IBM®

Reference Manual

IBM Operators' Guide

Contents

Skill in operating any machine requires practical experience. But experience alone is not enough. A student operator can become skilled only with a combination of personal instruction, practice, and study of the written manual.

The purpose of this manual is to help you understand how IBM basic data processing equipment operates, and to serve you as a guide during practice sessions. Study of the *Operating Procedure* and *Operating Suggestions* sections will help avoid confusion.

After instruction, practice, and study of each machine, evaluate your understanding of the machine by answering the review questions without reference to the text. When you have learned to answer the questions in your own way, you will approach each machine with confidence, because you will know what you are doing, and why.

Don't be discouraged if you can't immediately remember some of the terms used to describe the various features of the machines. The important thing is to learn where to find them on the machine, and when and how to use them.

From the operator's point of view, learning to operate IBM basic data processing equipment is no more difficult than learning to drive an automobile. The results obtained from each type of IBM machine vary considerably, but the basic operating steps are very much alike. These steps for operating any IBM punched-card machine can be generally classified:

Setting Up the Operation. This includes inserting the proper control panel when one is required, and setting the various switches according to the specific operations to be performed.

Inserting the Cards in the Hopper. The hopper is the part of the machine into which the operator places the IBM cards. Some IBM machines, through which only one file of cards can be processed at a time, have one hopper; other IBM machines, through which two files can be processed (such as reproducers and collators), have two hoppers.

Operating the Machine. The machines are controlled by operating keys which are pressed by the operator. These always include the START and STOP keys. Several machines have additional operating keys, such as RESET and TOTAL keys.

Observing the Signal Lights. Most of the machines have one signal light to indicate that the machine is ready for operation. Other signal lights are provided to indicate various special conditions.

Removing the Cards from the Stacker. The stacker receives the cards after they pass through the machine. Reproducers have two stackers; collators have four or five stackers; sorters have thirteen stackers; other machines have one stacker as standard. The operator removes the cards from the stackers and places them in boxes, trays, or bins for filing or subsequent processing.

Testing the Operation. Operations should be started only after a thorough test of the results of a short trial run. Knowledge of the specific operations to be performed is necessary to test the setup.

This guide gives the information needed to operate IBM data processing equipment. Wiring of control panels is described in manuals for each specific machine or group of machines.

IBM Card Punches and Verifier

Recordkeeping is one of the most important tasks of any business or government agency.

Planning and handling supplies, records, and services of personnel depend on accurate and up-to-date knowledge of details. This, in turn, depends on compilation of reports from written records of many types. IBM data processing equipment is used to great advantage for preparation of these reports.

The very first operation in the whole process is transcribing written records to punched cards, and checking or verifying these cards. Just as punched holes in a roll of paper can produce music, so punched holes in IBM cards can be used to produce reports.

Written records can be read only by the eye, but punched-card records can be read automatically by machines as well. Such records are sorted and summarized by machines in larger volume, at higher speed and with greater accuracy than is possible by any manual process. Therefore, once the cards are punched and verified, they are the basis for all printed reports.

Several types of IBM card punches are available for transcribing written data to holes punched into an IBM card. The two most commonly used are the IBM 24 Card Punch and the IBM 26 Printing Card Punch. The IBM 56 Card Verifier is used to check the accuracy of the keypunching operation.

Figure 1. IBM 24 Card Punch

IBM 24 Card Punch

The IBM 24 Card Punch (Figure 1) can be used to punch numerical, alphabetic, and special-character information. One of three keyboards is available:

   a. Numerical keyboard.

   b. Combination numerical and alphabetic keyboard (three special characters).

   c. Combination numerical and alphabetic keyboard (eleven special characters).

The keyboard is connected to the punch by a cable and can be moved on the reading board to suit the convenience of the operator.

On the combination numerical and alphabetic keyboard, a group of the right-hand keys serves for punching digits, as well as letters. The shift is made from one to the other manually by a shift key, or automatically by the program unit. (See page 12).

A light touch on a key on the keyboard causes a punch or punches to be electrically driven through the card, thereby cutting one, two, or three holes in a column, according to the key used. As each column is punched, the card is automatically advanced to the next column. This is similar to the action that takes place on a typewriter as letters are typed on paper. As the card moves from right to left, the columns are punched from left to right.

OPERATING FEATURES

Card Hopper

The card hopper, which holds approximately 500 cards, is located at the upper right of the machine.

The cards are placed in the hopper, face forward, with the 9-edge down, and are fed front card first. A sliding pressure plate assures uniform feeding.

A card is fed down from the hopper to the card bed by pressing a card-feed key. The first two cards to be punched must be fed by key depression, but all other cards in the hopper can be fed automatically under the control of a switch.

Punching Station

Punching is performed at the first of two stations along the card bed. Normally, to start an operation, two cards are fed into the card bed at the right of the punching station. As the second card is fed, the first card is automatically registered for punching — that is, it is positioned at the punching station to the left. While the first card is being punched, the second card waits at the right of the card bed. When column 80 of the first card passes the punching station, the card is transported to the next station, the second card is registered at the punching station, and the next card in the hopper is fed down to the card bed.

A single card can be placed in the card bed by hand and registered in punching position by pressing the registering key.

The whole card is visible before it is registered at the punching station, and at least 71 columns are visible after punching has started. For example, when column 15 is to be punched (Figure 2), columns 1-12 and columns 22-80 are visible.

Cards with lower left-corner cuts cannot be fed through the card bed because they do not engage the registration roller.

Figure 2. Card Visibility at the Punching Station

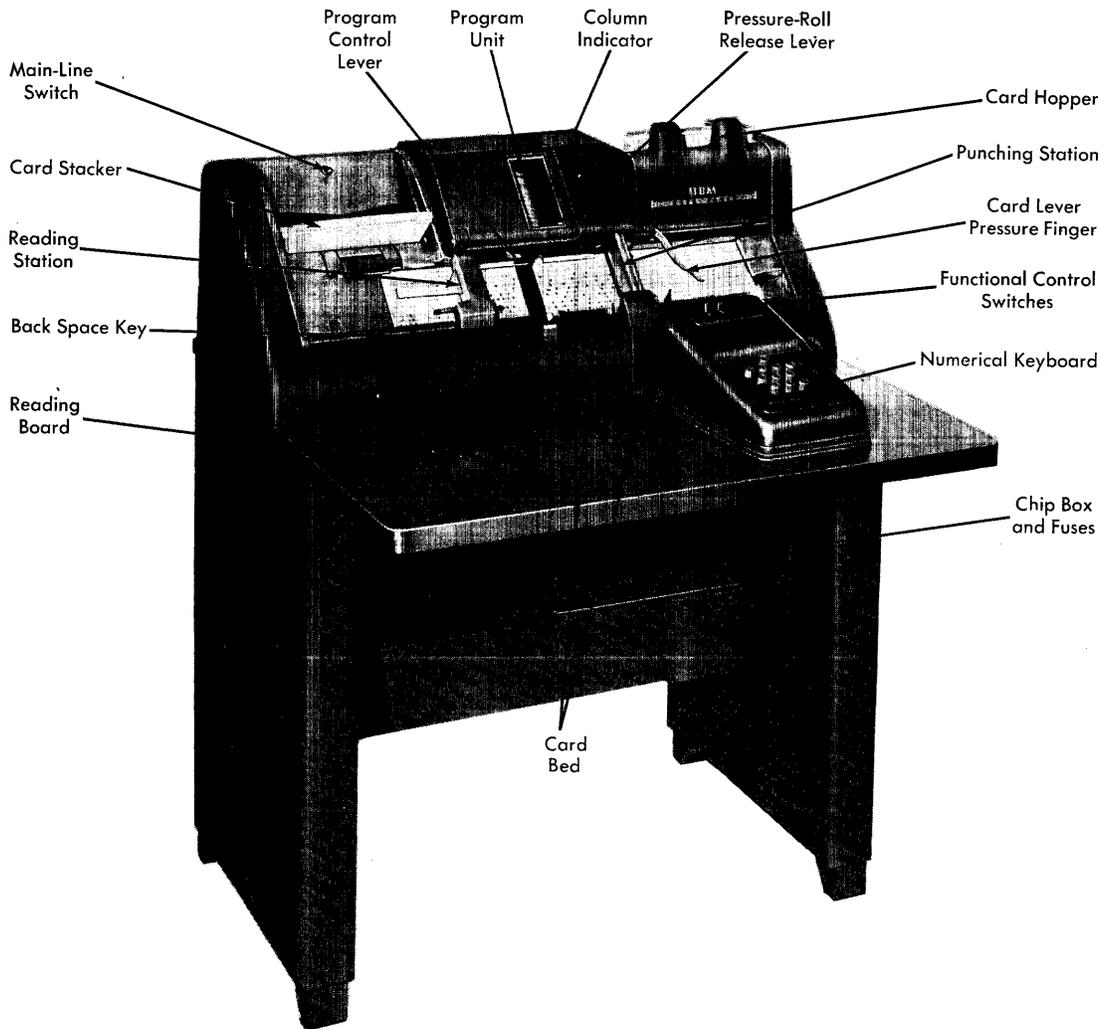## Reading Station

Cards are read for duplicating at the reading station. This is located approximately the distance of one card to the left of the punching station. Consequently, each card that has been punched passes through the reading station as the next card is being punched. The two cards move in synchronism, column by column, and information to be duplicated is transferred from the first card to the second.

Punching from one card to another can be controlled, field by field, so that only the desired information is duplicated. This feature eliminates much card handling as card handling is necessary only when an operation requires duplication from prepunched master cards. In this case, the prepunched master card is inserted manually at the right of the reading station before the next card to be punched is registered. Then both the master card and the next detail card are registered at their respective stations.

The whole card is visible before it is registered at the reading station, and at least 68 columns are visible after reading has started. For example, when column 15 is being read, columns 1 through 8 above the 7-row and columns 21 through 80 are visible.

Card Stacker

The card stacker, which holds approximately 500 cards, is located at the upper left of the machine. After each card passes the reading station, it is fed into the stacker. Cards are stacked at an angle, 12-edge down, with the back of the card facing the operator. A pressure plate holds the cards in position. When the cards are removed from the stacker, they are in their original sequence.

Main-Line Switch

The main-line switch is located at the top of the stacker. Key punching can be started approximately one minute after the main-line switch is turned on. This allows sufficient time for the electronic tubes to heat. When the stacker is full, the switch is turned off automatically.

Reading Board

A reading board provides ample space for the source documents from which the cards are punched.

Backspace Key

This key is located below the card bed between the reading and the punching stations. As long as it is held down, the cards at the punching and the reading stations are backspaced continuously. At the same time the program card, which controls skipping and duplicating, is also backspaced. Backspacing should not be attempted after column 78 is passed without first removing the card in the card bed at the right. The backspace key can also be used to release the keyboard when it becomes locked. (See *Keyboard Locking,* page 21.)

Column Indicator

The indicator, located at the base of the program-drum holder, indicates to the operator the *next* column to be punched. The numbers are scaled around the base of the drum holder, which turns as the cards are being punched. Spacing forward or backspacing to a particular column is facilitated because of the indicator.

Pressure-Roll Release Lever

Pressing on the pressure-roll release lever permits removing a card caught at the punching or reading station. Normally, a card can be removed in one piece if it is pulled out with care. If torn pieces are caught at either station, however, they can be pushed out with another card or a smooth-edged metal blade, while the pressure-roll release lever is held down. Saw-edged metal blades should not be used.

Chip Box and Fuses

Card chips from the punches accumulate in the chip box located in a compartment under the reading board. When this box is removed, the fuses for the machine are accessible.

Keyboards (Figures 3 and 4)

On all keyboards, the punching keys are gray with blue lettering, and the control keys are blue with white lettering. The *home* keys are more concave than the other keys to facilitate accurate touch operation. The keyboard is so interlocked that no two keys can be pressed at the same time. However, it is not necessary to wait for one key to rise before pressing another. This design permits *rolling* the keys. Multiple digits can be punched manually in one column by holding the multiple-punch key down, while the keys are pressed one at a time. If the punch is not equipped with a multiple-punch key, the space bar is used.

Combination keyboards combine the best features of a typewriter and a numerical keypunch. The letter keys are arranged according to the standard typewriter touch system. The digit keys are placed so that a rapid three-finger touch system can be used. The usual nu-

Figure 3. Numerical Keyboard

Figure 4. Combination Alphabetic and Numerical Keyboard

merical keys on a typewriter have been eliminated; instead, at the right, a group of dual-purpose keys (readily distinguishable by the blue keyplate) serves for digit as well as letter punching. This permits numerical punching with the right hand from the normal home position for alphabetic punching. The touch system for these ten numerical keys is: index finger for digits 1, 4, 7; middle finger for digits 2, 5, 8; and ring finger for digits 0, 3, 6, 9. Punching a digit or a letter with any of the combination keys depends on the shift of the keyboard. For example, the 4-J key punches a 4 when the keyboard is in numerical shift, but a J when in alphabetic shift. This shifting is

similar to upper or lower case shifting on a standard typewriter, and can be controlled automatically by the program unit, or manually by pressing a key.

PUNCHING KEYS

On the combination keyboard chart (Figure 5) each key is numbered for purposes of description. Keys 1 through 18 can be pressed only when the keyboard is in alphabetic shift, to punch the letters indicated. If one of these keys is pressed while the keyboard is in numerical shift, the machine locks. Operation can be resumed by releasing the card, backspacing, or pressing the alphabetic shift key which causes the letter to be punched.
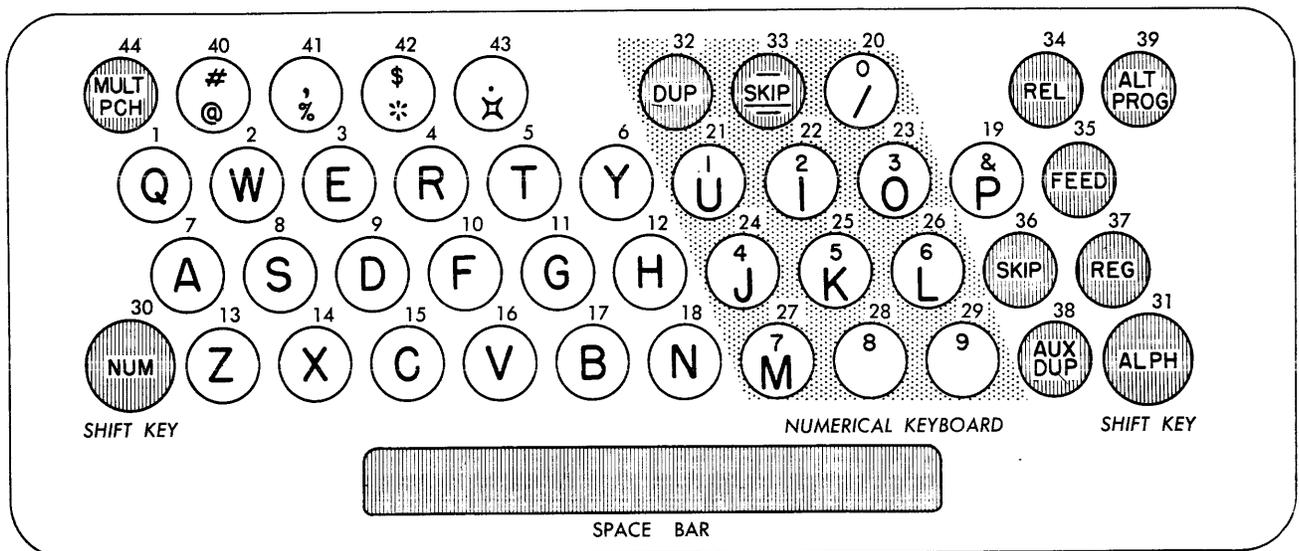

Figure 5. Keyboard Chart

Combination keys 19 through 29 can be pressed when the keyboard is in either numerical or alphabetic shift, to punch the characters indicated below. (These keys in numerical shift correspond to the keys on the numerical keyboard.)

Key	Numerical Shift	Alphabetic Shift
19	& (12)	P
20	0	/ (0, 1)
21	1	U
22	2	I
23	3	O
24	4	J
25	5	K
26	6	L
27	7	M
28	8	8
29	9	9

On the full-capacity keyboard, keys 40 through 43 punch multiple digits for eight special characters. They can be pressed when the keyboard is in either numerical or alphabetic shift, and they punch the characters shown:

Key	Numerical Shift		Alphabetic Shift	
40	#	(3, 8)	@	(4, 8)
41	,	(0, 3, 8)	%	(0, 4, 8)
42	$	(11, 3, 8)	*	(11, 4, 8)
43	.	(12, 3, 8)	□	(12, 4, 8)

FUNCTIONAL KEYS

30. NUM (numerical shift) shifts the combination keyboard into numerical position as long as it is held down. It is normally used to punch numbers in an otherwise alphabetic field.

31. ALPH (alphabetic shift) shifts the combination keyboard into alphabetic position as long as it is held down. It is normally used to punch letters in an otherwise numerical field.

32. DUP (duplicate): With program control, this key duplicates the field for which it is pressed. The rate of duplication is 20 columns per second.

    Without program control, this key duplicates at the rate of 10 columns per second as long as the key is held down.

33. —SKIP (or) —: This key punches an 11 (—). In numerical shift this key also causes skipping in fields programmed for skipping.

34. REL (release) causes the cards at the punching and reading stations to be advanced completely past those stations. Fields programmed for automatic duplication beyond the point of release are punched in the card as it advances.

35. FEED (card feed) causes a card-feed cycle:
    a. Feeds a card from the hopper.
    b. Registers the cards at the punching and reading stations.
    c. Stacks the card from the left of the card bed.

36. SKIP causes skipping of the field for which it is pressed. It is normally used for skipping the unused right-hand portion of an alphabetic field.

37. REG (card register) is used primarily when inserting cards manually in the card bed. This key registers the cards at the punching and reading stations, and stacks the card from the left of the card bed.

38. AUX DUP (auxiliary duplicate) is supplied only if the machine is equipped with the auxiliary duplication feature. This key causes duplication from a master card on the auxiliary duplicating drum. One depression duplicates the entire field from the master card.

39. ALT PROG (alternate program) is supplied only if the machine is equipped with the alternate program unit. This key is pressed, either at the beginning of or during the card cycle, for each card requiring alternate instead of normal program control. The alternate program is effective for the remainder of the card, and drops out at the end of that card.

44. MULT PCH (multiple punch) is held down to prevent normal spacing, so that more than one digit can be punched in that particular column. The keyboard is in numerical shift when this key is pressed.

SPACE BAR

The space bar can be pressed at any time in a manual field to cause spacing over one column of the card. If a machine is not equipped with a multiple-punch key, the space bar can be held down to permit multiple punching in the same column. When the column to be multiple-punched is under the punches, the card must be backspaced one column before pressing the space bar for multiple punching.

FUNCTIONAL CONTROL SWITCHES

AUTO-SKIP, AUTO-DUP (Automatic Skip and Duplicate). When the switch is ON, the program punching for automatic skipping and automatic duplicating is effective. When this switch is OFF, the 11 (start automatic skip) and 0 (start automatic duplication) codes in the program card are nullified.

AUTO FEED (Automatic Feed). With this switch ON, whenever column 80 of the card passes the punching station, a new card is fed automatically. At the same time, the card at the left of the card bed is stacked, the one at the center is registered at the reading station, and the one at the right is registered at the punching station.

Program Unit

The program unit controls automatic skipping, automatic duplicating, and shifting from numerical to

alphabetic punching, or *vice versa*. Each of these operations is designated by a specific code punched in a program card. The program card is locked around a program drum and inserted in the machine, where it is read by a sensing mechanism. The drum revolves, in step with the movement of the cards past the punching and reading stations, so that the program codes control the operations column by column.

The program unit also controls printing functions as described in the section IBM *26 Printing Card Punch* (page 22).

PROGRAM CARD

A program card, which is a basic part of the program unit, is prepared for each different punching application and can be used repeatedly. Proper punching in this program card controls the automatic operations for the corresponding columns of the cards being punched. Each row in the program card governs a specific function:

Field Definition (12). A 12-hole must be punched in every column except the first (left-hand position) of every field to be automatically skipped, duplicated, or manually punched. These 12's continue to the end of a field any skip or duplication started within that field. Several consecutive fields to be automatically skipped or duplicated as one field can be programmed as a single field.

The 12's are punched in the program card for manually punched fields to permit occasional skipping or duplicating. Such skipping or duplicating is initiated at any point in the field by pressing the specific key, and is carried across the field by the 12's. Occasional duplicating may be desired in the case of two or more cards with the same information, or in duplicating the correct fields of an error card.

Automatic Skip (11). An 11-punch in the first column of any field automatically starts a skip, which is then continued by the 12's punched in the remaining columns of the field. If a single column is to be skipped automatically, it is punched with an 11. This coding operates in conjunction with the AUTO SKIP, AUTO DUP switch, which must be ON to start the skipping automatically.

Automatic Duplication (0). A zero punched in the first column of any field automatically starts duplication, which is then continued by the 12's punched in the remaining columns of the field. If a single column is to be duplicated automatically, it is punched with a zero. This coding operates in conjunction with the AUTO SKIP, AUTO DUP switch, which must be ON to start the duplicating automatically.

Alphabetic Punching (1). When the program card is in the machine, the combination keyboard is normally in numerical shift, and pressing any one of the dual-purpose keys causes a digit to be punched. To punch a letter, the combination keyboard must be shifted for alphabetic punching. This shifting is performed automatically by a 1 in the program card in *each* column of the alphabetic field. During duplication of alphabetic information, the 1's permit automatic spacing over blank columns, and prevent X-skipping caused by letters containing X-punches (J through R).

The four basic program codes are summarized here, and illustrated in Figure 6.

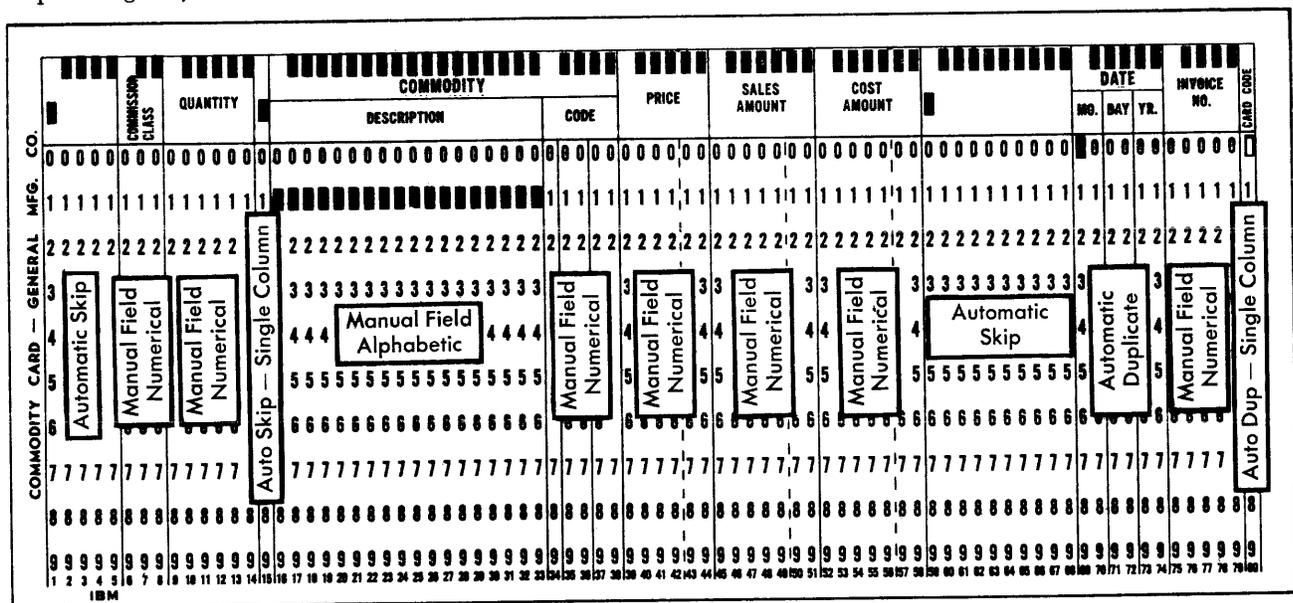| Code	Function
12	Field Definition
11	Start Automatic Skip
0	Start Automatic Duplication
1	Alphabetic Shift

Figure 6. Program Card

The other digit rows in the program card control functions in conjunction with optional features or with the IBM 26 Printing Card Punch.

PROGRAM DRUM

The program card is mounted on the program drum for insertion in the machine. The program drum has a clamping strip to hold the card, and a handle on the top to tighten or release the strip. To fasten a card around the drum (Figure 7):

1. Hold the drum horizontally with the handle to the right. Turn the handle away (counterclockwise) as far as it will go. This loosens the smooth edge of the clamping strip.
2. Insert the column-80 edge of the card under the smooth edge of the clamping strip. Two alignment check holes in the clamping strip make it possible to see that the card is flush with the metal edge under the strip. The card should be positioned so that the 9-edge is against the rim of the drum.
3. Turn the handle to the center position. This tightens the smooth edge of the clamping strip and loosens the toothed edge.
4. Wrap the card tightly around the drum and insert the column-1 edge under the toothed edge of the clamping strip. Be sure that the punching rows fall over the grooves in the drum.
5. Turn the handle toward you (clockwise direction) as far as it will go. This fastens the toothed edge of the clamping strip. The drum is now ready to be inserted in the machine.

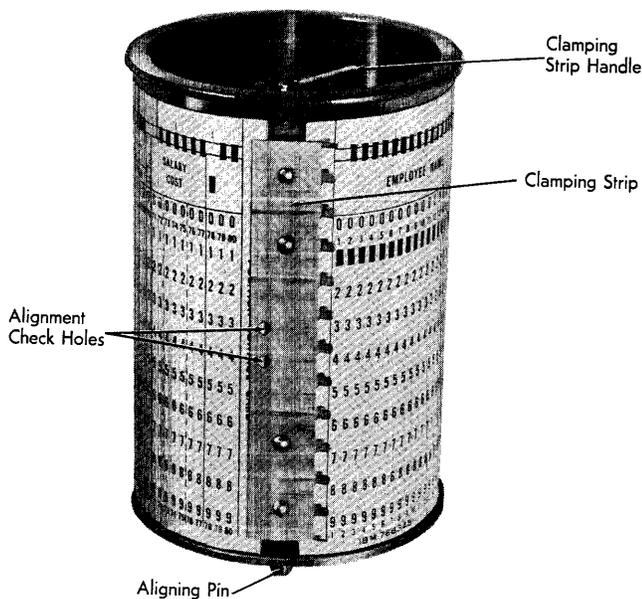To remove a card from the drum, reverse this procedure.

Figure 7. Program Drum

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PROGRAM-CONTROL LEVER

Operation of the program unit is controlled by the program-control lever, located below the program unit (Figure 1). When this lever is turned on, the program-sensing mechanism is lowered so that the star wheels rest on the program drum, and the codes punched in the program card control the various automatic operations. When the program-control lever is turned off, the program-sensing mechanism is raised so that the program drum can be easily removed or inserted. This lever should be turned off whenever a program card is not in the machine. With the star wheels raised, the keyboard is in alphabetic shift.

With the program-sensing mechanism raised by the program-control lever, the drum is placed on a spindle under the center cover of the punch, and positioned so that the aligning pin falls in the aligning hole in the base of the drum holder. The program-control lever is then turned to the left to lower the reading star wheels on the program card, and the release key is pressed to engage the reading mechanism fully. Whenever the drum is to be removed, the star wheels must be raised.

MACHINE FUNCTIONS

Numerical Punching

Punching numerical information is simply punching holes representing particular digits (0 to 9) in predetermined rows of the card. For example, if a 3 and a 7 are punched in two successive columns, the number 37 is recorded for use in operations such as printing, accumulating, classifying, reproducing, filing, and multiplying, when that card is fed through other IBM machines.

What this number represents is determined by the card-field heading. The term *field* is used to describe a column or group of columns set aside, often by vertical lines, for a particular item of information. Thus, the number 37 may represent year, location, warehouse, quantity, or amount. If the serial number should appear in the first 8 vertical columns of the card, and read 36214901, the 3 would be punched in the first column, the 6 in the second, and so on (Figure 8).

If the serial number to be punched in an 8-column field has only five digits such as 56074, columns 1, 2, and 3 would be punched with zeros to keep the significant digits 5, 6, 0, 7, and 4 in their proper relation to other serial numbers.

In addition to punching the digits (0 to 9), special indications, for control purposes in subsequent opera-
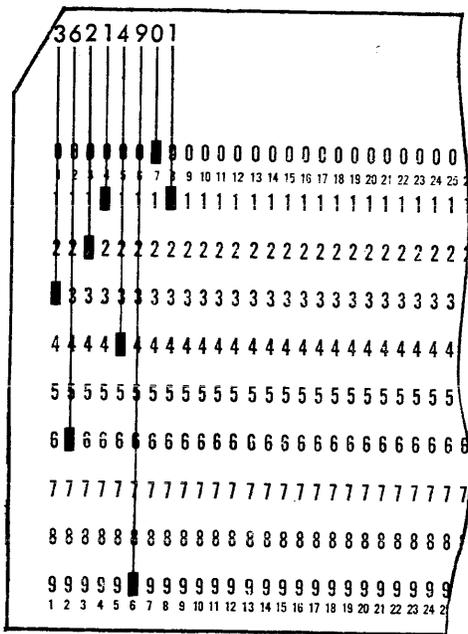
Figure 8. Numerical Punching

tions, can be punched in the 11 and 12 positions of the card (Figure 8). The 11 is punched by use of the -SKIP key, and the 12 by the ampersand key on the combination keyboard (11 -SKIP key, and 12-key on the numerical keyboard).

Alphabetic Punching

Recording letters in IBM cards is accomplished by keys on the combination keyboard. There are 26 letters in the alphabet but only 12 possible positions in which to record a letter. Therefore, it is necessary to punch two holes in a column for each letter. This requires a

low or digit punch (1 through 9) in combination with a high or zone punch (0, 11, 12). Thus, the punching for each letter of the alphabet is as follows:

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

The two holes for any given letter of the alphabet are punched simultaneously by one depression of an alphabetic key. The complete alphabet, punched with 26 key strokes, is shown in Figure 9.

Note that the *alphabetic X* is composed of a 0-punch and a 7-punch, and it should not be confused with the X or 11 position punched by the -SKIP key on the numerical keyboard. The former is a letter of the alphabet, the latter a control punch used to differentiate various classes of cards.

OPERATING PROCEDURES

Inserting Cards Manually

In certain circumstances, it is desirable to insert cards manually, one at a time, to make over a damaged card, or to correct an error. Also, when an individual card accompanies each original document, manual insertion is necessary. A single card should not be inserted in the hopper. It should be manually inserted directly in the card bed to the right either of the punching station or of the reading station.

Figure 9. Alphabetic Punching

Figure 10. Manual Insertion

Figure 10 shows a card prepunched with *part code*. *Part name* is to be punched.

1. Place the card in the card bed to the right of the punching station.
2. Press the register key to advance the card into punching position.
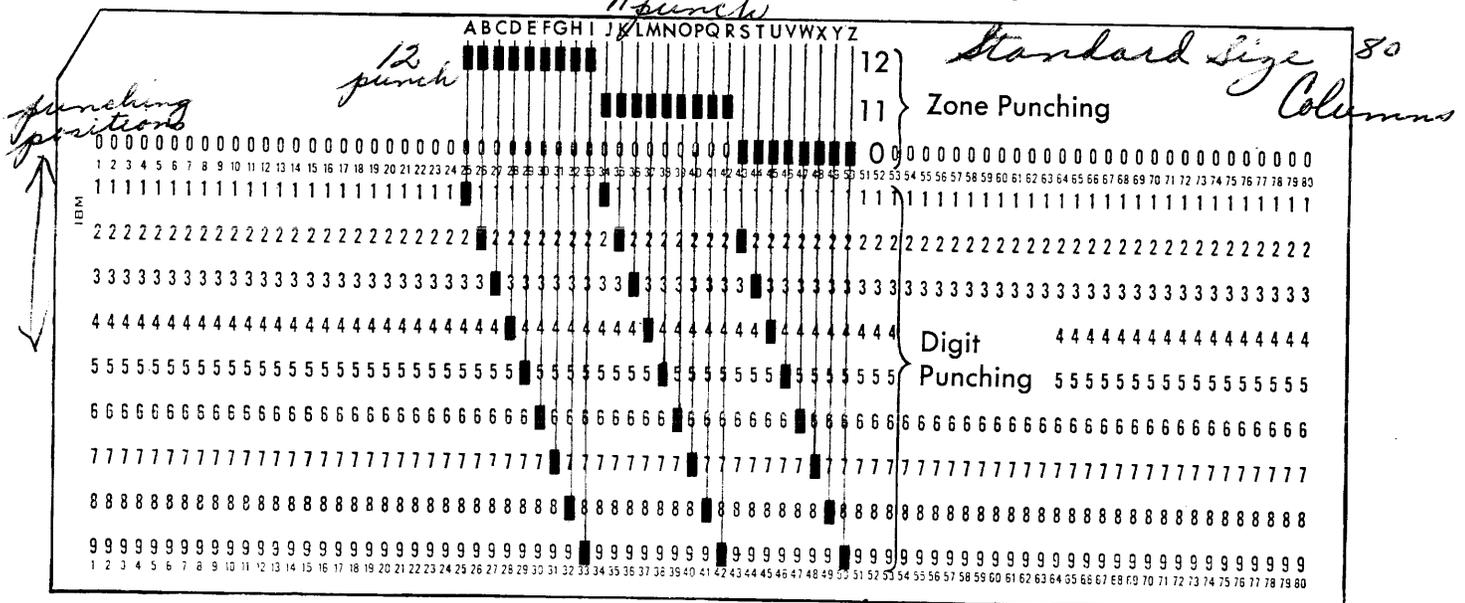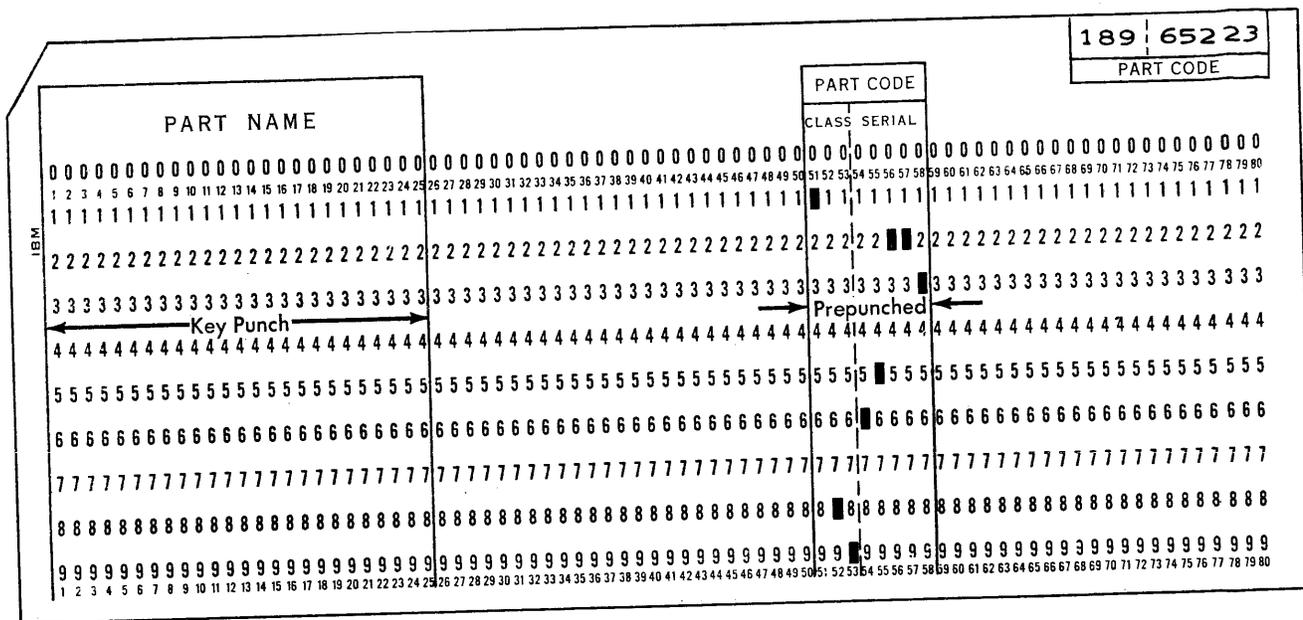3. Punch part name, starting in column 1, pressing the numerical shift key when necessary.
4. Release the card, after punching the part name.
5. Insert the next card in the card bed to the right of the punching station and press the register key. This registers the first card at the reading station and the second card at the punching station. When the release key is pressed for the second card, the first card is released to the left of the reading station. Then, when the third card is registered, the first card is moved into the stacker.

Numerical Punching with Program Control

Normally, in a punching operation, the cards are fed from the card hopper into the card bed automatically. Also, as the cards are punched, the program card controls the automatic functions, such as skipping and duplicating. For example, labor distribution cards are to be punched with numerical information according to the fields shown. Figure 11 shows how a card is punched to serve as a program card, indicating what type of operation is to be performed in each field. Columns 3 through 6 and 34 through 35 are to be automatically duplicated. Columns 48 through 80 are to be automatically skipped. All other fields are to be key-punched.

1. Place a deck of unpunched cards in the card hopper.
2. Press the FEED key twice to feed two cards into the card bed. The first card registers automatically as the second card is fed.
3. Keypunch columns 1 and 2 (program card punched with a 12 in column 2).
4. Columns 3 through 6 are programmed for automatic duplication (program card punched with a 0 in columns 3 and 12's in columns 4 through 6). The first card of each new date group is keyed manually with the automatic duplicate switch OFF. When that card is punched, the switch is turned on, and the date in each succeeding card duplicated automatically from the preceding card.
5. Keypunch columns 7 through 33 (program card punched with a 12 in each column except the first position of each field).
6. Columns 34 through 35 are programmed for automatic duplication (program card punched 0 in column 34 and 12 in column 35). In the same manner as *date* in columns 3 through 6, *machine group* is manually keyed for the first card of each group, but duplicated automatically for the rest of the cards.
7. Keypunch columns 36 through 47 (program card punched with a 12 in each column except the first position of each field).
8. Columns 48 through 80 are automatically skipped (program card punched with 11 in column 48, and 12's in columns 49 through 80). The automatic skip and duplicate switch must be ON.
9. An automatic feed occurs after column 80 is skipped. The automatic feed switch must be ON.

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Figure 11.   Numerical Punching with Program Control

Alphabetic and Numerical Punching with Program Control

Although the keyboard is normally in numerical shift when the program control is operating (star wheels lowered), alphabetic information can be punched by changing to alphabetic shift. This is done either manually by use of the shift key, or automatically by coding in the program card. Columns 6 through 26 of Figure 12 illustrate the 1-coding for shifting automatically to alphabetic position.

In punching alphabetic information, it is usually desirable to skip over that part of the field that is not used. Because the starting point of this skipping varies from card to card, it must be controlled manu-

ally by using the SKIP key in conjunction with the program control. (See Field Definition, page 13.)

Another type of skipping that must be controlled from the keyboard is illustrated in the trading-area field (Figure 12). The trading-area code is punched for some customers, but not for others. In the latter case, column 75 is X-punched to indicate that no code is supplied, and the rest of the field is skipped by the -SKIP key. The X-punch is used as a control-punch in later operations.

When a field is to be punched with the same information in a few successive cards, only the first card needs to be manually punched. The field in the following cards can be duplicated by a single stroke of

Figure 12.   Alphabetic and Numerical Punching with Program Control

the DUP key. For instance, salesman number in columns 78 through 79 may be the same for several consecutive cards and can be duplicated by pressing the DUP key.

1. Press the FEED key twice to feed two cards.
2. Columns 1 through 5 are automatically skipped (program card punched with 11 in column 1 and 12's in columns 2 through 5). The automatic skip and duplicate switch must be ON.
3. Punch columns 6 through 26 with customer name, address, or carrier name (program card punched with 1's in columns 6 through 26). The 1's automatically shift the keyboard from numerical to alphabetic punching. When figures are to be punched, use the numerical shift key.
4. Press the SKIP key at the end of the alphabetic punching to skip over the rest of the field (program card punched with 12's in columns 7 through 26).
5. Columns 27 through 56 are automatically skipped (program card punched with 11 in column 27 and 12's in columns 28 through 56).
6. Keypunch carrier code in columns 57 and 58 (program card punched with 12 in column 58).
7. Columns 59 through 69 are automatically skipped (program card punched with 11 in column 59 and 12's in columns 60 through 69).
8. Keypunch customer number in columns 70 through 73 (program card punched with 12's in columns 71 through 73).
9. Column 74 is automatically skipped (program card punched 11).
10. The trading-area field is coded in the program card for manual numerical punching (blank in column 75 and 12's in columns 76 and 77).

Optional X-skipping of the field is controlled by using the -SKIP key, which also punches 11 in column 75.

11. Keypunch columns 78 and 79.
12. Keypunch column 80, after which the next card feeds automatically. The automatic feed switch must be ON.

Error Correction

Errors in punching are often noticed and corrected by the operator at the time they are made. Here is an example of correction of an error in the *pieces* field (Figure 13):

1. Press the release key immediately upon detection of the error. This advances the card without punching the fields coded for manual punching, but duplicates fields programmed for automatic duplication. Therefore, columns 34 and 35 are duplicated into the error card as it is being released. This retains the common information for duplication into the following cards. The three cards in the card bed advance to their proper stations, and a new card feeds from the hopper.
2. Duplicate the *kind* field by a single stroke of the duplicate key.
3. Columns 3 through 6 are programmed to duplicate automatically (Figure 11).
4. Manually duplicate the regular rate, overtime rate, and part or account number by pressing the duplicate key at the beginning of each field. Duplication stops at the end of the *part* or *account number* field.

Figure 13. Error Correction

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5. Re-key the *pieces* field, and manually punch the remaining fields programmed for manual punching. The *machine group* field is automatically duplicated, and columns 48 through 80 are automatically skipped.

6. Remove the error card from the stacker.

Prepunched Master Card Insertion

In an operation in which certain fields are to be duplicated from prepunched master cards, it is necessary to insert each master card manually before duplicating the first card of the group. The master cards are inserted in the card bed at the right of the reading station.

1. Turn off the automatic feed switch before completely punching the last card of the preceding group.

2. After the last card is released from the punching station, manually move it to the left, until its left end touches the feed rolls at the reading station.

3. Press the release key to advance that card past the reading station.

4. Place the master card in the card bed between the punching and the reading stations.

5. Press the FEED key to register the master card and the detail card that is waiting at the right in the card bed, and to feed a new card from the hopper. Turn on the automatic feed switch. Normal punching of the first card of the new group can then proceed with automatic feeding of the following detail cards.

6. If the master card is not to be stacked with the detail cards, remove it immediately after completing the punching of the first detail card.

7. This kind of operation prevents automatic duplication of any common information, such as date, from one group of cards to the next, because the continuity of such duplication is interrupted by inserting the prepunched master cards. Consequently, when common punching is required, the information must be manually punched in the first card of each new group. This keying can be avoided by the use of the optional Auxiliary Duplication Device, operated by key 38 on the keyboard chart. (See *Optional Features*, page 27.)

Making Over Damaged Cards

It is sometimes necessary to make over damaged cards. If the card is torn as a result of a jam, the pieces should be properly assembled and a new card manu-

ally punched. If the card is not torn, it can be made over as follows:

1. Turn off the program-control lever.
2. Place the damaged card in the read bed.
3. Place a blank card in the punch bed.
4. Register both cards by using the register key.
5. Press the DUP key until all punched columns have been duplicated. To avoid possible damage to the machine, make sure that whenever the DUP key is used a card is fully registered at the reading station.
6. Release both cards by means of the release key.
7. Sight check.

OPERATING SUGGESTIONS

The following suggestions are given as an aid to most efficient operation of the IBM card punches.

STARTING A PUNCHING OPERATION

When a new job is started, the release key should be pressed (but need not be held) after the main-line switch is turned on. After a short time delay, a release cycle occurs to indicate that the operation can be started. If the automatic feed switch is OFF, the FEED key should then be pressed twice to register the first card; if the switch is ON, the FEED key need be pressed only once. If a prepunched master card is to be inserted, it should be placed in the center of the card bed after the first feed cycle.

When master information for automatic duplication is to be keyed in the first card of the group, the automatic skip and duplicate switch should be turned off before the first card is registered, and left off until the master information is keyed. On this first card, the -SKIP key is used to skip the fields programmed for automatic skipping.

ENGAGING THE PROGRAM READING MECHANISM

Turning the program-control lever to lower the star wheels may not fully engage the reading mechanism. Therefore, it is necessary also to press the release key. For this reason, once the program is turned on it should be left on, and whenever possible any temporary changes or interruptions in the punching routine should be handled by the functional switches and keys.

The star wheels must not be lowered unless a card is on the program drum. With star wheels raised, the keyboard is in alphabetic shift.

STOPPING A PUNCHING OPERATION

When an operation is to be stopped and the main-line switch turned off before a batch of work is completed

(as at a lunch hour), the automatic feed switch should be turned off before the card at the punching station is completely punched and released. This permits restarting the job without additional card handling.

When one batch of work is to be followed by another batch using the same master information and program control, a blank card should follow the last card of the batch through the punching station. The blank card can be released past the punching station as the last card is released past the reading station. This causes the blank card to be automatically punched with the master information for duplication into the first card of the next batch, and thus eliminates the necessity of re-keying the master information. The automatic feed switch should be OFF when the cards are released.

CLEARING THE CARD BED

When the card bed is to be completely cleared at the end of a punching operation without feeding more cards from the hopper, the automatic feed switch should be turned off during the punching of the next-to-the-last card. The last card is then registered for punching by pressing the register key. After the last card is punched and moved to the center of the card bed, it is moved on to the stacker by pressing the register key, the release key, and then the register key again.

If the automatic feed switch is turned off after the last card to be punched is completed, the release and register keys must be pressed alternately three times. In this case two blank cards stack behind the last punched card in the stacker.

REMOVING A CARD FROM THE CENTER OF THE CARD BED

A card can be removed from the center of the card bed without affecting the following cards by manually moving it into the reading station and pressing the release key. This moves it to the left of the card bed where it can be lifted out.

REMOVING A CARD FROM THE LEFT OF THE CARD BED

When a card has been released from the reading station but not stacked, it is positioned in the left of the card bed. For easy manual removal, the card can be moved to the extreme left by pressing down on the arm that extends from the reading station.

REMOVING A CARD FROM THE PUNCHING OR READING STATION

If for any reason a card must be removed manually from the punching or reading station, the pressure-roll release lever should be held down while the card is pulled out. If a card at the punching station does not move easily, it can be freed by holding the MULT PCH key (or space bar) while pressing each numerical key. Then, with the lever held down, the card can easily be pulled out without tearing.

SPACING OVER COLUMNS

Without program control, the DUP key can be used to space over columns, if the same columns are unpunched in the preceding card or if there is no card immediately ahead. This operation is faster than using the space bar.

MULTIPLE-PUNCHED COLUMNS

Two or more digits can be punched in one column by holding the multiple-punch key down while the digit keys are pressed one at a time. If a machine is not equipped with a multiple-punch key, the space bar can be held down for this operation. The keyboard is automatically shifted to numerical position when the MULT PCH key or the space bar is pressed.

X-PUNCHING AND SKIPPING

Punching an X in a numerical field normally causes skipping, but in an alphabetic field it does not. If a control X (such as a credit X or a date X) is to be punched in a numerical field but skipping must not occur, the following should be considered:

1. If the X is punched (keyed or duplicated) *alone* in a column, skipping to the beginning of the next field occurs. This skipping can be prevented by coding the single column of the field with a 1 in the program card (in an alphabetic machine) or by eliminating the program 12-code in the column following the X-punching. In the first method, if a digit instead of the X is to be keyed, the numerical shift key must be held down. In the second method, the program card must be punched with a 0 in the following column if automatic duplication is performed; or the duplicate key must be pressed a second time, or held over the blank column in the program card, if manual duplication is performed.

2. If a control X is to be keyed over a digit, the MULT PCH key must be pressed to key the two digits in one column. (With machines not equipped with the MULT PCH key, the space bar is used.) This prevents X-skipping, and no provision need be made in the program card.

3. If the control X and a digit are duplicated, skipping to the end of the field occurs. This can be prevented by coding the column with a 1 in

the program card (in an alphabetic machine) or by eliminating the program 12-code in the following column. In the first method, if the column is keyed at any time, the MULT PCH key (or space bar) must be pressed. This shifts the keyboard into numerical position and prevents skipping. In the second method, the program card must be punched with a 0 in the following column if automatic duplication is being performed; or the duplicate key must be pressed a second time, or held over the blank column in the program card, if manual duplication is being performed.

CORNER CUTS

Cards with lower left corner cuts cannot be used, because they will not feed through the card bed. This should be kept in mind especially when designing tumble cards, because an upper right corner cut becomes a lower left corner cut when the card is tumbled.

SINGLE-CARD FEEDING

When cards are to be fed manually, one at a time, they should be placed directly in the card bed, to the right for punching or in the center for reading. To save time and avoid possible misfeeding, single cards should not be placed in the card hopper.

When a card is to be inserted at the reading station, place it in the center of the card bed and slide it to the left through the two notches in the frame. It should be positioned so that the column-1 edge is between the feed rolls at the right of the reading station. If the card is pushed in too far, improper feeding and duplicating may result.

KEYBOARD LOCKING

The keyboard locks under any of the following conditions:

1. The main-line switch is turned OFF, and then ON, while a card is registered at the punching station. The keyboard can be unlocked by pressing the release key.
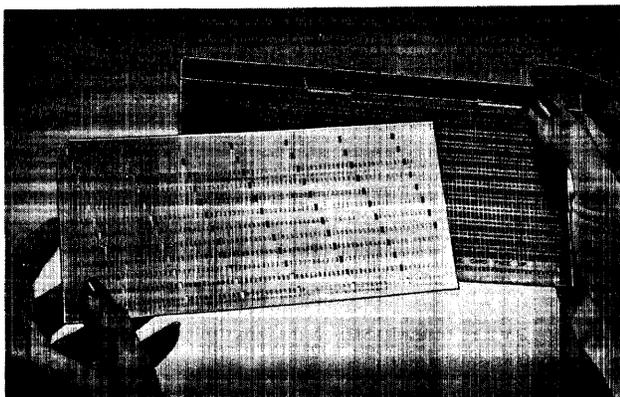
2. On the combination keyboard, an alphabetic key (other than a combination key) is pressed in a field programmed for numerical punching. The keyboard can be unlocked by pressing the backspace key (the operator then spaces to the next column), the release key (the card is released without punching), or the alphabetic shift key (the letter is punched).

3. A blank column is duplicated in a field programmed for numerical punching. This serves as a blank-column detection device to assure that a digit is punched in every column of a numerical field which is being duplicated. The keyboard can be unlocked by pressing the backspace key or the alphabetic shift key on the combination keyboard.

4. A card is not registered at the punching station. This feature makes it impossible to do any punching or spacing unless a card is in position to be punched. With the automatic feed switch ON the register, feed, or release key can be pressed to move a card into punching position.

5. The register key or the FEED key is pressed when a card is registered at the punching station. The keyboard can be unlocked by pressing the release key or the backspace key.

SUSPENDING AUTOMATIC DUPLICATION IN FIRST CARD

Master information in the first card of each new group must be keyed. Automatic duplication must, therefore, be suspended for that card by turning off the automatic skip and duplicate switch.

CHECKING REGISTRATION

The punching registration of the machine should be checked daily. Punch a card in all 80 columns and check the registrations with a card gage (Figure 14). Off-gage punching causes difficulty when the cards pass through other types of machines. This precaution is extremely important.

Figure 14. Card Gage

IBM 26 Printing Card Punch

The IBM 26 Printing Card Punch is the same in appearance, features and function as the IBM 24 Card Punch. With the IBM 26, however, characters can be printed as they are punched (Figure 15). Each character prints above the column punched, thus permitting full interpretation of the card. The printing feature is controlled by the PRINT switch, which is the third functional control switch shown in Figure 4. Zero printing or suppression of printing in an individual column or field is controlled by program-card coding.

Left-Zero Print (2)

With program control, zeros punched to the left of the first significant digit in a numerical field determined by 12's in the program card are automatically suppressed in normal printing (00025 is printed 25).

To print zeros to the left in a field, as in a social security number, a 2 is punched in *each* column of the field in the program card. For example, the program card for Figure 16 would be punched with 2's in columns 1-5 and 21-29. A zero in the units position of a field always prints unless printing is suppressed.

Like zeros, the dash (-) and the ampersand (&), which are normally suppressed when occurring to the

Figure 16.   Character Printing

left of a significant digit in a field, can be forced to print by the 2-code in the program card.

Print Suppression (3)

The print suppression feature provides an extremely flexible control of printing. Even though the print switch is ON, printing can be prevented for one or more columns of the card. Print suppression for a column is controlled by a 3-code in the program card. To suppress printing for a field, the 3-code is punched for *each* column of the field. For example, the program

Figure 15.   IBM 26 Printing Card Punch

card for Figure 16 would be punched with 3's in columns 34-40.

These additional codes that apply to the IBM 26 Printing Card Punch only are summarized here, and their use is illustrated in Figure 16.

Code	Function
2	Left-Zero Print
3	Print Suppression

Ribbon Replacement

The ribbon on the IBM 26 Printing Card Punch feeds between two spools, through ribbon guides, and under the punch die, as shown in Figure 17. On machines with serial numbers lower than 10029, the ribbon should be replaced by a customer engineer. On other machines, the old ribbon is removed and a new one installed as follows:

1. Turn off the main-line switch.
2. Remove the ribbon-spool retaining clamp.
3. Cut or break the old ribbon.
4. Remove both spools from their spindles and pull out the two pieces of ribbon. Empty one of the spools.
5. Place the spool of new ribbon on the right-hand spindle; position it so that the ribbon feeds from the top of the spool toward the front of the machine. Lift up the right end of the ribbon-reversing arm, if it is not already up, and unroll about a foot and a half of ribbon; then push down the right end of the ribbon-reversing arm to hold the spool steady.
6. Feed the metal leading-end of the ribbon between the punch die and the card bed, sliding it through the groove in the center of the card bed (between the 3 and 4 punching positions). The groove permits the extra thickness of the metal end and the reversing eyelet to pass between the punch die and the card bed. Be sure to keep the ribbon straight, with the top side up at all times.
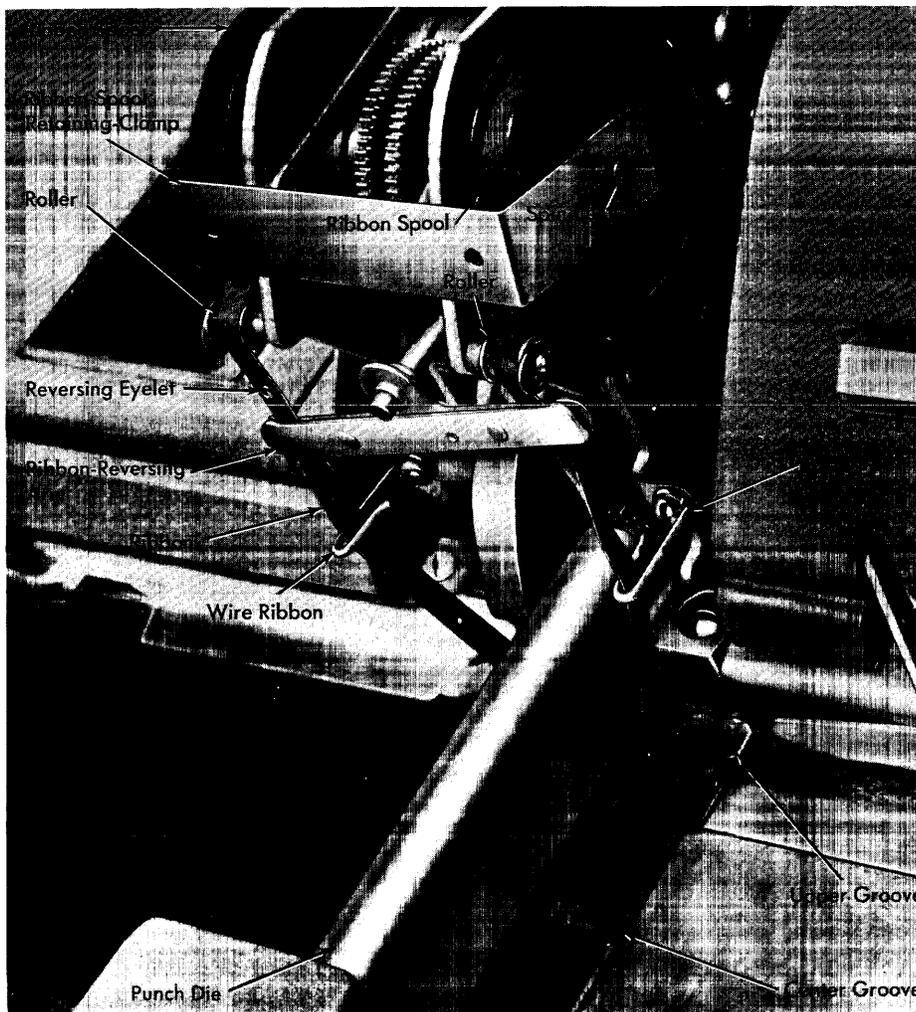
Figure 17. Ribbon Replacement

7. Hook the metal leading-end of the ribbon in the slot in the center of the empty spool and wind the ribbon onto the spool until the reversing eyelet is on the spool.

8. Place the spool on the left spindle; position it so that the ribbon feeds onto the spool over the top. Be sure that the ribbon is not twisted and that the top side of the ribbon is still up.

9. Hook the ribbon around the right and left wire ribbon guides, and slide it through the right and left ends of the reversing arm and over the rollers in front of the ribbon spools.

10. Slide the ribbon up under the punch die so that it is in the upper groove provided for it in card-printing position (above the *12* punching position), and take up the slack.

11. Replace the ribbon-spool retaining clamp.

IBM 56 Card Verifier

Accurately punched cards are essential to recordkeeping. Therefore cards are usually verified in some manner immediately after they are punched. The IBM 56 Card Verifier (Figure 18) verifies alphabetic, numerical or special-character punching manually or automatically.

OPERATING FEATURES

The IBM 56 Card Verifier is the same in appearance, features, and operation as the IBM 24 Card Punch. The significant differences are:
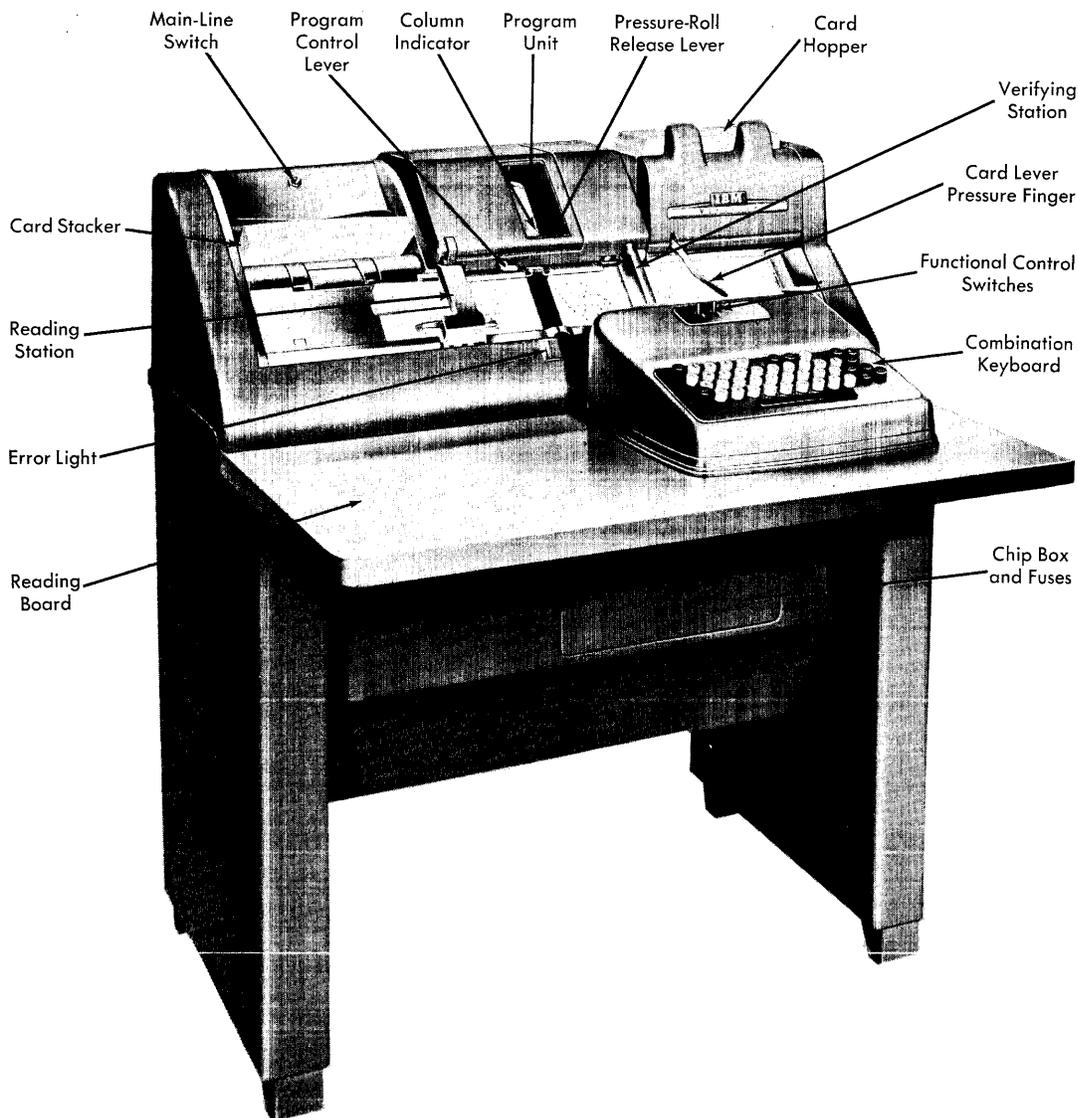
Figure 18. IBM 56 Card Verifier

Figure 19. Verified Card

Verifying Station

Verification is performed at the first station in the card bed across which the cards pass from right to left. When a card is verified, a notch is cut at the end between rows 0 and 1 (Figure 19). If the card is incorrect, a notch is cut in the card over the column containing an error (Figure 20).

Error Light

When an error is detected, the error light goes on. The light goes off if the second attempt at verification is correct; if not, it goes off when the third attempt is made. If the SKIP key is pressed instead of a second or third try at verification, the light goes off.

Combination Keyboard

Except where noted, the combination keyboard (Figure 21) is the same as that for the IBM 24 Card Punch.

FUNCTIONAL KEYS

32. VER DUP (verify duplication) causes verification of the card field at the verifying station by comparing it with the preceding card.

With program control, a single key depression causes verification of the field for which it is pressed. The rate of verification is 20 columns per second.

Figure 20. Error Card

Figure 21. Combination Keyboard Chart

Without program control, this key verifies at the rate of 10 columns per second as long as the key is pressed.

38. AUX VER (auxiliary verify) operates only when the machine is equipped with the Auxiliary Verification Device. This key causes verification by comparison with a master card on an auxiliary drum. Under program control, one stroke of the key verifies an entire field; without program control, one stroke verifies a single column.

44. MP-ER (multiple-punch, error-release) is a dual-purpose key:

1. It prevents normal spacing of the card, as long as it is pressed, to permit verification of two or more punches in one column.

2. It releases the keyboard whenever it becomes locked during a verifying operation. The keyboard is in numerical shift when this key is pressed for verificating multiple digits in a column.

OPERATING PROCEDURES

For general operation refer to the chapter on the IBM 24 Card Punch (page 15). The only difference is in the error-detection routine.

An error is detected as a discrepancy between the digit punched and the key pressed (or the digit in the preceding card during automatic verification). At this time the error light goes on and the keyboard locks.

Provision is made for three trials in the verification of a column. So, if the operator makes the error, he has two more chances to strike the correct key. He can determine which position is in error and must be re-keyed, by reading the punched holes in a few columns preceding the error column and relating them to the source material. The card and the source document can easily be associated in this way because all columns but one preceding the error column are visible.

In Figure 20, for example, columns 1 through 13 are visible when the error is signalled in column 14, and the operator can note that the overtime rate field (punched 0750) has been completed. Therefore, by reference to the source document, the operator can readily determine that the first position of part or account number has signalled the error and must be re-keyed. Similarly, when the error is signalled in column 27, the operator can note that the first digit (punched 2) of order number has been verified and the second must be re-keyed.

ERROR ROUTINE

After the operator determines which position signals the error, that column can be re-verified as follows:

1. Press the error-release key to free the keyboard.

2. Make a second attempt to verify the column. If this trial is correct, the light goes off and verification can be continued in the next column. If it is incorrect, the error light remains on and the keyboard becomes locked again.

3. Press the error-release key to free the keyboard again.

4. Make a third attempt to verify the column. At this time the light goes off and verification can be continued in the next column regardless of whether or not the third attempt is correct. If it is incorrect, the column is error-notched (Fig-

ure 20). The sound of notching is easily distinguishable above the sound of normal verifying.

When an error notch is cut in one or more columns of a card, the final OK notch in the right end of the card is omitted and *automatic feeding is suppressed.* The card stops, completely visible, between the reading and verifying stations. This permits the operator to note the correction on the card before it is registered at the reading station. The next card is fed by pressing the FEED key.

The -SKIP key can be pressed instead of making the second or third attempt to verify the error column. When this is done, the column is notched (if it is a punched column), the error light goes off and the rest of the field is skipped (Figure 20); verification can be continued in the first column of the following field. This method of handling an error is especially advantageous when it becomes evident, after error notching two or three columns of a long field, that a character has been omitted and the rest of the punching is off one column. Errors of this type are not uncommon in alphabetic fields.

An error signal occurring in a field programmed for automatic verification normally indicates that the first card of a new group, with a change in the common information, is at the verifying station. The error-release key should be pressed so that the field can be key-verified. Pressing the correct key turns off the error light and permits verification of the rest of the field.

If an error is signalled while either of the shift keys is pressed, the keyboard remains in that shift for the second and third trials even though the key is no longer held down. If pressing the shift key was in itself an error, it can be corrected by pressing the opposite shift key when the next attempt at verification is made.

OPERATING SUGGESTIONS

The following suggestions are given as an aid to efficient operation of the IBM 56 Card Verifier, in addition to the *Operating Suggestions* in the IBM *24 Card Punch* section.

OK NOTCH

When a card is verified, a notch is cut in the right end of the card. Every field of the card must be either verified or programmed to skip for the final OK notch to be punched. The card is not notched if it is released. Therefore, if a card is to be verified without program control, each column must be keyed, spaced, or automatically verified to obtain the OK notch.

X-VERIFYING AND SKIPPING

Key verification of an X punched alone in a column normally causes skipping in a numerical field but not in an alphabetic field. If this skipping is not desired, it can be prevented by coding the single column of the field with a 1 in the program card (in an alphabetic machine) or by eliminating the program 12-code in the column following the X. In the first method, if a figure instead of the X is keyed, the numerical shift key must be held down; in the second method, if the field is verified by use of the verify-duplication key, the key must be pressed a second time or held over the blank column in the program card.

Key verification of an X and a digit punched in a single column of a numerical field requires the use of the multiple-punch (MP) key. Pressing this key prevents X-skipping. Verification of an X automatically or by use of the VER DUP key does not cause skipping.

MULTIPLE-PUNCH VERIFICATION

Two or more digits can be verified in one column by holding down the multiple-punch key (MP) while the digit keys are pressed one at a time. All punches in a column must be verified unless one of the verification-elimination features is used.

If the operator presses a key that does not correspond to the hole punched in the card, the keyboard locks. When the operator senses that the keyboard is locked, he can determine the digit to be re-verified by visually associating the preceding punched columns with the source document. Before re-verification, the keyboard must be unlocked by pressing the error-release key.

Optional Features — IBM 24, 26, 56

The following devices for the IBM 24 or 26 Card Punch and IBM 56 Card Verifier are available as optional features. Full discussion can be found in the IBM 24, 26, 56 manuals.

Auxiliary Duplication (Auxiliary Verification)

Information common only to certain cards can be punched into a master card, which is fastened around an auxiliary drum and mounted on a spindle behind the program drum. When the AUX DUP (AUX VER) key is pressed, this prepunched information is duplicated into the card under control of the program card.

11-12 Elimination (56 only)

Cards are frequently punched with control X's or 12's that do not need to be key-verified. By 11-12 Elimination, operating in conjunction with program-card

coding, 11-12 verification is made selective by column. Program code 2 in a column eliminates the necessity to verify the 11 or 12 punching but requires the verification of the 0 through 9 punching.

0-9 Elimination (56 only)

When only the 11 or 12 punching, or a portion of the numerical punching, needs to be verified, 0-9 Elimination can be installed. Normally, this feature splits the column between 0 and 11 so that 11 and 12 punches must be verified, and digits 0 through 9 are eliminated from verification. Any split other than between 0 and 11 may be specified (for example, between 8 and 7) so that all punches above split (7 through 12) must be verified, and all punches below the split (8 and 9) need not be verified.

Like 11-12 Elimination, this feature operates selectively in conjunction with program-card coding. Code 3 in a column of the program card eliminates the necessity of verifying the 0 through 9 punching, or any specified portion of the numerical digits, but requires the verification of the 11 or 12 punching.

Alternate Program Device

With this device, two program setups can be punched in one program card. The corresponding codes (differences for the verifier are noted in parentheses) are:

Normal Code		Alternate Code
12	Field Definition	4
11	Start Auto Skip	5
0	Start Auto Duplication (Start Auto Duplication)	6
1	Alphabetic Shift	7
2	Left-Zero Print (11-12 Elimination)	8
3	Print Suppression (0-9) Elimination)	9

When the ALT PROG key is pressed, the alternate program is effective for the remainder of that card. Program cards punched with both normal and alternate-program codes should not be duplicated.

Interspersed Gangpunch Device (24, 26 only)

This distinguishes master cards from detail cards by a different corner cut. All punching and programming are suspended for master cards, as they automatically release to the reading station. The master-card information is gangpunched into following detail cards. Normal use requires that the AUTO-FEED and AUTO-DUP switches be ON.

Card Insertion Device

This simplifies manual insertion of a master duplicating card in front of a group of cards to be punched (or

verified), or insertion of a blank or prepunched trailer card at the end of a group of punched cards.

Self-Checking Number Device (24, 26 only)

This permits punching and verifying numerical data in one operation. Account number, part number, customer number, order number, and other classifying and indicative information contain a pre-calculated check digit. This device recalculates the field as it is punched and compares this result with the prepunched check digit. If the two do not agree, the keyboard locks and a 12 is punched in the card.

High Speed Skip

This device permits program-controlled skipping at a rate approximately three times normal skipping speed. This device is advantageous when 55 or more consecutive columns require skipping.

Continuous Skip

This device enables the operator to skip programmed fields by pressing the continuous skip key and releasing it in the last field to be skipped.

Continuous Spacing

This device allows the operator to space over successive columns as long as the key is pressed.

Alphabetic Field Limit (24, 26 only)

This device defines the limits of a programmed alphabetic field to prevent accidental punching beyond that field.

Decimal Tabulation

This device permits semi-automatic punching (or verifying) of zeros to the left of the first significant digit of a card field which has seven positions or less. To use the device, the operator presses the numerical key corresponding to the number of significant digits in the field to be punched (or verified). Zeros are automatically punched (or verified) to the left of the first significant digit, and the card is positioned at the column in which the operator is to begin keying significant digits. Eight of the regular numerical keys are used for the decimal-tabulation operation. No additional keys are needed on the keyboard.

Review Questions — IBM 24, 26, 56

1. What is the purpose of the card punch?

2. How is the keyboard attached to the punch?

3. Both numerical and alphabetic information can be punched from the same keyboard. How is the shift from one to the other accomplished?

4. How are cards placed in the hopper?

5. How must the first two cards be fed from the hopper?

6. About how many columns of the card are visible after punching has started?

7. The machine contains a reading station and a punch station. What is the purpose of each?

8. How are the cards stacked in the stacker?

9. In what sequence are the cards when they have been removed from the stacker?

10. When the main-line switch is turned on, how soon can operations begin?

11. What is the purpose of the column indicator?

12. How many multiple digits can be manually punched in one column of a card?

13. The combination keys on the keyboard contain both letters and numbers. How are they distinguished from the other keys on the keyboard?

14. If the keyboard is in numerical shift and a letter key (other than a combination key) is pressed, what happens?

15. What is the purpose of the DUP key with program control? Without program control?

16. What happens when the -SKIP key is used in numerical shift? In alphabetic shift?

17. What does the REL key do when it is pressed?

18. Normally, what is the purpose of the SKIP key?

19. Define *field*.

20. What is the purpose of the program card?

21. What punch in the program card starts skipping? What punch continues skipping?

22. What punch in the program card starts duplication? What punch continues duplication?

23. What punch in the program card automatically causes alphabetic shifting?

24. How is the program card fastened around the drum?

25. How is the drum inserted in the punch?

26. What is the purpose of the AUTO-SKIP, AUTO-DUP switch?

27. What is the purpose of the AUTO-FEED switch?

28. When a card is punched on the printing punch, where do the characters print?

29. What is the purpose of the PRINT switch?

30. How are zeros printed?

31. Explain the procedure for making over a damaged card.

32. Why should punching registrations be checked daily?

33. What is the purpose of the verifier?

34. What is the procedure for turning off the error lights on the verifier?

35. How are the error cards and the verified cards indicated?

Intermediate - second

IBM Sorters

Major - third

Accuracy and timeliness of reports are very important to administrative action. Documents used in preparation of these reports must be grouped and in proper order.

Manual sorting or rearrangement of documents into numerical or alphabetic sequence has always been a time-consuming and tedious operation, and frequently results in missorting due to human error. Likewise, manual selection of desired documents from a file of records is a slow and inaccurate process.

One of the advantages derived from the use of IBM punched-card records lies in the ability to arrange card documents with the aid of high-speed sorting machines: the IBM 82 Sorter, rated at 650 cards per minute; the IBM 82 Sorter, Series 50, rated at 450 cards per minute; and the IBM 83 Sorter, rated at 1000 cards per minute.

For matter

Normal sorting

IBM 82 Sorter

The IBM 82 Sorter (Figure 22) has a card-feed hopper located at the right end of the machine. This hopper has a capacity of approximately 1200 cards. The cards are placed in the feed hopper of the machine face down, 9-edge toward the throat.

To the left of the hopper are 13 compartments or pockets that receive the cards. Cards pass through the machine at the rate of 650 cards per minute. One column at a time can be sorted.

When the START key is pressed, the cards are automatically fed from the bottom of the stack and advanced between a sorter brush and a metal roller. As the brush drops through the first punched hole in the column, contact is made with the metal roller to close

Consider only the columns sorted when hand filing a reject or missorted card.

Sort Brush   Feed Hopper

Commutator
Selection
Switches

Main-Line
Switch

Start and
Stop Keys

Pockets
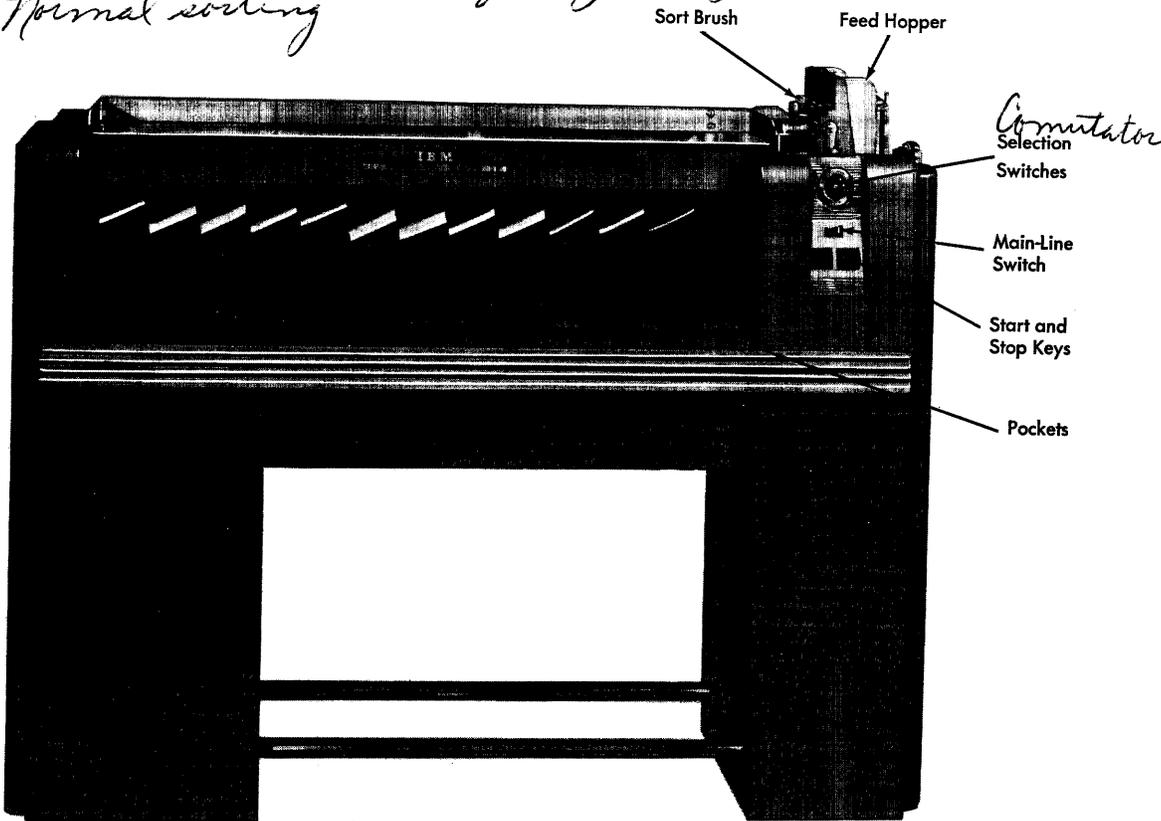
Figure 22. IBM 82 Sorter

Face down 9 edge first
Units sorted first - right-hand column

30

volts direct current
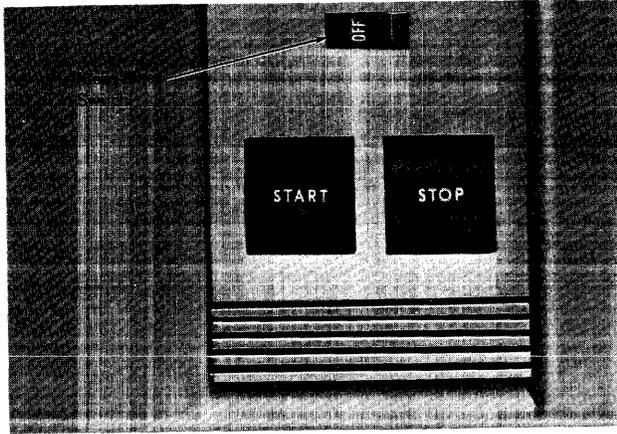
Figure 23. Machine Controls

an electrical circuit. A chute blade corresponding to the punched hole is electrically opened, and the card is directed by the chute and feed rollers into the proper pocket. Thus, all cards punched 1 in the column being sorted fall into the 1 pocket of the machine; all cards punched 2 fall into the 2 pocket, etc. If no punching appears in the column, the card falls into the reject pocket. For a double-punched column, as in the case of an alphabetic character, the card is sorted according to the first contact made (punch nearest the bottom edge of the card).

OPERATING FEATURES

Machine Controls (Figure 23)

MAIN-LINE SWITCH

This switch must be ON to supply current to the machine. A 60-second warm-up period is required before the machine operates. On some models a red signal light indicates the machine is ready to operate.

START KEY

This key must be pressed to start the cards feeding from the hopper. Once started, the cards are fed automatically until the hopper is empty.

STOP KEY

This key must be pressed to stop card feeding.

Sort Brush and Selection Handle

The actual sorting of each card is controlled by a sort brush (Figure 24), which is mounted in a holder directly to the left of the card-feed hopper. The sort brush can be set on any column by turning the selection handle located on the front of the machine near

single column selection
fill...
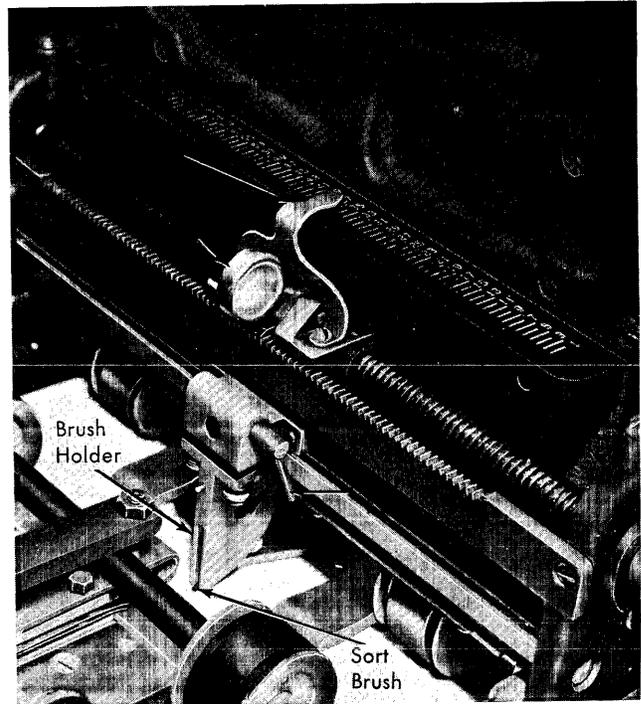
Figure 24. Sort Brush and Column Indicator

the hopper. Each turn of the handle, clockwise or counterclockwise, moves the brush one column. The brush can be moved across a number of columns by raising the handle to the upper position and moving the brush holder to the desired column while pulling down the finger lever on the top of the brush assembly. A column-indicator guide and pointer are located above the brush for convenient setting of the brush on any one of the 80 card columns. One column can be read by the sort brush at a time.

Selection Switches

The selection switches (Figure 25) make it possible to separate from a file all cards containing any specified punch, without disturbing the sequence of the remainder of the file. The selected cards fall into their
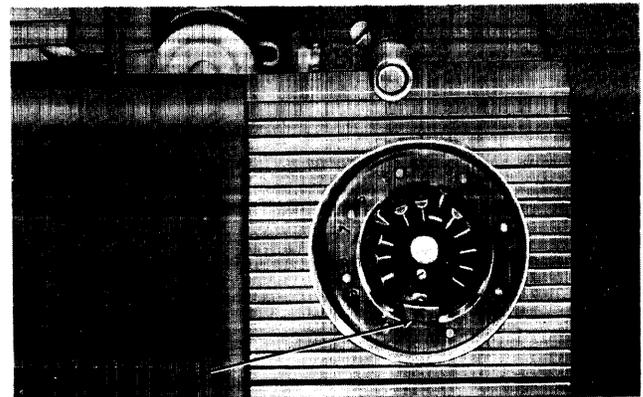
Figure 25. Selection Switches

respective pockets and the remaining cards fall into the reject pocket.

In normal sorting, when cards are to be sorted on all punches 9 through 12, all the switches must be in the outer position. When only cards with certain punches are to be selected, it is necessary to pull toward the center all the selection switches *except* those corresponding to the punches to be selected. All other cards are treated as blanks, and rejected.

The large red switch is the alphabetic sorting switch. Setting this to the center has the same effect as setting all the switches 1-9; in this position, it permits sorting only the 0, 11, and 12 punches (zones), without regard for the punching in the rest of the column.

Pockets and Pocket Stops

The 13 receiving pockets are arranged from left to right: 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, 11, 12, R. Each pocket corresponds to one of the 12 punching positions in a card column. The R (reject) pocket receives cards that are unpunched in the column being sorted, or cards treated as blanks according to the setting of the selection switches.

Each pocket is equipped with a pocket-stop lever which automatically stops card feeding when a pocket is full. Each pocket has a capacity of approximately 550 cards. To resume operation, the cards must be removed and the START key pressed.

Hand Feed Wheel

This wheel, located on the right end of the machine below the hopper, is pushed in and turned manually to feed cards when testing the machine or removing a card jam.

MACHINE FUNCTIONS

Numerical Sorting (one field)

To arrange cards in numerical order, each column in the field requires one sort. In other words, the cards must pass through the machine once for each column of numerical information to be sorted. This sorting progresses column by column, from right to left, across the field. For example, when cards are to be sorted by a department number that is punched in a two-column field, the right-hand or units column must be sorted first. Cards sorted in the 0 pocket contain all department numbers ending in zero; for example, department numbers 10, 50, 40, 30, 90, etc. Cards sorted in the 1 pocket contain all department numbers ending in 1; for example, department numbers 21, 31, 61, 01, 91, 81, etc. Other cards fall in their respective pockets (Figure 26). The cards are removed from the sorter pockets, sight-checked to assure accuracy, and placed in ascending numerical sequence so that the zeros will be first, followed by 1, 2, 3, etc.
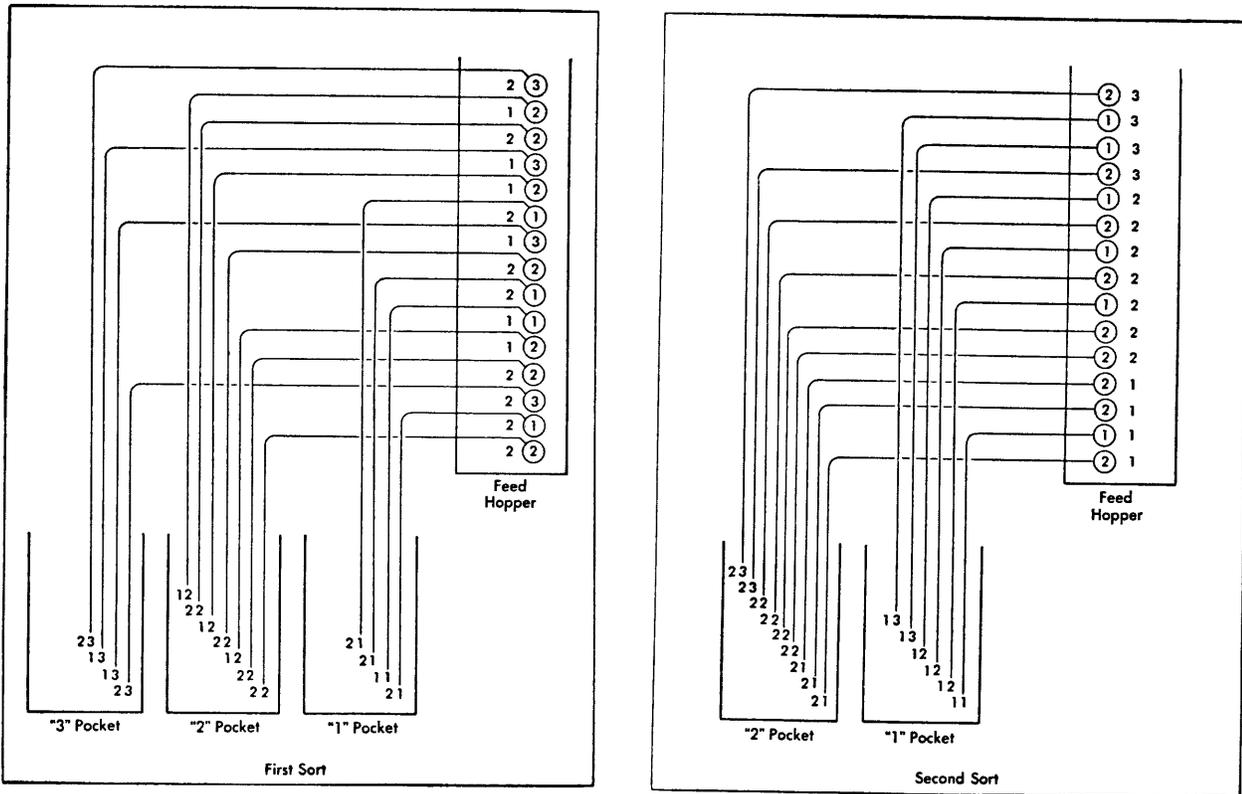
Figure 26. Sorting Principle

To complete the numerical arrangement, the sort brush must be set on the tens column (the next column to the left), and the cards sorted a second time. Zeros on the previous sort must be fed through the machine first, followed by the 1's, then the 2's, and so on. On the second run, cards sorted in the 0 pocket contain department numbers 01 to 09; cards sorted in the 1 pocket contain department numbers 10 to 19; cards sorted in the 2 pocket contain department numbers 20 to 29, and so on. If the cards are stacked in ascending order after the completion of the second sort, the cards become arranged in numerical sequence from department number 01 to department number 99.

For sorting larger fields, this procedure must be repeated for the third and subsequent columns.

It is usual practice to punch all numerical card-fields completely; by preceding significant data with zeros. Hence, in recording a two-digit number in a five-column field, the fifth, fourth and third columns (counting the columns in the field from right to left) would be punched with zeros, and the number would be punched in the second and first columns (for example, 00025). Therefore, in a strictly numerical sort, no cards should fall in the 11, 12, or R pockets.
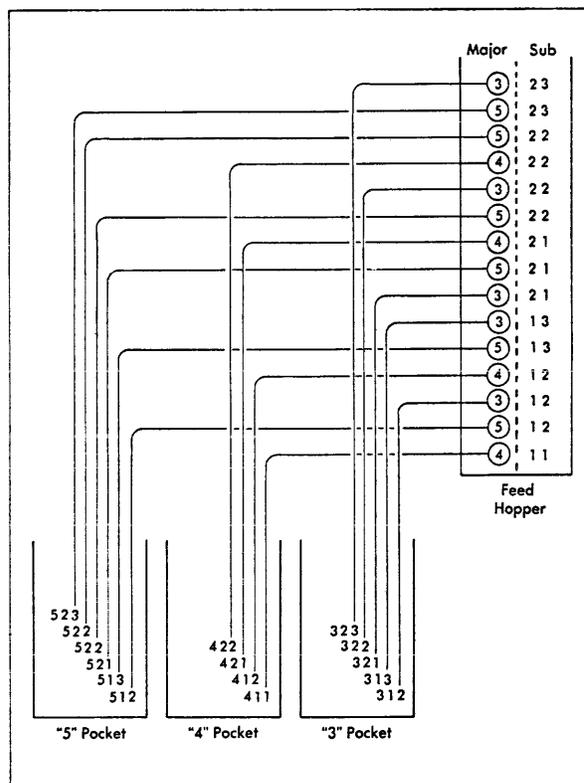
Figure 27. Block Sorting

Numerical Sorting (more than one field)

In certain sorting operations, the desired sequence or order involves more than one field. For instance, it may be desired to arrange the cards in state order and in county order within each state. This is known as a major and minor sort. Because a county is a subdivision of a state, the county field is considered the minor sort, and the state field the major sort.

Minor sorts in a small file of cards are always made first. Upon the completion of the minor sort, the sorting brush is moved to the units column of the major field, and from then on sorting continues in the usual manner.

Block Sorting

When the volume of cards is so large that it would be slow and impractical to complete the sorting operation on one machine only, considerable over-all time can be saved if the cards are separated into blocks, so that each block can be handled independently of the others.

If it is desired to separate the file into 10 blocks, the sort is made on the left-hand column of the field. Then, each block is handled as a separate group and sorted normally from the units column of the field through all unsorted columns to the left.

In operations involving more than one field, blocking can be accomplished by first sorting the major field (Figure 27). Each major group can then be treated as a separate unit of the file. In block sorting, as in any other sorting operations, cards should be sight-checked as they are removed from each pocket of the machine.

Block sorting reduces the over-all time required to prepare a report by permitting completed blocks to be processed through other machines while the remaining blocks are still being sorted. Another advantage is that an error in sorting is localized to a particular block, and is easier to correct than if spread through the entire file. Block sorting also permits the use of more than one sorter, not only in establishing the blocks, but in the final sorting as well.

Alphabetic Sorting *review*

Alphabetic sorting requires two sorts on each column because a letter is recorded by two holes punched in a single column.

Each letter A through I combines a punch in position 12 with a numerical punch 1 through 9; the letters J through R combine an 11-punch with punches 1 through 9; and the letters S through Z combine a 0-punch with punches 2 through 9. Thus, the combination 12-1 records the letter A; 12-2 records the letter B; 11-1 records the letter J, and so on.

In alphabetic sorting, each card column is sorted first on the numerical portion of the letters to group them by the digits 1 through 9, and then sorted on the zone portion by moving the red alphabetic sorting switch toward the center. This setting of the alphabetic sorting switch cuts out the normal circuits 1 through 9. Consequently, in the second run, all cards fall into the 12, 11, or 0 pockets. The 12 pocket contains cards punched with the letters A through I; the 11 pocket those with J through R; and the 0 pocket those with S through Z, all in alphabetic sequence.

Note that in alphabetic sorting, as well as in numerical sorting, the sorting proceeds from right to left in a field. All cards should be sight-checked when removed from each pocket of the machine.

Because alphabetic punching can involve word descriptions with spaces between words, the unpunched columns caused by spacing are sorted into the reject pocket on the first run. It is not necessary to sort the rejected cards through the machine a second time. However, at the completion of the second sort on a column, they must be placed in front of the file when proceeding to the next column.

What has been said regarding block sorting of numerical fields applies equally to alphabetic fields. Large files of cards can be sorted alphabetically for any given column of a field, after which each letter (or block) can be handled as a separate unit of the file.

Single-Column Selection

Cards punched with a certain digit can be selected from a file of cards without disturbing the original sequence of the remainder of the file. The sort-selection switch corresponding to the specified digit must be set to the outer rim and the other switches pushed toward the center. For example, to select cards punched with the digit 6 in column 31, set the brush on column 31 and push all selection switches except number 6 toward the center. As cards pass through the machine, those punched 6 sort in the normal manner, the rest of the cards fall into the reject pocket in their original sequence.

More than one digit can be selected on one pass of the cards through the machine. For example, if switch 3 is allowed to remain in its normal position, as well as switch 6, cards that are punched with either 3 or 6 sort in the normal manner and the rest of the cards are rejected.

In some cases, it may be desirable to separate the selected cards without disturbing their original sequence, and without regard to the arrangement of the remainder of the file. In this case, switches 3 and 6 are pushed toward the center with all other switches remaining in their normal position. In this operation,

cards punched either 3 or 6 fall into the reject pocket, in their original sequence, and cards punched with other digits are sorted normally.

All impulses 1 to 9 are ignored when the alphabetic sorting switch is moved toward the center. The same effect would be obtained by pushing in the switches for positions 1 to 9. For numerical selection as outlined in the preceding paragraphs, the alphabetic sorting switch should be set in its normal position.

OPERATING PROCEDURE

1. Plug the cord to a source of current.
2. Turn on the main-line switch.
3. Clear the machine by holding the START key down to make sure that there are no cards in the machine. Don't throw away any cards found in the machine. They may be good records. Ask your supervisor what to do with such cards.
4. Check all selection switches.
5. Determine the exact sequence to be followed. If you're not sure, ask your supervisor.
6. Set the sort brush on the column to be sorted. Cards must go through the machine at least as many times as there are columns to sort. Alphabetic sorting requires two runs through the machine per column. In a normal sorting operation not involving too large a volume, start sorting in the units column.
7. Joggle a handful of cards until edges are in perfect alignment, then place the cards in the feed hopper, face down, 9-edge toward the throat. Do not drop or force cards into the feed hopper. If you do, the feed knives may damage the edges of the cards.
8. Place the pressure plate on top of the cards.
9. Press the START key until automatic feeding starts.
10. If card feeding stops, check the pockets to see if one is full. The pocket-stop lever, in the bottom of a pocket, stops the machine if the pocket fills. If a pocket is full, remove the cards and press the START key to restart card feeding. Joggle the cards and sight-check them to be sure none of them has missorted, and place the cards face down in the proper compartment of the sorting tray.
11. Empty all machine pockets; joggle, sight-check, and place cards in the proper rack.
12. Move the sort brush to the next column to the left and repeat the operation, feeding 0's into the machine first, followed by other digit groups in numerical order.

    (NOTE: In removing cards from sorting trays, be certain to feed them into the hopper from

the bottom of each compartment. If this is not done, previous sequence is destroyed.)

13. Repeat the procedure for all other columns of the field.

14. File the cards according to instructions from the supervisor.

OPERATING SUGGESTIONS

Handling Cards

Most of the difficulty that occurs in a sorting operation can be traced to improper handling of cards. Edges of the cards are sometimes damaged in joggling or in placing them in the feed hopper. This may cause a jam as they pass through the machine. Cards may wrinkle or fold at the throat, under the brush, or between the chute blades and rollers of the machine.

Always check the edges of the cards to be sure that none is bent or torn. Check the feed hopper to be certain that it contains no dirt, card dust, pieces of paper, or other obstruction that might clog the throat.

Always *fan* cards before putting them in the feed hopper. This removes static electricity, which causes cards to stick together, particularly in damp weather. Fanning also allows any foreign material between the cards to drop out. Keep the hopper well supplied with cards to assure continuous card feeding.

When cards are being fed, do not:

1. Rest a hand on the cards in the hopper,

2. Use a heavier-than-normal card weight, or

3. Fill the hopper higher than the side plates. The extra weight may cause misfeeds, missorts, and rejecting of cards.

Card Jams

In the event of a jam, immediately stop card feeding by pressing the STOP key, and turn off the main-line switch. If the jam has occurred at the throat, empty the hopper and raise the brush from the roller by turning the brush handle a half turn; that is, until the handle is in the upper position. Turn the locking key and remove the brush holder to prevent damage to the brush while cards are being removed. If part of the jam is between the chute blades, raise the glass top of the machine by lifting the front.

In removing jammed cards from the machine:

1. Make every effort to straighten the cards enough so that they can be run into the pockets by turning the hand feed wheel on the right end of the machine.

2. If the jam is severe, it may be necessary to remove the cards under the blades. In doing this, pull

from one side of the chute blades, exerting steady pressure on one end of the card. Be careful not to pull the chute blades out of line while removing the cards.

3. Make every effort not to tear damaged cards any more than necessary, because this makes it more difficult to assemble the pieces in order to punch duplicate cards. These must be hand-filed in their proper sequence.

4. Pieces of torn cards should be matched to be certain no torn pieces still remain in the machine to cause further jams.

5. When all damaged cards have been removed and no pieces remain in the machine, close the top and replace the brush holder in the proper sorting position. Always check to be sure that the wire strands of the brush are not spread or damaged.

Make every effort to keep the machine clean. Dirt and other foreign material can cause the machine to jam.

Timing the Brush

When it is necessary to install a new sort brush, check to see that it is adjusted properly. Electrical timing can be affected if this precaution is not taken.

Timing the brush (Figure 28) is a simple operation:
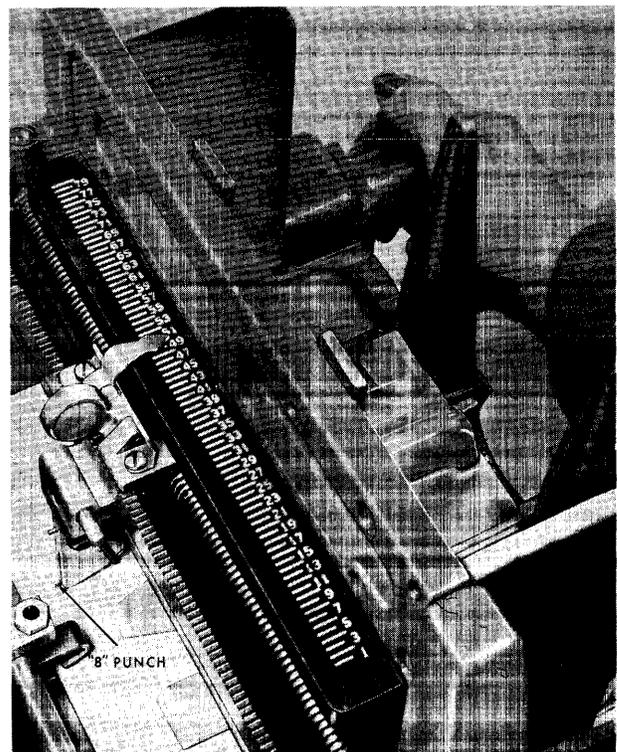
1. Turn on the main-line switch.

Figure 28. Timing the Brush

2. Punch a card with an 8 in a column at each end of the card, and place it in the feed hopper with the card weight.
3. Set the brush on one of these columns.
4. Turn the hand feed wheel so that the card is slowly advanced into the machine until contact is made by the brush through the hole.
5. When contact is made, a click is heard caused by the dropping armature plate. The card edge should be approximately ½ inch under the end of the first chute blade. Press the START key. The card should fall into the 8 pocket. If it does not, the brush has not been properly timed. Ask the supervisor to adjust the brush for you.
6. Repeat the operation for the punched column at the other end of the card. This checks for proper card alignment to assure correct timing for the entire card.

The transparent protecting cover over the brush holder assembly must be closed for the machine to operate. Raising it during a sorting operation stops card feeding.

CHECKING AND STACKING CARDS

Missorting is sometimes caused when punched holes are off-gage or when the leading edge of the card is slightly damaged. If cards appear to be off-punched, have your supervisor check several of them with a card gage. If edges are damaged, it may be necessary to have the cards duplicated.

Any cards falling vertically into the stackers must be straightened immediately. Otherwise they may get out of sequence or cause a jam as other cards are fed into the pocket.

Sight Checking. When the cards are removed from a pocket, the sorting should be checked. Joggle the cards (Figure 29) into perfect alignment; then hold the cards in front of a source of light and look through

Figure 30. Sight Checking

the hole corresponding to the pocket from which they were removed (Figure 30). If the cards have been sorted properly, the holes form a tunnel through which light can be seen. If the position being checked is not punched in every card in the group, it is impossible to see light through that position. This indicates that one or more cards have been missorted. These must be located, removed, and hand-filed in their proper places. In hand-filing, consideration should be given to any columns previously sorted, as well as the column just completed.

Using a Sorting Needle. Locating missorted cards can be facilitated by using a sorting needle as illustrated in Figure 31. A missorted card blocks the needle and can be readily removed.

Figure 29. Joggling Cards
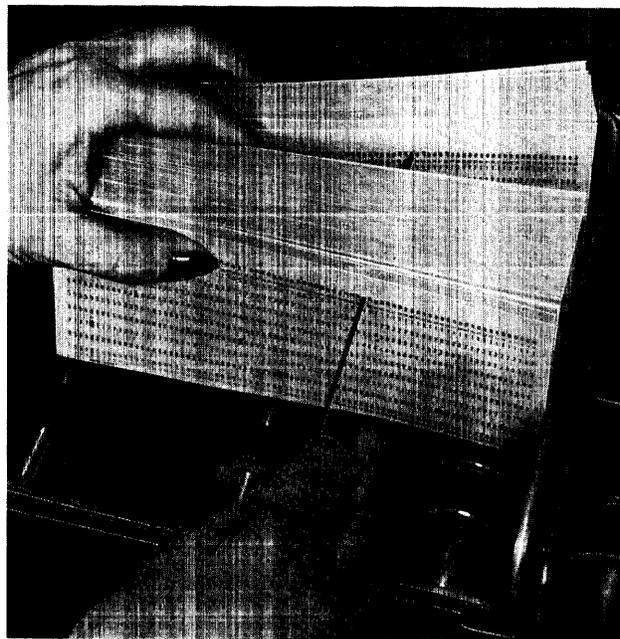
Figure 31. Use of Sorting Needle

Another use of the sorting needle is for manual sorting of comparatively large groups of cards having the same punching in a given column.

Stacking Cards Temporarily. After sight-checking each group of cards, stack them *face down* in sorter trays, usually attached to the back of the machine. In the absence of sorter trays, a working table with file drawers or boxes should be located conveniently near the machine.

If the volume of cards to be sorted is small (2,000 or less), the glass top of the machine can be used for temporary stacking of cards.

Cards removed from the temporary stackers for subsequent sorting must be fed into the hopper from the *bottom* of each stack, or from the *front* of a file drawer. If this is not done, previous sequence is destroyed.

IBM 83 Sorter

With the exception of the differences noted, the IBM 83 Sorter (Figure 32) operates the same as the IBM 82 Sorter, but at the rate of 1000 cards per minute.

OPERATING FEATURES

Digit Suppression Keys

Twelve keys (Figure 33), corresponding to each punching position, can be latched down to suppress sorting on specific punches. To unlatch or reset the keys, merely run a fingertip along the bottom edges of keys.
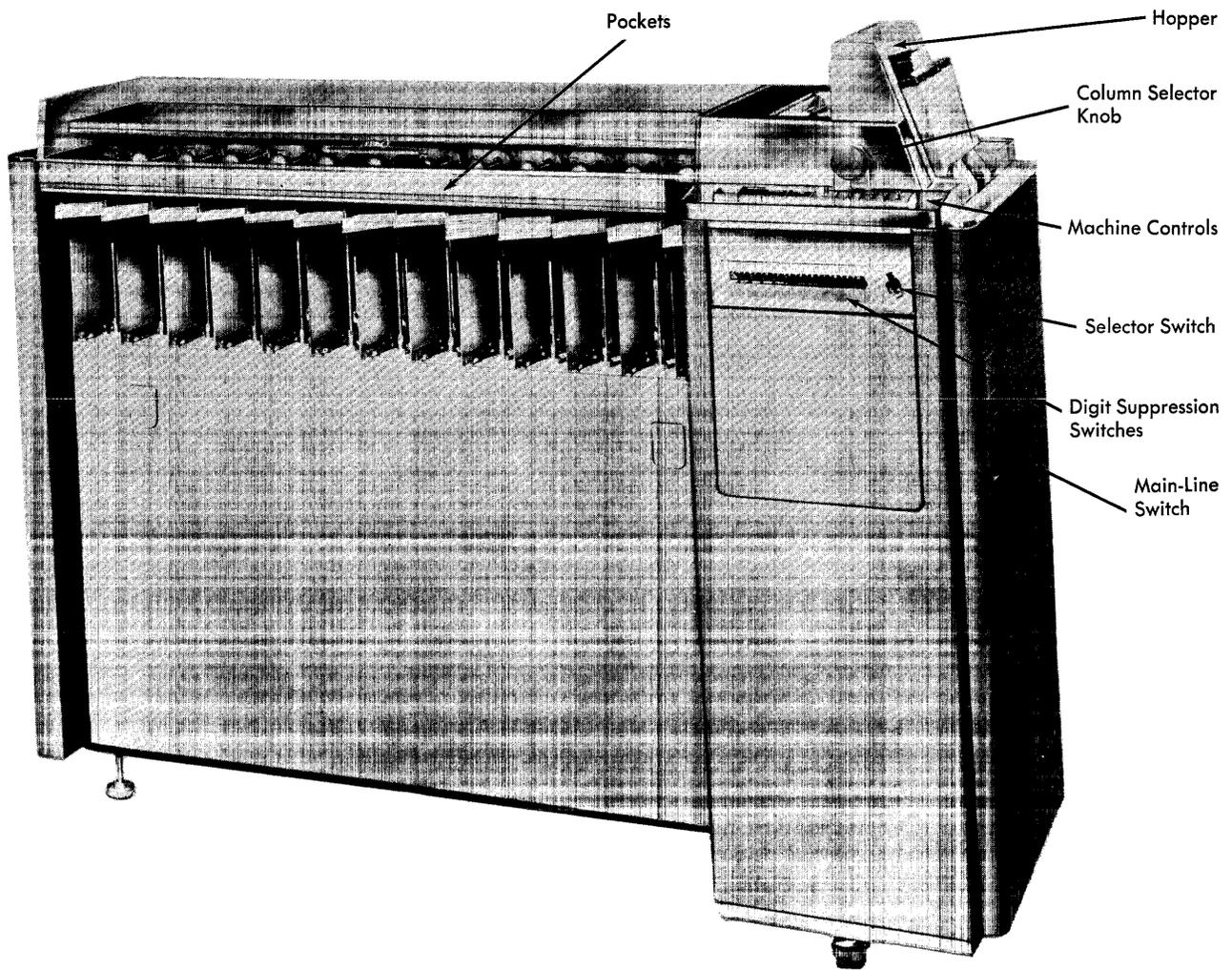
Figure 32. IBM 83 Sorter

Sort Selection Switch

A 5-position rotating switch (Figure 33) determines the sorting pattern: Numerical, Zone, Alphabetic Sort 1, Alphabetic Sort 2, and Alpha-Numerical. Figure 34 shows the sorting pattern for each setting of the sort selection switch.

Numerical (N). Cards are sorted on the first punch read. Blanks are rejected. Double punches are rejected as errors if the Edit or Edit-Stop switch is ON.

Zone (Z). Cards are sorted on zone (0, 11, 12) punches only. Cards without a zone punch are rejected. Any card with more than one zone punch is
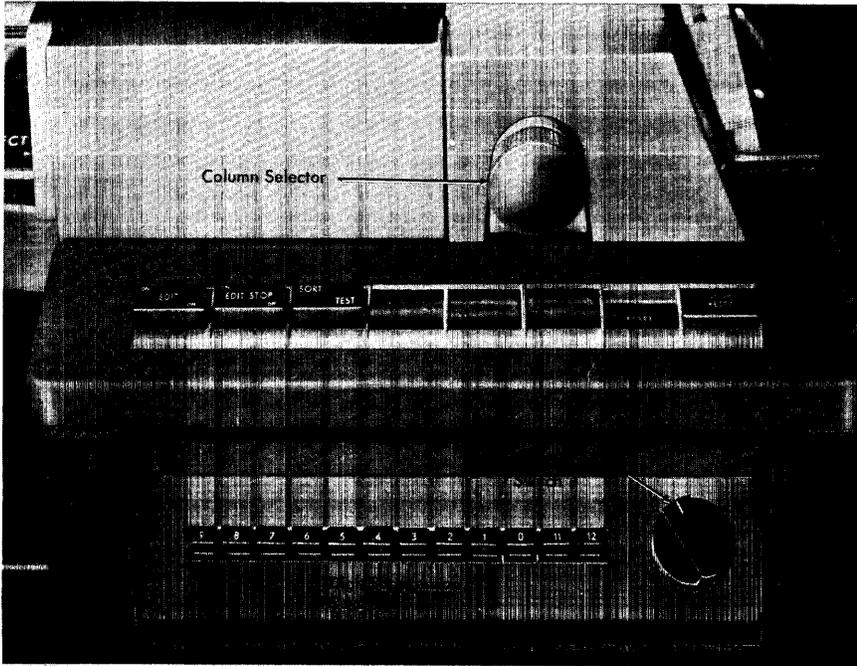
Figure 33. Machine Controls

SORT SELECTION SWITCH SETTING	POCKETS												REJECTS REGARDLESS OF EDIT	ERRORS (When Edit or Edit-Stop is ON.)
	9	8	7	6	5	4	3	2	1	0	11	12		
Numerical	9	8	7	6	5	4	3	2	1	0	11	12	Blanks	Multiple-punched cards (incl. letters)
Zone										0	11	12	Any card without a zone punch	Any card with more than one zone punch
Alpha-1	I	H	G	F	E	D	C	B	A	0 S-Z	11 J-R		Blanks and cards with a 12-zone punch but no digit punch. Digits 1 to 9.	Any card with more than one zone punch or with more than one digit punch
Alpha-2	R,Z	Q,Y	P,X	O,W	N,V	M,U	L,T	K,S	J 0-1				Cards with 0 or 11-zone only. Blanks. Letters A to I, and 12-zone spec. char. Digits 1 to 9.	Same as A-1
Alpha-Numerical	9	8	7	6	5	4	3	2	1	0 (digit)	11 J-R	12 A-1	Blanks, 0-zone (S-Z)	Same as A-1

This pattern is based on cards being fed face down, 9 edge first.

Figure 34. Sorting Pattern for Standard Machine

rejected as an error if the Edit or Edit-Stop switch is ON.

Alphabetic Sort 1 (A-1). Cards punched with a digit and a 12 zone (A-I) are sorted on the digits (1 through 9). Cards punched with an 11 zone are sorted into the 11 pocket. Cards punched with a zero zone are sorted into the zero pocket. Blank cards, cards with only a digit punch, and cards with only a 12-zone punch are rejected. Cards with multiple-digit punches or multiple-zone punches are rejected as errors if the Edit or Edit-Stop switch is ON.

Alphabetic Sort 2 (A-2). Cards punched with a zero or 11 zone are sorted on the digits. Blanks, cards with a zero or 11 zone only, cards with digits only, or letters A through I are rejected. Error is the same as A-1.

Alpha-Numerical (A-N). Cards with a digit punch but no zone punch are sorted into their respective digit pockets. Cards punched with an 11 or 12 zone are sorted into the 11 or 12 pocket, respectively. Cards punched with a zero zone are rejected. Error is the same as for A-1.

Edit Switch

With this switch ON, errors are rejected without stopping card feeding.

Edit-Stop Switch

With this switch ON, errors are rejected, the error light goes on, and card feeding stops. The STOP key must be pressed to reset the error circuits when the machine has stopped with the error light ON.

Test-Sort Switch

This switch is set to TEST by the customer engineer when checking machine timing. It must be set to SORT while performing sorting operation.

Power On Light

This light glows when the main-line switch is ON, and the machine is ready to operate.

Edit Light

This light glows when the Edit-Stop switch is ON and the machine senses an error. It also glows when the Test-Sort switch is set to TEST and the brush is reading a punch in the card.

Sort Brush (Figure 35)

This assembly operates the same as for the IBM 82 Sorter, except that the selection knob moves the brush three columns for each full rotation—one-third turn per column.

Pocket Stops

Each of the 13 pockets has a pocket-stop lever. A control knob on the rear of the sorter can be set to adjust
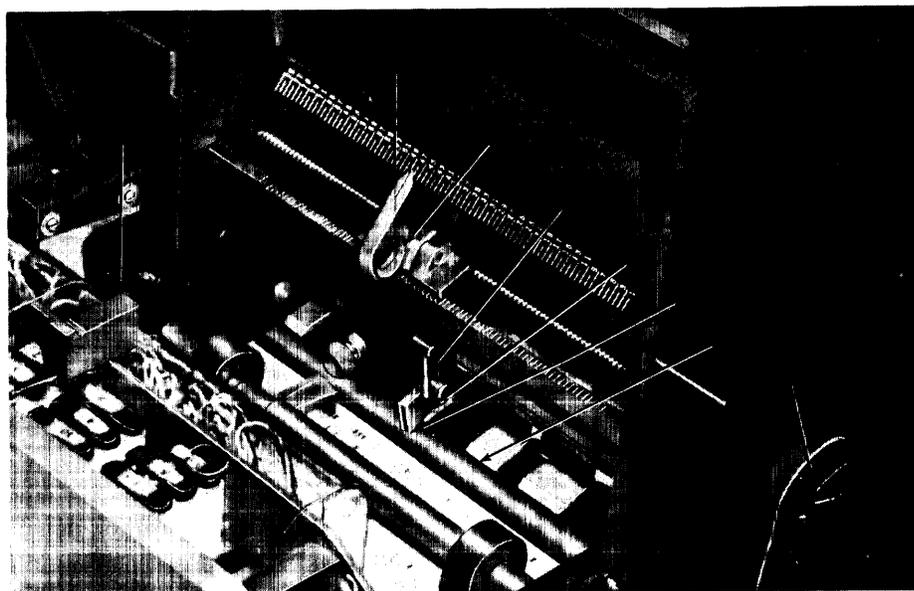
Figure 35. Sort Brush Assembly

the capacity of each pocket for approximately 400, 565, 735, or 900 cards. Figure 36 shows the pocket-stop control knob as seen from the front of the machine. From this position, the operator can adjust the control knob by moving it until it clicks into one of the four positions.
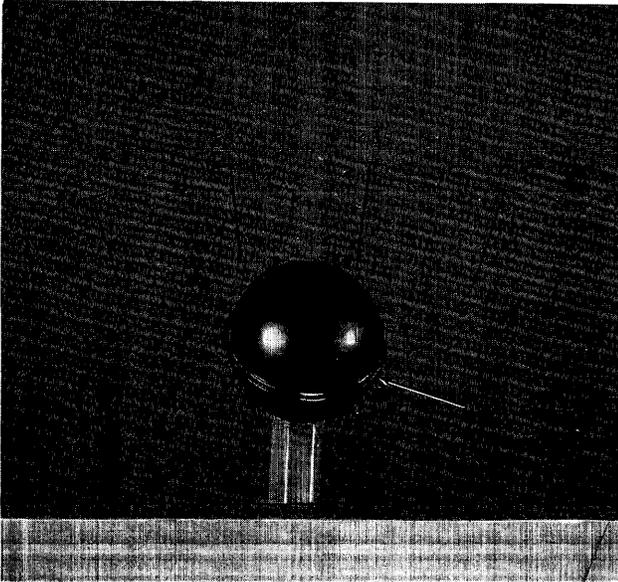
Figure 36. Control Knob for Adjustable Pocket Stop

MACHINE FUNCTIONS

Numerical sorting, block sorting, and single-column selection are performed the same as with the ibm 82 Sorter, but by means of the Sort Selection switch and digit suppression keys. The operator should be thoroughly familiar with the principles set forth in these sections.

Alphabetic Sorting

Alphabetic sorting with the ibm 83 is much like that with the ibm 82 but is accomplished by setting the Sort Selection switch on A-1 and A-2. With the switch set on A-1:

1. Letters A through I are sorted into pockets 1 through 9 on the first pass.
2. Letters J through R, which have 11 zoning, are sorted into the 11 pocket.
3. Letters S through Z, which have zero zoning, are sorted into the 0 pocket.
4. Any card that is blank or punched with only a 12 zone or only a digit is rejected.

If cards punched with either letters or digits in a column are to be sorted, they should be pre-sorted using the A-N setting of the Sort Selection switch.

The Edit or Edit-Stop switch should be on so that any cards with double-punched digits or double-punched zones reject; if the Edit-Stop switch is on card feeding stops.

At the end of the sort on A-1, the cards should be removed from pockets 1 through 9. These are the A to I cards, which are sorted. The cards in the 0 and 11 pockets should be removed and kept separate, ready for the second pass. Only the cards punched with letters A through I are sorted on the first pass. The rejects may be left in the pocket or checked for valid punching and held for the next column sort.

The Sort Selection switch should be changed to A-2, but the brush setting should not be changed for the second pass. It is not necessary to put the rejects and A through I cards through again.

The 11- and zero-zone cards must be fed through the machine separately on the second pass. The 11's are fed through first. This sorts the J through R cards. These cards are removed and put behind the A through I cards. Next the zero-zone cards (S through Z) are sorted. These cards are removed and placed at the end of the deck.

All valid cards from the reject pocket are placed in front of the file for the sort on the next-column.

This sorting is repeated on each column progressing to the left across the field.

Alpha-Numerical Sorting

When the Sort Selection switch is set to A-N, all the digits are sorted. Cards punched with letters are sorted to their respective zone pockets. This method offers a quick means of separating alphabetic and numerical punches. The digit-zero and the zone-zero are separated automatically: A digit-zero is sent to the zero pocket; a zone-zero is rejected.

When either letters or numbers may appear in a column, the cards should be sorted using the A-N setting first, to separate the letters from the digits. The digits 0 through 9 are sorted into their respective pockets. The 12-zone, 11-zone, and zero-zone letters should then be sorted separately using the A-1 and A-2 switch settings.

OPERATING SUGGESTIONS

When a card jam occurs at the sort brush, rotate the locking key (Figure 35) and remove the brush assembly. The brush should be checked against the brush gage before being replaced. This gage is located on top of the selector unit (Figure 37).

When a card jam occurs at the entrance to the chute blades, release the latch (Figure 37) and raise the selector unit. Care should be taken in handling the selector unit and the chute guides.

When a card jam occurs in the chute blades over the pockets, raise the cover (Figure 22) and remove the
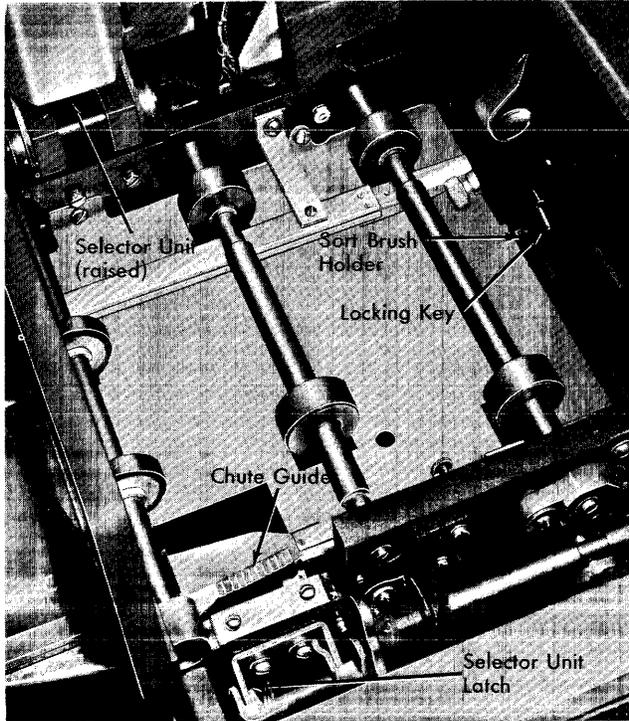

Figure 37. Selector Assembly and Latch

damaged cards by a steady pull on the cards, being careful not to damage the chute blades.

OPTIONAL FEATURES — IBM 82, 83

Special devices can be installed on the IBM 82 and 83 Sorters to extend the application possibilities. Full discussion can be found in the IBM 82 and 83 manuals.

Auxiliary Card Counter

An electrically-operated counter registers each card passing through the brush. It is mounted on the hopper side-plate to the rear of the sorter. This device is controlled by a Card-Count switch located near the machine controls. To clear the total, turn the reset wheel until all counter wheels read zero.

A count for an individual group can be made by a special pass through the machine, or as each group is fed through the machine on the next sort.

The capacity of the counter in the IBM 82 Sorter is 99,999; in the IBM 83 Sorter, 999,999.

978 Card Counting Unit

This demountable device (Figure 38) has fourteen 5-digit counters to count all punches and blanks in a column and give a sub-total. If desired, this count can be made without disturbing the sequence of the file by directing all cards to the reject pocket by the Count-Only switch.
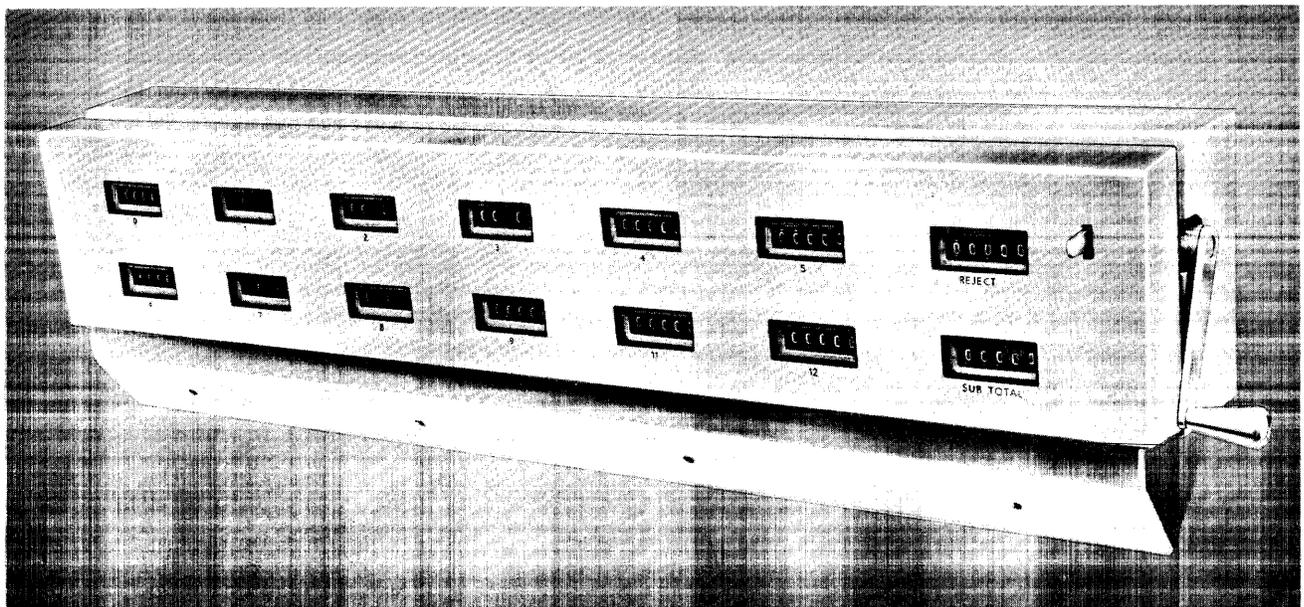
Figure 38. IBM 978 Card Counting Unit

Counters are cleared by pressing the clearing lever, and turning the crank two turns to a locked position. With the Count Switch ON, if the cable is disconnected or the counters are not properly cleared, the sorter does not operate.

Card Matching Device

This device enables the sorter to separate unmatched detail or master cards from a merged file. A special rail brush distinguishes a master card from a detail card by the corner cut or a punch in column 1 or 80.

In the IBM 83 Sorter, the regular sort brush, reading a significant punch in the card, can be used to distinguish between master and detail cards.

Group Sorting Device

This device permits sorting an entire group of detail cards according to the punching in a *leader* master card. Interspersed master cards are distinguished by a corner cut, which is recognized by a special rail brush.

Sorting Suppression Device

This device allows sorting cards into either the reject pocket or the 12 pocket, without disturbing the sequence of the two groups of cards. The cards which reject are determined by the Sort Selection switches and digit suppression keys.

Multiple-Column Selection

With this device, cards punched with a predetermined numerical or alphabetic code in as many as 10 consecutive columns, can be sorted in a single pass. Additional multiple-selection operations are possible:

Zero Elimination. This reduces sorting time by automatically rejecting cards that need no further sorting, like those with only zeros remaining to the left.

Common Digit Selection. This permits sorting out all cards having one or more common digits.

Length of Field. (IBM 83 only) permits sorting cards into pockets according to last column punched. On a single pass, shorter names can be separated from longer names in order to reduce the number of times cards must be passed through the sorter.

These features use a 10-position brush assembly, inserted by the operator in place of the regular sort-brush assembly. A small control panel and 10 Column-Control switches (Figure 39) are located at the right end of the machine.

Alphabetic Sorting Device (IBM 83 only)

This device modifies the sorting pattern of the Sort Selection switch to reduce the number of card passes. Cards sort in a sequence (Figure 40) that does not require them to be removed from the pockets until the run is complete.

File Feed (IBM 83 only)

This device (Figure 41), which holds approximately 3600 cards, triples the sorter's hopper capacity. Cards are automatically joggled in the hopper by a joggle plate and in the pockets by pocket jogglers (Figure 42).
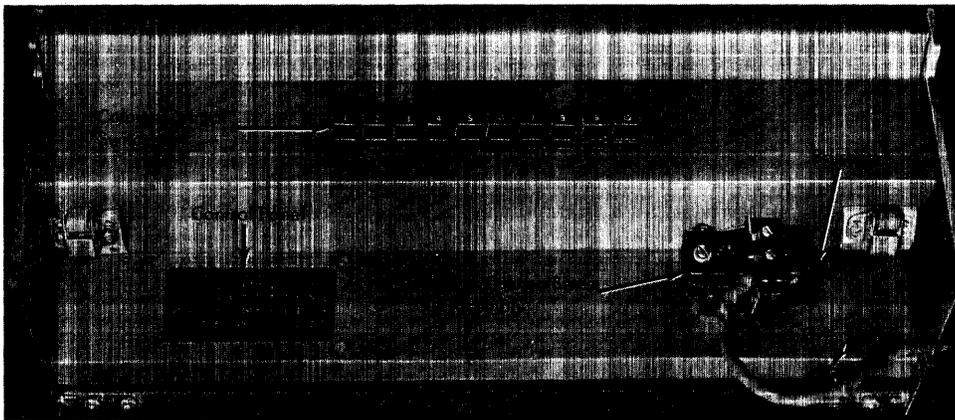

Figure 39. Ten-Column Brush Assembly, Control Panel and Switch

SORT SELECTION SWITCH SETTING	POCKETS												REJECTS REGARDLESS OF EDIT	ERRORS (When Edit or Edit-Stop is ON)
	9	8	7	6	5	4	3	2	1	0	11	12		
Alpha-1	X	U	R	O	L	I	G	E	C	A	KN QT WZ	BD FH JM PS VY	Cards punched with digits only, zones only, 0-1 combination, or blank	Any card with more than one zone punch or more than one digit punch
Alpha-2	Z Y X	W V U	T S R	Q P O	N M L	K J I	H G	F E	D C	B A			Same as A-1	Same as A-1
A-N	9	8	7	6	5	4	3	2	1	0	KN QT WZ 11	BD FH JM PS VY 12	Blanks. A,C,E,G,I, L,O,R,U,X and the combination 0-1.	Same as A-1

This pattern is based on cards being fed face down, 9 edge first.

Figure 40. Sorting Pattern for Alphabetic Device
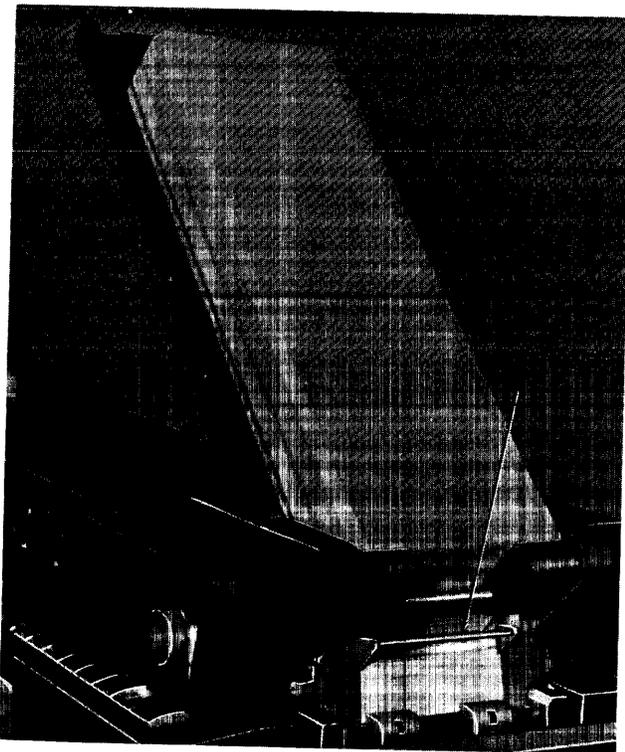
Figure 41. File Feed
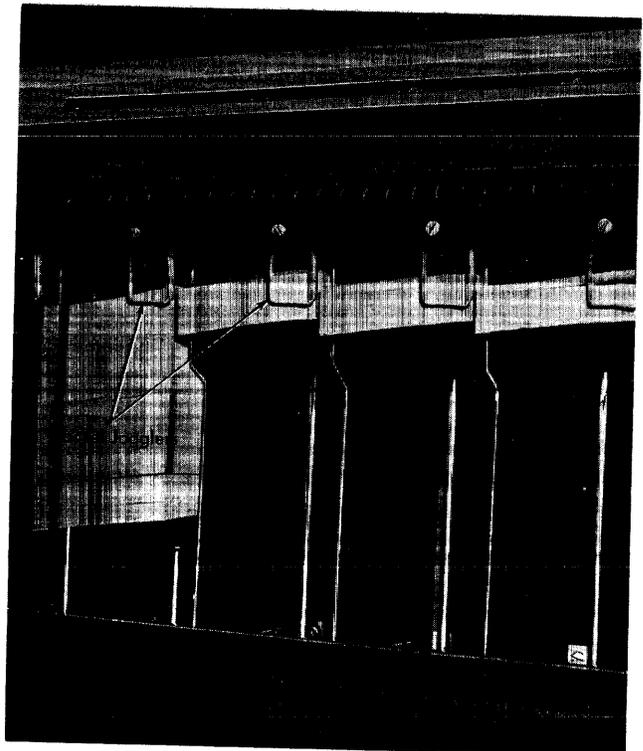
Figure 42. Pocket Jogglers

Review Questions — IBM 82, 83

range cards in ascending order by field

1. What is the purpose of the sorter?

2. How is sorting accomplished?

3. How many pockets are there and what is the purpose of each one?

4. How are the cards placed in the hopper?

5. What directs the cards to the pockets?

6. What is the purpose of joggling cards before placing them in the sorter?

7. Why must the cards be sight-checked after removing them from the sorter pockets?

8. Why is it possible to locate missorted cards with a needle?

9. How is the brush changed from column 15 to column 18 in the IBM 82? In the IBM 83? From column 15 to column 79?

10. If a card missorts during any sort after the first one, what factors must be taken into consideration before hand filing?

11. When one column of a field has been sorted, which cards should go into the machine first for the next sort?

12. Give two reasons for card feeding to stop automatically.

13. Where should cards be stacked temporarily between sorts when sorting small groups of cards? When sorting a large group of cards?

14. If cards are to be sorted by man number, punched in columns 13 through 18, what column would normally be sorted first?

15. In normal sorting, which punch is recognized in a double-punched column?

16. Give the advantages of block sorting.

17. How can the block sorting principle be used when sorting alphabetically?

18. Why is it necessary to sort alphabetically punched columns twice? What is the procedure on the IBM 83 Sorter using the A-1 sort selection setting?

19. Describe the function of each setting of the Sort Selection switch of the IBM 83 Sorter.

20. When sorting in an alphabetic field, why may cards fall in the reject pocket in the IBM 82? In the IBM 83?

21. If cards punched with a 2 or 5 in a given column are to be rejected and all other cards are to be sorted, how would the selection switches be set on the IBM 82? How would the digit supression keys be set on the IBM 83?

22. When is it necessary to reverse the operation described in the preceding question?

23. Describe the function of the Edit and Edit-Stop switches.

24. Explain the procedure for timing a sort brush.

25. What may cause cards to missort?

A major problem of accounting is filing and file maintenance. Records must be kept accurate, up-to-date, and accessible. The IBM collator is a filing machine that arranges cards according to a pre-determined pattern for subsequent processing.

The principal function of the collator is to feed and compare two files of punched cards simultaneously, in order to match them or combine them into one file. At the same time, cards in each file that do not match those in the other can be separated automatically from the rest of the file.

Two card-feed units (primary and secondary) accommodate the two files of cards. Pockets are provided for stacking the cards in desired groupings. When cards are fed from the hoppers, the punching is compared to control card feeding and stacking.

The basic operations that can be performed on the collator are: selecting specific cards from a file; checking the sequence of cards in a file; combining two files into one complete file, with or without the selection of cards; and matching two files of cards while selecting any unmatched cards from each file.

IBM collators can be divided into groups: numerical — IBM 77, 85, 88; alphabetic — IBM 87, 89. For the purpose of presentation, the IBM 77 Collator is described, and the differences noted for other machines.

IBM 77 Collator

The IBM 77 Collator (Figure 43) compares and files two groups of cards according to the numerical information punched in the cards. Each feed can operate at a speed of 240 cards per minute. The number of cards fed when both feeds are used ranges from 240 to 480 cards per minute, depending upon the control required by the operation.

Secondary Feed Hopper

Stackers

Primary Feed Hopper

Main-Line Switch

Machine Control

Control Panel
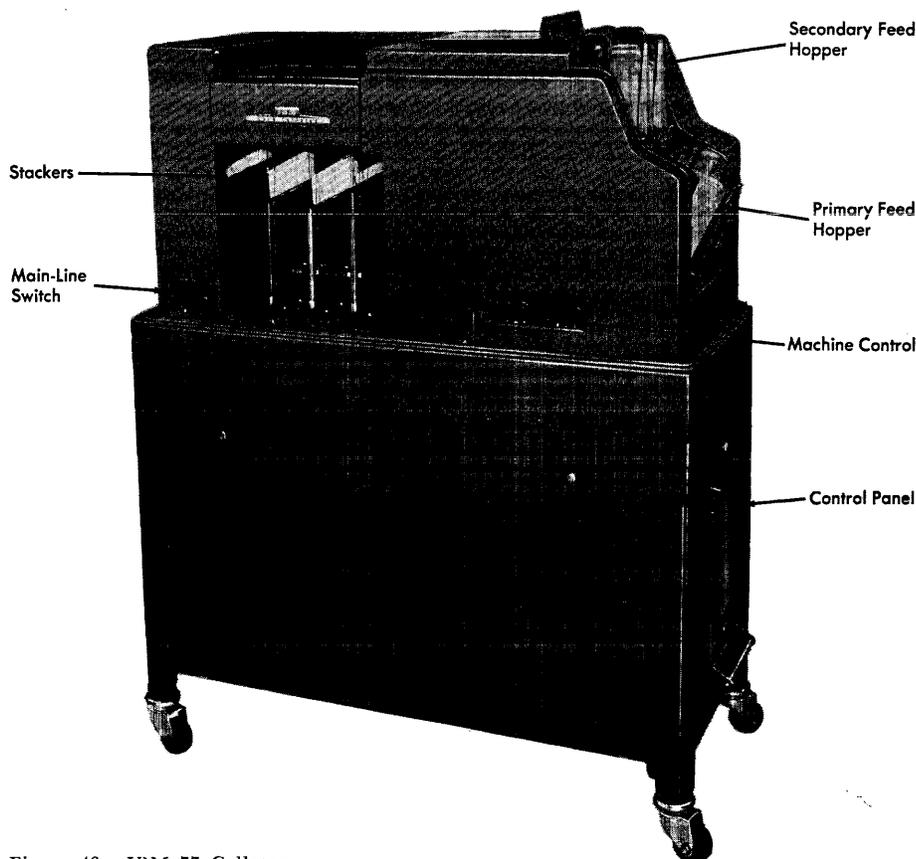
Figure 43. IBM 77 Collator
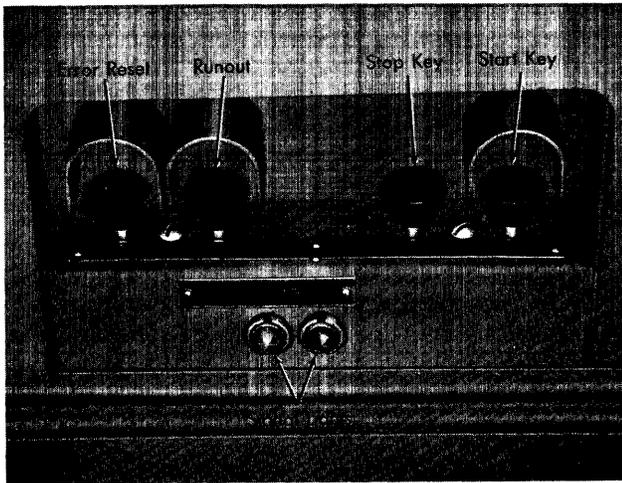
Figure 44. Machine Controls

OPERATING FEATURES

Machine Controls (Figure 44)

MAIN-LINE SWITCH

The main-line switch controls the power and must be ON before the machine can be operated. This switch must not be turned off during operation without first pressing the STOP key.

START KEY

Pressing this key starts card feeding. It must be held down for three cycles before automatic operation begins.

STOP KEY

This key is pressed to stop card feeding.

RUN-OUT KEY

When the machine stops after the last card is fed from either hopper, the RUN-OUT key must be pressed until the feed with the empty hopper is emptied of cards.

ERROR LIGHT

This red light goes on when card feeding stops because of an error condition recognized by control-panel wiring.

ERROR RESET KEY

When the red error light is on, the ERROR RESET key must be pressed before card feeding can be restarted.

RUNNING INDICATOR LIGHT

A green running indicator light goes on whenever the main-line switch is ON and cards are not passing through the machine.

Hoppers

The collator has two separate feed units: the lower feed unit is the primary unit, and the upper is the secondary unit.

Cards are placed in the hoppers face down, 9-edge toward the throat. Each hopper holds about 800 cards and is equipped with a hopper-stop contact. As soon as the last card is fed from either hopper, the machine automatically stops. Additional cards can be placed in the hopper, and card feeding can be resumed by pressing the START key.

Stackers

After cards are read by the brushes, they pass into one of four pockets or stackers (Figure 45). Each pocket holds approximately 1000 cards and is equipped with a lever to stop the machine when the pocket is full. The four pockets are numbered right to left from 1
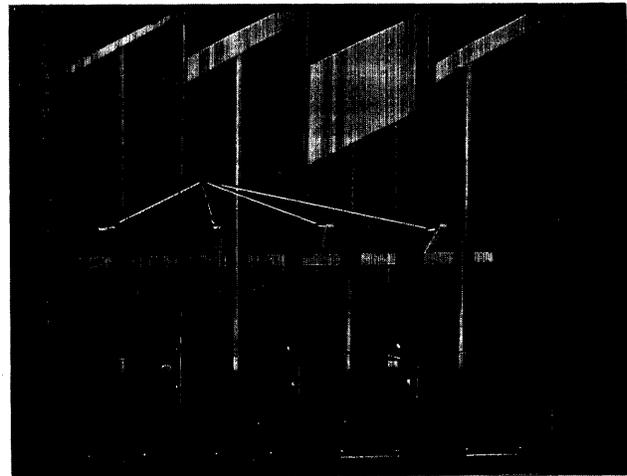
Figure 45. Stackers

to 4. Pocket 1 is for selected primary cards; 2 for merged cards; 3 and 4 are for selected secondary cards. Primary cards can stack in either pockets 1 or 2. Secondary cards can stack in pockets 2, 3, or 4. If two sets of cards are to be merged, the merged cards stack in pocket 2.

The schematic diagram of the collator (Figure 46) is, in effect, a cutaway view of the primary and secondary feed units, the three sets of brushes, and the control units. The lower line drawn at an angle represents the primary feed unit; the upper line, the secondary feed unit. The four pockets are shown at the left.

Control Panel

The control panel is the brain of the machine, and controls card reading and card feeding. Cards are not fed unless a suitably wired control panel is clamped in the machine.
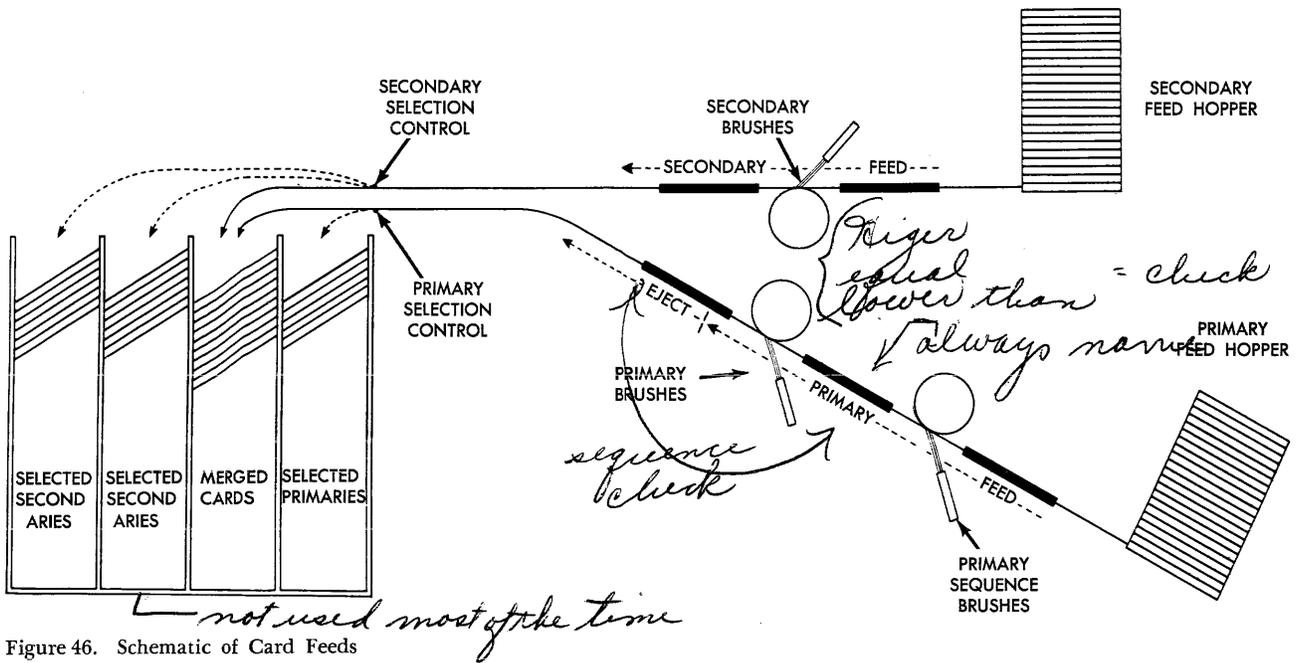
Figure 46. Schematic of Card Feeds

MACHINE FUNCTIONS

The operations accomplished by the collator fall into four major classifications: Sequence Checking, Selecting, Merging, and Matching.

Sequence Checking

This term is used to describe the operation in which the ascending order of a file of cards is automatically verified. Though not ordinarily done, cards can also be checked for descending sequence. As the cards are fed through the machine, each card is compared with the one ahead to determine whether the card is higher, lower, or equal to the preceding card. This operation can be performed as an independent function, or in combination with a merging, matching, or selecting operation. In normal practice, any file to be checked for sequence is run through the primary feed, and the cards enter the second stacker (Pocket 2).

The control panel is wired so that whenever an error in sequence is detected, card feeding automatically stops and the error light goes on. An error in sequence can be defined as a step-down condition in which a card is recognized as lower in number than the preceding card.

When card feeding stops because of an error in sequence, the cards should be removed from both the hopper and the stacker. Then, after pressing the ERROR RESET key, the cards in the machine should be run out by pressing the RUN-OUT key. The step-down card is the second one run out, but may or may not be the card out of sequence. A check must be made of several cards from both the stacker and the hopper to determine exactly which card or cards are out of order

so that they can be properly filed manually. Figure 47 illustrates three different errors in sequence: in A, the step-down card (3) is out of order; in B, the card (9) preceding the step-down card is out of order; and in C, the step-down card (3) and the two cards (4 and 5) following it are out of order. The operator should be familiar with these three types of sequence errors.

An alternate method of locating a misfiled card can be used—but only with discretion and care. When an error condition occurs, press the ERROR RESET key to turn off the error light; press the START key to start
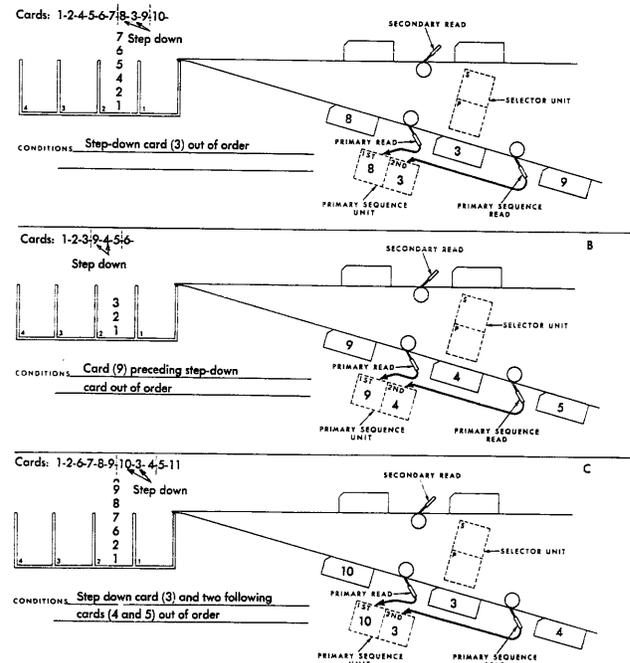

Figure 47. Three Types of Sequence Errors

card feeding; press the STOP key after three cards have been fed into the stacker; check these cards visually to find the error; file these cards in proper sequence; press the START key to continue the operation.

Selecting

This term is used to describe the withdrawal of any card or cards from the file according to the conditions wired in the control panel. These conditions may vary considerably. For example, it may be desired to withdraw or select:

1. the first of each group of cards punched with the same control number,
2. the last of each group of cards punched with the same control number,
3. single cards not a part of any group,
4. all cards with a given number,
5. cards punched with numbers between an upper and lower limit (for instance, 1240 and 3599).

Selection involving sequence is usually limited to the primary feed. Other types of card selection are possible, but these are mentioned to indicate the flexibility of the machine.

In any of these selection operations, selected cards are normally stacked in the first pocket, while cards to remain in the file are stacked in the second pocket. In the secondary feed, where double selection is possible, selected cards can be directed by control-panel wiring to Pocket 3 or Pocket 4. Cards to remain in the file are stacked in Pocket 2.

When cards are fed and selected in one feed, the selected cards can be automatically replaced by indicator, or signal, cards fed from the other feed.

Selection can be performed by itself or in conjunction with other operations.

Merging

Merging is an operation in which two files of cards, already in numerical sequence, are combined to produce one complete file also in numerical sequence. The cards to be merged are usually arranged in ascending order, and therefore the merged file is also in ascending order.

To merge the two files, a card in the first file is compared with a card in the second file to determine which one should be moved first to the combined file. The comparison indicates one of three conditions (Figure 48):

1. The card in the first file is low (A and C).
2. The card in the second file is low (B).
3. The cards in both files are equal (D).

Low cards are merged in front of the file. This arranges the cards in ascending numerical order. For equals, the card in the first file is merged in front of the card in the second file.
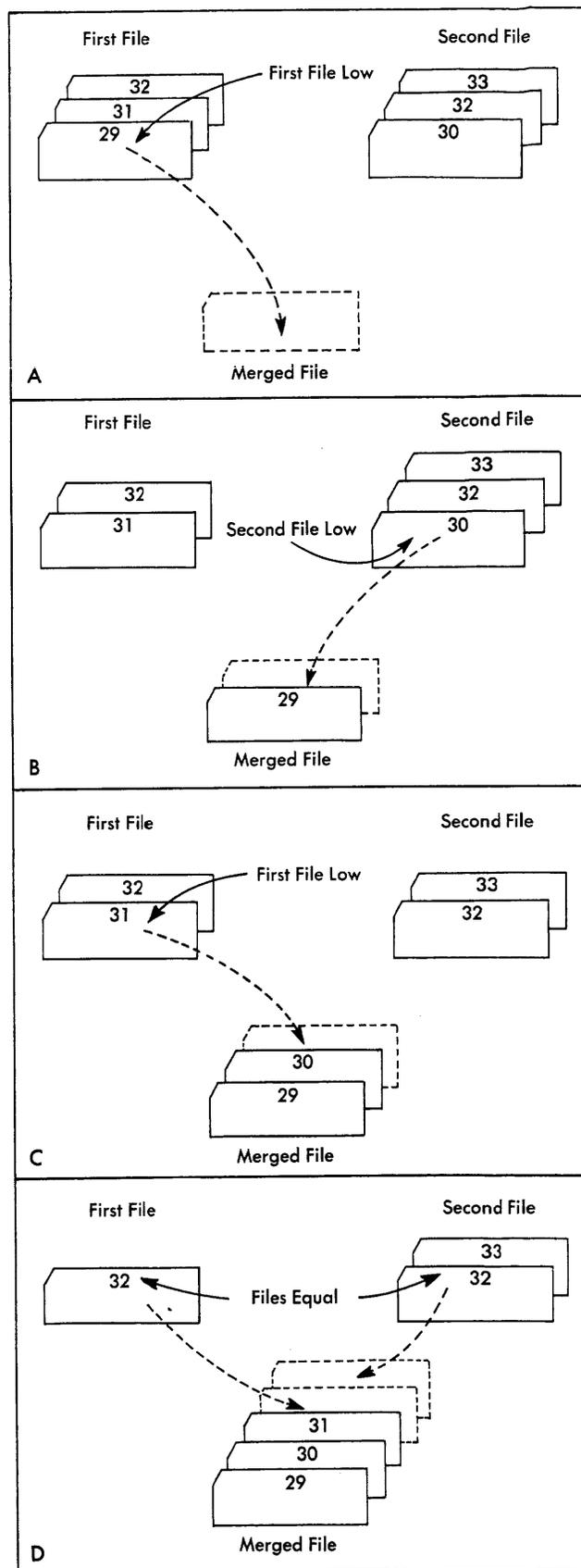

Figure 48. Merging Operation.

48

When the collator is used to merge two files of cards, one file is placed in the primary feed hopper and the other in the secondary feed hopper. In normal operation, primary cards are merged ahead of secondary cards whenever the cards in both feeds are equal (Figure 48D). Therefore, those cards that should be first in the completed file should be placed in the primary feed hopper.

Merging can be performed in combination with both sequence checking and selection. Selected primary cards are stacked in Pocket 1 and selected secondary cards are stacked in either Pocket 3 or Pocket 4.

Matching

Matching is the operation in which two files of cards are compared to determine that there is a card or group of cards in one file corresponding to a card or group of cards in the other file. The corresponding, or matched, cards are stacked separately; unmatched cards in either or both files are selected. When the operation is completed, there may be four groups of cards: two groups that match and two groups of selected cards.

Thus, matching differs from merging with selection in only one respect: the matched cards from data files are stacked in two groups rather than in one combined group.

OPERATING PROCEDURE

1. Make sure you understand the operation to be performed. If in doubt, ask your supervisor to explain.
2. Arrange the cards to be processed so that no confusion will occur in handling the files.
3. Make sufficient preparation for temporary storage space.
4. Plug the cord to the proper source of current and turn on the main-line switch.
5. Insert proper control panel in the receptacle and close the door.
6. Make complete test according to the requirements of the operation.
7. Joggle cards and place them in the proper hopper, face down, 9-edge first.
8. Press the START key.
9. Watch the hoppers and stackers in order to load and empty the machine as required, without loss of machine time.
10. In the event of an error stop, to find the misfiled card:
    a. Remove cards from both the hopper(s) and stacker(s).
    b. Press the ERROR RESET key.
    c. Press the RUN-OUT key to run the cards out of the machine.
    d. Check the cards for the misfiled card(s).
    e. File the checked cards manually.

OPERATING SUGGESTIONS

STARTING THE OPERATION

Groups of cards should always be joggled into perfect alignment before they are placed in the hoppers.

Hoppers should never be overloaded. Special care should be taken when cards are placed in the primary feed hopper, because this hopper is placed at an angle on the machine.

In any merging operation, no errors should exist in the numerical sequence of either file. To safeguard against misfiled cards, both files should be checked for sequence. The secondary file may be checked as a separate operation. The primary file is checked simultaneously with the merging operation.

Before processing an operation where sequence checking is required, make a test by purposely inserting several blank cards in the first 400 or 500 cards to be checked. The blank cards break the continuity of any series of numbers, and card feeding should stop when the blank cards feed through. If card feeding does not stop when these blank cards pass through, an error has been made in wiring the control panel. When this occurs, ask your supervisor to correct the control panel.

HANDLING THE CARDS

When the operation includes merging and selection, be sure that you know what to do with each file. This applies not only in the handling of the files previous to the operation but also in the handling of the files after the operation has been completed.

To save time in a merging operation, check the first card of each file. For example, if the first card in the primary file is punched 128 and the first card in the secondary file is punched 988, the primary file cards from 128 to 987 need not go through the machine. Merging can start with group 987 in the primary file. If the first card in the secondary file is a considerably lower number than the first card in the primary file, none of the secondary cards that are punched with numbers lower than the first card in the primary file need go through the machine.

STOPPING THE OPERATION

Never turn off the main-line switch while cards are going through the machine. Use the STOP key.

In case of a jam in the machine, press the STOP key immediately, turn off the main-line switch, and call your supervisor. Any damaged cards must be duplicated or repunched, and hand filed.

IBM 85, 87 Collators

The IBM 85 Collator (Figure 49) and the IBM 87 Collator operate the same as the IBM 77 Numerical Collator and IBM 89 Alphabetic Collator, respectively. The differences are in appearance and in the additional function of editing for blank columns.

Cards in both feeds can be checked for blank columns separately or in combination with other operations. Whenever a blank occurs in a field wired to either of the two detection units, card feeding stops and a blank-column-detection light (BCD1, BCD2)

goes on (Figure 50). BCD1 is normally used for cards in the secondary feed; BCD2 for cards in the primary feed.

A BCD light can be turned off and card feeding restarted by pressing the RESET key and then the START key.
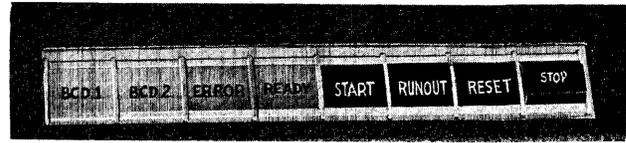
Figure 50. Keys and Lights
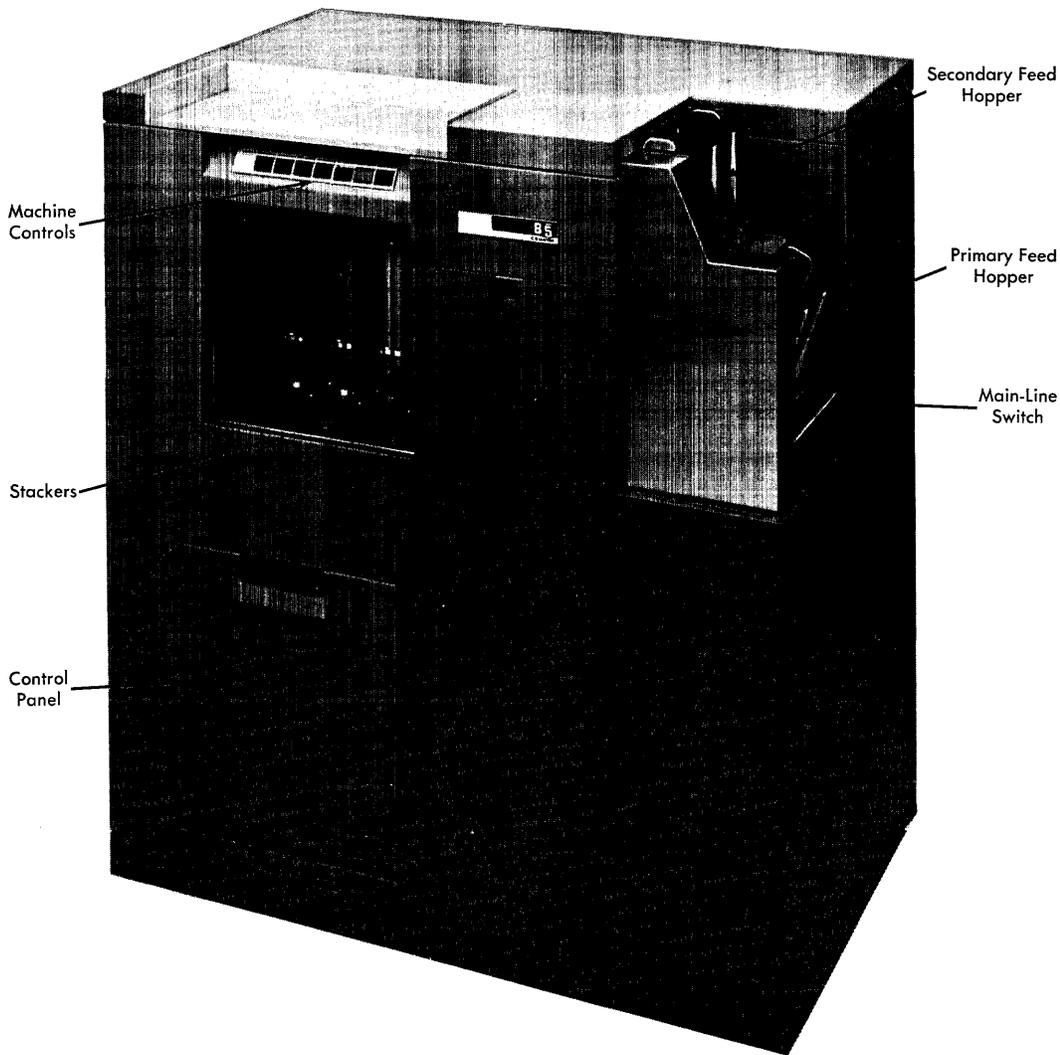
Figure 49. IBM 85 Collator

IBM 88 Collator

The IBM 88 Collator (Figure 51) is a numerical collator performing the same functions as the IBM 77 Collator, but at higher rates of speed. Cards are fed from opposite ends of the machine (9-edge first in the primary; 12-edge first in the secondary), and are stacked in 5 pockets according to the grouping desired.

Each feed can operate at a speed of 650 cards per minute. With both feeds in use, up to 1300 cards per minute can be processed in some operations.

Sequence checking can be done in both feeds, together with other operations.

Machine Controls (Figure 52)

The normal complement of control switches and keys performs the same functions as for other collators. Indicating lights are installed to correspond to the primary and secondary feeds.

READY LIGHT

This green light goes on when the electronic circuits are warmed up after the MASTER switch has been
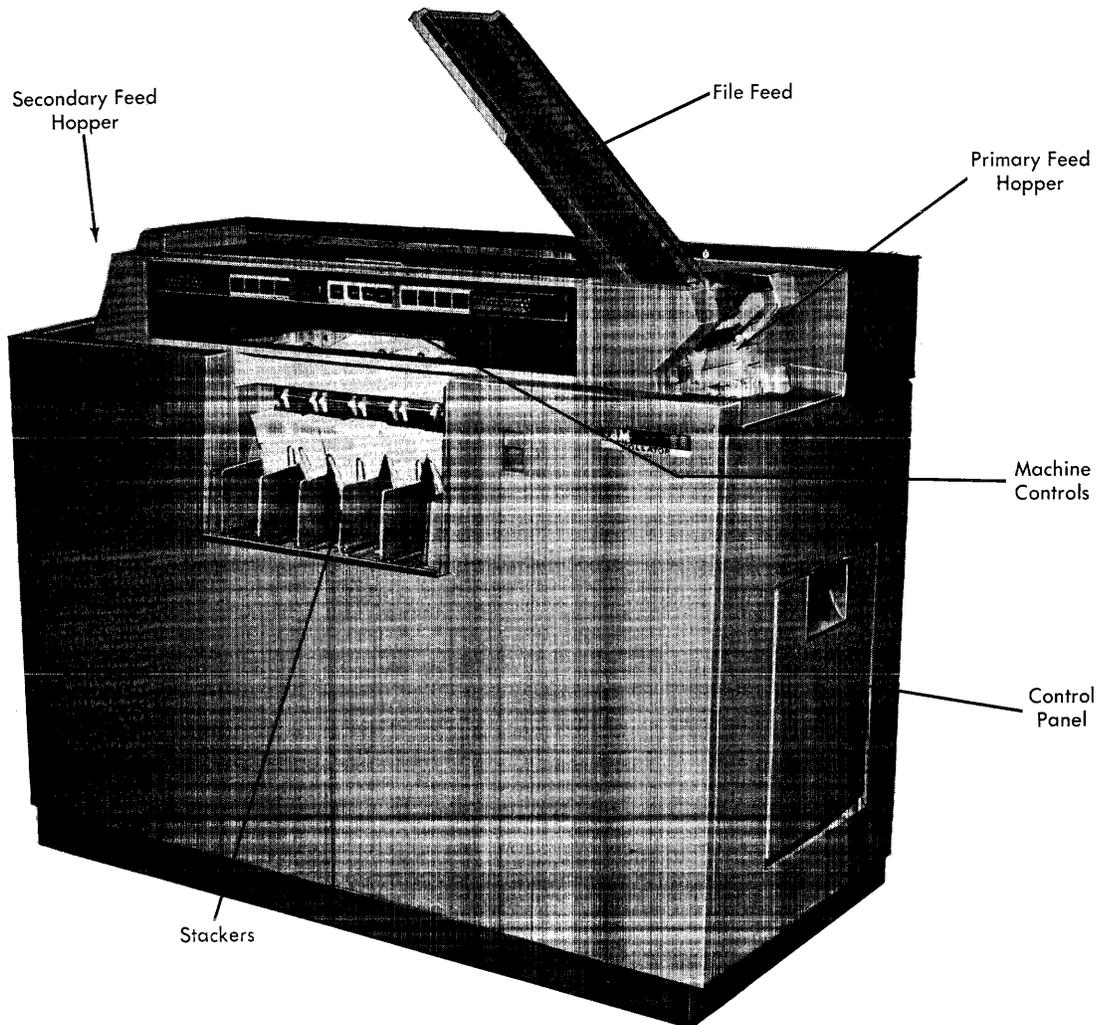
Figure 51. IBM 88 Collator
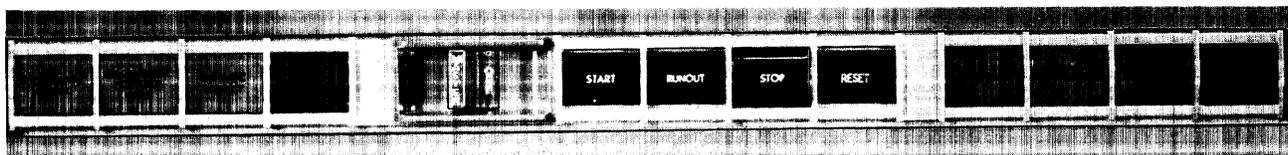
Figure 52. Machine Controls

turned on, and when card feeding stops because either one of the hoppers is empty and ready for more cards. Pressing the START key extinguishes the light.

TRANSPORT LIGHT

This light indicates a card jam in the continuously-running rollers leading to the stackers.

DP&BC DETECT LIGHT

This light goes on when a double punch or a blank column has been detected in a card. A column indicator for each feed (Figure 53) shows which position of comparison contains the blank.
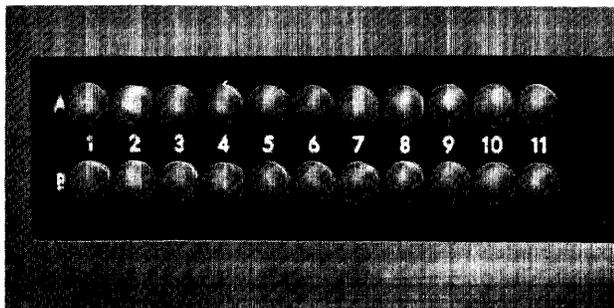

Figure 53. Primary Blank Column Indicator Panel

PRIMARY AND SECONDARY CHECK LIGHTS

These lights indicate which feed caused card feeding to stop due to a card-feed failure such as a card jam, a failure to feed from the hopper, or a malfunction of a feed clutch. These CHECK lights also indicate in which feed a double punch or blank column has been detected.

PRIMARY AND SECONDARY CONTROL STOP LIGHTS

These lights indicate that card feeding stopped for a condition in the primary or secondary feed that has been recognized by control-panel wiring.

FUSE LIGHT

This light goes on when a fuse in the machine burns out. The fuses are located in a panel under the sliding top between the hoppers.

File Feed

This feature (Figure 54) holds approximately 3600 cards and thus triples the capacity of the primary hopper. Cards are joggled into alignment as they drop into the hopper.
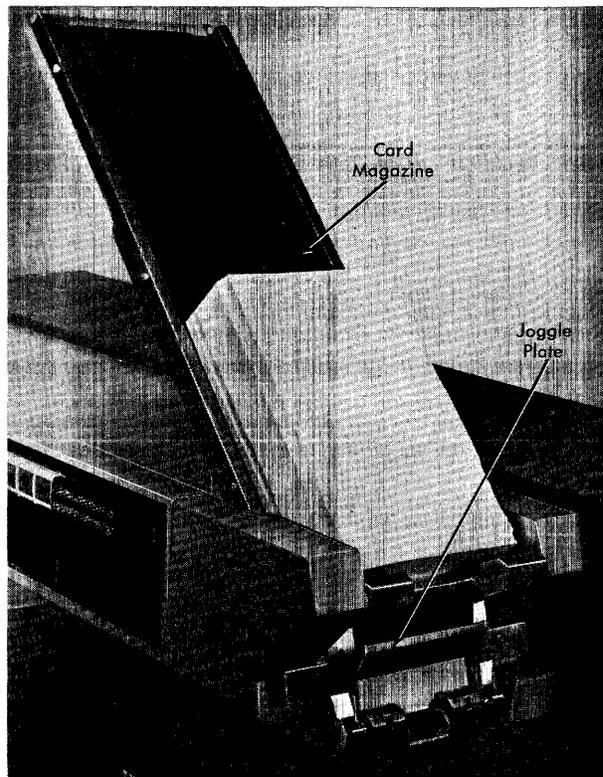

Figure 54. File Feed

Stackers

The five stackers or pockets (Figure 55) are designated 1 to 5 from right to left. Primary cards are stacked into Pocket 1 unless selected into Pocket 2 or 3. Secondary cards go into Pocket 5 unless selected into Pocket 4 or 3. Pocket 3 is the merge pocket. Each pocket holds approximately 1000 cards and when filled, card feeding stops. Cards stack on the column-80 end and can be removed without stopping the machine.
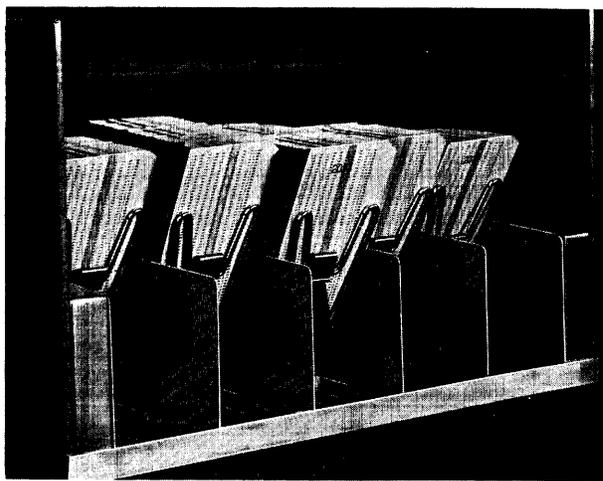

Figure 55. Stackers

IBM 89 Alphabetic Collator

The operation of the IBM 89 Collator (Figure 56) is similar to that described for the IBM 77 Collator. The main difference between the two machines is that the IBM 89 Collator can read letters as well as numbers. Alphabetic characters, special characters and blanks, as well as numerical fields in a card, can be sequence-checked, selected, matched and merged.

NOTE: When performing such operations as those described for locating and filing error cards, letters as well as numbers can be out of order.

A zone switch on the control panel permits elimination of alphabetic zones so that the machine can be used to compare numerical information only.

The collating sequence (low to high) for the various types of information is:

1.	Blank column	
2.	Special Characters:	
	12-3-8	(.)
	12-4-8	(⌑)
	12	(&)
	11-3-8	($)
	11-4-8	(*)
	11	(-)
	0-1	(/)
	0-3-8	(,)
	0-4-8	(%)
	3-8	(#)
	4-8	(@)
3.	Letters: A through Z	
4.	Digits: 0 through 9	

Figure 56.   IBM 89 Collator

Secondary Feed Hopper

Primary Feed Hopper

Main-Line Switch

Stackers

Machine Controls

Control Panel
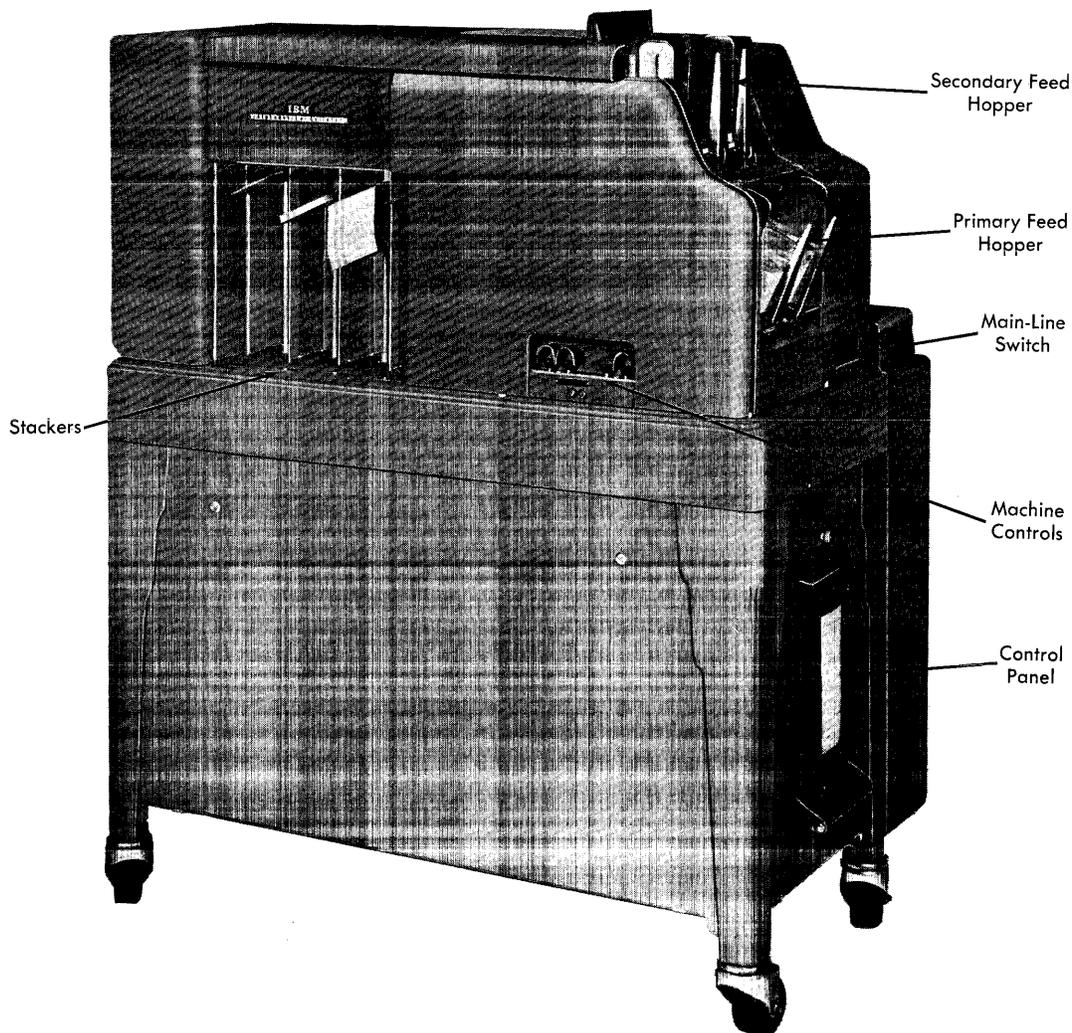
Optional Features —
IBM 77, 85, 87, 88, 89

Auxiliary Card Counter (IBM 77, 85, 88 only)

This device registers each card passing through each feed, or the number of cards in a particular classification.

Collator Counting Device

With this device it is possible to perform collating operations that involve a count of cards. Control-panel wiring then performs such operations as:
1. inserting a predetermined number of cards behind or ahead of each master card;
2. inserting a single card behind or ahead of a predetermined number of cards;
3. inserting a variable number of cards behind or ahead of each master card;
4. merging a predetermined number of primaries and secondaries; and
5. two-column consecutive-number checking.

Alphabetic Collating Device
(IBM 77, 85 only)

This device permits collating a limited amount of alphabetic information with a numerical machine.

Split Control Units
(IBM 77, 85, 88 only)

This device splits the standard comparing units so that two or more fields can be compared independently, and the results of each used to control machine operation.

Review Questions — IBM 77, 85, 87, 88, 89

1. What is the purpose of the collator?
2. How are cards fed into the machine?
3. In normal merging, what is the purpose of the primary feed? secondary feed?
4. In what pockets can primary cards be stacked? secondary cards? How is the IBM 88 Collator different from this?
5. How long must the START key be held pressed before automatic operation begins?
6. What is the purpose of the RUN-OUT key?
7. What is the purpose of the ERROR-RESET key?
8. When does the ERROR light go on?
9. Can cards be fed without a control panel?
10. What is necessary before two groups of cards can be merged accurately?
11. Which feed is normally used for sequence-checking? In the IBM 88 Collator?
12. How fast can the IBM 77 collator operate? The IBM 88 Collator?
13. What procedure should be followed after an error is detected, and which card(s) is the error card?
14. If more than one card is in error, what must be done?
15. In a merging operation, which cards of the same control number merge in front, primaries or secondaries?
16. In a matching operation, in what pockets are primary cards stacked? In what pockets are secondary cards stacked?
17. In matching or merging with selection, what pocket can receive selected primaries? In the IBM 88 Collator?
18. In the same operation, what pockets can receive selected secondaries? In the IBM 88 Collator?
19. When either hopper becomes empty and the operation is complete, what must be done before the main-line switch is turned off?

IBM 101 Electronic Statistical Machine

The science relating to the collection and classification of facts on the basis of relative number or occurrence is called *statistics*. Once the facts are recorded and coded they must be:

1. edited to assure accuracy and consistency,

2. arranged and re-arranged to allow cross-analysis,

3. counted to enable evaluation, and

4. tabulated to permit comparison and interpretation.

The IBM 101 Electronic Statistical Machine (Figure 57) combines in one unit the functions of editing, sorting, counting, accumulating, balancing, and summarizing of facts recorded in IBM cards. Cards are fed from the hopper, past the two 80-column reading stations, to the stackers at the rate of 450 cards per minute.

Print Units — Hopper — Machine Controls — Cover Latch — Hand Feed Wheel — Selection Switches — Main-Line Switches — Stackers — Pocket Stop Levers — Control Panel
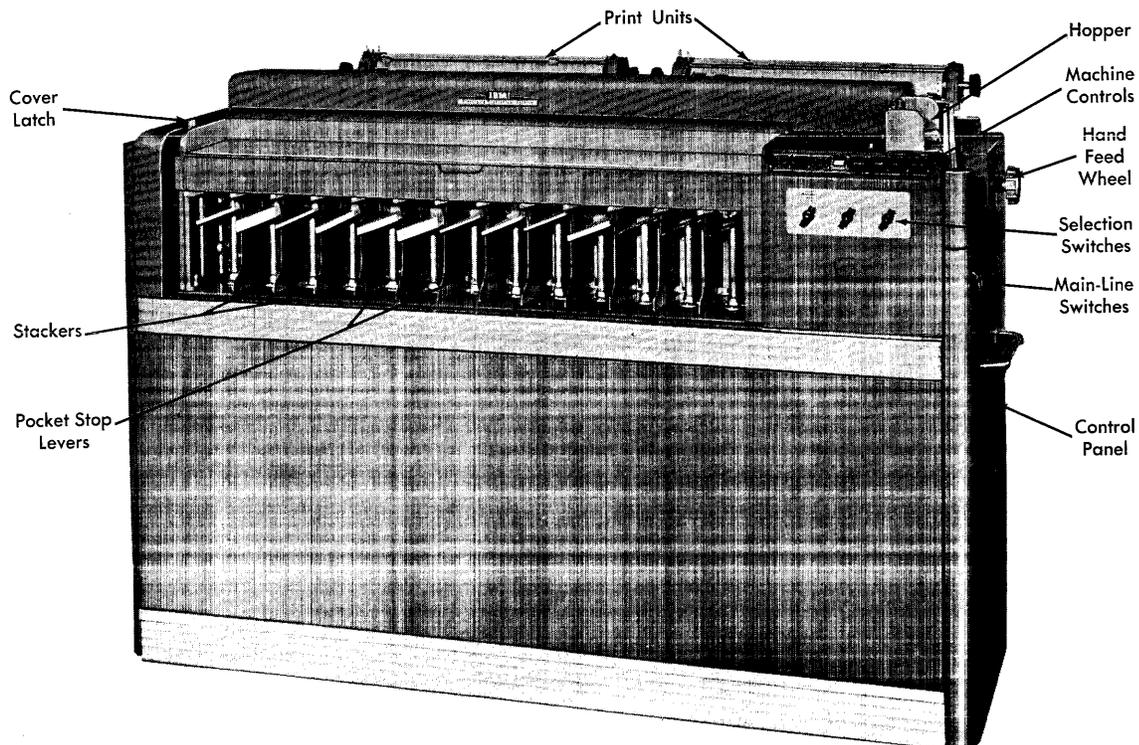
Figure 57. IBM 101 Electronic Statistical Machine

OPERATING FEATURES

Machine Controls (Figure 58)

MAIN-LINE SWITCH AND POWER LIGHT

The main-line switch is located on the right end of the machine. After a brief delay, the POWER light goes on to indicate the machine is ready to operate.

START KEY

Card feeding is started by pressing the START key, and continues automatically until stopped by the STOP key, an empty hopper, a full pocket, or control-panel wiring. If the START key is pressed without cards in the hopper, the RESTORE key must be pressed before the START key operates again.

STOP KEY

Card feeding can be stopped at any time by pressing the STOP key.

RESTORE KEY

The RESTORE key must be pressed before the machine can be restarted after the SORT COMPARE or CROSSFOOT signal turns on, or after the START key has been pressed when the hopper is empty.

PRINT KEY

Totals can be printed manually by pressing the PRINT key. As total counts are printed, the machine checks their accuracy by crossfooting to obtain a zero balance. The result of crossfooting is indicated by a zero or the difference printed in the column to the right of the last count on each report.

9M SWITCH

The 9M (master) switch is set to its UP position when master cards are being sorted into a file of cards. It is set to its DOWN position when master cards are being used for automatic print control and then rejected.

SORT-COMPARE LIGHT

This light goes on and card feeding stops if a card does not enter the correct pocket. Also, a line is marked on the back of the card for locating the card if it should reach a sort pocket. Ordinarily, two cards follow a marked card. The cards in the machine can be run out by pressing the START key, but feeding does not start until the RESTORE key is pressed.

FULL POCKET-CROSSFOOT LIGHT

This light goes on when any pocket becomes filled during a sorting operation. Card feeding cannot be restarted until cards are removed from the filled pocket. This light also goes on if, in a printing operation, the
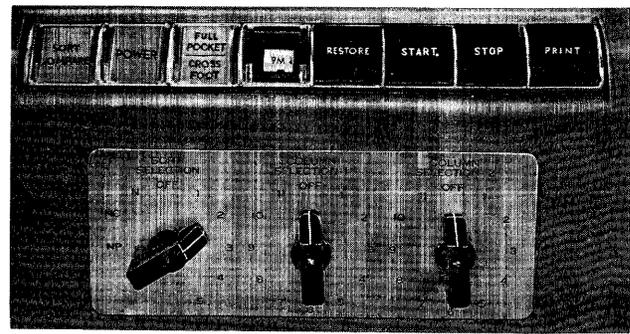

Figure 58. Machine Controls

machine stops when distributed counts do not crossfoot to a zero balance. The RESTORE key must be pressed before card feeding can be restarted.

Column Selection Switches

These switches are used to select the column in which cards are to be sorted. By means of control-panel wiring in conjunction with these switches, any 22 columns of the card can be sorted successively. The two switches can be used independently for selecting columns and control impulses during specific runs of the cards.

Sort Selection Switch

This switch can be set to one of eight positions to control the following operations:

Eliminate printing and summary punching of totals	NP (non-print)
Normal sorting and counting	NC
Normal sorting	N
Selective sorting — 4 different patterns	1-4
Sorting all cards into pocket 11	5

Hopper

Cards are placed in the hopper face down, 9-edge toward the throat of the machine. The hopper holds approximately 800 cards. The machine stops when the last card reaches its pocket.

Located in the bottom of the hopper is a card-feed stop device that suspends card feeding, but allows the cards in the machine to run out into the pockets. It consists of arms that lift cards above the feed knives when the STOP key is pressed, when a sort pocket becomes filled, or when card feeding is stopped by control-panel wiring.

Hand Feed Wheel

This wheel is pushed in and turned manually to feed cards when removing a card jam or testing the machine.

Pockets

The machine has 13 pockets or stackers — 12 for sorting cards into groups and one for rejects. Cards are directed to all pockets, except the reject pocket, by control-panel wiring. When any pocket is filled, card feeding stops.

Printing Carriages (Figure 59)

The machine can be equipped with one or two carriages for printing reports: one for printing a total of punched amounts, a group indication, and the counts from unit-counters 1 through 30; the second for printing another total amount, the same group indication, and the counts from unit-counters 31 through 60. Four typebars for each carriage print the totals across the form as the carriages advance, like typewriter carriages.

Preprinted or blank forms are inserted in each carriage as in a typewriter. The carriages can be equipped with pin-feed platens for feeding marginally punched paper, so that after the first form is in proper position subsequent alignment is automatic. Single-sheet forms can be used, in which case alignment can be made by placing the first column of each form in printing position. The margin stops behind the carriages can be set for 8 or 12 positions of total amount, or for normal or extra columns of group indication. These marginal stops must be set alike on both carriages.

The carriages can be moved laterally by hand, but they must be restored to the extreme right to start card feeding or printing. The carriages can be moved column by column by alternately pressing the carriage release button on each carriage. To move the carriages freely, press the carriage release buttons on both carriages simultaneously.

Single, double, or triple spacing can be set by a lever on each carriage.

Control Panel

The control panel is the brain controlling all the functions of the machine.

MACHINE FUNCTIONS

Sorting

Cards can be arranged, or sorted, numerically or alphabetically in any desired pattern. In normal sorting, cards are stacked in their respective pockets according to the punches in the column: i. e., 9-cards into the 9-pocket; 8-cards into the 8-pocket, and so on.

Selection switches and control-panel wiring permit a great variety of selective-sorting patterns:
1. Group sorting according to a *leader* card
2. Length of name or number sorting
3. Alphabetic and special character sorting
4. Predetermined sequence
5. Nth card of a group
6. File search for specific facts or combination of facts
7. Sample selection

Counting

The number of cards in a file can be counted without disturbing their sequence, or while performing a sorting operation. As many as sixty different classifications of cards can be selectively counted in one run, according to the setting of the selection switches.

Accumulating

While cards are being sorted or counted, amounts in the card can be added. Two 5-digit amounts punched in the cards can be added to accumulate two 8-position totals; or one 9-digit amount, to accumulate one 12-position total.
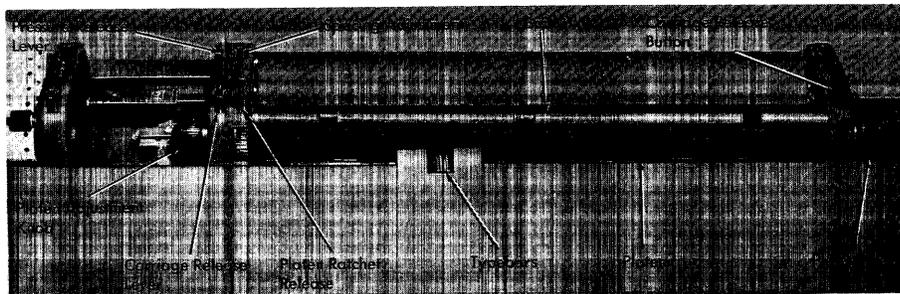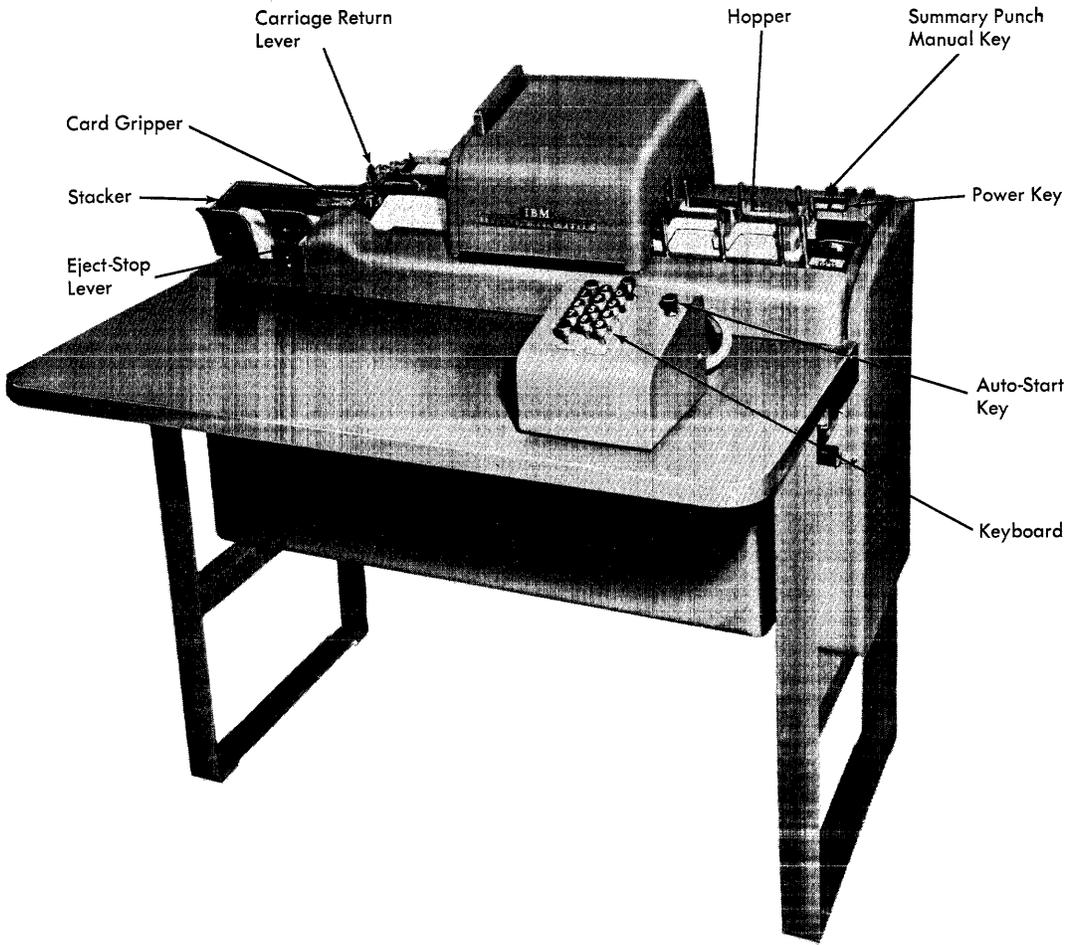

Figure 59. Printing Carriage

Editing

Because accuracy and consistency is essential for statistical reports, the machine edits a statistical fact before the fact is sorted or counted. Cards are checked for double punches and blank columns. The code itself is checked for validity within the sorting pattern. The sequence of cards and their consecutiveness can also be checked.

The actual sorting of cards is also checked to be certain a card is sorted into the proper pocket as directed by control-panel wiring. If a card fails to sort properly it is marked on the back with an ink stripe, card feeding stops, and the Sort-Compare light goes on.

A crossfooting check is made during printing, to balance all the printed counts for a line. A zero or the difference is printed in the crossfoot-check column to indicate the balance for the line.

Printing

When the counts for various groups are made and the amounts in a field accumulated, the totals are printed on a form in a tabulated report. An identification of the group can also be printed at the same time.

Because accumulated amounts, group indications, and unit counts always print in fixed positions on a report form, the column arrangement in designing a report form is quite standard. The only difference between one design and another, therefore, is the width of the form and column headings.

Figure 60 illustrates the standard column arrangement of any report form. The first column is used to print 8- or 12-position totals from accumulating counters. The second column is used to print numerical group indications. The third column is used to print a total card count from unit-counter 1. The rest of the counter columns (2 through 30) are used to print totals from counters 2 through 30). The last column is used to print a zero-check signal or a difference, indicating whether or not the totals printed

on that line balance. When less than 30 unit-counters are used, the zero-check symbol prints in the column after the last unit-counter used. This arrangement applies to any form prepared on the left carriage.

The same column arrangement applies to the right carriage, except that the 30 unit-counts print from unit-counters 31 through 60. Printing can be suppressed on the right carriage by control-panel wiring.

Summary Punching

One or two IBM 524 Duplicating Summary Punches can be attached to an IBM 101, to summary punch results as they are printed (Figure 61). Summary cards can be punched automatically with group indications, accumulated amounts, and the count for each of the unit-counters. One summary punch is used for each carriage. Cards are placed in the hopper of the IBM 524 face up, column 1 to the left, and are ejected to the stacker face down.

The standard statistical summary card (Figure 62) is designed for use with a full-capacity machine or with a single carriage machine that is equipped with not more than one accumulating counter.

The summary card has 15 fields for punching four-position count totals. This means that four cards are required for the 60 possible count totals; two for the 30 counters that print on the left carriage, and two for the 30 counters that print on the right carriage. The fields are numbered to indicate the counters from which the counts are punched.

At the left of the counts is a column (20) for card code. The summary punch associated with the left carriage punches a 1 in the card for counters 1 through 15 and a 2 in the card for counters 16 through 30. Similarly, cards are punched by the second summary punch with a 3 for counters 31 through 45 and with a 4 for counters 46 through 60. Consequently, the counts contained in each card are identified by card number. Notice that the arrow under each card number shows the unit-counters punched for that card.

Figure 60. Standard Report Form

Figure 61. IBM 524 Summary Card Punch

Figure 62. Standard Statistical Summary Card
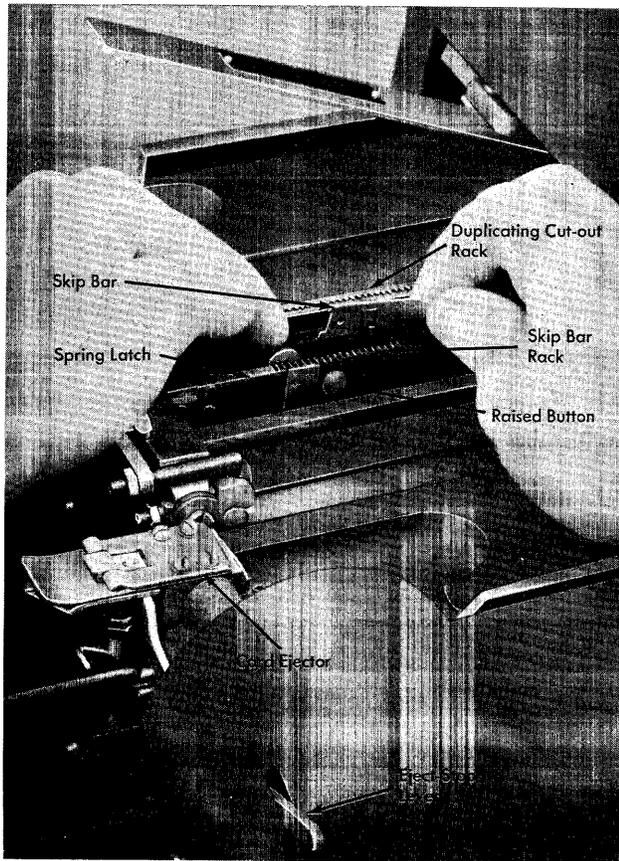
Figure 63. Inserting a Skip Bar

Group indication is punched in columns 16 through 19. The same group indication is punched in all four cards and, with the card number, provides a means for sorting or merging the cards.

Eight-position totals can be punched in columns 8 through 15 from accumulating counter 1 into card 1, and from accumulating counter 2 into card 3. These eight columns are X-skipped on cards 2 and 4.

When the two accumulating counters are coupled, a 12-position total is punched in columns 4 through 15 of card 1. In this case columns 4 through 15 in card 3 (the second summary punch) are punched automatically with 12 zeros. These columns are X-skipped on cards 2 and 4.

Skipping from column to column is controlled by skip bars that are inserted in back of the punch bed.

Because the two summary cards must remain in step, the skip bars in each machine must be identical. The skip bar fits over two pins and is held in position by a spring catch at the left (Figure 63).

Skip bars (Figure 64) for use with the IBM 524 should be designed as follows:

1. Low cut for the first position punched from accumulating counters.
2. Low cut for the first position punched with group indication.
3. X level for all other summary punch positions.
4. X level for columns on the left (up to the group indication field) if these columns are to be X-skipped or duplicated from a master card.
5. High level for columns on the left (up to the group indication field) if these columns are always to be skipped.

OPERATING PROCEDURES

Normal Operation

1. Attach power cable to source of power.
2. Turn on main-line switch.
3. Press START key when the POWER light comes on, to run out any cards that might be in the machine.
4. Insert proper control panel and set the selection switches according to instructions.
5. Insert the report form and adjust for alignment and spacing.
6. Move carriage so that the typebars are in position to print the first column.
7. Fan and joggle the cards, and place them in the hopper, face down, 9-edge first.
8. Press the PRINT key to take a print cycle, in order to clear the counters of any totals left in the machine from a previous operation.
9. Press the START key and hold until automatic feeding occurs.
10. When the operation is finished, press the START key to be certain no cards remain in the machine
11. Turn off the main-line switch.
12. Remove and store the control panel.
13. File the cards according to instructions.
14. Remove the report from the carriage.
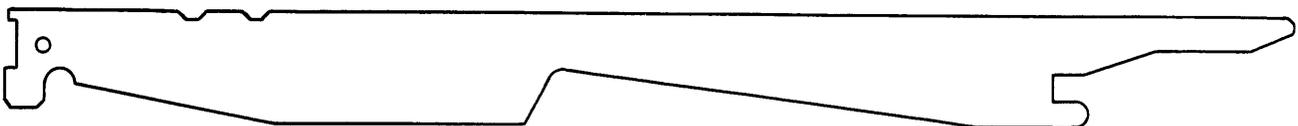
Figure 64. X-Skip Bar

Error Correction

If card feeding stops, check for: empty hopper, Sort-Compare light, or Full Pocket-Crossfoot light.

When an error is detected and the Sort-Compare light goes on:

1. Press the START key to run out the cards in the machine.
2. Locate the marked card, earmark and file it properly.
3. Press the RESTORE key.
4. Press the START key to continue the operation.

Summary Punching

When summary punches are to be connected to the IBM 101, use the following procedure:

1. Connect the summary-punch cables.
2. Plug the power cords of the summary punches into the power outlets in the IBM 101.
3. Insert skip bars in each summary punch.
4. Set the duplicating column cut-out buttons on both machines for the first column to be punched. Buttons slide on the bar located in front of the duplicating rack.
5. Turn the Summary Punch-Manual switch on each IBM 524 to SUMMARY PUNCH (Figure 65).
6. Turn on the power switches for both the IBM 101 and the 524's.
7. Place cards in the IBM 524 hoppers *face up,* column-1 end toward the throat.
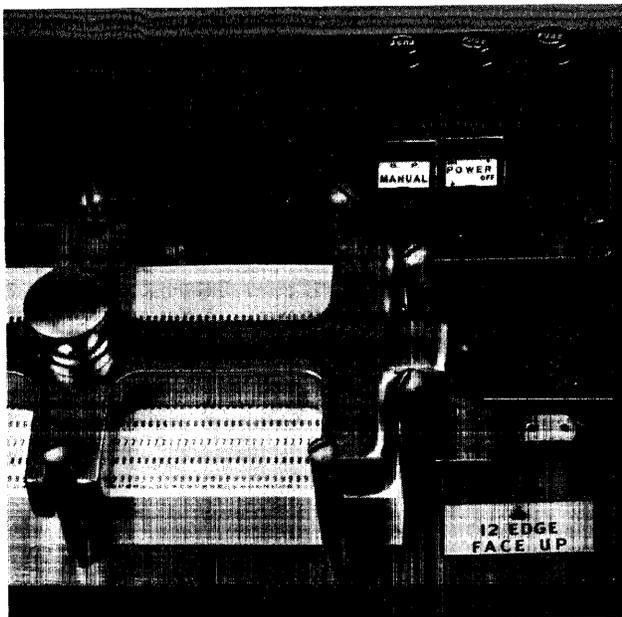
Figure 65. Machine Controls

8. Press the Release key on the summary punch (not necessary for any summary card punched with 15 unit-counts).
9. Lower the Eject-Stop levers on both machines to permit automatic operation.
10. Press the Auto-Start key for each IBM 524.
11. The IBM 101 is now ready for operation.

The summary punches and the IBM 101 operate together as long as both are supplied with cards. As each item prints on the report, it is summary punched. Printing and summary punching proceed together until after the 15th (or 45th) unit-counter summary punches. The IBM 101 then pauses momentarily while the summary punch feeds another summary card. Printing and summary punching then continue according to control-panel wiring.

After the last unit-counter prints, a summary card punched with less than 15 unit-counts is automatically X-skipped to column 80 and stacked. A new summary card is fed into punching position. If, however, the Crossfoot-Check light comes on, the summary card does not skip out to column 80 and both machines stop. Operation is resumed as follows:

1. Press the Release key on the summary punch (not necessary for any summary card punched with 15 unit-counts).
2. Press the Auto-Start key on the summary punch.
3. Press the RESTORE key on the IBM 101.

The presence of an X in the column immediately following the last unit-counter summary punched is an indication that the line of printing crossfooted correctly. If the X is not punched, the printing did not crossfoot-check correctly.

A 12 is punched in columns 29 and 77 if printing and summary punching proceed in sequence. If, for any reason, the two get out of step, the counts and the 12's are not punched in the proper columns. When summary cards are sight checked for a 12 in columns 29 and 77, error cards can be readily detected. The 12 is not punched in a skipped column.

Manual Keypunching

The IBM 524 can be used as a numerical keypunch. The power cable must be removed from the receptacle in the IBM 101 and connected directly to an independent source of power. The main-line switch must be ON and the Summary Punch-Manual switch must be set to MANUAL. The summary-punch cable need not be disconnected from the IBM 101.

The keyboard is the normal numerical keyboard with 12 punching keys, a space key and a release key.

OPERATING SUGGESTIONS

Handling Cards

Most of the difficulty that occurs in a sorting operation can be traced to improper handling of cards. Edges of the cards are sometimes damaged in joggling, or in placing them in the feed hopper. This may sometimes cause a jam as they pass through the machine.

Always check the edges of the cards to be sure that none is bent or torn. Check the feed hopper to be certain that it contains no dirt, card dust, pieces of paper, or other obstruction that might clog the throat.

Always *fan* cards before putting them in the feed hopper. This removes static electricity, which causes cards to stick together, particularly in damp weather. Fanning also allows any foreign material between the cards to drop out.

Keep the hopper well supplied with cards to assure continuous card feeding.

Before starting a counting operation, always take a print cycle to clear the counters of any totals left in the machine from a previous operation.

When cards are being fed, do not:

1. rest a hand on the cards in the hopper,
2. use a heavier-than-normal card weight, or
3. fill the hopper higher than the side plates.

The extra weight may cause misfeeds, missorts, and rejecting of cards.

Cards mark-sensed on the back should not be fed through the machine as sorting between adjacent brushes may occur.

Card Jams

In the event of a card jam, immediately stop card feeding by pressing the STOP key, and turn off the main-line switch. If the jam has occurred in the throat or at the reading stations, call your supervisor. If the jam has occurred along the chute blades, release the cover latch, raise the glass cover, and remove the jammed cards.

In removing jammed cards from the machine, make every effort to straighten the cards enough so that they can be run into the pockets by turning the hand feed wheel on the right end of the machine. If the jam is severe, it may be necessary to tear the cards under the blades. In removing the cards, pull from one side of the chute blades, exerting steady pressure on one end of the card. Be careful not to pull the chute blades out of line while removing the cards. Make every effort not to tear damaged cards any more than necessary, because this makes it more difficult to assemble the pieces in order to punch duplicate cards. These must be hand filed in their proper sequence.

Pieces of torn cards should be matched to be certain that no pieces still remain in the machine to cause further jams.
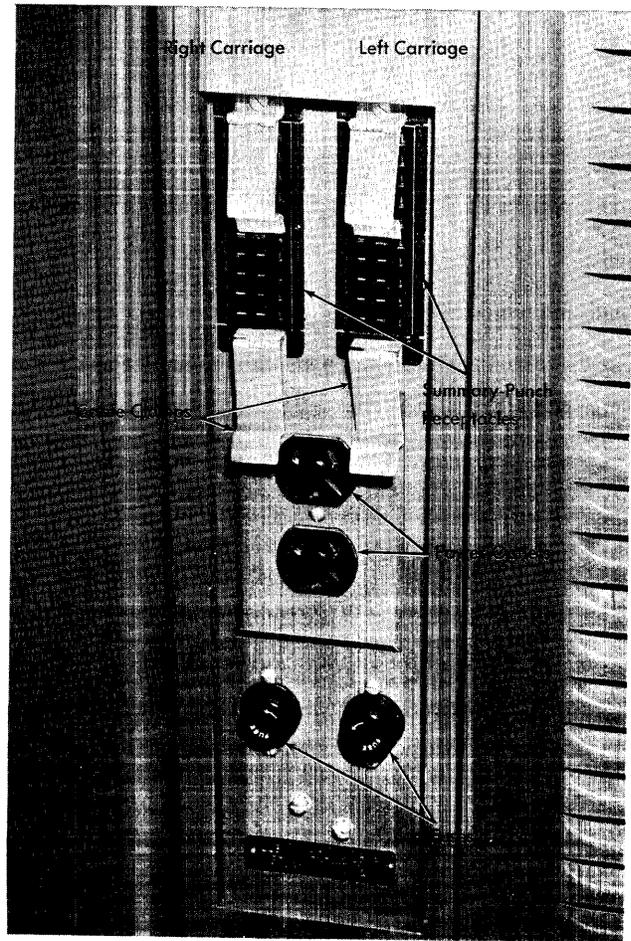
Figure 66. Summary-Punch Receptacles

Make every effort to keep the machine clean. Dirt and other foreign material can cause the machine to jam.

The covers over the reading stations and the chute blades must be closed for the machine to operate. Raising a cover during an operation stops card feeding, but may cause missorting.

Summary Punching

The IBM 101 has two receptacles on the back for summary-punch cables (Figure 66). Summary punches connected to these receptacles punch information corresponding respectively to the information printing on the two carriages.

The power cable of each summary punch must be plugged into a power outlet in the IBM 101. An IBM 524 should never be connected to an independent source of power for a summary-punch operation.

The duplicating column cut-out button must be set for the first column to be summary-punched.

The skip bars used in each summary punch must be identical, in order for the two carriages and summary cards to remain in step.
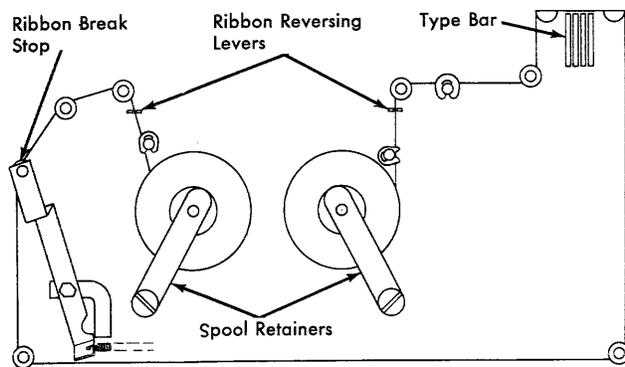
Figure 67. Schematic of Ribbon Feed

Ribbon Break Stop

Ribbon Reversing Levers

Type Bar

Spool Retainers

RIBBON REPLACEMENT

When installing a new ribbon, make sure the leading end of the ribbon is securely attached to the empty spool. Wind enough ribbon around this spool so that the eyelet is between the spool and the ribbon-reversing lever. The ribbon must pass through both ends of the ribbon-reversing lever. Thread the ribbon guide rollers as shown in Figure 67.

Optional Features

Auxiliary Card Counter

This device registers each card passing through the machine, or, when desired, it counts the number of cards in a specific group.

Sample Selection Device

This device permits the selection of any number or portion of a group at any interval according to the usual formulas for selecting samples.

Review Questions

1. What is the purpose of the IBM 101?
2. What major functions can be performed by the IBM 101?
3. How are cards placed in the hopper?
4. Why should the cards be fanned and joggled before placing them in the hopper?
5. When the Sort-Compare light goes on and card feeding stops, what type of error is indicated? How is the error card located?
6. How is a crossfoot error indicated?
7. How is the operation continued after a Sort-Compare or Crossfoot signal?
8. Explain the function of the 9M switch.
9. How should the Sort-Selection switch be set for normal sorting and counting? For counting alone?
10. How is the form aligned and the carriage positioned for printing?
11. How must the IBM 524's be connected for summary punching?
12. What must be the position of the Eject-Stop lever to start summary punching?
13. How can the summary punch be used independently as a keypunch?

IBM Accounting Machines

Management must be kept constantly informed by reliable up-to-date information about material, sales, inventory, payroll, production, etc. This information is prepared in the form of reports and analyses that become the basis of administrative action.

Many computations must be made, checked, and summarized before data can be presented in report form. Because of the length of time required, manual methods often fall far short of meeting management requirements.

When the basic information is contained in IBM cards, management reports can be prepared with speed and accuracy. The IBM accounting principle consists of three basic steps:

1. Information written on source documents is transcribed to IBM punched cards.
2. Punched cards are arranged by an IBM sorter in the sequence desired.
3. Printed reports are prepared automatically by IBM accounting machines that read the holes in the cards, and print the reports.

Several types of IBM accounting machines are covered in this manual: the IBM 402, 403, 419, and 407.

IBM 402, 403, 419 Accounting Machines

The IBM 402 Accounting Machine (Figure 68) operates automatically in both feeding of cards and printing of results. Information punched in cards can be read, added, subtracted, compared, and selected, according to the requirements of a report, at a rated speed of 150, 80, or 50 cards per minute depending on the model. Complete flexibility is provided in the arrangement of printed data on the report form. Summary, or total, cards can be punched simultaneously with the preparation of a printed report.

The IBM 402 and the IBM 403 are similar in operation and function. They differ only in the number of lines that can be printed from one card. The IBM 402 normally prints only one line from a card. The IBM 403 can print three lines from a single card and, for this reason, it is called a Multiple-Line-Print (MLP) Machine. The IBM 419 is like the IBM 402 except that only numerical information can be printed. In other respects these three machines are alike, and the same basic principles of operation apply to each.
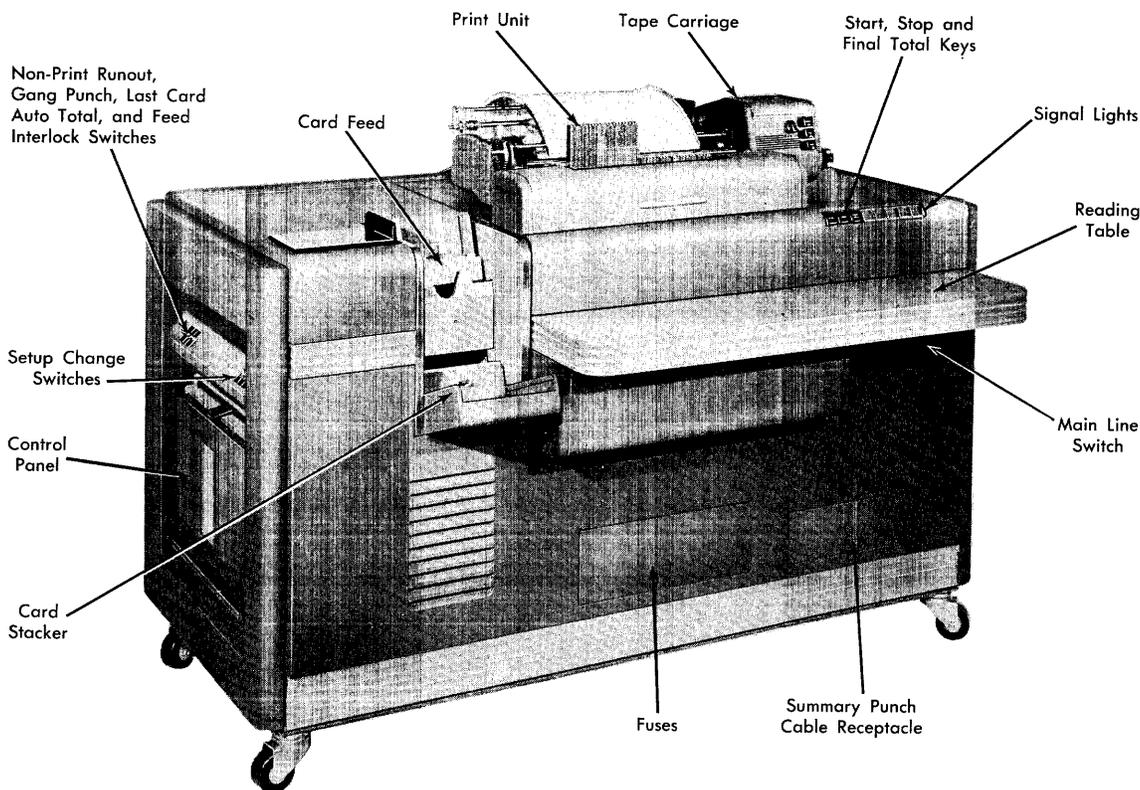
Figure 68. IBM 402 Accounting Machine
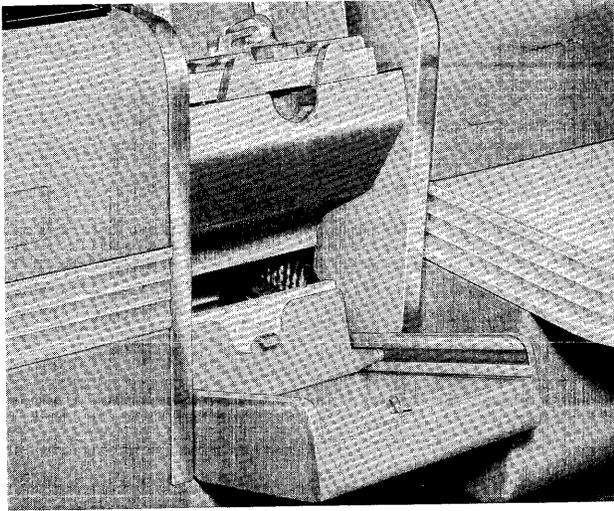
Figure 69. Feed Hopper and Stacker

OPERATING FEATURES

Control Panel

This is the control center of the machine. It controls reading of information from the card, and printing this information in the proper place on the report form. It is inserted in the rack provided for it on the left side of the machine.

Hopper and Stacker (Figure 69)

The card-feed hopper is located at the left end of the machine. Cards are placed in the hopper, face down, with the 9-edge toward the throat. The hopper holds from 800 to 900 cards. As soon as the last card is fed, card feeding stops automatically; the cards remaining in the machine must be run into the stacker by pressing the START key.

The stacker is located directly below the card-feed hopper. When the stacker is full, card feeding stops. Its capacity is about 1,000 cards.

Cards can be added to the hopper and removed from the stacker without stopping the machine.

Machine Controls (Figure 70)

MAIN-LINE SWITCH

To operate the machine, the main-line switch must be turned on. This switch is located beneath the right end of the reading table.

START KEY

This key must be pressed to start feeding cards through the machine. It must also be pressed to resume operation after card feeding has stopped for any

reason other than feed interlock, as described later. The START key is also used in conjunction with the FINAL TOTAL key to take a final total.

STOP KEY

When this key is pressed, card feeding stops before the next card is fed.

FINAL TOTAL KEY

This key provides for manual control of total printing. The following conditions must be satisfied before a final total prints:
1. The machine must be idling.
2. The hopper must be empty.
3. The last card must be in the stacker.
4. The FINAL TOTAL key must be held down while the START key is pressed.

LIGHT (UNLABELED)

The red unlabeled light goes on when the main-line switch is turned on and the machine is idling.

STOP LIGHT

This red light goes on whenever card feeding stops because of conditions set up by control-panel wiring. While the STOP light is on, card feeding cannot be restarted. To turn it off, press the FINAL TOTAL key.

FUSE LIGHT

This red light goes on, and card feeding stops whenever a fuse burns out. The fuses are located near the bottom of the machine below the reading table.

FORM LIGHT

This red light goes on and the card feeding stops whenever the last form is within 10 inches of the platen. *when form light goes on*

CARD-FEED STOP LIGHT

This red light goes on whenever a summary-punch operation is started by the accounting machine. It remains on and prevents further operation of the accounting machine if for any reason the summary-punch operation is not satisfactorily completed. This light also goes on if a card fails to feed from the hopper of either the accounting machine or the summary punch, or when the hopper on the summary punch runs out of cards.
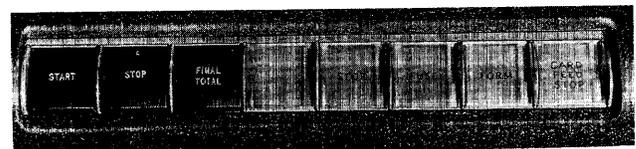
Figure 70. Machine Controls

Reading Table

The reading table is provided on the machine for arranging cards prior to placing them in the card feed. It also serves as a working area while the operator is at the machine.

Print Unit

The function of the print unit (Figure 71) is to record information on a report form or document. This information can be alphabetic or numerical, and can be printed one line for each card (detail printing), or one line for a group of cards (group printing). The IBM 403 can print one, two, or three lines of a data from a single punched card.

The print unit consists of a variable number of typebars, depending upon the model of the machine. The maximum number of typebars is 88, of which 43 print both alphabetic and numerical information, and 45 print numerical information only. The 43 alphabetic
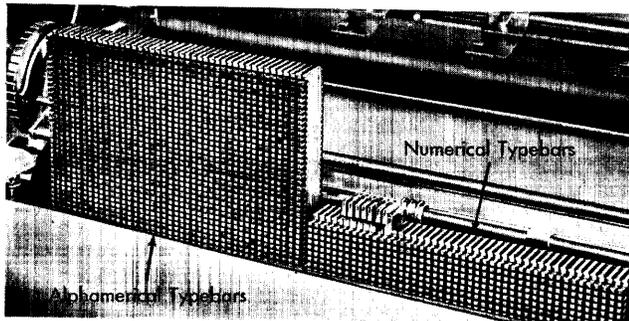
Figure 71. Print Unit

and numerical (alphamerical) typebars are located on the left side of the print unit, and the 45 numerical typebars on the right side. A ribbon guide, equivalent to one typebar space, separates the two sets of typebars. The IBM 419, having no ribbon guide, has 89 numerical typebars.

Each alphamerical typebar consists of the 26 alphabetic characters, the numbers 0 through 9, and a special-character position that normally contains an ampersand (&). Each numerical typebar consists of the 10 numerals (0-9) and one symbol. In an odd-numbered typebar this symbol is an asterisk (*), and in an even-numbered typebar it is a credit cymbol (CR).

A ribbon, similar to that used on typewriters, moves behind the typebars from a spool on the right, through the ribbon guide in the center, to a spool on the left. When the right spool is completely unwound, the action is automatically reversed.

The character in the typebar to be positioned for printing is determined by the holes punched in the card, or by the totals that the machine has accumulated. Behind each typebar is a hammer that fires after the typebar has been positioned, forcing the typebar character against the paper.

Hammerlock Levers

Each typebar in the machine is equipped with a pair of hammerlock levers (Figure 72): a short lever, which is on the right, and a long lever, which is on the left. When both levers are down, the hammer strikes the typebar on every cycle, and printing from the typebar takes place normally.
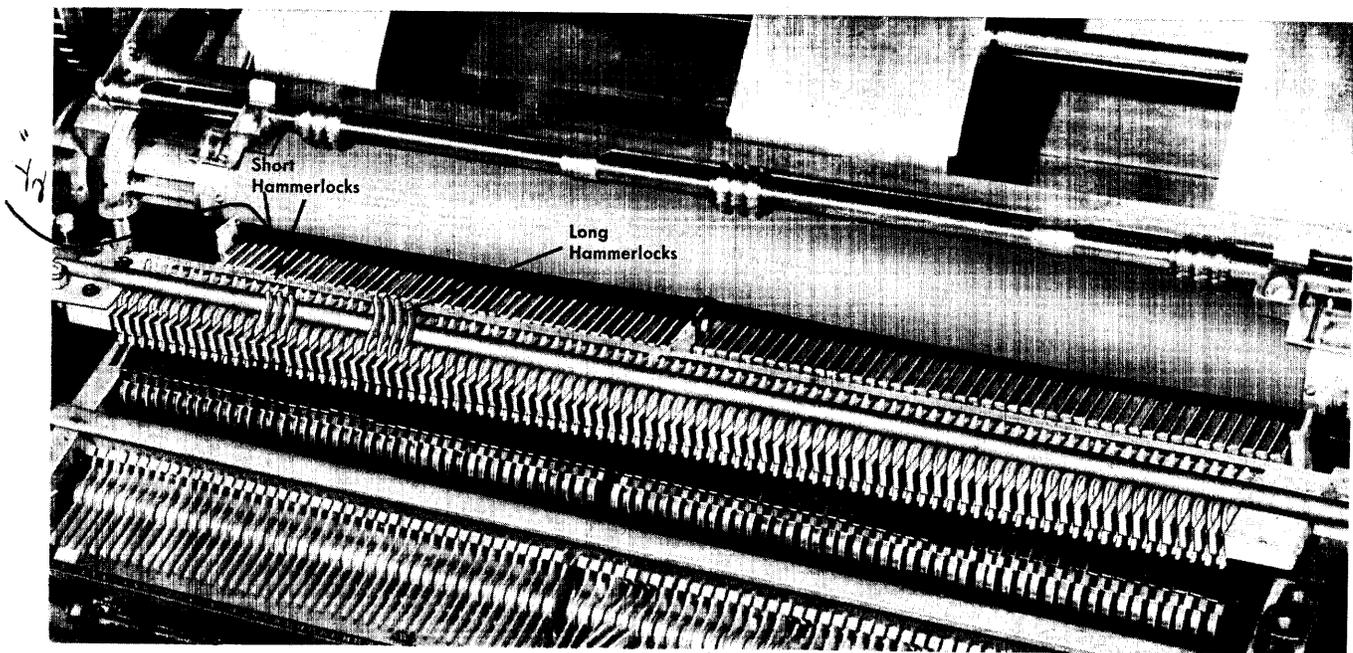
Figure 72. Hammerlock Levers
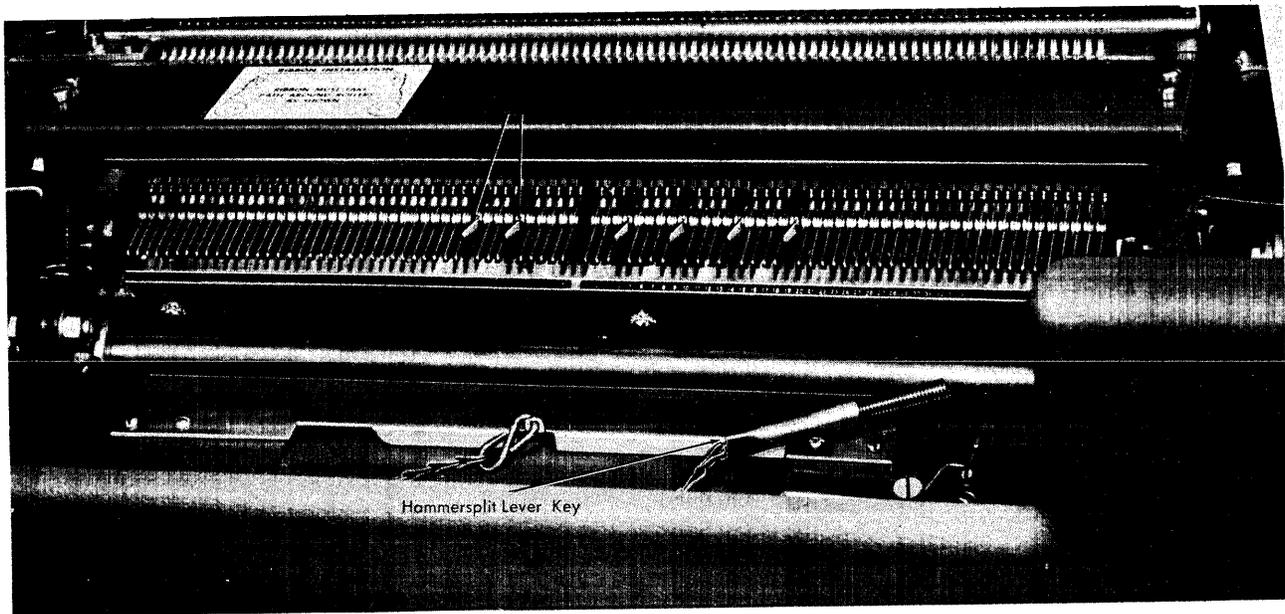
Figure 73. Hammersplit Levers

When a short hammerlock lever is raised, the hammer does not strike the typebar, and no printing takes place from that typebar.

When a long hammerlock lever is raised, the hammer is under the control of wiring in the control panel. If the conditions set up on the control panel for suppression of printing are not present, the hammer fires because the support bar remains in a normal position. When such conditions are present, the hammer does not fire because the support bar is tilted just enough to stop it from firing.

The long hammerlocks have one general purpose, to suppress printing of all or part of the information on particular cards, or to suppress printing of totals. This is accomplished by raising the long hammerlocks for those typebars from which printing is to be suppressed.

The long hammerlock levers can also be used for indicating only the first card of minor, intermediate, or major program groups. This function is known as *group indication*.

Hammerlock levers should not be raised by the operator while the typebars are printing.

Hammersplit Levers

Each typebar is equipped with a hammersplit lever (Figure 73), often referred to as a *zero-suppression lever.* Each lever, when raised, suppresses printing of zeroes to the right of it up to the next significant digit. The lever in the units position of each column of a report is normally raised so that unnecessary zeros in the adjoining columns are eliminated.

Zeros in the alphamerical typebars print only when:
1. zeroes are punched in the cards or are present in a counter total;
2. the typebars are wired on the control panel; and
3. a significant digit is printing to the left.

These are known as *electrical zeros*. These conditions also apply for special characters in the alphamerical typebars.

The upper part of Figure 74 shows printing from the alphamerical typebars without the use of hammersplit levers. The lower part shows the same printing with the proper hammersplit levers raised to suppress the electrical zeros that are not required.

	Alphamerical		Numerical	

24 25 26 27 28 29 30 31 32 33 34	35 36 37 38 39 40 41 42 43	1 2 3 4 5 6	7 8 9 10 11 12 13	14 15 16 17 18 19 20 21 22
A B B O T B R O S	0 1 1 7 9 1 2 3 1	3 1 8	0 0 1 5 8 7 8	0 0 1 5 5 6 0 0 0
A B B O T B R O S	0 1 1 7 9 1 2 3 1	1 9 6	0 0 0 9 8 1 3	0 0 0 9 6 1 7 0 0
		Hammersplit levers not raised.		
A B B O T B R O S	1 1 7 9 1 2 3 1	3 1 8	1 5 8 7 8	1 5 5 6 0
A B B O T B R O S	1 1 7 9 1 2 3 1	1 9 6	9 8 1 3	. 9 6 1 7
		Hammersplit levers 34 alphamerical, and 6, 13 and 20 numerical raised.		

Figure 74. Zero Printing
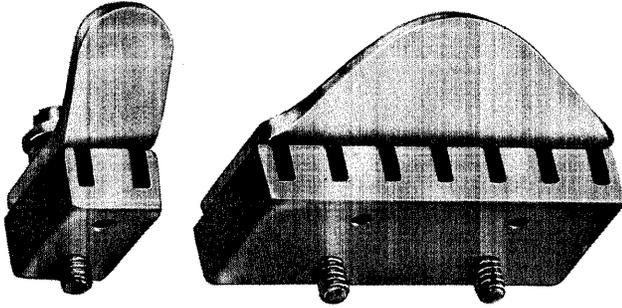
Figure 75. Zero-Carry Clips

When the numerical typebars are not wired, mechanical zeros print to the right of any significant digit. The upper part of Figure 74 shows printed results without the use of hammersplit levers. The lower part of the illustration shows the same results with the proper hammersplit levers raised to suppress zeros that are not required.

It is possible to print zeros without a significant digit to the left either by special card punching or by using a *left-zero-carry* clip. This clip (Figure 75) can be placed on the hammersplit lever of a typebar printing a significant digit, and on the hammersplit levers of as many as 7 typebars to the left of this position, to force zeros to print along with the significant digit.

Functional Controls

SETUP CHANGE SWITCHES

These switches (Figure 76) enable the control panel to perform several different types of operations, without the necessity of changing the wiring. They function either in the OFF or ON position and should be set according to instructions from the supervisor. One example of their use is changing from a detail printing to group printing.

GANGPUNCH SWITCH

This switch (Figure 77) must always be OFF when the accounting machine is used. When this switch is ON and the summary-punch cable is connected to the accounting machine, the IBM 523 Gang Summary Punch
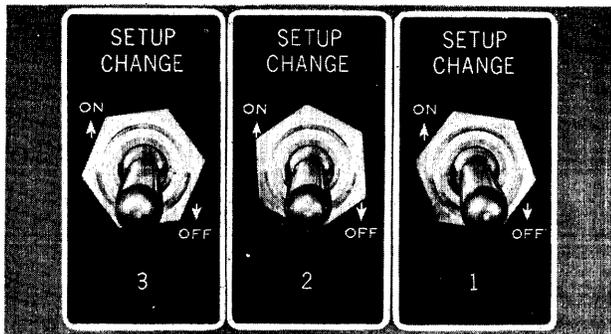
can operate independently as a gangpunch, but the accounting machine cannot be used.

NON-PRINT RUNOUT BUTTON

This button should be pressed whenever (except after a card-feed failure) it is desired to run cards out of the machine without printing on the report. The hopper must be empty for this button to operate.

LAST CARD AUTO-TOTAL SWITCH

When this switch is ON, all normal program controls are suspended, and a major program change is automatically forced on both the run-in and run-out, regardless of control-panel wiring. When this switch is OFF, program-control wiring functions in the normal manner. The primary purpose of this switch is to provide a means of obtaining totals automatically on the run-out, without the necessity of program control.

FEED INTERLOCK START BUTTON

The purpose of feed interlock is to stop card feeding and prevent accidental total printing in the event of a card-feed failure. If a card fails to feed from the hopper, card feeding stops and the CARD FEED STOP light goes on. At this point, there are cards in the hopper and cards in the machine, one of which is about to add, subtract or print, according to the operation being performed. The machine cannot be restarted except by pressing the FEED INTERLOCK START button, at which time the card about to be added, subtracted, or printed runs out into the stacker. On its way to the stacker, this card performs all the normal functions except programming.

The card in the hopper that failed to feed must be corrected. The last card in the stacker must then be placed in front of the corrected card and the rest of the file, and inserted in the hopper. To restart the machine, the FEED INTERLOCK START button must be pressed again. In the run-in, the first card does not add, subtract, or print, but it does compare. The operation for succeeding cards is normal.

If it is not desirable to continue the run after a card-feed failure, it is necessary to clear the feed interlock before a new run can be started. This is done by using

Figure 76. Setup Change Switches
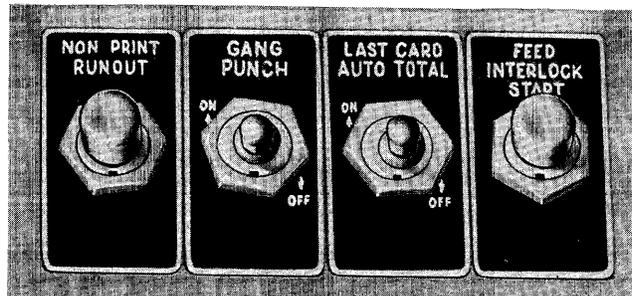
Figure 77. Switches and Runout Buttons

the FEED INTERLOCK START button to pass a blank card through the machine.

MACHINE FUNCTIONS

The machine can be set up to perform the following main functions:

Detail Printing

Detail printing, or listing, is the printing of information from each card as it passes through the machine. Information can be selectively printed or printed anywhere on the form according to control-panel wiring. The rated speed of this operation is 100, 80, or 50 cards per minute on the IBM 402 and 403, and 150, 125, or 80 cards per minute on the IBM 419, depending on the model.

Accumulating

Amounts punched in cards can be added or subtracted selectively, according to control-panel wiring, to give a crossfoot total for a single card, or to give sub-totals or a grand total for successive cards.

Group Printing

Group printing, or tabulating, is the operation in which information on each card is automatically accumulated, but not printed. The only information printed is the indicative data sufficient to identify the group of cards and the totals for each group of cards. The rated speed of this operation is 150, 80, or 50 cards per minute, depending on the model.

Programming

Programming is the function by which the machine can distinguish the cards of one group from those of another, so that individual group totals can be printed. There are three classifications of program control: major, intermediate, and minor. For example, if automatic totals are desired by states, counties, and cities, state is the major group, county is the intermediate group, and city is the minor group.

Summary Punching

Summary punching is automatic recording of summary, or total, information in cards, in the form of punched holes. For example, when an inventory report is prepared on an accounting machine, it can be set up to show, by each type of product or material, the balance on hand at the first of the month, the receipts and issues during the month, and the balance on hand at the end of the month. As totals are printed by each type of product, the information can be automatically punched into summary cards. This information is transmitted from the accounting machine to a summary-punch machine through a summary-punch cable that connects the two machines. (See section on *Automatic Punches* — IBM 514, 519, 523, 526, page 101.)

Summary punching can be performed either in a detail- or group-printing operation. All information to be summary-punched is controlled by both the control panel in the accounting machine and the control panel in the summary punch.

Before a summary-punch operation can start, two cards must be fed from the summary-punch feed hopper. Card feeding stops in both the accounting machine and the punch, and the CARD FEED STOP light goes on, when a card fails to feed in either machine, or when the punch hopper becomes empty.

OPERATING PROCEDURE

1. Make sure that you understand the operation to be performed. If in doubt, ask the supervisor to explain fully.
2. See that the power cord is plugged to the proper source of current.
3. Insert the proper control panel in the slide and clamp it tightly.
4. If summary cards are to be punched, connect the summary-punch cable to the accounting machine and insert the summary-punch control panel.
5. Set the necessary hammerlock and hammersplit levers according to instructions.
6. Insert the proper control panel.
7. Turn on the main-line switch. If the summary punch is to be used, feed two cards into the summary punch.
8. Insert the proper report form and position it correctly.
9. Press the FINAL TOTAL key and the START key to be certain all counters are cleared.
10. Joggle the cards and place them in the hopper, face down with the 9-edge toward the throat.
11. Make a test run. It is necessary to hold the START key down for at least two card-feed cycles. Any errors in the test run should be brought to the attention of the supervisor. If the test is satisfactory, you are ready to start the operation.
12. Load the hopper (not too full) with cards to be processed and place the card weight on top.

13. Press and hold the START key till card feeding is automatic.
14. Store the cards from the stacker in the proper receptacles.
15. When the report is finished, press the FINAL TOTAL and START keys to clear the counters, and turn the main-line switch off.
16. Give the completed report to the supervisor and file the processed cards according to instructions.

OPERATING SUGGESTIONS

STARTING THE OPERATION

Cards must be joggled and arranged in perfect alignment before being placed in the hopper, face down with the 9-edge toward the throat.

When starting an operation, always hold the START key down for at least two card-feed cycles.

Always make a short test run to make certain that the report form is properly positioned in the carriage. (See the *Carriage* section, page 77). The test should prove that the control panel is properly wired to handle every situation that occurs throughout the operation. This includes control of the counters and other special conditions indicated in the cards by X's or other types of control punching. The test deck used by the operator is usually made by the person who analyzed the requirements of the report and wired the control panel.

Never attach the connector cable of the summary punch to the accounting machine unless the main-line switches on both machines are OFF.

Always press the FINAL TOTAL and START keys (hopper empty) before starting an operation to be certain no totals remain in the counters. (This procedure is unnecessary if Last Card Program is wired on the control panel or the Last Card Auto-Total switch is ON).

DURING A RUN

Watch the control information occasionally to see that the totals print at the end of each control group. It is good practice to check periodically the total of items listed. Use small groups of four or five items for this visual check.

When card feeding stops with the STOP light on, the circuits can be reset and the light turned off by pressing the FINAL TOTAL key. The operation can then be restarted by pressing the START key.

HANDLING CARDS

Cards can be added to the hopper and removed from the stacker without stopping card feeding. However, if there is less than one inch of cards in the hopper at the time of reloading, card feeding should be stopped.

If this is not done, cards may fail to feed because of insufficient weight when the card weight is removed.

In handling cards, be careful that the cards that have gone through the machine are stacked in the proper containers. Such cards should be kept separate from the cards that are to go into the hopper. Carelessness in handling either group of cards leads to confusion and inaccurate reports.

STOPPING THE OPERATION

Never turn off the main-line switch to stop card feeding. Use the STOP key.

Run out the cards by pressing the START key after the report is completed, because the last cards do not run into the stacker automatically.

Press the FINAL TOTAL and START keys to be certain all counters are cleared. This is unnecessary if Last Card Program is wired on the control panel.

CARD-FEED FAILURE

When a card fails to feed, the following operations must be performed:
1. Remove the cards from the hopper.
2. Run the cards in the machine into the stacker by pressing the FEED INTERLOCK START button.
3. Correct the card that failed to feed.
4. Place the last card from the stacker in front of the corrected card, and place both cards in front of the rest of the file. Insert them in the hopper.
5. Restart the machine by pressing the FEED INTERLOCK START button.
6. If the run is not to be continued, clear the feed interlock by passing a blank card through the machine, using the FEED INTERLOCK START button.

REPLACING THE RIBBON

The ribbon feeds from one spool to the other about ¼ of an inch on each print cycle. It feeds in one direction until a metal eyelet about ten inches from the end of the ribbon on either spool operates the ribbon-reversing lever, thus reversing the feed.

When installing a new ribbon, make sure the leading end of the ribbon is securely hooked on the empty spool. Wind enough ribbon around the empty spool so that the metal eyelet is between the spool and the ribbon-reversing lever. Thread the ribbon around guide rollers as shown in Figure 78.

REVIEW QUESTIONS

1. What is the purpose of the IBM 402, 403, and 419 Accounting Machines?
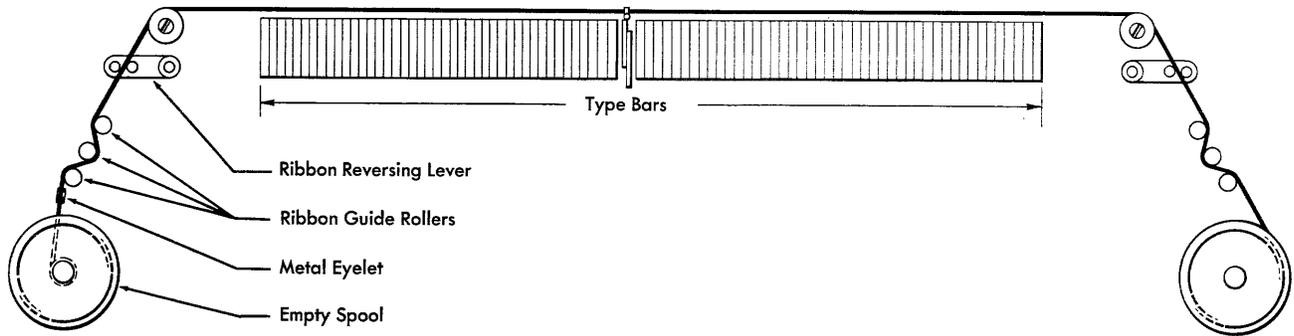2. What other functions besides printing can the machines perform?

Figure 78. Schematic of Ribbon Feed

3. What is the difference between detail printing and group printing, and what is the maximum speed of each operation?

4. What is meant by *programming* and what is its purpose?

5. Where is the control panel inserted?

6. How are cards placed in the hopper?

7. What happens when the last card leaves the hopper?

8. Is it possible to add cards in the hopper or remove them from the stacker when the machine is running?

9. What conditions must be satisfied before a final total can be taken?

10. Name the five lights and describe the purpose of each.

11. How many of the typebars can print both alphabetic and numerical information? Where are they located?

12. How many of the typebars can print numerical information only? Where are they located?

13. What symbol is normally printed by the odd-numbered numerical typebars?

14. What symbol is normally printed by the even-numbered numerical typebars?

15. What is the purpose of the short hammerlock levers?

16. What is the purpose of the long hammerlock levers?

17. What is the purpose of the hammersplit levers? What printing positions are affected?

18. What procedure should be followed to be certain no totals remain in the machine?

19. What is the procedure for starting a summary-punch operation?

IBM 923 TAPE-CONTROLLED CARRIAGE

The IBM Tape-Controlled Carriage (see Figure 68) controls feeding and spacing of continuous forms at high speed while documents or reports are being prepared on the IBM 402 and 403 Accounting Machines. This carriage is controlled by punched holes in a paper tape that corresponds in length to the length of one or more forms. Holes punched in the tape stop the form when it reaches any predetermined position.

The carriage accommodates continuous forms measured in 6ths of an inch up to a maximum of 22 inches in length and 19½ inches in width, including punched margins.

Forms can be designed to permit printing in practically any desired arrangement. Skipping to different sections of the form can be controlled by control-panel wiring and by holes punched in the carriage tape.

The carriage uses the IBM Forms Tractor or the IBM Pin-Feed Platen Device for feeding continuous forms.

Operating Features

CARRIAGE CONTROLS (FIGURE 79)

Platen Clutch Knob. When the arrow on this knob is pointing upward, as shown in Figure 79, the platen is engaged and can be turned manually only by the
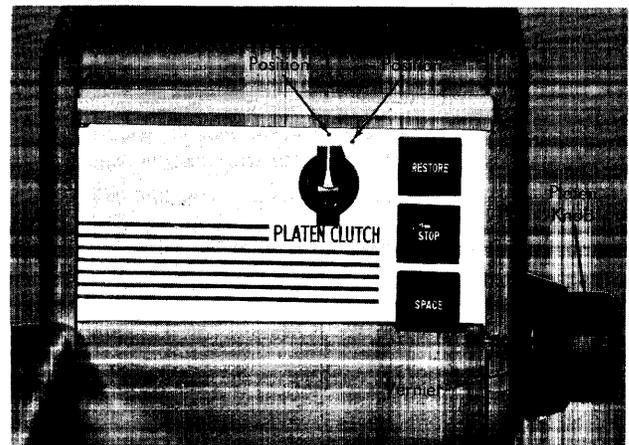
Figure 79. Carriage Controls

vernier knob. To disengage the platen from machine control, the knob is turned to the right. The platen can then be turned manually by the platen knob.

Restore Key. The carriage is set at the start, or home, position by pressing the RESTORE key. This is done with the platen disengaged. Restoring is necessary because the distance that each form travels through the carriage, as it is being printed, is measured by the tape. Starting from the first printing line of one form, the tape moves in synchronism with the form, until the first printing line of the next form is reached.

Stop Key. Pressing this key stops the carriage operation instantly, and card feeding on the accounting machine at the end of the cycle.

Space Key. When the accounting machine is stopped, a form can be advanced by pressing the SPACE key. The form advances one space for each key depression, regardless of the spacing for which the space control is wired. The first form can be fed into position by pressing the SPACE key if the platen clutch is engaged, but the platen clutch should then be disengaged to permit restoring the tape without advancing the form.

Platen Knob. The platen knob can be turned backward or forward, to position the form, only when the platen clutch is disengaged.

Vernier Knob. The vernier knob is used to obtain exact registrations in relation to the horizontal lines. The platen advances, thus lowering the printing on the form, when the knob is turned counterclockwise. Turning the knob clockwise causes printing higher on the form. In either case, the carriage tape is not affected, and adjustments can be made while the platen is engaged or while the machine is in operation.

CONTROL TAPE

The Control Tape (Figure 80) has 12 columnar positions indicated by vertical lines. These positions are called channels. Holes can be punched in each channel throughout the length of the tape. A maximum of 132 lines can be used to control a form, although for convenience, the tape blanks are slightly longer. This allows form depths of 22 inches when 6-lines-to-the-inch spacing is used. All forms 3⅔ inches or less in depth are considered short forms. On the IBM 402, Series 50, forms 7⅓ inches or less in depth are con-

1. Channel 1 — First Printing Line Stop.
2. Channel 2 — First Body Line Stop.
3. Channel 12 — Overflow Start and Page Total Control.
4. Channels 3 to 11 — Normal Stops.

22" Maximum Length of Form
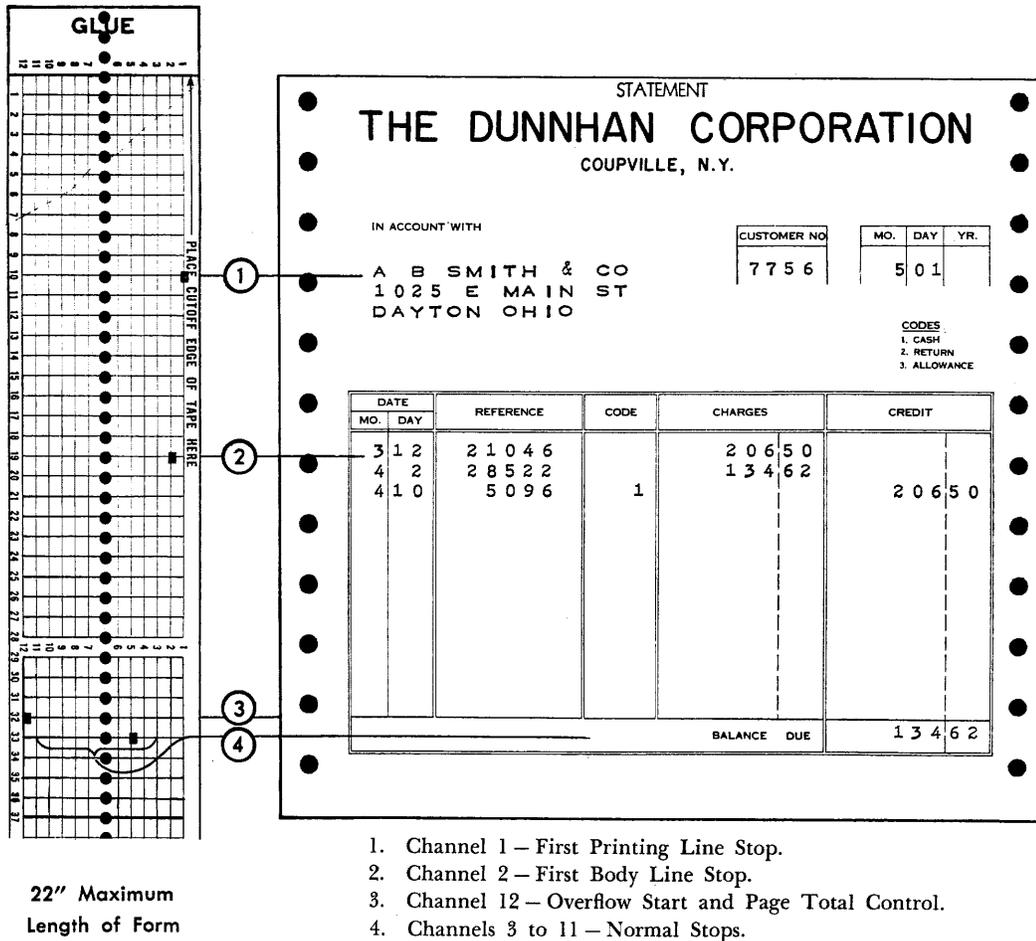
Figure 80. Control Tape and Sample Form

sidered short forms. Round holes in the center of the tape are prepunched for the pin-feed drive that advances the tape in synchronism with the movement of a printed form through the carriage. The effect is exactly the same as though the control holes were punched along the edge of each form.

Punching the Tape. A small, compact punch (Figure 81) is provided for punching the tape. The tape is first marked in the channels in which the holes are to be punched. This can be done easily by laying the tape beside the left edge of the form which it is to control, with the top line (immediately under the *glue* portion) even with the top edge of the form. A mark is then made in the first channel, on the line that corresponds to the first printing line of the form. Additional marks are made in the appropriate channels for each of the other skip stops and the overflow signal required for the form.

The marking for one form should be repeated as many times as the usable length of the tape (22 inches) allows. With the tape thus serving to control several forms in one revolution through the sensing mechanism, the life of the tape is increased. Finally, the line corresponding to the bottom edge of the last form should be marked for cutting after the tape is punched.

The tape is inserted in the punch by placing the line to be punched over a guide line on the base of the punch and placing the center feed holes of the tape over the pins projecting from the base. The dial is then turned until the arrow points at the number of the channel to be punched. Pressing on the top of the punch, toward the back, cuts a rectangular hole at the intersection of a vertical and horizontal line in the required channel of the tape.
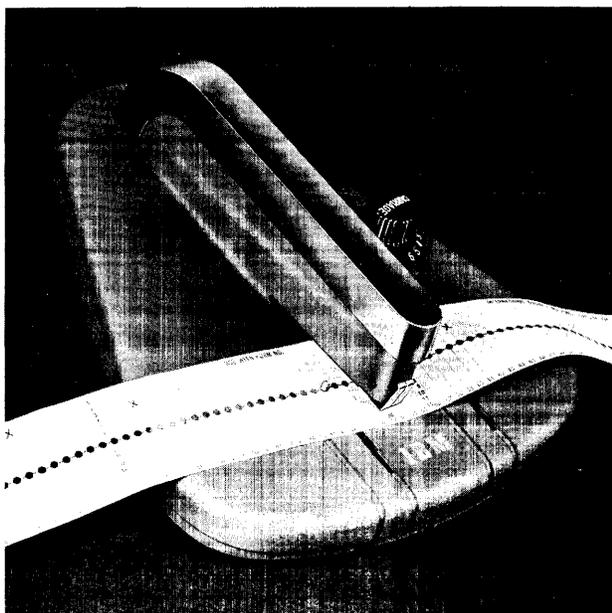
Figure 81. Tape Punch

After the tape is punched, it is cut and looped into a belt. The bottom end is glued to the top section marked *glue*, with the bottom line coinciding with the first line. Before the tape is glued, the glaze should be removed by an ink eraser; if this is not done, the tape ends may come apart. The center feed holes should coincide when the two ends of the tape are glued together.

The last hole punched in the tape should not be less than four lines from the cut edge, as approximately the last half inch of the tape overlaps the *glue* section when the two ends are spliced. If it is necessary to punch a hole lower than four lines from the bottom of the form, the tape should be placed with the top line (immediately under the *glue* portion) four lines lower than the top edge of the form before marking the channels. To compensate for the loss, the tape should then be cut four lines lower than the bottom edge of the form.

Inserting Tape in Carriage.

1. Tilt back the cover of the carriage to gain access to the tape-reading mechanism.
2. Turn the PLATEN CLUTCH knob to the disengaged position.
3. Raise the brushes by moving to the left the latch located on the side of the brush holder.
4. *With the tape loop held so that the printed captions can be read,* place one end of the loop over the pin-feed drive wheel so that the pins engage the center drive holes.
5. Place the opposite end of the loop around the nearest half-circle guide piece.
6. Remove the excess slack from the tape by lifting the lever away from the notched bar, and by moving the guide piece unit to the right. The tape should be just tight enough so that it gives slightly when the top and bottom portions of the loop are pressed together as shown in Figure 82. It should not fit too tightly, or damage occurs to the pin-feed holes.
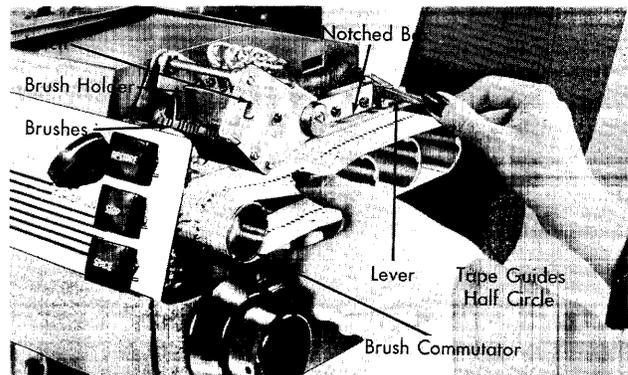7. When the tape is in position, press the brushes down until they latch, and close the cover.

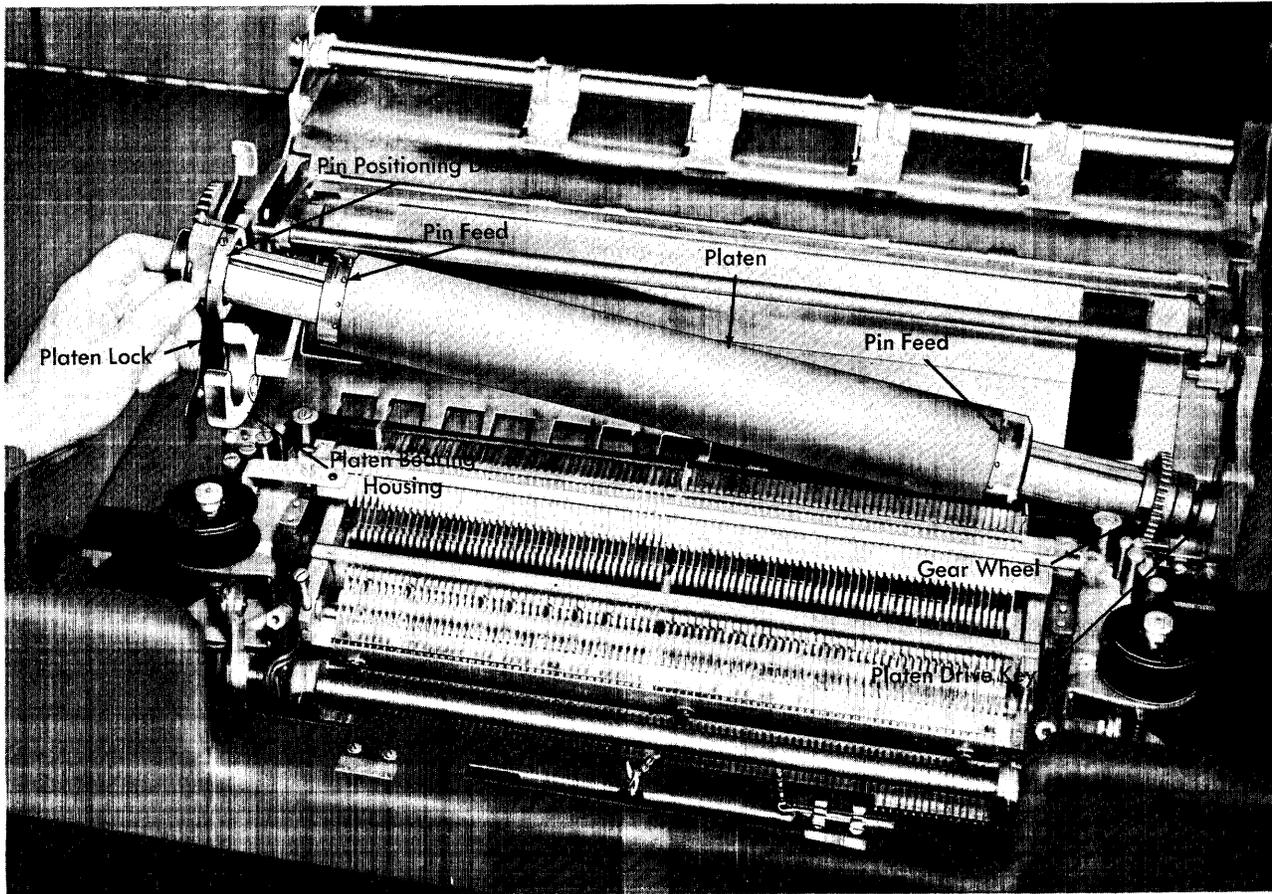Figure 82. Inserting Tape in Carriage

Figure 83. Platen

8. Press the RESTORE key to bring the tape to its home position, and turn the PLATEN CLUTCH knob back to the engaged position. The carriage is ready to operate.

PLATEN

The carriage can be equipped with an IBM Pin-Feed Platen Device, or a solid platen assembly for use with the IBM Forms Tractor, or approved feeding devices of other manufacturers.

Either the pin-feed or the solid platen assembly can be easily removed (Figure 83) by raising the platen lock on the left side, pulling the assmbly to the left and lifting it from the platen bearing housing. When the platen assembly is inserted, the end with the gear wheel should be placed in the slot on the right of the carriage and the left end should be dropped into the platen bearing housing. The platen assembly must then be moved to the right, turning it back and forth in order to fit the platen drive key into the carriage drive mechanism. The platen lock is then closed.

FORM-THICKNESS ADJUSTMENT

The distance between the typebars and the platen is adjustable for thickness of paper stock or for varying number of copies. The form-thickness adjustment (Figure 84) is located under the cover between the reading brushes and the print unit. This device contains 7 notches numbered from 0 through 6. When the dial is in the 0 notch, the typebars are $\frac{1}{8}$ (.125) inch from the platen. When the dial is set to 6, the distance is increased to approximately .178 of an inch. The dial should be set wherever the best results are obtained. To adjust for varying thicknesses, the dial lock is pulled out, and the dial is turned clockwise to increase the distance between the typebars and the platen, and counterclockwise to decrease the distance.
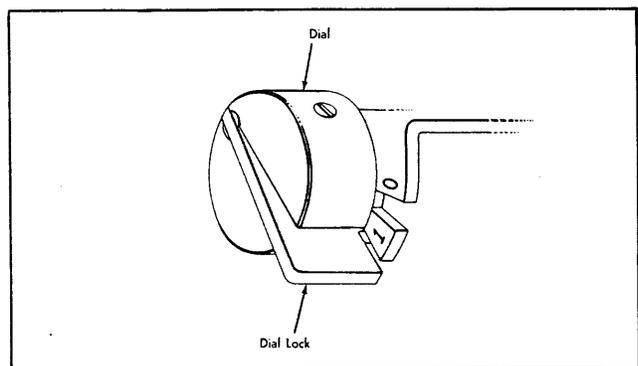
Figure 84. Form Thickness Adjustment

74
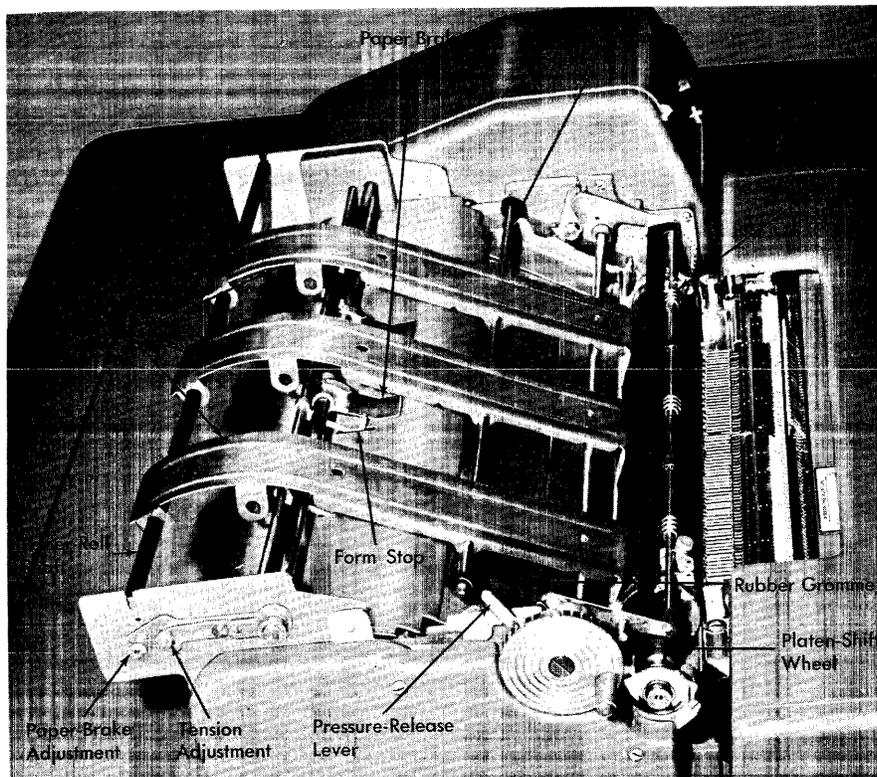
Figure 85. Carriage Features

PAPER BRAKE AND FORM STOPS

In back of the platen is a paper-brake lever (Figure 85), for adjusting drag or tension on the paper. The drag on a form can be increased or decreased to obtain the best operation for a specific form, by regulating the tension adjustment lever located on the paper-brake lever. The lever can be set in one of four positions above the middle line on the dial to decrease tension, or in one of four positions below the middle to increase tension.

As a part of the paper-brake device, there are four form stops that stop card feeding when the carriage runs out of paper. When the bottom edge of the last form passes under the form stops, all four form stops drop into slots as shown, and card feeding stops. The distance between these stops and the printing line is about ten inches.

Both the paper-brake and form stops can be made operative, separately or together. When the paper-brake lever is in the top notch, as illustrated, both the paper brake and form stops are operative. When the lever is in the middle notch, the paper-brake device is OFF and the form-stop control is ON. When the lever is in the bottom notch, both the paper brake and the form-stop control are OFF.

PRESSURE-RELEASE LEVER

When this lever is pushed back, the feed rolls are released so that the paper can be moved freely around the platen. Pressure must always be released when a form-feeding device is in use. Pressure should be applied when form-feeding devices are not in use.

PLATEN-SHIFT WHEEL

The platen can be moved laterally a total of six inches to the left or right by turning the platen-shift wheel. This adjustment can be made while the machine is operating.

TEAR-BAR ASSEMBLY

The tear-bar assembly has a dual function: to hold the forms against the platen and to provide a cutting edge against which forms can be torn off when completed. The carriage tear-bar rollers can be raised off the platen when the pin-feed mechanism is in the operating position.

The tear-bar adjusting lever, mounted on the left-hand arm of the tear-bar, pivots forward and can be latched at any one of three positions. When the lever is at the lowest position, the tear-bar rollers rest on the platen. As the lever is raised, it causes the tear-bar rollers to be raised farther off the platen for each succeeding latching position. The adjusting lever should be latched in the position that raises the rollers an amount corresponding to the thickness of the forms in use.

Form-Feed Guides

The upper form guides are mounted on two shafts. The paper roll shaft extends through the rear set of holes in each guide. A front support shaft extends through the front holes, and rubber grommets are mounted on each end of this shaft to hold it in position. Set the guides equidistantly across the carriage so that the center guide supports the center of the form, and the outer guides support the marginal edges of the form.

Carriage Functions

Forms can be designed to permit printing in practically any desired arrangement. Skipping can be controlled to 8 different sections of the form. The number of sections can be increased by 3 as an optional feature, or in some instances by repeated use of the same holes in the tape. Refer to Figure 80 for illustrations using 6 lines per inch.

Line Spacing and Normal Skipping

Single, double, or triple spacing can vary between lines as controlled by wiring on the control panel. Thus, the heading section of a form may be single spaced and the body section double spaced.

When more than half inch (triple) spacing is required, it must be controlled by the tape. Spaces up to $3\frac{2}{3}$ inches between lines can be skipped at the same rate of speed as normal spacing. This skipping is a smooth, high-speed advance of the form. Successive lines can be printed up to $3\frac{2}{3}$ inches apart at the rated listing speed of the standard IBM 402 and 403 machines. (This spacing and skipping factor is $2\frac{1}{3}$ inches in the IBM 419, and $7\frac{1}{3}$ inches in the IBM 402, Series 50.)

Channels 3 through 11 are used for normal skip stops.

First-Printing-Line Stop

Channel 1 is always punched for the first printing line of a form. This is the starting, or home, position.

First Body Line Stop

Channel 2 is always punched for the first body line of a conventional two-part form using heading cards. If heading cards are not used, Channel 2 can be used as a normal skip stop.

NOTE: When Channel 2 is used for the first body line, it should be at least two lines after the punch in Channel 1.

Predetermined-Total Line

Any class of total can be printed on a predetermined line, whether the form is completely filled or not. For example, although only two or three items have printed on a form, the total of these items can be printed on a designated line of the form instead of directly beneath the last item printed.

Overflow Skipping

When one form is completely filled, it can be ejected, and the next form advanced to the first printing line, or to the first body line. This overflow skipping is caused by sensing a punch in Channel 12 of the tape, corresponding to the last printing line of the form. The paper advances to the required line on the next form. If the last card of a group prints on the last available detail printing line, the total prints before skipping to the next form takes place.

The overflow punch can also be used to initiate other operations before or after ejecting the printed form. For example, a page total or a page number can be printed on the bottom of the sheet, or page identification can be printed on the first printing line of the next form when heading cards are used.

When heading cards are not used, overflow skipping is made to the first body line (Channel 2) of the next form.

Single Sheet Forms

Single sheet forms can be fed easily without moving the carriage in any way. With tape control, each form can be advanced to any desired line for printing. After one or more lines or sections have been printed, the form can be ejected automatically.

Operating Procedure

1. Turn the PLATEN CLUTCH knob to disengage the platen.
2. Raise the cover of the carriage.
3. Raise the carriage brushes by a slight pressure on the latch.
4. Remove the tape by raising the lever on the notched bar and moving the lever slightly to the left. The tape can then slide off the half-circle guide pieces and the pin-feed drive wheel.
5. Insert the new tape:
   a. Hold the tape so that the printed captions can be read.
   b. Loop one end over the pin-feed drive wheel so that the pins engage the center drive holes.
   c. Place the opposite end of the loop around the nearest half-circle guide piece.
   d. Remove excess slack by lifting the lever away from the notched bar and moving the guide piece to the right. The tape should be just tight enough so that it gives slightly when pressed together.
6. Clamp the brushes in position.

7. Close the cover.
8. Press the RESTORE key.
9. Push the pressure-release lever back.
10. Place the paper-brake lever in the bottom notch (brake OFF, control OFF).
11. Feed the forms from the back of the machine under the form stops and under the platen, until the end of the form can be grasped by the hand.
12. Adjust and align the form according to the type of form-feed device used. If no form-feed device is used, straighten and align the form around the platen.
13. Locate the first printing line on the forms, and position the line so that it is just barely covered by the ribbon. It may be necessary to start with the second form.
14. Replace the paper-brake lever in either of the two top notches, according to instructions from the supervisor.
15. Pull the pressure-release lever forward if a pin-feed mechanism is not used; otherwise, leave it back.
16. Press the RESTORE key.
17. Turn the PLATEN CLUTCH knob to engage the platen drive.
18. Press the START key to begin the operation.

Operating Suggestions

INSERTING THE TAPE

The platen clutch should be disengaged (knob turned to right) while the tape is being inserted in the carriage, and especially when the RESTORE key is pressed.

The tape must be inserted in the carriage so that the printed captions can be read. After inserting the tape, excess slack should be removed. The tape should be just tight enough so that it gives slightly when the top and bottom portions of the loop are pressed together.

Be sure that the brushes are clamped in position after tape is inserted. Failure to do so causes continuous running of the tape when the RESTORE key is pressed, or when the first skip occurs.

Tapes should never be folded, because the tape tends to overlap at the creases when traveling around the pin-feed drive wheel.

When the carriage is not in use, the brushes should be clamped tightly against the pin-feed drive wheel.

INSERTING THE FORMS

Be sure that the form-thickness adjustment is set properly for the forms that are being fed through the machine. If it is set at notch 6 and single-sheet forms are being fed, printing may not be clear because the platen is too far from the typebars.

The pressure-release lever should be pushed back whenever form feeding is accomplished by a pin-feed mechanism. It should be pulled forward when form feeding is accomplished by pressure rolls.

If a report form contains a positioning mark (▲), the form should be positioned in the carriage so that the positioning mark lines up with the ribbon guide on the machine.

Be sure the forms are fed under the form stops and not over them.

OPERATING THE CARRIAGE

Do not use the STOP key on the carriage to stop card feeding in the accounting machine. Although this key does stop card feeding, it is not intended to be used in place of the regular accounting machine STOP key. Its purpose is to stop a carriage operation.

The platen cannot be turned backwards unless the platen clutch is disengaged.

Make sure that the carriage is restored and the platen clutch is engaged before an operation is begun. Failure to restore causes improper spacing of the forms; failure to engage the platen causes overprinting:

Review Questions

1. What is the purpose of the tape-controlled carriage?
2. How are single, double, and triple spacing controlled?
3. What is the purpose of the round holes in the center of the tape?
4. Which way should the tape face while it is being inserted in the carriage?
5. How are the brushes lifted away from the pin-feed drive wheel?
6. How tight should the tape be for most efficient operation?
7. Can a tape be used more than once?
8. What direction must the platen clutch knob be pointing before the platen can be moved manually?
9. How is the carriage set at the start, or home, position?
10. What is the purpose of the form-thickness adjustment?
11. What happens when the last form passes form stops?
12. In what position must the pressure-release lever be so that the paper can be moved freely around the platen?
13. The platen can be shifted laterally six inches to the left or right. How is this done?
14. Can the platen be shifted laterally while the machine is in operation?
15. What is the purpose of the vernier knob? When can it be used?

The Model F-3 IBM Forms Tractor (Figure 86) designed for use with the IBM 923 Tape-Controlled Carriage, can be attached or removed from the carriage by the operator without the use of tools. With this device, marginally-punched continuous forms are fed by two tractor assemblies located above the platen. The tractors can be located laterally to accept forms of various widths up to 19 inches, including the punched margins. If forms are narrower than the minimum width that can be obtained between the tractors, these forms can be advanced by a single tractor engaging the pin holes in only one side of the form.

The platen pressure rolls must be disengaged at all times when the IBM Forms Tractor is used to feed forms.

With the use of this form-feeding device, six- or eight-line spacing per inch can be obtained without altering the accounting machine carriage in any way. The operator simply shifts a drive gear plate on the forms tractor to one of two indicated positions for the desired spacing results (Figure 87).

Installation Steps

To attach the forms tractor to the carriage:
1. Rest the lower forms-tractor paper guides on the carriage paper table behind the platen.
2. Hook the rear forms-tractor mounting studs in the rear slots in the carriage side frames.
3. Lower the front of the forms-tractor assembly, and latch the front forms-tractor mounting studs in the front slots in the carriage side frames.

See that the platen gear and the forms-tractor drive gear are fully meshed. Be sure the forms tractor and platen turn freely by hand before operating under
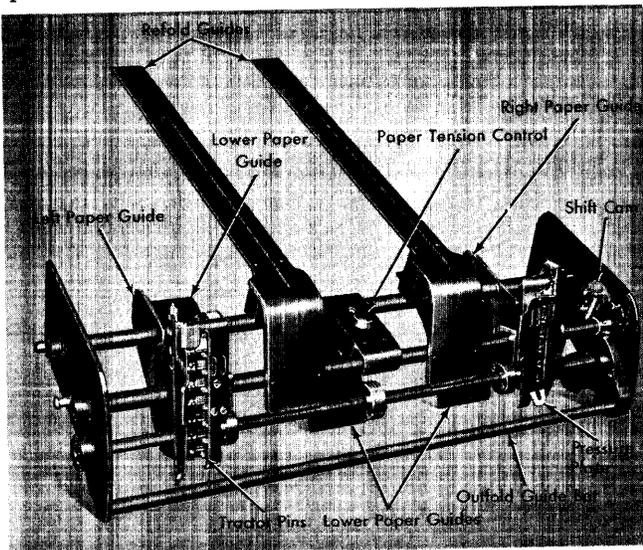
Figure 86. Forms Tractor
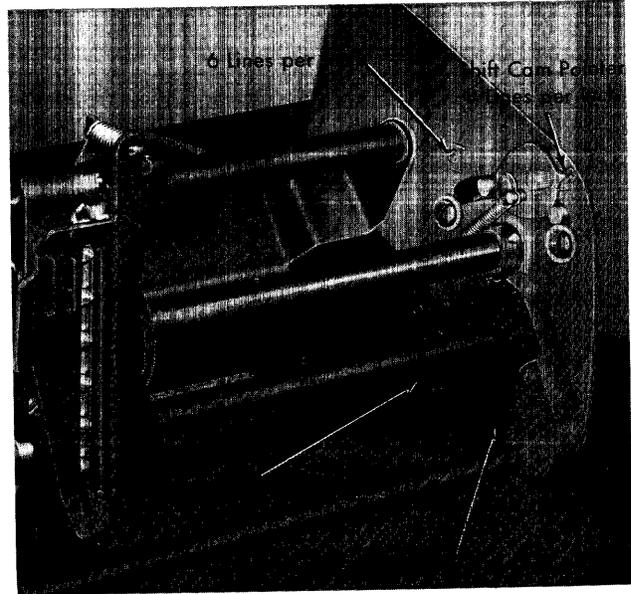
Figure 87. Six- or Eight-Line Drive

power. Because the paper guides are free to disengage from the tractor-adjusting wheels when the device is not attached to the carriage, these units must be guided into engagement.

When removing the device, reverse the procedure. The front forms-tractor mounting-stud latches are simply cammed out of the way as the front of the device is raised.

The 6- or 8-line drive-gear mechanism is shown at the 6-lines-per-inch setting in Figure 87. When 8 lines per inch are required, revolve the spacing adjustment cam until the scribed line is opposite the *8* on the gear plate. Attach the device to the carriage and see that the forms tractor drive gear fully engages in the platen gear without binding. An improperly engaged drive gear results in non-uniform spacing.

Reverse the procedure to shift the mechanism back to the 6-lines-per-inch position.

Operating Procedure (Refer to Figure 86.)
1. Loosen both lower paper-guide lock-nuts.
2. Move the left-hand paper guide and tractor laterally to the desired position and tighten that lock nut.
3. Insert forms over the lower paper guides and under the platen.
4. Move the right-hand paper guide and tractor in toward the form. Allow a slight amount of clearance between the form and the right- and left-hand guides so that forms are fed without bind-

ing. Tighten the right-hand paper guide lock nut.

5. Center the paper-support disk between the tractor assemblies.

6. Locate the center lower paper guide midway between the outer paper guides.

7. Clip the refold guides on the tractor guide rod, and position them approximately midway between each tractor assembly.

8. With the carriage pressure rolls disengaged and the tractor pressure plates raised, draw the forms up and attach the margins of the forms to the tractor. Lower the tractor pressure plates.

9. Center the tractor pins laterally in the marginal holes of the form by rotating the knurled adjusting wheel on each tractor assembly in the proper direction. Improperly centered pins may cause crooked feeding.

10. Usually, printing is started on the second form because the first form is needed to attach to the forms tractor. However, if it is necessary to start printing on the first form, place that form on the tractor pins and engage the carriage pressure rolls. Next, turn the platen backwards until the first line of the form is in position to be printed. Press the START key to begin the operation. After the form has advanced to the tractors, stop the machine, attach the form to the tractor chain pins, and disengage the pressure-feed mechanism.

IBM PIN-FEED PLATEN DEVICE

The IBM Pin-Feed Platen (Figure 88) advances forms by the retractable pin-feed mechanisms located on each end of the platen. As the platen revolves, the pins engage in the marginal holes of the forms and pull the forms forward and up, thus advancing the forms without the use of pressure rollers.

On all IBM carriages, to obtain continuous accurate form alignment when the IBM Pin-Feed Platen is being used, the pressure rollers must be disengaged. The pins alone must advance the forms. Also the forms must flow under the platen and out of the carriage without undue pull, drag, or interference of any kind.

The operator can easily change the operations and functions of this platen device.

Pin Wheels

A pin-wheel assembly is located at each end of the platen on the platen shaft. The distance between the pin wheels can be changed to fit any standard length platen. The lateral position of the platen on the shaft is determined by the location of the left-hand, or fixed, pin wheel. The retractable pin wheels can be shifted to the inoperative position so that the pins emerge at the rear rather than the front of the platen when friction-feeding the forms, or when using an above-platen feeding device.

Forms without marginal holes, and which are shorter in width than the platen, can be friction-fed without making any changes. However, when forms
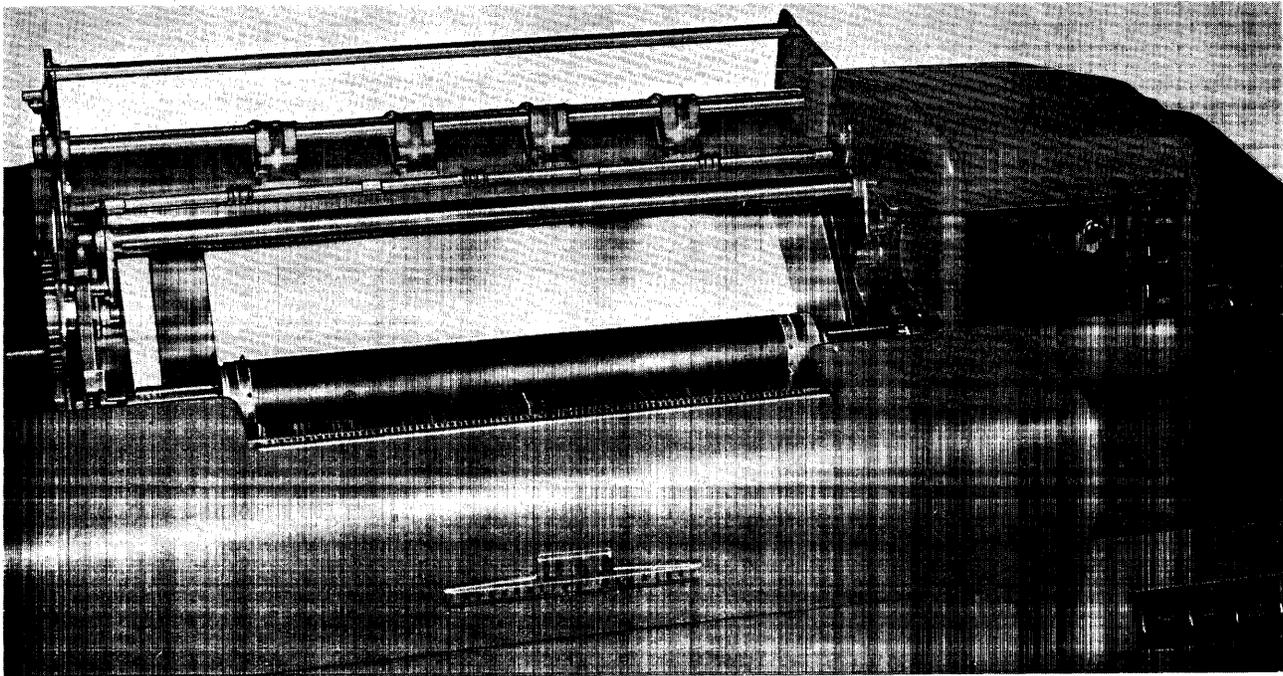
Figure 88. IBM Pin-Feed Platen
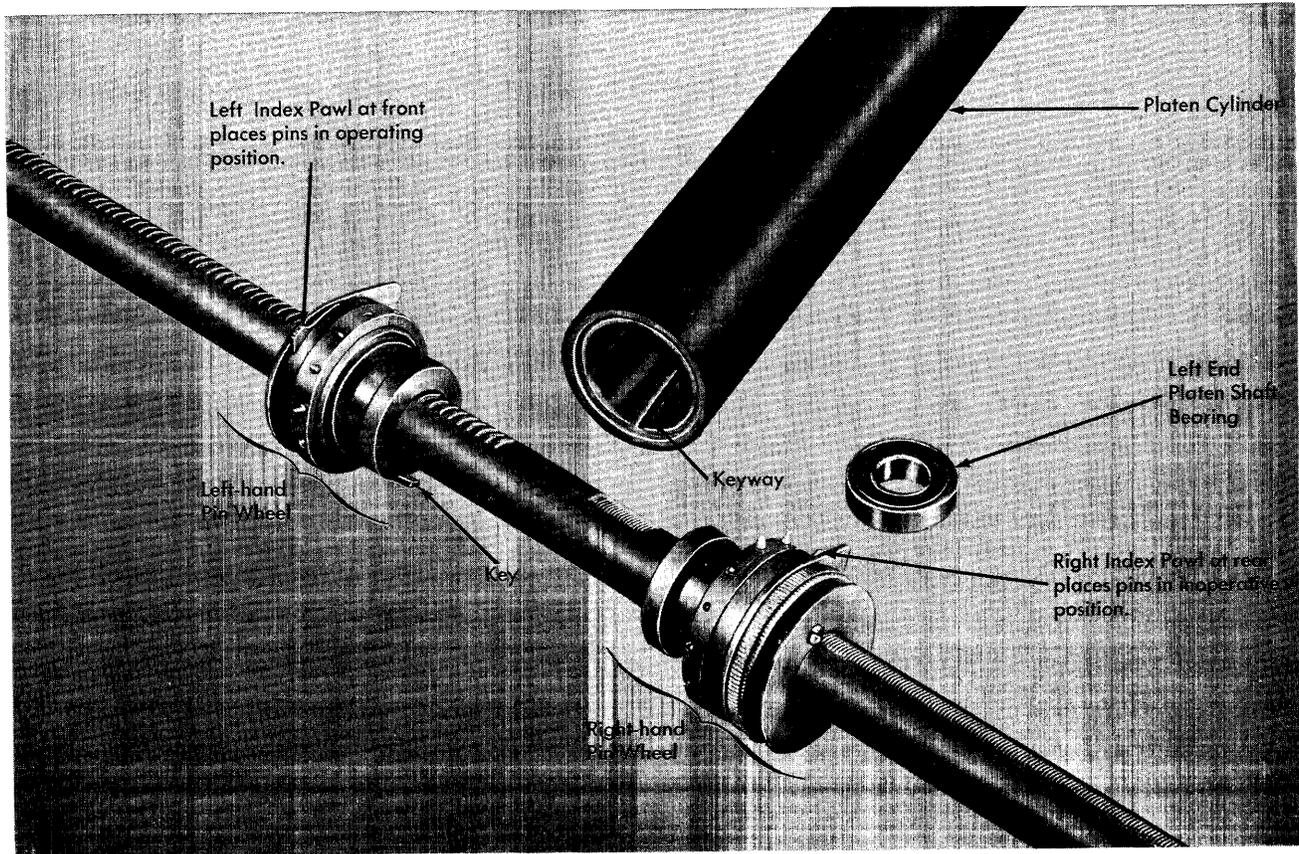
Figure 89. Pins in Operating and Inoperative Position

the same size as the platens are to be friction-fed or fed by an above-platen feeding device, the pin wheels must be shifted to the inoperative position. Any length platen can be used this way, provided the form is not wider than the platen. Type characters should never be allowed to print against, or directly strike, the metal pin wheels.

Changing the Position of the Pins

The platen shaft assembly is designed so that each pin wheel operates as an independent assembly. Therefore, it is necessary to position the left and right index pawls so that the pins are in the operating or non-operating position at the same time.

To change the pins to the inoperative position, press and move the index pawls to the rear latching position (right-hand pin wheel, Figure 89). The pins are in the operating position when the index pawls are in the forward latching position (left-hand pin wheel, Figure 89).

Platens

Two different types of platens are manufactured for use with the IBM Pin-Feed Platen Device: platen cylinders (Figure 90) and platen sectors (Figure 91).
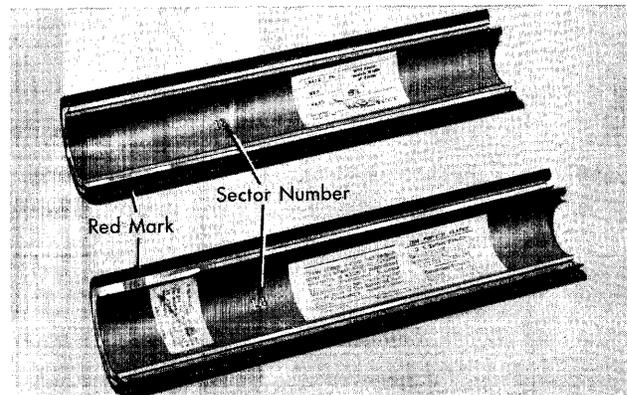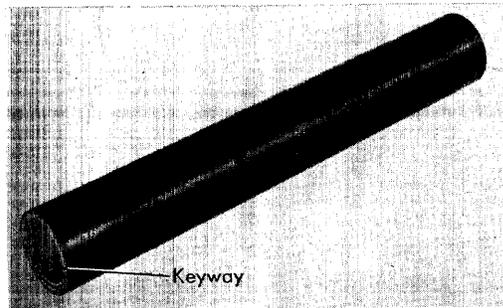
Figure 91. Platen Sectors
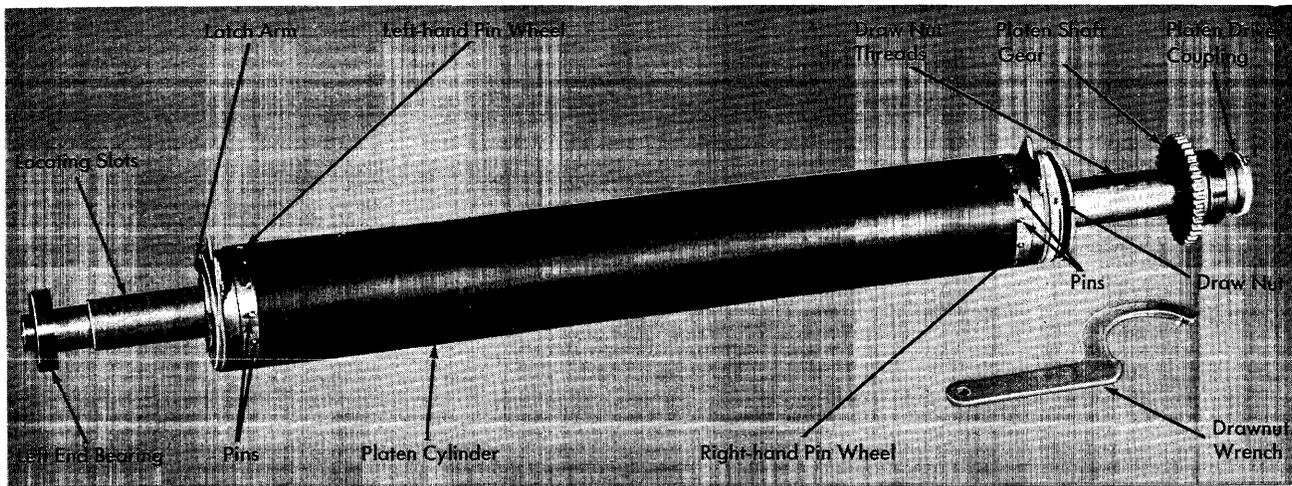
Figure 92. Pin-Feed Platen Assembly

PLATEN CYLINDERS

Platen cylinders are designed for use with the platen shaft assemblies that can easily be removed from the machine by the operator.

Changing Platen Cylinders. Remove the platen assembly from the carriage in the normal manner. After the assembly (Figure 92) has been taken out of the machine, remove the left end bearing, which is held in place by spring tension. Next, the pressure placed on the platen must be released by rotating the draw nut of the right-hand pin wheel counterclockwise until the stud in the side of the draw nut lifts the draw-nut latch up out of the threads in the platen shaft. When the pressure has been released, the latch arm of the left-hand pin wheel can be pressed, and the assembly will slide off the shaft. The platen cylinder can then be removed from the left end of the shaft.

To re-assemble the pin-feed platen:

1. Place the platen cylinder, left-hand pin wheel and left-hand bearing on the shaft in that order.
2. Bring the platen cylinder up against the left pin wheel.
3. Slide the right pin wheel to the left, aligning the key with the keyway of the platen.
4. When the right pin wheel is as tight against the platen as possible, rotate the draw-nut latch to engage with the threaded portion of the platen shaft. Turn the draw nut as far as possible. A wrench (Figure 92) is provided for this operation. Place the platen on the reading board with the wrench engaged and under the platen, and turn the platen with both hands, thus tightening it against the wrench.

Positioning Platen Cylinder on Shaft. A platen cylinder can be positioned laterally to align the form with the typebars. The lateral position of the platen sectors on the shaft is determined by the location of the left-hand or fixed pin wheel (Figure 92). The left-hand pin wheel can be moved by loosening the draw nut and pressing the latch arm and sliding the pin wheel along the shaft to a new location. Make sure that the latch is firmly seated in one of the large cross-cut locating slots in the platen shaft.

PLATEN SECTORS

Platen sectors are lengthwise halves of a platen. Changing the platens is thus simplified on machines with non-removable platen shaft assemblies. These sectors are manufactured as matched pairs and should be used as such. An identifying number is stamped on the inner core of each sector half so that the halves can be readily matched. Each sector half also has a red mark painted on one corner of the inner metal sleeve. The sector halves fit together properly only when these marks touch each other.

Changing Platen Sectors. When removing platen sectors from the shaft, release the right-hand pin-wheel draw-nut latch as previously described for platen cylinders and move the pin wheel to the right. Now the platen sectors can be pulled apart for removal.

When replacing platen sectors:

1. Place the two halves around the shaft. See that the red mark on each sector half is at the left end of the shaft and over the key in the left-hand pin-wheel assembly.
2. Butt the sectors against the left-hand pin wheel.
3. Move the right-hand pin wheel in position, and tighten as previously described for tubular cylinder.

Storing Platen Sectors. Cardboard tubes are provided for shipping the sectors and should be used for storing the extra sectors. Do not store the sectors near heat. Keep the platen sectors together as matched pairs at all times.
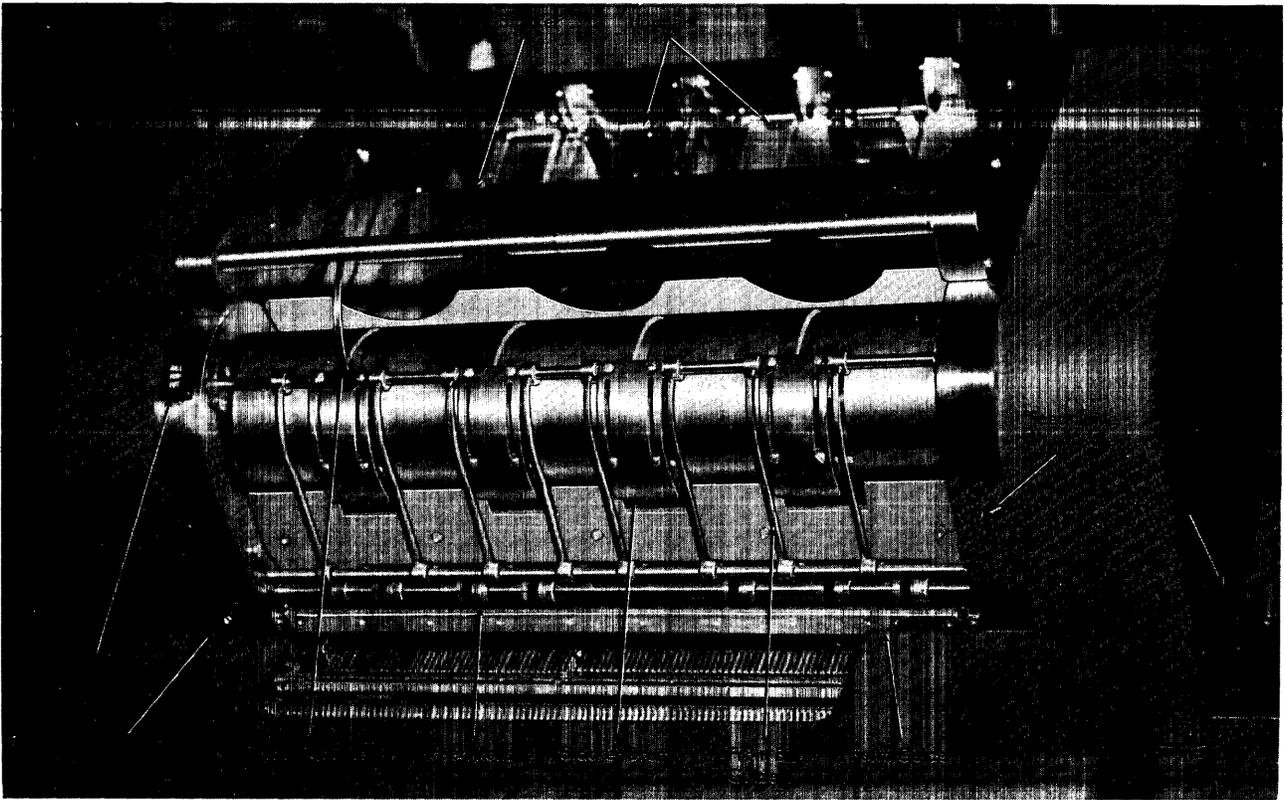
Figure 93. IBM 916 Bill Feed

IBM 916 BILL FEED

Rapid and automatic preparation of original documents such as checks, service bills, and earnings records is a significant feature of the IBM data processing method. The IBM 916 Bill Feed (Figure 93), installed on an accounting machine, facilitates preparation of documents (such as IBM cards, single paper forms, folded forms or envelopes) by automatically positioning them in the printing position desired. While the bill feed was primarily designed to handle small, separate forms, other records printed on large separate sheets or roll paper can also be processed.

The IBM 916 Bill Feed can be installed on the IBM 402 or 403 Accounting Machine. Normal line spacing, printing, accumulating and other functions of the accounting machine can be utilized during bill-feed operations.

Operating Features (Figures 94, 95, 96)

STACKER DRUM

Forms are removed from the scanning position (front bill guide) and placed in the stacker by the stacker drum.

STACKER CONTACT

This sensing arm stops card feeding when a form fails to pass from the printing station to the stacker. The arm can be situated in any one of four positions, according to the location of the form. Where two forms are being fed side by side, two sensing arms can be installed.

FEED-DRIVE CLUTCH RELEASE

In order to turn the platen backward, this lever must be pushed down to release the drive clutch. The platen clutch (Figure 95) must also be released before the platen can be turned backward.

PLATEN KNOB

The form can be moved forward or backward as desired by moving the platen knob. Before the knob can be turned backward, the platen clutch and feed-drive clutch must be released.

UPPER FEED ROLLS

The upper feed rolls can be moved horizontally on the feed roll shaft. This permits placement of feed rolls in unprinted portions of the form, to prevent smudging the form.

FRONT BILL GUIDE

This guide allows the operator to observe the forms before they are stacked. It can be lifted out by releasing the two latches at the top of the guide assembly. Forms at this location are said to be in the *scanning* position.

FORM GUIDE

The card is guided around the platen, without interfering with the ribbon and the typebars, by the form guide. The guide can readily be removed for adjustment or relocation of the guide wires. These wires are spaced to fall between typebars and, if possible, they should be located in a position where there is no printing.

The form guide can be adjusted to accommodate forms of various thicknesses. A small red or black dot seen through a hole at each end of the form guide indicates the amount of clearance. When the black dot is showing there is .035 inch between the bar and platen; when the red dot is showing the distance is .013 to .015 inch. The adjustment is made by removing the form guide and rotating the eccentric positioning hole for the form-guide release knob in each end of the bar.

FORM GUIDE RELEASE KNOBS

Pulling out the form-guide release knobs releases the form guide for removal from the machine. The right knob is located inside the cover (Figure 94).

RUN-OUT KEY

In order to remove excess forms from the bill feed, the RUN-OUT key and the machine START key are pressed simultaneously.

PRESSURE-RELEASE LEVER (FIGURE 94)

The purpose of this lever is to release the pressure on the feed rolls so that individual or continuous forms can be aligned. This lever can be placed in one of three positions.

Forward: all pressure is released from all rolls.
Center: pressure is applied to the feed rolls above the platen. This position is used for feeding continuous forms.
Back: pressure is applied to all feed rolls. This is the normal position for feeding individual forms.

CRANK STUD AND FIRST-PRINTING-LINE ADJUSTMENT NUT

The distance that forms feed into the printing station determines the position of the first printing line and is controlled by the crank stud. This stud is adjusted by turning the first-printing-line adjustment nut. Moving the stud nearer the center of the gear places the first printing line nearer the top of the form. On forms less than 5 inches in depth, the first line can be printed
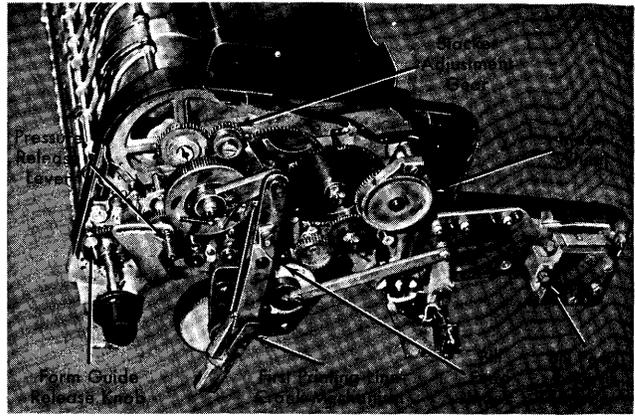
Figure 94. Right Side of Bill Feed

anywhere; the first printing line on 5-inch forms cannot be less than ⅚ inch from the top of the form. Once the first-printing-line adjustment is made, the first line is printed in the same place on all succeeding forms. When setting up the bill feed for a particular form, adjust the first-printing-line position first.

STACKER ADJUSTMENT GEAR

This gear with a knurled shank can be pulled out to disengage the drum stacker. The drum can then be rotated to position the grippers higher or lower according to the width of the form.

PLATEN-CLUTCH RELEASE (FIGURE 95)

Before the platen can be turned backward, this knurled disk must be moved upward to release the platen clutch. The platen can be turned forward without operating either the platen-clutch release or the feed-drive-clutch release.
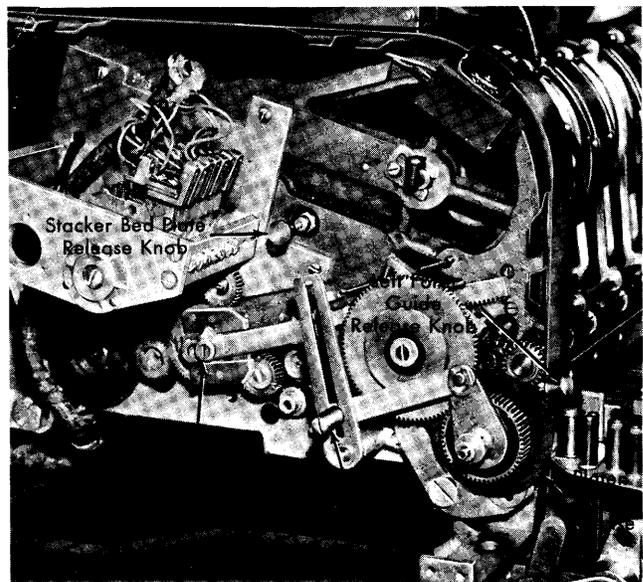

Figure 95. Left Side of Bill Feed

LINE-SPACE ADJUSTMENT STUD

Any desired line spacing between the limits of ⅛ inch and ⅚ inch can be obtained. Moving the line-space stud upward in the slotted arm increases the space between lines.

PREDETERMINED-LINE ADJUSTMENT STUD

The position of a line of printing, such as a predetermined list or total line, can be pre-located on the form by the predetermined-line adjustment mechanism. Moving the screw stud in the slotted blockgear assembly adjusts the printing to fall in the required predetermined position. The farther from the center of the assembly the stud is placed, the farther the predetermined line prints from the first printing line on the form. The predetermined line can be printed anywhere on the form between 1⅚ inches from the bottom edge of the form and 2⅞ inches from the first listed line on the form.

If the last (or only) line is to be printed near the top of the form, it may be necessary to set the predetermined-line adjustment to assist in moving the form out of the printing position, after printing, so that the following form does not feed against the first form. This is necessary only when all printing is high on the form.

It is advisable to have a change in the predetermined-line adjustment made by an IBM customer engineer, because most machines are built for specific operations and standard adjustments do not always apply.

STACKER-BED-PLATE RELEASE KNOB

This knob must be pulled out in order to remove the stacker-bed plate.

HOPPER SIDE PLATES (FIGURE 96)

The side plates of the bill-feed hopper are movable and can be adjusted to align the form with the typebars and to accommodate different length forms. The side plates can be adjusted horizontally to any point except a position occupied by a feed knife. For this reason, forms to be used with the bill feed should be located so that neither the right nor the left edge falls in a feed knife position. However, forms can terminate in feed knife positions, if no knife is installed on the particular bill feed in use.

It is sometimes desirable to feed two IBM cards, or two cut forms, side by side at the same time. To do this, two extra side plates must be installed and the four side plates (two for each form) are set up to make two hoppers. The two forms being fed must be separated by at least the distance equivalent to one typebar thickness, in order to allow room for the center side plates. Removable side plates can be ordered so that, in combination jobs, the unused side plates can be removed when single forms are fed.

THROAT KNIFE

The purpose of the throat knife is to allow one and only one form to pass into the feed rolls on a feed cycle. At least one throat knife must be used on each form being fed, and the form should be positioned so that the knife is as near the center of the form as possible. On large forms, more than one throat knife should be used. For example, a form 17 inches wide requires two throat knives. Provision is made for placing a throat knife in any one (or combination) of six positions in the bill feed.

If cards are to be fed in one run, and thin paper forms in another in the same bill feed, a special two-adjustment throat knife is provided that can easily be set for the thickness of the form being fed.
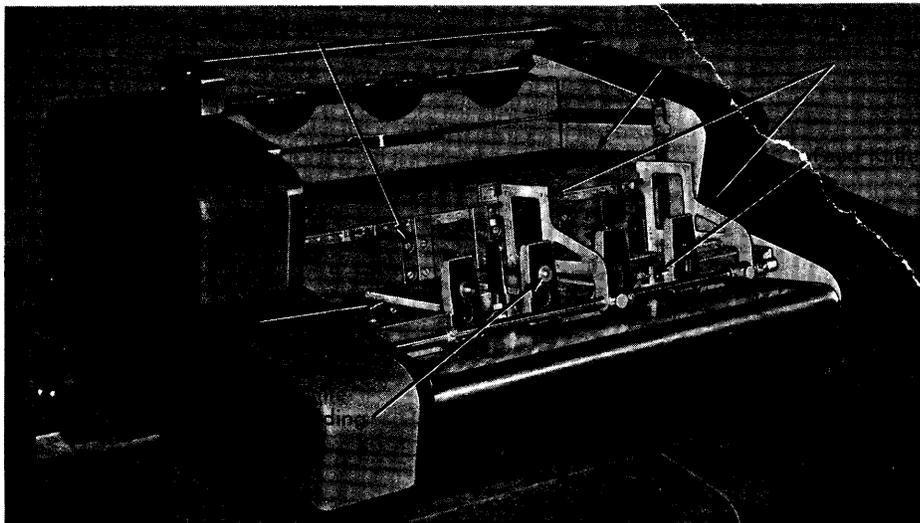

Figure 96. Rear of Bill Feed

FEED KNIVES

The feed knives move forms, one at a time, from the hopper into the feed rolls. At least two feed knives must be used on each form being fed. Four feed knives are used when feeding large forms, or two forms side by side. A special knife cover is provided on machines equipped with more than two feed knives if only two knives are to be used. Covering the knives not in use eliminates the possibility of jamming foreign material in back of them.

Bill Feed Functions

As shown in Figure 97, forms are placed in the bill-feed hopper (1) face down, top edge toward the throat. They are moved by feed knives (2) out of the hopper and into feed rolls (3), which move the forms against the bottom edge of the platen (4). As the previous form is ejected, the next form is drawn into position to receive the first line of printing. This ejection movement takes place between machine cycles, so that a form is always in the printing position and there is no resultant loss of accounting-machine time. After ejection, the form resets in the scanning position (5) until the next form is ejected. During this next eject cycle, the form is moved from the scanning position to the card stacker (6) by action of the stacker drum (7).

LINE SPACING

Line spacing can be adjusted for any dimension between ⅛ inch and ⁵⁄₁₆ inch. The spacing operation takes

place in the normal manner. No wiring is necessary for normal line spacing, but extra spacing can be obtained through control-panel wiring.

EJECTION

Ejection consists of moving a completed form from the printing position in the bill feed and inserting another in its place. Ejection occurs at accounting-machine speed, so that no accounting-machine time is lost.

SKIPPING

Skipping is the term applied to the movement of the form, over one or more line spaces, to a predetermined position within the form. Only one skip is possible on each form. No machine time is lost in skipping operations. If the skip is used to cause the printing of a total in a specific position, the form is usually ejected after skipping to, and printing on, the predetermined-total line. However, the skip can be used to move from the heading to the first line of the body of the form where several lines are to be printed after the skip. On a non-comparing bill feed, if items are to be listed both before and after skipping, a maximum of ¾ inch of printing can occur both before and after the skip. The number of lines of printing varies with the setting of the line-space adjustment stud, but when the bill feed is set for six lines to the inch, four lines (including blank spaces) can be printed before and after the skip. On a comparing bill feed, only one line
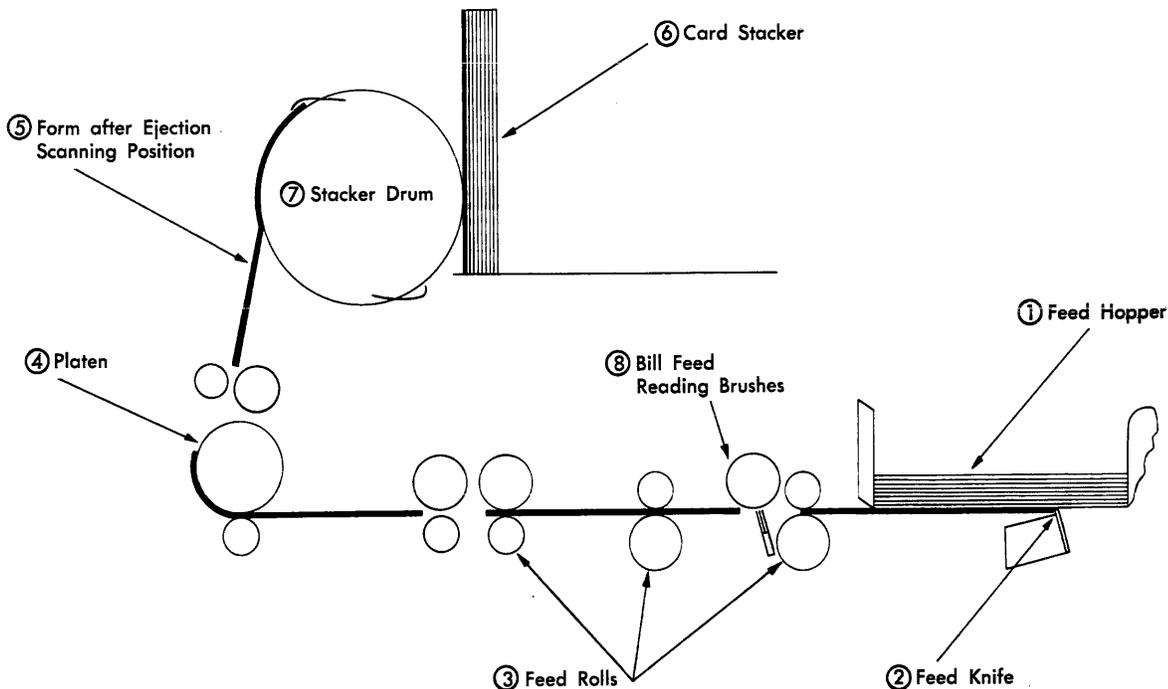

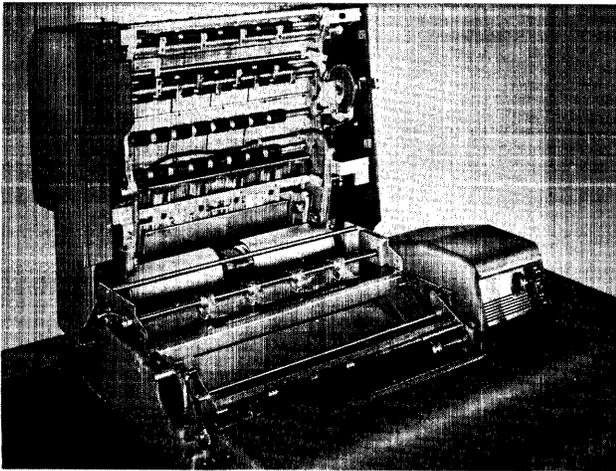Figure 97. Schematic of Form Feeding

Figure 98. Bill Feed Raised, Tape-Controlled Carriage in Use

can be printed after a skip. If this is a total line, followed by an ejection, the operation can be readily performed. If the skip occurs during a list cycle, however, sufficient counter capacity must be available to store the reading from the bill-feed card. With a bill feed equipped with high-low passing control, skipping to a total line is acceptable but skipping during a list cycle cannot be done.

Operating Procedure

ENGAGING THE BILL FEED

On an accounting machine equipped for operation with both a tape-controlled carriage and a bill feed, the bill feed is tilted back while the carriage is in operating position (Figure 98). When the bill feed is to be used, the carriage can be tilted up on the right end, using the carriage-lifting device, and the bill feed can be engaged (Figure 99), as outlined here.
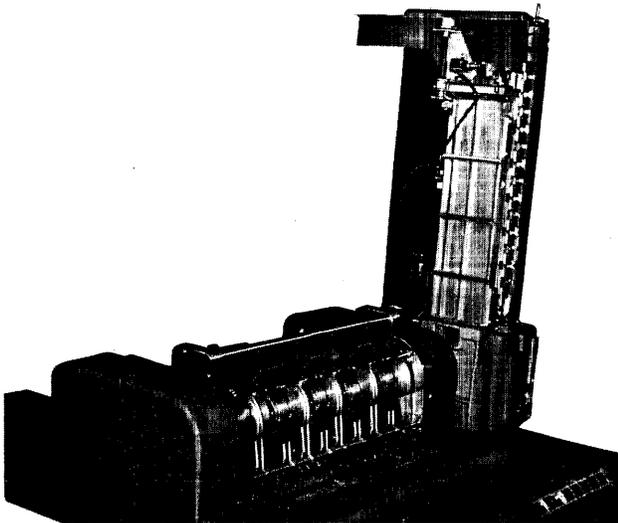
Figure 99. Bill Feed Lowered, Carriage Raised

To tilt the carriage:

1. Run all cards out of the accounting machine.

2. Turn off the main-line switch.

3. Move the carriage to the left as far as it goes, so that the right end clears the machine cover when the carriage is tilted up.

4. Pull the carriage interlock lever on the accounting machine forward as far as it goes to permit raising the carriage. This lever is located at the left end of the typebars under the machine cover (Figure 100). (When the carriage is to be used, this lever must be pushed back to make the carriage operative.)

5. Crank the carriage up until it locks in a vertical position, using the crank provided. The crank is inserted in the opening in the machine cover below the signal lights; it is turned clockwise to raise the carriage, and counterclockwise to lower it. (Before the carriage can be lowered, the red locking lever must be released by swinging it to the left.)

The bill feed can then be engaged as follows:

1. Place the bill-feed support bar (Figure 100) in position immediately behind the typebars and screw it onto the machine frame. On top of each end of the support bar is a button, and when the bill feed is lowered, it rests on these buttons. The support-bar assembly also includes two latches that hold the bill feed in operating position, and a lever on the left end that releases the latches in order to raise the bill feed (Figure 100).

2. Make sure there are no forms in the bill-feed hopper. Set the bill-feed index (Figure 94), which
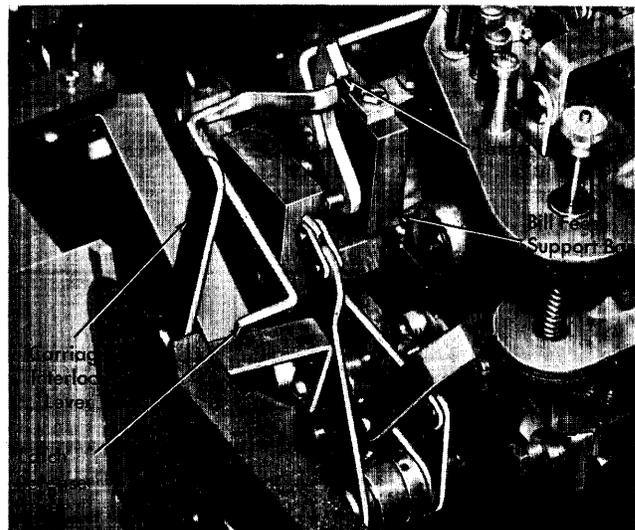

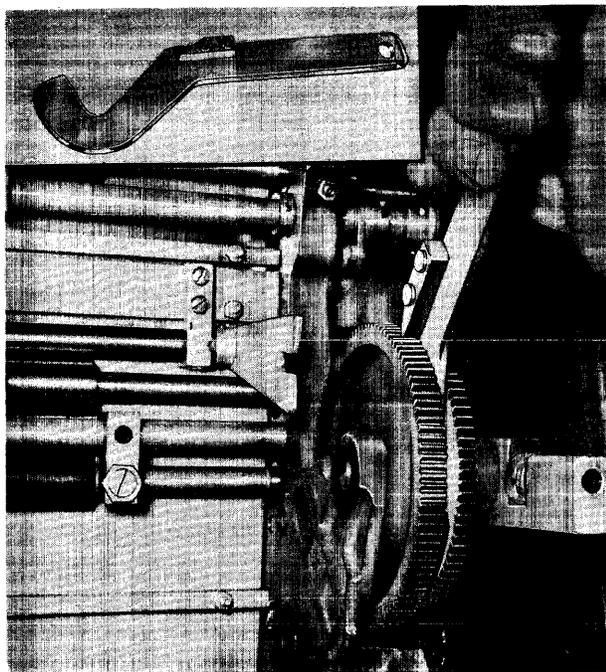Figure 100. Carriage Interlock and Bill Feed Latch Assembly

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Figure 101. Setting Bill Feed Index

is accessible when the right side cover of the bill feed is open. The proper setting of the index varies from one bill feed to another. Consult an IBM customer engineer to determine the setting for each bill feed. The usual setting is 6 degrees or 186 degrees. The index is set by turning the first-printing-line crank mechanism counterclockwise to advance the index until the proper position lines up with the scribed line on the index pointer above. Use the hand lever wrench (Figure 100) to turn the mechanism to the desired index.

3. Unlatch the bill feed by pulling out the release button (Figure 94) located under the right side cover, toward the rear of the bill feed. Then pull the bill feed down slowly.

4. As the bill feed is lowered, make sure that the forked lever (Figure 102), which extends down from the bill feed, engages the line-space lever. The fork should straddle the small stud that extends inward from the end of the line-space lever. The forked lever can be moved forward or backward to place it in position to engage the line-space-lever stud.

5. Make sure that the bill feed is lowered as far as possible and is latched in operating position, so that it cannot be raised without lifting the release lever on the left end of the support bar (Figure 100). If the bill feed cannot be lowered far enough to latch into position, the gears probably are not meshed. In this case, raise the bill feed

and turn the first-printing-line crank mechanism slightly to change the position of the bill-feed gears. When the bill feed is then lowered, the gears should mesh so the bill feed can be latched into position.

6. Check the timing of the index; check that the forked lever has engaged the line-space lever.

7. Turn on the main-line switch, press the START key several times, and check the index each time. From the front of the machine, the index can be readily observed on the index idler-wheel (Figure 94).

Like the setting in step 4, the position at which the index should stop at this time varies, and the proper position should be determined from an IBM customer engineer. At this time, after the START key has been pressed but cards have not been fed, the index should stop at 340 degrees on most bill feeds. If it does not stop at the correct position, turn off the main-line switch, raise the bill feed, and set the index at 340 degrees. Then lower the bill feed, turn on the main-line switch, and again press the START key and check the index.

Figure 102. Bill Feed Partially Lowered

OPERATING THE BILL FEED

With the bill feed in position and adjusted for printing:

1. Place cards in the hopper of the accounting machine.
2. Place forms in the hopper of the bill feed, face down, top edge toward the throat.
3. Press the START key and hold until machine feeds automatically.
4. If the forms in the bill-feed hopper fail to feed, or if the hopper becomes empty, card feeding in the accounting machine automatically stops. After the bill-feed hopper is replenished, form feeding in the bill feed is started again by pressing the accounting machine START key. As a form is fed against the platen, card feeding in the accounting machine then automatically starts and normal operation continues.
5. If the accounting-machine card-feed hopper becomes empty, form feeding in the bill feed stops until cards have again been fed into the reading position of the accounting machine in the normal manner.

DISENGAGING THE BILL FEED

To raise the bill feed and lower the carriage:

1. Pull the carriage interlock lever forward as far as it goes (Figure 100).
2. Raise the support-bar-latch release lever.
3. Lift the bill feed slowly and lock in the upright position.
4. Loosen the line-space-lever pivot stud and swing the spacer bar down.
5. Unscrew and remove the support bar.
6. Crank down the tape-controlled carriage.
7. Lock the carriage in place by pushing back the carriage interlock lever.

Optional Devices

EQUAL-UNEQUAL COMPARING DEVICE

This comparing device is designed to assure that all cards of a control group print on the correct bill-feed card, the first card of each group is compared to the bill-feed card, and then all the following cards of the group are compared to each other by the normal control wiring on the accounting-machine control panel.

If, at the time of a control change in the card feed, the bill-feed card and the card-feed card do not match, the machine stops, and the red error light goes on. The cards must be removed from both hoppers, those in both feeds must be run out, and the discrepancy lo-
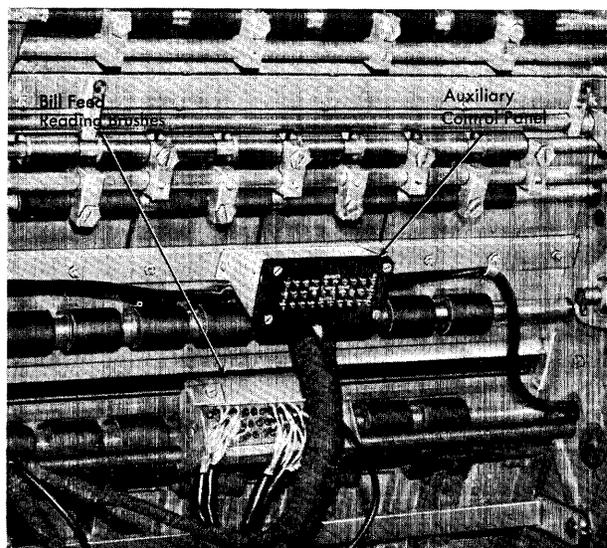
Figure 103. Reading Brushes and Auxiliary Control Panel

cated, before the operation can be resumed. To prevent printing when running out error cards from the card feed, the NON-PRINT RUN-OUT button should be used.

Reading Brushes. The punched cards are fed face down, 12-edge first, and are read by a set of 45 brushes (Figure 103) mounted on the bill feed (see *Schematic of Form Feeding,* Figure 97). The brush holder can be positioned to read any 45 adjacent columns of the card. Once the brush holder has been set, it should not be moved. A second holder of 21 brushes (optional) is needed if any two bill-feed card columns, not within the 45-column span, are to be read in either the same or another operation. If two brush holders are adjusted as close together as possible, the separation between brush 45 of the first holder and brush 1 of the second is equal to the width of nine columns. When column 1 or 80 is used for comparing, the edge of the card must be $\frac{7}{16}$ inch from the side frame for mechanical clearance.

Auxiliary Control Panel. Numerical control information read by the bill-feed brushes can be made available for controlling the accounting machine by wiring an auxiliary control panel, located underneath the bill-feed mechanism (Figure 103). The panel contains the following hubs:

    20 bill-feed brushes — 10 standard
    10 storage entries — 5 standard

With the standard equipment, any five of the first ten bill-feed brush outlets can be wired to the first five storage-entry positions on the auxiliary control panel. With this wiring, the bill-feed control information is available at the corresponding storage-exit hubs in the accounting-machine control panel.
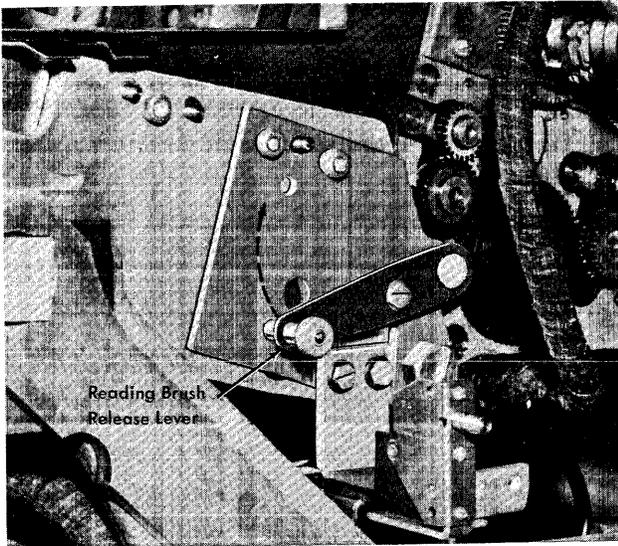
Figure 104. Reading Brush Release Arm

Reading-Brush Release Arm. Machines equipped with this comparing device have a lever (Figure 104) that positions the bill-feed reading brushes against the contact roll. When the brushes are not in use, the arm should be locked in the upper socket to prevent unnecessary wear on the brushes.

High-Low Passing Control

A bill feed equipped with equal-unequal comparing can be equipped also with high-low passing control to pass unmatched cards. This device provides automatic control between the punched card in the card feed and the punched card in the bill feed, by testing for a high, low, or equal bill-feed condition. When the comparison is not equal, the feed containing the higher card stops, and the feed containing the lower card continues to operate until its reading becomes equal. Thus, with the file of cards in one feed hopper complete and that in the other incomplete, the extra cards in the complete file are passed so that information is printed on the correct bill-feed card. This type of passing is readily adaptable to ledger posting.

Passing in one feed only (either bill feed or card feed) can be accomplished with full protection if one file is known to be complete. For example, in an operation requiring passing in the bill feed with the bill-feed file complete, the passing is controlled on a low bill-feed reading, and a high bill-feed reading should never occur. If it does occur, the high reading is due to an error in card arrangement in either of the two files, and can be wired to stop card feeding.

When card feeding stops, the cards must be removed from both hoppers and those in both feeds must be run out. The cards both before and after the error should be investigated because the high reading is merely an indication that there is some error.

In an operation requiring passing in the card feed with the card-feed file complete, the passing is controlled on a high bill-feed reading, and a low bill-feed reading should never occur. If it does occur, the low reading stops card feeding. This type of passing is advantageously used in an addressing application.

When card feeding stops, the cards must be removed from both hoppers and those in both feeds must be run out. The cards both before and after the error should be investigated, because the low reading is merely an indication that there is some error.

All operations performed on the comparing and passing bill feed installed on the IBM 403 Accounting Machine must be planned so the cards are grouped in one of these ways:
1. All cards are non-MLP cards.
2. All cards are MLP cards.
3. MLP cards and normal cards, with all MLP cards first in each control group.
4. MLP cards and normal cards, with all normal cards first in each control group.

Folded-Form Feeding Device

The folded-form feeding device for the IBM 916 Bill Feed permits feeding folded forms, such as policies or circulars, having a folded thickness greater than .016 inch but not over .046 inch. With the device installed, all normal functions of the standard bill feed are applicable. However, any boxed-off printing positions on the form should have a liberal allowance of space, because precise printing positions are affected by variations in the folds.

The forms should be machine-folded, and both the leading and trailing edges of the forms should be folds. The forms should be so folded that when they are placed in the hopper, with the area to be printed down, the open edge is on top.

Refer to the IBM 916 Bill Feed manual for specifications.

Review Questions

1. What is the purpose of the bill feed?

2. What is the function of the stacker contact?

3. State the use of the three positions of the pressure-release lever.

4. How is the position of the first printing line adjusted.

5. Explain the use of the line-space adjustment.

6. How is printing adjusted for a specific line?

7. What are the normal settings of the bill feed index? How is it adjusted?

IBM 407 Accounting Machine

The IBM 407 Accounting Machine (Figure 105) operates automatically both in feeding cards and in printing results. Information punched in cards can be read, added, subtracted, compared, selected, and printed at the rate of 150 cards per minute. If all typewheels are used in printing, 18,000 characters can be printed in one minute. Complete flexibility is provided in the arrangement of printed data on the report form, and summary cards can be punched simultaneously with the preparation of reports. The machine is also capable of multiple-line reading (MLR).

OPERATING FEATURES

Control Panel

The control panel controls reading information from the card and printing information in the desired locations on the report form. The control panel is inserted in a rack provided for it on the right end of the machine (Figure 106).
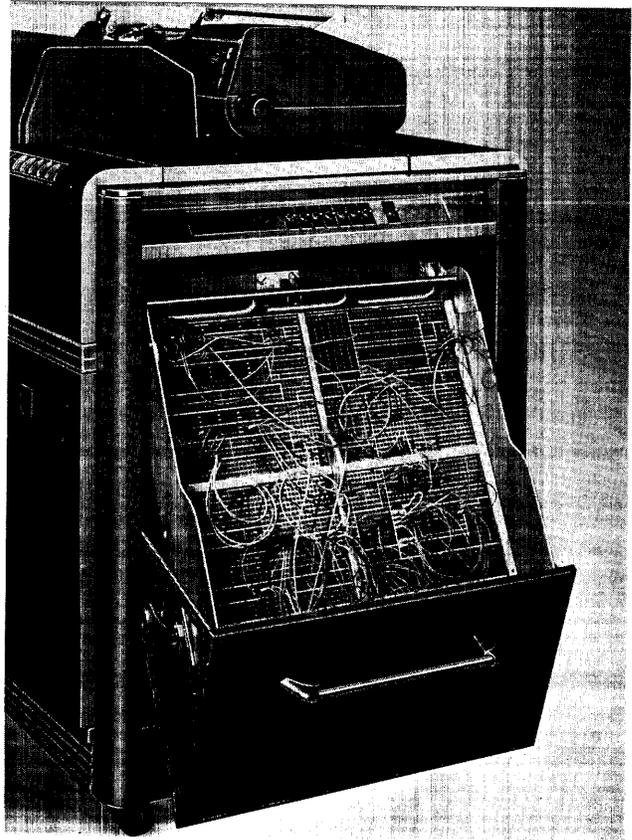
Figure 106. Control Panel Inserted in the Machine
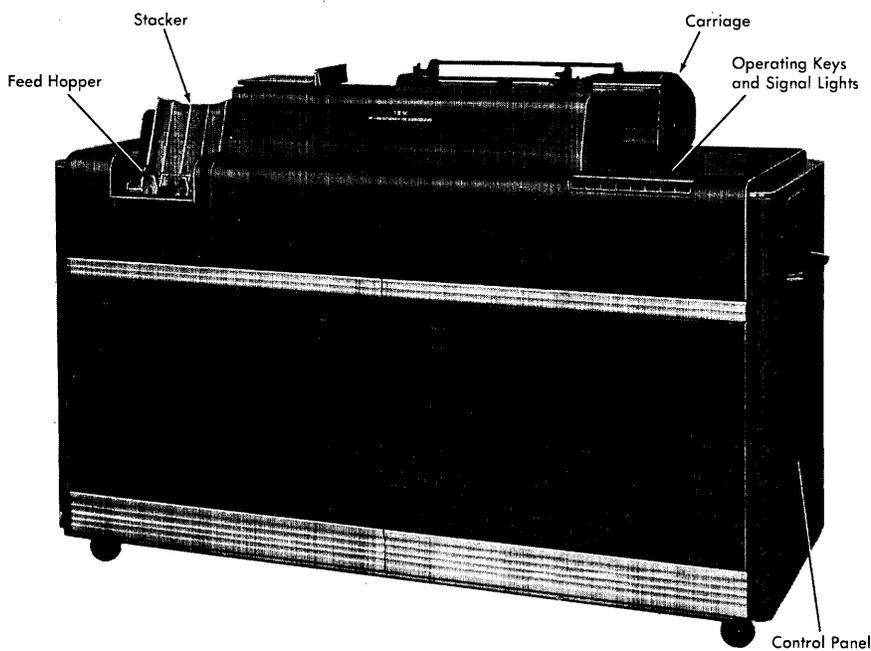
Figure 105. IBM 407 Accounting Machine
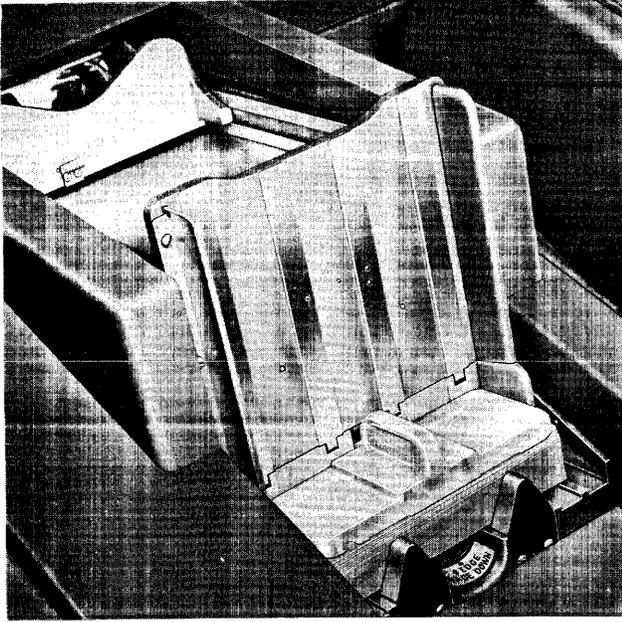
Figure 107. Hopper and Stacker

Hopper and Stacker

The card-feed hopper and stacker (Figure 107) are located at the left of the print unit. Cards are placed in the hopper, face down, with the 9-edge toward the throat. Cards are fed from the hopper into the machine, by feed knives, and are then fed by feed rollers through the machine to the stacker, located above and behind the hopper. The hopper holds about 1,000 cards. If the hopper becomes empty during automatic operation of the machine, card feeding stops.

At the end of an operation, the cards in the machine can be run out by pressing the START key. This is unnecessary if the control panel has been wired for automatic runout.

Cards can be added to the hopper and removed from the stacker without stopping card feeding. A stacker switch automatically stops card feeding when the stacker is full.

Machine Controls (Figure 108)

MAIN-LINE SWITCH

The main-line switch, located at the left end of the machine, must be ON to operate the machine. This switch should not be turned off while cards are feeding, or during any other machine operation.

START KEY

The START key must be pressed to start feeding cards through the machine. It is also used to turn off the FORM light and the AUTO STOP light.

STOP KEY

Pressing the STOP key stops card feeding before the next card is fed from the hopper. This key is also used to turn off the CARD FEED STOP light.

FINAL TOTAL KEY

The FINAL TOTAL key is used to print final totals manually, if they are wired on the control panel. Before final total prints:
    a. The Final Total switch must be ON.
    b. The last card must be run out of the machine.
    c. The machine must be idling.

CARD FEED STOP LIGHT

The CARD FEED STOP light goes on whenever a card in the hopper fails to be fed, or a card in the last reading station fails to be stacked. It also goes on during a summary-punch operation, if the summary punch fails to feed a card or if the summary-punch hopper becomes empty.

This light can be turned off by the following procedure if a card-feed failure has occurred in the accounting machine:
    1. Remove the cards from the hopper and correct the bottom card that failed to feed.
    2. Replace the cards in the hopper.
    3. Press the STOP key to turn off the light.
    4. Press the START key to resume operation.

The cards are then fed normally without interruption of the normal control or spacing operations.

This light is on when the summary-punch hopper is empty; it can be turned off by replenishing the hopper, and pressing the START key.

FORM LIGHT

The FORM light goes on and card feeding stops when the last form is within 13⅝ inches of the platen, provided the Form-Stop toggle switch is ON. This light is turned off by inserting a new form and pressing the START key.

AUTO STOP LIGHT

The AUTO STOP light goes on whenever card feeding stops because of control-panel wiring. This light can be turned off and the operation resumed by pressing the START key.

FUSE LIGHT

The FUSE light goes on and card feeding stops when a fuse burns out. The fuses are located on the lower
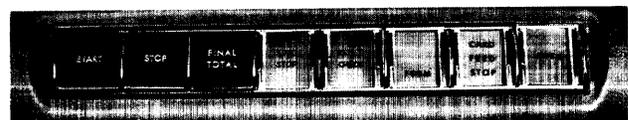

Figure 108. Operating Keys and Signal Lights

left side of the machine. This light remains on until the fuse has been replaced and the start key pressed.

Light (Unlabelled)

This light (the upper half of the form light) is on when the main-line switch is on and the machine is idling.

Reset Check Light

The reset check circuit is designed to determine whether counters in the machine are reset correctly. The circuit is controlled by a Reset-Check toggle switch. If this switch is off the test circuit is made inoperative, and the reset check light flashes during machine operation to call attention to the fact that the test circuit is inoperative. If the switch is on, this light goes on and card feeding stops upon detection of an error as a result of an incorrect reset. A reset error is generally caused by improper counter wiring.

Reset Check Indicators

These lights, located beside the reading stations under the cover (Figure 110), operate in conjunction with the reset check light, to indicate which counter group failed to reset properly.

Print Unit

Printing is accomplished by 120 printwheels arranged in a solid bank. These print within a width of 12 inches, 10 characters to the inch. The print wheels are all the same and consist of 47 separate character positions:

10 digits: 0 through 9
26 letters: A through Z
11 special characters: / $ □ * % @ & — # . ,

Functional Switches (Figure 109)

Alteration Switches

These switches enable the control panel to be used for several different types of operations, without changing the wiring. The switches function in both positions, transferred (T) or normal (N).

Inverted-Form Switch

This switch must be on whenever inverted forms are being run. Inverted forms are those in which detail cards are printed before the heading cards. The switch must be off for running conventional forms.

Final Total Switch

With this switch on, final totals can be manually printed by pressing the final total key, provided the control panel has been wired for final totals, all cards have been stacked, and the machine is idling. It also permits a run-out final total to print automatically when the control panel is wired for this operation.

With the Final Total switch off, neither final totals nor run-out final totals can be taken, and the final total remains in the machine indefinitely and may subsequently cause an erroneous total if the counters are not reset.

Form Stop Switch

With this switch on, the form stops located at the back of the carriage bed are operative, and stop card feeding when the last form is within 13¾ inches of the printing line. With this switch off, the form stops are inoperative.

Reset Check Switch

The purpose of this switch is explained under reset check light.

MACHINE FUNCTIONS

The ibm 407 Accounting Machine can be set up to perform the following main functions:

Detail Printing

Detail printing (listing) is printing information from each card as it passes through the machine. Information can be selectively printed or printed anywhere
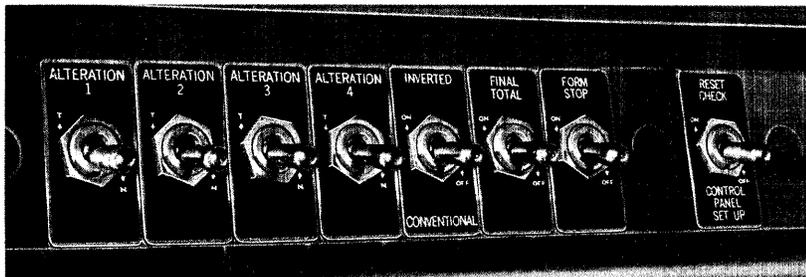

Figure 109. Functional Switches

on the form, according to control-panel wiring. The rated speed of this operation is 150 cards per minute.

Accumulating

Amounts punched in cards can be added or subtracted selectively according to control-panel wiring, to give a crossfoot total for a single card, or to give subtotals or a group total for successive cards.

Group Printing

Group printing (tabulating) is the operation in which information on each card is automatically accumulated but not printed. The only information printed is indicative data, sufficient to identify the group of cards and the totals for each group of cards. The rated speed of this operation is 150 cards per minute.

Programming

Programming is the function by which the machine can distinguish the cards of one group from those of another, so that individual group totals can be printed. There are three classifications of program control: minor, intermediate, and major. For example, if automatic totals are desired by states, counties, and cities, state is the major group, county is the intermediate group, and city is the minor group.

Summary Punching

Summary punching is automatic recording of summary or total information in cards, in the form of punched holes. For example, when an inventory report is prepared on an accounting machine, it can be set up to show, by each type of product or material, the balance on hand at the first of the month, the receipts and issues during the month, and the balance on hand at the end of the month. During the preparation of this report, totals are printed by each type of product, and this information can be automatically punched into summary cards. Information is transmitted from the accounting machine to a summary-punch machine through a summary-punch cable that connects the two machines. (See section on *Automatic Punches* — IBM 514, page 101.)

Summary punching can be performed either in a detail- or group-printing operation. All information to be summary punched is controlled by the control panel in the accounting machine and also the one in the summary punch.

Before a summary-punch operation can start, two cards must be fed from the summary-punch feed hopper. Card feeding stops in both the accounting machine and the summary punch, and the CARD FEED STOP light goes on, when a card fails to feed in either machine, when the punch hopper becomes empty, or when a card is not fed to the stacker in the accounting machine.

OPERATING PROCEDURE

1. Make sure that you understand the operation to be performed. If in doubt, ask your supervisor for complete details of the operation.
2. Plug the power cord into the proper voltage source.
3. Insert the proper control panel in the rack and close it tightly.
4. If summary cards are to be punched, connect the summary-punch cable to the accounting machine, and insert the summary-punch control panel in its rack.
5. Set the control switches according to the instructions for the particular report being run.
6. Turn on the main-line switches of both machines, if summary-punching. Also, if summary-punching, feed two cards into the summary punch.
7. Insert the proper report form and position it correctly. (See section on the *Tape-Controlled Carriage*, page 76.)
8. Joggle and place the cards in the hopper, face down, 9-edge toward the throat.
9. Make a test run. Any errors in the test run should be brought to the attention of the supervisor. If the test is satisfactory, you are ready to start the operation.
10. Load the hopper (not too full) with the cards to be processed; place the card weight on top, and begin the operation.
11. Store the cards from the stacker in the proper receptacles.
12. When the report is finished, turn off the main-line switch and give the completed report to the supervisor.
13. File the processed cards according to instructions.

OPERATING SUGGESTIONS

Starting the Operation

Cards must be joggled and arranged in perfect alignment before being placed in the hopper, face down, 9-edge toward the throat.

Hold the START key down for at least two card-feed cycles to start automatic feeding.

A short test run should always be made to make certain that the report form is properly positioned in the carriage. (To position the form correctly, see the section on the *Tape-Controlled Carriage*, page 76.) The test should prove that the control panel is properly wired to handle every situation that occurs throughout the operation. This includes control of the counters, and other special conditions indicated on the cards by X's or other types of control punching. The test deck used by the operator is usually made by the person who analyzed the requirements of the report and wired the control panel.

Never attach the connector cable of a summary-punch machine to an accounting machine unless the main-line switches of both machines are OFF.

During a run, watch the control information occasionally to see that the totals print at the end of each control group. It is good practice to check periodically the total of items listed. Use small groups of four or five items for this visual check.

Handling Cards

Cards can be added to the hopper and removed from the stacker without stopping card feeding. However, if less than one inch of cards remains in the hopper at the time of reloading, card feeding should be stopped. If this is not done, cards may fail to feed because of insufficient weight when the card weight is removed.

In handling cards, be careful that cards that have gone through the machine are stacked in the proper containers, and kept separate from the cards that are to go into the hopper. Carelessness in handling either group of cards leads to confusion and inaccurate reports.

Stopping the Operation

Never turn off the main-line switch to stop card feeding. Use the STOP key. When a report is completed, run the cards out of the machine by pressing the START key, if the control panel is not wired for an automatic run-out. If a final total is to be taken, press the FINAL TOTAL key (Final-Total switch ON).

Card-Feed Failure

When a card fails to feed, the steps listed under *Card-Feed Stop Light* should be followed to correct the situation. Should a card fail to be stacked, or a jam occur in the card bed, the cards can be removed by first pressing the stacker lock, then raising the stacker itself (it swings toward the back of the machine as in Figure 110), and raising the brush holder (it swings toward the front of the machine as in Figure 111). The cards can then be easily removed from the machine by hand.

The brushes, which normally protrude slightly below the brush holder, recede into the holder when it is in a raised position, thus preventing any possible damage to the brushes.

Replacing the Ribbon

When a new ribbon is installed make sure the leading end of the ribbon is securely hooked on the empty spool. Wind enough ribbon around the empty spool so that the metal eyelet is between the spool and the ribbon-reversing lever. Thread the ribbon around the guide rollers as shown in Figure 112.

Checking for a Reset Error

If the machine is not equipped with a reset-check indicator panel, the cards in the machine must be run out before the error can be found and corrected. To run out the cards:

1. Remove cards from the hopper.
2. Press the START key to run cards out of the machine. At this time re-programming occurs, and the counters are reset a second time. The machine continues to run.
3. To stop the machine, press the STOP key. The RESET CHECK light may or may not go off.
4. If the light goes off, it means that all cards are out of the machine and are in the stacker.
5. If the RESET CHECK light is still on, there are still cards in the machine. To run them out it is now necessary to:
   a. Turn off the Reset Check switch.
   b. Press the START key and run the cards out into the stacker.
   c. Press the STOP key to stop the machine. The RESET CHECK light goes off when the machine stops.
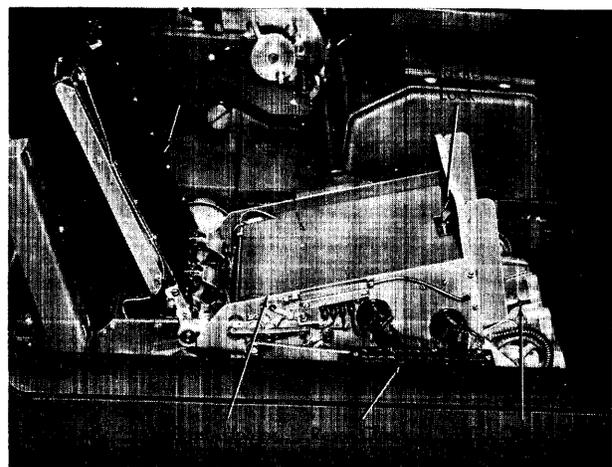6. Call the supervisor to find the counter error.
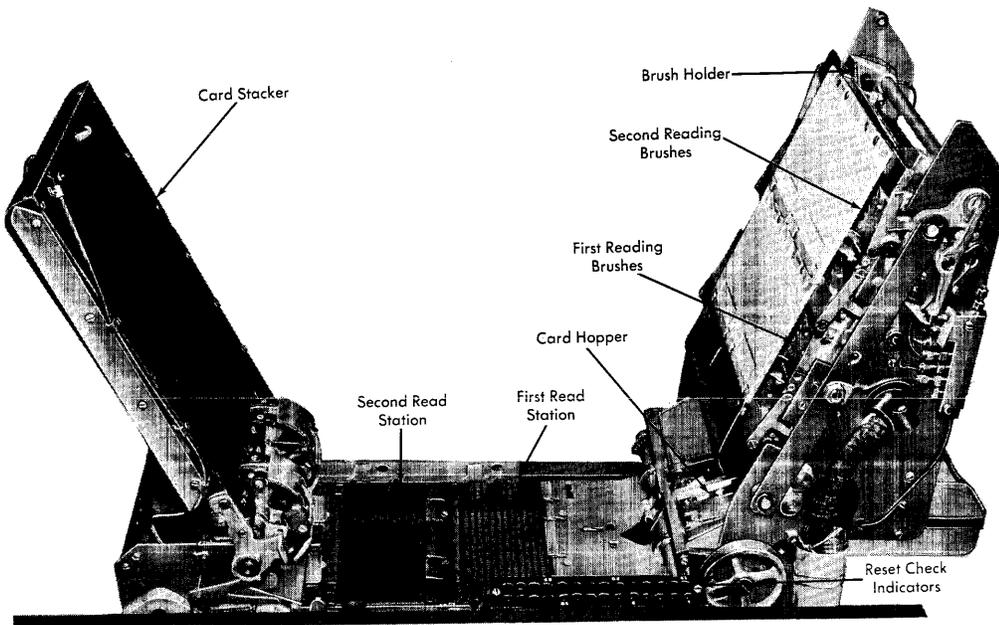

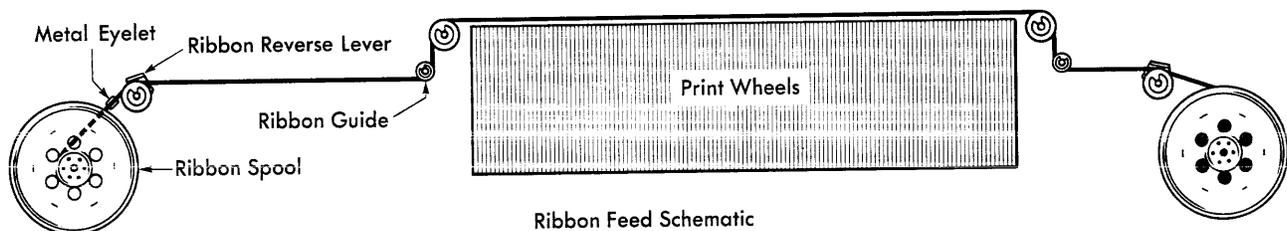Figure 110. Stacker Raised

Figure 111. Brush Holder Raised

Ribbon Feed Schematic

Figure 112. Schematic of Ribbon Feed

REVIEW QUESTIONS

1. What is the purpose of the IBM 407 Accounting machine?

2. What functions other than printing can this machine perform?

3. At what speed does the IBM 407 operate?

4. Where is the control panel inserted?

5. What happens when the last card leaves the hopper?

6. Is it possible to add cards in the hopper while the machine is running? Remove cards from the stacker?

7. Can a final total be taken automatically? Manually? How?

8. Name the six lights and describe the purpose of each.

9. How many printwheels does the IBM 407 have? How many can print both alphabetic and numerical information?

10. How many different special symbols can be printed from a printwheel? What are they?

11. Explain detail and group printing.

12. What is programming?

13. Name four types of automatic totals.

14. Assume the CARD FEED STOP light is on. Describe the procedure to turn it off.

15. Describe the procedure to turn off the RESET CHECK light.

16. What is the purpose of the alteration switches?

17. What is summary punching?

18. How is information in the accounting machine transmitted to the summary-punch machine?

19. If cards are placed in the hopper of both the accounting machine and the summary punch, and the accounting machine does not start when the START key is pressed, what is most likely the reason?

20. Do cards automatically run out of the machine into the stacker when the report is completed?

IBM 922 TAPE-CONTROLLED CARRIAGE

Mechanically and functionally the IBM 922 Tape-Controlled Carriage is the same as the IBM 923 but is used on the IBM 407 Accounting Machine. Only operational differences are explained in this section. Otherwise the information under IBM 923 applies to both carriages. (See page 71.)

Operating Features

The following operating features differ from those in the IBM 923 as described.

FORM STOPS

The form stops, located at the back of carriage bed, stop card feeding when the carriage runs out of paper, provided the Form-Stop switch is ON. The distance between the form stops and the printing line is about 12⅝ inches. This carriage has no paper brake.

PLATEN SHIFT WHEEL

The platen can be shifted, laterally, a total of four inches by turning the platen shift wheel (Figure 113).

FORM-THICKNESS ADJUSTMENT

The distance between the print wheels and the platen is adjustable, for thickness of paper stock or for varying number of copies, by the form-thickness adjustment at the left side of the carriage (Figure 113). This device contains seven positions numbered 0 through 6. When the dial is in the 0 position, the print wheels are ⅛ (.125) inch from the platen. Each of the remaining six positions add to the ⅛-inch distance by approximately the thickness of 1½ cards. When the dial is set to 6 the distance is increased to approximately .178 inch. The dial should be set wherever the best results are obtained. To adjust for varying thicknesses, the dial lock is pulled out and turned to increase or decrease the distance between the platen and the print wheels.

Operating Procedure

1. Turn the PLATEN CLUTCH knob to disengage the platen.
2. Raise the cover of the carriage.
3. Raise brushes by a slight pressure on the latch.
4. Remove the tape by raising the lever on the notched bar and moving the lever slightly to the left. The tape then slides off the half-circle guide pieces and the pin-feed drive wheel.
5. Insert new tape as follows:
   a. Hold the tape so that the printed captions can be read.
   b. Loop one end over the pin-feed drive wheel so that the pins engage the center drive holes.
   c. Place the opposite end of the loop around the nearest half-circle guide piece.
   d. Remove excess slack by lifting the lever away from the notched bar and moving the guide piece to the right. The tape should be just tight enough so that it gives slightly when pressed together.
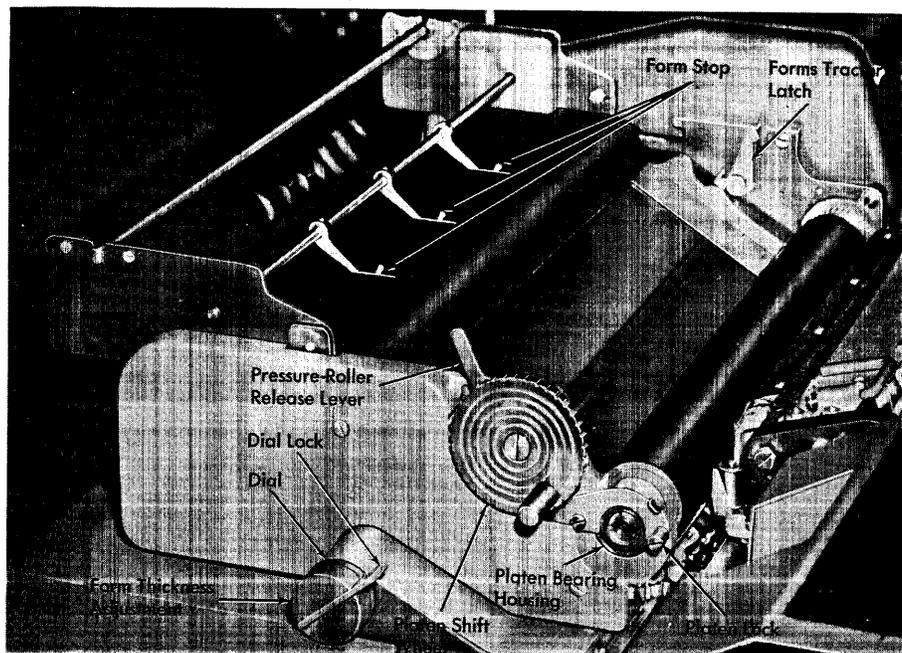6. Clamp the brushes in position.

Figure 113. Left Side of Carriage

7. Close the cover.

8. Press the RESTORE key.

9. Push the pressure-release lever back.

10. Feed the forms from the back of the machine, under the form stops and under the platen, until the end of the form can be grasped by the hand.

11. Adjust and align the form according to the type of form-feed device used. If no form-feed device is used, straighten and align the form around the platen.

12. Pull the pressure-release lever forward if the pin wheels are not used; otherwise, leave it back.

13. Press the RESTORE key once more.

14. Turn the PLATEN CLUTCH knob to engage the platen.

15. Press the START key to begin the operation.

Operating Suggestions

INSERTING THE TAPE

The platen clutch should be disengaged (knob turned to the right) while the tape is being inserted in the carriage, and especially when the RESTORE key is pressed.

The tape must be inserted in the carriage so the printed captions can be read. After inserting the tape, excess slack should be removed. The tape should be just tight enough so that it gives slightly when the top and bottom portions of the loop are pressed together.

Be sure that the brushes are clamped in position after the tape is inserted. If the brush holder is not latched, the tape runs continuously when the RESTORE key is pressed, or when the first skip occurs.

Tapes should never be folded, because the tape tends to overlap at the creases when traveling around the pin-feed drive wheel.

When the carriage is not in use, the brushes should be clamped tightly against the pin-feed drive wheel.

INSERTING THE FORMS

Be sure that the form-thickness adjustment is set properly for the specific forms that are feeding through the machine. If it is set at notch 6 and single-sheet forms are being fed, printing may not take place because the platen is too far from the typewheels.

The pressure-release lever should be pushed back, whenever form feeding is accomplished by a pin-feed mechanism. It should be pulled forward when form feeding is accomplished by pressure rolls.

Be sure the forms are fed under the form stops, not over them.

OPERATING THE CARRIAGE

Do not use the STOP key on the carriage to stop card feeding in the accounting machine. Although this key does stop card feeding, it is not intended to be used in place of the regular accounting machine STOP key. Its purpose is to stop a carriage operation.

The platen cannot be turned backwards unless the platen clutch is disengaged.

Make sure that the carriage is restored and the platen clutch is engaged before beginning an operation. Failure to restore causes improper spacing; failure to engage the platen causes overprinting.

Review Questions

1. What is the purpose of the tape-controlled carriage?

2. How are single and double spacing controlled?

3. What is the purpose of the round holes in the center of the tape?

4. Which way should the tape face while it is being inserted in the carriage?

5. How are the brushes lifted away from the pin-feed drive wheel?

6. How tight should the tape be for most efficient operation?

7. Can a tape be used more than once?

8. In what direction must the PLATEN CLUTCH knob be pointing before the platen can be moved manually?

9. How is the carriage set at the start, or home, position?

10. What is the purpose of the form-thickness adjustment?

11. What happens when the last form passes the form stops?

12. In what position must the pressure-release lever be so that the paper can be moved freely around the platen?

13. The platen can be shifted laterally four inches to the left or right. How is this done?

14. What is the purpose of the vernier knob? When can it be used?

IBM FORMS TRACTOR

Two models of the IBM Forms Tractor are available for use with the IBM 922 Tape-Controlled Carriage:

The IBM F-2 Forms Tractor — 6- or 8-lines-per-inch spacing,

The IBM F-4 Forms Tractor — 6- or 4-lines-per-inch spacing.

The F-2 (Figure 114) is standard. The F-4 may be specified in place of, or in addition to the F-2. Forms Tractors for machines with serial number 407-16139-LW or higher, are not interchangeable with those for machines with a lower serial number. Within these groups IBM Forms Tractors are interchangeable.

Each of these devices is used for feeding marginally-punched continuous forms, and each has two adjustable tractor-type pin-feed units, one for each side of the form.

When installing the forms tractor on the carriage, position the carriage paper guides, located behind the platen, to the far left and right sides of the carriage. Then hook the rear pins of the forms tractor in the carriage slots and lower the front to lock in position.

Figure 114. IBM Forms Tractor

Spacing Adjustment

The F-2 provides spacing of 6 or 8 lines to the inch. The F-4 provides spacing of 6 or 4 lines to the inch. On the F-2 this adjustment is made by moving the shift cam until its pointer is positioned between the two scribed lines at either the 6 or 8 on the side frame (Figure 115). If the pointer cannot be positioned between the scribed lines, a tooth-on-tooth condition exists between the platen gear and the forms-tractor drive gear. In this case, move the shift cam to release the pressure on the 6- or 8-line drive gear and turn the platen slightly to allow the teeth to engage fully. A similar procedure should be followed when positioning the F-4 for 6- or 4-lines-per-inch spacing.

Regardless of the setting of the forms tractor (F-2 at 6 or 8 lines per inch, or F-4 at 6 or 4 lines per inch), the platen moves at 6 lines per inch. When the F-2 is spacing at 8 lines per inch, the platen has a tendency to move the back copies of a multicopy form faster than the original and front copies, even though the pressure-release lever is disengaged. For this reason, single spacing on the F-2 at 8 lines per inch is not recommended if the accuracy of line spacing is critical.

For spacing 8 or 4 lines per inch, the control tape is punched as it would be for normal spacing of 6 lines per inch. That is, each line on the tape always equals one line on the form regardless of whether the form
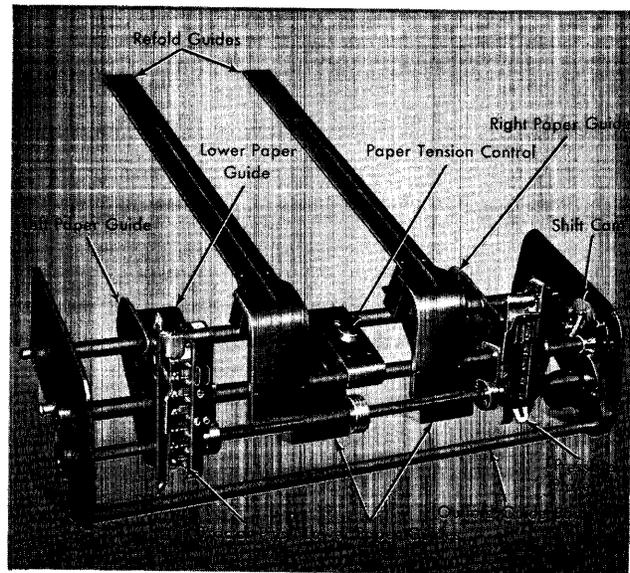
is to be printed 4, 6, or 8 lines per inch. However, in measuring a control tape for a document printed 8 lines to the inch, the tape cannot be matched line for line with the forms. Instead, each line on the tape represents $\frac{1}{8}$ inch on the form. Similarly, in spacing 4 lines per inch, each line on the tape represents $\frac{1}{4}$ inch on the form.

Normal spacing is 6 lines per inch. Variations that must be considered for spacing 8 or 4 lines per inch are illustrated in Figure 116.
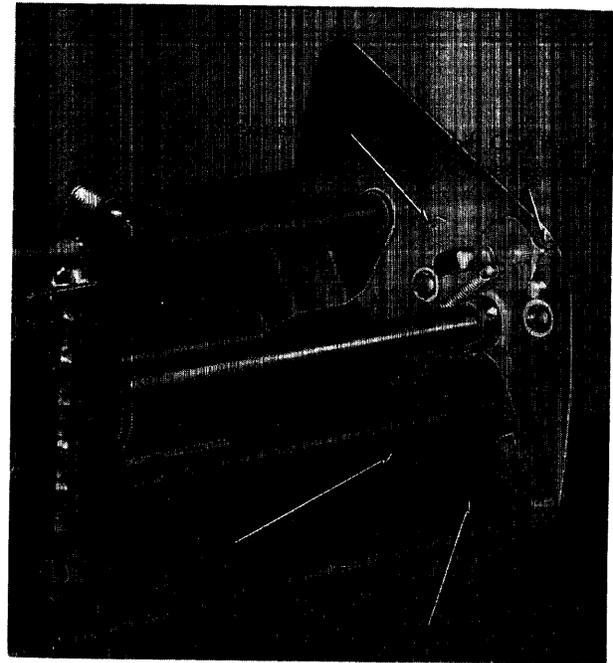

Figure 115. Spacing Adjustment

| | 6 LINES PER INCH | | 8 LINES PER INCH | | 4 LINES PER INCH | |
| | F-2 and F-4 | | F-2 | | F-4 | |
	Carr. Tape Lines	Distance on Form	Carr. Tape Lines	Distance on Form	Carr. Tape Lines	Distance on Form
Maximum Length of Form	132 Lines	22 Inches	132 Lines	16 1/2 Inches	132 Lines	33 Inches
Length of Form Compared with Length of Tape	———	Same	———	Form is 3/4 as long as one tape revolution	———	Form is 1 1/2 times as long as one tape revolution
Short Skip	12 Lines Maximum	2 Inches Maximum	12 Lines Maximum	1 1/2 Inches Maximum	12 Lines Maximum	3 Inches Maximum
Distance to Move First Printing Line Back from Indicator to Print	14 Lines	2 1/3 Inches	19 Lines	Approximately 2 1/3 Inches *	9 Lines	Approximately 2 1/3 Inches *

* Vernier adjustment may be necessary

Figure 116. Carriage Tape Specifications

Operating Features (Figures 114, 117)

TRACTOR ADJUSTMENT WHEELS

The tractor adjustment wheels can be turned to provide a ⅛-inch lateral movement of the tractors. These wheels make the tractor pins line up exactly with the center of the marginal holes in the paper after the paper guides have been set.

PAPER TENSION CONTROL

This device is adjustable, and exerts a slight pressure on the paper as it feeds through the Forms Tractor. Earlier Forms Tractors have a non-adjustable paper weight for this purpose.

OUTFOLD GUIDE BAR

The outfold guide bar fits across the front of the Forms Tractor as an aid in the feeding of forms. It can be removed easily by the operator, if desired.

REFOLD GUIDES

The refold guides provide support for continuous forms passing from the Forms Tractor for refolding on a forms stand at the rear of the machine.
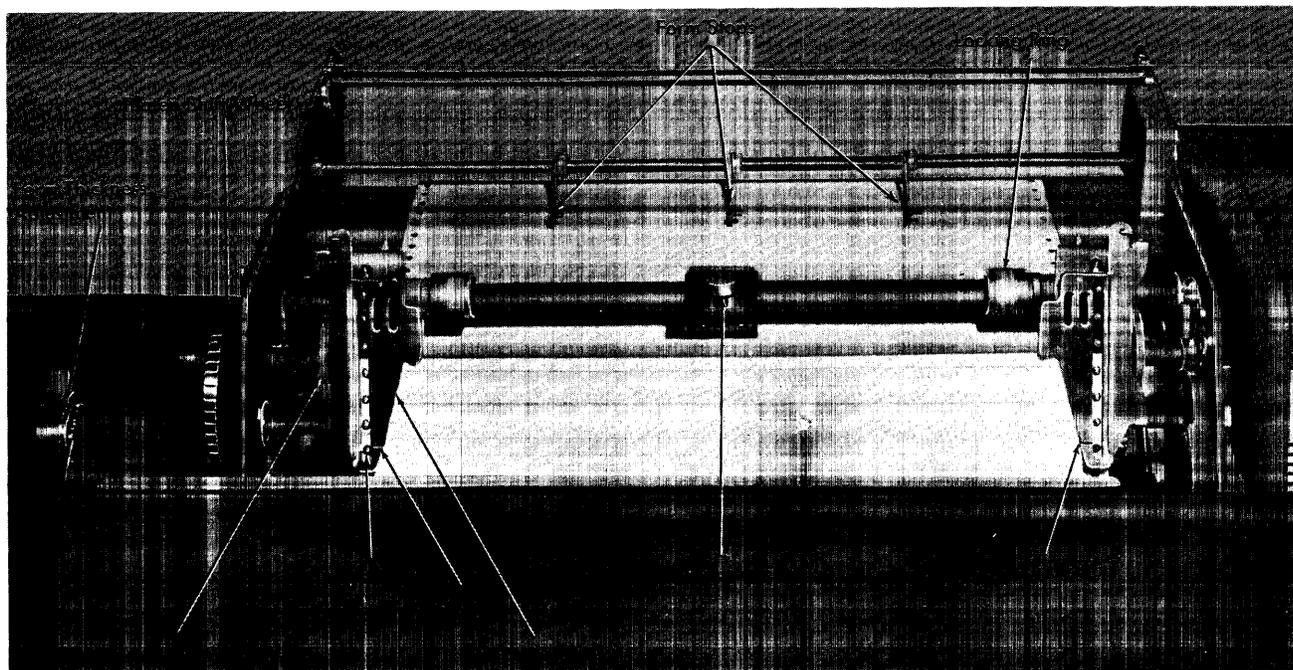

Figure 117. Carriage Ready to Operate

The carriage is equipped with a removable solid platen as a standard feature. Platen hardness requirements vary with the number of parts and type of paper in each form. The following platen hardnesses are recommended:

Hard platen (100 durometer), 2-part forms and over.

Medium platen (90 durometer), most single-part forms or very thin multiple-part forms.

If there is doubt as to the platen hardness required or to the quality of the carbon paper to be used, test runs should be made with sample sets of forms.

The platen can be removed by raising the platen lock on the left side (Figure 113) and lifting the platen from the bearing housing. When the platen is inserted, the end with the gear wheel should be dropped into the platen-bearing housing. The platen must then be moved to the right, turning it back and forth to fit the platen drive key into the carriage drive mechanism. The platen lock is then closed.

Figure 118 shows the platen being inserted into the carriage.
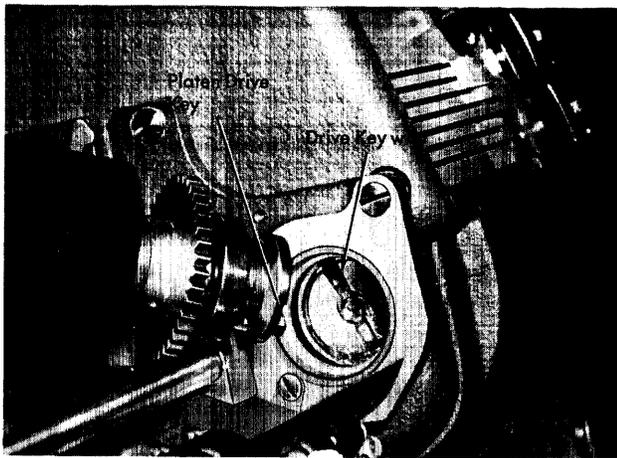
Figure 118. Inserting Platen

Operating Procedure

1. After the Forms Tractor is in position, disengage the platen clutch. Make sure that the platen and the Forms Tractor can be moved freely by hand.
2. If the form used is less than 7 inches wide, the center paper guide and paper-tension control may be removed.
3. Move the left lower paper guide and tractor slightly to the left of the first printing position. Place the first form between the left and right lower paper guides, and move the right guide in against the edge of the form. Allow a slight clearance, so that the form slides freely between both guides. Tighten both locking rings to hold the guide assemblies in place.
4. With the pressure rolls engaged, insert the form over the Forms Tractor paper guides, under the round rod, and then into the pressure rolls and platen. Turn the platen by hand (platen clutch disengaged) until the end of the form can be grasped.
5. Raise the pressure plates away from the tractor pins.
6. Release the pressure rolls, draw up the form, and position the pin-feed holes on the tractor pins.
7. Lower the pressure plates.
8. Set the form so that the first printing line is even with the first printing line indicator mark on the lower part of the pressure plates; then turn the form back fourteen spaces if spacing is set for 6 lines per inch, nineteen spaces if set for 8 lines per inch, and 9 spaces if set for 4 lines per inch. Finer adjustments can be achieved by use of the vernier knob.
9. Insert the control tape, restore the carriage, and engage the platen clutch. Figure 117 shows the carriage ready to operate.

Continuous forms can also be fed by a pin-feed platen instead of the standard IBM Forms Tractor. (See section IBM *Pin-Feed Platen Device,* page 79.)

Monontonous repetition is a characteristic of manual records. Records made on the same day must be dated identically. Records made at the same source must have identical location information. Likewise, information used at one point may be needed at another, requiring duplication of the same basic records. In some cases, partial changes to the original records must be made continually, in order to keep the records up-to-date. At times, entire files must be partially changed or duplicated.

When records are maintained in punched-card form, these repetitious operations can be performed automatically by machines known as automatic punches.

The principal operations performed by automatic punches are: reproducing, verifying, gangpunching, summary punching, mark-sense punching, and end printing. Some or all of these functions are performed by the three types of automatic punches:

1. Reproducing Punches (two feeds) — IBM 514, 519, 528, 549.

   Reproducing punches are designed primarily to copy, or reproduce, original files so that the duplicate, or second set, can be used for diverse operations without disturbing the original file.

2. Summary Punches (one feed)—IBM 523, 524, 526

   Summary punches are designed primarily to punch tabulated information from accounting machines into total or new-balance cards.

3. Card Read Punches (one feed)—IBM 521, 529

   Card read punches are designed primarily as the input-output units for calculating systems.
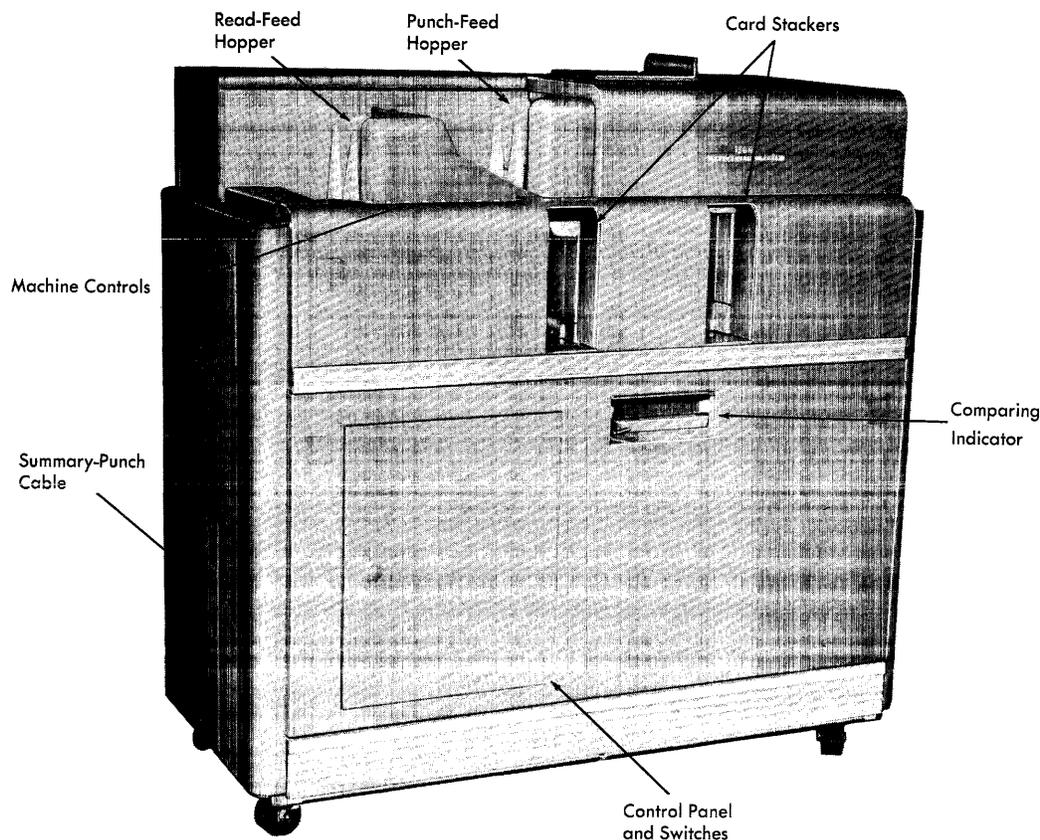
Figure 119. IBM 514 Reproducing Punch

IBM 514 Reproducing Punch

The IBM 514 Reproducing Punch (Figure 119) has two card-feed hoppers: a read-unit hopper at the left, and a punch-unit hopper at the right. In a reproducing operation, one unit of the machine reads previously punched cards, while the other unit punches blank cards that are to become copies of the original.

Because the card files (original and copy) are to remain separate, the machine also has two stackers that receive the processed cards, one for the cards fed through the read unit and one for the cards fed through the punch unit.

The standard IBM 514 operates at a rated speed of 100 cards per minute. The IBM 514 Series 50 is rated at 50 cards per minute. These machines can be attached to IBM 402, 403, 407, or 419 Accounting Machines as summary punches.

OPERATING FEATURES

Machine Controls (Figure 120)

MAIN-LINE SWITCH

This switch, located on the right side of the machine, controls the power. A red signal light indicates that the switch is ON, and no cards are passing through the machine.

START AND STOP KEYS

These two keys are used to start and stop card feeding.

RESET KEY

- This key is used to reset the double-punch and blank-column detection circuits, and to extinguish the DP&BC light when the machine is equipped with this optional feature.

DP&BC LIGHT

This signal light goes on when a double punch or blank column has been detected in a column being
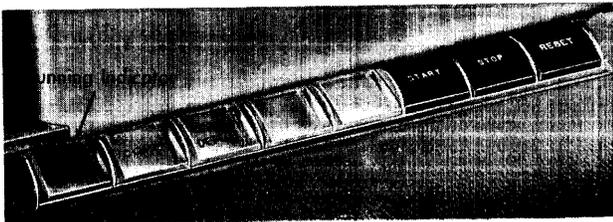
Figure 120. Machine Controls

compared. Pushing the RESET key extinguishes this light.

COMPARE LIGHT

The COMP light indicates that card feeding has stopped because of an error in verifying. It is extinguished by pushing the reset lever on the comparing indicator.

LIGHT (UNLABELED)

This light indicates the main-line switch is ON, but no cards are being fed.

Hoppers

Each of the two hoppers holds approximately 800 cards. Cards are fed face down, 12-edge toward the throat.

X-Brushes, X-Panels (Figure 121)

As a card is fed from the hopper, it passes a reading station of 5 brushes in the read unit (Read X-Brushes) or 6 brushes in the punch unit (Punch X-Brushes). Each of these brushes can be positioned to read the
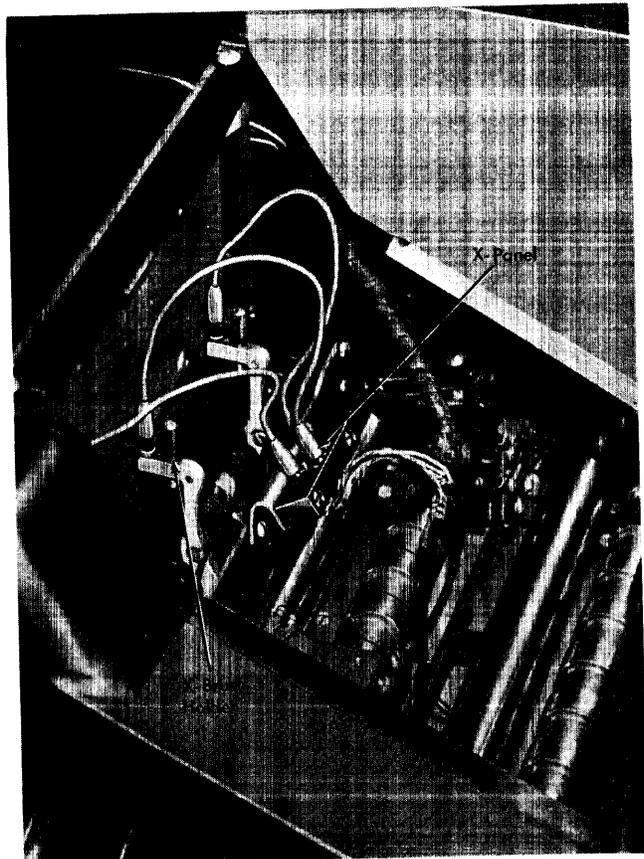

Figure 121. X-Brushes; X-Panel

control information in a column. (Two columns must separate adjacent brushes.) Connection is made from the brushes to the main control panel by wires to a small X-panel for each feed.

Stackers

Each of the two stackers holds approximately 1000 cards. When either stacker is filled to capacity, card feeding stops automatically.

Control Panel (Figure 122)

The control panel determines the functions and operation of the machine.

Summary-Punch Cable

When the machine is used as a summary punch, the summary-punch cable at the left side of the machine must be removed from its receptacle and attached to the accounting machine. When the machine is not used for summary punching, this cable must be kept in the receptacle and latched or the machine does not operate properly.

Figure 122. Control Panel; Functional Switches

Functional Switches (Figure 122)

REPRODUCING SWITCH

When ON, this switch synchronizes the reading and punching feeds so the two feeds can be used together to perform an operation.

When OFF, this switch permits operating the two feeds independently to perform separate operations, or allows a single feed to be used.

SELECTIVE REPRODUCING AND GANGPUNCH COMPARE SWITCH

The SEL REPD and G. P. COMP switch, when ON, permits continuous feeding in the read unit. When the switch is OFF, card feeding in the read unit can be stopped by control-panel wiring while a card is fed in the punch unit.

CARD X-PUNCHED DETAIL OR MASTER SWITCH

This detail-master switch controls the operations in which two types of cards are distinguished by control X-punching. It is normally used in a gangpunching operation, and should be set to MASTER when master cards have the control X-punch (punching NX-cards). It should be set to DETAIL when detail cards have the control X-punch (punching X-cards). In normal re-
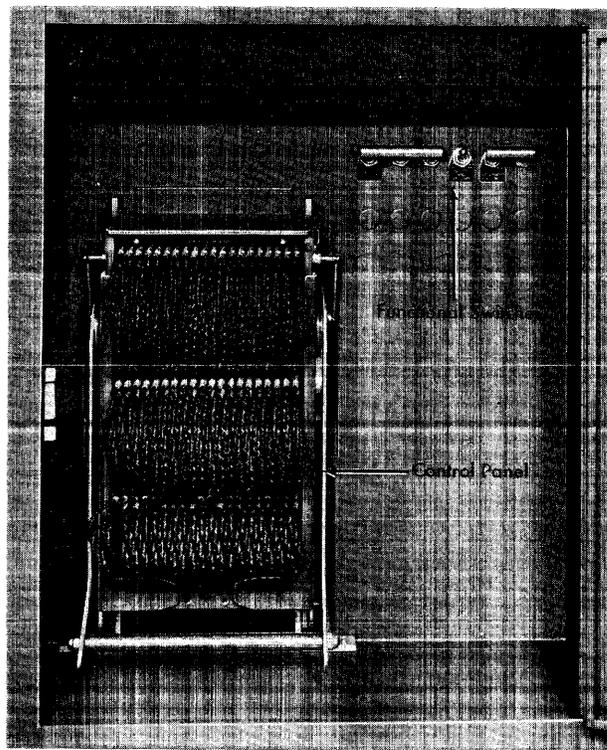
producing operations (punching NX-cards) this switch must be set to MASTER.

MARK-SENSING SWITCH

This switch must be ON for any mark-sensing operation.

MASTER-CARD PUNCHING SWITCH

In a combination reproducing and gangpunching operation with mark-sensed master cards, this switch, when ON, permits mark-sensed information to be punched into the master card. It should be OFF at all other times.

BLANK-COLUMN CHECK SWITCHES

Each position of double-punch and blank-column detection (optional) has a corresponding switch. When the switch is ON and the position is wired on the control panel, card feeding stops if either a blank or double-punched column is detected. With the switch OFF, only double punches stop card feeding.

Comparing Indicator

When the punching in two fields wired to the comparing unit is different, card feeding stops, the COM-
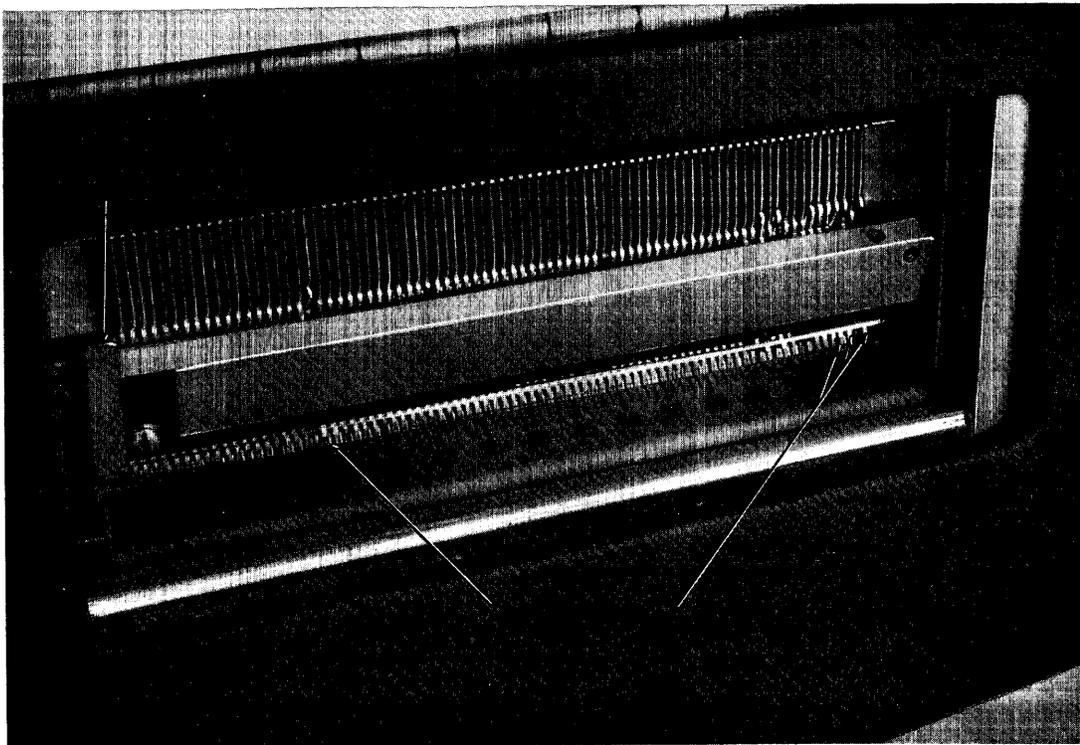
Figure 123. Comparing Indicator

PARE light goes on, and the comparing indicator (Figure 123) shows the comparing position containing the error.

Restoring Lever

The comparing indicator is cleared and the COMPARE light extinguished by pushing the Restoring lever at the left of the indicator.

MACHINE FUNCTIONS

Reproducing and Verifying

A reproducing operation always involves two groups of cards: (1) the original (punched) group that is to be read, and (2) the group of blank (or partially blank) cards that are to be punched with information from the original cards. In any reproducing operation, the REPRODUCE switch should be turned on. When ON, this switch interlocks both feeds so that it is impossible to operate the machine unless cards are in both hoppers. Feeding and stacking cards in both units are synchronized automatically.

The design of the card forms of both groups need not be indentical, and the information can be repro-duced from the original cards into the same or entirely different columns of the blank cards. Variations in card design, or columns to be punched, are handled by control-panel wiring.

The accuracy of the punching operation can be simultaneously verified by the comparing feature of the machine.

The relation of the read and punch units to each other, and the sequence in which the cards pass the operating stations in the two units, are shown in the schematic diagram (Figure 124).

Gangpunching

Gangpunching is the operation in which information in a field of a master card is repeated or transferred to each succeeding card requiring the same information. As cards pass through the punch unit, the master card at the punch-brush station is read, and its information is automatically punched into the following card. Cards are fed continuously, and as the first detail card (field originally blank, but now punched) is read by the punch brushes, the information is transferred to the next card, and so on, until the operation is completed.

There are two types of gangpunching operations. One uses a single master card from which the same

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information is punched in every card passing through the machine; the other uses multiple master cards; properly interspersed throughout the file to be gangpunched. This type of operation is used where the common information differs by groups within the file. Master-card information is gangpunched into the following detail cards until the next master card is read.

In the single-master-card operation, the master card is placed in the punch feed in front of the file to be gangpunched. All cards are punched with identical information, and can be verified by sight checking.

When interpsersed master cards are used, they must be distinguished from the detail cards by an X-punch This X can be punched either in the master cards or in the detail cards, but not in both. A punch X-brush must be set on the column containing the control X, and it must be properly wired in the control panel before interspersed gangpunching can be performed.

When the control X is punched in the master cards, the DETAIL-MASTER switch must be set to MASTER. Punching is then suspended for cards containing the control X, but cards without the X are punched. When the control X is punched in the detail cards, this switch must be set to DETAIL. Cards containing the X are then punched, but punching is suspended for cards without the X.

In either of these gangpunching operations, the RE-PRODUCE switch must be OFF.

The SELECTIVE REPRODUCING AND GANGPUNCH COMPARING switch must be ON when gangpunched cards are to be compared or verified with interspersed master cards. To do this, the file is run through the read unit of the machine as an independent operation, or simultaneously with a gangpunching operation being performed in the punch unit of the machine.

Combination Reproducing and Gangpunching

This operation combines both reproducing and gangpunching functions in one run of the cards through the machine, and is a simple operation when only one master card is to be used. The original set of cards should be preceded by a blank card in the read-unit hopper, in order to prevent reproducing into the master card. The master card should be placed in front of the blank cards in the punch-unit hopper. From an operating standpoint, this operation is the same as reproducing without gangpunching, and the Reproduce switch must be ON.

The comparing unit can be used to verify the reproducing portion of the duplicate cards, but the gangpunched columns of the duplicate cards should be sight-checked each time the punch stacker is emptied.

Summary Punching

Summary punching is automatic punching of totals accumulated or summarized by an accounting machine.

For example, when an inventory report is being prepared on an accounting machine, it can be set up to show, by each type of product, the balance on hand at the first of the month, the receipts and issues during the month, and the balance on hand at the end of the month. As totals are printed by each type of product, the information can be automatically punched into summary cards, by the summary-punching circuits in the reproducing punch. These summary cards can then be used the following month for the preparation of the report.
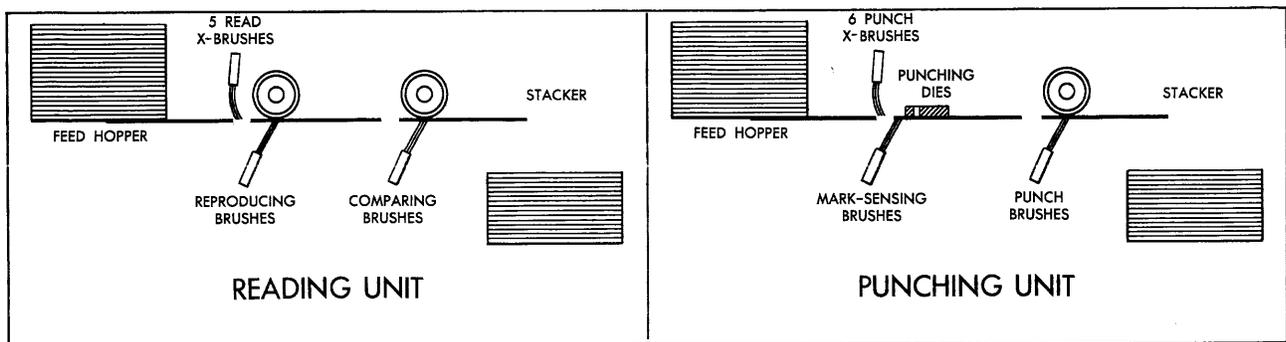

Figure 124. Schematic Diagram

Figure 125. Mark Sensing

When summary punching is to be performed, the summary-punch cable must be connected to the accounting machine. The cable transmits the summary information to be punched in each summary card. Blank summary cards must be placed in the punch hopper of the reproducer, and at least two cards must be fed, before the accounting machine can be started. The REPRODUCE switch must be OFF.

It is possible to gangpunch common information that must appear on all summary cards, simultaneously with punching summary information.

Mark Sensing (Optional)

In this operation, information recorded in the form of ELECTROGRAPHIC® pencil marks on IBM cards is automatically transcribed into punched holes in those cards.

Each side of a card has a capacity of 27 mark-sensing columns. Figure 125 shows a time card with 8 mark-sensed columns in card columns 16 to 39.

OPERATING PROCEDURE

1. Determine the type of operation to be performed: reproducing, gangpunching, combination reproducing and gangpunching, or summary punching.

2. Obtain sufficient supply of the proper card forms to be used.

3. Arrange the cards carefully to avoid confusion in handling the files during and after the operation.

4. Plug in the cord to a source of current and turn on the main-line switch.

5. Press the START key for at least three card cycles, to insure that no cards have been left in the machine from a previous operation.

6. If you find any cards in the stackers, turn them over to the supervisor.

7. Insert the proper control panel.

8. Check the X-brushes and notify the supervisor if they are not set according to instructions.

9. Set the switches according to the operation to be performed:

   Summary Punching: All switches OFF; Detail-Master Switch on MASTER.

   Reproducing: Reproduce switch ON; Detail-Master Switch on MASTER; all others OFF.

   Gangpunching: Reproduce switch OFF; De-tail-Master Switch on MASTER if master cards are X-punched, or on DETAIL if detail cards are X-punched; Selective Reproduce and Gangpunch Comparing switch ON for checking.

   Mark Sensing: Mark-Sense switch ON; Detail-Master switch on MASTER; all others OFF. If gang-punching with mark-sensed master cards, the Master Card switch must be ON.

10. Place cards in the hoppers face down, 12-edge toward the throat.

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11. In a reproducing operation, place the originals in the read hopper and the cards to be copies in the punch hopper.

12. Press the START key.

13. Stop the machine after 4 or 5 card cycles, and check the cards punched to see that all required columns are being properly reproduced, gangpunched, or summary punched (depending upon the operations performed).

14. In a summary-punching operation, feed at least two cards through the machine before starting the accounting machine. When the last card is fed from the punch hopper, card feeding stops in both the summary punch and the accounting machine. If the operation is not complete, reload the hopper.

15. When card feeding stops for a comparing error, remove the cards from both hoppers and stackers. Note the comparing indicator for the position in error. Push the Restoring lever, and press the START key to run out the cards in the machine. The discrepancy is in one of the two first cards into the stackers.

16. When the operation is finished, press the START key until all cards remaining in the machine have been fed into the stackers. Turn off the main-line switch.

17. File the cards according to the instructions of the supervisor.

OPERATING SUGGESTIONS

The following suggestions are given as an aid to most efficient operation of the IBM 514 Reproducing Punch.

STARTING THE OPERATION

When the cable is being attached to the accounting machine, the main-line switches of both accounting machine and summary punch must be OFF.

In a gangpunching operation using interspersed master cards, make certain the Detail-Master switch is properly set. Also, have your supervisor check the setting of the punch X-brush.

Be sure the unused read X-brushes are positioned regularly across the 80 columns. If grouped at one end, uneven feeding may result.

In a reproducing and gangpunching operation, the first card in the punch feed can be used for the gangpunched data. If this is not done, be certain to place a blank card ahead of the file in the read feed.

Joggle cards into perfect alignment before placing them in the feed hopper, face down, 12-edge toward the throat of the feed.

Do not overload hoppers nor allow stackers to become too full.

In a reproducing operation, fill both hoppers to approximately the same level, and replenish both at the same time.

DURING THE OPERATION

If the machine stops and a red light appears, check for an empty hopper or a full stacker.

Occasionally check the punching registration on a standard card gage.

When emptying the stackers during a reproducing operation, stop card feeding and remove cards from both stackers at the same time. Always match the last card removed from one stacker with the last card removed from the other stacker before placing the cards in the files.

In a gangpunching operation in which only one master card is used, the cards should be sight-checked when removed from the punch stacker. Check the last card removed, to make sure that it is exactly like the master card. If it is not, card feeding should be stopped, as the entire group may need checking.

It is impractical to sight-check small groups of cards in interspersed gangpunching operations, but they can be machine verified if the cards are run through the read unit. This requires a special setup on the control panel and also requires that G. P. COMPARING switch be ON.

If a card jam occurs call the supervisor. The jam must be carefully removed. The operation can be learned only by personal instruction, repeated practice, and experience.

STOPPING THE OPERATION

When an operation is finished, remove extra cards from the punch hopper, and press the START key until all cards have dropped into the stackers. Three card cycles are sufficient.

IBM 519 Document-Originating Machine

The IBM 519 Document-Originating Machine (Figure 126) is a reproducing punch, identical in function and operation to the IBM 514, with the exception that it has a print unit for printing as many as eight digits of information on the face of the cards passing through the punch unit. The information can be printed from the card itself (interpreting), from a card in the read unit at the comparing brushes (transcribing), or from an emitter.

Information can be printed on either of two lines (Figure 127) in one pass of the cards through the machines.

Print Unit

The print unit is located behind the front cover just left of the punch stacker, and can be latched in one of three positions (Figure 128). When the print unit is latched in the notch farthest from the operator, printing occurs on the second line. When the print unit is latched in the middle notch, printing occurs on the first line.

If the print unit cannot be engaged readily, the following steps should be taken:

1. Draw the unit toward the front of the machine.
2. Turn the knurled knob on the left side of the unit until the letter D on the index wheel is in

Figure 127. End Printing

line with the arrow scribed on the unit (Figure 129).

3. Hold the wheel in this position and slide the unit toward the rear of the machine, stopping at the notch desired.

When the printing feature is not used, the print unit should be latched in the notch nearest the operator to prevent unnecessary wear on the ribbon and other moving parts.

As an optional feature, the IBM 519 can print inverted characters or on the column-80 end of the card.

Print Light

The PRINT light goes on when the print unit is engaged and ready to print. The light goes off when the unit is disengaged.
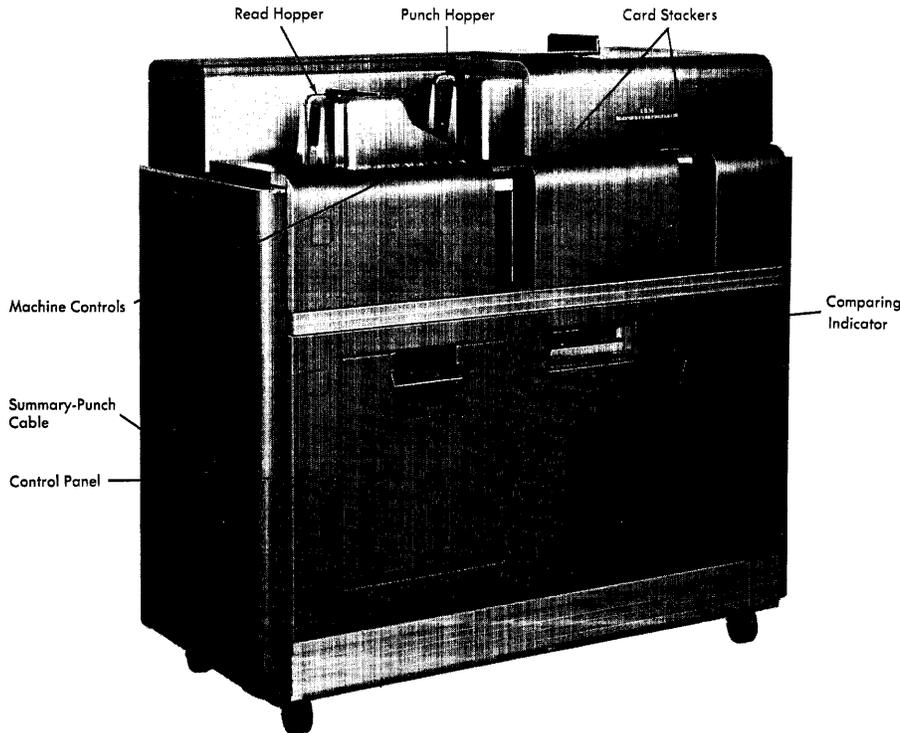
Figure 126. IBM 519 Document-Originating Machine

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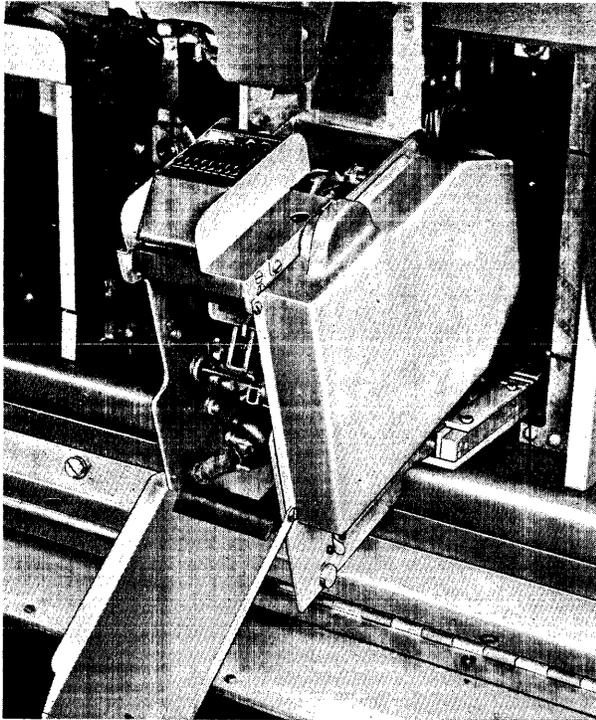
Figure 128. Printing Unit
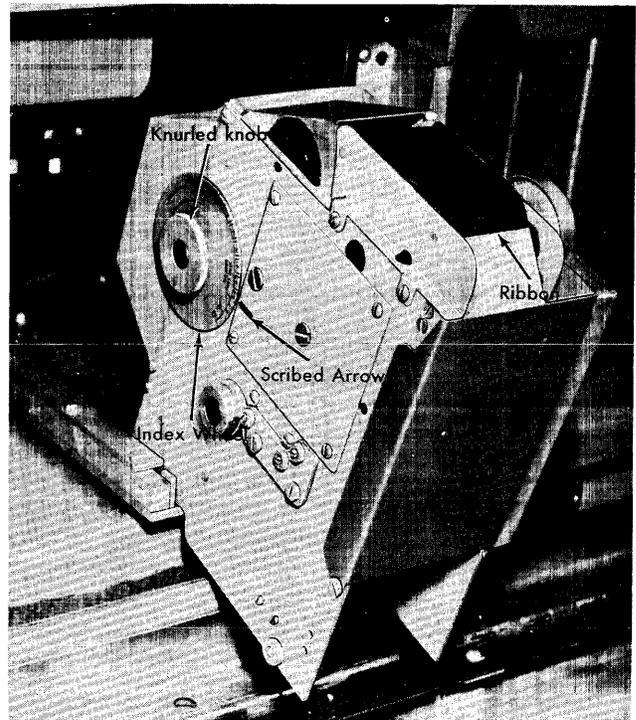
Figure 129. Left Side of Print Unit

IBM 528 Accumulating Reproducer

The IBM 528 Accumulating Reproducer (Figure 130) is a high-speed punch that performs addition and subtraction in combination with any of the operations of gangpunching, reproducing and summary punching. If no printed report is required, the accumulating reproducer can prepare summary cards from detail cards at high speed, without the use of an accounting machine.

A second major feature of this machine is its ability to reproduce selectively, by suppressing card feeding on the basis of any control punch in the cards. This permits speeds up to 200 cards per minute in the read feed, even though the punch feed operates at 100 cards per minute.

The IBM 528 operates the same as the IBM 514. Only the differences in operating features are noted here.
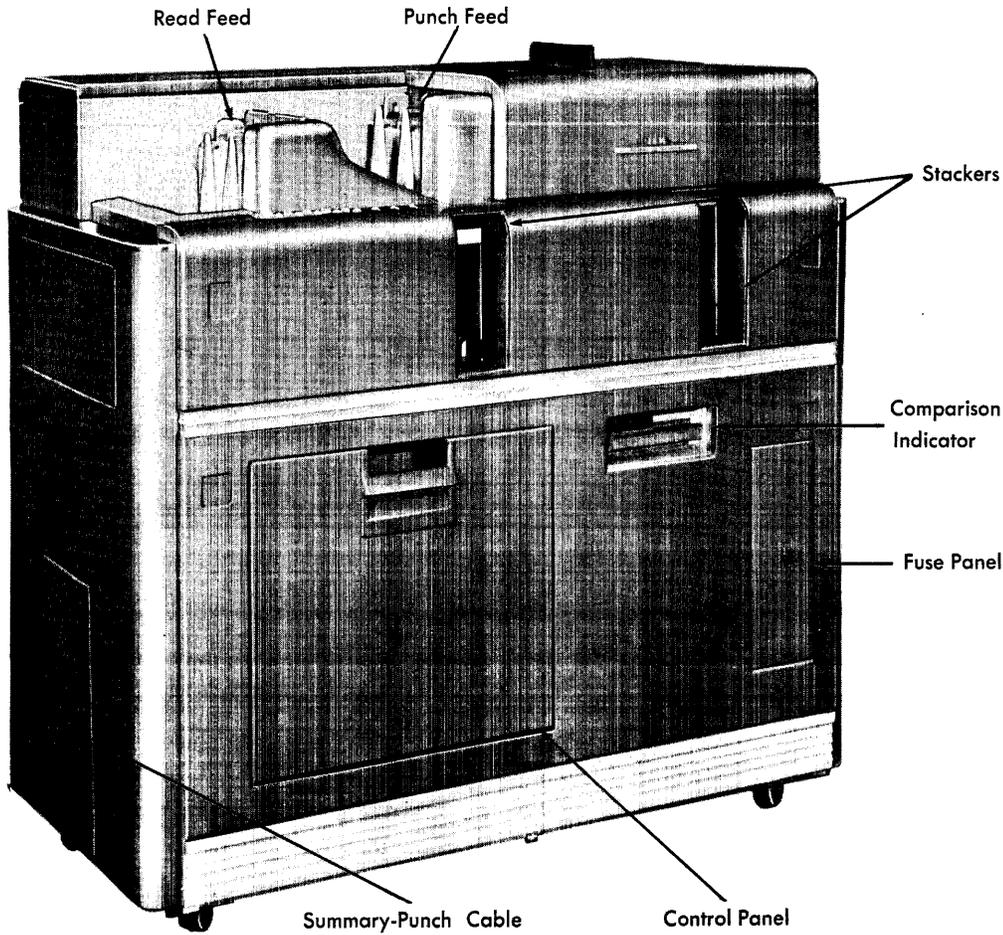
Figure 130. IBM 528 Accumulating Reproducer

Figure 131. Machine Controls

COMPARING OR RESET ERROR LIGHT (FIGURE 131)

This light goes on whenever counters fail to reset correctly, or whenever readings brought to the comparing unit fail to agree. In the latter case, the lights in the comparing unit are also turned on.

If counters have not reset correctly, the START key must be pressed to run the cards out of the machine. No punching occurs during runout. Pressing the RESET key then causes the machine to take a reset cycle to try to reset the counters again. If the Error light goes off, the cards can be run into the machine again. If not, call your supervisor.

When the light comes on as a result of a comparing error, the cards should be removed from the hoppers and stackers, and the cards in the machine run out by holding down the START key. The cards can be compared visually against the indicator on the comparing unit to determine in which columns the error occurred. Then the comparing unit should be reset, and the cards run in again.

MACHINE STOP LIGHT

The MACH STOP light goes on whenever card feeding stops as a result of control-panel wiring. Card feeding can be restarted only after the operator presses the RESET key.

IBM 549 Ticket Converter

Current reports and low inventory levels are essential to the operation of retail establishments. Of the several sources of information, price tickets often represent the greatest volume of transactions. Transcribing sales data from these tickets into IBM cards is done automatically by the IBM 549 Ticket Converter (Figure 132).

The price ticket* consists of a basic section and one or more punched stubs (Figure 133). When an article is sold, a stub is removed from the price ticket and used for accounting purposes in IBM punched-card system. To convert the ticket stubs to punched cards, these price stubs are placed in the ticket feed of the converter and cards in the punch feed. Detail information is read from the tickets and punched in any of the 80 columns of the IBM cards, which can then be processed normally for the reports needed.

The IBM 549 can also perform the functions of gang-punching, summary punching and editing for double punches and blank columns. Operation is the same as that for the punch feed of the IBM 514.

* Printed and punched by the Dennison Print-Punch Marking Machine, manufactured by the Dennison Company of Framingham, Massachusetts.
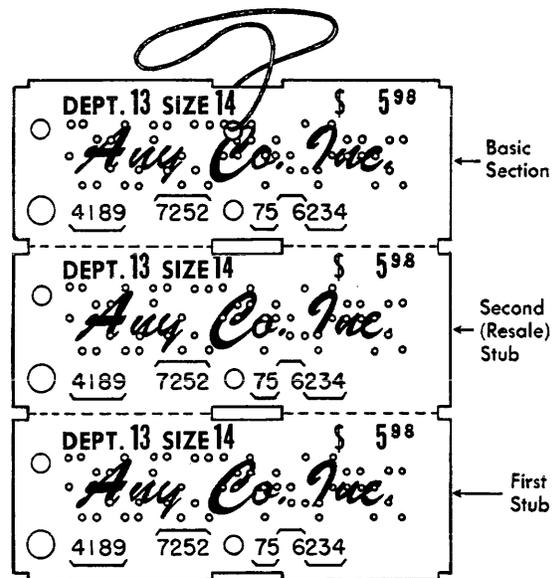
Figure 133. Three-Section Price Ticket

OPERATING FEATURES

With the exception of the read feed, the operating features of the IBM 549 are identical to those of the IBM 514.
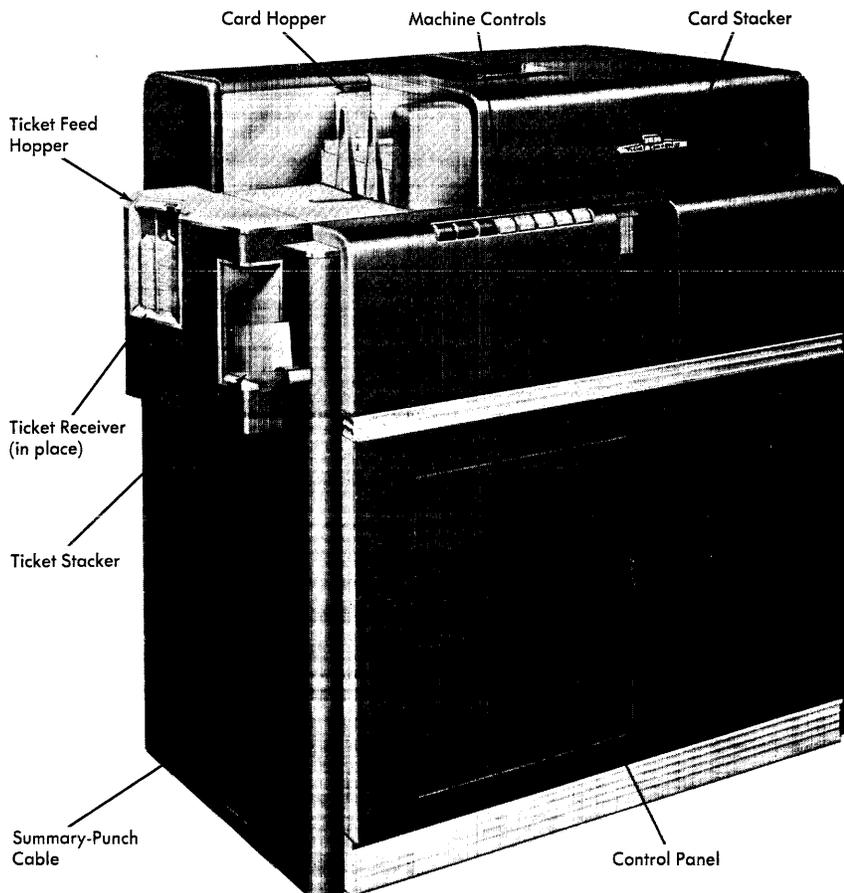
Figure 132. IBM 549 Ticket Converter

Ticket Receiver

Price tickets, when removed from the merchandise, are placed face up on a spindle in a specially-designed receiver (Figure 134). This receiver is inverted and snapped into place in the ticket hopper.

Ticket Hopper

With the receiver in place in the ticket hopper, the tickets are fed, face down, to the reading station.

Ticket Stacker

The tickets are stacked at an angle, face back, in the reverse sequence from which they entered the machine.

MACHINE FUNCTIONS

Converting Tickets

Price stubs are often unsuitable for processing in automatic accounting procedures. Tickets stubs, punched with coded information, are therefore converted (decoded and reproduced) into IBM cards that can then be used for accounting purposes.

Figure 135 shows the relationship between tickets in the ticket feed and cards in the punch feed at the end of a machine cycle. If card feeding is stopped with the first card stacked, three tickets are in the ticket stacker, with the first-fed ticket at the front. Thus, the ticket corresponding to the last card stacked is always the third ticket from the back in the ticket stacker. On the next cycle when card feeding is restarted, cards and tickets move as follows:

Card 2 is stacked.

Card 3 is read at punch brushes for DPBC checking.

Card 4 is punched as ticket 4 is read, decoded for numerical punching, and stacked.

Card 5 and ticket 5 are fed from their respective hoppers.
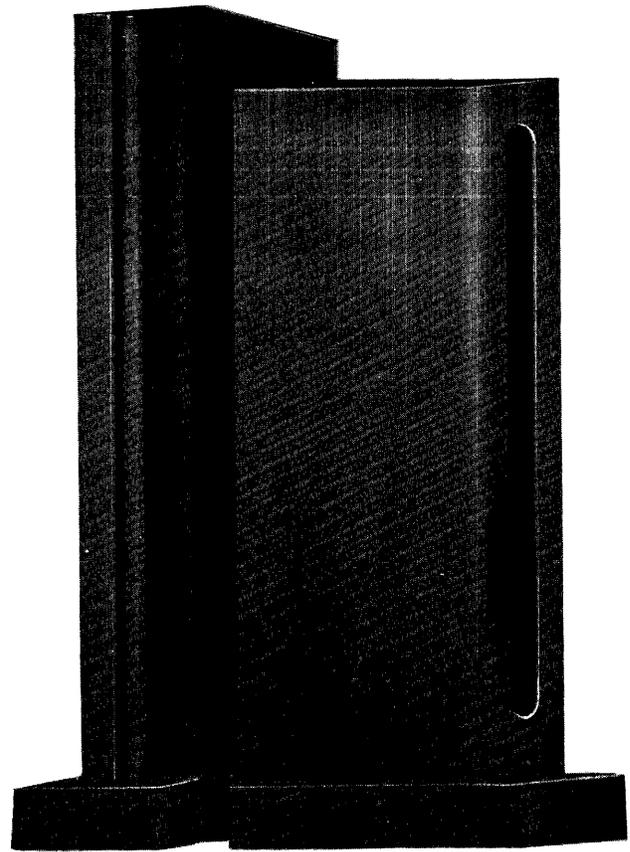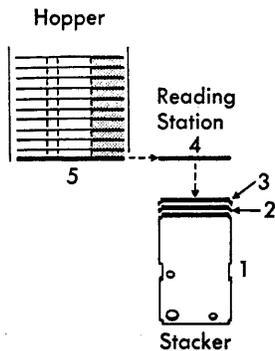
Figure 134. Ticket Receiver

Gangpunching with Master Tickets

It may be necessary to precede each batch of ticket stubs with a single master ticket stub containing additional required information common to all tickets or groups of tickets.

During the conversion of tickets to cards, the master tickets are converted into master cards from which the common information is gangpunched into the detail cards. This is the only use for the master cards. Therefore they should be X-punched, sorted out (or offset-stacked), and destroyed after the conversion operation is completed.
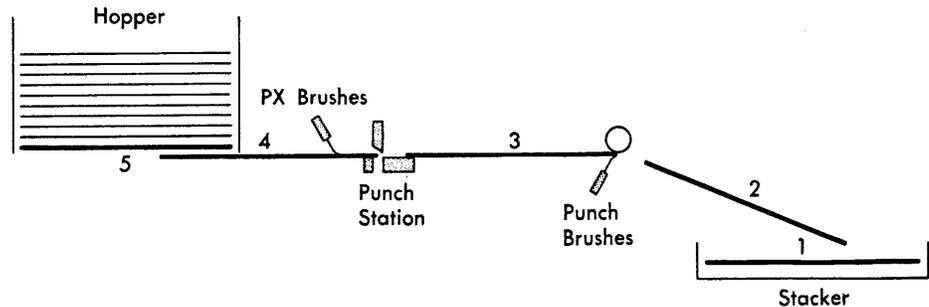
Figure 135. Schematic Relationship between Ticket and Punch Feed

IBM 523 Gang Summary Punch

Reproducing Punches can perform summary-punch operations. However, certain punches are designed specifically to accompany accounting machines as summary punches. Detail information is accumulated in the accounting machines and the totals conveyed to the summary punch by a connecting cable.

The IBM 523 Gang Summary Punch (Figure 136) operates on the same principles as the punch unit of the IBM 514 Reproducing Punch. Though designed primarily as a summary punch for the IBM 402, 403, 407, 419 Accounting Machines, the IBM 523 can also be used as an automatic gangpunch in conjunction with, or independent of, an accounting machine.
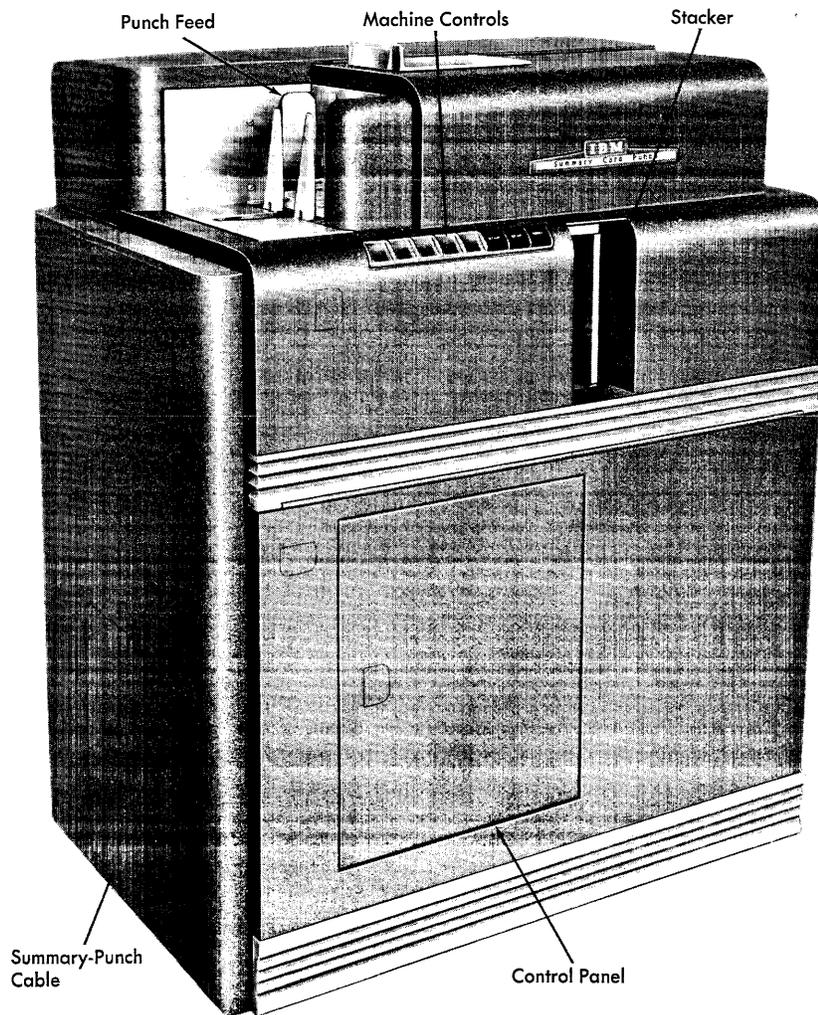
Figure 136. IBM 523 Gang Summary Punch
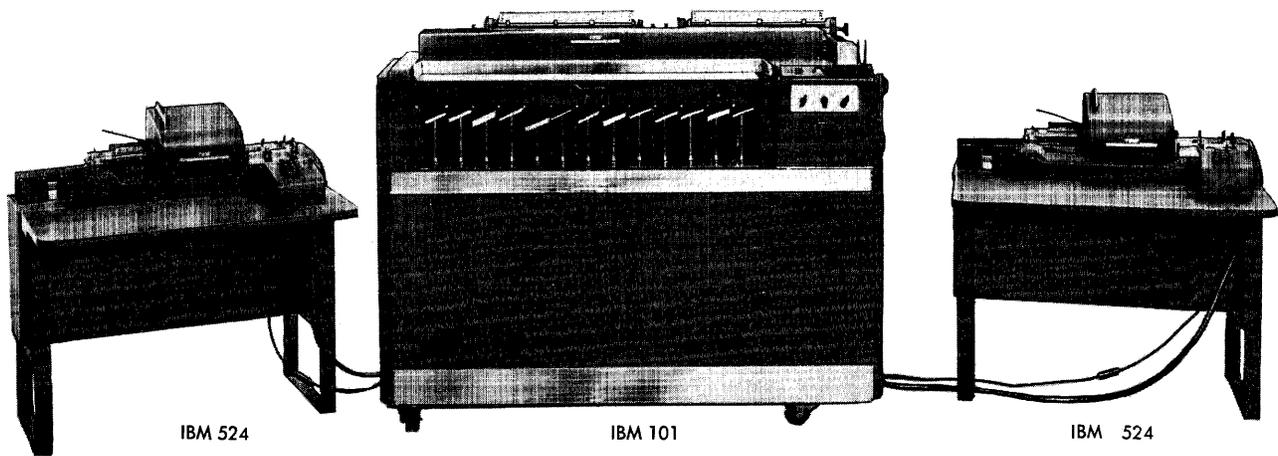
Figure 137. IBM 524 Duplicating Summary Punch Connected to IBM 101

IBM 524 Duplicating Summary Punch

The IBM 524 Duplicating Summary Punch (Figure 137) is designed for use exclusively as the summary-punch attachment for the IBM 101 Electronic Statistical Machine. It can be operated independently as a card punch if its power cord is connected to a separate power source. Refer to IBM *101 Electronic Statistical Machine* (page 58).

IBM 526 Printing Summary Punch

The IBM 526 Printing Summary Punch (Figure 138) punches summary cards automatically while reports are being prepared on IBM 402, 403, or 419 Accounting Machines. The punched information can also be printed on the summary cards. When it is not being used for summary punching, this machine can be used as a key punch for regular card-punching (and
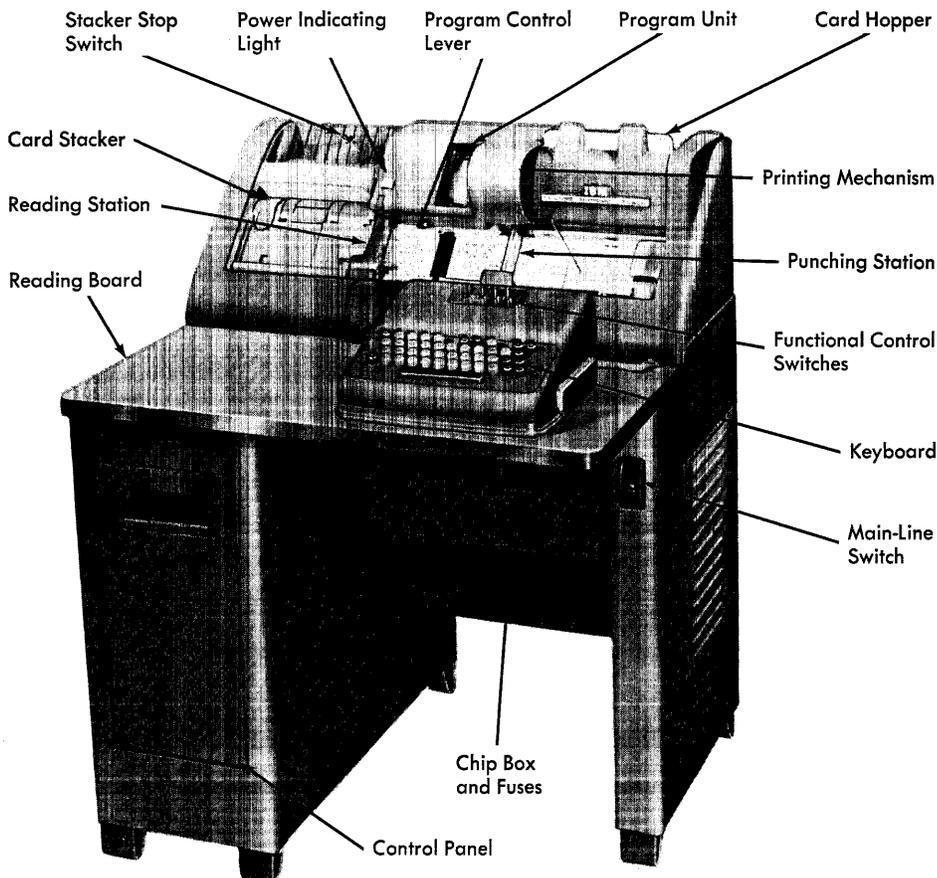
Figure 138. IBM 526 Printing Summary Punch

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printing) operations as performed by an IBM 26 Printing Card Punch.

With the exception of summary punching, the IBM 526 performs the same functions and operates the same as the IBM 26 Printing Card Punch. Refer to this section for full description (page 22). Only the differences are noted here.

Operating Features

POWER LIGHT

A white light, located to the left of the program unit, indicates when the main-line switch is ON.

STACKER STOP SWITCH

This switch stops card feeding in the accounting machine when the stacker is full.

CONTROL PANEL

The control panel governs punching and skipping operations of the machine. The panel must be inserted in the rack and the door closed for summary punching. If the door is opened while cards are registered at the punching and reading stations, the card bed must be cleared and new cards fed before operation can be resumed.

SUMMARY-PUNCH CABLE

The summary-punch cable extends from the left end of the machine. When not in use, it can be stored in a compartment provided in the side.

For simultaneous independent operation of the IBM 526 and the accounting machine, the cable may be left connected and both machines used independently merely by *not* wiring the summary-punch switch hubs in the accounting machine control panel.

To begin a summary-punching operation, cards must be registered at both the punching and reading stations of the summary punch, the control panel must be in place with the door closed, and the summary-punch cable must be connected to the accounting machine. A program card is inserted to control automatic program functions.

If the IBM 526 runs out of cards during summary punching, the operation can be restarted by placing cards in the hopper and pressing the FEED key twice.

IBM 521, 529 Card Read Punches

IBM calculators can use automatic punches as input-output units of the system. These punches read information from the cards and punch the calculated results in the cards. This operation is accomplished at a speed of 100 cards per minute by the IBM 521 and 529. Each punch is presented fully in the manual of its associated calculator unit:

IBM 521—IBM 604 Electronic Calculating Punch

IBM 529—IBM 607 Electronic Calculator

Optional Features — IBM 514, 519, 523, 528, 549

Offset Stacking Device

An error card, or one selected by control-panel wiring, can be offset ⅜ inch forward in the stacker. Care must be exercised in removing the cards from the stacker not to disturb the offset of the cards. This device is available for either or both the punch and read feeds.

Auxiliary Card Counter

One or two auxiliary card counters can be installed to count the cards processed by either or both feed units (punch feed only on IBM 549).

Mark Sensing Device (IBM 514, 519 only)

With this device installed on either the punch or read unit, ELECTROGRAPHIC® marks on IBM cards can be sensed and reproduced into cards as punched holes.

Review Questions — IBM 514, 519, 528, 549

1. What is the purpose of reproducing punches? Of summary punches? Of card read punches?

2. Name the card hoppers and give their location on the machine.

3. How are cards placed in the hoppers?

4. What is the rated speed of reproducing punches?

5. Define *gangpunching*.

6. What unit of the machine is used for gangpunching?

7. What are the two types of gangpunching operations?

8. In what manner do the two methods differ?

9. What is the purpose of the Comparing Indicator?

10. Which method of gangpunching does not require the use of the Comparing Indicator?

11. What unit of the machine is used for gangpunch comparing?

12. Name the three switches and their functions. State how each would be set for a gangpunch-comparing operation.

13. What determines the setting of the Detail-Master Switch?

14. Define *reproducing*.

15. When reproducing information from one file of cards to another, is it necessary that the two card forms be identical? If not, how is the reproducing from one form to another varied?

16. Why is it advisable to use the comparing device in a reproducing operation?

17. Name three conditions in the machine, involving the cards that may cause card feeding to stop during a normal reproducing operation.

18. In a combination reproducing and gangpunching operation, using only one master card, what information can be verified by the comparing unit and what information is sight-checked?

19. In the above operation, how is reproducing into the master card prevented?

20. Define *summary punching*.

21. What machine produces the information to be summary punched and how is the information transmitted?

22. What is the position of the Reproduce switch in a summary-punching operation? Detail-Master switch?

23. Where is the summary-punch cable located?

24. How is the Comparing Indicator restored?

25. How do you set the print unit on the IBM 519 to end print on the first line?

26. In which feed are cards end printed? In which feed is the information read?

27. How is the print unit latched when the printing feature is not desired?

28. In which feed are the mark-sensed cards placed for transcribing?

29. Explain the function of the IBM 549 Ticket Converter.

30. Which ticket and card in the stacker correspond?

IBM cards can be used as documents as well as for automatic production of reports. For example, original source documents such as address cards, payroll cards, time tickets, inventory tags, checks, income tax returns, and car registrations are often designed on IBM cards. To assist in visual reading of punched data, it is desirable that punched information be translated into printed form on the card itself. Thus, the information punched in the cards can be read with the same ease as typewritten records.

Machines designed to print on the card information that has been punched in the card are called *interpreters:* IBM 548, 552 and 557 Interpreters.

IBM 548 Interpreter

The IBM 548 Interpreter (Figure 139) is designed to translate 60 columns of punched data into printed characters on each of two printing lines on the face of the card. To interpret more than 60 columns, the cards must be run through the machine a second time using the second printing line. The machine interprets 60 cards per minute.
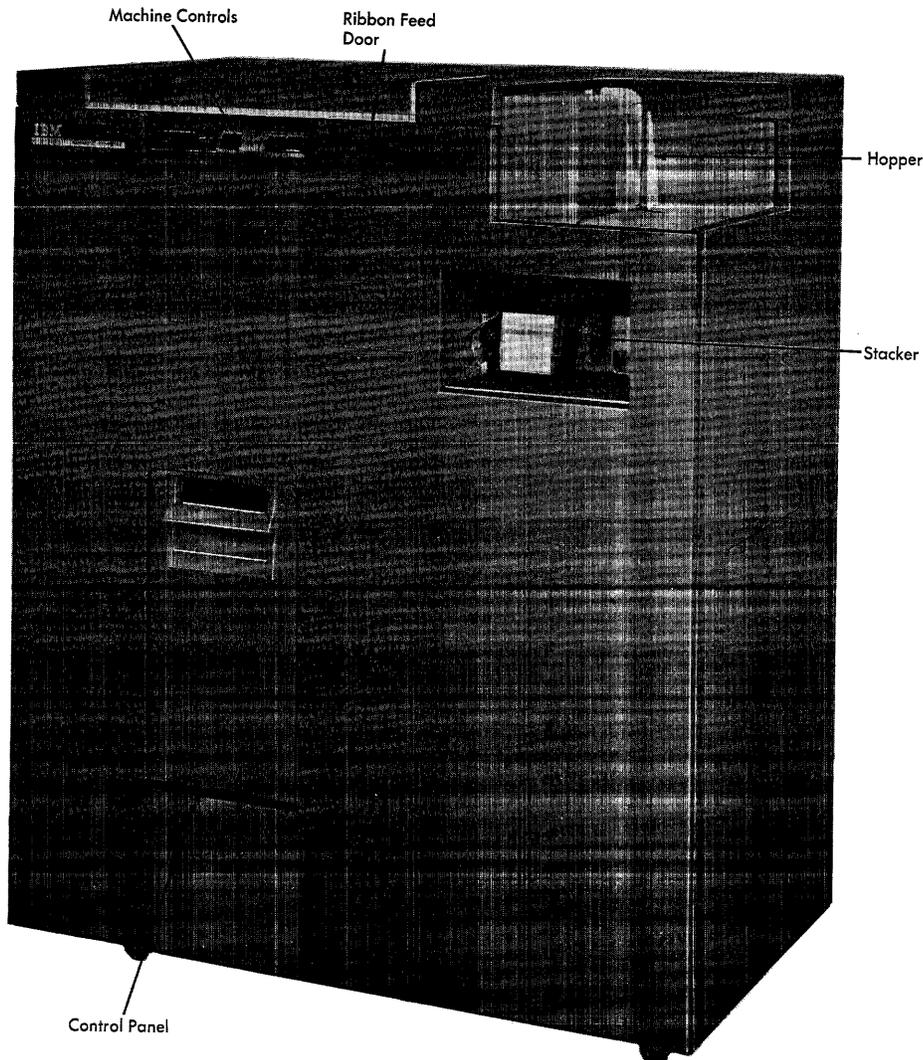
Figure 139. IBM 548 Interpreter
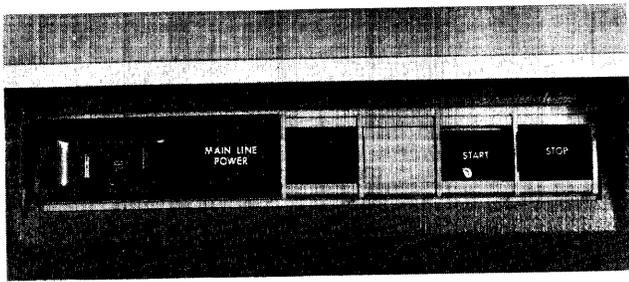
Figure 140. Machine Controls

OPERATING FEATURES

Machine Controls (Figure 140)

MAIN-LINE SWITCH

This switch must be ON for all machine operations. A green READY light indicates the machine is ready for operation.

START KEY

This recessed key must be pressed and held for three card-feed cycles to start machine operation.

STOP KEY

This key must be pressed to stop card feeding and interpreting.

Hopper

The cards must be placed in the hopper *face up*, with the 12-edge toward the throat.

When the supply of cards in the hopper becomes exhausted, all cards within the machine are interpreted and run out into the stacker. The capacity of the hopper is approximately 700 cards.

Stacker

The stacker is located directly below the hopper, and holds about 900 cards. Cards can be removed from the stacker without stopping the continuous operation of the machine. If the stacker becomes full, card feeding stops automatically.

Printing-Position Knob (Figure 141)

Sixty characters can be printed on either of two lines on the card face. Upper-line printing is along the top of the card above the 12-punch position (Figure 142). Lower-line printing occurs between the 12- and 11-punch positions (Figure 143). The printing-position
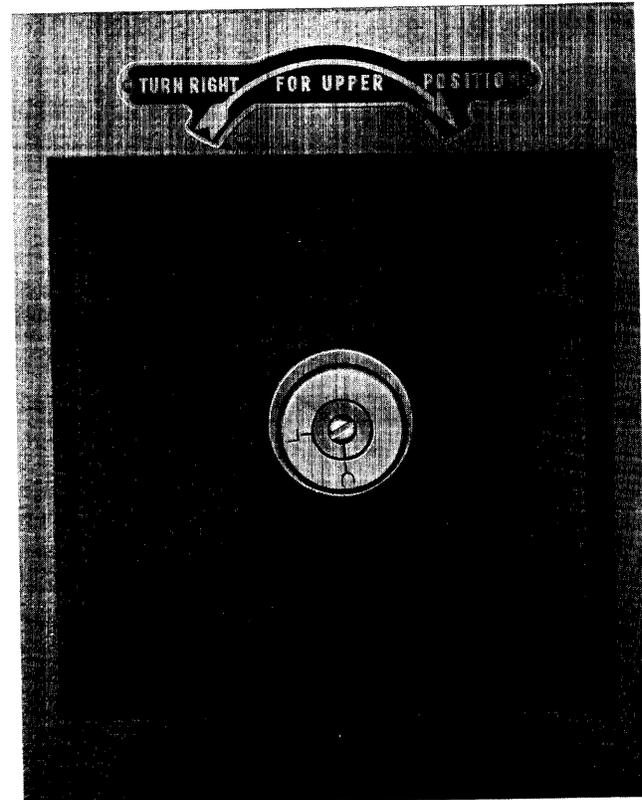
Figure 141. Printing Position Knob

knob, located in a recess on the back of the machine, behind the hopper, determines the printing line. An indicating mark shows which position is to be printed (U—upper, L—lower). To change the printing line, pull out the knob and turn it clockwise for the upper line, or counterclockwise for the lower line. This change must be made when the machine is stopped, because the knob rotates while cards are being fed.

Print Unit

The printing mechanism consists of 60 typebars. Each bar contains 39 printing characters: 10 numerical (0 through 9); 26 alphabetic (A to Z); and three special characters (when specified).

For printing in specific locations, exact typebar positions must be determined before wiring the control panel. The ratio of typebars to card columns is 60:80 or 3:4, because 60 typebar positions print horizontally in an area covered by 80 columns. Thus, typebar 3 prints over column 4; typebar 6 prints over column 8; typebar 45 prints over column 60, etc. (Figure 144).

The ribbon in the printing unit is a little wider than the length of an IBM card; and moves vertically as each card is interpreted. It reverses its direction of movement automatically, and does not require operator attention until printing on the cards becomes too light and a new ribbon is required.

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Figure 142. Upper-Line Printing

Figure 143. Lower-Line Printing
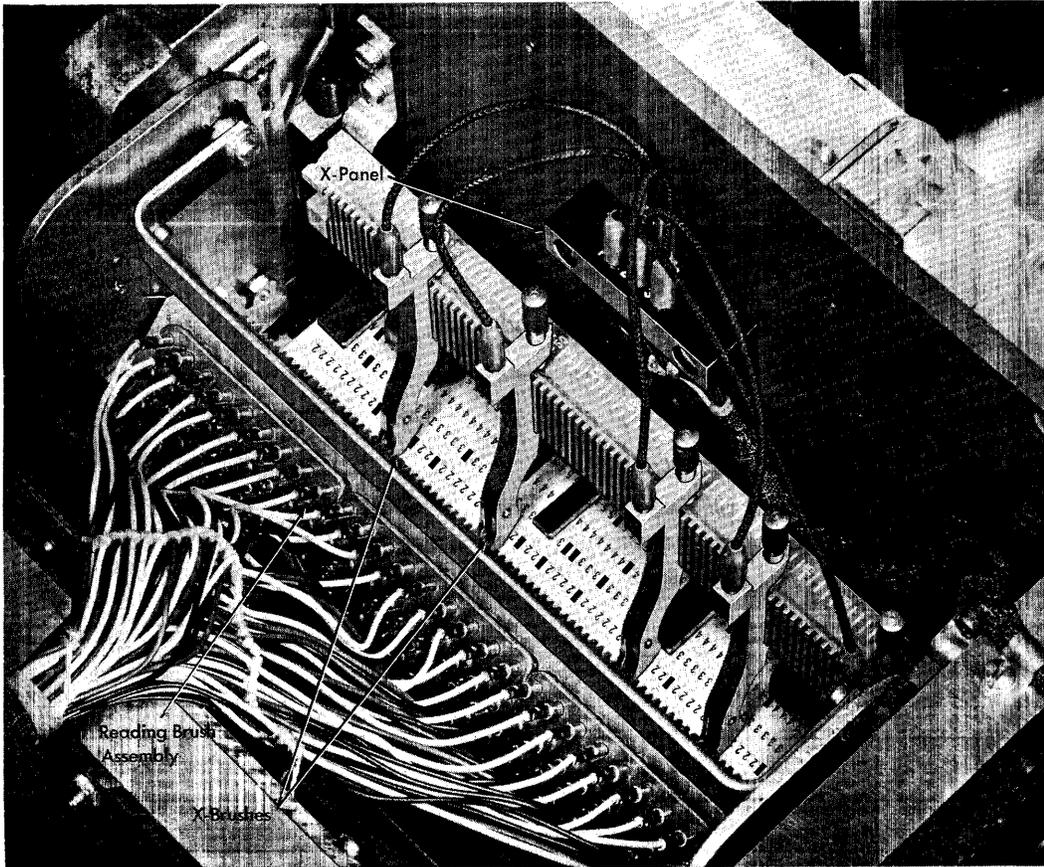

Figure 144. Interpreter Printing Position

Figure 145. X-Brushes, X-Panel

X-Brushes, X-Panel

Five X-brushes are located under the top cover just to the left of the hopper (Figure 145). Each brush can be positioned by the operator to read a card column and, when wired to the X-panel, controls printing on X- or NX-cards.

Control Panel

Printing is controlled by the control panel, which is inserted in the front of the machine.

OPERATING PROCEDURES

1. Make sure that the proper control panel is inserted in the machine, and that the X-brushes are positioned properly.

2. See that the cord is plugged to the proper source of current, and turn on the main-line switch.

3. Place one card in the feed hopper, *face up,* 12-edge first, and place the card weight on top of the card.

4. Check the printing-position knob.

5. Press the START key.

6. Remove the card from the stacker and check the printing. This is done by reading the holes interpreted and comparing them with the printing.

7. If an error in interpreting occurs (bad positioning or wrong printing), have your supervisor check the control-panel wiring.

8. If the printing is correct, joggle the cards, load the hopper, and place the card weight on top of the cards. The hopper should not be filled beyond the level of the sides.

9. Remember that because cards feed through the interpreter *face up,* it is necessary to start feeding the cards from the *back* of the file instead of from the front, if the card sequence is to be maintained.

10. Load hopper and empty stacker as required. As cards are removed from the stacker, fan through them to check legibility of printing. If the printing becomes indistinct, the ribbon should be replaced.

11. Joggle cards and file according to instructions.

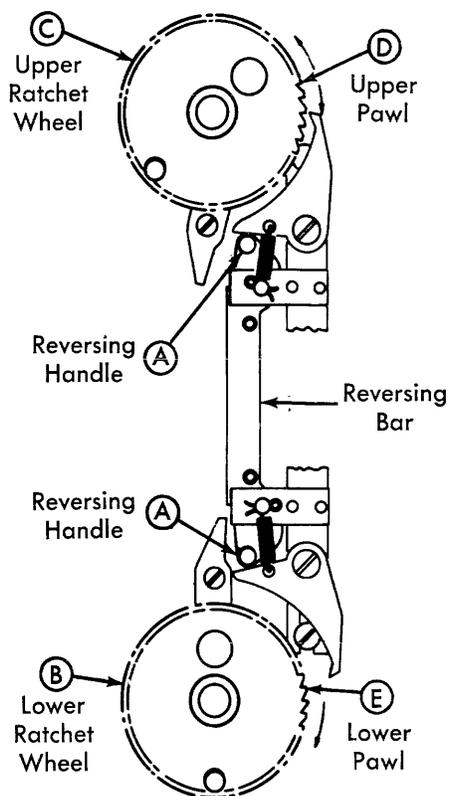12. When the operation is finished, turn off the main-line switch.

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Figure 146. Ribbon Feed Mechanism Schematic

9. Install the new ribbon with the notched end of the spool toward the front of the machine with connecting loop on top.

10. Attach the ribbon leader clip to the ribbon loop.

11. Turn the bottom ratchet wheel *B* clockwise about 10 times.

12. Lower and latch the brush assembly; close the covers.

OPERATING SUGGESTIONS

To avoid card-feed failures, cards should be joggled and arranged in perfect alignment before they are placed in the hopper.

Remember that because the cards are fed *face up,* the last card in the handful placed in the hopper is the first card of that group to be interpreted. Cards must therefore be taken from the back of the file, and returned to the file in front of those already interpreted.

If card feeding stops with the hopper loaded and the stacker not full, check the last card fed into the stacker. If this card did not stack properly because of folding or pleating, card feeding stops automatically.
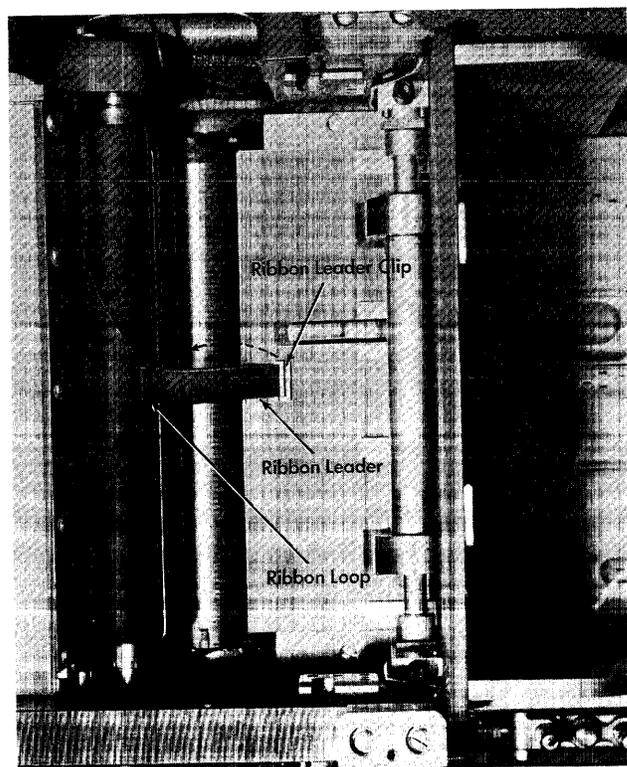
When changing the ribbon, follow this procedure:

1. Raise the top cover; unlatch and remove the brush assembly by lifting the brush-holder release lever (Figure 145).

2. Open the front door exposing the ribbon-feed mechanism. (Figure 146 is a labeled schematic of the ribbon mechanism viewed from this position.

3. Push down either of the reversing handles *A* to disengage pawl *E.* If impossible to disengage the lower pawl, turn lower ratchet wheel *B* clockwise to release the pawl.

4. Turn upper ratchet wheel *C* counterclockwise until the ribbon leader is wound around the upper ratchet wheel.

5. Push up either of the reversing handles *A* to disengage upper pawl *D.*

6. Turn upper ratchet wheel clockwise until the leader clip is in view from the top (Figure 147).

7. Disconnect the leader clip. Be careful not to let the leader fall down into the machine.

8. Remove the ribbon by pushing the spool toward the rear of the machine.

Figure 147. Ribbon Inserted

IBM 552 Interpreter

The IBM 552 Interpreter (Figure 148) though different in appearance from the IBM 548, operates almost the same. The differences are noted here.

The IBM 552 has no X-brushes or X-panel for recognizing control punches prior to the reading station.

The ribbon should be replaced only by a customer engineer, because the operation involves removing and replacing the print unit.

IBM 557 Interpreter

The IBM 557 Interpreter (Figure 149) reads information punched in a card and prints that information at the rate of 100 cards per minute. As many as 60 characters can be printed on one of 25 lines of each card with a single pass through the machine. These lines are located from the 12-edge to the 9-edge of the card and can be selected by a manually-operated printing-position dial or by control-panel wiring. Flexibility of printing and control is provided through a control panel.
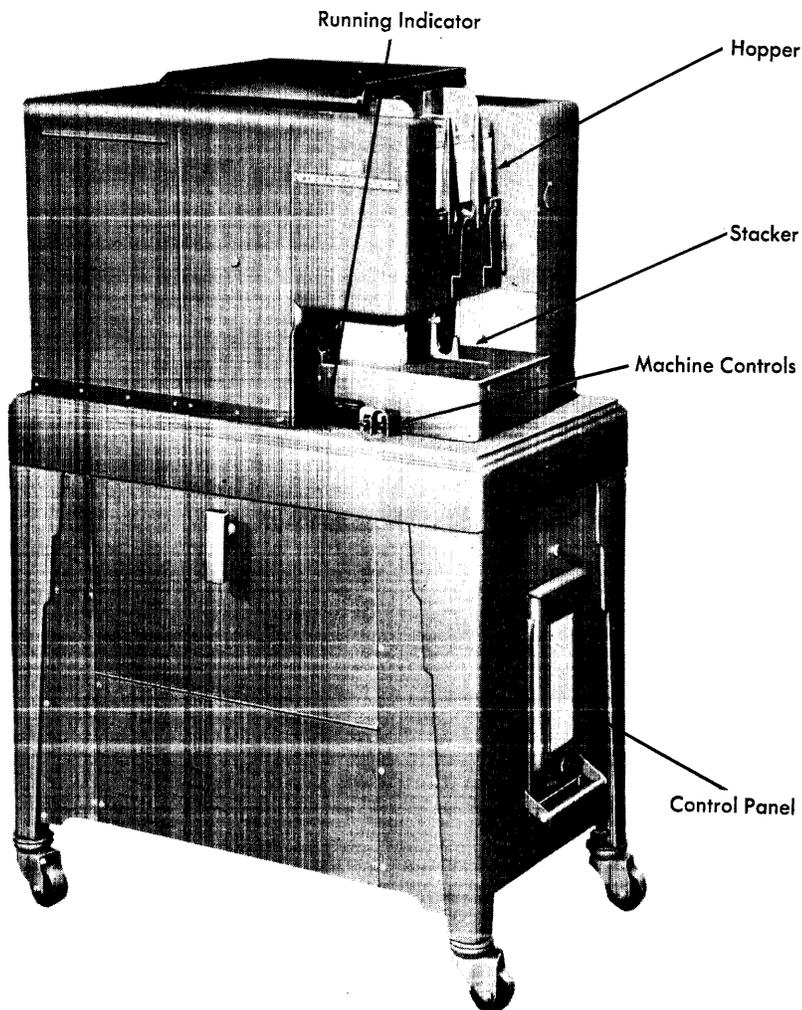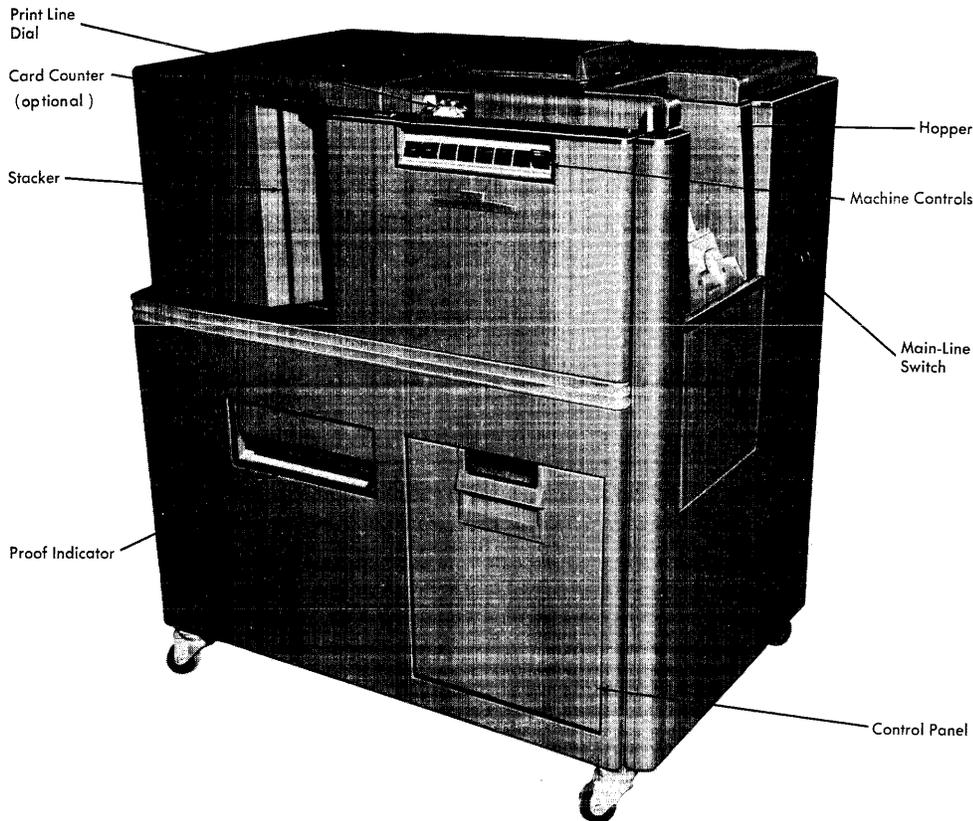

Figure 148. IBM 552 Interpreter

Figure 149. IBM 557 Interpreter

OPERATING FEATURES

Machine Controls (Figure 150)

MAIN-LINE SWITCH

This switch must be ON for the machine to operate. When this switch is turned on, the running indicator light indicates that the machine is ready for use. The light goes off when the machine is feeding cards.

START KEY

Card feeding is started by pressing the START key. Pressing this key for three card-feed cycles causes automatic operation.

STOP KEY

This key can be pressed at any time to stop card feeding. When the STOP key is pressed, cards stop feeding from the hopper; those already in the machine are automatically fed into the stacker.

The STOP key is also used as a reset key when card feeding stops with the COMPARE STOP light on.

PRINT-ENTRY SWITCH AND LIGHTS

This switch controls the selection of two printing or card-form setups on one control panel. When the switch is set to 1, ENTRY 1 light is on. Similarly, when the switch is set to 2, ENTRY 2 light is on. (When this optional feature is not installed these positions are blank.)
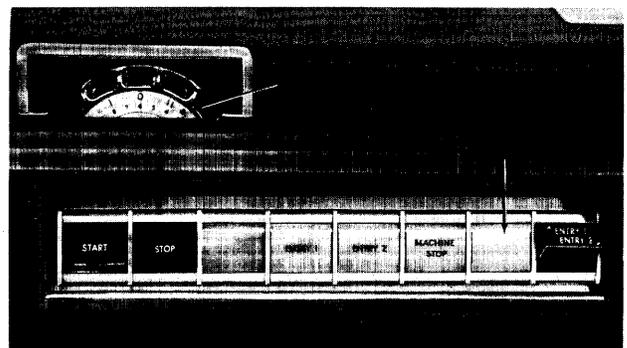

Figure 150. Machine Controls

Machine Stop Light

When this machine is equipped with the Proof device and an error is detected, card feeding stops, this light goes on, and the Proof Indicator points out the location of the error. The light is turned off by resetting the Proof Indicator.

Compare Stop Light

When the machine is equipped with Card-to-Card Comparing, card feeding stops and this light turns on to indicate a condition set up by control-panel wiring. This light is turned off by pressing the STOP key.

Print-Line Dial

This dial can be set by the operator for any one of 25 positions on the card. Figure 151 illustrates the 25 lines of printing. When the dial is set on position 1, printing occurs above the 12 position of the card; when set on position 2, printing occurs at the 12 position; when set on position 3, printing occurs between the 12 and 11 positions, etc. This dial is inoperative when the control panel is wired for selective line printing.

Hopper

The hopper, located at the right end of the machine, holds approximately 800 cards. Cards are placed in the hopper, *face down* with the 12-edge toward the throat.

Stacker

The stacker is located at the left side of the front and holds approximately 900 cards. A stacker-stop switch is provided to stop card-feeding when the stacker is filled. The cards stack in their original sequence. (Up to three additional stackers are available optionally for selection of cards.)

Control Panel

The operations of the machine are directed by wiring on the control panel located on the front of the machine.

Pre-Sensing Station (Figure 152)

The pre-sensing brushes read any of the control punches in the 80 columns of the card. The 80 contact pins corresponding to the brushes are arranged in two banks: odd numbers on the lower, even numbers on the upper. Twenty pre-sensing wires, corresponding to the 20 control X-hubs on the control panel, can be clipped to any of the 80 terminals by the operator. The pre-sensing station is accessible when the top cover of the machine is raised. (This feature is standard on Models 2 and 3 only.)
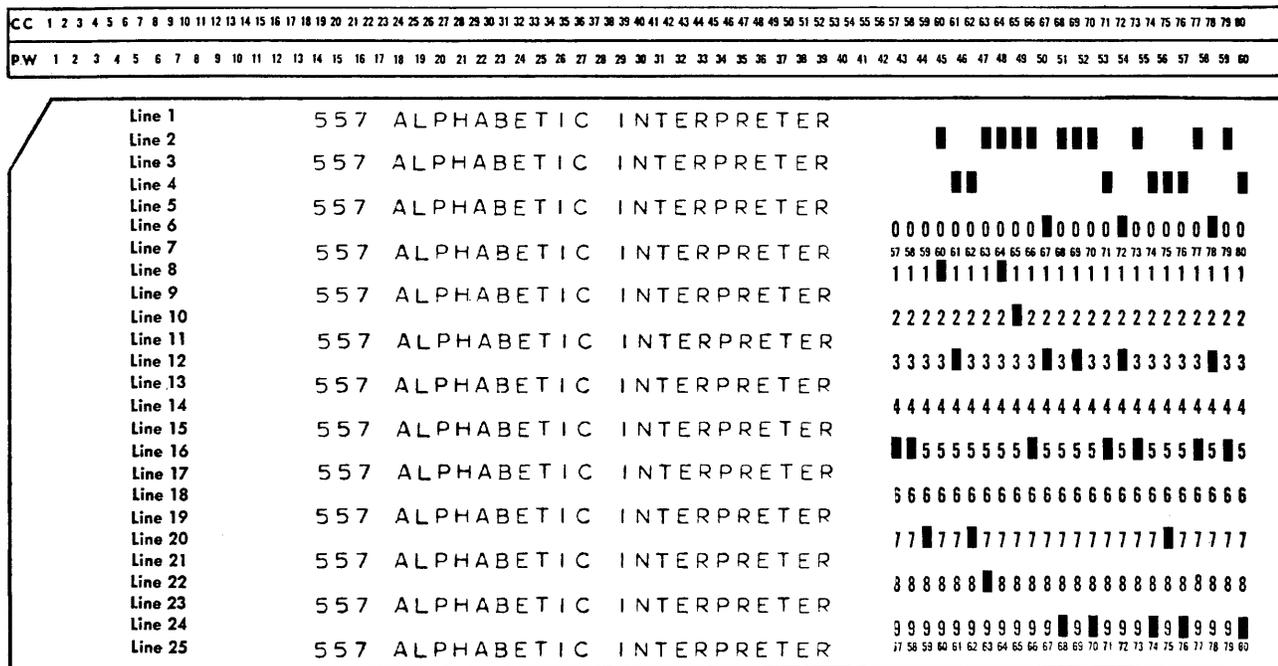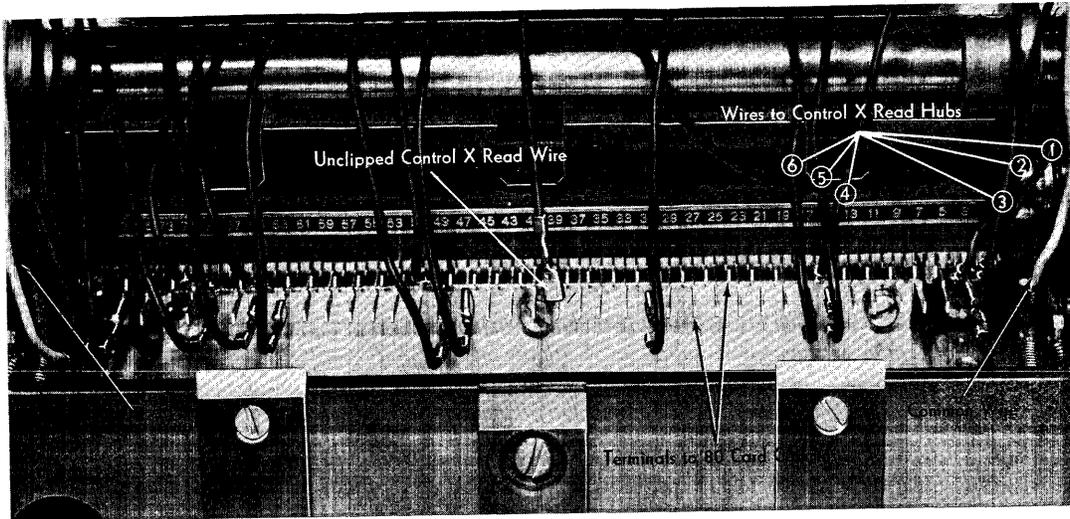

Figure 151. Interpreted Card

Figure 152. Pre-sensing Station

Proof Indicator

The Proof Indicator (Figure 153) is located to the left of the control panel. When an error is detected by the proof device, indicators are extended showing the location and type of error. The unit is reset by pressing the proof-indicator cover. This also turns off the MACHINE STOP light, which signals an error condition.

The various numbers and letters on the proof indicator represent the following:

1 through 60. These numbers indicate the typewheel in which a printing error has occurred.

s. p. This indicator is extended if the suppress print has been controlled correctly, but the machine has failed to perform the operation. Card feeding stops on the cycle following the indication.

SPX. This indicator is extended for an error in the suppress-print control. This may mean that the control panel is incorrect, or that the machine is in error. (A 12-punch in the suppress-print control column is detected as an SPX error.)

TA. This indicator is extended if the typewheels are not in proper alignment for printing. Card feeding stops on the cycle following the indication. Printing is not suppressed on the error card, but is suppressed on the following cards.

RP. This indicator is extended if the repeat print operation has failed, that is, the control is correct, but the machine has failed to perform the operation.

RPX. This indicator is extended if there is an error in the repeat-print control. It may mean that control-panel wiring is incorrect, or that the machine is in error. (A 12-punch in the Repeat-Print control column is detected as an RPX error.)
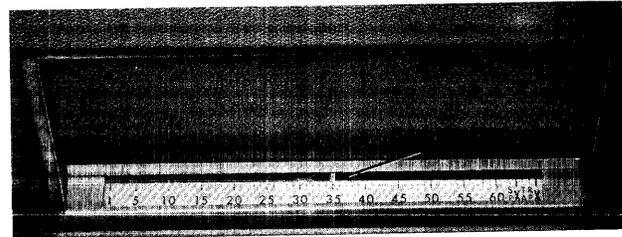

Figure 153. Proof Indicator

MACHINE FUNCTIONS

These machine functions are performed by the standard, full-capacity model:

Printing

The basic operation of the IBM 557 is to record information from a card and print that information on the same card. Information in master cards can also be held in the print unit and repeated into successive detail cards. Printing can also be arranged to take place on the next assigned line on the detail card. Up to 50 lines can be selectively printed on the face of a card.

Proving

Proving is checking the operation of the print unit. Incorrect printing of valid characters, failure to print characters, the operations of repeat and suppress print, and the typewheel alignment can be checked by the proof device. If any of these operations fail, an error is indicated, cards stop feeding from the hopper, and the cards in the machine run into the stacker.
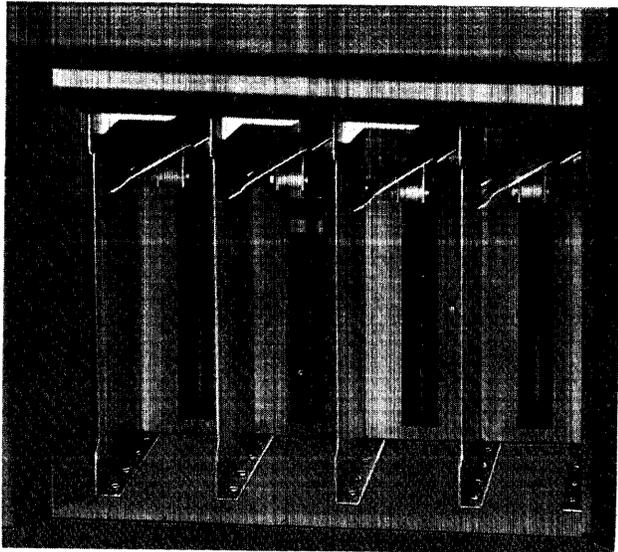
Figure 154. Selective Stackers

Comparing

The comparing feature verifies the operations when information from a master card is transferred to successive detail cards during a repeat-print operation. The comparing unit can also be used to check the arrangement of a file composed of alternating single master and single detail cards.

Selective Stacking

Cards can be directed, by control-panel wiring, to any one of a maximum of four stackers (Figure 154). This permits a limited sorting operation along with interpreting (for example, selecting out unmatched cards, duplicate master or detail cards, cards with special punching, etc.)

OPERATING SUGGESTIONS

Error Correction

Any error indicated by the proof device results in stopping the machine, suppressing printing on the error card, lighting the MACHINE STOP light, and extending one or more indicators. When the error is sensed, no additional cards are fed from the hopper, and all cards already in the feed are advanced into the stacker before the machine is stopped. The error card is the second card in the stacker. Because printing is suppressed for the error card and the card following, be sure to replace these two cards ahead of the file in the hopper.

Ribbon Replacement

The ribbon feeds from one spool to the other, until a metal eyelet about ten inches from the end of the ribbon on either spool operates the ribbon-reversing lever, thus reversing the feed.

When installing a new ribbon, be sure the leading end of the ribbon is firmly hooked on the empty spool. Wind enough ribbon around the empty spool so that the metal eyelet falls between the spool and the ribbon-reversing lever. Threading the ribbon around guide rollers is shown in Figure 155.

Optional Features

Auxiliary Card Counter

This device counts the number of cards passing through the machine. It can also selectively count the number of cards in different classifications or groups.

Zero Elimination Device (548, 552 only)

This device suppresses printing of zeros to the left of the highest significant digit in a field.

Review Questions — IBM 548, 552, 557

1. What is the purpose of the interpreter?
2. How are the cards placed in the IBM 548 and 552 hopper? In the IBM 557 hopper?
3. How are they stacked?
4. What may stop cards from feeding from the hopper?
5. Where does interpreted information appear on a card fed in the IBM 548? In the IBM 552? In the IBM 557?
6. How are the printing positions controlled on the IBM 548, 552, 557?
7. How many characters can be printed on one line?
8. How can all 80 columns be interpreted?
9. What precautions are necessary to prevent failures in feeding?
10. If a card is punched JONES and interprets as JNOES, what do you think is the trouble?
11. On the IBM 548, 552, how should cards be run through the machine if the original sequence of the file is to be maintained?
12. What conditions cause card feeding in the IBM 557 to stop and the MACHINE STOP light to come on?
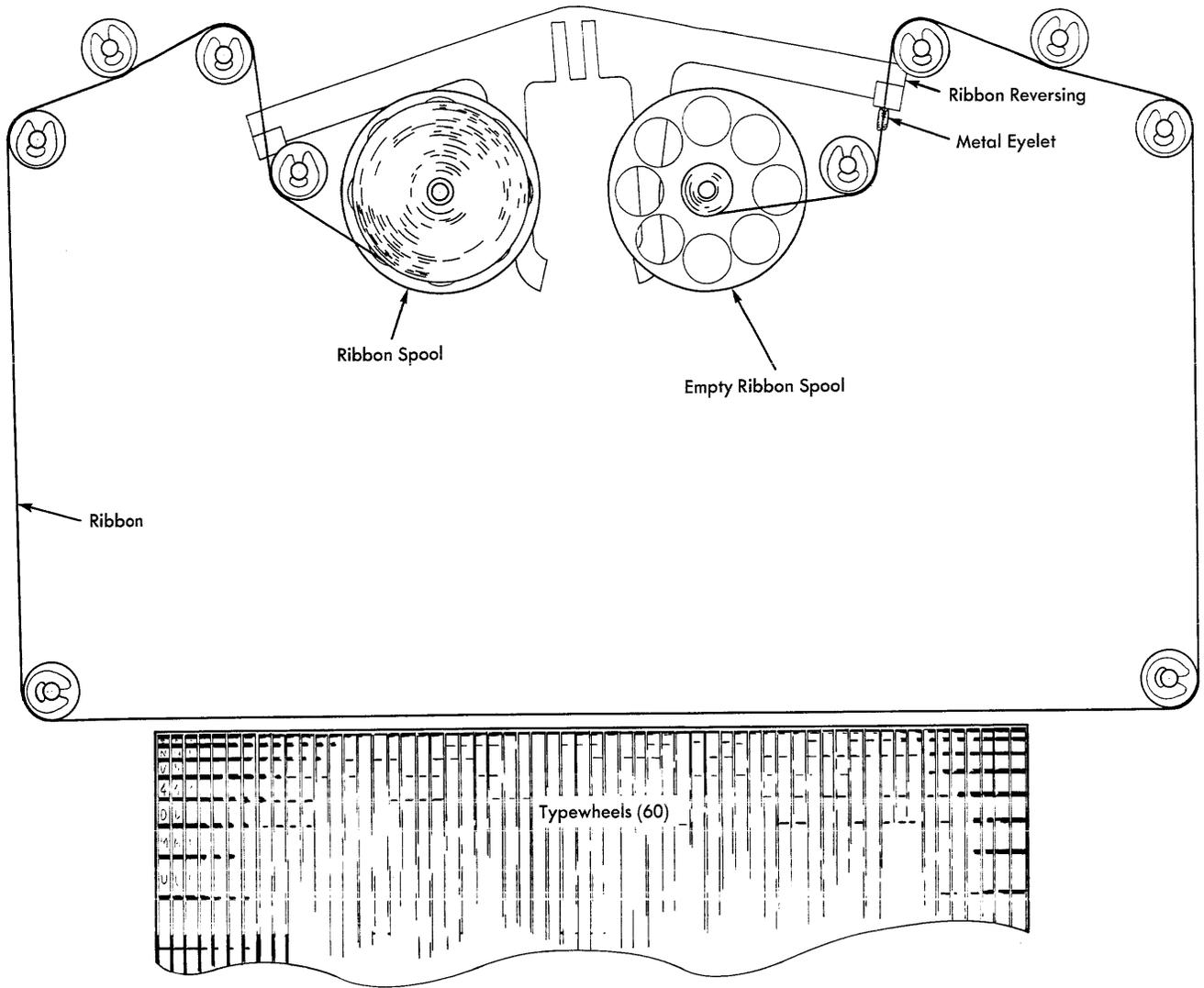13. How do you set the X-brushes on the IBM 548? The Control X wires on the IBM 557?

Figure 155. Ribbon Feed Schematic

IBM Calculating Punches

Maintaining individual records makes it necessary to perform many computations, such as addition, subtraction, multiplication, and division on each record. The accuracy of final reports depends on the accuracy of these computations.

The pencil and paper method is commonly used to obtain the result of a combination of figures. Other methods involve the use of key-driven machines, manually operated, such as adding and calculating machines.

Several IBM calculating punches have been developed which are capable of automatically performing computations involving adding, subtracting, multiplying, and dividing. The factors are read from the cards and the results punched in the same, or different cards. Three of these machines are covered in this manual: the IBM 602 Calculating Punch, the IBM 604 Electronic Calculating Punch, and the IBM 607 Electronic Calculator.

IBM 602 Calculating Punch

The IBM 602 Calculating Punch (Figure 156) reads factors punched in IBM cards, performs calculations using these factors, and punches the results either in the card from which the factors are read, or in designated cards that follow. The calculations consist of combinations of the basic operations of adding, subtracting, multiplying, and dividing. The standard machine operates at a speed of 200 cycles per minute. The IBM 602 Series 50 is rated at 130 cycles per minute. The number of cycles required for the calculation of a card depends on the size of the factors and the type of problem.
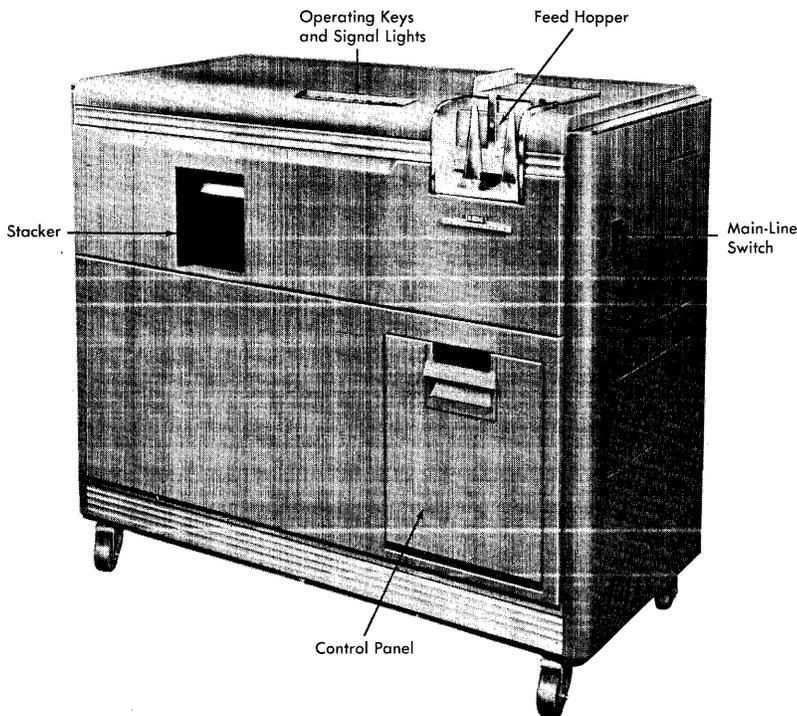

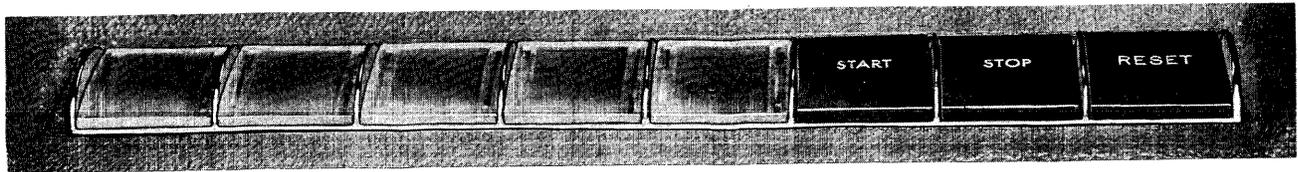Figure 156. IBM 602 Calculating Punch

Figure 157. Machine Controls

OPERATING FEATURES

Machine Controls (Figure 157)

MAIN-LINE SWITCH

The Main-Line Switch is located at the right end of the machine. This switch must be ON to supply power to the machine.

START KEY

Pressing the START key causes the machine to start card feeding and calculating.

STOP KEY

The STOP key can be pressed at any time to stop action instantly, even though the machine may be in the middle of a calculation. Calculation and card feeding can be started again by pressing the START key.

RESET KEY

When the machine has stopped because of an error in checking, the RESET key extinguishes the COMPARE light and permits card feeding to be restarted.

COMPARE LIGHT

This light is used principally to signal an error detected during a checking operation. It may also signal a burned-out fuse, an error in control-panel wiring, a card-feed failure, a card jam, improper counter reset, improper storage punching, or a specific control-panel wiring condition. It is turned off by pressing the RESET key.

LIGHT (UNLABELED)

This light goes on when the main-line switch is ON and the machine is ready to feed cards. This light goes off while the cards are feeding.

Hopper

Cards are placed in the hopper, face down, with the 9-edge toward the throat. As each card enters the machine (Figure 158), it passes the control brushes, where the control punches are read. The card then moves past the reading brushes, where the factors are read for making the calculation. The card continues to feed in a semicircular path into the punch bed, where it is
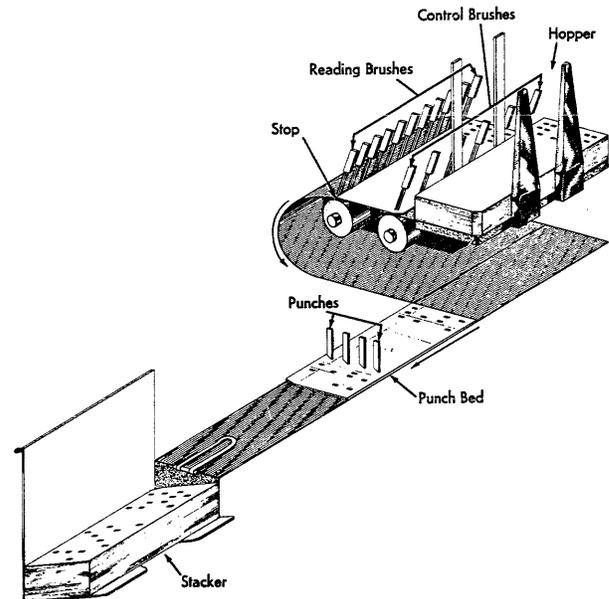

Figure 158. Path of Card through the Machine

skipped into position for punching the results. After calculation is completed, a new card is fed, and the machine begins calculation for this card while the previous card is being punched. As soon as punching of each card is completed, it is ejected into the stacker face down.

Stacker

The stacker receives the cards after they have been processed through the calculator. When the cards are released from the punch bed, they are ejected face down and stacked in the same sequence as they were placed in the hopper.

Adjustable Skip Bar

The skip bar governs the location of the punching according to the fields in the card. The skip bar (Figure 159) contains 80 positions (one for each column of the card) in which a small insert is placed for the *first*
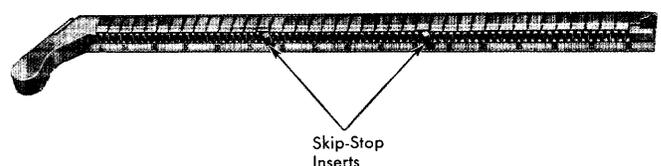

Skip-Stop
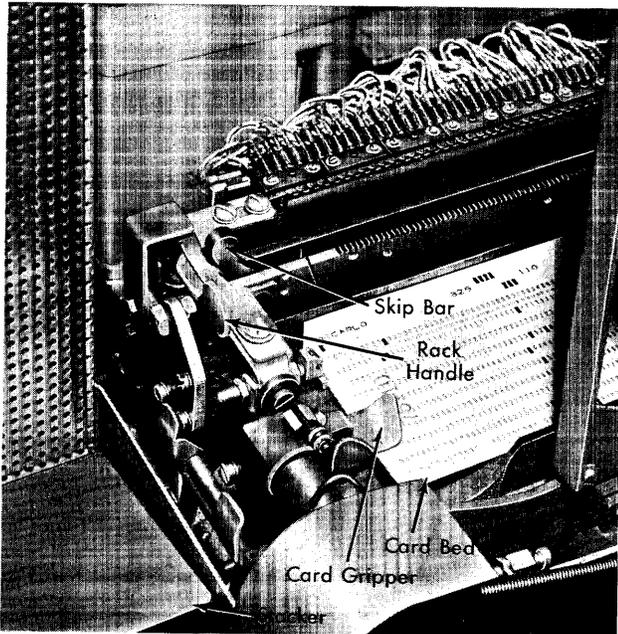Inserts

Figure 159. Adjustable Skip Bar

Figure 160. Skip Bar in Rack

column of each field to be punched after a skip. The small notch under the triangular head of the insert faces toward the back of the bar.

After the skip bar is prepared, it is inserted in the machine directly behind the punch bed, which is accessible when the top or front cover of the machine is opened (Figure 160). The skip bar is most easily removed by pushing it slightly to the right and lifting it up. The rack holding the skip bar should be all the way to the left before the skip bar is removed.

Single skip-stop inserts cannot be placed in adjacent positions; use a special double skip-stop insert for this purpose.

For operations requiring no punching, a skip bar without inserts must be used.

Control Panel

The control panel, wired for the specific calculation, is placed in the rack in the front of the machine. The control panel must be in position and the cover closed to operate the machine. Opening the control-panel cover automatically runs out the cards into the stacker without calculating or punching. When cards are to be run out, cards in the hopper should first be removed.

MACHINE FUNCTIONS

The calculating punch can be used to perform the following functions as set up by the control panel:

Crossfooting

Two or more factors in the same card can be added or subtracted, and the result can be punched and/or used as a factor for further calculations during the same pass of the cards through the machine. Crossfooting two factors is described as $A + B = T$, or $A - B = \pm T$.
    Example:
        Regular Hours + Overtime Hours = Total Hours
        Item Amount − Cost Amount = ± Profit or Loss

Multiplication

One factor can be multiplied by another factor to produce a single product. Several factors can be multiplied simultaneously by a single factor to produce several products. Several individual multiplications can be performed in a single run.
    Example:

$$\text{Piecework Rate} \times \text{Number of Pieces} = \frac{\text{Piecework}}{\text{Earnings}}$$

Division

When this feature is available, one factor can be divided by another factor to produce a single quotient. Several individual division operations can be performed in a single run. Simple division is expressed as $A \div B = Q$.
    Example:
        Regular Earnings ÷ Actual Hours = Average Rate

Combination Operations

Crossfooting, multiplication, and division can be performed successively in any sequence during a single run. Separate results can be punched for each type of calculation and/or each result can be used as a factor for following calculations. One type of combined operation is expressed as $A \times B = P$; $P \div C = R$.

Group Calculation

This method allows a common factor to be set up in the machine. This factor is usually set up from an X-punched master card fed in front of a group of de-

tail cards. Factors in the detail cards and in the master card are used in the manner determined by the control-panel wiring.

Example: A master card punched with the hourly rate precedes the detail cards that contain the number of hours. The hourly rate is entered in the machine from the master card, and the hours in each detail card are multiplied by that rate; the result (gross pay) is punched into each detail card. As each master card passes through the machine, the X-punch causes the previous multiplier to be cleared, and the new multiplier to be read in.

Summary Punching

Factors or calculated results can be accumulated from each card of a group, and the sum punched in a summary card at the end. Calculations can also be performed for the summary card.

Checking

Punched results can be verified during a separate run of the cards through the machine. Control-panel wiring determines whether an error is indicated by a card-feed stop, or by an X-punch for error cards and a 12-punch for all correct cards.

OPERATING PROCEDURE

1. Make sure that you understand the operation to be performed. If in doubt, ask the supervisor to explain fully.

2. See that the cord is plugged into the proper source of power. The main-line switch on the machine should be OFF when the machine is being plugged in.

3. Insert the control panel and close its cover.

4. Raise the top cover of the machine and check the adjustable skip bar to see that the inserts are in the proper columns. (If the rack is not all the way to the left, close the cover, turn on the main-line switch and press the START key.) Insert the skip bar in its holder in the machine.

5. Turn on the main-line switch. The unlabeled light should glow, indicating that the machine is ready to operate.

6. Joggle the cards into perfect alignment and place them in the hopper, face down, with the 9-edge toward the throat. Fill the hopper about three-fourths full. Always place the card weight on top of the cards.

7. Press the START key and feed several cards through the machine. When two cards have entered the stacker, press the STOP key. Check the computations on these two cards manually. If correct, place them back in the stacker in proper sequence, face down, 9-edge toward the front of the machine, and press the START key to resume operation. If cards do not check, call the supervisor.

8. At frequent intervals, remove the cards from the stacker, joggle, and file according to instructions.

9. At the completion of a checking operation in which 12's are punched for correct cards and X's for incorrect cards, needle-check the proper column for 12's. Remove and correct any cards punched with an X.

10. When the operation is completed, turn off the main-line switch.

OPERATING SUGGESTIONS

STARTING THE OPERATION

Be certain no wires fall between the panel and the contacts, or interfere with the closing mechanism at the sides of the cover.

If cards do not feed when the START key is pressed with the ready light on, check to see that all covers are closed. Open doors or covers prevent the machine from starting.

If the skip-stop inserts are positioned correctly, but cards feed from the hopper only and do not feed through the machine to the stacker, have the supervisor check the control-panel wiring.

Always conduct a test run of a few cards. Check these cards manually to be certain the calculations and punching are correct. If in error, call your supervisor.

SKIP BAR OPERATION

The skip bar is most easily removed by pushing it slightly to the right and up. The rack holding the skip bar should be all the way to the left before the skip bar is removed.

If skip-stop inserts are not in the proper columns, the results are not punched properly. If an insert is placed to the left of the proper column, card feeding stops and no punching occurs. Remove the cards from the hopper, and open the control-panel cover to cause the cards in the machine to enter the stacker.

When checking the first cards, if you find that only part of a calculated result has been punched, the skip-stop insert has been placed too far to the right. There is no other immediate indication that the card is not punched correctly. This is an important reason why the manual check of the first cards is important.

When results are to be punched in the cards, failure to place inserts in the skip bar causes the machine to skip the card immediately to column 80 and remain there until the control panel is opened.

During the Operation

Watch the stacker and remove cards at frequent intervals. Don't allow the stacker to become too full.

If a fuse should blow, a small plunger drops from the lower end, making it readily detectable. This plunger prevents further operation of the machine until the fuse is replaced.

The main-line switch should never be turned off during an operation. Stop the operation by pressing the STOP key before turning off the main-line switch.

When card feeding stops for any reason, cards in the machine can be run out automatically by opening the control-panel cover. The cards are ejected into the stacker without calculation or punching. Before the control-panel cover is opened, cards in the hopper should be removed; otherwise they all run through the machine into the stacker.

In a checking operation in which card feeding stops for errors, the error card may be either the last card in the stacker or the card in the rack, depending on the way the control panel is wired. If the card is in the stacker, it has been punched and must be corrected. If the card is in the rack, the erroneous calcu-lation has not been punched and the card can be re-run. To do this:

1. Remove the cards from the hopper.
2. Press the RESET key.
3. Open the control-panel rack to run out the cards in the machine.
4. Place the group of cards, from the error card on, in the hopper.
5. Press the START key to restart card feeding.

REVIEW QUESTIONS — IBM 602

1. What is the purpose of the calculating punch
2. When the results of calculations are obtained, how are they recorded?
3. When a card reaches the card bed but fails to punch, skip, or eject, what are most likely the causes?
4. The machine is wired to multiply two 2-position numbers. If the multiplier is 12 and the multiplicand is 12, the machine punches 44. What is most likely the cause?
5. The first card to enter the machine skips immediaately to column 80 without punching any answers. What is most likely the cause?
6. What happens when the control-panel cover is opened with cards in the machine?
7. When the COMPARE light goes on, what occurs, and how is it turned off?
8. Why must all covers and doors be closed before an operation is begun?
9. How can a blown fuse be located?
10. The machine has stopped and signaled an error condition. The control panel is wired so that the error card is the top card in the stacker. What must the operator do now?

IBM 604 Electronic Calculating Punch

The IBM 604 Electronic Calculating Punch (Figure 161) uses electronic means for performing the basic calculations: addition, subtraction, multiplication, and division. In addition to the functions of the IBM 602, the IBM 604 has increased speed (100 cards per minute) and the ability to gangpunch.

The IBM 604 Electronic Calculating Punch consists of two basic units, which are connected by a cable:

1. IBM 521 Punching Unit
2. IBM 604 Electronic Calculating Unit

Cards are fed through the punching unit, where factors are read for calculation. The factors are transferred to the electronic calculating unit, where calcutions for each card are made while the card moves to the punching station in the punching unit. Calculated results are then transferred back to the punch unit and punched in the card. At a second reading station in the punching unit, the card can be read for gangpunching, recalculation, and double-punch and blank-column checking. Thus, while one card is being read for calculation, the card ahead is being punched, and the card ahead of that can be read for checking.

Punch-Unit Controls (Figure 162)

MAIN-LINE SWITCH

When the main-line switch (located on the right side of the punch unit) is turned on and the POWER ON key on the calculating unit is pressed, power is supplied to both units. Operation can be started when the red unlabeled light on the punching unit and the green unlabeled light on the calculating unit go on, indicating the machine is ready to operate.

START KEY

This key is pressed to feed cards and start calculation. It is effective only when both unlabeled lights are on. If the punch unit is used independently, the START key may be pressed as soon as the main-line switch is turned on.
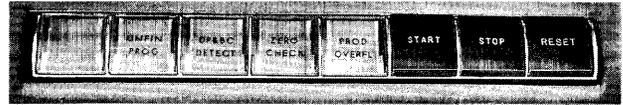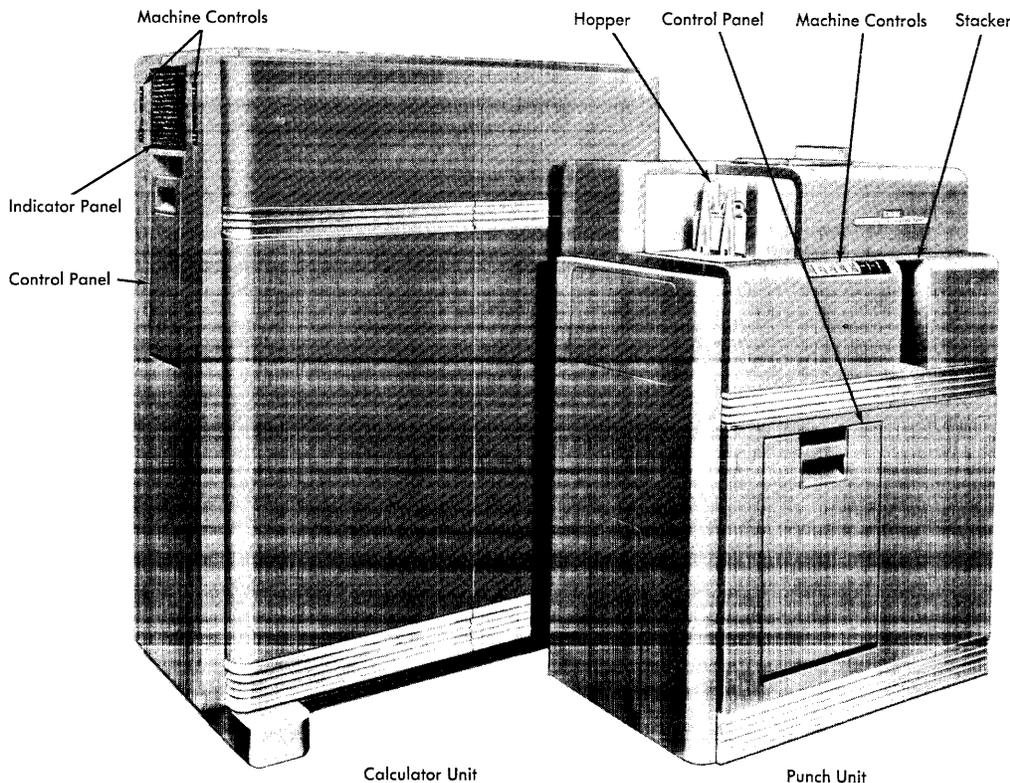

Figure 162. Machine Controls—Punch Unit

Figure 161. IBM 604 Electronic Calculating Punch

STOP KEY

This key stops the operation of both the punching and calculating units.

RESET KEY

When an error is signaled by one of the four error-condition lights, the RESET key must be pressed before card feeding can be restarted.

LIGHT (UNLABELED)

This red light goes on as soon as the machine is ready to operate. It goes off while cards are passing through the machine and goes on again when card feeding stops. It also goes off when the control panel in either unit is removed.

UNFINISHED PROGRAM LIGHT

The red UNFIN PROG light goes on, card feeding stops, and all punching is suppressed, when a calculation cannot be completed in the time it takes a card to move from the first reading station to the punch station. This light is operated by control-panel wiring.

DOUBLE-PUNCH AND BLANK-COLUMN LIGHT

The red DP&BC DETECT light goes on and card feeding stops whenever a double punch or blank column is sensed.

ZERO CHECK LIGHT

The red ZERO CHECK light goes on and card feeding stops if the counter is not zero during a zero-check operation. This light is operated by control-panel wiring.

PRODUCT OVERFLOW LIGHT

The red PRODUCT OVERFLOW light goes on and card feeding stops if the result of a calculation exceeds the number of card columns to be punched. This light is operated by control-panel wiring.

Calculating-Unit Controls (Figure 163)

POWER ON, POWER OFF KEYS

These keys operate like a main-line switch for the calculating unit. When the POWER ON key is pressed (with the main-line switch on the punching unit also ON), power is supplied to the electronic tubes, the STARTING light goes on immediately, and the unlabeled light goes on after approximately three minutes. When the POWER OFF key is pressed, power to both the calculating and punch units is turned off.

STARTING LIGHT

The red STARTING light goes on when the POWER ON key is pressed. It goes off when the calculating unit is ready to operate, as indicated by the green unlabeled light.

LIGHT (UNLABELED)

This green light goes on approximately three minutes after the POWER ON key has been pressed, if the main-line switch of the punch unit is also ON. It indicates that the machine is ready to operate. The light goes
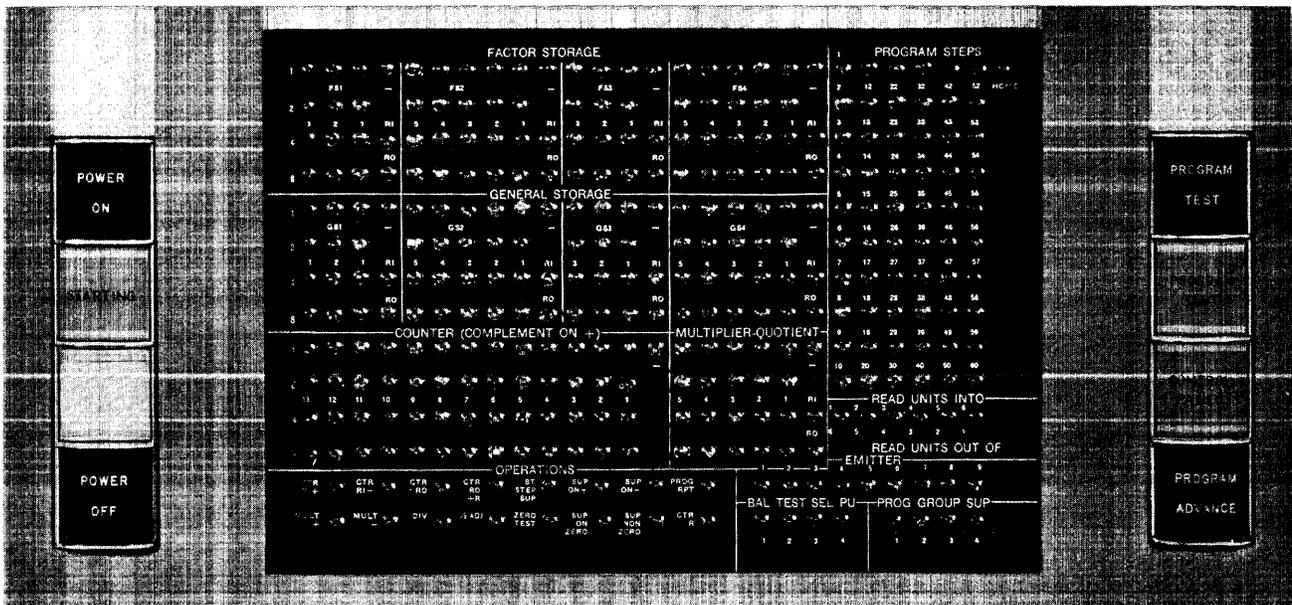

Figure 163. Machine Controls and Indicator Lamp Panel — Calculator Unit

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off when the control panel in the calculating unit is removed.

PROGRAM TEST KEY, PROGRAM TEST LIGHT

Pressing this key once makes it possible to operate the IBM 604 one step at a time and turns on the PROGRAM TEST light immediately. Pressing the key a second time returns the IBM 604 to high-speed operation.

A program test is made to check the machine calculation with the planning calculation or the control-panel wiring.

CONTROL-PANEL LIGHT

This red light goes on when the control panel is removed from the IBM 604 Calculating Unit.

PROGRAM ADVANCE KEY

When the PROGRAM TEST key has been pressed once, the program steps can be advanced one at a time by pressing the PROGRAM ADVANCE key. No punching occurs during this operation.

Hopper

Cards are placed in the hopper of the punch unit face down, 12-edge toward the throat. Capacity of the hopper is approximately 800 cards.

Stacker

The stacker of the punch unit holds approximately 1000 cards. When filled to capacity, card feeding stops automatically.

Control Panels

Separate control panels are required for the punching unit and the calculating unit. All functions that concern card reading and card punching are wired in the punch control panel, and all functions concerning the actual calculation are wired in the calculator control panel.

Indicator Panel

The indicator panel (Figure 163) consists of a group of small neon lamps that light up to indicate the factors stored and the functions performed during any given program step. Its purpose is to facilitate location of errors in planning or control-panel wiring.

OPERATING PROCEDURE

1. Make sure that you understand the operation to be performed. If in doubt, ask the supervisor to explain fully.

2. Insert the control panels in the control-panel racks and close the covers.

3. Turn on the main-line switch and press the POWER ON key. After about three minutes the ready lights should glow, indicating that the machine is ready to operate.

4. Cards should be joggled into perfect alignment and placed in the hopper, face down with the 12-edge toward the throat. Always place the card weight on top of the cards.

5. Press the START key and feed several cards through the machine. When two cards have entered the stacker, press the STOP key. Check the computations in these two cards manually. If correct, place them back in the stacker in proper sequence, and press the START key to resume operation. If cards do not check, call the supervisor.

6. At frequent intervals, remove the cards from the stacker, joggle, and file according to instructions.

7. Whenever card feeding stops because of an error, the error card is the last one into the stacker. The RESET key must be pressed before the START key is operative. (The Error Offset feature [optional] offsets the error card in the stacker instead of stopping the machine.)

8. When the operation is completed, turn off the main-line switch and press the POWER OFF key.

OPERATING SUGGESTIONS

Before starting an operation, always conduct a test run of a few cards. Check these cards manually to be certain the calculations and punching are correct. If in error, call your supervisor.

In the event card feeding stops because of an unfinished program, the particular card involved is the top card in the stacker. The card is not punched and can be re-run by pressing the STOP key after each card is fed. This allows ample time to complete the calculation.

Scheduling work on the IBM 604 should provide for operation as continuous as possible. Leave the machine turned on if it is to be inoperative for a short period of time (one hour or less). If the calculator is inoperative for a longer period of time, it should be turned off.

IBM 607 Electronic Calculator

The IBM 607 Electronic Calculator (Figure 164) functions and operates the same as the IBM 604, but has additional capacity. The flexibility and extra capacity of this calculator enable it to handle a wider range of calculations for business and industry.

Operations and calculations are performed at a basic rate of 100 cards per minute. By control-panel wiring, the IBM 607 can be instructed to delay punching for any given card until all calculations on that card are completely finished. This feature brings many complex calculating problems within the scope of this machine.

The IBM 607 Electronic Calculator consists of two standard units and one optional unit:

1. IBM 529 Punch Unit
2. IBM 607 Electronic Calculating Unit
3. IBM 942 Electronic Storage Unit (optional)

The IBM 529 Punch Unit is similar in operation to the IBM 521 Punching Unit of the IBM 604.

The IBM 607 Electronic Calculating Unit, cable-connected to the punch unit, performs all calculations.

The IBM 942 Electronic Storage Unit (optional) is cable-connected to calculating and punch units. It provides additional electronic storage to complement the standard storage capacity in the calculating unit.
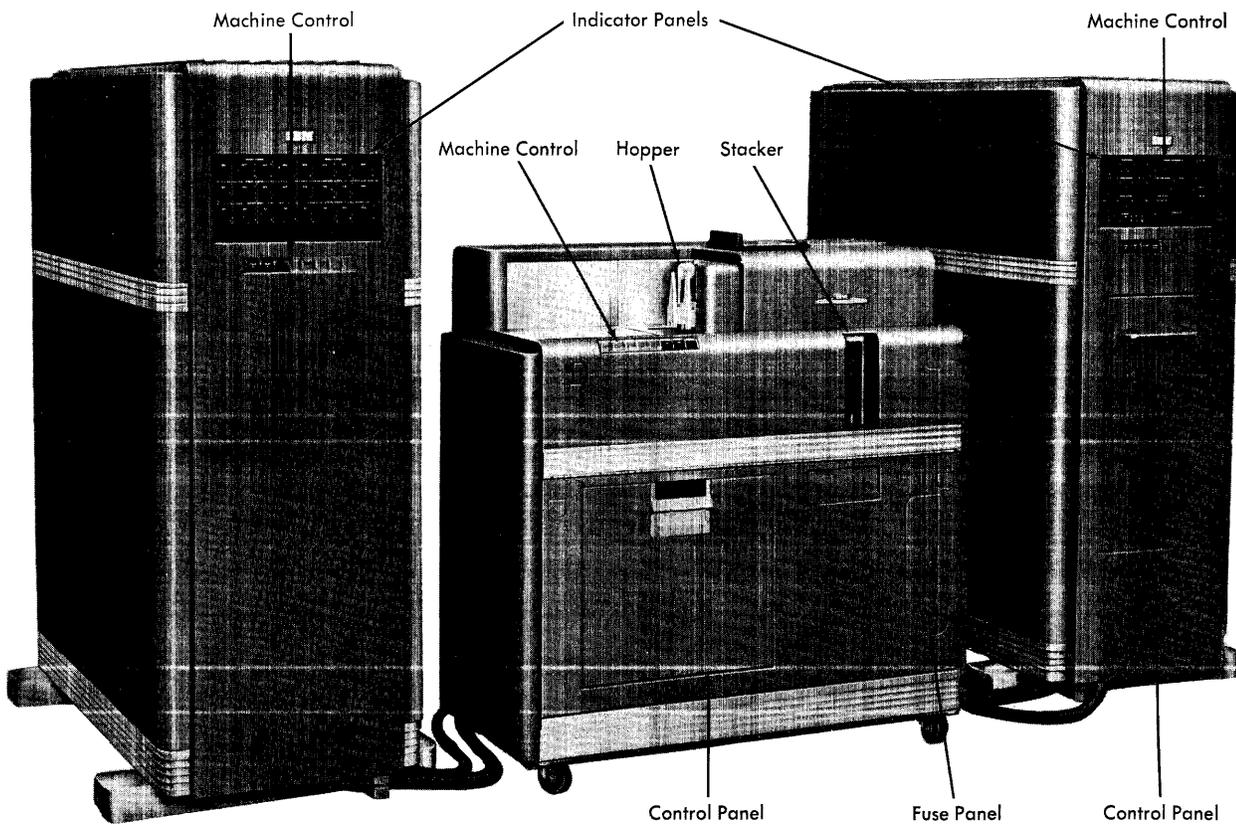

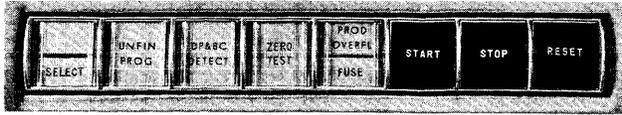Figure 164. IBM 607 Electronic Calculator

Figure 165. Machine Controls — Punch Unit

OPERATING FEATURES

Punch-Unit Controls (Figure 165)

MAIN-LINE SWITCH

When the main-line switch of the punch unit is turned
on and the POWER ON keys of the calculating and stor-
age units are pressed, power is supplied to the calculat-
ing system. Operation can be started after a delay of
approximately two minutes. The red light of the
punch unit goes on as soon as the main-line switch
is turned on; the green ready lights of the calculating
and storage units go on when these units are ready to
operate.

START KEY

This key is pressed to feed cards and start calculation.
This key is effective only when the red light of the
punch unit and the green ready lights of the calculat-
ing and storage units are on. If the punch unit is used
independently, card feeding can be started as soon as
the main-line switch is turned on.

STOP KEY

This key stops the operation of all units before an-
other card is fed.

RESET KEY

When an error is signaled by one of the five error-
condition lights on the punch unit, the RESET key
must be pressed before card feeding can be restarted.
Pressing this key turns off all the signal lights only if
all the error cards have been run into the stacker.

LIGHT (UNLABELED)

This red light goes on as soon as the main-line switch
is turned on. This light goes off while cards are pass-
ing through the machine and goes on again when card
feeding stops.

SELECT LIGHT

The flashing red SELECT light indicates that card feed-
ing has stopped because of a condition set up by con-
trol-panel wiring.

UNFINISHED PROGRAM LIGHT

It is possible to set up the machine to provide ample
calculating time for any problem. However, if an un-

finished program condition does occur, the red UNFIN
PROG light goes on, card feeding stops, and all punch-
ing is suppressed.

DOUBLE-PUNCH AND BLANK-COLUMN LIGHT

The red DP&BC DETECT lights goes on whenever a dou-
ble punch or a blank column is sensed.

ZERO TEST LIGHT

The red ZERO TEST light goes on and card feeding stops
because of control-panel wiring set up for a checking
operation.

PRODUCT OVERFLOW LIGHT

The red PROD OFL light goes on and card feeding stops
if the result of a calculation exceeds the number of
card columns to be punched.

FUSE LIGHT

The red FUSE light goes on and card feeding stops
whenever a fuse in the punch unit burns out.

Calculator-Unit Controls (Figure 166)

POWER ON, POWER OFF KEYS

These keys operate like a main-line switch for the
calculating unit. When the POWER ON key is pressed
(with the main-line switch on the punch unit also ON),
power is supplied to the electronic tubes and the
STARTING light goes on immediately.

Pressing the POWER OFF key stops the operation of
both the calculating unit and the punch unit, and
turns off the lights on the calculating unit.

PROGRAM TEST KEY, PROGRAM TEST LIGHT

Pressing this key once makes it possible to operate
the calculating unit one step at a time, and turns on
the PROGRAM TEST light. Pressing the key a second time
returns the calculator to high-speed operation and
turns off the light.

A program test is made to check the machine calcu-
lation with the planning calculation or the control-
panel wiring.

PROGRAM ADVANCE KEY

When the PROGRAM TEST key has been pressed once, the
program steps (indicated by Program Step lights on
the neon panel) can be advanced one at a time by

Figure 166. Machine Controls — Calculator Unit

pressing the PROGRAM ADVANCE key. No punching occurs during this operation.

STARTING LIGHT

The red STARTING light goes on when the POWER ON key is pressed. It goes off when the calculating unit is ready to operate.

CONTROL-PANEL LIGHT

The red CONTROL-PANEL light goes on when the control panel is removed from either the calculating or punch units, when a cover of the punch unit is open, or if the power is turned off either the punch or storage unit.

LIGHT (UNLABELED)

This green light goes on approximately two minutes after the POWER ON key has been pressed. It indicates that the machine is ready to operate.

Storage-Unit Controls (Figure 167)

POWER ON, POWER OFF KEYS

These keys operate like a main-line switch for the storage unit. When the POWER ON key is pressed, power is supplied to the storage unit and the red STARTING light goes on.

When the POWER OFF key is pressed, the operation of the storage unit stops and all the lights on the storage unit go off.
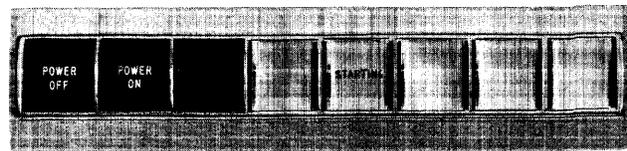

Figure 167. Machine Controls — Storage Unit

STARTING LIGHT

This light goes on when the POWER ON key is pressed. It goes off when the storage unit is ready to operate, as indicated by the green unlabeled light.

LIGHT (UNLABELED)

This green light goes on approximately two minutes after the POWER ON key has been pressed. It indicates that the unit is ready to operate.

Indicator Panels

The indicator panel of the calculator unit (Figure 168) consists of a group of small neon lamps that light up to indicate the factors stored and the functions performed on any given program step. The indicator panel of the storage unit indicates the factors stored in the storage unit (Figure 169). These panels facilitate location of errors in planning or control-panel wiring.
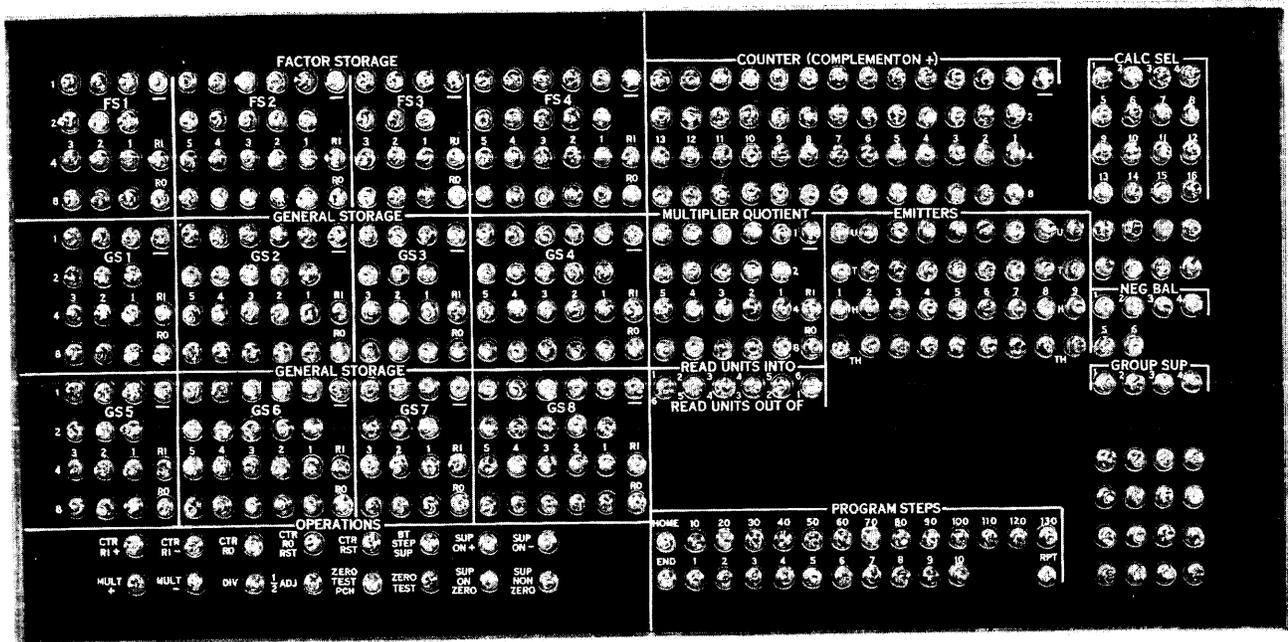

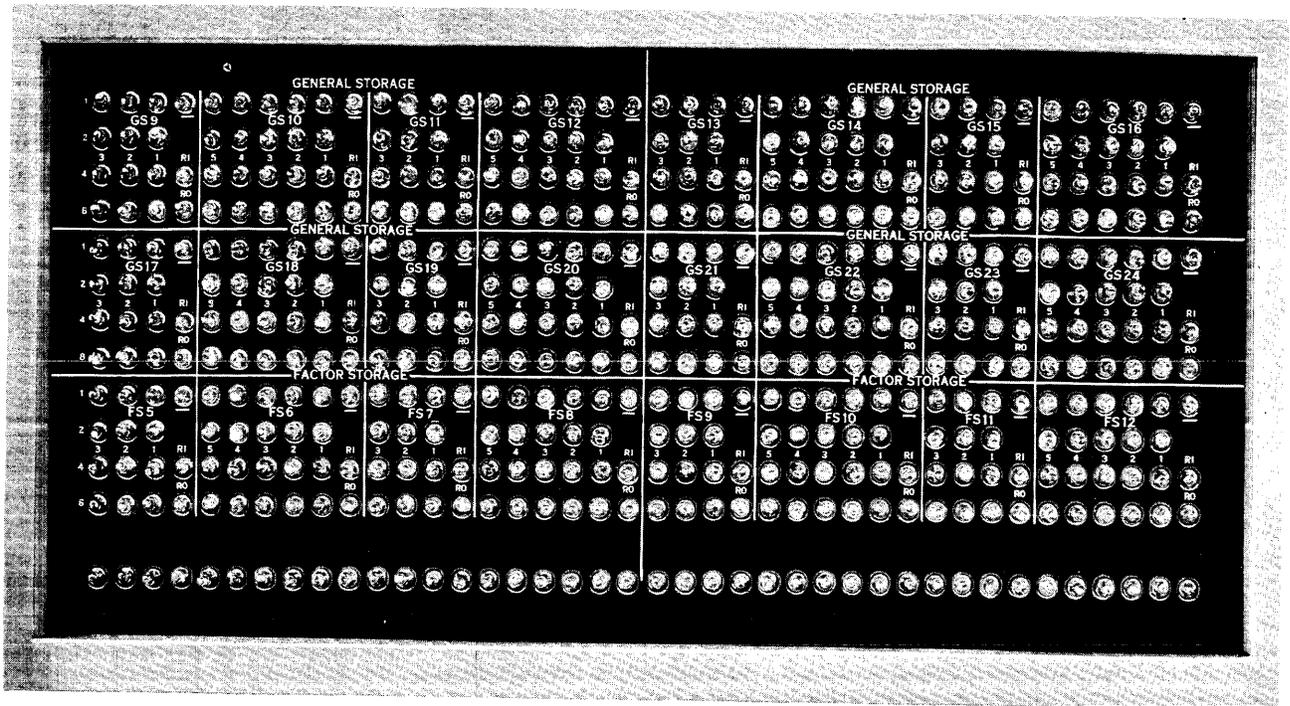Figure 168. Indicator Panel — Calculator Unit

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Figure 169.   Indicator Panel — Storage Unit

REVIEW QUESTIONS — IBM 604, 607

1. What is the purpose of the electronic calculators?

2. What is the function of the various units of the electronic calculators?

3. When card feeding stops with an error-condition light on, how is the machine restarted?

4. What is the procedure for re-running a card that was not punched due to an unfinished program?

5. What conditions must prevail for cards to start feeding when starting an operation?

6. Explain the purpose of the PROGRAM TEST and PROGRAM ADVANCE keys.

7. When card feeding stops due to an error condition, where is the error card to be found?

Glossary

Accumulating — Adding or subtracting in a counter to obtain a total.

Alteration Switch (Set-up Change Switch) — A toggle switch mounted on the machine to change control-panel wiring so that a single panel can perform different operations.

Auxiliary Counter — A device for counting cards passing through the machine.

Bill Feed — An attachment to the 402, 403 used in place of the carriage to feed cut forms for printing (for example, bills, checks).

Brush — An electrical conductor for reading information from a punched card. Normally, each brush has a corresponding hub on the control panel.

Cable — A group of wires bound together and used to connect machine units (for example, summary-punch cable).

Card Bed — A flat plate over which cards travel from hopper to stacker.

Card Feed — The path of the card from the hopper to the stacker.

Card Gage — A metal plate, precisely inscribed with all punches of an 80-column card, used to check the accuracy of punching registration.

Card Jam — A pile-up of cards in a machine.

Card Lever — A lever for electrically detecting the presence of a card along the card path.

Card Weight — A weight placed on the cards in the hopper to permit feeding the last cards.

Carriage — A device on the accounting machine for controlled feeding of continuous forms.

Carriage Tape — A 12-channel paper band punched with holes to stop skipping of forms at a predetermined printing position.

Channel — One of 12 specific positions on the carriage tape to govern skipping of forms.

Chip Box — A container that collects the punched-out chips, or chads, from the punches.

Chute Blades — Metal strips that guide a card along the card path to the selected pocket.

Column Indicator — The pointer showing the column to be punched or read in a card punch, verifier, or sorter.

Column Selector — A device for positioning the sort brush on a specific column.

Collating — Arranging two files of cards into a single file according to a predetermined pattern.

Comparing — Examining two fields in the same or different cards to see if the punching checked is the same. Some machines establish which is greater.

Continuous Forms — Paper or card forms attached for continuous feeding in the accounting machine carriage.

Control Panel — The demountable panel containing the external wiring to govern machine operations.

Control Punch — A punched hole (usually the X- or 12-punch) for controlling machine operation, normally by selectors.

Corner Cut — A diagonal cut at the corner of a card as one means of every identification (for example, master or detail cards) by sight or by a special rail brush.

Crossfooting — Accumulating numbers in different fields in the same card.

Cycle — A complete series of operations at the end of which the entire series can be repeated.

Deck, Test Deck — A set of cards representative of all operations performed in a particular application. Used to test control-panel wiring and machine operation.

Demountable Typebar — See TYPEBAR.

Detail Card — A term applied to an IBM card to distinguish it from a master or heading card.

Detail Printing (Listing) — Printing information from each card passing through the machine.

Editing — Checking cards for accuracy of punching, counting, or sorting according to a specific pattern.

ELECTROGRAPHIC® *Pencil* — The high-graphite-content pencil used to mark IBM cards for reading in automatic punches.

Ejection — Movement of a card from the card bed to a stacker.

Emitting — Originating digits, letters and special characters electrically within the machine rather than from the punched card.

Fanning the Cards — The operation for removing particles lodged between cards and for eliminating static charges causing cards to stick together. Grasp one end of the cards securely, draw the other end back, and allow a few cards at a time to "fan" to the normal position.

Feed Knife — The device for feeding cards from the hopper into the machine.

Feed Rollers — The rollers that transport a card along the card feed from hopper to stacker.

Field — A column or group of columns in an IBM card allocated for punching specific information.

5081 Card — A standard IBM card printed with columns 1-80 and all 0-9 punching positions.

File Feed — A device for reducing card-handling time by automatically feeding cards from a 3600-card magazine to the hopper.

Form Stop — A device for sensing when the last continuous form feeds in an accounting machine.

Form Thickness — The distance between the platen and print unit in an accounting machine. This distance is adjustable to accommodate forms of various thicknesses.

Forms Tractor — An above-platen device on an accounting machine for feeding marginally-punched continuous forms.

Gangpunching — Punching information read from a master card into the following detail cards. Each card then serves as the master card for the succeeding card.

Group Indication — Printed information identifying a group.

Group Printing (Tabulating) — Printing group totals and group indication as cards pass through an accounting machine.

Hammerlock Levers — Two levers for each printing position in the 402, 403 that can prevent printing in that position. Printing regulated by one of the levers is governed by control-panel wiring.

Hammersplits — A lever for each printing position in a 402, 403 that can be raised to prevent printing zeros to the right of that position.

Heading Cards — IBM cards punched with significant information used to print headings on forms such as invoices or checks.

High Order — The left, or high, position of a number.

Home Keys — The position from which the fingers operate in the touch system of keypunching.

Hopper — The receptacle for holding cards to be fed into a machine.

Interlock — A means of preventing machine operation until required mechanical or electrical conditions are met.

Interpreting — Printing information on the same card in which it is punched.

Inverted Form — A form (for example, remittance statement, check voucher) on which the body information is printed first followed by heading information and special instructions.

Joggle — To align a deck of cards by jostling them against a plane surface.

Keyboard Locking — An interlocking of a keyboard because of improper operation or keying.

Lacing — Extra multiple punching in a card column giving the appearance of lacework.

Leader Card — See MASTER CARD.

Line Finder — The scribed mark on the Forms Tractor pressure fingers serving as a guide for positioning the first printing line on a pre-printed form.

Listing — See DETAIL PRINTING.

Low Order — The right, or low, position of a number.

Mark Sensing — Punching information marked on IBM cards with an ELECTROGRAPHIC pencil.

Master Card — The first card of a group containing fixed or indicative information for that group (for example, gangpunch master card).

Matching — Checking two files to see that there is a corresponding card or group of cards in each file.

Merging — Combining two files, already in sequence, into a single file.

MLP (Multiple-Line Printing) — Printing more than one line from a card passing through a 403.

MLR (Multiple-Line Reading) — Reading a card more than once for printing or processing with a 407.

Needle Checking — Verifying that all cards in a deck contain the same punch in a given column. The prod or needle, pushed through the punched hole, stops at a card containing a different punch.

Off-Punching — Punching not properly positioned in a card. Use a card gage frequently to check punching registration.

Offsetting — Stacking cards slightly out of the normal stacking position for easy identification.

Overflow — The carriage operation ejecting one fully printed form to continue printing on the next. Also, exceeding the capacity of a counter.

Over-Punches — Punches (usually control punches) over the significant digits in a column.

Paper Brake — The device on the carriage of the 402, 403 or on a Forms Tractor, for maintaining proper tension on continuous forms.

Pin-Feed Platen — A platen device for feeding marginally-punched continuous forms.

Platen — The hard rubber roller providing a solid backing for the paper at the printing position.

Pockets — Receptacles (stackers) for receiving cards from the card feed in a multiple-stacker machine (for example, sorter, collator).

Print Position Dial, Knob — The device in an interpreter for controlling the location of the printing line.

Print Wheels — Wheels, embossed with letters, digits and special characters, for printing on forms.

Program Card — An IBM card, punched with specific coding, placed around a program drum to control automatic operations in a card punch and verifier.

Program Drum — The card-controlled mechanism on a card punch or verifier for controlling the automatic operations (for example, skipping, duplicating).

Programming — Establishing a sequence of operations to be performed in processing data.

Proof — The editing feature of the 557 for checking the printing operation.

Punch — A mechanism to punch holes in a card.

Punch Feed — In automatic punches, the card-feed unit containing the punching mechanism.

Punch Station — The position in the card feed where punching occurs.

Rail Brush — A brush, specially installed along the edge or rail of a card feed, for reading corner cuts to distinguish cards (for example, master and detail cards).

Read Feed — In automatic punches, the card feed containing the reproducing brushes.

Read Station — The position in the card feed where reading occurs.

Registration — The position of punched holes in an IBM card. Using the card gage, check registration daily and before every major operation, to assure accuracy.

Reproducing — Copying punched information from one deck of cards into another.

Restore — To clear or return a unit to its normal starting position (for example, comparing unit or carriage tape).

Rolling the Keys — The rapid keying operation of pressing the second key before the first is fully released.

Runout — Moving the last cards in the machine to the stacker.

Scanning Position — That position along the card bed or forms path where the card or form can be fully viewed.

Scored Cards — IBM cards that have been partially pre-cut for detaching stubs or for use in a Port-A-Punch.*

Selecting — Removing cards from a file, or processing cards according to predetermined conditions.

Sequence Checking — Checking cards to assure that they are all in ascending (or descending) order.

Set-Up Change — See ALTERATION SWITCH.

* Trademark

Short Card — An IBM card of less than 80 columns.

Sight Checking — Examining a group of cards for identical punching by viewing a light source through the punched holes.

Single Sheet Form — Forms inserted individually in a carriage for printing.

Skip Bar — A bar containing inserts or cuts that determine where a punch carriage stops under the punches.

Sorting — Arranging cards in a predetermined sequence according to the punching in the card.

Stacker — A receptacle for receiving cards fed through a machine.
Stacker Drum — A device for stacking cards or documents.

Star Wheels — Rotating contact wheels reading the program card in a card punch or verifier.

Station — Any position along a card feed where a card is processed (for example, reading station, punch station).

Stripe — A narrow band of a different color across a card for identification. Also, the inked mark on the back of an error card in the 101.

Stub Cards — IBM cards with one or more detachable portions (or stubs) scored for easy separation.

Summary Punching — Punching summary or total information in cards automatically while printing a report or while calculating.

Tabulating — See GROUP PRINTING.

Tape — See CARRIAGE TAPE.

Tape Punch — A device for punching the 12-channel carriage tape.

Tension — The pull exerted by the paper brake to keep the forms against the platen for proper printing registration.

Throat, Throat Knife — The opening from the hopper into the machine. A throat knife permits only one form to be fed at a time.

Toggle Switch — A manually-operated switch.

Trailer Card — A card placed at the end of a group to serve as a summary or overflow card.

Transcribing — Printing information punched in one card on another card.

Tray — A file drawer.

Typebars — A movable bar containing letters, digits, and special characters for printing. A demountable typebar is one that can be readily removed by the operator and replaced with a different typebar.

Under-Punches — The low punches in a card column (usually the digit punches under zone punching).

Vernier — A device for making fine adjustments (for example, vertical positioning of printing on a form).

X-Brushes — Adjustable reading brushes for sensing control punches.

X-Panel — A small panel for connecting the X-brushes to the main control panel.

X-Punches — See CONTROL PUNCHES.

Zero-Carry Clips — Clips mounted on hammersplit levers to force zeros to print to the left of a significant digit.

Zone Punches — Punches in the 12, X and 0 position of a card column, used in combination with digit punches 1-9 to code alphabetic and special characters.

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