

**IBM**

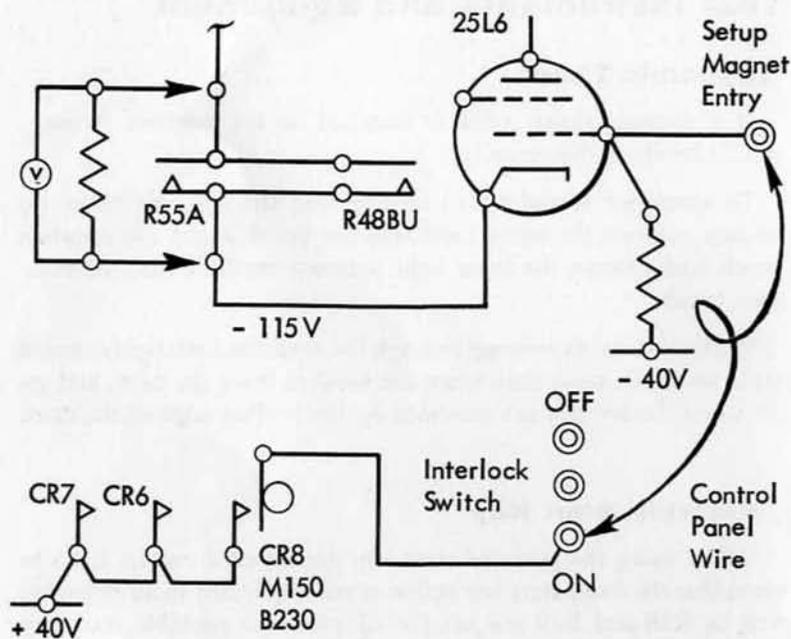
*J. Barnwell*

**IBM** Customer Engineering  
Training

**DIAGNOSTIC TECHNIQUES**

IBM 77 COLLATOR





CHECKING 25L6 TUBES

**IBM 24 Method:** Tubes can be checked by inserting them one at a time in the escape magnet tube position of an IBM 24, 26, or 56 machine, and measuring the voltage drop across the escape magnet. Refer to IBM 24 C. E. Reference Manual, under heading "Tube Checking," for further information.

**New Tubes:** It should not be assumed that a new tube is completely satisfactory.

**Removal of Plate Load:** If the plate load (selector of sequence unit setup magnet) is removed from a tube while it is in conduction, the screen grid will be damaged.

**Tube Shorts:** A heater-to-cathode short in one tube can cause the filament of another tube, in the same filament string, to open.

An intermittent grid short in one tube can cause selector and sequence unit positions, controlled by other tubes, to set up 9's.

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## **Test Instruments and Equipment**

### **Dynamic Timer**

If a dynamic timer index is installed on the machine, brushes should be timed dynamically.

To check for straight card feeding, put the dynamic timer on contact, connect the outer light between brush 3 and the common brush, and connect the inner light between brush 77 and the common brush.

With blank cards running through the machine, both lights should come on at the same time when the brushes leave the card, and go off when the brushes are insulated by the leading edge of the card.

### **Portable Start Key**

When using the portable start key during card run-in, keep in mind that the fixed start key action is not duplicated in all respects; that is, R18 and R19 are not picked when the portable start key is used.

## **Tube Units**

### **Checking 25L6 Tubes**

*Substitute Load Method:*

1. Connect a 250-ohm resistor in series with the cathode return, and place the voltmeter across the resistor.
2. Turn machine to between 150 and 230 degrees on the index.
3. Connect control-panel wire between ON side of INTERLOCK switch and each grid (control-panel magnet entry hub) in turn.
4. Voltmeter should read between 20 and 30 volts if emission of tube is satisfactory.

## Troubles and Possible Causes

*Trouble*      *Possible Causes*

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**Sluggish relay  
operation**

1. Binding or sticking armature pivots
2. Excessive armature-to-core air gap
3. Foreign matter between armature and core
4. Sticky or oily armature brass stop pin
5. Worn armature pad

## Lubrication

To lubricate the eject-clutch drive shaft (non-bevel gear drive machines), remove the setscrew located in the first lower continuously-running feed roll, and pump oil through the hole. The feed roll is hollow, and contains the eject-clutch drive shaft, which turns at a different rate of speed. The setscrew is located in the feed roll about 1 inch in from the front casting.

Lubricate the following from the rear of machine through holes provided in the end of the combination worm gears.

1. Selector and sequence unit restoring bail cam shaft bearings.
2. Selector and sequence unit setup ratchet shaft oil wells (machines without Bijur system).
3. Main idler gear bearings—bevel-gear drive machines.
4. High-speed contact roll oil wells.
5. Primary and secondary brush assembly bearings and pressure shoes.
6. Rear lower pocket feed roll bearings—non-bevel gear drive machines.

An atomizer filled with IBM 6 is helpful in lubricating selector and sequence units. Oil should be applied sparingly. An excess will run down onto setup magnet cores and armatures, and cause trouble.

A Plews oiler filled with IBM 17 will permit efficient application of lubricant to many difficult-to-get-at points. It may be necessary to cut off the tip of the oiler tube.

THIS BOOKLET presents analytical procedures, machine tests, methods of checking components, and service information that will assist Customer Engineers in the analysis and correction of machine troubles on the IBM 77 Collator.

2. The original cams and mounting bar are still in the machine. (If the original cams and CB mounting bar are not in the machine, it is not practical to make the change just mentioned. No Bill of Material exists to supply the required parts.)

*Duration:* The impulses from CB's 1, 2, 3, and 4 on machines without tubes should be 6 degrees. However, in difficult cases of erratic reading trouble, increasing duration slightly, but not beyond 7 degrees, has proved successful. The impulses from CB's 1, 2, 3 and 4, on machines equipped with tube circuits, should be 8 degrees.

*Contact Conditions:* The condition of CB 1, 2, 3, and 4 contact points should be checked very carefully. Correct air gap, duration, and timing are essential to good reading conditions. Cam follower rollers should be checked for wear.

### **Possible Effect of Early CR3 Timing**

If CR3 makes too early (before the main CB's have broken for 10 time), it is possible to set up 9's in some, or all, positions wired, because the reading brushes are not yet insulated from the contact roll by the card. (This trouble is more likely to occur on machines equipped with tube circuits because of longer main CB duration.)

### **Loose Contact Points in Duo Relay Straps**

*Silver Points:* Evidence of a loose silver relay point often appears as powdered silver near the point. The point should be recrimped or replaced as necessary.

*Tungsten Points:* A loose tungsten point is usually indicated by the formation of red rust at the point of connection of the point to the contact strap.

## ANALYZING

### MACHINE TROUBLES

ACCURATE AND RAPID diagnosis of other than an obvious machine trouble can usually result only from a careful analysis of the machine failure by the Customer Engineer.

Because of the many variables involved in the analysis of a machine failure, no specific rules can be established to govern the method of procedure. Methods will vary with each Customer Engineer according to his personal preferences.

Good understanding of machine functions, control-panel wiring, and typical applications is essential to the development of successful trouble analysis technique on the IBM 77 Collator.

### Customer Assistance

The customer is the primary source of information concerning a machine trouble. If necessary, the Customer Engineer should have the machine operator demonstrate and explain the operation being performed. In any event, the customer should contribute the control-panel wiring, IBM cards, etc. involved in the machine failure, and furnish the Customer Engineer with all available information about the exact nature of the machine malfunction.

It is important that the Customer Engineer receive machine trouble information in terms he understands. He should have the machine operator clarify the meaning of any expression about which he is doubtful.

- Failure to unlatch**
1. Excessive magnet armature knockoff
  2. Insufficient unlatching clearance
  3. Open or shorted magnet
  4. Weak impulse to magnet

### Pocket Selection

#### Troubles and Possible Causes

<i>Trouble</i>	<i>Possible Causes</i>
----------------	------------------------

- 
- |  |   |
|--|---|
| <b>Failing to select or continuous selection</b> | <ol style="list-style-type: none"><li>1. Pocket selection magnet restoring cam shaft out of time</li><li>2. Incorrect chute blade tension</li><li>3. Incorrect magnet or armature adjustment</li><li>4. Worn armature pivot</li></ol> |
|--|---|

- |                                       |   |
|---------------------------------------|---|
| <b>Failing to select occasionally</b> | <ol style="list-style-type: none"><li>1. Impulse through unit contacts is not strong enough to energize select magnet occasionally.<br/><br/>(It is recommended that a selector be picked with unit output and impulse pocket select magnet with plug to C through transfer side of selector for stronger pulse).</li></ol> |
|---------------------------------------|---|

### CB's and Relays

#### CB's 1, 2, 3, and 4

*Location:* On machines where CB's 1, 2, 3, and 4 are located on the side of the selector unit, they may be moved to the CR cam assembly if the following conditions exist:

1. The machine has constant speed drive.

Machine operator terminology varies considerably. The following terms are some that are frequently encountered:

<b>Merging</b>	Combining two files without selection.
<b>Match Merge</b>	Merging together, or matching, the equal cards of two files and selecting the unmatched cards.
<b>Multiple Secondaries (or Primaries)</b>	Two or more secondary (or primary) cards with the same control number.
<b>1st Primary Sequence Brushes</b>	Term used interchangeably with primary brushes.
<b>2nd Primary Sequence</b>	Term used interchangeably with primary sequence.
<b>Pulling Zero Balance</b>	Similar to sequence checking, except that the primary reading is compared with a blank unit (no reading). An "Equal Primary Sequence" indicates a zero balance card and is selected.
<b>Pulling Lows</b>	Sequence checking and selecting low-primary sequence cards instead of wiring to error stop. Restoring of the first primary-sequence magnets is suspended on a low-primary sequence reading by wiring the first primary restore magnet through a normally-closed selector contact, and energizing the selector relay on a low-primary sequence.

(b) Insufficient setup ratchet guide comb clearance

3. Unit out of time
4. Bad reading brush—short strands, crossed strands, etc.

**Unequal output with equal readings set up in unit**

1. Binding or sticking ratchet in unwired setup magnet position. Ratchet snaps to zero after test impulse has gone through unit contact points.

## Feed Clutches

### Checking Card at Eject Station

If a customer's cards are used in the analysis of a machine trouble, it is often desirable to check the punching in a card that has been read at the primary brushes against the readings in the units.

A method of ejecting the card into the stacker pocket, without running the machine an additional feed cycle, is to trip the eject clutch manually and depress the runout key only to a point that will cause idle cycles.

### Troubles and Possible Causes

<i>Trouble</i>	<i>Possible Causes</i>
<b>Failure to latch</b>	<ol style="list-style-type: none"> <li>1. Insufficient magnet armature knockoff</li> <li>2. Insufficient relatching clearance</li> <li>3. Worn armature tip or insufficient latching overlap of the armature and latch</li> </ol>

**O's set up  
in error**

2. Failure to restore unit on run-in
3. CR3 making too early
4. Weak or broken restoring bail springs
1. Restoring bail failing to latch when associated feed clutch latches
2. Failure to read
  - (a) Card lever contacts
  - (b) Card lever relays — sluggish, points fail to make or have insufficient rise
  - (c) Dirty, burned, or grooved contact roll
  - (d) Bad reading brush, worn, loose, lack of tension, poor tracking, out of time, loose brush lead
  - (e) CB's 1, 2, 3, and 4—contact condition; air gap, duration, timing. Check for worn cam follower rollers.
3. Weak or late unit output pulse—restores unit but does not unlatch feed clutch
4. Open setup magnet
5. Setup magnet armature binding on its pivot
6. Excessive or insufficient magnet armature-to-core air gap
7. Off-punched card

**Incorrect  
readings set up  
(higher than  
normal)**

1. Insufficient stop pawl to setup ratchet clearance — nipping
2. Binding or sticking ratchet or binding differential link
  - (a) Excessive contact strap tension — shows up more often with new style differential-link guide plates

**Hangs Up  
Locks Up**

Ambiguous; may refer to several conditions:

1. Fails to feed, but motor idles.
2. Stops, but restarts with start key.
3. Stops and cannot be restarted.
4. Continues to feed out one feed regardless of card value.

**Fails to Feed  
Secondaries  
(or Primaries)**

Primary (or secondary) continually feeds, and the secondary (or primary) will not feed regardless of the card readings. Cards must be run out and started over.

### **Verify Machine Trouble**

The Customer Engineer should verify that the control-panel wiring, the IBM cards, and the general set-up of the machine are correct for the operation being performed. If another machine is available, the operation may be performed on the second machine, using the same control panel and IBM cards for such verification.

## IDENTIFYING

### MACHINE TROUBLES

#### Customer's Diagnosis

Many machine operators can be relied upon to diagnose machine troubles accurately because of their long experience with the IBM 77 Collator. A substantial saving in time and effort to the Customer Engineer may result from listening to the customer's analysis of the machine failure.

#### Machine Operation

Machine operation should be observed to learn as much as possible about the trouble. Listening for unusual sounds may rapidly locate the trouble area. Questioning the machine operator about recent machine difficulties, such as unusual noises, card jams, etc., will frequently provide information necessary to pinpoint the source of trouble.

The Customer Engineer should note the rhythm or pattern of machine operations with which he is familiar. Any deviation from the rhythm or pattern can instantly be detected by sight or sound.

#### Control Panels and Cards

The customer's control panel and cards should be used to identify a machine trouble if at all possible. In some instances, it may be identified more readily by using a test control panel or a simplified control panel, rather than the customer's panel.

When the trouble has been identified, the Customer Engineer may continue to use the customer's control panel and cards in the analysis and correction of the trouble, if the customer can leave them available to him, and if failures occur often enough on the particular operation being performed to warrant their use.

Exercise care in handling customer cards. Control-panel wiring must be returned to normal if temporary changes are made.

is wired to select unequals. This can occur when a weak or late pulse trips a selector unit restoring magnet, but does not trip the feed clutch at all, or does not trip it in time to engage the one-tooth ratchet. If the area around and directly behind the one-tooth ratchet is highly glazed, this type of failure may be suspected and can be highly intermittent.

#### Installation of Reading Strips

Care should be taken when installing reading strips on read-strip type selector units. It is recommended that a blank IBM card be used as an aid and to prevent damage to the contact fingers. Slip the card under the 16 fingers, and while holding the card against the finger contact points, slide the reading strip in place by sliding it under the card and down into home position. Remove the card, insert the four reading-strip holding screws, position the strip for proper alignment, and tighten the screws.

#### Troubles and Possible Causes

<i>Trouble</i>	<i>Possible Causes</i>
9's set up in error	1. Failure to relatch stop pawl (a) Setup magnet adjustment (b) Worn setup magnet armature latching surface (c) Restoring bail cam loose on shaft (d) Worn restoring bail cams, cam follower rollers, or restoring bail cam shaft bearings (e) Oil on setup magnet armature causing armature to follow knockoff bail (f) Oil between setup magnet armature and core (g) Residual magnetism (h) Worn stop pawl pivot rod

*Checking Restoring Bail Relatching Clearance:* Unlatch bail and turn machine over to the point that is just before bail latch drops off the restoring pawl. Turn machine very slowly and stop the moment the latch drops off. Then turn the machine over slowly again and observe how much further the latch and bail move beyond the drop-off point. That movement is the actual relatching clearance.

### **Uneven Restoring-Bail Adjusting Screws**

If it is observed that the restoring-bail adjusting screws in the upper and/or lower half of a selector or sequence unit are adjusted unevenly, check for a loose or worn restoring-bail cam. Failure of stop pawls to relatch on one side of a unit is an indication of restoring-cam trouble.

### **Loose Unit-Drive Gear**

Highly intermittent selector or sequence unit trouble may be caused by loose unit-drive gears.

### **Worn Setup Magnet-Armature Tips**

If a setup magnet-armature latching surface is worn, a new latching surface may be secured simply by turning over the armature. (Adjustments and clearances should be checked and corrected as necessary.)

### **New Style Differential-Link Guide Plates**

Selector and sequence units containing new style differential-link guide plates (CEM 2263) require slightly different contact adjustments, because more motion is imparted to the contact operating cam. Excessive contact strap movement or tension will place an undue load on the cam and cause binds in differential links and setup ratchets.

### **Restoring Selector Unit Without a Feed Cycle**

A weak equal selector unit output pulse may cause either a primary or secondary card to be selected in error when a control panel

## **Test Control Panels and Cards**

The primary objectives in the design of IBM 77 machine test control panels and cards are: (1) to check the performance of a function or part adequately (a sufficient number of times), and (2) to cause the machine to *Error Stop* or *Idle* when a failure occurs with the condition, or reading, responsible for the failure still intact.

*Standard IBM 77 Collator Testing Procedure:* A complete description of the standard IBM 77 Collator testing procedure may be found in the IBM 77 C.E. Reference Manual.

*Supplementary Tests:* The following supplementary tests may be used in the identification and analysis of machine trouble. Test 1 checks general machine operation. Tests 2 through 7 check specific types of machine trouble.

The seven tests can be performed in any order with a minimum number of control-panel wiring changes. Control-panel wiring, from reading brushes to selector and sequence unit entry hubs, can be left unchanged for all seven tests. (In Tests 2 and 5, the reading brush to selector unit entry-hub wiring has no significance, but will not affect the tests.)

Reference may be made to the Selector and Sequence Units section under Trouble Analysis, for orientation with respect to units, specific unit positions, test impulses, unit outputs, and output relays.

Four test decks consisting of 144 cards each, and punched as indicated in the tabulation in the IBM 77 C.E. Reference Manual, Testing Procedure section are used in supplementary tests 1 through 4. The punching should be located in card columns normally used by the customer. The four decks are identical, except that an X-hole should be gangpunched in column 40 (or any convenient column) in two of the decks. (The reversed fields deck, which is required in the IBM 77 C.E. Reference Manual Testing Procedure, is not used in these IBM supplementary tests. The other three decks can be used, and a fourth identical deck should be reproduced from one of the three. Gangpunch an X-hole in column 40 in two of the four decks.)

A different color card stock should be used for each of the four decks, and identifying X's or digits may be punched in the decks if desired.

*Test Deck A:* Place one of the No X-40 decks in the primary feed and one of the X-40 decks in the secondary feed, and merge in the normal manner. This merged deck becomes test deck A. (If desired, the merging operation can be checked while it is being performed by wiring MS&S OFF, and LOW PRIMARY and LOW SECONDARY to ERROR STOP through selectors. Error lights will occur on run-in. As an alternative, the ERROR STOP wiring may be added after the three run-in cycles have been taken.)

*Test Deck B:* Place the other No X-40 deck in the primary feed and the other X-40 deck in the secondary feed and merge in the normal manner. This merged deck becomes test deck B.

Test decks A and B are identical except for any identifying X's or digits that may have been punched in the four individual decks. Each deck consists of 144 two-card groups, with the last card of each group containing an X-40 punch.

It is recommended that test decks A and B be kept intact for future use once they have been prepared.

### Supplementary Test 1

**Objective** To test general machine operation.

**Checks** Primary, primary sequence, and secondary reading for failure to read; and extraneous reading-brushes, contact rolls, separator rolls.

Card levers, card-lever contacts, card-lever relays.

Restoring, setup, and latching of selector and sequence units, and condition of contacts.

Primary and secondary clutches for unlatching and latching.

Pockets 1 and 3 selection.

Cycle delay operation; picking up and dropping out.

Primary X-selector operation.

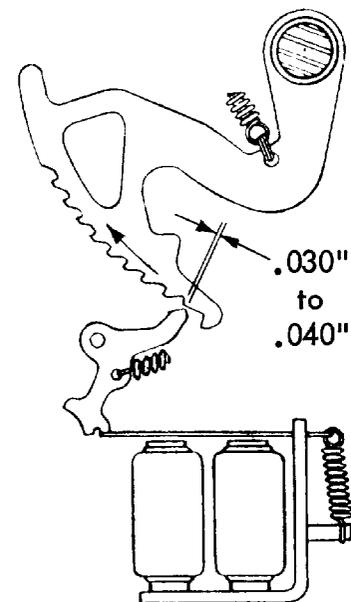


FIGURE 10

8. With conditions outlined in the preceding steps satisfied, and the upper and lower halves of the unit cleared to zero, check that no contact is made on both sides. Worn differential links are indicated if such a shorted contact condition exists.

*Contacts (Over-all Circuit Resistance of N/C Points):* It is recommended that, particularly during an inspection of selector and sequence units, an ohmmeter be used to check the over-all circuit resistance of the N/C contact points. This can be done by setting up an equal reading in the unit to be checked, and connecting the meter across the equal input and output terminals of the contact unit. If this combined point resistance is not close to zero, it should be brought to near zero by cleaning points, tightening terminal clip holding screws, etc.

*Contacts (Cleaning):* Running strips of cards, moistened with IBM cleaning fluid, through unit contacts while applying slight pressure is a good method of cleaning. Following the moistened strips with dry strips will remove any residue.

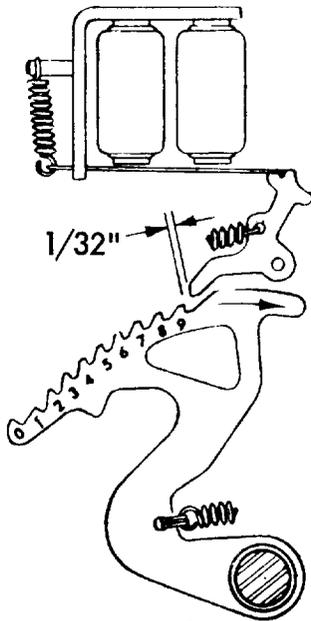


FIGURE 9

5. Unlatch the upper bail, and turn the machine over until the stop pawl is approximately  $\frac{1}{32}$  inch from the 9 tooth (Figure 9). Then check that all upper contacts are transferred (broken on the N/C side and just fully made on the N/O side).
6. Continue to turn the machine over until the stop pawl overlaps the 1 tooth approximately .030 inch to .040 inch (shown in Figure 10 for lower half of the unit). Check to see that all upper contacts are still transferred (broken on the N/C side and still fully made on the N/O side).
7. With the upper bail latched, unlatch the lower bail. Turn the machine over until the stop pawl overlaps the 1 tooth approximately .030 inch to .040 inch (Figure 10). Check to see that all lower contacts are still transferred (broken on the N/C side and still fully made on the N/O side).

#### Control-Panel Wiring (Figure 1)

Normal merge wiring is used for selector and sequence unit restoring, setup, and test input.

All BASIC SETUP SWITCHES are wired ON.

All primary cards are selected into pocket 1. (PRIMARY EJECT wired to PRIMARY SELECT).

All secondary cards are selected into pocket 3. (SECONDARY FEED wired to SECONDARY SELECT POCKET 3).

LOW SECONDARY and LOW PRIMARY SEQUENCE wired to ERROR STOP through SELECTORS 1 and 5, respectively.

Primary X-selector picked by X-40 card at primary sequence brushes. (Last card of each 2 card group.)

Primary X-selector :

HIGH-PRIMARY SEQUENCE wired to TRANSFER.

EQUAL-PRIMARY SEQUENCE wired to NORMAL.

COMMON wired to ERROR STOP through SELECTOR 4. (Readings in sequence) unit should follow the pattern outlined under *Information* which follows. (The primary X-selector operation prevents an error stop on a normal high-primary sequence, and permits sensing an erroneous equal primary sequence.)

Cycle delay picked by X-40 card at secondary brushes. Cycle delay dropped out from primary feed.

Cycle Delay Selector :

EQUAL SELECTOR output wired to TRANSFER through SELECTOR 2.

LOW PRIMARY wired to NORMAL through SELECTOR 3.

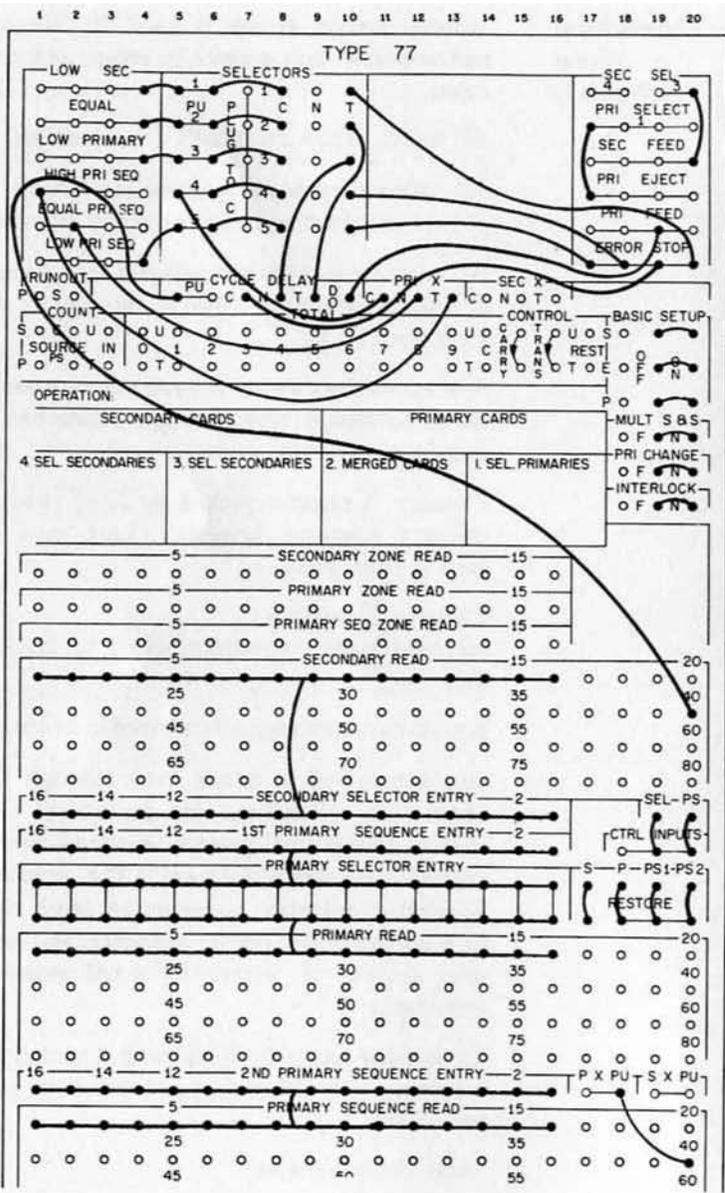


FIGURE 1

2. Check that distance between contact assembly mounting pads on the side frame and the contact mounting bar is approximately  $\frac{3}{32}$  inch (Figure 8).

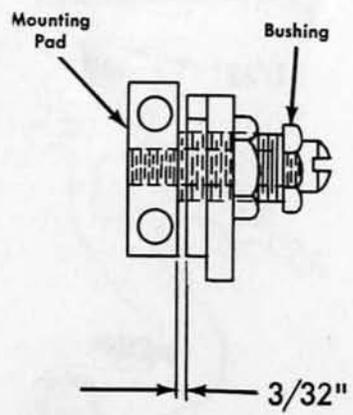


FIGURE 8

3. Lower contact assembly adjustment bushings should be located so that a clearance of .005 inch to .008 inch exists between the center straps and cam lobes. On units with new style differential-link guide plates (CEM 2263), it may be necessary to have a slightly greater clearance between the center straps and the cam lobes to decrease cam load. Cam load due to excessive contact strap movement or tension can cause binds in differential links and setup ratchets.
4. Check that the center strap follows the N/C strap back almost as far as the N/C strap support at each contact position.

4. Feed-knife slides binding in guides
5. Feed knives out of time. Brushes often are moved off of scribed line to compensate for incorrect feed-knife timing.
6. Worn contact rolls and separator rolls. Worn end sections can cause crooked feeding or feeding out of time.
7. Excessive travel of feed knives beyond 12-edge of cards in hopper (over .040 inch). Highly intermittent reading trouble usually occurs only when hopper is full or nearly full of cards. (Cards may feed-in late occasionally.)

**Gear marking of cards**

1. Cards feeding crookedly from the eject station to the stacker pockets is caused by lower-eject feed roll being forced downward. Insufficient lubrication of lower eject feed roll, and the last primary feed roll bearings and pressure shoes is a likely cause.

## Selector and Sequence Units

### Inspection

*Unit Timing:* Check to see that at 8 time (18 degrees) on the index, the stop pawls overlap the 9 tooth of the setup ratchets approximately .030 inches to .040 inch.

*Contacts (Method of Rapidly Checking Contact Adjustments):*

1. Clear both halves of unit to zero.

COMMON wired to ERROR STOP. (Readings in selector unit should follow the pattern under *Information* which follows. The cycle delay operation prevents an error stop on a normal low primary, and permits sensing an erroneous EQUAL output from the selector unit.)

### Cards

Test decks A and B

### Instructions

Sequence check test decks A and B in the normal manner. (The lower control panel wiring, the basic setup switch wiring, and the low-primary sequence to error stop wiring portions of the control panel used in this supplementary test 1 may be used. Then it will only be necessary to add a few control-panel wires to complete supplementary test 1 control panel.)

Place either test deck A or test deck B in the primary hopper and the other deck in the secondary hopper, and start the machine.

### Information

Error lights will occur on run-in and run-out.

The error stop wiring is routed through selectors 1—5, only for the purpose of preventing the pick of more than one output relay from the selector unit (R22-24), and more than one output relay from the sequence unit (R25-27), when an error has been detected and the outputs are being investigated, and should not be permitted to add any element of confusion to the control-panel wiring.

The following conditions should occur on successive machine cycles :

MACHINE CYCLE	SELECTOR READING	SEQUENCE READING	RESULT
At end of 3rd run-in cycle	Equal	Equal	Primary feed
4th	Equal	High-primary sequence	Secondary feed and primary eject
5th	Equal	High-primary sequence	Secondary feed and primary eject
6th	Low primary	High-primary sequence	Primary feed
7th		(Same as 3rd cycle)	
8th		(Same as 4th cycle)	
9th		(Same as 5th cycle)	
10th		(Same as 6th cycle)	
11th		(Same as 3rd cycle)	
12th		(Same as 4th cycle)	

If any cards fall into pockets 2 or 4, an incorrect pocket selection operation is indicated.

The machine will error stop with the incorrect reading, or condition, still intact.

**Supplementary Test 2**

**Objective** To test sequence unit for sequence checking operation and false high-primary sequence output.

**Checks** Primary and primary sequence reading for failures to read, and extraneous reading-brushes, contact rolls, separator rolls.

Restoring and setup of both halves of the sequence unit.

Condition of selector unit N/C contacts.

Cycle delay operation ; picking up and dropping out.

**Troubles and Possible Causes**

<i>Trouble</i>	<i>Possible Causes</i>
<b>Failure to Feed from Hopper</b>	<ol style="list-style-type: none"> <li>1. Insufficient hopper side plate clearance</li> <li>2. Insufficient throat clearance</li> <li>3. Insufficient hopper post clearance</li> <li>4. Worn or maladjusted feed knives</li> <li>5. Binding feed knife cam follower arm</li> <li>6. Worn throat roller</li> <li>7. Insufficient travel of feed knives beyond 12-edge of card</li> <li>8. Damaged card</li> <li>9. Worn card weight — shows up primarily on last card in hopper</li> </ol>
<b>Nicks and jams at throat</b>	<ol style="list-style-type: none"> <li>1. Alignment of throat roller to throat knife</li> <li>2. Incorrect throat clearance</li> <li>3. Excessive hopper post clearance</li> </ol>
<b>Faulty feeding, or transport resulting in incorrect reading</b>	<ol style="list-style-type: none"> <li>1. Binding feed roll pivots—insufficient feed roll tension</li> <li>2. Loose feed roll pivots causing poor feeding conditions. First feed roll pivots cause troubles difficult to locate.</li> <li>3. Binding feed roll pressure shoes—uneven tension</li> </ol>

Individual step-cut brushes cannot be used in the same brush block with old style reading brushes, because the projection differs from the previous brush (CEM 2374).

### IBM 77 Alphabetic Collator

**Check for Worn Brush Separator Rolls:** The brush separator rolls should provide even pressure over the length of the card. To check for this condition, feed in strips of cards near the ends and near the center of the roll (turn machine by hand). There should be approximately the same drag on a strip at the center as on a strip near the end. If this condition does not exist, the roll should be replaced (CEM 2375).

**Zone Brush Timing (Non-bevel, gear-drive machines):** The zone brushes should be timed so that, when the numerical brushes make properly through an 8-hole in the card, the corresponding zone brushes make through a 0 hole in the same card. Therefore, the distance between the heel of the two sets of brushes must be exactly 2 inches because there is  $\frac{1}{4}$  inch to the cycle point. However, the distance between the centers of the two contact rolls is  $2\frac{1}{16}$  inches. To compensate for this variation, the numerical brushes are offset  $\frac{1}{32}$  inch toward the card hopper, and the zone brushes  $\frac{1}{32}$  inch towards stacker pockets with respect to the normal position of the card brushes. Neither the collator brush alignment gage, part number 178087, nor the brush adjusting glass, part number 450388, can be used in the normal manner to position these brushes.

**Zone Brush Timing (Bevel gear-drive machines):** It is not necessary to offset the brushes on bevel gear-drive machines.

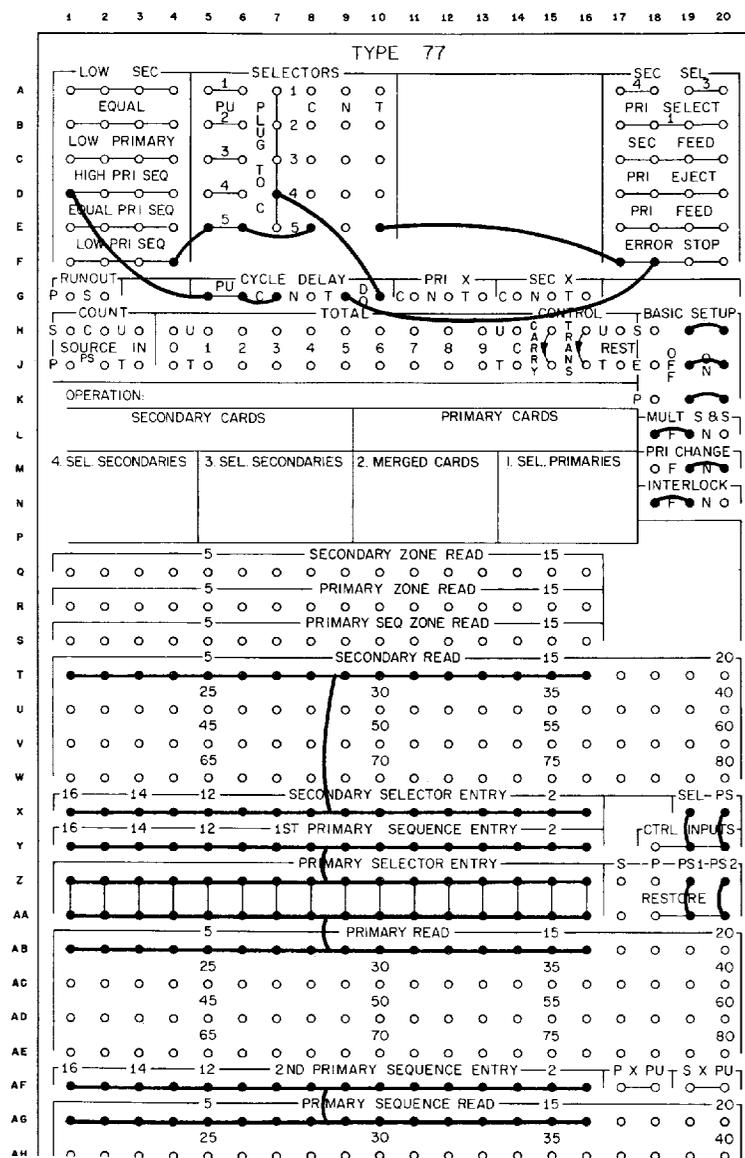


FIGURE 2

**Control-Panel  
Wiring  
(Figure 2)**

*Alternate Equal-Primary Sequence* and HIGH-PRIMARY SEQUENCE outputs should be available from the sequence unit. (The cycle delay operation prevents an error stop on a normal high-primary sequence, and permits sensing an erroneous high-primary sequence.)

INTERLOCK switch is wired OFF (or not wired), so R23 will pick every cycle from the EQUAL output of the selector unit.

MS&S switch is wired OFF to complete the circuit to the primary-feed clutch on the combination of EQUAL SELECTOR and HIGH-PRIMARY SEQUENCE outputs. (Another circuit path is also available on the combination of EQUAL SELECTOR and EQUAL-PRIMARY SEQUENCE outputs.)

Halves of the selector unit are restored only on run-in.

**Cards** Test deck A or B.

**Instructions** Place test deck A or B in primary hopper and start machine.

**Information** Low-primary sequence outputs and consecutive high-primary sequence outputs should not occur, and are wired to error stop the machine.

Machine will idle if any N/C selector unit contact fails to make. (Primary feed clutch can be impulsed only through R23 points.)

*Individual Reading Brush Replacement:* When replacing a single worn or damaged reading brush, the toes of adjacent brushes, rather than the heels, should be used as a guide for alignment because the adjacent brushes may have long faces.

*Cellophane Tape Method of Checking Brush Tracking:* The cellophane tape method of checking brush tracking is presented here as one method and it is not intended that it should replace other satisfactory methods.

1. Punch X's and 8's in columns of the card.
2. Stick cellophane tape over the holes on the side of the card that will pass next to the contact roll.
3. Run the card through the machine under power.
4. The brush strands will leave a mark on the tape itself.
5. Distance between leading edge of hole and starting point of track on tape indicates that an interval of time is required for brush to drop through hole and make contact with the contact roll. Excessive distance is an indication of weak brush tension.
6. This method does not readily indicate crooked feeding.

(See CEM 2070 for other satisfactory methods of checking brush tracking.)

*Checking For Worn Contact Rolls and Separator Rolls:* To check for worn contact rolls and separator-roll end sections, remove the contact roll from the machine and hold it against the separator roll. If the clearance between the high-speed section of the contact roll and the undercut section of the separator roll is less than .008 inch, excessive wear is indicated and replacement is necessary.

*Step Cut Brushes:* Brush reading can be improved on machines, made before the feed collator was redesigned, by installing new step-cut brush and block assemblies.

The PRIMARY CHANGE switch should be wired ON whenever a sequence unit comparison is to affect card feeding during a merging or matching operation.

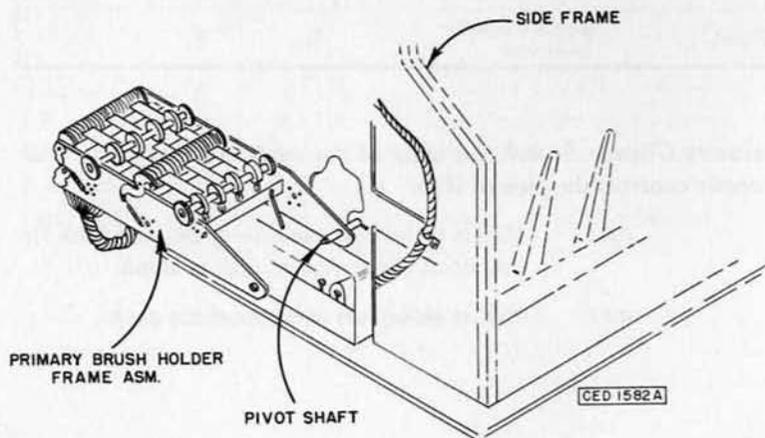
The PRIMARY CHANGE switch should be wired OFF in operations where it is desired to feed cards without regard to a control change in the primary cards. (Examples are merging (more than 16 columns); mixed merging; and matching card-for-card.)

## Card Feeding and Sensing

*Support of Primary Brush Assembly for Servicing:* The primary brush assembly may be supported during servicing by inserting one end of the pivot rod in the front frame as shown in the following sketch.

The position of the assembly may be reversed to facilitate plugging the brush leads.

Avoid bending the pivot rod or positioning the unit so that it could fall.



## Supplementary Test 3

**Objective** To test selector unit for false low secondary output.

**Checks** Primary and secondary reading for failure to read, and extraneous reading-brushes, contact rolls, separator rolls.

Restoring, setup, and latching of upper half of selector unit.

Primary and secondary clutches for unlatching and latching.

Pockets 1 and 3 selection.

**Control-Panel Wiring (Figure 3)** LOW SECONDARY output should not occur and is wired to ERROR STOP.

Primary cards are selected into pocket 1, and secondary cards are selected into pocket 3, to keep the decks separate and check pocket selection operations.

**Cards** Test decks A and B.

**Instructions** Place either test deck A or test deck B in the primary hopper and the other deck in the secondary hopper, and start machine.

**Information** Error lights will occur on run-in and run-out.

Unit readings and clutch impulses should occur as in test 1. (See chart under *Information*, test 1.)

If any cards fall into pockets 2 or 4, incorrect pocket selection operation is indicated.

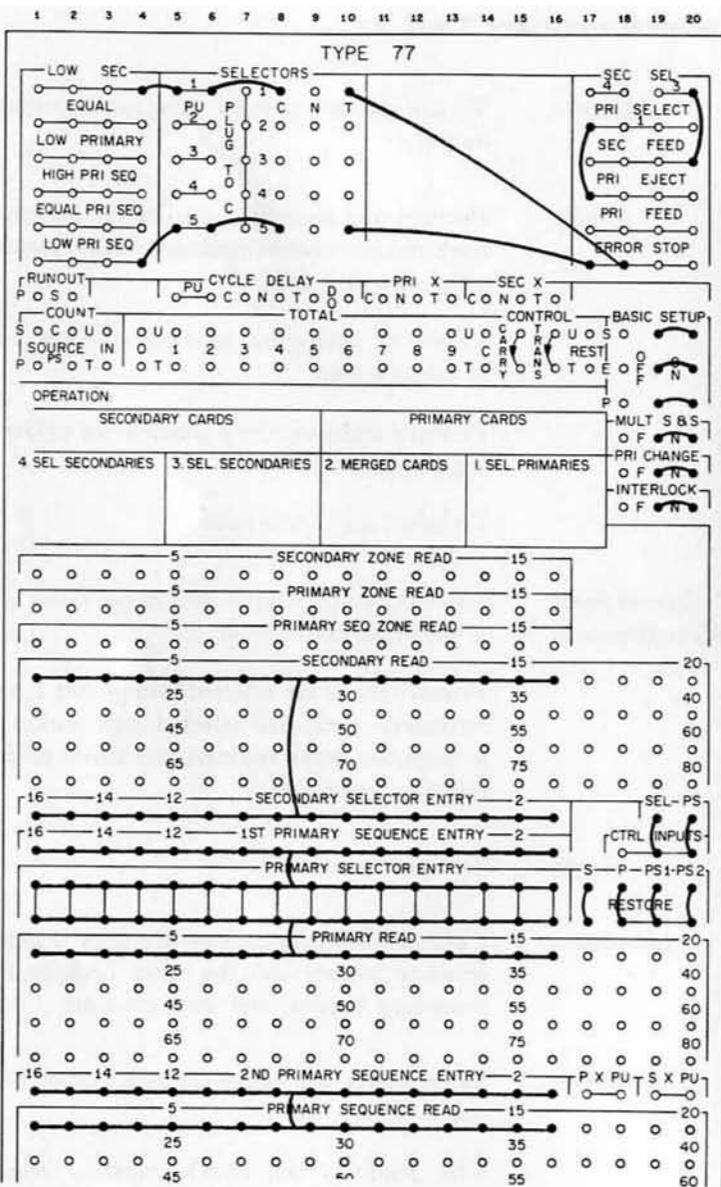


FIGURE 3

All BASIC SETUP switches wired ON.

Output from Selector Unit	Output from Sequence Unit	Clutches Operated		
		Eject	Primary Feed	Secondary Feed
Low Primary	Low-, Equal-, or High-Primary Sequence	X	X	
Low Secondary	Low-, Equal-, or High-Primary Sequence			X
Equal	Low- or High-Primary Sequence	X		X
Equal	Equal-Primary Sequence	X	X	

MS&S wired OFF; all other switches wired ON.

Output from Selector Unit	Output from Sequence Unit	Clutches Operated		
		Eject	Primary Feed	Secondary Feed
Low Primary	Low-, Equal-, or High-Primary Sequence	X	X	
Low Secondary	Low-, Equal-, or High-Primary Sequence			X
Equal	Low- or High-Primary Sequence	X	X	X
Equal	Equal-Primary Sequence	X	X	

*Primary Change Switch:* Wiring of the PRIMARY CHANGE switch directly controls the pick of R26.

- ON: R26 is picked on machine cycles in which the output of the sequence unit is equal.
- OFF: R26 is picked on every machine cycle.

## Pri Change — PRIMARY CHANGE

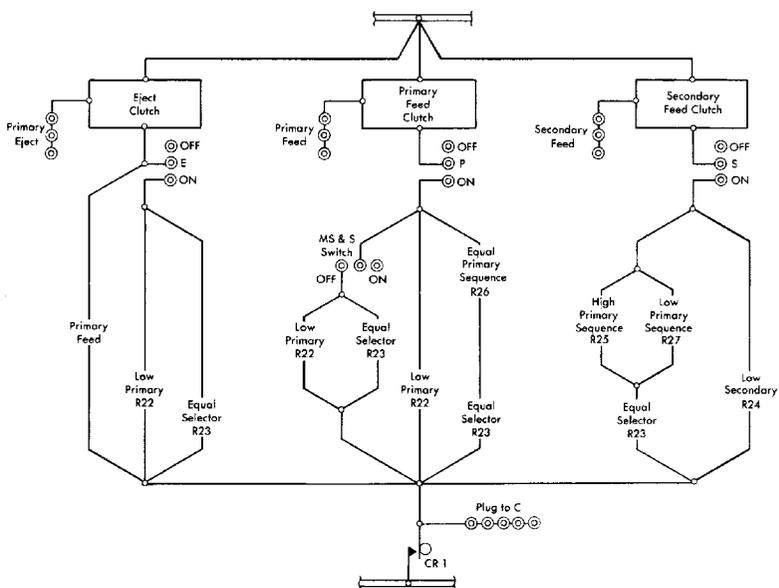
**Purpose:** To condition PRIMARY FEED and SECONDARY FEED switches, depending on a control change in primary cards.

**ON:** 1. Primary feed on an equal selector and equal primary sequence condition, if MS&S switch is also wired ON (or not wired).

2. Secondary feed on equal selector, and unequal primary sequence condition.

**OFF:** Primary feed on equal selector unit output, regardless of sequence unit output.

**MS&S Switch:** The MS&S switch must be wired ON (or not wired) in a merging or matching operation, whenever there are multiple secondaries *and* whenever the selection of unmatched secondaries is required. (If the MS&S switch were wired OFF under these conditions, all cards, except the first of the multiple secondary card groups, would be erroneously selected as low secondary cards.) The MS&S switch should be wired OFF for all other operations.



## Supplementary Test 4

**Objective** To test selector unit for false low-primary output.

**Checks** Primary and secondary reading for failure to read, and extraneous reading-brushes, contact rolls, separator rolls.

Restoring, setup, and latching of lower half of selector unit.

Primary and secondary clutches for unlatching and latching.

Pockets 1 and 3 selection.

Eject clutch for failure to latch.

### Control-Panel Wiring (Figure 4)

LOW-PRIMARY output should not occur and is wired to ERROR STOP.

PRIMARY CHANGE switch is wired OFF to permit the primary feed clutch to operate without regard to a control change in primary cards, and thereby prevent the normal occurrence of a low-primary selector unit output.

Primary cards are selected into pocket 1 and secondary cards are selected into pocket 3 to keep the decks separate and check pocket selection operations.

**Cards** Test decks A and B.

**Instructions** Place either test deck A or test deck B in the primary hopper, and the other deck in the secondary hopper and start machine.

**Information** Error lights will occur on run-in and run-out.

## SERVICE POINTERS AND INFORMATION

### Basic Setup Switch Operation

A summary of conditions under which card feeding occurs, when each of the five switches is wired ON or OFF, is as follows:

#### E — EJECT

- ON: 1. Low primary  
2. Equal selector

OFF: No Function.

#### P — PRIMARY FEED

- ON: 1. Low primary  
2. Equal selector if MS&S switch or PRIMARY CHANGE switch is wired OFF.  
3. Equal selector and equal primary sequence if MS&S switches is wired ON (or not wired) and PRIMARY CHANGE switch is wired ON.

OFF: No Function.

#### S — SECONDARY FEED

- ON: 1. Low secondary  
2. Equal selector and unequal primary sequence, if the PRIMARY CHANGE switch is wired ON.

OFF: No Function.

#### MS&S — MULTIPLE SECONDARIES AND SELECTION

Purpose: To condition the PRIMARY FEED switch.

ON (or not wired): Primary feed on equal selector and equal primary sequence condition, if PRIMARY CHANGE switch is also wired ON.

OFF: Primary feed on equal selector unit output, regardless of sequence unit output, regardless of sequence unit output.

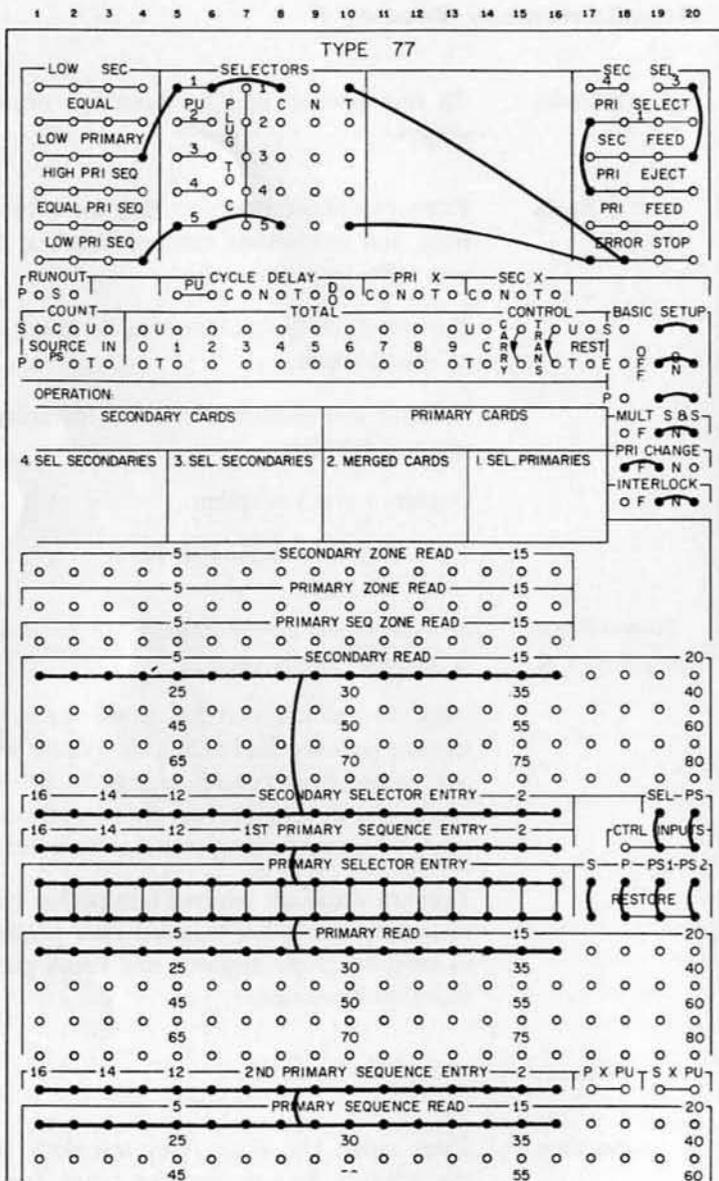


FIGURE 4

After the unit causing the trouble has been determined, go along the contacts and short them out one at a time until the relay that is failing to pick gets an impulse to pick. (In shorting contacts, consider whether a contact is normal or transferred. The side that should be made is the one that should be shorted.) The contact that picks the relay is the one requiring cleaning or adjustment.

Instead of shorting contacts, a voltmeter or dynamic timer may be used to locate the failing contact.

*Single-Cycle Clutch Operation:* If it is desired to observe clutch operation on a single-cycle basis, HS4 point may be held open, and then closed only momentarily, to effect single-cycle clutch operation.

### Adjustments

Before making a specific adjustment in an effort to correct a machine trouble, a mental review of basic mechanical operation of the unit concerned should be made to determine if other factors are involved in this adjustment. This is particularly necessary when an adjustment falls within a package, or sequence, of adjustments.

### Relay

Machine troubles are sometimes caused by improper adjustment or lack of preventive maintenance on duo relays. The correct amount of contact rise, the lubrication of armature pads and pivots, and the correct armature-to-core air gap are important items. The general *Customer Engineering Reference Manual* section on *Relays*, Form 22-5857, should be used as a reference for the proper performance of adjustments, and for preventive maintenance on duo relays.

The following conditions should occur on successive machine cycles:

MACHINE CYCLE	SELECTOR READING	SEQUENCE READING	RESULT
At end of 3rd run-in cycle	Equal	Equal	Primary feed
4th	Equal	High-primary sequence	Primary feed (because PRI CHANGE switch is wired OFF)
5th	Low secondary	Equal	Secondary feed
6th	Low secondary	Equal	Secondary feed
7th		(Same as 3rd cycle)	
8th		(Same as 4th cycle)	
9th		(Same as 5th cycle)	
10th		(Same as 6th cycle)	
11th		(Same as 3rd cycle)	
12th		(Same as 4th cycle)	

If any cards fall into pocket 2, either incorrect pocket selection operation, or failure of the eject clutch to latch on secondary feed cycles, is indicated.

The test deck for supplementary tests 5 through 7 should consist of approximately 500 equal cards. It is suggested that the cards be punched alternately 1, 2; 1, 2; etc. completely across the cards. With all 80 columns of the cards punched in this manner, control panels for supplementary tests 5 through 7 can be wired to read from the card columns most commonly used by any customer, with no change in test cards. The 1, 2; 1, 2; etc. punching will provide a good check for selector and sequence unit positions setting up false higher-than-normal readings. In addition, the tests can be conducted with a heavier-than-normal reading load so that condition of CB's, reading brushes, and contact-roll common brushes may be checked.

## Supplementary Test 5

<b>Objective</b>	To test sequence unit for correct operation with equal readings in the unit. (Check for false low or high-primary sequence.)
<b>Checks</b>	Primary and primary sequence reading for failures to read, and extraneous reading-brushes, contact rolls, separator rolls.  Restoring and setup of both halves of sequence unit.  Condition of N/C selector and sequence unit contacts.
<b>Control-Panel Wiring (Figure 5)</b>	All cards are equal, so LOW-PRIMARY SEQUENCE and HIGH-PRIMARY SEQUENCE outputs should not occur and are wired to ERROR STOP.  INTERLOCK switch is wired OFF (or not wired), so R23 will pick each cycle from the EQUAL output of the selector unit.  Halves of the selector unit are restored only on run-in.
<b>Cards</b>	Use same equal cards as in tests 6 and 7.
<b>Instructions</b>	Place equal card deck in primary hopper and start machine.
<b>Information</b>	Error lights will occur on run-in and run-out.  Machine will idle if any N/C contact of either the selector or the sequence unit fails to make. (After run-in cycles, the primary feed clutch can be impulsed only through R23 B N/O and R26 A N/O in series.)

*Irrelevant Reading of Unit Positions:* The first contact from the left (that is transferred) determines the output of a unit; so that is the position that should be investigated in the analysis of most machine troubles involving selector and sequence units. The reading of positions to the right is usually irrelevant and should usually be avoided.

In some instances, such as a complete failure to read in one half of a unit, it is helpful to note that all, or nearly all, of the contacts in wired positions are transferred. However, this condition is usually obvious.

*Sequence Unit Function in Merging and Matching:* The importance of the sequence unit output should not be overlooked when correcting machine performance in merging or matching operations.

*Determining Unit Output:* A determination of selector and sequence unit outputs may be made by observing the operation of relays 22 through 27; (relays 22—24 for selector unit); (relays 25—27 for sequence unit).

After error stop, without resetting error detection circuit, operate R50 manually and observe R22 through 27.

At the end of any card feed cycle, with the machine stopped at the end of the desired card feed cycle, block open CR1, R17B N/O, or HS4 to prevent feeding. Then depress the start key or operate R50 manually and observe R22 through 27.

Selector and sequence unit contact failures will frequently result in an idling condition on the machine. That is, the motor will run, but feed clutches will not engage. The idling results because a unit test impulse is unable to pass through the contacts and energize the output relays that control the clutches.

When a machine idles, depress the stop key immediately to prevent the possibility of feed clutch operation before the failure can be investigated. Then block open CR1, R17 B N/O, or HS4 to prevent feeding, and depress the start key. Observation of R22 through 27 should disclose either a lack of output or intermittent output from one of the units.



## Supplementary Test 6

**Objective** To test selector unit for correct operation with equal readings in selector unit and multiple primary cards. (Checks for false low secondary or low primary).

**Checks** Lower half of selector unit for correct setup, and particularly for binding or sticking ratchets and binding differential links.

Primary reading for failure to read and extraneous reading-brushes, contact roll, separator roll.

Condition of N/C selector and sequence unit contacts.

**Control-Panel Wiring (Figure 6)** All cards are equal, so LOW PRIMARY and LOW SECONDARY outputs should not occur and are wired to ERROR STOP.

This upper control-panel wiring may be used with the customer's cards and control panel in the analysis of machine troubles involving merging or matching with multiple primary cards.

**Cards** Use same equal cards as in tests 5 and 7.

**Instructions** Place at least 5 cards in the secondary hopper, and the remainder of the equal deck in the primary hopper, and start machine.

**Information** Error lights will occur on run-in and run-out. Primary feed should operate continuously after run-in. Observe mechanical operation of lower half of selector unit to locate setup ratchets that are not following the restoring bail.

Machine will idle if any N/C contact of either the selector or the sequence unit fails to make.

## TROUBLE ANALYSIS

### Frequency of Machine Failure

*Consistent Failures:* When a machine failure occurs frequently, and the observed results of the failure follow a definite pattern, it is usually easy to identify the exact nature of the trouble. Then, by the application of good trouble-analysis technique, the trouble area can be located and the trouble corrected.

In identifying a machine trouble, it is good practice to check the results of several failures, rather than just one or two, in order to determine that the pattern of failure is constant. False conclusions often result from an analysis based on the results obtained from a single failure.

*Intermittent Failures:* An intermittent failure requires patience and careful analysis by the Customer Engineer. It is sometimes necessary to pass many cards through the machine in order to detect a machine malfunction. Do not assume that a single pass, or even two or three passes, of a test deck through the machine is sufficient to indicate correct machine operation.

If a machine failure cannot be made to occur by the Customer Engineer after his arrival at a customer's installation to correct a machine trouble or demonstrated by the machine operator, he must make an analysis of the trouble, based on the information at his disposal, and check the suspected trouble area carefully.

### Machine Failures of a General Nature

The analysis of many machine troubles indicates the failure of a specific reading brush, unit setup magnet, unit contact, or relay point. However, this is not always the case. When failures of a general nature are indicated or suspected, check such basic things as power supply voltage, feed adjustments, main circuit breakers adjustments, and mechanical drive.

When trouble on a machine is chronic, check mechanical drive for loose or broken pins; index for looseness or breakage; sets of brushes for timing and tracking; circuit breakers for general condition — air gap, duration, and timing; and so forth.



## Supplementary Test 7

**Objective** To test selector unit for correct operation, with equal readings in selector unit and multiple secondary cards. (Check for false low primary or low secondary).

**Checks** Upper half of selector unit for correct setup, and particularly for binding or sticking ratchets and binding differential links.

Secondary reading for failure to read and extraneous reading-brushes, contact roll, separator roll.

Condition of N/C selector and sequence unit contacts.

**Control-Panel Wiring (Figure 7)** HIGH PRIMARY SEQUENCE and EQUAL PRIMARY SEQUENCE are connected together to force the effect of a high-primary sequence reading, and cause the secondary feed to operate continuously.

Note that PRIMARY CHANGE switch is not wired.

All cards are equal, so LOW PRIMARY and LOW SECONDARY outputs should not occur and are wired to ERROR STOP.

This upper control-panel wiring may be used with the customer's cards and control panel in the analysis of machine troubles involving merging or matching with multiple secondaries.

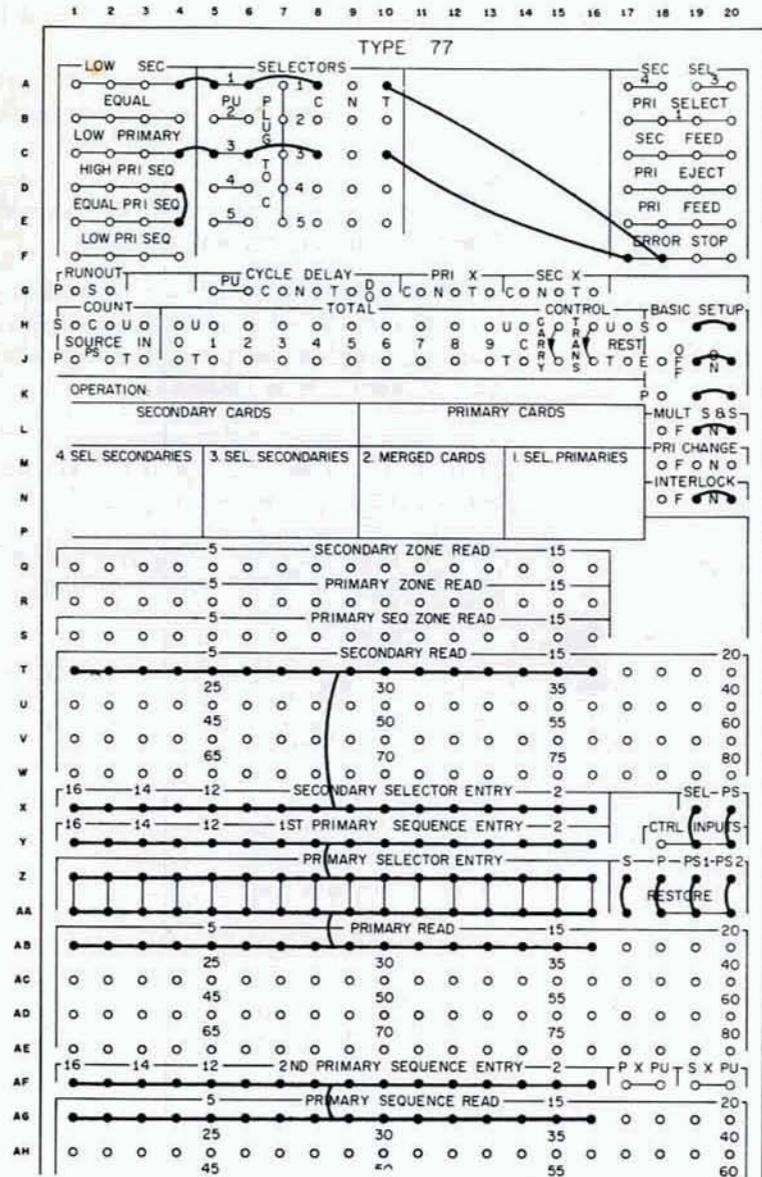


FIGURE 7