IBM FE Supplement

System/Unit 29 Card Punch

Re: Form No. 223-2926-1, -2

This Supplement No. S23-4065

Date August 15, 1969

Previous Supplement Nos. S23-4046 (applies to -1)

Field Engineering Theory-Maintenance Manual
IBM 29 Card Punch Features/IBM 29 Interpreting Card Punch, Model C

Pages to be inserted and/or removed are:

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Preface
i, ii
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A change to the text or a small change to an illustration is indicated by a vertical line to the left of the change; a changed or added illustration is denoted by the symbol • to the left of the caption.

Summary of Amendments

Additional reference material is given in the Preface. Technical corrections have been made to Chapters 1, 3, 4, 9, 11, 12 and Appendix A. Additional installation and operational check procedures are given in Chapter 12.

File this cover letter at the back of the manual to provide a record of changes.

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IBM Field Engineering

Theory-Maintenance

29 Card Punch Features

29 Interpreting Card Punch, Model C

223-2926-2

Form 223-2926-2
FES S23-4065

Preface

This theory-maintenance manual provides information necessary for comprehension and maintenance of the IBM 29 Interpreting Card Punch, Model C and the special features of the IBM 29 Card Punch, all models.

Information in this manual is limited to areas distinctive to the Model C and the special features. Prerequisite knowledge and part identification may be attained from the following IBM 29 Card Punch Manuals:

Field Engineering Theory of Operation, Form 225-3358

Field Engineering Maintenance Manual, Form 225-3357

Reference Manual, Form A24-3332

Illustrated Parts Catalog, Form 124-0085

This manual includes wiring diagrams for the Model C and the following special features:

Variable Length Feed
Interspersed Gangpunch
Auxiliary Duplication
High-Speed Skip
Character Inhibit
Master Card Insertion
Self-Checking Number, Modulus 10
Self-Checking Number, Modulus 11
Self-Checking Number Generator

The wiring diagrams included in this manual are for reference only and do not apply to all machines. Use the wiring diagram which accompanies a particular machine when servicing that machine.

Third Edition (July 1969)
This edition, 223-2926-2, is a reprint of 223-2926-1 incorporating changes released in the following FE Supplement:

Form Number	*Date*
S23-4046	October 30, 1967

This edition does not obsolete previous editions. Specifications herein are continually subject to change. Any changes will be reported in subsequent revisions or FE Supplements.

This manual has been prepared by the IBM Systems Development Division, Product Publications, Dept. B96, PO Box 390, Poughkeepsie, N. Y. 12602. A form is provided at the back of this publication for the reader's comments. If the form has been removed, comments may be sent to the above address.

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Contents

Safety Procedures

Safety cannot be overemphasized. To insure personal safety and the safety of co-workers, each customer engineer should make it an everyday practice to observe safety precautions at all times. All customer engineers should be familiar with the general safety practices and procedures for performing artificial respiration that are outlined in IBM Form 229-1264.

Always use a reliable voltmeter to verify that power is actually off after using power off switches. Although all power supplies are provided with bleeder resistors to drain off capacitor charges when power is dropped, it is wise to check all capacitors with a meter before attempting maintenance. A defective bleeder resistor could create an unexpected hazard.

The Model C uses a ferro-resonant power supply capable of developing a potential of several hundred volts. Extreme caution should be practiced when working in this area.

To prevent injury when checking friction torque, assure that starwheels are raised. Energizing of the High-Speed Skip clutch through the program circuits creates driving force, similar to direct gear driving force, throughout the entire escapement gear train.

Theory of Operation

- **The Variable-Length Feed allows the processing of 51-, 60-, 66-, and 80-column cards.**
- **The operator controls the conversion of the machine from one card length to another.**
- **Only one length of card may be processed at one time.**

Figure 1-1 shows the Variable-Length Feed feature on an IBM 29 Card Punch. With this feature, the operator can set the machine to process any one of four different card lengths. This conversion is made by changing settings of the feed hopper guide, card pusher, stacker stop, and the timing of program-cam contact 1 (PCC1).

An IBM with the Variable-Length Feed feature has the following modifications:

1. Additions to the feed hopper and card-feed mechanism.
2. New registration assembly.
3. Additions to the card transport.
4. Additions to the program assembly.
5. Additions to the stacker assembly.
6. Additions to the electrical system.

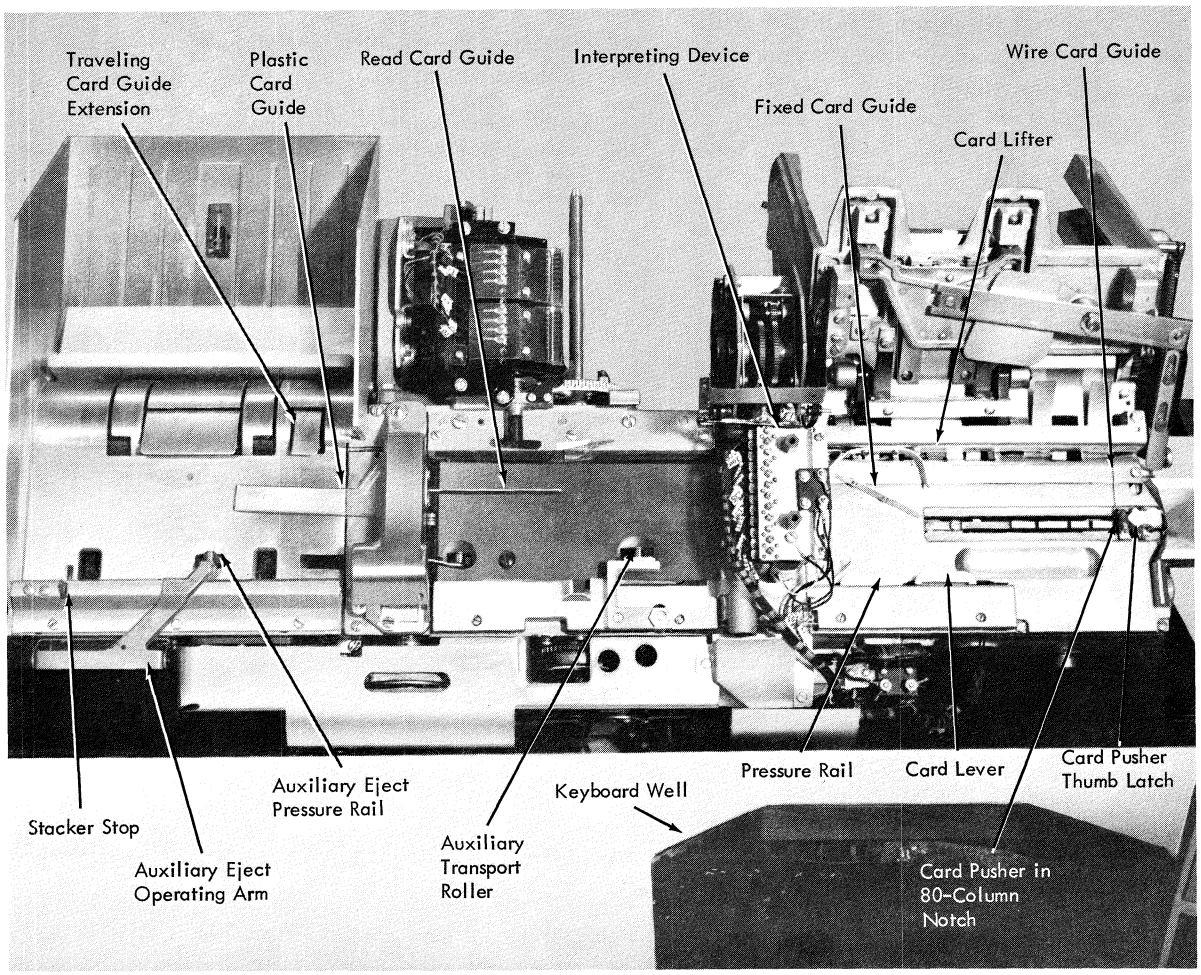


Figure 1-1. Variable-Length Feed Feature (on the IBM 29 Model C)

Introduction

- **Program-card preparation is the same for cards of all lengths.**
- **Field definition must *not* be punched beyond the last column of the particular short cards that are being processed.**
- **Operator instructions on converting from one card length to another are inside the program-drum cover.**

Program Control

Program cards must be punched, starting at column 1 only, with the number of columns in the cards to be processed. However, if the machine is equipped with a high-speed skip feature, high-speed skip can be programmed beyond the number of columns in the cards being processed to obtain the maximum benefits of this feature. Otherwise, program-card preparation is the same as for 80-column cards.

Knobs in the column-indicator control program-cam extensions for skipping from card to card (Figure 1-2). Use care, in installing the program drum, to guide the locating pin into the hole in the column indicator without damage to the knobs. It may be necessary to move the clamping-strip handle slightly to aid the installation.

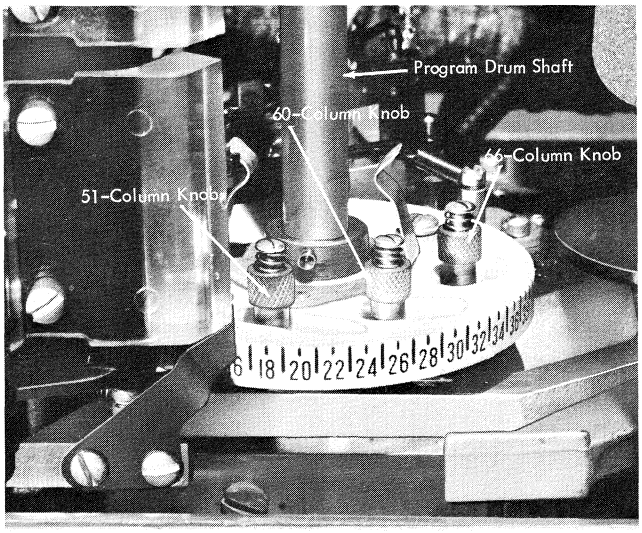


Figure 1-2. Program-Cam Extension Knobs (80-Column Setting)

Machine Settings

The operator can easily make all settings to change card lengths but only one length of card may be processed at one time. For each length of card there is a card guide, which is raised on the hopper bed to form a right-hand guide. The operator performs these preliminary steps to process each length of card:

1. Select the proper card guide in the hopper and lift it forward into position. For any selected card length, all card guides for cards of shorter length must rest in the hopper bed. Note that the 80-column card guide is fixed at the right side of the hopper. The sliding pressure plate in the hopper is notched to pass over the raised card guides.

2. Lift the thumb latch and move the card pusher to the proper card-column notch. A spring guides each card under the card pusher for correct feeding position.

3. Align 51- and 60-column cards to the stacker drum by pulling the stacker stop operating lever toward the front of the machine. For 66- or 80-column cards, push the lever back.

4. The following settings are necessary whether or not a program drum is used. To set program-cam extension knobs, lift the program-drum cover forward and turn the program-control lever to raise the program-drum starwheels. Space to column 16 on the column indicator and turn off the main switch. Remove the program drum.

Caution: These program-cam extension knobs are interlocked and will bind if moved in any sequence but the one given here. To adjust the knobs, lift them out of their countersunk recesses and move in this sequence:

a. To change to a longer card, move each knob in ascending numeric sequence to the countersunk recess at the left end of each slot. For example, to change from 51-column cards to 80-column cards, first move the 51-column knob, then the 60-column knob, and then the 66-column knob.

b. To change to a shorter card, move each knob in descending numeric sequence to the countersunk recess at the right end of each slot. For example, to change from 80-column cards to 51-column cards, first move the 66-column knob to the right, then the 60-column knob, and then the 51-column knob.

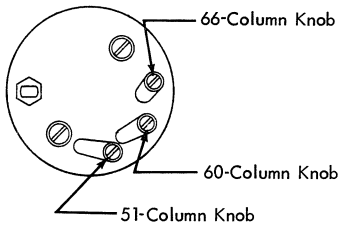
Abbreviated instructions for preparing the machine for each card length are shown in Figure 1-3.

Backspace

Backspacing may not be used in or through the 16th column from the end of the card. Backspacing in this area would interfere with a card in the pre-registered position.

Manual Insertion of a Card

Manual card insertion for detail-station registration is possible for all four card lengths. For correct registration, move the card to the right against the registration pusher.



HOPPER
For 51-, 60-, 66-column cards, lift left, center, or right card guide in hopper bed, respectively.
PUNCHING STATIONS BED
Lift card pusher and position securely in desired notch. Left to right, the notches correspond to 51-, 60-, 66-, and 80-column cards respectively.
STACKER BED
For 51- and 60-column cards, move card stop in stacker bed to raised position.
PROGRAM DRUM
To set program assembly for length of card:
1. Turn program control lever off.
2. Space to column 16.
3. Turn main line power switch off.
4. Remove program drum.
5. Position knobs on column indicator by lifting and moving full length of slots:
   80-column cards - All knobs to left.
   66-column cards - Knob 66 only to right.
   60-column cards - Knobs 60 and 66 only to right.
   51-column cards - All knobs to right.

Always move knobs in sequence (66-column knob, 60-column knob, 51-column knob) for shorter card setting. For longer cards, move knobs in reverse sequence.

Figure 1-3. Instructions

Functional Units

- **Three movable guides are added to the hopper.**
- **The card pusher has four different positions to accommodate the different card sizes.**
- **The detail card lever is located at the detail right pressure rail.**
- **Two auxiliary transport rolls are added.**
- **The eject station has a movable stop to be used for 51- or 60-column cards only.**
- **Three program-cam extensions control automatic skipping from the last column of a short card to column 1 of the program drum.**

Feed Hopper

Regardless of length, all cards are aligned to the left side of the hopper. Alignment is maintained by one of three hopper guides that is in an elevated position. Normally, preselect a guide by lifting the rear edge. The guides correspond to 51-, 60-, and 66-column card feeding (Figure 1-4).

To handle both short and long cards, the feed knives and feed rolls are located more to the left, and positioned closer together than on standard hoppers. Three aligner fingers and two curved guides are added to the right end of the card guide.

Card Registration

The registration assembly and detail station are changed considerably. A sliding registration device replaces the arc-motion pusher arm. The mechanism consists of a notched bar mounted in guides and driven by the pusher arm. The card pusher is carried on the bar and latched in one of the notches. The position of the pusher can be changed by the operator for the correct card length. The notches are used for 51-, 60-, 66-, and 80-column cards (Figure 1-4).

Beneath the bar is the gripper plunger rod. When the pusher registers a card, the plunger is moved a short distance, causing the pusher to grip the card. Registration and the amount of gripping action are adjustable. They are not changed by the removal of the detail-station bed plate (Figure 1-5).

A wire card guide, mounted to the card pusher, replaces the pusher-hood plate and guides the card under the pusher gripper.

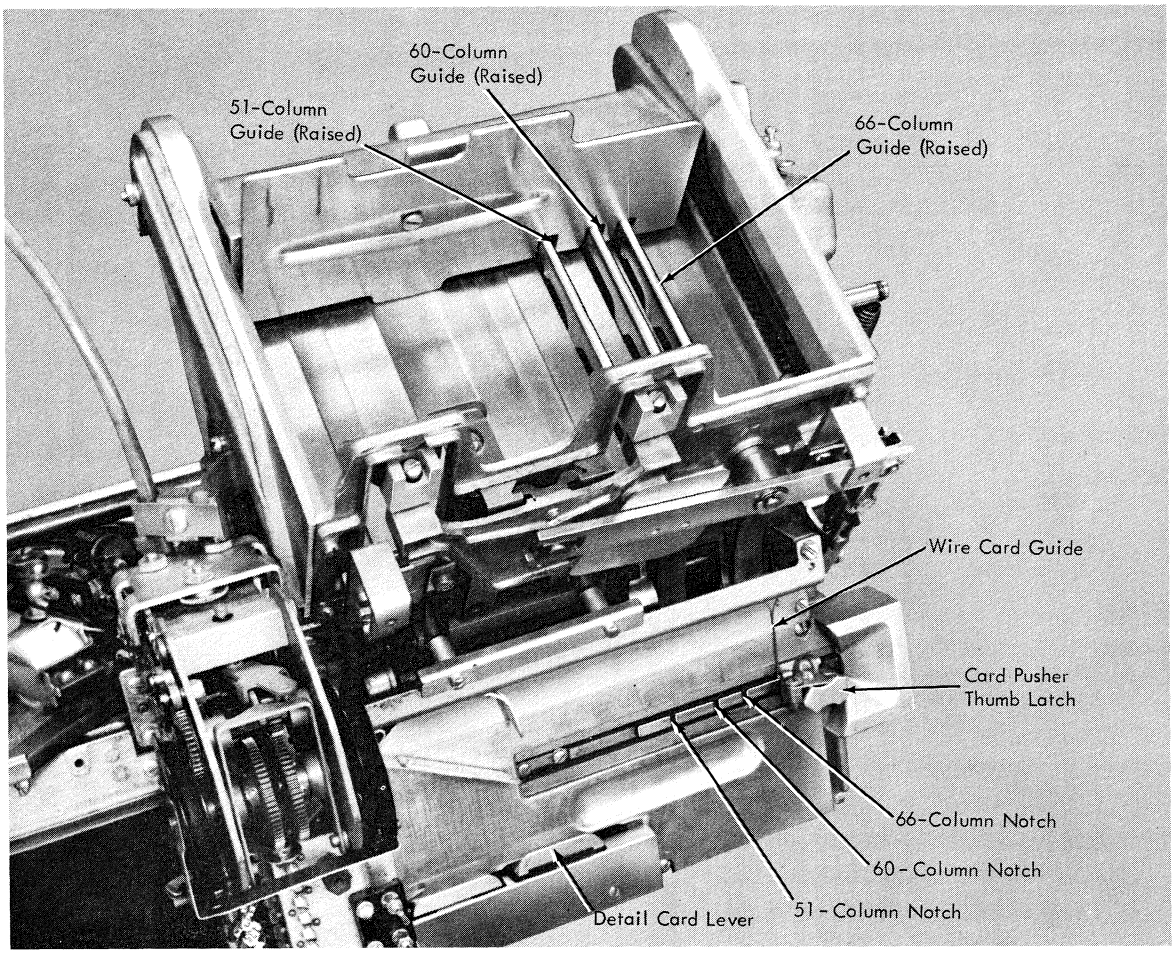


Figure 1-4. Hopper and Detail Station

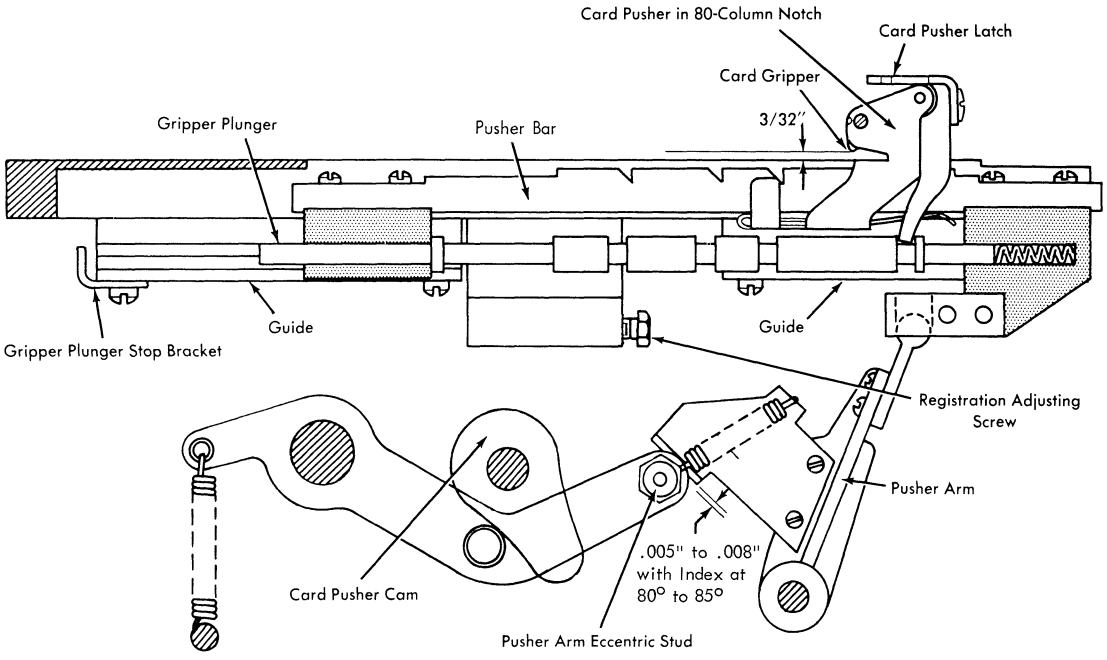


Figure 1-5. Card-Pusher Registration Assembly

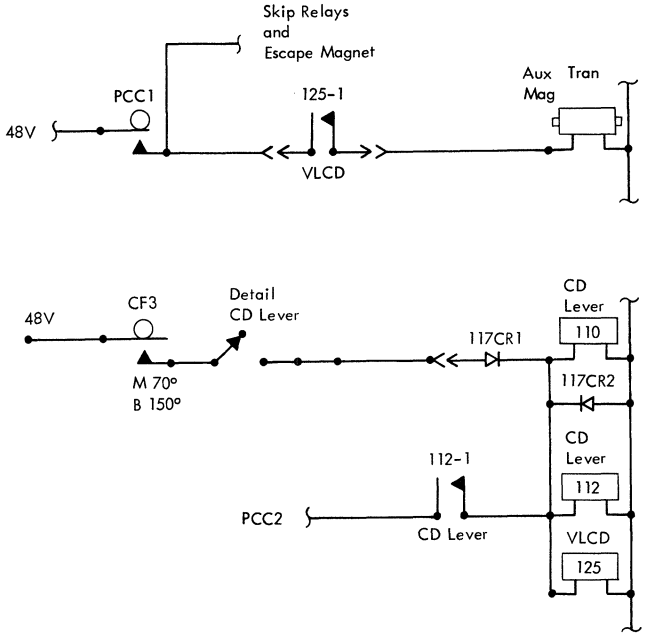


Figure 1-9. Variable-Length Feed Schematic (Reed Relay)

Circuit Objectives (Wire-Contact Relay)

Figure 1-10 is a schematic and is not intended as a point-to-point wiring diagram.

To transfer PCC1 when the end of a short card is reached and to skip the card to the read station via the auxiliary-transport mechanism:

1. Pick skip relay. PCC1.
2. Energize escape magnet. PCC1.
3. Pick variable-length feed (VLCD) relay. CF4
4. Hold VLCD relay. PCC2.
5. Energize AUX TRANS MAG. VLCD 48-4.PCC1.
6. Drop AUX TRANS MAG. PCC1 breaks 88-1/3.

Maintenance

The variable-length card device processes 51-, 60-, 66-, and 80-column cards. The following modifications are made to the standard machine:

1. Three movable guides are added to the hopper.
2. The card pusher has four different positions to accommodate the different-length cards.
3. The stacker has a movable stop to be used for 51- or 60-column cards only.
4. Program cam 1 has three movable extensions for short cards.
5. Two auxiliary transport rolls are added.

Adjustments

This section describes procedures peculiar to the variable-length feed; items common to all feeds are shown in Field Engineering Maintenance Manual, *IBM 29 Card Punch*, Form 225-3357.

Pusher Card Guide

Form the spring next to its mounting screw for the following conditions:

1. Spring guide should be at right angle to the pusher.
2. Mounting end of guide should clear punch bed plate by $\frac{1}{32}$"; other end should clear by $\frac{1}{16}$".

Card-Registration Assembly

1. Adjust guides so that the pusher bar moves freely without excessive play (Figure 1-5).
2. Mount the registration assembly on the machine with the pusher arm engaged in its socket and the bed plate to the left, against a machined stop.
3. Pusher bar must have free motion throughout its entire travel.
4. Form the card gripper so that it is $\frac{3}{32}$" above the pusher block and, when moved against the block, it makes contact squarely.
5. With pusher-arm eccentric stud backed away, position the registration-adjusting screw for correct registration by using a card of any length.
6. Set card-feed index at 60° to 65° and adjust the pusher-arm eccentric stud for 0.005" to 0.008" clearance to the pusher arm.

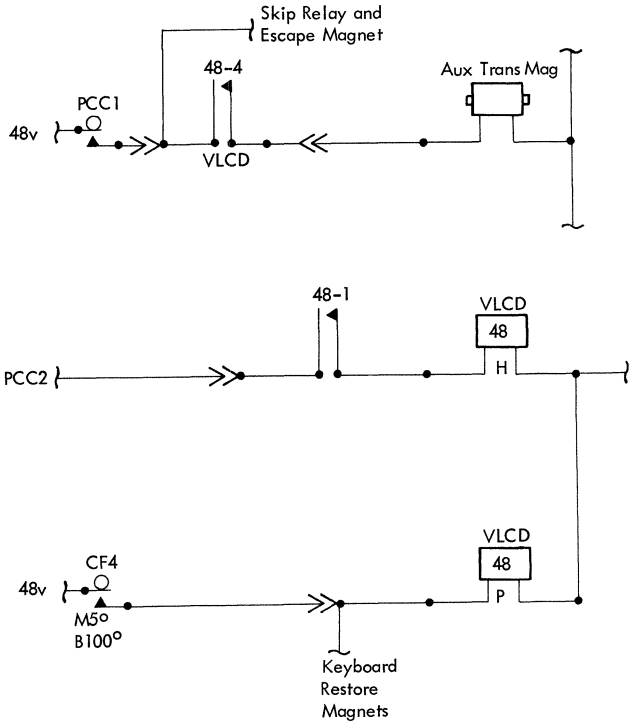


Figure 1-10. Variable-Length Feed Schematic (Wire-Contact Relay)

7. Adjust the gripper-plunger travel (by moving its stop bracket) to grip a card at registration position so that 100 grams (±25 grams) are required to pull it free. When making this adjustment, check to be sure that the plunger is positioned to the extreme left. The entire assembly may then be removed and replaced without affecting registration.

Program-Cam Contacts

These contacts are timed to standard adjustments. The 51-, 60-, and 66-column cam extensions are carried by the 81st-column cam, and require no further timing adjustments.

Pressure Rolls

Feed wheels at punch station are to be open 0.035″ to 0.040″ when the cam roller is on the high point of the cam. Feed wheels at master station are to be open 0.025″ to 0.030″ at the same time. The method of adjustment is same for standard machines.

Eject Unit

With the card-stop cam roller on the high point of the cam, the register and eject rolls should exert 250 grams to 325 grams pressure on the feed rolls. See "Pressure Rolls."

Detail-Station Card-Lever Contact

The right pressure rail operates the detail-station card-lever contact.

1. With the card lever assembly removed from the machine and the stationary strap straight, the contact should have 0.015″ to 0.020″ air gap (Figure 1-10). Make the adjustment with the assembly held at 45° angle (same angle at which it rests in the machine).

2. The stationary strap must be adjusted so that, with force of 23 grams to 27 grams applied at the center of the lip on the rail, the contacts are closed with a minimum deflection of 0.025″.

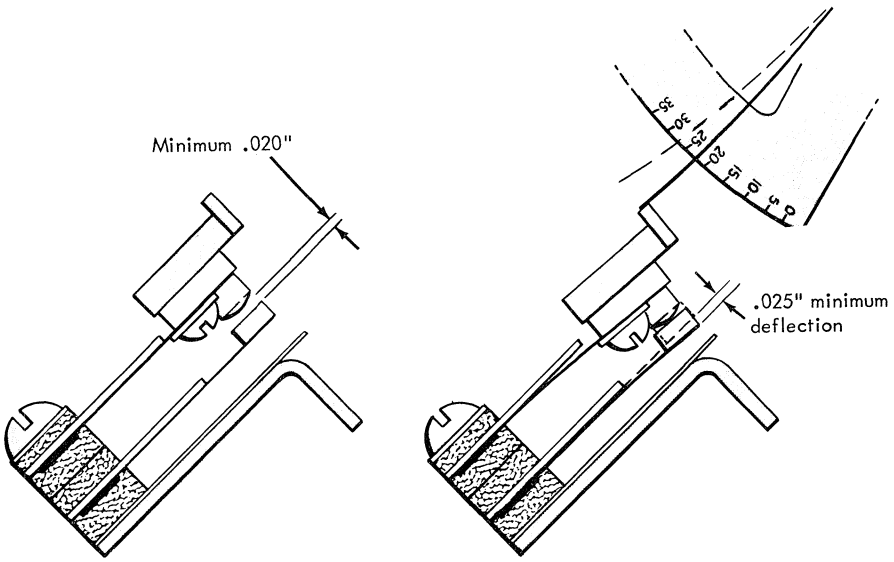


Figure 1-11. Detail-Station Card-Lever Contact

Auxiliary Eject Pressure Roll

Form the auxiliary eject operating arm where it passes over the stacker card guide to allow 0.015″ to 0.020″ clearance between the pressure roll and its feed roll (Figure 1-7). This adjustment must be made when the cam follower is on high dwell.

Auxiliary Eject Feed Roll (Continuously Running)

Adjust the auxiliary eject roll flush with the stacker bed surface by positioning the roll shaft bracket (Figure 1-7). Bracket is mounted to front of main base casting by two screws. During adjustment, maintain slight (but not excessive) backlash to the drive gears.

Auxiliary Eject Cam

Adjust the auxiliary eject cam to cause auxiliary eject pressure roll to contact the continuously running roll at 4° to 8° on the index. Screws that position the cam are accessible through the slot in the stacker plate to the left of the stacker drum.

Auxiliary Transport Mechanism

The auxiliary transport housing (Figure 1-6) should pivot freely on the program shaft.

1. Shim the magnet to obtain armature-to-core clearance of 0.004″ to 0.008″, with the armature seated against the yoke (Figure 1-12).
2. Position the idler roll 0.009″ to 0.012″ above the read-station bed plate by moving the idler-roll mounting plate (Figure 1-13).
3. Adjust the two armature stop screws to allow armature travel of 0.008″ to 0.010″, measured between the yoke and each armature end (Figure 1-12).
4. Move the magnet assembly up or down on the mounting bracket to obtain 0.014″ to 0.017″ clearance between the feed roll and its idler roll (Figure 1-13).
5. Recheck the armature adjustment.
6. Position the idler-roll bracket over the feed roll so that it does not skew a card when the auxiliary transport magnet operates.

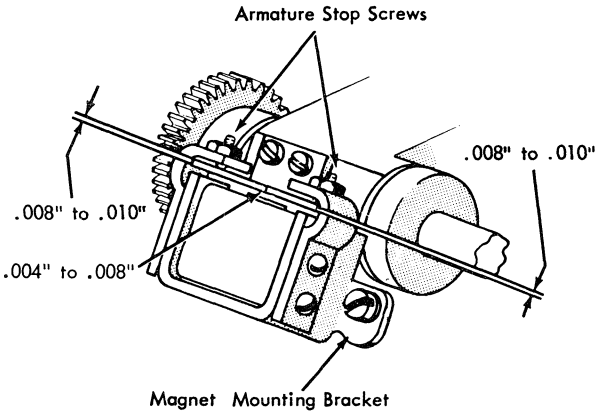


Figure 1-12. Auxiliary Transport Adjustment

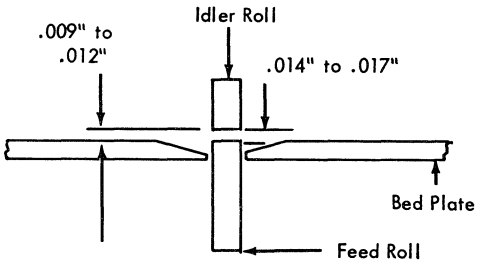


Figure 1-13. Auxiliary Feed and Idler Roll Adjustment

Chapter 3. Auxiliary Duplication Feature

Theory of Operation

- **This feature permits duplicating information from a master card rather than from the card at the reading station.**
- **A separate drum unit (auxiliary drum) holds the master card and is controlled from the keyboard by the auxiliary-duplicate (AUX-DUP) key.**
- **The field to be duplicated from the master card to the detail card is defined in the program card.**

The master card information is punched into the auxiliary-drum card and fastened around an auxiliary drum. The auxiliary drum is inserted in the machine on a spindle that is located in back of the program drum and driven in step with the program drum. The auxiliary-drum starwheels must be raised and lowered when the auxiliary drum is inserted or removed.

The AUX-DUP key on the keyboard starts auxiliary duplication, which continues under the control of the field-definition punches in the program card. The punches in the auxiliary duplicating card are read one column ahead of the detail card by starwheels similar to the program starwheels. The master information in the auxiliary-drum card must be in the same columns defined for duplication by the program card.

Auxiliary duplication is useful when:

1. Common information is required for certain cards but not for others.
2. Major-minor duplicating is performed.
3. Prepunched master cards are inserted.

In major-minor duplicating, the major data can be dropped when:

1. The AUTO-SKIP-DUP switch is turned off for a change of information in the minor field.
2. Prepunched master cards are used. Any information common to all cards (such as date) is dropped when a new master card is inserted.

In either case, the master information can be punched in the first detail card of each group, with one key depression and without reference to a source document.

Functional Units

- **The auxiliary duplication drum shaft is driven by the escapement gear train under control of the escapement mechanism.**
- **A starwheel sensing unit reads the information from the master card attached to the auxiliary drum to energize the interposer magnets.**

The auxiliary duplication sensing assembly can be factory- or field-installed on the underside of the base unit. The gears are meshed so that column 1 of the auxiliary duplication drum will coincide with column 1 of the standard program drum. The auxiliary starwheel timing is adjusted the same as for starwheel timing on the standard program drum.

On reed-relay machines, a four-position reed relay is added to location 130 on the circuit for this feature. The additional wiring and circuits are shown on the replacement page for sections 1 and 2 of the machine wiring diagram.

Relay 49 is added to wire-contact relay machines. The additional feature wiring diagram shows the associated circuits affecting sections 1 and 2 of the basic wiring diagram.

Principles of Operation

- **The AUX-DUP key starts the operation.**
- **Programmed: The field-definition code continues the operation to the end of the field.**
- **Unprogrammed: The AUX-DUP key must be pressed and released for each cycle of operation.**

Description

Pressing the auxiliary duplication key closes its latch contact and provides +48 volts to energize the aux-dup relay and the dup 1 and dup 2 relays. With program control, a hold for the aux-dup relay is provided by the same circuit for dup 1 and dup 2 relays to the field-definition starwheels. The common line to the read station pin contacts is opened, and the common line to the auxiliary duplicating contacts is closed.

The operation is similar to an automatic duplication operation except that the interposer magnets are energized from the sensing of holes punched in the master card on the auxiliary drum instead of the sensing of holes punched in the master card at the read station. The field-definition starwheel contacts on the program drum continue the auxiliary duplication to the end of the field.

Without program control (for example, program starwheels raised), the AUX-DUP key must be pressed for each cycle of operation. The operation is similar to a manual duplication operation without program control.

Circuit Objectives (Reed Relay)

Figure 3-1 is a schematic and is not intended as a point-to-point wiring diagram.

Programmed

1. Pick aux-dup relay and dup 1 and dup 2 relays. Aux-dup latch contact. Dup 2 is picked at P3 time of first punch cycle.
2. Hold aux-dup relay and dup 1 and dup 2 relays. Field definition.
3. Sense the auxiliary-drum card. 130-4 N/O. 120-1 N/O.
4. Energize keyboard restore magnets. 114-1 N/O.
5. Escape and punch cycles continue until the end of field definition.

Unprogrammed

1. Pick aux-dup relay and dup 1 relay. Aux-dup latch contact. Dup 2 is picked at P3 time of first punch cycle.
2. Hold aux-dup relay and dup 1 relay. P4 (175°-355°) or escape interlock N/C.
3. Pick and hold dup 2 relay. P3 (10°-60°). P4 (175°-355°) or escape interlock N/C.
4. Sense the aux-drum card. 120-1 N/O. 130-4 N/O. P5 (86°-166°).
5. Energize keyboard restore magnets. 114-1 N/O.
6. One escapement and two punch cycles result from each depression of the AUX-DUP key. Aux-dup latch contact.

Circuit Objectives (Wire-Contact Relay)

Figure 3-2 is a schematic and is not intended as a point-to-point wiring diagram.

Programmed

1. Pick aux-dup relay and dup 1 and dup 2 relays. Aux-dup latch contact. Dup 2 is picked at P3 time of first punch cycle. (Dup 3 cannot be picked.)
2. Hold aux-dup relay and dup 1 and dup 2 relays. Field definition.
3. Sense the auxiliary-drum card. 49-2 N/O. P5.
4. Energize keyboard restore magnets. 7-6 N/O.
5. Escape and punch cycles continue until the end of field definition.

Unprogrammed

1. Pick aux-dup relay and dup 1 relay. Aux-dup latch contact. Dup 2 is picked at P3 time of first punch cycle.

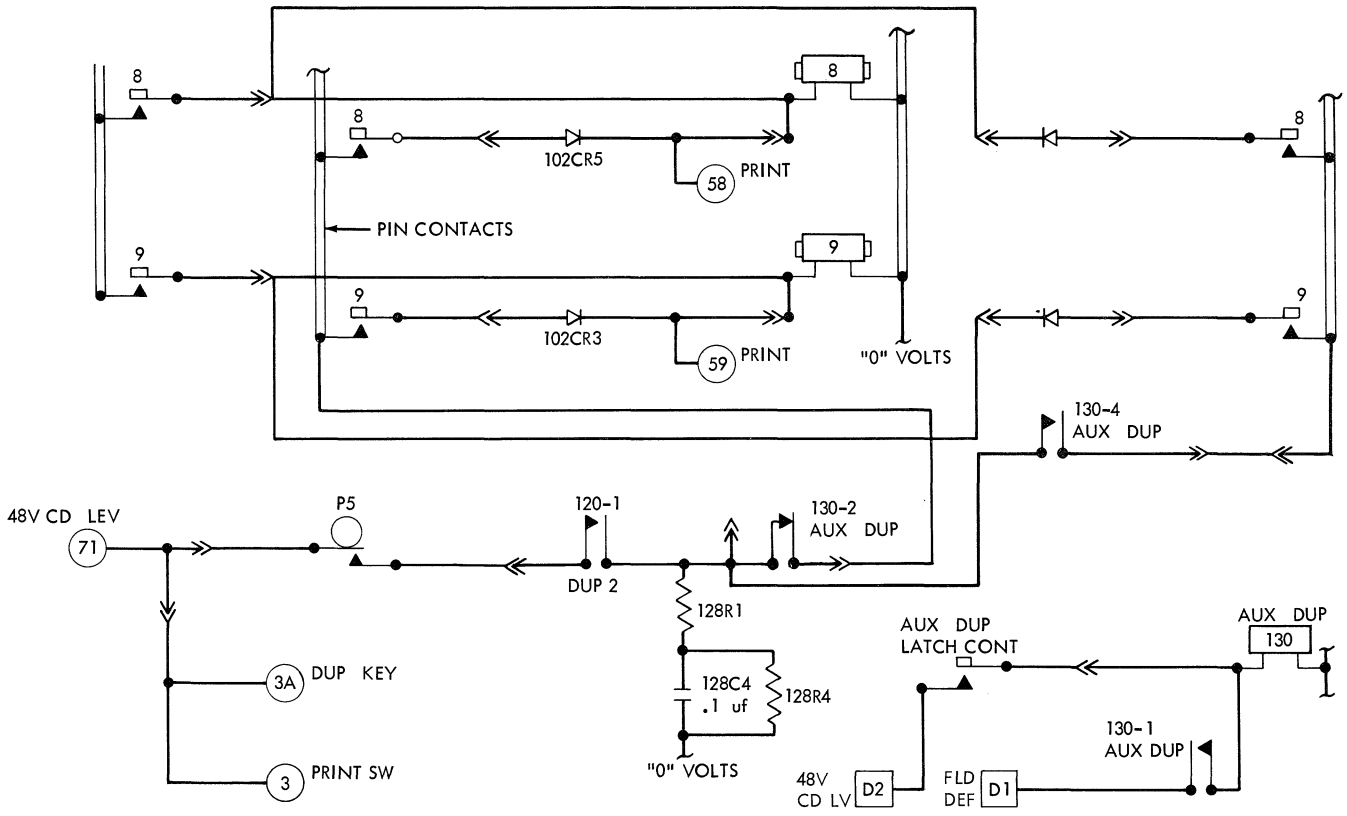


Figure 3-1. Auxiliary Duplication Schematic (Reed Relay)

2. Hold aux-dup relay and dup 1 relay. P4 (175°-355°) or escape interlock N/C.
3. Pick and hold dup 2 relay. P3 (5°-65°). P4 (175°-355°) or escape interlock N/C.
4. Sense the aux-drum card. 49-2 N/O. P5 (86°-166°).
5. Energize keyboard restore magnets. 7-6 N/O.
6. One escapement and two punch cycles result from each depression of the AUX-DUP key. Aux-dup latch contact.

Maintenance

Checks and Adjustments

Refer to Field Engineering Maintenance Manual, *IBM 29 Card Punch*, Form 225-3357, "Program Drum Unit." Adapt the basic procedure to the auxiliary unit.

Removal and Replacement

The auxiliary duplication sensing assembly must be timed to the program index.

1. Punch a card in column 1 and place it on the auxiliary drum.

2. With the program unit at column 1, install the auxiliary duplicate sensing unit so that the starwheels are reading column 1.

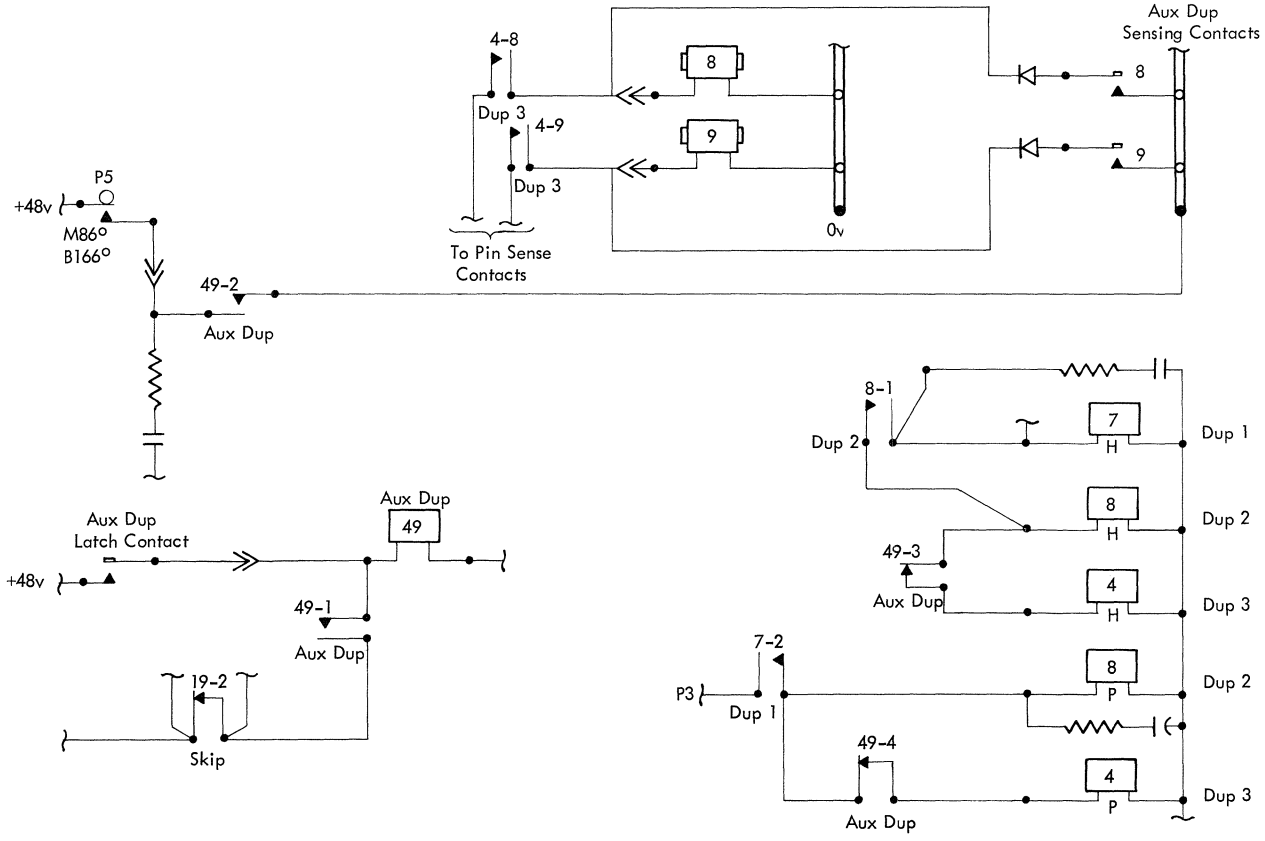


Figure 3-2. Auxiliary Duplication Schematic (Wire-Contact Relay)

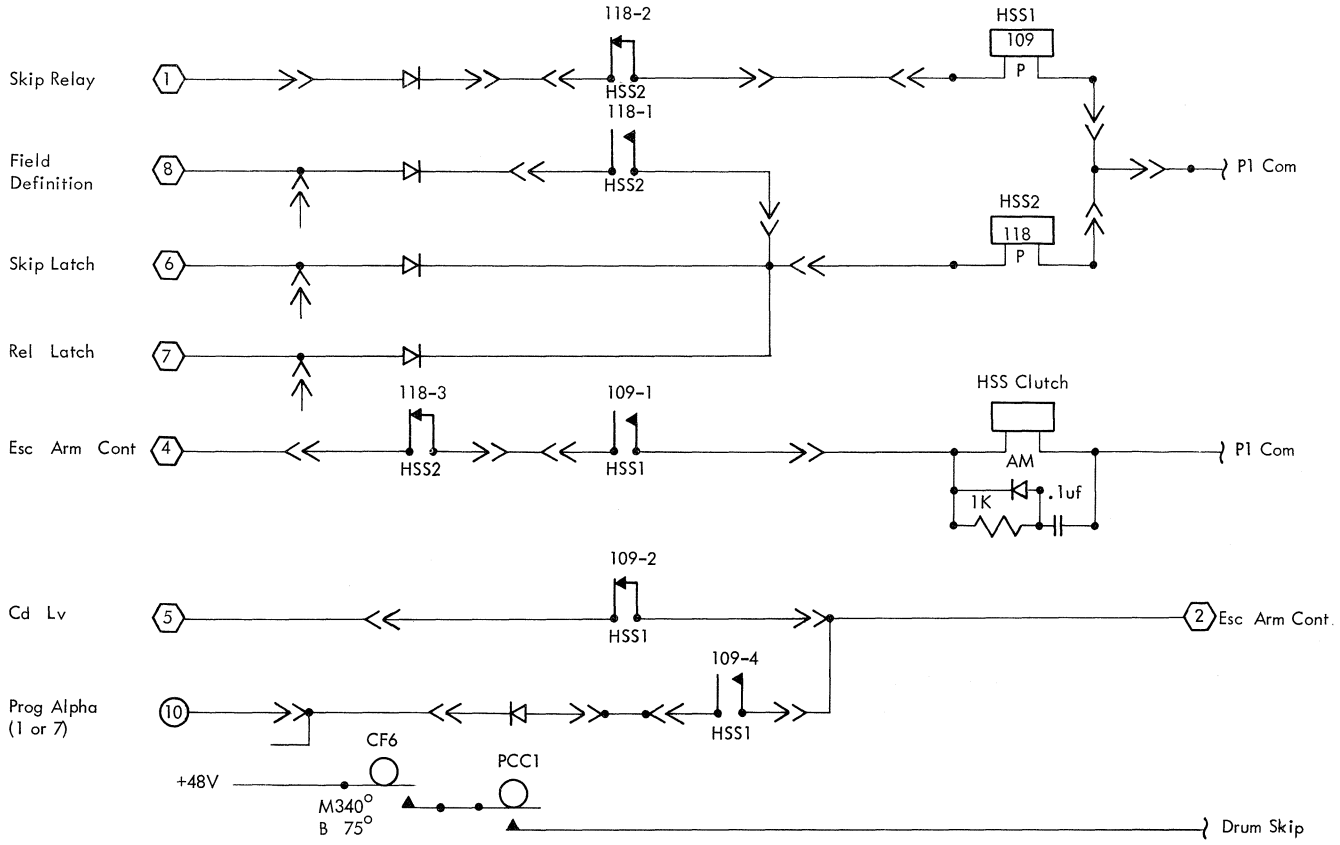


Figure 4-2. High-Speed Skip Schematic (Reed Relay)

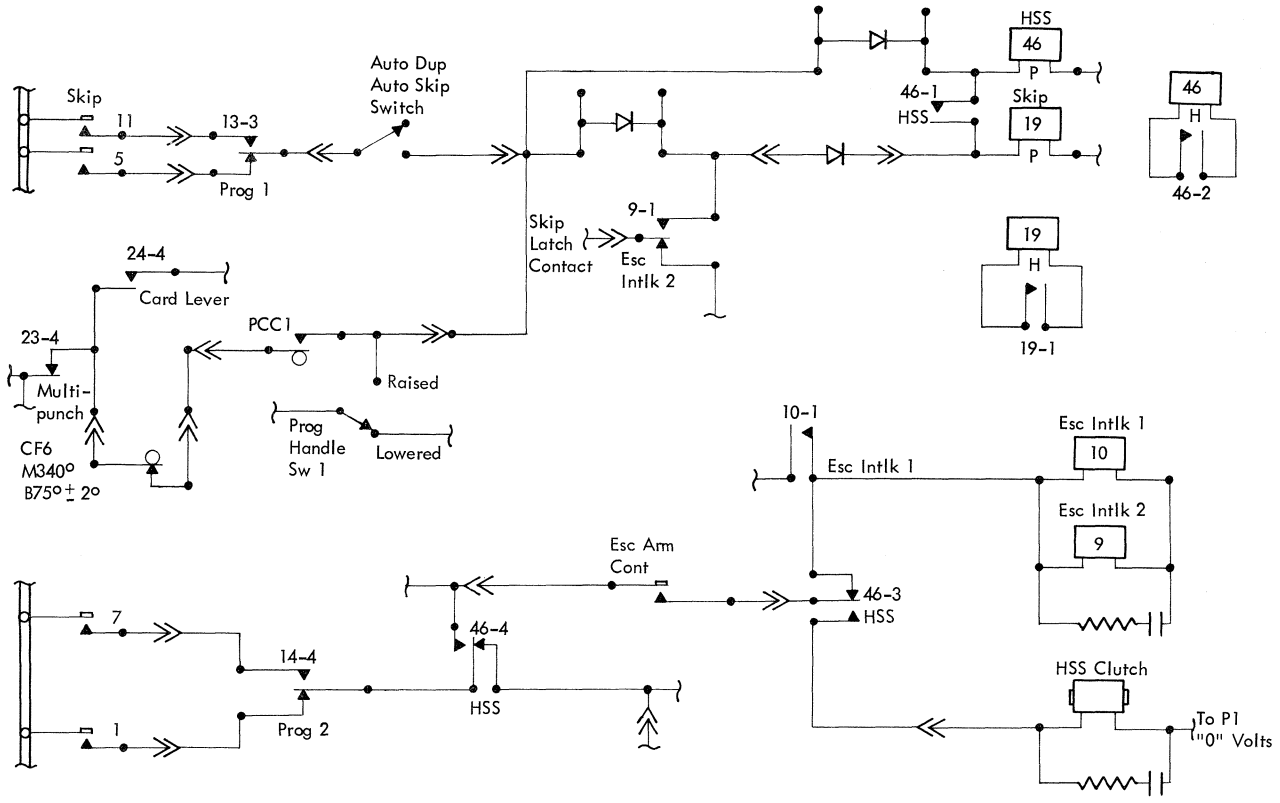


Figure 4-3. High-Speed Skip Schematic (Wire-Contact Relay)

Circuit Objectives

Figure 4-3 is a schematic and is not intended as a point-to-point wiring diagram.

During a programmed skip operation, energize the high-speed clutch and cause a high-speed skip:

1. Pick HSS relay. Same path as skip relay.
2. Switch escape magnet armature contact from escape interlock circuitry to HSS circuitry. 46-3 N/O. 46-4 N/O.
3. Energize HSS clutch. Escape armature contact. Starwheel 1 or 7.

Maintenance

Overlubrication of the clutch gear may allow grease to enter the clutch and cause torque failures.

DANGER

When you check the friction drive on a machine with the high-speed skip feature, be certain that the starwheels are raised. Otherwise there is a possibility of injury if the high-speed clutch picks, bypasses the friction-clutch drive, and turns the gears directly at high speed.

Adjustments

For stacker unit timing, refer to Field Engineering Maintenance Manual, Form 225-3357. Follow basic procedure, substituting 4⅛ inches for the standard dimension.

To adjust clutch armature clearance, the high-speed skip unit must be removed.

1. Remove large cog-belt drive pulley (Figure 4-1) and cog belt.
2. Remove the four mounting screws holding high-speed skip casting. These screws are accessible from the rear of the machine; lower right screw is behind high-speed skip clutch.
3. Drive taper pin on split yoke gear assembly.
4. Remove the four mounting screws on magnetic clutch housing.
5. Loosen setscrews in the two high-speed clutch shaft collars or hubs.
6. Pull high-speed clutch and shaft assembly out of casting. Split yoke gear assembly must be removed as high-speed clutch and shaft assembly is pulled out of casting. NOTE: Lower right high-speed casting mounting screw (step 2), which has been held in place by the clutch assembly, may fall out at this time.
7. Loosen allen setscrews (inside magnetic clutch housing) that hold clutch armature to shaft.
8. Adjust clutch armature to provide 0.010″ ±0.002″ clearance between armature and clutch. For this adjustment, use two feeler gages, one on each side of shaft. Tighten setscrews. When two feeler gages are not available, two IBM cards may be used.
9. Replace lower right casting screw. This screw cannot be inserted after high-speed clutch assembly is in place.
10. Push clutch and shaft assembly into casting. Place split yoke gear assembly on its shaft before clutch shaft is fully inserted. Assemble the two clutch shaft collars on shaft.
11. Replace pin in split yoke gear assembly.
12. Push clutch shaft into casting as far as possible. While holding shaft in this position, pull clutch shaft collar against bearing nearest clutch assembly, and tighten setscrews in collar.
13. Mount magnetic clutch housing loosely. Locate housing so that rotor does not touch housing at any point, and tighten housing screws. Clutch shaft should rotate freely after this adjustment.
14. Tighten clutch shaft collar farthest from clutch assembly to eliminate shaft end-play. Clutch shaft should turn freely without binding.
15. Replace high-speed skip casting assembly in machine. Be careful not to disturb pin sense unit wiring and punch drive unit wiring when installing high-speed skip casting to base. These wires are not accessible after high-speed skip casting is installed.
16. When reassembling high-speed-skip casting on machines equipped with auxiliary duplication, time the auxiliary duplication shaft to the program drum shaft.
17. Install large cog-belt drive gear and cog belt. Adjust belt tension for a slightly loose condition (a tight cog belt becomes noisy).

NOTE: The clutch face and rotor are factory run-in matched assemblies; replacement of these parts may require changing the complete unit.

Chapter 9. Card Insertion Feature

Theory of Operation

- **This feature permits the manual insertion of a card at the read station or in the hopper.**
- **The feature switch located on the keyboard switch panel selects the insert or stack mode of operation.**
- **The operation is initiated when the master card (MC) key is pressed after the last detail card is registered and before column 80 of that card.**

This feature simplifies the manual insertion of a master duplicating card in front of a group of cards to be punched, or the insertion of a blank or prepunched trailer card at the end of a group of punched cards.

Functional Units

A punch-station registration magnet is mounted on the base, to the right of the escapement magnet, and a latch is mounted on the pusher arm shaft (Figure 9-1). When the punch-station registration magnet is energized, its armature engages the latch to prevent the card pusher arm from moving the detail card into the punch station.

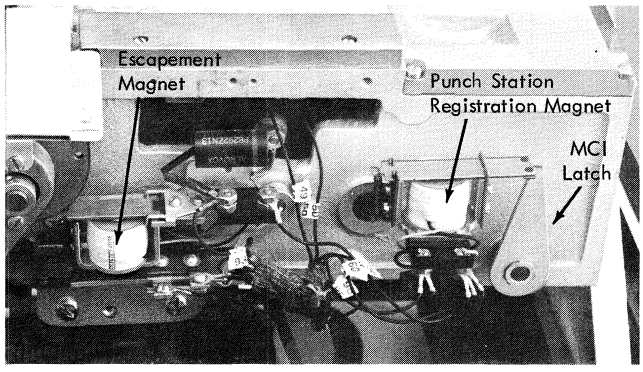


Figure 9-1. Master-Card Insertion

Principles of Operation

- **The *insert* operation consists of a register cycle, followed by a release cycle.**
- **The *stack* operation consists of a register cycle, followed by a release cycle, followed by a register cycle.**

When the master card switch is set on INSERT:

1. The card that was punched at the punch station releases through the master station and read station and stops in the eject (pre-stack) station.
2. A new master card can be manually inserted in the master station.
3. Press the feed key to: register the master card at the read station, register the detail card at the punch station, and feed a card from the hopper.

When the MC switch is set on STACK:

1. The card that was punched at the punch station is released through the master station and the read station and stacked. The card in the detail station is registered in the punch station, and a card is fed from the hopper.
2. A new master (trailer) card can be inserted manually behind the cards in the stacker.

Description (Reed Relay)

Wiring diagram replacement sheets for sections 5, 6, 7, and 8 accompany this feature.

Figure 9-2 shows the conditions that pick or activate the main operating components of the card-insertion feature.

Insert Operation

1. Set the card insertion switch to INSERT. The autofeed switch must be on.

2. After registering or while punching the last detail card preceding the master card to be inserted, press the MC (master card) key. The MC key must be pressed before column 80 is reached. The MCI key latch contact picks MCI relay 119. The 119-4 and 119-5 points transfer PCC2 N/O to the CF latch magnet during a card-to-card skip.

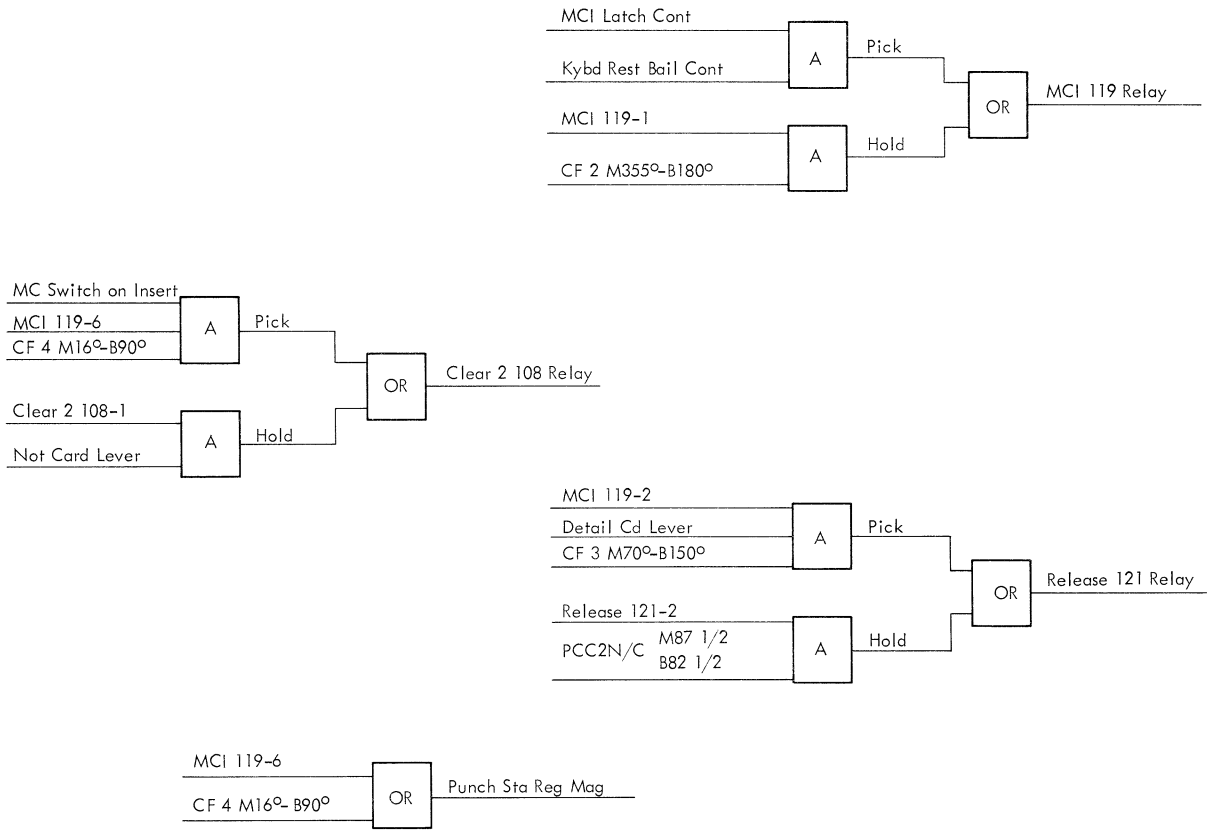


Figure 9-2. Master-Card Insertion Logic (Reed Relay)

3. When the last detail card is completed, the CF latch magnet picks and causes a register cycle instead of a normal feed cycle. With the MC switch on INSERT, the ensuing register cycle causes CF4 to pick clear-2 relay 108.

CF3 makes at 70° to 150° and, with 119-3 N/C picked at this time (relay 119 drops out at 180°), card lever relays 110 and 112 are not picked.

Release relay 121 is picked by CF3 through 119-2 points. Clear-2 relay 108 is being held by the 112-4 N/C points and prevents a feed cycle when PCC2 transfers between column 82½ and 84.

CF4 energizes the punch-station-register magnet at the same time clear-2 relay 108 is picked through 119-6. The punch-station-register magnet prevents the last card in the detail station from registering in the punch station.

4. The card from the punch station was registered in the read station and released to the eject station (prestack position), leaving the read and master stations void of cards.

5. A new master card can now be manually inserted in the master station.

6. Press the feed key to: register both the new master card at the read station and the next detail card at the punch station, and feed a card from the hopper.

7. Normal operation can be resumed. Any fields programmed for duplication are duplicated from the new master card.

Stack Operation

1. Set the insertion switch to STACK. The auto-feed switch must be on.

2. After registering or while punching the last detail card preceding the master card, press the MC key. The MC key must be pressed before column 80 is reached. MCI key latch contact picks MCI relay 119. The 119-4 and 119-5 points transfer PCC2 to the CF latch during a card-to-card skip.

3. When the detail card is completed, the CF latch magnet is energized and, during the card-to-card skip, CF4 energizes the punch-station-register magnet. This suppresses the registering of the last card in the punch station from the detail station.

The MC switch on STACK prevents CF4 from picking the clear-2 relay 108. MCI relay 119 drops out at 180° through 119-1 and CF2. This is too late to pick card lever relays 110 and 112.

PCC2 transfers between column 82½ and 84 and energizes the CF clutch magnet through 119-4 (normal) to initiate a feed cycle. Card lever relays 110 and 112

are picked by CF3 through 119-3 (normal) as the last detail card is released and stacked. The card in the detail station is registered in the punch station, and a new detail card is fed down. There is no card at the read or master station.

4. A new master card can be inserted manually behind the last detail card in the stacker.
5. Normal operation can be resumed.

Circuit Objectives (Reed Relay)

Insert Operation

MC switch on INSERT, auto-feed switch on:

1. Pick MCI relay 119. MCI key latch contact.
2. Initiate a register cycle upon completion of detail card. Energize CF latch magnet. 119-5. PCC2.
3. Pick clear-2 relay 108. MCI switch on INSERT. 119-6. CF4.
4. Pick release relay 121 M2. 119-2. CF3.
5. Prevent picking card lever relays 112 and 110. 119-3 is up (transferred). (CF3 circuit is open.)
6. Hold clear-2 relay 108. 112-4.
7. Prevent a feed cycle when PCC2 transfers. 108-2 N/C, now open, breaks CF clutch magnet circuit.
8. Suppress registering the last card in the punch station. Energize punch station register magnet. 119-6. CF4.
9. Energize card-feed clutch magnet. Feed key latch contact.

Stack Operation

MC switch on STACK, auto-feed switch on:

1. Pick MC relay 119. MCI key latch contact.
2. Initiate a register cycle upon completion of detail card. Energize CF latch magnet. 119-5. PCC2.
3. Energize punch station register magnet. 119-6. CF4 (M16°-B90°).
4. Pick release relay 121 M2. 119-2. CF3 (M70°-B150°).
5. Prevent picking card lever relays 112 and 110. 119-3 is up (transferred). (CF3 circuit is open.)
6. Initiate a feed cycle. Energize CF clutch magnet. 108-2 (normal). 119-4 (normal). MCI relay 119 dropped at 180°. PCC2.
7. During the feed cycle:
   a. The last detail card is released and stacked.
   b. Card lever relays 110 and 112 are picked.
   c. The card in the punch station is registered.
   d. A new card is fed from the hopper.

Description (Wire-Contact Relay)

An additional wiring diagram page (accompanying this feature) shows circuit changes to parts of sections 5, 7, 8, 9, and 11 of the basic machine wiring diagram.

Figure 9-3 shows the conditions that pick or activate the main operating components of the card-insertion feature.

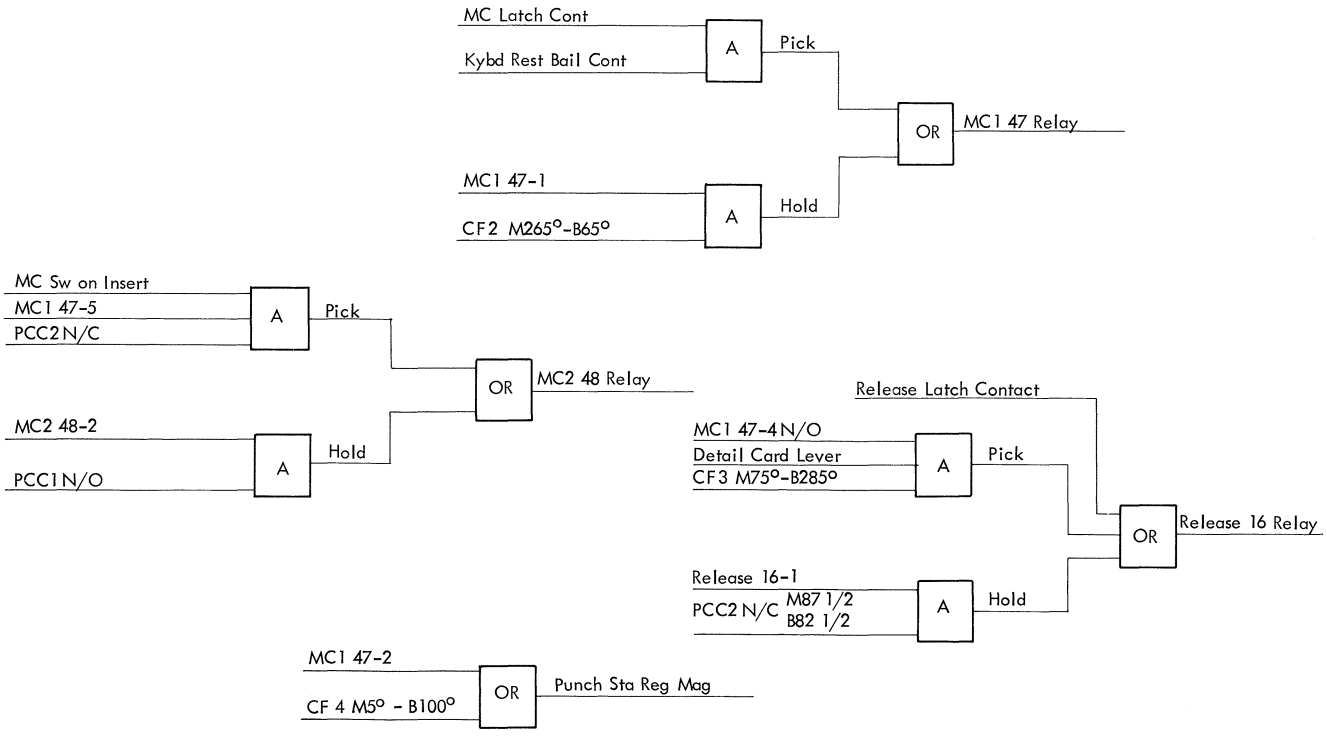


Figure 9-3. Master-Card Insertion Logic (Wire-Contact Relay)

Insert Operation

1. Set the card insertion switch to INSERT. The auto-feed switch must be on.

2. After registering or while punching the last detail card preceding the master card to be inserted, press the MC (master card) key. The MC key must be pressed before column 80 is reached. The MC key latch contact allows CF4 to pick MC1 relay 47 at 5°. The 47-3 points transfer PCC2 N/O to the CF latch magnet during a card-to-card skip.

3. When the last detail card is completed, the CF latch magnet picks and causes a register cycle instead of a normal feed cycle. With the MC switch on INSERT, the ensuing register cycle causes CF3 to pick release relay.

CF3 makes at 75° to 285° and, with 47-4 N/C picked at this time, card lever relay 24 is not picked.

Release relay 16 is picked by CF3 through 47-4 points. MC2 relay 48 is picked through the 47-5 N/O points and PCC2 N/C and prevents a feed cycle when PCC2 transfers between column 82½ and 84.

CF4 energizes the punch-station-register magnet at the same time MC1 relay 47 is picked through 47-2. The punch-station-register magnet prevents the last card in the detail station from registering in the punch station.

4. The card from the punch station was registered in the read station and released to the eject station (prestack position), leaving the read and master stations void of cards.

5. A new master card can now be manually inserted in the master station.

6. Press the feed key to: register both the new master card at the read station and the next detail card at the punch station, and feed a card from the hopper.

7. Normal operation can be resumed. Any fields programmed for duplication are duplicated from the new master card.

Stack Operation

1. Set the insertion switch to STACK. The auto-feed switch must be on.

2. After registering or while punching the last detail card preceding the master card, press the MC key. The MC key must be pressed before column 80 is reached. MC key latch contact picks MC1 relay 47. The 47-3 points transfer PCC2 to the CF latch during a card-to-card skip.

3. When the detail card is completed, the CF latch magnet is energized and, during the card-to-card skip, CF4 energizes the punch-station-register magnet. This suppresses the registering of the last card in the punch station from the detail station.

The MC switch on STACK prevents PCC2 from picking the MC2 relay 48. MC1 relay 47 drops out at 100° through 47-2 and CF2. This is too late to pick card lever relay 24.

PCC2 transfers between column 82½ and 84 and energizes the CF clutch magnet through 47-4 N/C to initiate a feed cycle. Card lever relay 24 is picked by CF3 through 47-4 N/C as the last detail card is released and stacked. The card in the detail station is registered in the punch station, and a new detail card is fed down. There is no card at the read or master station.

4. A new master card can be inserted manually behind the last detail card in the stacker.

5. Normal operation can be resumed.

Circuit Objectives (Wire-Contact Relay)

Insert Operation

MC switch on INSERT, auto-feed switch on:

1. Pick MC1 relay 47. MC key latch contact.
2. Initiate a register cycle upon completion of detail card. Energize CF latch magnet. 47-3. PCC2.
3. Pick release relay 16. MC1 switch on INSERT. 47-4. CF3.
4. Pick MC2 relay 48. 47-5. PCC2 N/C.
5. Prevent picking card lever relay 24. 48-3 is transferred. CF3 circuit is open.
6. Hold MC2 relay 48. 48-2. PCC1.
7. Prevent a feed cycle when PCC2 transfers. 48-4 N/C, now open, breaks CF clutch magnet circuit.
8. Suppress registering the last card in the punch station. Energize punch station register magnet. 47-2. CF4.
9. Energize card-feed clutch magnet. Feed key latch contact.

Stack Operation

MC switch on STACK, auto-feed switch on:

1. Pick MC1 relay 47. MC key latch contact.
2. Initiate a register cycle upon completion of detail card. Energize CF latch magnet. 47-3. PCC2.
3. Energize punch station register magnet. 47-2. CF4 (M5°-B100°).
4. Pick release relay 16. 47-4. CF3 (M75°-285°).
5. Prevent picking card lever relay 24. 47-4 is transferred. CF3 circuit is open.
6. Initiate a feed cycle. Energize CF clutch magnet. 47-3 N/C. MC1 relay 47 dropped at 100°. PCC2.
7. During the feed cycle:
   a. The last detail card is released and stacked.
   b. Card lever relay 24 is picked.
   c. The card in the punch station is registered.
   d. A new card is fed from the hopper.

Chapter 11. Self-Checking Number Feature, Modulus 11, and Self-Checking Number Generator Feature

Theory of Operation

- **The modulus 11 self-checking number feature detects punching errors by the time the end of a field is reached.**

The Self-Checking Number Feature, Modulus 11, is available only for the IBM 29 Model A. It is not compatible with two other features: auxiliary duplication and self-checking number feature, modulus 10.

The modulus 11 technique of self-checking predetermined numbers (such as account numbers, part numbers, or order numbers) detects any error by the time the end of the field is punched. The method detects single-digit mispunches, single transpositions, and double transpositions.

The modulus 11 technique differs from that of other systems in that it applies five different weights (checking factors) to the digit positions in the basic number, to calculate a check digit. The check digit is added at the right of the basic number to form the self-checking number.

The check digit can be determined by IBM computer calculation, by manual arithmetic, or by using the self-checking number generator feature which may be installed with the modulus 11 feature.

Calculation of the Check Digit

- **The check digits are developed from the value and position of each basic number digit.**
- **Numbers that generate a check digit of 10 must be excluded.**

The decimal value of the check digit is derived from the value and position of each digit of the basic number. Each position of the basic number has a pre-assigned checking factor. Starting with the low-order position of the basic number, the checking factors are 2, 3, 4, 5, 6, 7. If a basic number is longer than six digits, the sequence of checking factors is repeated.

Figure 11-1 shows an example with an account number as the basic number. The pre-assigned checking factors are shown below each position of the basic number. The check-digit value of the account number is computed manually as follows:

1. Multiply the value of each digit position by its checking factor. Add the resulting products together.
2. Divide the sum of the products by 11.
3. Subtract the remainder from 11. The result is the check-digit value for the account number. Place the check digit to the right of the basic account number to make a self-checking account number.

The modulus 11 self-checking number system has one restriction. Only one digit position is reserved for the check digit. Therefore, a check digit of 11 is punched as a zero, and all basic numbers that generate a check digit of 10 must be excluded from the sequence numbering system.

Program Card

- **Checking factors are defined (controlled) by the auxiliary program drum card.**

Because the modulus 11 program card requires more codes (punching positions) than are available on the standard program card, an auxiliary program drum is installed as part of the modulus 11 feature.

For program 1, the rightmost position of the self-checking number field (the check digit column) is punched 12-3. Proceeding to the left, the next column is punched 3, and successive columns are punched 2, 1, 0, 11, 12. If additional positions require coding, the sequence is repeated, starting with 3, and continuing until the high-order position of the field is reached.

For program 2, the check digit field is punched 4-9; the remaining positions are punched, from right to left, with 9, 8, 7, 6, 5, 4, and the sequence is repeated up to the high-order position.

Operating Procedure

- **Numbers to be checked are keyed manually or duplicated automatically.**

In normal operation, the account number is keyed and punched through the check-digit position. Internal circuits verify the accuracy of the keying or validity

Account Number:	9	4	3	4	5	7	8	4	2	
Checking Factors:	×4	×3	×2	×7	×6	×5	×4	×3	×2	
1. Multiply and Add:	36	+ 12	+ 6	+ 28	+ 30	+ 35	+ 32	+ 12	+ 4	= 195
2. Divide:	195 ÷ 11 = 17 and a Remainder of 8									
3. Subtract:	11 - 8 = 3 Check Digit Value									
Self-Checking Account No. 9434578423										

Figure 11-1. Arithmetic Method of Finding Check-Digit Value

of the account number and, if correct, automatically punch an 11 in column 81. (On machines processing short cards, the 11-punch will appear in column 52, 61, or 67, depending on the card length.)

An error is signaled by a red light on the keyboard after the last digit of the self-check field is punched. A 12 is automatically punched over the check-digit column, and the keyboard is held restored. To release the card and unlock the keyboard, the error-reset key is pressed. Whenever such an error occurs, the 11 punch in column 81 is suppressed.

When more than one self-checking field is programmed, the successful keying of any *one* field can produce an 81X if the other fields are skipped or bypassed by a change in program level. The appearance of an 81X signifies that all self-checking fields that are *punched* in the card are correct, whether keyed or duplicated. Skipping or bypassing an entire self-checking field is a valid operation.

Duplication

Duplication of a self-checking number field, or part of a self-checking number field, is possible but must be initiated in the high-order position of the field. Duplication may be initiated by a 0-punch (6-punch in program 2) in the main program card (high-order position) or by pressing the duplicate key. In either case, the portion of the field to be duplicated *must* be defined in the main program card (by 12 or 4 punches). If only part of the field is to be duplicated, the field definition punch is omitted over the first column of the part to be manually punched. If duplication is initiated at some point after the high-order position of the self-checking field, an error will result.

In the manual keying of a self-checking field, the alpha shift key can be used when entering an alpha character. This type of self-checking field should not be duplicated.

Operating Information

- **Numbers requiring a check digit of 10 cannot be used.**
- **The number checked and the self-checking field must be equal in number of digits; no spaces are allowed.**
- **Left-aligned numbers cannot be checked.**
- **Self-checking fields must be separated by at least one column.**
- **An 11 in column 81 is not punched when a release follows a checked correct field.**

Basic numbers requiring a check digit of 10 cannot be used as self-checking numbers. The accounting system must be adjusted to remove such numbers from codes that are to be self-checked. If an operator is generating check digits and punches a basic number requiring a check digit of 10, the machine indicates an error condition. It punches a 12 in the check-digit column, the error light goes on, and the keyboard locks. The operator must release the card and substitute another basic number.

Although a field to be self-checked may be of any length (up to 79 columns plus the check digit), once the predetermined field length has been programmed for self-checking, all numbers to be self-checked *must* contain the same number of digits as the programmed self-checking field. The check digit *must* always occupy the units position of the self-checking number field.

The modulus 11 technique of self-checking is not valid with left-aligned (left-base) numbers.

More than one self-checking field can be checked per card, but self-checking fields must be separated by at least one card column. When the first self-checking field with an error is detected, a 12 is punched over the check-digit position of the field. The card is released by pressing the error-reset key.

If the remainder of the card is to be skipped after the end of a self-checking field, skipping can be initiated by program control or the skip key. Skipping can be initiated by the skip key only when in the high-order position of the self-checking field. The skip circuit is broken when the field-2 relay is picked after the first key is pressed in a self-checking number field. If the release key is used for this skipping, the X in column 81 is not punched, even though the self-checking field is correct.

In the first column of a self-checking field, the following operations can be performed:

1. The field can be manually keyed and the validity of the number is checked by the arithmetic circuits.
2. When the self-check field has no spaces, the entire field (or part of the field) can be duplicated and checked by use of the duplicate key.
3. The entire field can be manually skipped without calculation.
4. A shift in program level can bypass the entire field.

Once keying of the self-checking field has started, the manual dup, manual skip, program-1, and program-2 keys are all inoperative.

The release key is not inhibited unless a checking error has been indicated. The release can be used in a self-checking field if the operator has miskeyed and wishes to make over the card.

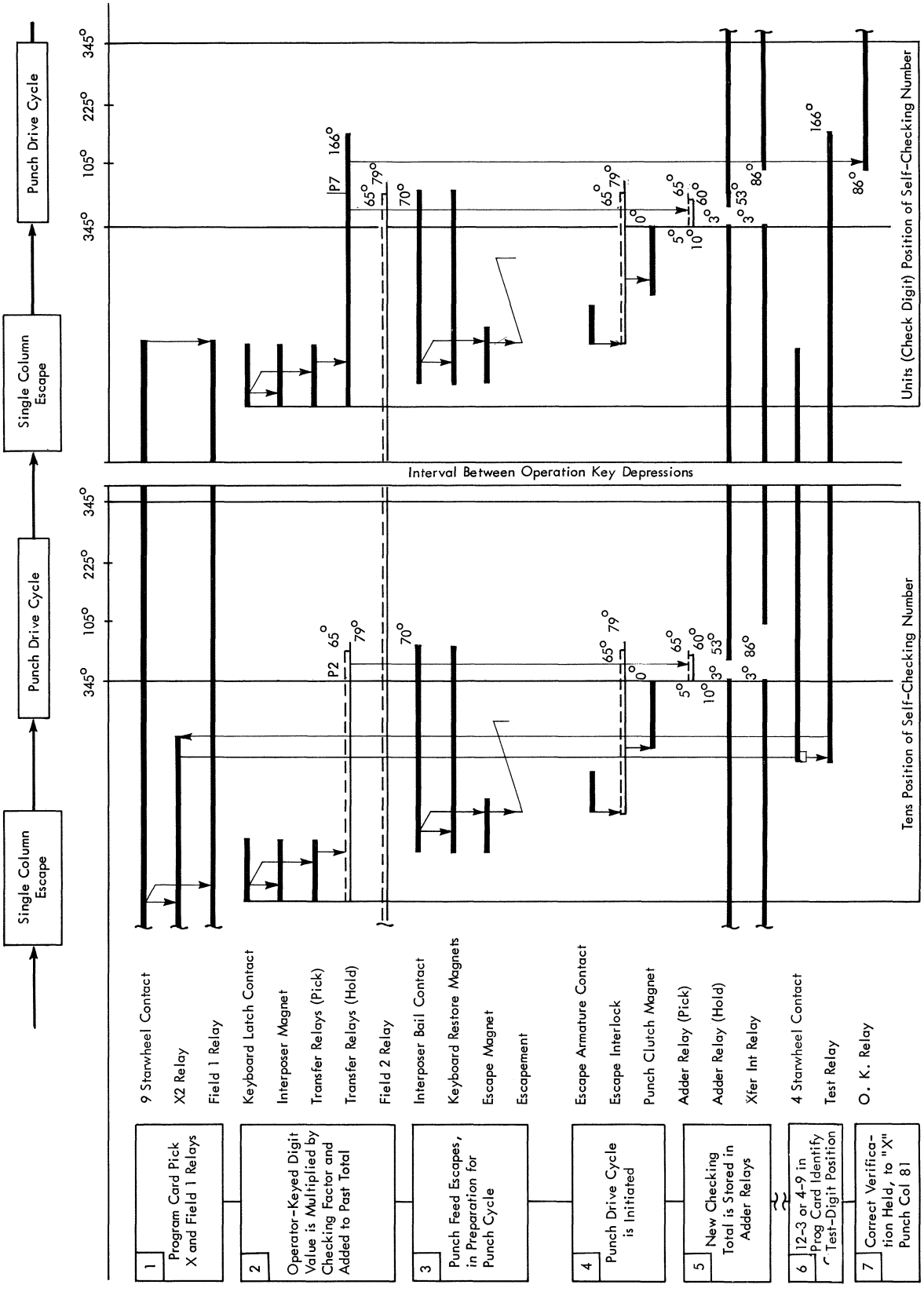


Figure 11-8. Sequence (Checking the Tens and Units Positions of a Number)

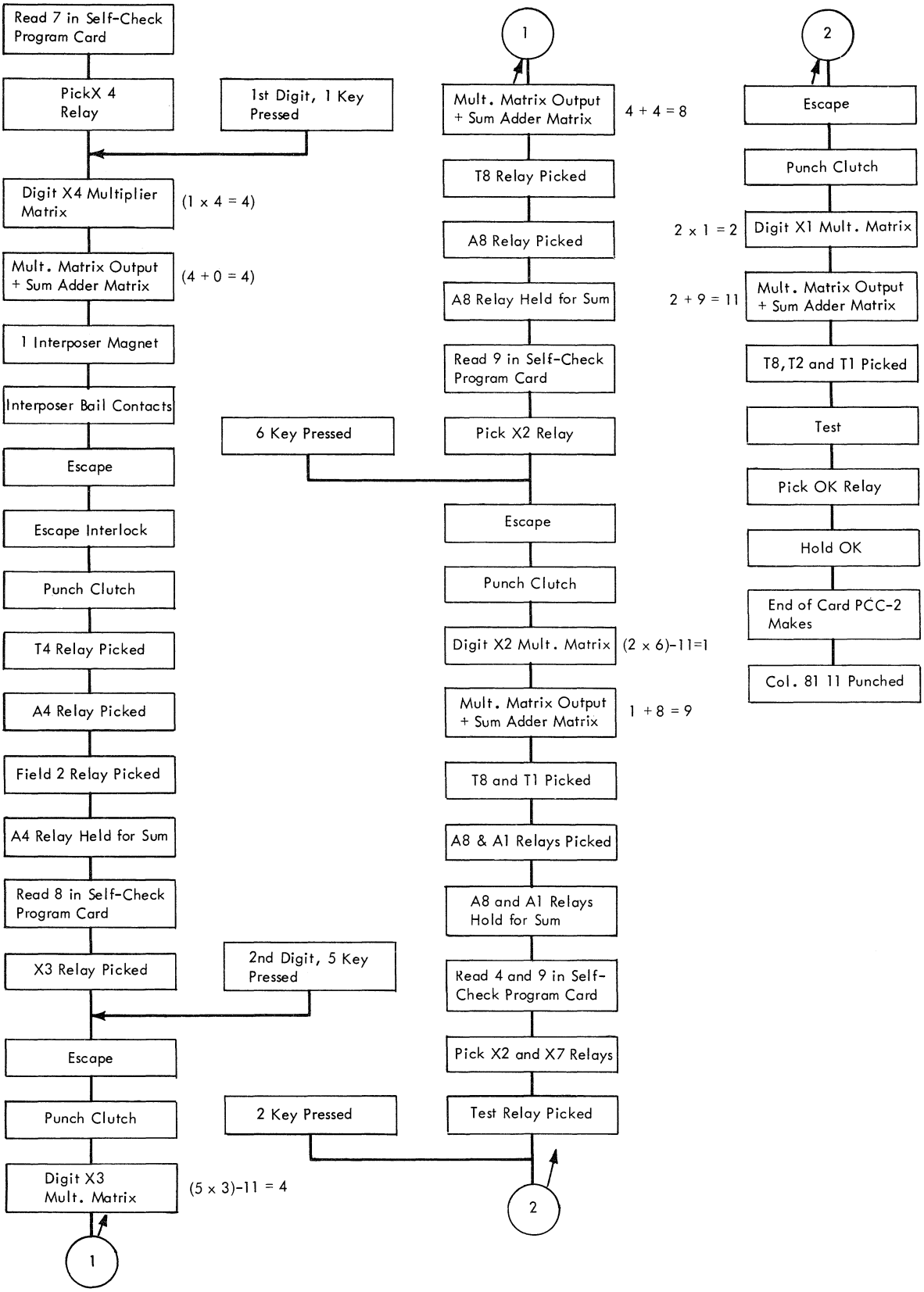


Figure 11-9. Operational Flow Chart

Column 1

ACTION	RESULT
0 program contact	×5, FLD 1 pick
5 key pressed	5-interposer, T1, T2 pick
P2 (N/C) (M-149°)	T1, T2 hold
Interposer bail contact	Escape magnet
Escape arm contact	Escape interlock, punch clutch
P6 (B-3°)	XFER INT drops
P3 (M-10°), T1, T2	FLD 2, A1, A2 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°), A1, A2	A1, A2 hold
P2 (M-149°), FLD 2	FLD 2, T1, T2 hold
P5 (M-86°)	XFER INT pick

Final result: 3 stored in add relays (A1, A2).

Column 2

ACTION	RESULT
1 program contact	×4, FLD 1 pick
1 key pressed	1-interposer, T1, T2, T4 pick
P2 (N/C) (M-149°)	T1, T2, T4 hold
Interposer bail contact	Escape, punch
P6 (B-3°)	XFER INT drops
P3 (M-10°), T1, T2, T4	A1, A2, A4 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°), A1, A2, A4	A1, A2, A4 hold
P2 (M-149°), FLD 2	FLD 2, T1, T2, T4 hold
P5 (M-86°)	XFER INT pick

Final result: 7 stored in add relays (A1, A2, A4).

Column 3

ACTION	RESULT
2 program contact	×3, FLD 1 pick
1 key pressed	1-interposer, T8, T2 pick
P2 (N/C) (M-149°)	T8, T2 hold
Interposer bail contact	Escape, punch
P6 (B-3°)	XFER INT drops
P3 (M-10°), T8, T2	A8, A2 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°) A8, A2	A8, A2 hold
P2 (M-149°), FLD 2	FLD 2, T8, T2 hold
P5 (M-86°)	XFER INT pick

Final result: 0 stored in add relays (A8, A2).

Column 4

ACTION	RESULT
3 program contact	×2, FLD 1 pick
3 key pressed	3-interposer, T4, T1 pick
P2 (N/C) (M-149°)	T4, T1 hold
Interposer bail contact	Escape, punch
P6 (B-3°)	XFER INT drops
P3 (M-10°), T4, T1	A4, A1 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°), A4, A1	T4, T1 hold
P5 (M-86°)	XFER INT pick

Final result: 5 stored in add relays (A4, A1).

Column 5 (Last column of field)

ACTION	RESULT
12 & 3 program contact	Pick TEST
6 key pressed	6-interposer, T8, T2, T1 pick
P6 (M-53°), A8, A2, A1	A8, A2, A1 hold
P2 (M-149°), FLD 2	Hold T8, T2, T1
P7 (M-241°), TEST	Hold TEST
P5 (M-86°), TEST, FLD 1	Pick OK. Hold OK until following position or column 81

Final result: 11 (zero balance) stored in add relays (A8, A2, A1).

Column 81

ACTION	RESULT
PCC1, OK	Pick 11 interposer

Circuit Objectives: Error Condition (Reed Relay)

Punch a 5 in the units position of the preceding example instead of the 6 (punch 51135).

Columns 1 through 4:

ACTION	RESULT
Same as preceding example	5 stored in add relays

Column 5

ACTION	RESULT
12 & 3 program contact	Pick TEST
5 key pressed	5-interposer, T8, T2 pick
P2 (N/C) (M-149°)	T8, T2 hold
Interposer bail contact	Escape, punch
P3 (M-10°), T8, T2	A8, A2 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°), A8, A2	A8, A2 hold
P2 (M-149°), FLD 2	Hold T8, T2
P7 (M-241°), TEST	Hold TEST
P5 (M-86°), TEST, FLD 1	Pick ERR and 12-interposer
ERR	Pick MP and release
MP	Block escapement and punch 12 over units position
Error-reset key pressed	Resets error condition and releases the card

Circuit Objectives: Correct Number (Wire-Contact Relay)

The ACTION column does not necessarily mean actions by an operator. It contains circuit initiators such as contacts closed by keys, cams, and relays. The RESULT column gives the effect of the action on the circuit. With a five-column self-checking field programmed, the number 51136 is to be entered from the keyboard and checked for validity.

Card lever picks XFER INT during the card feed cycle.

Column 1

ACTION	RESULT
0 program contact	×5, FLD 1 pick
5 key pressed	5-interposer, T1, T2 pick
P2 (N/C) (M-135°)	T1, T2 hold
Interposer bail contact	Escape magnet
Escape arm contact	Escape interlock, punch clutch
P6 (B-3°)	XFER INT drops
P3 (M-5°), T1, T2	FLD 2, A1, A2 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°), A1, A2	A1, A2 hold
P2 (B-65°)	T1, T2 drop
P5 (M-86°)	XFER INT pick

Final result: 3 stored in add relays (A1, A2).

Column 2

ACTION	RESULT
1 program contact	×4, FLD 1 pick
1 key pressed	1-interposer, T1, T2, T4 pick
P2 (N/C) (M-135°)	T1, T2, T4 hold
Interposer bail contact	Escape, punch
P6 (B-3°)	XFER INT drops
P3 (M-5°), T1, T2, T4	A1, A2, A4 pick
FLD 2, +48V	FLD 2 hold
P6 (M-53°), A1, A2, A4	A1, A2, A4 hold
P2 (B-65°)	T1, T2, T4 drop
P5 (M-86°)	XFER INT pick

Final result: 7 stored in add relays (A1, A2, A4).

Column 3

ACTION	RESULT
2 program contact	×3, FLD 1 pick
1 key pressed	1-interposer, T8, T2 pick
P2 (N/C) (M-135°)	T8, T2 hold
Interposer bail contact	Escape, punch
P6 (B-3°)	XFER INT drops
P3 (M-5°), T8, T2	A8, A2 pick
FLD 2, +48v	FLD 2 hold
P6 (M-53°), A8, A2	A8, A2 hold
P2 (B-65°)	T8, T2 drop
P5 (M-86°)	XFER INT pick

Final result: 0 stored in add relays (A8, A2).

Column 4

ACTION	RESULT
3 program contact	×2, FLD 1 pick
3 key pressed	3-interposer, T4, T1 pick
P2 (N/C) (M-135°)	T4, T1 hold
Interposer bail contact	Escape, punch
P6 (B-3°)	XFER INT drops
P3 (M-5°), T4, T1	A4, A1 pick
FLD 2, +48v	FLD 2 hold
P6 (M-53°), A4, A1	A4, A1 hold
P2 (B-65°)	T4, T1 drop
P5 (M-86°)	XFER INT pick

Final result: 5 stored in add relays (A4, A1).

Column 5 (Last column of field)

ACTION	RESULT
12 & 3 program contact	Pick TEST
6 key pressed	6-interposer, T8, T2, T1 pick
P2 (M-135°), FLD2	Hold T8, T2, T1
Interposer bail contact	Escape, punch
P6 (M-53°), A8, A2, A1	A8, A2, A1 hold
P7 (M-241°), TEST	Hold TEST
P5 (M-86°), TEST, FLD 1	Pick OK. Hold OK until following position or column 81

Final result: 11 (zero balance) stored in add relays (A8, A2, A1).

Column 81

ACTION	RESULT
PCC1, OK	Pick 11-interposer

Circuit Objectives: Error Condition (Wire-Contact Relay)

Punch a 5 in the units position of the preceding example instead of the 6 (punch 51135).

Columns 1 through 4:

ACTION	RESULT
Same as preceding example	5 stored in add relays

Column 5

ACTION	RESULT
12 & 3 program contact	Pick TEST
5 key pressed	5-interposer, T8, T2 pick
P2 (N/C) (M-135°)	T8, T2 hold
Interposer bail contact	Escape, punch
P3 (M-5°), T8, T2	A8, A2 pick
FLD 2, +48v	FLD 2 hold
P6 (M-53°), A8, A2	A8, A2 hold
P2 (M-135°), FLD 2	Hold T8, T2
P7 (M-241°), TEST	Hold TEST
P5 (M-86°), TEST, FLD 1	Pick ERR and 12-interposer
ERR	Pick MP and release
MP	Block escapement and punch 12 over units position
Error-reset key pressed	Resets error condition and releases the card

Self-Checking Number Generator

- **The self-checking number generator (standard for Modulus 10) is a feature for Modulus 11. A switch is provided on the keyboard to select check mode or punch mode.**
- **The machine can calculate the check digit during keying and punch it out.**
- **The field size must provide for the check digit.**
- **Program codes are identical to those used with the basic modulus 11 feature.**

The generator is a feature that can be added to modulus 11. The generator sets up and punches the correct check digit immediately after the basic number is punched. Because the operator does not key the check digit, this is *not* a checking operation.

The procedure for generating self-checking numbers is the same as the self-checking operation except that the self-check switch is on PUNCH. The switch position holds the generate relay up continuously. Figure 11-10 shows the sequence of events when the operator keys the low-order position of the basic number.

The check-digit impulse is generated during the punch cycle for the units position of the basic number. The add relays are not picked. The impulse from P5 goes through TEST and field-1 relay points and a combination of transfer relay points as determined by the value present in the transfer relays. The resulting output from one of the T1 points energizes the interposer magnet for the correct check-digit value. Another escape-and-punch cycle is required to punch the check digit value into the next column. Note that the check digit is an 11's complement of the value in the transfer relays. For example, if T4 and T2 are up, a check digit of 5 is punched.

Self-checking numbers with a check-digit value of 10 must be ruled out of the modulus 11 number system. A generated check digit of 10 is indicated if T1 is the only transfer relay in the up position when the check-digit position is reached. In this case, the check-digit impulse goes through T8, T4, and T2 relay points to latch-pick the error relay. The error light comes on, a 12 is punched, and the machine locks. Press ERROR RESET to latch-trip the error relay and release the card.

Circuit Objectives (Reed Relay)

The basic number 5113 is keyed in the first four columns of a five-column field.

Columns 1 through 3

ACTION	RESULT
Same as in check operation, except the switch is set to PUNCH	Pick GEN

Code	Unit or Routine	Freq. (wks)	Lubricate-Clean	Observe
6	Punch Suppress Unit	52	Lubricate the transfer plate and shaft, operating plate pivot pins, lower punch support pins, solenoid bell crank and bell crank arm pivots. Clear card dust and chips from the punch station pressure roller, and from the slots in the punch stripper.	Check connections to sense unit. Check for free movement of sensing pins and punch suppression mechanism. Check condition of moving contacts.
1	Feed		Clean moving parts and base. Lubricate gears, cams, pivots, bearings, oil wicks, motor and friction drive.	Check for worn belts, linkages, cams, and bearings.
2	Print			
3	CB	52		
4	Punch			
5	Drive			
Cleaning and lubrication of special features or other additional electro-mechanical devices should be scheduled with basic scheduled maintenance. Lubricate punch clutch and clear card dust from the slots in the punch stripper in conjunction with 01 calls. Test the operation of the punch suppression unit and general machine operation after completing each scheduled maintenance call.				

Figure 12-7. Preventive Maintenance Routine

Operational Check

Check basic program and functions using the procedure for Model A machines, Field Engineering Maintenance Manual, *29 Card Punch*, Form 225-3357.

Perform the punch-suppression mechanism operational check as a part of installation or regular preventive maintenance (Figure 12-7) and after each servicing of the punch-suppression mechanism or associated circuits.

1. Set auto-feed switch off and interpret/punch switch to PUNCH.
2. Use all keyboard characters to punch a blank card.
3. Turn machine power off.
4. a. Move wire in WCR 2-1 N/C to WCR 2-1 N/O (reed-relay machines).
   b. Jumper TB 32-01G to R26-2 OP (wire-contact relay machines).
5. Turn machine power on and set the interpret/punch switch to INTERPRET.
6. Register the punched card at the read station and register a blank card at the punch station. The machine prints the punched-card information along the top of the blank card (without punching the blank card). The punch-suppression mechanism prevents punching while machine is in interpret mode.
7. Turn machine power off and relocate wire or remove jumper (see step 4.).

CAUTION

Machine malfunction can be caused by dust or chip particles created while repunching holes. Proper punch-suppression mechanism operation is imperative. Practice the previous operational check regularly to ensure punch suppression while machine is in interpret mode.

Using the Model C program card (Figure 12-7A), check interpreting program and functions. With auto skip/dup switch on, machine in interpret mode, and a punched card registered at the punch station, the machine interprets columns 1-5, 34-59, and 78-80. The zones are eliminated in columns 34, 36, 38, 40, 42, 44, 46, 48, and 50. Machine must be in punch mode to allow operation of the clear switch.

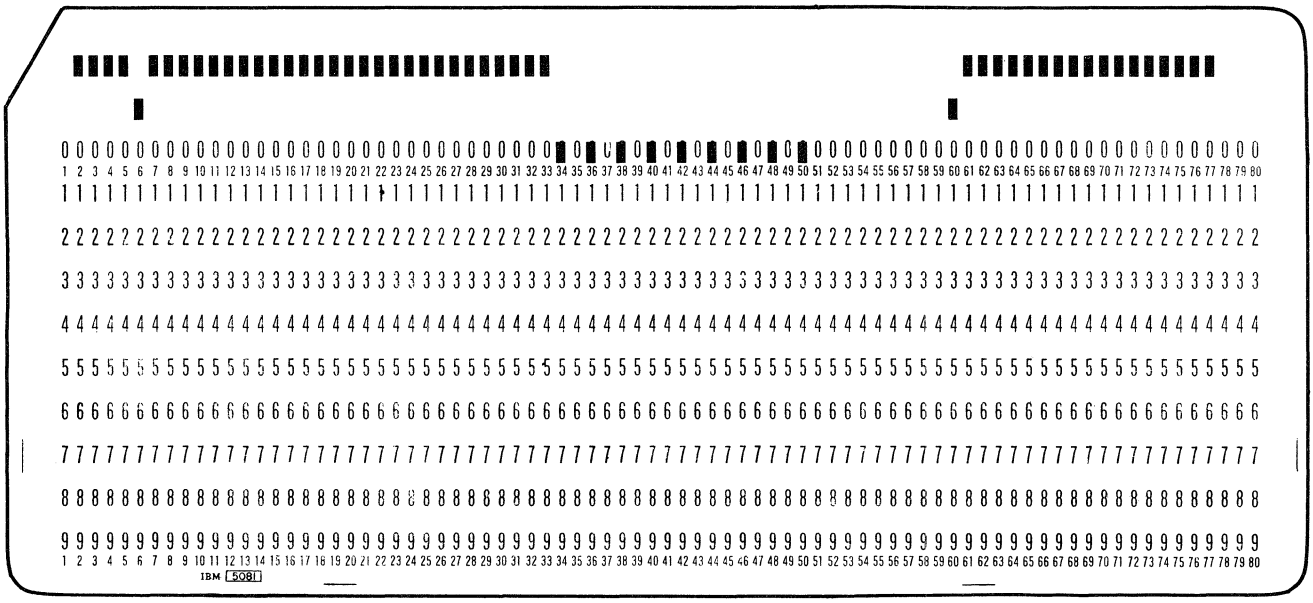
Checks, Adjustments, and Removals

Interpret Sensing Unit

Adjustments

The following adjustments can be checked and made with the pin-sense unit (Figure 12-1) installed in the machine. Check all sensing-unit adjustments with power applied.

1. Turn the main-line switch off.
2. Using a strip of card, insulate cam P7 which is closed at latch time.
3. Place a blank card between the die and the stripper.
4. Turn on the interpret switch and the main-line switch.
5. Turn off the motor switch.



● Figure 12-7A. Model C Program Card

6. Release the punch clutch and turn the index to 10°. This puts a 50 ohm resistor across P7 in series with P6. As a result, about 18 volts are applied to the pin-sense magnet.

Do not turn the punch index to P5 time (86° to 166°) during this procedure as this would energize all interposer magnets.

7. Check for a clearance of 0.012″ between the armature and the core (Figure 12-8). Use three strips of card cut to approximately ⅛ inch as a gage. Two strips should go with no drag; three strips should have a slight drag. Loosen the four mounting screws, and shift the magnet to obtain this adjustment. If the magnet location is changed, recheck both the 12- and the 9-ends. It is possible to check the 12-end through the print-unit area.

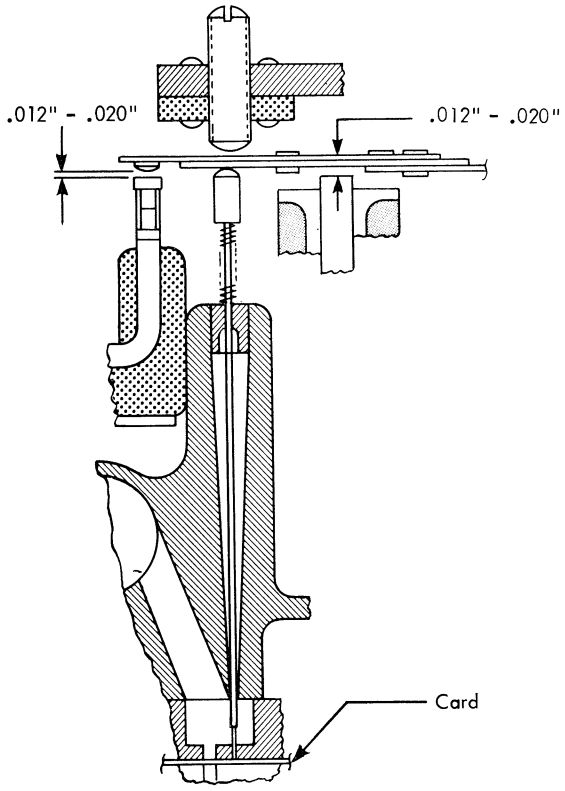


Figure 12-8. Pin-Sense Unit — Blank Card

8. Check for 0.012″ to 0.020″ air gap on all contacts (Figure 12-8). Two cards cause no drag; three cards cause slight drag. Loosen the two mounting screws and shift the contact molding assembly to accomplish this adjustment.

9. Remove the blank card and turn the main-line switch on and off intermittently (about 18 volts applied to the sensing magnet). The contacts must fully operate at this voltage. If any failures occur, remove the contact assembly and form the failing contact downward. As a final check, with the power off, measure the contact tension with a gram gage. The contact strap should move away from th adjusting screw with a minimum of 22 grams tension (Figure 12-9).

10. With the power still off, remove the card insulating P7 and turn on the motor switch.

11. Remove the card. Turn the power on momentarily. The contact-spring assembly should have a visual air gap from the armature when the armature is held on the core. This ensures correct wiping action (Figure 12-10). Relieve the tension in the contact spring if the air gap is not present.

12. The sensing pins must be inside the lower face of the die when the armatures are not attracted (Figure 12-3). Use the thickest feeler gage possible between the die and the stripper without creating excessive drag. Run down the top adjusting screw until the

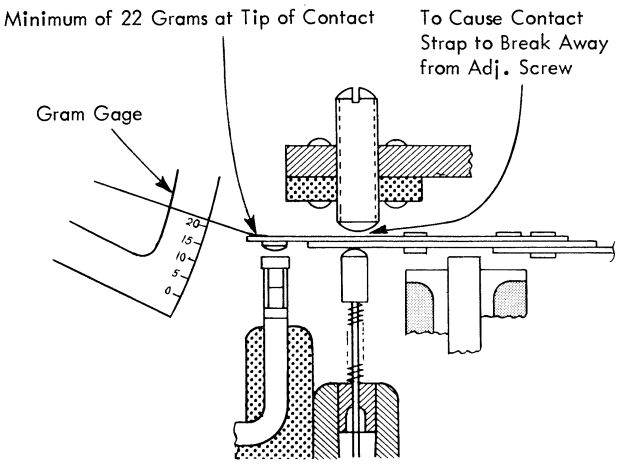


Figure 12-9. Contact Tension

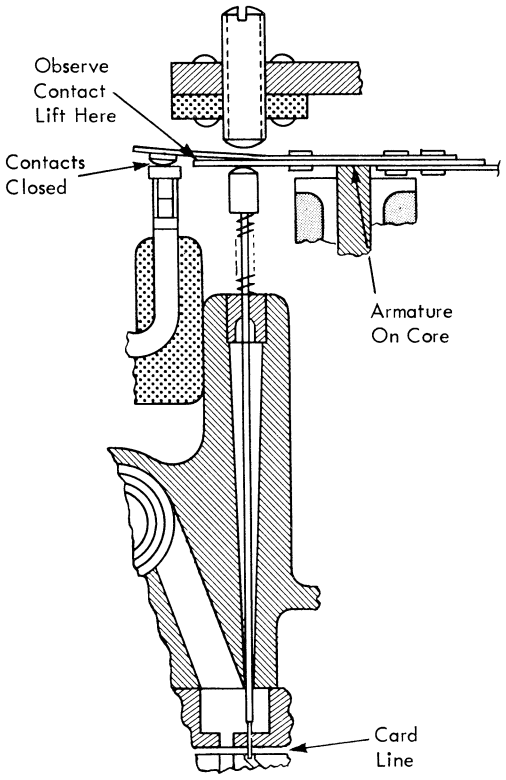


Figure 12-10. Pin-Sense Unit — Hole Sensed

sensing pin just contacts the feeler gage. Back off the screw ¼ turn.

13. Run a card through the machine in the interpret and punch modes to check for correct operation.

Removal

The sensing unit and the punch unit cannot be independently interchanged or replaced. Each punch die and stripper is matched to a sensing casting during manufacture.

For example, replacing the sensing unit makes it necessary to replace a matched punch unit; conversely,

Appendix A. Special Feature Compatibility

The special features described in this manual provide additional flexibility for applications requiring special handling on the IBM 29 Card Punch. These special features are compatible in groups as shown in the following chart:

Feature	Model A						B		C	
Variable Length Card Device	X		X	X			X		X	
Interspersed Gang Punch		X			X	X		X		X
Auxiliary Duplication	X	X	X		X		X	X	X	X
High Speed Skip	X		X	X			X		X	
Character Inhibit	X	X	X	X	X	X	X	X	X	X
Mutilated Card Feed	X	X	X	X	X	X	X	X	X	X
Reading Board Extension	X	X	X	X	X	X	X	X	X	X
Card Lifter	X	X	X	X	X	X	X	X	X	X
Master Card Insertion		X			X	X		X		X
SC Modulus 10	X	X								
SC Modulus 11				X		X				
SC Number Generator				X		X				

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