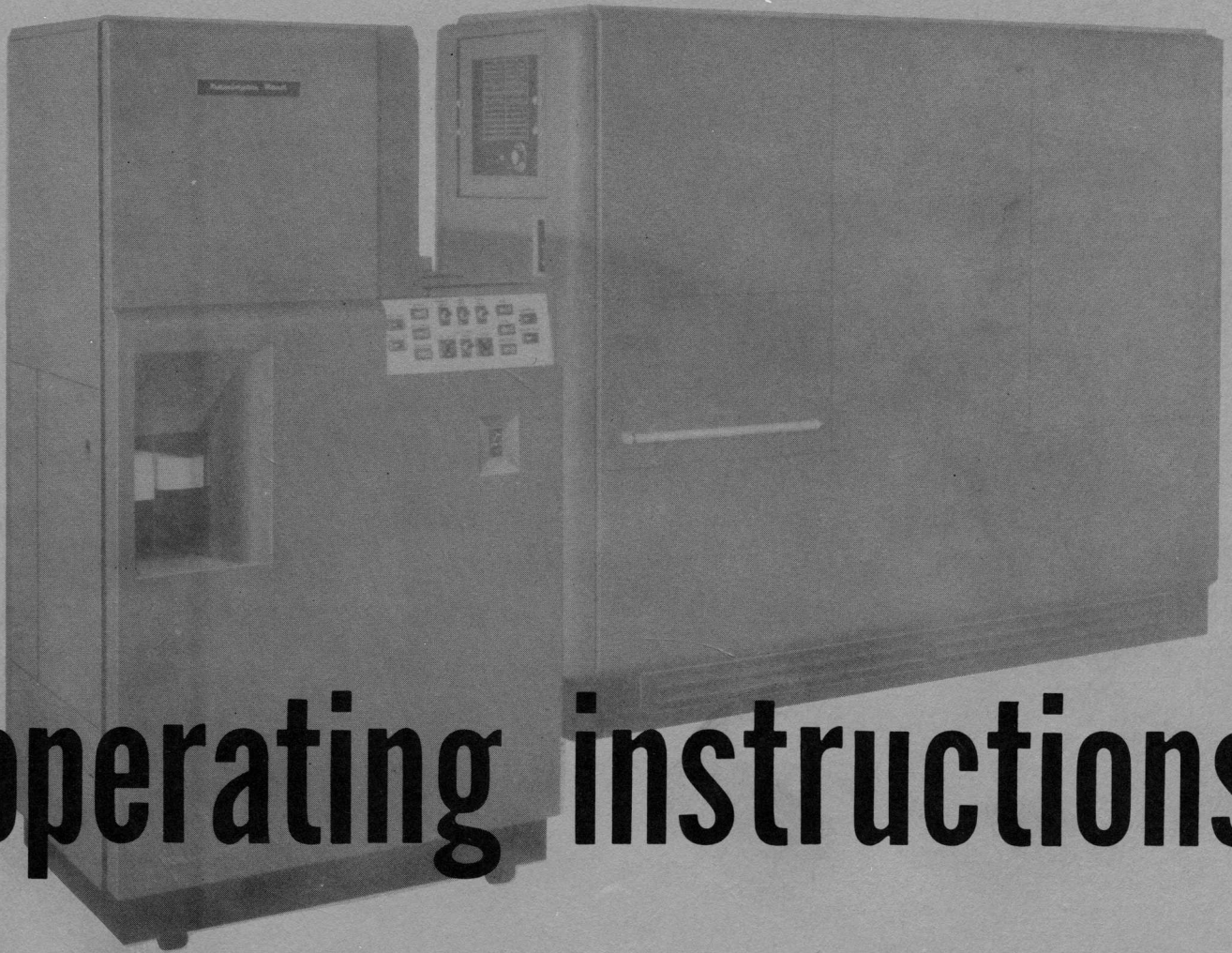


UNIVAC

**60
AND
120**

**PUNCHED-CARD
ELECTRONIC
COMPUTERS**



operating instructions

Remington Rand punched-card accounting machines

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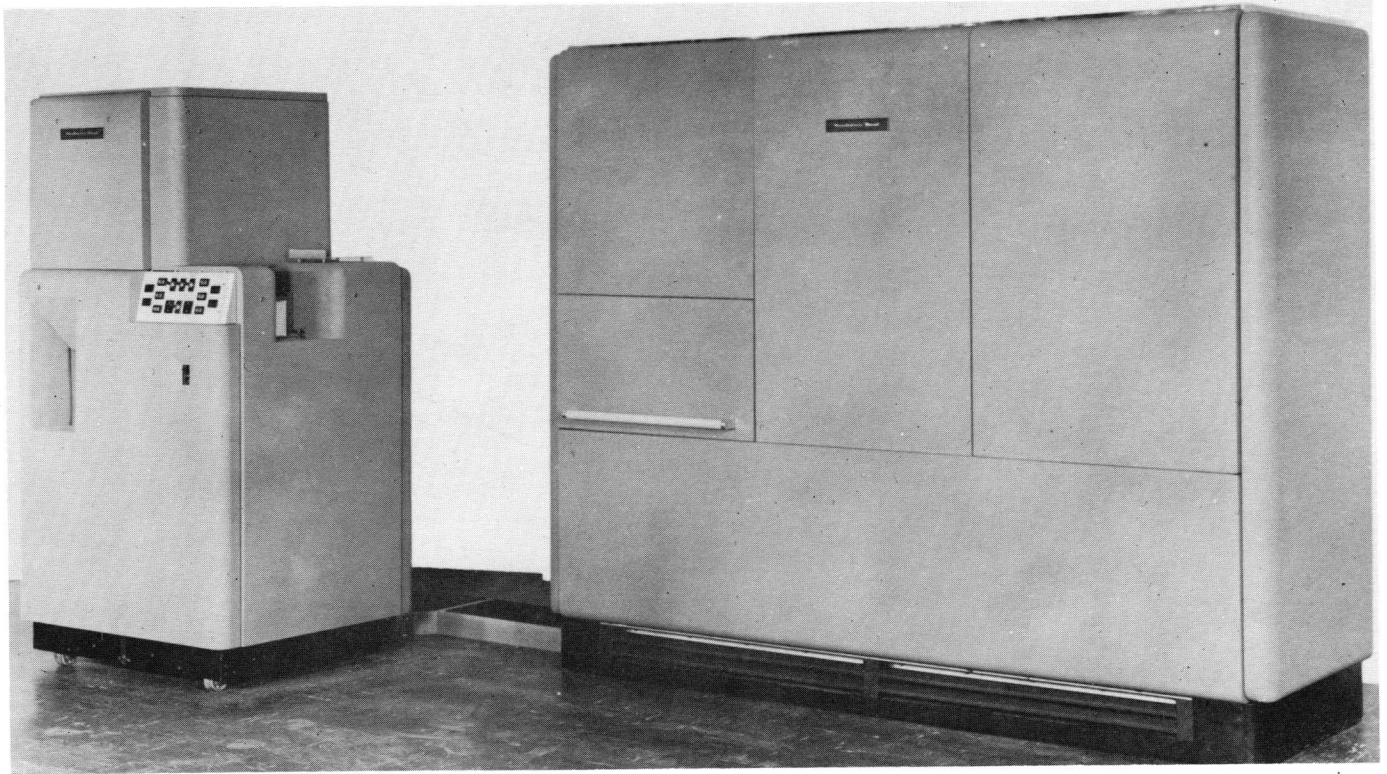
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Punched-Card Electronic Computer

Univac 60 & 120

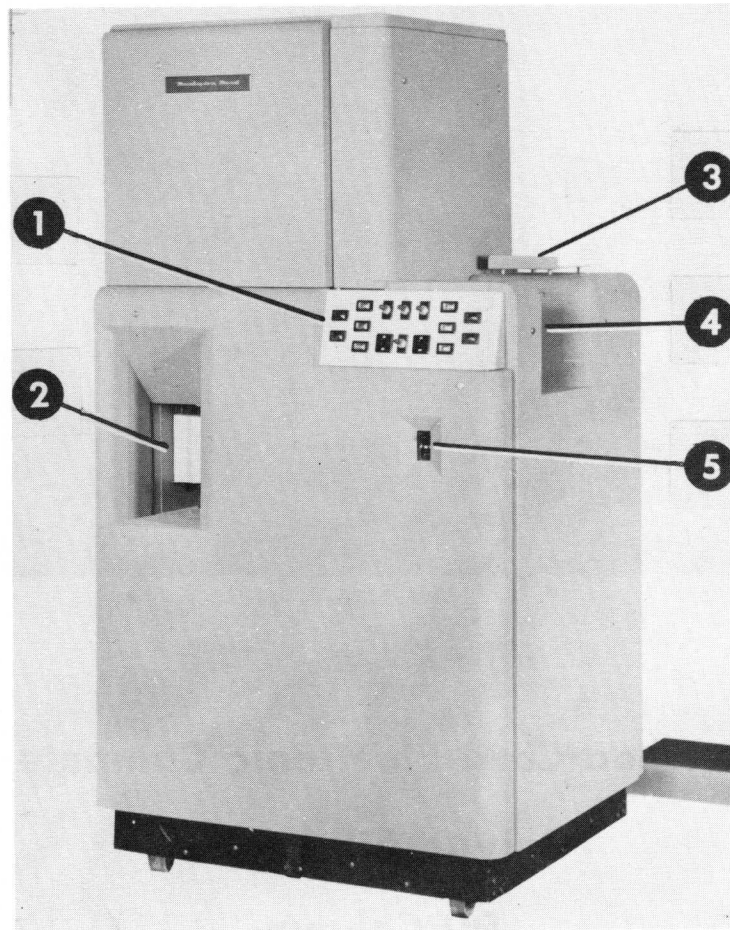
90-Column

This writeup covers the maximum capacities of the Univac 120 Punched-Card Electronic Computer.



CONTROLS and FEATURES

Indicated below are the principal controls and features of the Card Sensing-Punching Unit of the Punched-Card Electronic Computer.

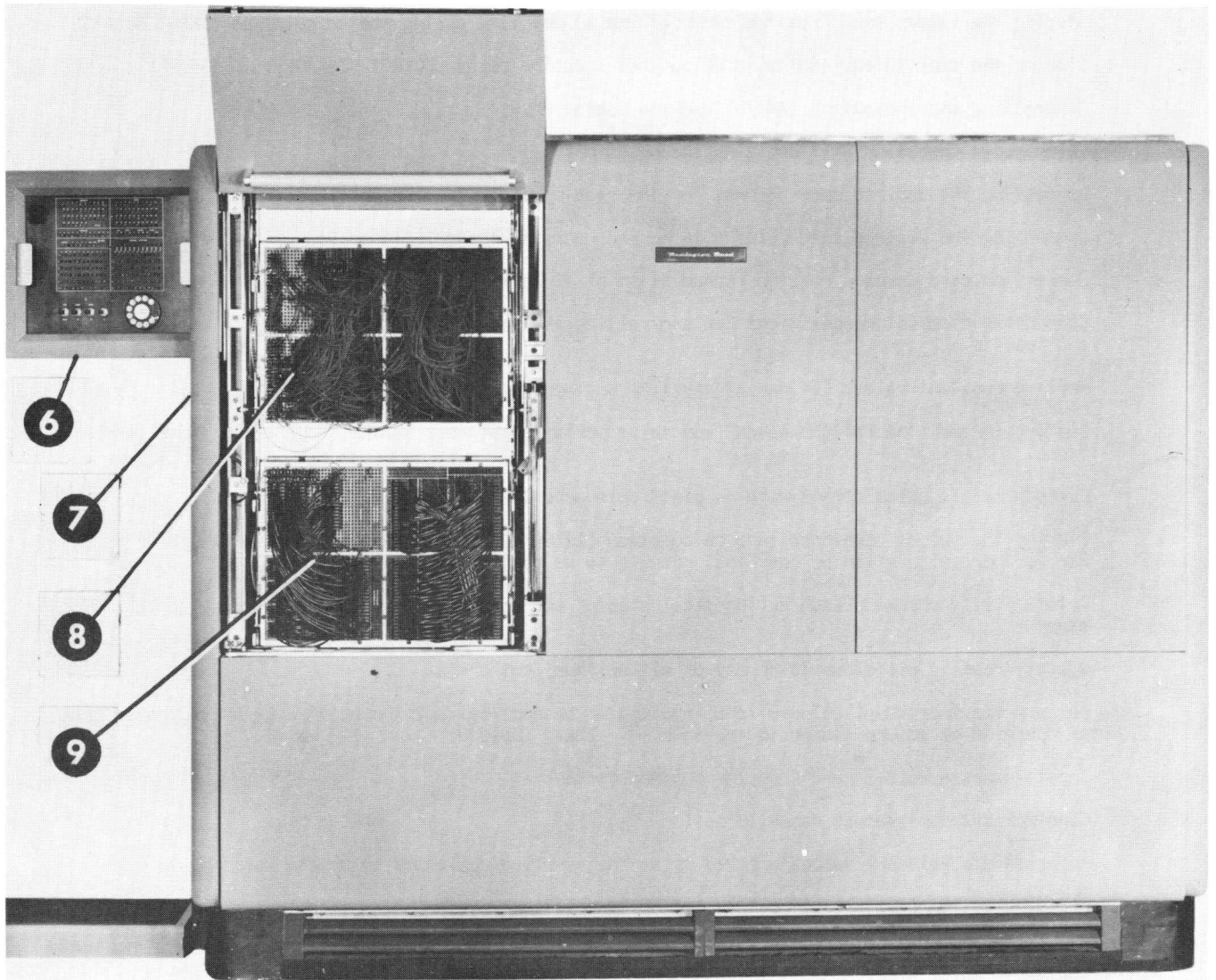


1. Control Panel
2. Card Receivers
3. Card Stacking Tray
4. Card Feeding Magazine
5. Power Switch



CONTROLS and FEATURES

Indicated below are the principal controls and features of the Electronic Computing Unit of the Punched-Card Electronic Computer.



6. Program Test Panel
7. Computer On-Off Switches (on side of machine)
8. Constant & Program Panel
9. Input & Output Panel



PURPOSE

The Punched-Card Electronic Computer performs the arithmetical operations of addition, subtraction, multiplication and division with values sensed from punched cards or values manually set into the machine. The results of these operations are then punched into the same card from which the values were obtained or into any desired following cards.

The Punched-Card Electronic Computer consists of two units electrically connected:- the Card Sensing-Punching Unit; the Electronic Computing Unit.

The Card Sensing-Punching Unit contains the means of:

Feeding the cards for sensing and punching purposes.

Storing the values read from the card for use at any time during the calculation (INPUT STORAGE).

Storing the calculated results to be punched into the cards (OUTPUT STORAGE).

Controlling and indicating general machine operation.

The Electronic Computing Unit contains the means of:

Connecting the desired card columns for the reading of punched values into the machine (INPUT).

Connecting the desired card columns to be punched with the calculated values (OUTPUT).

Connecting card columns for the reproduction of alphabetical and numerical information.

Connecting card column positions for controlling the operation and for indicating negative values and results.

Setting constant values for use at any time during the calculation (CONSTANT STORAGE).

Setting the machine for the operations to be performed as well as the sequence of these operations.

Performing all calculations with an electronic accumulator.

Storing the values developed in a calculation (INTERMEDIATE STORAGE). These values to be used for further calculation or for final results to be punched in the cards.

Automatically checking each arithmetical step of each calculation before proceeding to the next step.

Visibly reading all elements of any or all arithmetical steps.

To perform the individual calculations involved in an application, the Punched-Card Electronic Computer operates on values stored in the machine. These include:

Input Values - Values read from the punched cards.

Constant Values - Values manually set.

Intermediate Values - Values arrived at as the result of calculation by the machine.

In arriving at the final result or results of an application, the machine follows a pre-planned course of operation, called a PROGRAM. The individual elements of a Program are PROGRAM STEPS.

During one Program Step, the following operations are performed:

1. The two values to be calculated are selected. These may be any combination of Input, Constant, or Intermediate Values.
2. The desired arithmetical calculation is performed.
3. The result is stored in the desired Intermediate Storage Unit.
4. The accuracy of the calculation is checked.



5. The next Program Step or operation is selected.

The machine provides for 40 of these Program Steps. They may be used in any numerical sequence desired. Furthermore, one Program Step or series of Steps can be re-used or repeated as often as required in any calculation.

Each of the 40 Program Steps is an arithmetical operation or PROCESS (addition, subtraction, multiplication, or division) performed through the use of an EQUATION to obtain a RESULT; ($V1 + V2 = R$, $V1 - V2 = R$, $V1 \times V2 = R$, $V1 \div V2 = R$).

Furthermore, the machine performs such Operational Steps as; Set, Sort, Program Select, Clear, Skip, and Trip.

Provision is included for the selection of different series of Program Steps or routines within one Program in accordance with the requirements of a particular card or the results developed in a preceding Program Step.

The electronic Accumulator used to accomplish all calculations has a capacity of 22 Counters. This accumulator is capable of operating on two ten digit values to arrive at a result of ten significant digits together with the sign (plus or minus) of the result.

The basic capacity of a field of Input, Constant, Intermediate, or Output Values, as far as the Accumulator is concerned, is ten columns of digits. These basic ten columns are termed, the ACCUMULATOR COLUMNS. They are identified by number from 1 through 10 starting at the right end column, thus:

10, 9, 8, 7, 6, 5, 4, 3, 2, 1

When the Accumulator has operated on two values and produced a result, that result is immediately delivered to an Intermediate Storage Unit; the Accumulator is cleared ready for the next calculation.

Negative values entering the machine as Input or Constant Values and leaving the machine as Output Values are true values. Input and Output Values may be made constantly negative or be either positive or negative as determined by the absence or presence of related control punching. Negative Output Values are identified by the punching of a related identifying position.

The two ELEMENTS acted upon in the Equation of a Program Step to arrive at the Result may be any combination of Input, Constant, or Intermediate Values. The machine provides for a total of 48 Elements as follows:

12 from Intermediate Storage. These are identified as S1 through S12.

36 which may be from; Input Storage only, from Constant Storage Only, from both Input and Constant Storage. These are identified as N1 through N36.

The Punched-Card Electronic Computer provides for the following capacities:

Input Storage - 90 columns; one for each column of a 90 Column card.

Input - 120 columns from the 90 columns of Input Storage.

The Input is grouped into 12 identical Units of 10 columns each - each Unit related to Accumulator Columns 1 through 10.

These 120 columns of Input will accommodate as many as 36 Elements or individual Input Values varying in size from one digit to 10 digits.

Constant Storage - 108 digits. These digits may be grouped into as many as 36 Elements or individual Constant Values of from one to 10 digits.

Intermediate Storage - 12 Units of 10 columns each - each Unit related to Accumulator Columns 1 through 10.

Output Storage - 90 columns; one for each column of a 90-Column card.

Output - 120 columns for the 90 columns of Output Storage.

The Output is from the twelve, 10-Column Intermediate Storage Units, for the punching of the 10-digit (maximum) results.



The Input Values are retained in the Input Storage from the time a card is sensed until the next card is fed into the Sensing Section. At any time during this interval, any one or two of the values thus stored may be called upon in a Program Step as one or both of the Elements used to perform the calculation on that Step.

Constant Values are established and stored in the machine by means of Connection Panel wiring. They will remain available until the wiring is changed. One or two of the values thus stored may be called upon at any time in a Program Step as one or both of the Elements used to perform the calculation on that Step.

An Intermediate Storage Unit has the ability to retain the value entered into it from the Accumulator indefinitely until changed or cleared, provided the proper operating voltage is maintained. A value in an Intermediate Storage Unit is changed by reading in a new value from the Accumulator; the new value completely replaces the old. Values in selected Intermediate Storage Units may be erased leaving those units at zero by means of an operation called "CLEAR".

As long as a value remains in an Intermediate Storage Unit, it may be used as an INTERMEDIATE VALUE to be called on as an Element in a Program Step to perform the calculation on that Step or, by an operation called "SET", be entered into Output Storage as an OUTPUT VALUE for punching into the cards. Once the value in an Intermediate Storage Unit has been Set, that value may continue to be used as an Intermediate Value or the Unit may be used to receive a new result to act as an Intermediate Value.

The Decimal point of each Input, Constant, Intermediate, and Output Value is manually set by means of Connection Panel Wiring. The machine provides for automatic decimal alignment in all calculations.

The Punched-Card Electronic Computer will REPRODUCE alphabetical and numerical information into any of the 90 card columns. Information sensed from one card may be reproduced into the following card or cards. Information sensed from one card may be reproduced into other columns of that card as well as into the following card or cards. Supplemental reproducing (SECONDARY REPRODUCE) information may be sensed from following cards to be reproduced together with the primary reproducing information into following cards. The reproducing operation is entirely under the influence of control punching.

The punching of all information in a card may be automatically prevented.

The machine is signalled to START the Program Steps from individual cards automatically. By means of control punching, the Program may be initiated at any Program Step.

Any card not requiring calculation is quickly fed through the machine at the high card feeding speed by connecting the Start to the Trip.

The Program proceeds from Step to Step by means of an operation called "BRANCHING". The sign (plus or minus) of the result of one Program Step instructs the machine of the next action to be taken. This action may be; to proceed to another Program Step; to perform an Operational Step such as Sort, Set, Clear, or Trip.

Two Card Receivers permit the segregation of the cards fed through the machine. Individual cards, either because of their nature or because of results produced during the Program, may be automatically signalled to be separated from the balance of the cards by means of an operation called "SORT".

The Card Sensing-Punching Unit is automatically signalled to "TRIP" (Punch and Eject) the calculated card at the end of the Program. The Trip operation automatically causes the machine to revert to the selected first step of the Program. Upon receiving the starting signal, the Program will begin for the new card.

Twenty, 4-Column and 16, 1-Column Selectors are provided to add countless variations to all the machine operations, functions, and Program routines. The Selectors are operated by card control or automatically (PROGRAM SELECT) from impulses received during the Program Branching. Selectors may be operated for the duration of the controlling impulse or held for as long as desired following the initial controlling impulse.

The entire machine performance for individual applications is obtained through, and is under the influence of Connection Panels. Two Connection Panels are used; both are installed in the Electronic Computing Unit. These Connection Panels are called; the Input & Output Panel, the Constant & Program Panel.



By means of these removable panels, all phases of machine operation may be varied from application to application to meet the individual requirements. The operator may rewire these panels as required for individual applications or the operator may readily install a panel prewired for the application.



BASIC SPECIFICATIONS

General

The Punched-Card Electronic Computer is designed for 90-Column Numerical and Model 3 Alphabetical Code application.

CAPACITIES

The maximum capacities of the Univac 120 Punched-Card Electronic Computer are described in this writeup.

The difference between the Univac 60 and the Univac 120 machines is in the Input, Intermediate Storage, and Output capacities. With the Univac 60, these capacities are 60 columns each. With the Univac 120, these capacities are 120 columns each.

The two machine types are furnished at "basic" capacities, less than the maximum, with the ability to increase the capacity to the maximum through the inclusion of expansion increments as outlined in the following charts.

Univac 60			
Features	Basic Computer Capacities	Expansion Increment Units	Maximum Capacities
Program Steps	20	8 & 12	40
Elements	12	12	36
Selectors	10 - 4-column 8 - 1-column	9 (5 - 4-column & 4 - 1-column)	20 - 4-column 16 - 1-column
Constant Digits	27 columns	27 & 54	108 columns
Input	60 columns	-----	60 columns
Intermediate Storage	60 columns	-----	60 columns
Output	60 columns	-----	60 columns

Univac 120			
Features	Basic Computer Capacities	Expansion Increment Units	Maximum Capacities
Program Steps	20	8 & 12	40
Elements	12	12	36
Selectors	10 - 4-column 8 - 1-column	9 (5 - 4-column & 4 - 1-column)	20 - 4-column 16 - 1-column
Constant Digits	27 columns	27 & 54	108 columns
Input	120 columns	-----	120 columns
Intermediate Storage	120 columns	-----	120 columns
Output	120 columns	-----	120 columns



POWER REQUIREMENTS

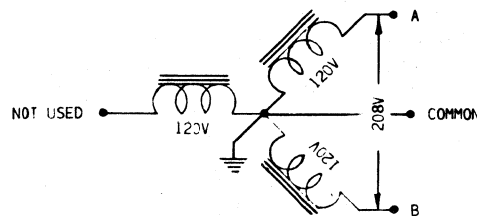
The Punched-Card Electronic Computer is adaptable to any of the power systems outlined below. The system to be used is to be specified on the original machine order.

The machine may be adjusted at the time of installation to operate from 208, 220, or 230 Volts, Alternating Current; providing the regulation of the power source can be held to plus or minus 5% of any of the above voltages. This voltage must be measured at the junction of the power supply line and computer power line, and under normal line load conditions.

If a test is required before a computer is available, an artificial load can be supplied. Should the regulation be adequate but nominal voltage different from the above voltages, a transformer could be used to lower or raise the voltage. In the event the regulation is not within plus or minus 5%, a voltage regulator is necessary. Remington Rand voltage regulator #3143-1 can be used for systems I and II below.

A separate equipment ground is necessary in all cases, as described by the National Electric Code.

- I. Single phase operation of the computer on a three phase system of 208 Volts, 4-Wire, 60 Cycles.

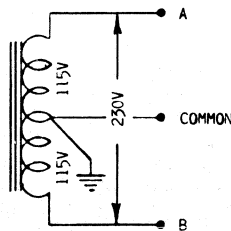


Two wires of the four wire system are used, with 208 Volts across the outside wires. The remaining two phases are not used. Center wire is for voltage regulator only, if used.

Each wire for this type of installation must be capable of carrying 40 Amperes of current. Full load is 38 Amperes.

The common wire of this system is grounded.

- II. Single phase operation of the computer on a single phase system of 230 Volts, 3-Wire, 60 Cycles.



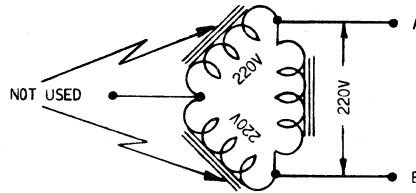
Two wires of a three wire system with 115 Volts from center wire to each outside wire with 230 Volts across the outside wires. Center wire is for voltage regulator connection only.

Each wire used in this system must be capable of carrying 40 Amperes of current. Computer current is 36 Amperes.

The common wire is returned to the system ground.

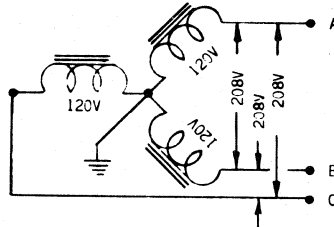
- III. Single phase operation on a three phase system of 220 Volts, 3-Wire, 60 Cycle (Delta system).





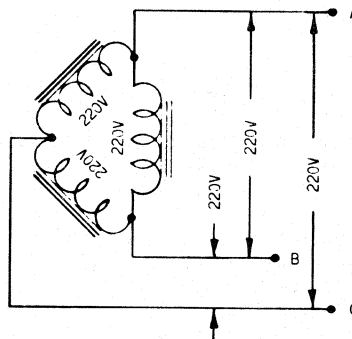
Two wires of a three wire system are used, with 220 Volts across each pair. No common ground is used. Wires must be capable of carrying 40 Amperes of current. Computer current is 37 Amperes.

- IV. Three phase operation of the computer from a three phase system of 120 Volts, 4-Wire, 60 Cycles.



Three wires of the four wires are used, with 208 Volts across each pair of wires. Wires must be able to carry 30 Amperes. Computer current is 21 Amperes, plus or minus 2 Amperes on each leg.

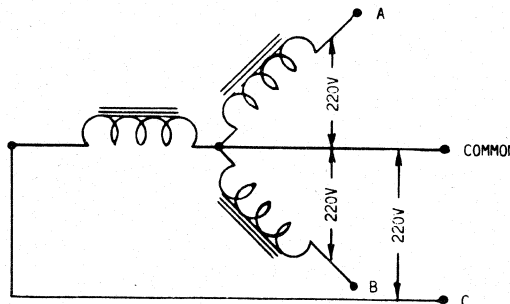
- V. Three phase operation of the computer on a three phase system of 220 Volts, 3-Wire, 60 Cycle (Delta system).



Three wires of a three wire system are used, with 220 Volts across each pair of wires. Wires must be capable of carrying 30 Amperes. Computer current is 21 Amperes, plus or minus 2 Amperes on each leg.

- VI. Most prevalent European system.

Three phase, 50 Cycle operation of the computer on a three phase wye system of 220 Volts on each leg, with respect to common.



Four wires are used, each must be capable of carrying 20 Amperes. Computer current is 13 Amperes, plus or minus one Ampere on each leg.

A power connection box is provided inside the Card Sensing-Punching Unit cover at the lower rear right corner as indicated in the drawings on the following pages. A flexible 4 conductor AWG No. 8 power cable will be furnished with each machine. This cable will be 10 feet long unless a different length is specified; it is fitted with a Hubbell No. 7302 plug. A No. 7301 receptacle and a No. 7114 plate are also furnished.

FRAME GROUNDING SPECIFICATIONS

A separate Equipment Ground is necessary as described by the National Electric Code. Connection to the Equipment Ground is made through one of the four conductors in the cable.

The HEAT DISSIPATION is approximately 400 BTU/MIN. The air flow through the machine to affect cooling is 2500 cubic feet per minute.

The HEIGHT of:

The Card Sensing-Punching Unit is 5 feet, 5 inches.
The Electronic Computing Unit is 5 feet, 9 inches.

A clearance of 12 inches above the Electronic Computing Unit is required for the Connection Panel Cover when open.

The FLOOR SPACE occupied by:

The Card Sensing-Punching Unit is 2 feet, 6 inches by 2 feet, 11 inches.
The Electronic Computing Unit is 7 feet, 2 inches by 2 feet, 6 inches.

The WORKING AREA to be allowed for efficient machine operation and service should provide for a minimum of four (4) feet around all sides of both units.

The WEIGHT of:

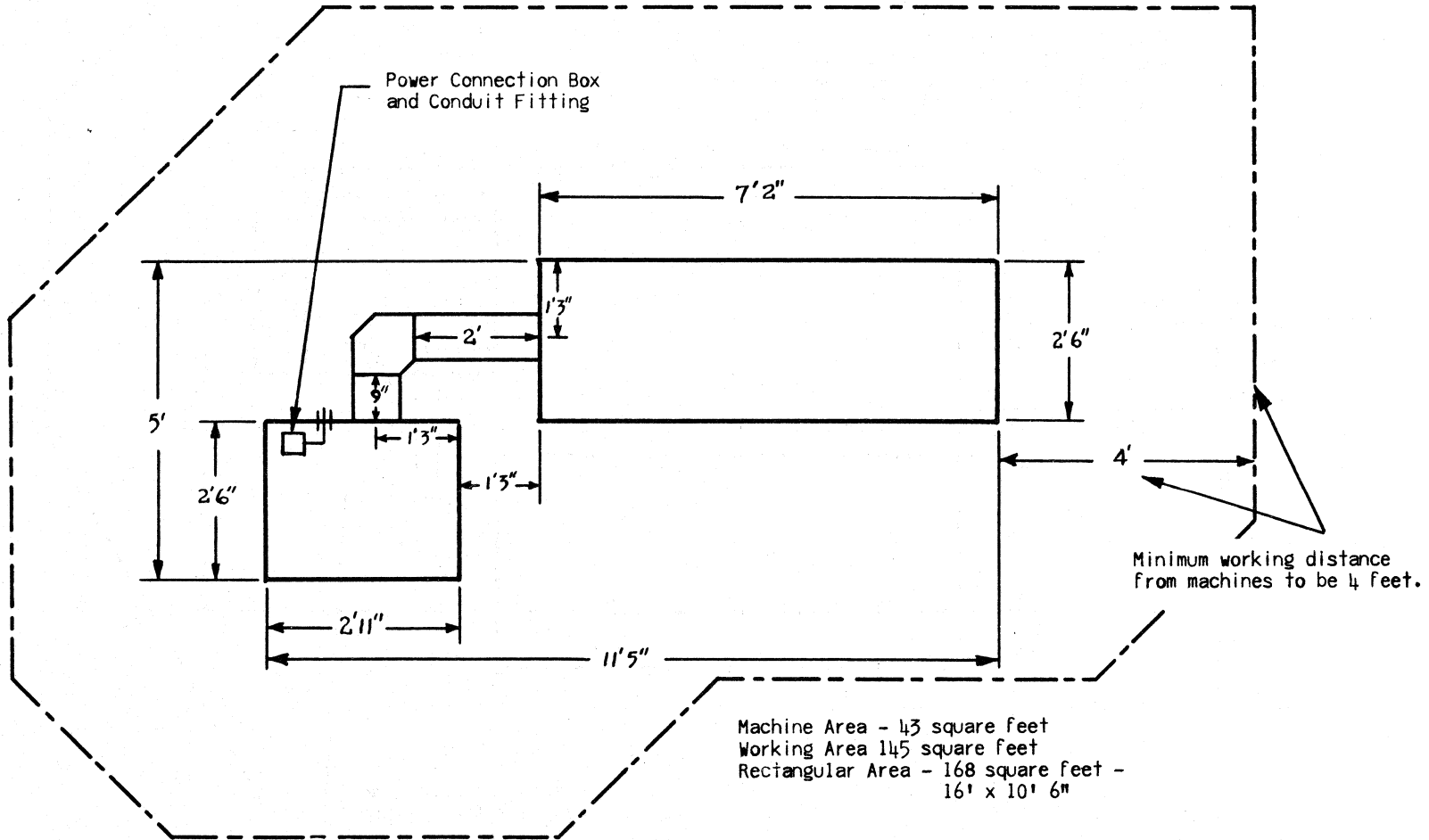
The Card Sensing-Punching Unit is approximately 1020 pounds.
The Electronic Computing Unit is approximately 2210 pounds.

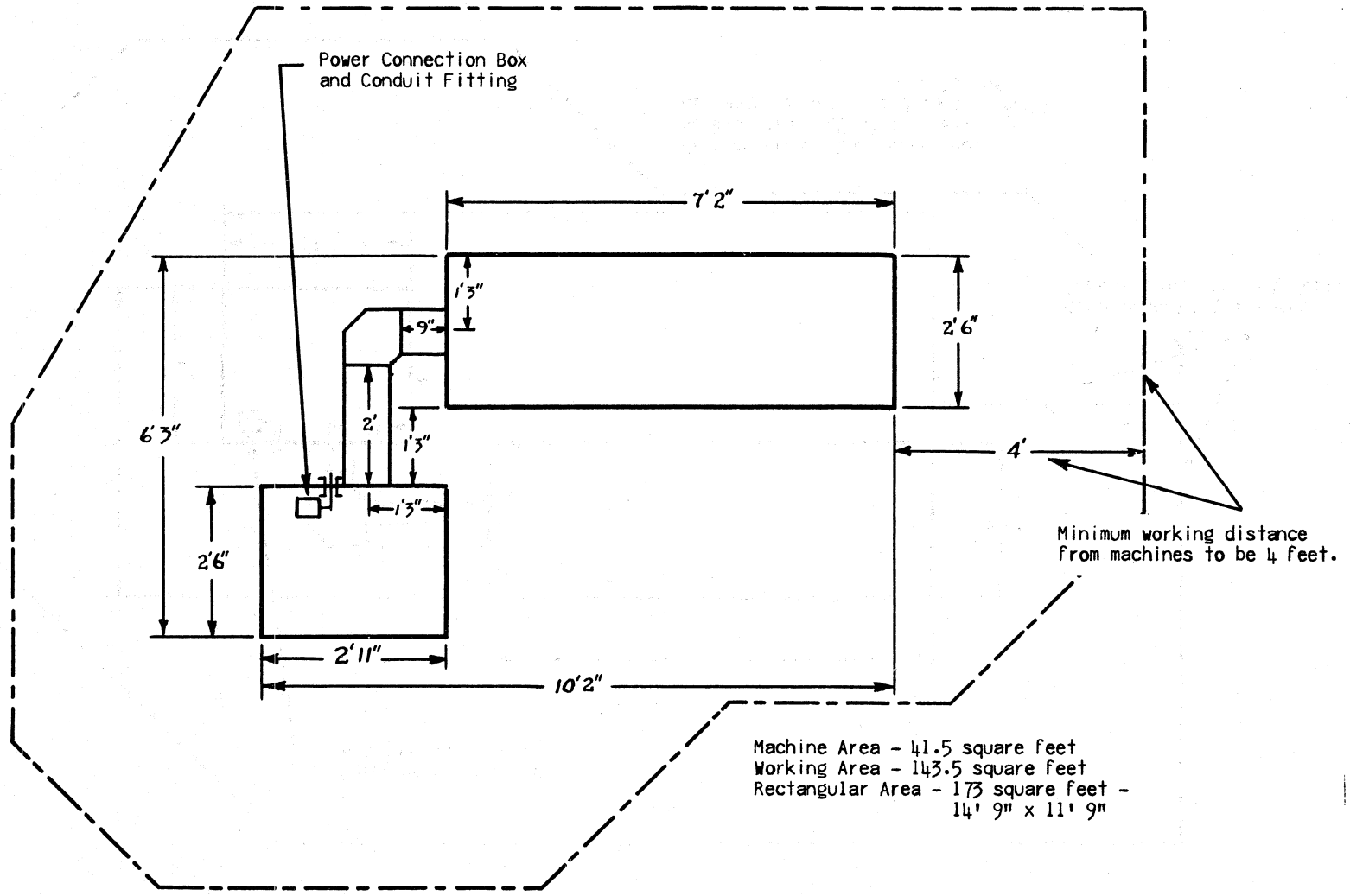
The frames of both units of the Punched-Card Electronic Computer are mounted on casters to facilitate movement of the units whenever desired. It is advisable, however, that any machine movement be done under the supervision of Mechanical Service.

Electrical cables, approximately 3 feet in length, connect the right side of the Card Sensing-Punching Unit to the left end of the Electronic Computing Unit. The two units are installed in either of the two positions shown in the drawings on the following pages. The electrical cables connecting the two units are provided with a metal housing.

The area occupied by the two units in either of the two positions is illustrated on the following page. The outside dotted lines indicate the minimum working area. The scale of these drawings is 1/4" = 1".







Machine Area - 41.5 square feet
 Working Area - 143.5 square feet
 Rectangular Area - 173 square feet -
 14' 9" x 11' 9"



BASIC SPECIFICATIONS

Card Sensing-Punching Unit

The following is basic specification information applying particularly to the Card Sensing-Punching Unit.

A CARD FEEDING MAGAZINE feeds the file of cards from which information is sensed and into which results are punched. Cards, placed in this magazine face up with the top edge leading into the machine, are fed from the bottom of the stack into a Sensing Section. The capacity of this magazine is approximately 600 cards.

The Card Feeding Magazine is provided with a means of signalling the machine to stop when empty. When the last card leaves the magazine, the machine will stop when a conclusion to the Program for that card is reached - this is usually a Trip Signal. An indicator (Magazine) on the Control Panel (see below) will light to indicate the empty magazine.

The CARD LIFTING LEVER, located at the front right corner of the Card Feeding Magazine, is depressed to assist in the removal of cards from the magazine when desired.

A CARD WEIGHT is used to insure the positive, uniform feeding of cards from the magazine down to and including the last card.

THE SENSING SECTION contains the means of reading the punched information for; Input Value, Reproducing, and control purposes.

At the time of initial card feeding, a card is fed from the Card Feeding Magazine to the Sensing Section in position ready for sensing. On the next card feeding operation; the initial card is sensed, it is then delivered to the Punching Section (see below) in position for punching, the following card is fed into the Sensing Section ready for sensing. This pattern of feeding continues automatically for each card.

Should a card fail to feed from the Card Feeding Magazine into the Sensing Section, the automatic card feeding operation will stop. The absence of a card in the Sensing Section automatically prevents the machine from attempting to perform any of its card sensing or calculating operations.

The 90 columns of INPUT STORAGE are included in the Sensing Section. The sensing of the punched Input Values, negative sign identifications, and control punchings cause the closing of electrical contacts. There are 540 of these contacts; one for each card column position - the Input Storage is, in fact, by card column position. These contacts remain closed until such time as the Trip Signal is delivered from the Electronic Computing Unit.

The values and related negative signs, if any, thus stored are available for the duration of the Program - until the next card is fed. One or more of these values may be called on at any time during the Program to enter into a calculation.

The control positions operate through the Input Storage to perform their functions.

The reproduce sensing also operates through Input Storage.

A PUNCHING SECTION is located just beyond the Sensing Section.

When the machine is signalled for card feeding (TRIP), a card in the Punching Section is punched with information contained in the Punching Setup Section. The card is then ejected into a Card Receiver. At the same time, a card in the Sensing Section advances to the Punching Section with a new card fed from the Card Feeding Magazine to the Sensing Section.

A PUNCHING SETUP SECTION located above the Punching Section receives and stores the information SET for punching; the Output Value results, the Reproducing information, the control positions for identifying negative Output Values.

The Punching Setup Section is the Output Storage with a capacity of 90 columns. The Output is Set and stored in the form of the 90-Column Numerical code for the digits 1 through 9; the ciphers in an Output Value are not Set and, therefore, not punched.

Following each Tripping operation, the Punching Setup Section is automatically cleared of Output Values and negative sign identifications Set into that Section. The Reproducing information, however, is retained until cleared by the sensing of a related control punching.



Information in the Punching Setup Section may be withheld from punching by means of a Skip Cycle (SKIP) operation. This operation is obtained by card control or automatically from an impulse obtained during the Program.

The information in the Punching Setup Section may be retained in that section despite a Tripping operation by means of a SET HOLD operation.

The calculated results to be punched into the card may be transmitted to the Punching Setup Section during the Program. The Punching Setup Section as the Output Storage thus acts to increase the Intermediate Storage capacity. On the other hand, all values to be punched may be transmitted simultaneously to the Punching Setup Section at the end of the Program.

Two CARD RECEIVERS, accessible from an opening near the rear of the left side of the Card Sensing-Punching Unit, receive the cards fed from the Punching Section following a Tripping operation. Each Card Receiver has a capacity of approximately 750 cards.

The Front Card Receiver receives those cards signalled (SORT) to be segregated during the Program.

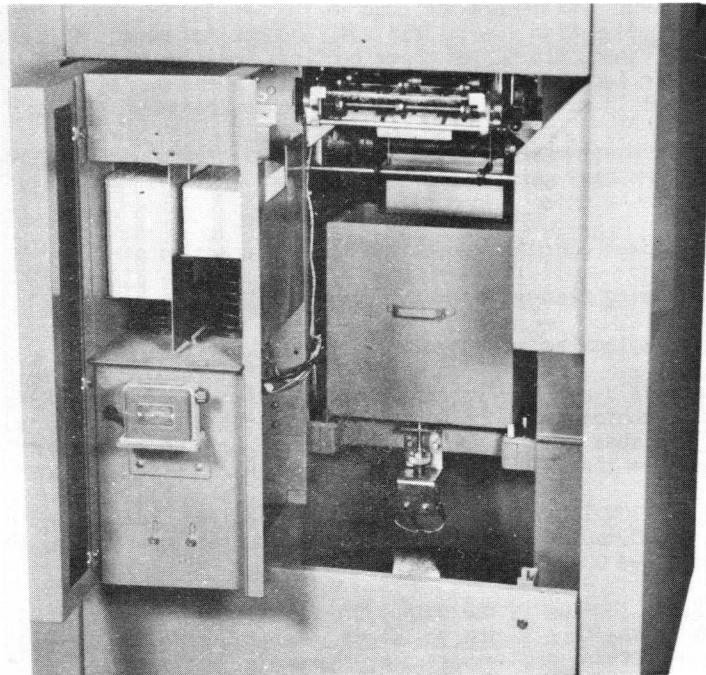
The Rear Card Receiver receives all cards except those signalled for segregation.

Each Card Receiver is provided with a means of signalling the machine to stop when filled. When a receiver is full, the machine will stop just before the next Trip Signal; no stoppage will occur from this source until the Steps of a Program up to a Trip operation have been completed. An indicator (Receiver) on the Control Panel (see below) will light as a result of a full Card Receiver.

Should a card fail to feed from the Punching Section to the Card Receivers, an indicator will light on the Control Panel (see below).

CHIP PAN of a large capacity is accessible by opening the hinged panel of the lower rear of the machine. This panel contains the Card Receiver assembly. With the panel open, the pan may be readily removed to be emptied of chips.

A full Chip Pan will stop the machine at the conclusion of a Program and cause an indicator (Receiver) on the Control Panel (see below) to light.



This view of the rear of the Card Sensing-Punching Unit with the rear panel open shows the Chip Pan as well as the Card Receivers.



The SPEED of card feeding is basically 150 cards per minute. This speed is maintained if the machine is used for a straight reproducing operation without calculating.

When the machine is performing calculations under the guidance of a Program, the card feeding is entirely under the control of signals from the Electronic Computing Unit.

With the usual calculating problems generally associated with record keeping systems, the 150 cards per minute speed will be obtained. On long or iterative calculations, card feeding occurs when the calculations are complete. Thus, any problem, regardless of length, will be completed. Card feeding will not occur until the Trip Signal is delivered.

The POWER (Circuit Breaker) SWITCH is located near the front of the machine on the left side just below the Control Panel. This switch serves to turn On and Off all current to the machine from the main power supply. No machine operations can take place until this switch is turned ON.

Because this switch is a circuit breaker, it will be thrown Off immediately in the event of an overload or short circuit within the machine.

Although the Power Switch controls the flow of current from the main power supply, two subsidiary switches are provided:

1. The Motor Switch on the Control Panel to turn the current to the Motor on or off.
2. The Computer On-Off Switches on the left end of the Electronic Computing Unit to control the flow of current to that unit.

An Electrical MOTOR supplies the motive power for card feeding and card punching. The motor receives its current directly from the main power supply.

A switch on the Control Panel (see below) serves to turn On and Off the current to the Motor.

A CONTROL PANEL is provided; to control and indicate the card feeding operation, to control and indicate the status of the power supply to the Electronic Computing Unit, to indicate several conditions within the Electronic Computing Unit that affect computing and card feeding, to allow optional clearing of the Punching Setup Section and the Intermediate Storage Unit.

MOTOR (Toggle Switch) - This switch serves to turn On and Off the current to the Motor of the Card Sensing-Punching Unit. The Power Switch must be On as well as the Motor Switch before the current will flow to the Motor.

AUTO. FEED (Toggle Switch) - This switch is set On or Off to obtain one of the following two card feeding operations:

On - (Continuous) - After card feeding has been started, it will continue automatically. The last card from the Card Feeding Magazine will feed completely through the machine to the Card Receivers.

Off - (Single Cycle) - After card feeding has been started, but one card will be fed or one machine cycle taken.

CARD FEED (Throw Switch) - This switch is moved momentarily either up or down to one of the following two positions. The switch returns to the center position when released.

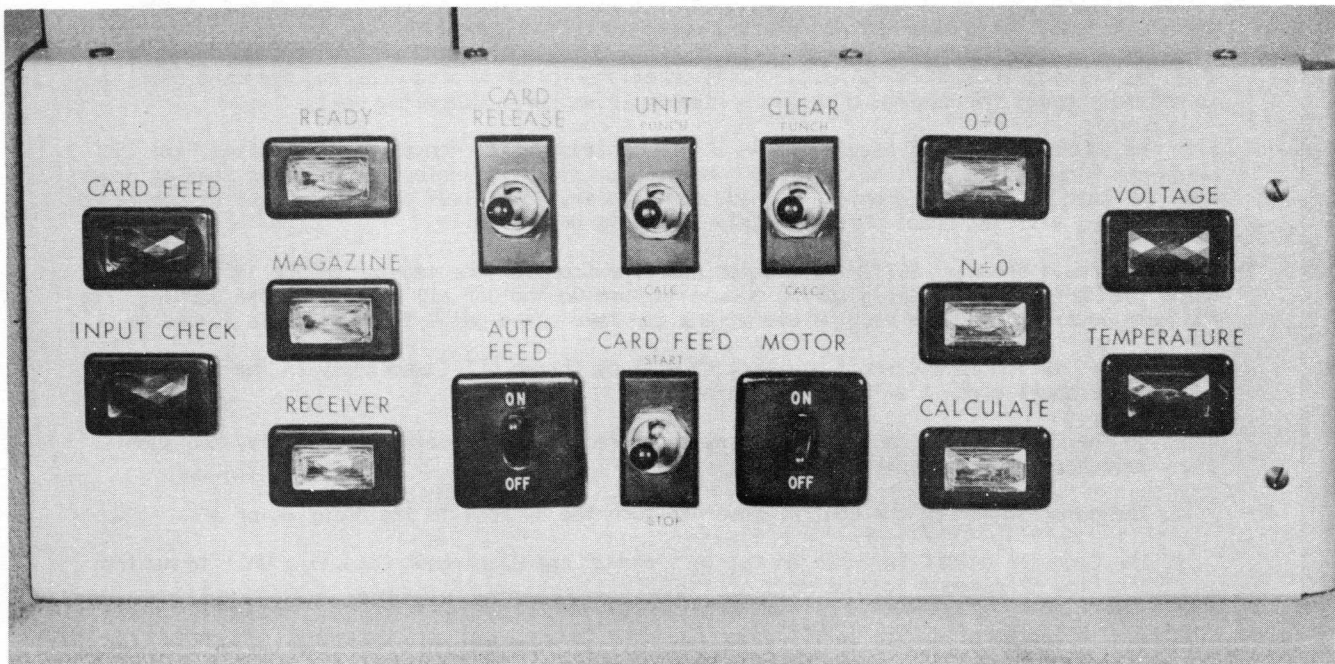
START - With cards in the Card Feeding Magazine, this switch is moved UP momentarily to this position to start the card feeding operation. Whether the card feeding operation continues automatically or whether but one card is fed depends on the setting of the Auto. Switch.

When the machine is set for automatic card feeding, but one movement to the Start position is necessary. The card feeding will continue automatically following that initial impulse.

When the machine is set for single cycle operation, this switch is moved to the Start for each card feeding cycle desired. To feed one card completely through the machine, three machine cycles are required.

STOP - To obtain optional stopping during an automatic run, this switch is moved momentarily to the DOWN position. Card feeding will stop at the conclusion of the current Program.





The Control Panel

UNIT (Throw Switch) - This is a safety switch used in conjunction with either the Clear Switch to its right or the Card Release Switch to its left (see below).

This switch is moved momentarily either up to its PUNCH position or down to its CALC. (Calculate) position. The switch returns to the center position when released.

CLEAR (Throw Switch) - This switch is moved momentarily either up to its PUNCH position or down to its CALC. (Calculate) position simultaneously with like movements of the Unit Switch. The switch returns to the center position when released.

PUNCH - To clear all information from the Punching Setup Section, this switch together with the Unit Switch, are moved UP momentarily to this position. The clearing will occur on the next card feeding cycle.

CALC. - To clear all 12 of the Intermediate Storage Units and to restore all 36 Selectors to non-select, this switch together with the Unit Switch are moved DOWN momentarily to this position. The clearing and restoring occur immediately.

The Clear Switch alone is moved momentarily to its up (PUNCH) position to clear the Voltage indicator (see VOLTAGE below).

CARD RELEASE - (Throw Switch) - This switch is moved momentarily to its UP position simultaneously with an Up movement of the Unit Switch. This switch movement causes a card to be ejected from the machine into the Rear Card Receiver without punching. Any information in the Punching Setup Section will, however, be cleared.

One Up movement of both the Card Release and Unit Switches will feed a card from the Punching Section to the Rear Card Receiver, (despite the fact that the Sort may have been impulsed during the Program for that card), feed a card from the Sensing Section into the Punching Section (this card will be sensed), feed a card from the Card Feeding Magazine into the Sensing Section unless the cards had been removed from the Magazine before moving the switch.

Before using the Card Release Switch, any card in the Card Feeding Magazine would usually be removed or prevented from feeding by means of the Card Lifting Lever.



READY (White Indicator) - This indicator will light when the machine is ready for operation. This means that the Computer is being supplied with the calculating voltage (B+ voltage) and the Motor is turned On.

When the current is turned On (Power Switch turned On, Computer On Switch depressed), a warm-up period of about two minutes is required before the machine is ready for operation. When the warm-up is completed, the Ready Indicator will light if the Motor Switch is turned On at that time.

NOTE:- It is not necessary that the Motor Switch be turned On during the warm-up period. The Ready Indicator will, however, not light until and unless this switch is turned On.

VOLTAGE (Red Indicator) - This indicator will light at the start of a run when the current is turned on to the Motor and the Electronic Computing Unit. The Clear Switch alone (not with the Unit Switch) is moved up to the PUNCH position. The indicator should then turn off if the proper voltage is being supplied; it will remain on if the voltage is not within the range of tolerance.

During the run should the voltage regulation rise above or fall below the tolerance or should a voltage failure occur, this indicator will light; card feeding will stop.

Automatic card feeding cannot be obtained as long as this indicator is lit.

When the proper voltage is again supplied, the Clear Switch is moved to the PUNCH position to turn off the light. The Card Feed Switch is moved to the START position to resume card feeding.

CALCULATE (White Indicator) - While the machine is performing the calculations in a Program, this indicator will be lit. It will go out during card feeding.

Reference to this indicator applies especially when the Computer is performing a lengthy or iterative Program to assure the operator that the machine is functioning.

Should a Program Step fail to prove, this indicator will remain lit; no cards will feed.

INPUT CHECK (Red Indicator) - The machine will stop during a Program with this indicator lit should any other code than the 1 through 9 Numerical Codes is sensed into Input.

The card containing the faulty code can be ejected into the Rear Card Receiver with new cards fed into the Punching and Sensing Sections through the use of the Card Release Switch.

If the card immediately following the faulty card is correctly punched, the indicator will go out; automatic card feeding will resume.

When this indicator lights and as long as it stays lit, no automatic card feeding can be obtained.

CARD FEED (Red Indicator) - The machine will stop at the conclusion of a Program with this indicator lit to detect a mis-fed card between the Punching and Sensing Sections or between the Punching Section and the Card Receivers.

All such mis-fed cards must be removed from the machine before resuming the card feeding operation. When the card feeding channel is clear, the operation is resumed with the Card Feed Switch.

RECEIVER (White Indicator) - The machine will stop at the conclusion of a Program with this indicator lit in the event of; a full Card Receiver, a full Chip Pan.

After removing the cards from the full Card Receiver or after emptying the Chip Pan, the light will go out. The card feeding is resumed by moving the Card Feed Switch to the Start position.

When the indicator lights and as long as it stays lit, no automatic card feeding can be obtained.



MAGAZINE (White Indicator) - The machine will stop with this indicator lit when the last card leaves the Card Feeding Magazine.

Should the Card Feeding Magazine become empty during a run, the stoppage will occur with this light lit. When the new supply is placed in the magazine, the indicator will go out. The card feeding is resumed by moving the Card Feeding Switch to the Start position.

0 ÷ 0 (White Indicator) - If the Connection Panel being used is wired to stop the machine should an attempt be made to divide zero by zero, the card feeding will stop with this indicator lit when this division is detected.

The card on which this division occurred can be ejected into the Rear Card Receiver with new cards fed into the Punching and Sensing Sections through the use of the Card Release Switch.

The movement of the Card Release Switch with the resultant ejection of the card will conclude the Program for that card. A new Program will occur for the following card; the automatic card feeding will resume.

N ÷ 0 (White Indicator) - If the Connection Panel being used is wired to stop the machine should an attempt be made to divide a number by zero, the card feeding will stop with this indicator lit when this division is detected.

The card on which this division occurred can be ejected into the Rear Card Receiver with new cards fed into the Punching and Sensing Section through the use of the Card Release Switch.

The movement of the Card Release Switch with the resultant ejection of the card will conclude the Program for that card. A new Program will occur for the following card; the automatic card feeding will resume.

TEMPERATURE (Red Indicator) - The machine will stop immediately with this indicator lit if the operating temperature of the Electronic Computing Unit rises above that deemed proper for accurate results.

Reasons for high operating temperature are:

Failure to clean the air filters in the base of the Electronic Computing Unit.

Poor ventilation or excessively high temperature in the room housing the machine.

Failure of the fans in the machine's air conditioning system.

When this indicator lights, the computing voltage automatically shuts off and all Intermediate Storages clear; the air conditioning fans in the base of the Electronic Computing Unit continue to operate to circulate air through the unit.

As long as this indicator stays lit, no automatic card feeding can be obtained.

When this indicator turns off, the computing voltage automatically turns on. The card feeding and the balance of the machine operation is resumed by moving the Card Feed Switch to Start.



BASIC SPECIFICATIONS

Electronic Computing Unit

The following is basic specifications information applying particularly to the Electronic Computing Unit:

The COMPUTER ON-OFF SWITCHES of the push button type are located near the center of the left end of the Electronic Computing Unit.

The ON Switch is colored red; the OFF Switch is black.

These two switches turn On or Off the current from the main power supply to the Electronic Computing Unit.

A white indicator, just above the On Switch, will light when that switch is depressed to indicate the flow of current to the Unit. This indicator will turn off when the Off Switch is depressed.

AN AIR CONDITIONER is included in the Electronic Computing Unit to assist in maintaining that unit at the most desirable operating temperature.

The Air Conditioner consists of four 15 inch fans in the base located above air filters. These fans operate at 1750 R.P.M. to force air through the inside of the unit.

To clean the four filters, they are removed from the rear of the machine at the base. To maintain the machine at its best operating efficiency, these filters should be cleaned at regular intervals. The frequency of cleaning depends primarily on the individual operating conditions.

The twelve electronic INTERMEDIATE STORAGE UNITS are included in the Electronic Computing Unit. Each Intermediate Storage Unit is of ten Accumulator Column capacity.

The Intermediate Storage Units are represented externally by the twelve Storage Outputs on the Input and Output Panel. The twelve Intermediate Storage Units and their related Storage Outputs are identified by the alphabetical-numerical symbols S1 through S12.

An Intermediate Storage Unit retains values transferred to it from the Accumulator until:

1. A new value is read into that Unit; the new replaces the old.

NOTE:- This includes an operation termed, "ZEROIZING". By delivering a zero result (0×0 , $0 - 0$, $0 + 0$, for example) to an Intermediate Storage Unit, that Unit is selectively cleared of significant digits.

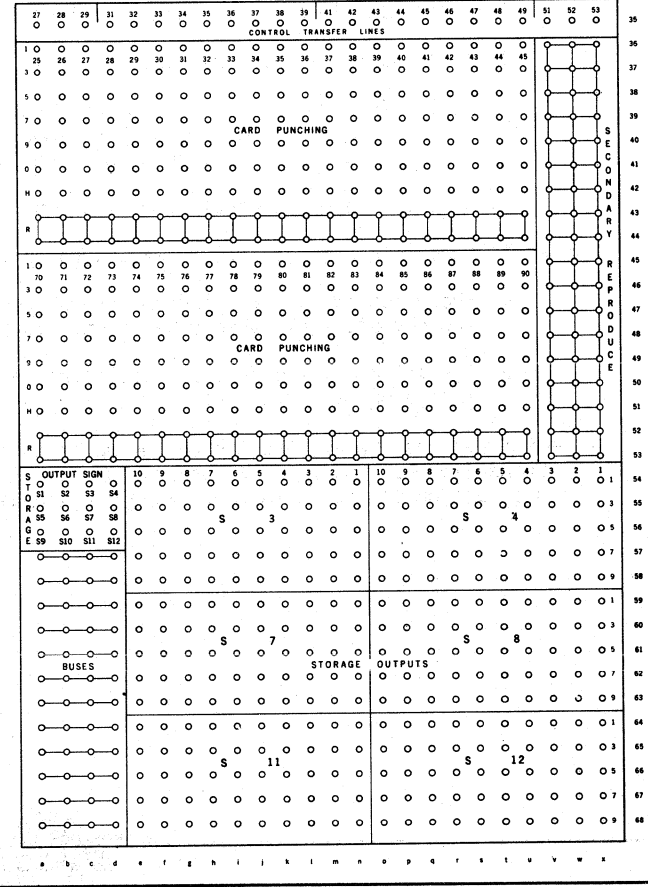
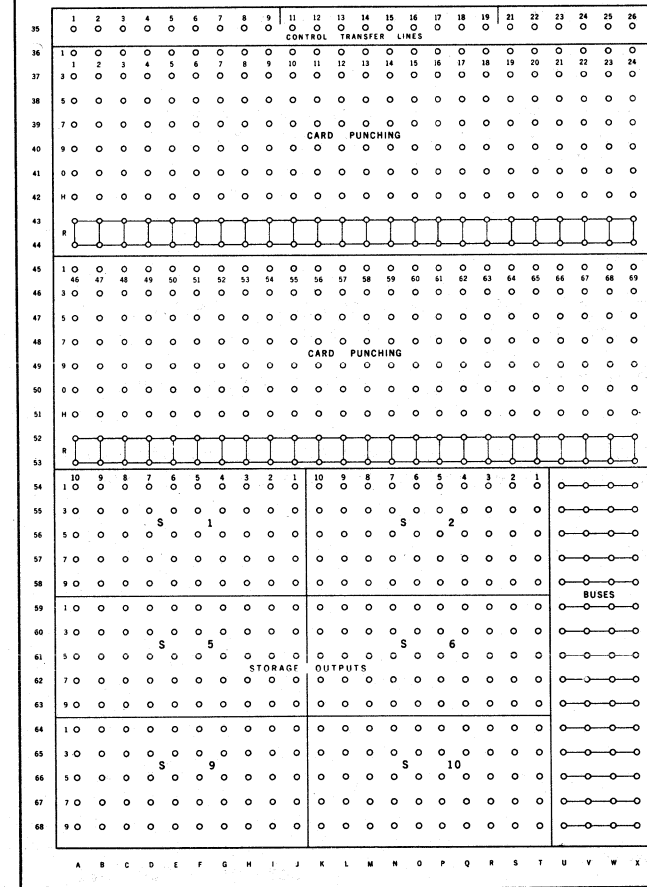
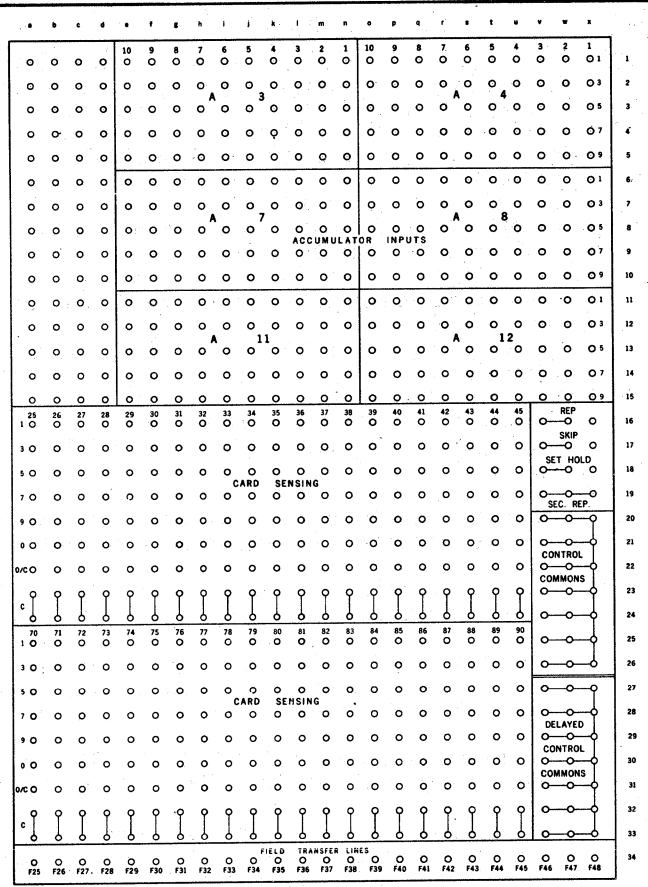
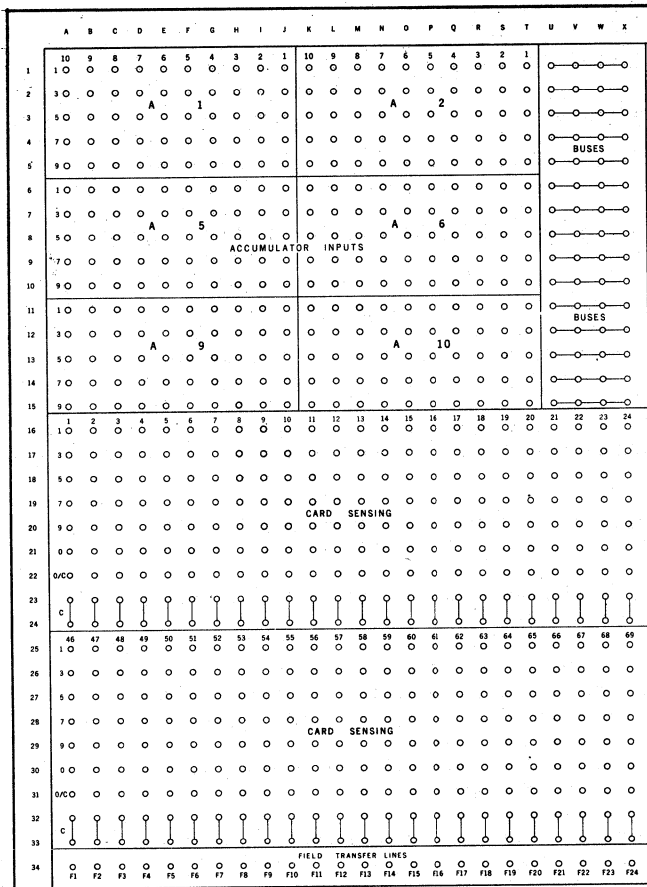
2. A Clear Signal is received by that Unit.

An Intermediate Storage Unit retains a value so that:

1. The value may be transferred through the Storage Output to the Punching Setup Section (Output Storage), when a Set signal is received, to be punched into a card.
2. The value developed by a calculation may be referred to at will during a Program to enter into other calculations.

The Program Test Panel, located on the upper portion of the Electronic Computing Unit, and the two Connection Panels, Input & Output, Constant & Program, located on the left of the front of the Unit are described in the following paragraphs.





INPUT & OUTPUT PANEL

The Input & Output Panel as well as the Constant & Program Panel are installed beneath a common cover at the left of the front of the Electronic Computing Unit. Access to the Connection Panels is obtained by raising the Connection Panel Cover with the Lifting Bar at its base.

The Input & Output is the lower panel in this section; the Constant & Program is the upper.

A Connection Panel is readily removed for rewiring by the operator or for the installation of a panel already wired with the setup desired:

A Connection Panel is removed by raising the Connection Panel Cover. When the cover is fully raised, it is carried up and over the top of the machine. The raising of the cover releases both Connection Panels from the machine. It also shuts off the power to the Electronic Computing Unit. A panel is then removed by lifting it slightly by its handles and then drawing straight out. When any change is to be made to the wiring, the panel should be removed from the machine.

A Connection Panel is installed with the cover raised by: holding the panel at an angle with the top in toward the machine; placing the studs located on the outer left and right corners of the panel into the hooks at the upper corners of the Connection Panel housing; swinging the bottom of the panel into the machine; lowering the cover to secure the panel into position.

The Connection Panel Cover cannot be fully lowered unless the Connection Panels are in place in the machine. This also means that the power to the Electronic Computing Unit will not resume.

✓ NOTE:- It is good operating practice always to have both Connection Panels in place in the machine, to guard against the inadvertent damage to the contacts in the Terminal Connection Panels.

When the Connection Panel Cover is raised with the current to the Electronic Computing Unit turned On, the Voltage Indicator will light. This indicator will stay lit until the cover is closed and the Clear Switch on the Control Panel is moved up to its Punch position.

The Input & Output Panel provides the means of connecting individual card columns and card column positions for Input, Output, and Reproducing purposes.

This Connection Panel also provides the means of; connecting individual card column positions for control purposes, positions sensed from the card to control machine operation as well as positions to be punched into the card to indicate negative Output Values.

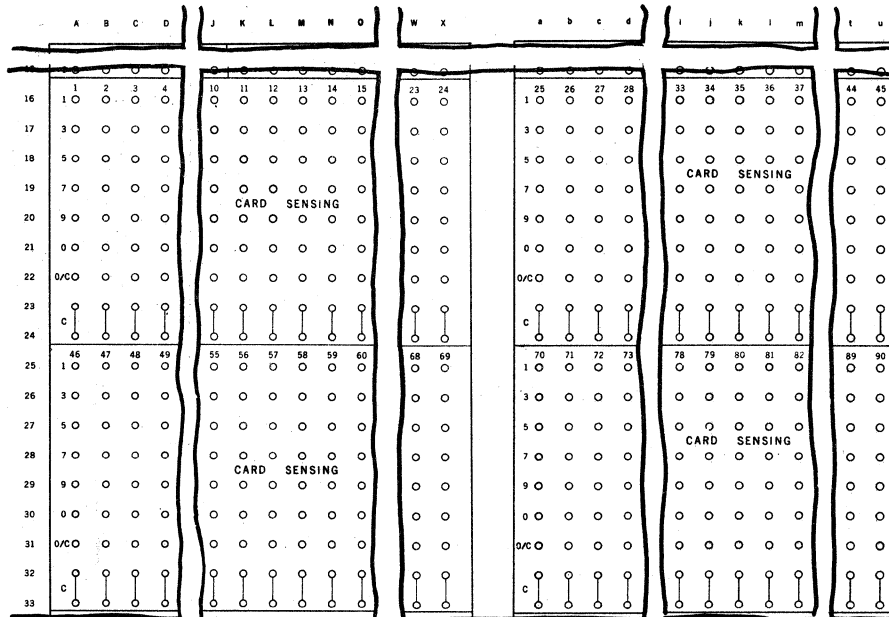
The Connection Panels contain sockets into which connection wires are plugged to establish the card column and control connections desired. Connection wires of various length are provided to connect adjacent sockets or to span the panel. Connection wires are provided for single or multiple connections.

The upper portion of the Input & Output Panel is concerned primarily with Input, the lower portion with Output.

The primary purpose of each section within the Input & Output Panel is contained in the following paragraphs:



CARD SENSING



Columns 1 - 24 (A-X,16-24)
 Columns 25 - 45 (a-u,16-24)
 Columns 46 - 69 (A-X,25-33)
 Columns 70 - 90 (a-u,25-33)

These 90 vertical rows of nine sockets each represent the columns of the 90-Column card to be sensed.

The horizontal rows of sockets within each of these four sub-sections are identified by numbers and letters at their left:

- 1, 3, 5, 7, and 9 - These five horizontal rows (16-20&25-29) are the output of the sensing for the 1, 3, 5, 7, and 9 positions of the respective card columns.
- 0 (Zero) - This horizontal row (21&30) is the output of the sensing for the zero position for the related card column.
- O/C - (Zero Call) - horizontal row (22&31) - These sockets are used in completing the electrical circuit when the zero position of a card column is to be sensed for control, negative sign, or reproducing purposes.
- C (Call) - Horizontal rows (23&24,32&33) - The two sockets in each vertical row are interconnected at the rear of the panel to serve equally.

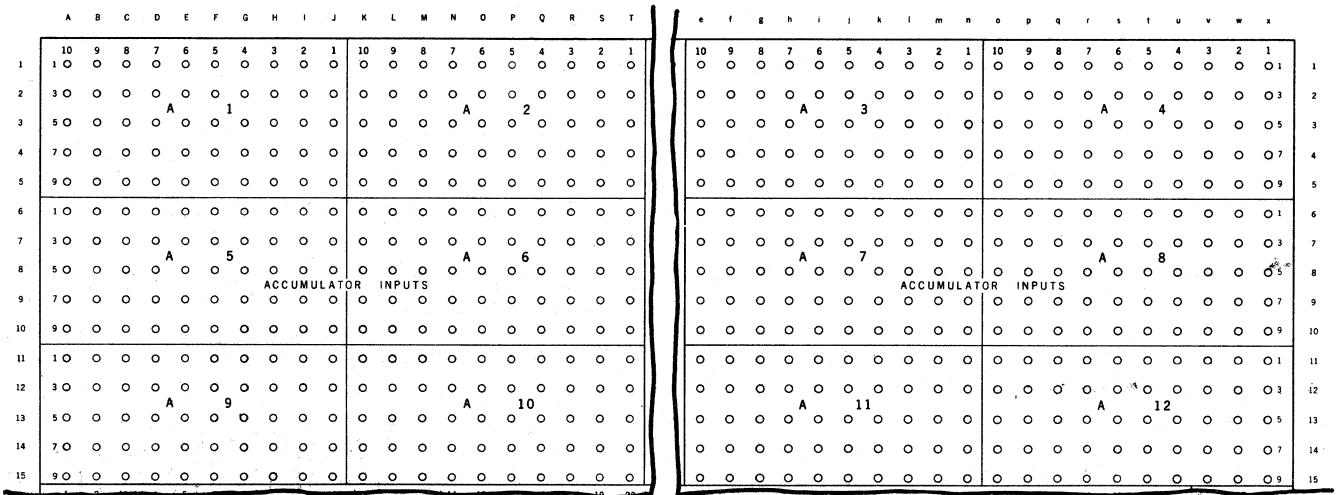
These sockets are used in completing the electrical circuit:

1. To call in the digit sensed from the related card column as an Input Value.
2. When the zero is used for negative sign identification.
3. To call in the punched positions sensed for Reproducing.
4. To initiate card control.

ACCUMULATOR INPUTS

The 120 columns of Input are represented by the twelve groups within this section. Each group consists of 10 vertical rows of 5 sockets each (10 columns). Each group is identified by an alphabetical-numerical symbol from A1 to A12:





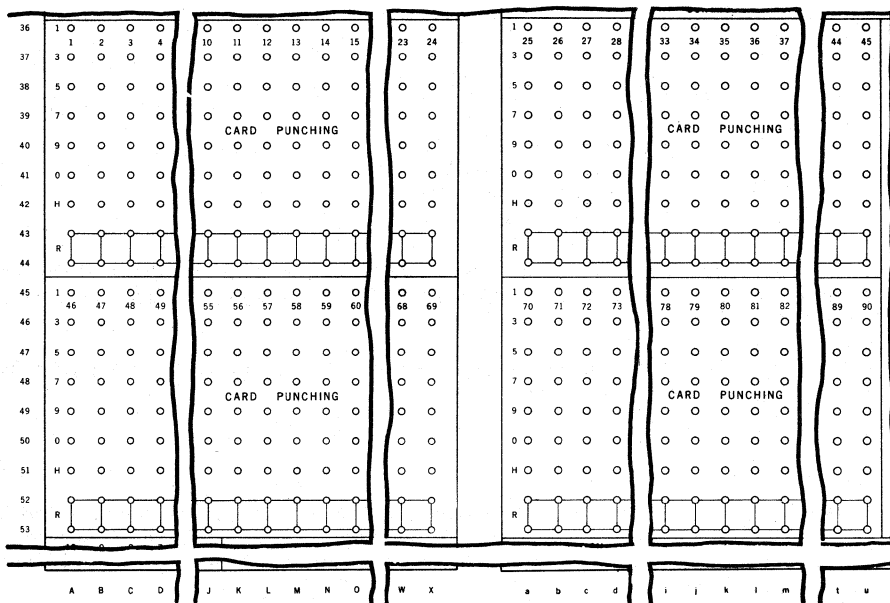
- A1 (A-J,1-5)
- A2 (K-T,1-5)
- A3 (e-n,1-5)
- A4 (o-x,1-5)
- A5 (A-J,6-10)
- A6 (K-T,6-10)
- A7 (e-n,6-10)
- A8 (o-x,6-10)
- A9 (A-J,11-15)
- A10 (K-T,11-15)
- A11 (e-n,11-15)
- A12 (o-x,11-15)

Each vertical row within each group is related to one of the ten Accumulator Columns. The numbers (1 through 10) at the top of each row in this section indicates the Accumulator Column to which that vertical row is related.

Each horizontal row within each group is related to one of the five (1, 3, 5, 7, 9) 90-column Numerical code positions. The number (1, 3, 5, 7, 9) at the left and right of each horizontal row in this section indicates the code position to which that horizontal row is related.

Connection is made between the sockets in this section and the 1 - 9 (and 0) sockets in the Card Sensing section for the sensing of Input Values.

CARD PUNCHING



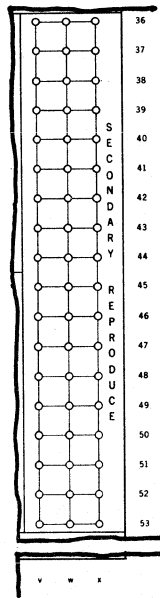
- Columns 1 - 24 (A-X,36-44)
- Columns 25 - 45 (a-u,36-44)
- Columns 46 - 69 (A-X,45-53)
- Columns 70 - 90 (a-u,45-53)

These 90 vertical rows of nine sockets each represent the columns of the 90-Column card to be punched.

The horizontal rows of sockets within each of these four sub-sections are identified by numbers and letters at their left:

- 1, 3, 5, 7, 9 - These five horizontal rows (36-40&45-49) are the input for the punching of the 1, 3, 5, 7, and 9 positions of the respective card columns.
- 0 (Zero) - This horizontal row (41&50) is the input for the punching of the zero in the related card column.
- H (Hold) - Horizontal row (42&51) - These sockets are used in completing the electrical circuit when the information wired to the related column is to be held for reproducing into following cards.
- R (Reproduce) - Horizontal row (43&44,52&53) - All of the sockets within each of these two rows are interconnected both horizontally and vertically to serve a common purpose during Reproducing.

A connection is made between these sockets and the C sockets in Card Sensing for the columns to be sensed for Reproducing.



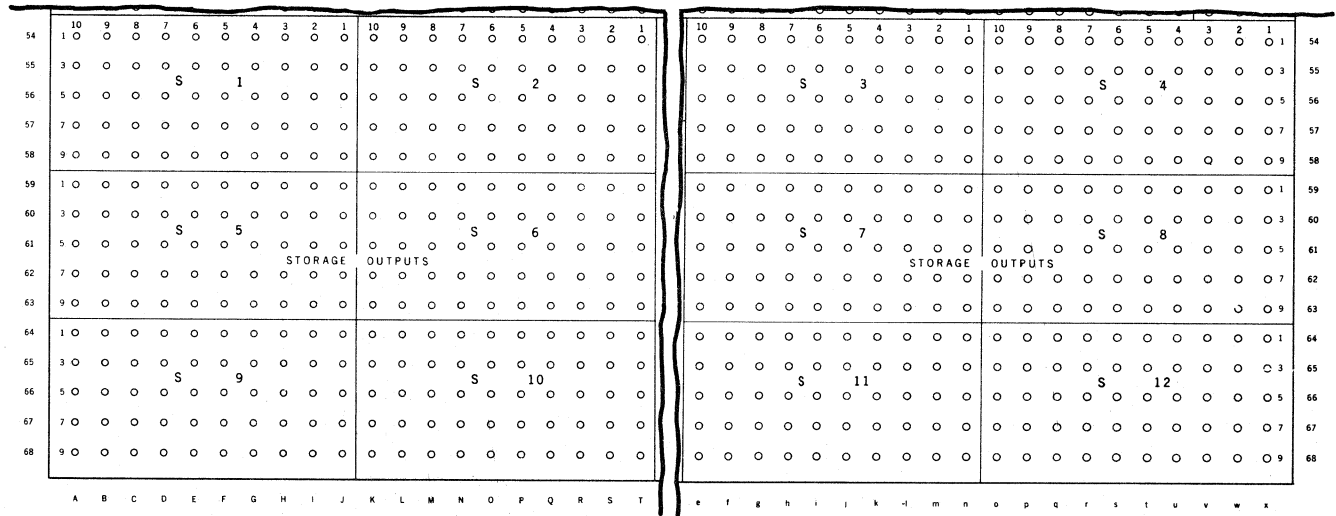
Secondary Reproduce (v-x,36-53) - All of the sockets within each of these three vertical rows are interconnected both horizontally and vertically to serve a common purpose during Secondary Reproducing.

A connection is made between these sockets and the C sockets in Card Sensing for the columns to be sensed for Secondary Reproducing.

STORAGE OUTPUTS

The 120 columns of Output from the 12 Intermediate Storage Units are represented by the twelve groups within this section. Each group consists of 10 vertical rows of 5 sockets each (10 columns). Each group is identified by the alphabetical-numerical symbol used to identify its related Intermediate Storage Unit:





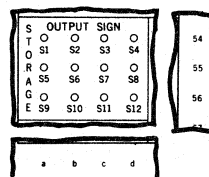
- | | |
|----------------|-----------------|
| S1 (A-J,54-58) | S7 (e-n,59-63) |
| S2 (K-T,54-58) | S8 (o-x,59-63) |
| S3 (e-n,54-58) | S9 (A-J,64-68) |
| S4 (o-x,54-58) | S10 (K-T,64-68) |
| S5 (A-J,59-63) | S11 (e-n,64-68) |
| S6 (K-T,59-63) | S12 (o-x,64-68) |

Each vertical row within each group is related to one of the ten Accumulator Columns. The numbers (1 through 10) at the top of each row in this section indicate the Accumulator Column to which that vertical row is related.

Each horizontal row within each group is related to one of the five (1, 3, 5, 7, 9) 90-Column Numerical code positions. The numbers (1, 3, 5, 7, 9) at the left and right of each horizontal row in this section indicate the code position to which that horizontal row is related.

Connection is made between the sockets in this section and the 1 - 9 (and 0) sockets in the Card Punching section for the punching of Output Values.

Output Sign - Storage (a-d,54-56)



Each of 12 sockets in this section is related to an Intermediate Storage Unit to designate when the value in the related Unit is negative. The Unit to which each socket is related is indicated by the alphabetical-numerical printed below the socket.

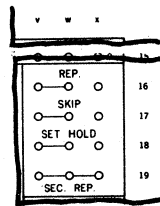
- | | | |
|-----------|-----------|------------|
| S1 (a,54) | S5 (a,55) | S9 (a,56) |
| S2 (b,54) | S6 (b,55) | S10 (b,56) |
| S3 (c,54) | S7 (c,55) | S11 (c,56) |
| S4 (d,54) | S8 (d,55) | S12 (d,56) |

Connection is made from one of these sockets to an 0, 1, 3, 5, 7, or 9 socket in Card Punching to identify a negative Output Value from the related Intermediate Storage Unit.



FUNCTION CONTROL

Four functions of machine operation are controlled by wiring of the Input & Output Panel. These are card controlled functions obtained by the sensing of related control punchings in individual cards. The sockets and functions within this section (v-x,16-19) are:

REP. (Reproduce) (v-x,16)

The two sockets (v&w,16) are interconnected to serve equally. This pair of sockets or the single socket (x,16) may be used for either input or output.

These sockets provide the means of authorizing the Punching Setup Section to accept the information wired for Reproducing. The Reproduce may be performed automatically for each card or it may be performed optionally upon the sensing of control punching.

The impulsing of the Reproduce sockets performs two operations:

1. Clears the Punching Setup Section of all Reproducing information set up in that section from a previous card.
2. Authorizes the Punching Setup Section to accept the Reproducing information from the card currently sensed.

Reproduce information set up from one card will be retained for punching into following cards only if the H (Hold) sockets in Card Punching are wired.

SKIP (Skip Cycle) (v-x,17)

The three sockets in this horizontal row are used to perform the Card Controlled Skip Cycle operation. The two sockets (v&w,17) are interconnected to serve equally. This pair of sockets or the single socket (x,17) may be used for either input or output.

Card punching is prevented through the use of these sockets. Skip Cycle may be performed optionally upon the sensing of control punching.

NOTE:- The SKIP sockets on the Constant & Program Panel, although they perform the same function, are for use only with signals obtained from the Program. (see Constant & Program Panel).

When the Skip Cycle signal is delivered, none of the information Set into the Punching Setup Section - either Reproduce or Output Value - will be punched in the card sensed at the time the signal is delivered.

SET HOLD (v-x, 18)

The two sockets (v&w,18) are interconnected to serve equally. This pair of sockets or the single socket (x,18) may be used for either input or output.

These sockets provide the means of retaining Output Values in the Punching Setup Section from card-to-card (Reproduce information is retained until the Reproduce signal is again delivered).

Set Hold usually operates in conjunction with the Skip Cycle operation. In this case, the Skip Cycle must be impulsed for the Set Hold to be effective.

Set Hold may be performed automatically each time the Skip Cycle is impulsed or it may be performed optionally upon the sensing of its own control punching to be effective or not when Skip Cycle occurs.



At the time a Trip signal is delivered, the Punching Setup Section is automatically cleared of all information except that wired for Reproducing. Set Hold is used to retain that information for the card feeding cycle during which the Set Hold signal is delivered. The Skip Cycle and Set Hold must be impulsed each time Set Hold is to be effective.

Should the Set Hold signal be delivered simultaneously with the Reproduce signal, the Set Hold will take precedence. No information, Reproduce or Output Value, will be cleared from the Punching Setup Section. Reproduce information punched in the card currently being sensed will be accepted.

SEC. REP. (Secondary Reproduce) (v-x,19)

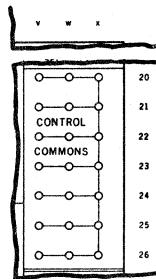
These three common sockets provide the means of authorizing the Punching Setup Section to accept the information wired for Secondary Reproducing. The Secondary Reproduce function is performed optionally upon the sensing of control punching.

Secondary Reproduce information set up from one card will be retained for punching into following cards only if the H (Hold) sockets in Card Punching are wired.

Secondary Reproduce information Held is cleared when the next Reproduce signal is delivered.

CONTROL COMMONS

Control Commons (v-x,20-26)

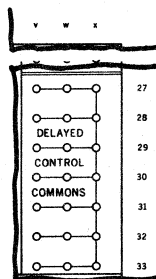


These three vertical rows of sockets are all interconnected at the rear of the panel to serve equally.

These sockets are used in completing the electrical circuit for card controlled Selector operation and in the Secondary Reproduce operation.

When these sockets are used, the card controlled operation is effective immediately for the card containing the control punching.

Delayed Control Commons (v-x,27-33)



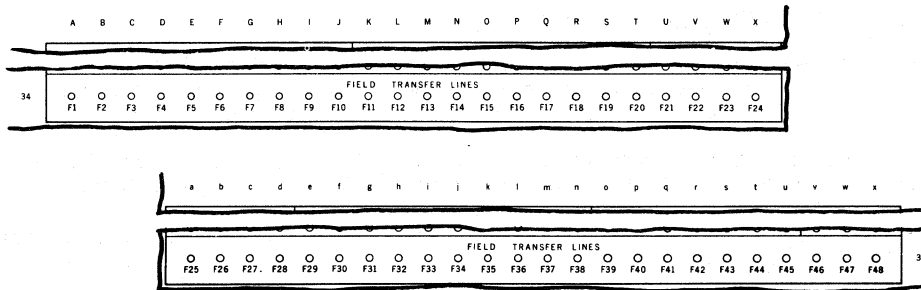
These three vertical rows of sockets are all interconnected at the rear of the panel to serve equally.



These sockets are used in completing the electrical circuit for card controlled Selector operation when a Selector or Selectors function through the Selector Hold feature is to become effective for the card immediately following that containing the control punching.

TRANSFER LINES

Field Transfer Lines (A-x,34)

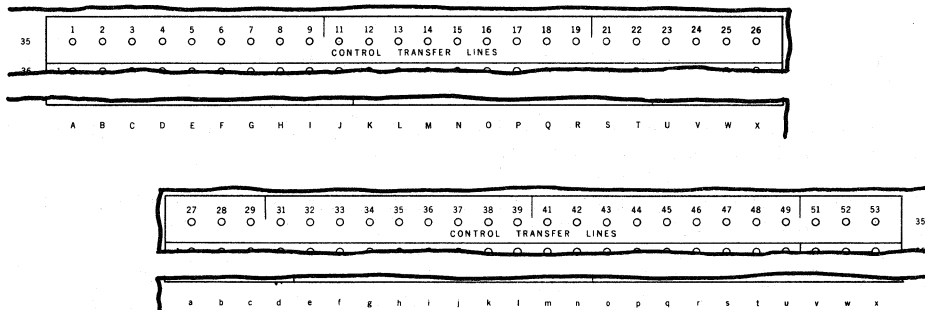


These 48 sockets, numbered F1 through F48, are terminals for direct connections between the Input & Output Panel and the Constant & Program Panel. There is a similar set of 48 sockets bearing the corresponding numbers of the Constant & Program Panel.

The Transfer Lines afford a convenient means of carrying any phase of machine operation from one panel to the other. They are not directly related to any of the basic sockets on either panel.

A Transfer Line is used by wiring from a basic socket on one panel to a Transfer Line socket on the same panel. The basic socket so wired is then represented on the other panel by the Transfer Line socket bearing the same number.

Control Transfer Lines (A-x,35)



These 48 sockets, numbered 1 through 53 (the numbers 10, 20, 30, 40, and 50 are not used) are also terminals for direct connections between the Input & Output Panel and the Constant & Program Panel. There is a similar set of 48 sockets bearing the corresponding numbers on the Constant & Program Panel.

The Control Transfer Lines are identical in purpose and use to the Field Transfer Lines.

BUSES

There are three areas of Bus sockets on the Input & Output Panel (U-X,1-15), (U-X,54-68), (a-d, 57-68). Each Bus within these sections is of 4 sockets.

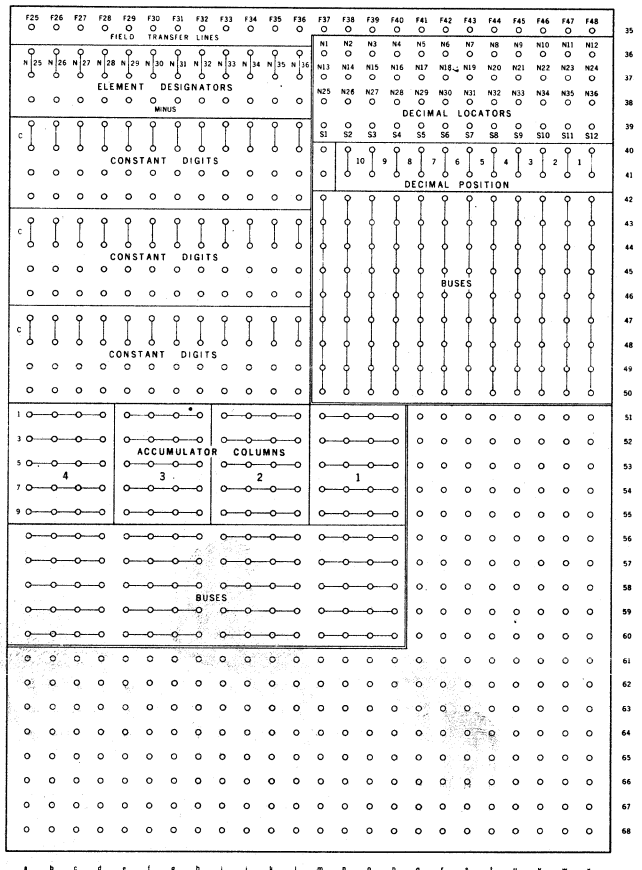
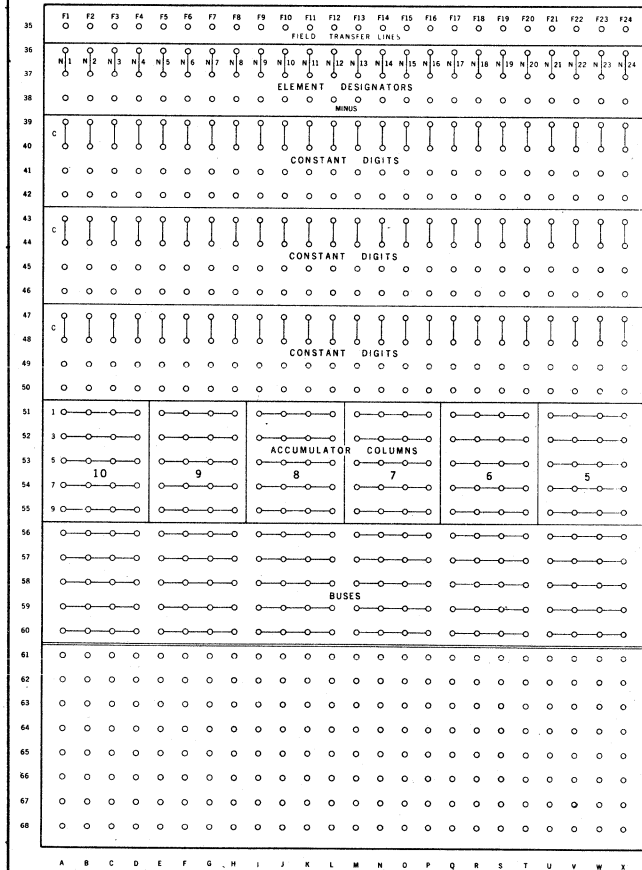
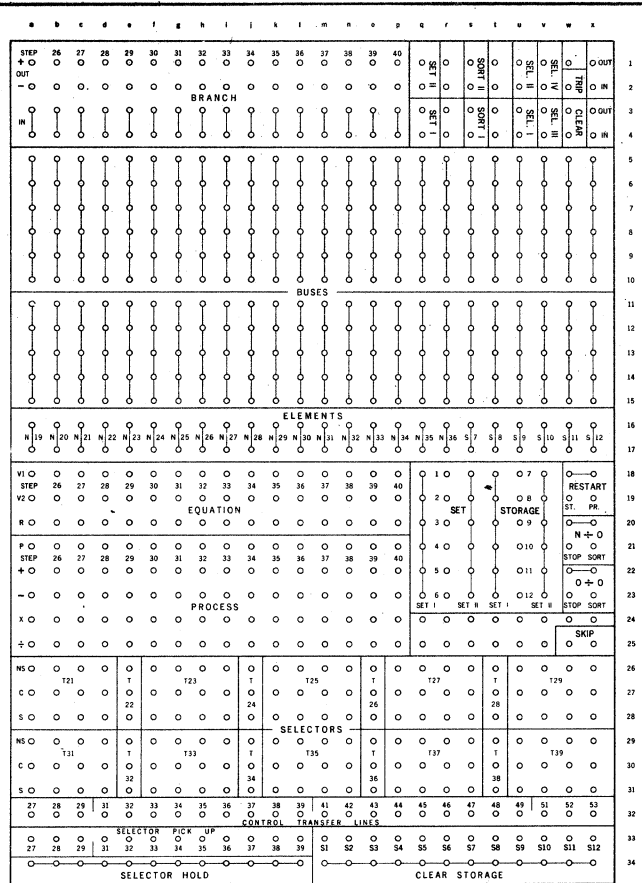
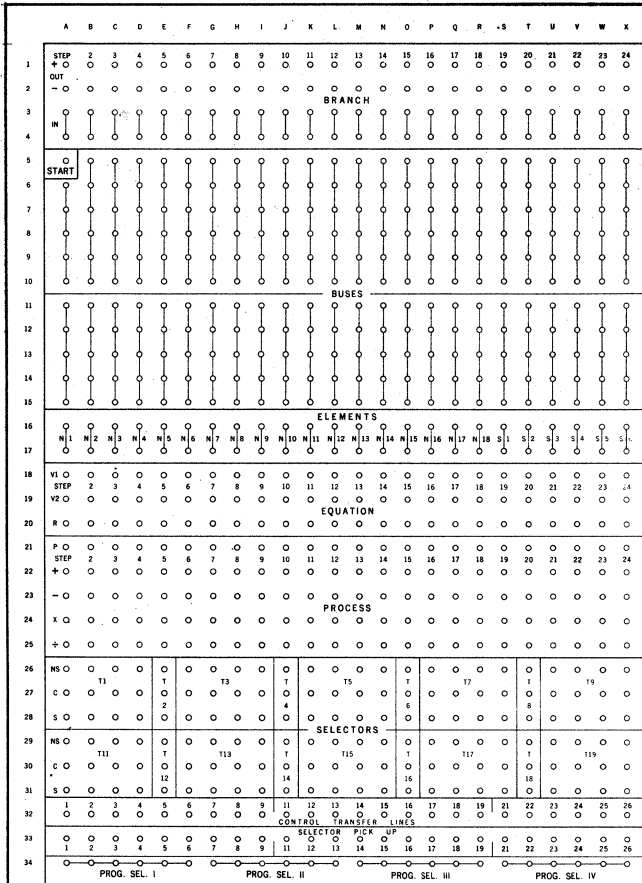
The sockets comprising each Bus are permanently connected internally. This connection is indicated on the panel by the horizontal lines between the sockets. The sockets thus joined will, therefore, serve equally for a common purpose.



The Buses are provided to supplement the basic sockets previously outlined to give added capacity for connection whenever required. They are not directly related to any of the basic sockets.

A Bus is made to relate to a basic socket, however, by wiring from the basic socket to any one of the sockets in that Bus. The other sockets in that Bus will then serve the same purpose as the basic socket. If more sockets are required for the same purpose, two or more Buses may be interconnected by wiring from one socket in one Bus to a socket in a second Bus.





Constant & Program Panel

The Constant & Program Panel is the Connection Panel which occupies the upper area beneath the Connection Panel Cover in the Electronic Computing Unit. The Constant & Program Panel provides the means of setting the Constant Values to enter into a Program. It is used to establish the Program to be followed for an application.

This Connection Panel also establishes the Set and Clear operations for the Intermediate Storage Units as well as the action to be taken in the event of an infinite or indeterminate result. The sockets related to Selector operation are also contained on this panel.

The Constant & Program Panel contains sockets into which connection wires are plugged to establish the Constant Value, Program, and control connections desired. It is installed and removed from the machine in identically the same manner as the Input & Output Panel. The removal and installation of this panel has the same effect on the power supply as the Input & Output Panel.

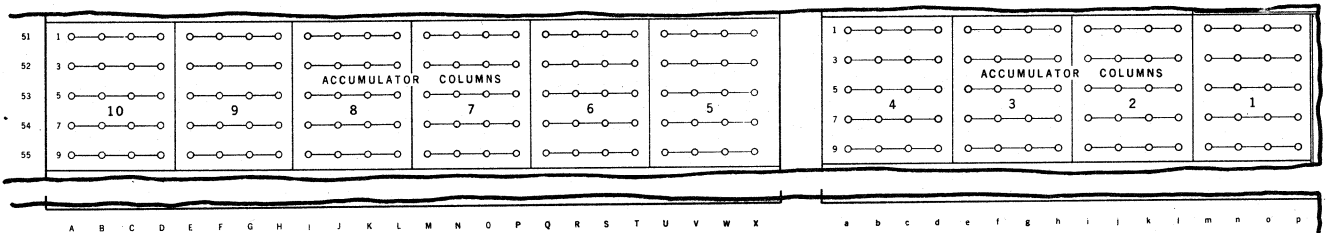
The upper portion of the panel is concerned primarily with Programming; the lower portion with Constant Values and Decimal Location.

The primary purpose of each section within the Constant & Program Panel is contained in the following paragraphs:

CONSTANT VALUES

The two sections of the Constant & Program Panel used in the formation of the Constant Values to be used in the Program are located in the lower portion of the panel. These sections are titled; Accumulator Columns, Constant Digits.

Accumulator Columns



This section (A-p,51-55) is divided into ten sub-sections, numbered from 1 to 10. Each sub-section represents one of the ten Accumulator Columns:

- Accumulator Column 10 (A-D,51-55)
- Accumulator Column 9 (E-H,51-55)
- Accumulator Column 8 (I-L,51-55)
- Accumulator Column 7 (M-P,51-55)
- Accumulator Column 6 (Q-T,51-55)
- Accumulator Column 5 (U-X,51-55)
- Accumulator Column 4 (a-d,51-55)
- Accumulator Column 3 (e-h,51-55)
- Accumulator Column 2 (i-l,51-55)
- Accumulator Column 1 (m-p,51-55)

Within each of the sub-sections are five horizontal rows of four sockets each. Each horizontal row is related to one of the five (1, 3, 5, 7, 9) 90-Column Numerical code positions. The (1, 3, 5, 7, 9) at the left of each horizontal row in this section indicates the code position to which that horizontal row is related:

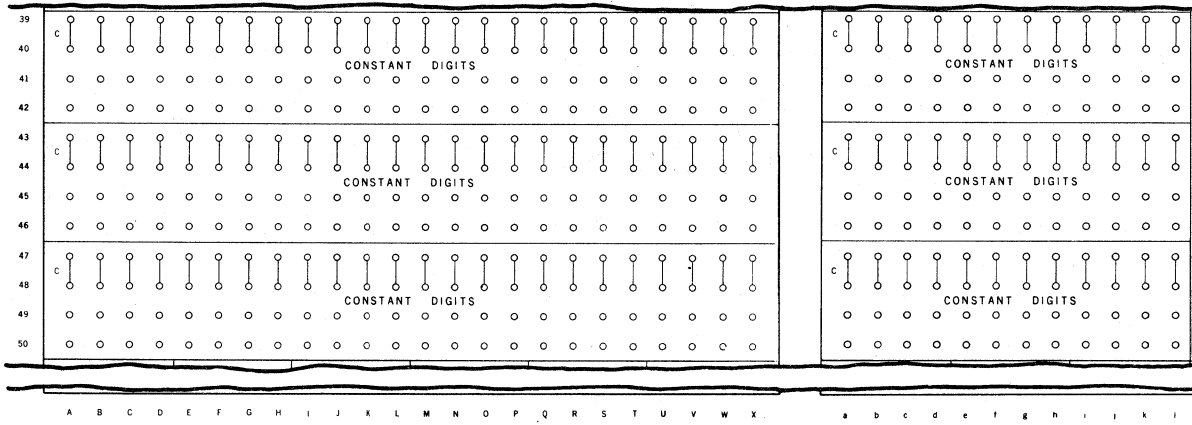
- Code Position 1 - Horizontal row (51)
- Code Position 3 - " " (52)
- Code Position 5 - " " (53)
- Code Position 7 - " " (54)
- Code Position 9 - " " (55)



Connection is made between the sockets in this section and in the Constant Digits (see below) to form a digit or number and to relate that digit to an Accumulator Column.

When the digit is zero, no connection is necessary.

Constant Digits



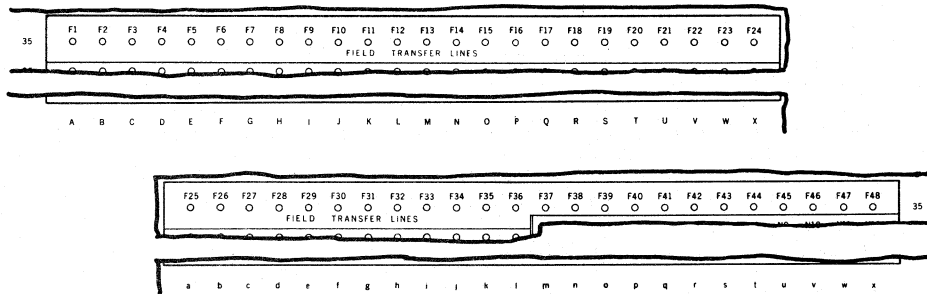
The 108 digits of Constant Value are obtained through the use of the sockets in this section (A-1,39-50). The three sub-sections (A-1,39-42; A-1,43-46; A-1,47-50) are identical. The four sockets in each vertical row of these sub-sections are used in the formation of a Constant Digit as follows:

The lower two sockets (41&42,45&46,49&50) are connected to the desired code position socket or sockets of the Accumulator Columns section to form the digit to be used.

The upper two sockets, marked C (Call) (39&40,43&44,47&48), in each vertical row are interconnected at the rear of the panel to serve equally. A connection is made between these sockets and those in the Element Designators section (see below) when the related Constant Digit is to be used as an Element in the Program.

TRANSFER LINES

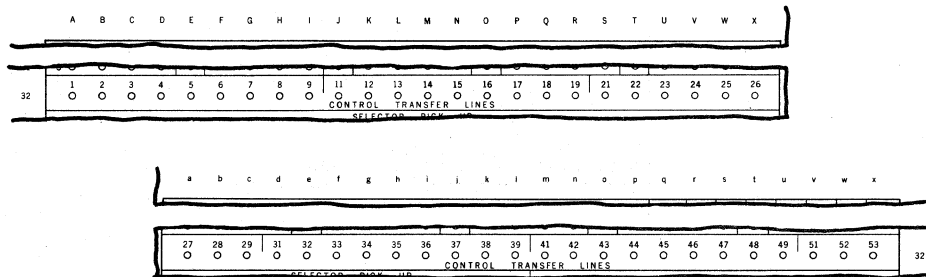
Field Transfer Lines (A-x,35)



These 48 sockets, numbered F1 through F48, are the terminals on the Constant & Program Panel for the direct connections between this panel and the Input & Output Panel. Each terminal here is related by number to its corresponding terminal on the Input & Output Panel.

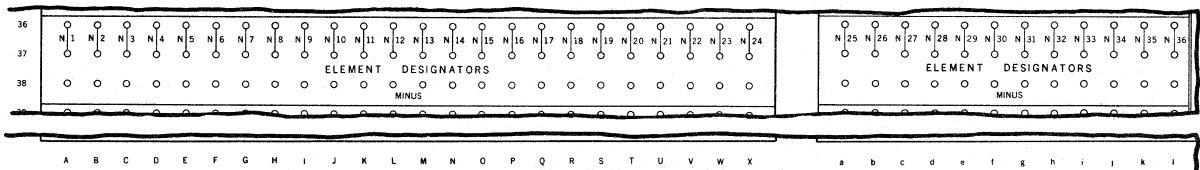


Control Transfer Lines (A-x,32)



These 48 sockets, numbered 1 through 53 (the numbers 10, 20, 30, 40, and 50 are not used) are the terminals on the Constant & Program Panel for the direct connection between this panel and the Input & Output Panel. Each terminal here is related by number to its corresponding terminal on the Input & Output Panel.

ELEMENT DESIGNATORS



The 36 vertical rows of three sockets each within this section (A-I,36-38) are used to designate or identify the individual Input Values and Constant Values as Elements; and also, whether those individual Elements are positive or negative.

The upper two sockets in each vertical row (36&37) are interconnected at the rear of the panel to serve equally. A connection is made from the C (Call) sockets of either Card Sensing or Constant Digits to either of these sockets to designate the related value as an Element.

The lower socket (MINUS) in each vertical row (38) is used to identify the related Element as a negative.

For a constant negative Value, either Input or Constant, the Minus socket is connected to one of its Element Designator sockets.

For a Value, either Input or Constant, that may be either negative or positive depending upon the presence or absence of control punching, the related card control position of Card Sensing is connected to the desired Minus socket.

When the Minus socket is not connected, the Element is positive.

DECIMAL LOCATION

Two sections are provided to set the decimal point of each Element used in the Program:- Input Values, Constant Values, Intermediate Values, and Output Values.

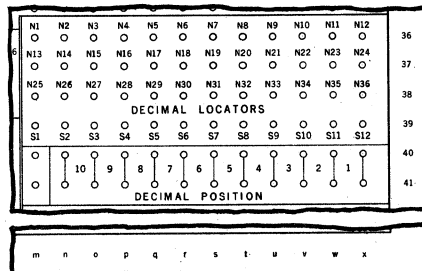
Decimal Locators (m-x,36-39)

These 48 sockets represent the Elements of the Program. They are identified with the related Element by the symbol over each socket.

N1 through N36 - These sockets would represent Input and Constant Values.

S1 through S12 - These sockets would represent Intermediate and Output Values.





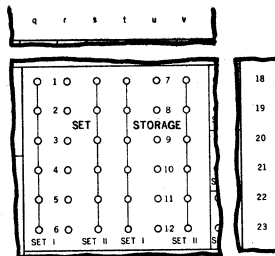
Decimal Position (n-x,40-41)

These 11 sets of two sockets each represent the 11 possible decimal settings within the 10 Accumulator Columns, Each set of two sockets is interconnected to serve equally.

The numbers between the individual sets of sockets are the Accumulator Column numbers. Thus the decimal positions range from the right of Column 1 to the left of Column 10, from right to left.

A connection is made from the Decimal Locator socket for the Element to the desired Decimal Position socket to set the decimal point for that Element. As many Element connections to an individual Decimal Position may be made as is required.

SET CONTROL



The Set operation is controlled by the six vertical rows of six sockets each within this section (q-v,18-23).

Calculated results delivered from the Accumulator to Intermediate Storage Units are transmitted, upon signal during the Program, from the Intermediate Storage Units to the Punching Setup Section as Output Values. These values are those wired from the Storage Output to Card Punching on the Input & Output Panel.

The SET operation is used to transfer the Intermediate Values to Output Values. REMEMBER:- This operation does not clear the related Intermediate Storage Units.

The Set operation is, in fact, divided into two separate operations, SET I and SET II; they may be programmed accordingly.

During Set I, the results in certain of the Intermediate Storage Units wired for Output may be transmitted to the Punching Setup Section.

During Set II, the results from the balance of the Intermediate Storage Units may be transmitted.

On the other hand, all of the results may be transmitted simultaneously on either Set I or on Set II.

The two vertical rows of six single sockets each (r&u) in this section are related to the individual Intermediate Storage Units according to the symbols to the left of those for Units 1 - 6 and to the right of those for Units 7 - 12.



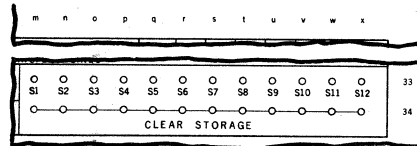
The Set I sockets are in two vertical rows of six common sockets each (q&t). They are designated "SET I" at the bottom of each row. The sockets in each of these rows are interconnected to serve equally.

The Set II sockets are in two vertical rows of six common sockets each (s&v). They are designated "SET II" at the bottom of each row. The sockets in each of these rows are interconnected to serve equally.

A connection is made from the individual Unit sockets to either the SET I or SET II sockets for the Intermediate Storage Units to deliver Output Values.

Any unconnected Unit will, of course, not be Set. The results delivered to those Units would only be used as Intermediate Values.

CLEAR STORAGE



The Clear operation is controlled by the two horizontal rows of 12 sockets each within this section (m-x,33-34).

The values in Intermediate Storage Units are erased with the Units restored to zero upon signal during the Program. This is the CLEAR operation. Whether a Unit will Clear or not when this signal is delivered depends upon the wiring in this section.

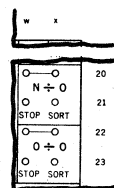
In the upper row (m-x,33), the individual sockets are each related to an Intermediate Storage Unit (S1 - S12) according to the symbol immediately below each socket.

The lower row of common sockets (m-x,34) are interconnected to serve equally to emit the Clear signal when that signal is delivered during the Program.

A connection is made from the individual Unit sockets to the Clear sockets for the Intermediate Storage Units to receive the Clear signal during the Program.

Any unconnected Unit will, of course, not be affected when the Clear signal is delivered.

ZERO DIVISOR SELECTION



The two Zero Divisor Selectors are represented by the four sockets within each of these two sections (w&x,20-23). The wiring of these sockets determines what action the machine is to take when attempting a calculation whose result is infinity (dividing a number by zero) or indeterminate (dividing zero by zero).

$N \div 0$ - This group of four sockets (w&x,20&21) is related to an infinite result.

The upper two common output sockets (w&x,20) in this section emit a signal when any attempt is made during the Program to divide a number by zero.

$0 \div 0$ - This group of four sockets (w&x,22&23) is related to an indeterminate result.

The upper two common output sockets (w&x,22) in this section emit a signal when any attempt is made during the Program to divide zero by zero.

The lower two input sockets (w&x,21&23) within each of these two sections permit two different actions to be taken by the machine when an infinite or indeterminate result occurs. The action related to each is printed on the panel below the sockets.



STOP - (w,21&23) - By connecting this socket with its related output socket (w&x,20) or (w&x,22), a zero result will be delivered from the Accumulator to the related Intermediate Storage Unit. The card feeding stops with the proper Indicator lit on the Control Panel; either $N \div 0$ or $0 \div 0$ according to the wiring in these sections.

SORT & TRIP (SORT) - (x,21&23) - By connecting this socket with its related output socket (w&x,20) or (w&x,22) a zero result will be delivered from the Accumulator to the related Intermediate Storage Unit. The card causing the result is automatically fed from the machine (Trip) into the front Card Receiver (Sort).

That card will be punched with any information Set into the Punching Setup Section before the Sort & Trip signal is received. The Program for that card is stopped. A new Program is started for the following card.

Either setting can be made for either Zero Divisor or no connection can be made for either or both.

If a Zero Divisor is not connected, a zero result will be delivered from the Accumulator to the related Intermediate Storage Unit without interruption to the Program.

PROGRAM

The Program sections of the Constant & Program Panel are located in the upper portion.

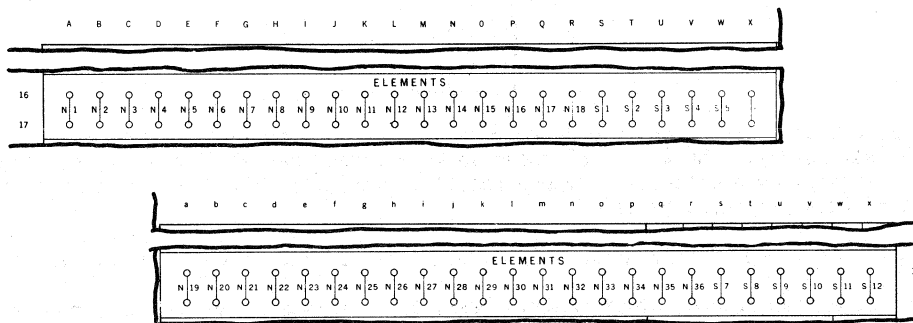
This portion of the panel contains the sockets wired to set the machine to perform the pre-planned course of actions involved in a Program. Among these are the means:

1. To start the Program.
2. To connect the two Values of a Program Step to their source.
3. To inform the machine of the arithmetical process involved in each Program Step.
4. To direct the result of each calculation to its proper Intermediate Storage Unit.
5. To Branch from one Step to the next Step or operation.

Depending primarily upon the number of Steps involved in individual Programs; one, two, or more separate Programs may be incorporated in the wiring of the Program sections. A Program can be wired to start at whatever Program Step Number desired; not necessarily Step 1.

The various sections in the Program portion of the panel are as follows:

Elements



The 48 vertical rows of two common sockets each within this section (A-x,16&17) represent the Elements to be used and the Result to be obtained in the Equation for each Program Step. The two sockets in each vertical row are interconnected at the rear of the panel to serve equally.

The sockets numbered N1 through N36 call upon the Elements of Input or Constant Value as defined by the wiring of the like numbered Element Designators to enter into the Equation as V1 or V2.



The sockets numbered S1 through S12 call upon the 12 Intermediate Storage Units:

1. As Intermediate Values to enter into the Equation as V1 or V2, or
2. To receive the Result (R) of the Process.

Equation

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P									
18	V1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	V1	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
	STEP	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	STEP	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40										
19	V2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	V2	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
20	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

There are 40 vertical rows of three sockets each within this section (A-p,18-20), one row for each of the 40 Program Steps. Each row is identified with its related Step by number, from Step 1 at the left to Step 40 at the right.

The three sockets in each vertical row of this section emit the signals to call in the desired Storages (Input, Constant, or Intermediate) containing the two values to be used in the Process for each Program Step and to call in the desired Intermediate Storage to receive the Result of the Process of the Program Step.

Connection is made between these sockets and those in the Element section:

- V1 - The sockets in the upper horizontal row (18) emit the impulse to call in the Element to be used as Value 1 in the Process for the related Program Step.
- V2 - The sockets in the center horizontal row (19) emit the impulse to call in the Element to be used as Value 2 in the Process for the related Program Step.
- R - The sockets in the lower horizontal row (20) emit the impulse to call in the desired Intermediate Storage Unit to receive the Result of the Process for the related Program Step.

Process

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P									
21	P	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	P	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
22	+	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	+	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
23	-	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	-	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
24	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	X	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
25	÷	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	÷	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

There are 40 vertical rows of five sockets within this section (A-p,21-25), one row of each of the 40 Program Steps. Each row is identified with its related Program Step by number, from Step 1 at the left to Step 40 at the right.

The arithmetical Process (addition, subtraction, multiplication, division) to be applied to the two values entering into each Step of the Program is determined by the wiring of the sockets within this section.

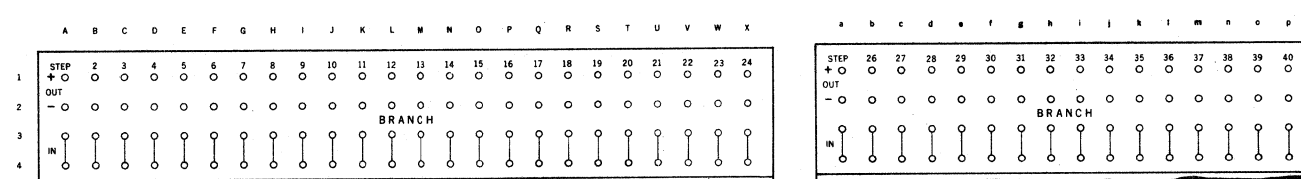
- Process (P) - The sockets in horizontal row (21) emit the signal used in impulsing the Process desired for the related Program Step.
- Add (+) - The sockets in horizontal row (22) receive the impulse to cause the addition of the two Values for the related Program Step.
- Subtract (-) - The sockets in horizontal row (23) receive the impulse to cause the subtraction of the two Values for the related Program Step.



Multiply (x) - The sockets in horizontal row (24) receive the impulse to cause the multiplication of the two Values for the related Program Step.

Divide (÷) - The sockets in horizontal row (25) receive the impulse to cause the division of the two Values for the related Program Step.

Branch



There are 40 vertical rows of four sockets within this section (A-p,1-4), one row for each of the 40 Program Steps. Each row is identified with its related Program Step by number, from Step 1 at the left to Step 40 at the right.

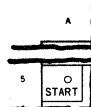
The four sockets in each vertical row are concerned with the Branching from and to the Program Steps.

The interconnected sockets in the lower two horizontal rows (3&4), IN, receive the impulse to start the related Program Step.

The sockets in the upper horizontal row (1), OUT, emit an impulse at the end of the related Program Step when the Result is positive (+). This impulse is used in Branching to the next Program Step or operation to be performed.

The sockets in the second horizontal row (2), OUT, emit an impulse at the end of the related Program Step when the Result is negative (-). This impulse is used in Branching to the next Program Step or operation to be performed.

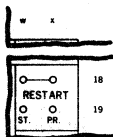
Operations



START - (a,5) - This socket emits the signal used to start the Program. This signal is emitted when the Card Feed Switch on the Control Panel is moved to the Start Position. When the Auto. Feed Switch on the Control Panel is set On, the start signal is automatically emitted from this socket to initiate each Program.

A connection is made between this socket and an IN socket in the Branch section for the initial Program Step.

If a card is to feed through the Sensing Section without initiating a Program, a connection would be made from the Start directly to the Trip (see below). This would be true during a straight Reproducing operation.



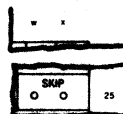
RESTART - (w&x,18&19) - The wiring within this section determines which one of the two Restart operations the machine will perform should a Program Step fail to prove on the first attempt.

The upper two common output sockets (w&x,18) emit the Restart impulse used in governing this operation.



The lower socket to the left (w,19), marked ST., is the input for the Restart impulse when Step Restart is to be performed. The particular Program Step will be repeated for the attempt at Proof when this connection is made.

The lower socket to the right (x,19), marked PR., is the input for the Restart impulse when Program Restart is to be performed. The Program will revert to the initial Step to repeat the particular Program for the attempt at Proof when this connection is made.

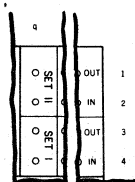


SKIP - (w&x,25) - The two sockets in this section are used to perform the Program Controlled Skip Cycle operation. Either socket may be used for either input or output.

Card punching is prevented through the use of these sockets. When the Skip Cycle is delivered, none of the information Set into the Punching Setup Section - either Reproduce or Output Value - will be punched in the card sensed at the time the signal is delivered.

NOTE:- The SKIP sockets on the Input & Output Panel perform the same function by card control.

The wiring of these sockets is routed through a Selector with the Selector controlled by Program Select (see below).

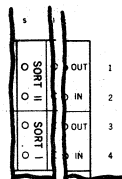


SET I - (q,3&4) - These two sockets are the input and output for the impulsing of the Set I operation; (q,4) is the input, (q,3) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.

SET II - (q,1&2) - These two sockets are the input and output for the Set II operation; (q,2) is the input, (q,1) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.



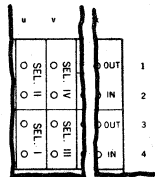
SORT I - (s,3&4) - These two sockets are the input and output for the impulsing of the Sort operation; (s,4) is the input, (s,3) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.



SORT II - (s, 1&2) - These two sockets are another input and output for the impulsing of the Sort operation; (s,2) is the input, (s,1) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.



SEL. I - (u,3&4) - These two sockets are the input and output for the impulsing of the Program Select I operation; (u,4) is the input, (u,3) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.

SEL. II - (u,1&2) - These two sockets are the input and output for the impulsing of the Program Select II operation; (u,2) is the input, (u,1) is the output.

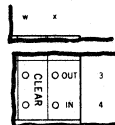
Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.

SEL. III - (v,3&4) - These two sockets are the input and output for the impulsing of the Program Select III operation; (v,4) is the input, (v,3) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.

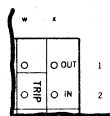
SEL. IV - (v, 1&2) - These two sockets are the input and output for the impulsing of the Program Select IV operation; (v,2) is the input, (v,1) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input socket of another operation.



CLEAR - (w,3&4) - These two sockets are the input and output for the impulsion of the Clear operation; (w,4) is the input, (w,3) is the output.

Branch wiring from an OUT Branching socket of a Program Step or the output socket of another operation is routed through these sockets to the IN Branching socket of another Program Step or the input of another operation.



TRIP - (w,2) - This socket is the input for the impulsing of the TRIP operation.

Branch wiring from an OUT Branching socket of a Program Step or the output of another operation is to this socket.

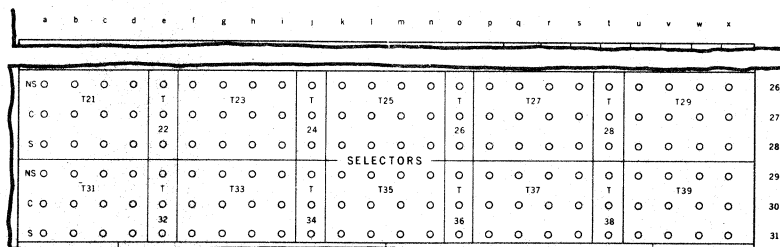
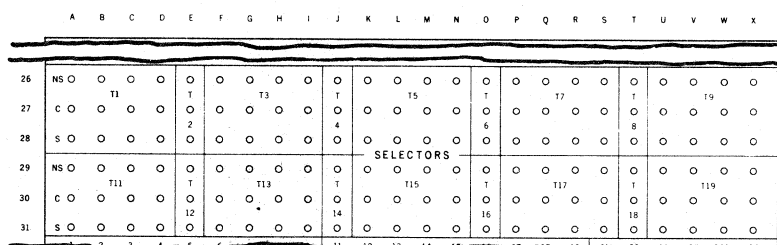


As Trip is the final operation, there is no external output from the Trip operation. The Trip is, however, internally connected to deliver an automatic signal from the Start to initiate the next Program.

SELECTORS

The sections of the Constant & Program Panel directly related to the Selector operation are located just above the center of the panel.

Selectors



The sockets representing the 36 Selectors are in the area (A-x,26-31). Each Selector is identified by symbol from T1 through T39 (The symbols T10, T20, and T30 are not used). The 4-column Selectors bear odd numbered symbols. The single-column Selectors are identified with even numbered symbols.

- NS (Non-Select) - The sockets in horizontal rows (26&29) are the Non-Select sockets for the individual Selectors.
- C (Common) - The sockets in horizontal rows (27&30) are the Common sockets for the individual Selectors.
- S (Select) - The sockets in horizontal rows (28&31) are the Select sockets for the individual Selectors.

NOTE:- The NS, C, and S sockets in each vertical row of the Selectors are related to one another regardless of whether the Selector is single - or four-column. Related wiring must be to or from these three related sockets in the same vertical row.

Those Selector sockets do not of themselves impart any impulse to the digits or controls passing through them; they enter and leave the Selectors only under their own impulse.

A Selector is always in the Non-Select position unless its Pick Up (see below) is being impulsed. When impulsed, the Selector assumes the Select position.

The wiring to and from the NS, C, and S sockets in each vertical row is according to which one of the two general types of Selector operation is desired:

1. To select one of two digits or controls:

One of the digit or control impulses is wired to the S (Select) socket; the other is wired to the NS (Non-Select) socket. Wiring out of the Selector is from the C (Common) socket.



While the related Pick Up is being impulsed, the digit or control impulse wired to the S socket is emitted from the C socket when, of course, that digit or control receives its own impulse.

When the Pick Up is not being impulsed, the digit or control impulse wired to the NS socket is emitted from the C socket whenever that digit or control receives its own impulse.

2. To send one digit or control in either of two directions:

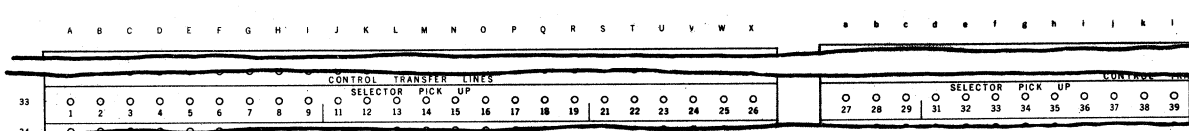
The digit or control is wired to the C socket. The digit or control is wired out of the S socket in one direction; out of the NS socket in the other direction.

While the related Pick Up is being impulsed, the digit or control is emitted from the S socket when, of course, that digit or control receives its own impulse.

When the Pick Up is not being impulsed, the digit or control is emitted from the NS socket whenever that digit or control receives its own impulse.

Of course, a digit or control wired to a C socket may be wired out of that Selector on only the Select side or only the Non-Select side. In the first case, the digit or control will only be delivered while the Pick Up of that Selector is being impulsed. In the second case, the digit or control will be delivered at all times except during the interval the Pick Up is impulsed.

Selector Pick Up



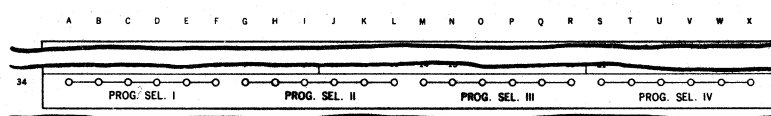
The sockets in the horizontal row (A-1,33) are the Pick Up sockets to control the individual Selectors. There is a Pick Up socket for each of the 36 Selectors. Each socket is identified with the Selector it controls by the number (1 - 39) printed beneath the socket.

When an impulse is delivered to one of these Pick Up sockets, the related Selector assumes the Select position. The Selector will revert to the Non-Select position just as soon as that impulse ends.

A Selector Pick Up may be impulsed by: card control, the Program Select (see below), or by the Selector Hold (see below).

A Selector whose Pick Up is impulsed by card control will remain in the Select position for the duration of that Program. The Selector will automatically revert to Non-Select at the end of the Program to be once again impulsed or not depending upon whether the following card contains the related control punching.

Program Select



The sockets in the horizontal row (A-X,34) are related to the four Program Select operations for the control of Selectors. There are four groups of six common sockets each in this section:

- Program Select I (PROG.SEL. I) - (A-F,34)
- Program Select II (PROG.SEL. II) - (G-L,34)
- Program Select III (PROG.SEL. III) - (M-R,34)
- Program Select IV (PROG.SEL. IV) - (S-X,34)



When the Program Select operation socket (u-v,1-4) in the upper right corner of the panel is impulsed during the Program, an impulse is emitted from the related six common sockets in this section.

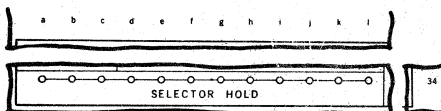
The impulsing of SEL.I (u,3&4) causes PROG.SEL.I (A-F,34) to emit.
 The impulsing of SEL.II (u,1&2) causes PROG.SEL.II (G-L,34) to emit.
 The impulsing of SEL.III (v,3&4) causes PROG.SEL.III (M-R,34) to emit.
 The impulsing of SEL.IV (v,1&2) causes PROG.SEL.IV (S-X,34) to emit.

To control a Selector during a Program, the Pick Up socket of that Selector is wired to one of the sockets in the group of six in this section for the desired Program Select. When the related SEL. operation socket is impulsed during the Program, the Selector thus picked up will immediately assume the Select position ready for the next Program Step or operation.

A Selector whose Pick Up is impulsed by Program Select will remain in the Select position for the balance of that Program. The Selector will automatically revert to Non-Select at the end of the Program to be once again impulsed or not depending upon whether that Program Select impulse is delivered during the following Program.

A Program Select may, however, be deactivated for reuse during the same Program.

SELECTOR HOLD



The 12 common sockets in this section (a-l,34) are used to maintain Selectors in the Select position as long as desired without interruption as long as the current to the Electronic Computing Unit is ON.

The wiring from a Selector Pick Up socket can be direct to a Selector Hold socket. The Selector thus controlled will remain in the Select position for the duration of the run.

To obtain control over the Selector Hold operation, it would be wired through a separate Selector from the Pick Up socket rather than directly. The control Selector would then be operated by card control or Program Select so that the Selector Hold would be used only when desired.

BUSES

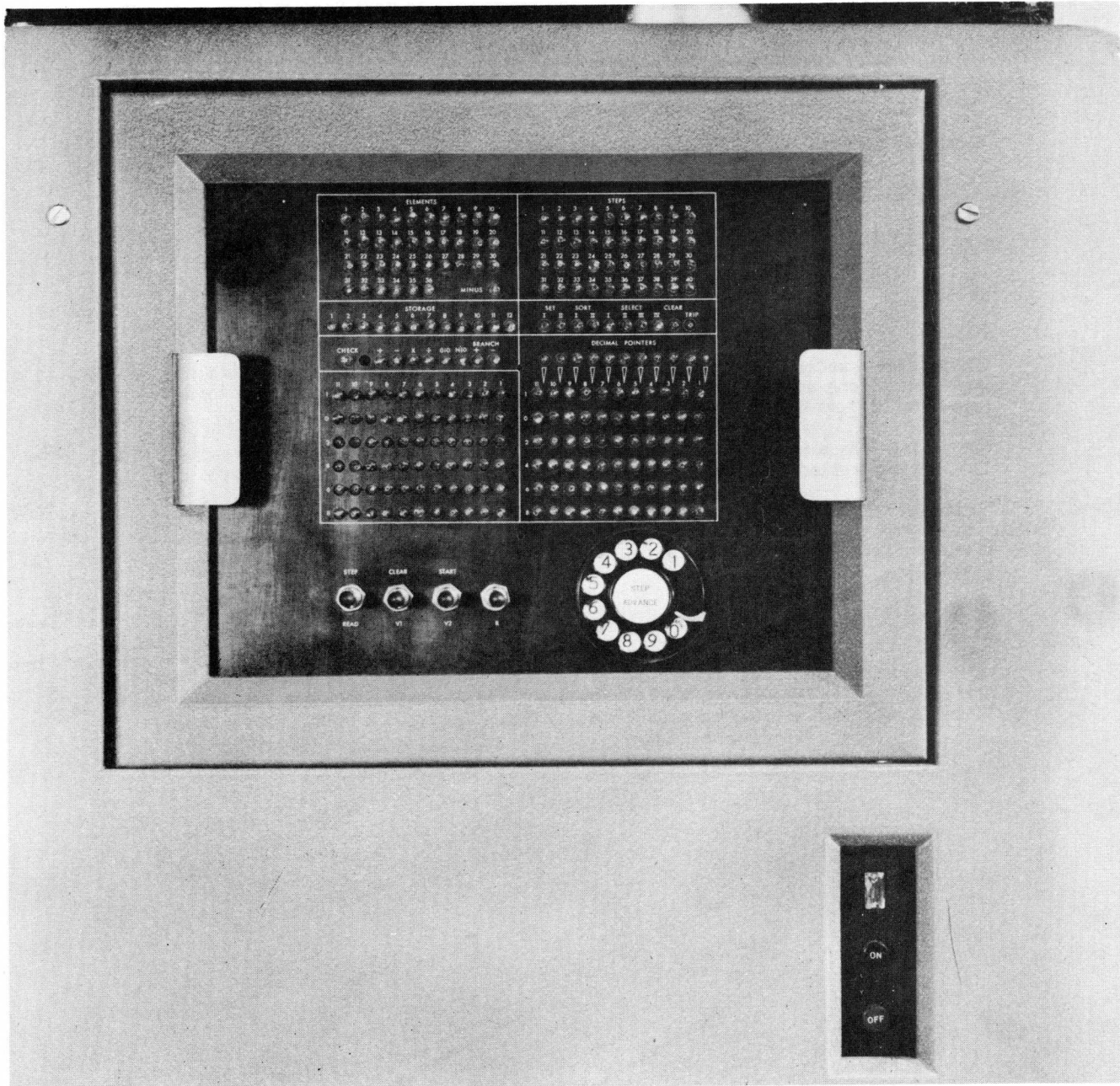
There are seven areas of Bus sockets on the Constant & Program Panel; (A-X,5-10), (a-x,5-10), (A-X,11-15), (a-x,11-15), (m-x,42-50), (A-X,56-60), and (a-p,56-60). The Bus capacities of 4, 5, 6, and 9 sockets are provided within these areas. (See Input & Output Panel, Buses).



Program Test Panel

The Program Test Panel is located on the upper left end of the Electronic Computing Unit. With flashing indicating lights, this panel portrays the machine operation during a run. By means of this panel when card feeding is stopped:

1. The operator can visually analyze all operations of any desired Step of a Program. In fact, the operator can analyze an entire Program; Step-by-Step, operation-by-operation.
2. Mechanical Service can carry the analysis still farther into each detail of the process as it is developed within the Accumulator for individual Program Steps.



Included in this view of the Program Test Panel is the Computer On-Off Switch Panel at the lower right corner.



With a unique double hinge, the Program Test Panel can be swung to the rear of the Electronic Computing Unit or to the front by means of the handles at the left and right on the panel:

To swing the panel to the front; use the handle at the left side, swing the left edge to the front. The panel will hinge on its right edge. The swing is 90 degrees.

To swing the panel to the right; use the handle at the right side, swing the right edge to the rear. The panel will hinge on its left edge. The swing is about 145 degrees.

The Program Test Panel contains; four switches to control the machine operation when using the panel, a telephone type dial to obtain the Program Step or Steps desired, neon indicator lights to show all phases of a Program Step.

CONTROL SWITCHES

The four Control Switches are located at the lower left of the panel. These switches, from left to right, are:

STEP-READ SWITCH - This toggle type switch is set in the center position when the Program Test Panel is not being used for an analysis of the Program. When using the Panel, this switch is set in either one of the following two positions:

STEP (Up) - The switch is set up to the STEP position when the Step Advance Dial (see below) is to be used.

READ (Down) - The switch is set down to the READ position when the indicating lights on the panel are to be read.

During a run, the Step-Read Switch is set in the center position. All indicators of the Program Test Panel will function as a reference for the operator as to the progress of the run.

CLEAR-V1 SWITCH - This throw type switch is moved either up or down; it returns to the center position when not in use.

Clear (Up) - The switch is moved up to the CLEAR position to clear the Intermediate Storage of all values. This switch movement will be effective to clear all Intermediate Storage Units regardless of the wiring of the Clear Storage section of the Constant & Program Panel.

V1 (Down) - The switch is moved down to the V1 position to read all indications related to the Value 1 of the Program Step. The switch is held down while making the reading.

START-V2 SWITCH - This throw switch is moved either up or down, it returns to the center position when not in use.

START (Up) - The switch is moved up to the START position to bring the Program to and through the initial Program Step.

V2 (Down) - The switch is moved down to the V2 position to read all indications related to the Value 2 of the Program Step. The switch is held down while making the reading.

R SWITCH - This throw switch is moved down to the R position to read all indications related to the Result of the Program Step. The switch is held down while making the reading; it returns to the center position when not in use.

STEP ADVANCE DIAL

This telephone type dial is located at the lower right corner of the panel. This dial contains the numbers 1 through 9 and 0. The "0" is equal to 10.

This dial is used to advance through the Steps of a Program or directly from the initial Step to a particular Step desired.

The Step Advance Dial operates on an additive basis:

To go through the Program Step-by-Step, the "1" is dialed each time the operator wishes to advance to the next Step.



To reach a Step within the Program directly from the initial Step, the numerical difference between the initial Step (as 1) and the Step desired is dialed. Thus:

To reach the 10th Step from the initial Step, the 9 is dialed.

To reach the 19th Step from the initial Step, the 0 is dialed followed by the dialing of the 8.

To reach the 35th Step from the initial Step, the 0 is dialed three times followed by the dialing of the 4.

To dial from one Step to another within the Program, the same procedure of dialing the difference is followed. Thus; to dial from the 19th Step to the 35th Step, the 0 is dialed followed by the dialing of the 6.

When the dial is used to advance through intervening Steps, those Steps are performed by the machine.

When using the Step Advance Dial, each Program Step of the Program and each operation (Operational Step) performed within the Program is considered a Step. These Steps are numbered, as far as dialing is concerned, according to their occurrence in the Program.

INDICATOR LIGHTS

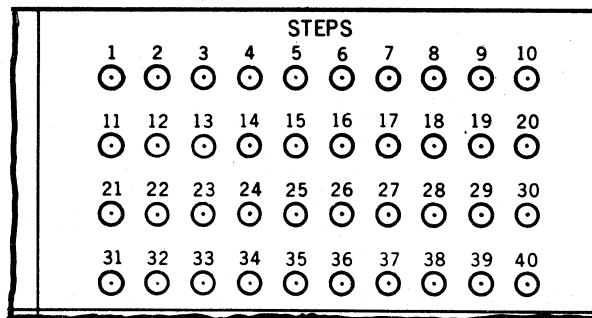
<p>ELEMENTS</p> <p>1 2 3 4 5 6 7 8 9 10 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>11 12 13 14 15 16 17 18 19 20 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>21 22 23 24 25 26 27 28 29 30 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>31 32 33 34 35 36 MINUS <input type="radio"/></p>	<p>STEPS</p> <p>1 2 3 4 5 6 7 8 9 10 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>11 12 13 14 15 16 17 18 19 20 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>21 22 23 24 25 26 27 28 29 30 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>31 32 33 34 35 36 37 38 39 40 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>
<p>STORAGE</p> <p>1 2 3 4 5 6 7 8 9 10 11 12 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>	<p>SET SORT SELECT CLEAR</p> <p>I II I II I II III IV TRIP <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>
<p>BRANCH</p> <p>CHECK + - X ÷ 0÷ON÷0 + - <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>	<p>DECIMAL POINTERS</p> <p><input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>11 10 9 8 7 6 5 4 3 2 1 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>
<p>11 10 9 8 7 6 5 4 3 2 1</p> <p>1 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>0 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>2 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>4 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>6 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>8 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>	<p>11 10 9 8 7 6 5 4 3 2 1</p> <p>1 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>0 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>2 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>4 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>6 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p> <p>8 <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/></p>

The major portion of the Program Test Panel contains groups of neon indicators which, when lit, show the following:



The Step
 The Element number
 The Intermediate Storage number
 The Operation
 The Process
 The Branching
 Zero Division Selection
 The Proof
 The amount of the Value or Result
 The sign of the Value or Result
 The decimal point of the Value or Result

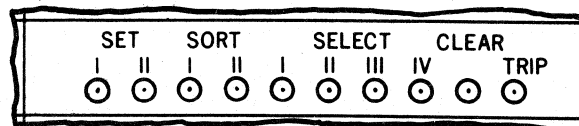
Program Steps



The 40 indicators in this section headed "Steps" are related to the 40 Program Steps. The Program Step to which each indicator is related is printed on the panel just above that indicator. These are the actual Program Step Numbers; not necessarily the sequence within a particular Program.

As the machine proceeds through a Program, one of these indicators will light as the machine performs the related Program Step. When the machine stops or is stopped during a run, one of these indicators will be lit (if the stop occurs on a Program Step) to show the point in a Program at which the stoppage occurred.

Operational Steps



The 10 indicators in this section are related to the 10 Operational Steps. The operation to which each indicator is related is printed on the panel just above that indicator.

From left to right, these indicators and their related operations are

SET - Set I and Set II
 SORT - Sort I and Sort II
 SELECT - Program Select I, Program Select II, Program Select III, and Program Select IV.
 CLEAR
 TRIP

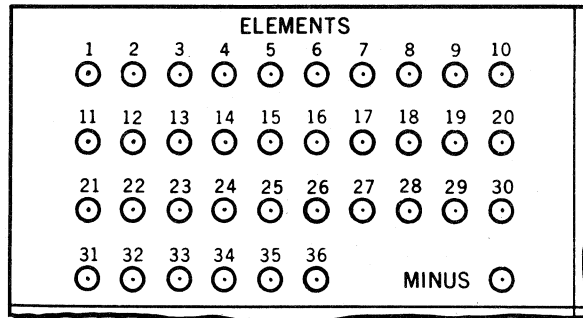
As the machine proceeds through a Program, one of these indicators will light as the machine performs the related Operational Step. When the machine stops or is stopped during a run, one of these indicators will be lit (if the stop occurs on an Operational Step) to show the point in a Program at which the stoppage occurred.

When a Program Select operation has been performed, its indicator will light. That indicator will remain lit for the balance of the Program unless that Program Select is deactivated during the Program. The balance of the indicators will go out, however, immediately after the related Operational Step has been performed.



Elements (Input or Constant Values)

The 36 numbered indicators in this section headed "ELEMENTS" are related to the Element Numbers assigned to the Input and Constant Values used in the Program. The number of the Element to which each indicator is related is printed on the panel just above that indicator.

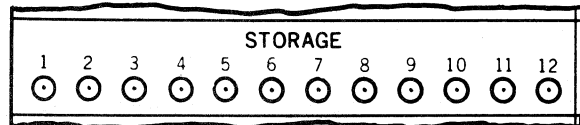


As the machine proceeds through a Program, one of these indicators will light each time the related Input or Constant Value is used in a Program Step as V1 or V2. When the machine stops or is stopped during a run, none of these indicators will be lit as the stoppage occurs at the conclusion of the Step.

With the machine stopped on a Program Step for a reading of the Program Test Panel, the movement of the Clear-V1 Switch to the V1 position or the movement of the Start-V2 Switch to the V2 position will cause one of these indicators to light if an Input or Constant Value is being used as the V1 or V2 on that Program Step. This Element indication signifies which one of the Input or Constant Values is being used at that time.

The MINUS indicator, in the lower right corner of this section, will light to signify a negative Value or Result.

Intermediate Storage (Intermediate or Output Value)

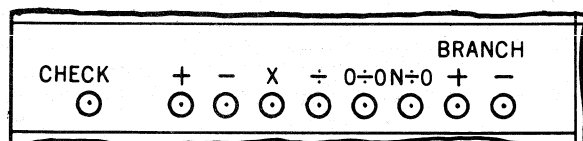


The 12 numbered indicators in this section headed "STORAGE" are related to the 12 Intermediate Storage Units. The number of the Intermediate Storage Unit to which each indicator is related is printed on the panel just above that indicator.

As the machine proceeds through a Program, one of these indicators will light each time the related Intermediate Storage Unit delivers an Intermediate Value to be used as V1 or V2 in a Program Step. When the Result of a Program Step is delivered to Intermediate Storage, the indicator related to the Intermediate Storage Unit receiving that Result will light.

With the machine stopped on a Program Step for a reading of the Program Test Panel, the movement of the Clear-V1 Switch to the V1 position or the movement of the Start-V2 Switch to the V2 position will cause one of these indicators to light if an Intermediate Value is being used as the V1 or V2 on that Program Step. Also, when the R Switch is moved to its R position, one of these indicators will light to signify which of the Intermediate Storage Units has received that Result.

Process



The 9 indicators in this section are related to the machine process and branching. When the machine stops or is stopped during a run, the indicators within this section applying to the particular Program Step will be lit.

From left to right, these indicators are:

CHECK - This is the Proof indicator. It will light if the Proof operation is successful.

As the machine proceeds through a Program, this indicator will light following each proven Program Step.

During a run should this indicator not light at the conclusion of a Program Step and the Program or Program Step repeat itself (depending on the wiring in the Restart section of the Constant & Program Panel), it is an indication of the failure to obtain Proof for that Program Step.

ADD (+) - This indicator, if lit, signifies that the process of addition is being used on the particular Program Step.

SUBTRACT (-) - This indicator, if lit, signifies the process of subtraction is being used on the particular Program Step.

MULTIPLY (x) - This indicator, if lit, signifies the process of multiplication is being used on the particular Program Step.

DIVIDE (\div) - This indicator, if lit, signifies the process of division is being used on the particular Program Step.

0 \div 0 - If the machine attempts to divide zero by zero to obtain an indeterminate result, this indicator will light.

The action to be taken by the machine when this division is attempted is determined by the Zero Divisor Selection wiring of the Constant & Program Panel.

N \div 0 - If the machine attempts to divide a number by zero to obtain an infinite result, this indicator will light.

The action to be taken by the machine when this division is attempted is determined by the Zero Divisor Selection wiring of the Constant & Program Panel.

BRANCH (+ and -) - Either the plus or the minus indicator will light at the end of each Program Step. These indicators show whether the Result is positive or negative. In the event of a negative Result, both the Minus Branch indicator and the Minus indicator in the Elements section will light.

Accumulator

The indicators in these two sections represent the 22 Counters of the Accumulator:

The indicators in the first ten vertical rows from the right in the right hand section, numbered from 1 to 10, represent the 10 Accumulator Columns into which Values are entered and from which the Result is delivered to the Intermediate Storage.

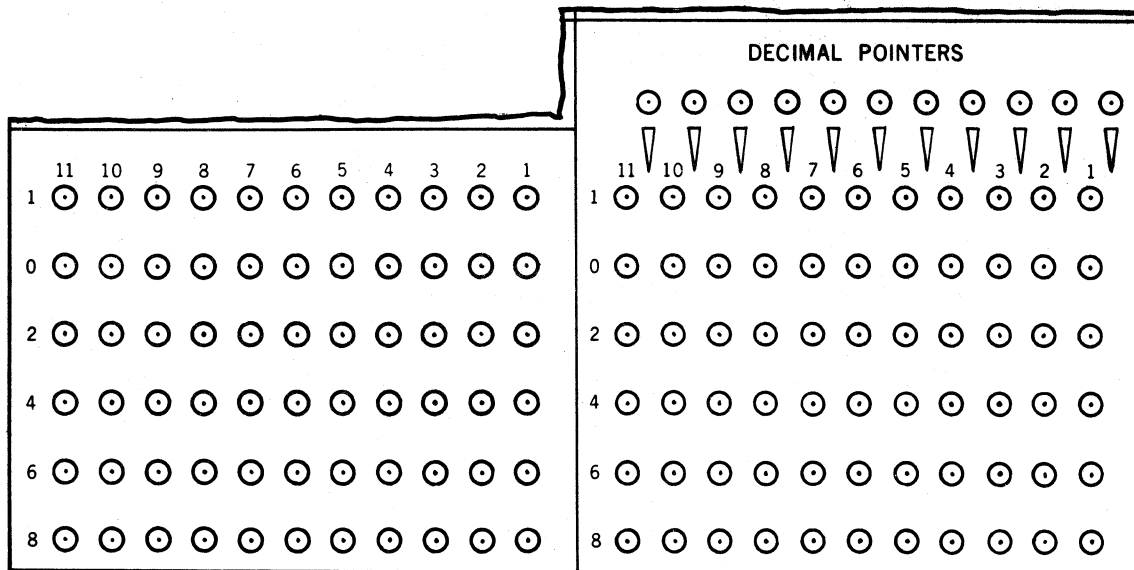
The indicators in the vertical row numbered 11 in the right hand section together with the indicators in the 11 vertical rows in the left hand section represent the balance of the Counters of the 22-Counter Accumulator.

Each of the 22 vertical rows contains six indicators. These six horizontal rows are numbered, from top to bottom; 1, 0, 2, 4, 6, 8, to represent the respective digital value of the Value or Result. The odd numbers; 3, 5, 7, and 9 are formed by the simultaneous lighting of the "1" indicator and the indicator for the preceding even number.

The ten digital values; 0, 1 - 9, are represented by the six indicators in one vertical row as follows depending on whether the Minus indicator is lit or not:

With the Minus indicator unlit to designate a positive Value or Result, a direct reading is obtained:





- Digital Value 0 - Indicator 0
- " " 1 - Indicators 1 and 0
- " " 2 - Indicator 2
- " " 3 - Indicators 1 and 2
- " " 4 - Indicator 4
- " " 5 - Indicators 1 and 4
- " " 6 - Indicator 6
- " " 7 - Indicators 1 and 6
- " " 8 - Indicator 8
- " " 9 - Indicators 1 and 8

With the Minus indicator lit to designate a negative Value or Result, a reading of the 10's complement of the Value or Result is obtained.

- Digital Value 0 - Indicator 0
- " " 1 - Indicators 1 and 8 (9)
- " " 2 - Indicator 8
- " " 3 - Indicators 1 and 6 (7)
- " " 4 - Indicator 6
- " " 5 - Indicators 1 and 4 (5)
- " " 6 - Indicator 4
- " " 7 - Indicators 1 and 2 (3)
- " " 8 - Indicator 2
- " " 9 - Indicators 1 and 0

The Accumulator indicators will light during:

The V1 reading to show the digits of the Value 1 for the Program Step entering the Accumulator.

The V2 reading to show the digits of the Value 2 for the Program Step entering the Accumulator.

The R reading to show the Result of the Program Step. This Result reading is obtained from the Intermediate Storage to which the Result has been delivered following the process.

At the time the Accumulator indicators are lit, the related Element or Storage Indicator will also be lit to identify the Value or Result.



Decimal Pointers

The eleven indicators in the horizontal row located above the indicators for the 10 Accumulator Columns designate the decimal point for the Values and Results.

Notice that; one of these indicators is to the right of Accumulator Column 1, one is to the left of Column 10, while the balance are located between the Columns.

When a Value or Result is indicated, one of the Decimal Point indicators will also light to show the decimal setting for that Value or Result.



OPERATION

The most important element in the operation of the Punched-Card Electronic Computer is the design of the Program for each application.

The design of a Program depends, of course, primarily on the nature and complexity of the application. The aim is to gain the maximum efficiency of machine operation in obtaining the end result in the minimum number of Program Steps. This calls for careful planning and the use of ingenuity on the part of the Program designer.

The purpose of the following paragraphs is to outline the components of a Program as well as various means and possibilities of wiring the individual sections of the Connection Panels.

PROGRAM STEP

The Punched-Card Electronic Computer provides for a maximum of 40 Program Steps. A Program Step consists of the following operations performed in this sequence:

1. Pick up the first value - VALUE 1 (V1).
2. Prepare the machine for the arithmetical function (PROCESS) to be performed:- Addition, Subtraction, Multiplication, or Division.
3. Pick up the second value - VALUE 2 (V2).
4. Perform the Process on the Values to arrive at the RESULT (R), together with its SIGN (+ or -).
5. Deliver the Result together with its Sign to INTERMEDIATE STORAGE.
6. Verify the arithmetical operation performed - PROOF.
7. Guide the machine into the next action to be taken according to the Sign (+ or -) of the Result - BRANCHING.

Values V1 and V2.

The values entering into a Program Step may be a combination of two from any of the three sources; Input, Constant, or Intermediate Storage. In fact, it is possible to use the same value from the same source for both values.

It is the practice to refer to the Input and Constant Values used in a Program by the alphabetical-numerical Element symbol (N1 - N36) assigned these individual values. The Intermediate Values are referred to by the alphabetical-numerical symbol of the Intermediate Storage Unit (S1 - S12) to which they have been assigned.

When performing Addition or Multiplication, it is not important to the Process which of the two values is assigned as V1 or V2. For the maximum speed of Multiplication however, the value with the lesser number of digits should be assigned as the multiplier - V1.

For Subtraction or Division, however, it is important in the Process that the two values be properly assigned as V1 or V2 as follows:

Subtraction - The Minuend is assigned as Value V1.

The Subtrahend is assigned as Value V2.

The value to be subtracted (Subtrahend), regardless of whether it is a plus or minus value, is to be assigned as Value V2.

Division - The Dividend is assigned as Value V1.

The Divisor is assigned as Value V2.

Process

The machine treats the signs of Values in arriving at the sign of the Result when performing a Process in exactly the same manner as in algebra:



Multiplication and Division

$$\begin{array}{l} +V1 \left(\begin{array}{l} \times \text{ or } \div \\ \times \text{ or } \div \end{array} \right) +V2 = +R \\ +V1 \left(\begin{array}{l} \times \text{ or } \div \\ \times \text{ or } \div \end{array} \right) -V2 = -R \\ -V1 \left(\begin{array}{l} \times \text{ or } \div \\ \times \text{ or } \div \end{array} \right) +V2 = -R \\ -V1 \left(\begin{array}{l} \times \text{ or } \div \\ \times \text{ or } \div \end{array} \right) -V2 = +R \end{array}$$

Should the Result of Multiplication or Division be a negative zero, that negative sign is retained only until the Proof operation is completed. The sign will then become plus. The Zero value in the Intermediate Storage Unit, if used as a Value on following Steps or if Set, will be a plus. Branching out of the zero Step will always be plus.

If neither the value V1 nor V2 is zero and should the Result of Multiplication or Division be a negative zero, that negative sign is retained. The zero value in the Intermediate Storage Unit, if used as a Value on following Steps or if Set, will be a minus. Branching out of the zero Step will then be minus.

If either the Value V1 or V2 is zero, the negative sign of the Multiplication or Division is retained only until the Proof operation is completed. The sign will then become plus. The zero value in the Intermediate Storage Unit, if used as a Value on following Steps or if Set, will be a plus. Branching out of the zero Step will always be plus.

Addition and Subtraction

$$\begin{array}{l} +V1 + (+V2) = +V1 + V2 = +R \\ +V1 + (-V2) = +V1 - V2 = +R* \\ +V1 - (+V2) = +V1 - V2 = +R* \\ +V1 - (-V2) = +V1 + V2 = +R \\ -V1 + (+V2) = -V1 + V2 = +R* \\ -V1 + (-V2) = -V1 - V2 = -R \\ -V1 - (+V2) = -V1 - V2 = -R \\ -V1 - (-V2) = -V1 + V2 = -R* \end{array}$$

*When the Result in these cases is greater or less than zero, whether that Result will be plus or minus depends on whether the positive or negative value is the greater. When the values are equal, the zero value in the Intermediate Storage Unit, if used as a Value on following Steps or if Set, will be a plus. Branching out of the zero Step will always be plus.

Intermediate Storage

When the Accumulator has completed the Process, the Result, together with its Sign, is delivered to the designated Intermediate Storage Unit.

Where a value in an Intermediate Storage Unit is used as a Value in a Program Step, that same Intermediate Storage Unit may not be used to receive the Result of the Process of that Program Step:- to do so would prevent Proof.

Proof

The Result delivered to Intermediate Storage is used, together with the two Values, in the automatic Proof operation, as follows:

Addition is proved by the subtraction of V2 from R and subtracting V1 from the result of that subtraction to arrive at zero.

$$\begin{array}{l} V1 + V2 = R \\ \text{Proof: } R - V2 - V1 = \text{zero} \end{array}$$

Subtraction is proved by adding R to V2 and Subtracting V1 from the result of that addition to arrive at zero.

$$\begin{array}{l} V1 - V2 = R \\ \text{Proof: } R + V2 - V1 = \text{zero} \end{array}$$



Multiplication is proved by dividing the Result by V2, subtracting V1 to arrive at zero.

$$V1 \times V2 = R$$

$$\text{Proof: } R \div V2 - V1 = \text{zero}$$

Division is proved by multiplying the Result by V2, subtracting V1 to arrive at zero.

$$V1 \div V2 = R$$

$$\text{Proof: } R \times V2 - V1 = \text{zero}$$

If the Result does not prove on the first attempt, the machine will perform either one of two RESTART operations according to the wiring of the Restart sockets of the Constant & Program Panel:

1. Repeat the same Program Step (Step Restart).
2. Revert to the initial Program Step to repeat the partial Program (Program Restart).

Branching

The final phase of a Program Step is the Branching operation. The sign (+ or -) of the Result of one Program Step instructs the machine of the next action to be taken. This action may be: to proceed to another Program Step; to perform an Operational Step such as Program Select (SEL.), Sort, Set, Clear, or Trip.

Single Branch - Where the Sign of the Result is known to be either always positive or always negative, the machine may be allowed but one choice for the next action to be taken. A Single Branch would be either a Plus Branch or a Minus Branch.

Double Branch - Where the Sign of the Result may be either plus or minus, the machine may be allowed the choice of two actions depending on whether the Result is plus or minus or it may be allowed but one choice of action regardless of whether the result is plus or minus. A Double Branch would consist of both a Plus Branch and a Minus Branch.

Operational Branch - Where a Program Step branches to an Operation Step for the performance of an operation, that in turn can cause branching to another Operational Step. The branching from a Program Step to an Operational Step would be either a Plus Branch or a Minus Branch or both a Plus and Minus Branch. When branching from an Operation Step, however, there is no Sign involved. The Operational Branching possibilities are:

Sel. I to Sel. II, Sel. III, or Sel. IV
 Sel. II to Sel. I, Sel. III, or Sel. IV
 Sel. III to Sel. I, Sel. II, or Sel. IV
 Sel. IV to Sel. I, Sel. II, or Sel. III
 Sel. I, Sel. II, Sel. III, or Sel. IV to Set I or Set II
 Sel. I, Sel. II, Sel. III, or Sel. IV to Sort I or Sort II
 Sel. I, Sel. II, Sel. III, or Sel. IV to Clear
 Sel. I, Sel. II, Sel. III, or Sel. IV to Trip
 Sel. I, Sel. II, Sel. III, or Sel. IV to any of the 40 Program Steps other than the one from which the Program Select operation originated.

Set I to Set II
 Set II to Set I
 Set I or Set II to Sel. I, Sel. II, Sel. III, or Sel. IV
 Set I or Set II to Sort I or Sort II
 Set I or Set II to Clear
 Set I or Set II to Trip
 Set I or Set II to any of the 40 Program Steps other than the one from which the Set operation originated.



Sort I to Sort II
Sort II to Sort I
Sort I or Sort II to Sel. I, Sel. II, Sel. III, or Sel. IV
Sort I or Sort II to Set I or Set II
Sort I or Sort II to Clear
Sort I or Sort II to Trip
Sort I or Sort II to any of the 40 Program Steps other than the one from which
the Sort operation originated.

Clear to Sel. I, Sel. II, Sel. III, or Sel. IV
Clear to Set I or Set II
Clear to Sort I or Sort II
Clear to Trip
Clear to any of the 40 Program Steps other than the one from which the Clear oper-
ation originated.

NOTE:- The Sel. I, Sel. II, Sel. III, Sel. IV, Set I, Set II, Sort I, and Sort II are
each distinct operations. They may be programmed accordingly.



Reproduce, Input, Constant and Output Connections

Part of the Program design and machine operation includes the connection of card columns for; Reproduction, Input Value sensing, Constant Value formation, and Output Value punching.

The card columns to be connected, the particular sockets within each Accumulator Input and Storage Output to be used for these connections, the Element Number to be assigned each Input and Constant Value, together with the Decimal Locator setting for each Input, Constant, and Output Value should all enter into the pre-planning of a Program.

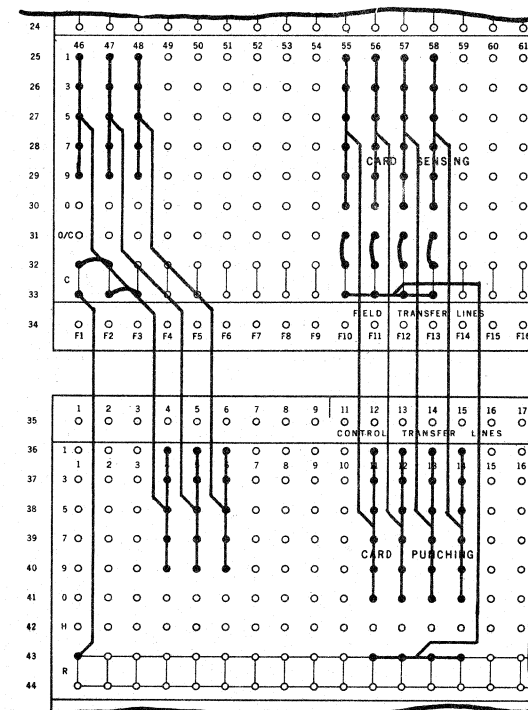
REPRODUCTION

Reproduce Connections

The card columns from which information is to be sensed for Reproduction and into which card columns the information so sensed is to be punched depends entirely upon the card design. Alphabetical and numerical information may be reproduced.

The Reproducing function is divided into two operations; Reproduce, the basic and primary operation, and Secondary Reproduce, a dependent operation.

The information sensed from one card may be Reproduced into the following card or cards. Information sensed from one card may be Reproduced into other columns of that card as well as into the following card or cards. The operation of Reproducing may be entirely under the influence of control punching or it may be automatically controlled.



This is an example of transposed Reproducing of columns within the same card.

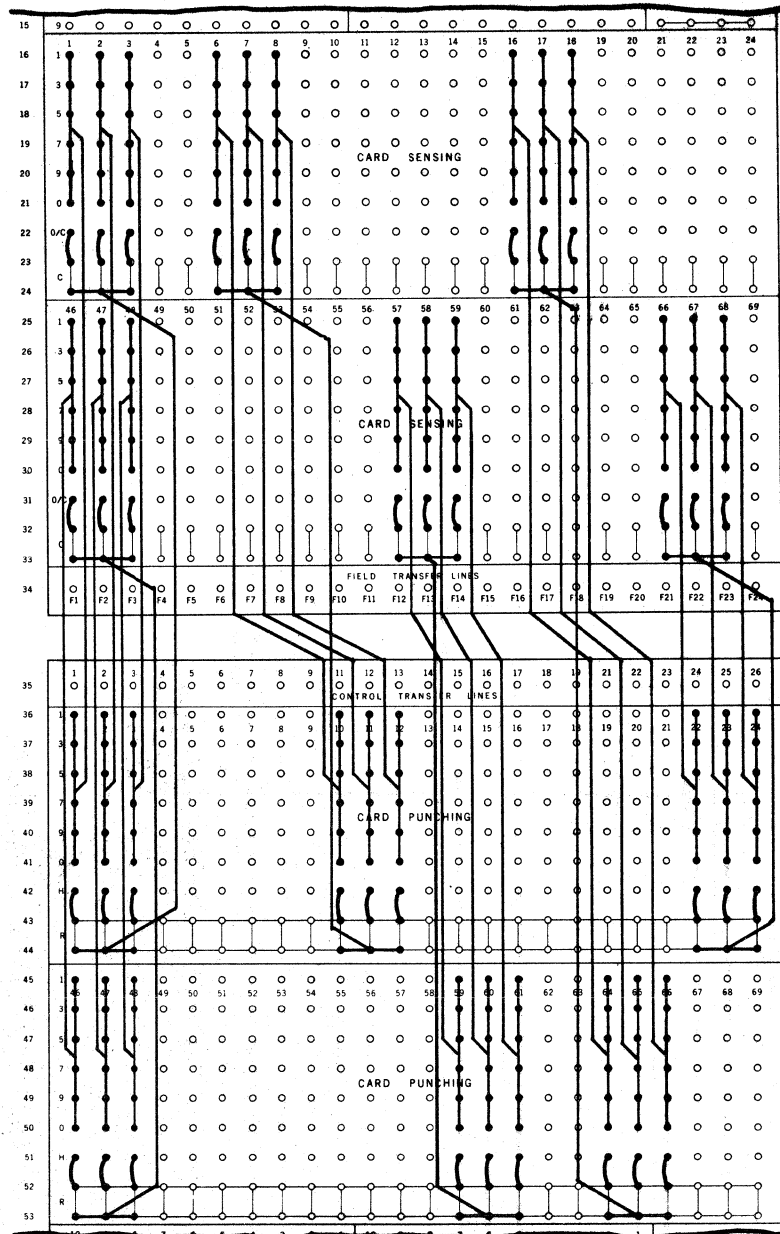
Where the information is numerical only, the 1 - 9 sockets of Card Sensing are connected on a socket-for-socket basis with the related 1 - 9 sockets of Card Punching; the C sockets of the Sensing Columns are connected to an R socket in Card Punching. In this example, Card Columns 46 - 48 are wired to reproduce into Card Columns 4 - 6 of the same card.

NOTE:- Where a single wire is used to connect an R socket to a multiple number of C sockets of Card Sensing, the maximum number of C sockets connected through that one wire is not to exceed ten (10). Additional R connections are made when this minimum is exceeded.



Where the information is alphabetical only or alphabetical and numerical, the 1 - 9 and 0 sockets of Card Sensing are connected on a socket-for-socket basis with the related 1 - 9 and 0 sockets of Card Punching; the C and 0/C sockets of the Sensing columns are connected to R sockets in Card Punching. In this example, Card Columns 55 - 58 are wired to reproduce into Card Columns 11 - 14 of the same card.

NOTE:- The R sockets of all four sections of the Input & Output Panel are interconnected to serve equally.



Five different types of Reproduce connections are shown in this example. In each case, the wiring is for full alphabetical-numerical sensing and punching. In addition, wiring is included to retain the Reproduce information, once sensed, for punching into following cards.

The Holding for punching into following cards is accomplished by connecting the H sockets of the Punching columns to the R sockets.



With the exception of the H (Hold) connections, the wiring in this example is identical in principle to that of the previous example. If the information to be reproduced is numerical only, the 0 and 0/C sockets need not be connected.

The connections shown in this example include the following:

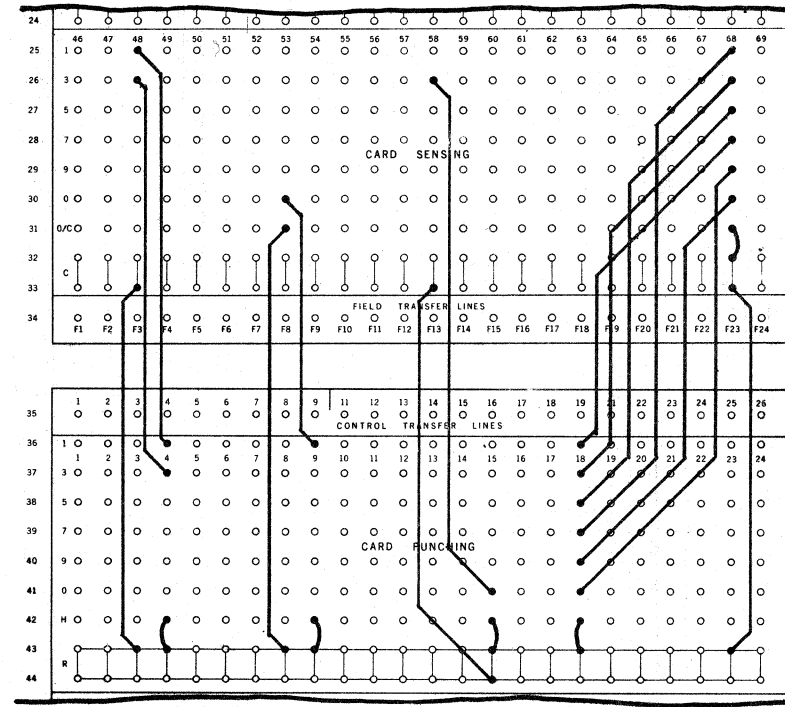
Column-for-Column - Card Columns 1 - 3 are connected to punch into Card Columns 1 - 3; 46 - 48 to punch into 46 - 48. The position sockets, 1 - 9 and 0, in each Sensing column are connected to the related Punching sockets.

Upper-to-Upper - Card Columns 6 - 8 are connected to punch into Card Columns 10 - 12.

Lower-to-Lower - Card Columns 57 - 59 are connected to punch into Card Columns 59 - 61.

Upper-to-Lower - Card Columns 16 - 18 are connected to punch into Card Columns 64 - 66.

Lower-to-Upper - Card Columns 66 - 68 are connected to punch into Card Columns 22 - 24.



Because of the individual Position sockets in the columns of Card Sensing and Card Punching, partial split and transposed wiring for Reproducing, such as shown in this and the following example, is possible.

In this example:

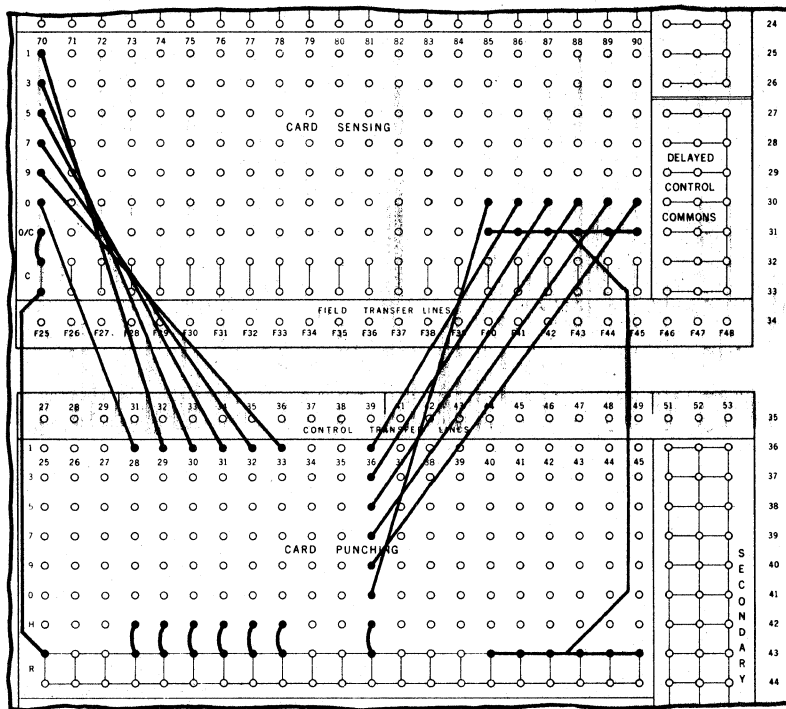
Positions 1 and 3 of Card Column 48 are wired to punch in Card Column 4.

The 0 position in Card Column 53 is wired to punch in the 1 position of Card Column 9.

The 3 position in Card Column 58 is wired to punch in the 0 position of Card Column 15.

The wiring from Card Column 68 is completely transposed for punching into Card Column 19; 9 to 0, 7 to 1, 5 to 3, 3 to 5, 1 to 7, 0 to 9.

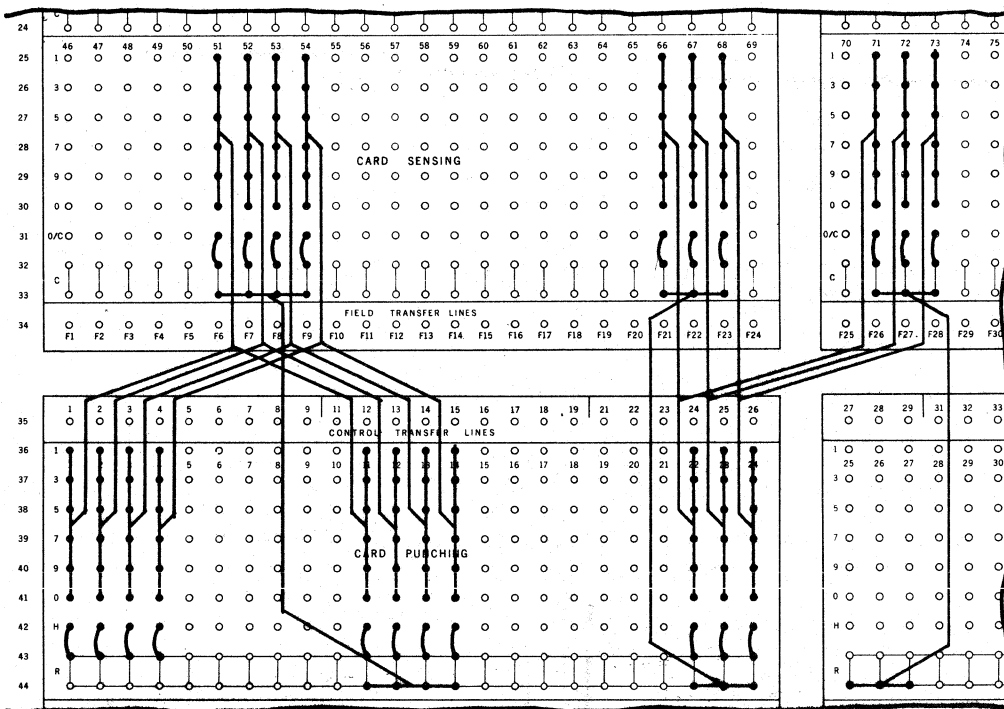




In this example:

The individual positions, 1 - 9 and 0, of Card Column 70 are wired to the 1 sockets of Card Columns 28 - 33.

The 0 sockets of Card Columns 85 - 90 are wired to the 1 - 9 and 0 sockets of Card Column 36.



Y-Wired and Inversion connections for Reproducing can be made.

Information sensed from one card field may be wired to reproduce into two or more card fields. In the example, Card Columns 51 - 54 are wired to reproduce into Card Columns 1 - 4 and 11 - 14.

Information sensed from two card fields may be wired to Reproduce into one card field where practical. Card Columns 66 - 68 and 71 - 73 are wired to punch in Card Columns 22 - 24. In this event, either the two fields would both not be punched in the same card or, if both are punched in the same card, the C and O/C wiring of the individual fields to the R sockets would be routed through Selectors; as would the "9" position wiring of Card Punching and Card Sensing. With this wiring, but one field would be called in at one time.

Secondary Reproduce Connections

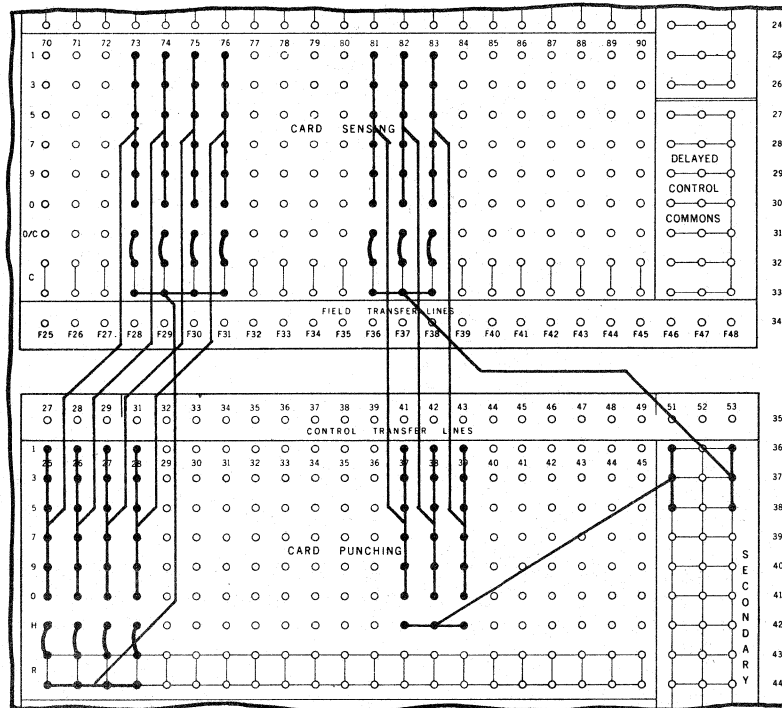
With the Secondary Reproduce operation, supplementary or additional information may be sensed from one or more cards within a group or within the run for reproducing into the same card or in following cards.

The Secondary Reproduce operation is made effective for the sensing of information by its own control. The clearing of Secondary Reproduce information is governed by the same control used in the Reproduce operation.

The same types of connections described above for Reproduce can be made for Secondary Reproduce sockets at the lower right side of the Input & Output Panel:

The C and O/C sockets of Card Sensing are wired to Secondary Reproduce sockets rather than R sockets.

The H sockets of Card Sensing are wired to Secondary Reproduce sockets rather than R sockets when the Secondary Reproduce information is to be Held for punching into following cards.



In this example; Card Columns 73 - 76 are wired to Reproduce in Card Columns 25 - 28; Card Columns 81 - 83 are wired to Secondary Reproduce in Card Columns 37 - 39.



Reproduce Control

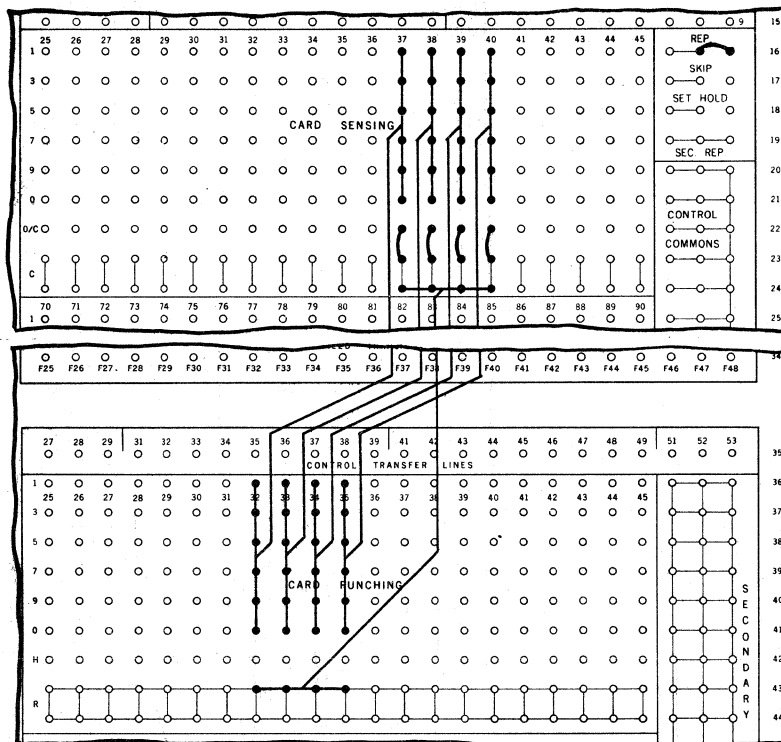
Because of the various means of controlling the Reproducing operation, it is possible to; perform a run for Reproducing purposes only containing Reproduce information only or Reproduce and Secondary Reproduce information, perform a run where all cards are punched with Reproduce or Reproduce and Secondary Reproduce information and Output Values.

It is also possible to incorporate in one run; Reproduce or Reproduce and Secondary Reproduce punching only in selected cards, Output Value punching only in other cards, with a combination of both Reproduce or Reproduce and Secondary Reproduce plus Output Value punching in others.

The Reproduce sockets (v-x,16) provide the means of controlling the Reproduce operation. The impulsing of these sockets cause:

1. The clearing of the Punching Setup Section of all Reproducing information (Reproduce and Secondary Reproduce) set up in that section from a previous card.
2. The authorizing of the Punching Setup Section to accept Reproduce (not Secondary Reproduce) information from the card currently being sensed.

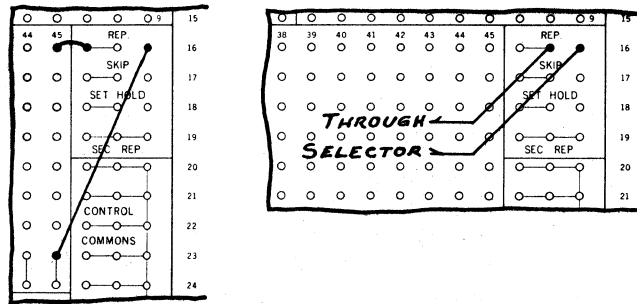
The Reproduce operation may be performed automatically for each card or it may be performed optionally upon the sensing of control punching.



When it is desired to automatically transpose Reproduce information sensed from one set of card columns into another set of card columns in the same card for each card in the run, the Reproduce sockets are interconnected as shown in this example. Notice also that the H sockets are not connected.

With these connections, the Punching Setup Section receives the information sensed from each new card. It automatically clears that information immediately after punching the information into the card from which it was sensed. The Punching Setup Section is then ready to receive new Reproduce information from the next card.



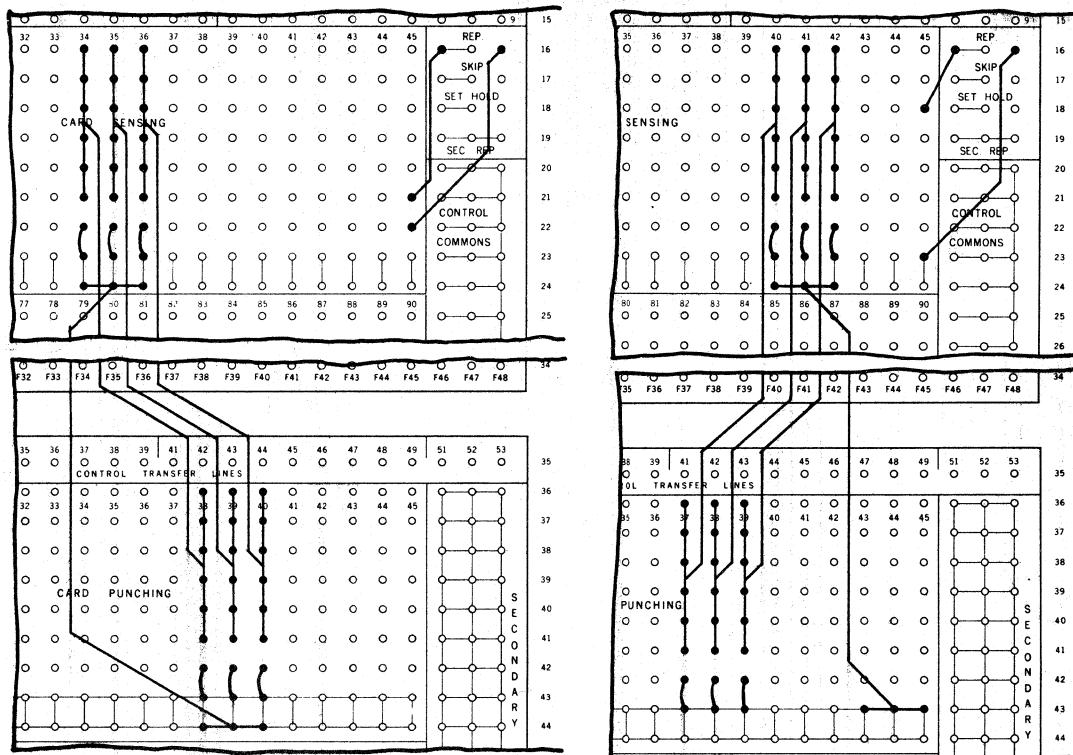


The transposed reproduction of information sensed from one set of columns in a card to another set in the same card can be performed on a selective basis by card control.

Two methods of controlling this type of Reproduce operation are shown in the above example.

In the example to the left, the Reproduce operation will be performed only for those cards containing the Reproduce control punching; in this case, the 1 in Card Column 45. Cards not containing this punching will not be reproduced.

In the example to the right, the automatic Reproduce operation is controlled from the Non-Select side of a Selector; the Selector in turn being card controlled. All cards will automatically Reproduce except those containing the control punching governing the Selector operation.

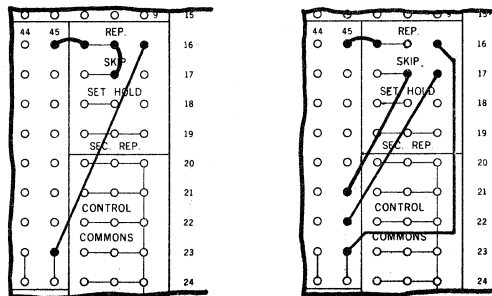


With the wiring shown in the above examples, the Reproduce information sensed from the card containing the Reproduce control punching will be punched in the card containing the control punching and into all following cards until the next Reproduce control punching is sensed. The Reproduce information is retained because of the H (Hold) connections in the Card Punching section.

In the example to the left, a 0 is used as the Reproduce control.



In the example to the right a position (1, 3, 5, 7, 9) is used as the Reproduce control.



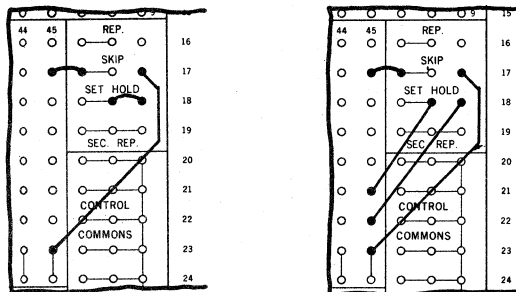
When punching is not desired in the card from which Reproduce information is sensed, the Skip Cycle operation is used in conjunction with the Reproduce control. Skip Cycle may also be used within a group to prevent punching in selected cards.

In the example to the left, the Reproduce control punching also controls the Skip Cycle (Skip) by interconnecting the Skip and Reproduce sockets.

In the example to the right, the Reproduce and the Skip Cycle are impulsed from separate control positions.

The impulsing of the Skip Cycle prevents all punching in the card containing the control punching; Reproduce, Secondary Reproduce, and Output Value.

Skip Cycle does not cause the Reproduce or Secondary Reproduce information to clear; it still remains Set until the Reproduce control punching is again sensed. On the other hand, Skip Cycle does not prevent Output Values from clearing on a Trip signal; that can only be prevented through the use of Set Hold.



To prevent Output Values from clearing during a Skip Cycle operation, the Set Hold is used.

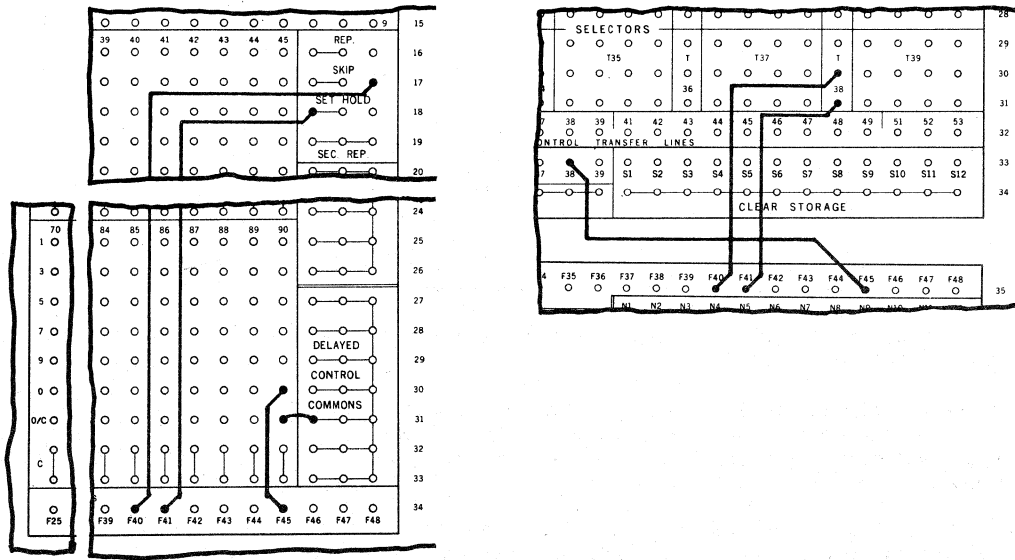
In the example to the left, the Set Hold is performed automatically each time the Skip Cycle is impulsed. The right socket of Set Hold is connected directly to one of the left sockets of Set Hold. Each time Skip Cycle is impulsed, the Set Hold operation occurs.

In the example to the right, the Set Hold is performed selectively whenever Skip Cycle is impulsed. The connection between the right and the left Set Hold sockets is routed through a control position. If Set Hold is to occur, the card containing the control punching used to cause the impulsing of Skip Cycle must also contain the control punching used to make the Set Hold connection.

The Set Hold is immediately effective for the card being sensed at the time the signal is delivered to prevent any information from being cleared or retracted until that card is passed through the Punching Section.

When the Set Hold is impulsed, no Reproduce or Secondary Reproduce information will be cleared when the card causing the Set Hold function reaches the Punching Section despite the fact that the card may be punched with the Reproduce control or that the Reproduce control may be impulsed automatically.



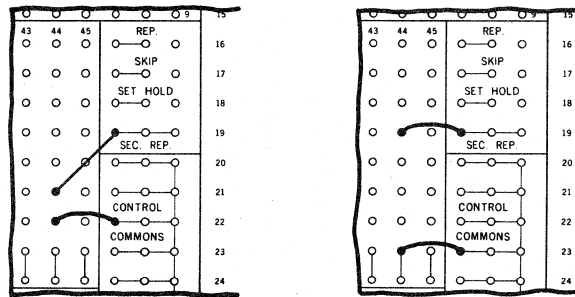


The Set Hold function may be performed independently of Skip Cycle by connecting the right socket of Skip Cycle to one of the left sockets of Set Hold. To make the function selective, this connection is routed through a Selector.

To perform this independent Set Hold operation, a Selector must be used. The Delayed Control Commons are used for the wiring of the control position used for the Selector Pick Up.

If it is to be operated by Program Select, the Program Select may not be impulsed until such time in the Program as would be equivalent to either 6 multiplications or divisions or 18 additions or subtractions.

In this example, the wiring for the independent Set Hold operation is wired through the Select side of a Selector. The 0 position of Card Column 45 is used to control the Selector. The O/C socket of Card Column 45 is connected to the Delayed Control Commons.



The Secondary Reproduce is impulsed by control punching in the card containing the information to be sensed.

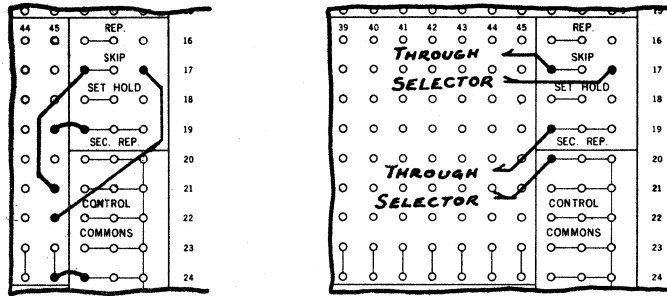
In the example to the left, a 0 position is used to control the Secondary Reproduce.

In the example to the right, a position (1, 3, 5, 7, 9) is used as the Secondary Reproduce control.

The Secondary Reproduce control only causes the information to be set up. If it is to be retained, the H (Hold) connections are made. Regardless of whether it is Held, it is retracted only by the sensing of the Reproduce control.

Reproduce and Secondary Reproduce may not both be made effective on the same card.





The Skip Cycle and Set Hold functions are equally effective for the Secondary Reproduce as they are for Reproduce.

In the example to the left, the Secondary Reproduce and the Skip Cycle are to be controlled from separate control positions isolated from one another. This could be through the use of separate card columns or, if within the same card column, the 0 is used for one control while a position (1 - 9) is used for the other.

In the example to the right, the Secondary Reproduce and the Skip Cycle are to be controlled from one control position. The Secondary Reproduce and Skip Cycle connections are routed through a Selector. One control position is then used to operate that Selector.

INPUT

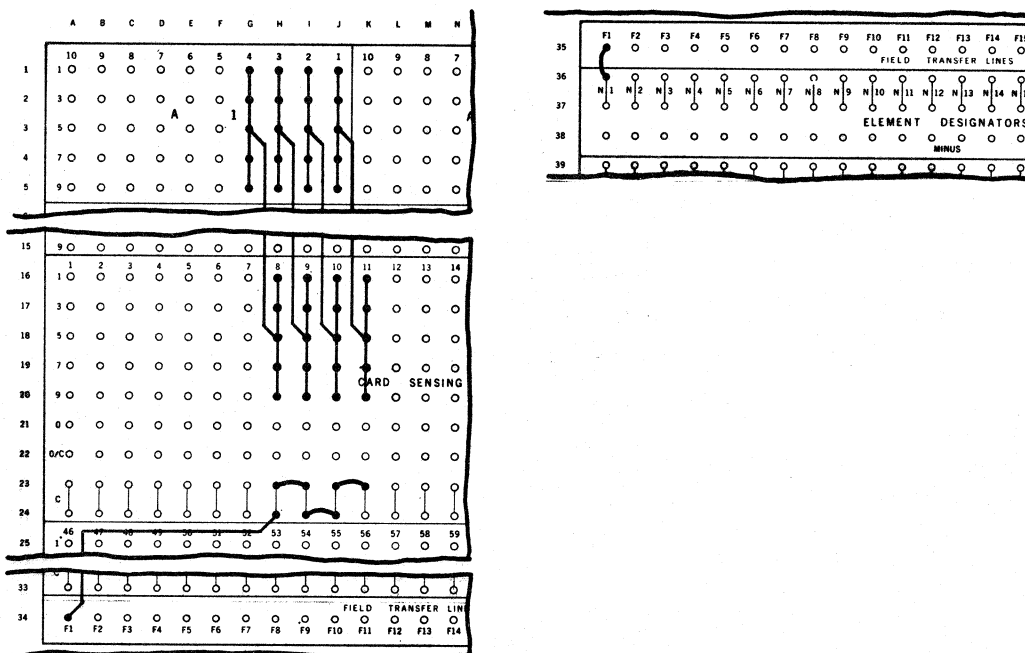
Input Value Connections

The card columns to be sensed for Input depend entirely upon the card design. Any of the 90 columns, either as single column or multiple column fields may be used for this purpose.

To which one of the twelve Accumulator Inputs a particular card field is to be connected is not important; all twelve are identical. The Accumulator Columns to which the field is connected are important as this established the initial relationship of the Value with the Accumulator Counters. The Decimal Locators (see below) permit considerable liberty in pointing off the decimal.

With the Input Value related to the Accumulator Columns by the Input wiring, it is identified as one of the Elements by routing its Call wiring to the Constant and Program Panel.

The following are examples of some of the wiring possibilities for Input Values:



Shown above are typical connections for an Input Value.

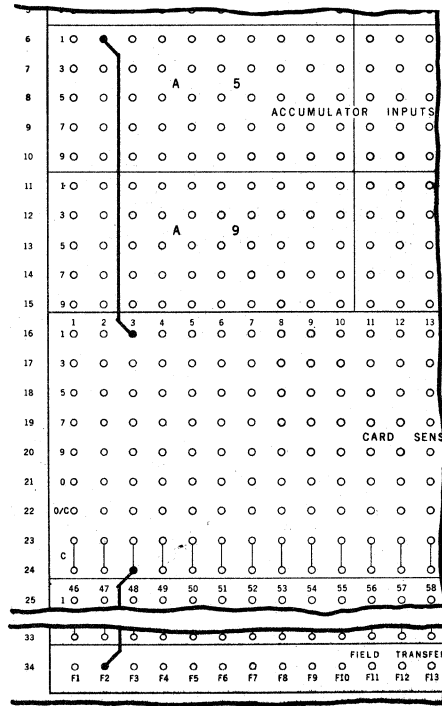
The five sockets (1, 3, 5, 7, & 9) in Card Sensing for the card field, Card Columns 8 - 11, are connected to Accumulator Columns 4 - 1 in Accumulator Input A1. This relates the individual card columns in this field with Accumulator Columns 1 - 4.

The C (Call) sockets for the four card columns are interconnected. One of the C sockets is wired to the F1, Field Transfer Line. The terminal of the F1, Field Transfer Line, on the Constant & Program Panel is wired to an N1 Element Designator socket. This Call wiring identifies the Input Value punched in Card Columns 8 - 11 as Element N1.

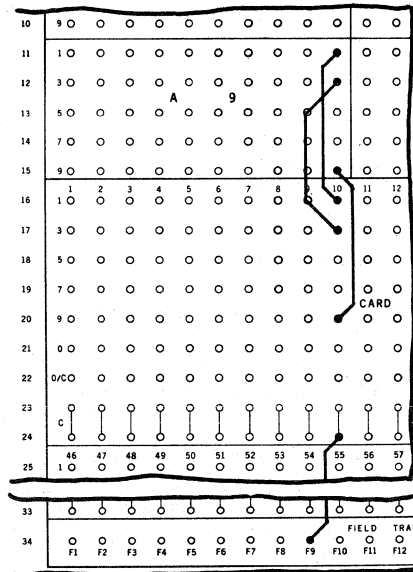
With an individual socket provided for each card column position together with an individual socket for each of the five numerical code positions within each column of Accumulator Input; partial, split, and transposed wiring are possible, as follows:

The "1" in Card Column 3 is wired to the "1" of Accumulator Column 9 in Accumulator Input A5. Any punching in the 1 position of this card column will enter a 1 in Accumulator Column 9.



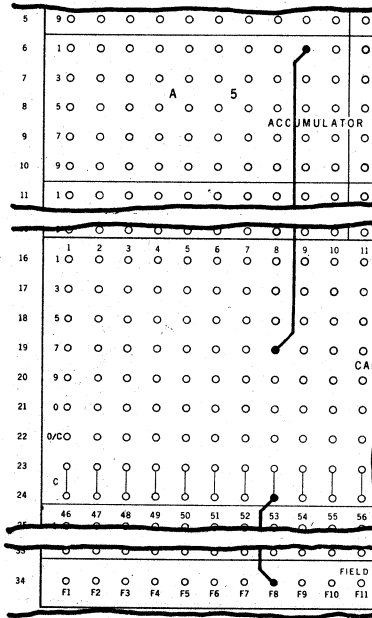


If this is to be a single digit Input Value, the C socket of Column 3 is wired through a Field Transfer Line to the desired Element Designator.

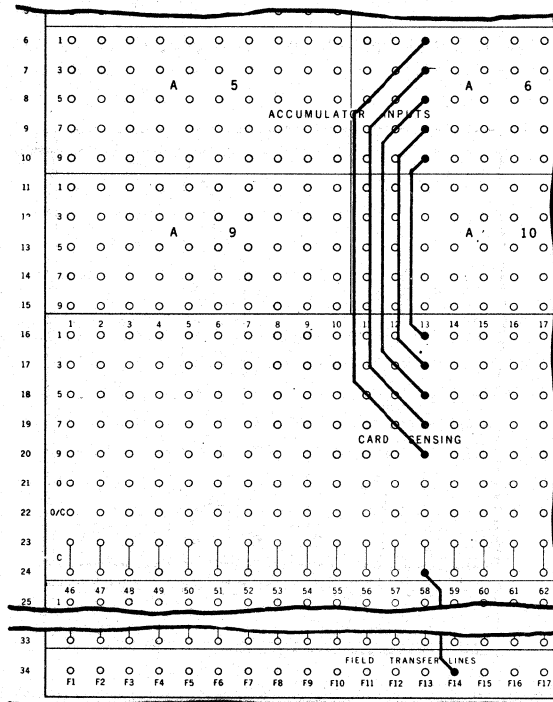


The 1, 3, and 9 in Card Column 10 are connected to the 1, 3, and 9 of Accumulator Column 1 in Accumulator Input A9. The digits 1 through 4, and 9 may be entered from Column 10.



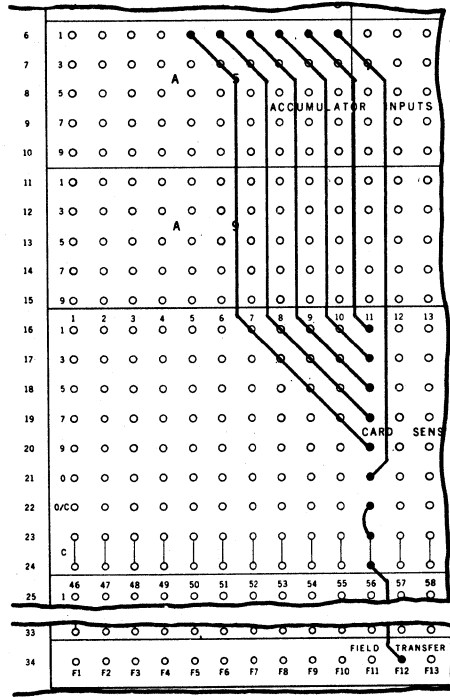


The 7 position in Card Column 8 is wired to the 1 socket of Accumulator Column 2 in Accumulator Input A5. Any punching in the 7 position of this card column will enter a 1 in Column 2 of the Accumulator.



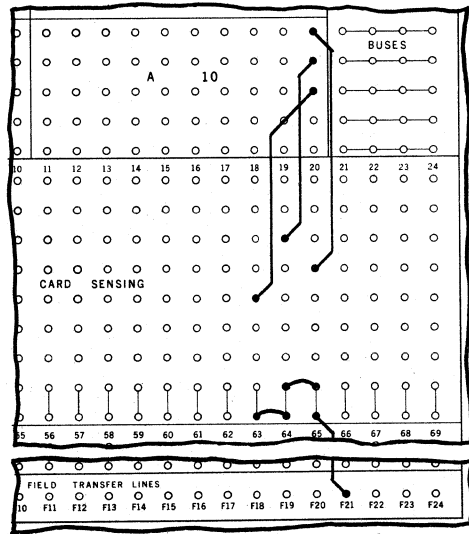
The wiring of Card Column 13 to Accumulator Column 8 in Accumulator Input A6 is completely transposed; 1 to 9, 3 to 7, 5 to 5, 7 to 3, 9 to 1.





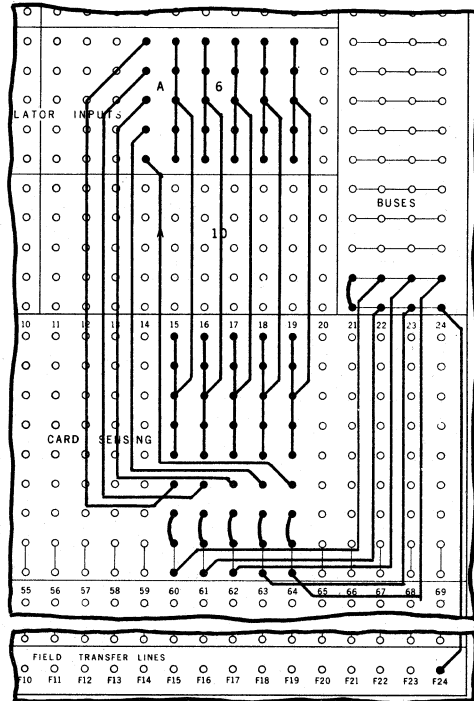
The wiring of Card Column 11 is split so that the individual positions, including the zero, will register as "1's" in Accumulator Columns 1 through 6.

Notice that the O/C (Zero Call) socket for card column 11 is connected to the Column 11 C (Call) socket.



Individual positions within three different card columns are wired to one Accumulator Column, Column 1 of Accumulator Input A10; 9 in Column 18 to the 5, 5 in Column 19 to the 3, 7 in Column 20 to the 1. The C sockets for the three card columns are interconnected.

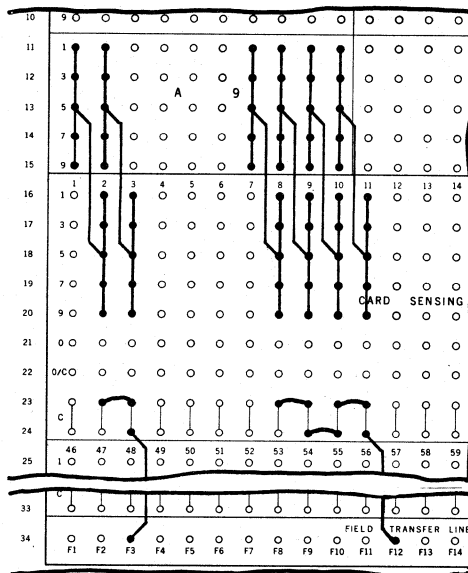




The zero positions of a card field are used for added capacity. The five sockets (1, 3, 5, 7, & 9) for each card column are connected on a socket-for-socket basis to the related sockets (1, 3, 5, 7, & 9) for Accumulator Columns 2 through 6 of Accumulator Input A6.

The zero socket for each of the five card columns is connected to an individual socket (1, 3, 5, 7, 9) for Accumulator Column 7 of Accumulator Input A6.

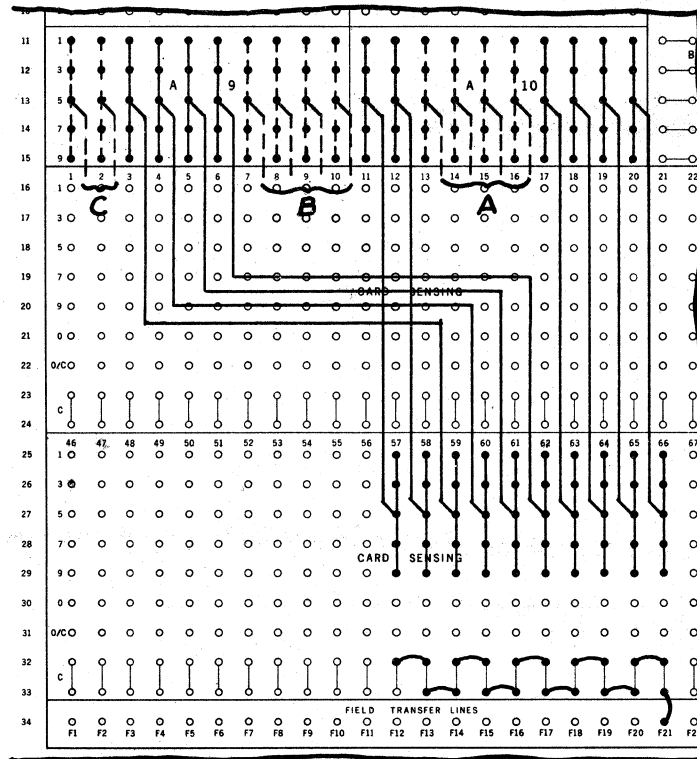
The Zero Call and the Call sockets for the five card columns are all interconnected.



Two or more Input Values may be connected to one Accumulator Input. The important aspect of connections of this type is that the values are wired to the proper Accumulator Columns.



In this example; Card Columns 2 and 3 are wired to Accumulator Columns 10 and 9, Card Columns 8 - 11 are wired to Accumulator Columns 4 through 1. Accumulator Input A9 is used to enter both values.

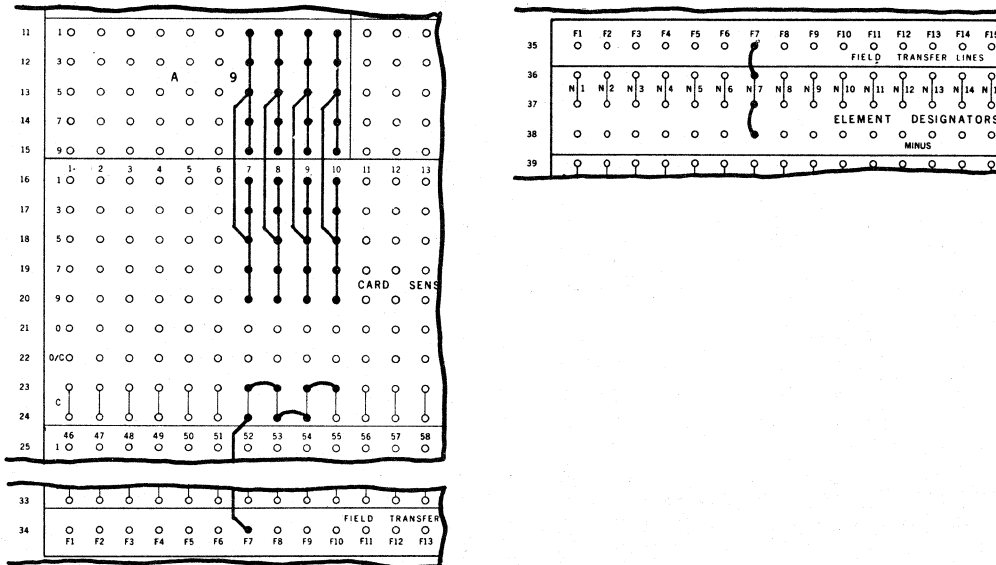


The wiring of the individual card columns of one Input Value may be connected to the desired individual Accumulator Columns in two or more Accumulator Inputs.

In this example; Value A has been wired to Accumulator Columns 8 - 5 in Accumulator Input A10, Value B to Columns 4 - 1 in A9, and Value C to Columns 9 and 8 in A10. The Input Value punched in Columns 57 - 66 may then be wired to; Accumulator Columns 4 - 1 in A10, Columns 8 - 5 in A9, and Columns 10 and 9 in A10.

Negative Sign Connections

An Input Value may be either positive or negative from individual cards. On the other hand, an Input Value for each card in the run may always be considered negative; constant negative.



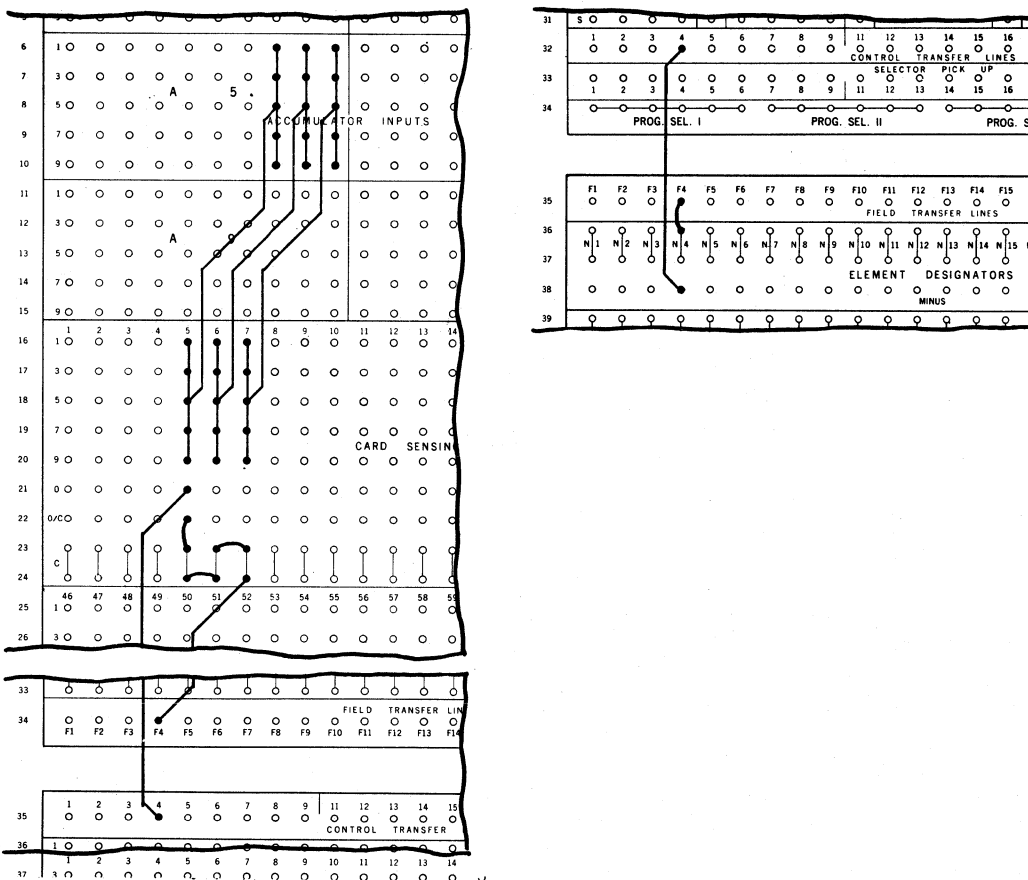
In this example, the value sensed from card columns 7 - 10 is to be negative for each card in the run. With this Input Value identified as Element N7, it is made a constant negative by connecting the N7 Minus socket to the N7 Element Designator socket.

When an Input Value may be either positive or negative, it is identified as negative by the sensing of control punching at the same time the digits of the value are sensed. Any value not so identified enters as positive. Individual values sensed from the individual cards are individually identified.

Each Input Value requires its own separate control position for negative sign identification.

The control punching used for negative sign identification on an Input Value may be any zero position. It may also be a position (1, 3, 5, 7, or 9) in any of the 90 card columns.





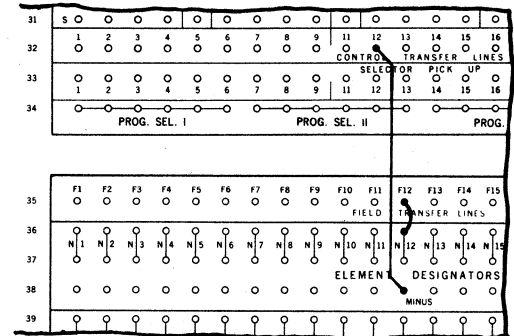
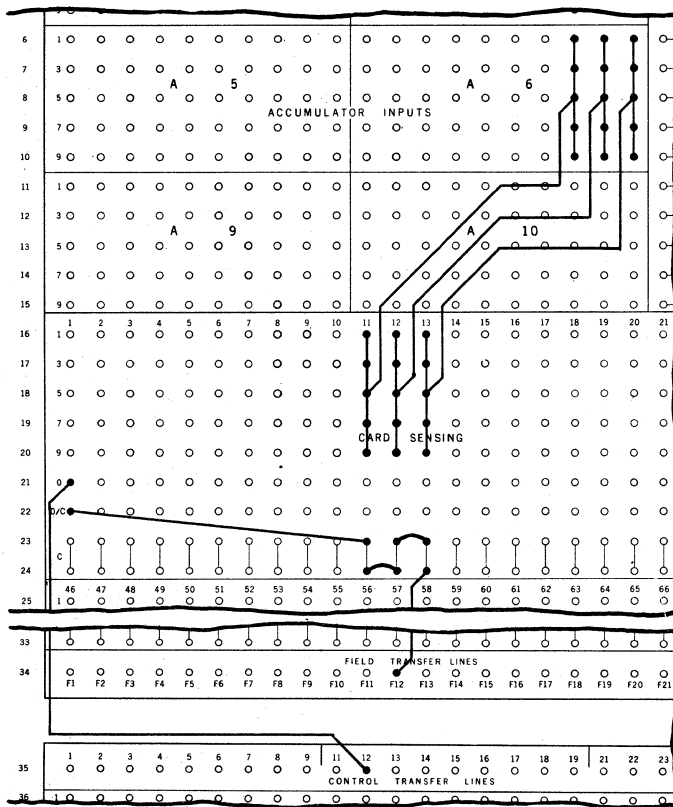
A zero within the Input Value card field is used in this example. A field consisting of Card Columns 5 - 7 is wired to Accumulator Columns 3 - 1 of Input A5. The zero in Card Column 5 is punched when this value is negative.

The 0/C socket of Card Column 5 is connected to a C socket of the same column; the C sockets for Columns 5, 6, & 7 are interconnected and routed through the F4 Field Transfer Line to N4 Element Designator socket.

The 0 socket of Card Column 5 is routed through the No. 4 Control Transfer Line to the Minus socket for the N4 Element Designator.

When the zero in Card Column 5 is sensed, the amount punched in Columns 5 - 7 of the same card will enter as negative.



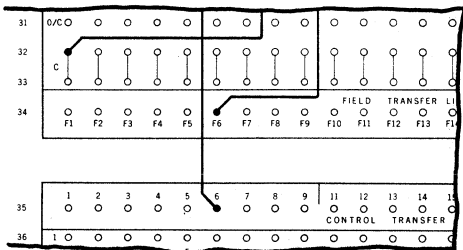
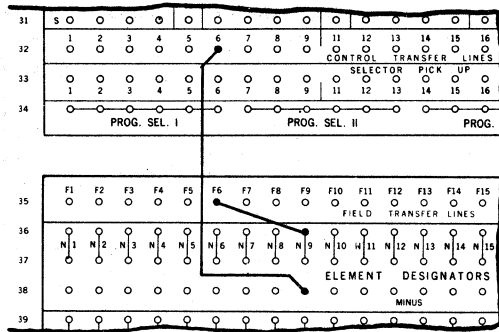
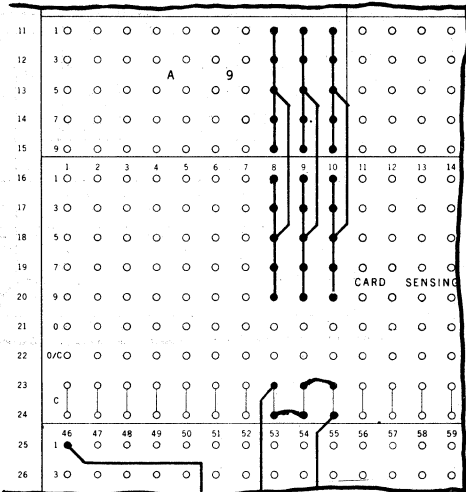


A zero in a card column outside the Input Value card field is used in this example. A field consisting of Card Columns 11 - 13 is wired to Accumulator Columns 3 - 1 of Input A6. The zero in Card Column 1 is punched when this value is negative.

The 0/C socket of Card Column 1 is connected to a C socket for Card Columns 11 - 13. These C sockets are connected to the N12 Element Designator.

The 0 socket of Card Column 1 is connected to the Minus socket for the N12 Element Designator.





The position (1, 3, 5, 7, 9) in a card column is used in this example. A field consisting of Card Columns 8 - 10 is wired to Accumulator Columns 3 - 1 of Input A9. The 1 in Card Column 46 is punched when this value is negative.

A C socket of Card Column 46 is connected to a C socket for Card Columns 8 - 10. These C sockets are connected to the N9 Element Designator.

The 1 socket of Card Column 46 is connected to the Minus socket of Element Designator N9.



Y-Wired and Inversion Connections

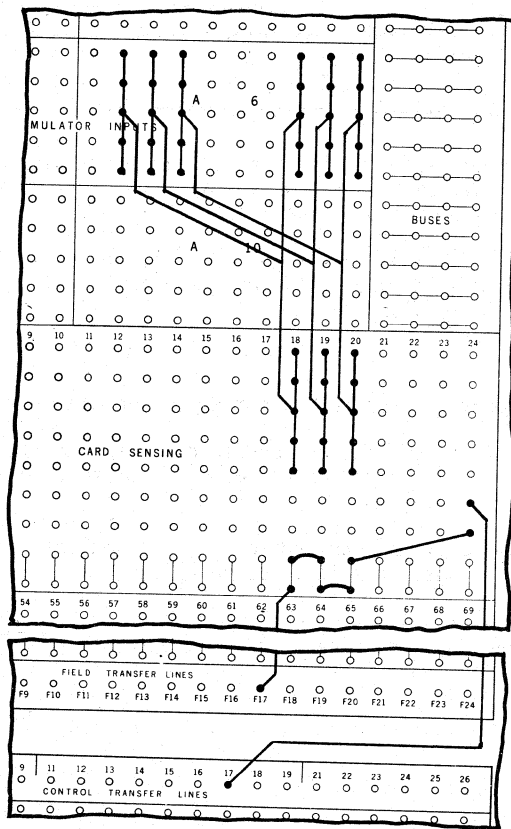
One card column may be wired to two or more different Accumulator Columns. When the Program calls for the value thus wired, it is read into all Accumulator Columns to which it is connected.

One card field may be wired to different, but overlapping, Accumulator Columns through the use of Selectors.

All six positions within a card column may not be connected to Reproduce and to Accumulator Input.

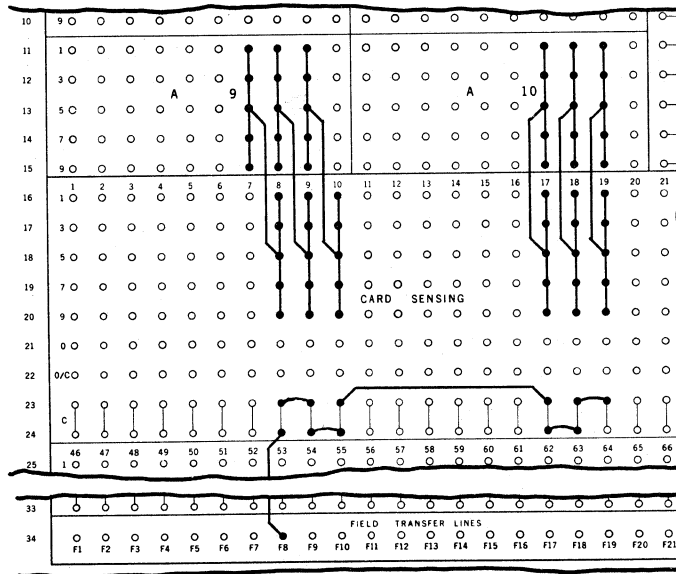
Within a card column, the positions 1 - 9 may be connected to Accumulator Input or for Card Control while the 0 position is connected to Reproduce. On the other hand, the 0 position may be connected to Accumulator Input or for Card Control while the positions 1 - 9 are connected to Reproduce.

Typical of these connections are as follows:



One card field, Card Columns 18 - 20, is connected to two sets of Accumulator Columns 3 - 1 and 9 - 7. The two inputs are controlled by one negative sign identification; a separate negative control cannot be applied to both sets unless that control wiring is routed through Selectors.





Two card fields may be connected to the same set of Accumulator Columns to form one Element only on the condition that both fields would not be punched in the same card or if the punching in the two fields of one card is identical.

The two card fields, Card Columns 8 - 10 and 17 - 19 are both wired to Accumulator Columns 4 - 2. The C sockets of both card fields are interconnected and wired through Field Transfer Line F8 to an Element Designator.

Decimal Location

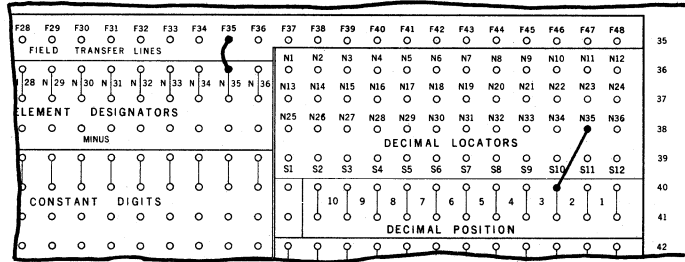
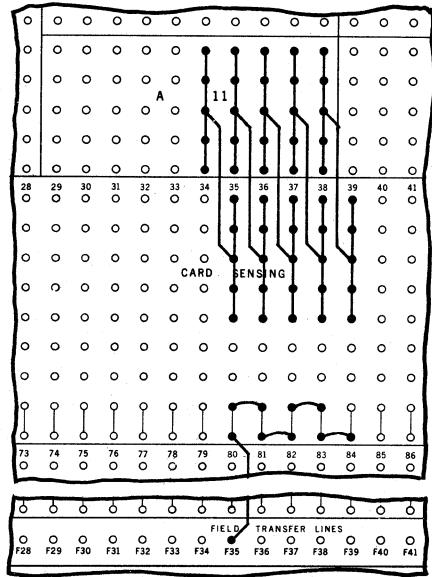
A Decimal Locator is provided for each Input Value defined as an Element.

Two common Decimal Position sockets are provided for each of the 11 possible decimal settings ranging from a setting to the right of Accumulator Column 1 to a setting to the left of Accumulator Column 10.

NOTE:- Ample Bus capacity is provided beneath the Decimal Position sockets to expand the capacity for connections to those sockets.

The decimal point for an Input Value is set by wiring the Decimal Locator socket bearing the Element Number assigned that Input Value to the desired Decimal Position socket.





In this example, the card field consisting of Card Columns 35 - 39 is wired to Accumulator Columns 5 - 1. The value to be punched in this card field will be in dollars and cents with the decimal point between Card Columns 37 & 38. The decimal point for the value as it enters the Accumulator is to be between Accumulator Columns 3 and 2.

The C sockets for this field are connected through Field Transfer Line F35 to the N35 Element Designator.

With this card field thus designated as Element N35, the N35 Decimal Locator socket is wired to the 3/2 Decimal Position socket.

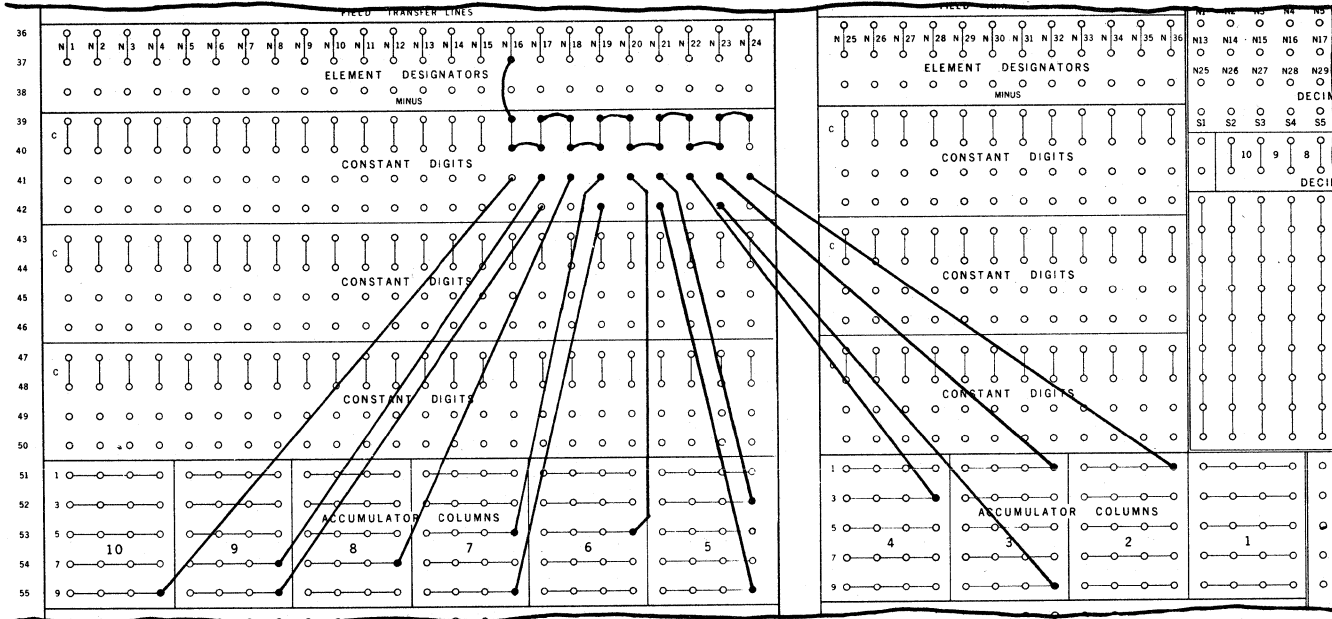
IMPORTANT:- Additional information regarding decimals together with certain rules governing decimal point setting are outlined under the subject, "OUTPUT - Decimal Location" on following pages.



CONSTANT

Constant Value Connections

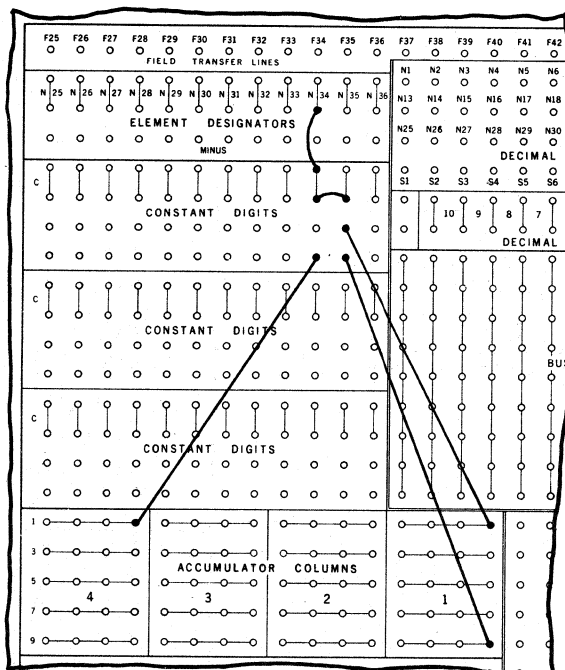
The Constant Values are established by connections between the Constant Digits and the Accumulator Columns sections on the Constant & Program Panel. Wiring to the Element Designators then establishes the Constant Value thus formed as one of the Elements.



In this example, the value 987654321 is to enter Accumulator Columns 10 through 2. This Constant Value is to be Element N16.

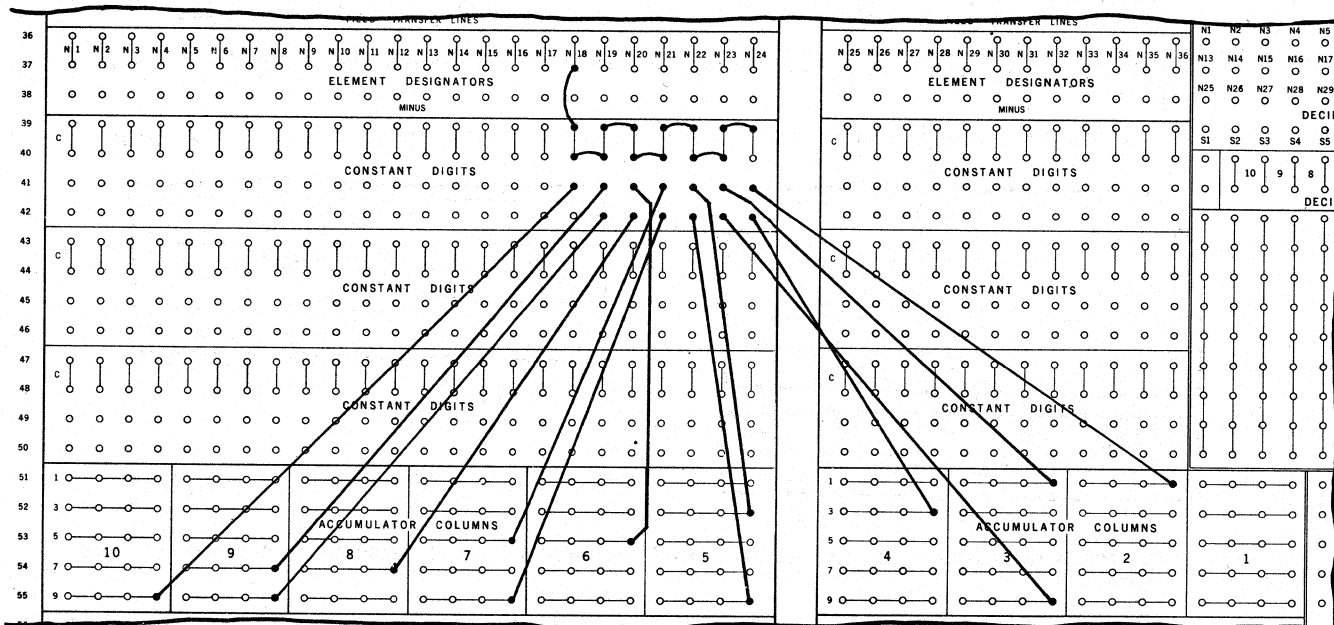
The code position sockets for the individual digits are wired from the desired Accumulator sub-sections to Constant Digit sockets. The C (Call) sockets for the Constant Digits thus wired are interconnected. One of the C sockets so interconnected is wired to the desired Element Designator socket.





When one or more of the digits of a Constant Value is zero, no connection is made from the Accumulator Columns section to the Constant Digits section. With no connection made to the Constant Digits section, Call (C) wiring for zeros is not required.

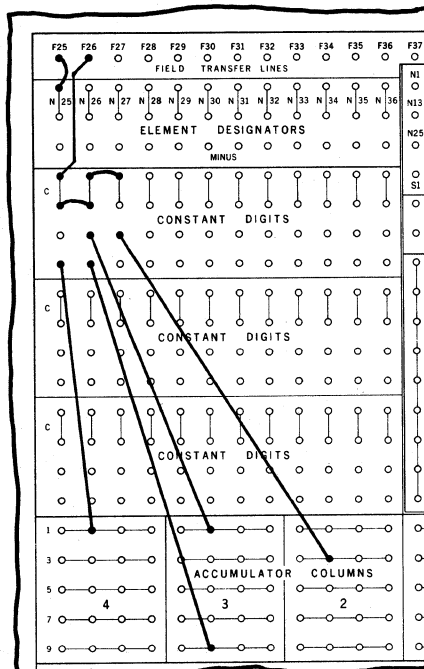
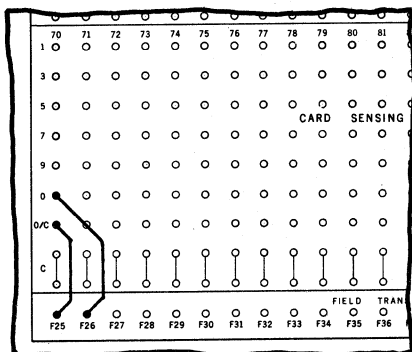
In the above example, the value 1002 is to enter Accumulator Columns 4 through 1. With no connections made for the zeros, the C sockets for the two significant digits are interconnected and wired to the N34 Element Designator.



To economize in the number of columns of Constant Digit sockets used and thus to increase the Constant Digit capacity over the basic 108, two odd numbered digits may be connected to one Constant Digit column.

Using this principle with the Constant Value 987654321 as shown above, seven Constant Digit Columns are used instead of the nine shown in the previous example for the same value.





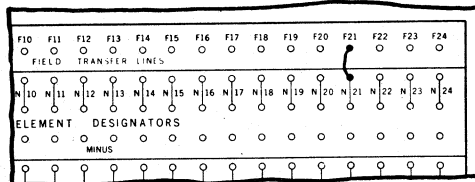
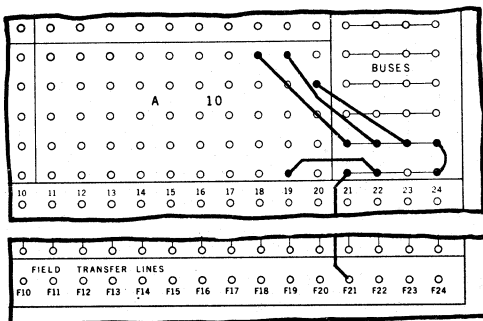
A Constant Value can be either zero or a significant digit value according to the absence or presence of control punching.

In this example, the connection between the C sockets in the Constant Digits section and the desired Element Designator socket is routed through a control position.

When the control punching is sensed, the connection between the C sockets and the Element Designator sockets is made; the Constant Value will be the significant digits wired.

When the control punching is not sensed, the connection is broken; the Constant Value will be zero.

NOTE:- This same method may be used to make an Input Value zero for a particular Program.



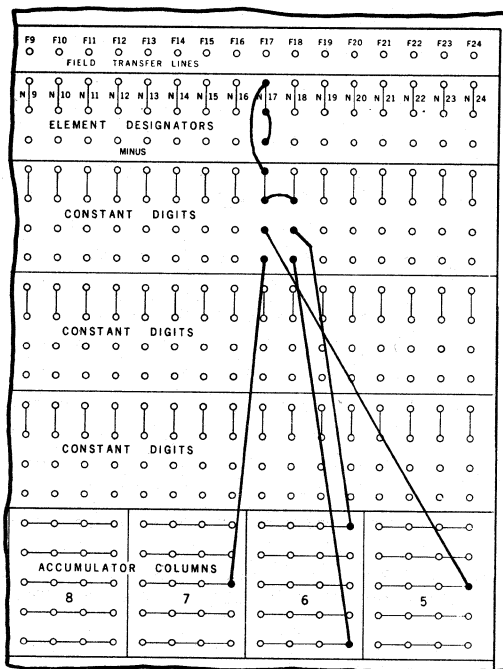
The Accumulator Input can be used to expand the Constant Digit capacity in the manner illustrated above.

The sockets in the desired Accumulator Columns of the Accumulator Input are wired to represent the digits of the Constant Value required. This wiring is connected through Buses and a Transfer Line to the Element Designator socket.



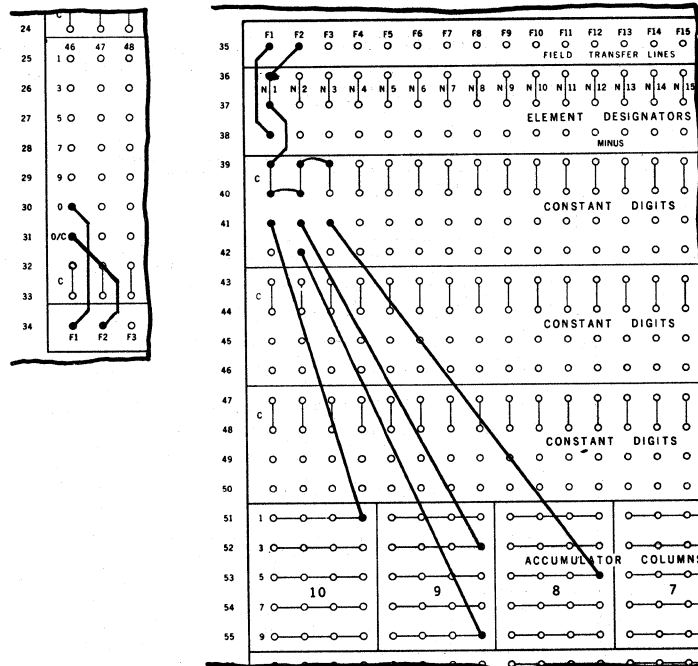
Negative Sign Connections

It is possible to identify individual Constant Values as always negative or, by control punching in individual cards, a Constant Value may be selectively negative or positive according to whether that control punching is sensed or not.



In this example, the value 525, Element N17, is to enter Accumulator Columns 7 through 5 as a Constant Negative Value. The connection between the Minus socket and the Element Designator socket in the Element Designators section causes that Element always to be negative.





In this example, the Constant Value 145, Element N1, is to enter Accumulator Columns 10 through 8, as either negative or positive depending on whether the 0 in Column 46 is punched or not.

The 0 in Column 46 of Card Sensing is connected through the F1 Field Transfer Line to the Minus socket for the N1 Element Designator. The O/C is wired through the F2 Field Transfer Line to the N1 Element Designator. When the zero is sensed, the Constant Value will be negative. When the zero is not sensed, the Constant Value will be positive.

Decimal Location

A Decimal Locator is provided for each Constant Value defined as an Element.

The setting and functioning of the Decimal Locators and Decimal Position sockets for Constant Values is identical to that previously described for Input Values (see INPUT - Decimal Location).

IMPORTANT:- Additional information regarding decimals together with certain rules governing decimal point setting are outlined under the subject, "OUTPUT - Decimal Location" on following pages.



OUTPUT

Output Value Connections

The card columns to be punched with Output Values depends entirely upon the card design. Any of the 90 columns, either as single column or multiple column card fields, may be used for this purpose.

To which one of the twelve, 10-column Storage Outputs a particular card field is to be connected to receive the punching of final results depends entirely upon the programmed use of the twelve Intermediate Storage Units.

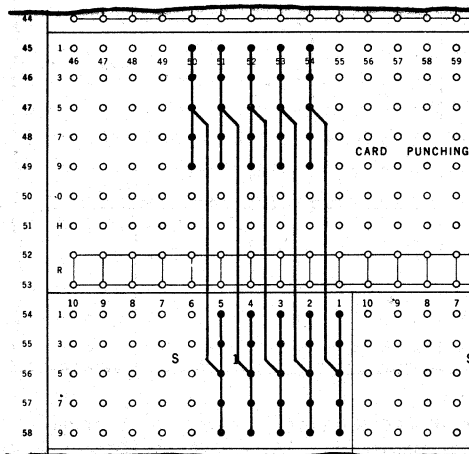
The first purpose of an Intermediate Storage Unit is to receive and store, as long as desired, a calculated Result delivered to it from the Accumulator.

A value thus stored may be transmitted to the Punching Setup Section (Output Storage) on a Set operation for punching into the card. On the other hand, a value in a particular Intermediate Storage Unit may be called on as many times as desired during a Program as an Intermediate Value in a Program Step regardless of whether that value is to be punched or not.

The twelve internal Intermediate Storage Units are represented externally by the twelve Storage Outputs (S1 - S12) on the Input & Output Panel. The same alphabetical-numerical symbols used to identify the Storage Outputs are used to identify the related Intermediate Storage Units.

The Storage Outputs emit on the basis of the 90-Column code.

The following are examples of some of the wiring possibilities:

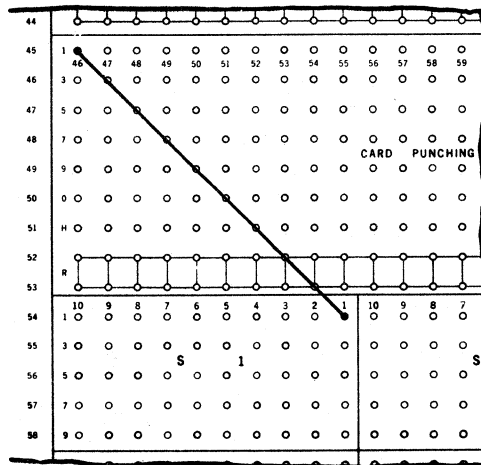


Shown above are typical connections from Storage Output to Card Punching. With these connections, the value in Intermediate Storage is delivered during a Set operation to the Punching Setup Section as an Output Value.

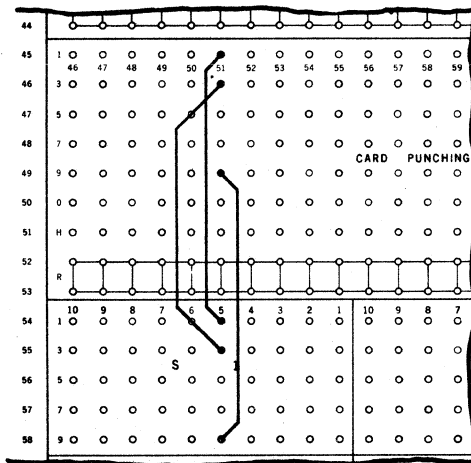
In this example the output of Accumulator Columns 5 - 1 of Intermediate Storage Unit S1 is wired to punch in Card Columns 50 - 54. The five sockets (1, 3, 5, 7, & 9) of the columns of Storage Output are connected on a socket-for-socket basis to the related sockets (1, 3, 5, 7, & 9) of the desired card columns in Card Punching.

With an individual socket provided for each of the five numerical code positions within each of the Storage Outputs together with an individual socket provided for each card column position in Card Punching; partial, split, and transposed wiring are possible. Examples of these various types of wiring are as follows:



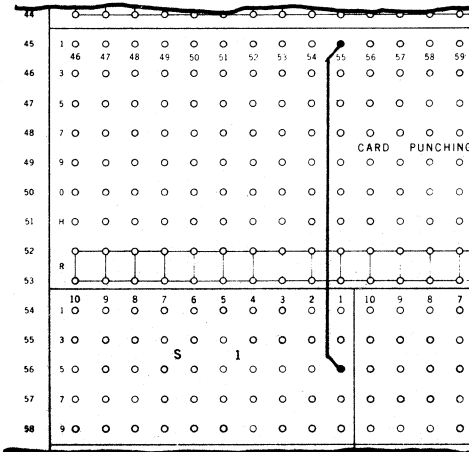


The "1" in Accumulator Column 1 of Storage Output S1 is wired to the 1 socket of Card Column 46. Any emission from the 1 socket of S1 will cause punching in position 1 of Column 46. This emission occurs for both the 1 and 2 of the 90-Column Numerical code.

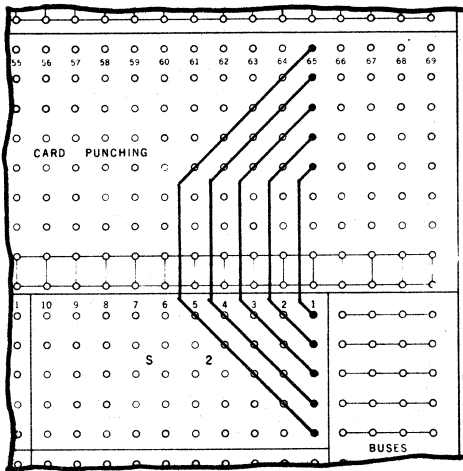


The 1, 3, and 9 sockets in Accumulator Column 5 of Storage Output S1 are connected to the 1, 3, and 9 sockets of Card Column 51. The digits 1 through 4 will be punched in Card Column 51 and, in addition, any emission from the 9 socket of Accumulator Column 5 of S1 will cause punching in position 9 of Card Column 51. These 9 emissions occur on the 6, 8, and 9.



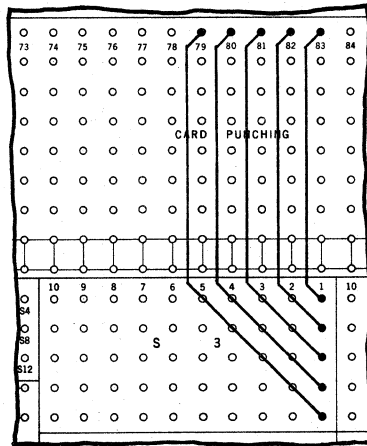


The 5 socket in Accumulator Column 1 of Storage Output S1 is connected to the 1 socket in Card Column 55. Any emission from the 5 socket of Accumulator Column 1 of S1 will cause punching in position 1 of Card Column 55. This emission occurs for both the 5 and 6.

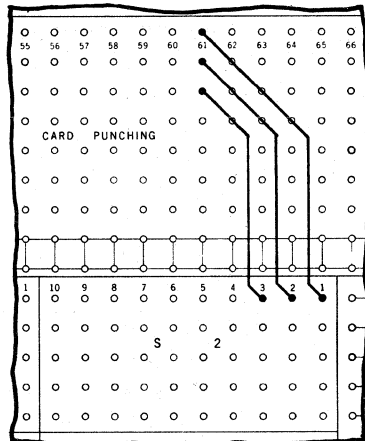


The wiring to Card Column 65 from Accumulator Column 1 of Storage Output S2 is completely transposed; 1 to 9, 3 to 7, 5 to 5, 7 to 3, 9 to 1.



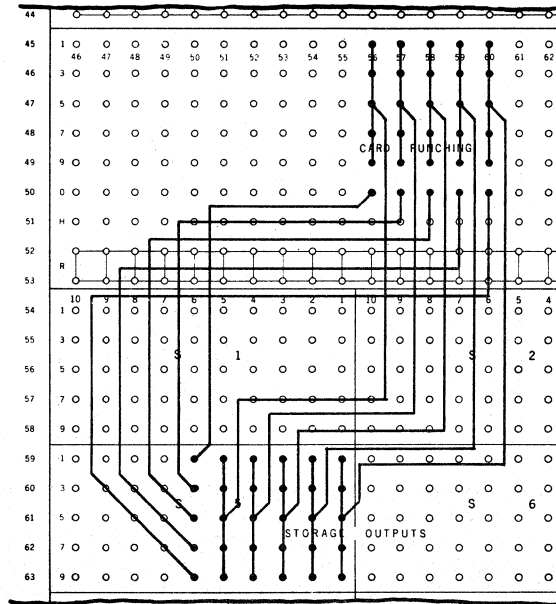


The wiring from Accumulator Column 1 of Storage Output S3 is split so that the emissions from the individual sockets will register as "1's" in Card Columns 79 - 83. Note that the 9 socket of Accumulator Column 1 of S3 will emit for all even numbers.



The "1" sockets of Accumulator Columns 1, 2 and 3 of Storage Output S2 are wired to three different sockets in Card Column 61. An emission from a 1 socket will be punched in the card column position to which it is wired.





The zero positions of a card field are used for added capacity in this example. The 1 - 9 sockets in Accumulator Columns 5 - 1 of Storage Output S5 are wired to Card Columns 56 - 60 on a socket-for-socket basis. Each socket in Accumulator Column 6 of S5 is wired to a zero socket in Card Columns 56 - 60.

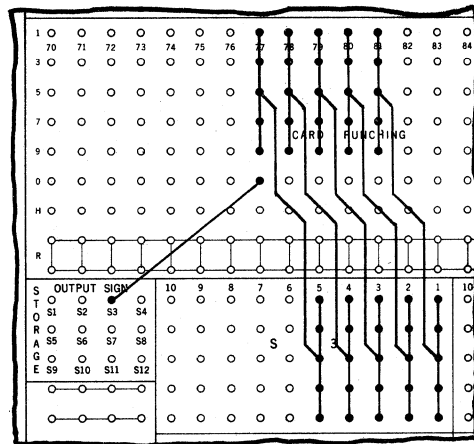
Negative Sign Connections

When making the Output Value connections, consideration must be given to the punching of negative sign identifications. Should the application involve the possibility of arriving at negative values for individual Output Value card fields, a control position is assigned to be punched at the same time the negative value is punched. Any position (0, 1, 3, 5, 7, or 9) in any card column may be used for this purpose. A separate position is used for each Intermediate Storage Unit that may emit a negative Output Value.

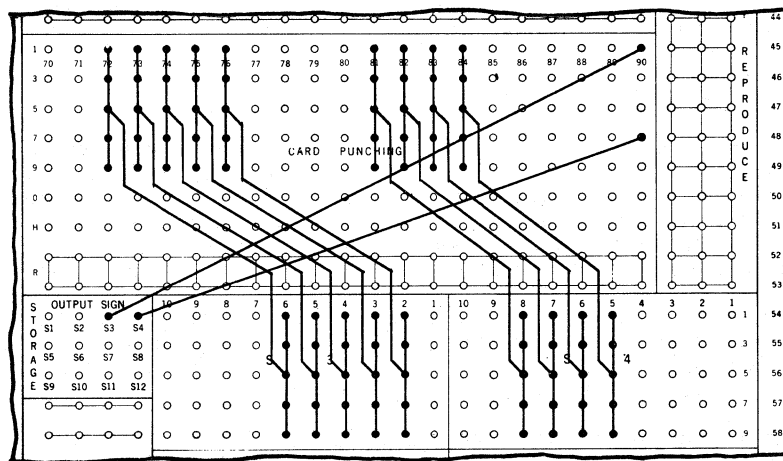
At the time the card column connections to a field are made from a Storage Output, a connection is made from the related Storage Output Sign socket to the card column position desired. Thus, when a negative Output Value is punched, the card column position used to identify that value as negative will also be punched.

Typical examples of these connections are as follows:





A zero is used in this example. Storage Output S3 is wired to Card Columns 77 - 81. The Storage Output Sign S3 is connected to the zero in Card Column 77. When the Intermediate Storage Unit emits a negative Output Value, that value will be punched in Card Columns 77 - 81. Simultaneously, the zero in Card Column 77 will also be punched to identify the value as negative. If desired, the position used for this purpose could be in any other card column than that shown in the example regardless of the location of the related value field.



The output of Unit S3 is wired to Card Column 72 - 76; its Storage Output Sign is wired to the 1 position in Card Column 90. The output of Unit S4 is wired to Card Columns 81 - 84; its Storage Output Sign is wired to the 7 position of Card Column 90.

Y-Wired and Inversion Connections

But one Storage Output may be connected for punching into but one field of the same card on the same Program. No Y-Wired or Inversion Connections are permissible.

Decimal Location

A Decimal Locator is provided for each one of the twelve Intermediate Storage Units, S1 - S12 whether the values in those Units are to be used as Intermediate Values or delivered to Output Storage as Output Values.

The wiring of the Decimal Locators and Decimal Position sockets to set the decimal point for Intermediate Storage Units is identical to that previously described for Input Values (see INPUT - Decimal Location).

The primary purpose of the twelve Decimal Locator sockets labeled S1 - S12 is to automatically align the decimal point of a Result delivered to the related Intermediate Storage Unit from the Accumulator. The decimal point of a Result delivered from the Accumulator enters an Intermediate Storage Unit according to the decimal point setting of that Intermediate Storage Unit.

Whenever an Intermediate Storage Unit is to be used in a Program, the related decimal point setting must be made. This is true regardless of whether the Result or Results delivered to that Unit are to be used only for further calculations (Intermediate Values) or be Set for punching (Output Values).

Because the Intermediate Storage Units are of 10-column capacity with those columns directly related to the ten Accumulator Columns, the decimal point for an Intermediate Storage Unit must be set so that the significant digits of the Result desired to be stored will fall within the ten Accumulator Columns. Because the calculation can use all 22 Counters of the Accumulator, digits of the full calculated result will, quite frequently, fall outside the ten Accumulator Columns; additional considerations must be given to the decimal point setting to permit proper Proof (see below).

The decimal point settings for Elements and Intermediate Storage Units are the means of determining what value the digits will assume. This determination is, to a great extent, independent of the Accumulator Columns to which the digits are related.

With four columns of digits, 5421 for example, these four digits may assume any of the following values according to where the decimal point is placed:

.5421
5.421
54.21
542.1
5421.

The decimal point settings can be such as to make the value of the digits small by placing ciphers between the first significant digit and the decimal point; .005421, for example. On the other hand, the value of the digits can be enlarged by decimal point setting by placing ciphers between the last significant digit and the decimal point; 542100. Of course, the limit to the size as affected by the decimal point setting is contingent upon the Accumulator Columns to which the digits are related.

The decimal point settings permit considerable liberty in pointing off the decimal. Using the single digit "1" as an example, that single digit can represent a wide variety of values according to the Accumulator Column to which it is related and the decimal point setting, as follows:



With the "1" related to Accumulator Column 1, successive decimal point settings will produce the following values:

/10 -	.0	0	0	0	0	0	0	0	0	1
10/9 -	.0	0	0	0	0	0	0	0	0	1
9/8 -	.0	0	0	0	0	0	0	0	0	1
8/7 -	.0	0	0	0	0	0	0	0	0	1
7/6 -	.0	0	0	0	0	0	0	0	0	1
6/5 -	.0	0	0	0	0	0	0	0	0	1
5/4 -	.0	0	0	0	0	0	0	0	0	1
4/3 -	.0	0	0	0	0	0	0	0	0	1
3/2 -	.0	0	0	0	0	0	0	0	0	1
2/1 -	.1									
1/ -	1.									

With the "1" related to Accumulator Column 2, successive decimal point settings will produce the following values:

/10 -	.0	0	0	0	0	0	0	0	0	1
10/9 -	.0	0	0	0	0	0	0	0	0	1
9/8 -	.0	0	0	0	0	0	0	0	0	1
8/7 -	.0	0	0	0	0	0	0	0	0	1
7/6 -	.0	0	0	0	0	0	0	0	0	1
6/5 -	.0	0	0	0	0	0	0	0	0	1
5/4 -	.0	0	0	0	0	0	0	0	0	1
4/3 -	.0	0	0	0	0	0	0	0	0	1
3/2 -	.1									
2/1 -	1.									
1/ -	1	0.								

With the "1" related to Accumulator Column 3, successive decimal point settings will produce the following values:

/10 -	.0	0	0	0	0	0	0	0	0	1
10/9 -	.0	0	0	0	0	0	0	0	0	1
9/8 -	.0	0	0	0	0	0	0	0	0	1
8/7 -	.0	0	0	0	0	0	0	0	0	1
7/6 -	.0	0	0	0	0	0	0	0	0	1
6/5 -	.0	0	0	0	0	0	0	0	0	1
5/4 -	.0	0	0	0	0	0	0	0	0	1
4/3 -	.1									
3/2 -	1.									
2/1 -	1	0.								
1/ -	1	0	0.							

With the "1" related to Accumulator Column 4, successive decimal point settings will produce the following values:

/10 -	.0	0	0	0	0	0	0	0	0	1
10/9 -	.0	0	0	0	0	0	0	0	0	1
9/8 -	.0	0	0	0	0	0	0	0	0	1
8/7 -	.0	0	0	0	0	0	0	0	0	1
7/6 -	.0	0	0	0	0	0	0	0	0	1
6/5 -	.0	0	0	0	0	0	0	0	0	1
5/4 -	.1									
4/3 -	1.									
3/2 -	1	0.								
2/1 -	1	0	0.							
1/ -	1	0	0	0.						



With the "1" related to Accumulator Column 5, successive decimal point settings will produce the following values:

/10	-	.0	0	0	0	0	1
10/9	-	.0	0	0	0	0	1
9/8	-	.0	0	0	0	1	
8/7	-	.0	0	0	1		
7/6	-	.0	1				
6/5	-	.1					
5/4	-	1.					
4/3	-	1	0.				
3/2	-	1	0	0.			
2/1	-	1	0	0	0.		
1/	-	1	0	0	0	0.	

With the "1" related to Accumulator Column 6, successive decimal point settings will produce the following values:

/10	-	.0	0	0	0	1	
10/9	-	.0	0	0	1		
9/8	-	.0	0	1			
8/7	-	.0	1				
7/6	-	.1					
6/5	-	1.					
5/4	-	1	0.				
4/3	-	1	0	0.			
3/2	-	1	0	0	0.		
2/1	-	1	0	0	0	0.	
1/	-	1	0	0	0	0	0.

With the "1" related to Accumulator Column 7, successive decimal point settings will produce the following values:

/10	-	.0	0	0	1			
10/9	-	.0	0	1				
9/8	-	.0	1					
8/7	-	.1						
7/6	-	1.						
6/5	-	1	0.					
5/4	-	1	0	0.				
4/3	-	1	0	0	0.			
3/2	-	1	0	0	0	0.		
2/1	-	1	0	0	0	0	0.	
1/	-	1	0	0	0	0	0	0.

With the "1" related to Accumulator Column 8, successive decimal point settings will produce the following values:

/10	-	.0	0	1					
10/9	-	.0	1						
9/8	-	.1							
8/7	-	1.							
7/6	-	1	0.						
6/5	-	1	0	0.					
5/4	-	1	0	0	0.				
4/3	-	1	0	0	0	0.			
3/2	-	1	0	0	0	0	0.		
2/1	-	1	0	0	0	0	0	0.	
1/	-	1	0	0	0	0	0	0	0.



With the "1" related to Accumulator Column 9, successive decimal point settings will produce the following values:

$\frac{1}{10} - .01$
 $\frac{10}{9} - .1$
 $\frac{9}{8} - 1.$
 $\frac{8}{7} - 10.$
 $\frac{7}{6} - 100.$
 $\frac{6}{5} - 1000.$
 $\frac{5}{4} - 10000.$
 $\frac{4}{3} - 100000.$
 $\frac{3}{2} - 1000000.$
 $\frac{2}{1} - 10000000.$
 $\frac{1}{1} - 100000000.$

With the "1" related to Accumulator Column 10, successive decimal point settings will produce the following values:

$\frac{1}{10} - .1$
 $\frac{10}{9} - 1.$
 $\frac{9}{8} - 10.$
 $\frac{8}{7} - 100.$
 $\frac{7}{6} - 1000.$
 $\frac{6}{5} - 10000.$
 $\frac{5}{4} - 100000.$
 $\frac{4}{3} - 1000000.$
 $\frac{3}{2} - 10000000.$
 $\frac{2}{1} - 100000000.$
 $\frac{1}{1} - 1000000000.$

The decimal points of values entering the Accumulator from Input, Constant, or Intermediate Storage are automatically aligned within the Accumulator according to the decimal point setting of the respective Intermediate Storage Units.

Counters	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Accumulator Columns													10	9	8	7	6	5	4	3	2	1

The relationship between the 22 Counters and the ten Accumulator Columns is shown in this illustration. This is the relationship portrayed by the indicators in the Accumulator section of the Program Test Panel. Counters 1 - 11 are represented by the indicators in the right hand sub-section; Counters 12 - 22 are represented by the indicators in the left hand sub-section.

The additional considerations regarding decimal point setting and Proof are outlined in the following paragraphs.

It is permissible to use decimal setting combinations that will cause some or all of the significant digits of the result to fall into the Counters to the right of the ten Accumulator Columns, however, the calculated result must not extend so far to the right as to fall in Counter 11.

When all of the significant digits of a result of addition or subtraction fall to the right outside the ten Accumulator Columns leaving a zero Result in the Accumulator Columns, a positive zero Result will be stored with Plus Branching.

It is not permissible to use decimal setting combinations that will cause some or all of the significant digits of the result to fall into Counters to the left of the ten Accumulator Columns. To do so will prevent Proof.

Addition and Subtraction

In Addition and Subtraction, the Value V2 enters the 10 Accumulator Columns according to its decimal setting. When the Value V1 is entered into the Accumulator, it aligns itself decimally with the decimal of the Value V2.



In this alignment, the Value V1 may be anywhere along the horizontal line comprising the 22 Counters. It may exceed the capacity of the 10 Accumulator Columns by falling partially or completely in Counters 11 - 22.

To gain the maximum speed in the Process, it is preferable that the decimal setting for the Value V1 be different than that for the Value V2; also that the decimal setting for the Result be different than that for V2. In either case if the decimal setting is the same, more time is required in the Process. For example:

Given, two 6-digit, dollar and cent Input Values to be wired to Accumulator Inputs A1 and A2 as V1 and V2 with a 7-digit, dollar and cent Result to enter Intermediate Storage Unit S1.

It is preferable to wire V1 to Accumulator Columns 7 - 2 of A1 with the decimal setting $5/4$ and V2 to Accumulator Columns 8 - 3 of A2 with the decimal setting $4/3$, for example, than to wire both values to the same Accumulator Columns with the same decimal settings.

As far as the Result is concerned, it is preferable that the decimal setting be $3/2$, for example, than $4/3$ which is the V2 decimal setting.

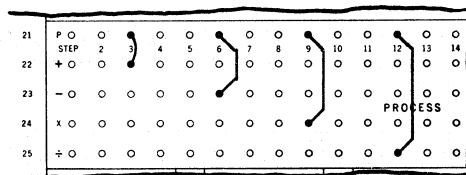


Program Connections

The Program Connections consist of the following types of wiring for the individual Program Steps; Process, Equation, and Branching. The upper portion of the Constant & Program Panel provides for these Program Connections for the 40 Program Steps.

PROCESS

The Process wiring instructs the machine of the arithmetical process (addition, subtraction, multiplication, or division) to be performed on the two values used on a Program Step.



In this example; Step 3 is wired for addition (V1 plus V2), Step 6 is wired for subtraction (V1 minus V2), Step 9 is wired for multiplication (V1 multiplied by V2), Step 12 is wired for division (V1 divided by V2).

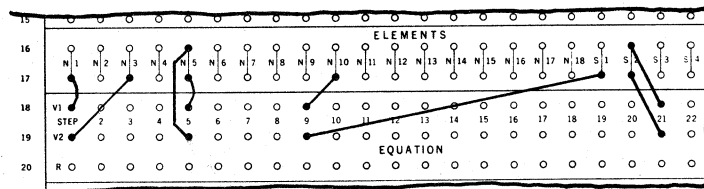
EQUATION

The Equation wiring calls in the two Values to be used in a Program Step and directs the Result of that Step to the desired Intermediate Storage Unit. The Equation wiring is between the sockets in the Equation section and those in the Elements section immediately above.

Value

The wiring to the V1 and V2 sockets is from the desired Element sockets; N1 - N36 representing Input and Constant Values, S1 - S12 representing Intermediate Values. Both Values for a Program Step may be of the same type, one Value may be of one type with the other of another type, in fact, the same Value may be used both as V1 and V2.

The same Element, N1 - N36 and S1 - S12, may be called on as many times as desired, as long as it is available, in the same Program. Ample Bus capacity above the Element sockets is provided for this purpose.



In this example:

Step 1 uses; Element N1 (an Input or a Constant Value) as V1, Element N3 (an Input or a Constant Value) as V2.

Step 5 uses Element N5 (an Input or a Constant Value) as both V1 and V2.

Step 9 uses; Element N10 (an Input or a Constant Value) as V1, Element S1 (an Intermediate Value) as V2.

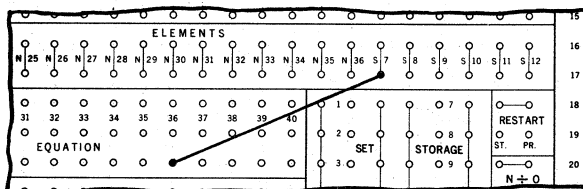
Step 21 uses Element S2 (an Intermediate Value) as both V1 and V2.

IMPORTANT:- A zero value may be obtained by using an unassigned Element. This would be an Element not connected to Card Sensing (Input Value), or not connected to Constant Digits (Constant Value). It is necessary, however, that the decimal point setting for that Element be made.



Result

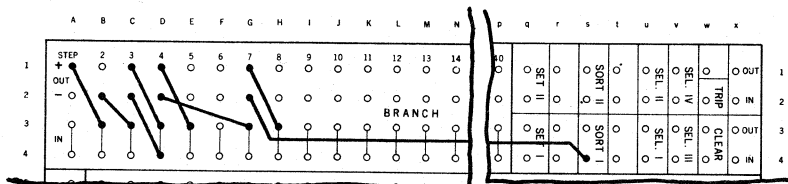
The wiring of the Result is from the R socket of a Program Step to an S1 - S12 Element socket to deliver that Result to the desired Input Storage Unit.



In this example, the Result of Step 36 is delivered to Intermediate Storage Unit S7.

The Branch wiring establishes the routine or routines to be followed for the Program. The Branch operation guides the machine from one action to the next within the Program; from Program Step to Program Step, from Program Step to Operational Step, from Operational Step to Operational Step, from Operational Step to Program Step.

The Branching from Program Step to Program Step or from Program Step to Operational Step is according to the sign (+ or -) of the Result. Such Branching may be Single or Double.



In this example:

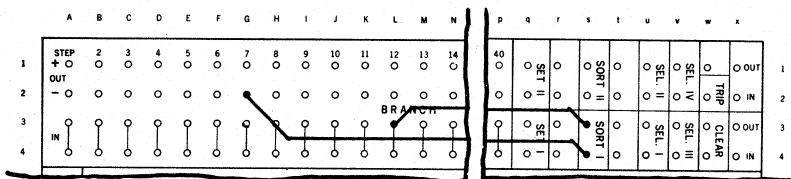
A Single, Plus Branch is wired from Program Step 1 to Program Step 2 on the assumption that the Result of Program Step 1 will always be plus.

A Single, Minus Branch is wired from Program Step 2 to Program Step 3 on the assumption that the Result of Program Step 2 will always be minus.

A Double Branch is wired from Program Step 3 to Program Step 4. Regardless of whether the Result of Program Step 3 is plus or minus, Program Step 4 will follow Program Step 3.

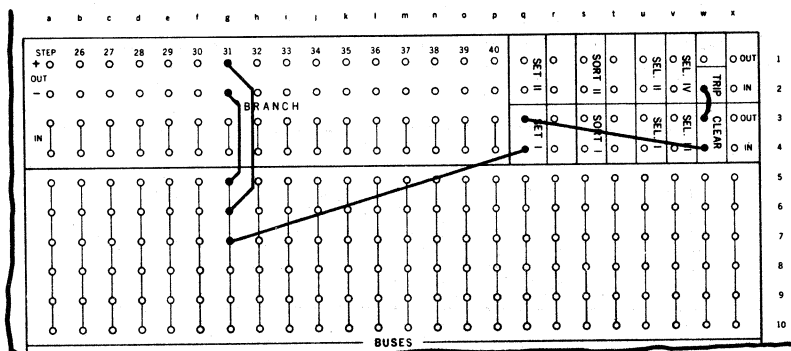
A Double Branch is wired from Program Step 4. The Plus Branch is wired to Program Step 5; the Minus Branch to Program Step 7.

A Double Branch is wired from Program Step 7. The Plus Branch is to Program Step 8; the Minus Branch is to the Operational Step, Sort I.



Branching may be from a Program Step to an Operational Step, from an Operational Step to a Program Step as illustrated above. In this case, a Minus Branch connects Program Step 7 to the Sort I Operation; an Operational Branch connects Sort I to Program Step 12.





Branching may be from a Program Step to an Operational Step, from an Operational Step to an Operational Step as shown in this example. This illustrates possible wiring at the end of a Program. A Double Branch connects the final Program Step, No. 31 in this case, to Set I, Set I is wired to Clear, Clear is wired to Trip to conclude the Program.



Control and Function Connections

The Control and Function Connections include wiring for; Negative Sign identification, Decimal Location, Reproduce and Secondary Reproduce, Skip Cycle, Set Hold, Set Storage, Clear Storage, Zero Divisor Selection, Start, Restart, and Selectors. Card Position Selection is also included as a means of varying these and other types of connections.

NEGATIVE SIGN IDENTIFICATION

This subject is discussed on previous pages with its relationship to Input, Constant, Intermediate, and Output Values.

DECIMAL LOCATION

This subject is discussed on previous pages with its relationship to Input, Constant, Intermediate, and Output Values.

REPRODUCE AND SECONDARY REPRODUCE

These subjects are discussed on previous pages (see REPRODUCTION) - Reproduce Control).

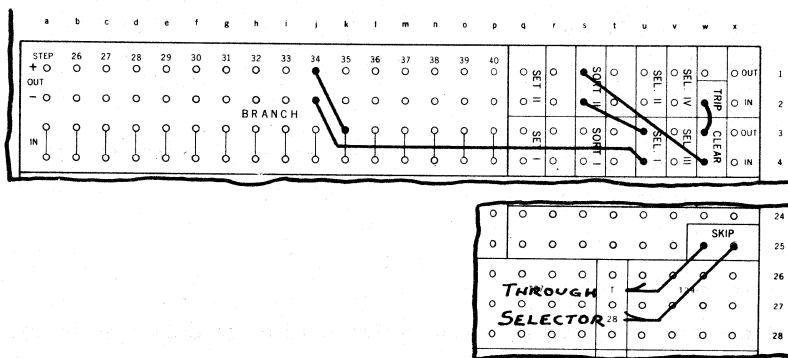
SKIP CYCLE

This subject is discussed on previous pages with regard to its functioning during Reproduction (see REPRODUCTION - Reproduce Control). The Skip Cycle sockets discussed at that time are those on the Input & Output Panel (v-x,17) used to perform the Card Controlled Skip Cycle operation.

The Skip Cycle (Program Controlled) sockets on the Constant & Program Panel (w&x,25), on the other hand, are controlled by routing the connection between the two sockets through a Selector. The Selector, in turn, is controlled by a Program Select operation as an Operational Step in the Program.

The only difference between the two sets of Skip Cycle sockets is the manner in which they may be impulsed.

The previous paragraphs on this subject mention that the Skip Cycle is effective to prevent all punching. This includes both Reproducing information and Output Values Set in the Punching Setup Section of the machine. The Skip Cycle, regardless of which set of sockets is used, may, therefore, be used to prevent punching where the Punching Setup Section contains Output Values only, Reproducing Information only, or both Output Values and Reproducing Information.



This is a typical example of the use of the Program Controlled Skip Cycle. On Program Step 34 when the Result is positive, the Program is to proceed to Program Step 35. When the Result is negative; the Program is to end, all punching is to be withheld from the card, the card is to be segregated into the Front Card Receiver, and Intermediate Storage is to be Cleared.

The Minus Branch wiring from Program Step 34 is routed through; the Sel. I, Sort II, Clear, to the Trip.



NOTE:- Because the Set Hold is not being impulsed, all information Set in the Punching Setup Section will be retracted when the Trip signal is delivered.

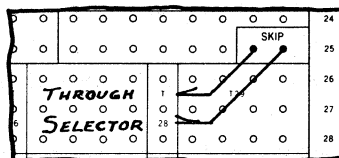
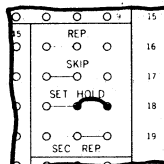
SET HOLD

This subject is discussed on previous pages with regard to its functioning during Reproduction (see REPRODUCTION - Reproduce Control). Set Hold functions only through the sockets (v-x,18) on the Input & Output Panel. As previously explained, Set Hold will function:

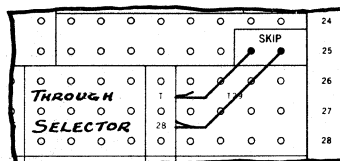
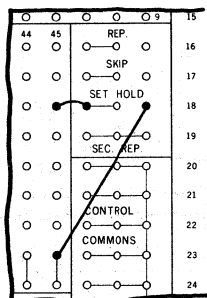
1. Automatically whenever Skip Cycle is impulsed by interconnecting the Set Hold sockets. This automatic Set Hold will function with either Card Controlled or Program Controlled Skip Cycle or both on the same Program.
2. Selectively whenever Skip Cycle (Card Controlled or Program Controlled) is impulsed by routing the connection between the Set Hold sockets through a control position. Skip Cycle will then occur for a card containing the Set Hold control punching when Set Hold is impulsed simultaneously with the control punching.
3. Independently by connecting the right socket of the Card Controlled Skip Cycle (x,17) to one of the left sockets of Set Hold. To make the function selective, this connection is routed through a Selector (see REPRODUCTION - Reproduce Control).

The Set Hold function provides the means of retaining Output Values Set in the Punching Setup Section from card-to-card as long as desired despite the fact that one or more Trip signals may be delivered. It is also used to retain Reproducing information despite the simultaneous impulsing of the Reproduce control.

IMPORTANT:- When Program Controlled Skip Cycle is to operate in conjunction with Set Hold, the Program Select used to pick up the Selector controlling the Skip Cycle may not be impulsed until such time in the Program as would be equivalent to either 6 multiplications or divisions or 18 additions or subtractions.

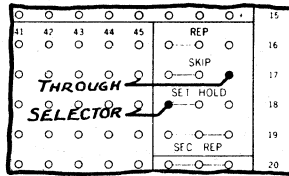


This example illustrates the automatic impulsing of Set Hold in conjunction with Program Controlled Skip Cycle.



This example shows the selective impulsing of Set Hold by card control in conjunction with Program Controlled Skip Cycle.





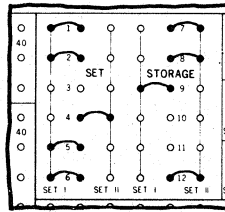
Independent control of Set Hold is shown in this example. Selectors are used to perform this operation as previously explained (see REPRODUCTION - Reproduce Control).

SET STORAGE

The Set function for Intermediate Storage is divided into two operations, Set I and Set II. The wiring within the Set Storage section (q-v,18-23) of the Constant & Program Panel determines which of the Intermediate Storage Units will Set Output Values on Set I and which on Set II.

It is possible to Set one or more of the values in Intermediate Storage on Set I with the balance on Set II. All of the values may be Set on Set I on one Program or all may be Set on Set II.

The wiring in this section is for only those Intermediate Storage Units that are to deliver Output Values for punching.



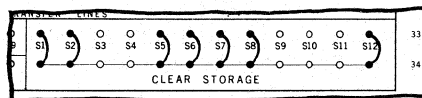
In this example, the Set Storage is wired to; Set Units 1, 2, 5, 6 and 9 on Set I, Set Units 4, 7, 8, and 12 on Set II. Any values in Intermediate Storage Units 3, 10, and 11 will not be Set.

CLEAR STORAGE

The Clearing or Non-Clearing of the individual Intermediate Storage Units at the time the Clear Operation is impulsed is determined by the wiring within the Clear Storage section (m-x,33&34) of the Constant & Program Panel.

All Intermediate Storage Units wired to "Clear Storage" in this section will be Cleared each time the Clear operation is impulsed within the Program. The Units not so wired, whether they are being used or not, will not be Cleared by the Clear impulse.

Any Intermediate Storage Unit may be cleared at any time by Zeroizing (delivering a zero Result to the desired Unit). The value in any Intermediate Storage Unit will be replaced at any time by reading in a new value.



In this example, Intermediate Storage Units S1, S2, S5, S6, S7, S8, and S12 will Clear; Units S3, S4, S9, S10, and S11 will not.



ZERO DIVISOR SELECTION

What action the machine is to take when an infinite Result ($N \div 0$) or an indeterminate Result ($0 \div 0$) is obtained is determined by the wiring in the two Zero Divisor Selection sections.

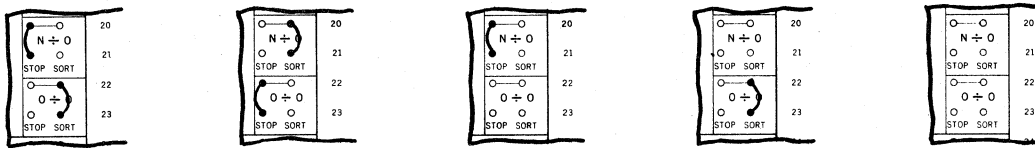
The machine will take the following actions according to the settings made:

Stop - The Stop socket is wired to a common socket.

Sort and Trip - The Sort socket is wired to a common socket.

No action - Neither the Stop nor the Trip is connected; the value in the Intermediate Storage Unit will be zero.

But one setting can be made within each Zero Divisor Selector. The same setting can be made in both sections; or they may differ according to the requirements of the application.



Shown above are various settings of the Zero Divisor Selectors:

The $N \div 0$ is set to Stop; the $0 \div 0$ is set to Sort.

The $N \div 0$ is set to Sort; the $0 \div 0$ is set to Stop.

The $N \div 0$ is set to Stop; the $0 \div 0$ is set for no action.

The $N \div 0$ is set for no action; the $0 \div 0$ is set to Sort.

Both the $N \div 0$ and the $0 \div 0$ are set for no action.

When the machine stops as the result of an $N \div 0$ or $0 \div 0$ setting, the card on which the stoppage occurred may be punched or not as desired.

If the card is to be punched and the operation continued, the Card Feed Switch is moved to the Start position after moving the Clear and Unit Switches down to the Calc. position.

If the card is not to be punched, the Card Release and Unit Switches are moved to their Up positions.

START

The impulse emitted from the Start socket is connected to an "IN" socket in the Branch section for the initial Program Step.

When the Program is to be initiated for each card in the run, the Start is wired directly to the IN socket of the initial Program Step.

When the application involves no calculating such as would be the case with a straight Reproducing operation, the Start is connected directly to the Trip.

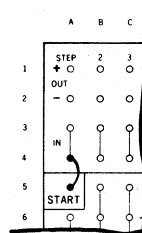
When the application includes cards to be calculated and others to be fed through without calculating, the connection from the Start may be, either:

1. Through Card Controlled Selection (see below) with; one position used to connect the Start to the initial Program Step for the calculation, the other position used to connect the Start to the Trip.
2. Through a Selector. With this type of connection, the Start is first wired to an initiating Program Step to permit proper Selector operation. The Branch wiring from this initiating Step is then routed through the Selector to the initial Program Step and to the Trip.

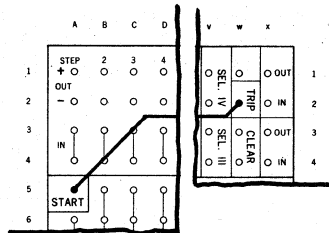


The fact that the Start signal may not be delivered to the initial Program Step does not prevent the Sensing operation.

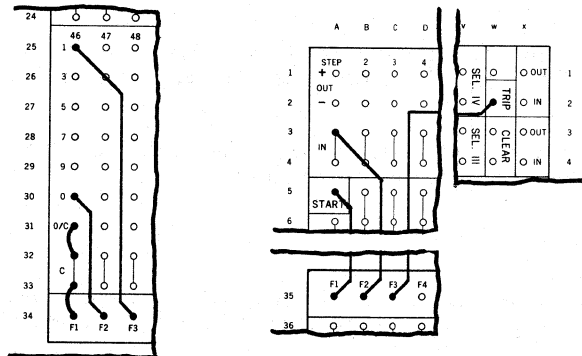
NOTE:- Any card fed into the Punching Section will be punched with all Reproduce, Secondary Reproduce, or Output information Set in the Punching Setup Section unless the Skip Cycle is impulsed.



In this example, the Start is connected directly to the initial Program Step, Step 1 in this case. The Program will be initiated automatically for each card fed through the machine.



In this example, the Start is connected directly to the Trip. Each card will feed through the machine at the high card feeding speed. No calculating will occur. Any information punched in the cards will be sensed. Reproducing can take place if desired.

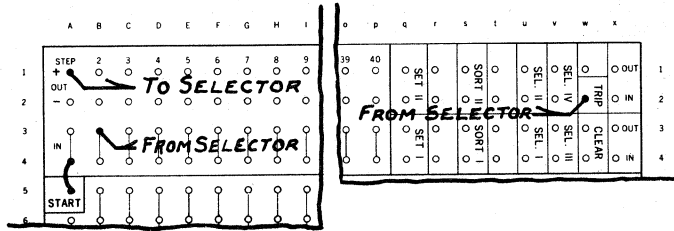


In this example, either the initial Program Step or the Trip is impulsed according to the control punching sensed from individual cards.

The 0 in Card Column 46 is connected through Field Transfer Line F2 to the initial Program Step, Step 1 in this case. The 1 in Card Column 46 is connected through Field Transfer Line F3 to the Trip. The Start is connected through F1 Field Transfer Line to the C and 0/C sockets of Card Column 46.

When the 0 in Card Column 46 is sensed, the card containing that punching will be calculated. When the 1 in that card column is sensed, the card will feed through without calculating.





In this example, the connection from the Start to the initial Program Step for the calculating operation and the Trip is routed through a Selector.

Notice that the Start is first wired to an initiating Program Step with the Branch wiring from that Program Step to the Selector. The purpose of such an initiating Program Step is to allow time for proper Selector operation.

RESTART

Should a Program Step fail to prove, a signal is emitted by the Restart sockets (w&x,18). This signal may be used to instruct the machine to start again at the initial Program Step or to repeat the particular Program Step on which the failure to prove occurred. The wiring for the Restart is entirely within the Restart section (w&x,18&19) of the Constant & Program Panel.



By making the connection shown in the example to the left, the particular Program Step will repeat itself. By making the connection shown in the example to the right, the Program will automatically revert to the initial Program Step.

It is important that a Restart connection be made as an assurance of proper programming and machine performance.

When a Restart occurs, the particular Restart will repeat itself until the machine operation is stopped by the operator moving the Card Feed Switch on the Control Panel to the Stop position.

If a reading of the Program Test Panel is made, the Check indicator will not light on the Program Step for which the Proof was not successful.

CARD POSITION SELECTION

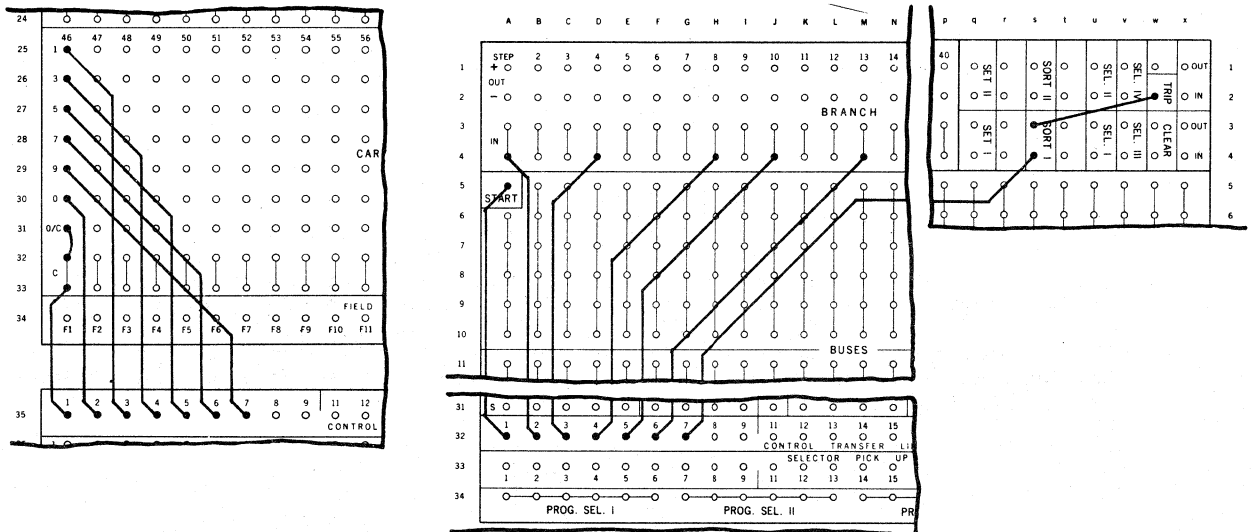
Connections of various types; such as Control, Function, Element Designators, Branching, etc., may be optionally varied (selected) by routing the wiring through control positions in the cards rather than by direct connection.

Card Position Selection may not be used for:

- Connections between the Element section and the Equation section.

- Connections between the Constant Digits section and the Accumulator Columns section of the Constant & Program Panel.





In the above illustration, Card Position Selection is being used as a means of branching from Start to one of five different Program Steps or to an Operation.

The Start is wired through a Transfer Line to the C and O/C sockets in the card column to be used to control the branching. The 0, 1 - 9 positions in this column are each wired back through the Transfer Lines to the IN sockets of the individual branches.

The Branch from Start selected for each card sensed would be according to the one position punched in that card.

SELECTORS

Selectors, to a greater or lesser extent, are used in practically all Programs. The use of Selectors affords the Programmer an opportunity of economizing in the number of Program Steps required for a solution. Conversely, they make possible the adaptation of long or iterative problems with many sub-routines to one Program.

Any connection made from socket to socket on either the Input & Output Panel or the Constant & Program Panel may be routed through the Selectors.

The connections between the Constant Digits section and the Accumulator Columns section of the Constant & Program Panel may not be routed through Selectors.

The ability to govern the Selector Pick Up by Card Control, Program Select, and Selector Hold adds to their versatility and value in Programming.

A Selector whose Pick Up is impulsed by card control will assume the Select position after the initial Step of the Program (regardless of whether that initial Step is a Program or Operational Step). The Selector will be in its Select position on the second Step of the Program.

When a Selector is picked up or dropped out (changed from Select to Non-Select or the reverse), it will assume its new position (Select or Non-Select) after an interval equivalent to one Program Step or Operational Step.

When the picking up or dropping out of one Selector controls the picking up or dropping out of another Selector, the second Selector will assume its new position after an interval equivalent to one Program Step or Operational Step.

Selector Wiring

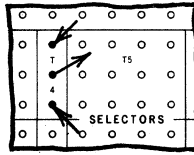
The basic purpose of Selector wiring, as previously outlined, may be:

To select one of two digits or controls.

To send one digit or control in either one of two directions.

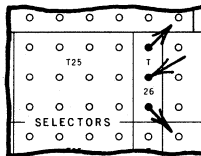


The wiring is as follows:



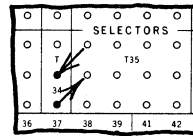
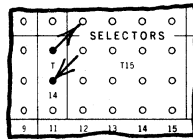
One of the digit or control impulses is wired to the S (Select) socket; the other is wired to the NS (Non-Select) socket. Wiring out of the Selector is from the C (Common) socket.

The impulse entering the NS socket will exit from the C socket when the Selector Pick Up is not impulsed. While the Pick Up is being impulsed however, the impulse entering the S socket will exit from the C socket.



The digit or control is wired to the C socket. The wiring out of the Selector is from the S socket in one direction and from the NS socket in another direction.

The impulse entering the C socket will exit from the NS socket when the Selector Pick Up is not impulsed. While the Pick Up is being impulsed however, the impulse will exit from the S socket.



A digit or control impulse may be wired through the NS side only or through the S side only.

In the example to the left, the impulse wired to the C socket will exit from the NS socket as long as the Selector Pick Up is not impulsed. During the time the Pick Up is being impulsed, the circuit is broken.

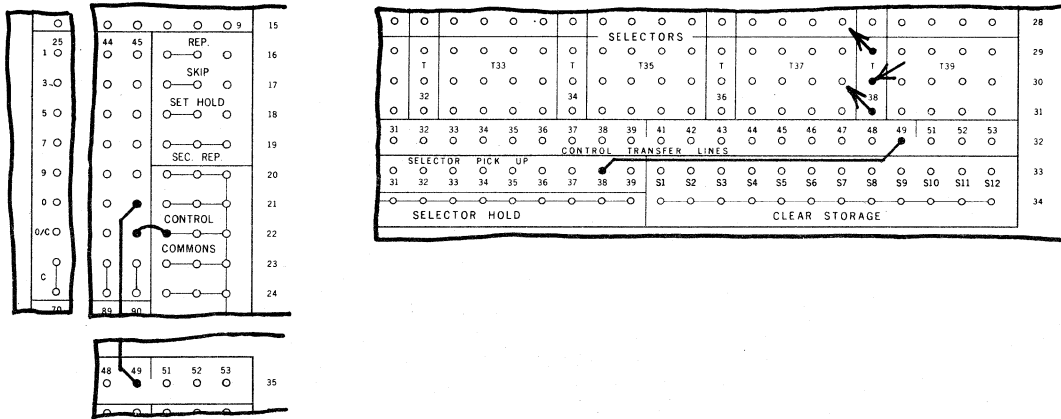
In the example to the right, the impulse wired to the C socket will exit from the S socket during the time the Selector Pick Up is being impulsed. As long as the Pick Up is not being impulsed, the circuit is broken.

Selector Control

The following examples illustrate various means of impulsing a Selector Pick Up so that the related Selector will assume the Select position.

It is to be noted that any number of Selector Pick Ups may be energized through the contacts of one Selector.



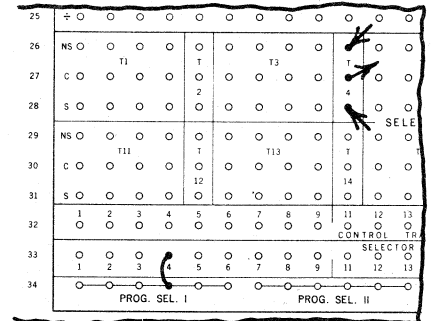
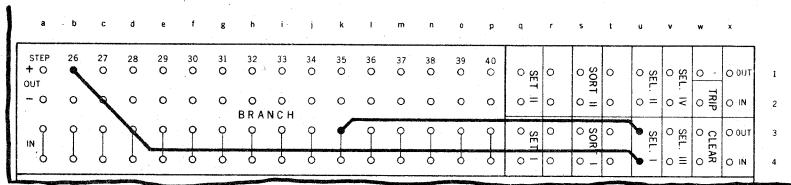


Card Control is to be used to impulse the Selector Pick Up. The related Selector will assume the Select position at the end of the initial Program Step for the card containing the control punching.

It will remain in the Select position until the end of the Program for that card. At the Trip signal, it will resume the Non-Select position ready to be impulsed or not depending on whether the following card contains the same control punching.

The 0 in Card Column 45 is connected through Control Transfer Line 49 to Selector Pick Up 38. The 0/C socket for Card Column 45 is connected to a Control Common socket.

NOTE:- As many as 5 (maximum) Selector Pick Ups may be impulsed directly from one Card Control position.

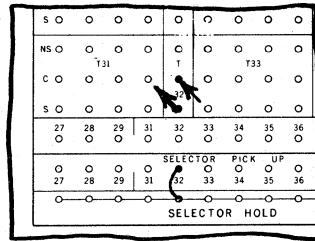


A Program Select is used to impulse the Selector Pick Up. The related Selector will assume the Select position immediately after the related Select Operation socket is impulsed ready for the following Program or Operational Step.

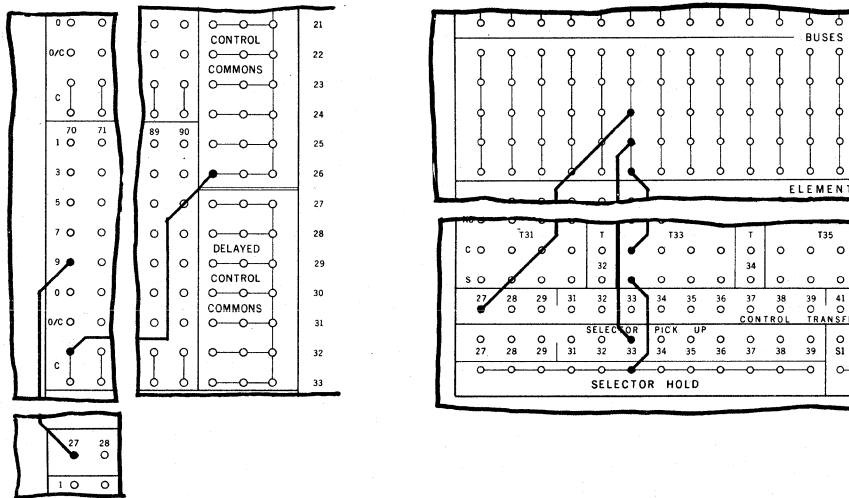
It will remain in the Select position for the balance of the Program. At the Trip signal, it will resume the Non-Select position ready to be impulsed or not during the Program for the following card.

The Plus Branch of Program Step 26 is routed through the Sel. I sockets to the IN socket of Program Step 35. A Program Select I socket is connected to Selector Pick Up 4.





A Selector Pick Up is connected directly to a Selector Hold socket. The related Selector will assume the Select position when the current to the Computer is turned On. It will remain in the Select position as long as the Computer current remains On.

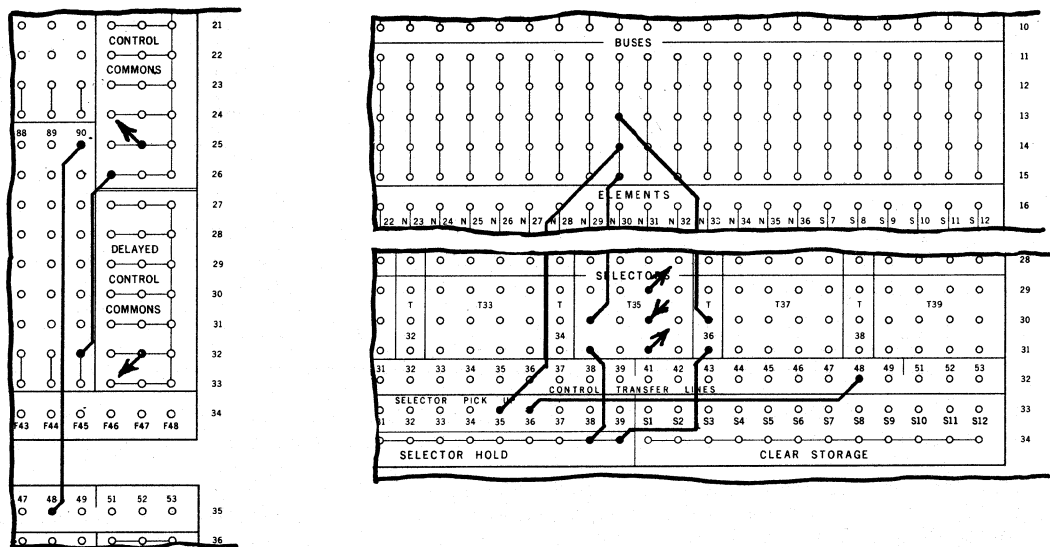


A Selector Hold operation is initiated by Card Control. The wiring from the Selector Pick Up is routed through the Select side of the Selector to be controlled to the Selector Hold.

IMPORTANT:- When either the Control Commons or the Delayed Control Commons or both are being used purely for Selector Hold operation, control positions may be wired directly to the Pick Up of the Selectors to be Held.

When the control punching is sensed to impulse the Selector Pick Up, the related Selector then assumes the Select position. The connection is then made between that Selector Pick Up and the Selector Hold.

The Selector assumes the Select position when the control punching is sensed. It then remains in the Select position because of the Selector Hold as long as the Computer current remains On or until manually cleared by switch movement on the Control Panel or Program Test Panel.



A Selector Hold operation is to be initiated by Card Control. However, the Control Commons and the Delayed Control Commons are to be used for other purposes than Selector Hold.

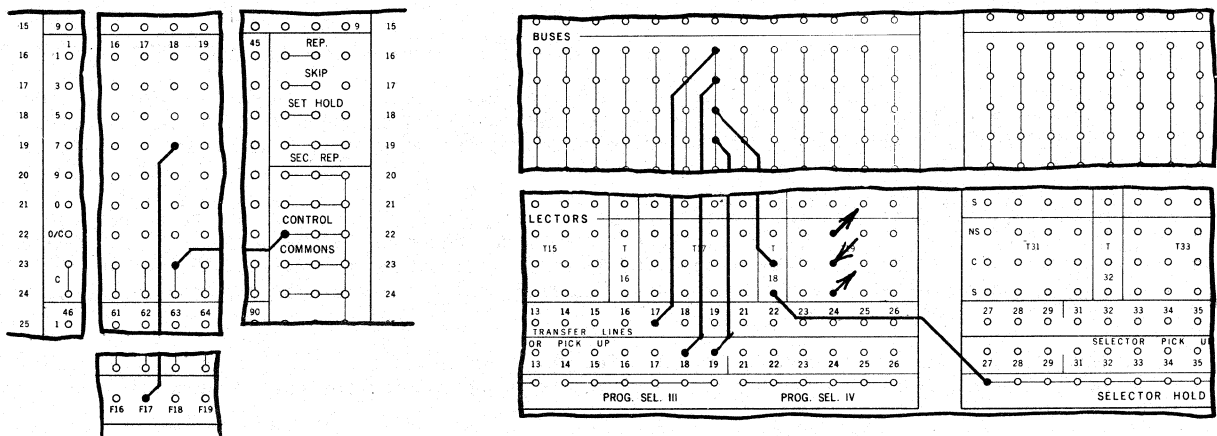
IMPORTANT:- When either the Control Commons or the Delayed Control Commons or both are to be used for Selector Hold operations as well as for any other purpose, the Selector Hold wiring must be isolated from the Card Control wiring.

In this example, the Selector Hold wiring is routed through a control Selector, T36, to the Pick Up of the Selector to be controlled, T35.

When the control position is sensed (1 in Card Column 90), Selector T36 assumes the Select position for the duration of the Program for the card containing the control punching.

With Selector T35 in the Select position, the Selector Hold connection through the Select side of T35 to the Pick Up of that Selector continues to maintain the T35 Selector in the Select position following the Program for the card containing the control punching.

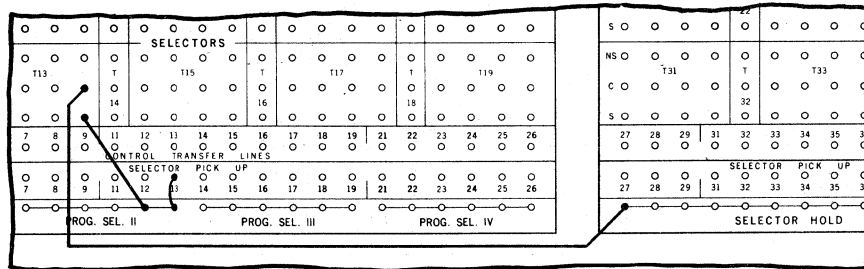
As can be seen in this example, there is no connection between the Card Control wiring and the Selector Hold wiring as is the case in the previous example.



One Selector whose Pick Up is impulsed by card control, is used to initiate a Selector Hold operation for another Selector. The Selector Hold wiring from the Selector Pick Up of the Selector to be Held is routed through the Select side of the controlling Selector.



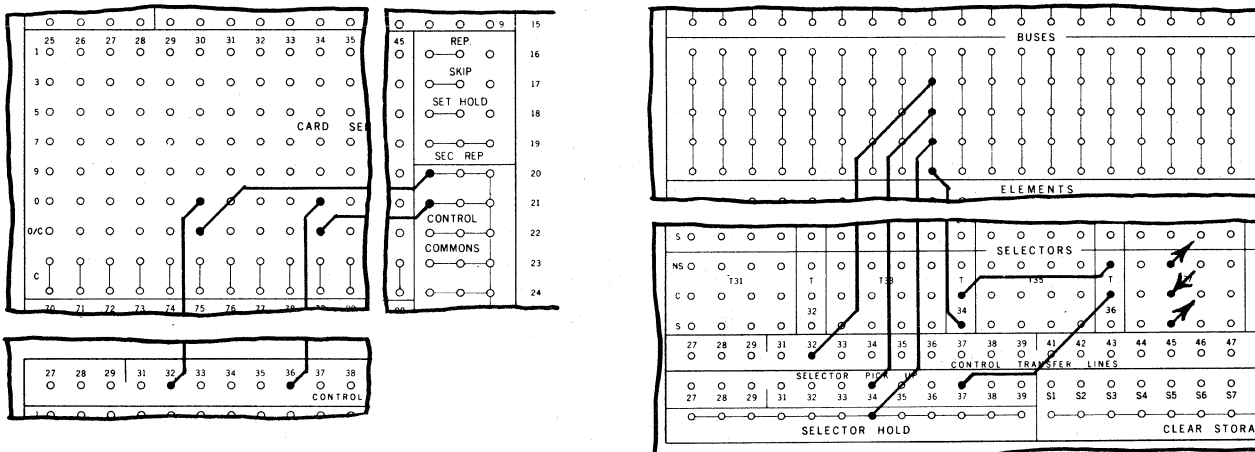
When the control punching is sensed to impulse the T18 Selector Pick Up, the Pick Up for Selectors T18 and T19 is connected to the Selector Hold. Both Selectors will remain in the Select position as long as the Computer current is turned On or until manually cleared.



A Selector Hold operation is initiated by Program Select. The wiring from the Selector Pick Up is routed through the Select side of the Selector to be controlled to the Selector Hold.

When the Program Select operation occurs, the Selector Pick Up is impulsed to cause the related Selector to assume the Select position. The connection is then made between that Selector Pick Up and the Selector Hold.

The Selector assumes the Select position when its Pick Up is impulsed by the Program Select. It then remains in the Select position because of the Selector Hold as long as the Computer current remains On or until manually cleared.



One Card Control is used to initiate a Selector Hold with another Card Control used to drop out that Selector Hold. The wiring from the Selector Hold is routed through the Non-Select side of one Selector, through the Select side of another Selector to the Selector Pick Up of the Selector to be controlled.

When the Pick Up of the first control Selector is impulsed, the Pick Up of the Selector to be controlled and the first control Selector will be connected to the Selector Hold. The first control Selector and the controlled Selector will assume the Select position and remain in Select until a card containing the control position associated with the second control Selector is sensed.

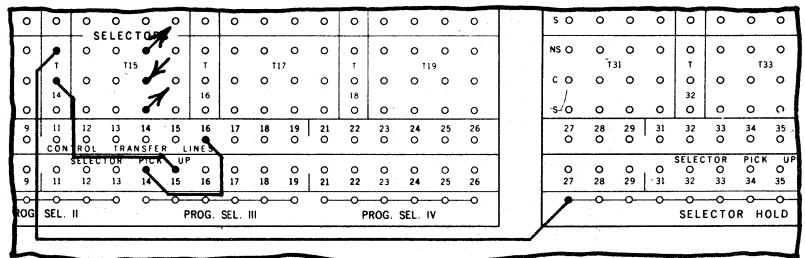
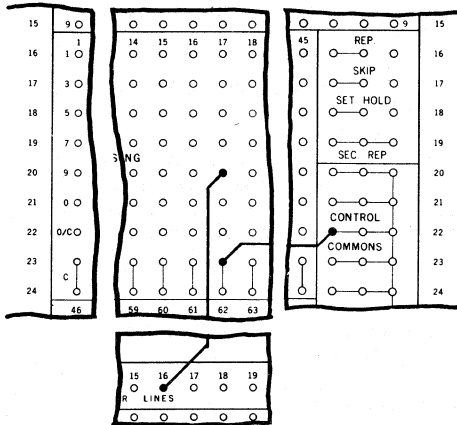
When the Pick Up of the second control Selector is sensed, the connection to the Selector Hold is immediately broken; the first control Selector and the controlled Selector revert to Non-Select.

In the example, Selector T37 is to be controlled. The T37 & T34 Pick Ups are routed through the Select side of Selector T34, through the Non-Select side of Selector T36 to the Selector Hold. The 0 of Card Column 30 is wired to the Pick Up of Selector T34. The 0 of Card Column 34 is wired to the Pick Up of Selector T36.



When a card containing the 0 in Card Column 30 is sensed, Selectors T34 and T37 will assume the Select position to allow the connection from the T34 and T37 Selector Pick Up to be connected to the Selector Hold. Selectors T34 and T37 will remain in the Select position until dropped out.

When a card containing the 0 in Card Column 34 is sensed, the Pick Up of Selector T36 is impuised to break the connection between the T34 and T37 Selector Pick Up and the Selector Hold. The Selector Hold is dropped out. Selectors T34 and T37 immediately revert to Non-Select for that card to remain in Non-Select until a card containing the 0 in Card Column 30 is again sensed.

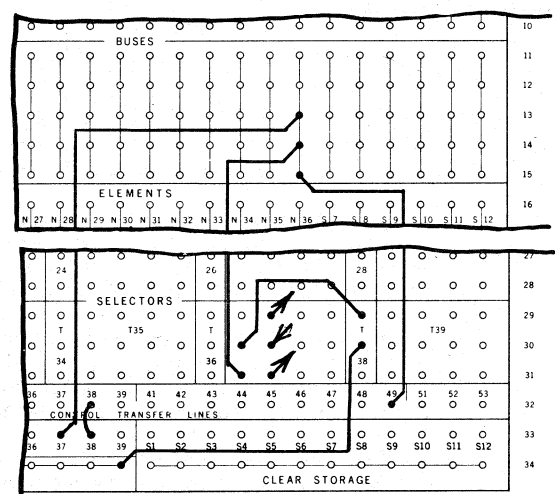
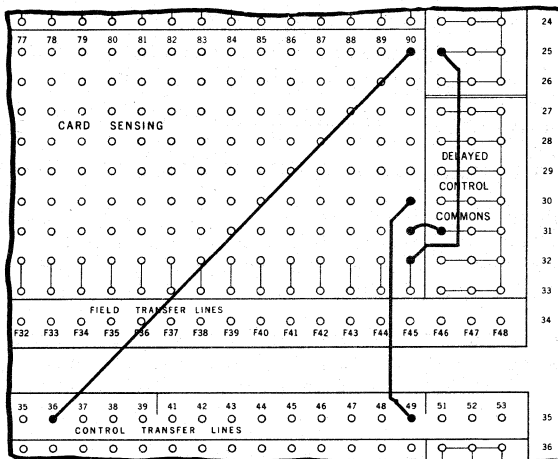


A Card Control impulse is used to drop out a Selector Hold for the Program of the card containing the control punching. The Pick Up of the Selector being controlled is connected through the Non-Select side of a control Selector to the Selector Hold.

When the Pick Up of the control Selector is impuised, the connection is broken between the Pick Up of the controlled Selector and the Selector Hold. The controlled Selector will remain in Non-Select as long as the Pick Up of the control Selector is impuised. It will revert to Select when the control Selector Pick Up is not impuised.

In the example, the Pick Up of Selector T15 is connected through the Non-Select side of Selector T14 to the Selector Hold. The 9 in Card Column 17 is connected to the Selector T14 Pick Up.

Selector T15 is held in the Select position until a card punched in the 9 position of Card Column 17 is sensed to break the Selector Hold connection. Selector T15 will assume the Non-Select position for that card. It will revert to Select following the Trip operation for that card.



A Selector Pick Up impulsed by Delayed Card Control is maintained for the duration of the Program for the following card or cards by Selector Hold. The Selector Hold is dropped out by Card Control when it has served its purpose. The control punching for the drop out can be in the same card used to make the pick up.

The Pick Up of the Selector to be controlled is impulsed by Delayed Card Control to be effective following the Tripping operation for that card. The Selector Hold is connected through the Non-Select side of a second Selector, through the Select side of the first Selector to the Pick Up of the first Selector.

The control position used to drop out the Selector Hold is connected to the Pick Up of the second Selector to break the connection from the Selector Hold to the Pick Up of the Selector being controlled.

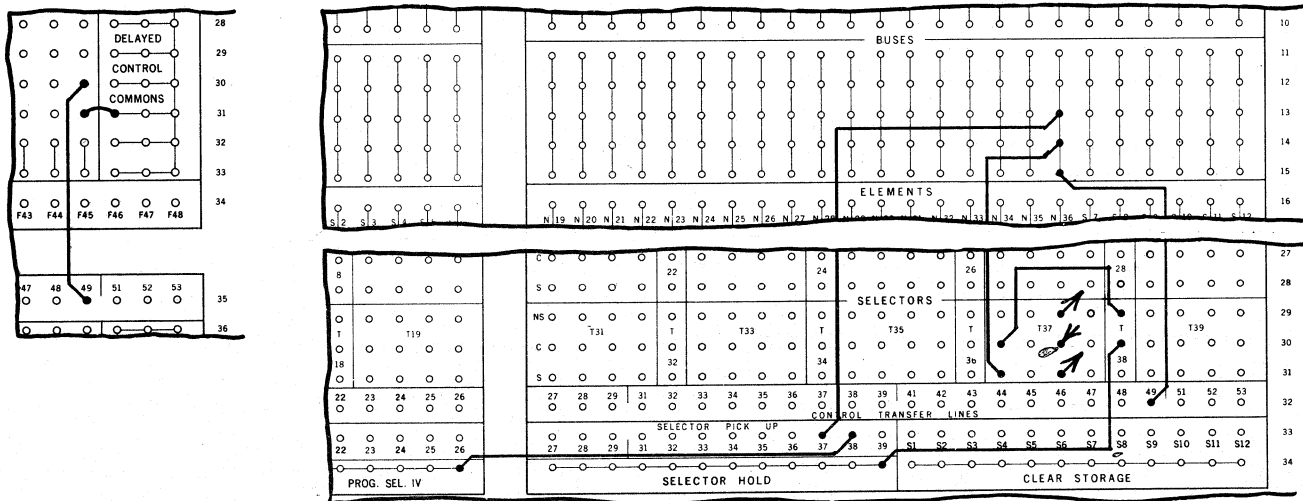
The Selector Hold will then not be effective until such time as the Delayed Card Control position is again sensed.

Because of the difference in timing between the use of the Control Commons and Delayed Control Commons, the Selector Hold drop out and pick up control punching may be in the same card. The drop out punching to break the connection, if it had been made, would be in each such card so that the connection may be made or not for following cards by the presence or absence of the pick up punching.

In this example, the 0 position in Card Column 90 is connected to the Pick Up of Selector T37. The Selector Hold wiring is through the Non-Select side of Selector T38, through the Select side of Selector T37 to the Pick Up of Selector T37.

The 1 position in Card Column 90 is connected to the Pick Up of Selector T38.

When the 0 position is sensed, the Selector Hold connection is made to cause Selector T37 to assume the Select position. When the 1 position is sensed, Selector T38 assumes the Select position to break the Selector Hold connection to cause Selector T37 to assume the Non-Select position.



A Selector Hold impulsed by Delayed Card Control is maintained for the duration of the Program for the following card or cards until such time as a Program branches into a Program Select. At that time, the Selector Hold is dropped out. The Selector Hold will not be re-initiated until the Delayed Card Control punching is again sensed.

The Pick Up of the Selector to be controlled is impulsed by Delayed Card Control from a card to be effective following the Tripping operation for that card to permit the Selector Hold to be connected to the Pick Up of that Selector. This Selector Hold wiring is routed through the Non-Select side of a second Selector.

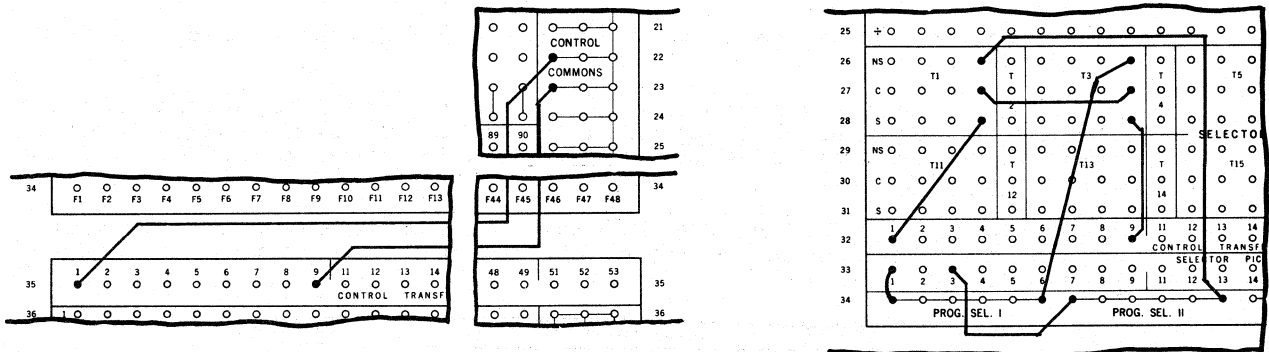
The Program Select used to drop out the Selector Hold is connected to the Pick Up of the second Selector to break the connection from the Selector Hold to the Pick Up of the Selector being controlled.



In this example, the 0 position in Card Column 90 is connected to the Pick Up of Selector T37. The Selector Hold wiring is routed through the Non-Select side of Selector T38, through the Select side of Selector T37 to the Pick Up of Selector T37.

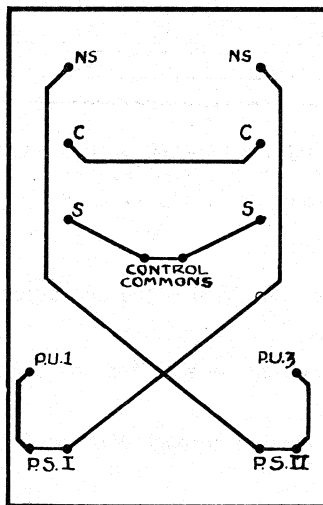
The Program Select IV is connected to the Pick Up of Selector T38.

When the 0 position is sensed, the Selector Hold connection is made to cause the Selector T37 to assume the Select position. When the Program Select IV is impulsed during a Program, the Selector T38 assumes the Select position to break the Selector Hold connection to cause Selector T37 to assume the Non-Select.



The individual Program Selects may be de-activated and reused repeatedly during the same Program. If the connection between a Program Select and the Selector Pick Up or Pick Ups to which it is connected is broken, the related Program Select will drop out ready to be reused in the same Program.

A method of de-activating two Program Selects (I and II) is shown in the above example. The above wiring is shown graphically below.



At the Start of the Program, Selectors T1 and T3 are in Non-Select.

When the Sel. I operation is first impulsed, the connections from the Program Select I:

1. Picks Up Selector T1. Selector T1 then transfers to Select.
2. Through the Non-Select side of Selector T3, through the Select side of Selector T1 to the Control Commons causes the Program Select I to be de-activated ready for reuse.

This same connection, however, maintains the Pick Up of Selector T1 to keep that Selector in Select.

When the Sel. II operation is first impulsed:

1. The connection from the Program Select II Picks Up Selector T3. Selector T3 then transfers to Select.

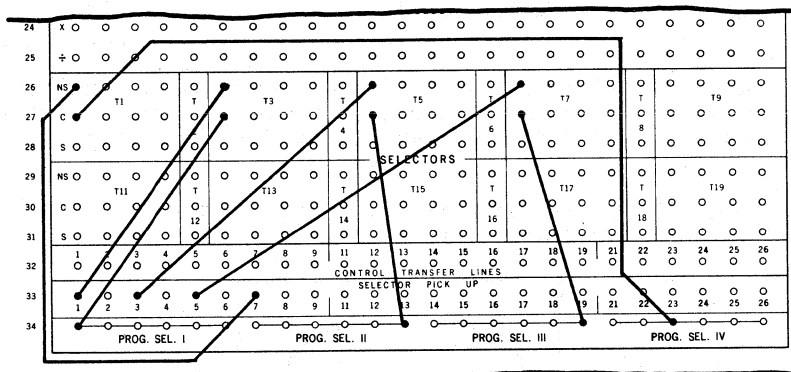
This transfer from Non-Select to Select breaks the connection from the Pick Up of Selector T1 to the Control Common. Selector T1 then assumes the Non-Select position.

2. With Selector T1 now in Non-Select, the connection from Program Select II through the Non-Select side of Selector T1, through the Select side of Selector T3 to the Control Commons causes the Program Select II to be de-activated ready for reuse.

This same connection, however, maintains the Pick Up of Selector T3 to keep that Selector in Select.

When the Sel. I operation is again impulsed, the connection from the Program Select II causes Selector T1 to again assume the Select position. This transfer from Non-Select to Select breaks the connection from the Pick Up of Selector T3 to the Control Common. Selector T3 assumes the Non-Select position.

Thus, Program Select I and II are alternately active and inactive to be used and reused as many times as is desired within the Program. This same practice may be applied to all four Program Select operations.



Another method of de-activating the Program Select is shown in this example. With this method, it is necessary to use the Program Selects in sequence in the Program. With the wiring shown, the sequence would be I, II, III, IV.

The wiring shown is as follows:

The Program Select I is routed through the Non-Select side of Selector T3 to the T1 Selector Pick Up.

The Program Select II is routed through the Non-Select side of Selector T5 to the T3 Selector Pick Up.

The Program Select III is routed through the Non-Select side of Selector T7 to the T5 Selector Pick Up.

The Program Select IV is routed through the Non-Select side of Selector T1 to the T7 Selector Pick Up.

At the Start of the Program Selectors T1, T3, T5, and T7 are all in the Non-Select position.

When Program Select I is impulsed, Selector T1 becomes Select.

When Program Select II is impulsed, Selector T3 becomes Select. This breaks the connection between the Program Select I and T1 Selector Pick Up to drop out the Program Select I ready for reuse. Selector T1 becomes Non-Select.

When Program Select III is impulsed, Selector T5 becomes Select. This breaks the connections between the Program Select II and the T3 Selector Pick Up to drop out the Program Select II ready for reuse. Selector T3 becomes Non-Select.



When Program Select IV is impulsed, Selector I7 becomes Select. This breaks the connection between the Program Select III and the T5 Selector Pick Up to drop out the Program Select III ready for reuse. Selector T5 becomes Non-Select.

When Program Select I is again impulsed, Selector T1 becomes Select. This breaks the connection between the Program Select IV and the T7 Selector Pick Up to drop out the Program Select IV ready for reuse. Selector I7 becomes Non-Select.

The Program Selects may continue to be reused in sequence as many times as desired during the Program.

NOTE:- When the Program Selects are used in this manner, the Program Selects so used may not be employed for any other purpose.

Process and Operation Time

For the purpose of calculating the approximate card-per-minute production speed of a Program, the following average time in milliseconds for the various processes and operations may be applied to the individual Steps of the Program to arrive at the total time:

Addition -----	10	Milliseconds
Subtraction ----	10	"
Multiplication --	50	"
Division -----	50	"
Program Select --	20	"
Sort -----	20	"
Clear -----	20	"

The approximate total time thus calculated is then applied to the following chart to obtain the approximate card-per-minute production for the Program.

Total Program Time in Milliseconds	Approximate Card per Minute Production
325	150
330	144
340	138
350	132
375	125
400	118
425	112
450	108
500	101
550	95
600	88
650	83
700	78
750	74
800	70
850	66
900	62
950	60
1000	58



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