IBM CUSTOMER ENGINEERING

REFERENCE MANUAL

PREVENTIVE MAINTENANCE

Collator Type 077

CONTENTS

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PREVENTIVE MAINTENANCE
Collator, Type 077

FEEDS

I. Cleaning

Proper cleaning is one of the most important parts of preventive maintenance on the 077. Many of the troubles on this machine stem from crooked feeding of the cards. Dirt on the feed rolls or in the teeth of the feed roll gears will cause bouncing of the rolls and aggravate any poor feeding condition. Therefore, special care should be taken to clean *all* dirt and old grease from these points, not forgetting the feed roll gears located in the removable brush assembly units. Both brush assembly units and the dust covers over the primary feed rolls should be removed before cleaning the feeds. The following list gives a number of points that should be checked for cleaning:

1. **Contact Rolls.** These should be cleaned even if there is no evidence of burning. Use an ink eraser to clean.
2. **Upper Feed Rolls and Brackets.**
3. **Selector Magnets.** A tab card dipped in cleaning fluid may be used to clean dust and grease from between the armature and core.
4. **Feed Hoppers and Under Feed Knives.**
5. **Main Drive Shafts and Gears.** Pay particular attention to dirt in the teeth of feed roll drive gears.
6. **Feed Rolls.**
7. **Feed Clutches.**
8. **Brush Separator Rolls.** Pay particular attention to dirt between separators. Revolve the rolls and watch for brush movement. Any dirt between the separators will result in brush movement.

II. Inspection

1. **Brush Assemblies.** (see *General Section*) Check the following:
   (a) END SHAKE. All possible end shake should be removed from the contact and brush separator rolls by shifting the end bearings.
   (b) BRUSH SEPARATORS
   (c) BRUSHES
   (d) ALIGNMENT TO SCRIBED LINE. Use brush gauge #450388 and the line furthest from the bend in the gauge.
   (e) BRUSHES EVENLY SPACED BETWEEN SEPARATORS. Revolve the separator roll while checking to make sure brush does not touch at any point. Use brush bending tool to align any brushes necessary. It will be easier to reach some of the brushes if the card guide over them is removed. Replace any rolls with broken segments or on which the steel collars are badly worn. On the latest Type 077 machines, new brush holder locating blocks have been released. These new blocks are approximately ten thousandths thinner than the part which they replace and are threaded for the brush block aligning screw, Part #197475. It is, therefore, possible to align the majority of the brushes readily to the center of the grooves in the brush separator rolls. However, it will still be necessary to use the three group brush bending tool to align such brushes as cannot be centered in the separator roll by the lateral adjustment of the brush block.

   The brush separator rolls should be positioned before attempting to align the brushes so that the distance from the inside of the front side frame to the front edge of the first groove in the separator roll is 5/8". If this adjustment is obtained prior to attempting to align the brushes to the separator roll, it will make it easier to obtain correct brush alignment, particularly in the primary feed and also in the secondary feed on machines equipped with additional brushes for alphabetical collating.
   (f) BRUSH TRACKING
   (g) BRUSH TIMING. If no dynamic timer is available, feed cards to brush station under power and then through brushes by hand timing

on a "5" hole. It is advisable to check also at least one column in all positions, "9" through "1" to check wear on variable speed cam.

2. **Feed Drive Shafts.** Check the following:
   (a) END PLAY in either shaft will further aggravate poor feeding conditions. End play may be removed at end bearings.
   (b) WORN GEAR COLLARS for wear, loose pins, etc.
   (c) LOCK NUTS ON FEED ROLL WORM GEARS. If these are loose, variation in feeding will result. The spiral gears that drive the contact rolls on Type 077 Collators are accurately meshed with the worm drive to insure constant speed of the roll. Variations in manufacturing tolerances, if not compensated for when meshing the gears, will result in variation in contact roll circumference speed. This in turn will cause erratic brush timing and occasional failures.

   To insure that the correct relationship between the gear members does exist when replacing a contact roll, the spiral gear should be tied with twine or a rubber band in its original position before removing the contact roll. Where it is required that replacement gears be installed, it may be necessary to try the new gear in several positions of mesh, checking brush timing dynamically at 9, 7, 5, etc., until the most satisfactory overall condition is obtained. It is necessary to check at least 11 consecutive cards to know that the gear mesh is correct.
   (d) WORM GEAR DRIVING EJECT ROLL for wear and loose set screws; their being loose will affect the primary select magnet timing.
   (e) CLUTCH ADJUSTMENTS. Primary, Secondary and Eject.
   (f) PRIMARY AND SECONDARY CAM CONTACTS. (see *General Section* under *CB Contacts*)

3. **Feed Units.** (see *General Section—Horizontal Feeds*)
   (a) FEED KNIFE ADJUSTMENTS
   (b) FEED KNIFE SLIDE GUIDES. This is especially important on the 077 since the feed knives are returned by spring action only.
   (c) EVEN FEEDING OF CARDS
   (d) HOPPER SIDE PLATES are adjusted to position brushes to the center of holes. In the primary unit the sequence brushes should be used for this. Run the test card under power through only the sequence brushes and remove it by dropping the brush assembly, then the alignment of the remaining set of brushes may be checked by running a chalked card through the machine and comparing the difference in the width of the brush marks.
   (e) ROLLER THROAT
   (f) FEED ROLL TENSION
   (g) TIMING OF FEED KNIVES. Obtain proper timing by rotating the feed knife cam on the primary shaft. Care must be taken not to move this cam laterally on the shaft as it may cause binds in the feed knife cam follower guide.
   (h) HOPPER POSTS

4. **Selection Magnets** for timing and adjustment.

5. **Chute Blades**

6. **Card Lever Contacts.** (see *General Section*)

7. Make a final check for even feeding by running a card under power to, but not through, the eject station. With the power off, trip the eject clutch and turn the machine by hand. If the card has fed evenly through the primary station, it will be gripped by the eject roll and pulled evenly ahead without twisting.

III. Lubrication

IBM 6

(1) Feed knife slides.
(2) Select magnet armature pivots.
(3) Contact roll oil wells. The shafts on each end of the high speed contact rolls are hollow and act as oil wells to lubricate the idler section. Oil should be pumped into the wells in the center of these shafts at both front and rear ends.

(4) Feed clutch latch lever pivots.
(5) Clutch knockoff lever pivots.
(6) Feed clutch armature pivot points.

IBM 9

(1) Upper and lower feed roll bearings. In all cases (even on machines equipped with Bijur System) the feed roll and brush separator roll bearings in the brush assembly units must be oiled by hand.
(2) Feed roll pressure shoes.
(3) Eject clutch drive shaft. The first lower continuously running feed roll is hollow. Inside of it, and turning at a different speed, is the eject clutch drive shaft. Remove a screw located on the hollow feed roll about an inch in from the front casting. Through this screw hole, lubricate the eject clutch drive shaft.
(4) Feed drive shaft oil cups, one on secondary and two on primary shafts.

IBM 17

(1) All main drive shaft feed roll gears.
(2) Feed knife cam follower guide and roller.
(3) Primary and secondary cam contact rollers.
(4) Eject clutch knockoff arm.
(5) Primary and secondary clutch knockoff cam follower roller.
(6) Thin film on linen dilecto cams.
(7) Feed clutch magnet armatures at latch point.

IBM 21

(1) Thrust bearings on end of feed drive shafts.

CONTINUOUS RUNNING UNITS

I. Cleaning

(1) STACKER POCKETS. Clean all dirt from feed roll surfaces and dust out of pockets. Clean stacker tube with cloth dipped in cleaning fluid, but do not oil.
(2) VARIABLE SPEED CAM. All dirt and old grease from around cam and from linen dilecto gears.

II. Inspection

(1) STACKER POCKETS for free operation and worn auxiliary stacker springs.
(2) CONTINUOUS RUNNING SHAFT for loose pins in drive gears pinned on it.
(3) VARIABLE SPEED CAM AND CAM FOLLOWER for wear. This can be partially checked by punching one card column for all holes "9" through "1". Any variation of timing will indicate wear at this point. Another method is to turn the machine to a point on the index of about 226° to 228°. At this point hold the reverse lock free with a screw driver and rock back and forth on the large linen dilecto gear back of the index. If the cam roller is not worn, the CR Drive Shaft will rock with the gear without any appreciable lag or slop.
(4) CR CAMS (see *General Section—CB Units*). Duration time of CB1-2-3-4 on the 077 should be 8° on the tube type, and 6° on the non-tube type.

III. Lubrication

IBM 6

(1) CR cam contact lever pivot point.

IBM 9

(1) CR drive shaft oil cups. One located behind sequence unit and the other beside the secondary one tooth ratchet gear.
(2) CR feed roll bearings (front and rear). Remove front cover to get at front feed roll bearings.
(3) Reverse friction lock.
(4) CR cam contact shaft bearings.

IBM 17

(1) CR feed roll drive gears.
(2) Linen dilecto cams: light film only.
(3) CR cam follower rollers.

IBM 21

(1) Variable speed cam.
(2) Drive pulley bearings.

SELECTOR AND SEQUENCE UNITS

MOST OF THE cable wires going to the bottom connections of these units terminate on the upper and middle rows of the bakelite binder post panel located directly under the units. Disconnecting the cable at panel instead of on the bottom of the units will greatly facilitate removal of the wires so that it will only be necessary to remove 3 wires that go directly to the unit instead of all 19.

The 3 wires that do not terminate on the binder post panel are the heavy common lead to the setup magnets (a red wire in most machines), and the 2 wires going to the restoring magnet, (1 red and 1 black wire). Care should be taken in noting the color coding of the restoring magnet wires before removal in order that they be replaced the same way to insure proper polarity to the magnets.

I. Cleaning

The contact unit should be removed and all dirt and old grease should be cleaned from the cams, cam followers and the setup ratchet pivot shaft.

II. Inspection

1. **Magnet Armatures** for wear.
2. **Setup Bail Adjusting Screws** for wear.
3. **Setup Bail Cam Follower** for wear.
4. **Setup Bail Springs Have Their Heaviest Load** at a point where they are stretched the least. As they age, the unit sometimes fails to clear and sets up 9's. This will usually show up if setup pawls are tripped and one side of unit is restored slowly by hand. If, at the time cams are at the low point, it is possible to push setup bail back, the springs are not strong enough and should be replaced or shortened.
5. **Differential Links** for wear. This may be easily checked as follows: With zeros in the unit, lay a scale or other straight edge across the lower operating surface of the linen dilecto cams. Holding the scale thus, rock each cam. Any excess movement of a cam indicates a worn differential link stud.
6. **Setup Pawl Pivot Rod** for wear. This should be carefully checked for any vibration in the ratchet guide plate assembly. If the rod is slightly loose in its mounting, the setup pawls will vibrate sufficiently to unlatch armatures occasionally even in positions not wired. On units having locating set screws for ratchet guide plate assembly, any movement of the pivot rod is easily seen. Since the rod is removed through these holes to simplify replacing a pawl, it is obviously plainly visible.
7. **All Unit Adjustments.** A quick check on proper overlap of stop pawls to the setup ratchet teeth is to set machine at 160° and trip stop pawls by hand. The pawls should have just enough room to seat in the "one" tooth. But should not do so at 162°.
8. **Contact Unit Adjustment.** Care should be exercised in changing tension on the center strap, since too much tension in the normally closed direction places a load on the cam and linkages and can cause the setup ratchet to drop back a tooth under certain operating conditions. For example, if one setup ratchet is stopped at number 5 tooth for a few cycles, the movement of the other ratchet actuates the differential link and the control lever (each cycle), due to excess tension on contact straps, to such an extent that this ratchet is moved from the #5 tooth to the #6 tooth.

This condition must be watched because if the latest type cams are installed in unit, the increased travel of center strap may cause too much load because of some previous increase in contact strap tension.

With power on the machine, no cards and all 16 positions wired, trip the bottom restoring magnet mechanically in both units. At "one" time short the primary card lever and turn the machine to 160°. At this time all positions are the same as they would be if "ones" had been read into the units.

None of the lower contacts should be making on the outer (N/O) straps. Turn the machine to 162° and all of the N/O straps should be made.

Clear the unit and repeat this check for the upper points by tripping the upper restoring magnets and shorting the primary sequence and secondary card levers.

The inner (N/C) contacts should be set so that with zeros in the unit the center strap will break away from the inner (N/C) strap before making on the outer (N/O) strap. This can easily be checked with zeros in the unit by plugging one end of a test light into the control input hub on the control panel and the other end to the equal hub of the unit being tested. If the two unequal hubs of the unit are both jack-plugged to the equal, the light will stay on at all times unless one of the center straps is not made on either its N/O or N/C side. Check the points one at a time using a spring hook or contact bending tool to pull the center strap forward. The N/C contact should break before the N/O contact makes, thus allowing the light to go out momentarily.

III. Lubrication

Keep restoring bails and operating cams and springs lubricated so that bails operate freely and fully restore the pawls when the unit is turned over by hand. Check to see that the oil cup is feeding oil to the set up ratchet shaft as well as to the wick which runs almost the length of the shaft.

IBM 6

(1) Setup ratchet pawl shaft oil well. This is the only part of the unit that is lubricated automatically with the Bijur System.
(2) Stop pawl pivots.
(3) Differential link studs followed with IBM 17.
(4) Restoring magnet knockoff cam follower, followed with IBM 17.

IBM 17

(1) Cams.
(2) Restoring bail spring stud.
(3) Differential link studs.
(4) Restoring magnet knockoff cam followers.

TUBE UNIT

I. Line Voltage

Check AC line voltage to insure that it is 112.5 volts or upwards. This will provide a minimum of 22.5 volts across the heater of each tube.

II. Heater to Cathode Short

In some instances, open filament tube failure is due to a heater to cathode short in another tube in the same filament string. This short can be of a high enough resistance so as not to extinguish the tube in question, but will put a higher than normal voltage on the filaments of some of the tubes in the string depending on the location of the shorted tube with respect to the line. A quick test of all tubes for a cold short can be made by removing the cathode common from 40 volt plus post #1 and connecting an ohmmeter from this wire to main line terminal #8. A cold short in any of the tubes will show a deflection on the meter.

It is advisable, when replacing a tube with an open filament, to check with an ohmmeter the rest of the tubes in the string for heater-to-cathode shorts, rejecting any tubes with a shorted or partially shorted condition. If filament failures persist in a string, the tubes in that string should be checked for a "hot short" between filament and cathode as some shorts do not show up unless the filaments are heated. This test can be done on any standard tube checker.

III. Voltage Drop Across the Magnets

With power on, connect the voltmeter across magnet terminals of position to be checked. Manually turn the machine to between 150° and 230° to make the "on" side of the feed interlock switch hot. Insert a plug wire from this "on" hub to the input hub of the position to be checked. If the instantaneous voltage read is less than 16 volts, the tube should be replaced. Test each position one at a time in this manner, taking care that the voltmeter is connected across the magnet before inserting the plug wire in the input hub for that position, as the correct voltage to be read is the instantaneous voltage at the time the magnet is first energized. The instantaneous voltage drop across a magnet energized by a weak tube may be less than 16 volts, but the voltage drop can increase as much as 10 volts in 15 seconds after the magnet is first energized. Reading the meter at that time would make a weak tube seem satisfactory.

In order to insure that failures in the brush circuit do not result in replacing tubes where they are not required, the brush input to the magnets has been purposely avoided in this procedure.

IV. Vibration Test

Vibration will sometimes cause intermittent shorts resulting in incorrect readings in the units. This may be tested for by running the collator test number one and tapping each tube several times with the eraser end of a pencil while cards are feeding. Any errors resulting only when a tube is tapped will indicate a vibration short in that tube.

BASE

1. Relays. (see *General Section*)
2. Motor Generator. (see *General Section*)
3. Bijur System. (see *General Section*)
4. Control Panel. (see *General Section*)

OPERATION TESTS

PUNCH TEST cards as indicated by the following table. To avoid repetition some cards have been omitted from the list but 144 cards should be punched. The punching of the test field for those which are omitted from the list follows a regular progression, in the pattern indicated by the first part of the list.

TEST FIELD	CARD NO.	TEST FIELD	CARD NO.	TEST FIELD	CARD NO.
---------------1	001	-------------999	027	-------etc.-----	
---------------2	002	------------1999	028	------9999999999	090
---------------3	003	------etc.-----		-----19999999999	091
---------------4	004	------------9999	036	-------etc.-----	
---------------5	005	-----------19999	037	-----99999999999	099
---------------6	006	------etc.-----		----199999999999	100
---------------7	007	-----------99999	045	-------etc.-----	
---------------8	008	----------199999	046	----999999999999	108
---------------9	009	------etc.-----		---1999999999999	109
--------------19	010	----------999999	054	-------etc.-----	
--------------29	011	---------1999999	055	---9999999999999	117
--------------39	012	------etc.-----		--19999999999999	118
--------------49	013	---------9999999	063	-------etc.-----	
--------------59	014	--------19999999	064	--99999999999999	126
--------------69	015	------etc.-----		-199999999999999	127
--------------79	016	--------99999999	072	-------etc.-----	
--------------89	017	-------199999999	073	-999999999999999	135
--------------99	018	------etc.-----		1999999999999999	136
-------------199	019	-------999999999	081	-------etc.-----	
-------etc.-------		------1999999999	082	9999999999999999	144

TEST I: Tests General Machine Operation

Control Panel Wiring: Wire control panel as shown in Figure 1.
Feeds: One deck of 144 cards in each feed unit.

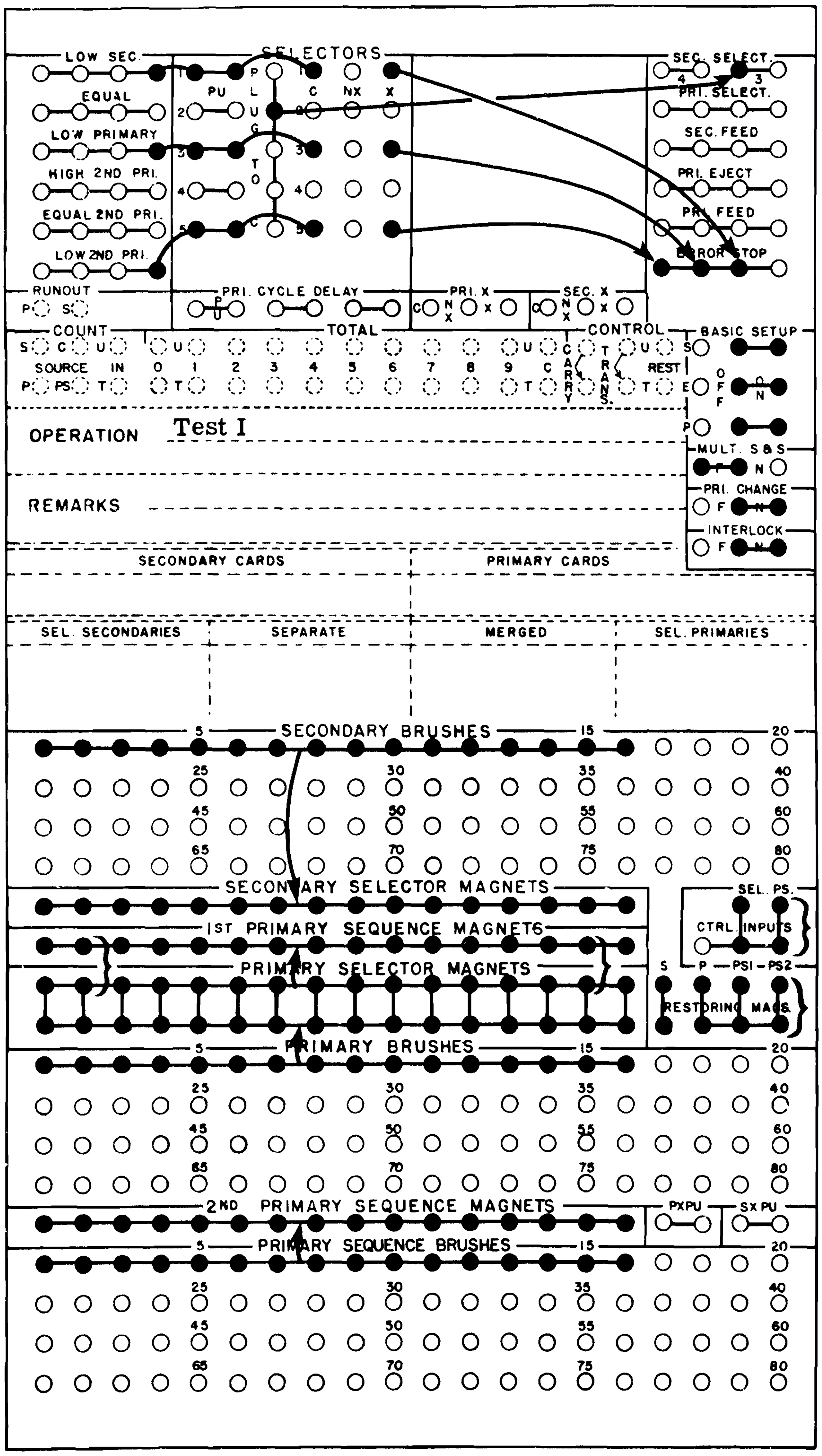

Figure 1

Run-in: Primary feed should take three cycles, and the secondary two. This tests the card lever circuits to the clutches.

Since the decks are matched, after the first three machine cycles the selector unit should have an equal reading and the sequence unit a high 2nd primary.

Note: *The error stop is used to stop the machine on an unequal reading in the selector unit or low 2nd primary in sequence unit.*

This tests the feeds for correct feeding, the brushes for proper reading; the setup magnets, selector contacts, and stop pawls for proper operation. In case any of the above are in error the machine will stop with the erroneous reading in the units.

Check the selector unit for an equal reading and the sequence unit for a high 2nd primary. The unit which does not satisfy this condition is the the unit in error. During this test, both feeds should run continuously. This tests the clutch pawls for "pulling out" during the cycle. If either clutch pulls out during a feed cycle, an erroneous reading will enter the selector unit and the error stop will function to stop the machine. If this happens, the last card in the secondary select pocket 3 and the merge pocket will not match. When test has been run satisfactorily, remove the "Plug to C" to "Sec. select #3" and merge these two groups.

TEST II: Tests Primary Feed Clutch for Latching and Unlatching

Control Panel Wiring: Functional plugging as shown in Figure 2. Brush wiring same as previous test.

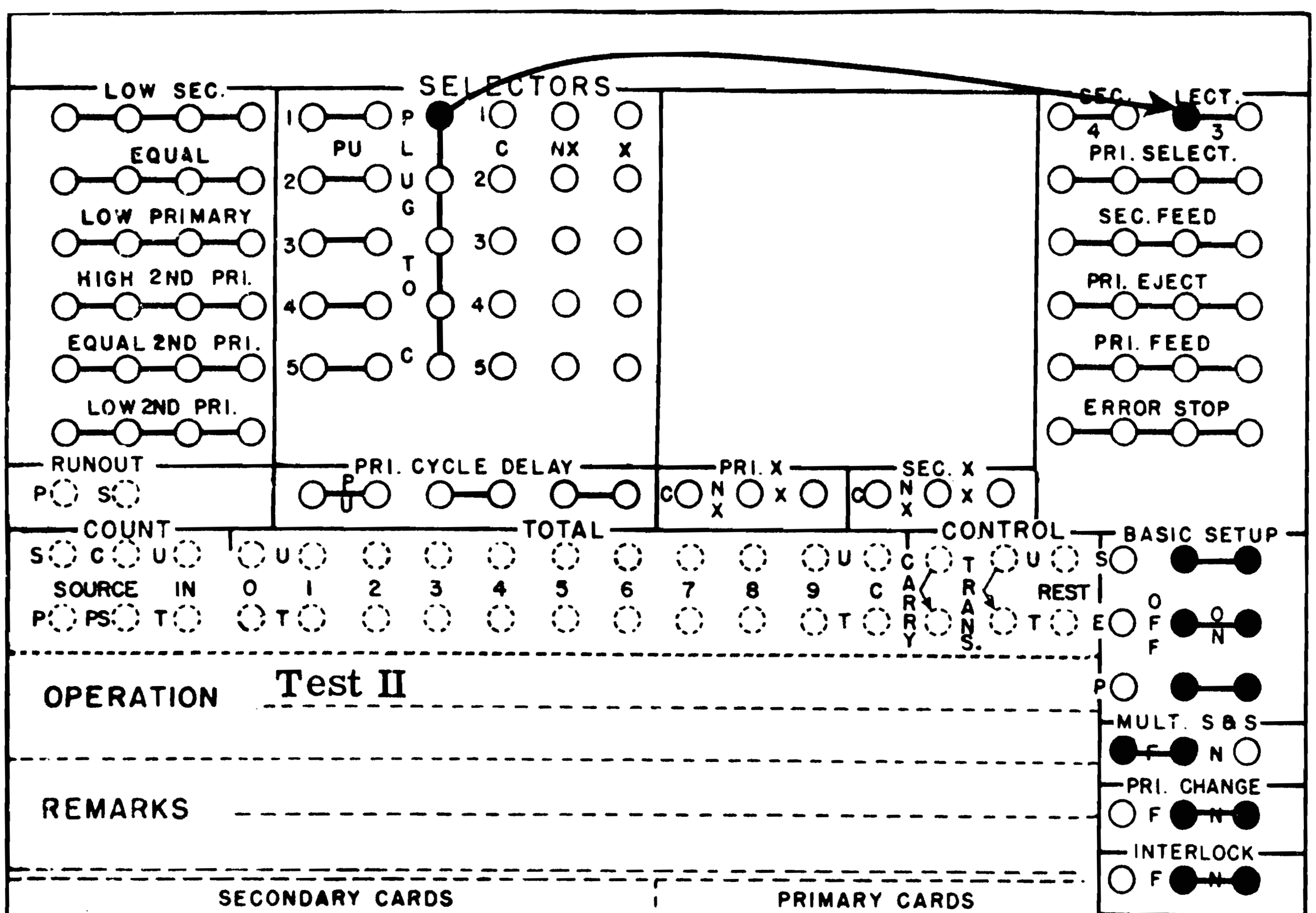

Figure 2

Feed Units: Single deck in primary; double deck (merged) in secondary. After the run-in, watch the feed clutches. Primary should operate every other cycle, secondary should operate every cycle. On one cycle the conditions will be selector unit equal with sequence unit high 2nd primary, and on the following cycle selector unit low secondary. These conditions will alternate.

Perform this test a second time, with M. S. & S. ON. After the three run-in cycles the secondary clutch will operate for two cycles, the primary for one cycle, secondary for two cycles, primary for one cycle, etc. The primary eject clutch will operate continuously.

This also tests the selector unit for equal and low primary readings and the sequence unit for a high 2nd primary, tests restoring bails of sequence and selector units for latching up, and tests feed clutches for latching and unlatching.

TEST III: Tests Secondary Feed Clutch for Latching Up

Control Panel Wiring: Brush wiring as Test I. Functional plugging as shown in Figure 3.

Feed Units: Double deck (merged) in primary, and single deck in secondary. After the run-in, primary feed clutch should operate every cycle, secondary every other cycle.

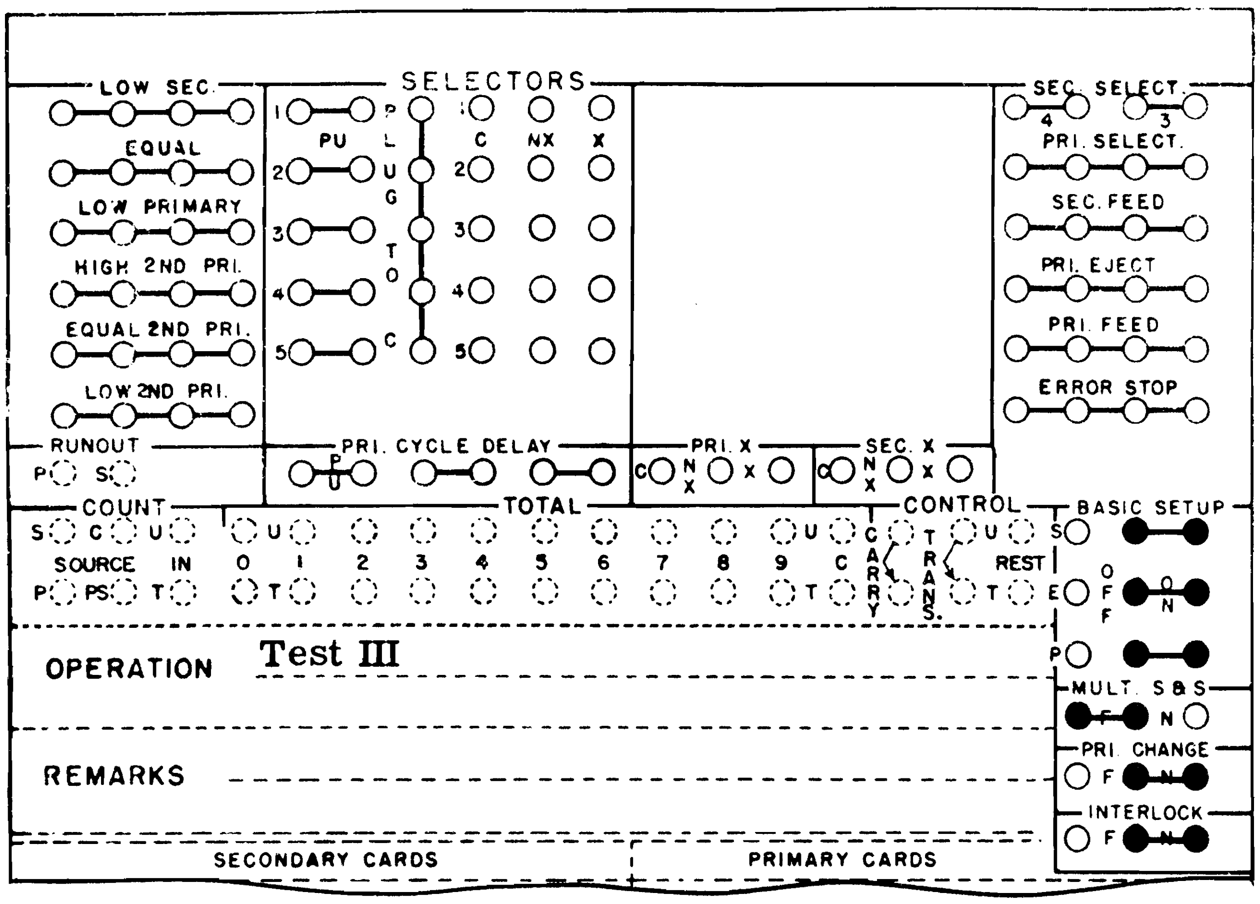

Figure 3

TEST IV: Tests Pri Select Magnet for operation and Latching Up Pri Cycle Delay unit for pickup and dropout

Control Panel Wiring: Brush wiring same as previous tests. Functional wiring as shown in Figure 4.

Feeds: Double deck (merged) in primary; single deck in secondary. After the run-in, the primary feed clutch should operate every cycle; the secondary, every other cycle. Every other primary card should be selected.

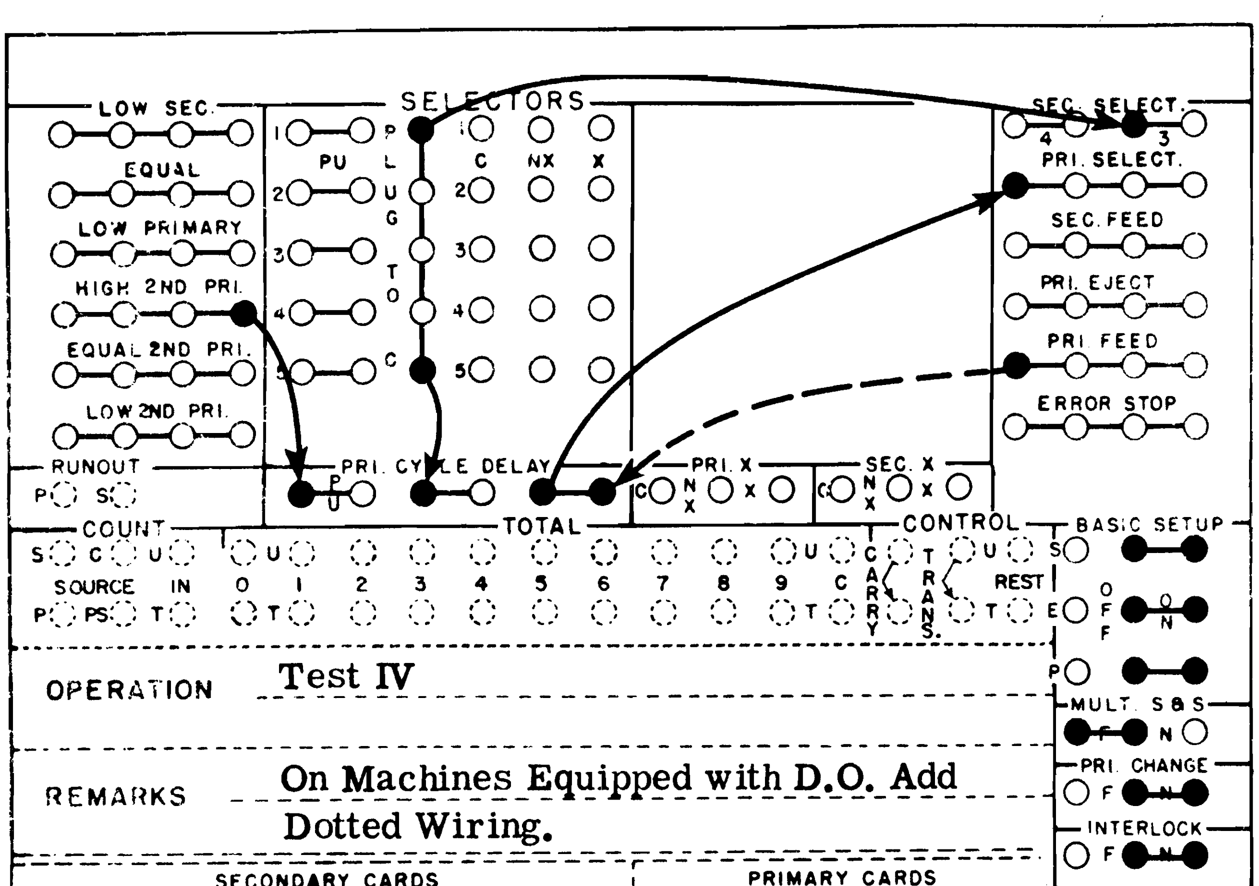

Figure 4

The primary cards selected, therefore, constitute one complete test deck of 144 cards. These cards can be matched with another 144 card deck by machine, or checked visually. (After this test two decks should be merged for next test.)

TEST V: Tests Secondary Select Magnet 4

Control Panel Wiring: Brush wiring same as previous tests. Functional wiring as shown in Figure 5.

Feeds: Single deck in primary; double deck (merged) in secondary. After the run-in, the primary should operate every other cycle; secondary should operate every cycle. Every other secondary card should be selected. Watch Sec. Pocket #4, or check cards after operation has been completed. Cards in pocket 4 should constitute one deck of 144 cards.

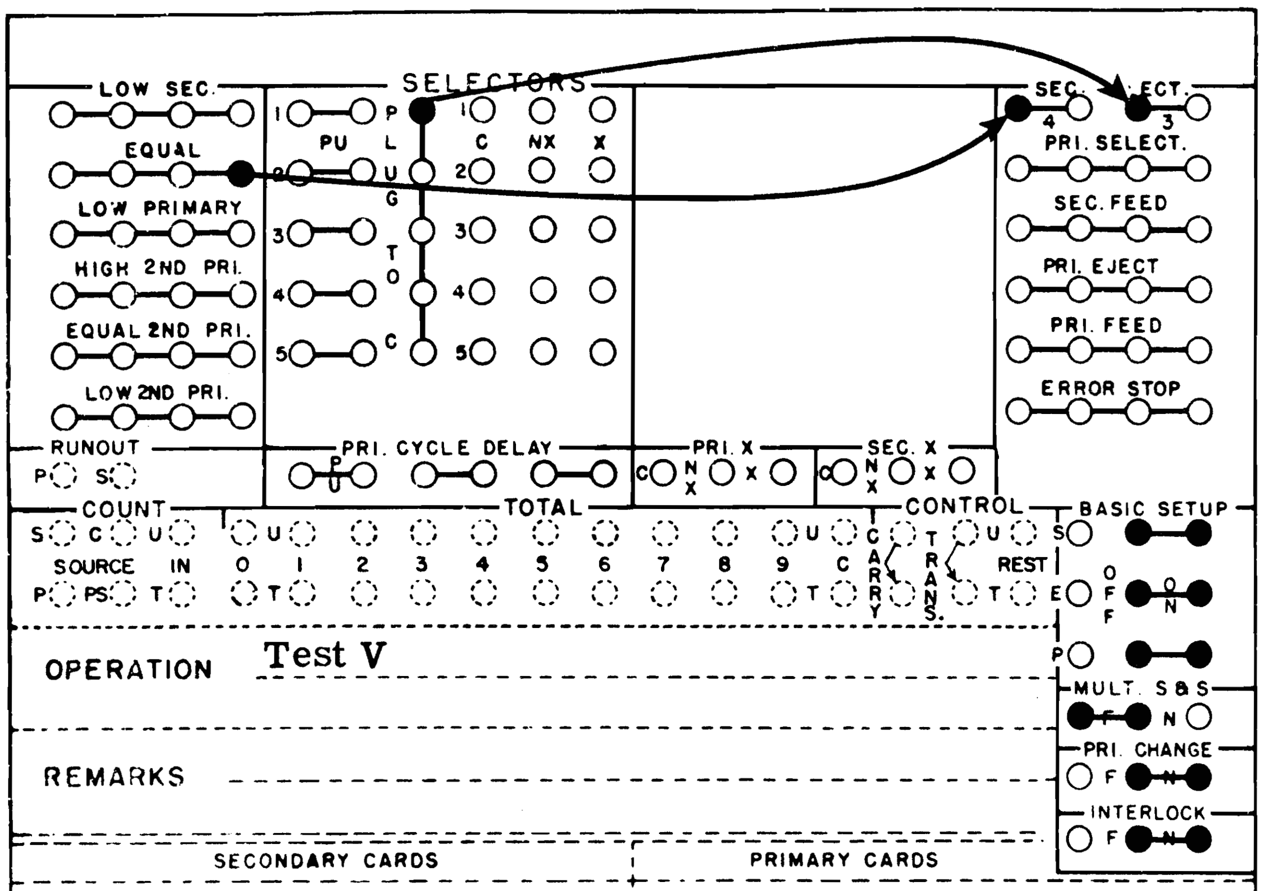

Figure 5

TEST VI: Tests Low Primary, Low Secondary, and operation of Select Magnets

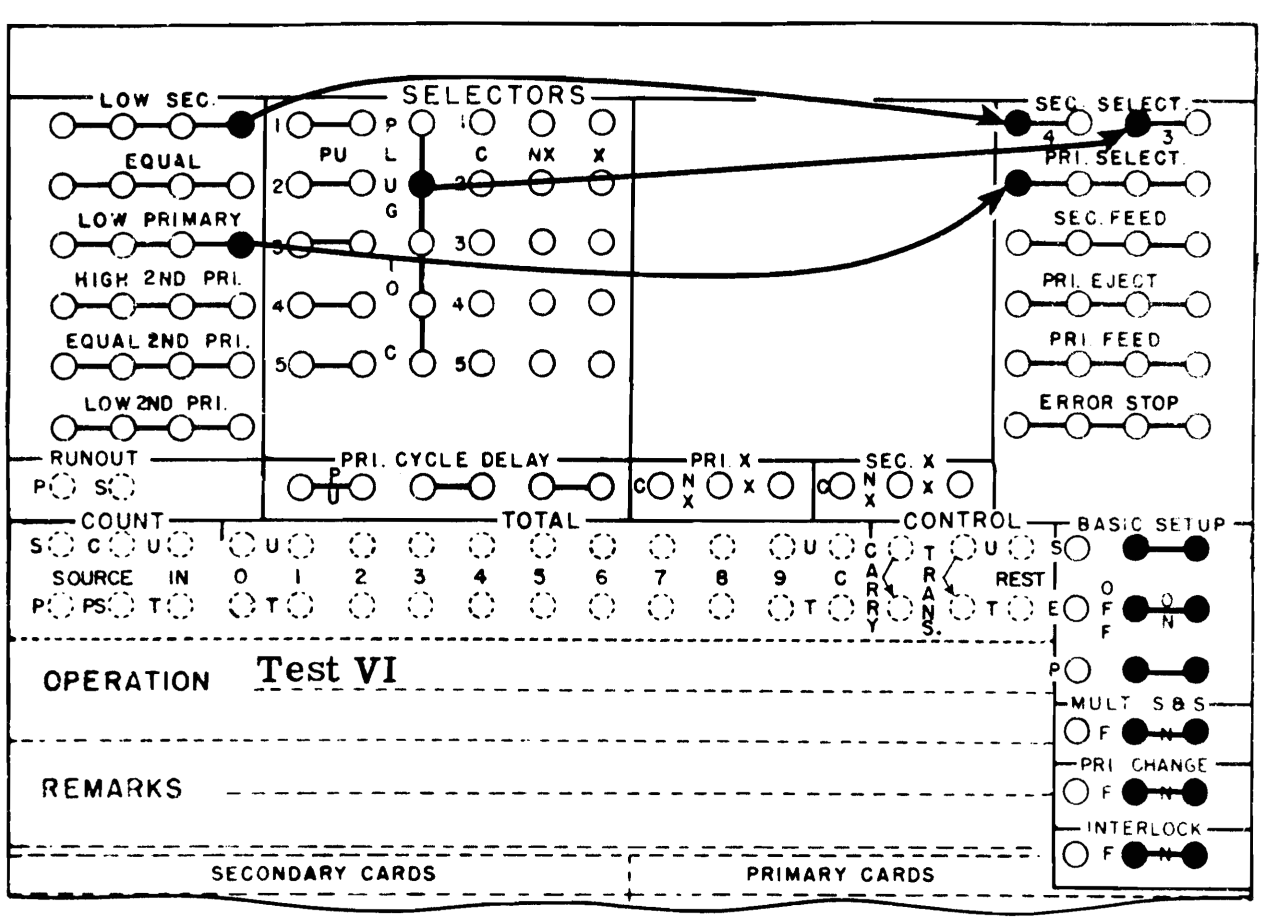

Figure 6

Control Panel Wiring: Brush wiring as shown in previous tests. Functional plugging as shown in Figure 6.

Feed Units: In primary, single deck with cards 4, 9, 27, 56, 68, 109 removed. Secondary, single deck with cards removed for 7, 13, 30, 59, 64, 88. (These numbers correspond to punching columns 78, 79, 80.) Check for correct selection of unmatched cards. If operation is satisfactory, cards may be filed in their correct positions by hand.

TEST VII

A — Tests: Primary Cycle Delay Unit.

Control Panel Wiring: Brushes wired same as in previous tests. Functional plugging shows in Figure 7.

Feeds: Single deck in primary feed. Every other primary card is selected. (Keep cards separated for next part of test.)

B — Tests: For complete swing from Low Primary to Low Secondary on alternate cycles.

Control Panel Wiring: Brush wiring same as for previous test. Functional plugging—basic setup switches on. Remove all others.

Feeds: One half of deck in primary, other half in secondary. (Odd numbered cards, primary, even numbered cards, secondary). Primary and secondary feed alternately.

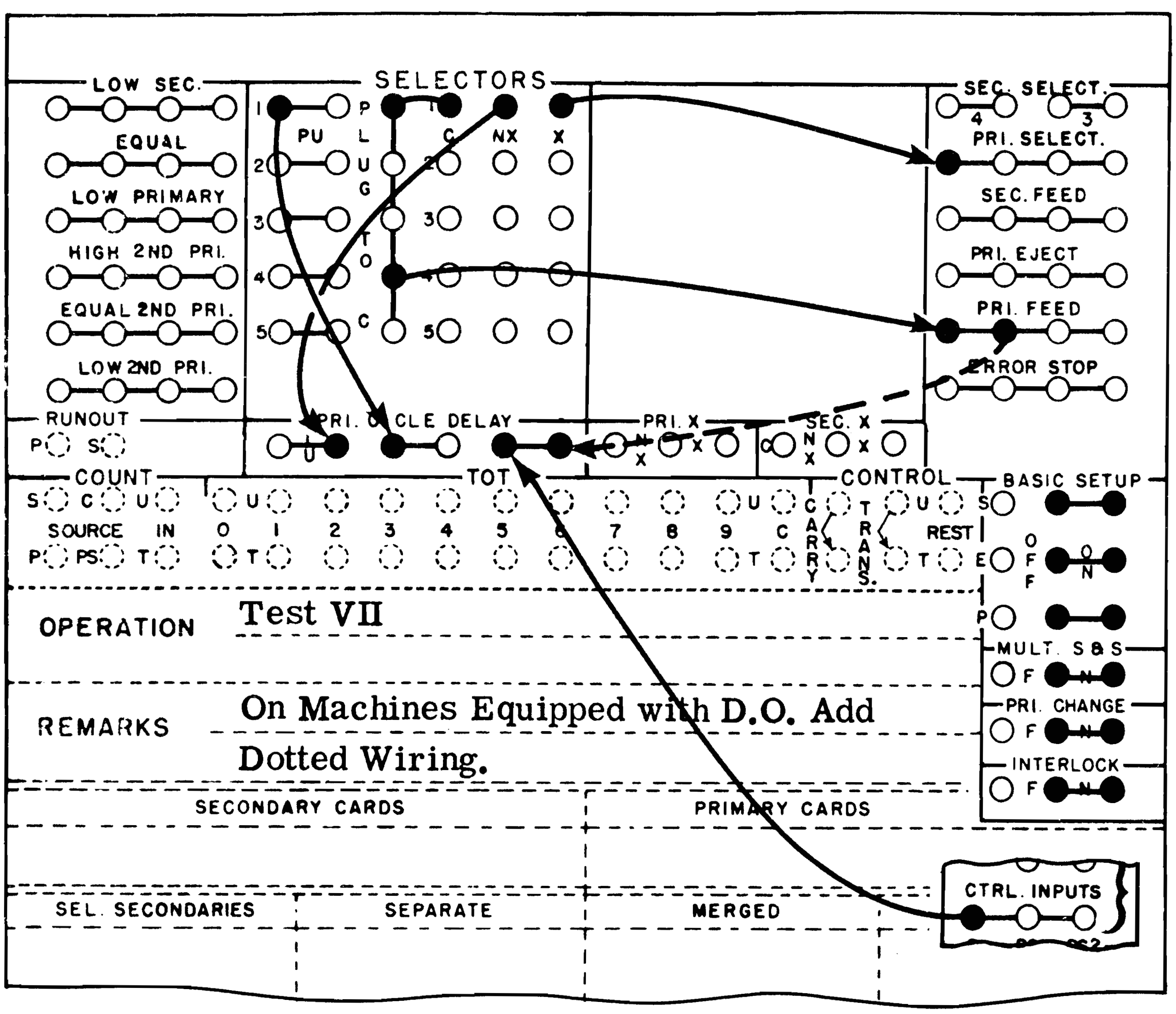

Figure 7

TEST VIII: Tests Low Second Primary and Error Light

Control Panel Wiring: Wire as shown in Figure 8.

Feeds: Reverse the sequence of some of the cards and run in primary feed. Watch for red light at every step down in sequence.

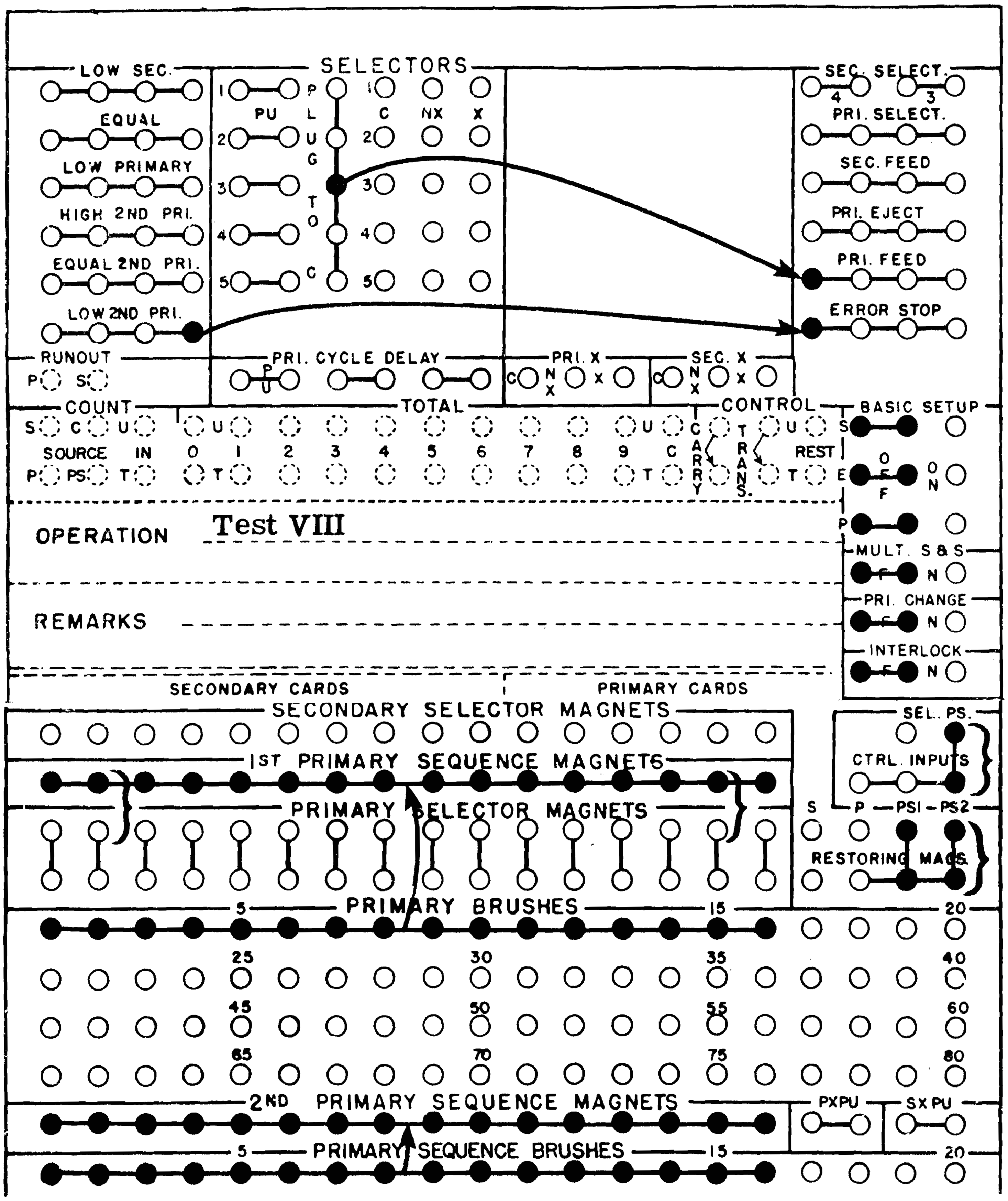

Figure 8

TEST IX: Tests X-Selectors

Control Panel Wiring: Wiring as shown in Figure 9 with secondary brush #60 wired to sec. X pickup and primary brush #60 wired to Pri X pickup.

Feed Units: Place one deck in primary feed and one deck in secondary feed. All X-60 cards should be selected.

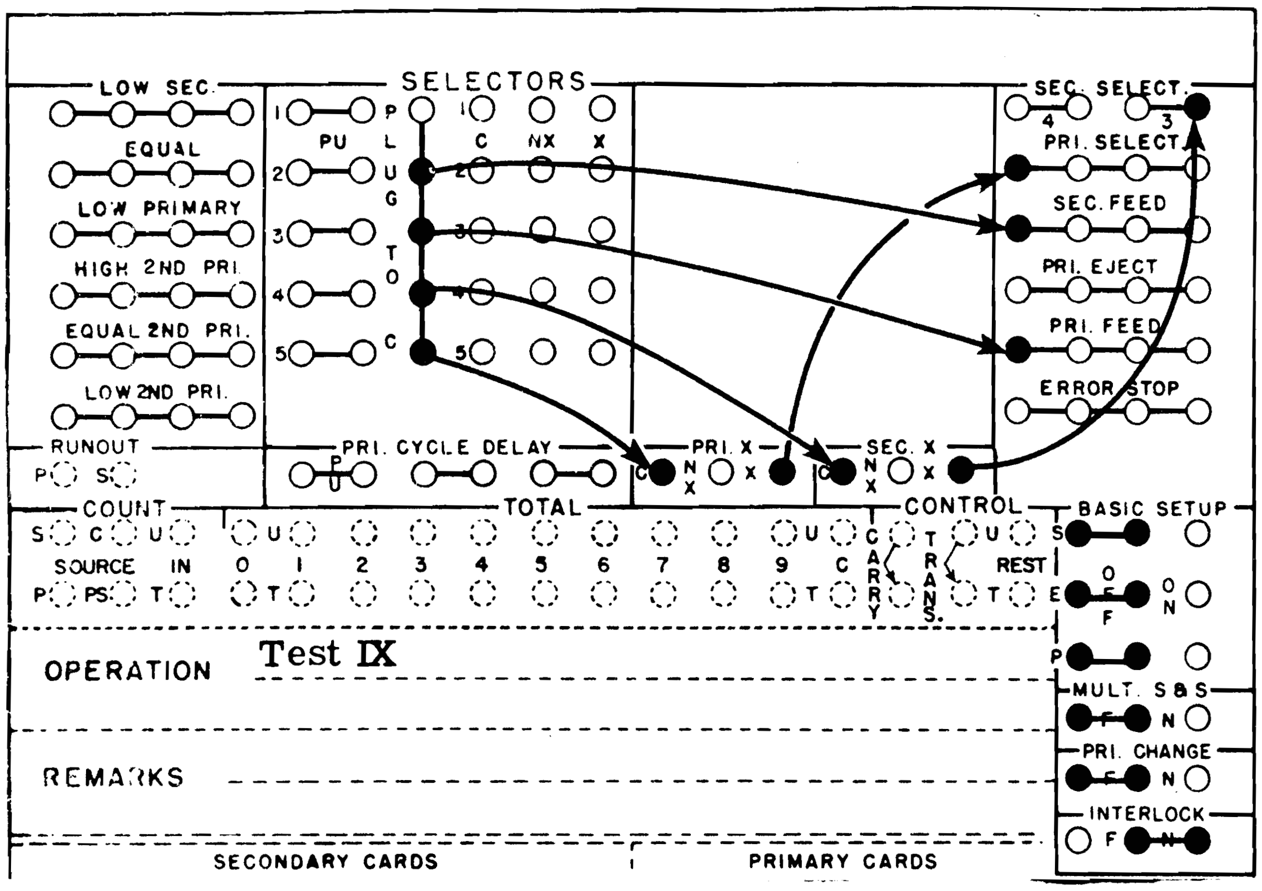

Figure 9

TEST X: Tests operation of the 5 Selectors

Control Panel Wiring: Wire as shown in Figure 10.

Feed Units: Place any cards in the primary feed. After the run-in, cards should continue feeding.

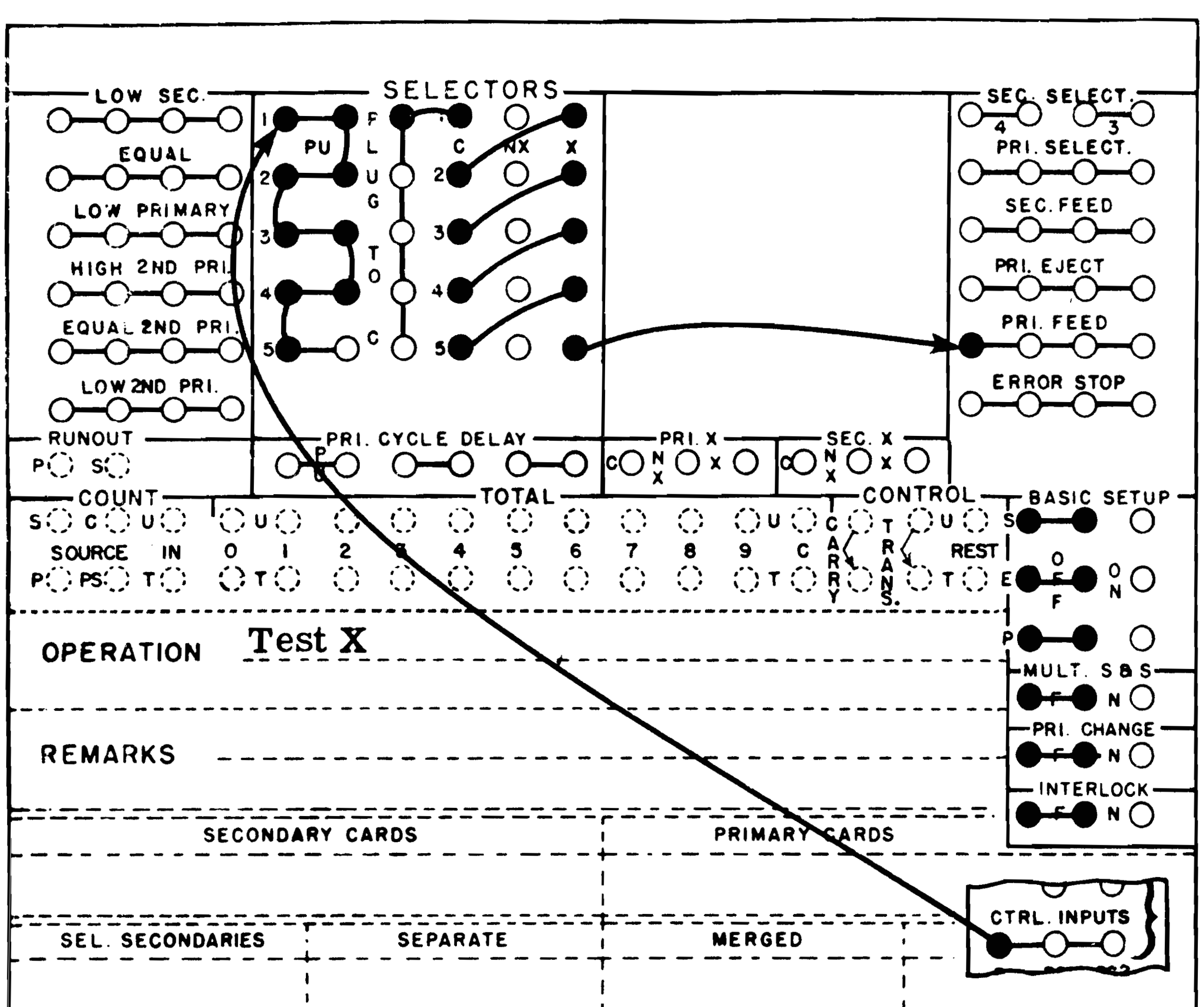

Figure 10