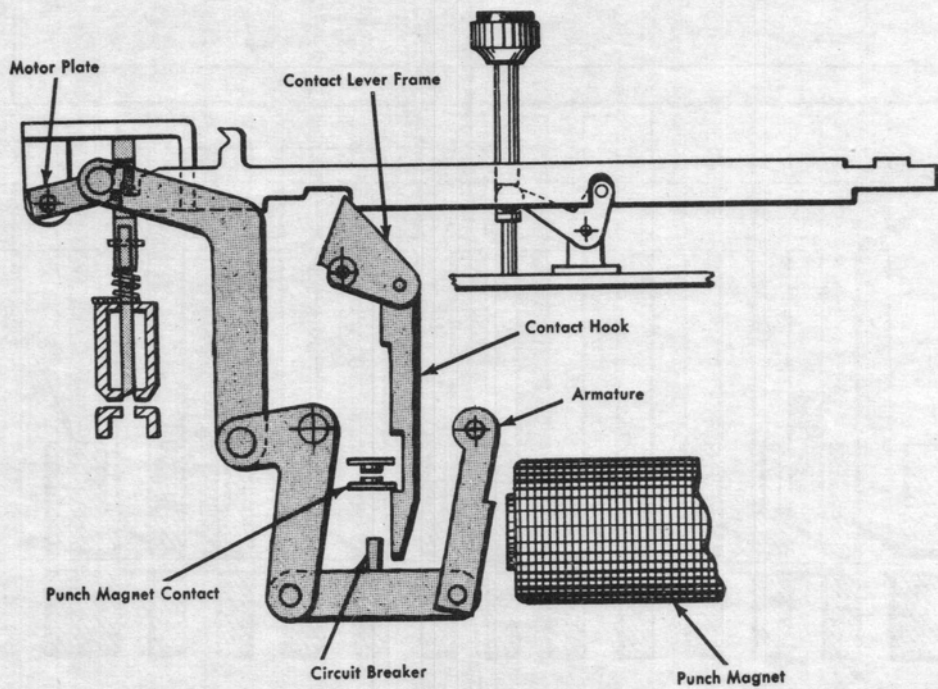


Figure 66. Punch Operating Mechanism — Normal

tact lever frame forward (Figure 66). The contact lever frame then revolves about the pivot shaft and lifts the contact hook, closing the punch magnet contact. When this contact closes, it energizes the punch magnet which attracts the armature to its cores. This movement operates through the linkage shown in Figure 66, pulling down on the motor plate which, in conjunction with the interposer drives the proper punch into the die.

When the punch magnet armature has reached the limit of its travel, the circuit breaker operates against the foot of the contact hook and allows the punch magnet contact to spring open, de-energizing the punch magnet. The armature, now released, is pulled back to its original position by the armature return spring (Figure 67). The motor plate and linkage are thereby returned to their original positions.

The punch spring pulls the punch out of the card and returns the punch to its normal position. To assure positive restoration, however, the motor plate on its upward stroke engages with the top of the punch. This insures the punch will be out of the card before the card advances to the next column. The interposer spring pulls the interposer back to its normal position and, through the bell crank, returns the key. The contact hook spring pulls the contact hook down and

against the punch magnet contact; the entire mechanism is then back in its original position and ready for the next key to be depressed. This mechanism is found in the Type 16 and 31 Card Punches.

#### Type 31 Spacing

The spacing mechanism is also operated as a result of the punching operation. Figure 68 shows the motor plate connected to a space bar by means of a stud in a slot. As the motor plate moves down to drive the punch through the card, the space bar adjusting screw moves down against the rock shaft spindle. As the rock shaft spindle rotates, it causes the escapement to move down into the rack, and the dog is lifted out. As punching is completed and the motor plate moves up, it permits the escapement to move up out of the rack teeth, and the dog to move down to engage the next tooth in the rack. This results in a card movement of one column and puts the card in a position to receive the next punch.

#### Type 24 Punch Selection

The Type 24 and 26 Card Punches have still another type of punching mechanism. Figure 69 shows the essentials of the Type 24-26 punching mechanism.

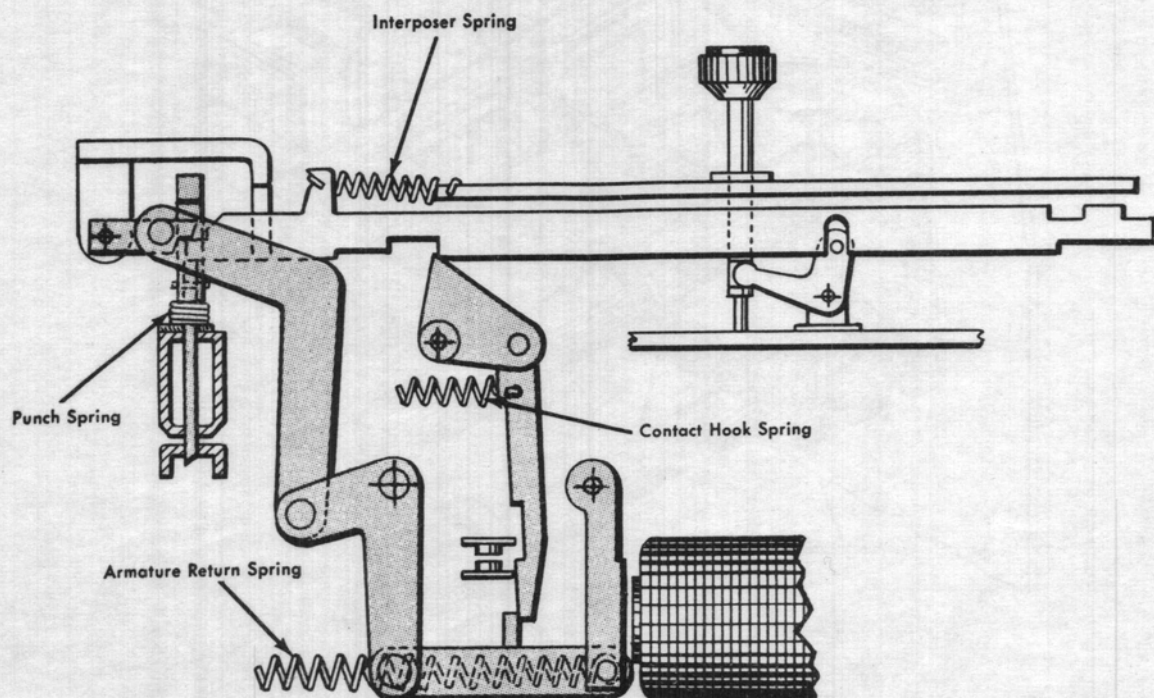


Figure 67. Punch Operating Mechanism — Operated



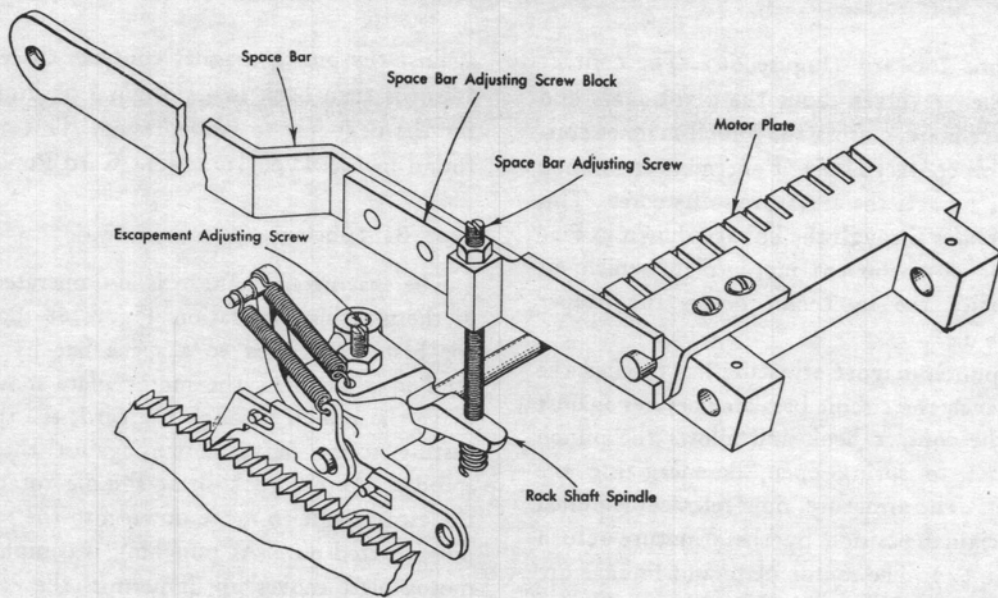


Figure 68. Spacing Mechanism

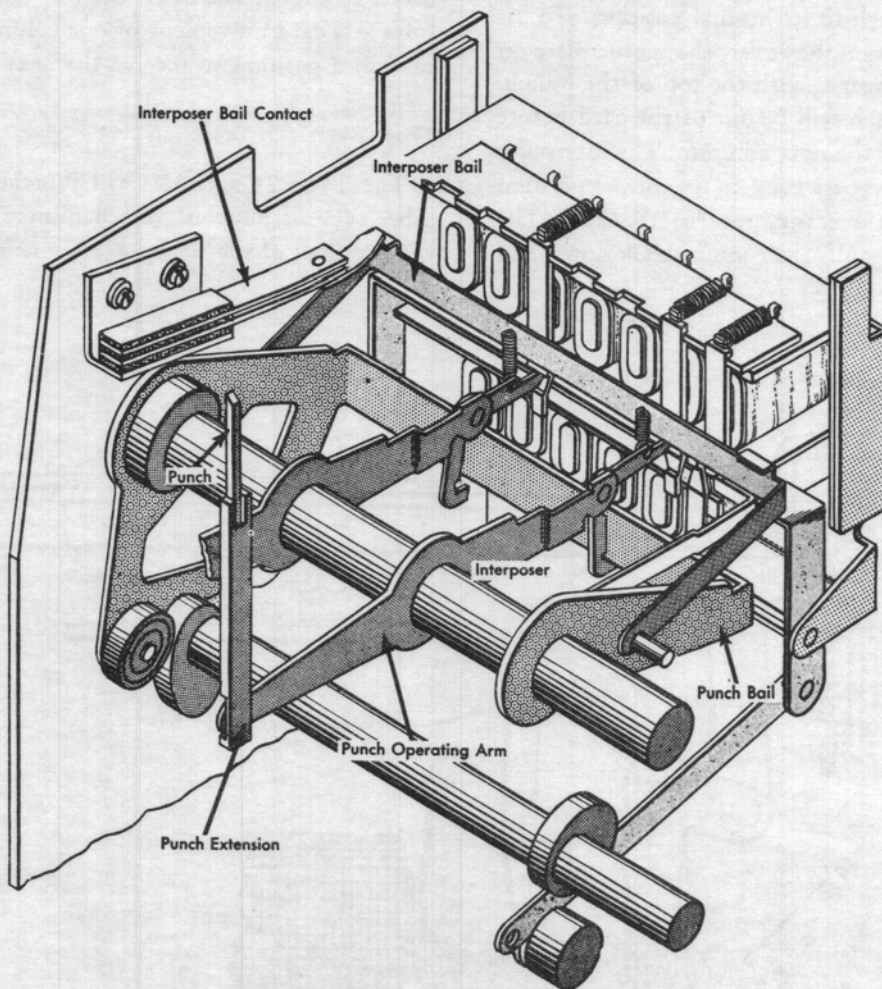


Figure 69. Type 24 Punch Mechanism

Like the Type 31 punching mechanism, this mechanism contains 12 punches (one for every punching position), 12 punch extensions, 12 punch operating arms, 12 interposers, but only *one punch bail*. Figure 70 is a side view of the punching mechanism in the normal position and with the punch clutch latched. A punch interposer magnet is energized to make the mechanism operative, and, in a manual operation, is the result of a key being depressed. The energization of this punch interposer magnet starts a train of events that leads to the punching of that particular digit or digits. It can be seen from the figure that, as a result of energizing the punch interposer magnet, the armature moves toward the magnet. This permits the interposer to rotate clockwise under spring tension up against the interposer bail which moves up and closes the bail contact. At the same time, the hook on the other end of the interposer moves under the punch bail. The closing of the bail contact results in the energization of a space magnet, moving the card one column. The action of the space magnet armature closes a contact which ener-

gizes the punch clutch magnet. The punch clutch will engage, causing the complimentary cams, which drive the punch bail, to make one revolution.

#### Type 24 Punch Operation

The punch bail is driven downward by one of the complimentary cams and returned to a normal position by the other. When the punch bail moves down, it pulls down the interposer that was hooked under it. The interposer pinned to the punch operating arm causes the left end of the punch operating arm to move down. Because the punch operating arm pivots about a shaft, the right end moves up. The extreme right end of the punch operating arm, which drives the punch extension, is in a slot in the punch extension. Consequently, the punch moves up. When the punch moves up into the die it cuts a hole in the card. As the cams continue to turn, the punch bail begins to move up, pulling the punch and punch extension down and out of the card. At the same time, the interposer is moved up until it strikes the notch in the armature. This stops the left end of the inter-

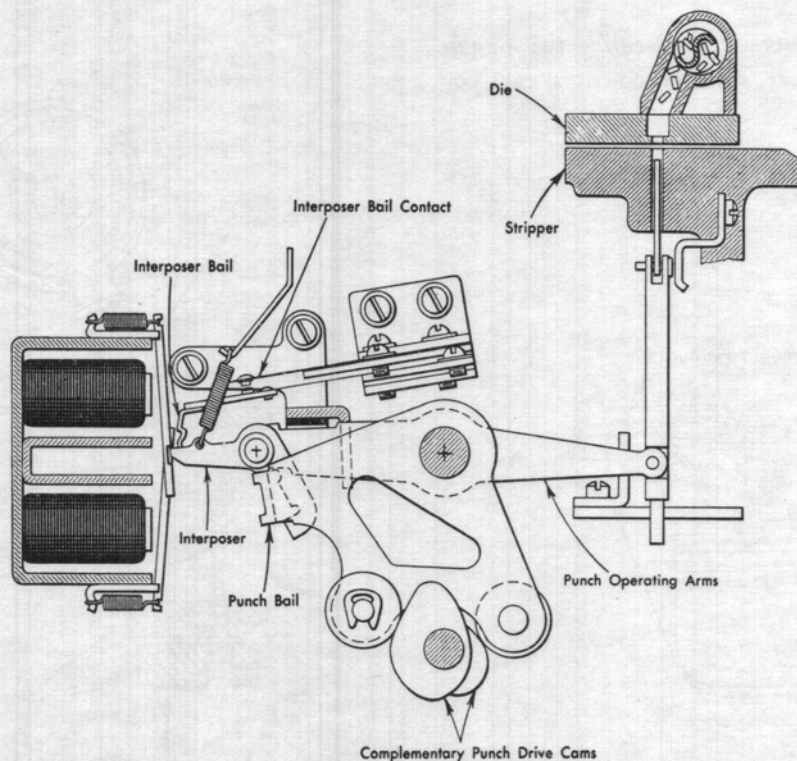


Figure 70. Type 24 Punch Mechanism



poser, but the bail continues to move up as well as the pivot point of the interposer. The right end of the interposer, therefore, will move out from under the punch bail, and the punch clutch will latch completing the punch cycle.

#### TYPE 24 SPACING

When a key is depressed, an interposer magnet is energized, trips the interposer bail contact, and energizes the escape magnet (Figure 71). The escape magnet armature pulls out of a tooth in the escape wheel, allowing it to rotate through force from the friction drive. At the end of the escapement armature travel, the armature pin closes the escapement contact and picks up the circuit to release the escape magnet. The time interval is short enough to drop the escape armature back in approximately the center of the next tooth of the escape wheel. Each tooth on the escape wheel causes the escapement gear train and feed rolls to advance one card column. To skip, it is necessary to hold the escape magnet energized, thus allowing the escape wheel to rotate freely at its maximum speed of 12 ms. per column over the desired number of columns. This method is also used to skip between cards.

The escape magnet contact energizes the punch clutch magnet; therefore, the escapement always occurs before punching.

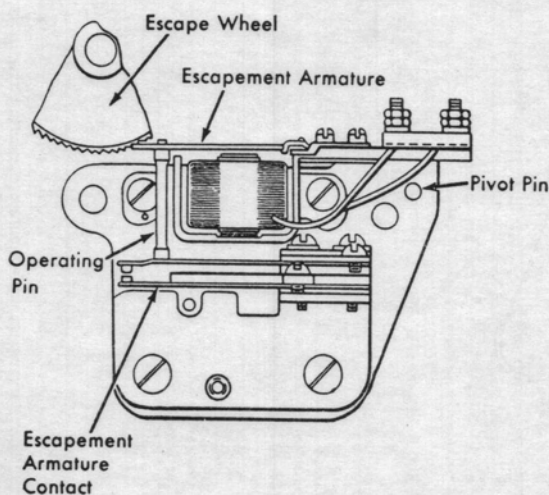


Figure 71. Escapement Magnet Assembly

#### DIGIT-BY-DIGIT PUNCHING

THE TYPES 513, 514, 519 are high speed punching machines, and the punching takes place in a digit-by-digit sequence with the cards feeding 12-edge first, so that the 12 is the first punching position to reach the punching station. At the punching station there are 80 punches, one for each card column. All like digits are punched simultaneously, i. e. all 12's punch, the card moves one cycle point; all 11's punch, the card moves one more cycle point; all 0's punch, etc., until the card has been completely punched with the desired data. The card must be at rest when punching occurs. The necessary intermittent motion of the card is provided by a geneva driving mechanism which will be studied later.

#### Type 513 Punch Selection and Operation

Figure 72 shows a schematic of the 513 punch mechanism with the magnet in a de-energized position. It has been pointed out that it must be possible for punching to take place every cycle point. The

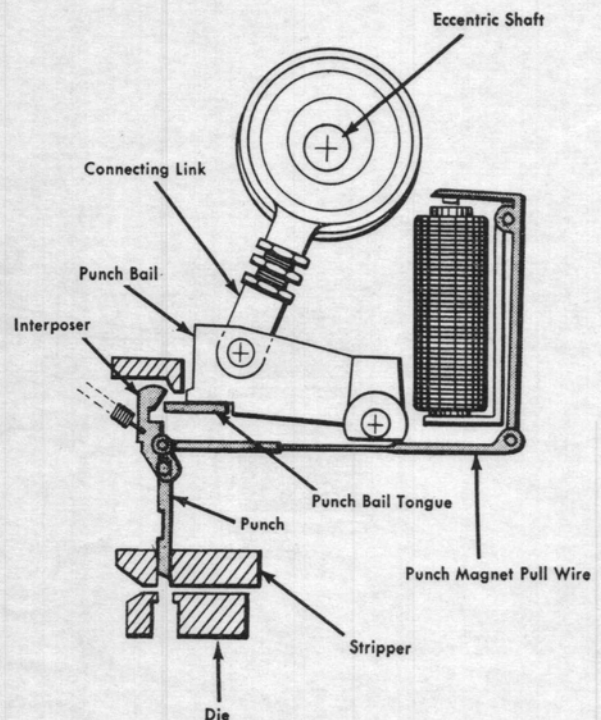


Figure 72. Type 514 Punch Mechanism — Normal

eccentric shaft is geared so that it makes one revolution for each cycle point. The eccentric shaft is connected by connecting links to the punch bail which has a reciprocating motion as a result of the rotation of the eccentric shaft. It can also be seen in the same figure that, as the eccentric shaft rotates and the punch bail and punch bail tongue move up and down, no punching takes place. If, however, the punch magnet is energized, the armature is attracted to the core and the pull wire is moved to the right. Then the interposer is pulled to the right and, as the punch bail tongue moves down during that cycle point, it engages the interposer. The interposer is driven down and, because the punch is connected to the interposer, it is driven down into the die. Figure 73 shows the punch unit with the magnet energized

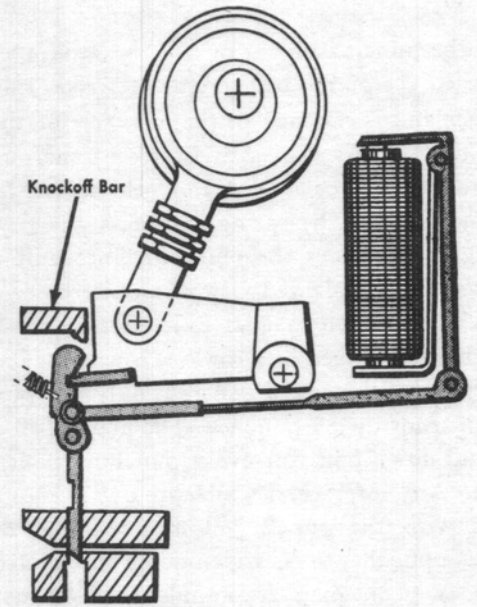


Figure 73. Type 514 Punch Mechanism — Operated

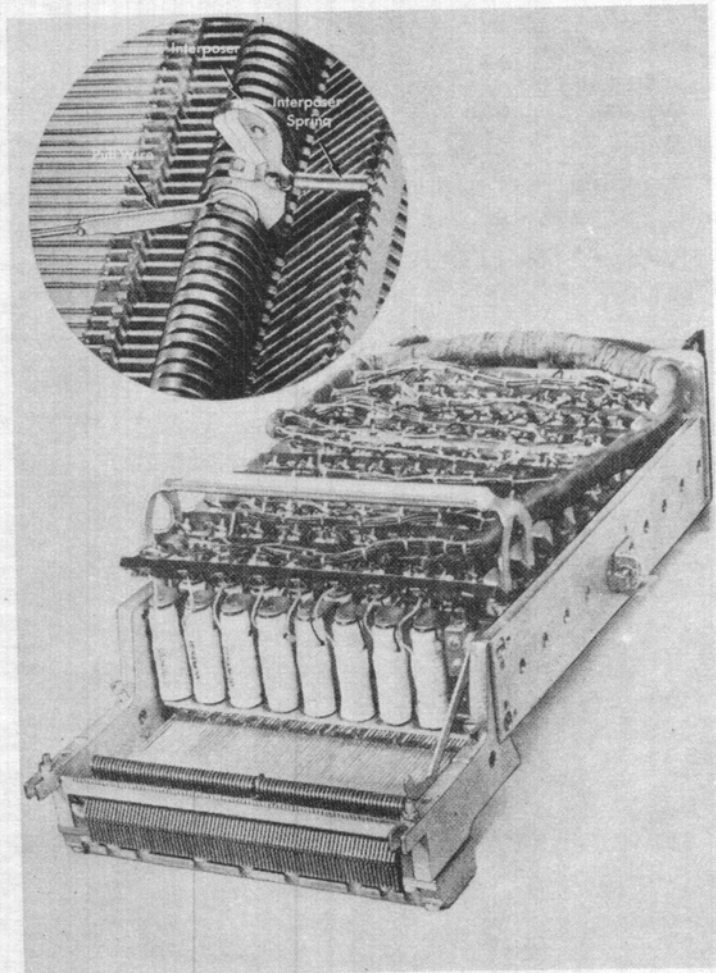


Figure 74. Type 514 Punch Magnet Unit



and the punch bail down. As the interposer moves up with the punch bail tongue, it strikes the knock-off bar and is cammed to the left, free of the punch bail tongue. As soon as it is free of the punch bail tongue, it will be moved and held to the left, in a normal position, by spring tension.

Figure 74 shows the punch magnet unit and the inset shows an enlarged view of an interposer and pull wire. The punch magnet unit contains 80 punches which are arranged in a row, each with its individual interposer and magnet. There is only one punch bail which spans the 80 punches. The punch bail operates up and down once for every punching position of a cycle. Any interposers which are pulled into engagement with the punch bail tongue cause their respective punches to be driven down through the card. Thus, if 80 magnets are impulsed, all 80 interposers are engaged with the punch bail and 80 holes will be punched.

There are three types of punch interposers. One type is used in the first column, another type is used in the 80th column and yet another is used in all columns from 2 to 79 inclusive. The interposer used in the 80th column is provided with a long stud for the eye of the magnet pull wire to prevent it from slipping off the stud. The interposer used in column 1 is attached to the punch to prevent the interposer from slipping off. The other interposers, being protected on both sides by other interposers, do not require any such precautionary design. The three types are shown in Figure 75.

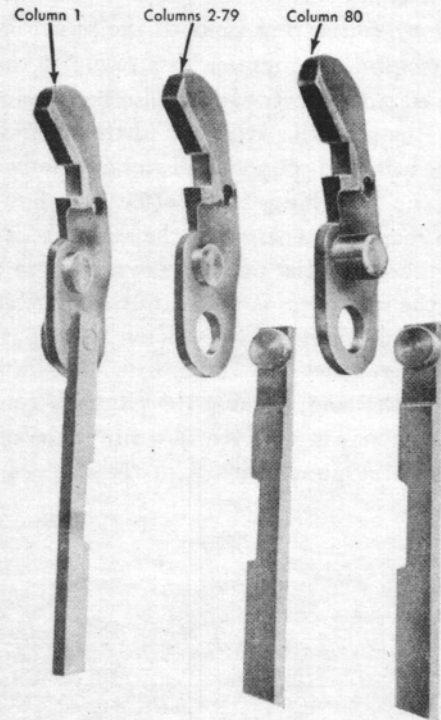


Figure 75. Three Types of Interposers