IBM / Technical Newsletter

E4790   5/2/68
E4790
5/2/68

IBM 29 Card Punch Reference Manual

This newsletter includes a description of the IBM 29 functional control switches, changes to the program drum and card insertion and removal procedures, and various other minor changes and improvements.

Remove the following pages and replace them with the attached:

REMOVE	INSERT
5, 6	5, 6
9-12	9-12
15-18	15-18
25-30	25-30
37-40	37-40

Changes to text are indicated by a vertical bar to the left of the change; revised illustrations are denoted by the symbol ● to the left of the caption.

File this cover letter at the back of the publication. It will then serve as a record of the changes received and incorporated.

PDL. POUGHKEEPSIE, N.Y. SDD LAB.

A0000032

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.
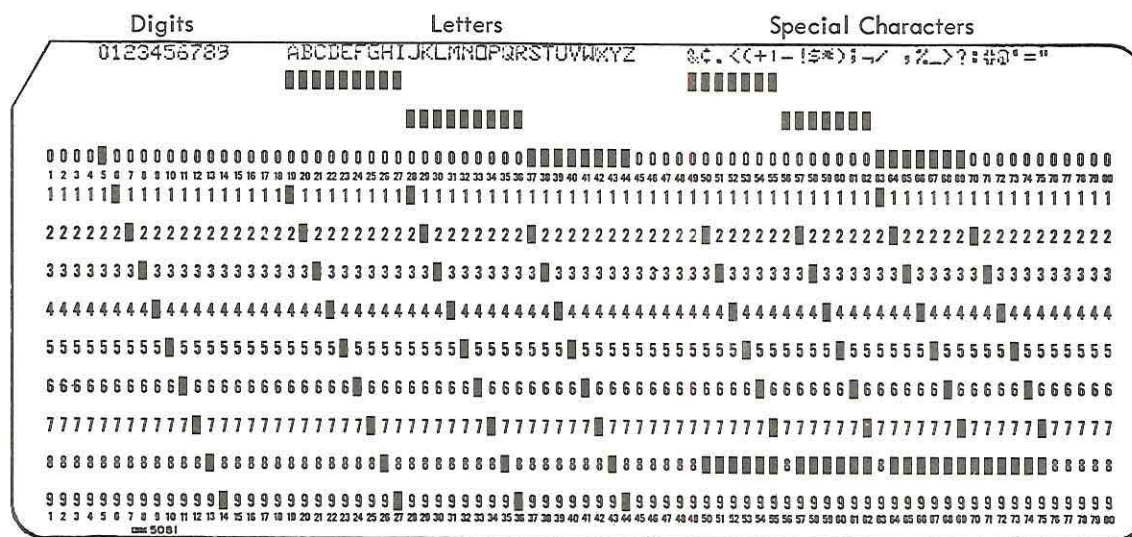

Figure 1. Card Codes and Graphics for 64-Character Set

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."

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.
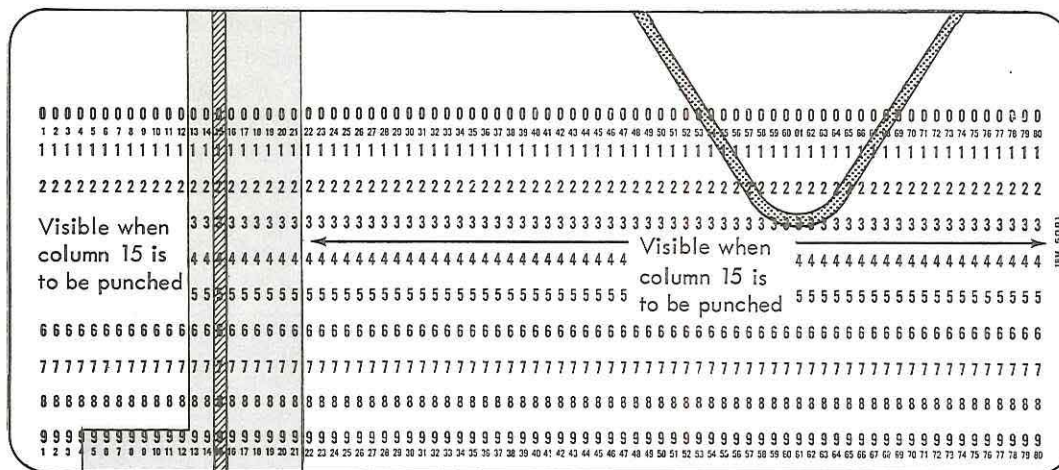
Punch Station

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)

Visible when column 15 is to be punched

Visible when column 15 is to be punched

● 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 prepunched master cards. In this case, insert the prepunched 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 (Figure 4.1), 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 must be left in that position when no program drum is 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 backspacing 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 (Figure 4.1). 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 depression. 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.
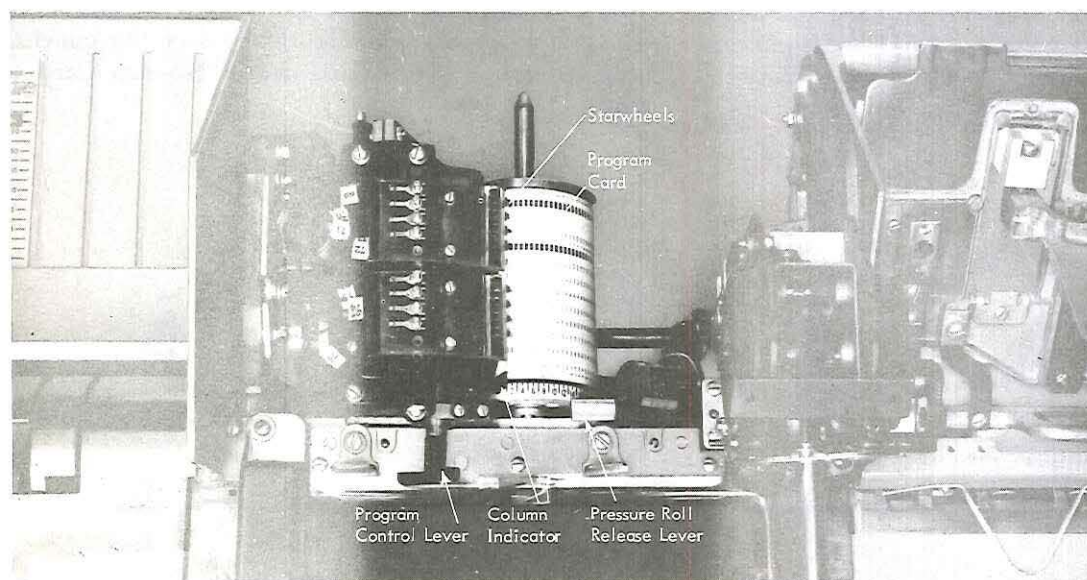
● Figure 4.1   Program Unit

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. When a shift key is manually operated, care should be taken to ensure that the shift key is fully depressed before data keying starts.

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:

Auto Skip/Duplicate (Auto Skip/Dup): This switch must be set on to obtain automatic skipping and duplicating initiated by the program card 11 and 0 punches respectively. When the switch is off, these functions can be started only by the skip and dup keys.

Program Selection (Prog Sel): With a program card in place and the program control lever in the on position, the position of this switch determines whether program control starts in Program One (12-3) or Program Two (4-9). The switch setting selects the program level as a new card is registered for punching. The program level may be changed at will during punching by using the program selection *keys.* However, each time a card is registered, the switch setting selects the start program level.

Auto Feed: When the auto feed switch is turned on and column 80 of the card passes the punch station, a new card is fed automatically. At the same time, the card in the left of the card bed is stacked, the one in the center is registered at the read station, and the one at the right is registered at the punch station. This automatic feeding occurs after the card, completely processed, passes column 80.

When the switch is off, cards may be fed manually by pressing the feed key, program one key, or the program two key. (See "Functional Keys.")

Clear: The clear switch is a spring-loaded, self-restoring switch used to clear all cards from the feed bed, without feeding additional cards from the hopper. One operation of the switch initiates the multiple cycles necessary to complete the operation.

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."
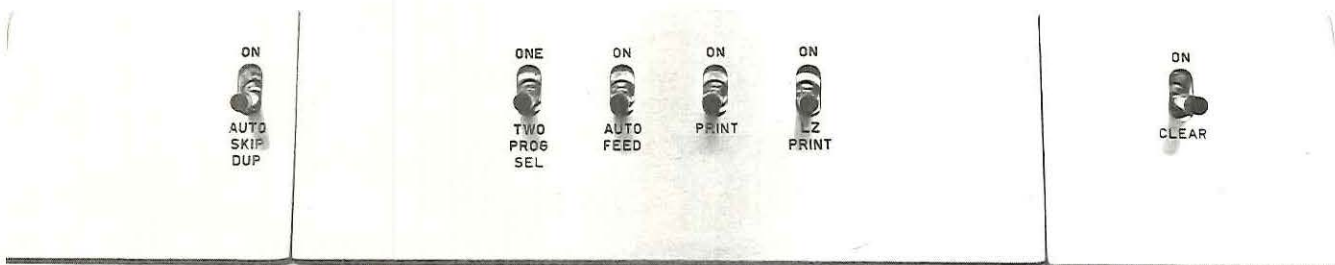
Figure 5. Keyboard Switch Panel

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.

Drum Removal

1. Raise the sensing mechanism by turning the program control lever to the right or off position.

2. Remove the program drum by pulling in a direction parallel to the sensing mechanism. The program card can then be removed from the drum.

Card Removal

1. Turn the clamping strip handle to the center position and remove the column-1 end of the card from beneath the clamping strip.

2. Now turn the handle fully counterclockwise and remove the card from the drum.

Card Insertion

1. With the clamping strip handle turned fully counterclockwise, insert the column-80 end 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.

2. Turn the handle to the center position. This tightens the smooth edge of the clamping strip and loosens the toothed edge.

3. Wrap the card tightly around the drum and insert the column-1 edge under the toothed edge of the clamping strip.

4. Turn the handle 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.

Drum Insertion

1. 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.

2. Turn the program control lever to the left or to the on position to lower the sensing mechanism to the program card. Press the release key.

CAUTION:

An empty program drum should not be inserted in the program unit, and the sensing mechanism must never be lowered when no program drum is in place.
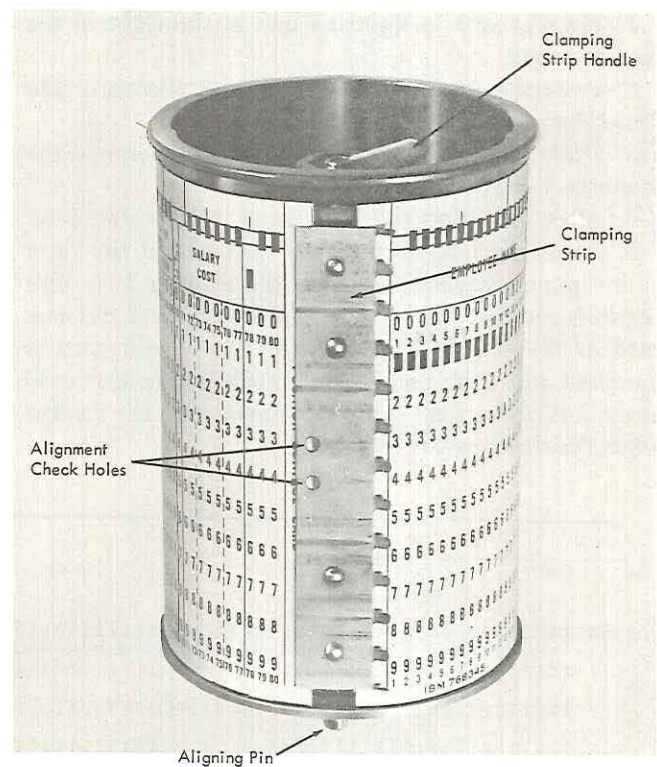

Figure 8. Program Drum

Operations

Inserting Cards Manually

In certain instances it is desirable to insert cards manually, one at a time, as in the case of making over a damaged card or correcting an error found while verifying. Also, when an individual card accompanies each original document, manual insertion is necessary. A card can be manually inserted in the card bed to the right of either the punch station or the read station. Do not insert a single card in the hopper.

In Figure 9, cards prepunched with part code are to be punched and printed with part name, which is written on an accompanying ticket.

Procedure for Inserting Cards Manually

1. Place a card in the card bed at the right of the punch station.

2. Press the register key to advance the card into punching position.

3. Punch part name, starting in column 1; press the numeric shift key when necessary.

4. After punching the part name, release the card.

5. Insert the next card in the card bed at the right of the punch station and press the register key. This registers the first card at the read station and the new card at the punch station. After the second card is punched, press the release key to release the first card at the left of the read station. It moves into the stacker when the third card is registered.

Numeric Punching with Program Control

Normally, in a punching operation, the cards are in the card hopper and are fed into the card bed automatically. Also, as the cards are punched, the program card controls the automatic functions such as skipping and duplicating.

Figure 10 is an example of a labor distribution card to be punched with numeric information according to the fields shown. The example shows how the card is punched to serve as a program card, indicating the type of operation to be performed in each field. Columns 3-6, 34 and 35 are to be automatically duplicated; columns 26-31 are to have left zeros automatically inserted as necessary; columns 48-80 are to be automatically skipped; all other fields are to be punched.

If the auto feed switch is off and prog 1 or prog 2 key is depressed at the end of a completed card, a feed cycle is initiated; the next card registered at the punch station will be controlled by the corresponding program level.

In this example (Figure 10), the switch is set for Program One.

Procedure for Numeric Punching with Program Control

Figure 10 shows an example of the program card for Program One; Program Two is the identical hole pattern in punch rows 4-9.
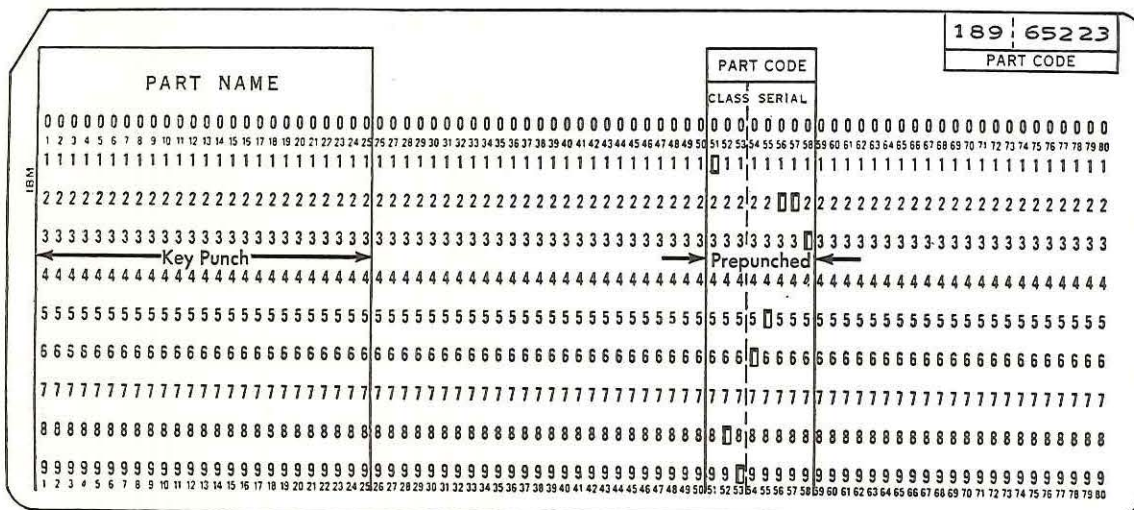
1. Place unpunched cards in the card hopper.

Figure 9.   Inserting Cards Manually

● Figure 10. Numeric Punching

2. Hold the feed key depressed until the cards are fed into the card bed. The first card registers automatically as the second card is fed.

3. Punch columns 1 and 2 (program card punched with a 12 in column 2).

4. Columns 3-6 are programmed for automatic duplication (program card punched with a 0 in column 3 and 12's in columns 4-6). Manually key the first card of each date group with the auto dup switch off. Then, set the switch to ON and the date in each succeeding card is automatically duplicated from the preceding card. Thus, no card handling is necessary even for changes in information being automatically duplicated.

5. Punch columns 7-25 (program card punched with a 12 in each column except the first position of each field).

6. *Key only the significant digits* (numerals other than zero) for columns 26-31 (program card punched with a 2 and 3 in column 26, and 12's in columns 27-31). These digits do not punch as they are keyed; they enter into storage. In this field, while the keyed digits are going in storage and not being punched, if a keying error is recognized, correction is made by pressing the error reset key.

After all significant digits have been keyed, press the left-zero key to start punching; the machine automatically punches the numbers from storage, that had just been keyed in, preceded by the number of zeros necessary to completely fill the defined left-zero field.

7. Punch columns 32-33 (program card punched with a 12 in column 33).

8. Columns 34 and 35 are programmed for automatic duplication (program card punched with a 0 in column 34, and 12 in column 35). In the same manner as date in columns 3-6, manually key the machine group for the first card of each group and it is automatically duplicated in other cards.

9. Punch columns 36-47 (program card punched with a 12 in each column except the first position of each field).

10. The card punch automatically skips columns 48-80 (program card punched with an 11 in column 48, and 12's in columns 49-80). The auto skip/dup switch must be on.

11. With the auto feed switch on, an automatic feed occurs after column 80 is skipped.

Left-Zero Insertion—Model B

The following operating techniques are peculiar to and exclusive with the Model B Card Punch:

Keyed Storage Entry

In a left-zero field, keying the significant digits does not simultaneously punch the digits in the card; they enter into storage instead. After all the significant digits of the field have been keyed, press the left-zero key to start punching. The machine adds the necessary number of zeros to the number of significant digits to equal the number of columns defined for the field (1st column coding in program card). The zeros, followed by the digits, are punched in the card.

Storage Clearout

At any time before the left-zero key is pressed, storage can be cleared, if the operator recognizes that he has made a keying error, by pressing the error reset key. The correct digits can immediately be rekeyed.

Exceeding Field Capacity

One recognizable error condition that requires storage clearout or erasing, is overkeying the left-zero field capacity. Additional digits that are entered in excess of the programmed left-zero field size cause erroneous punching from storage. If recognized before the left-zero key is pressed, storage can be cleared with the error reset key, and the field rekeyed. There is no "built-in" interlock to prevent overkeying a left-zero field; operators have to guard against it.

Skipping

Left-zero fields can be manually skipped if no punching is desired, but the decision to skip the field should be made before any digits are keyed into storage. The manual skip is executed without punching from stor-

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 ½ 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

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.
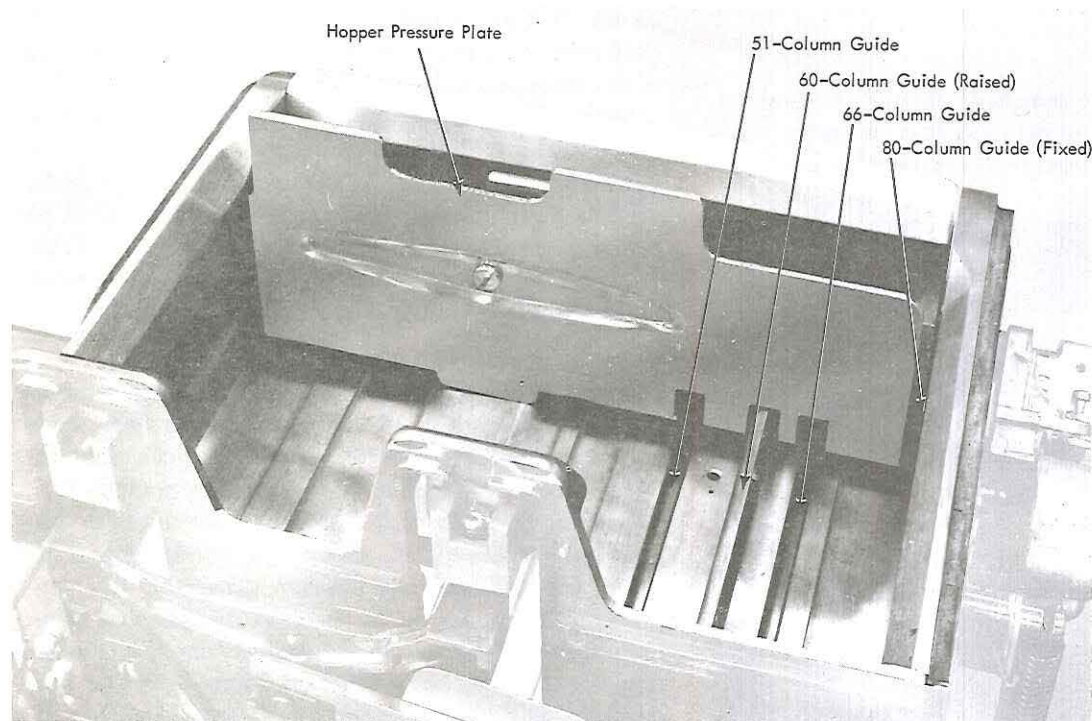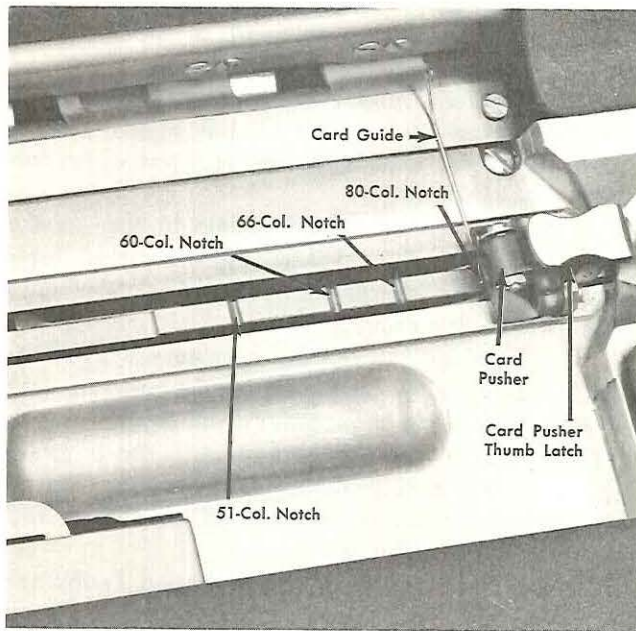

Figure 16. Hopper Card Guides

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
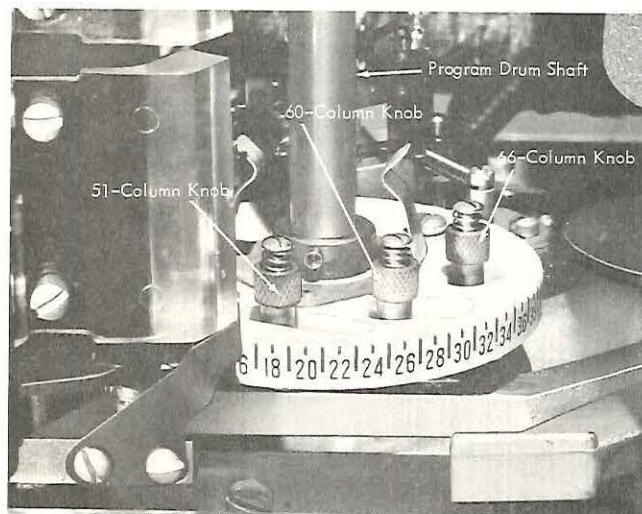
Figure 18. Program Cam Extension Knobs

26

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 length. The right end of each card must rest 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 mispunches, 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					$\times 2$
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.

Note: When duplicating any numeric field, the keyboard locks when encountering a blank column. On a Modulus 10 machine, the backspace key or the alphabetic shift key can be used to overcome the locked condition.

Compatibility (Figure 14)

Modulus 10 self-checking is compatible with:

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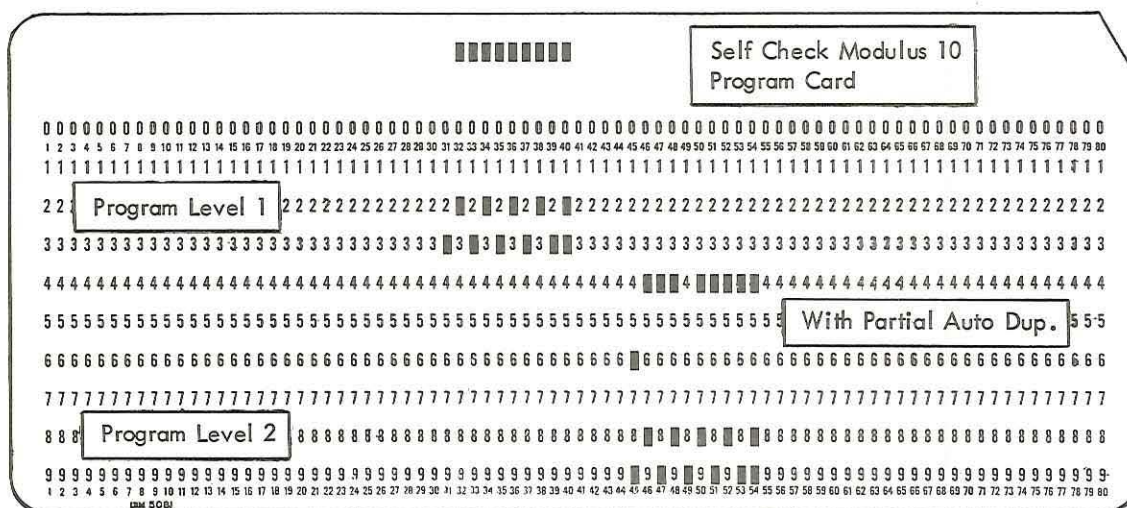
Figure 19.   Self-Check Modulus 10 Program Card (80-Column Card Setting)

tion 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.

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 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.

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	2
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

When the calculations on the basic number result in a check digit of 11, the digit 0 can be substituted and appended to the basic number to make a valid self-checking number. Eleven and zero have the same value in this part of the calculation.

Compatibility (Figure 14)

Modulus 11 self-checking is compatible with:
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.
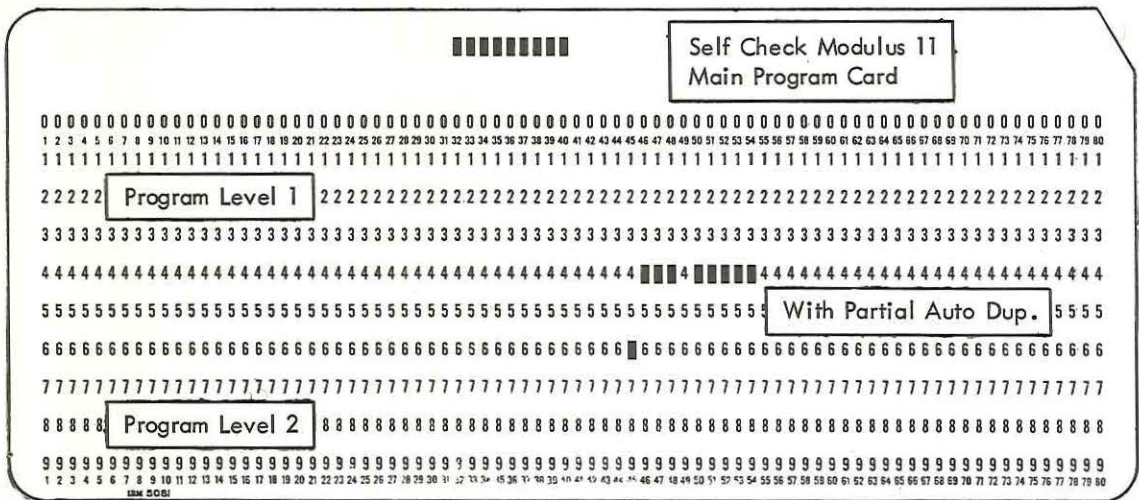
Figure 21. Self-Check Modulus 11 Main Program Card

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 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.
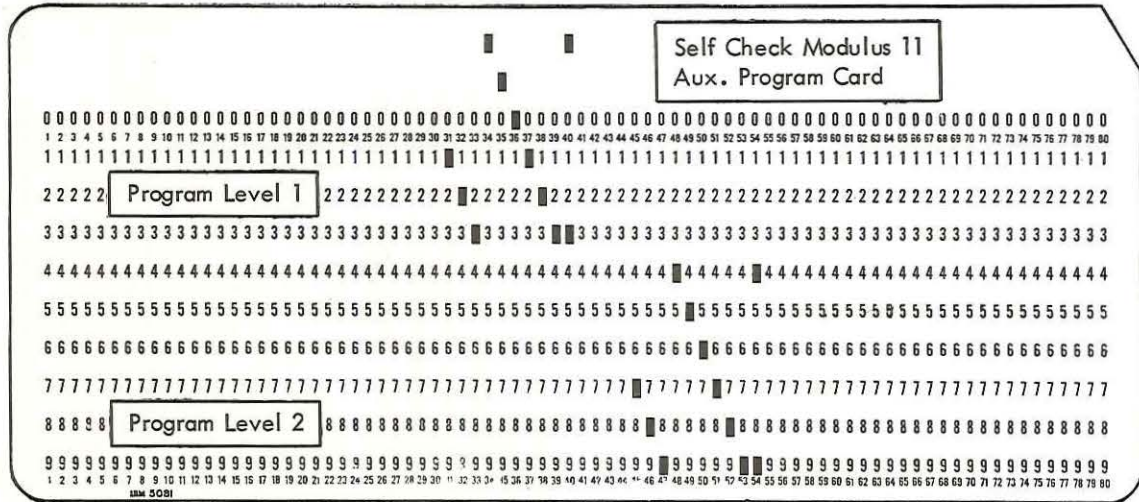

Figure 22. Self-Check Modulus 11 Auxiliary Program Card

30

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 11 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 26 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	/	/	/
12-8-3	.	.	.
11-8-3	$	$	$
0-8-3	,	,	,
8-3	#	#	=
12-8-4	<	¤	)
11-8-4	*	*	*
0-8-4	%	%	(
8-4	@	@	'
12-8-2	¢		
11-8-2	!		
0-8-2	(No Graphic Assigned)		
8-2	:		
12-8-5	(		
11-8-5	)		
0-8-5			
8-5	⌐		
12-8-6	+		
11-8-6	;		
0-8-6	>		
8-6	=		
12-8-7				
11-8-7	⌐		
0-8-7	?		
8-7	"		

Figure 26. Special Characters

&	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

All characters of either the 48- or 64-character set may be duplicated and printed. However, any multiple punching that is not a valid character should not be duplicated on a 29 printing card punch. Duplicating invalid combinations of punches can cause damage to the print unit, whether or not the print switch is set to on.

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

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.
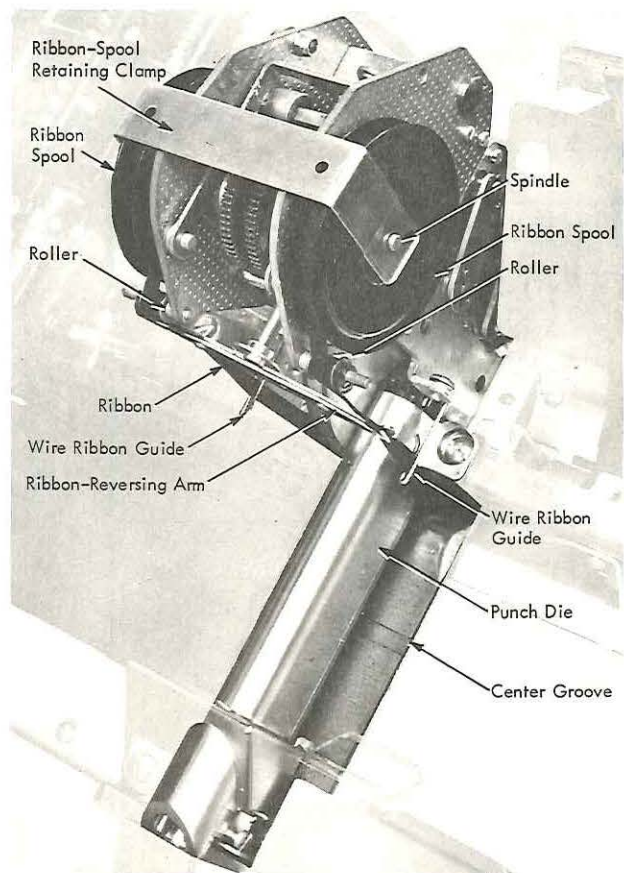
11. Replace the ribbon-spool retaining clamp.

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. See "31. Alpha (Alphabetic Shift)."

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 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.

Note: Pressing either the alpha or the numeric key and a character key simultaneously may cause extraneous extra punches. The alpha or numeric key should be fully depressed before data keying is started.

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 into the cards that follow. Under program control, one depression of the dup key initiates the operation. Duplication continues until the end of field definition.

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 allow duplication of the space.

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 permits precise column control in a card correction or make-over application.

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, under program control, 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).

40