

MACHINE METHODS OF ACCOUNTING

ALPHABETIC DIRECT SUBTRACTION ACCOUNTING MACHINE

THE Alphabetic Accounting Machine constitutes the most recent development in International Electric Accounting Machines. It embodies, in addition to most of the features of numerical accounting machines, a mechanism capable of printing complete alphabetic descriptions from punched cards. This combination of features makes it a complete, flexible, and efficient all-purpose accounting machine.

The machine is designed to obtain both alphabetic and numerical data from punched cards and to furnish either listed or tabu-

lated reports. Alphabetic information is printed in clear, easily readable type, there being no combination letters. Numerical lists and totals may be printed in any desired arrangement, with proper indication of positive and negative items. Like other International Electric Accounting Machines, this machine performs all operations automatically and requires only a minimum of attention from the operator.

The illustration below shows a typical finished report prepared on the Alphabetic Direct Subtraction Accounting Machine.

STOCK REPORT										
STORE NO. <u>14</u>				WEEK ENDING <u>July 20</u>						
CLASS	DESCRIPTION	UNIT	ITEM NO.	OLD BALANCE	RECEIPTS	SHIPMENTS	UNFILLED ORDERS	NEW BALANCE (LESS UN-FILLED ORD.)	'VALUE OF' SHIPMENTS	
TIRES	EAGLE SUPER 4 PLY	EACH	1201	20	40	54		6	34290	
	EAGLE SUPER 6 PLY	EACH	1202	10	12	18	8	4CR	12510	
	SPECIAL X CORD 4 PLY	EACH	1205	6	48	40	6	8	26000	
	SPECIAL X CORD 6 PLY	EACH	1206	14	10	21	6	3CR	15750	
	SPECIAL X CORD 8 PLY	EACH	1207	4	24	12	12	4	10800	
	ACME GOLD STRIPE 4 PLY	EACH	1210	24	48	60	24	12CR	43500	
	ACME GOLD STRIPE 6 PLY	EACH	1211	17	20	24	2	11	19440	162290*
TUBES	PARAMOUNT REGULAR	EACH	1301	12	24	30	2	4	3450	
	PARAMOUNT HEAVY DUTY	EACH	1302	8	12	14		6	2310	
	PARA GUM SINGLE	EACH	1304	14	18	24	12	4CR	3000	
	PARA GUM SPECIAL	EACH	1305	6	14	12		8	1920	
	RITZ BLOWOUT PROOF	EACH	1308	16		6		10	1260	11940*
LINERS	EAGLE REGULAR	DOZ	1401	4	4	6	4	2CR	3600	
	EAGLE EXTRA HEAVY	DOZ	1402	4		2		2	1600	5200*
PATCHES	EAGLE LIGHT 6 INCH	DOZ	1501	6	6	8	2	2	1600	
	EAGLE TRUCK 8 INCH	DOZ	1502	10	6	14	2		4200	
	ACME 6 INCH	DOZ	1503	2	12	12	6	4CR	2760	
	ACME EXTRA HEAVY 8 INCH	DOZ	1504	6	7	8		5	2600	11160*

Features

The Alphabetic Accounting Machine (Type 405) is distinctive in design and appearance. It does not resemble outwardly the numerical accounting machine; and even the principles of operation of much of the internal mechanism have been modified to permit greater flexibility in its application to all accounting routines.

Because of these changes, all the features of the Alphabetic Direct Subtraction Accounting Machine are described in the following paragraphs.

Counters

This machine is equipped with a series of single-position accumulators arranged permanently into groups to form counters of various capacities—two-position, four-position, six-position, and eight-position groups (counter groups are hereinafter referred to as counters). Although counter capacities are fixed, any counter may be coupled with any other counter to form a single-acting counter of greater capacity. Counters may be coupled for either adding or subtracting.

Every counter is of the "controlled" type. Each has the ability to add, subtract, or eliminate any given class of cards or all classes of cards, according to the method in which it is wired. Each counter also has the ability to control the simultaneous listing of information which is being accumulated in it. Added items are listed in true figures, subtracted items in true figures with a designating credit symbol, and eliminated items are omitted entirely. Listing may or may not be under control of the counters, depending upon the method of wiring.

Print Unit

The print unit consists of two solid banks of type separated by a space equivalent to one type bar.

The alphabetic or left type section consists of 43 type bars which may be used for listing or indicating either alphabetic or numerical data, or for total-printing numerical data. Each type bar in this section has 37 characters—9 numerals, 26 letters, and two zero positions. One additional special character can be added in these type bars as explained in a later section. The arrangement and operating principles of the alphabetic type bar are explained in the section on Operating Principles.

The numerical or right type section consists of 45 type bars which may be used for listing, indicating, or total-printing numerical data only. Each type bar in this section has 11 characters—the numerals 0 to 9 and either an asterisk or a credit symbol. The standard arrangement provides an asterisk on every odd-numbered bar and a credit symbol on every even-numbered bar, but any other arrangement may be specified.

In addition to the regular hammerlock lever, each type bar has an auxiliary lever which when properly set permits automatic, selective hammerlocking as directed by either card sensings or machine resets. Automatic hammerlock control is explained in detail in a later section.

The use of continuous banks of type instead of a separate bank for each counter provides a maximum number of usable printing positions since there are no positions lost by the necessity of reserving printing capacity greater than is needed. This arrangement also permits the preparation of very compact reports by reducing the space between report columns. A report utilizing all 88 type-bar positions can be printed on a sheet 14 inches in width.

Carriage

This machine is equipped with a 20" carriage of the same standard design as that supplied on other International Accounting Machines. A lever is provided for setting the carriage for either single or double spacing. Single spacing is six lines to the inch; double spacing, three lines.

The carriage has a lateral movement of 7 inches, i.e., it may be moved $3\frac{1}{2}$ inches to either the right or the left of its central position. A notched rod at the back of the carriage provides a holding position for each lateral movement of four type bar spaces.

Card Feed and Eject

The card feed of this machine is similar to that of the Horizontal Sorting Machine; therefore, cards may be fed continuously, i.e., they may be stacked in the feed hopper without stopping the machine. The card feed hopper has a capacity of from 800 to 900 cards.

Cards which have been tabulated are stacked in an accessible position and may be removed without stopping the machine. The capacity of the eject stacker is approximately 1000 cards.

Control Keys

There are four keys mounted on the frame of the machine to the right of the print unit, which are used as follows:

The "Start" and "Stop" keys are self-explanatory; the "Hand Total" key is used to take major, intermediate, or minor totals manually and must be pressed twice in the first two cases (Major and Intermediate totals are taken on the same reset cycle); the "Final Total" key is used to take totals manually after all cards of a particular group have been tabulated. Final totals cannot be taken automatically and can be taken manually only when the Final Total Switch is set. Final totals print on the second cycle following depression of the key.

Current

The machine has its own motor generator and may therefore be specified for operation on either alternating or direct current of 110 or 220 volts.

Flexibility

The machine is equipped with an automatic plugboard which permits rapid changes. Where set-ups can be predetermined, a fixed set-up plugboard increases the ease, simplicity, and speed of operation.

Any field of any card may be used to record either alphabetic or numerical data. Gang-punched fields, duplicated fields, and key-punched fields may therefore be located for the greatest efficiency in punching.

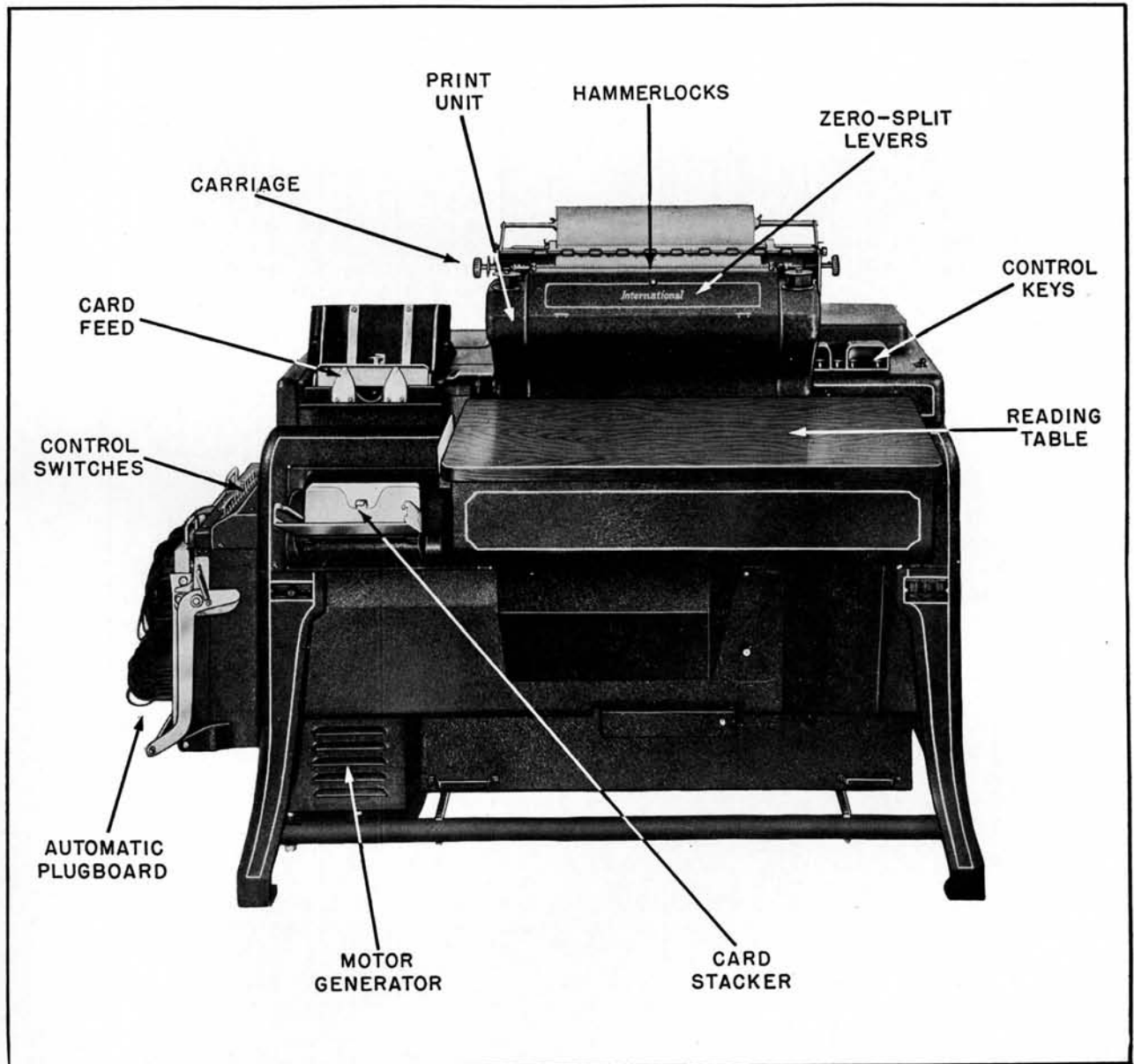
Any alphabetic field of the card may be indicated, listed, or used for automatic control. Any numerical field of the card may be indicated, listed, added, subtracted, or used for automatic control.

Four "Class, Total or Balance Selection" devices are furnished for the purpose of (1) class

or field selection, (2) printing major or intermediate totals directly beneath minor totals, (3) printing both positive and negative totals in true figures in a single report column, (4) group indication of either alphabetic or numerical data.

Convenience of Operation

The Alphabetic Direct Subtraction Accounting Machine is designed for maximum operating efficiency. The automatic plugboard, keys, switches, card-feed, and carriage all may be reached easily from the operating position.



Plugging and Operation

The following paragraphs present a description of the wiring necessary to cause the Alphabetic Direct Subtraction Accounting Machine to perform its various functions. The diagrams shown do not illustrate complete machine wiring but serve merely to clarify the explanation of the function being discussed.

Alphabetic Listing

In arranging the machine to list or list-indicate alphabetic data, it is necessary to plug both the Control and the Add Brushes, the former establishing the "zone" and the latter causing the registration of the proper character within the particular zone.

For zone set-up, the Control Brushes are plugged to the single row of hubs directly beneath them labelled "Plug to Control Brushes for Alphabet or Control Unit for Control." These hubs represent the inlets for the zoning mechanism on each of the 43 alphabetic type bars. The wiring is from the card column positions to the type bar positions selected for the particular case.

For proper character printing, the Add Brushes are plugged to the list hubs labelled "Plug to Add Brushes for Alphabet or Numerical." These hubs represent the inlets for the print magnets of the alphabetic type bars. The wiring is from the card column positions to the type bar positions and corresponds exactly with the wiring for zone set-up.

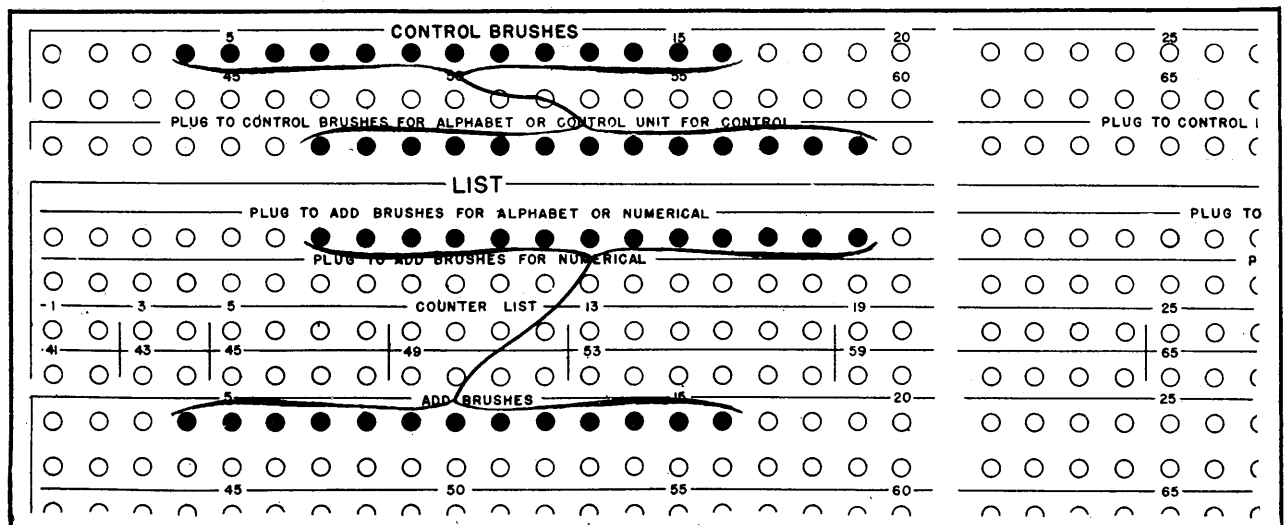
A description of the alphabetic type bar at the end of this section points out the functions of the zoning mechanism and the print magnet and clarifies the above description of plugging for alphabetic listing. The plugboard diagram illustrates the complete wiring arrangement for listing alphabetic data punched in card columns 4 to 16 from type bars 7 to 19 of the alphabetic type section.

Numerical Listing

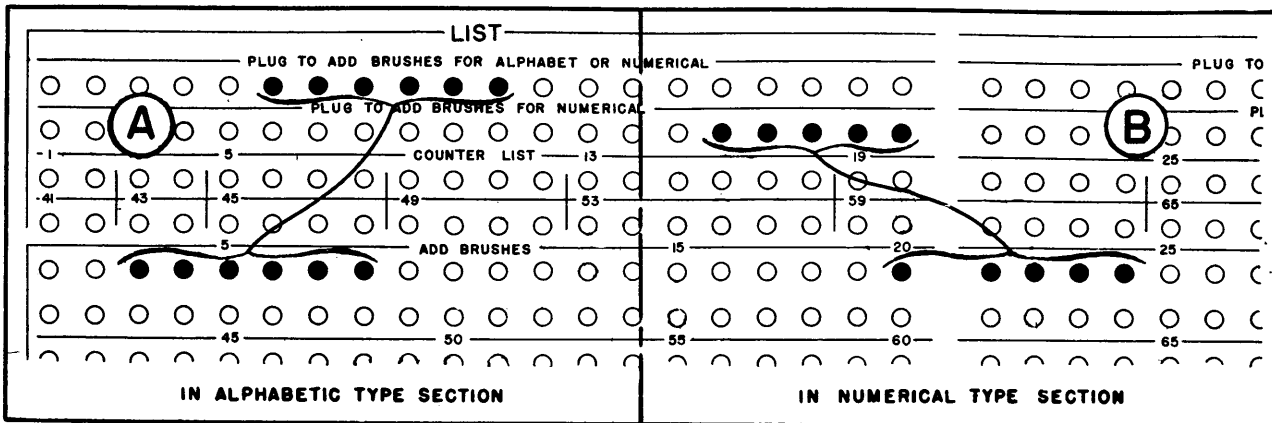
Numerical data are listed by wiring from the Add Brushes to either the alphabetic or the numerical type sections of the print unit. Since it is not necessary to zone numerical punching, it is not necessary to plug the Control Brushes for this type of work.

If numerical data are listed from the alphabetic type bars, the plugging is from the Add Brushes to the list hubs of the alphabetic type section labelled "Plug to Add Brushes for Alphabet or Numerical." This plugging is illustrated in Section A of the diagram on the following page. If numerical data are listed from the numerical type bars, the plugging is from the Add Brushes to the list hubs of the numerical type section labelled "Plug to Add Brushes for Numerical." This plugging is illustrated in Section B.

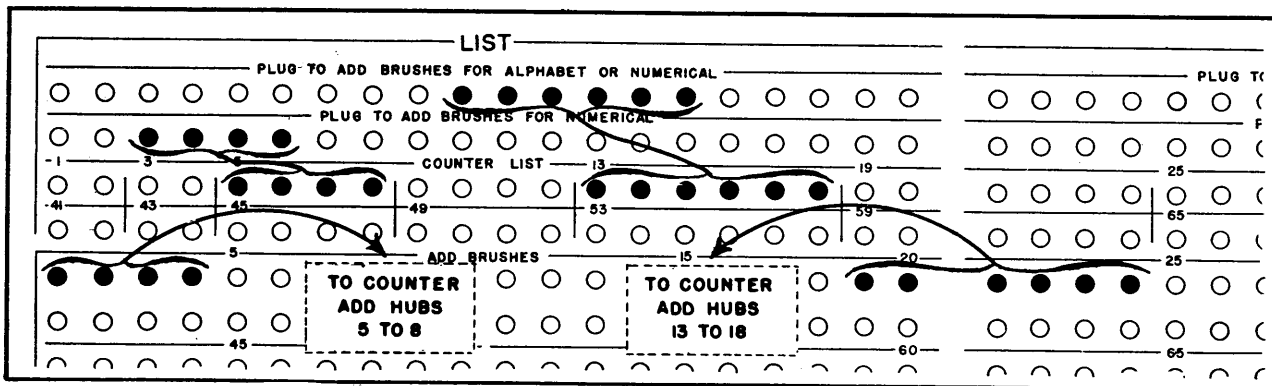
When listing is to be under control of a counter, the "Counter List" hubs corresponding to the controlling counter are plugged to the



Alphabetic Listing



Numerical Listing



Counter Controlled Listing

desired list hubs instead of plugging the Add Brushes directly to these hubs. The Counter List hubs are outlet hubs for the same card impulses which cause registration in the counter and, therefore, energize the print magnets for listing only when data are accumulated in the counter. Plugging for listing under control of a counter is illustrated in the diagram "Counter Controlled Listing."

Class Selection

Alphabetic information can be class-selected, i.e., it can be printed in two places on the report from one field of the card. It cannot, however, be field-selected, i.e., data punched in different card fields cannot be selected to print in one report field because zoning and class selection control occur simultaneously at the upper brush station. The diagram illustrates the class selection of alphabetic data. Split wires are used in plugging the control brushes for zoning.

Numerical data can be class-selected or field-selected at will in all positions which are not plugged for alphabetic printing. Whenever any positions are plugged for both alphabetic and numerical operations, the arrangement of data must be such that "zoning" interference is avoided.

Zoning interference occurs whenever the plugging is such that any type bar receives a zoning impulse from one position of a card and a print-magnet impulse from a different position of the same card. This combination of impulses results in the printing of letters rather than the straight numerical data desired, because every type bar which is plugged for alphabetic printing has two inlet wires—one from a control brush and one from an add brush (through a class selector). If, in any case, a 12,

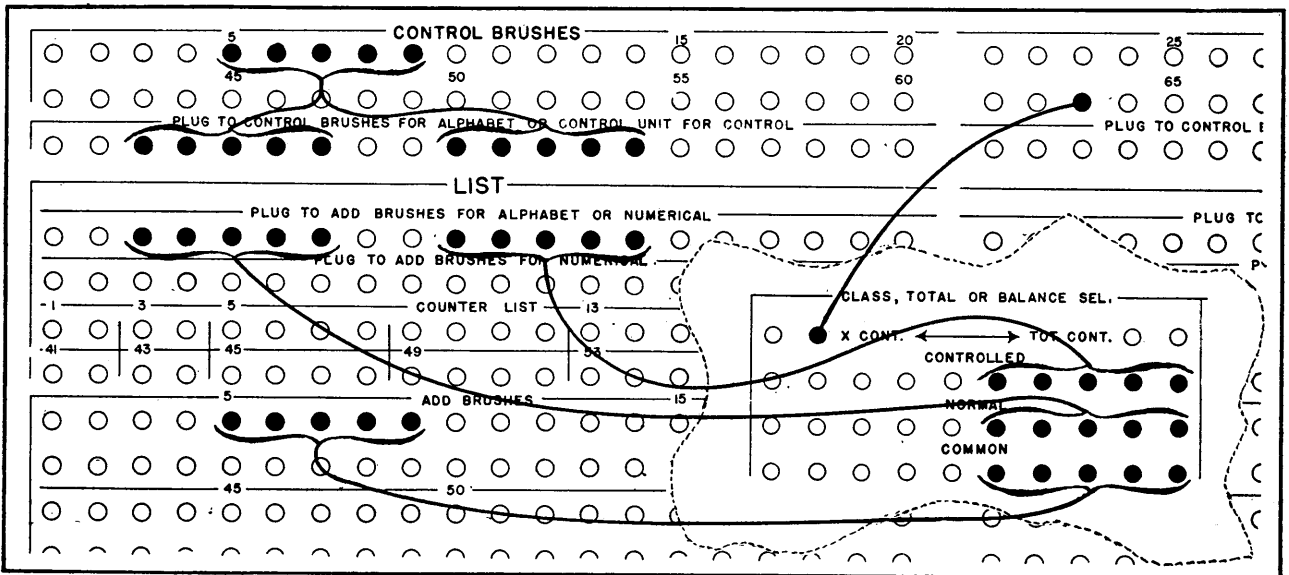
11, or 0 hole is punched in the column of the card which is plugged from a control brush, the type bar is "zoned" and cannot print a numeral even though the add brush impulse comes from a numerically punched column of the card. Zoning interference can be avoided by proper card design and punching.

Numerical information which is punched in alphabetic fields of the card can be selected out of these fields to print in any non-alphabetic section of the report. The diagram shows the wiring arrangement for this type of selection.

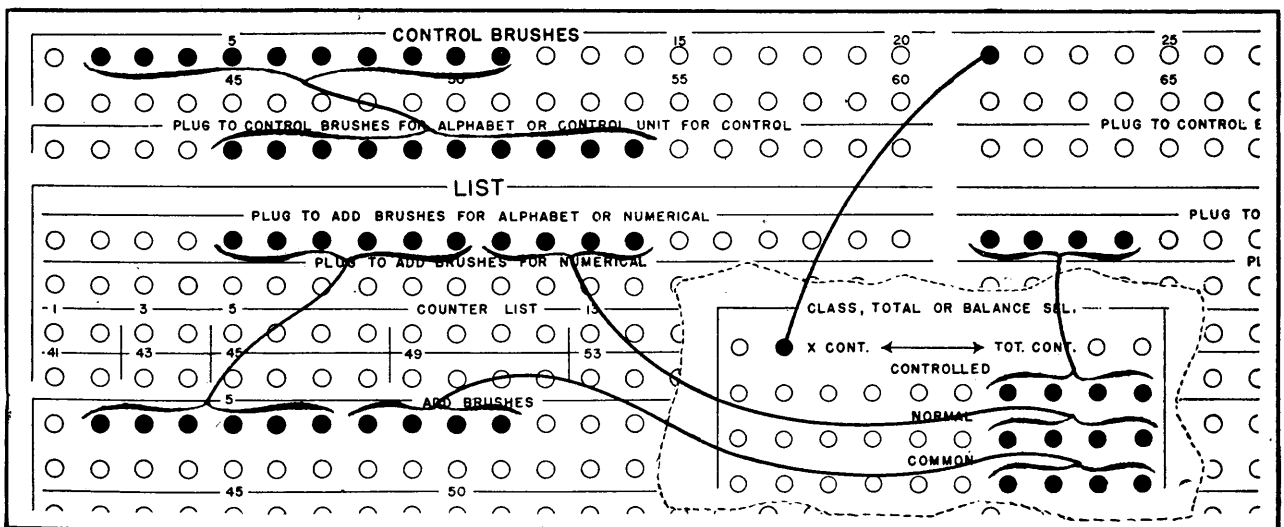
Accumulating

The counters of this machine are of the "controlled" type; being capable of adding, subtracting, or eliminating numerically punched data according to the method in which the counters are controlled. The principles of counter operation and of counter control plugging are explained later.

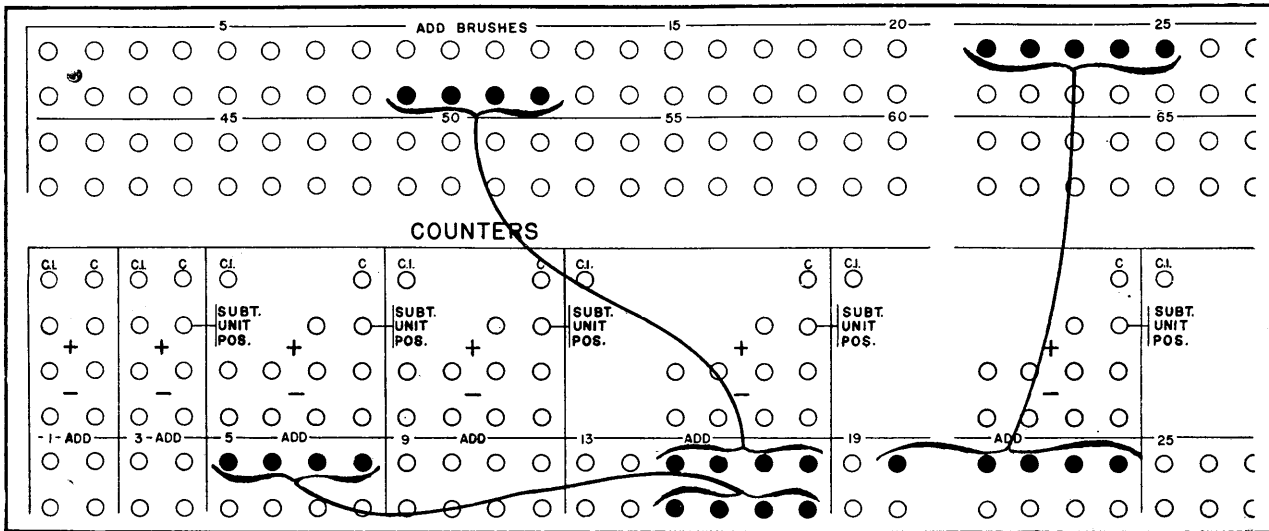
For all accumulating operations, the Add Brushes are plugged directly (or indirectly) to the counter Add hubs. These hubs are the inlets for the individual counter wheels and should be



Alphabetic Class Selecting



Numerical Data Selected From an Alphabetic Field

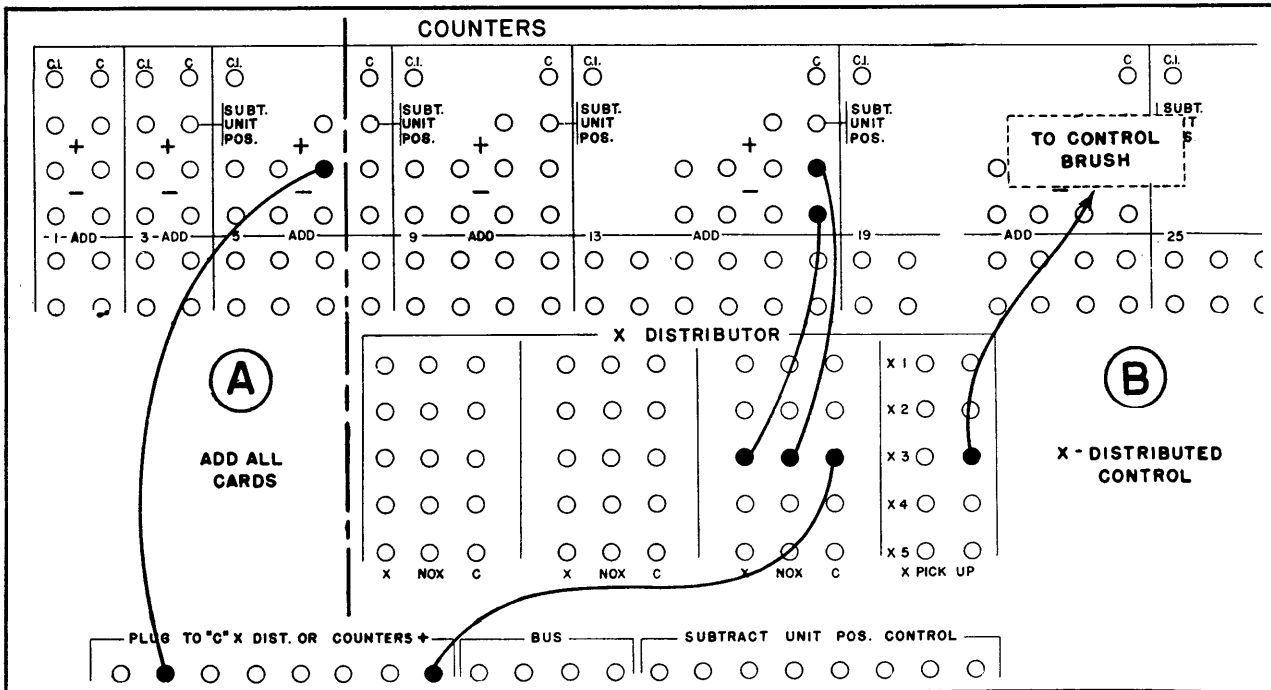


Accumulating

plugged only for impulses coming from the Add Brushes or Card Count. The double row of hubs, representing the outlets of the adding brushes, is provided for multiple plugging of the same card fields. The diagram shows the plugging arrangement for accumulating in counters. Counter-control plugging is not shown in this diagram.

Counter Controlling

A counter is caused to add, subtract, or eliminate by a counter control impulse which is available at every card cycle and is plugged to the Counter Control hubs either directly or through the X-distributor. The outlet hubs for this impulse are located below the X-distributor and are labelled "Plug to 'C' X-Dist. or Counters".



Counter Controlling

+.” The Counter Control hubs are located directly above the counter Add hubs and are designated by + and - (minus) signs. Multiple hubs are furnished to permit multiple plugging.

If a counter is to add all cards, the control impulse is plugged directly to the “+” Counter Control as illustrated in Section A of the accompanying diagram. If the control impulse should be plugged directly to the - (minus) Counter Control, the counter would subtract every card.

In order to control a counter differently for different classes of cards, the control impulse is first “class-selected” by wiring it through the X-distributor. By plugging the control impulse to the “Common” position of any one of the individual class selectors of the X-distributor, it is possible to direct the impulse in either of two ways—one from the No-X position and one from the X position. The presence or the absence of an X-punch in the card determines which path the control impulse will take. If either of these positions is not plugged to Counter Control, the counter will eliminate the particular class of card for which the plugging is omitted. Section B of the diagram illustrates X-distribution of the control impulse. The operating principle of the X-distributor is further explained later.

Whenever a counter is used for subtraction, it is necessary to plug the “Subt. Unit Pos.” hub, located above the units position of the counter, to one of the “Subtract Unit Pos. Control” hubs located directly beneath the X-distributor. These latter hubs furnish an impulse which automatically adds “one” in the units wheel of a counter whenever the counter is subtracting—a necessary operation because direct subtraction is accomplished by the use of automatic complements.

Counter Coupling

The plugging arrangement for coupling two or more counters together to form a single-acting counter of greater capacity involves

merely the cross-connecting of the carryover and the controlling hubs.

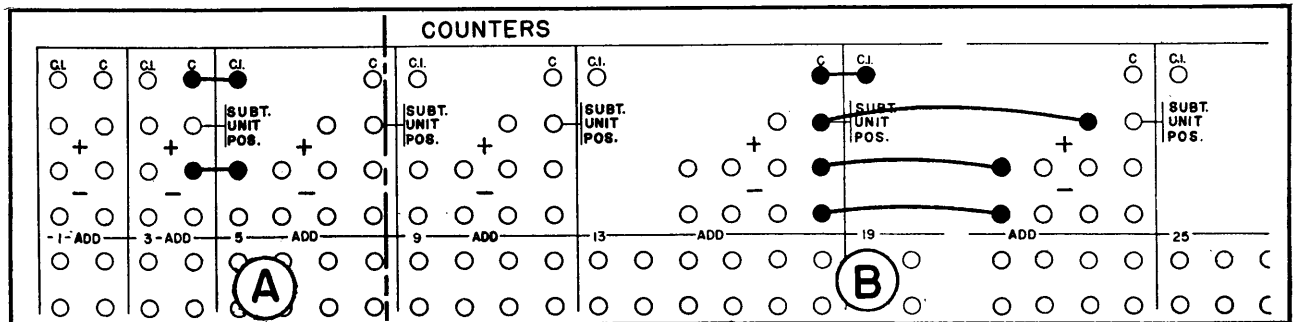
When counters are coupled for adding operations, it is necessary to plug only the carryover and the “+” counter controls as illustrated in Section A of the accompanying diagram. When counters are coupled for both adding and subtracting operations, all of the controlling hubs of the counters must be connected as illustrated in Section B of the diagram. The unlabelled hub directly to the left of the “Subt. Unit Pos.” hub and the C (carryover) hub are plugged only when counters are coupled—they have no other function.

Whenever counters are coupled, the resulting single-acting counter is treated as a unit in all subsequent plugging for total printing, balance selecting, etc., as described elsewhere.

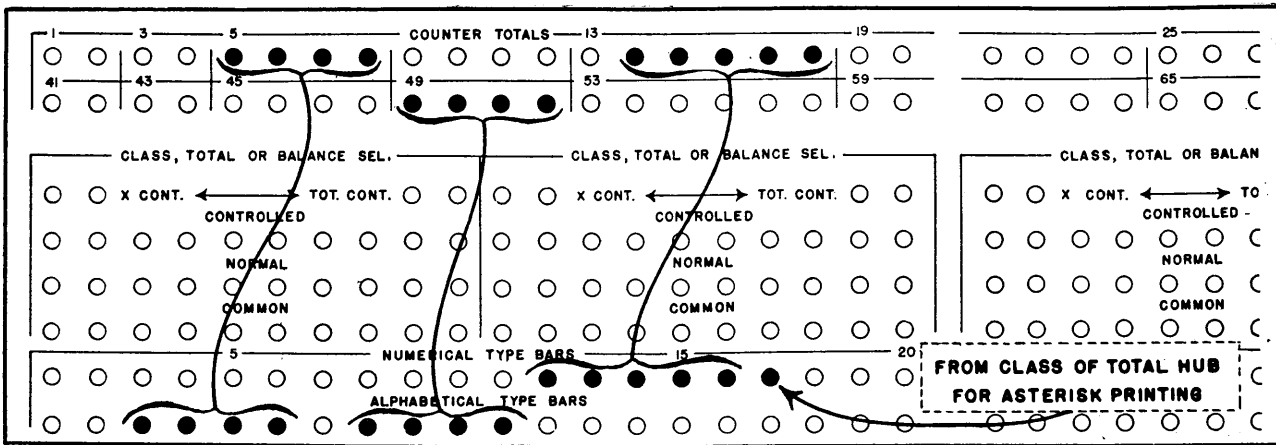
Total Printing

In order to print the totals accumulated in any of the counters of this machine, the proper “Counter Totals” hubs are plugged to the desired type bar hubs of either the alphabetic or the numerical type sections. Counter Totals hubs are located directly beneath the counter Add hubs and represent the outlets for the data contained in each counter-wheel at the time of the total reset cycle. The type bar hubs for total printing are located at the bottom of the plugboard and are labelled “Numerical Type Bars” and “Alphabetical Type Bars.” There are no internal connections between counters and type bars—the plugging for total printing is entirely flexible. The diagram on the top of the next page illustrates the wiring arrangement.

Intermediate or major totals may be printed directly beneath minor totals by plugging the respective counter totals through one of the “Class, Total, or Balance Selection” units. The minor Counter Totals are plugged to the “Normal” row of the selector; the major (or



Counter Coupling



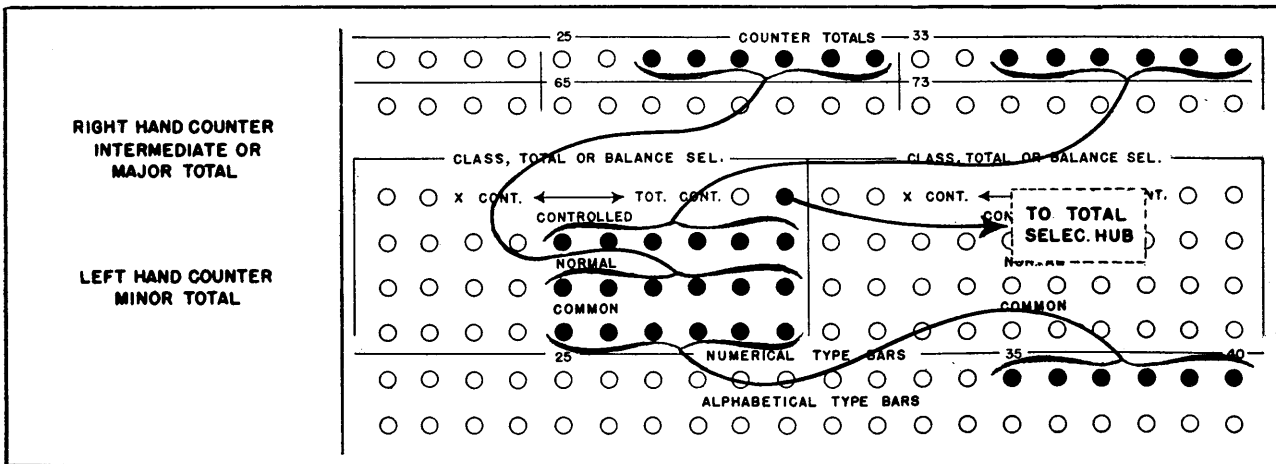
Total Printing

intermediate) Counter Totals are plugged to the "Controlled" row of the selector; the "Common" row of the selector is plugged to the type bars. The selector is controlled by plugging the "Tot. Cont." hub to one of the "Total Selection" hubs located at the left of the X-distributor. A control impulse is available at the Total Selection hubs at every intermediate and major total cycle. The plugging arrangement for total transfer is illustrated in the accompanying diagram.

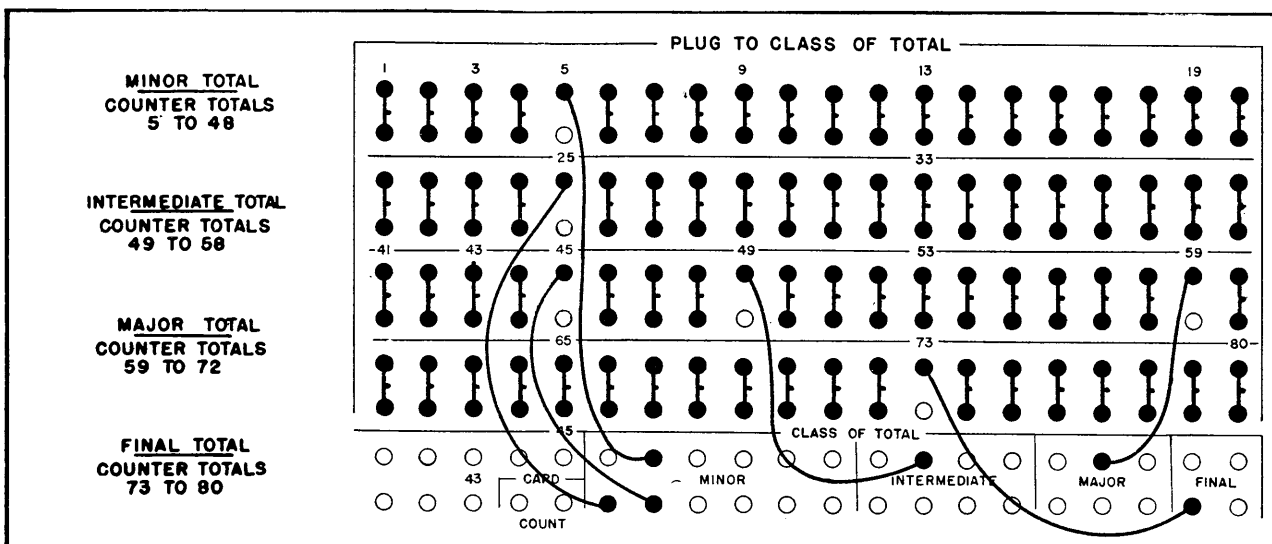
To fix the particular total reset cycle at which the counter totals are to become active (minor, intermediate, major, or final), it is necessary to plug the Class of Total unit located in the lower right section of the plugboard. This unit consists of a group of Class of Total impulse hubs (12 minor, 8 intermediate, 6 major, and 4 final) and a double row of hubs which corre-

spond, in numbering, to the Counter Totals hubs. Every position in the upper row is normally connected to the corresponding position in the lower row by a removable two-pronged jack plug.

To arrange the machine to total print from a particular counter on any desired total cycle, the jack plug corresponding to the extreme left-hand position of the counter is removed. A plugwire then is inserted from the required Class of Total hub to the upper hub of the position from which the jack plug was removed. Each Class of Total plug so inserted controls the positions to the right (not exceeding twenty positions), up to the next Class of Total plug. The diagram illustrates the plugging arrangement for total printing the several classes of totals.



Total Transfer



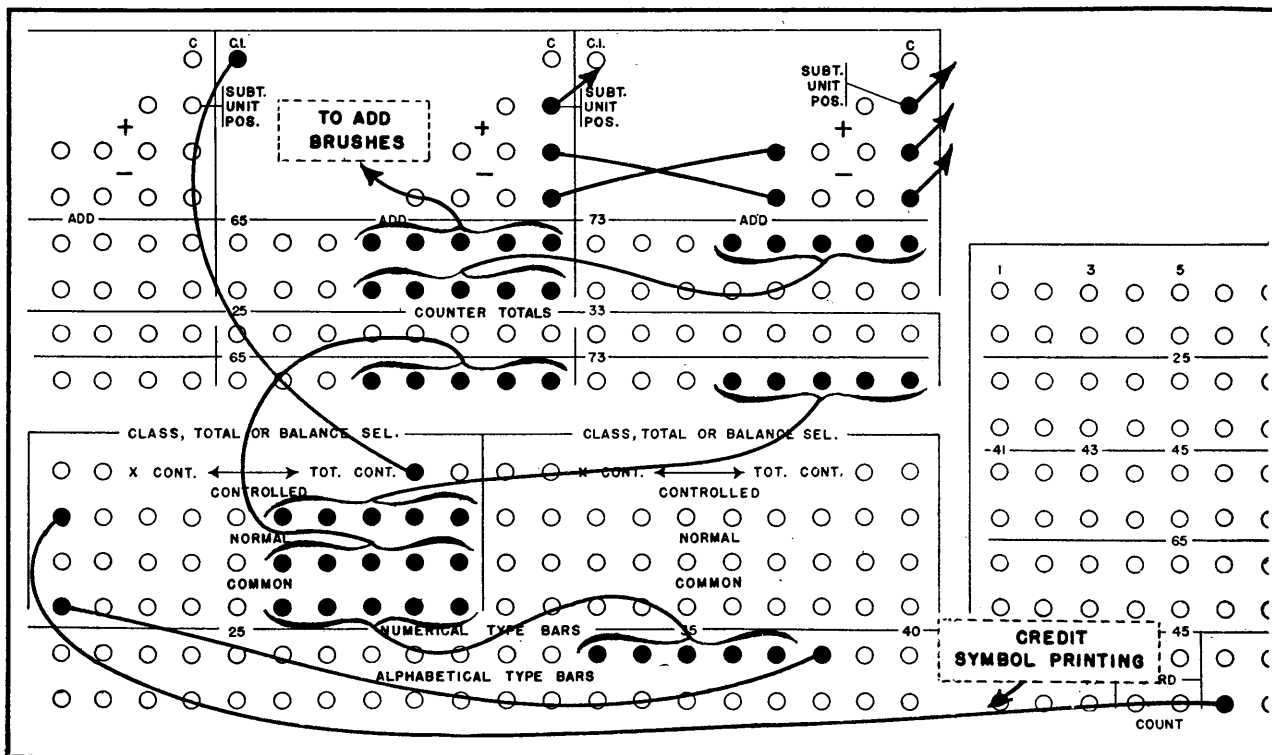
Class of Total Printing Control

The Class of Total hubs are used also to cause an asterisk or a credit symbol to print on total cycles as required. To print an asterisk, the desired Class of Total hub is plugged directly to the "Numerical Type Bar" hub which corresponds to the position in which the asterisk is to appear (see diagram "Total Printing"). The printing of credit symbols is explained in a following paragraph.

Balance Selecting

Since the counters of this machine are subtracting counters but not balance counters, the principle of balance selection must be employed when both plus and minus items are to be printed in true figures in one printing field.

Balance selection is accomplished by plugging the card field into two counters and controlling



Balance Selection

the respective counters so that any amount entered into one counter as plus is entered into the other counter as minus, and vice versa. Selection is then made of the counter which contains the true figure total, as determined by the presence or the absence of a "9" in the last position at the left of the governing counter. (When a counter is used for balance selection its capacity is reduced by one position due to the fact that the left position is reserved for sensing the "9".)

The outlet hub for this sensing is labelled C. I. (complement impulse) and it is plugged to the "Tot. Cont." hub of the selector unit to cause the selector to be controlled whenever a "9" appears in the left counter wheel at a total cycle. One group of counter totals is plugged to the "Normal" row of the selector, and the other group of counter totals is plugged to the "Controlled" row. The "Common" row is plugged to the type bars selected for printing.

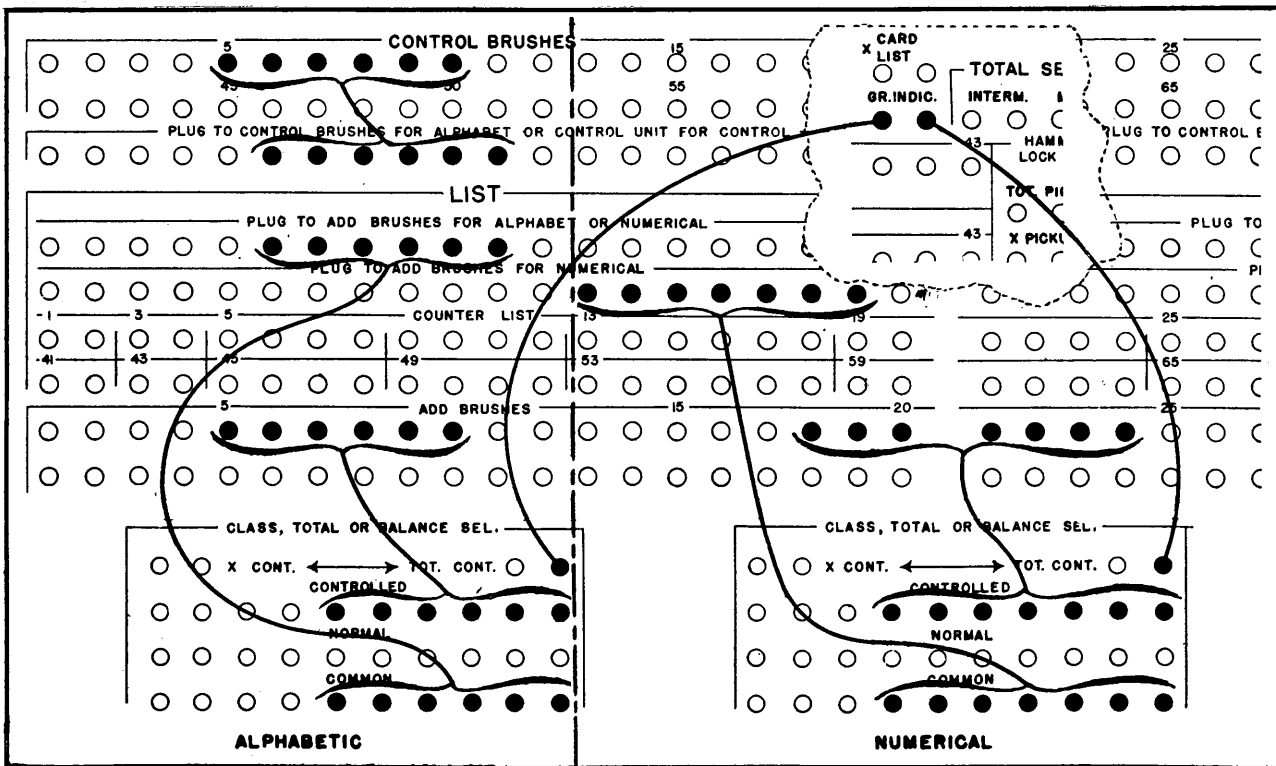
To print a credit symbol for designating minus balances, the proper Class of Total hub is plugged through any available position of the selector unit which is used for the balance selection. This plugging is from the Class of Total hub to the "Controlled" row of the selector, and

from the "Common" row to the desired Numerical Type Bar, as illustrated. This causes the credit symbol to print only when the balance selector unit is "controlled" or, in other words, only when a credit total is selected for printing.

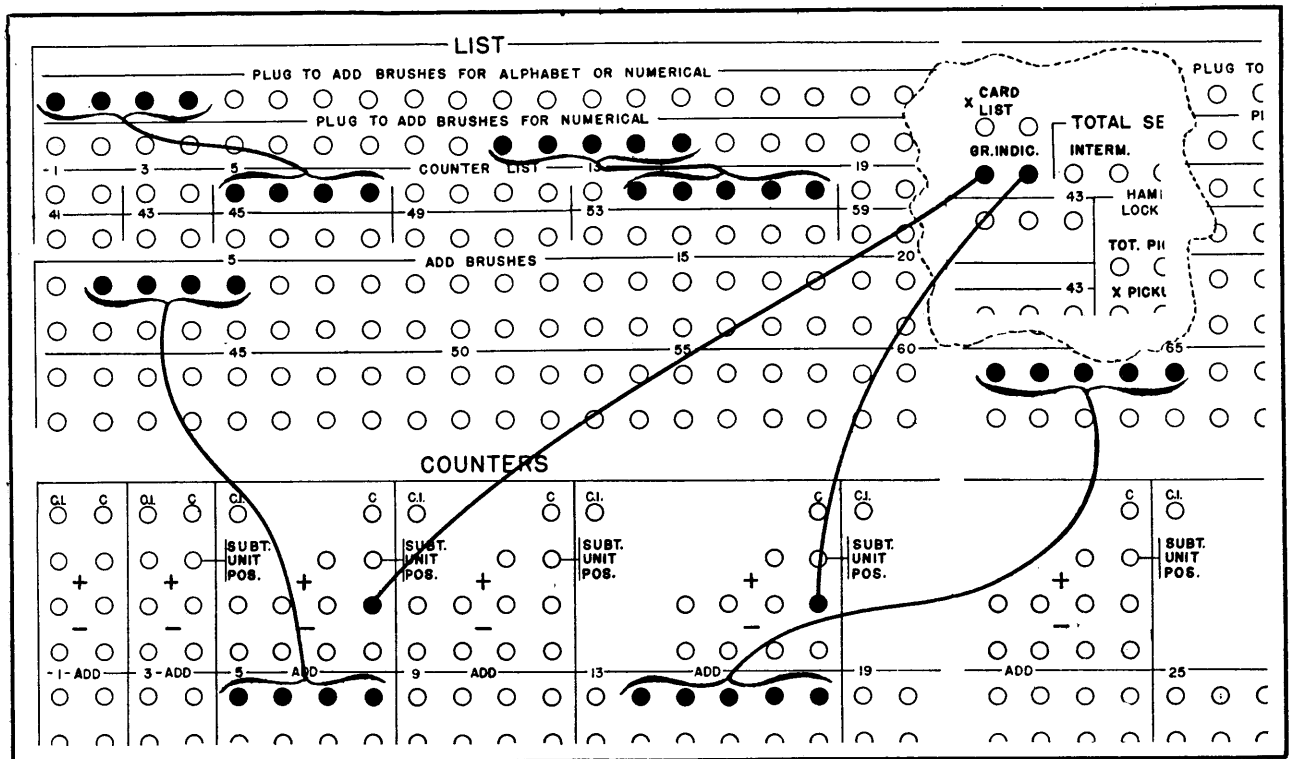
Group Indicating—Non-Repetitive Printing

There are three ways of wiring this machine to effect group-indication or non-repetitive printing of the same punched data—(1) by the use of a "Class, Total or Balance Selection" unit; (2) by controlling the counters with a G. I. impulse; and (3) by the Hammerlock Control Device. Any of the three methods may be used for either alphabetic or numerical data.

To obtain group indication by the use of a "Class, Total or Balance Selection" unit, the Add Brushes are plugged to the "Controlled" row of the selector, the "Common" row of the selector is plugged to the selected type bars of the List section, and the selector is controlled by plugging the "Tot. Cont." to the "Gr. Indic." hub which is located to the left of the X-distributor. The accompanying diagram shows this arrangement for both alphabetic and numerical indication of minor groups. Major or intermediate groups can be group-indicated by plug-



Group Indication



Group Indication—Counter List

ging the "Tot. Cont." to the major or intermediate "Total Selec." hubs. This method of group indication is necessary only for listing operations since in tabulating operations the normal list-indicate cycle of the machine results in the printing of only the first card.

To obtain group indication by counter control, the Add Brushes are plugged to the Add hubs of the particular counter or group of counters to be reserved for this use and the corresponding Counter List hubs are plugged to the desired type bars of the List section. The counter is controlled by plugging from the "Gr. Indic." hub to a + Counter Control hub. This plugging is illustrated in the diagram "Group Indication—Counter List" and may be used for the group indication of either alphabetic or numerical data to be listed.

Hammerlock Controlling

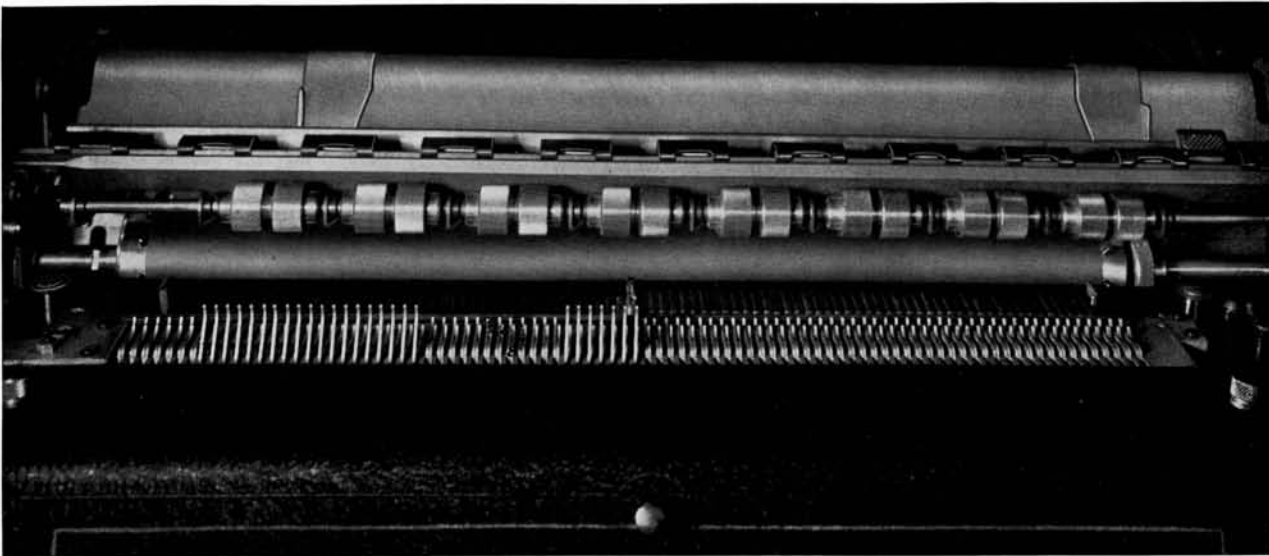
This machine is equipped with Automatic Hammerlock Control which, when properly set, prevents any selected type-bar hammers from operating for certain cycles and allows these same hammers to operate for other cycles. This feature has several important functions. It can be used to prevent repetitive printing of group indications in listing; it can be used for selec-

tion of printing, i. e., it can select certain cards or portions of cards for printing and eliminate all others; it can be utilized for the prevention of the overprinting of indications and totals which normally occurs when a machine is shifted from listing to tabulating without change of plugging.

The mechanism consists of 88 automatic hammerlock levers, one of which is mounted directly to the left of each of the standard hammerlock levers. Thus, for each type bar there are two hammerlock levers—a standard lever which may be set in the usual manner to prevent the hammer from operating, and an automatic hammerlock lever which may be set to prevent the hammer from operating except under those conditions for which it is controlled.

Automatic hammerlocks control printing in any one of four ways according to the method of plugging the "Hammerlock Control" hubs located to the left of the X-distributor. Only those type-bar hammers which are set for automatic hammerlocking are affected by the control—all other hammers operate normally.

1. *X-Punched Card*—If an "X-Pickup" hub of the Hammerlock Control is plugged to a control brush position containing an X, the hammers operate only when an X-punched card



SETTING OF AUTOMATIC HAMMERLOCKS

The type bars corresponding to the raised Automatic Hammerlock Levers will be inoperative except during the machine cycles for which the Hammerlock Control hubs have been wired.

passes the adding brushes. The hammers will not operate and there will be no printing from cards which are not X-punched. Section A illustrates this plugging.

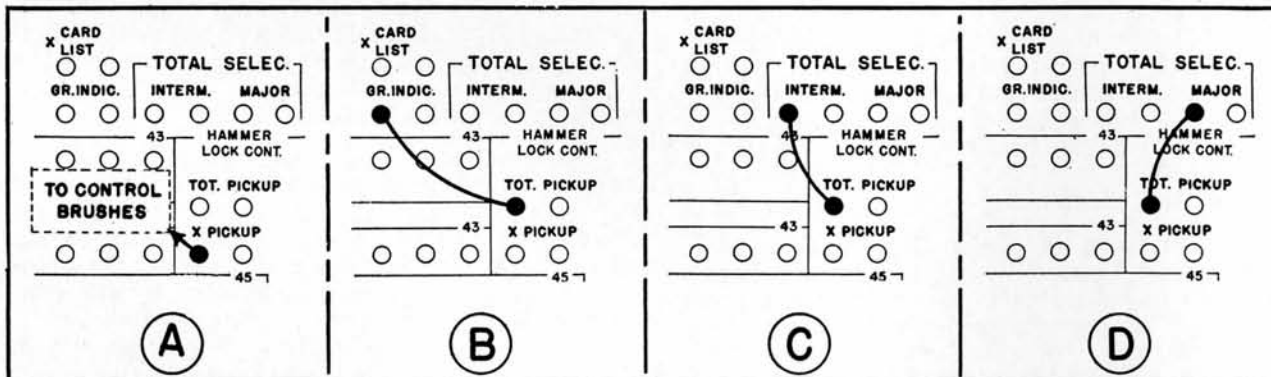
2. *Minor Total*—If a "Tot. Pickup" hub of the Hammerlock Control is plugged to a "Gr. Indic." hub, the hammers operate only when the first card after a minor total reset cycle passes the adding brushes. For all cards following the first in a minor group, the hammers will not operate. See Section B of the illustration.

3. *Intermediate Total*—If a "Tot. Pickup" hub of the Hammerlock Control is plugged to an "Interm. Total Selec." hub, the hammers oper-


ate only when the first card after an intermediate total reset cycle passes the adding brushes. For all cards following the first in an intermediate group the hammers will not operate. See Section C of the illustration.


4. *Major Total*—This plugging is the same as that for Intermediate Total except that a "Major Total Selec." hub is used. See Section D of the illustration.

A Hammerlock Control Switch is provided for reversing the action of all the above controls, for example—an X-punched card or a total impulse can be made to prevent the hammers from operating rather than allowing them to operate.



Hammerlock Control

SALES REPORT		
SALESMAN	COMMODITY	VALUE
JOHN JONES	TIRES	40525
	TUBES	4976
	CHAINS	32519
V A KATZ	PATCHES	3654
	TIRES	65216
	TUBES	15227
B L VERGE	CHAINS	9450
	TIRES	53394
	TUBES	16420
 HAMMERLOCKS SET		46153
		5524
STRAIGHT LISTING		
GROUP INDICATING WITH X-PUNCH CONTROL		



SALES REPORT		
SALESMAN	COMMODITY	VALUE
JOHN JONES	TIRES	40525
	TUBES	4976
	CHAINS	32519
V A KATZ	PATCHES	3654
	TIRES	65216
	TUBES	15227
B L VERGE	CHAINS	9450
	TIRES	53394
	TUBES	16420
 HAMMERLOCKS SET		46153
		5524
		121491*
CONTROLLED LISTING		
GROUP INDICATING WITH MINOR TOTAL CONTROL		

The entire 88 positions of Automatic Hammerlock Control can be governed by only one type of control at one time. It is not possible to control the operation of one group of hammers at one time and another group at a different time—all hammers are controlled simultaneously.

Group indication or non-repetitive printing of the same punched data may be accomplished by setting the desired automatic hammerlock levers and controlling them by either the X-punch or the Total Cycle method. For listing operations without automatic control, the X-punch method of hammerlock control is used. For listing operations with automatic control the Total Cycle method of hammerlock control

is preferable although the X-punch method may be used where convenient. The accompanying Sales Reports show how a report would appear when listed with hammerlocks under X-punch control and when tabulated with hammerlocks under minor total control.

The X-punch method of hammerlock control may be used for printing certain portions of certain cards and eliminating the printing of these same portions of other cards. A typical example of this type of operation is shown in the illustrated Inventory Report where the management does not wish the cost figures of certain items to be printed although they are punched in the tabulating cards. In most listing operations, hammerlock control can be used instead of class selection to cause elimination.

INVENTORY REPORT				
COMMODITY		UNIT COST	QUANTITY	TOTAL COST
CLASS	ITEM			
RADIO	ACME	2350	26	61100
	ETHER	2845	120	341400
	TONONE		65	
	WESTERN	3420	31	106020
IRON	HOTTEX	136	125	17000
	LIBERTY		214	
 GROUP INDICATION THROUGH A SELECTOR		 PRINTING SELECTION BY X-PUNCHED CARD METHOD OF HAMMERLOCK CONTROL		

When a machine which is plugged to list a certain group of cards is shifted to tabulate these same cards, it is necessary either to re-plug the machine or employ hammerlock control to prevent total printing over the first card indication of each control group. The prevention of overprinting is effected by hammerlock control by setting the automatic hammerlock levers for those positions from which totals are printed and using the Minor Total method of hammerlock control with the Hammerlock Control Switch in the reverse position. Thus, upon a first card indication cycle, the hammers which are set will not operate and the space for totals is left blank until total printing occurs.

X-Card Listing

In tabulating operations, the machine can be arranged to list only those cards which have a specific X punched in them, ignoring all others.

The "X Card List" hub, located in the upper right section of the plugboard, is plugged to the control brush of the column containing the X. Cards containing the X punch will be listed. All other cards will pass through the machine without registration, although totals may be accumulated if desired. The carriage advances only after a printing cycle so that no blank spaces occur between the listed items.

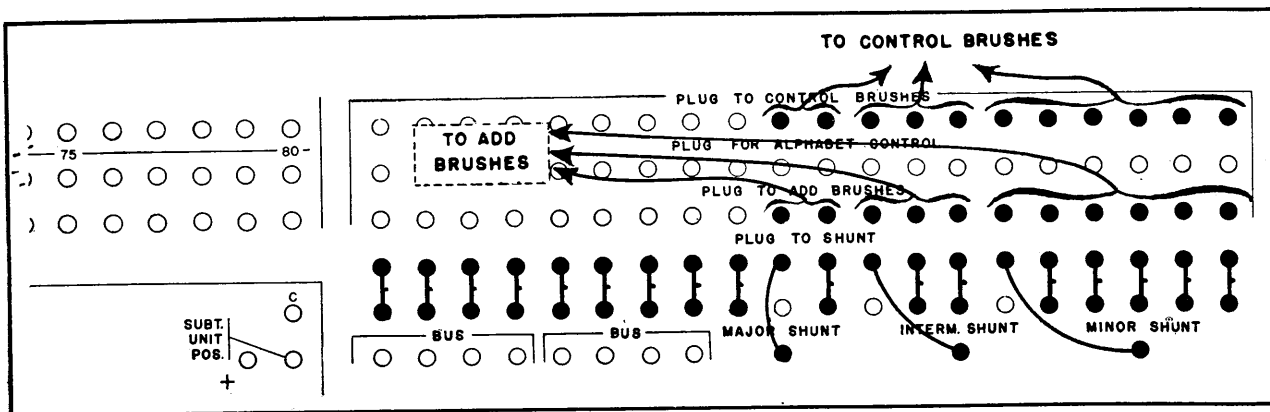
X-card listing can be used with automatic control only in those cases where it is desired to have first card group indication in addition to X-card printing, regardless of whether the first card of a group is X-punched or not.

Automatic Controlling

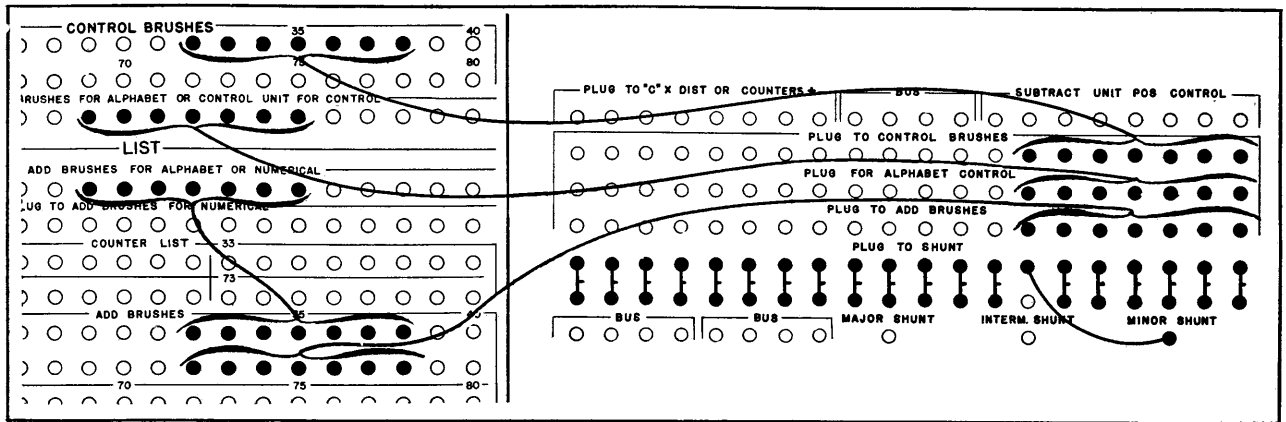
The automatic control in this machine operates from either numerical or alphabetic punched data, or both simultaneously.

For numerical automatic control, the selected Control Brush positions are plugged to the top row of the Control Unit labelled "Plug to Control Brushes." The corresponding Add Brush positions are plugged to the third row of the Control Unit labelled "Plug to Add Brushes." The "Plug to Shunt" section consists of two rows of hubs in which the upper row positions are normally connected to the corresponding lower row positions by two-pronged jack plugs. When plugging the control shunt (Major, Intermediate, Minor) the jack plug directly beneath the left-hand position of the group to be controlled is removed and a plugwire inserted from the required shunt hub to the upper hub of the position from which the jack plug was removed. Each shunt plug so inserted controls all positions to the right, up to the next shunt plug. The plugging for the several classes of automatic control is shown in the accompanying diagram.

For alphabetic automatic control, the Control Unit is injected between the normal plugging for alphabetic zoning. The Control Brush positions are plugged to the top row of the Control Unit labelled "Plug to Control Brushes." The "Plug to Control Brushes for Alphabet or Control Unit for Control" positions to which the Control Brushes would have been connected normally, are plugged instead to the second row of the Control Unit labelled "Plug for Alphabet Control." The corresponding Add Brush positions are plugged to the third row of the Control Unit labelled "Plug to Add Brushes." The shunt plugging is the same as for numerical automatic control. The plugging for alphabetic automatic control is shown in the diagram.



Numerical Automatic Control



Alphabetic Automatic Control

In plugging the machine for combined alphabetic and numerical automatic control, the arrangement for each type of control is as described above. The next diagram illustrates this plugging.

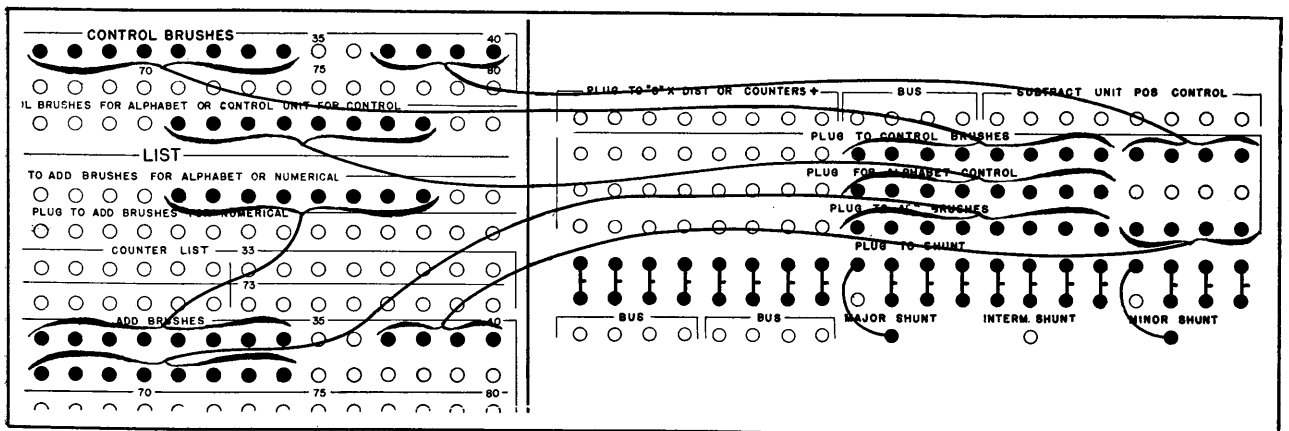
The automatic control unit in this machine is of the "balanced" type and is different from that used on Numerical Electric Accounting Machines. With this type of control unit it is possible to control on unpunched card columns—an essential operation in alphabetic control.

Zero Printing

In this particular model of Alphabetic Accounting Machine, the printing of zeros in both type sections is entirely under control of the hammer split levers (zero suppression levers). There are 88 of these levers, one for each type bar position, enclosed under a cover on the front of the print unit. For printing zeros, each lever

permits the firing action of the type-bar hammer directly to the right of it providing it is set to the depressed position and its own hammer is fired. If a hammer split lever is set to the raised position it does not permit the action of the hammer to the right and a zero cannot be printed from this type bar. Zero suppression between report fields is effected by raising those levers which correspond to the units position of each field.

Numerical Type Section—In this type section, zeros are printed in the usual manner from the automatic mechanical zero position controlled by the hammer splits and actuated by the familiar zero pawl action. Zeros do not print to the left of significant figures and will print to the right only when the hammer splits are all depressed. Zeros print to the right of significant figures regardless of whether the card is punched with zeros or not. The accompany-



Combined Alphabetic and Numerical Control

BILLING AND SALES ANALYSIS

ONE	PRODUCT CLASS	ITEM	UNIT PRICE	GROSS BILLING	DISCOUNT	NET BILLING	CUSTOMER			SALESMAN	DATE		QUANTITY	ALPHABETIC DESCRIPTION
							STATE	CITY	NO.		DAY	MO.		
000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000	000000000000000000000000	
111111	111111	111111	111111	111111	111111	111111	111111	111111	111111	111111	111111	111111	111111111111111111111111111111	
222222	222222	222222	222222	222222	222222	222222	222222	222222	222222	222222	222222	222222	222222222222222222222222222222	
333333	333333	333333	333333	333333	333333	333333	333333	333333	333333	333333	333333	333333	333333333333333333333333333333	
444444	444444	444444	444444	444444	444444	444444	444444	444444	444444	444444	444444	444444	444444444444444444444444444444	
555555	555555	555555	555555	555555	555555	555555	555555	555555	555555	555555	555555	555555	555555555555555555555555555555	
666666	666666	666666	666666	666666	666666	666666	666666	666666	666666	666666	666666	666666	666666666666666666666666666666	
777777	777777	777777	777777	777777	777777	777777	777777	777777	777777	777777	777777	777777	777777777777777777777777777777	
888888	888888	888888	888888	888888	888888	888888	888888	888888	888888	888888	888888	888888	888888888888888888888888888888	
999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999999999999999999999999999	

DATE CARD

SPACE CARD

CITY AND STATE CARD

STREET ADDRESS CARD

NAME CARD

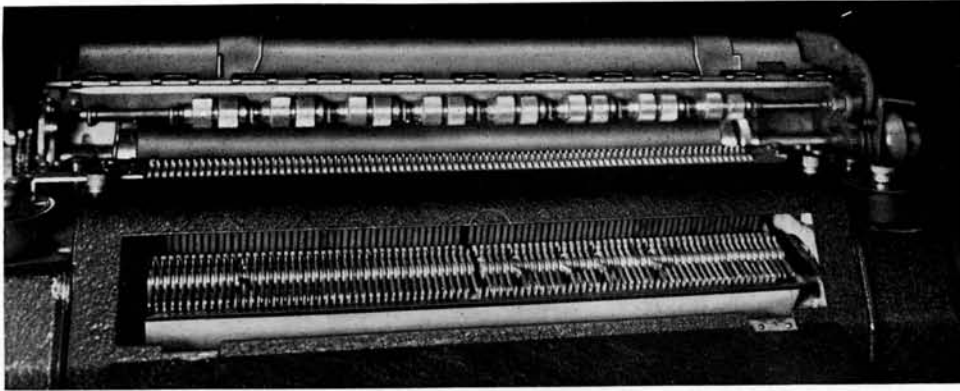
Westom Drug Co.
1400 East 102 Street
Dugansburgh, New York

THE NATIONAL MANUFACTURING CO.

WESTOM DRUG CO
1400 EAST 102 STREET
DUGANSBURGH NEW YORK

DATE BILLED	REGISTER NO.	CUST. ORDER NO.
AUG 24	4301	401

QUANTITY	UNIT	ARTICLE	UNIT PRICE	GROSS AMOUNT	DISCOUNT	NET AMOUNT
5	LB	ALUMINUM CHLORIDE	24	120	6	114
1	OZ	CARBON DISULPHATE TECH	12	12	1	11
5	OZ	COCAINE HYDROCHL USP	650	3250	163	3087



Zero suppression levers set for printing the report shown on the preceding page

ing diagram shows the arrangement of the hammer split levers in the numerical type section to effect the printing illustrated on the report.

Alphabetic Type Section—Punched zeros whether “zoned” or “not zoned,” are not listed in this type section unless the hammer splits are down. Unpunched columns do not print zeros under any conditions. A zero cannot be printed in any position of this type section unless a character is printed simultaneously (or the hammer is fired) in the next bar to the left, and the intervening hammer split is depressed.

In total printing, zeros will print to the right of significant figures only when plugged from the counter totals. There are no automatic mechanical zeros in this type section.

The previous diagram shows the hammer split lever arrangement for printing a typical bill. Zeros do not print between the heading names because these positions are unpunched on the cards. The zeros in the street number print because the hammer splits are down in these positions and the cards are punched. Zeros do not print to the left of significant figures in the item listing because the units position hammer split lever of each field is in the raised position.

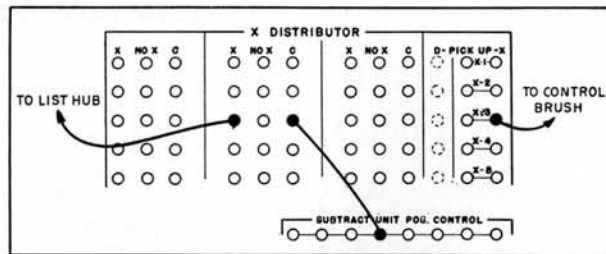
Street numbers, or any other numerical data which might appear in the heading of a bill, must be printed over fields in which the hammer splits are depressed. If such an arrangement is not possible, the letter “O” can be used instead of zero to cause the appearance of zeros in headings.

Note—There is one exception in setting hammer splits to control zero printing. The combination punching of a zero and the number “1” in a card column will cause the type bar to which the column is plugged to print a zero regardless of the position of the hammer split levers. However, there is no such combination punching in the alphabetic code, and if it is used it must be punched manually.

Miscellaneous Functions

Special Character Printing—One special character can be printed from the alphabetic type bars by punching the “12” hole alone. This special character will print only when under control of the hammer splits. In this respect, the control of special character printing is exactly the same as that for zero printing.

Credit Symbol Listing—In straight listing operations, the credit symbol can be printed by plugging from any “Subtraction Units Position Control” hub to an X-distributor “C” hub and from the “X” hub of the distributor directly to the selected type bar of the List section hubs. In this case, the X-punch on the credit cards governs the action of the X-distributor. The diagram illustrates the plugging arrangement.



Credit Symbol Listing

Bus Plugging—Each of the three groups of hubs labelled “Bus” consists of four “commoned” plugging positions. By plugging any type of impulse into one hub of a Bus unit, three outlets for the impulse are made available. Thus, these units can be used to increase the outlet capacity of any of the units of the machine which have a constant type of impulse plugged, or they can be used to “split” impulses in two or more ways. For example, the outlet capacity of the “Subtract Unit Pos. Control” can be increased two positions by plugging one wire to a Bus unit.

Operating Principles

The following paragraphs give a brief, non-technical description of the principles of operation of the major parts of the Alphabetic Direct Subtraction Accounting Machine.

Reading Brushes

Like other International Electric Accounting Machines, this machine is equipped with two sets of card-reading brushes—the upper or “control” brushes and the lower or “adding” brushes. Cards are caused to pass these brushes by a semi-circular feeding mechanism.

The sensing of alphabetic data requires the action of both the upper and the lower brushes. The upper brushes first read the “zone” punching (12, 11 or 0) and the lower brushes later read the lower hole of the punched column to determine the character to be printed. The necessity for this separate sensing of “zone” and “character” punching is made apparent by the following explanation of the alphabetic punching code.

The accompanying illustration shows the four punching zones. The complete code for alphabetic and numerical characters is made up of the numbers from 0 to 9 alone and the numbers 1 to 9 in combinations with 12, 11, and 0. The effect of the upper and lower brush sensings on the action of the alphabetic type bar is described later.

The reading brushes are used also for automatic controlling and, individually, for such familiar functions as supplying card impulses to the counters and X-control impulses to the

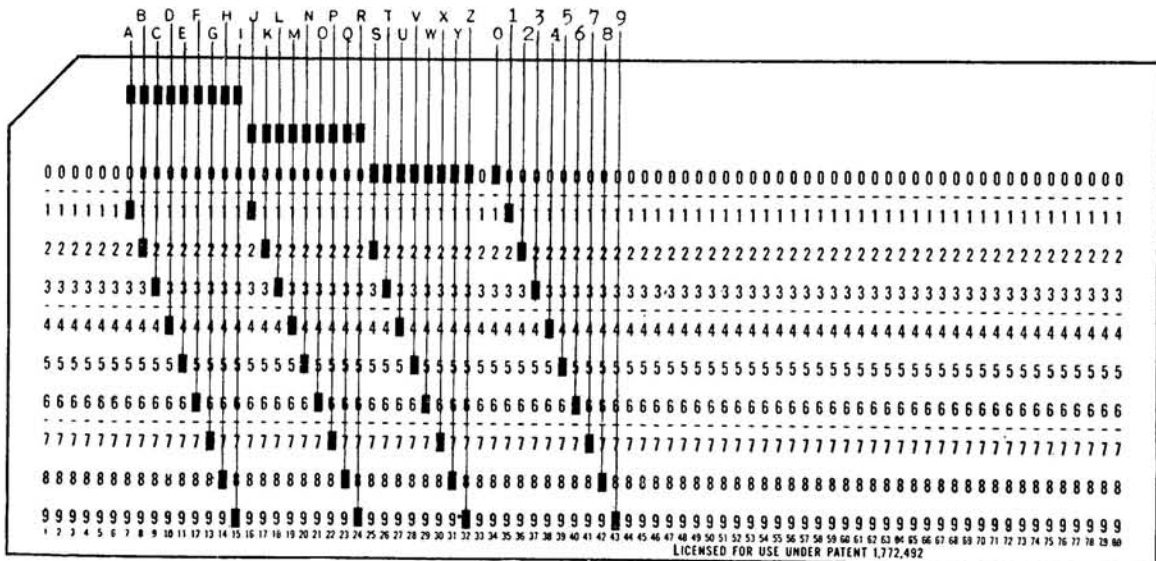
class selectors, X-distributor, etc. Other plugging diagrams and descriptions serve to illustrate and clarify the principles of operation for these functions.

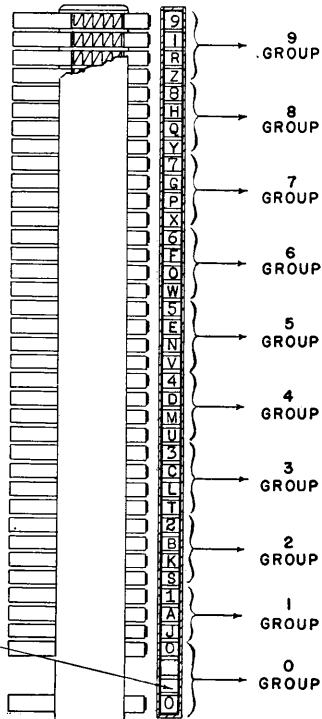
Alphabetic Type Bar

The alphabetic type bar unit consists of two major parts—the outside casing and the inside bar (see diagram). The outside casing is arranged with 10 steps corresponding to the digits of a card column (or counter wheel). The inside bar carries the 37 type characters and is positioned within the casing as shown on the diagram.

At the base of the inside bar there are three steps corresponding to the three zones, 12, 11, and 0. A latch arrangement, governed by the upper brush sensing of the zone hole, positions the inside bar within the casing at one of the four places, 12, 11, 0, or (if no zoning occurs) normal. Zoning occurs at the time a card is at the upper brush station and while the card at the lower brush station is being listed. When the type bar returns to normal the inside bar is positioned within the casing so that when the card is read in the lower brushes, the entire type bar unit rises in the normal manner to a point fixed by the lower hole of the alphabetic code punching.

Thus, zoning determines which character of a group is on the printing line and the lower brush reading determines which group is brought to the printing line. The ten groups and the arrangement of the characters within each group are shown on the diagram.



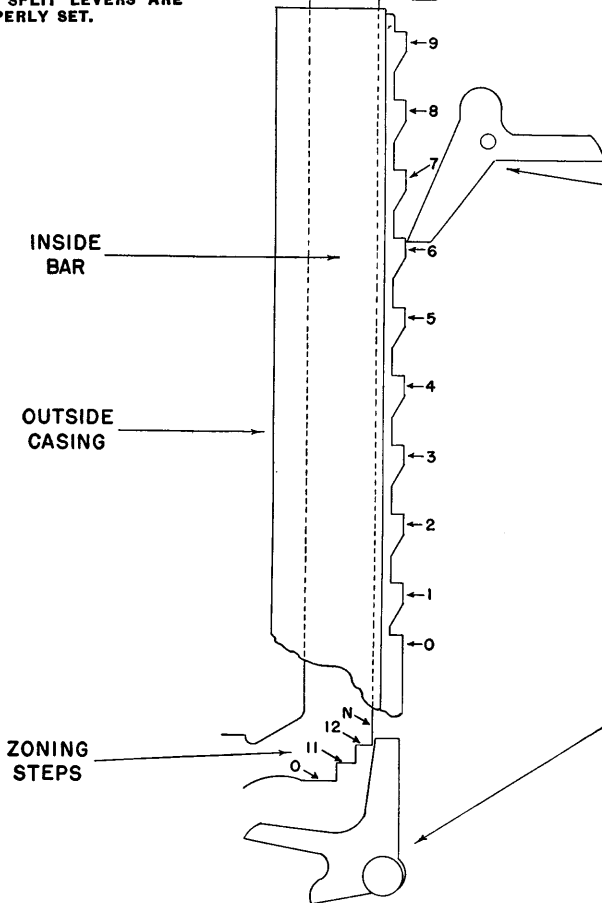


ALPHABETIC TYPE BAR
 SHOWING
 TYPE ARRANGEMENT,
 PRINT MAGNET ACTION
 AND
 ZONE MAGNET ACTION

SPECIAL CHARACTER POSITION
 "12" HOLE ALONE CAUSES SPECIAL CHARACTER TO PRINT PROVIDING HAMMER SPLIT LEVERS ARE PROPERLY SET.

PRINT MAGNET LATCH—THE ACTION OF THIS LATCH IS DETERMINED BY THE ADD-BRUSH SENSING OF THE LOWER HOLE OF THE ALPHABETIC CODE PUNCHING. THE LATCH STOPS THE UPWARD MOTION OF THE TYPE BAR UNIT BY ENGAGING AT A STEP CORRESPONDING TO THE PUNCHED HOLE WHEN LISTING, OR TO THE POSITION OF THE COUNTER WHEEL WHEN TOTAL PRINTING. IF NO IMPULSE REACHES THE PRINT MAGNET, THE TYPE BAR RISES TO ITS HIGHEST POSITION.

ZONE MAGNET LATCH—THE ACTION OF THIS SET-UP LATCH IS DETERMINED BY THE CONTROL BRUSH SENSING OF THE UPPER HOLE OF THE ALPHABETIC CODE PUNCHING. THE LATCH POSITIONS THE INSIDE BAR WITHIN THE OUTSIDE CASING AT ONE OF THE FOUR PLACES 12, 11, 0 OR (IF NO ZONING IMPULSE IS RECEIVED) NORMAL.



INSIDE BAR

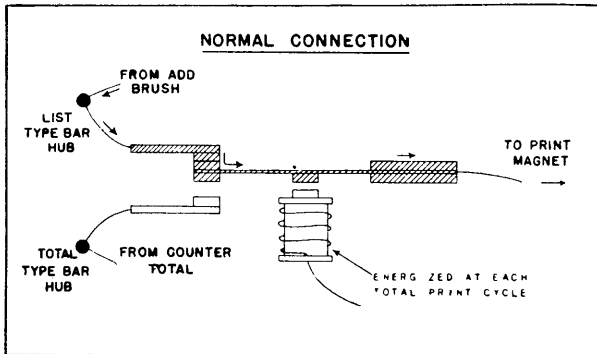
OUTSIDE CASING

ZONING STEPS

List; Total Print Units

The action of each type bar in this machine is governed by impulses coming from two sources—from the list hubs when listing or indicating, and from the total type-bar hubs when total printing. An explanation of how both listed items and totals can be printed from the same type bar is outlined as follows:

The diagram shows a single plugging position of the list unit and the corresponding position in the total type-bar unit, both provided, through a relay, with a connection to the print magnet for that particular type bar.



The normal position of the relay makes a direct connection from the list hub to the print magnet. Thus, all listing whether alphabetic or numerical, is direct from the Add Brushes (or Counter List hubs) to the print magnets.

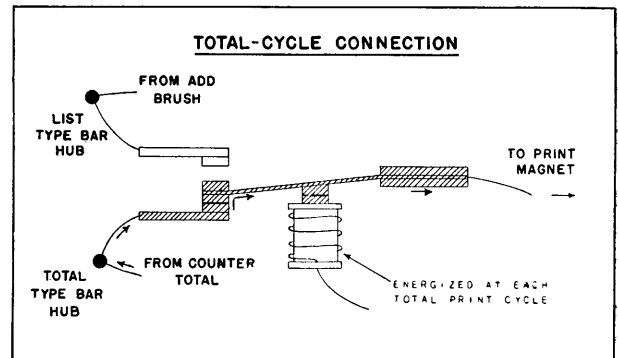
At each total reset cycle, the relay magnet is energized causing the normal connection to be broken and the connection between the total hubs and the print magnet to be made. (See illustration.)

With the relay in the lower position as shown, it is obvious that only the information which is plugged in the total hubs from the counter totals will print.

Counter Operation

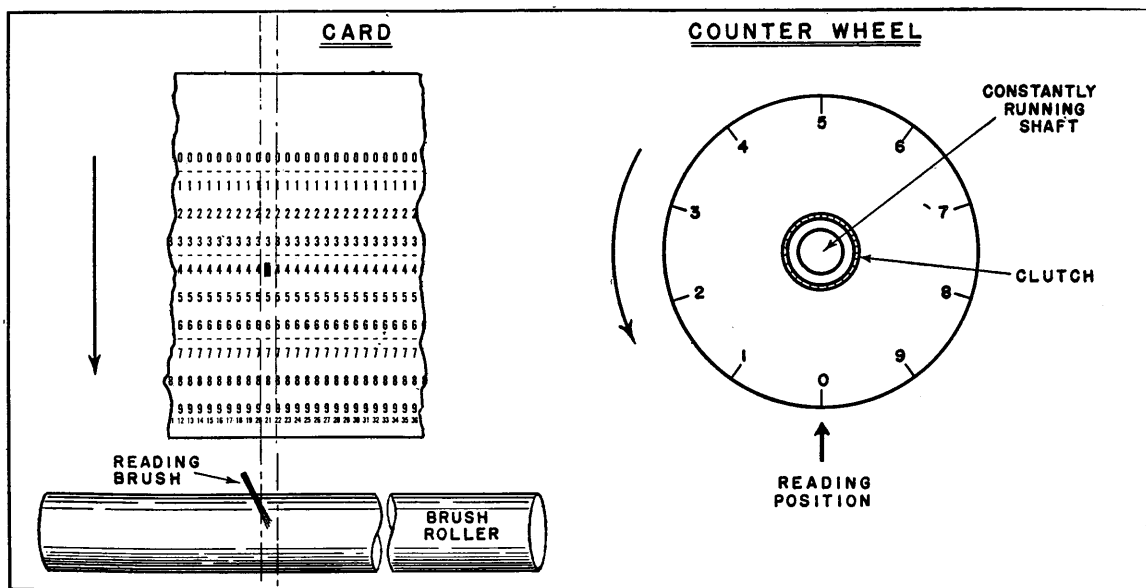
For purposes of explanation, the action of a single counter wheel serves to illustrate the operating principles of a counter.

Adding—The objective in adding is to have the counter wheel advance the number of points indicated by the digit punched in the column of the card being read. The diagram



shows a card about to pass the adding brushes. At the right of the illustration is a diagrammatical sketch of the counter wheel corresponding to the card column being read.

A definite relation exists between the positions of a single card column and the positions of the counter wheel—a card movement of one position (passing the adding brush) is equivalent to a wheel movement of one position. Each



movement of one position, either on the card or the counter wheel, is termed a "point."

In adding, the presence of a punched hole in the card column causes a clutch "throw-in" magnet to engage the wheel clutch at the instant the hole reaches the brush. The clutch remains engaged until the "0" position of the card reaches the brush, at which time a disengagement occurs automatically. Thus, if a "4" is punched in the card, the wheel advances four points, one point for each position remaining on the card after the "4" (3, 2, 1, and 0).

The principle of addition may be summed up briefly as follows—a punched-hole sensing causes a clutch *engagement* which advances the counter wheel one point for each point *remaining* on the card. (Carryovers are electrical and may be disregarded at this point.)

Subtracting—Subtraction is performed by the familiar method of adding the complement of the punched number. This is accomplished automatically by causing the wheel clutch to engage the moment the "9" position of the card reaches the brush, and to disengage when a punched hole is sensed. Thus, with a wheel movement of one position for each position preceding the punched hole, the complement of the punched number is added automatically; for example, if a "4" is punched in the card, the wheel advances 5 points, one for each position on the card preceding the "4" (9, 8, 7, 6, and 5).

The principle of subtraction may be summed up briefly as follows—a punched-hole sensing causes the *disengagement* of the clutch which had advanced the counter wheel one point for each point *preceding* the punched hole on the card.

Subtracting—Units Position Wheel—When using automatic complements to perform subtraction, the units position wheel of a counter must register the difference between 10 and the punched number. To accomplish this, the units wheel clutch is arranged, by plugging, to engage automatically at one point ahead of "9" on the card. This point is arbitrarily called 10.

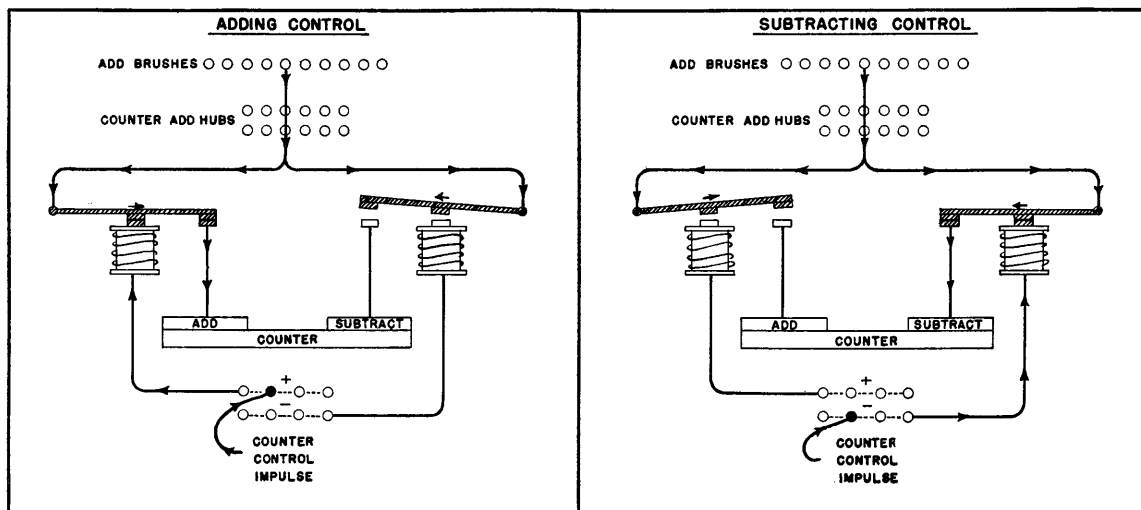
Assuming that a "4" is punched in the card column which is plugged to the units position of a counter, the wheel advances 6 points, one for each position on the card preceding the "4" (10, 9, 8, 7, 6, and 5).

Since the units position of a counter cannot be fixed because of the flexibility of counter coupling, the plugging of the "Subtraction Units Position Control" is necessary to cause the automatic subtraction from 10.

Counter Control Unit

The addition, subtraction, or elimination of different classes of cards in a subtraction counter is determined by a counter control impulse which is plugged from the "Plug to 'C' X-Dist. or Counters +", if all cards are to be added in the same way, or from the X-distributor, if different classes of cards are to be treated separately. The accompanying diagrams illustrate how the control impulse, when properly plugged to the "add" (+) or "subtract" (−) side of the counter control, causes addition or subtraction. Failure to plug the control impulse to either side of the counter control results in elimination.

A control impulse is available at every machine cycle. This impulse reaches the counter control at each cycle if the plugging is from



the "Plug to 'C' X-Dist. or Counters +" hubs but only upon the passing of a properly X-punched card when the plugging is from the X-distributor.

When the control impulse comes from the X-distributor, it has been previously "class-selected" according to the principles set forth in the following paragraphs.

Individual X-Distributor

The Individual X-Distributor is a device used for the purpose of selecting counter control impulses so that different classes of cards may be added, subtracted, or eliminated by the counter. It consists of five groups of three position class selection relays which operate as follows:

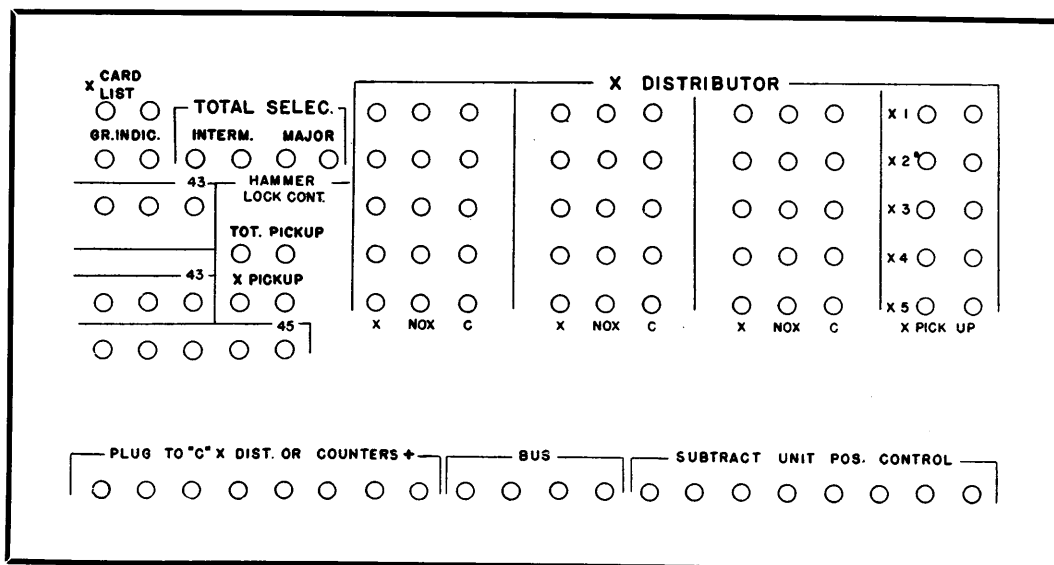
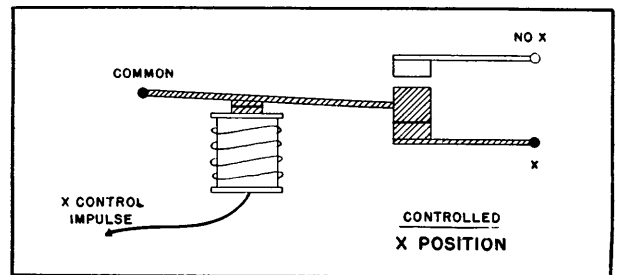
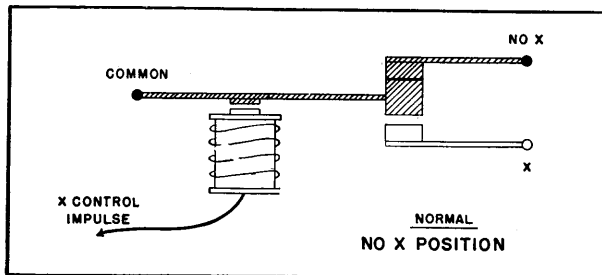
In each relay a spring action normally holds the "common" and "No-X" contacts together.

The entry of a properly X-punched card energizes the relay magnet and causes the contact between Common and No-X to be broken and the contact between Common and X to be made.

Thus it is obvious that this device employs the familiar principle of ordinary class selection.

The following illustration shows the plug-board arrangement of the X-distributor. The hubs labelled "Plug to 'C' X-Dist. or Counters +" are the outlets for the counter control impulses which are to be selected. The double hubs marked X-1, X-2 etc., are the inlet hubs for the X-plugging from the Control Brushes. (The double hubs for each X are common and are furnished for multiple plugging.) Each X hub controls all three of the individual selectors to which it is assigned.

At every card cycle a counter control impulse is available automatically at all of the "Plug to 'C' X-Dist. or Counters +" hubs. By plugging from any one of these hubs to the common position of any one of the individual class selectors, it is possible to direct the impulse in either one of two ways—one from the X and one from the No-X position. The presence or the absence of an X-punch in the card determines which path the counter control impulse takes.



Switches

The switch panel is located at the left end of the machine directly above the automatic plug-board. The function and operation of each switch is described as follows:

Hammerlock Control Switch

This switch is used only when hammerlock control is employed. When thrown to the "No X-Sup." position, the printing of all No-X cards (or all but the first cards of selected control groups) is suppressed. When thrown to the "X-Sup." position, the printing of X-punched cards (or first cards of selected control groups) is suppressed.

Automatic Start Switch

This switch, when ON, causes the machine to start automatically after taking totals. When OFF the machine stops after taking totals.

Automatic Total Switches

These switches are used for arranging the machine to take totals automatically as follows:

Last Card—When ON, the machine takes a total automatically after the last card of a non-controlled tabulation passes through the machine. When OFF, such a total is held in the counter until manually cleared.

Intermediate or Major—When ON, the ma-

chine takes a total automatically at every intermediate or major control change. When OFF, the machine stops at each intermediate or major control change and totals are held in the counters until manually cleared.

Minor—When ON, the machine takes a total automatically at every minor control change. When OFF, the machine stops at each minor control change and totals are held in the counters until manually cleared.

Final Total Switch

This switch is used only for taking final totals manually. When ON, final totals can be taken manually. When OFF, final totals cannot be taken.

Automatic Control Switches

These switches are used for arranging the machine for automatic control.

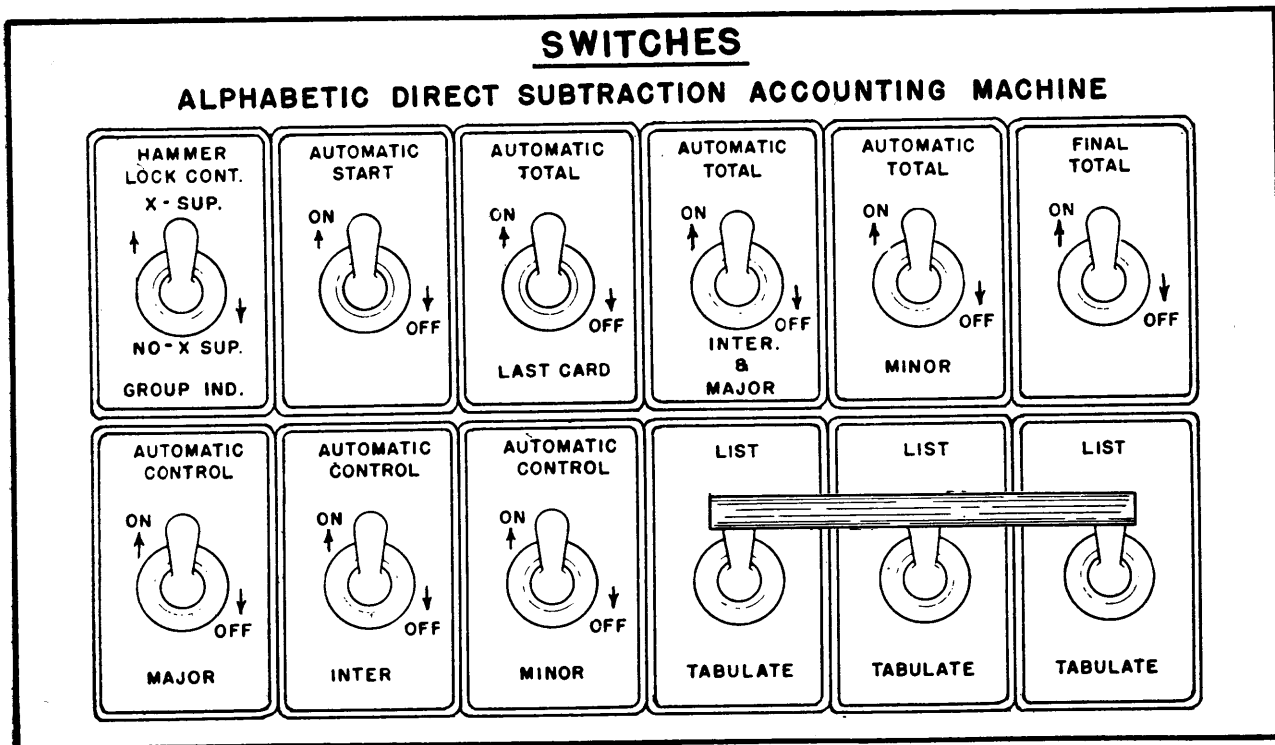
Major—When ON, causes the machine to break control at major changes. When OFF, the machine ignores such changes.

Intermediate—Same as above for intermediate changes.

Minor—Same as above for minor changes.

List—Tabulate Switch

This switch is used to arrange the machine for listing or tabulating as required.



Capacities

The Alphabetic Accounting machines are manufactured in two basic models—one having 88 printing bars and the other having 55 print-

ing bars. The variations in these two models are summarized in the following chart containing their comparative features.

Standard Features of Type 405 Alphabetic Accounting Machines

FEATURES	88-TYPE-BAR MACHINES	55-TYPE-BAR MACHINES
Cards	80 Column only	80 Column only
Print Unit Capacity	43 bars—Alphabetic and Numerical 45 bars—Numerical only	25 bars—Alphabetic and Numerical 30 bars—Numerical only
Counters	56 or 80 Counters ("+" and "-" counter control)	32 Counters ("+" control only) or 32 Counters ("+" and "-" counter control)
Counter Grouping	56 counter— 4 two-position counters 4 four-position counters 4 six-position counters 1 eight-position counter. 80 counter— 4 two-position counters 4 four-position counters 4 six-position counters 4 eight-position counters	Any combination of counters selected from those listed below which totals thirty-two. 2 two-position counters 2 four-position counters 2 six-position counters 2 eight-position counters
Automatic Control	20 positions	10 positions
Group Indication	Standard	Standard
Class, Total, and Balance Selection	4 of ten positions each	None with adding counters 1 with "+" and "-" counter control
Speed	80/80 or 80/150	80/80 or 80/150
Current	110 or 220 volts AC or DC	110 or 220 volts AC or DC
Reset Time	.75 second	.75 second
Automatic Plugboards	2 manual (standard)	1 manual (standard)
Carriage	Standard 20"	Standard 20"
X-Distributor	Individual type Five three-position units	Individual type Five three-position units

Special Devices for Alphabetic Accounting Machines

Digit Selector

The digit selector for Alphabetic Accounting Machines is a special device by means of which such units as class selectors, X-distributors, hammerlock control, etc., which are normally X-controlled, may be controlled by any desired punched digit (or digits) of a card column. The installation of this device also makes possible the field selection of alphabetic data.

The device is represented on the plugboard by a pair of "D. S. C." (digit selector common) hubs and twelve pairs of "digit" hubs. The operation of the device is the same as that described for the digit selector for numerical accounting machines.

Each class selector, X-distributor, hammerlock control and X-card list unit is provided with special pick-up hubs, designated "D" (digit pick-up), which permit control of the units by any digit. These special hubs are in addition to the regular X and Total Pick-up hubs which permit control of the units in the normal manner. A "U. C. I." (upper constant impulse) is provided also to supply a constant impulse from the upper brushes when required.

A constant impulse from the lower brushes, such as is necessary for dating, is available from the "Plug to C" hubs. For the field selection of alphabetic data, a pair of special pick-up hubs labeled "Z. F. S." (zone field selection) is provided with each class selector.

Progressive Totals

Any counter group or groups on the Alphabetic Accounting Machine can be arranged for progressive totalling. Twelve-position multi-contact relays are supplied for this purpose. Each relay unit has the capacity for handling progressive totals on 12 counter positions, these positions to be made up of any counter groups specified. A progressive total dial switch is provided in order that the counters may be set easily for either normal or progressive totalling operations.

One dial switch controls all progressive total counter positions. Progressive totals for any number of counter positions can be supplied in units of twelve positions each. Thus, for progressive totals on from 1 to 12 counter positions, one relay unit is required; on from 13 to 24 counter positions, two relay units are required, etc.