Punched Card Data Processing Principles

Section 4: The IBM Collator

IBM Personal Study Program

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The IBM Personal Study Program offers the opportunity to develop an understanding of and an appreciation for the tools of data processing, their operation and application. In recent years, the use of automatic data processing equipment has been extended into almost every area of business, government and science. As a result, the need for people knowledgeable in the subject has multiplied manifold—and is continuing to multiply.

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Introduction

The main objective of a data processing installation is the preparation of printed forms and statements. Sometimes the data required for the printing operation must be obtained from two or more card files. In order to prepare the forms or statements, the cards from the individual files must be merged. For example, the preparation of W-2 forms requires a name and address card and an accumulated earnings card for each employee (see Figure 1).

Merging of two files of cards can be done with an IBM sorter if each card's field for controlling the merge operation is in the same columns. Of course, the number of passes through the sorter depends on the number of columns in the merge control field. To merge 5,000 name and address cards with 5,000 accumulated earnings cards on a five-digit employee serial number requires one hour and 36 minutes with the IBM 82 Sorter. The IBM 85 Collator (see Frontispiece), expressly designed for merging, does the job in less than 25 minutes, and does not require employee number to be in the same columns (see Figure 2).

A simple card-for-card merge is, in itself, an elementary operation. There is a frequent possibility, however, that conditions exist which complicate the merging requirements. For example, cards from each of the two files may be out of the file for a number of reasons. The accumulated earnings cards of several terminating employees may be out for computing separation pay. Name and address cards may have been removed for those employees who require new cards with changed addresses.

In other words, a file of cards may be incomplete because some of the cards require special attention.

Merging the two incomplete files would produce some W-2 forms without a name or address, and some W-2 forms would be without the Social Security and income tax information. Such incomplete forms would not benefit anyone. The IBM 85 Collator is able to certify that there is a name and address card for each accumulated earnings card and, if there is not, prevents the unmatched card from merging. (In other words, it selects the unmatched cards.) Generally speaking, the merging operation and the selecting operation just mentioned are done simultaneously.

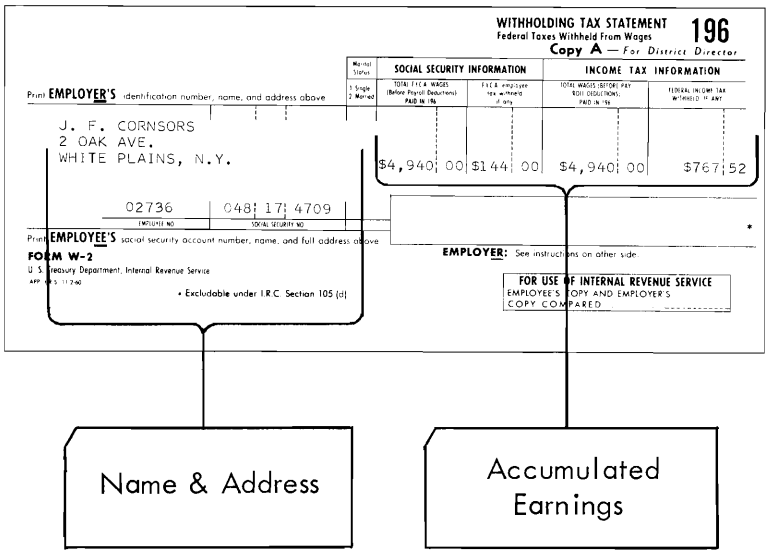


Figure 1.

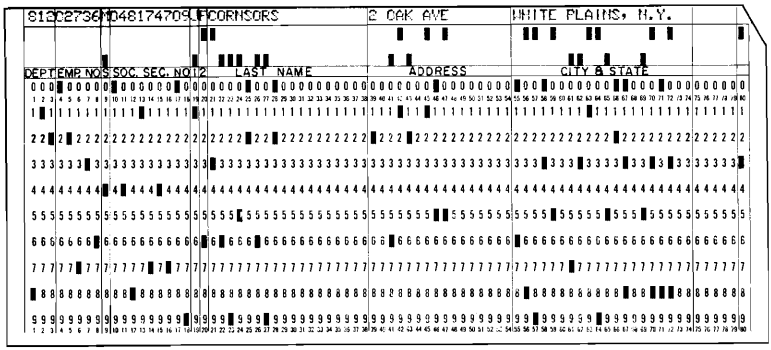


Figure 2a. Name and Address Card.

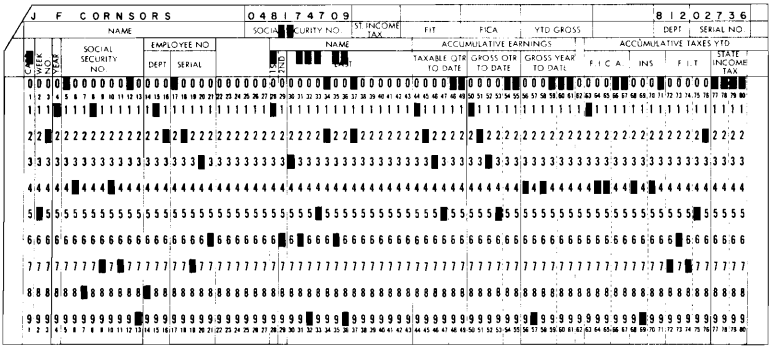


Figure 2b. Accumulated Earnings Card.

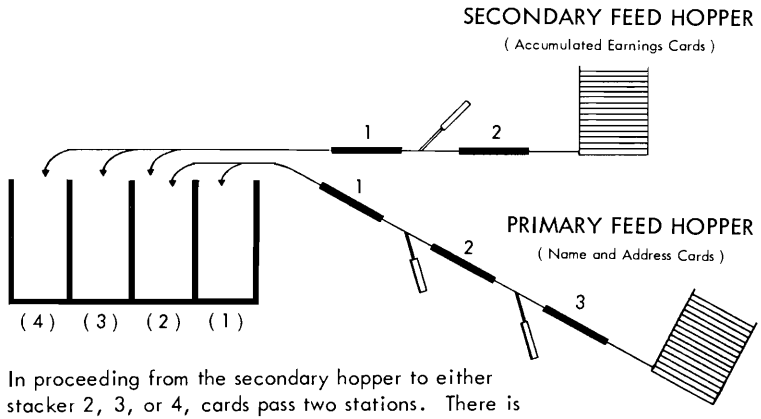
Another condition to be considered is the *sequence* of the cards in the files to be merged, even if they have been recently sorted. Cards that are manually removed from the file for some special purpose are usually put back manually. If a card is not put back in its exact location, an out-of-sequence condition exists in the file. This, too, the collator can detect by an operation called "sequence checking." If an out-of-sequence condition exists, the collator can be made to stop.

Another function that the collator performs is that of selecting special cards. It is shown in Section 2 that from a card file, the IBM sorter can select cards with a specific punch in one column. The collator can also select these—and, in addition, it can select cards punched with a specific multi-digit number or punched with a multi-digit number between certain limits.

For example, the collator can select from a file, for a special report, the accumulated earnings cards punched with 650000 ($6,500.00) or over in the year-to-date gross earnings field and also punched with an X in a chosen column to indicate female employee.

The main operations that the collator performs, then, are called merging, sequence checking, selection, and matching. Sometimes all of the operations can be performed simultaneously. Other times it may be necessary to perform each operation individually.

Path of Cards



In proceeding from the secondary hopper to either stacker 2, 3, or 4, cards pass two stations. There is one set of 80 reading brushes between the two stations.

In proceeding from the primary hopper to stacker 1 or 2, cards pass three stations. There are two sets of 80 reading brushes each between the three stations.

Figure 3.

Whether executed separately or jointly, however, they all require the ability to compare. On IBM collators a comparing unit is used to determine:

1. The two values are equal.
2. That one value is greater than another.
3. That one value is less than another.

Comparison of values to ascertain which of these three conditions exists, requires a reading of the card's data field which is to control the collator operation.

Since the operation of merging requires two files of cards, the collator has two separate feed hoppers. These are called the *secondary feed hopper* and the *primary feed hopper*.

There are three sets of 80 brushes each, one in the secondary feed unit and two in the primary feed unit. These are called the *secondary read* brushes, the *sequence read* brushes (the first set that a card from the primary feed hopper passes) and the *primary read* brushes.

To perform the collating operations previously mentioned, four stackers or pockets are required into which the cards from the hoppers can be directed (see Figure 3). Cards are fed face down, nine-edge first.

1. How many sets of brushes are in the secondary and primary units? What are they called? Label the brushes in Figure 3.

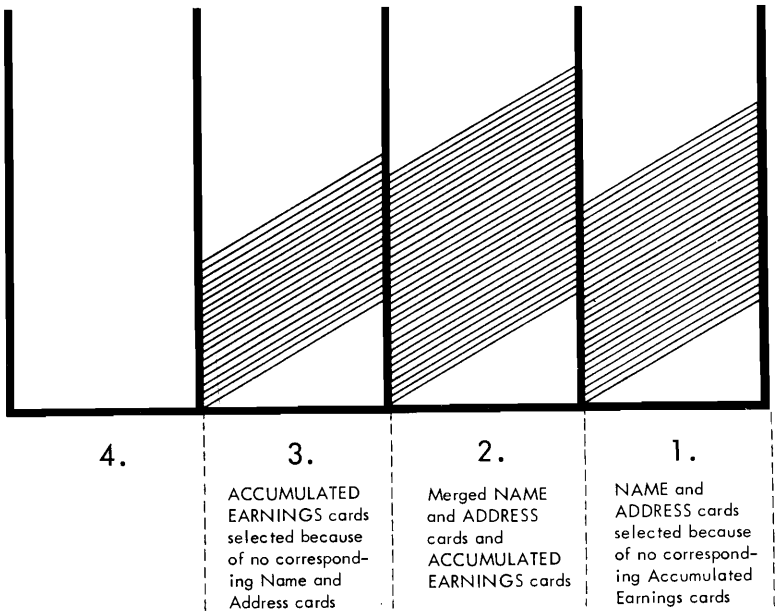
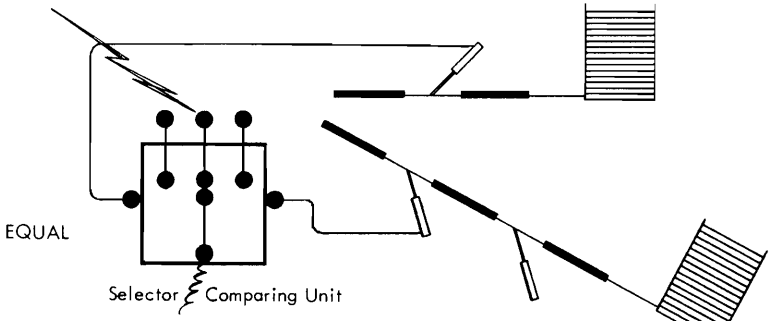


Figure 4.

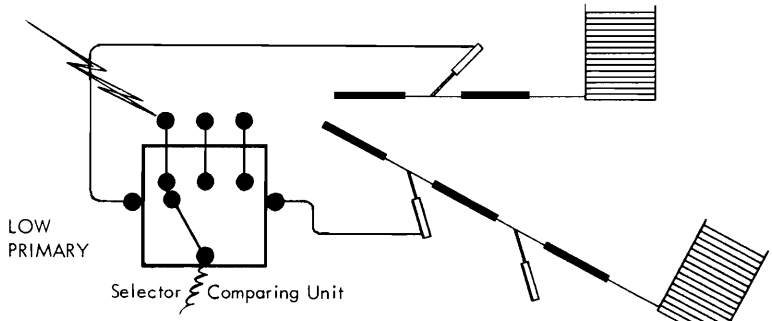
If there were a corresponding name and address card for each accumulated earnings card, the merging operation would be accomplished as follows: As soon as the two cards were run in from the secondary feed hopper and the three cards run in from the primary feed hopper (as shown in Figure 3), both feed units would be instructed to feed cards simultaneously. This would automatically cause pocket 2 to receive both the name and address cards and accumulated earnings cards from their respective stations and would cause all cards already in the feed unit to move up one station.

But since it is possible that there may be missing name and address cards or missing accumulated earnings cards, it is necessary to compare the cards to determine which pocket a card must enter (see Figure 4).

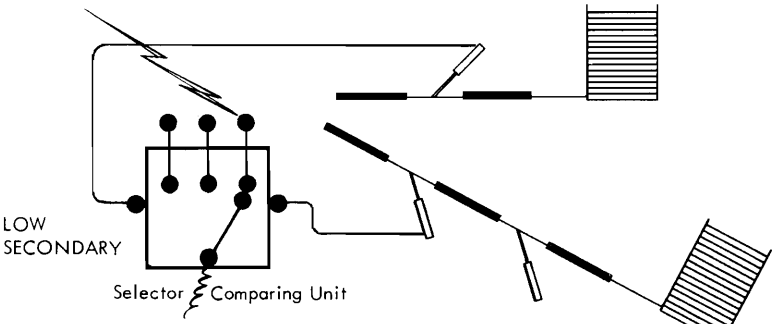
The comparison is made by connecting the secondary read brushes, which read the serial number field of the accumulated earnings cards, to one side of the comparing units and connecting the primary read brushes, which read the serial number field of the name and address cards, to the other side of the comparing units. The three relationships which result from the comparison are depicted in Figure 5.



1. An "EQUAL" impulse results when a value in a card read by the secondary read brushes is the same as a value in a card read by the primary read brushes.



2. A "LOW PRIMARY" impulse results when a value in a card read by the secondary read brushes is higher than a value in a card read by the primary read brushes.



3. A "LOW SECONDARY" impulse results when a value in a card read by the secondary read brushes is lower than a value in a card read by the primary read brushes.

Figure 5.

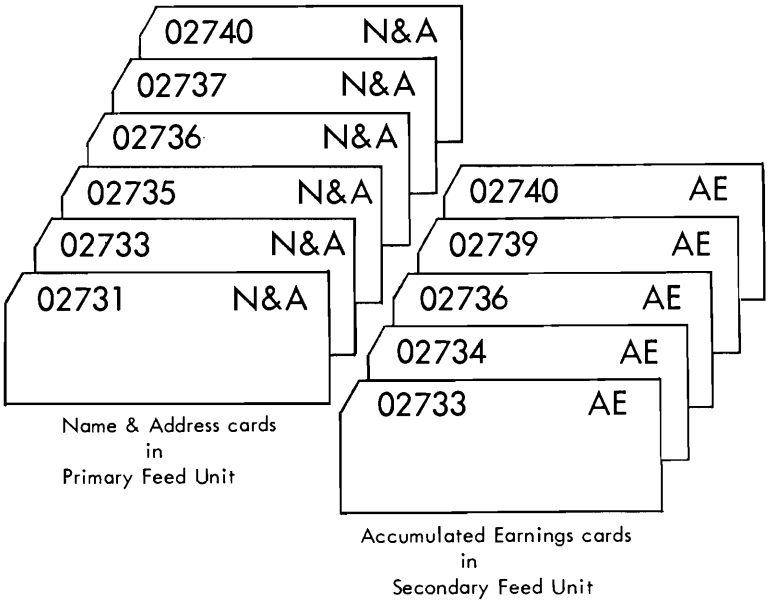


Figure 6a.

2. *What is the number of the stacker that can receive cards from both feed units?*
3. *Indicate what impulse results when the following pairs of cards are compared. (The first card of each pair was read by the primary read brushes and the second card of the pair by the secondary read brushes.)*

(a) 02731—02733
(b) 02733—02733
(c) 02735—02734
(d) 02735—02736
(e) 02736—02736
(f) 02737—02739
(g) 02740—02739
*(h) 02740—02740**

The sequence of the cards of question 3, as they appear in the hoppers, is shown in Figure 6a. The first comparison is between the 02733 AE card which was read by the secondary brushes and the 02731 N&A card which was read by the primary brushes. The result, a LOW PRIMARY, causes a primary feed to move all primary cards up one station; also, the LOW PRIMARY selects pocket 1 to receive the 02731 N&A card. As the cards in the primary feed move up one station, a new N&A card (02733) is read by the primary brushes.

*Review questions have been interspersed throughout the text. If, as in this case, the question is marked with an asterisk, the answer is supplied at the end of the book. If the question is not marked with an asterisk, the answer can be found in the text preceding the question. When the book is completed, answer all questions again—this time without using the book. Then compare your answers with those in the book.

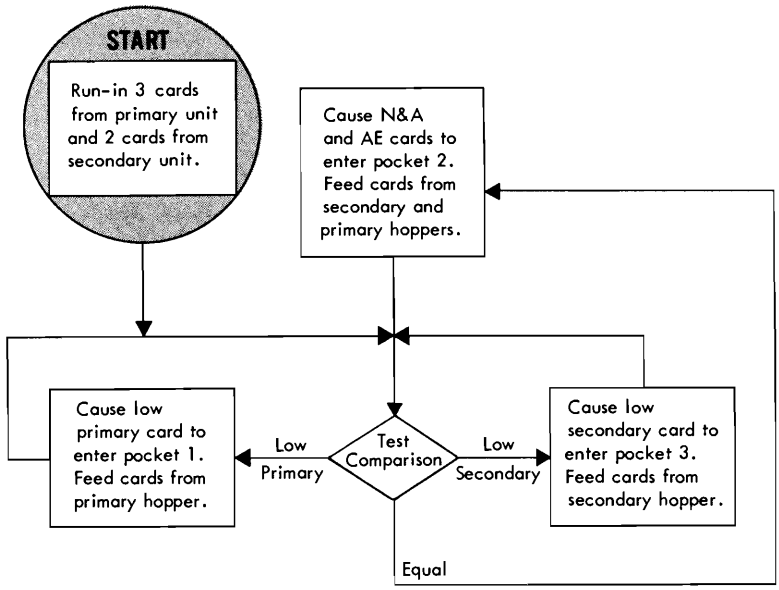


Figure 6b.

The second comparison, then, is between the 02733 AE card and the new primary card, 02733 N&A. The result, an equal, causes both a primary and secondary feed to advance all cards up one station. The equal cards drop into pocket 2. (Cards automatically enter pocket 2 unless another pocket is selected.) The N&A card enters pocket 2 ahead of the AE card because the entry chute from the primary unit is beneath the entry chute from the secondary unit (see Figure 3). As the cards in each feed move up one station, a new AE card (02734) is read by the secondary brushes and a new N&A card (02735) is read by the primary brushes.

The block diagram in Figure 6b is employed to show how the collator uses the results of the comparisons to control card feeding and pocket selection. (A block diagram is a graphic representation of the procedure used in accomplishing a job. The path taken in performing the operations is indicated by line and arrow. In the case of the diamond-shaped block, used to indicate a test, lines indicate alternate paths.)

4. *Proceed through the block diagram of Figure 6b for all the cards shown in Figure 6a.*

At the conclusion of the collating operation, pockets 1, 2 and 3 contain cards as shown in Figure 6c.

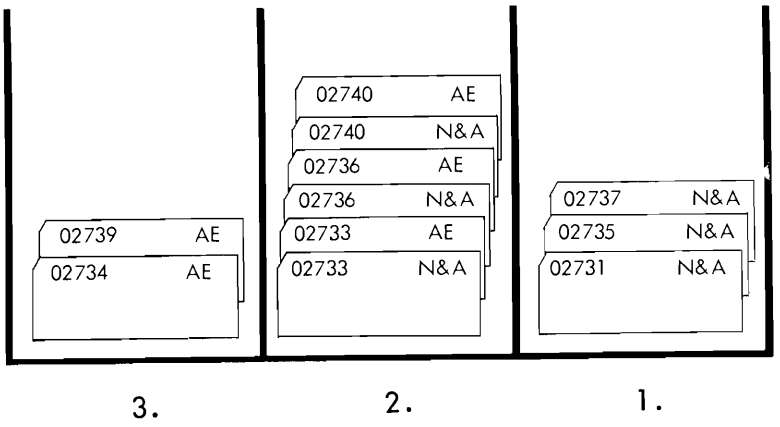


Figure 6c.

Sequence Checking

Checking sequence concerns the relationship of cards in one file. A sequence checking operation requires a comparison of two consecutive cards. Three results are possible when two consecutive cards are compared:

1. The first value is higher than the second value.
2. The second value is higher than the first value.
3. The first and second values are equal.

Figure 7 schematically shows the three relationships. As the schematic implies, sequence checking is accomplished by feeding cards from the primary hopper.

5. *Indicate what impulse results when the following pairs of cards are compared. (The first of each pair was read by the primary read brushes and the second card of the pair by the sequence read brushes.)*

(a) 03986—03987
(b) 03987—03988
(c) 03988—03988
(d) 03988—03991
(e) 03991—03989
(f) 03989—03990
(g) 03990—03992
*(h) 03992—03992**

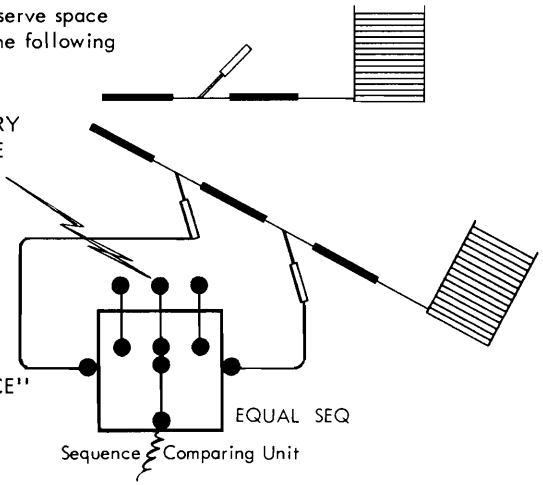
Note that the answer to condition (e) is a LOW SEQ. When a file of cards is being checked for ascending sequence, a LOW SEQ condition indicates that a card is out of order. Since sequence checking is an operation often performed with a merging operation, the collator is impulsed to stop upon the detection of a LOW SEQ condition. (Sometimes when a sequence checking operation is performed alone, the card that caused the out-of-sequence condition is directed to pocket 1, rather than causing the machine to stop.)

NOTE: In order to conserve space on the control panel, the following abbreviations are used.

PRI..... PRIMARY
SECDY.... SECONDARY
SEQ..... SEQUENCE
SEL..... SELECT
FD..... FEED

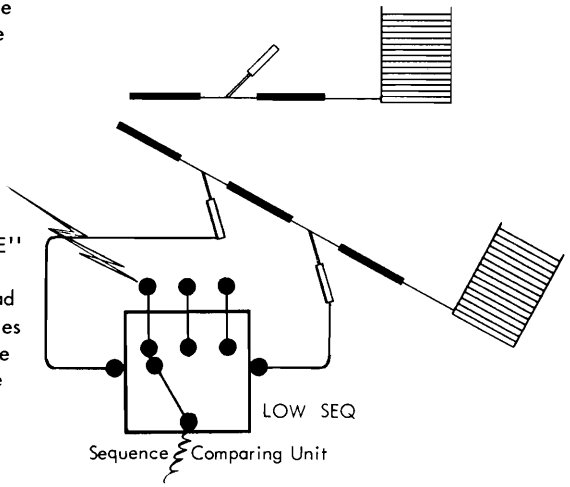
1.

An "EQUAL SEQUENCE" impulse results when a value in a card read by the primary brushes is the same as a value in a card read by the sequence brushes.



2.

A "LOW SEQUENCE" impulse results when a value in a card read by the primary brushes is higher than a value in a card read by the sequence brushes.



3.

A "HIGH SEQUENCE" impulse results when a value in a card read by the primary brushes is lower than a value in a card read by the sequence brushes.

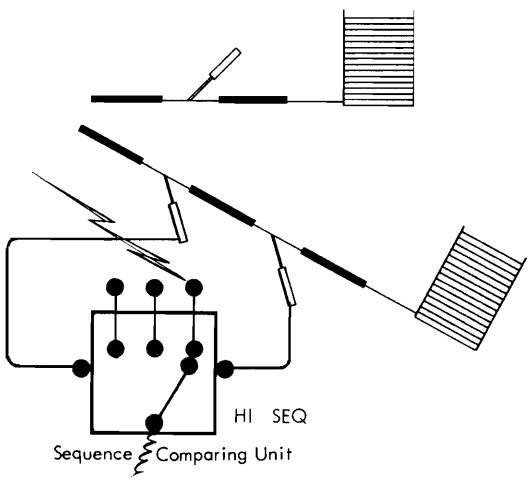


Figure 7.

Comparing

The selector comparing unit and the sequence comparing unit comprise storage devices for receiving information from card columns. After the card is read, the contents of the storage units are compared. The comparison then indicates the relationship of the values in the storage units and provides the proper control impulse (see Figure 8).

Before new information can enter the storage units, they must be reset to zero (that is, "restored"). If a storage unit is to be restored, this must be done just before the card is read. If it is not restored, the information in the card can not enter the storage unit. The ability to control the restoring of the storage units can be used to advantage, as will be shown later.

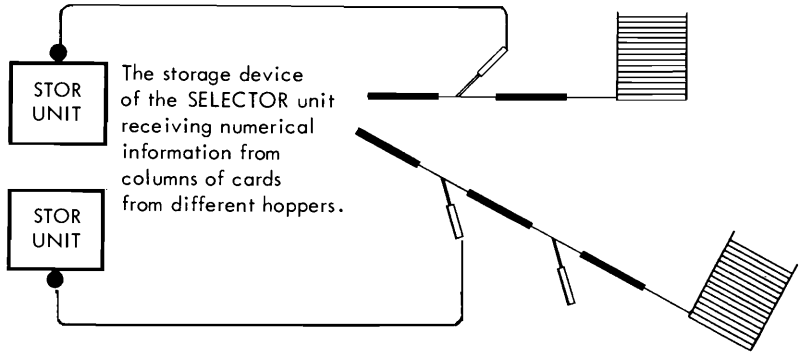
6. *What must be done to the storage units before new information can be entered?*
7. *When is the storage unit restorable?*

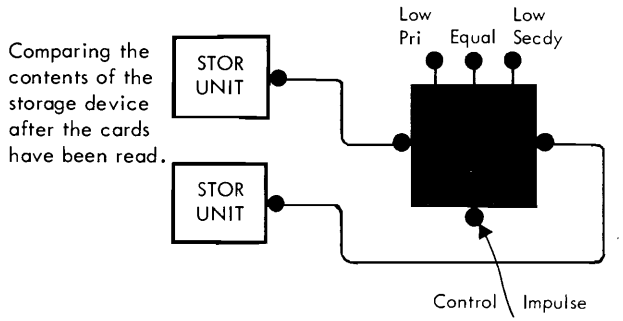
The IBM 85 Collator Control Panel

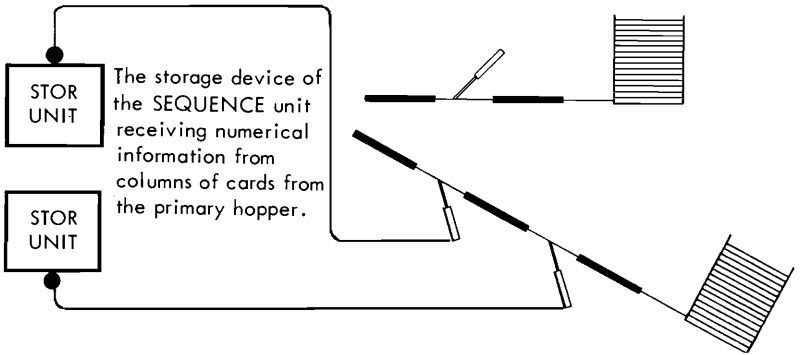
The control panel of the IBM 85 Collator is made up of two sections (see Figure 9). The left section has the hubs which provide the impulses from the three sets of reading brushes and the hubs which accept the impulses to be sent to the comparing unit. Hubs are also present for the detection of unpunched columns. (Checking to certify that there is punching in columns where there should be punching is accomplished by a technique called blank column detection.)

The storage devices of each comparing unit accept the numerals 1-9 for comparison. The hubs for these devices are called SECONDARY SELECTOR ENTRY, PRIMARY SELECTOR ENTRY, PRIMARY SEQUENCE ENTRY, and SEQUENCE ENTRY. The first two comprise the SELECTOR comparing unit; the last two, the SEQUENCE comparing unit. Normally, the secondary selector entry receives its impulses from the secondary read brushes and the primary selector entry is usually wired from the primary read brushes. Likewise, the primary sequence entry receives its impulses from the primary read brushes and the sequence entry is usually wired from the sequence read brushes.

The right side of the control panel has the hubs which (1) are used to control the feeding of cards, (2) are used to control the selection of pockets, (3) provide the resultant impulses from the comparisons, and (4) are required for restoring the comparing magnets, for controlling the selectors, etc.


STOR UNIT
STOR UNIT
The storage device of the SELECTOR unit receiving numerical information from columns of cards from different hoppers.


Comparing the contents of the storage device after the cards have been read.
STOR UNIT
STOR UNIT
Low Pri
Equal
Low Secdy
Control
Impulse


STOR UNIT
STOR UNIT
The storage device of the SEQUENCE unit receiving numerical information from columns of cards from the primary hopper.

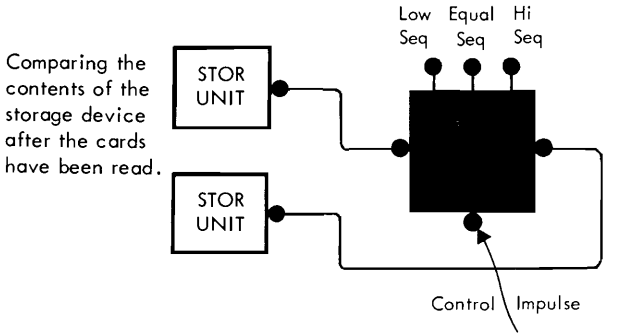

Comparing the contents of the storage device after the cards have been read.
STOR UNIT
STOR UNIT
Low Seq
Equal Seq
Hi Seq
Control
Impulse

Figure 8.

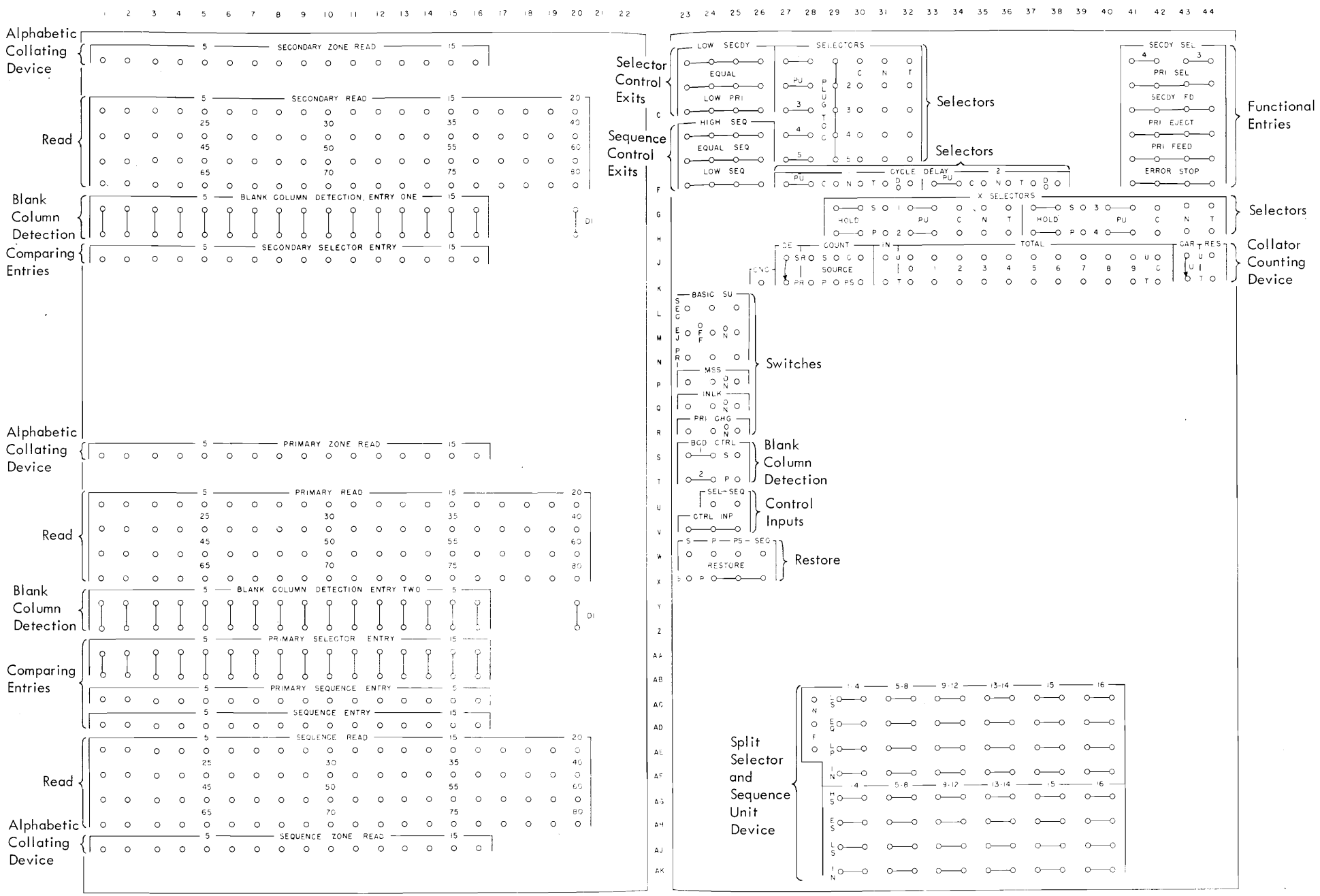

Alphabetic Collating Device
SECONDARY ZONE READ
Read
SECONDARY READ
Blank Column Detection
BLANK COLUMN DETECTION, ENTRY ONE
Comparing Entries
SECONDARY SELECTOR ENTRY
Alphabetic Collating Device
PRIMARY ZONE READ
Read
PRIMARY READ
Blank Column Detection
BLANK COLUMN DETECTION ENTRY TWO
Comparing Entries
PRIMARY SELECTOR ENTRY
PRIMARY SEQUENCE ENTRY
SEQUENCE ENTRY
Read
SEQUENCE READ
Alphabetic Collating Device
SEQUENCE ZONE READ
Selector Control Exits
Sequence Control Exits
LOW SECDY
EQUAL
LOW PRI
HIGH SEQ
EQUAL SEQ
LOW SEQ
SELECTORS
Selectors
Selectors
CYCLE DELAY
X SELECTORS
Selectors
SECDY SEL
PRI SEL
SECDY FD
PRI EJECT
PRI FEED
ERROR STOP
Functional Entries
COUNT
SOURCE
TOTAL
CARRIES
Collator Counting Device
BASIC SU
MSS
INLK
PRI CHG
Switches
BCD CTRL
Blank Column Detection
SEL-SEQ
CTRL INP
Control Inputs
S — P — PS — SEQ
RESTORE
Restore
Split Selector and Sequence Unit Device

Figure 9.

Wiring the Control Panel for Sequence Checking

In order to certify the sequence of both the name and address cards and the accumulated earnings cards, each file must pass through the primary feed unit. First, the accumulated earnings cards are sequence-checked. Then, during the merging operation, the name and address cards are sequence-checked.

Figure 10 shows the control panel wiring necessary to sequence-check the accumulated earnings cards.

The control impulse (wire 2) tests each position of the sequence comparing unit at ① and the impulse always starts at the leftmost position. After every position is tested, the control impulse emerges as either a HIGH SEQ, EQUAL SEQ or a LOW SEQ.

8. *What are the names of the hubs into which impulses from the brushes are directed for comparison?*
9. *When does the CTRL IMP make its test?*

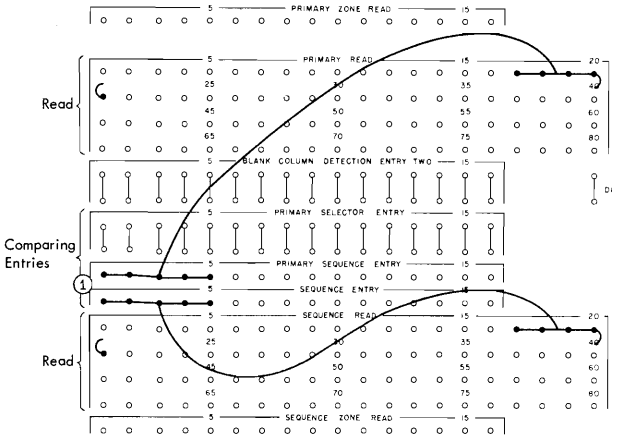
It has already been indicated that certain functions happen at a certain time relative to the rows of the card. For example, the control impulse starts just after the 11 row is read and continues through 13 time: a comparing unit must be set up for restoring with an impulse that starts just after 11 time and continues through 13 time. (The actual restoring takes place after 13 time, but before a new card is read by the brushes.) Figure 11 depicts a cycle on the IBM 85 Collator.

10. *Write CTRL IMP and RESTORE in the (a) box which begins just after 11 time (Figure 11) and ends just after 13 time to indicate the timing of these two impulses.*

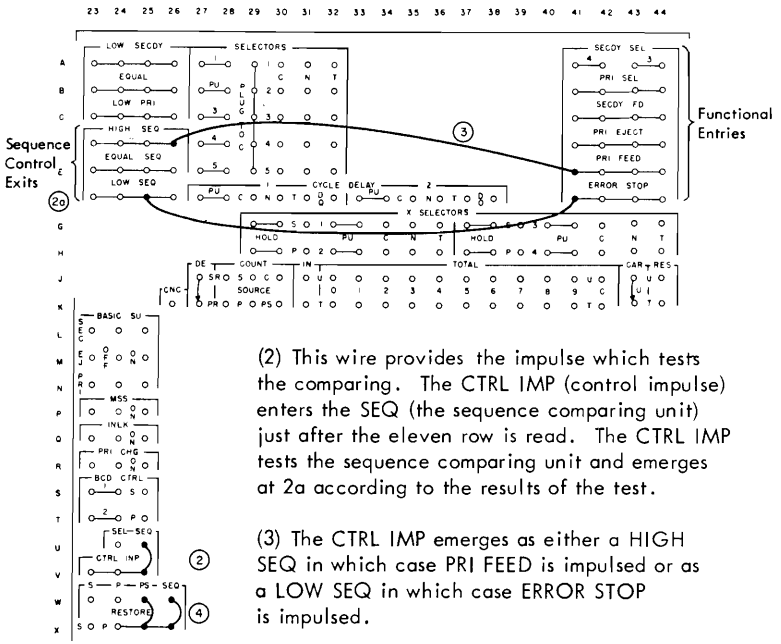
Control Panel Considerations for Merging

11. *Draw a diagram from the supplies packet with the following wiring:*
    a) *Secondary read hubs 4-8 (employee number of name and address card) to secondary selector hubs 1-5.*
    b) *Primary read hubs 17-21 (employee number of accumulated earnings card) to upper primary selector entry hubs 1-5.*
    c) *A CTRL IMP hub to SEL hub (SEL is directly above CTRL IMP).*
    d) *RESTORE S hub to S hub (S is directly above RESTORE S).*
    e) *RESTORE P hub to P hub (P is directly above RESTORE P).*

One element of the wiring diagram has been noticeably left out. It is the wiring required to control the feeding of cards and the selection of the pockets. At first glance it appears that the wiring can be completed



(1) The impulses from the reading brushes which read the employee number are directed to the sequence comparing unit.

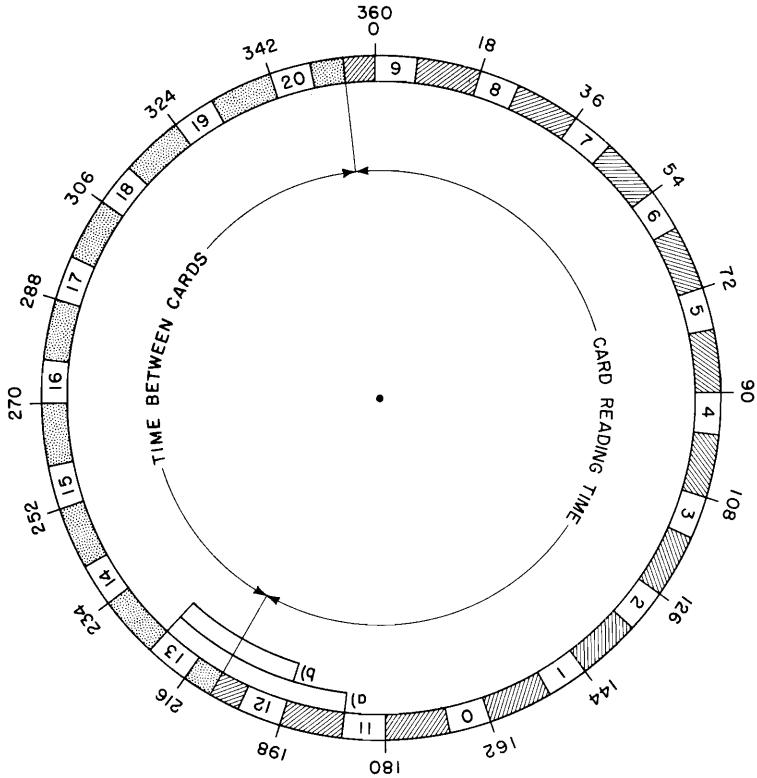


(2) This wire provides the impulse which tests the comparing. The CTRL IMP (control impulse) enters the SEQ (the sequence comparing unit) just after the eleven row is read. The CTRL IMP tests the sequence comparing unit and emerges at 2a according to the results of the test.

(3) The CTRL IMP emerges as either a HIGH SEQ in which case PRI FEED is impulsed or as a LOW SEQ in which case ERROR STOP is impulsed.

(4) When PRI FEED is impulsed, cards in the primary feed unit are put in motion. After the card is read, the restoring of the comparing unit is initiated. The PS and SEQ hubs may receive impulses at this time and they receive them from the RESTORE P hubs. (During the Run-In, restoring takes place even when not wired on the control panel.)

Figure 10.



The "timing clock" of the 85 collator has 20 equal "points", 12 points representing the rows of the card, and 8 points representing the space between cards. The other numbers are degrees (360° in a circle) and are often more easily used in place of "14 time" or "19 time", etc.

Figure 11.

with some simple connections, as shown in Figure 12. Wires 1a and 1b cause a card to be directed to pocket 3 when there is a secondary feed as a result of a LOW SECDY. Wires 2a and 2b cause both a SECDY FD and a PRI FEED as a result of EQUAL; because both are impulsed simultaneously, the card in the primary feed unit precedes the card in the secondary feed unit while automatically going to pocket 2. Wires 3a and 3b cause PRI FEED and a card to be directed to pocket 1 as a result of a LOW PRI. *This wiring is laden with "back-circuits," however.* (Remember that electrical impulses can pass through a wire in either direction. Also, control panel hubs that are common, such as the four SECDY FD hubs, are interconnected.) For example, in Figure 12 an equal causes pocket 3 and pocket 1 to be selected. That is, an impulse through wire 2a passes through wire 1b and 1a and causes pocket 3 to

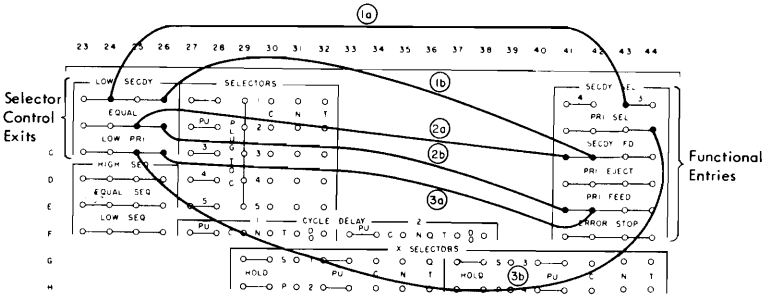


Figure 12.

be selected. Likewise, an impulse through wire 2b passes through 3a and 3b and causes pocket 1 to be selected. The wiring as shown in Figure 12 connects all the hubs together.

The back-circuits can be eliminated by "breaking" the circuit of wires 1b and 3a when there is an EQUAL (Figure 13a), by breaking the circuit of wire 2b when there is a LOW PRI (Figure 13b), and by breaking the circuit of 2a when there is a LOW SECDY (Figure 13c).

The breaking of the circuit can be accomplished by the use of selectors. Selectors on the IBM 85 Collator have the same basic components as the selectors of the IBM 514 and other IBM machines. (For purposes of review, refer to the part on selectors in Section 3.) The selectors (of which there are five) to be used for breaking the circuit are located immediately to the right of the CONTROL EXITS. Each selector has one Common, one Normal and one Transferred hub, and also one two-hubbed pickup. Between the pickup hubs and the C, N and T hubs are five common hubs vertically labeled as PLUG TO C—these are explained shortly. Figure 14 shows how the selectors could be used to break the circuits.

12. *Where do the impulses that must be used to control the selectors originate?* After this has been determined, complete the diagram in Figure 14.*

Since pickup hubs of the selectors of the IBM 85 Collator are connected *directly* to the pickup, any impulse available at the control panel hub of the pickup attracts the armature of the selector immediately. The armature stays transferred as long as the impulse lasts. If a CTRL IMP such as EQUAL is used to transfer the selector, the armature is attracted just after 11 time and remains transferred through 13 time. This is equivalent to the duration of the CTRL IMP.

It is a well known phenomenon that when a conductor of electricity, such as the selector's armature, is moved from one contact point to another while it is conducting a current, *arcing* will result (see Figure 15).

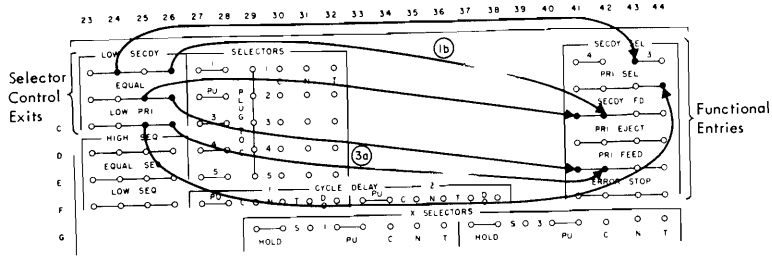


Figure 13a.

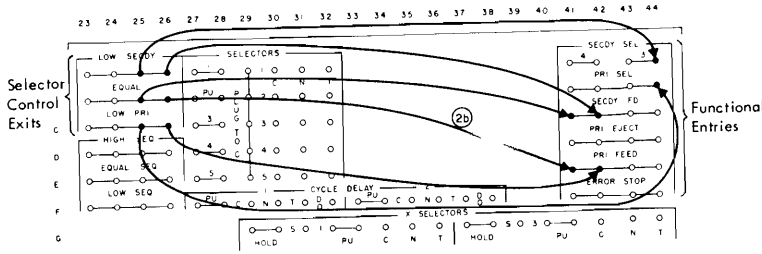


Figure 13b.

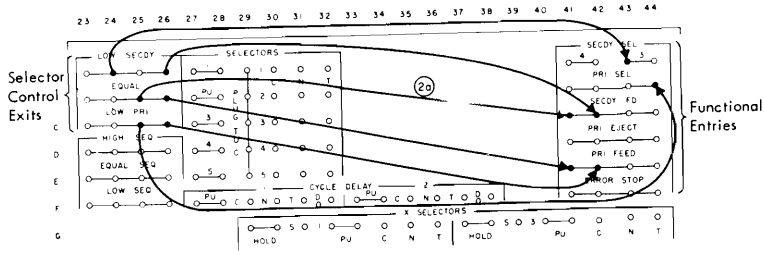
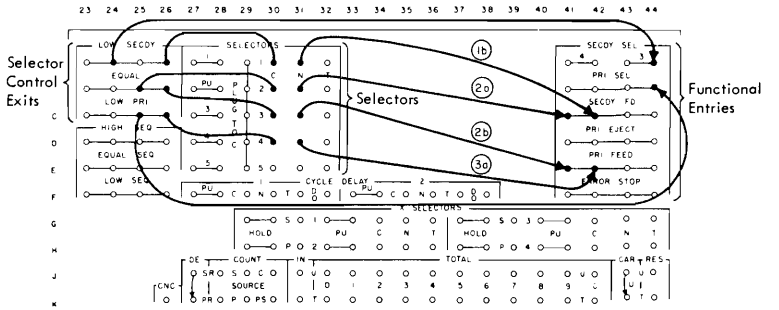


Figure 13c.

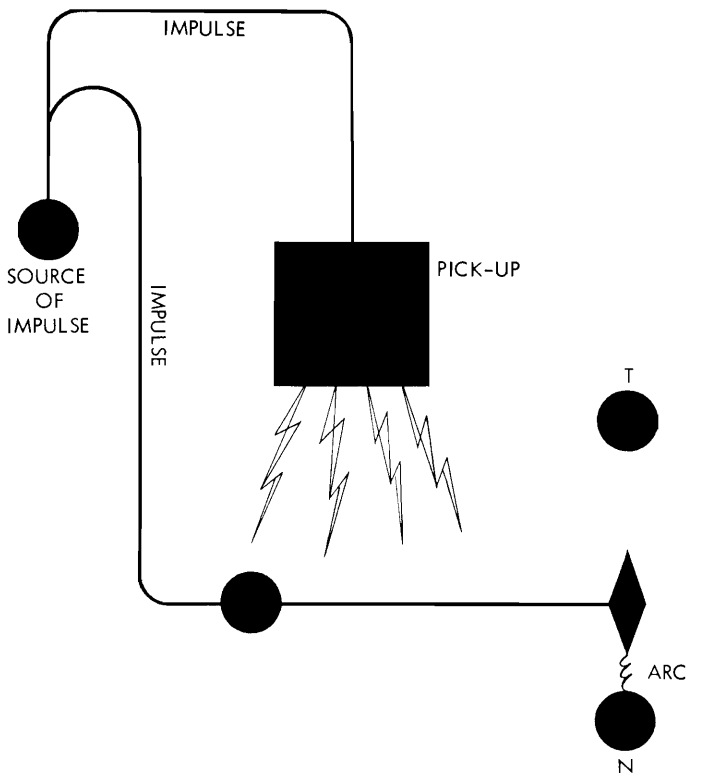
An analysis of Figure 14 shows that *arcing* is precisely what happens according to the wiring you were instructed to add. Consider the case of the EQUAL impulse. It enters the Common of selector 3 and exits from the Normal to the leftmost PRI FEED hub. Then, it comes out of the adjacent PRI FEED hub and on to the Normal of selector 4. At the same time that this is taking place, *the pickup of selector 4 is getting an impulse to attract the armature.* The result—arcing. Now, not only does arcing occur, but because of the slowness of the armature's motion relative to the speed of an electrical impulse, some of the EQUAL impulse "leaks through" the Normal-Common connection. This could result in an occasional erroneous selection of pocket 3.

The conclusion drawn from the preceding discussion is, then, that the wiring of Figure 14 must be revised.



A CONTROL EXIT impulse enters the Common of a selector and exits from the Normal. Impulsing a pickup of a selector breaks the circuit between the Common and Normal.

Figure 14.



This diagram shows how two simultaneously occurring impulses, one to the pickup which controls the selector and one to the common of the selector, cause arcing while the armature is leaving a contact point. (The same thing happens when approaching a contact point.) Arcing produces sufficient heat to "burn" the points. The burning of points greatly reduces the life of a selector and thus should be avoided.

Figure 15.

13. *What phenomenon takes place when a conductor transporting an electrical impulse moves from one contact point to another?*
14. *When is the armature of the selector transferable?*
15. *How long does the armature stay transferred?*

If a selector is transferred *before* an impulse enters Common, then no arcing or leaking occurs. The PLUG TO C hubs provide an impulse every time a card enters the collator from either hopper. However, it starts later than the CTRL IMP.

16. *Write* PLUG TO C *at (b), Figure 11, to indicate that the* PLUG TO C *impulse starts at 12 time (198°) and continues through 13 time.*

A PLUG TO C impulse can be used to initiate a card feed or select a pocket. Therefore, PLUG TO C (PTC) impulses wired through selectors controlled by CTRL IMP's are used to control card feeding and pocket selection. This is shown in Figure 16.

The diagram in Figure 16 shows a method in which selectors can be properly employed to perform the merging operation.

There is no one way, however, to use selectors for a specific job, whether on the IBM 85 Collator or any other IBM machine. Frequently, the solution to a problem in which selection is required can be achieved only by an analysis of the proposed wiring diagram. Of course, the best method for this is to analyze each "wire" as it is added to the control panel diagram, in order to find its effect on the rest of the wiring already proposed.

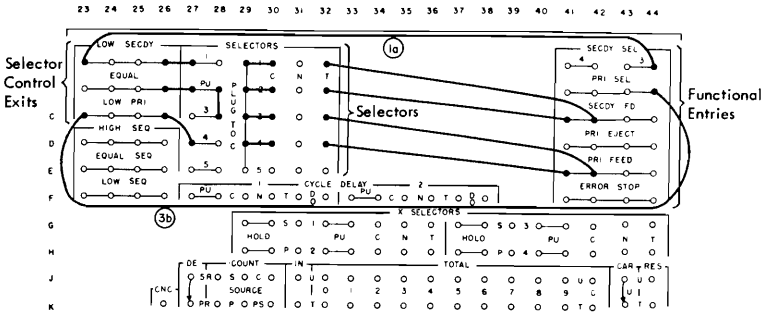
17. *Figure 17 comprises three proposed wiring diagrams to do the merging operation. Analyze each one to determine whether it will work.**

Special Selectors for Other Collating Operations

Two other basic components of the collator control panel are *X selectors* and *cycle delay selectors.*

The X selectors are used for identifying X-punched cards to control functions pertaining to them. For example, if it is necessary to write a special report on female employees (X 80 cards) who earn over $6,500.00, the following conditions must be met to select the required accumulated earnings cards (control panel diagram in Figure 18).

1. The value of 650000, punched in a "finder" card, is entered into the primary side of the SELECTOR comparing unit from the sequence



A LOW SECDY causes Pocket 3 to be selected as per wire 1a. A LOW SECDY impulse picks up selector 1. A PLUG TO C impulse enters common and exits from transferred to SECDY FD; then to the transferred of selector 2. Since selector 2 is not picked up on a LOW SECDY, the transfer is a "dead end".

An EQUAL impulse picks up selectors 2 and 3. A PLUG TO C impulse enters the common of selector 2, exits from the transfer to SECDY FD, then to the transfer of selector 1, a dead end. (Selector 1 is not picked up on an EQUAL.)

A PLUG TO C impulse enters the common of selector 3, exits from the transfer to PRI FEED; then on to the transfer of selector 4, a dead end. (Selector 4 is not picked up on an EQUAL impulse.)

A LOW PRI impulse picks up selector 4. A PLUG TO C impulse enters the common of selector 4, exits from the transferred to PRI FEED; then on to the transfer of selector 3, a dead end. A LOW PRI impulse causes Pocket 1 to be selected as per wire 3b.

Figure 16.

read brushes. The primary side of the selector unit *is not* impulsed to restore on the control panel. (Remember, impulsing a restore hub serves two functions: it *restores* the storage device of the comparing unit to zero, and it allows new information to enter.) The value in the *finder card* is able to enter despite the missing wiring because of the *automatic restore* during the RUN IN.

2. The year-to-date gross, punched in the accumulated earnings card, is entered into the secondary side of the SELECTOR comparing unit from the primary read brushes. The secondary side of the selector unit is impulsed to restore on the control panel.

3. A CTRL IMP is entered into the SELECTOR comparing unit to test the comparison. A gross of $6,500.00 provides an EQUAL; a gross over $6,500.00 provides a LOW PRI; and a gross under $6,500.00 provides a LOW SECDY. A LOW PRIM impulse therefore can be used to pick up a selector into the Common of which a PTC impulse is directed. Then, when there is a LOW SECDY, the PTC impulse emerges from the Transfer of the selector.

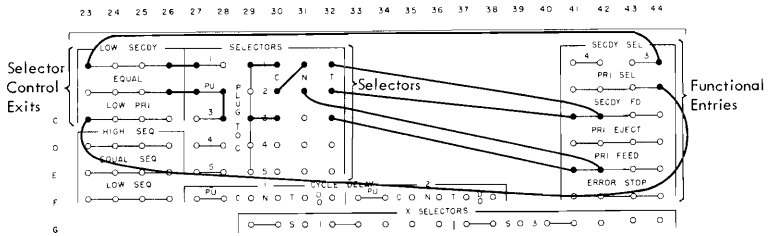


Figure 17a.

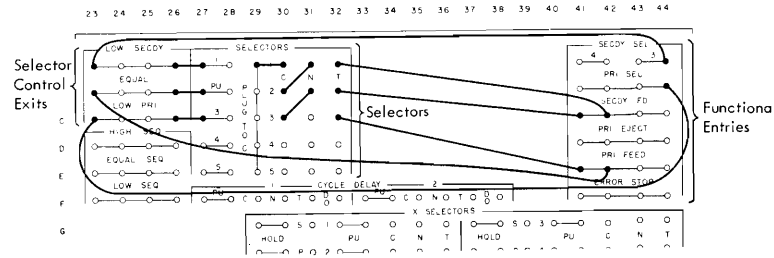


Figure 17b.

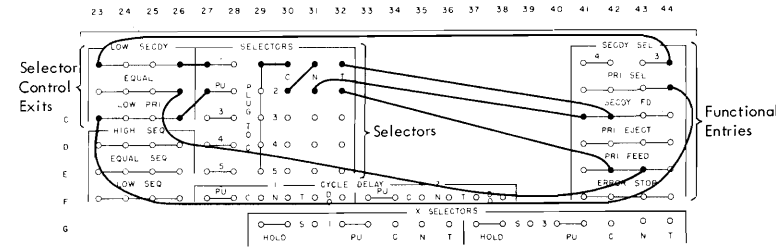


Figure 17c.

4. When a female employee card is read by the primary read brushes, an X-timed impulse is available from the column 80 hub. The pickup of an X selector is designed to accept impulses that occur at X time or at CTRL time. When it does receive an acceptable impulse, the selector transfers immediately. The HOLD hub is impulsed from the P hub to indicate that the X selector is being used with cards coming from the primary feed hopper.

The PTC impulse coming out of the Transfer of the selector picked up by the LOW PRIM is entered into the Common of the X selector and exits from the transfer. From there it is directed to select pocket 1.

5. An unselected PTC impulse is used to impulse PRI FEED. The PTC does not have to be selected because, regardless of the CTRL IMP, a PRI FEED is required.

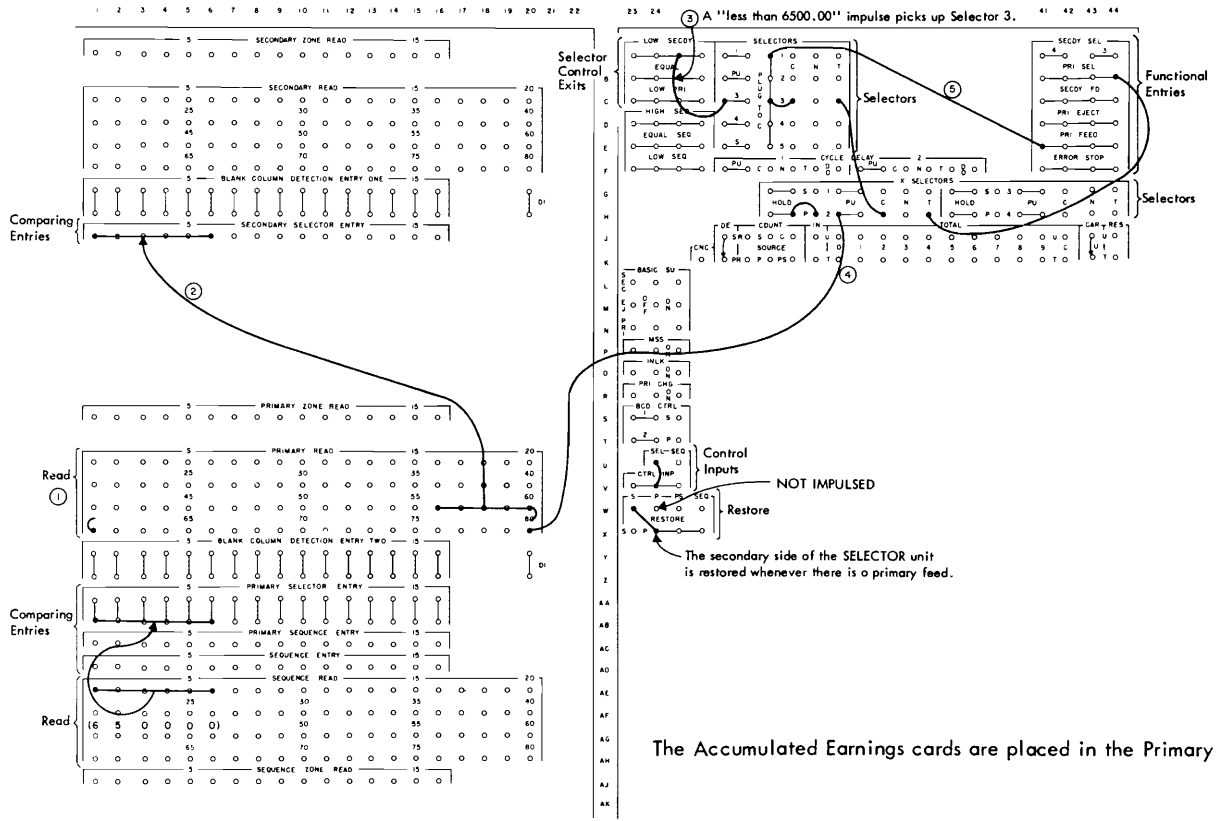
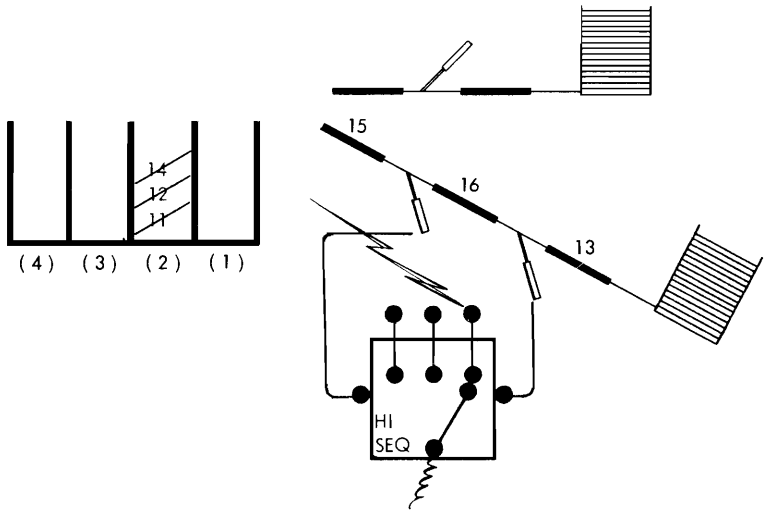
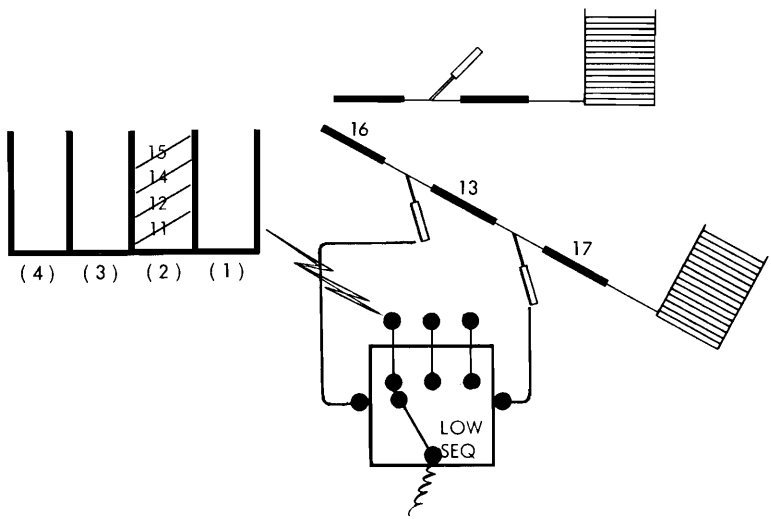


Figure 18.

The Accumulated Earnings cards are placed in the Primary Feed Hopper



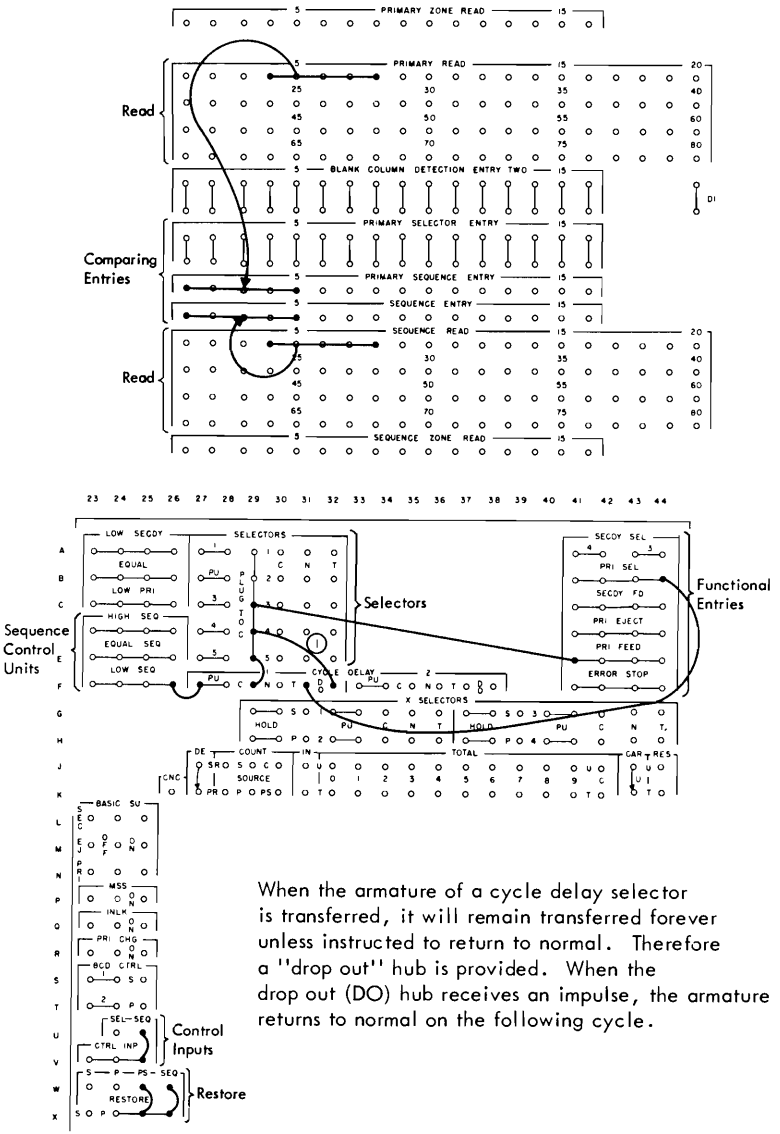
a. Cycle before detecting out-of-sequence condition.



b. Cycle on which out-of-sequence condition is detected. If the results of the LOW SEQ impulse were used to select Pocket 1 now card 16 would be selected.

Figure 19.

The cycle delay selector is used whenever it is necessary to wait an extra cycle before transferring the selector. For example, it may be desirable to select pocket 1 for out-of-sequence cards. Figure 19 illustrates why it is necessary to be able to "delay an impulse." As can be seen from part (b) of the diagram, if the results of a LOW SEQ impulse



When the armature of a cycle delay selector is transferred, it will remain transferred forever unless instructed to return to normal. Therefore a "drop out" hub is provided. When the drop out (DO) hub receives an impulse, the armature returns to normal on the following cycle.

Figure 20.

were used to select pocket 1 *now*, card 16 would be selected. By picking up the cycle delay selector with a LOW SEQ impulse, a PTC entered into the Common will emerge one cycle later from the transfer to select pocket 1. The wiring diagram for this is indicated in Figure 20.

Collators and Alphabetic Characters

As can be seen from the control panel diagrams, the IBM 85 can be provided with the ability to collate alphabetically. Collating operations which involve alphabetic characters utilize the same concepts as numerical collating operations. However, many punched card data processing installations have collators which are equipped with the circuitry for numerical operations only. The most common reason for this is that most identification and reference codes are numerical rather than alphabetic.

Answers to Asterisked Questions

3. a) LOW SECONDARY; b) EQUAL; c) LOW PRIMARY; d) LOW SECONDARY; e) EQUAL; f) LOW SECONDARY; g) LOW PRIMARY; h) EQUAL.

5. a) HIGH SEQ; b) HIGH SEQ; c) EQUAL SEQ; d) HIGH SEQ; e) LOW SEQ; f) HIGH SEQ; g) HIGH SEQ; h) EQUAL SEQ.

12. Selectors 1 and 4 should be transferred when there is an EQUAL to break the circuit of wires 1b and 3a. Therefore an EQUAL impulse should be used to pick up selectors 1 and 4.

Selector 3 should be transferred when there is a LOW PRIMARY to break the circuit of wire 2b. Therefore a LOW PRI impulse should be used to pick up selector 3.

Selector 2 should be transferred when there is a LOW SECONDARY to break the circuit of wire 2a. Therefore a LOW SECDY impulse should be used to pick up selector 2.

17(a). A LOW SECDY impulse selects pocket 3. A LOW SECDY impulse picks up selector 1. A PTC to Common exits from the Transfer to SECDY FD, then back to Transfer of selector 2, a dead end. OK.

An EQUAL impulse picks up selectors 2 and 3. The PTC entering the Common of selector 1 exits from the Normal into the Common of selector 2; it exits from the transfer to SECDY FD, then to the Transfer of selector 1, a dead end. Another PTC enters the Common of selector 3 and exits from the transfer to PRI FEED; then to the Normal of selector 2, a dead end. OK.

A LOW PRI impulse selects pocket 1. The PTC impulse entering the Common of selector 1 exits from the Normal of selector 2 and causes a primary feed. That impulse goes to the transfer of selector 3, a dead end. OK.

THEREFORE DIAGRAM A OF FIGURE 17 IS CORRECT.

17(b). A LOW SECDY impulse selects pocket 3. A LOW SECDY impulse picks up selector 1. A PTC to Common exits from the Transfer to SECDY FD, then back to Transfer of selector 2, a dead end. OK.

An EQUAL impulse picks up selector 2. A PTC into the Common of selector 1 exits from the Normal into the Common of selector 2. It

emerges from the transfer to SECDY FD; then back to the Transfer of selector 1, a dead end. An EQUAL impulse goes directly to PRI FEED; then to the Transfer of selector 3, a dead end. OK.

A LOW PRI impulse selects pocket 1. A LOW PRI impulse picks up selector 3. A PTC into the Common exits from the transfer to PRI FEED. From there it proceeds to EQUAL, then to the pickup of selector 2. This will cause selector 2 to transfer and redirect the PTC impulse to SECDY FD. Arcing also results. NOT OK.

THEREFORE DIAGRAM B OF FIGURE 17 IS INCORRECT.

17(c). A LOW SECDY impulse selects pocket 3. A LOW SECDY impulse picks up selector 1. A PTC into the Common of selector 1 exits from the Transfer to SECDY FD; then back to the Normal of selector 1, a dead end. OK.

An EQUAL impulse goes directly to PRI FEED. From there it goes to the Transfer of selector 2, a dead end. A PTC into the Common of selector 1 emerges from the Normal, enters the Common of selector 2 and exits from the Normal to SECDY FD. Then to the Transfer of selector 1, a dead end. OK.

A LOW PRI impulse selects pocket 1. A LOW PRI impulse picks up selector 2. A PTC to the Common of selector 1 comes out of the Normal and enters the Common of selector 2. It emerges from the transfer to PRI FEED. It then goes to EQUAL, a dead end. OK.

THEREFORE DIAGRAM C OF FIGURE 17 IS CORRECT.

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