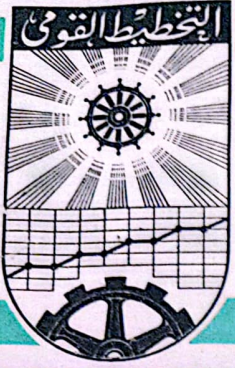


# الجمهورية العربية المتحدة



نسخة واحدة

مَعْمَد المخطط القومي

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CARD PUNCHING

By

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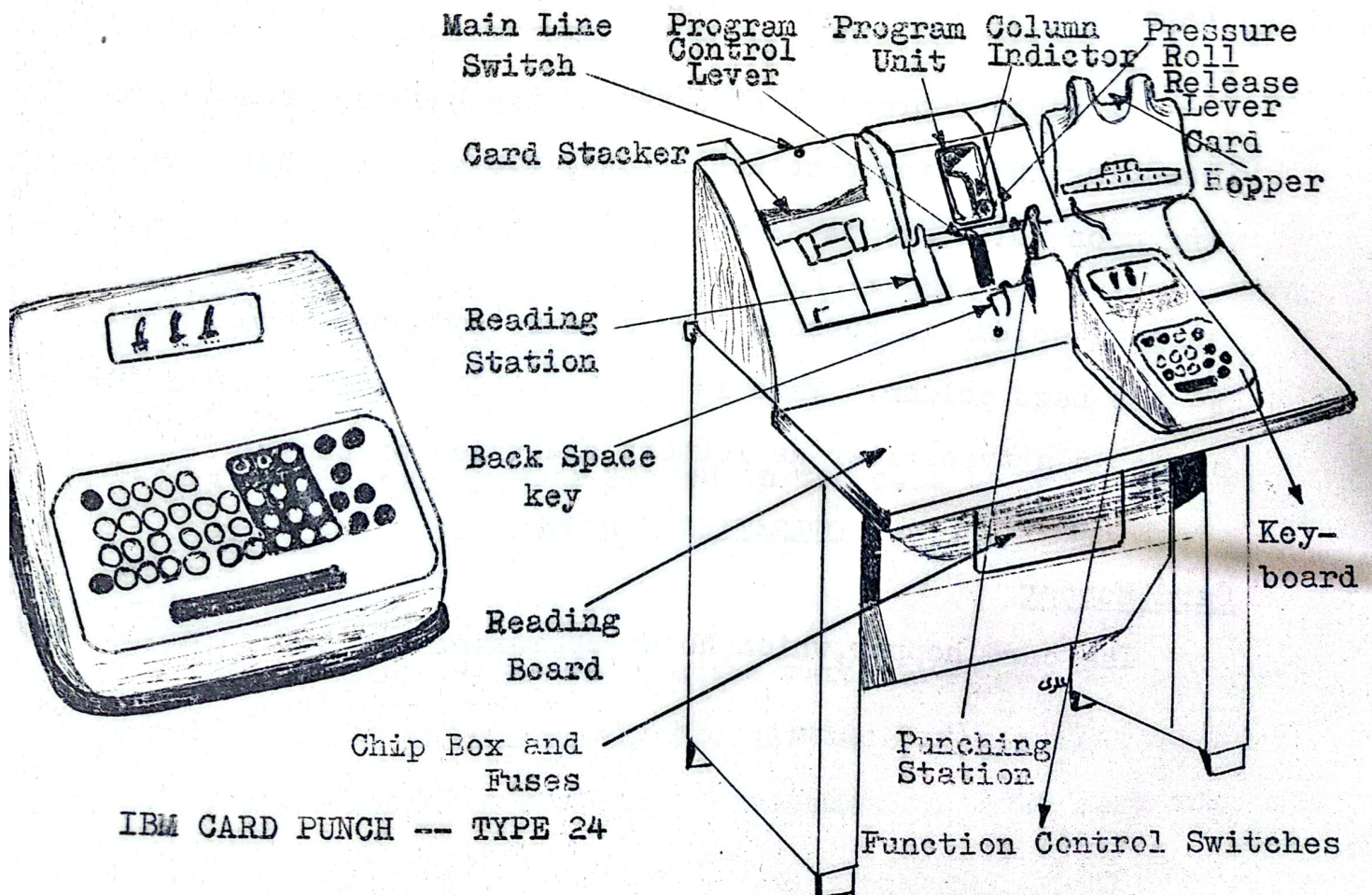


## Card Punching

### Description

For the successful conduct of any organization which employs people, it is necessary to record and maintain certain information pertaining to each employee in an accurate and readily accessible manner. Such records can be efficiently created and maintained by card machines.

The first step in applying these machines to any type of accounting function is to record the information in a card. In the application used for this practice problem, the information relative to each employee is punched into a Personnel Record card by means of a card punch, which is manually operated. Once it has been recorded, this card can be used for reference by clerical personnel, and can also be used by various machines to prepare many types of reports and other documents which may be required for the successful conduct of the business.





## General Description of Machine

THE TYPE 24 Card Punch can be used to punch numerical, alphabetical and special character information. The keyboard is connected to the punch by a cable and can be moved anywhere on the reading board, to suit the convenience of the operator.

On the combination numeric and alphabetic keyboard, a group of the right-hand keys serves for punching digits as well as letters, with the shift from one to the other automatically made by a program card. This permits the operator to punch an alphabetic field with both hands and, without shifting from the "home" position, to punch a numeric field with her right hand only. This frees the left hand for document handling.

A light depression of a key on the keyboard causes the punching in a single column of one, two or three holes depending upon which key is depressed.

As each column is punched, the card is advanced automatically to the next column. This is similar to the action which takes place on a typewriter as letters are typed on paper.

### OPERATING FEATURES

#### Card Hopper

The card hopper, which holds approximately 500 cards, is located



On the upper right side of the machine. The cards are placed in the hopper, face forward with the 9's down, and are fed front card first. A sliding pressure plate insures uniform feeding.

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

#### Punching Station

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

A single card may be placed in the card by hand, and registered in punching position by key depression.

#### Reading Station

The reading station where the cards are read for duplicating is located approximately the distance of one card to the left of the punching station. Consequently, each card that has



been punched passes through the reading station as the next card is being punched. The two cards move in synchronism, column by column and information to be duplicated is transferred from the first card to the second. Punching from one card to another can be controlled, field by field so that only the desired information is duplicated. This feature eliminates card handling for the duplication of information from cards prepared during the punching operation.

### Card Stacker

The card stacker, which holds approximately 500 cards, is located on the upper left side of the machine on a level with the hopper. After each card passes the reading station, it is fed into the stacker automatically or by key depression. Cards are stacked at an angle, 12<sup>1</sup>/<sub>2</sub>'s down, with the back of the card facing the operator, and are held in position by a pressure plate. When the cards are removed from the stacker, they are in their original sequence.

### Main Line Switch

The Main Line switch is located at the rear of the stacker. Operation of the machine may be started approximately one minute after the Main Line switch is turned on, to allow sufficient time for the electronic tubes to heat. When the stacker is full, the switch is thrown off automatically.

### Backspace Key

This key is located below the card bed between the reading and punching stations. As long as it is held depressed, the cards at the punching and reading stations are backspaced continuously. At the same time, the program card, which controls skipping and



duplicating, is also backspaced. Backspacing should not be attempted after column 78 is passed, without first removing the card in the card bed at the right

### Column Indicator

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

### Pressure Roll Release Lever

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

### Chip Box and Fuses

The chip box is located under the reading board. When it is removed, the fuses for the machine are accessible.

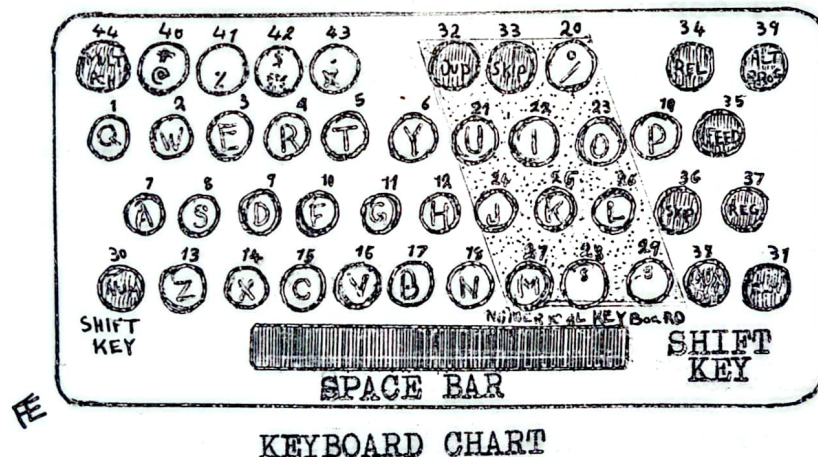
### Keyboard

The home keys are more concave than the other keys to facilitate accurate touch operation. The keyboard is interlocked so that no two keys can be depressed at the same time, but it is not necessary to wait for one key to rise before depressing another. This design permits "rolling" of keys. Multiple digits may be punched manually in one column, by holding the space bar down



while the keys are depressed. On some machines, a multiple punch key is supplied for this purpose.

The combination keyboard has the letter keys 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 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 these ten numeric keys is: index finger for digits 1-4-7, middle finger for digits 2-5-8, and ring finger for digits 0-3-6-9. The



punching of a digit or a letter with any of the combination keys depends upon the shift of the keyboard. For example, depression of 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 depression.



### Functional keys

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

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

DUP (duplicate). With program control: causes duplication of the field for which it is depressed at the rate of 20 columns per second.

Without program control: duplicates at the rate of 10 columns per second only as long as the key is depressed.

-SKIP (or) -. In numeric shift punches an ll (-) and causes skipping of the field for which it is depressed; in alphabetic shift punches an ll (-) only.

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

FEED (card feed) causes a card feed cycle:

- a. Feeds a card from the hopper.
- b. Registers the cards at the punching and reading stations.
- c. Stacks the card from the left of the card bed.

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

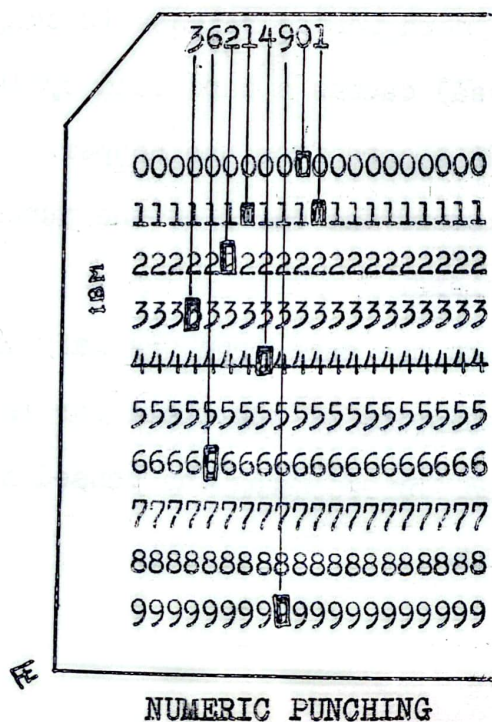


- a. Registers the cards at the punching and reading stations.
- b. Stacks the card from the left of the card bed.

## Switches

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

Automatic Feed. When this switch is turned ON and column 80 of the card passes the punching 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 reading station and the one at the right is registered at the punching station. This automatic feeding occurs when column 80 of the card passes the punching station by any one of three possible operations - punching, skipping, or releasing.





## Numeric Punching

In punching numeric information, the operation is simply that of punching holes representing particular digits (0 to 9) in predetermined columns of the card. If for example, a 3 and a 7 are punched in two successive columns, the number 37 is recorded. What this number represents is determined by the card field heading. The term field is used to describe a columns or group of columns set aside by vertical lines for a particular item of information.

| ABCDEFGHIJKLMNOPQRSTUVWXYZ |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0                          | 0 | 0 | 0 | 0 | 0 | 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 | 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 | 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 | 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 | 4 | 4 | 4 | 4 | 4 | 4 |
| 5                          | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 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 | 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 | 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 | 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 | 9 | 9 | 9 | 9 | 9 | 9 |

## ALPHABETIC PUNCHING



### Alphabetic Punching

The recording of letters in IBM cards is accomplished by keys on the combination keyboard. As previously stated, there are only twelve punching positions in each column of the card. Since there are 26 letters in the alphabet and only twelve possible positions in which to record a letter, it therefore is necessary to punch two holes in a column for each letter. This requires a low, or numeric punch (1-9) in combination with a high, or zone, punch (0-11-12). Thus, the punching for each letter of the alphabet is as follows:

FIRST ZONE  
12 punch in  
combination  
with

1-A  
2-B  
3-C  
4-D  
5-E  
6-F  
7-G  
8-H  
9-I

SECOND ZONE  
11 punch in  
combination  
with

1-J  
2-K  
3-L  
4-M  
5-N  
6-O  
7-P  
8-Q  
9-R

THIRD ZONE  
0 punch in  
combination  
with

2-S  
3-T  
4-U  
5-V  
6-W  
7-X  
8-Y  
9-Z

The two holes for any given letter of the alphabet are punched simultaneously by one depression of an alphabetic key.



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.

The control punching required in the program card depends on the functions to be performed, that is, skipping, duplicating, and alphabetic punching. Each row in the program card serves a specific purpose in this respect.

#### Field Definition

A 12 hole should be punched in every column except the first (lefthand position) of every field to be skipped, duplicated, or manually punched. These 12<sup>1</sup>s serve to continue to the end of a field any skip or duplication started within that field. Several consecutive fields to be automatically skipped or duplicated as one field should be programmed as a single field.

The 12<sup>1</sup>s are punched in the program card for manually punched fields to permit occasional skipping or duplicating. This skipping or duplicating is started by key depression and is carried across the field by the 12<sup>1</sup>s.

#### Automatic Skip

An 11 hole punched in the first column of any field automatically starts the skip, which is continued over that field by the 12<sup>1</sup>s punched in the remaining columns of the field. If a single column is to be automatically skipped, it is punched with an 11. This coding operates in conjunction with an automatic skip and duplicate switch, which must be ON to start the skipping automatically.



### Automatic Duplication

A zero punched in the first column of any field automatically starts duplication, which is continued over the field by the 12<sup>1</sup>s punched in the remaining columns of the field. If a single column is to be automatically duplicated, it is punched with a zero. This coding operates in conjunction with an automatic skip and duplicate switch, which must be ON to start the duplicating automatically.

### Alphabetic Punching

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

The four basic program codes are summarized below:

| <u>Code</u> | <u>Function</u>             |
|-------------|-----------------------------|
| 12          | Field Definition            |
| 11          | Start Automatic Skip        |
| 0           | Start Automatic Duplication |
| 1           | Alphabetic Shift            |

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

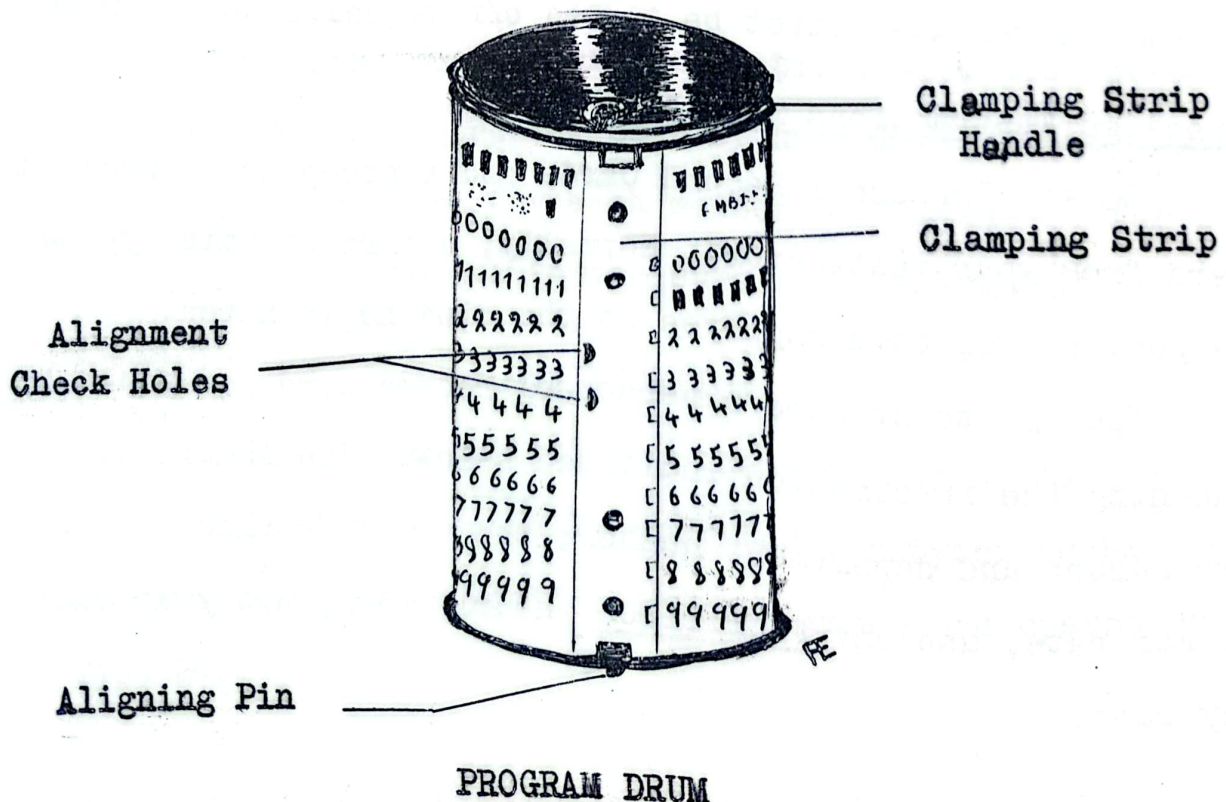


## PROGRAM DRUM

The program card is mounted on a program drum for insertion in the machine. The program drum has a clamping strip to hold the card, and a handle on the top to tighten or release the strip. To fasten a card around the drum the following steps should be taken:

1. Hold the drum in an horizontal position with the handle to the right. Turn the handle away (counterclockwise direction) 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<sup>1</sup>s edge is against the rim of the drum.





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

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

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

To remove a card from the drum, the above procedure should be followed in the reverse order.

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

#### Specific Instructions for this Problem:

Obtain Personnel Record Cards and a pre-punched program card from your instructor. Normally, a card of this type would be punched for each employee at the time he is hired.

You are to prepare a personnel record card for yourself by punching the information indicated below. You should use your own number and department number; the Plant Number is 1. For rate, use any FICTITIOUS hourly rate, not your actual pay rate.



| <u>Information</u>                        | <u>Card Columns</u> |
|-------------------------------------------|---------------------|
| Identity No.                              | 1 through 9         |
| 1st Initial of Name                       | 10                  |
| 2nd Initial of Name                       | 11                  |
| Last Name                                 | 12 through 26       |
| Plant No.                                 | 27                  |
| Department                                | 28-29-30            |
| Man No.                                   | 31 through 35       |
| Rate (to nearest 1/2 cent)                | 36 through 39       |
| Height (in inches to nearest<br>1/2 inch) | 42-43-44            |
| Weight(in pounds)                         | 45-46-47            |
| Age                                       | 48-49               |

You should prepare at least five identical cards in order to get the "feel" of the punch and to provide "test" cards for use in the problems which follow. The duplicating feature of the punch may be used to make the additional cards.

If you are a typist, be careful not to use lower case L for a digit I.

After finishing the punching operation, give one correctly punched card to the instructor so that he may use it to prepare a complete set (one card for each member of the class) for each member of the class to use in the subsequent problems.

#### VERIFICATION

In most actual installations, the accuracy of the punching would be verified by a manually operated verifying machine such as the Type 56 which is similar in appearance and operation to the Type 24.



If such a machine is available in the practice area, it is suggested that you verify one of your "test" cards in order to become acquainted with the operation of the verifier.

The principal difference in the operation of the Type 56 and Type 24 is that the 56 uses punched cards and makes a column by column comparison of the holes in the card with the key depressed on the keyboard. If there is no discrepancy in the comparison, the card advances through the machine and when the 80th column has been verified a semi-circular notch is cut in the right end of the card to indicate that the card is correctly punched.

In case of error, either in the holes in the card or in the key which is depressed, an error light, in the location of the backspace key on the punch, will light and the keyboard will "lock up". When this happens, depress key number 44 to reset the machine, and try again. If a correct comparison is obtained on the second trial, the light will go out, and operation can continue as before. In case of another error, reset and try again. If a correct comparison is obtained on the second trial, the light will go out, and operation can continue as before. In case of another error, reset and try again. If a correct comparison is obtained on the third trial, the light will go out and operation can continue. In the event of a third error, a semi-circular notch will be cut in the 12-edge of the card above the column in error, and the machine will not notch OK on the right end of the card after the verification of column 80.



## Interpreter

### Description

A document such as the Personnel Record Card which was prepared in Problem I can be useful both as a machine input and for visual reference if the punched information is made more readily readable by human beings. The best way of making the card able to serve these two functions is to cause the punched information to be printed on the face of the card. This operation can be done by interpreter.

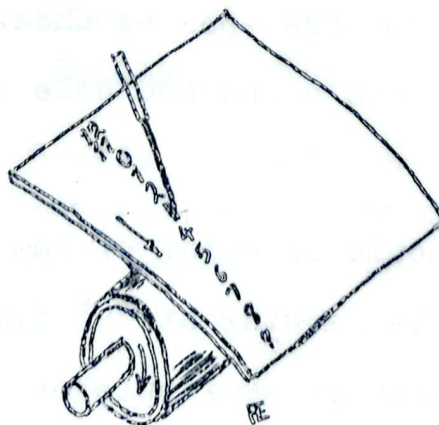
## CONCEPT OF AUTOMATIC MACHINE CONTROL

### Card Reading

Alphabetic and Numeric information is recorded in cards in punched hole form so that it may be read electrically at a very high rate of speed to control various operations automatically.

Each machine has a brush or brushes which read the holes in the cards as they pass through the machine.

As the card passes through the machine it passes over an electrically charged contact roll. While the card is passing over the contact roll, it passes under a wire brush. The illustration below shows the contact roll, the card, and the brush.



As the card feeds through the machine, the brush is kept from touching the copper contact roll by the card which acts as an insulator. However, when a punched hole is reached, (a 4 hole in the above illustration) the brush drops into the hole and touches the contact roll.

When the brush makes contact with the roll, electric current flows from the roller to the brush. This flow of current, or impulse, continues until the contact between the brush and the roll is broken by an unpunched portion of the card moving between the brush and the roll.

The brush impulse, or flow of current, is the means by which the machines recognize whether the punch was a 9, 8, 7, 6, 5, 4, 3, 2, 1, 0, 11, or 12. If the impulse were available just after the "9" edge of the card had passed between the contact roll and the brush, the machine would recognize that a hole had been punched in the "9" position of the card. If the impulse were available a little later, the machine would recognize that a hole had been punched in the "8" position of the card. This is true of all positions which may be punched. Thus, the machine recognizes which digit has been punched by the amount of time which elapses from the moment the leading edge of the card passes under the brush, to the moment when the brush drops into a punched hole and the impulse becomes available.

You will hear people speaking of impulses being available and things happening in the machine at "9" time, "8" time, etc. All they mean in that the impulse is available or things are happening at the time the 9, 8, etc., position of the card is between the brush and

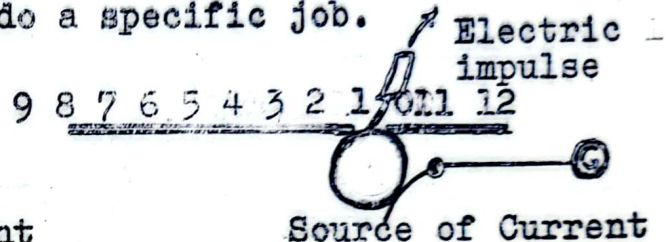
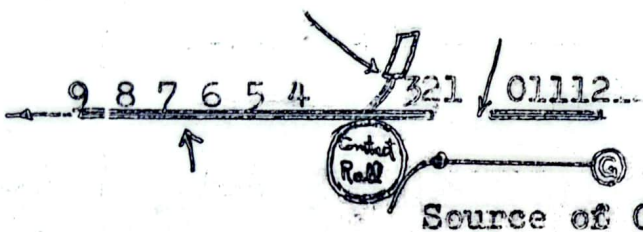


roller. In the illustration above, the impulse is available at "3" time.

You will hear the term "cycle", often preceded by a qualifying work. Machine cycle, card cycle, print cycle, and total cycle are terms you will meet in card work.

Card passing between roller and brush acts as on insulator so that no impulse is available at the brush.

When brush makes contact with roller, a circuit is completed and an electrical impulse is available to instruct the machine to do a specific job.



A cycle can be understood if you think of it as being like the sweep of a second hand around the face of a clock. If the second hand starts at a fixed point on the face of the clock, it will make a complete circle in one minute. The idea, then, is that something is rotating, and it takes a certain amount of time to complete one rotation. This amount of time is called a cycle.

In card machines there are gears which cause the machine to operate, and which take a certain amount of time to make a complete rotation, or cycle. The length of time required for a machine's gears to rotate is called a machine cycle.

During the machine cycle, the machine can complete each of its functions. If the machine has, as one of its functions, the ability to print; one line of printing can be accomplished per machine cycle.



If the machine has as one of its functions the ability to punch cards, one card can be punched per machine cycle.

Machine cycles are often qualified by the function taking place. This is how the other terms mentioned above entered into the IBM vocabulary. A card cycle is a machine cycle during which a card is read. A print cycle is a machine cycle during which a complete line of printing is accomplished. A total cycle is a machine cycle during which a total is printed.

Therefore, all of the cycles mentioned above are really machine cycles. Several machine functions may be accomplished during the same machine cycle.

In the preceding discussion there was just one brush, which read a single column. In most IBM machine, however, there is a set of 80 brushes, each brush reading one of the 80 card columns. Therefore the entire card is read as it passes between the set of 80 brushes and the contact roll.

In card machines there may be one, two or more sets of 80 brushes, depending on the type and function of the particular machine. This means that as cards pass through these machines they may be read completely once, twice, or even more times.

#### Control Panels and Control Panel Wires

You should keep in mind that each card machine is a general purpose machine, in order to perform a specific job for a specific customer, it must be given specific instructions. By means of control panel wiring, we can make a machine perform the functions desired automatically. This is accomplished readily by inserting a control panel, wired to specifications, into the machine in special rack designed to hold it.



Basically, the idea behind a control panel is very similiar to that of a telephone switchboard. An incoming call on a switchboard lights a signal which tells the telephone operator which line the incoming call is on. After she answers the signal, she plugs the card into a hole on the switchboard which is internally connected with the extension desired.

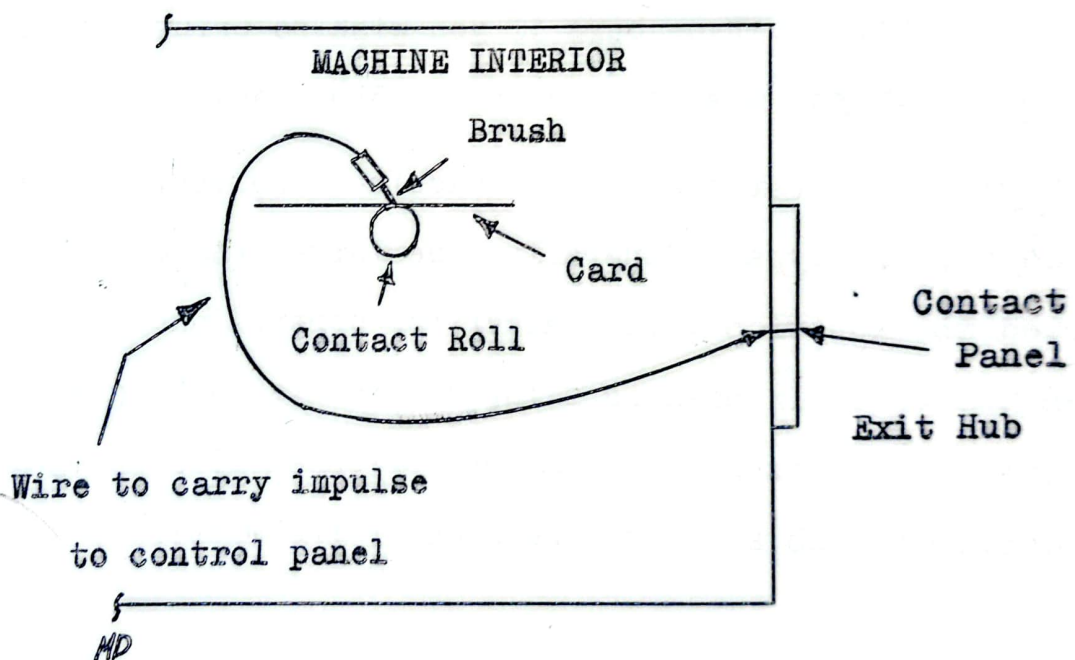
A control panel performs the same functions. As cards pass through a machine and are read by the brushes, the impulses which are the results of holes being sensed are available on the control panel. By external wiring of the control panel you can direct these impulses to do the specific job desired. You connect any or all of columns of the card to type bars if you wish to print the information, or to counters if you wish to add the information.

Control panels for the various machines are various sizes, depending on the machine type. Generally, the larger the machine, and the more varied the functions, the larger the control panel.

When the control panel is slipped into its rack in a machine, and the rack handle put in place, the control panel fits up against several rows of copper prongs set into the side of the machine.

These copper prongs, or contacts, are the ends of internal electric circuits, and they will accept or give out electric impulses depending on the internal wiring. When the control panel is in place a hole or "hub" on the control panel is connected to each one of the copper contacts. The hubs on the control panel are labelled, and serve to identify the machine circuits.

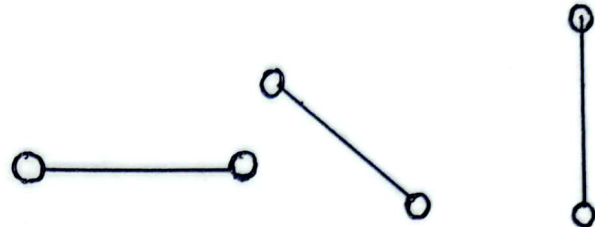
The hubs which represent circuits which will accept electric impulses are called entries; those which represent circuits which emit impulses are called exits.





Each brush in the machine which reads a column in the card is internally connected to one of the copper contacts in the stationary control panel on the machine, and is therefore represented by an exit hub on the control panel. When we have a set of 80 reading brushes in the machine, then we have 80 exit hubs on the control panel which are labelled "reading brushes".

COMMON HUBS



Control panel hubs may be single, or two or more may be connected by a diagonal, vertical or horizontal line. If two or more hubs are connected by a line it means that they are common; that is they internally connected to each other.

If these hubs are Exit hubs, the exit impulse will be available at all the hubs connected by a line. If these common hubs are Entry hubs, an impulse wired externally into any one of the connected hubs will be directed into the machine AND will be available at the other hubs common to each other.

BUS HUBS

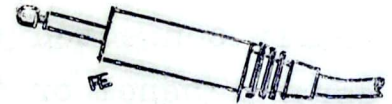


"Bus" hubs are several hubs internally connected to each other, which are neither Exit nor Entry hubs for although they are connected to each other they are **not connected** to an internal machine circuit. If an impulse is wired from an Exit hub on the control panel, to a bus hub, this same impulse will be available at all the other bus hubs of that group.

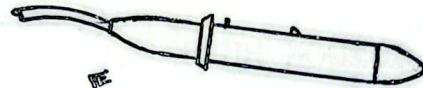
The external wires which are used to connect the Entry and Exit hubs are available in various shapes and lengths in order to facilitate the wiring. They are all the same; strands of copper wire covered with a cloth or plastic insulation, and the two ends of each wire have been designed to fit into the hubs on the

control panels.

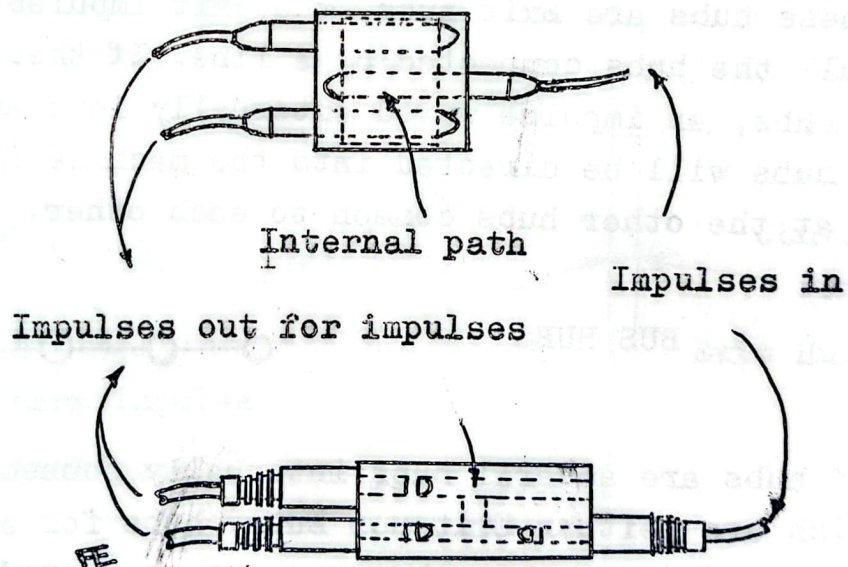
There are two types of wire tips:



The style shown above is used with control panels which have copper contacts on their back, which mesh with the contacts on the stationary panel of a machine when the control panel is locked into position.

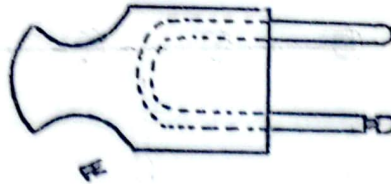


The type shown immediately above is used on control panels which do not have copper contacts on their backs. With this type, the end of the wire goes through the hub on the control panel, and meshes directly with the contacts on the stationary Panel.



You will also see "split" wires. These are used when one impulse is required in two or more places, and "bus" hubs" are not available.





"Jack plugs" are wires designed to externally connect two adjacent hubs. A regular wire of the type discussed above could be used, but a jack plug is more convenient and less bulky.

### Wiring Diagrams

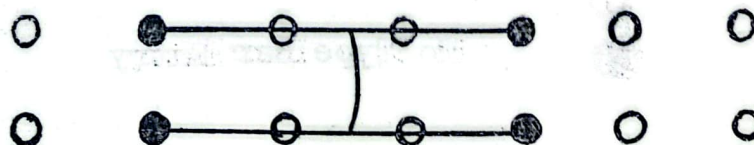
Paper diagrams (drawings) of the hub layouts on each type control panel are available. These are used to keep a permanent record of a control panel set-up, and for planning the wiring of a new job.

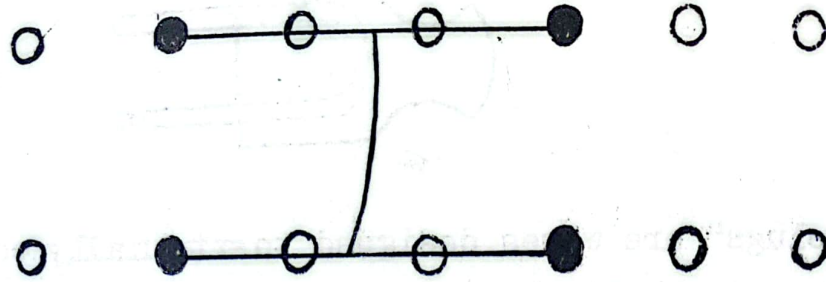
In order to make the diagram as legible as possible, there are a few simple rules to be followed when drawing a diagram:

1. If possible, use different colored pencils to diagram wiring which makes the machine perform different functions. For instance, wiring to print might be different color than the wiring for addition.
2. Pencil in the left and right hand hubs of a field, and connect these hubs with a horizontal line.

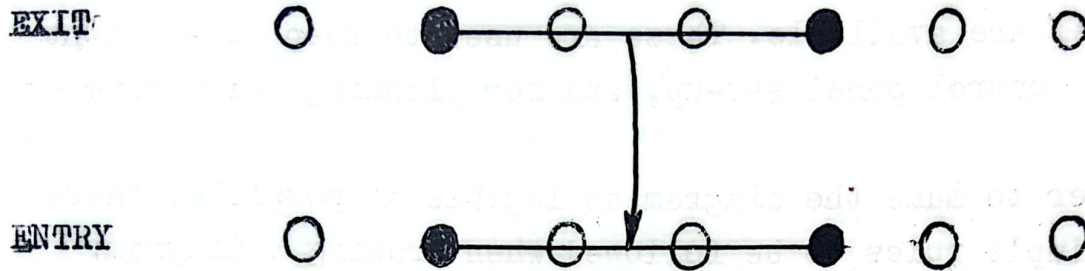


3. Connect the Exit and Entry fields by one line. Actually, this line may represent any number of individual wires in the control panel. However, in order to make the diagram easy to read, we use this abbreviation. Anyone familiar with IBM diagrams will understand that although only one line is shown on the diagram, if it is a four position field, four wires will be required on the actual control panel.

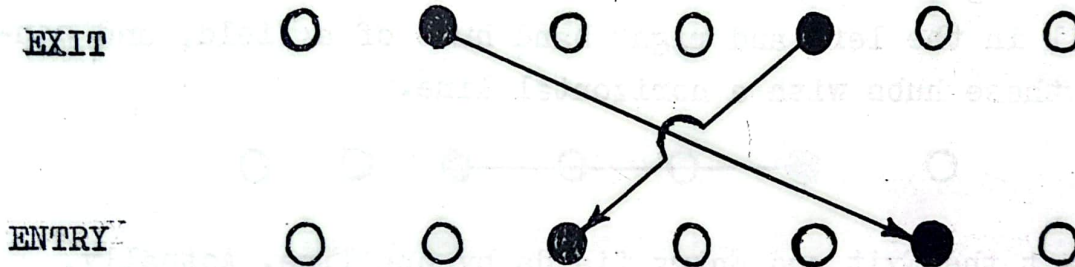




4. Indicate which are the Exit and which are the Entry hubs by drawing an arrow pointing to the Entry hubs.

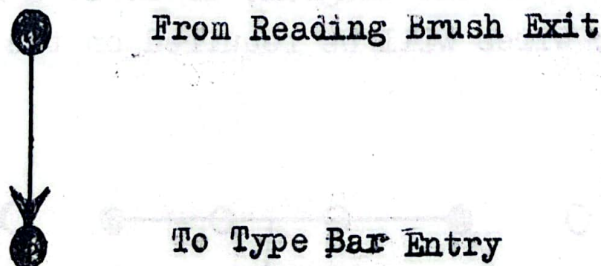


5. If it ever becomes necessary to cross lines on a diagram, loop one line over the other. This makes it possible to read the diagram correctly, for it prevents the possibility of following the wrong line to the wrong Entry hub.



### Printing

The control panel wiring needed to make any IBM machine print is essentially the same:

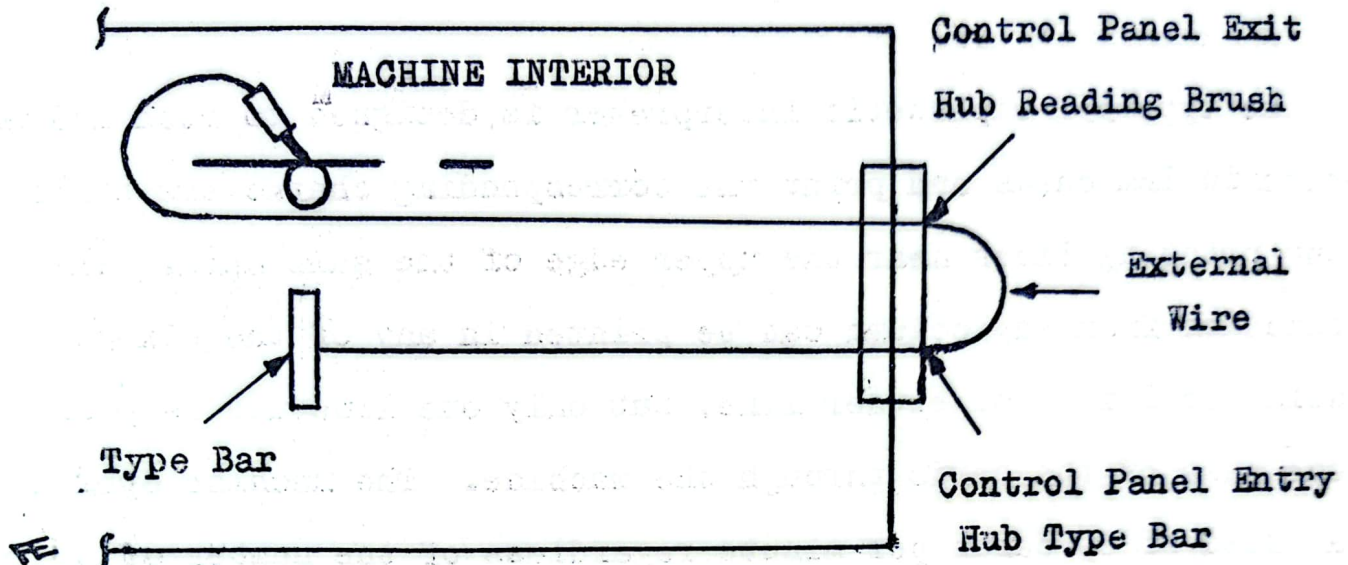


FE



## Numeric Printing

As you know, numeric punching is one hole in a column. In order to make a number print, we must wire the control panel from the Reading Brush Exit hub to the Type Bar Entry hub.



The actual printing is accomplished internally and automatically by the IBM machine after the hole punched in the card is read.

Do not be dismayed by the number of hubs on a control panel, for many of them perform identical functions. For instance, the control panel for any machine which has a set of 80 reading brushes will have 80 Reading Brush Exit hubs, one for each column of the card. Each machine with 60 type bars will have 60 Type Bar Entry hubs. Therefore, once you have learned the function of one of the Reading Brush Exit hubs, or one of the Type Bar Entry hubs, this same function applies to all Reading Brush hubs and all Type Bar hubs.

### General Description of Type 552:

The type 552 alphabetic interpreter is designed to read holes punched in IBM cards and print the corresponding characters on one of two printing lines near the upper edge of the same card. The information from any column can be printed in any of the sixty printing positions of either line, but only one line may be printed on one pass of the cards through the machine. The machine operates at a speed of 60 cards per minute regardless of the number of printing positions being used.

### Card Feed and Stacker

Cards to be interpreted are placed in the hopper at the upper right of the machine face upward, with the 12-edge toward the throat of the machine. They are transported through the machine and stacked 12's down in the stacker which is directly below the hopper. When the supply of cards in the hopper is exhausted; the machine stops automatically when the last card has been stacked.



### Main Line Switch

This switch is located just below and in front of the stacker. It is of the circuit breaker type, which automatically turns off if the motor is overloaded. If this condition occurs, the knob will position itself centrally between the ON and OFF positions. It must be pushed to the OFF position before it can be turned ON. This switch must be ON for all machine operations. When the switch is ON, a signal light indicates that the machine is ready for operation.

### Start and Stop Keys

The start and stop keys are located just to the right of the main line switch. The start key is covered, and must be depressed to start cards feeding into the machine. The machine continues to operate as long as cards are feeding or until the stacker becomes full. The stop key is uncovered, and is used to stop the operation of the machine at any time while cards are feeding.

### Printing Position Control

Interpreted characters may be printed along the top of the card above the 12 position or between the 12 and 11 positions according to the setting of the printing position knob. The printing position knob is located on the back of the machine behind the feed hopper. When the knob is pulled out and turned to the right (clockwise) the printing will be above the 12 punching position. When the knob is pulled out and turned to the left (counter-clockwise), interpretation will be between the 12 and 11 punching position. An indicator shows in which printing position the knob is set.

Specific instructions for this problem:

You are to wire the control panel of the interpreter to print the information listed below. Plan your wiring on a Control Panel Diagram Form before starting to actually wire the control panel.

| Information            | Card Columns | Print Positions |
|------------------------|--------------|-----------------|
| Social Security Number | 1 - 9        | 32 - 40         |
| 1st Initial            | 10           | 12              |
| 2nd Initial            | 11           | 14              |
| Last Name              | 12 - 26      | 16 - 30         |
| Plant                  | 27           | 7               |
| Department             | 28 - 30      | 8 - 10          |
| Man No.                | 31 - 35      | 1 - 5           |
| Rate                   | 36 - 39      | 42 - 45         |
| Height                 | 42 - 44      | 48 - 50         |
| Weight                 | 45 - 47      | 52 - 54         |
| Age                    | 48 - 49      | 56 - 57         |

Before interpreting your complete set of Personnel Record Cards, make sure that your wiring is correct by running one of your "test" cards.

When the wiring is correct, interpret all your cards.

Retain all cards, they will be required in the other problems which follow.

When all cards have been interpreted, remove the wires from the control panel, sort according to length, and return the wires to the proper bin.

Description of Problem:

The second essential step in applying machines to the solution of accounting problems is one of classification of the unit records (cards) into some logical sequence. The IBM sorters, Type 80 or 82 provide an accurate and rapid method of arranging cards into any desired alphabetic or numeric sequence so that they may



be used to prepare meaningful reports, etc.

These machines automatically arrange punched IBM cards into numerical or alphabetic order or into groups of similar classification in numerical sequence. All of the steps in the operation of the Sorter are simple. The operator merely has to place a group of cards in the feed hopper, face down, and with the "9" edge toward the throat, set the sorting brush on the column to be sorted, and depress the start button. Thirteen pockets receive the cards during the sorting operation—one pocket for the rejected cards (those having no hole punched in the column being sorted) and twelve other pockets, corresponding to the twelve punching positions on the card. Each pocket has a capacity of approximately 550 cards and when this limit is reached in any pocket the machine automatically stops. The machine also stops automatically if the hopper runs out of cards.

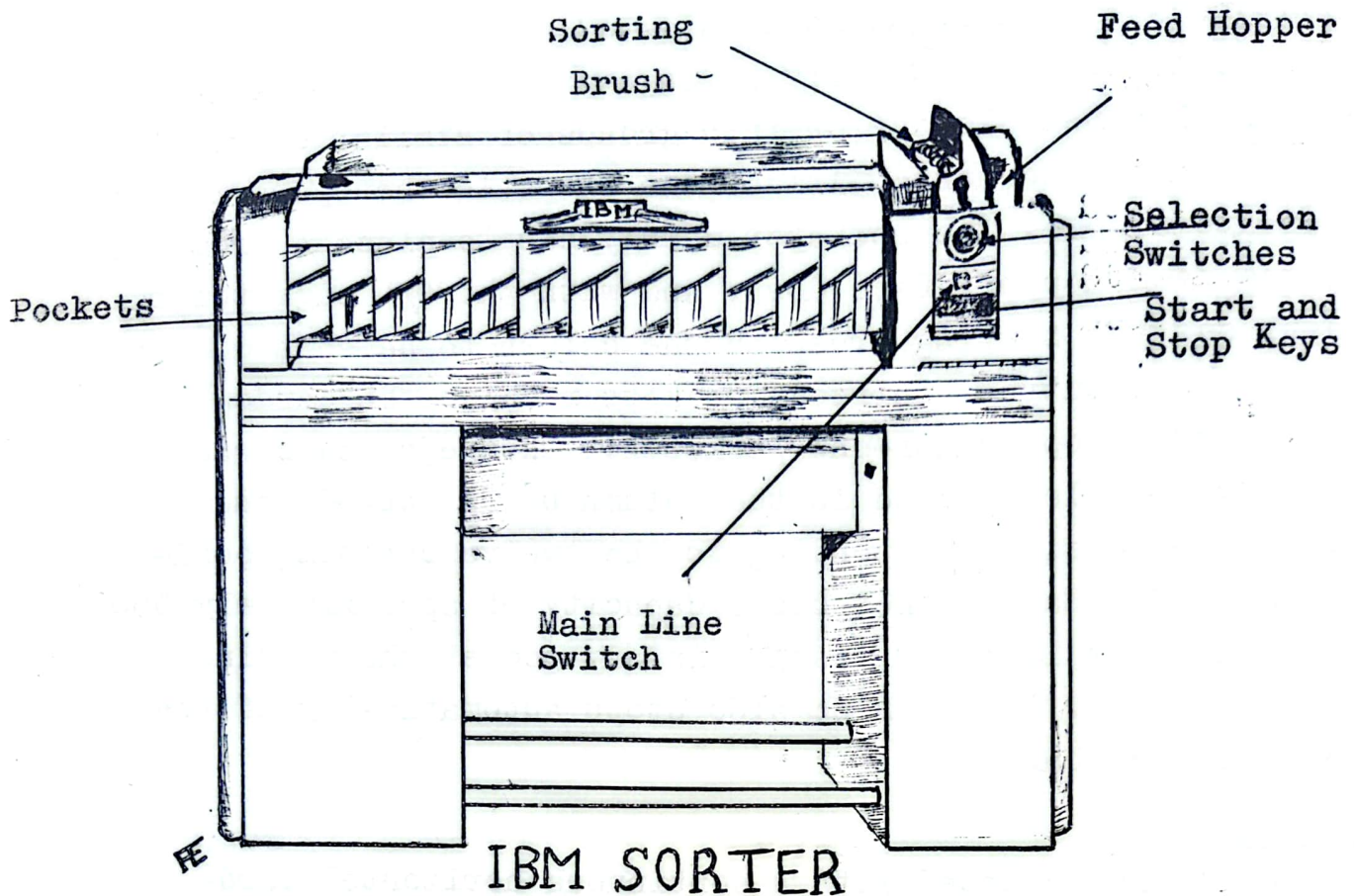
#### Card Feeding

The Sorter is equipped with a continuous horizontal card-feeding mechanism which permits refilling the hopper while the machine is in operation. Cards are automatically taken, one at a time, from the bottom of the pack and fed past the brush which determines the pockets into which they are to be deposited. Continuously turning rollers then carry the cards to the proper pockets where they are stacked. The speed of the machine varies according to specifications; for the Type 82 it is 650 cards per minute for column sorted; for the Type 80 model 1 it is 450, and for the model 2, 250 cards per minute.

#### Pocket Stops

Each pocket of the Sorter is equipped with an automatic pocket stop which automatically stops the Sorter when any one of the thirteen pockets becomes filled to capacity with cards. After the cards have been removed from a loaded pocket, the machine can be restarted by the depression of the start key.





Sorting Brush

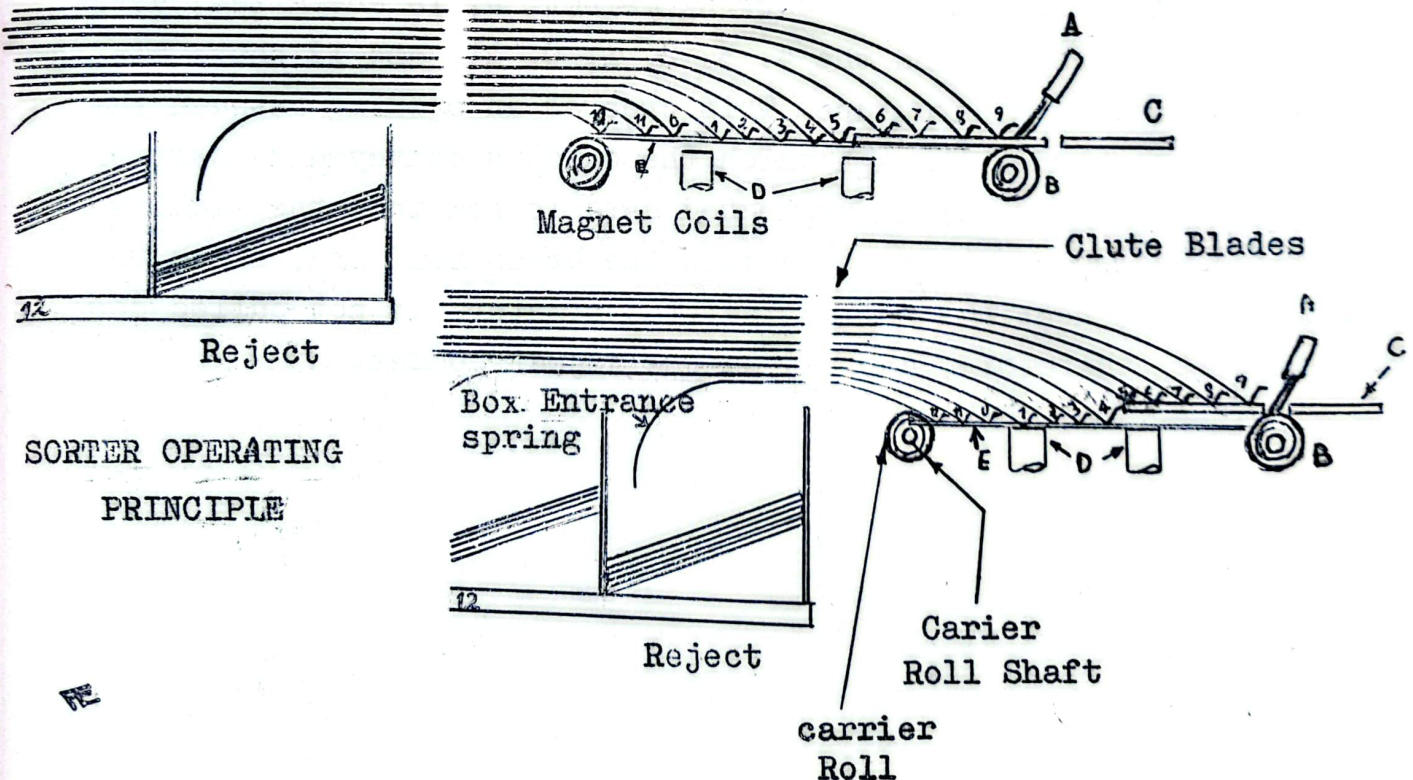
Type 82

The sorting brush may be set on any column to be sorted by rotating the small handle located at the front of the feed magazine. Each rotation of the handle moves the brush one column. The brush may be moved across a number of columns by raising the handle to the upper position and moving the brush holder to the desired column while pressing down the finger lever on the top of the brush assembly. A column indicator guide and pointer is located above the brush, in a position readily visible to the operator, for convenient setting of the brush on the column to be sorted.



### Selection Switches

It is sometimes desirable to select cards punched with a certain digit from a file of cards, without disturbing the original sequence. This may be accomplished by the use of the commutator, which is located just below, and to the left of, the feed hopper. This commutator, or "selection switch," is equipped with twelve small black switches, one for each pocket of the machine, not including the reject pocket. When pushed toward the center, corresponding impulses will be ignored by the machine, and the cards will be treated as blanks and therefore rejected.



In regular sorting, when the cards are to be sorted on all positions from 9 to 12 inclusive, all of the switches must be in the outer position. When only the cards punched in certain position are to be selected, it is necessary to pull toward the center all the selection switches except those corresponding to the positions to be selected. The illustration shows the switches arranged to select and sort into their corresponding pockets the cards punched 6 or 3 in the column being sorted. The remaining cards will fall into the reject pocket in their original sequence.

The large red switch in the selection segment is the alphabetic sorting switch. Setting this to the center of the segment has the same effect as setting toward the center all the switches 1-9; that is, it allows sorting only on 0, 11, 12 punches, without regard for the punching in the rest of the column.

#### Operating Principles

As illustrated in the illustration above cards are fed horizontally from a hopper and pass directly under a brush, A and over a brass contact roll, B. Assuming that the card, C, is punched 4, it will have traveled under the 9, 8, 7, 6, and 5 chute blades before the brush makes contact to complete the sorting circuit. As this contact is made, the sorting magnet, D, is energized, attracts the armature, E, and the 4, 3, 2, 1, 0, 11, and 12 chute blades follow down with the armature. This creates an opening between the 5 and 4 chute blades through which the card is conveyed by carrier rolls to its pocket. If an unpunched card is fed into the machine the brush fails to make contact with the brass roll and, since the sorting magnet receives no impulse, the armature is not pulled down. The card is, therefore, carried to the reject pocket.

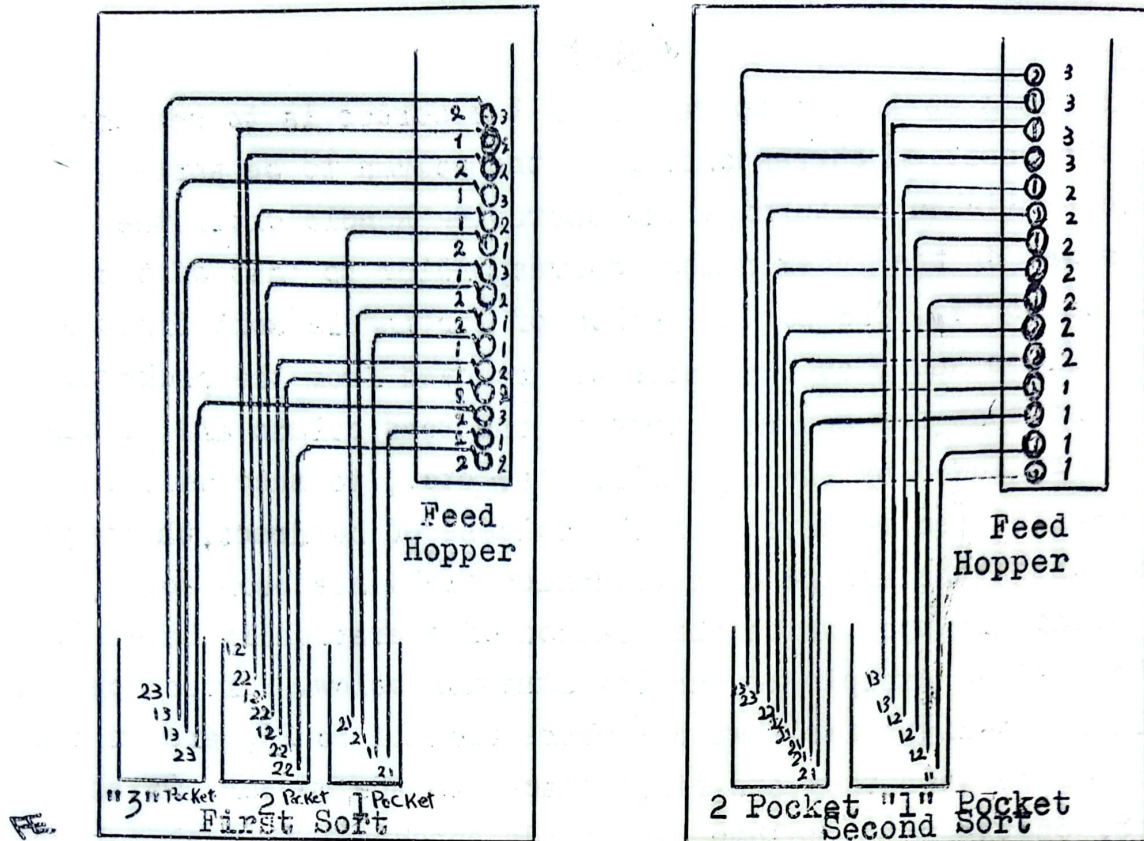


### Operation

The first step in the operation of the Sorter is to set the brush in the position corresponding to the column to be sorted. This is accomplished by turning the operating handle until the pointer is set on the index number corresponding to that of the column to be sorted. The normal method of sorting is sort first on the units column and , as the cards are removed from the pockets, stack them so that for the next sort on the tens column all of the 0's will be followed by the 1's, 2's, 3's, etc., in succession. This process is then repeated for the columns of hundreds, thousands, and so on, until the entire classification field has been sorted.

The principle upon which this method of operation is based is illustrated by the example in the illustration below. Fifteen cards, punched in a two-digit field with numbers from 11 to 23, are in miscellaneous order when they are first placed in the hopper. On the first sort, on the units column, all cards punched 1 in that column fall in pocket 1, all cards punched with a 2 in that column fall in pocket 2, etc. As the cards are removed from the pockets, those from pocket 1 are placed face up and in front of those from pocket 2, and the cards from pocket 3 are placed behind those pocket 2. Thus, when the stack of cards is again placed in the hopper for the second sort, on the tens column, they are fed from the machine in the order 1, 2, 3, according to the units column, sort. On this second sort, all cards punched 1 in the tens columns fall in pocket 1, and the cards punched 2 fall in pocket 2. When they are removed and the cards from pocket 1 are placed face up and in front of those from po pocket 2, the whole file of cards will be in numerical order from 11 to 23?





Sorting Principle

This sorting process could be illustrated further by the use of larger numbers, but from the above it will be observed that upon completion of the second sort, all cards will appear in groups arranged in correct numerical sequence.

After the brush and selection switches are set, a hand full of cards are taken up and held loosely in one hand on the joggle plate, with the back of the cards toward the operator and one end of the cards against the end plate. The cards are then tapped at the top and other end of the cards until all four sides are even. Next, the cards are placed face down (printed side down) in the hopper so that the lower (9's) edge will feed into the machine first. The card weight is placed on top of the cards.

Depression of the start key will begin the feeding of cards. After the machine has been started, it will continue to operate until the hopper has been emptied, a pocket becomes too full, or a damaged card fails to feed. While one pack of cards is running through the machine, another pack may be joggled and placed in the magazine in order to maintain continuous operation. Cards may be



removed from the pockets while the machine is running, but care should be exercised not to catch another card being conveyed into the pocket from the chutes while doing so.

#### Sight-Checking

As the cards are removed from the pockets, the sorting must be checked. This is accomplished by "joggling" the cards removed from each pocket into perfect alignment, then holding the cards in front of a source of light and looking through the hole corresponding to the pocket from which they were removed. If the cards have been properly sorted, the holes (punched the same in the position being checked) create a tunnel through which light may be seen. If the digit in question is not punched in any card of the group being checked, it is impossible to sight-check the position. This indicates that one or more cards have been missorted. These must be located, removed, and hand filed in their proper places. In hand filing, consideration should be given to any columns previously sorted, as well as the column just completed.

This operation must be performed as each group of cards is removed from any pocket of the machine.

#### Alphabetic Sorting

Arranging cards in alphabetic sequence requires the double sorting of each column, since each letter is recorded by two holes in a single column, one of which is 12, 11, or 0 and the other of which is a digit from 1 to 9.

The cards are first sorted in the normal manner according to the digits 1 to 9. In the next operation the alphabetic selection switch is set on. This has the effect of making only the 0, 11, and 12 selection switches effective, so that on this second run the cards are sorted on the 12, 11, and 0 positions. The cards which fall in the 12 pocket will contain the letters A to I. In alphabetic sequence, those in the 11 pocket the letters J to R, and those in the 0 pocket the letters S to Z.

#### Specific Instructions for this Problem:

The personnel record cards are to be arranged into alphabetic sequence by last name. To do this, follow the instructions outlined



above for operation of the machine and for alphabetic sorting. Perform an alphabetic sort on card columns 12 through 26.

When you are satisfied that the cards are in proper alphabetic sequence, set them aside for use in the next problem.

If there are no other students waiting to use the sorter to sort their personnel record cards, you may proceed to the next (optional) part of this project. If the other students are waiting, you may plan to return to this exercise at any time which is convenient later in the course.

### Description of Problem

An employer must maintain an accurate record of the working time of each employee in order to insure that all earned salary is paid, and to meet legal requirements. The IBM Attendance Recorder provides an accurate and efficient method of recording in "and Out" time on an attendance record.

An attendance record card for each employee each week can be prepared automatically from the personnel record cards by using the Type 519 machine. Using the cards prepared problems 1 and 2, you are to originate attendance cards for the class. (NOTE: This is a practice problem only, and these cards should NOT be placed in the time card racks.)



## General Description of Machine

519 Electric Document-Originating Machine is one of the machine units by means of which cards may be automatically punched. It performs the following standard functions:

**Reproducing:** the operation by which all or any part of the information punched in one set of cards can be punched in the same or different arrangement into another set of cards.

**Gang Punching:** the copying of punched information from a master card to a group of detail cards.

**End Printing:** printing numbers on the face of a card, across the left or right (special) end, as many as 8 digits punched in that card (interpreting), or as many as 8 digits punched in another card (transcribing).

Special features can be incorporated in the machine when specified for performing the following additional functions:

This problem consists of three separate operations, all of which can be accomplished on one pass of cards through the machine. It is suggested that for simplicity, you wire and test these operations one at a time, but retain the wiring for each operation in the control panel so that when the third operation is completed, you will have a control panel capable of doing the complete job in one pass.

You should of course, always draw a wiring plan on the control panel diagram form before starting to do the actual wiring.

Comparing verifying of both reproducing and gang punching operations. This feature is incorporated in the machine, if specified for either 45 or 80 columns.

**Summary Punching:** punching into a total or new balance card amounts which have been accumulated in the accounting machine.

This may be specified for use with the Type 402 or 407 Alphabetic Accounting Machines.

**Mark.Sensing:** the function by which information recorded in the form of pencil marks on IBM cards is automatically translated into punched holes in those cards.



The following features of the Electric Document-Originating Machine are shown in the accompanying illustration.

### Control Panel

The control panel controls the reading and punching of the proper card columns and directs the machine to perform its various functions.

### Card Feeds and Stackers

Cards placed in the reading unit feed pass through the reading unit to the read stacker. Cards placed in the punching unit feed pass through the punching unit to the punch stacker. If either feed becomes empty, or if either stacker is filled to capacity, the machine will automatically stop; the start key must be depressed to run the remaining cards in each feed into their stackers.

### Main Line Switch

This switch connects the machine to the power source and must be ON if the machine is to be operated.

### Operating Keys

The start and stop keys are used to start and stop feeding of cards. The reset key is depressed to turn off the double punch and blank column signal light.

### Signal Lights

The unlabeled light on the left indicates that the main line switch is ON but that neither feed is operating.

COMPARING signals that two readings brought to the comparing unit differ.

DPBC signals that either a double-punched or blank column has been detected. This signal is a standard feature when the machine is equipped with mark sensing.

PRINT signals that the print unit is in position ready for printing.

There are two feed units in the Type 519, the reading unit and the punching unit. Cards may be fed in either or both of the units according to the operation being performed. For any operation, the cards are fed face down, top or 12's edge first. Each feed hopper holds approximately 800 cards; feeding is continuous; and

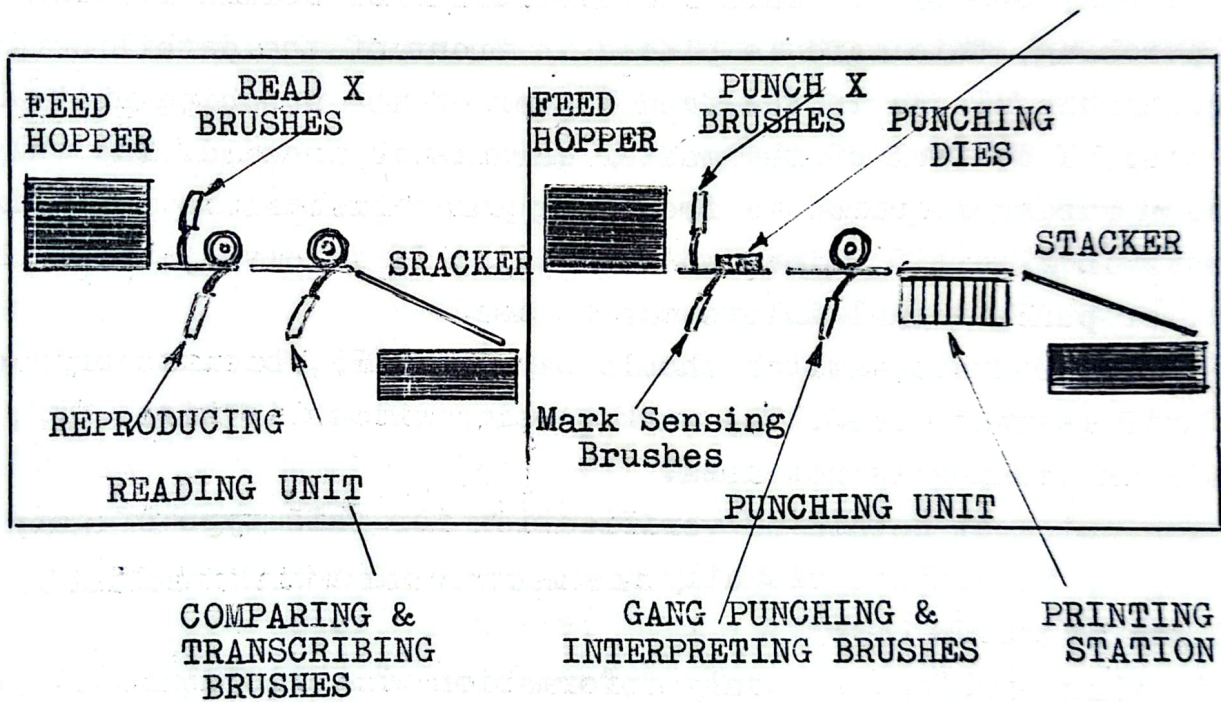


if either hopper becomes empty, if either stacker fills, or if a card fails to feed, the machine will automatically stop.

The relation of the two units to each other, and the sequence in which the cards pass the operating stations in the two units, are indicated in the schematic diagram.

The control panel serves as the basis for automatic operation of the Type 519 Document-Originating Machine. The panel is double, permitting simplified wiring for basic operations.

On the control panel, outlets are designated by red bands, which in turn are represented by shaded bands on the illustrations.



SCHEMATIC DIAGRAM

### Operation 1--Gang Punching

Only the punching unit is used in gang punching operations. A master setup card must precede the detail cards to be punched. When the first master card has reached the gang punch brushes, the blank card following it is at the punch dies. The master card is read by the gang punch brushes and the impulses are transmitted to the punch inlets. This results in the punching of the first detail card. The next card cycle then advances the punched detail card to the gang brushes where it, in turn, is read and serves as the setup card for the following detail card. Thus, every card passing through the machine serves in its turn as the setup card for the card directly behind it.

If only one master card is to be used for column-to-column gang punching, this card is placed in front of the detail cards and all cards are placed in the feed hopper of the punching unit. In this case, X control of the master card is not needed. The only position wiring required is from gang punch brushes to punch inlets as shown in Figure 6. Since no X punching is involved, either the direct or punch normal inlets can be used.

The reproducing switch should be wired OFF, because only one feed unit is being used. The mark sensing switch is wired OFF, since mark sensing is not used.

The quickest method of verification for this type of gang punching is to compare visually the master card with the last detail card punched.

In this problem, the only information which is common to all attendance cards is the "date of week ending" which appears in card columns 41 through 47. Wire the control panel using either of techniques shown in the illustration.

Prepare your own master card by punching the date of the current week in columns 41 to 47 of any unpunched card. Month is a three column Alphabetic abbreviation, day must have two digits, (if day is 1 through 9, put 0 to left) and Year is the last two digits of the current year.



Run two or three test cards to check your wiring before continuing to the next operation. Do not remove your wiring at this time.

## Operation 2--Reproducing and Comparing

(Retain wiring for operation 1)

For reproducing operations, the reading and punching units operate simultaneously and the two feeds are synchronized. The original cards, called the source cards, are placed in the reading unit. The cards to be punched, called the reproduced cards, are placed in the punching unit. As each card feeds in the reading unit, a corresponding card feeds in the punching unit. As the card in the reading unit passes the reproducing brushes, the punched information is picked up and punched into the card under the punch dies.

Verification of the punching can be done one card cycle later during the same operation. As the source card passes the comparing brushes, the corresponding reproduced card passes the gang punch brushes. If the punching sensed by the two sets of brushes is alike, the machine continues in operation. If there is any discrepancy, the comparing light will go on and the machine may be wired to stop. At the same time the comparing indicator will show any or all columns causing the discrepancy. All cards in the feed hoppers and the correct cards already in the stackers should be removed, the comparing light and indicator reset, and the machine started and kept in operation for at least three cycles. The cards in question will be next to the last card falling in each stacker.

The source cards are placed in the reading unit and the blank cards to be reproduced are placed in the punching unit. The reproducing brush outlets are wired to punch direct, or to punch normal if P Tfr is not wired. To verify the reproduced data, the proper columns of the source and reproduced cards are wired from the comparing brushes and gang punch brushes, respectively, to the comparing magnets.

Because the feeds must operate together, the reproducing switch must be ON. Mark sensing is wired OFF.

In this problem, it will be necessary to reproduce the desired descriptive information which is in the personnel record card, and



which will be different for each employee. The Personnel Record Cards will be used as the source cards, and the attendance cards will be the reproduced cards.

Card Columns

| <u>Information</u> | <u>Source Cards</u> | <u>Reproduced Cards</u> |
|--------------------|---------------------|-------------------------|
| Employee Name      | 10-26               | 10-26                   |
| Plant              | 27                  | 27                      |
| Department         | 28-30               | 28-30                   |
| Man No.            | 31-35               | 36-40                   |
| Rate               | 36-39               | 31-34                   |
| Exemptions         | 40                  | 35                      |

Wire the control panel to perform the above operation, keeping in mind that for comparing, each comparing position has two inputs, and that to obtain a valid comparison the same information from each card being compared must be wired to the same positions of the comparing unit.

Run two or three test cards to make sure that your wiring is correct before proceeding to operation 3.

Do not removed your wiring at this time.

Operation 3--End Printing

(Retain wiring from operations 1 and 2.)

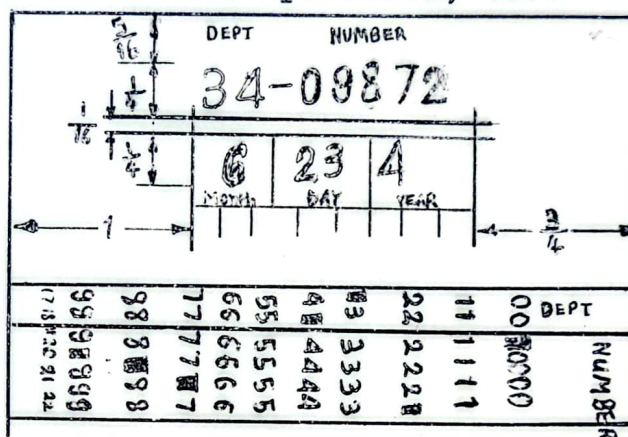
The printing unit is made up of 8 print wheels, each of which contains the digits 0-9 and a blank position. The unit is used for interpreting or transcribing as many as 8 columns on the end of the face of a card. Zeros carry to the right only when punched in a card and wired to the print wheels. A zero will not print unless there is significant digit printing to its left, although a space may intervene if a column is unpunched or a position is unwired.

Information can be printed on either of two lines on the card: first, 5/16" from the end of the card; second, 5/8" from the end of the card. The printing line is selected by latching the printing



unit in one of three notches: middle notch to print on the first line; notch farthest away from the operator to print on the second line; notch nearest the operator to disengage printing. The device should be disengaged when not used to prevent unnecessary wear on the ribbon and other moving parts. It is possible to print only one type of card, X or No X, by wiring the print control switch.

Eight digits of information read in a card at the gang punch brushes may be printed as the card passes the print unit. Columns to be interpreted are wired from the gang punch brushes to the print wheel inlets. The inlet numbered 8 is used to print the units position, the 7 inlet prints the tens position, etc.



LEFT-HAND END  
PRINTING  
(Standard)

If information is to be interpreted as well as gang punched, it is wired from the gang punch brushes to the print inlets, and from the common print wheel inlets to the punch inlets.

Information to be reproduced and interpreted is wired from the reproducing brushes to the punch inlets. Gang punch <sup>brushes</sup> <sub>x</sub> corresponding to the punch inlets are wired to the print wheels.

Wire your control panel to end print the Man Number on the upper printing line. Run two or three test cards to insure that the control panel is wired properly.

Now that the control panel is completely wired, use your complete set of personnel record cards and make an attendance card for each member of the class. When this has been completed, remove wires from control panel, sort by length, and place them in the wire bin.

The newly-created attendance cards now need to be interpreted across the top edge to make it more usable for clerical purposes. A control panel to cause the interpreter to do this job is available from the instructor. Set the interpreter to print on the upper line.

Save both the personnel record cards and attendance cards for use in the practice problems which follow.



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