LaFarr Stuart
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IBM

ELECTRIC PUNCHED CARD ACCOUNTING MACHINES

PRINCIPLES OF OPERATION

REPRODUCING PUNCHES

513 and 514

MINOR REVISION

This edition, Form 22-3180-3, is a minor revision of the preceding edition but does not obsolete Form 22-3180-2. The principal change in this edition is:

PAGE	SUBJECT
26	**Double Punch and Blank Column Detection Device**

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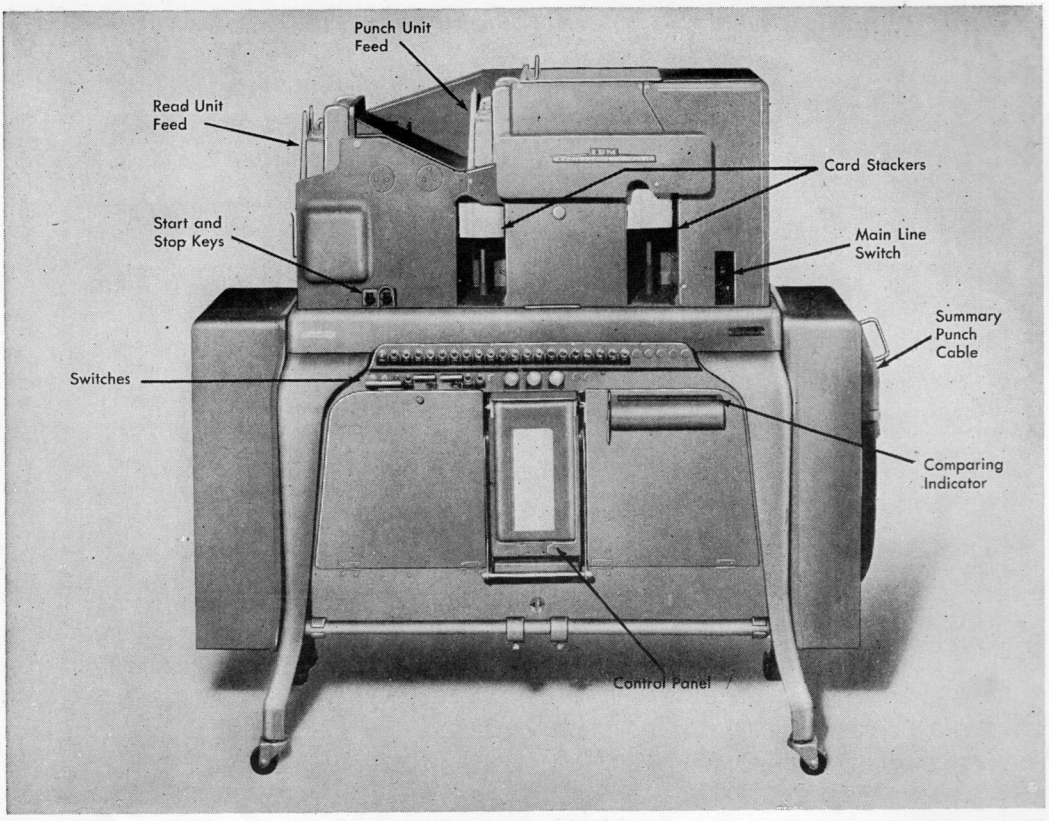
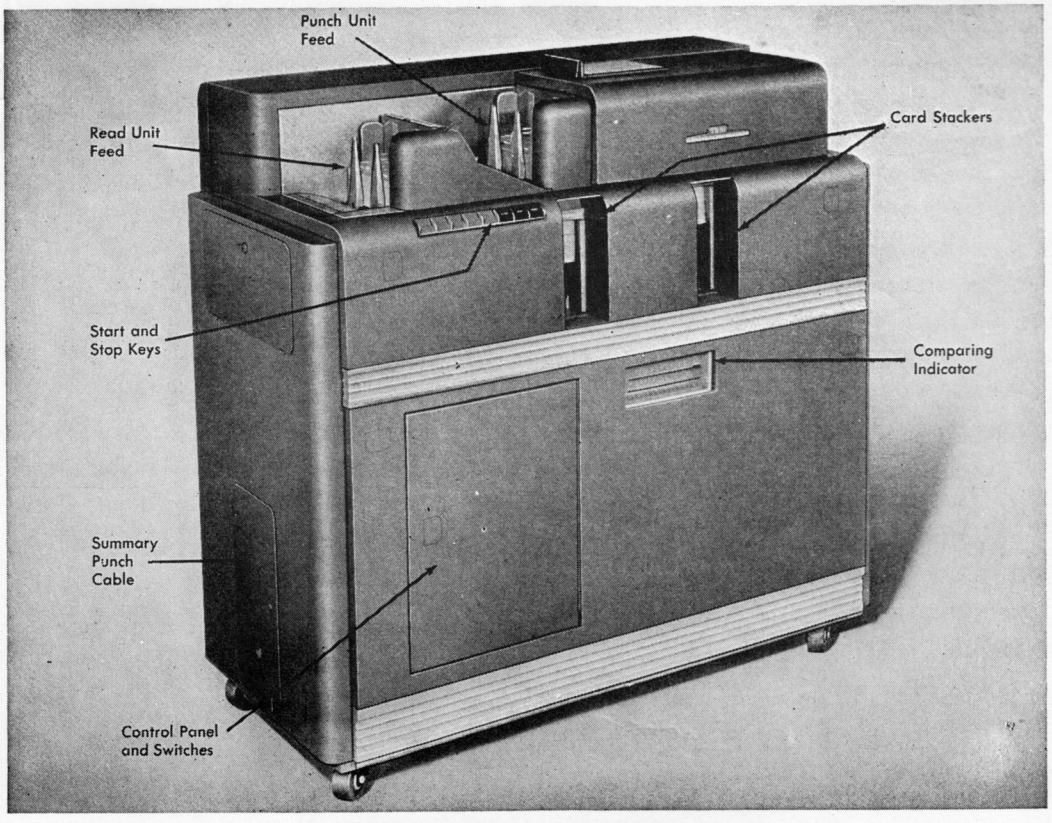


Reproducing Punch, Type 513



Reproducing Punch, Type 514

IBM REPRODUCING PUNCHES

Types 513 and 514

IN THE IBM Accounting method, an important function is the automatic preparation of the IBM cards which are the operating units of the method. The IBM Reproducing Punch is one of the machine units by means of which this automatic punching of cards is accomplished. It performs the following functions at the rate of 100 cards per minute:

Reproducing: the operation by which all or any part of the information punched in one set of cards can be punched into another set of cards. The accuracy of the punching operation can be simultaneously verified through the comparing feature of the machine.

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

Summary Punching: punching into a total or new balance card amounts which have been accumulated in the Accounting Machine.

Mark Sensing: the operation by which information recorded in the form of pencil marks on IBM cards is automatically transcribed as punched holes in those cards.

The Type 513 and Type 514 Reproducing Punches are similar in function and operation. The Type 513 is used with Types 405, 404 and 416 Accounting Machines, while the Type 514 is used with Types 402, 403, and 407 Accounting Machines. Either machine many be equipped with 45 or 80 columns of comparing, summary punching, and with mark sensing.

The location of the following features of the Reproducing Punch is shown in the accompanying illustration:

Control Panel

The mechanism which controls reading of information from the cards and punching of the information in the desired columns.

Card Feeds

The two hoppers, one each for the reading and punching units, in which cards are placed before they pass through the machine. If either hopper becomes empty, the machine will automatically stop.

Start and Stop Keys

The two keys used to start and stop feeding of cards.

Card Stackers

The location where the cards are stacked after they pass through the machine. Each stacker has a capacity of 1,000 cards; if either is filled to capacity, the machine will automatically stop.

Main Line Switch

This switch controls the power and must be ON if the machine is to be operated. A red signal light indicates that the switch is turned on.

Comparing Indicator

When a red light signals an error in verifying, the machine automatically stops and the indicator points out the comparing position in which the error occurred.

Summary Punch Cable

This permits the combined operation of Reproducing Punch and an Accounting Machine for the automatic preparation of total or new balance cards simultaneously with the preparation of reports.

MACHINE OPERATION

THERE are two feed units in the Reproducing Punch, the reading unit and the punching unit. Cards may be fed in either or both of the units according to the operation being performed. For any operation, the cards are fed face down, top or 12's edge first. Each feed hopper holds approximately 800 cards; feeding is continuous, and if either hopper becomes empty, or if a card fails to feed, the machine will automatically stop.

The relation of the two units to each other, and the sequence in which the cards pass the operating stations in the two units, are indicated in the schematic diagram (Figure 1).

Punching Unit

Cards fed in the punching unit first pass the six punch X brushes, which can be set to read six columns of the card. The purpose of the punch X brushes is to read X punches which identify master cards, in order to control the punching and feeding operations. If a mark sensing device is installed in the machine, the mark sensing brushes are the next station in the punching unit. The purpose of these brushes is to read marks on the card, in order to punch the corresponding positions into the card. The following station is the punching mechanism, consisting of 80 punches and dies corresponding to the 80 card columns. Since there is a separate punch for each column of the card, and since each card passes the punch dies with its top edge first, the 12 position is the first punching to take place. All 12 positions are punched at one time, the 11 positions are punched next, etc., through the last or 9 positions. Thus, the card is punched completely in twelve steps of the card cycle. A card passes these three stations during one card cycle as it passes through the unit.

The 80 punch brushes represent the last station in the punching unit. A card passes the punch brushes on the next card cycle as it passes through the punching unit. Thus, when the 5 position of the first card in the punching unit is being read by the punch brushes, the 5 position of the card immediately following it is at the punch dies; and as the 9 position of the first card is passing over the punch brushes, the 9 position of the following card is at the punch dies.

Reading Unit

Cards fed in the reading unit first pass the five reading X brushes, which can be set to read five columns of the card. The purpose of these brushes is to read X punches in order to control the reading of other information from the card. At the following station are the 80 reproducing

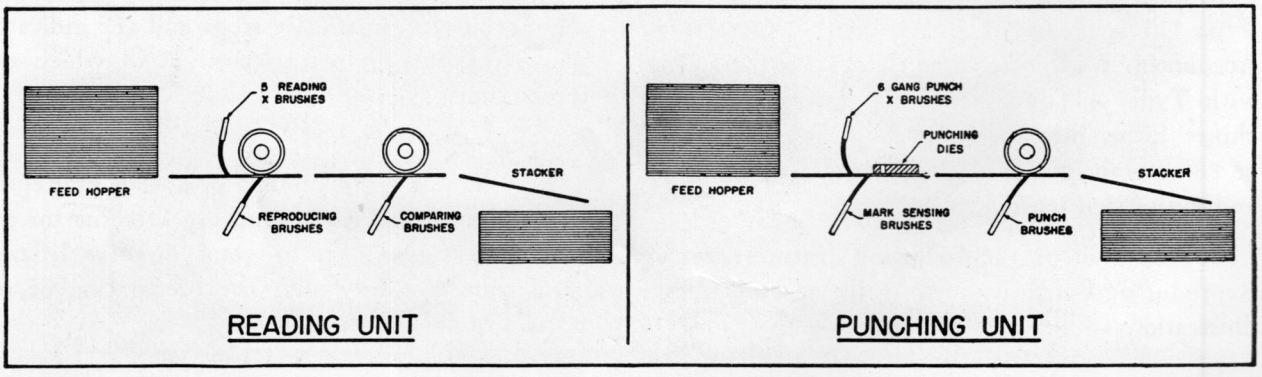


FIGURE 1. SCHEMATIC DIAGRAM OF CARD FEED

brushes, corresponding to the 80 card columns. A card passes these two stations on one card cycle as it passes through the reading unit.

If the comparing feature is installed on the machine, the next station is the set of 80 comparing brushes, one for each column of the card. The cards pass the comparing brushes on the next card cycle as they pass through the reading unit. Thus, when the 5 position of the first card in the reading unit is passing over the comparing brushes, the 5 position of the card immediately following it is being read by the reading brushes.

Combined Operation

When both units are being used for any operation, the cards feed simultaneously through the two units. At the time that the X position of a card in the reading unit is being read by the reading X brushes, the X position of the card in the punching unit is being read by the punch X brushes. At the time the 5 position of a card in the reading unit is being read by the reproducing brushes, the 5 position of a card in the punching unit is at the punch position. As the card in the reading unit passes on to the comparing brushes, the card in the punch unit passes on to the punch brushes, and at the time a 5 hole in a card in the reading unit is being read by the comparing brushes, the 5 position of a card in the punching unit is being read by the punch brushes.

Comparing Magnets

The comparing feature of the machine makes it possible to compare punching in two cards for purposes of verification and control. The comparison may be between one card in the reading unit and one in the punching unit, or between cards at the two stations in the reading unit. When the punching in the two cards is different, a signal light indicates the error, the machine stops, and the comparing indicator (Figure 2) points out the comparing position in which the error occurred. The comparing indicator is reset and the signal light is turned off by pressing the lever to the left of the indicator.

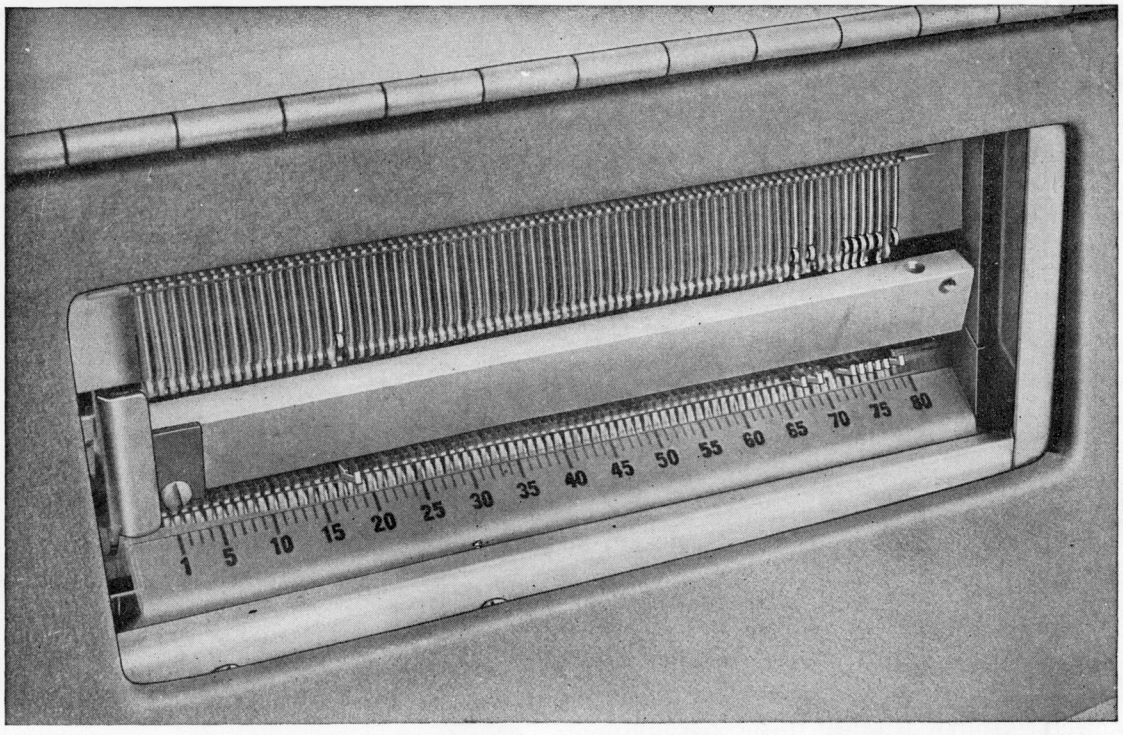


FIGURE 2. COMPARING INDICATOR, TYPE 514

CONTROL PANEL

AUTOMATIC operation of the Reproducing Punch is controlled through wiring of the control panel and the setting of switches. The control panel fits into a rack on the front of the machine, as shown in Figure 3. The various groups of hubs, shown in Figure 4, are explained below.

Reproducing Brushes

The 80 reproducing brush hubs are outlets for the reproducing brushes. They are wired to the punch magnets for straight reproducing, to a class selector for selected reproducing, or to a column split for X elimination or transfer. For verification of gang punching, they are connected to the comparing magnets.

Punch Magnets

The 80 punch magnet hubs are inlets for the punch magnets, which actuate the punching mechanism. The punch magnets are wired from the reproducing brushes for reproducing, from the punch brushes for gang punching, from the counter exit hubs for summary punching, and from the mark sensing OUT hubs for punching from pencil marks.

Punch Brushes

There are 80 outlet hubs for the punch brushes. These hubs are connected to the punch magnets for gang punching, to a class selector for offset gang punching, and to a column split for X elimination or transfer. The punch brushes are connected to the comparing magnets in order to verify reproducing.

Comparing Magnets

There are two sets of hubs which are inlets to the comparing magnets, one set which is wired from the punch brushes, and a second set wired from the comparing brushes. The Reproducing Punch may have either 45 or 80 columns of comparing. The full complement of comparing magnets can be used except when the operations include summary punching or mark sensing. When the connector cable is attached to the Accounting Machine, the two sets of hubs for the last 40 comparing positions become exits from the counters, and only 40 comparing units can be used for verification of punching. This is one reason why the cable is attached to the Accounting Machine for summary punching but returned to the punch receptacle for other operations. When mark sensing is being done, the last 20 hubs in the comparing magnet sections become mark sensing IN and OUT hubs.

Comparing Brushes

The comparing brushes are effective only in a machine equipped with the comparing feature. The 80 outlet hubs for the brushes are connected to the comparing magnets for verification of reproducing or gang punching.

Punch X Brushes

The six punch X brushes in the machine may be placed on any six columns, provided that two columns intervene between any two consecutive X punched columns. On the control panel there

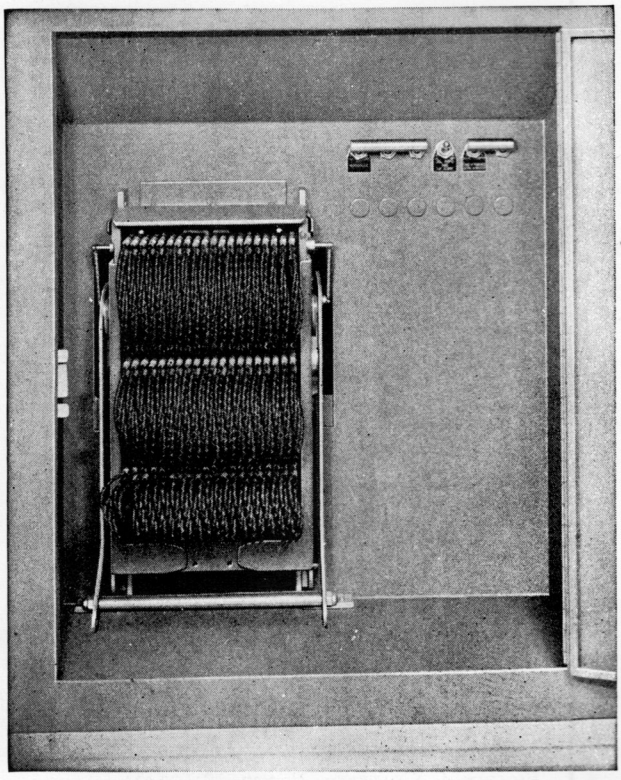


FIGURE 3. CONTROL PANEL AND SWITCHES, TYPE 514

are six outlets for the brushes, which may be connected to the PX hub or directly to a PX pickup hub of a selector.

Reading X Brushes

There are five outlets for the five reading X brushes. Any of the five outlets may be wired to the RX hub, the PX hub, or directly to the RX pickup hub of a class selector.

PX and PD Hubs

The two PX hubs are common, and may be wired from either a punch X or a reading X brush. If the X punch is in the master cards (and the detail or master switch is at MASTER), the PX is effective for an X master card. If the X punch is in the detail cards (and the detail or master switch is at DETAIL), the PX is effective for a No X master card. With the PX effective, machine operation is affected in two ways:

1. The punch magnets are inoperative for one card cycle. In an interspersed master gang punch operation, therefore, the master card would not be punched with information picked up from the last detail card of the preceding group.

2. The feeding in the reading unit is stopped for one card cycle (if the selective reproducing and gang punch comparing switch is off). In an operation combining master card gang punching and reproducing, therefore, a source card in the reading unit will not feed under the reproducing brushes while a master gang punch card is passing under the punch magnets.

In addition to these two results, the wiring of the PX also affects the PD hub. Whenever an X reaches the PX on one card cycle, this impulse is available from the PD hub one card cycle later. The PD can be used to control a class selector when the X punched card is at the punch brushes. The PD is not affected by the position of the detail or master switch; that is, regardless of whether the detail or master card contains the X, it is the X punched card which causes the PD to be in effect on the following card cycle, when the X card is at the punch brushes.

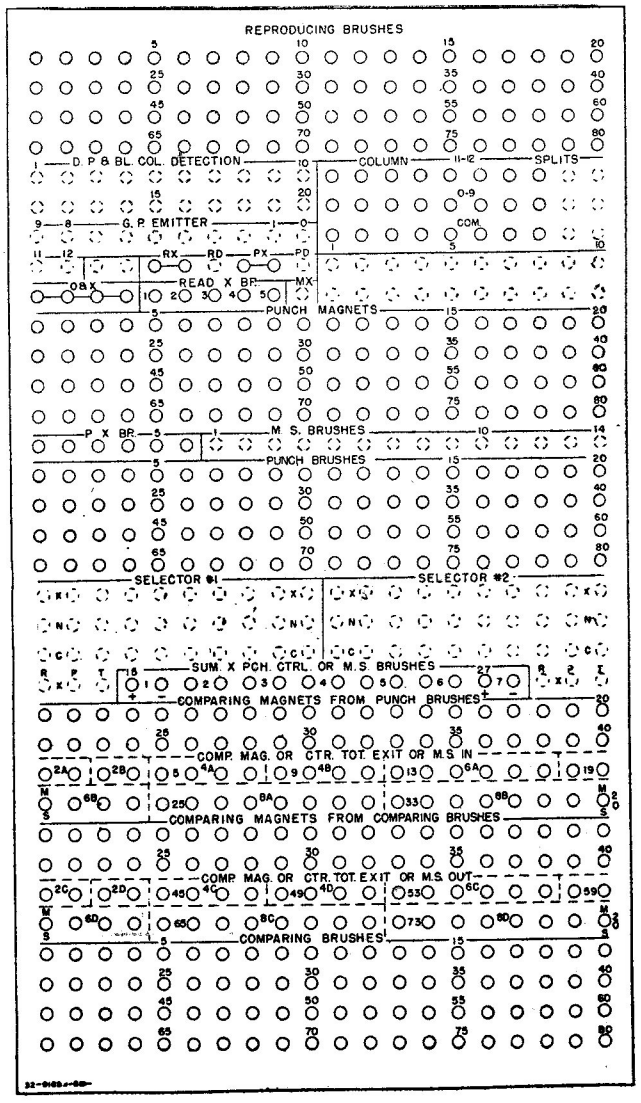


FIGURE 4. CONTROL PANEL DIAGRAM, SUMMARY PUNCHING MACHINE

RX and RD Hubs

The two RX hubs are common and may be wired from a reading X brush. If the X punch is in the master cards (and the detail or master switch is at MASTER), the RX is effective for an X master card. If the X punch is in the detail cards (and the detail or master switch is at DETAIL), the RX is effective for a No X master card. With the RX effective, the comparing unit is inoperative for the following card cycle (if the reproducing switch is off). In verifying an interspersed master gang punching operation, therefore, a master card would not be compared with the last detail card of the preceding group.

When an X is wired to the RX, the other RX hub may be wired to the pickup of a selector to control the selector as the X card is passing the reproducing brushes.

When the RX is effective, the RD is effective on the next card cycle. The RD can be used to control a class selector from an X read by the reading brushes and wired to the RX, when the X card is being read by the comparing brushes.

Column Splits

The 8 column splits are used to transfer or eliminate X or 12 punches. A control punch can be transferred to a column other than that to which the numerical punch of the same original column is going.

0 and X Hubs

Four hubs connected together are a source of both X and 0 impulses. These hubs may be used to add control X punches or for increasing the size of a field by adding 0's. To get either a single X or 0, a column split must be used.

Summary X Punch Control

A group of + and — summary X punch hubs are provided to summary punch a distinguishing X for either debit or credit totals. For use with a non-net balance Alphabetical Accounting Machine, the + and — hubs are paired and numbered 1, 2, 3, etc., to correspond with the number of the class selector on the Reproducing Punch used for balance selecting of totals. For use with the Numerical Accounting Machine, the hubs are paired and labelled 1, 2, 3, etc., to correspond with the number of the balance counter used on the Accounting Machine. The summary X punch control hubs are not needed in operations involving a net balance Alphabetical Accounting Machine.

These same hubs serve also as the outlets for mark sensing brushes 15-27.

Class Selectors

The 10-position class selectors may be installed as extra features. Each selector has three pickup hubs, the PX, RX, and total.

The PX pickup hub should be used if the selector must hold for a punching unit card cycle. This hub may be impulsed from the PX, PD, or directly from a punch X brush (the last to control a selector without affecting the regular PX circuit).

The RX pickup hub should be used if the selector must hold for a reading unit card cycle. This hub may be impulsed from the RX, RD, or directly from a reading X brush (the last to control a selector without affecting the regular RX circuit).

The total pickup hub is used only in balance selecting on the non-net balance Alphabetical Accounting Machine. It is impulsed from the left-hand position of one of the balance counters.

Mark Sensing Brushes

Outlets for the 27 mark sensing brushes are separated on the control panel; brushes 1-14 are to the right of the punch X brush outlets, and brushes 15-27 are the same hubs used for summary punch X control when summary punching.

Mark Sensing IN and OUT

These hubs are inlets and outlets for the amplifying unit. They are the same hubs used for comparing magnet positions 61-80, or for counter exits in summary punching. The mark sensing brush outlets are wired to the mark sensing IN hubs, and from the mark sensing OUT hubs to the punch magnets.

Double Punch and Blank Column Detection

These are inlet hubs to the unit which detects double punched or blank columns. They are wired from the punch brushes. On machines equipped with mark sensing, ten positions are standard, and 17 additional positions are available.

MX Hub

An X impulse is available at this hub when a 12 mark is read by a brush connected to the first mark sensing IN position. The impulse is used to control a selector for gang punching from marked master cards.

SWITCHES

Reproducing Switch

This switch, when on, synchronizes the feeds of the reading and punching unit, so that as a card is fed in the reading unit, one will be fed in the punching unit. If either hopper becomes empty, the machine will automatically stop. The reproducing switch must be on when the two feeds are used to perform a single operation. It is turned off when the two feeds operate independently to perform separate operations, or when only one feed is used.

Selective Reproducing and Gang Punch Comparing Switch

This switch, when on, allows continuous feeding in the reading unit. If the switch is turned off, an impulse in the PX hub will cause the feeding in the reading unit to stop for the following card cycle, while a card is fed in the punching unit.

Detail or Master Switch

This switch controls the handling of two types of cards distinguished by X punching. It should be set to MASTER when the master cards have the control X punch in gang punching, or when the No X source cards are to be reproduced. It should be set to DETAIL when the detail cards have the control punch for gang punching, or when the X source cards are to be reproduced.

Mark Sensing Switch

The mark sensing switch must be on for any mark sensing operation. When the switch is on, the last 20 comparing positions on the control panel become mark sensing IN and OUT hubs, and the summary X punch control hubs become outlets for mark sensing brushes 15-27.

Master Card Punching Switch

This switch, when on, allows marked information to be punched into a card regardless of the operation of the PX hub. It is turned on only for a combination reproducing and gang punching operation with marked master cards. It should be off for all other operations.

Blank Column Detection Switches

For each position of blank column and double punch detection, there is a blank column detection switch. To verify for blank columns or double punches, the punch brushes are wired to the detection unit and the corresponding blank column detection switches must be on. With the punch brushes wired and the blank column switch off, only double punching causes the machine to stop.

FIGURE 5. SWITCHES, TYPE 513