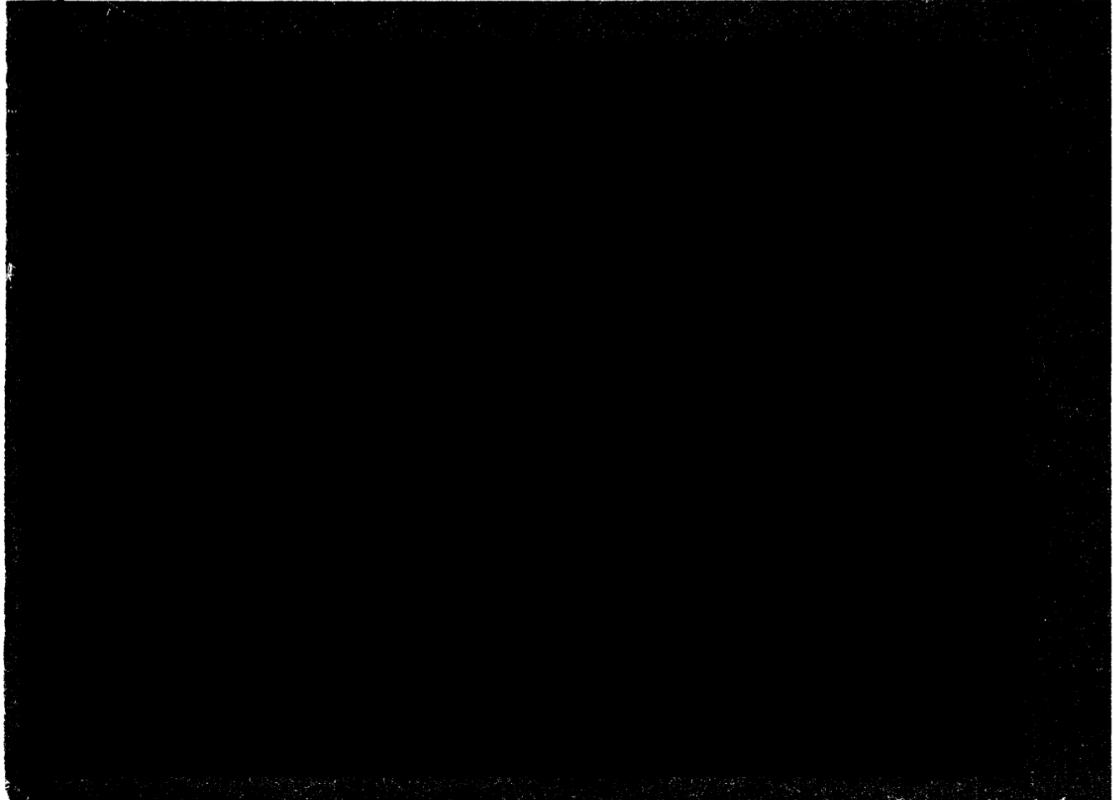
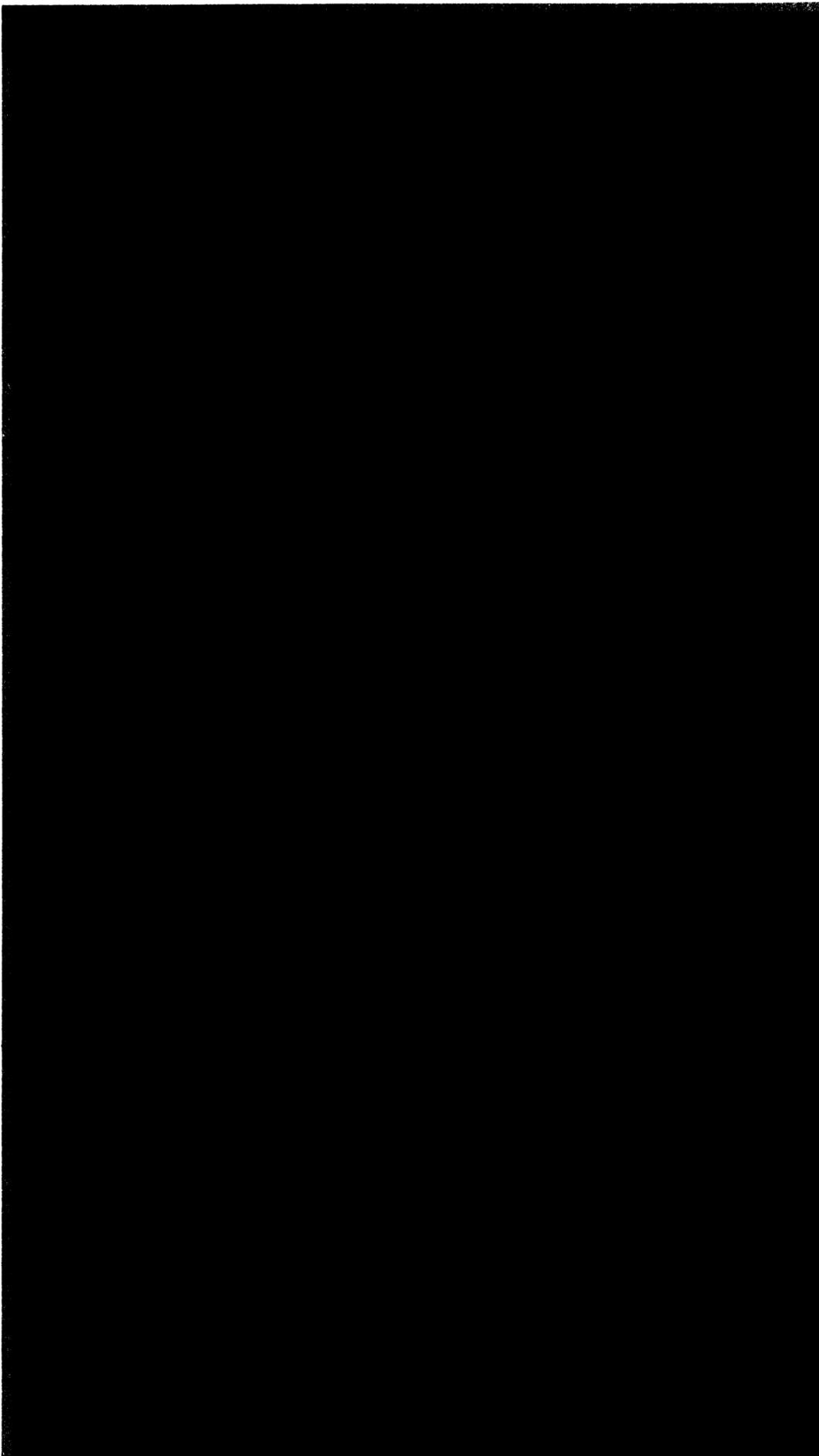
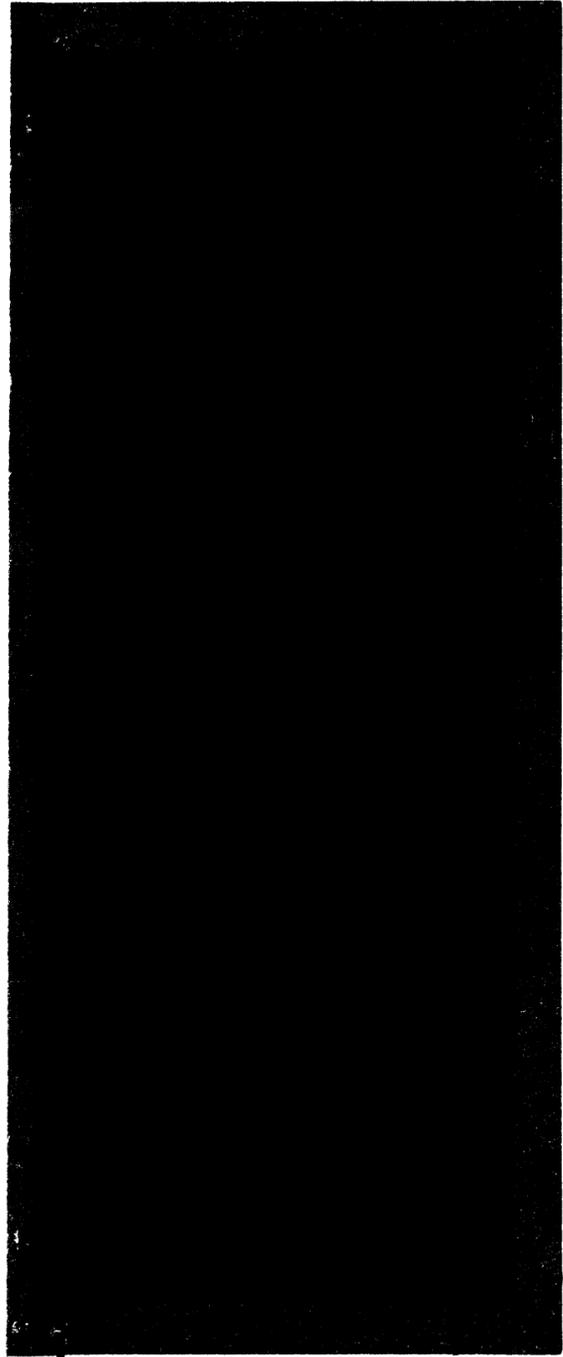


Reference Manual

IBM 29 Card Punch



**IBM**<sup>®</sup>

**Reference Manual**  
**IBM 29 Card Punch**

**FOURTH EDITION**

This is a major revision of, and obsoletes, A24-3332-2. The entire content has been significantly re-arranged and incorporates operating procedures and operating suggestions, but does not introduce any changes or additions to the specifications.

Significant changes or additions to the specifications contained in this publication will be reported in subsequent revisions or Technical Newsletters.

Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

This manual has been prepared by the IBM Systems Development Division, Product Publications, Dept. B98, PO Box 390, Poughkeepsie, N. Y. 12602. A form is provided at the back of this publication for readers' comments. If the form has been removed, comments may be sent to the above address.

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IBM 29 Card Punch

The basic operating unit in IBM accounting is the punched card. Punched cards, containing original data in the form of punched holes, actuate the IBM machines to perform automatically the various operations essential to record-keeping.

Original data is transcribed to punched cards by any of several types of IBM card punches. This manual explains the operation of the most recent of these machines, the IBM 29 Card Punch (frontispiece).

**Features**

The IBM 29 Card Punch has the popular features of other IBM card punches, with additional features such as unlimited use of two program levels and programmed automatic insertion of zeros to the left of the first significant digit in numeric fields, to provide greater flexibility in the operation and application of the card punch.

**Programs**

The machine is easy to operate, quiet, and attractive. One of its most important features is the simple means of setting it up quickly for automatic control of duplicating operations, automatic insertion of left zeros, or skipping. Each setup or program is made by punching a card and mounting it on a program drum, which is inserted in the machine.

On the 29 Card Punch, with unlimited use of two program levels, each program card can contain two totally different, complete 80-column programs. Either program can be selected for card to card use by setting a program selection *switch*. If it is desired to use both program levels to control punching on a single card, alterations from program to program can be made by program selection *keys* on the keyboard. Programs can be alternated at will, while punching a single card, by means of these keys.

**Card Punching**

Eighty columns on the card can be punched.

Each column has 12 punching positions: one each for the digits 1 to 9, and one each for the zones 0, 11, and 12. The 11-zone punch is sometimes referred to as X. The digits are recorded by punching a single hole in the corresponding digit or zero position of the desired column.

A letter is a combination of one zone punch and one digit punch in the desired column. For example, A is a 12-zone and digit-1 punches, N is an 11-zone (X) and digit-5 punches, and Z is a 0-zone (zero) and digit-9 punches.

A special character is one, two, or three holes in the desired column as shown in Figure 1. Punching two or three holes in one column for a letter or special character is automatic when the corresponding key is pressed.

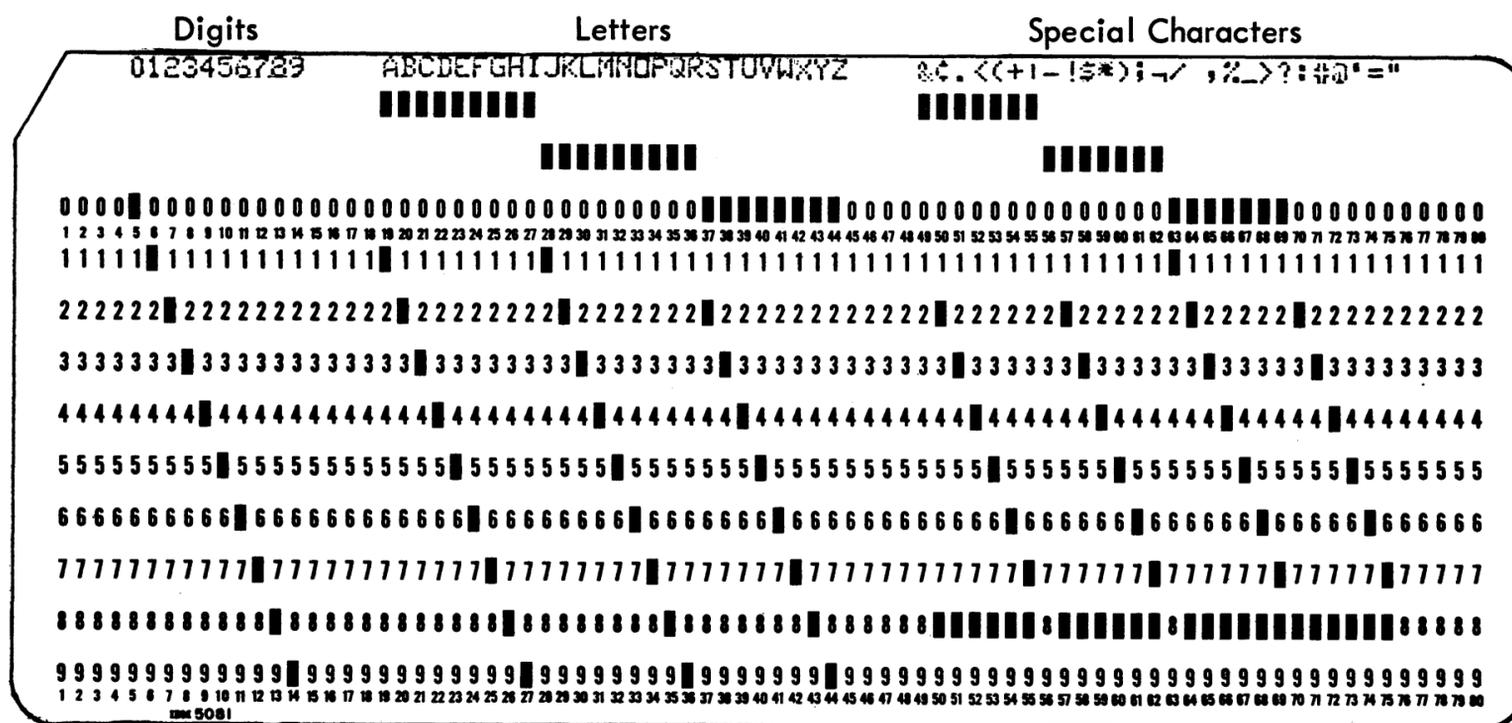


Figure 1. Card Codes and Graphics for 64-Character Set

## Duplication

The card punch duplicates common information from any card into the following card in a gangpunch operation. The duplication can be automatic, under program control, or manual, controlled from the keyboard. This method of duplicating reduces manual keying of repetitive data and consequently increases production.

All the characters of the expanded character set can be duplicated and printed. However, any multiple punching that is not a valid character should not be duplicated on a 29 Card Punch that is equipped with printing. Invalid combinations of punches (obtained by two or more key depressions while M-P key is held down) can cause damage to the print unit.

Cards created on the 29 Card Punch should not be duplicated on the 26 Card Punch because certain characters considered valid on the 29 exceed the printing capabilities of the 26 and can cause damage to the print unit. The damage can occur whether the print switch is set to ON or not.

The duplicating feature greatly facilitates error correction during punching. When an error is made, the operator need not repunch the whole card manually. Instead, without any card handling, the operator duplicates into the next card all correctly punched fields and rekeys only the field in error. The program control permits such duplication, field-by-field, without concern about column numbers.

Duplicating under program control proceeds at a rate of 20 columns per second on nonprinting models, and 18 columns per second on printing models. Skipping and card release proceed at a rate of 80 columns per second. After one card is punched in column 80, the next card feeds into column-1 position in one-fourth of a second.

NOTE: Where two duplicating speeds are indicated in this publication, the lower speed refers to printing models and the higher speed refers to nonprinting models of the 29 Card Punch.

## Printing

On printing models of the 29 Card Punch, characters are printed as they are punched. Each character prints at the top edge of the card, above the punches in the column (Figure 2), thus providing for full interpretation of the card. Printing is controlled by a switch on the keyboard. The print switch must be on to print. When the switch is off, all printing is suppressed.

Further control is provided by a second switch, the left-zero print switch. This switch, in conjunction with the print control switch mentioned previously, prints or suppresses printing of left zeros. (Left zeros are those zeros that are to the left of the first significant digit in any defined numeric field.) Control by the

left-zero print switch is immediate when it is turned on in the middle of a field; when turned off in the middle of a field, control is delayed until the end of the defined field.

As an example, Figure 2 shows the printing of several numeric fields. Left-zeros are present and printed in three of the fields: salesman number (columns 45-47), quantity (columns 57-61), and item amount (columns 67-73). Printed as shown, both switches had to be on. Had the left-zero print switch been off, the salesman number field printing would be 67, the quantity field printing would be 40, and the item amount field printing would be 3320.

## Card Design

The almost complete visibility of the cards in the card bed facilitates the design and punching of dual cards and the identification of prepunched cards into which more data must be punched. Direct access to all parts of the card bed also permits easy manual insertion and removal of cards when necessary.

Punched cards are usually designed so that each item (or field) of information recorded in the card can be readily identified. Figure 2 shows a card designed for use in a sales accounting application, and a typical invoice from which the card was punched.

The card contains, in punched-hole form, descriptive information such as customer name, customer number, and location printed in the heading of the invoice, and quantitative data for the first commodity printed in the body of the invoice. The fields on the card are in the same sequence as the corresponding items of information on the invoice. This simplifies the reading of the original document as the information is being punched.

The card form also illustrates other operations characteristic of many card-punching jobs. For example, columns 1-17 are always skipped; columns 18-56 are punched in the first card for an invoice, and duplicated into all other cards for that invoice; columns 57-61 (a five-column field in which the quantities are variable), the left-zero insertion feature can be used. This would assist the operator in eliminating keying errors, also the left-zero feature can be used for the 7-position item amount field. Columns 74-80 (invoice amount) can be punched in some cards and skipped in others. This field can also be programmed for the left-zero operation.

This publication contains a complete description of the operating features and methods of operation. Under "Operations," each function is described in detail as it is first used in a typical situation. All functions and the combination keyboard are summarized under "Combination Keyboard Summary."

# GENERAL MANUFACTURING COMPANY

ENDICOTT, N. Y.

CUSTOMER'S ORDER NO. 311

INVOICE DATE 12-31

INVOICE NO. 12349

SOLD TO New Mexico Company  
216 Wysor Building  
Houston, Texas

CUSTOMER NO. 59751

SHIP TO Above

*Make all checks  
payable to*

SALESMAN Macy-67

SHIPPED VIA Truck Prepaid

GENERAL MANUFACTURING COMPANY  
Endicott, N. Y

TERMS 2% 10 Days Net 30

QUANTITY	COMMODITY No.	DESCRIPTION	PRICE	AMOUNT
		Casters		
40	11202	Sq. Shank Swivel	.83	33.20
75	13102	Flat Top Rigid	.84	63.00
5	17203	Ext. Shank with Brk.	1.62	8.10
2	32105	Bolt and Nut Shank	2.64	5.28
4	44104	Rnd. Spr. Ring Stem	3.51	14.04
40	62110	Bolt and Nut Shank	7.25	290.00
		Freight		.78
				414.40

		NEW MEX CO		59751		41143		96813		0671231		12349		00040		11202		0003320	
		CUSTOMER NAME		CUST. NO.	LOCATION ST. CITY		TRADE CLASS	BRANCH	SALESMAN NO.	DATE MO. DAY		INV. NO.	QUANTITY	COM-MODITY NO.	ITEM AMOUNT	INVOICE AMOUNT			
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
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6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Sales Accounting

IBM

Figure 2. Document and Punched Card

## Models

The IBM 29 Card Punch is available in nine different models:

MODEL	NAME	KEYBOARD	FEATURE
A 11	Basic Card Punch	12-character	
A 12	Basic Card Punch	64-character	
A 21	Basic Card Punch	12-character	Print
A 22	Basic Card Punch	64-character	Print
B 11	Left-Zero Insertion Card Punch	12-character	
B 12	Left-Zero Insertion Card Punch	64-character	
B 21	Left-Zero Insertion Card Punch	12-character	Print
B 22	Left-Zero Insertion Card Punch	64-character	Print
C 22	Interpreting Card Punch	64-character	Print

The Model A is the basic card punch. It can have either the numeric (12-character) keyboard or the combination (48- or 64-character) keyboard (Figure 3); it can be a print or a nonprint model.

The Model B, or Left-Zero Insertion Card Punch, has the same keyboard or print/nonprint specifications as the Model A, performs the same functions as the Model A, and in addition, features left-zero insertion. With left-zero insertion, it is unnecessary to key zeros to the left of the first significant digit in numeric fields. This feature must be programmed; it can be programmed to insert zeros in fields that are three to eight digits in length.

The Model C, or Interpreting Card Punch, is available only with the combination keyboard, performs the

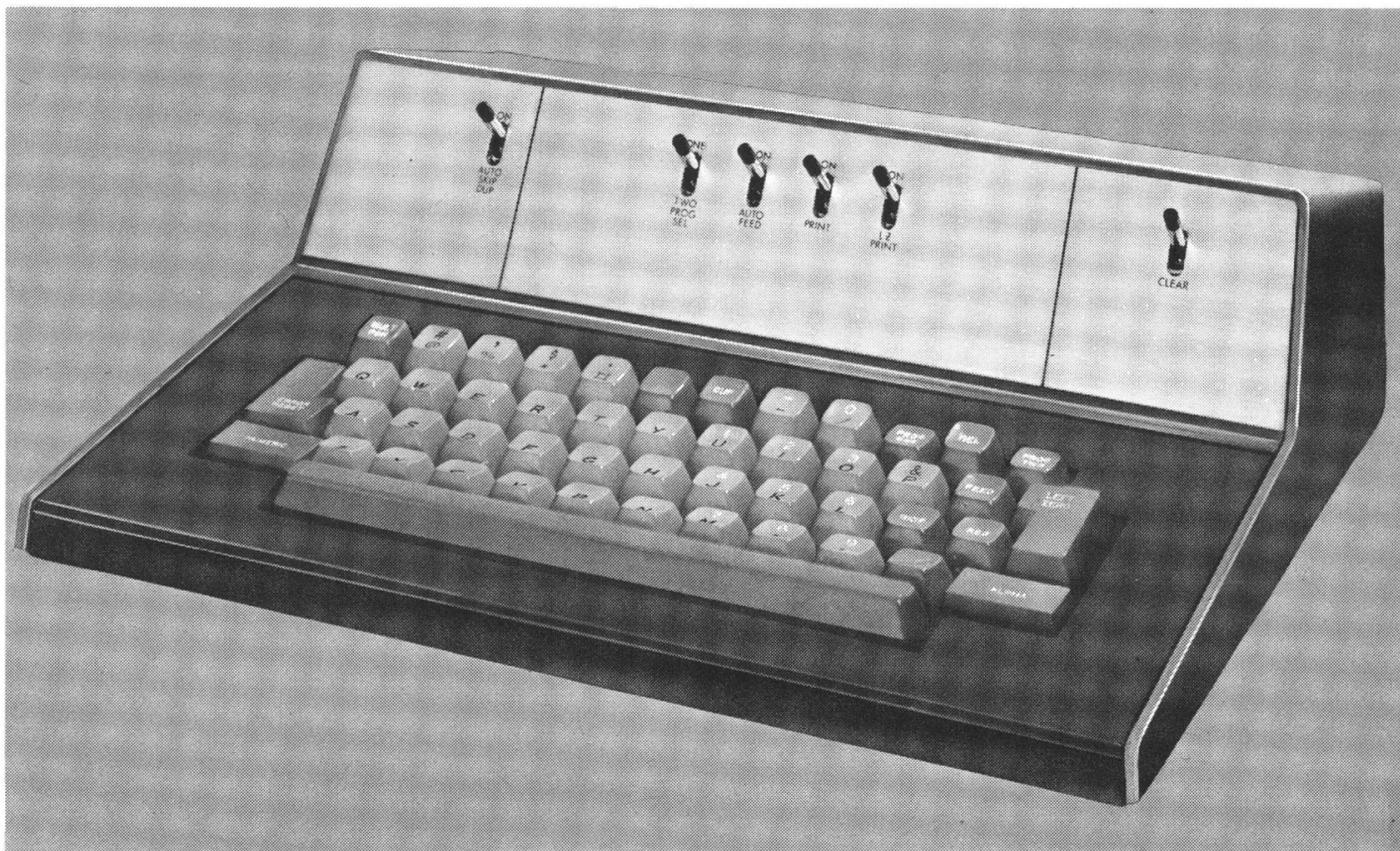
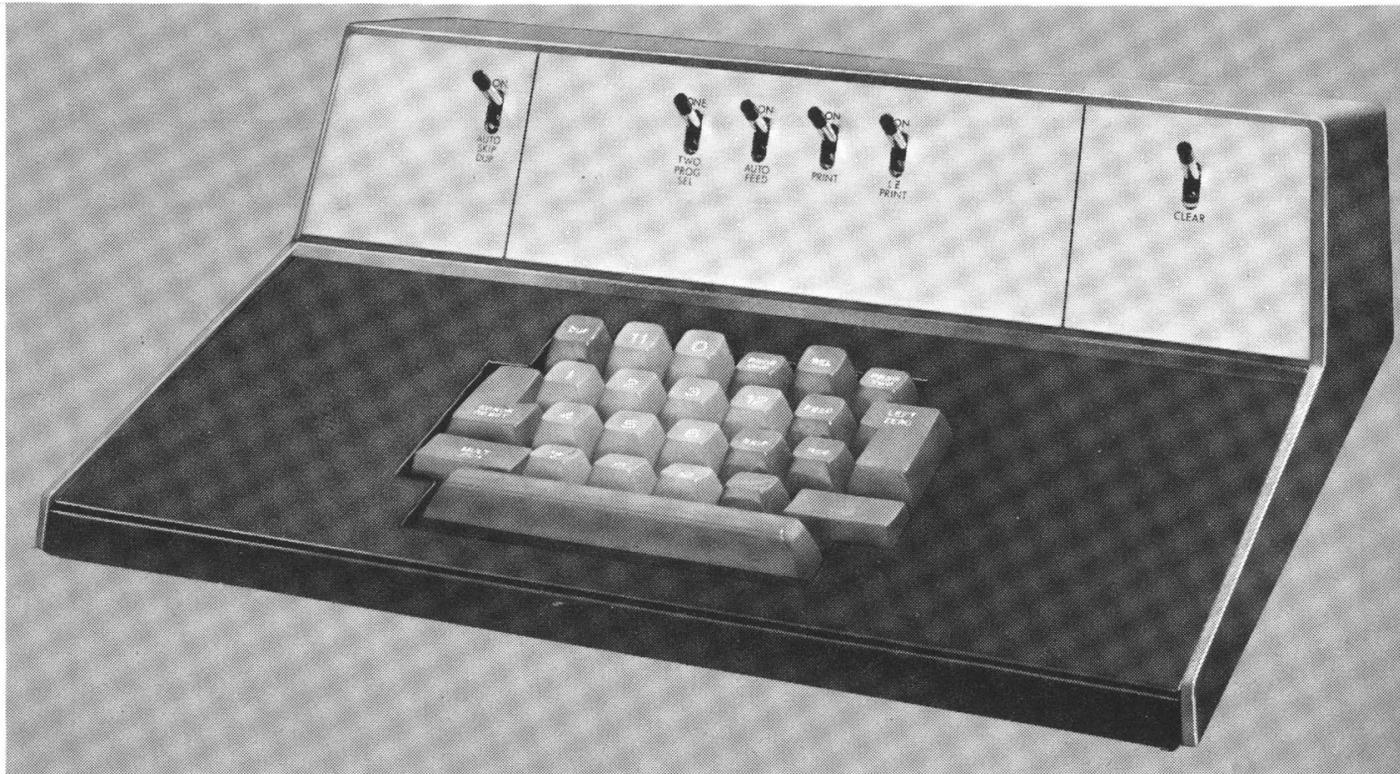


Figure 3. Numeric and Combination Keyboards

same functions as the Model A, and in addition, interprets prepunched cards. The combination keyboard can be either a 48-character or 64-character arrangement, as described under "Operating Features." The character arrangement chosen determines the special character graphic that prints for the various special-character punched-hole combinations.

An early read station reads prepunched cards, column-by-column, and prints the information punched in each column directly over the same column. Punching is suppressed during this interpreting operation; the punched cards are not repunched. Also, while set for interpreting, the machine is inoperative as a card punch. A switch on the keyboard controls this feature.

### Keyboards

The keyboard can be rotated on the desk (reading board) for the operator's greatest convenience and comfort. On alphabetic models, a group of the right-hand typewriter keys serves for punching digits as well as letters, with the shift from one function to the other normally made automatically by the program card. This permits the operator to punch an alphabetic field with both hands and then, without shifting from the *home* position, to punch a numeric field with the right hand only. Use of the right hand alone for numeric punching frees the left hand for document handling.

Numeric models are intended for punching numeric information only; the keyboard contains the usual 12 numeric keys, all operable by the right hand.

## 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 the feed key. The first two cards to be punched must be fed by the feed key, but all other cards in the hopper can be fed automatically under the control of a switch.

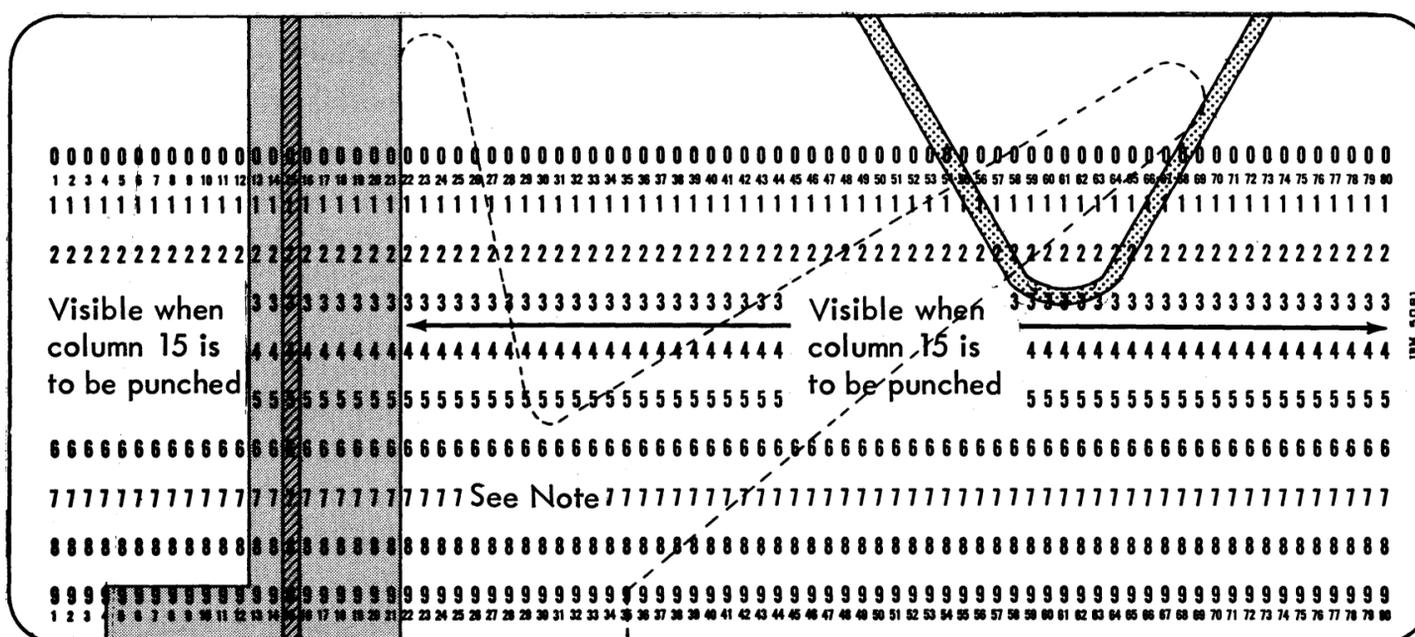
### Punch Station

Punching is performed at the first of two stations in the card bed through which the cards pass from right to left. To start a punching operation, two cards are fed into the card bed at the right of the punch station by pressing the feed key. As the second card is fed in, the first card is automatically registered for punching. The registering operation moves the card in position to punch column one. While the first card is being punched, the second card remains at the right of the punch station, in the preregister position. When the first card is punched or released through column 80, it is transported to the next station and the second card is registered at the punch station. The following (third) card feeds from the hopper to the preregister position.

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

The whole card is visible before it is registered at the punching position, and at least 71 columns are visible after punching has started. For example, when column 15 is to be punched (Figure 4), columns 1-12 and columns 22-80 are visible.

Cards with lower corner cuts (except lower-left corner cut C-3, 30-degree, 0.130-inch base measurement)



NOTE: Clear plastic card guides can be supplied in lieu of the metal guide.

Figure 4. Card Visibility at the Punch Station

cannot be fed. For registration and spacing, the card is gripped along its lower edge by two wheels. Lack of the two lower corners creates registration inaccuracies. Round corner cut cards are acceptable.

#### **Read Station**

The read station, where the cards are read for duplicating, is slightly greater than one card length to the left of the punch station. Consequently, each card that has been punched passes through the read 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 card. This principle of duplication is the same as gangpunching. Reading from one card to another can be controlled, field-by-field, so that only the desired information is duplicated.

This feature eliminates card handling for the duplication of information from cards prepared during the punching operation. Card handling is necessary only when an operation requires duplication from pre-punched master cards. In this case, insert the pre-punched master card manually at the right of the read station before the next card to be punched is registered. Register both the master card and the detail card at their respective stations by pressing the register key.

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

#### **Card Stacker**

The card stacker, with a capacity of approximately 500 cards, is on the upper left side of the machine on a level with the hopper. After each card passes the read station, it is fed into the stacker automatically, or by keying if the auto feed switch is off. The cards are stacked at an angle, 12-edge to the rear, face up, and are held in position by a card weight. When the cards are removed from the stacker, they are in their original sequence.

A full stacker operates a switch that interlocks the card feed. However, power is not turned off and the machine is immediately ready for operation as soon as the cards are removed from the stacker.

A scale is provided in the stacker so that an estimate can be made of the total cards processed before the cards are removed from the stacker.

#### **Main Line Switch**

The main line switch is located on the front right side of the cabinet under the keyboard. When the main line switch is turned on, the machine is ready for immediate use.

When the main line switch is turned on, press the release key before starting operation. This insures that the program card is at column 1.

#### **Reading Board Desk**

The desk area provides ample work space for the source documents from which the cards are punched. The keyboard can be rotated on the desk to provide the greatest convenience and comfort for the operator.

#### **Backspace Key**

The backspace key is located below the card bed between the reading station and punching station. As long as the backspace key is held down, the cards at the punching and reading stations backspace continuously until column 1 is reached. At the same time, the program card, which controls skipping and duplicating, also backspaces.

Backspacing should not be attempted after a card has passed column 78 in the punching station unless the following card (in the preregister position) is removed from the card bed. Cards should not be backspaced for more than 20 columns, because registration accuracy would be affected.

This key is no longer used for resetting a locked keyboard. The error reset key now serves this function.

#### **Program Unit**

The program unit controls automatic skipping, automatic duplicating, and shifting from numeric to alphabetic punching on all models of the 29 Card Punch. In addition, on the Model B, the program unit controls left-zero insertion; on the Model C, it controls the skipping of fields that are not to be interpreted, and the 11-12 elimination feature. The unit is accessible to the operator from the front of the machine. By lifting the middle portion of the top cover, the program drum can be removed for the installation of the program card.

Each of the operations performed under the control of the program unit is designated by a specific code recorded in a program card. The program card is punched with the program card codes to fit the application desired. The program card is mounted on the program drum, which is placed on the program unit of the 29 Card Punch. The program drum revolves in synchronism with the movement of the cards past the punching and reading stations so that the program card codes control the operations, column-by-column.

The program control unit on the 29 Card Punch is equipped with two program levels, which give added flexibility to a program operation. Automatic skipping, duplicating, field definition, alphabetic shift, and the additional controls of the Models B and C can be performed through both levels of the program control.

### **Program Control Lever**

The program control lever, located below the program unit, controls operation of the program unit. Turn the control lever on, to the left, to lower the sensing mechanism. The sensing mechanism consists of up to 12 starwheels, which, when the mechanism is lowered, ride along the surface of the program card to sense the program control punches in the card. When a punched hole is sensed by a starwheel, a signal goes to the controlling circuits of the machine. This signal initiates the particular function designated by the code punch detected in the program card.

Turn the control lever off, to the right, to raise the sensing mechanism. This lifts the starwheels off the program card; the program control punches will not be sensed. The control lever must be turned to the off position to remove the program drum, and always left in that position when a drum is not in the machine.

### **Column Indicator**

The indicator, located at the base of the program drum holder, indicates the next column to be punched. Refer to this indicator as a guide for spacing or back-spacing to a particular column.

### **Pressure-Roll Release Lever**

The pressure-roll release lever is next to the column indicator. It is accessible by raising the center cover over the program unit. Press this lever to permit the manual removal of a card from 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, push them out with another card or a smooth-edge metal blade while holding down the pressure-roll release lever. Do not use saw-edge metal blades.

### **Chip Box and Fuses**

The chip box is under the desk top below the keyboard. When the chip box is removed, the fuses for the machine are accessible.

### **Keyboards**

The keyboard on the 29 Card Punch is either numeric or combination numeric and alphabetic (Figure 3). The keyboards are so interlocked that no two character keys can be completely depressed at the same time, but it is not necessary to wait for one key to rise fully before pressing another.

### **Numeric Keyboard**

The numeric keyboard enables any one of 12 numerals (0-9, 11, 12) to be punched with a single key depres-

sion. To punch multiple digits manually in one column, hold down the `MULT PCH` (multiple punch) key while pressing the keys one at a time.

### **Combination Keyboard**

The combination keyboards have the best features of both a typewriter and a numeric keypunch. The letter keys are arranged for operation by the standard typewriter touch system, while the digit keys are placed so that a rapid three-finger touch system can be used. The usual numeric keys on a typewriter have been eliminated; instead, a group of dual-purpose keys at the right serves for digit punching as well as letter punching. This permits numeric punching with the right hand from the normal home position for alphabetic punching. The touch system for the ten numeric keys is: index finger for digits 1, 4 and 7; middle finger for digits 2, 5, and 8; and ring finger for digits 0, 3, 6 and 9. The punching of a digit or a letter with any of the combination keys depends on the shift of the keyboard. For example, pressing the 4-J key punches a 4 when the keyboard is in numeric shift, but a J when in alphabetic shift. This shifting is similar to upper or lower case shifting on a standard typewriter and may be controlled automatically by the program unit or manually by key.

The combination keyboard can be either a 64-character or a 48-character model. Figure 28 shows a 64-character keyboard, and the characters that can be punched by a single key depression. On printing models of the punch, these characters also print. These 64 characters are known as arrangement `EL`; the arrangement is System/360 compatible.

Two 48-character keyboard arrangements can be specified. They are designated as arrangements `A` and `H`. On printing models, only the specified characters are printable; *all three keyboards will punch the same characters.*

### **Functional Control Switches**

The following four switches, located on the keyboard (Figure 5), are common to all 29 Card Punches:

1. Auto skip/duplicate (`AUTO SKIP/DUP`)
2. Program selection (`PROG SEL`)
3. Auto feed
4. Clear

The function of these switches is explained in "Operations."

The following switches are also located on the keyboard, but are not common to all models of the 29 Card Punch:

1. Print—on all printing models
2. Left-zero (`LZ`) print—on all printing models
3. Punch/interpret—on Interpreting (Model `C`) machines

Refer to "Printing" for the functions of the print and left-zero print switches. The function of the punch/interpret switch is explained under "Program Card—Model C."

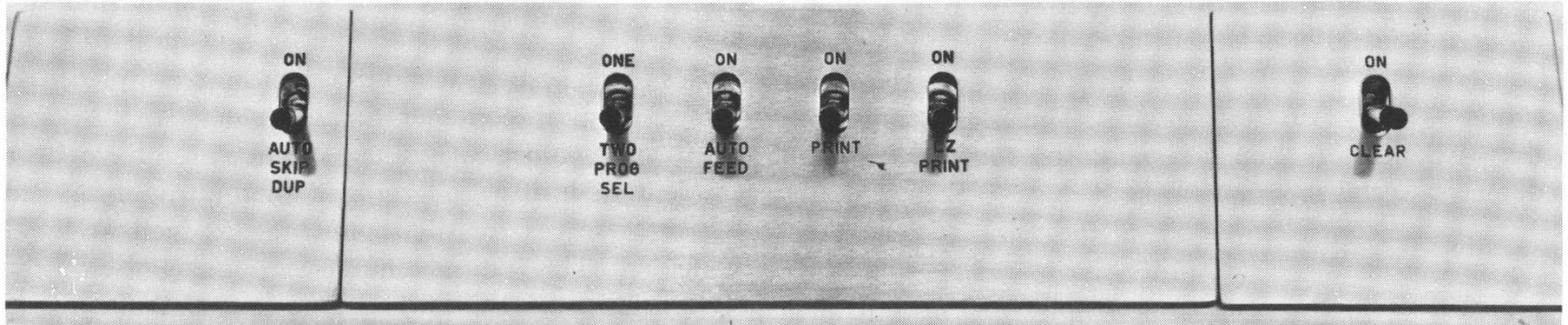


Figure 5. Keyboard Switch Panel

### Program Card—Model A

A program card, which is a basic part of the program unit, is prepared for each 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, 4)

The 12-punch is the field definition punch for Program One; the 4-punch is the field definition punch for Program Two. A field definition punch for the program level being used must appear in every column except the first (left-hand position) of every field to be automatically skipped, duplicated, or manually punched.

The field definition punch causes any skip or duplication operation started within a defined field to continue to the end of that field. Several consecutive fields to be automatically skipped or duplicated as one field can be programmed as a single field. Do not program a single column field with a field definition punch.

Field definition codes punched in the program card for manually punched fields permit occasional skipping or duplicating. This skipping or duplicating is started by keyboard control keys.

#### Automatic Skip (11, 5)

The 11-punch is the auto-skip start code for Program One; the 5-punch is the auto-skip start code for Program Two. In either program level, punching the auto-skip start code in the first column of the field to be skipped starts an automatic skip, which continues to the end of the field defined by the field definition punches.

This operation is also under control of the functional control switch (AUTO SKIP/DUP) on the keyboard. If this switch is off, the program card codes for auto-skip start are not recognized.

#### Automatic Duplication (0, 6)

The 0-punch (zero) is the start-automatic-duplication code for Program One; the 6-punch is the start-automatic-duplication code for Program Two. In either program level, punching the start-automatic-duplication code in the first column of the field to be duplicated starts automatic duplication, which continues to

the end of the field defined by the field definition punches.

This operation is also under control of the functional control switch (AUTO SKIP/DUP) on the keyboard. If the switch is off, the program card codes for start automatic duplication are not recognized.

#### Alphabetic Shift (1, 7)

The 1-punch is the alphabetic shift code for Program One; the 7-punch is the alphabetic shift code for Program Two. When a program card is in the machine, the combination keyboard is normally in numeric mode or shift. Therefore, to punch any alphabetic characters or special characters that are part of the alphabetic shift, the keyboard functions must be shifted to the correct mode. The shifting is accomplished by punching the alphabetic shift code, for the program level being used, into the columns of the program card that correspond to the columns of the card being punched with the alphabetic information. Every column to be punched as alphabetic must contain an alphabetic shift code in the program card. *Field definition does not extend alphabetic shift.*

Figure 6 shows a typical program card for a Model A machine, using Program One. For Program Two, the identical hole pattern would appear in punch rows 4-9, on the lower half of the card. For example; all the 12-punches would be 4-punches, all the 1-punches would be 7-punches, etc.

Figure 7 is a chart giving the codes just discussed for Model A, as well as all codes used in Models B and C.

### Program Card—Model B

The Model B is the Left-Zero Insertion Card Punch. Preparing a Model B program card, except for fields where left zeros are to be inserted, is identical to preparing one for the Model A; the Model B too, can be programmed to auto skip, auto duplicate, and shift alphabetic.

To program a field for left-zero insertion, count the number of columns in the field and from the following table select the code in the proper program level, for the exact column count. Punch the chosen code into the first, or high-order column of the left-zero field. Punch the remaining columns of the field with field definition punches.

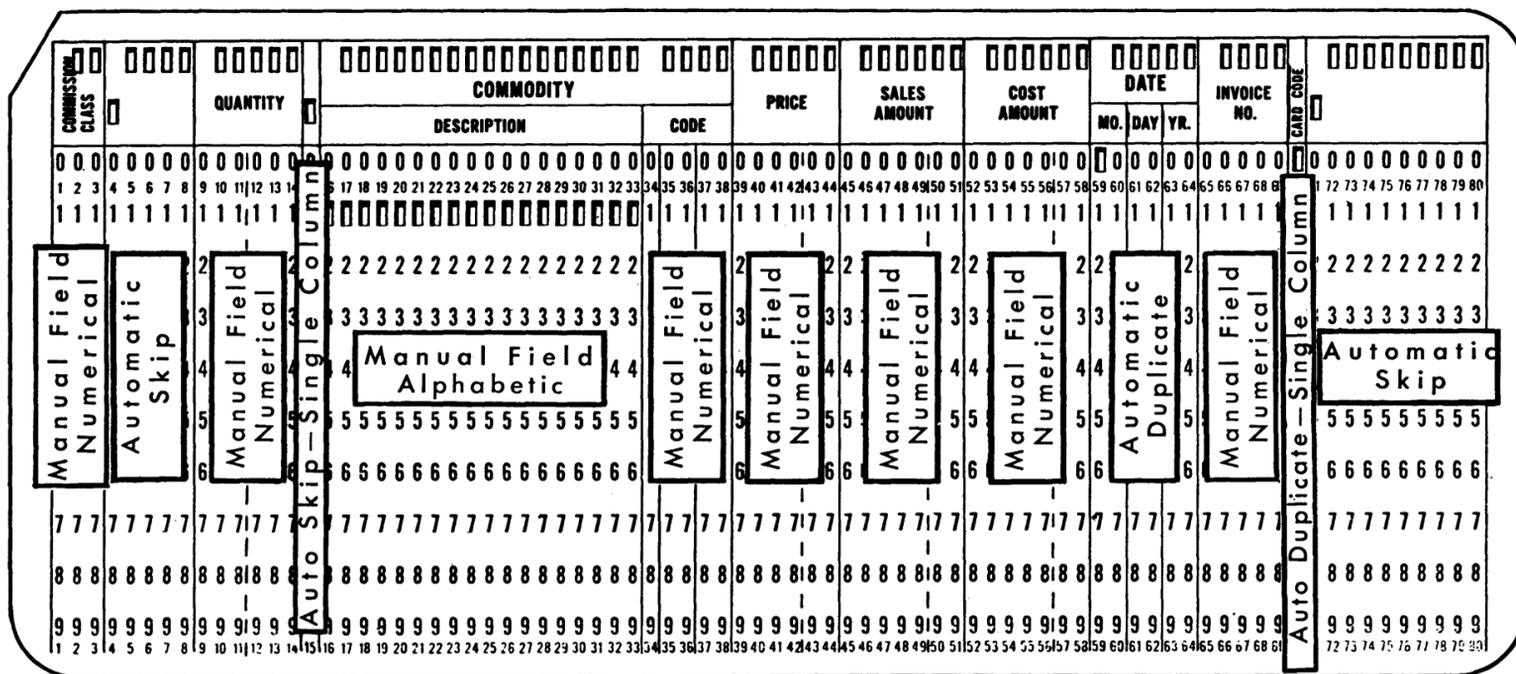


Figure 6. Program Card—Program One Level

FIELD SIZE (COLUMNS)	PROGRAM	
	ONE	TWO
8	2	8
7	3	9
6	2-3	8-9
5	1-2	7-8
4	1-3	7-9
3	1-2-3	7-8-9

Left-zero fields of various lengths, from 3 to 8 columns, may be on one card; handle every left-zero field in the manner just described.

### Program Card—Model C

The Model C, or Interpreting Card Punch, is a dual-mode machine controlled by a switch on the keyboard.

When this switch, the punch/interpret switch, is set to PUNCH, operation of the Model C is identical to the Model A, and programming is exactly the same.

When the punch/interpret switch is set to INTERPRET, the machine does not perform any of the normal card punch functions; it only interprets prepunched cards. Programming for this operation merely requires that any column(s) or field(s) not to be interpreted, be skipped. Skipping is programmed the same as on the Model A.

### 11-12 Elimination

When programming for an interpreting operation, one other consideration is the elimination of overpunches

Program One	Function	Program Two	Where Punched	Used On
12	Field Definition	4	Each column except first	Models A, B, C
11	Start Auto-Skip	5	First column only	Models A, B, C
0	Start Auto-Duplicate	6	First column only	Models A, B Model C only when in punch mode
0	11/12 Elimination	6	Necessary column only	Model C only when in interpret mode
1	Alphabetic Shift	7	Each necessary column	Models A, B Model C only when in punch mode
2	8-Column Left-Zero Field	8	First column only	Model B only
3	7-Column Left-Zero Field	9	First column only	Model B only
2,3	6-Column Left-Zero Field	8,9	First column only	Model B only
1,2	5-Column Left-Zero Field	7,8	First column only	Model B only
1,3	4-Column Left-Zero Field	7,9	First column only	Model B only
1,2,3	3-Column Left-Zero Field	7,8,9	First column only	Model B only

Figure 7. Program Codes—Models A, B, and C

from amount field columns. These are 11- or 12-punches used to identify the amount in that particular field as either a debit or a credit. When interpreting, it is usually more desirable to print the "5", for instance, rather than the "E" or "N" which results when the debit or credit overpunch is also read.

Punch a 0 (zero) for Program One or a 6 for Program Two in any column of the program card where the corresponding column of the cards being interpreted contains an overpunch, and interpretation of the numeral only is desired.

### Program Drum

The program drum (Figure 8) is the part of the program unit that holds the program card. This part can be removed by the operator so that the program card can be inserted to set up the program operation for a specific application.

To remove the program drum from the program unit, it is necessary to raise the sensing mechanism by turning the program control lever to the right or the off position. This provides the necessary clearance so that the program drum can be easily removed from its operating position. Pull the program drum off from its mounting in a parallel direction with the sensing mechanism, then the program card can be placed on the drum in the following manner:

1. Hold the drum in a horizontal position 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 of the card 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.

5. Turn the handle toward you (clockwise) as far as it will go. This fastens the toothed edge of the clamping strip. The drum is ready to be inserted in the machine.

To remove the card from the drum, reverse the mounting procedure.

With the program sensing mechanism raised, place the drum on the mounting shaft of the program unit, positioned so that the aligning pin falls in the aligning hole in the column indicator dial. Turn the program control lever to the left or to the on position to lower the sensing mechanism to the program card, and press the release key to engage the reading mechanism fully.

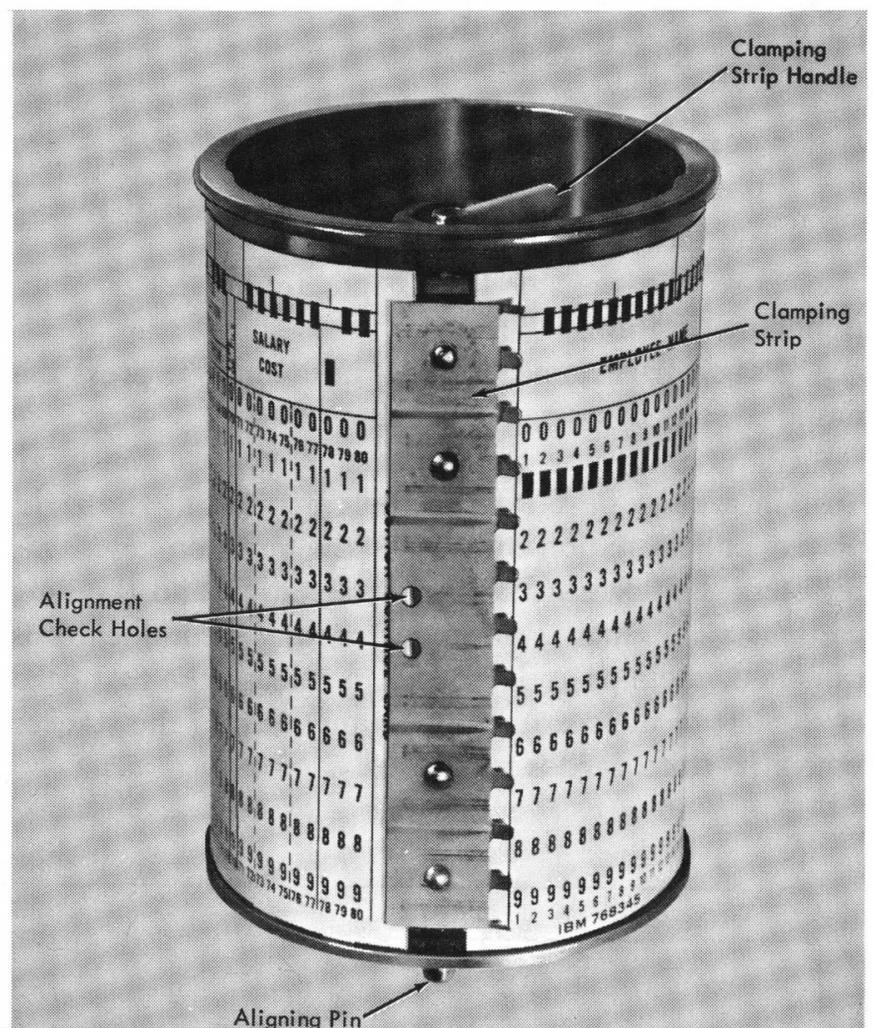


Figure 8. Program Drum





age. Therefore, any inadvertent entries into storage should be erased before or immediately after skipping by pressing the error reset key. This clears the storage of invalid digits before the next data is entered.

### **Duplication**

Left-zero fields of identical data can be duplicated from one card to the next by manually pressing the dup key. When manually duplicating a left-zero field, *duplicate the whole field*; keying part of the information and manually duplicating the remainder is not possible. Any inadvertent entries into storage should be erased by pressing the error reset key to avoid incorrect punching in subsequent left-zero fields if they are not to be duplicated.

### **Blank Fields**

A blank left-zero field can be zero-filled by a single operation of the left-zero key. This causes punching of zeros in every position of the left-zero field without keying any significant digit.

### **Completely Keyed Field**

A left-zero field completely filled with keyed data will not automatically punch out; the left-zero key must be pressed. This permits the correction of an error in the units position of the left-zero field.

### **Credit "X"**

When in a left-zero field, operation of the dash (—) key on an alphabetic keyboard, or the eleven (11) key on a numeric keyboard, initiates punchout and places a credit "X" over the units position of the field. On printing models, the dash (—) or minus sign will overprint the digit in the units position of the field.

### **Extending Capacity of Left-Zero Field**

In applications where a left-zero field in excess of eight positions must be processed, several techniques are available. One that could be used, for example, on a 10-position field ending in column 30, is:

1. Program columns 21-22 for automatic duplication (0 or 6 in column 21 and 12 or 4 in column 22). Program the remaining columns (23-30) as an eight-position left-zero field.

2. For the first card processed, turn off the auto skip/ dup switch and manually key two zeros in the high-order locations (columns 21-22). The left-zero field following, starting in column 23, is keyed in the usual manner (significant digits only), and ended by pressing the left-zero key.

3. Turn on the auto skip/dup switch and all succeeding cards are processed with the zeros in columns 21-22 being automatically duplicated.

4. When the operator reaches an entry that has significant data in the ninth or tenth (high-order) positions, the auto skip/dup switch is turned off before reaching the auto dup field so that the significant data can be keyed into this location. The eight-position left-zero field is then keyed normally for the eight columns and the left-zero key is pressed.

5. The auto skip/dup switch must remain off for the card following this operation until the auto dup zeros are again keyed. If the entries to follow contain eight or less significant digits, the auto skip/dup switch can be turned on for auto duplication of the ninth and tenth positions.

Another solution is to split the 10-position field into two left-zero fields of 3 and 7, or 4 and 6 positions. This method adds an extra left-zero key stroke for each card. For this reason, the auto dup technique previously described, is more efficient when a high proportion of fields contain eight or less significant digits.

### **Card as an Original Document**

In certain critical applications, where the card is an important document that cannot be discarded when a punching error occurs, all numeric fields should be coded as left-zero fields to take advantage of erasability. This technique adds one key stroke for each field keyed, therefore, it can only be justified where errors and discards cannot be tolerated.

### **General Operating Information**

Left-zero fields of different sizes can be programmed on the same card.

When the left-zero key is pressed, a slight pause in keying is necessary to permit the machine to complete punching the left-zero field. For an eight-position field, the time required is about  $\frac{1}{2}$  second; it is proportionately less for shorter fields. The keyboard is interlocked during punching and the operator notes a difference in "touch" if keying is attempted too early.

Some special character keys located to the left of the numeric section of the keyboard can cause the machine to unload storage and erroneously punch the left-zero field. Exercise care that these adjacent keys are not pressed accidentally, because this type of error cannot be corrected by the error reset key and card spoilage results.

### **Alphabetic and Numeric Punching with Program Control**

Although the keyboard is normally in numeric shift when the program is turned on, alphabetic information can be punched by changing to alphabetic shift. This



**Procedure for Alphabetic and Numeric Punching with Program Control**

Figure 11 shows the program card for this procedure. The instructions that follow describe Program One. They could apply to Program Two, also shown in Figure 11, by substituting codes 4-9 for the 12-3 used.

1. Place a deck of unpunched cards in the card hopper, and hold the feed key depressed. Two cards will feed down from the hopper.

2. The card punch automatically skips columns 1-5 (program card punched with an 11 in column 1 and 12's in columns 2-5). The auto skip/dup switch must be on.

3. Punch columns 6-26 with customer name, address, or carrier name (program card punched with 1's in columns 6-26). The 1's automatically shift the keyboard from numeric to alphabetic punching. When figures are to be punched in this field, press the numeric 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 7-26).

5. Columns 27-56 are skipped automatically (program card punched with an 11 in column 27 and 12's in columns 28-56).

6. Punch the carrier code in columns 57 and 58 (program card punched with a 12 in column 58).

7. Columns 59-69 are skipped automatically (program card punched with an 11 in column 59 and 12's in columns 60-69).

8. Punch the customer number in columns 70-73 (program card punched with 12's in columns 71-73).

9. Column 74 is skipped automatically (program card punched with an 11).

10. The trading area field in columns 75-77 is coded in the program card for manual numeric punching (blank in column 75 and 12's in columns 76 and 77).

Optional skipping of the field is controlled by pressing the skip key in column 75.

11. Punch columns 78 and 79. Salesman number is frequently the same for several successive cards. After punching the first card, duplicate the following ones by pressing the dup key in column 78.

12. Punch column 80, after which the next card feeds automatically. The auto feed switch must be on.

**Error Correction—Normal**

Errors in punching are often noticed and corrected by the operator at the time they are made. Usually this involves rekeying a large portion of the card. This card punch reduces rekeying to a minimum, requires no concern about the precise column in which the error occurred, minimizes the possibility of making another error while correcting the first, and practically eliminates card handling. As an example, the correction of an error in the order number field of the labor distribution card (Figure 12) is made as follows:

1. Press the release key immediately upon detecting the error. This advances the card without punching the fields coded for manual punching, but allows duplication of the fields programmed for automatic duplication beyond the point of release. 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 is fed from the hopper.

2. Duplicate the kind field by pressing the dup key once.

3. Columns 3-6 are programmed to duplicate automatically, as shown in Figure 10.

KIND	DATE		RATES		PART OR ACCOUNT NO.	ORDER NO.	DEPT. CHGD.	PIECES	OPER. NO.	MACHINE GROUP	EMPLOYEE NO.		HOURS	AMOUNT
	MO.	DAY	REG.	U.T.							DEPT.	CLOCK		
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

Automatic Duplication Columns 34-35

Transposition Error

Figure 12. Error Correction



11. Manually duplicate the commission class, commodity description, commodity code, and price fields by pressing the dup key in column 16. These fields are programmed as one field for automatic skipping in the regular punching operation. The commodity description field is coded with 1's in the program card to permit automatic spacing over blank columns during the correction of errors made in the punching operation.

12. Turn on the auto skip/dup switch for the automatic duplication of the date and the automatic skipping of the last four columns.

13. Manually punch the remaining fields programmed for manual punching. The date is duplicated automatically and columns 77-80 are skipped automatically.

14. Replace in the right of the card bed, the card removed in Step 2.

15. Turn on the auto feed switch.

16. Press the feed key to register the card replaced in Step 14 at the punch station, and to feed the next card from the hopper to the preregister position. Continue the operation interrupted by the error. The error card, again, is the last card in the stacker; remove it for disposal. The repunched card is in its proper sequence in the card deck.

### **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. Insert the master cards in the card bed at the right of the read station.

1. Turn off the auto feed switch before completing the punching of the last card of the preceding group.

2. After the last card is released from the punch station, manually move it to the left until it touches the feed rolls at the read station.

3. While still maintaining a slight pressure on the card against the feed rolls, press the release key to advance that card past the read station.

4. Place the master card in the card bed between the punch and read stations. Position it so that the left edge is just between the feed rolls and not in registered position.

5. Press the feed key to register the master card and the detail card that is at the right in the card bed, and to feed a new card from the hopper. Turn on the auto 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 completion of the punching of the first detail card.

7. This type of operation normally precludes the possibility of 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 insertion of 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 use of the auxiliary duplication feature. (See "Special Features.")

### **Interpreting—Model C**

With the punch/interpret switch set to INTERPRET, the machine will interpret up to 80 columns of information on prepunched cards. As the card progresses through the punch station, column-by-column, the information in each column is read and prints over the same column.

#### **All 80 Columns**

If all 80 columns are to be interpreted in each card of the group, it is not necessary to prepare a program card; nor does the program control lever have to be on. Put the cards in the hopper, turn on the auto feed switch, set the punch/interpret switch to INTERPRET, and press the start key for two feed cycles. Interpretation, at 18 columns per second, starts and continues until cards run out.

#### **Less than 80 Columns**

Any fields or columns that are not to be interpreted, must be skipped. To cause this skipping, a program card must be used (see "Program Card Preparation"), the program control lever must be on, and the auto skip/dup switch must be on before the first card is fed into the interpreting position. Skipping speed is 80 columns per second.

The special features described in this section provide additional flexibility for applications that require special handling on the IBM 29 Card Punch. These special features are compatible in groups as shown in the feature compatibility chart (Figure 14).

### Auxiliary Duplication

This feature enables duplicating from a master card rather than from the card at the read station. The auxiliary duplicating unit is a separate drum unit that is mounted in the back of the machine below the program unit, complete with its own sensing circuitry and keyboard control.

The information duplicated from the auxiliary duplicating unit is punched in a master card, which is mounted on a drum, exactly as a program card is mounted, and the drum installed on the spindle of the auxiliary unit. The auxiliary duplicate (AUX DUP) key manually controls this duplication. Pressing this key starts auxiliary duplication, which continues to the end of the field defined by field definition punches in the program card. The information in the master card must be in the same columns that are defined in the program card.

This type of duplication is advantageous when common information is required for certain cards but not for others, when major-minor duplicating is performed, or when prepunched master cards are inserted.

When prepunched master cards are used, any information common to all cards (such as date) is dropped

when a new master card is inserted. In this case, with the auxiliary duplication feature, the master information can readily be punched in the first detail card of each group by pressing the key once and without reference to a source document.

### Card Insertion

The card insertion feature simplifies the manual insertion of a master duplicating card in front of a group of cards to be punched, or the insertion of a blank or prepunched trailer card at the end of a group of punched cards.

To insert a new master card in front of a group:

1. Set the card insertion feature switch to INSERT. (This switch is mounted on the keyboard when the feature is installed.)
2. While punching the card that precedes the master card to be inserted, press the MC (master card) key (Figure 28, Key 46). When the card being punched is completed, it is released through the read station, but stops before it is stacked. There is no card at the read station, and the next card is in the preregister position, waiting to be registered for punching.
3. Manually insert the new master card in the read station.
4. Press the feed key to register both the master card at the read station and the next detail card at the punch station.
5. Resume normal operation. Any fields programmed for duplication are duplicated from the new master card.

To insert a new master card (or trailer card) behind a group of cards that have been punched:

1. Set the switch to STACK.
2. While punching the card that precedes the master card, press the MC (master card) key. When the card being punched is completed, it is released through the read station and stacked. There is no card at the read station. The next card is registered at the punch station ready to be punched.
3. Manually insert the master (trailer) card behind the cards in the stacker.
4. Resume normal operation.

### High-Speed Skip

The high-speed skip feature provides the greatest advantage for applications that require skipping of 55 or

	Model A				B	C
Auxiliary Duplication	X	X	X	X	X	X
Card Insertion		X		X	X	X
High-Speed Skip	X		X	X	X	X
Interspersed Gang Punch		X		X	X	X
Reading Board Extension	X	X	X	X	X	X
Self Checking--Modulus 10	X	X				
Self Checking--Modulus 11			X	X		
Self Checking Number Generator	X	X	X	X		
Variable Length Card Feed	X		X	X	X	X

Figure 14. Special Feature Compatibility Chart

more consecutive columns of the card. It is available for factory or field installation on the 29 Card Punch Models A, B, and C.

This is a program controlled high-speed skip that operates in conjunction with standard skipping. High-speed skipping takes place at the rate of approximately three times the standard skip speed and results in a savings of 8 milliseconds per skipped column. In Program One, the 1-punch is used to control high-speed skipping; for Program Two, the 7-punch is used.

### Operation

A skip-start 11-punch (or 5) and the high-speed 1-punch (or 7) in the first column of the program card, start the skip. Field definition 12-punches (or 4) and high-speed skip 1-punches (or 7) in all succeeding columns (except the last five) of the skip field, continue the skip.

To maintain proper registration in the card, after the high-speed skipping operation, the high-speed skip must be slowed down before it ends. This is done by leaving the last five 1-punches (or 7) of the skip field out of the program card. The 12-punches in these last five columns allow skipping of the rest of the field, but at a slower rate.

When high-speed skip is installed on machines with the variable-length card feed feature, card output is also increased. The missing portion of these cards (for example, columns 51-75 or 60-75) is skipped at high-speed, if so programmed.

### Programming a High-Speed Skip

Figure 15 shows a program card, prepared in both program-levels, for a high-speed skip in columns 6-72. Note that the high-speed 1-punch (or 7) is left out of columns 68-72. This causes the card skipping movement to decelerate or slow down so that when the card stops in column 72 it has maintained proper registra-

tion. This insures that the punching in the last field is also in proper registration.

### Interspersed Gangpunch

This feature recognizes master cards with either an upper-left or upper-right corner cut. Detail cards *must* have an upper corner cut *opposite* to that designated for the master cards. Punching is from master card to detail card, or detail card to detail card; never from detail to master, or master to master.

The keyboard switch that controls this feature is located to the right of the left-zero print switch. When the switch is off, the feature is inoperative. When the switch is set to UL or UR, the feature determines whether a card is a master or a detail, depending on the presence or absence of the specified master corner cut.

The toggle switch allows manual selection of either upper-left or upper-right corner-cut master cards in any interspersed gangpunch operation, but not both in the same operation. Normal use of the feature requires that the automatic feed and the automatic duplicating switches also be turned on.

To start an interspersed gangpunch operation, the feed key is held depressed for two card feed cycles. If the first card is a master, it is released to the read station after the second feed cycle. The first detail card that follows the master card registers at the punch station—ready for processing.

Because the purpose of the feature is to suspend punching for a corner-cut master card, programming is the same for detail cards as in any normal card punching operation.

Once duplicating has started, normal operation under control of the program card continues until the feature recognizes a master card. At this time, the card that precedes the master card is at the punch station.

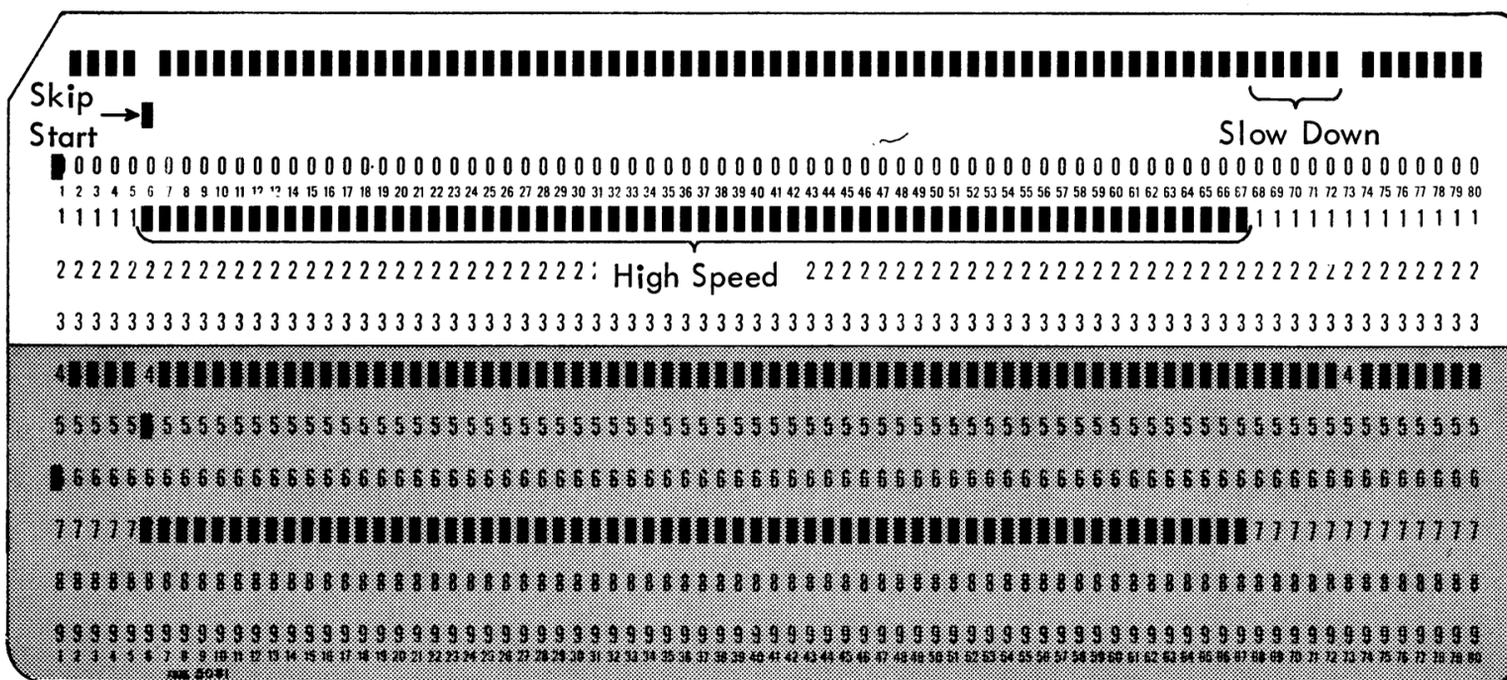


Figure 15. High-Speed Skip Program Card

The master card stays at the right of the card bed while the preceding card is duplicated. On the next card feed cycle, the master card passes the punch station at release speed, and all punching and programming is suspended. A master card requires approximately 1.25 seconds to pass to the read station. If the next card is also a master card, the process is repeated. When a detail card is fed, it is under normal control of the program drum, and punching is duplicated from the preceding card.

### Variable-Length Card Feed

The variable-length card feed feature on the 29 Card Punch allows the processing of 51-, 60-, 66-, and 80-column cards.

### Machine Settings

The operator can easily make all settings to change card lengths. Only one length of cards may be processed at one time. For each length of card there is a card guide, which is raised on the hopper bed to form a right-hand guide. The operator performs these preliminary steps to process each length of card.

1. Select the proper card guide in the hopper and lift it forward into position. For any selected card length, all card guides for cards of shorter length must rest in the hopper bed (Figure 16). Note that the

80-column card guide is fixed at the right side of the hopper. The sliding pressure plate in the hopper is notched to pass over the raised card guides.

2. Lift the thumb latch and move the card pusher to the proper card column notch (see Figure 17). A spring guides each card under the card pusher for correct feeding position.

3. Align 51- and 60-column cards to the stacker drum by pulling the stacker stop operating lever toward the front of the machine. For 66- or 80-column cards, push the lever back.

4. The following settings are necessary whether or not a program drum is used. To set the program cam extension knobs, lift the program drum cover forward, turn the program control lever to raise the program drum starwheels, and lift the drum off its shaft (Figure 18). Space to column 16 on the column indicator and turn off the main line switch.

*Caution:* These program cam extension knobs are interlocked and will bind if moved in any sequence but the one given here. To adjust the knobs, lift them out of their countersunk recesses and move in this sequence:

1. To change to a longer card, move each knob in ascending numeric sequence to the countersunk recess at the left end of each slot. For example, to change from 51-column cards to 80-column cards, first move the 51-column knob, then the 60-column knob, and then the 66-column knob.

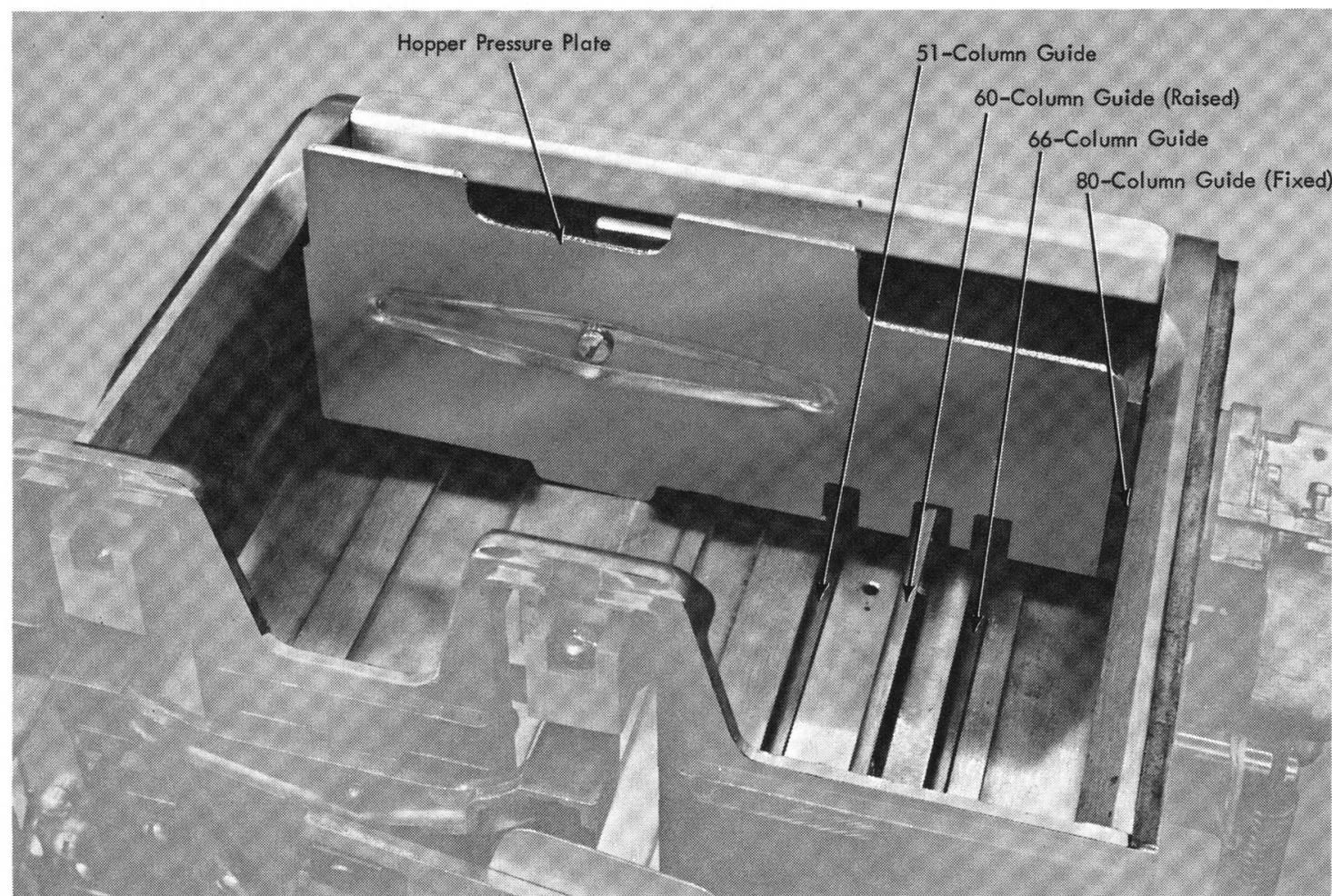


Figure 16. Hopper Card Guides

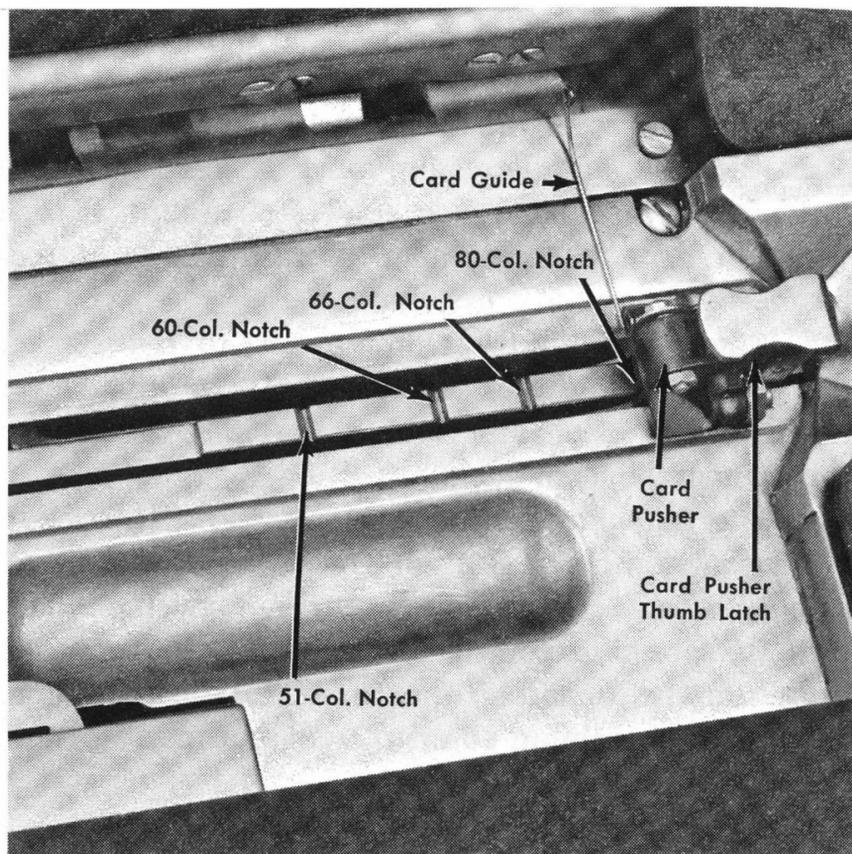


Figure 17. Latch-Type Card Pusher

2. To change to a shorter card, move each knob in descending numeric sequence to the countersunk recess at the right end of each slot. For example, to change from 80-column cards to 51-column cards, first move the 66-column knob to the right, then the 60-column knob, and then the 51-column knob.

### Operation

Program cards must be punched, starting at column 1, with the same number of columns that are in the cards to be processed. However, if the machine is equipped

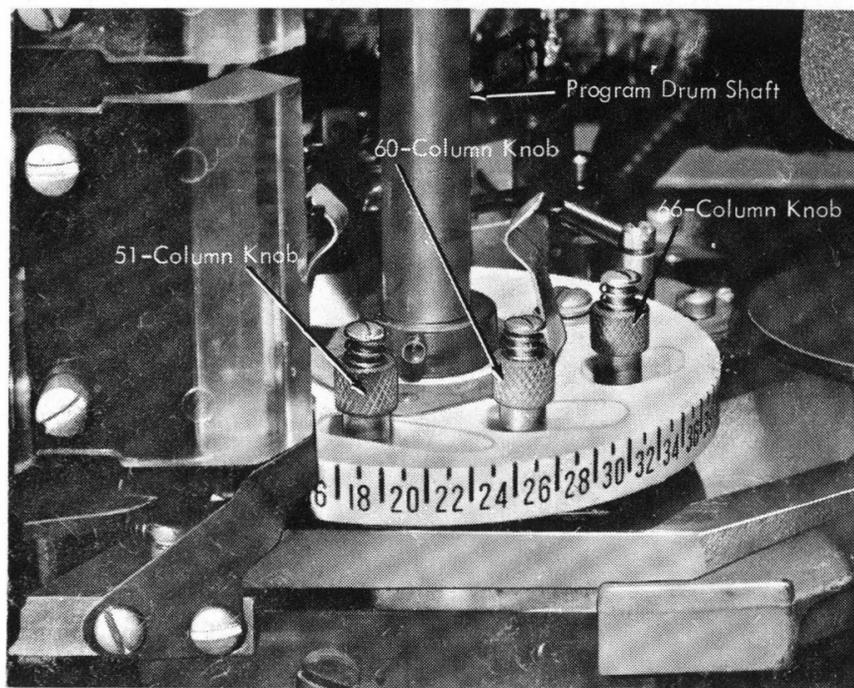


Figure 18. Program Cam Extension Knobs

with a high-speed skip feature, high-speed skip can be programmed beyond the number of columns in the cards being processed to obtain the maximum benefits of this feature. Otherwise, program card preparation is the same as for 80-column cards.

Any length card can be manually inserted if the card pusher, program cam extension knob, and the stacker stop operating lever are positioned for that cards, because the backspaced card would push against the card pusher.

Do not backspace within the last 16 columns of all cards, because the backspaced card would push against the following card and interfere with registration.

### Desk Extension

The desk area of the 29 Card Punch can be increased by adding an extension to the left side. This adds about 11½ inches by 12 inches of space to the working area. This extension can be installed without changing the present 36-inch reading boards.

### Self-Checking

The self-checking number feature provides a means of verifying precoded numeric information at the same time it is punched. This immediate verification of precoded data eliminates the need of any further verifying of this information. Thus, only the variable data, such as quantities and amounts, need be verified by a second operation if desired.

The self-checking number feature may be installed on the 29 Card Punch Model A only. The feature is controlled by a toggle switch and by special punching in the program card.

Self-checking is available in two models. The first, Modulus 10, is designed primarily to detect the most common type of errors, the incorrect keying of a single digit, and a single transposition. The second, Modulus 11, is designed to detect single digit misspunches, single transpositions, and double transpositions. The operation and programming of each type is discussed later.

### Operating Procedure

The use of the self-checking number feature requires that a check digit be developed for each basic code number to be self-checked. Once the check digit for the basic code number has been determined, it is added to the basic code number as the units or last position. (These check digits can be developed by using the self-checking number generator, by computer calculations, or by manual arithmetic.) This, then, becomes the self-check number, one digit longer than the original basic number. More than one self-checking field may be checked per card. Adjacent self-checking fields must be separated by at least one card column.

No special knowledge is required by code clerks who record these numbers on the original document, or by operators who punch the numbers in cards.

The operator keys and punches the number, through the check-digit position, as it appears on the source document. Internal calculations verify the accuracy of the keying or validity of the self-check number. When the number on the source document is correct and the number has been keyed correctly, the punching operation is not interrupted.

If no errors are detected throughout the punching of all the self-check fields in the card, an 11-hole is automatically punched in column 81. On machines equipped with the variable-length card device and processing 51-column cards, the ok punch appears in column 52.

When more than one self-check field is programmed, successful keying of any one field can produce an "X" in column 81, even if the other fields are skipped or bypassed by a change in program level. The appearance of an 81X signifies that all self-check fields punched in the card are correct, whether keyed or duplicated. Skipping or bypassing an entire self-check field is a valid operation.

If the number is recorded on the source document incorrectly, or if the number is punched incorrectly, an error is indicated after the last digit of the self-check field is punched. A red light appears on the keyboard, a 12-hole is automatically punched in the units (check digit) column, and the keyboard locks up. Whenever an error occurs, the automatic 11-punch in column 81 is suppressed.

The red light is turned off, the locked keyboard is unlocked, and the error card is released by pressing the error reset key. (The standard release key is inoperative while the keyboard is locked.)

The correctly punched fields of the error card can then be duplicated into a new card up to the self-check field in error, by manually pressing the dup key. The self-check field is then repunched. If it is punched as recorded on the source document, and the keyboard locks again, it means that an incorrect number appears on the source document.

#### **Operating Suggestions**

When the first column of a self-check field is reached, the following operations can be performed:

1. The field can be manually keyed; the validity of the number is checked by the arithmetic circuits.
2. The entire field can be skipped without validity check by using the skip key.
3. The entire field can be bypassed by shifting the program level.
4. The entire field can be duplicated and checked

by using the dup key. Duplication *must* start in the high-order (first) column of the field.

5. The first part of the field can be programmed for auto duplication. This is advantageous when punching a batch of cards that contain codes in which the first few digits remain unchanged while the remainder vary from card to card.

Duplicating the first part of the self-check field can also be initiated by pressing the dup key, if either the auto duplication start program code is not used, or the auto skip/dup switch is off. Both methods of partial field duplication *must* start in the first column of the field. If the dup key method is used, it must be used in conjunction with program (field definition punches) control. Under no circumstances should manual duplication by dup key alone, without program control, be attempted. Programming examples of partial field duplication are shown in Figures 19 and 21.

*Duplication:* Duplication of a self-check field that has one or more columns programmed alphabetic is possible if the columns so designated contain letters rather than spaces.

Do not attempt to duplicate a self-check field if the number contains one or more spaces; this locks the keyboard. Under these conditions, the release key is inoperative and the error reset key cannot unlock the keyboard. Depressing the alpha shift key permits the operator to get past the blank columns; however, the check digit calculations are incorrect. The card should be made over, manually keying the self-check number that contains spaces.

In the auto dup portion of a self-check field, certain extraneous punches can check out correctly. Cards should be examined periodically for double punching.

*Manual Operations:* Self-checking cannot be applied to left-aligned (left-base) numbers. Self-checking numbers can include letters and spaces, but only the numbers (0-9) and the digit portion of the letters (1-9) will be checked. Special characters cannot be checked. Letters, spaces, and zero-punched columns can be processed only if they were considered part of the basic code number when the check digit was established.

Once processing of the self-check field has started, the dup, skip, program one, and program two keys are all inoperative. The release key is not affected unless a checking error has been indicated; it can be used if the operator has miskeyed and wishes to make over the card.

If the remainder of the card is to be skipped anywhere after a self-checking field, skipping must be initiated by program control or the skip key. If the release key is used for this skipping, the 11-punch in column 81 is not punched, even though the self-checking field is correct.

In a self-check field, operating the backspace key creates an error condition. Such an invalid operation should be avoided.

Although a field to be self-checked may be of any length (up to 79 columns plus the check digit), once the predetermined field length has been programmed for self-checking, all numbers to be self-checked must contain the same number of digits as the programmed self-checking field. The check digit must always occupy the units position of the self-checking number field.

### Modulus 10

Modulus 10 is designed to detect either incorrect keying of a single digit or a single transposition. The following arithmetic process is used to generate the check digit, regardless of the method of generation employed (i.e., generator, computer, or manual):

1. The units position and every alternate position of the basic code number is multiplied by 2.
2. The digits in the product and the digits in the basic code number that are not multiplied by 2 are crossfooted.
3. The crossfooted total is subtracted from the next higher number ending in zero.
4. The difference is the check digit.

#### Example:

Basic code number	6 1 2 4 8	
Units and every alternate position of basic code number	6 2 8	
Multiply by 2	×2	
Product	1 2 5 6	
Digits not multiplied by 2	1 4	
Cross add	1+2+1+5+4+6	=19
Next higher number ending in zero		20
Subtract crossfooted total		-19
Check digit		1
Self-checking number	6 1 2 4 8 1	

#### Other Examples:

BASIC CODE NUMBER	SELF-CHECKING NUMBER	
	BASIC CODE	CHECK DIGIT
45626	45626	9
30759	30759	5
73074	73074	7

In Modulus 10 self-checking, the space and zero have the same numeric value; therefore, spaces can be substituted for nonsignificant leading zeros. The use of spaces is valid only *when they are keyed*. Any attempted duplication of blank spaces in a self-checking field causes a machine stop and keyboard lockup.

#### Compatibility

Modulus 10 self-checking is compatible with (Figure 14):

- Variable-length feed
- High-speed skip
- Card insertion
- Interspersed gangpunching
- Auxiliary duplication

It is not compatible with:

- Self-check Modulus 11
- Left-zero Insertion Card Punch, Model B
- Interpreting Card Punch, Model C

#### Program Card

To prepare a program card for Modulus 10 self-checking, fields must be defined exactly the same as in any other application; 12-punches (or 4's in Program Two) in all columns except the high-order column of the field. In addition, the following coding pattern must be used:

	Col	1	2	3	4	5	6	7*
Prog One		2		2		2		2
			3		3		3	3
Prog Two		8		8		8		8
			9		9		9	9

\*Col 7 is Check-Digit Position

The preceding example shows a 6-digit basic number which, with the check digit added, becomes a 7-digit self-check number. Any size basic number up to a 79-column maximum is handled the same way. With the check digit included, if the self-check field contains an odd number of digits, the starting code is 2 (or 8); with an even number of digits it is 3 (or 9). The check digit position must be programmed with both the 2 and 3 (or 8 and 9) codes.

Figure 19 shows a program card for two 10-position Modulus 10 self-check fields, one in Program One and the other in Program Two. Note that the Program Two example is for a partial duplication (first four columns) self-check field. Both programs shown are possible in either or both program levels.

### Modulus 11

Modulus 11 is designed to detect single digit mispunches, single transpositions, and double transpositions. The main feature of this system, distinguishing it from other self-checking number systems, is that it is based on a weighted checking factor for each digit in the basic number being tested. Regardless of how the self-check digit is generated, the following arithmetic process is used:

1. Each digit position of any basic number is assigned a weight (checking factor). These factors are: 2, 3, 4, 5, 6, 7, 2, 3, 4, 5 . . . starting with the units position of the number and progressing toward the high-order digit.
2. In the example shown in Figure 20, write the number as illustrated, leaving space between the digits.

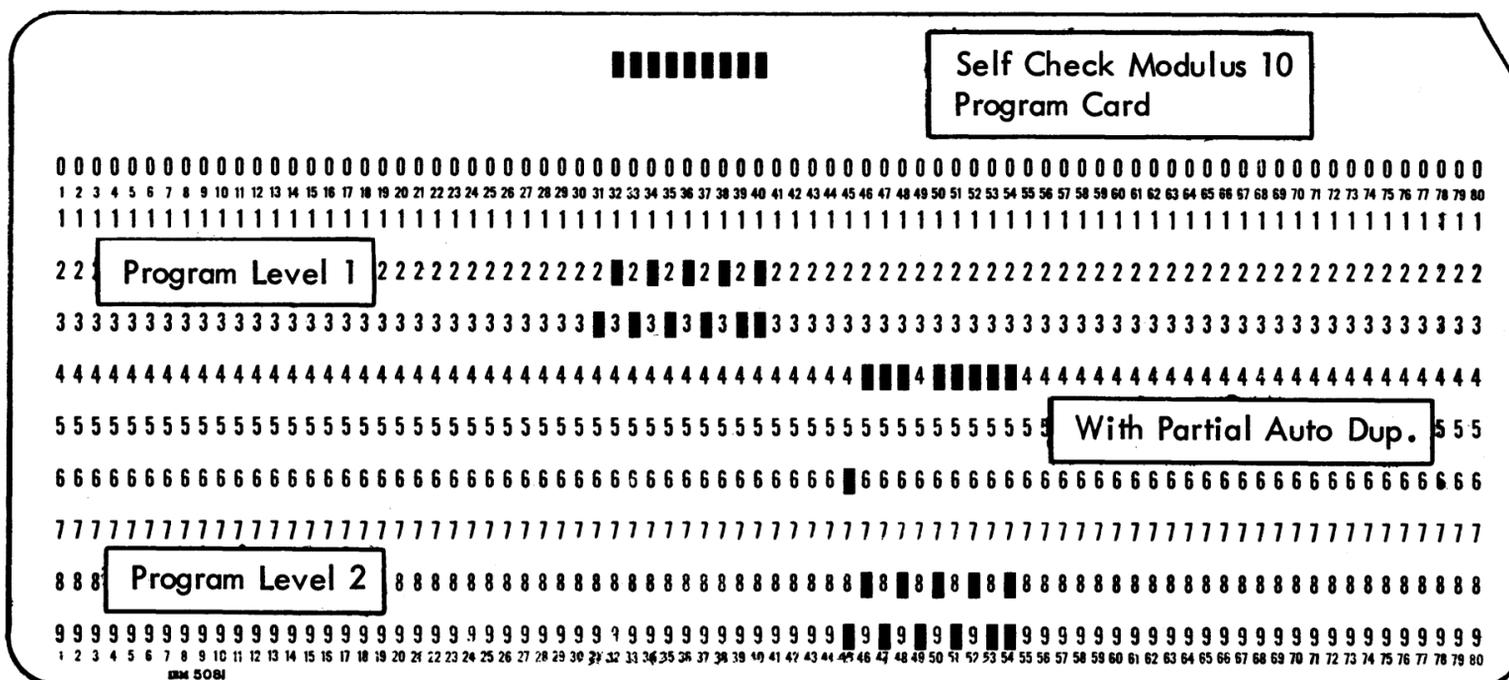


Figure 19. Self-Check Modulus 10 Program Card (80-Column Card Setting)

3. Below each digit, starting at the right and working left, place the corresponding checking (weighting) factor.

4. Multiply each digit by its checking factor and add the products.

5. Because this is a Modulus 11 operation, divide the sum of the products by 11, and subtract the remainder from 11. The result is the check digit.

In Modulus 11 operation, basic numbers that require a check digit of 10 cannot be used as self-checking numbers. The accounting system must be adjusted to eliminate such numbers from codes that are to be self-checked. If an operator is generating check digits and punches a basic number requiring a check digit of 10, the machine indicates an error condition. It punches a 12 in the check digit column, the error light goes on, and the keyboard locks. The operator must release the card and substitute another basic number.

#### Compatibility

Modulus 11 self-checking is compatible with (Figure 14):

Basic number: 943457842										
Write digits of basic number:	9	4	3	4	5	7	8	4	2	
From right to left, write checking factors:										
		4	3	2	7	6	5	4	3	
Add the products:		36	+ 12	+ 6	+ 28	+ 30	+ 35	+ 32	+ 12	+ 4 =
										Total 195
Divide:	195 divided by 11 = 17 plus a remainder of 8									
Subtract:	8 subtracted from 11 = 3 (the check digit)									
The new self-checking number is: 9434578423										

Figure 20. Self-Check Modulus 11—Manual Method of Developing a Check Digit

Variable-length feed  
High-speed skip  
Card insertion  
Interspersed gangpunching

It is not compatible with:

Self-check Modulus 10  
Auxiliary duplication  
Left-zero Insertion Card Punch, Model B  
Interpreting Card Punch, Model C

#### Program Card

The codes associated with Modulus 11 programming conflict with the normal codes used for the two program levels on the 29 Card Punch. Therefore, when Modulus 11 self-checking is installed, an auxiliary program unit is included. (This is the same unit described under "Auxiliary Duplication.") Thus, programming for Modulus 11 self-checking is contained on two program cards. The cards, mounted on drums in two different units, are used simultaneously.

**Main Program Card:** This card is prepared to define the self-check field; the field length is defined as any other field is defined, by 12-punches in every column except the high-order column of the self-check field. Figure 21 shows a program card for two 10-position Modulus 11 self-check fields, one in Program One, the other in Program Two. Note that the Program Two example is for a partial duplication (first four columns) self-check field. Both programs shown are possible in either or both program levels.

**Auxiliary Program Card:** The programming in this card controls the internal self-checking arithmetic circuitry. Start by punching a 12 and 3 (4 and 9 for Program Two) in the units position (check digit column) of the self-check field. Proceeding to the left, the next column is punched 3, successive columns to the left are punched 2,1,0,11,12, and if additional positions require

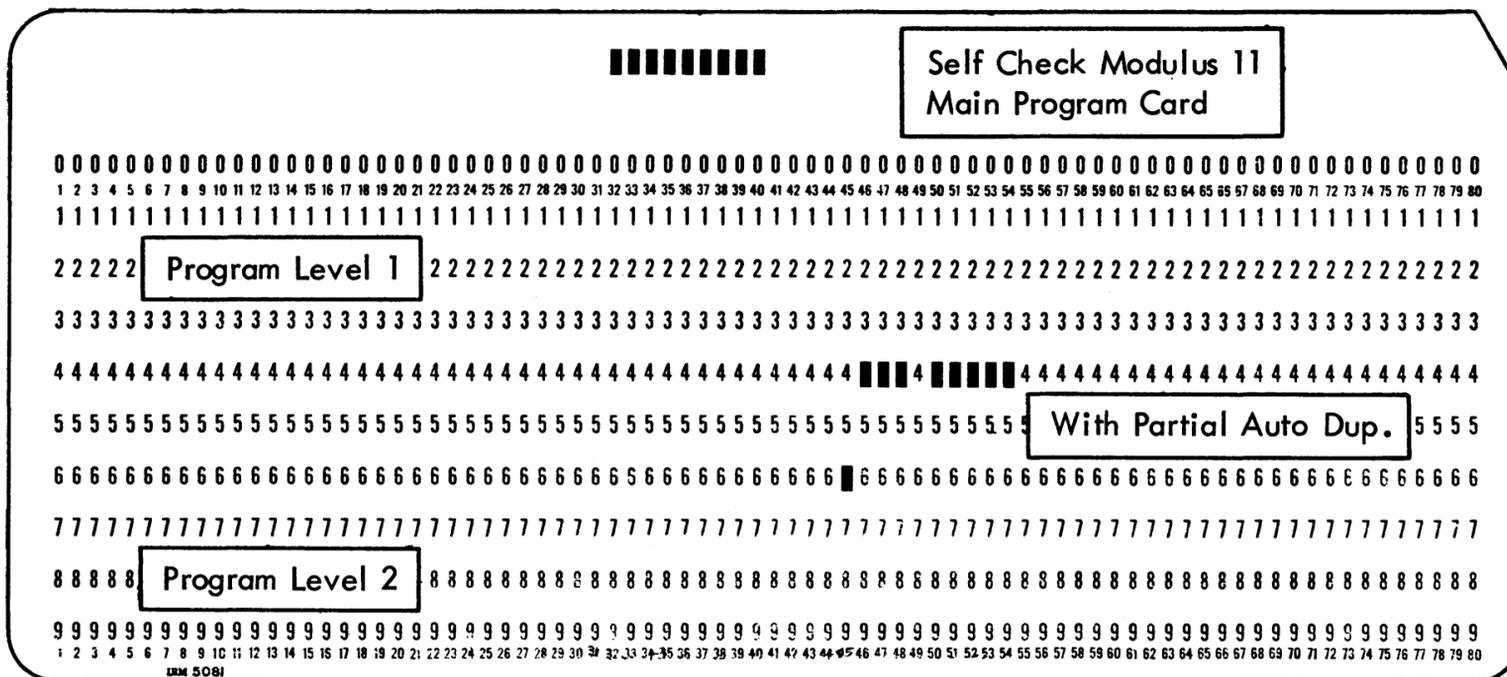


Figure 21. Self-Check Modulus 11 Main Program Card

coding, the sequence is started with 3 again until the high-order position of the field is reached. (For Program Two, these codes are 9,8,7,6,5,4,9,8,7,etc.) Figure 22 shows the auxiliary card programming for two 10-position self-check fields, one in each program level. Note that the fields in this card match the fields shown on the companion main program card (Figure 21).

**Self-Checking Number Generator**

This feature is standard with Modulus 10 and optional with Modulus 11. A switch is provided on the keyboard to select between check and punch modes.

With the switch in the check position, numbers that have the check digits assigned can be processed.

When basic numbers have no check digit appended, the machine calculates the check digit during keying and punches it out into the units position.

The field size must take into account the check digit. For example, a basic 7-digit number without a check digit must have eight columns assigned on the detail card. The program card is also coded for an 8-place field.

Program codes are identical to those used with the basic feature.

The switch location is to the left of the self-check error light on the keyboard switch panel.

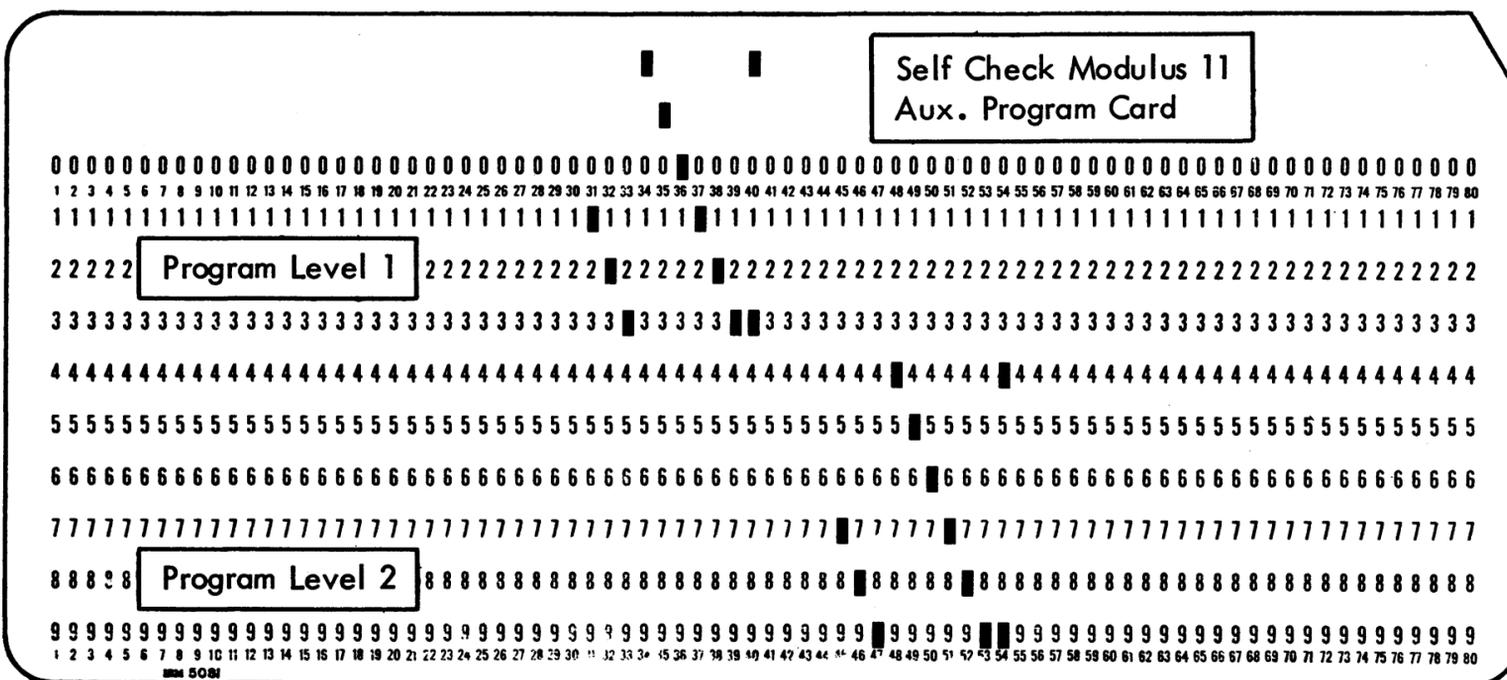


Figure 22. Self-Check Modulus 11 Auxiliary Program Card

When a program card is to be prepared for a particular punching application, the card design should be carefully analyzed to code the program card for maximum punching efficiency. Proper use of the various features of the card punch reduces operator time and effort to a minimum. Greater programming flexibility is gained by using both program levels on the 29 Card Punch. The following explanations mention both program levels; the second code in parenthesis is Program Two. Also, refer to Figure 7.

### Programming Common to All Models

To prepare a program card, the following analysis must be made of the cards to be punched:

1. Field definition coding, which determines the length of each field. Punch a field definition 12 (4) in each column except the first (left-hand) of every field regardless of the type of operation to be performed in that field. The 12's (4's) are used in skipped or duplicated fields to continue the skip or duplication across the field, once the operation is started. On the Model B, field definition is used to define the fields programmed for left-zero insertion; on the Model C, they are used to define the fields to be skipped. Field definition punches are also used in fields programmed for manual punching to make full use of the feature provided for the correction of errors made while punching. With all field-lengths defined, each *correct* field can be duplicated by a single depression on the dup key, and only the *field* containing the error must be rekeyed.

2. Automatic skipping for each field that is not to be punched at this time. If several successive fields are to be skipped on every card, program them as one large field with an 11 (5) in the first column and 12's (4's) in all successive columns.

3. Automatic duplication of each field that is punched with the same data for a group of cards. If several successive fields are to be duplicated on every card, program them as one large field with the zero (or 6) in the first column and 12's (4's) in all successive columns.

4. Alphabetic coding to shift the keyboard when letters are to be keyed. If all or most of a field is to be alphabetically punched, code it with 1's (7's) and use the numeric shift key for occasional numeric punching. In the duplication of alphabetic punching, the 1's (7's) permit duplication of blank columns.

### Programming the Model B

The Model B is the Left-Zero Insertion Card Punch and the only additional program card requirement is a code in the high-order (first) column of each *left-zero field* to indicate the number of columns in the field. To determine the code, count the number of columns in the left-zero field(s). Refer to Figure 7 and select the proper code in the program level desired. For example; punch a 3 (9) in the first column if the field is seven columns long; punch a 1 and 3 (7 and 9) in the first column if the field is four columns long. The remainder of the field(s) is punched with field definition 12's (4's), and the remaining non-left-zero fields are programmed as described under "Programming Common to All Models."

### Programming the Model C

The Model C, when being used to interpret, need only be programmed to skip, or to eliminate recognition of 11 and 12 overpunches in numeric fields.

To skip, as with any automatic skip, punch an 11 (5) in the first column and 12's (4's) in all the remaining columns of the portion of the card to be skipped. A single column skip is caused by the 11 (5) punch.

To eliminate interpreting either an 11 or 12 overpunch in a numeric column, punch the program card with a zero (or 6) in the corresponding column.

After the program is planned for these operations, punch the codes directly into a single card to serve as the program card. It is desirable to prepare the program card in a card of the same design as those to be punched. When punching the program card, punch all codes across the card in columns 1-80 without backspacing, to maintain accurate registration. When two codes are to be punched in one column, for Program One, use the proper letter or special character key on the combination keyboard (A for a 12-code and a 1-code, or the / symbol for a 0-code and a 1-code). These codes can also be punched by pressing each of the two numeric keys while holding the multipunch key depressed.

For Program Two codes (punch rows 4-9), the multipunch method must be used.

### Program Two used for Alternate Programming

When it becomes necessary to alternate programs to handle two types of cards in one punching operation, all the preceding operations must be analyzed for the



PROGRAM CODES FOR IBM CARD PUNCHES AND VERIFIERS

FOR 24-26-56 OPERATION	REGULAR		ALTERNATE	
	IS COL.	REST OF FIELD	IS COL.	REST OF FIELD
KEY NUMERICAL-FIELD DEFINITION	SPACE	12	SPACE	4
KEY ALPHABETIC	1	12-1	7	4-7
DUPLICATE-VERIFY AUTOMATICALLY	0	12	6	4
SKIP AUTOMATICALLY	11	12	5	4
LEFT ZERO PRINT -26 11-12 ELIMINATION -56	2	12-2	8	4-8
SUPPRESS PRINTING -26 0-9 ELIMINATION -56	3	12-3	9	4-9

**CAUTION:** PROGRAM CARDS WITH MULTIPLE PUNCHES PER COLUMN MUST NOT BE DUPLICATED ON THE IBM 26, OR PRINTING MODELS OF THE IBM 29, AS PRINT UNIT DAMAGE MAY OCCUR

FOR 29-59 OPERATION	PROGRAM ONE		PROGRAM TWO	
	IS COL.	REST OF FIELD	IS COL.	REST OF FIELD
KEY NUMERICAL-FIELD DEFINITION	SPACE	12	SPACE	4
KEY ALPHABETIC	1	12-1	7	4-7
DUPLICATE-VERIFY AUTOMATICALLY	0	12	6	4
HIGH SPEED VERIFY AUTOMATICALLY-59	0-3	12	6-9	4
SKIP AUTOMATICALLY	11	12	5	4
LEFT ZERO FILL-29				
8 POSITION FIELD	2	12	8	4
7 POSITION FIELD	3	12	9	4
6 POSITION FIELD	2-3	12	8-9	4
5 POSITION FIELD	1-2	12	7-8	4
4 POSITION FIELD	1-3	12	7-9	4
3 POSITION FIELD	1-2-3	12	7-8-9	4
{LEFT ZERO VERIFY AUTOMATICALLY-59	2	12	8	4
{LEFT ZERO VERIFY-CONTROL	--	*11-12	--	*4-5
11-12 ELIMINATION -59	3	12-3	9	4-9
0-9 ELIMINATION -59	1-3	12-1-3	7-9	4-7-9

\* PUNCHED IN UNITS (LAST) COLUMN ONLY

PROGRAM PLANNING												CARD OR JOB IDENTIFICATION: Payroll Master & Deduction																																																						
12	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	12
11	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	11
0	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	0
1	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	1
2	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	2
3	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	3
4	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	4
5	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	5
6	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	6
7	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	7
8	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	8
9	1	2	3	4	5	6	7	8	9	10	11	12	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	9

Figure 24. Program Planning Card

card shown in Figure 23. The field headings for the payroll master part of the card are at the top of the card; the headings for the deduction part are between the 7 and 8 punching rows. A payroll master card is prepared for each new employee and is punched under normal programming (Program One) coding. Miscellaneous deductions cards are punched for only those new employees who have deductions other than the

fixed deductions, and are punched under alternate program (Program Two) coding. Whenever possible, common information is duplicated from the payroll master cards into the deduction cards. The cards are punched in groups by date hired, and the rate-change date for a new employee is the same as the date hired. The program card is planned and punched as shown in Figure 25.

<u>Columns</u>	<u>Field Heading</u>	<u>Normal Program</u>	<u>Alternate Program</u>
1-9	Social Security No.	Manual punch	Automatic skip
10-27	Employee Name	Manual punch, alphabetic	Automatic duplicate, alphabetic
28	Sex	Manual punch	} Automatic skip
29	Tax Class	Manual punch	
30-35	Date Hired	Automatic duplicate	
36-40	Employee Number	Manual punch (Department and Clock coded as separate fields for error correction and zero suppression)*	Automatic duplicate (Department and Clock coded as separate fields for zero suppression)*
41-42	Occupation Code or Deduction Code	Manual punch	Manual punch
43-46	Base Rate	Manual punch	} Automatic skip
47-52	Rate Change Date	Automatic Duplicate	
53-58	Fixed Deductions	Manual punch (Insurance and Hospitalization coded as separate fields for error correction and zero suppression)*	
59-68	Deduction Name	} Automatic skip	Manual punch, alphabetic
69-74	Misc Ded Amount		Manual punch (left-zero insertion field)
75-80	Effective Date		Manual punch

Month and day in each date field are coded as separate fields for zero suppression\*

\*Left-zero print switch off

Figure 25. Table for Program Example

### **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 also necessary to press the release key. For this reason, once the program is turned on, leave it on, and, whenever possible, any temporary changes or interruptions in the punching routine should be handled by the functional switches and keys. A method that can be used if only one program level is punched in the program card, is to press the program selection key for the program level not being used. Program control can again be restored by pressing the selection key for the program level being used.

### **Starting a Punching Operation**

When a new job is started, the machine is ready for operation as soon as the main line switch is turned on. Press the feed key twice, or hold depressed for two feed cycles to register the first card. If a prepunched master card is to be inserted, place it in the center of the card bed after the first feed cycle. On the second cycle, the master card and the first blank card are registered at their respective stations.

When master information for automatic duplication is to be keyed in the first card of the group, turn off the auto skip/dup switch before the first card is registered, and leave it off until the master information is keyed. On this first card, use the skip key to skip the fields programmed for automatic skipping.

### **Stopping a Punching Operation**

When an operation is to be stopped and the main line switch is to be turned off before a batch of work is completed (as at a lunch hour), the card at the punch station should first be completely punched and released. Before the card is released, however, turn off the auto feed switch. This permits restarting the job without additional card handling.

When one batch of work is to be followed by another batch that is using the same master information and program control, a blank card should follow the last card of the batch through the punch station. The blank card can be released past the punch station as the last card is released past the read 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 rekeying the master information. The auto 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, turn off the auto feed switch during the punching of the next-to-last card. The last card is 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 operating the clear switch.

If the auto feed switch is not turned off after the last card is punched, operating the clear switch causes two blank cards to be stacked behind the last punched card in the stacker.

The clear switch is used to completely clear the card bed. When operated, the switch causes all cards in transport between the feed hopper and the stacker unit to progress, with no further punching, to the stacker. No new cards are fed from the feed hopper during this operation.

### **Removing a Card from the Center of the Card Bed**

To remove a card from the center of the card bed without affecting the following cards, manually move it into the read station and press the release key. This moves the card 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 read station but not stacked, it is in the left of the card bed. For easy manual removal, move the card to the extreme left by pressing down on the arm that extends from the read station.

### **Removing a Card from the Punch or Read Station**

If for any reason a card must be removed manually from the punch or read station, hold down the pressure roll release lever while pulling out the card. If a card at the punch station does not move easily, press all the numeric keys; then, while holding down the lever, pull out the card without tearing it.

### **Spacing Over Columns**

Without program control, the dup key may be used to space over columns if the same columns are unpunched in the preceding card at the read station or if there is no card at the read station. This operation is faster than using the space bar.

### **Multiple Punched Columns**

Punch two or more digits in one column by holding down the multiple punch key while pressing the digit keys one at a time. The keyboard is automatically shifted to numeric operation when the multiple punch key is pressed.

### **Corner Cuts**

Cards can have a normal upper-left or upper-right corner cut. Cards with lower corner cuts (except lower-left corner cut C-3, 30-degree, 0.130-inch base measurement) cannot be fed. Round corner cut cards are acceptable.

### **Single Card Feeding**

When the cards are to be fed manually, one at a time, place them directly in the card bed, to the right for punching or in the center for reading. Do not insert single cards in the card hopper. When placing a card in the center of the card bed, position it so that the column-1 edge is between the feed rolls at the right of the read 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 punch station. The clear switch should be operated to move the card to the stacker; however, the card at the punch station need not be removed. One depression of the feed key brings a second card down without advancing the first card, and restores the machine to operating condition.

2. On the combination keyboard, when either the A or the Z key is pressed in a column programmed for numeric punching. Press the error reset key to unlock the keyboard.

3. A blank column is duplicated in a field programmed for numeric punching. This serves as a blank-column detection device to insure that a digit is punched in every column of a numeric field that is being duplicated. Unlock the keyboard by pressing the error reset key or the alphabetic shift key on the combination keyboard.

4. A card is not registered at the punch station. It is impossible to do any punching or spacing unless a card is registered at the punch station. To move a card into punching position, press the register, the feed, or (with the auto feed switch on) the release key.

5. The register key or the feed key is pressed when a card is already registered at the punch station. Press the error reset key to unlock the keyboard.

### **Suspending Automatic Duplication on First Card**

Master information in the first card of each new group must be keyed. Automatic duplication must be suspended for that card by turning off the auto skip/dup switch. Because this requires the manual setting of the auto skip/dup switch each time master information changes, consideration should be given to proper card design as an aid to most efficient operation.

Several recommended procedures for punching the first card of each group are (the procedures vary depending on conditions brought about by differences in card design):

Whenever possible, program the first field in a card for manual operation. This gives the operator a chance to turn the auto skip/dup switch off before starting to punch the first card of a new group.

1. When the first card of a new group is registered at column 1, turn the auto skip/dup switch off.

2. Punch the complete card.

3. When the second card of the group is registered at column 1, turn the auto skip/dup switch on. (The switch could have been turned on after the master information was punched.)

Automatic duplication should not immediately follow an automatic skip.

1. Punch the first field.

2. Automatically skip the second field (auto skip/dup switch on).

3. Turn off the auto skip/dup switch; punch the third field.

4. Punch the fourth field; turn on the auto skip/dup switch.

Sometimes other factors in the use of the cards make it necessary for automatic duplication to follow an automatic skip. In such a case, study the two possible procedures and follow the best one.

1. Long-Skip Field

- a. Punch the first field.

- b. Automatically skip the second field. During the skip, turn off the auto skip/dup switch to prevent automatic duplication in the following field. (This can be done if the skip is fairly long.)

- c. Punch the third field and turn on the auto skip/dup switch.

2. Short-Skip Field

- a. Turn off the auto skip/dup switch when the card is registered at column 1.

- b. Punch the first field.

- c. Skip the second field by pressing the skip key.

- d. Punch the third field and turn on the auto skip/dup switch.

When automatic duplication is immediately followed by an automatic skip, punch the first card as follows:

1. Turn off the auto skip/dup switch when the card is registered at column 1.
2. Punch the first field.
3. Punch the second field. (Either during, or at the end of this field, turn on the auto skip/dup switch, so that the following field can be automatically skipped.)
4. Automatically skip the third field.

If an automatic skip must come first in a card immediately followed by automatic duplication, the procedure for handling the punching is as follows:

1. Long-Skip Field
  - a. Automatically skip the first field. During the skip, turn off the auto skip/dup switch to prevent automatic duplication in the second field. (This can be done if the skip is fairly long.)
  - b. Punch the second field and turn on the auto skip/dup switch.
  - c. Punch the third field.
2. Short-Skip Field
  - a. Turn off the auto skip/dup switch before the last card of a group is punched in column 80.
  - b. Press the skip key to skip the first field of the first card in the following group.
  - c. Punch the second field and turn on the auto skip/dup switch.
  - d. Punch the third field.

When an automatic skip field comes between two fields programmed for automatic duplication, punch the first card as follows:

1. Turn off the auto skip/dup switch when the card is registered in column 1.

2. Punch the first and second fields.
3. Skip the third field by pressing the skip key.
4. Punch the fourth field and turn on the auto skip/dup switch.

## Printing

### Character Arrangements

On printing models of the 29 Card Punch, the characters that print are usually determined by the type of keyboard attached. In general, machines with a 64-character keyboard print 64 characters; machines with a 48-character keyboard print only 48 characters. Machines with numeric keyboards can be equipped with either of the two printing capacities.

The printing provided with a 64-character (arrangement EL) keyboard includes the 26 letters, the 10 numerals, and the special characters shown in Figure 26 under EL.

The printing provided with a 48-character keyboard includes 26 letters, 10 numerals, and 10 special characters. Two 48-character keyboards are available (arrangements A and H). The special characters associated with options A and H are shown in Figure 26. Any attempt to print, either by punching or by duplicating, one of the 16 punched-hole combinations shown below the dotted line on Figure 27 causes a solid square printed warning mark. This indicates that characters not associated with a 48-character keyboard have been used.

Card Code	Graphic		
	EL	A	H (Fortran)
12	&	&	+
11	-	-	-
0-1	/	/	/
12-3-8	.	.	.
11-3-8	\$	\$	\$
0-3-8	#	#	#
3-8	<	<	<
12-4-8	<	⌘	)
11-4-8	*	*	*
0-4-8	%	%	(
4-8	@	@	'
<hr style="border-top: 1px dashed black;"/>			
12-2-8	¢		
11-2-8	!		
0-2-8	(No Graphic Assigned)		
2-8	:		
12-5-8	(		
11-5-8	)		
0-5-8	~		
5-8	+		
12-6-8	+		
11-6-8	;		
0-6-8	>		
6-8	=		
12-7-8			
11-7-8	⌋		
0-7-8	?		
7-8	"		

&	Ampersand
-	Minus or Hyphen (Dash)
/	Slash
.	Period
\$	Dollar Sign
,	Comma
#	Number Sign
<	Less Than Sign
*	Asterisk
%	Percent Sign
@	At Sign
⌘	Lozenge
¢	Cent Sign
!	Exclamation Point
:	Colon
(	Left Parenthesis
)	Right Parenthesis
_	Underscore
'	Prime or Apostrophe
+	Plus Sign
;	Semicolon
>	Greater Than Sign
=	Equal Sign
	Vertical Bar, Logical OR
⌋	Logical NOT
?	Question Mark
"	Quotation Mark

Figure 26. Special Characters

### Zero Print and Suppression

When printing, in addition to the analyses described under "Program Card Preparation," the cards should be analyzed for zero printing.

1. With the print switch on, zeros, dashes, and ampersands to the left of the first significant digit in a field are automatically suppressed unless the left-zero print switch is on. This suppression depends on the field definition 12's (4's) in every column except the first. Therefore, if several successive fields are to be programmed for automatic duplication but zero suppression is desired, program each field independently for automatic duplication rather than as one large field as described previously.

NOTE: A zero always prints in the units position of a field that does not have a significant digit (field with all zeros).

If zeros (dashes and ampersands) are desired to the left in a field, such as social security number, the left-zero print switch and the print switch must both be on.

Selective print suppression under program control is not available on the 29 Card Punch.

### Ribbon Replacement

The ribbon on printing models of the IBM 29 Card Punch is fed between two spools, through ribbon guides, and under the punch die (Figure 27). The old ribbon is removed and a new one is inserted 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, positioning it so that the ribbon is fed from the top of the spool toward the front of the machine. Lift the right end of the ribbon-reversing arm, if it is not already up, and unroll 1½ feet 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 position). 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.

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, positioning it so that the ribbon is fed 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.

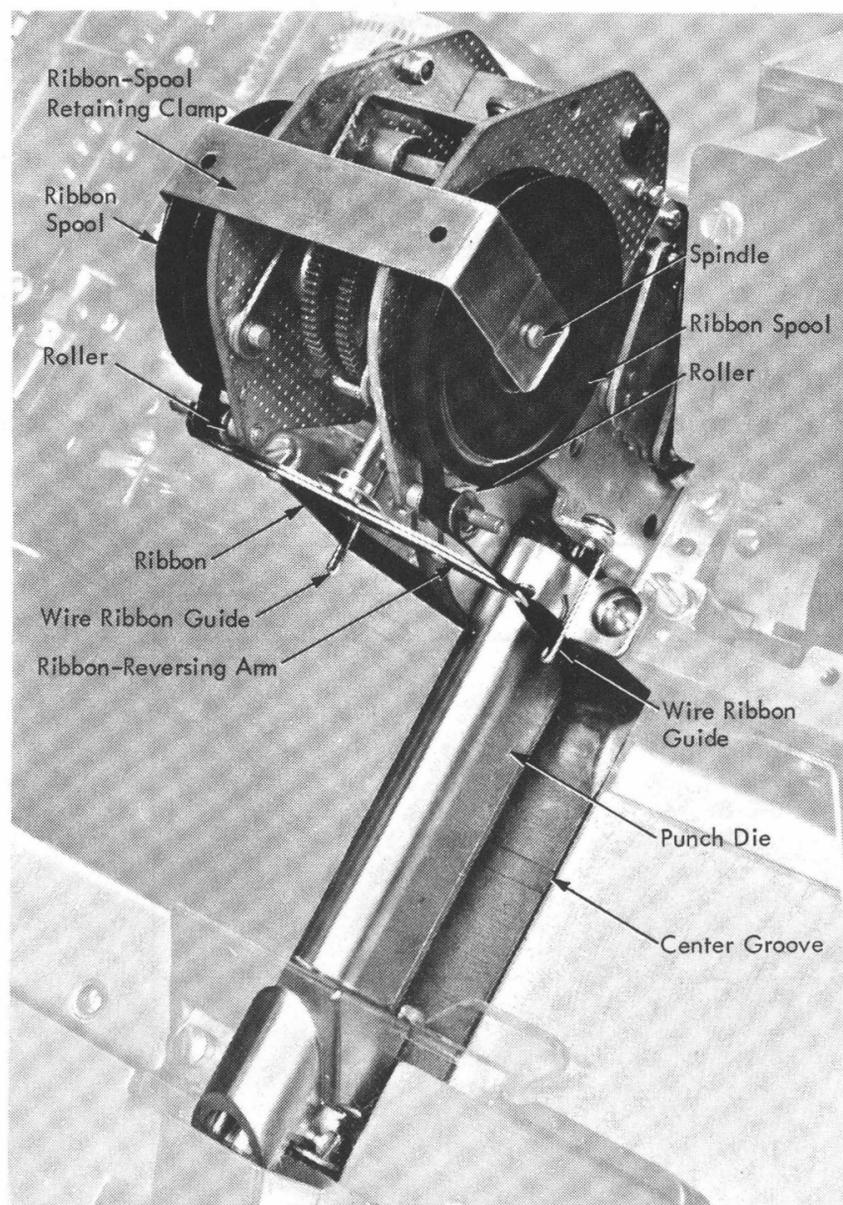


Figure 27. Ribbon Replacement

A 29 Card Punch can have either a 48-character keyboard or an expanded 64-character keyboard.

### 48-Character Keyboard

The 48-character keyboard can be designated as arrangements A or H. In addition to the 26 letters, and numerals 0-9, special characters in various combinations can be punched by a single key depression. Examples of the special characters available in arrangements A and H are shown in Figure 26.

### 64-Character Keyboard

The expanded 64-character (arrangement EL) keyboard is System/360 compatible. The 64 characters are: all the letters and numerals contained on the 48-character keyboard, plus all the special characters shown under arrangement EL in Figure 26.

In Figure 28, each key is numbered for purposes of description in the following summary.

#### Punching Keys

Keys 1-29, 33, and 40-43 are, except for key 7 (A) and key 13 (Z), dual character keys that may be pressed when the keyboard is in either numeric or alphabetic shift. (Keys 7 and 13 should be pressed only when the keyboard is in alphabetic shift; in numeric shift they cause the keyboard to lock up.) The resulting

punched-hole combinations represent numerals, letters, and special characters. See Figure 29 for a chart of the keytop graphics and punched-hole codes associated with each key on the expanded 64-character keyboard.

Note that in numeric shift, key 5 punches a combination of the zero, two, and eight holes in the card. A graphic has not been assigned to this combination, hence the punched-hole code punched by the key is shown on the keytop instead. *All 48-character keyboards show these punched-hole codes on keytops 1-18 instead of the special characters.* This is a reminder that these codes will punch if keys 1-18 (except 7 and 13) are depressed in numeric shift. Care should be exercised so that the left hand, when resting on this part of the keyboard, does not inadvertently trip off these keys.

#### Space Bar

The space bar can be pressed at any time in a manual field to cause spacing over one column of the card.

#### Functional Keys

The remaining keys, numbers 30-32, 34-39, and 44-48 control the various functions of the card punch.

**30. Numeric (Numeric Shift):** Pressing this key shifts the combination keyboard into numeric shift or mode as long as it is held down. It is normally used to punch numbers in an otherwise alphabetic field.

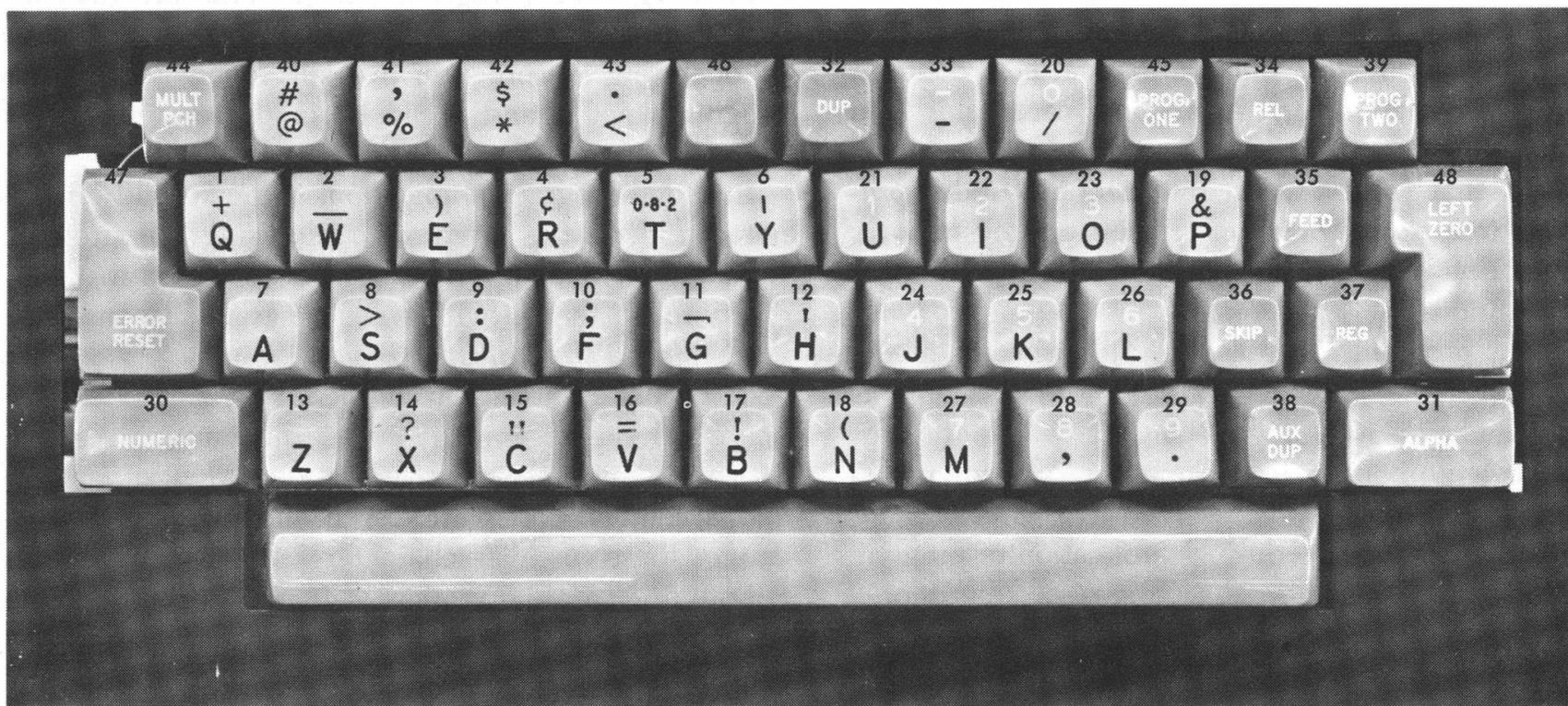


Figure 28. Keys—Combination Keyboard

Key Number	ALPHABETIC		NUMERIC	
	Card Code	Graphic	Card Code	Graphic
1	11-8	Q	12-8-6	+
2	0-6	W	0-8-5	-
3	12-5	E	11-8-5	)
4	11-9	R	12-8-2	¢
5	0-3	T	0-8-2	0-8-2
6	0-8	Y	12-8-7	
7	12-1	A	none	none
8	0-2	S	0-8-6	>
9	12-4	D	8-2	:
10	12-6	F	11-8-6	;
11	12-7	G	11-8-7	┌
12	12-8	H	8-5	,
13	0-9	Z	none	none
14	0-7	X	0-8-7	?
15	12-3	C	8-7	"
16	0-5	V	8-6	=
17	12-2	B	11-8-2	!
18	11-5	N	12-8-5	(
19	11-7	P	12	&
20	0-1	/	0	0
21	0-4	U	1	1
22	12-9	I	2	2
23	11-6	O	3	3
24	11-1	J	4	4
25	11-2	K	5	5
26	11-3	L	6	6
27	11-4	M	7	7
28	0-8-3	,	8	8
29	12-8-3	.	9	9
33	11	-	11	-
40	8-4	@	8-3	#
41	0-8-4	%	0-8-3	,
42	11-8-4	*	11-8-3	\$
43	12-8-4	<	12-8-3	.

Figure 29. Key Graphics and Punched-Hole Codes

31. *Alpha (Alphabetic Shift)*: Pressing this key shifts the combination keyboard into alphabetic shift or mode as long as it is held down. It is normally used to punch letters in an otherwise numeric field. When duplication is being performed in numeric shift, pressing this key permits automatic spacing over blank columns.

32. *Dup (Duplicate)*: When a manual field contains identical information for two or more cards, this field can be duplicated at 18 or 20 columns per second on the cards that follow. With the machine under program control, one depression of the dup key initiates the operation. Duplication continues until the end of field definition.

Without program control, duplication occurs at the rate of 9 or 10 columns per second and occurs only as long as the key is held down. This allows the operator precise column control in a card correction or make-over application.

Encountering a space during duplication of numeric fields locks the keyboard. The error reset key unlocks the keyboard and permits keying of the space, substitute data, or release. The alpha shift key can also be used to get over the space without pressing the error reset key.

Duplication of characters other than the standard 64 can cause damage to the print mechanism on printing models of the 29 Card Punch.

34. *Rel (Release)*: This key is used to advance the card in the read or punch station through column 80. If the machine is under program control and the release operation encounters an auto dup field, the auto dup information is punched before the release operation can continue. Thus, when a card is released because of a keying error, the common information is not lost.

Multiple release and register cycles are not required to clear the card transport area of cards. Use the clear switch for this operation.

35. *Feed (Card Feed)*: The feed key, if held depressed, moves two cards from the hopper into the punch station and preregister station. It is inoperative when a card is registered at the punch station.

36. *Skip*: A skip can be initiated manually by operating the skip key. Skipping occurs at 80 columns per second and continues to the end of field definition under program control, or in the absence of field definition, each key operation results in a single space.

37. *Reg (Card Register)*: When a single card is fed from the hopper, or when a card is manually inserted at either the punch or read station, operating the register key locates the card in the proper position for reading or punching column one. This key does not cause an additional card to be fed from the hopper.

38. *Aux Dup (Auxiliary Duplicate)*: This key is operable only when the machine has the auxiliary duplication feature installed. When pressed, it causes duplication from the master card on the auxiliary duplicating drum. Under program control, pressing the key once duplicates the entire field.

39. *Prog Two (Program Two)*: With the machine under program control, card format may be changed by operating the program two key. The shift between program level 1 and 2 can be made any number of times during the punching of a card.

In a one-program application, if the second level is not coded on the program card, using the program two key suspends programming. This makes it unnecessary to lift the starwheels for program suspension.

44. *Mult Pch (Multiple Punch)*: Characters or card code combinations not available on the expanded keyboard can be created by using the multipunch key. Spacing is suppressed while this key is held depressed and individual codes are keyed and punched. Duplicating these invalid characters should not be attempted on printing models of the 29 Card Punch.

45. *Prog One (Program One)*: Pressing this key causes the machine program control to transfer immediately to Program One, assuming it had been in Program Two (see key 39).

46. *MC (Master Card)*: This key is operable only when the master card insertion device is installed on the machine. Operation of this key is explained under "Special Features."

47. *Error Reset*: An interlocked keyboard can be unlocked by pressing the error reset key. The backspace key does not have to be used for this purpose.

On Model B, the error reset key also permits correcting operator-detected keying errors in a programmed left-zero field before that field is punched.

48. *Left Zero*: On Models A and C, this key is inoperative. On the Model B, it initiates punching a left-zero field when programmed for that operation.

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# READER'S COMMENT FORM

IBM 29 Card Punch

Form A24-3332-3

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