MACHINE METHODS OF ACCOUNTING

CARD-OPERATED SORTING MACHINES

IT HAS frequently been stated that the sorting machine is the heart of many tabulating installations, and that without it there would be no widespread commercial application of the punched hole system of accounting. All accounting systems based upon the use of unit records, whether manual or mechanical, necessitate a sorting or classifying operation. International Card-Operated Sorting Machines afford a speedy and accurate method of arranging cards into any desired sequence. By the use of these machines the drudgery of the manual sorting operations is entirely removed, the work being performed by fully automatic machine operation except for the feeding and removing of cards.

Machines of various styles and speeds are made to meet the varying requirements of users of the Electric Accounting Machine Method. In addition, special problems encountered in accounting routines have resulted in the development of special devices which may be attached to the sorting machine, making it more flexible and serviceable. Devices are available for collating cards into predetermined sets, for removal of paired cards from a file without disturbing the remainder of the cards in the file, for the selection of cards of like classification from a file of cards in a single sorting operation, for arranging cards by the use of the group sorting mechanisms according to classifications other than those recorded in the card

in the form of punched holes, and for the counting of cards of similar classification.

The Sorting Box

Like other machine units of the Electric Accounting Method, the Sorting Machine underwent many changes in the course of its development. The first device to be used for classifying punched cards into groups according to the holes recorded in them was the Sorting Box attached to the old manually-operated tabulating machine. The box contained twenty-four compartments, corresponding approximately to the maximum number of classifications recorded in any one field of the early census card. As a card was placed in the press of the machine, a compartment cover was electrically unlatched if a hole appeared in one of the positions of the card which was designated for sorting. Upon removing the card from the press of the tabulator, the operator inserted it in the compartment of which the cover was unlatched. After the card was deposited, the cover was pushed down and the next card was inserted in the press of the tabulator. This card was then deposited in the compartment of which the cover was released by the closing of the electrical circuit through the hole in the card field being sorted upon. This set of operations was continued until all cards were tabulated and sorted. In this manner, the cards were arranged according to a limited number of classes for the next tabulation, simultaneously with the tabulation of the previous report.
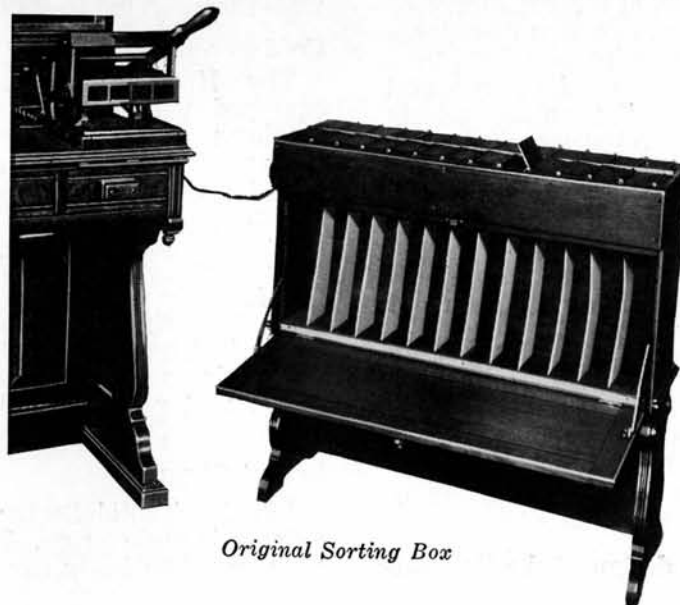
Original Sorting Box

Vertical Sorter (Type 71)

In developing this machine many of the basic principles of the original Vertical Sorting Machine were used. The machine is recommended for use with the Type 91 Vertical Tabulator where moderate sorting speed is sufficient to handle volume.

Card Feeding

Card feeding is automatic and a conveyor mechanism automatically carries each of the cards at a speed of 150 cards a minute from the feed hopper, past the card brush, where an electric circuit is completed through the hole in the card and to the pocket where the card is stacked. There are twelve pockets, corresponding to the twelve punching positions in a card column, with a capacity of eighty cards each.

Electrical Energy

The Vertical Sorter (Type 71) is equipped to operate on either Direct or Alternating Current of 110 or 220 volts. If Alternating Current, it may be of any frequency or phase, but these facts must be specified.

Horizontal Sorter (Type 80)

This machine automatically arranges punched tabulating cards into numerical order or into groups of similar classification in numerical sequence or other predetermined order. The sorting operation is performed at a speed of 225 or 400 cards a minute for each column sorted, according to the type of machine in use. All of the steps in the operation of the Horizontal Sorter are simple, making it a unit extremely easy to operate. The operator merely has to place a group of cards in the feed magazine, 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 is for the rejected cards (those having no hole punched in the column being sorted) and each of the other twelve pockets corresponds to one of the punching positions on the card. Each pocket has a capacity of approximately 800 cards and when this limit is reached in any pocket the machine automatically stops, as a signal to the operator to remove them. The mechanism also stops automatically if the machine runs out of cards.

Throughout the entire design of the Horizontal Sorter, careful consideration was given to attainment of accuracy, speed, and quietness of operation. Special standard features of the machine which enhance the scope of its usefulness were incorporated in its design.

Card Feeding

The Horizontal Sorters (Type 80) are equipped with a continuous horizontal card-feeding mechanism which permits replenishing the magazine hopper without the necessity of stopping the machine. 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 their proper pockets where they are stacked. The speed of the Model 1 machine is 400 cards a minute for each column sorted; the Model 2, for use with 80-column cards only, operates at a speed of 225 cards a minute.

Pocket Stops

The Horizontal Sorter is equipped with an automatic pocket stop. This is a safety device which automatically shuts off the current and
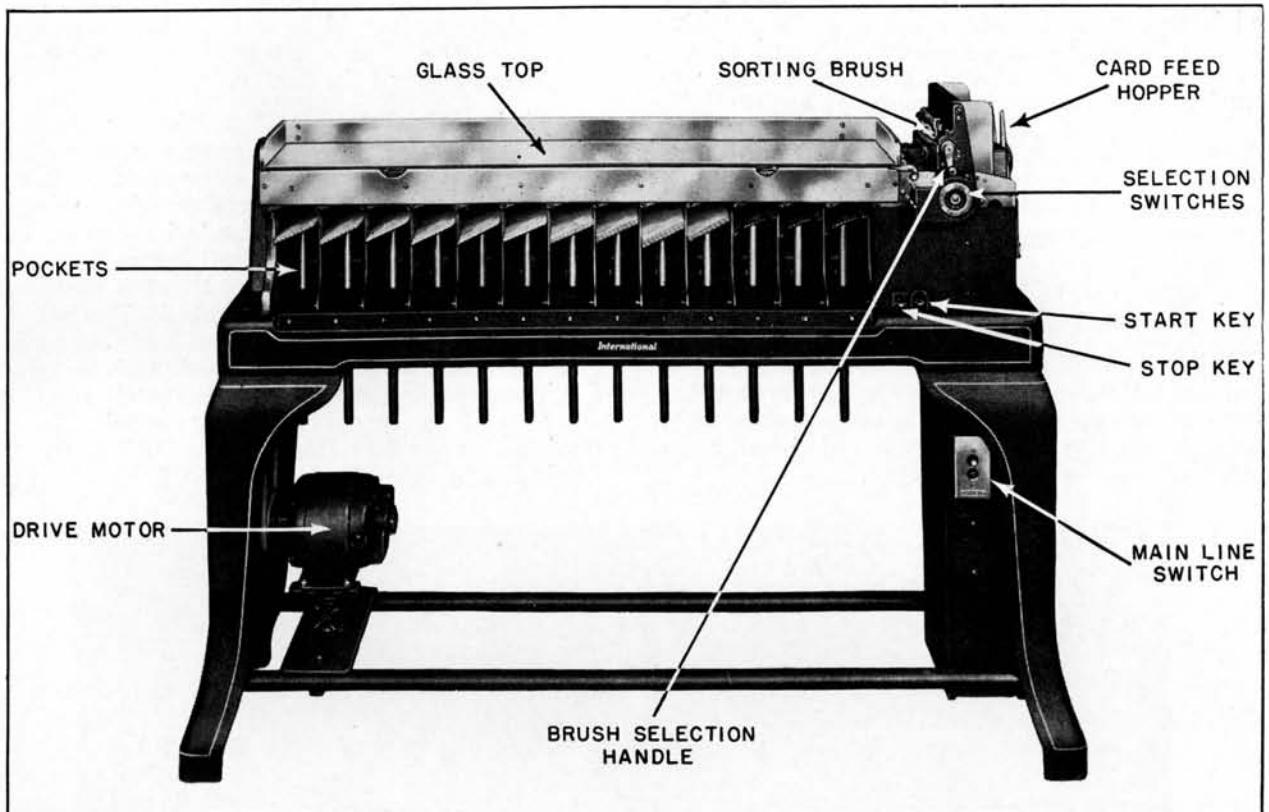
stops the sorter should any one of the thirteen pockets become filled to capacity with cards. After the cards have been removed from a loaded pocket, the machine can be restarted by the depression of the start key.

Quickset Sorting Brush

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. If the brush is to be moved across a number of columns, this may be accomplished 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.

Total Card Counter

A special electrically-operated card-counting mechanism which registers "1" for each card that passes the brush may be connected to the machine and mounted in such a manner that the dials are in a position that facilitates the reading and manual transcribing of totals. The

counter does not affect the normal speed or method of operation of the machine to which it is attached. The maximum capacity of the device is 99,999. Normally, this mechanism counts only the total number of cards passing through the machine. A count by pockets may, however,
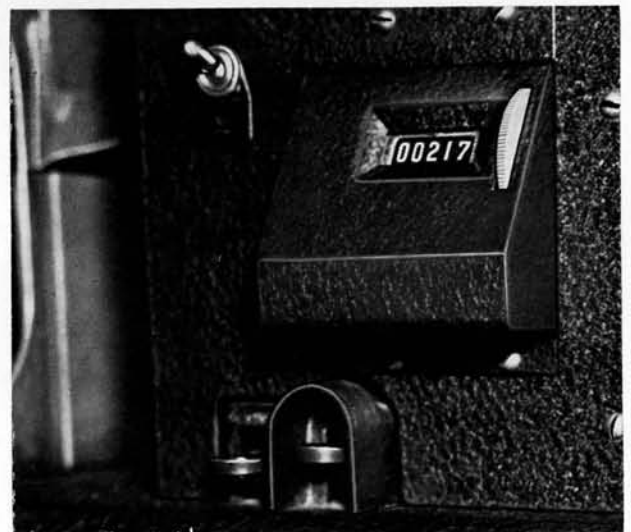

Total Card Counter

be made by a second sort. The customary method is to run all the cards through the machine in the regular sorting operation, and at the same time to determine the total number of cards. Then the largest group for any individual pocket is set aside, and the cards for each of the other pockets are run through the machine separately for group totals. The total of these groups may then be deducted from the grand total number of cards, to determine the number of cards in the largest group. This eliminates the necessity of running the latter group through the machine a second time.

When more than a single sorting and counting operation is to be performed, the counting for each group resulting from one sort may be accomplished as each group is fed through the machine to effect the next sort.

(located directly in front of and below the magazine hopper) would be set to the outer edge, and all of the other small black switches would be pushed toward the center.

If it is desired to sort all positions on the card from 9 to 12 inclusive (regular sorting) all of the switches on the commutator must be in the outer position. Should it be desired to select a group of one or more numerals in a given column, it is necessary to pull all the commutator switches to the center except those corresponding to the positions to be selected. The accompanying illustration shows the commutator with the switches arranged to select and sort into their corresponding pockets the cards punched 6 or 3 or 0 in the column being sorted. The remaining cards will fall into the "R" pocket in their original sequence.
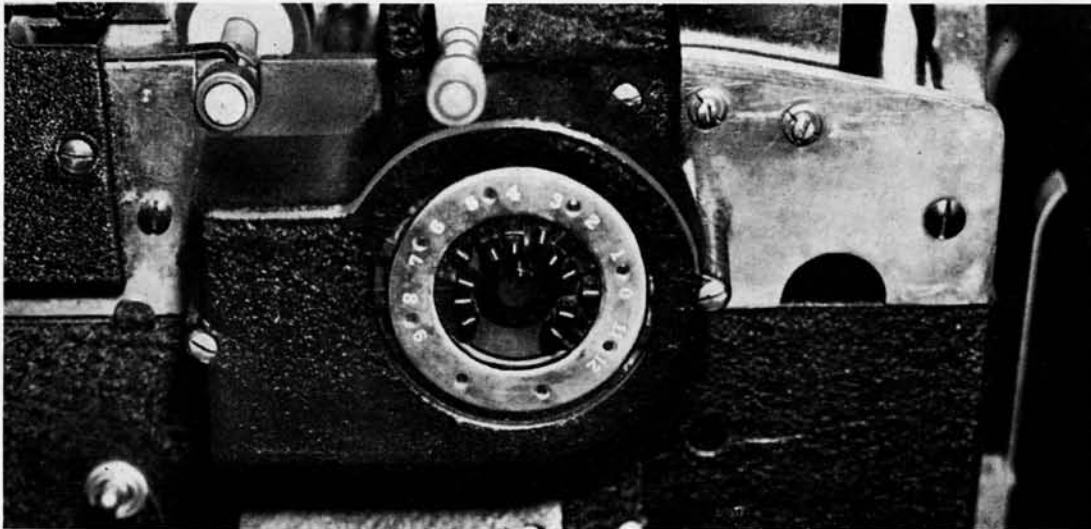
Selection Device

Selection Device

A selection device enables the machine to segregate into their respective pockets all cards punched in one or more specified individual positions of a single column and to deposit the remaining cards into the reject pocket without disturbing their sequence. Thus, if in a given card form, one column is devoted to recording the source of entries:—1. Sales Invoice, 2. Credit Memo, 3. Debit Memo, 4. Journal Voucher, 5. Inter-branch Transfer Memo, 6. Consignment Memo,—it is possible to select the cards punched from any one or more of these source records without disturbing the sequence of the other cards. To select all entries made from Journal Vouchers, the small black switch in the segment corresponding to the pocket marked "4" on the commutator device

In some cases it may be desirable to segregate the selected cards in such a manner that their sequence will not be disturbed, regardless of the possible disarrangement of the other cards. In that event the reverse principle should be followed—the 6 and 3 and 0 switches toward the inner ring, all others out in the normal positions. Cards unpunched in the column being sorted would be extraneously introduced into the "R" pocket along with those punched 6 or 3 or 0.

Capacity

The Horizontal Sorter is built to accommodate either 5⅝" (short) or 7⅜" (long) cards. It is supplied for either 5/32" or 3/32" (80-column) spacing, and may readily be changed from one spacing to the other in the field.

Electrical Energy

This machine is equipped for two different sources of electrical energy. The machine most generally used is operated entirely by direct current—110 or 220 volts, and consumes 6.5 amperes for starting and 2.5 amperes for running. When generators in use are not of sufficient capacity to provide the necessary current for starting this type of machine, one which is equipped with an alternating current drive motor will be furnished. The sorting circuit of this machine is operated by direct current and consumes 1.0 ampere when running. When ordering the latter type of machine the cycles and phase of the alternating current must be shown on the specifications.

with the brass roll "B" and, since the sorting magnet "D" receives no impulse, the armature "E" is not pulled down. The card is, therefore, carried to the "R" 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 corresponding to that of the column to be sorted. The normal method of sorting is to start with the units column, removing the cards from the pockets as the sorting proceeds, so that for the next sort on the tens columns all of the 0's will be fed into the machine first, followed by the 1's, 2's, 3's, etc., in
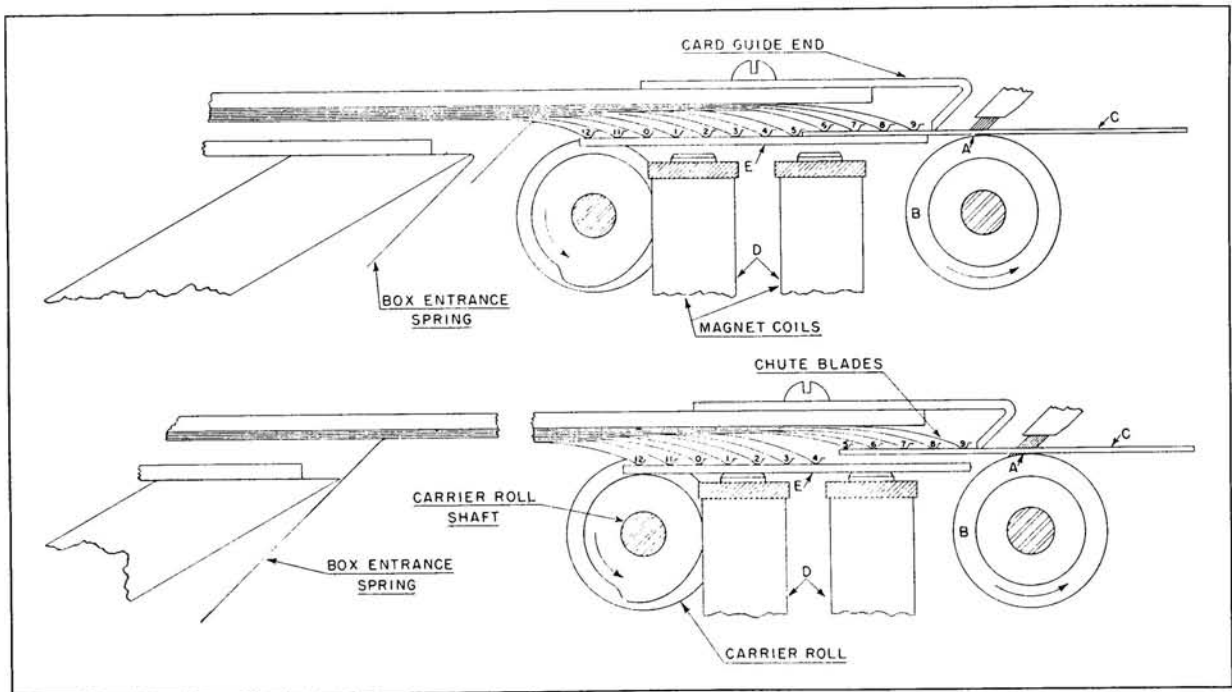
Operating Principles

As illustrated in the figure, cards are fed horizontally from a magazine 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 travelled under the 9, 8, 7, 6, and 5 chutes blades before the brush makes contact to complete the selecting 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 chutes blades follow down with the armature "E." 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 "A" fails to make contact

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 is based may be best illustrated by an example. Consider the following columns of numbers as cards first arranged in miscellaneous order and punched in a two digit field with numbers from 11 to 24. When sorting is effected upon the units column, all cards punched with a 1 in that column fall in the 1-pocket, all cards punched with a 2 in that column fall in the 2-pocket, etc.

The cards from the units sort are then fed through the machine from pockets 0, 1, 2, ... 9, to effect the sort on the tens position. When

FIRST SORT

SECOND SORT

SORTING BY MAJOR GROUPS
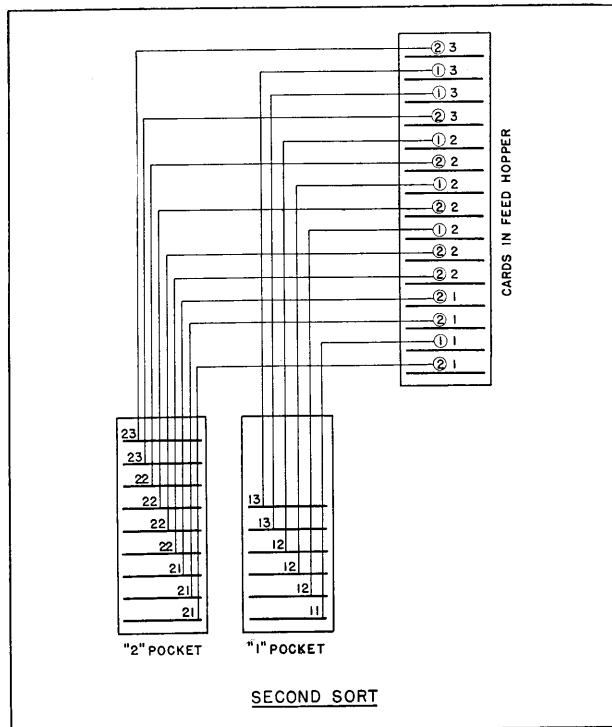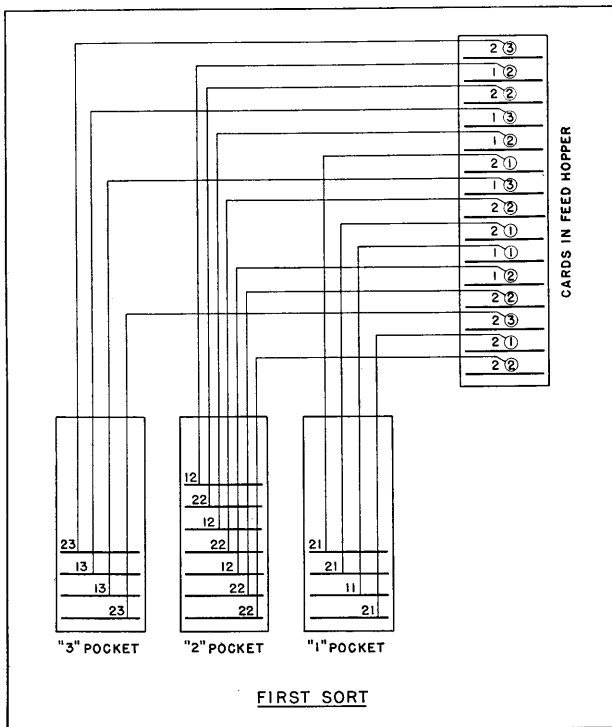
sorting is effected upon the tens column, all cards punched with a 1 in that column fall in the 1-pocket, etc. By placing the cards from the 1-pocket face up and in front of those from the 2-pocket, the original group of miscellane-

ous cards are found to be in numerical order from 11 to 23.

This sorting process could be illustrated further by the use of larger numbers; but from the above it will be observed that upon the completion of the second sort, all cards will appear in groups arranged in correct numerical sequence.
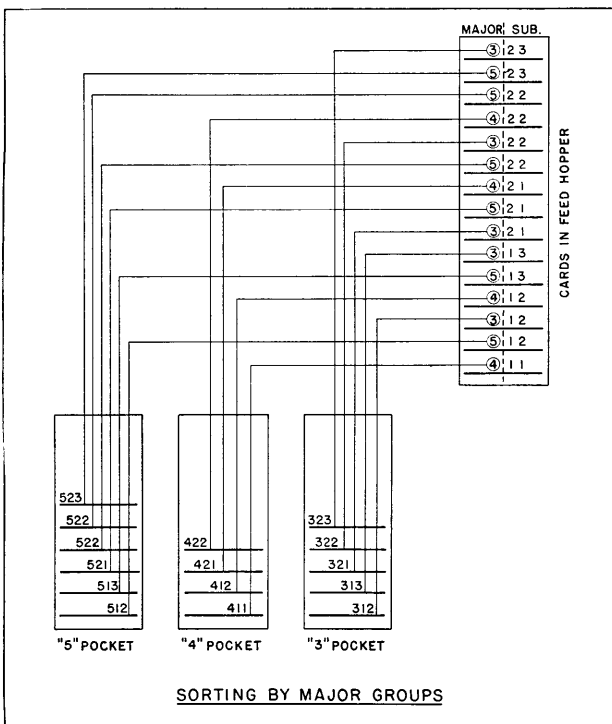
The procedure for sorting of cards to arrange them in proper sequence according to major and minor classifications follows the same general principle. If the above 2-digit numbers were subclassifications, and another one column field was a major classification, the next sort for major classification would bring these groups together, and the subclassifications would be in order within each group.

As a general rule, the sorts for the minor or subclassifications are made first and the sorts for the major groups are made last.

If it is desired to sort all positions of the card column from 9 to 12 inclusive (regular sorting) all of the commutator switches must be set in the outer position. Should it be desired to sort or select any one or more numerals in a given column, it is necessary to pull to the center all commutator switches except those corresponding to the positions to be selected.

After setting the brush and commutator switches for the positions of the column to be sorted, take enough cards to fill the magazine about two-thirds full; hold them 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. Gently tap the top and other end of the cards until all four sides are even. Next place the cards face down (printed side down) in the magazine so that the lower edge (9's) will feed into the machine first. The pressure weight should then be put on the top of the cards.

The depression of the start key will begin the feeding of cards. After the machine has been started, it will continue to operate until the magazine is 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 should be prepared 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.

After sorting one column, be sure to clear the chutes of cards by depressing the start key before proceeding to the next column sort. Cards taken from the Sorter may be placed face down in the compartments of a sorting tray as an aid in maintaining the proper sequence. They may be conveniently checked as they are taken from the pockets with a sorting needle, or by holding the cards up to the light and sighting through the punched holes.

The operation of the Sorter is extremely simple. An operator, however, should be taught to acquire the skill of handling the cards properly and to analyze each job in order that the most efficient routine may be developed.

Sorting Short Cuts

Block Sorting

Ordinarily cards are sorted by beginning with the units column, but where a large quantity is handled, it is usually advisable to separate them first into groups. This is done by sorting in the columns at the extreme left of the field. Each resulting group is then sorted in the customary manner. For example, if cards are to be arranged so that all cards for each customer will be together and all customers within each state will also be grouped, the cards should be sorted first according to state, and then each state group should be sorted by customer. The cards for each state would have to be kept segregated.

In this way it would be possible to finish all of the sorting involved for state 01 necessary to arrange the cards in customer number sequence. Then this batch of cards could be started through the Accounting Machine while the cards for state 02 are being sorted to customer sequence.

The superiority of this method of block sorting lies in the reduction of time required to prepare complete tabulated reports by taking advantage of the concurrent operation of the Accounting and Sorting Machines. The best explanation of the procedure is a practical illustration of the handling of 20,000 cards to prepare a report showing sales by customers and by states.

Assuming that the coding by state is recorded in a two-column field and that for customer in a four-column field, it would be necessary for all of the 20,000 cards to pass through the Sorter

six times to classify them by customer by state. The total operation would require 5 hours, taking the speed of the sorter to be 400 cards a

$$(20,000 \times 6) \div (400 \times 60) = 5$$

minute. This means that, according to the ordinary sorting routine, it would be 5 hours after the sorting operation began before the Accounting Machine could begin producing the required report.

By using the block method of sorting, it would require 1 2/3 hours to effect a division of the

$$(20,000 \times 2) \div (400 \times 60) = 1\ 2/3$$

cards by state. Assuming that the group of cards for any one state would not exceed 2,000, such a group could then be classified by customer in 1/3 hour. According to this method of attacking the sorting problem, the Accounting

$$(2,000 \times 4) \div (400 \times 60) = 1/3$$

Machine operation could begin 2 hours after the sorting is begun.

As the time required for the subsequent sorting of the remaining cards and the tabulating of all cards will be the same regardless of the method of sorting, it is evident that the 3 hours difference in starting time of the tabulating operation will result in the completion of the report approximately 3 hours sooner than under the regular sorting method.

Unless speed in the preparation of finished reports is essential, or if the Accounting Machine would be idle while the sorting is being accomplished, there is no special time advantage in block sorting. It does, however, permit the convenient subdivision of work where sev-

eral Sorting Machines are to be utilized in arranging the cards.

Pre-Sorting

Whenever a peak load of sorting would be involved in the preparation of month-end reports, the condition may be corrected by performing the block sorting just described on a daily or semi-weekly basis. Such detail cards as referred to in the above example could be presorted according to state classifications to eliminate the necessity for sorting two columns at the end of the accounting period.

Sequence of Sorting for Reports

The simplicity with which routine tasks are performed by automatic machines may obscure some of the steps in which application can be eliminated. The proper scheduling of reports is of extreme importance in the attainment of maximum economy in the preparation of reports through the medium of Electric Accounting Machines. These machines have the ability to sense changes of the group classifications of cards in such a way that major and minor totals are accumulated and printed automatically. In order for this to be effected, however, the sorting operation must have been performed first upon that group classification for which minor totals are to be obtained and then upon the group classification for which major totals are desired. Where the same cards are to be used for furnishing a set of reports involving certain group classifications in major and minor totals, proper sorting routine should be given careful consideration. The following illustration of the comparison between two methods of accomplishing the tasks involved in the preparation of reports will reveal the advantages of a well-organized routine.

A company using the illustrated payroll card requires the following reports showing total hours and amounts for each major and sub-classification:

(1) By Employee.
(2) By Part subdivided by Operation.
(3) By Operation subdivided by Employee.
(4) By Department subdivided by Order.
(5) By Order subdivided by Part.

If the reports are prepared in the sequence shown, the sorting would involve running the cards through the Sorter thirty-four times, as shown below:

Order of Report Preparation	Necessary Sorts
1	4
2	7
3	6
4	7
5	10
	—
	Total 34

But if the sequence of reports is changed to permit the maximum use of previous sorts for reducing the sorting involved in arranging sub-classifications, the sorting would be reduced to a total of eighteen runs through the sorter as follows:

Order of Report Preparation	Necessary Sorts
1	4
3	2
2	5
5	5
4	2
	—
	Total 18

In this manner, 16 columns of sorting would be completely eliminated. Should the work involve 10,000 cards, the economy would result in a saving of 6 2/3 hours.

$$(10,000 \times 16) \div (400 \times 60) = 6\ 2/3$$

DATE		MAN		DEPT. CHARGED	ORDER NO.	PART NO.	OPERATION	STANDARD		ACTUAL		
MO.	DAY	DEPT.	NO.					HOURS	AMOUNT	HOURS	AMOUNT	
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	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	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	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	3 3	3 3	3 3	3 3	3 3	3 3 3 3 3 3 3 3 3 3

SORTERS

Needle Sorting

Whenever comparatively large groups of cards having the same punching in a certain column are likely to be grouped together, the sorting operation can readily be performed by needle sorting. The sorting needle is held by the right hand and dropped through the similarly punched holes of a group of cards, while the left hand is used to raise the cards. In this manner the cards which are punched alike are separated from the rest of the cards at the card through which the needle did not pass. Each batch of similarly punched cards may then be placed in the proper compartment of the sorting tray.

It is possible to combine needle sorting and machine sorting whenever the bulk of the cards can be needled but some small batches of cards with widely varied punching are interspersed.

Alphabetic Sorting

To arrange cards containing names into alphabetic sequence necessitates 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.
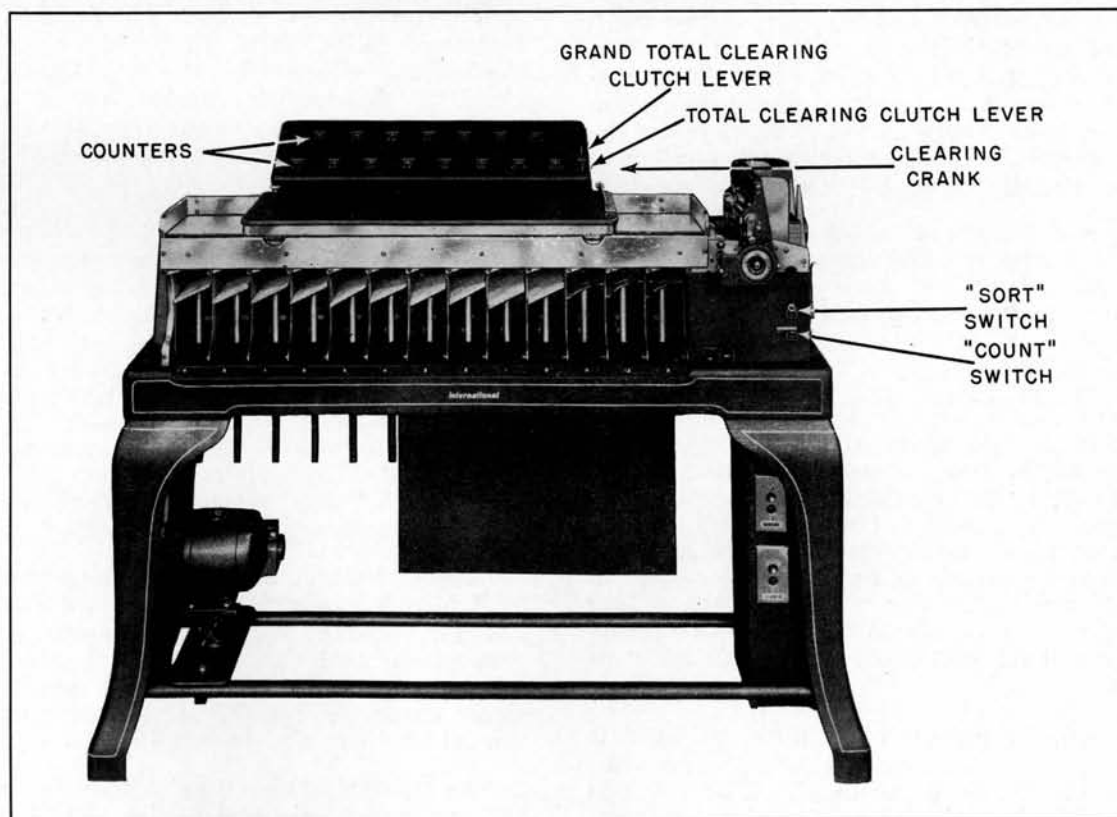
The cards are first sorted in the normal manner according to the digits 1 to 9. In the next operation the selection switches corresponding to these digits are moved to the center to permit sorting of the 12, 11, and 0 positions. The cards which fall in the 12-pocket will contain the letters A to I in alphabetic sequence; those in the 11-pocket the letters J to R; and those in the 0-pocket the letters S to Z.

A special switch may be installed on the sorter to eliminate the necessity for changing the position of the selector switches after each sorting operation. When this switch is turned to the ON position, the machine will function in the same manner as when the selector switches 1 to 9 are moved to the inner position.

Card Counting Horizontal Sorter (Type 75)

The Card Counting Horizontal Sorter is designed for the purpose of counting the holes punched in any or all positions of a given column of the card, and also to register the num-

ber of cards not punched in the column. It will simultaneously group all cards of similar classification and arrange such classifications in numerical sequence in the same manner as the Type 80 Horizontal Sorter.

Counting Mechanism

The counting mechanism is equipped with fifteen adding counters of five digit capacity each, arranged as follows:

12 counters, one for each of the 12 punching positions of the card
1 counter for unpunched cards (rejects)
1 counter for sub totals   (number of cards)
1 counter for grand totals (number of cards)

All counters can be cleared in a single operation by pushing the clutch levers at the right end of the counter mechanism to the rear position and rotating the crank located at the right side of the device. The grand total may be allowed to accumulate by keeping the Grand Total clutch lever forward during the clearing of sub totals.

Switches

Two special switches are placed on the machine marked SORT and COUNT. When both switches are ON, the machine will simultaneously sort all cards passing through the machine and count the punched holes appearing in the column being sorted. When only the SORT switch is on, the machine is similar in operation to the Type 80 Sorter. When only

the COUNT switch is on, the machine will count the punched holes, but all cards will be deposited in the R-pocket.

Electrical Energy

This machine may be operated on direct current at 110 or 220 volts. At 110 volts the current required for starting is 14.5 amperes, and the current for running 3.9 amperes.

When an alternating current drive motor is utilized, the direct current sorting circuit requires only .7 amperes. The alternating current motor operating at 110 volts requires 18.0 amperes for starting and 5.0 amperes for running.

*   *   *   *   *

Note: When direct current is not available and a horizontal sorting machine is used in conjunction with other machines which may be operated on alternating current, it may be arranged for alternating current operation. Alternating current sorters are equipped with tube rectifiers which have the following capacity limitations in regard to the installation of special devices: (1) Only one approved special device can be installed on any one machine (the counting sorter being considered as a device in this case), and (2) The Collating Device cannot be installed. With these exceptions, the A. C. Sorter can perform all of the functions of which the D. C. Machine is capable. When ordering this machine for operations from either 110 or 220 volts A. C., frequency and phase of current must be specified.

Special Devices for Horizontal Sorting Machines

Card Matching Device

The card matching device is an attachment for the horizontal sorter which is used to select matched cards from a group of cards by means of contrasting corner cuts.

By means of this device it is possible to develop a wide variety of specialized routines in connection with the use of Electric Accounting Machines. A representative use is the reconciliation of bank statements for tabulating card checks.

A punched duplicate of each check issued is created on a square cornered card and retained in the tabulating department. The original checks (distinguished by a corner cut) are eventually returned with the bank statement.

These are sorted to check number sequence along with the duplicates. They are then "matched"—the paired originals and duplicates fall in the 9-pocket, but duplicates which are not preceded by original checks fall in the R-pocket. These latter "unmatched" cards represent outstanding bank checks.

This device may be used where there are several master cards for each classification. For example, name and address cards may be treated as master cards, in which case the device may be used to eliminate the name and address cards for inactive accounts, i. e., those for which there are no detail cards.

The Card Matching Device may be installed on any type Horizontal Sorter. Field installation is permitted.

Collating Device

The horizontal sorter can be equipped with a collating device which will prepare sets of cards without requiring any identifying punching.

A number of cards of each kind exactly equal to the number of sets required are placed in the hopper of the sorting machine. The sorting brush is raised so that it does not touch the cards.

The collating device switch is then turned ON which causes the chutes to the pockets to open in rotation so that one card of each kind is distributed to each pocket.

The device can be set by means of a dial switch to prepare from two to twelve sets at one time. Any number of sets may be made by multiple runs.

The installation of this device does not affect the speed of the sorting machine or its normal operation.

This attachment can be used to advantage in an application such as payroll, where daily cards are gang-punched in advance for each employee for every day in a pay period. The device takes these cards, in employee order, and prepares a separate set for each day containing one card for each employee.

The Collating Device may be installed only on the Type 80 Horizontal Sorter if it is not in combination with the group sorting device. Field installation of this device is not allowed.

Group Sorting Device

The group sorting device is an attachment for horizontal sorting machines which enables the sorting of an entire group of cards to be controlled by the punching in a "leader" master card which precedes the group, irrespective of the punching of the detail cards. This device can be furnished for operation in either one of two ways.

A. The Single Master Card Basis requires a leader card but not a trailer card. The leader card determines the pocket into which the detail cards will be sorted even though they are punched differently in the column being sorted.

The detail cards in this case must have an upper corner cut (either right or left). The leader card must have no corner cut on the same side which is corner cut on the detail cards.

B. The Double Master Card Basis requires both a leader card and a trailer card for each group. The leader card controls the sorting,

as in the single master card basis, but a trailer card is required to prepare the machine for the next group. The leader card has a lower corner cut, the detail cards an upper corner cut, and the trailer card no corner cut.

A special brush, permanently mounted on the right (or left) outside rail, distinguishes between the classes of cards in both cases.

The use of the group sorting device does not affect the speed of the machine or its operation for other work. A switch is provided to render the device inoperative.

The Group Sorting Device may be installed only on the Type 80 Horizontal Sorter if it is not in combination with the Collating Device. Field installation of this device is not allowed.
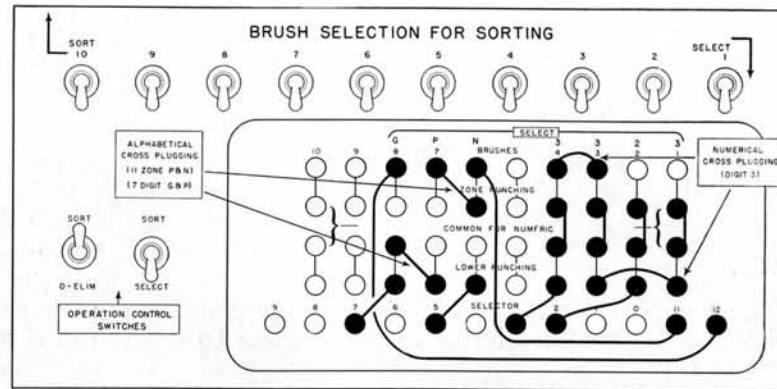
Multiple Column Selector

The Horizontal Sorter may be equipped with a demountable ten-position brush, a small plugboard, two switches for operation control, and ten switches for the selection of brushes for multiple column selection, or for zero elimination. The plugboard and switches are mounted on an inclined surface at the right, just below the card hopper, to provide maximum accessibility to the operator. The plugboard consists of a group of four hubs, arranged vertically, for each of the ten brushes; and a row of "Selector" hubs at the bottom, labelled from 9 to 12 one for each possible digit or punching position in a column.

This device has two distinct uses:

1. Multiple Column Selection: This permits selecting automatically from a file of cards, those cards which are punched with a predetermined alphabetical, numerical, or combination indication within any ten adjacent columns. In a single run, selected cards of the desired classification will fall in the "Reject" pocket while the remaining cards will be deposited in the "12" pocket of the sorting machine. The sequence of the unselected cards will not be disturbed.

   By means of this device it is possible to select all the cards for a specified branch, agent, product, date, part number, or other class of data.

The plugboard diagram illustrated is plugged for a combination alphabetic-numerical selection problem in which the indication is punched within a range of ten columns, but not in adjacent columns. Ordinarily the brushes would be plugged consecutively. The digits representing a number, or the combinations of digits and zones representing letters to be selected,

are plugged from the "Selector" hubs to the brushes which read the indication from the card. Cross-plugging is used as illustrated whenever a digit or zone is repeated. For numerical multiple-column selection, bottle plugs are used for the "Common for Numeric" plugging indicated by brackets. The "Zero Eliminate" switch is set to "Sort", the "Multiple Column Selection Switch" and the series of brush switches are all set to "Select." All selected cards are deposited in the reject pocket while the remaining cards fall in the "12" pocket.

2. Zero Elimination: The device permits greater speed in the completion of either alphabetical or numerical sorting operations, through the automatic rejection of cards which require no further sorting.

The speed of both *numerical* and *alphabetic* sorting operations can be considerably increased through the use of the "Zero-Elimination" feature incorporated in the device. Cards can be rejected during a regular sorting operation whenever the columns plugged at the left as well as the columns being sorted all contain zeros, elevens, or twelves only, or are blank. These rejected cards do not require further sorting, since they contain sorting codes lower than those in the remaining cards and, therefore, they are available for immediate tabulation or for further machine operation. Any significant punching from 1 to 9 in any column plugged to the left prevents rejection of a card.

The zero-elimination feature requires the use of the multiple brush in place of the standard brush on the sorter. To avoid unnecessary wear on both the brush and the cards, the multiple brush should be used for sorting only when zero elimination is of value.

This feature is made operative for numerical sorting by cross-plugging the Lower-Punching hubs of the field or fields by means of bottle plugs and in turn connecting them to the *zero* selector hub. Columns may be skipped in the right-to-left sequence by leaving them unplugged and sorting is accomplished by the successive turning of Brush Selection For Sorting switches to "Sort." Each switch at the left takes precedence over those at the right, which permits the successive switches to remain in the "Sort" position as an indication of columns completed. The two operation control switches are set to "Zero Eliminate" and "Sort" respectively.

Alphabetic sorting can be accelerated considerably by the zero-elimination feature, since it causes the rejection of cards in which the columns to the left are blank for those columns plugged. Thus cards with long names or descriptions can be segregated from cards with short names or descriptions. For example, card No. 1 below may be sorted on all 16 columns, while card No. 2 requires sorting on only 9 columns.

If the sort-elimination feature is used on the first sort on column 16 and the columns from 10 to 16 are plugged for elimination, all cards with names as short as, or shorter than, "Jones" will be rejected and need not be sorted further until the regular sort is made on column 9. The operator's knowledge of the data punched in the sorting field will determine the best number of columns to plug for zero-elimination on the first sort, as well as whether or not smaller portions of the field should be plugged for elimination on successive sorts. The plugging and switch settings are the same as for zero elimination during numerical sorting.

Card Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Card Number 1.	J		D		F	L	E	G	E	N	H	A	U	S	E	R
Card Number 2.	A		B		J	O	N	E	S							