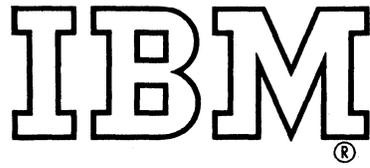


IBM

Field Engineering

Maintenance Manual

24 - Base Machines



**Field Engineering
Maintenance Manual**

24-Base Machines

24-26 Card Punch
24-26 Card Punch, Models 5 and 6
27-28 Card Proof Punch
46-47 Tape to Card Punch
56 Card Verifier
65-66 Data Transceiver
526 Printing Summary Punch
534-536 Card Punch
824-826 Typewriter Card Punch
834-836 Control Unit

Foreword

This manual provides information for the mechanical maintenance of machines using the IBM 24 base. These machine types are listed on the title page. The IBM 29 and IBM 59 have separate maintenance manuals (Form 225-3357 for the IBM 29, and Form 225-3367 for the IBM 59).

It is intended to include as much information as possible within a logical section of this manual. The sequence is related, as nearly as possible, to the card path through the machine. Features, such as the card column emitter, that pertain to a specific machine are treated in separate sections covering the differences in 24-base machines. Special features are also covered in a separate section, with some discussion in the main text.

Unless stated otherwise, a particular servicing procedure is valid for all machines using the feature. For example, the backspace mechanism adjustment (Section 2.2.3) is used for all machines having the backspace feature.

Timing adjustments may vary from machine to machine, even within a single type. These adjustments can vary due to engineering changes or special features; refer to the individual machine wiring diagrams to determine correct timing adjustments for a particular machine.

Maintenance data on the IBM 67-68 Signal Units is not included in this manual; this information is in Customer Engineering Reference Manual, *IBM 65-66 Data Transceiver*, Form 223-6635. Information on the adding machine used with the IBM 27-28 Card Proof Punch is in Customer Engineering Reference Manual, *Adding Machine Attachment*, Form 223-6813.

The reference material in this manual obsoletes material in the following Customer Engineering Reference Manuals:

- IBM 24-26 *Card Punches*, Form 223-8941
- IBM 27-28 *Card Proof Punch*, Form 223-6812
- IBM 46-47 *Tape to Card Punch*, Form 223-6602
- IBM 56 *Verifier*, Form 223-6146
- IBM 65-66 *Data Transceiver**, Form 223-6635

*Material on IBM 67-68 Signal Units is not obsoleted.

Copies of this and other IBM publications can be obtained through IBM Branch Offices. Address comments concerning the contents of this publication to:
IBM Corporation, FE Manuals, Dept. B96, Box 390, Poughkeepsie, N.Y. 12602

IBM 24-Base Machines

Minor Revision, December 1965

This edition, 225-6535-5, is a minor revision of, but *does not* obsolete, 225-6535-4. A revised *Scheduled Maintenance Routine Chart*, *Pin Sense Station Registration Adjustment*, and a new *Test for Broken Wire or Broken Code Plate* have been added.

Contents

Section 1. SCHEDULED MAINTENANCE

This section discusses the accepted approach to scheduled maintenance and safety considerations 5

Section 2. SERVICING PROCEDURES

This section contains service checks, adjustment, removal, and replacement of mechanical units 7

Section 3. SERVICE AIDS

This section explains servicing techniques and common troubles and cures. The lubricant for each area of the machine is indicated in a lubrication chart. Specifications and installation information are included 69

INDEX 75

Safety

Personal safety cannot be overemphasized. To insure your own safety, make it an everyday practice to follow all safety precautions at all times. Become familiar with, and use, the safety practices outlined in IBM Form 229-1264, a pocket-size card issued to all customer engineers.

Some machines covered in this manual have power supplies with resonant control circuits. Voltage developed in these control circuits is many times the output voltage of the supply. Use extreme care when working on or around these supplies.

The location of the casters is critical on some machines. Be certain that the casters are installed in the correct holes to prevent tipping of the machine and injury to personnel. See Section 3.5.

Round off sharp edges on plastic guides; replace broken guides.

Check the card feed safety devices for proper operation.

Leave the escapement gearing cover in place at all times when the machine is running.

Keep the belt guard in place; note that, although this guard is effective from the front, it is still possible to get a finger between the belt and pulley from the rear.

Turn off power when tilting the base.

Review Customer Engineering Memorandums (CEM's) for current safety practices.

The customer engineer's approach to scheduled maintenance is important to machine performance and customer satisfaction. Effective scheduled maintenance is essential; time spent systematically on scheduled maintenance results in complete inspection of key machine units. The Scheduled Maintenance Routine Chart shows the key areas to be inspected.

Note that some areas of the machine are not included in the chart. These units, such as relays, should not be overlooked, but inspection requirements should be determined by past machine performance. The Scheduled Maintenance Routine Chart recommends a lubricate, clean, and observe procedure to adequately inspect the machine.

1.1 Cleaning

A clean machine is important to good performance. While cleaning a machine, observe the bearings, cams, linkages, and other moving parts for rust accumulation. Rust accumulation indicates wear. Reduction of corrective maintenance is the goal of scheduled maintenance.

1.2 Safety

The customer engineer is responsible for seeing that all applicable safety devices are installed on his machines as soon as possible. Test these devices periodically to insure that they are in good operating condition. A check of the CEM summary will show which memoranda apply. Observe the safety practices stated on the opposite page.

How Does Electrical Current Through the Body Affect Us? For some answers, look at Ohm's law:

$$\frac{E \text{ (voltage)}}{R \text{ (resistance)}} = I \text{ (current)}$$

We usually know what the voltage is in a circuit. Individual body resistance varies; here are some examples of body resistance:

Very Dry Hands – From about 100,000 ohms to about 600,000 ohms.

Very Wet Hands – As low as 1000 ohms.

The following chart is computed in milliamperes.

CURRENT (MA)	EFFECT ON BODY
Less than 1	No Sensation
1 to 8	Sensation of Shock
8 to 15	Painful Shock – Muscular Control Not Lost
15 to 20	Muscular Control Lost
20 to 50	Severe Muscular Contractions
50 to 100	Heart Failure Possible
100 to 200	Heart Failure Probable
Over 200	Severe Burns and Heart Failure

Let's take an example:

Having very dry hands and working with 110 volts:

$$\frac{110 \text{ volts}}{100,000 \text{ ohms}} = 1.1 \text{ milliamperes}$$

Having very wet hands:

$$\frac{110 \text{ volts}}{1,000 \text{ ohms}} = 110 \text{ milliamperes}$$

Look at the chart and remember: just as no one's hands are always soaking wet, no one's hands are completely dry either. The only difference between a minor sensation and heart failure is a matter of circumstances.

SCHEDULED MAINTENANCE ROUTINE CHART

Code	Unit or Routine	Freq (mo's)	Lubricate-Clean	Observe
1	Feed	12	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			
4	Punch			
5	Drive			
6	Line Cord			Check conditions of plug wires, terminals and grounding.
<p>Cleaning and lubrication of special features or other additional electro-mechanical devices should be scheduled with basic scheduled maintenance.</p> <p>Lubricate punch clutch in conjunction with 01 calls.</p> <p>Test general machine operation after completing scheduled maintenance.</p>				

Contents

2.1	BASE	7	2.6	VERIFIER	28
2.1.1	Basic Power Supply	7	2.6.1	Verifier Drive Unit	28
2.1.2	dc Machines Using Dynamotors	9	2.6.2	Verifying Frame Assembly	29
2.1.3	Saturable Reactor Supply	9	2.6.3	Verifier Interposer Magnet Assembly	30
2.1.4	Constant Voltage Transformer Supply	10	2.6.4	Verifying Contacts	30
2.1.5	Vacuum Tubes	10	2.6.5	Notching Drive	31
2.1.6	Relays	10	2.6.6	Last Column Notch Solenoid	32
2.1.7	Polarity Trap Selenium Rectifiers	11	2.7	PIN SENSE STATION	33
2.1.8	Spark Suppressors	11	2.7.1	Pin Sensing Unit	33
2.2	DRIVE	11	2.7.2	Card Stop Cam	34
2.2.1	Drive Motors and Belts	11	2.8	EJECT UNIT	34
2.2.2	Reduction Drive	11	2.9	STACKER UNIT	35
2.2.3	Backspace Mechanism	11	2.9.1	Card Lifter Assembly	35
2.2.4	Friction Drive	12	2.9.2	Stacker Assembly	35
2.2.5	Escapement Unit	13	2.10	PROGRAM/AUXILIARY DRUM	36
2.3	CARD FEED	15	2.11	PRINT UNIT	39
2.3.1	Hopper	15	2.11.1	Print Unit Assembly	39
2.3.2	Feed Clutch	15	2.12	KEYBOARD	46
2.3.3	cb Latch Magnet	15	2.12.1	Keyboard Assembly	46
2.3.4	Card Aligner Fingers	16	2.12.2	Keyboard Lubrication	49
2.3.5	Pressure Rails	16	2.13	SPECIAL FEATURES	50
2.3.6	Card Bed Card Lever Contact	16	2.13.1	Self-Checking Number Device	50
2.3.7	Card Lever Pressure Finger	17	2.13.2	Alternate Program Device	50
2.3.8	Card Guides	17	2.13.3	Auxiliary Duplication Device	50
2.3.9	Card Registration	17	2.13.4	Card Reverse Stacker	50
2.3.10	Pressure Rolls	18	2.13.5	Variable Length Card Device	50
2.3.11	Card Feed Pressure Roll Springs	18	2.13.6	High-Speed Skip	53
2.3.12	Registration	18	2.14	IBM 46-47 TAPE TO CARD PUNCH	54
2.3.13	Feed Wheels	18	2.14.1	46-47 Base Machine	54
2.3.14	Card Feed Circuit Breakers	19	2.14.2	Print Magnet	57
2.4	PUNCH AND VERIFIER	19	2.14.3	Card Column Emitter Assembly	58
2.4.1	Index Pointer	19	2.14.4	Tape Read Unit	59
2.4.2	Interposer Magnet	19	2.15	IBM 65-66 DATA TRANSCIVER	64
2.4.3	Guide Comb and Bumper	20	2.16	IBM 526 PRINTING SUMMARY PUNCH	64
2.4.4	Interposer Bail Contacts	20	2.16.1	Relays (High Speed)	64
2.4.5	Punch and Verifier Drive	20	2.16.2	Card Column Emitter Assembly	65
2.4.6	Clutch Magnet	22	2.16.3	Program Sensing Contacts	65
2.4.7	Punch and Verifier Clutch	22	2.16.4	Read Card Lever Contact	65
2.4.8	Punch and Verify Clutch Assembly (New Style)	23	2.17	IBM 534-536 CARD PUNCH	65
2.4.9	High-Speed cb Assembly	24	2.17.1	Read Card Lever Contact	65
2.5	PUNCH	25	2.17.2	Program Sensing Contacts	65
2.5.1	Die and Stripper	25	2.18	IBM 824-826 TYPEWRITER CARD PUNCHES	65
2.5.2	Punches	26	2.18.1	Read Card Lever	66
2.5.3	Pin Bail Drive Link	27	2.18.2	Keyboard	66
2.5.4	Punch Interposer Magnet Assembly	27	2.19	IBM 834-836 CONTROL UNITS	66
2.5.5	Flexible Shaft and Agitator	27	2.20	IBM 24-26 Card Punches, Models 5 and 6	66

The adjustments in this manual are based on current engineering specifications for 24-base machines. Because of optional features or engineering changes, some timings on machines in the field may differ from those stated. Check the timing on the machine wiring diagram before making adjustments involving mechanical timings.

Procedures outlined for removal and adjustment of the machine units are intended as guides. Adjustments should be kept close to the specification, but the procedures preferred may vary among experienced customer engineers.

2.1 Base

2.1.1 Basic Power Supply

DANGER

Voltages hazardous to life are present in these circuits. Over 600 volts are present in some supplies. Use caution when servicing these units.

SERVICE CHECK

Low Voltage Check. By testing the machine at low operating voltages, marginal conditions that can cause occasional failures may often be detected. Low voltage

testing will reveal such items as weak magnet coils and tubes with low emission.

Most machines can be changed to a lower voltage for test purposes without additional equipment. To make this change on 115vac machines, remove the jumper between posts 3 and 5 and connect the 125-volt tap of the transformer to post 5 (Figure 1).

Newer machines have new basic power supply panels. The tube panel, if used, and the tube panel components are combined in the new panel (Figures 2 through 6).

NOTE: To change to a lower voltage on newer machines without terminal posts, refer to the machine wiring diagram for corresponding locations.

Voltage Requirements

1. Minimum voltages: 100vac line voltage for 115vac machines; 200vac line voltage for 230vac machines; 105vdc for DC machines.
2. Good rectifiers may have 20% variation in voltage among the legs. A large variation in AC voltage across the four sections of the rectifier usually indicates an open circuit in one section.

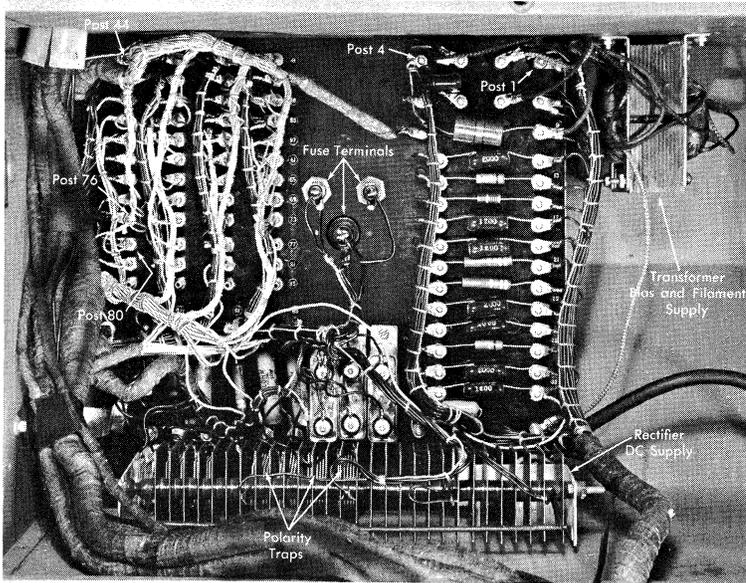


Figure 1. 24-Base Power Supply (Old Style)

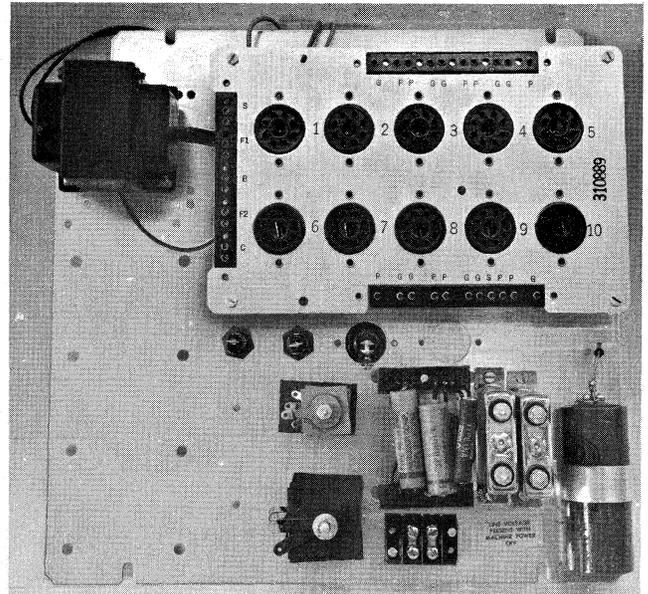


Figure 2. Power Supply for IBM 24-26

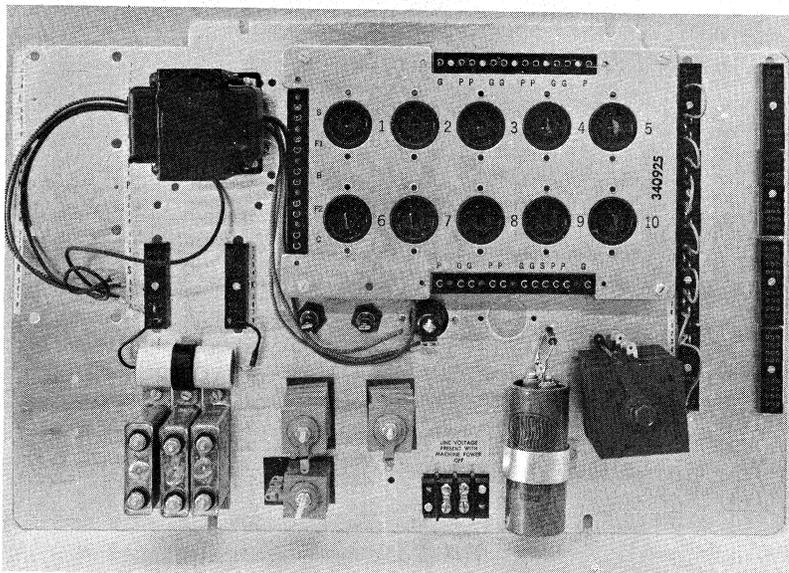


Figure 3. Power Supply for IBM 56

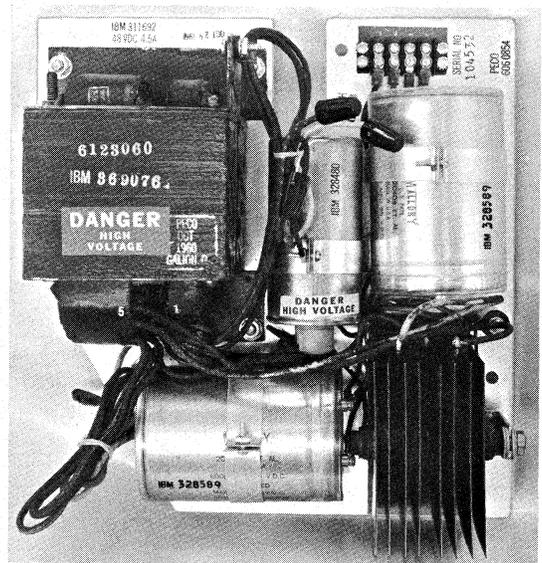


Figure 4. Power Supply for IBM 46-47, 65-66, and 834-836

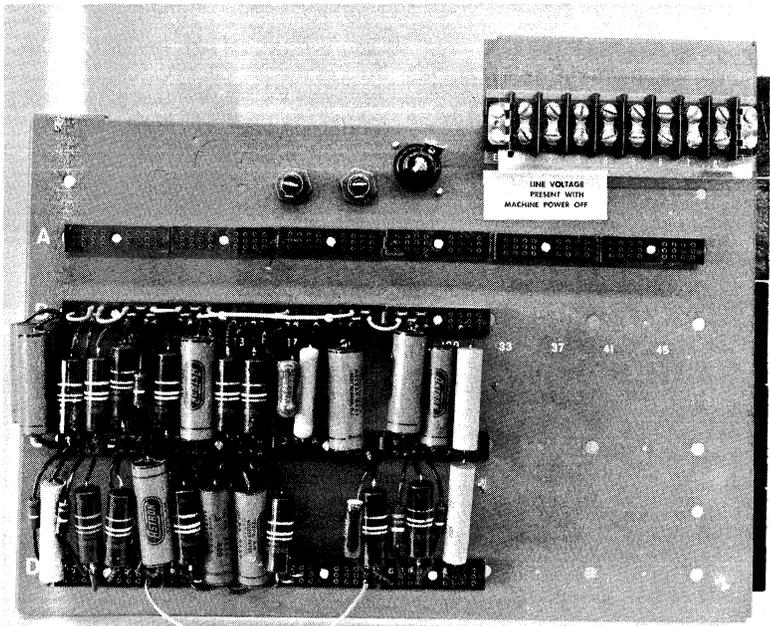


Figure 5. Power Supply for IBM 526

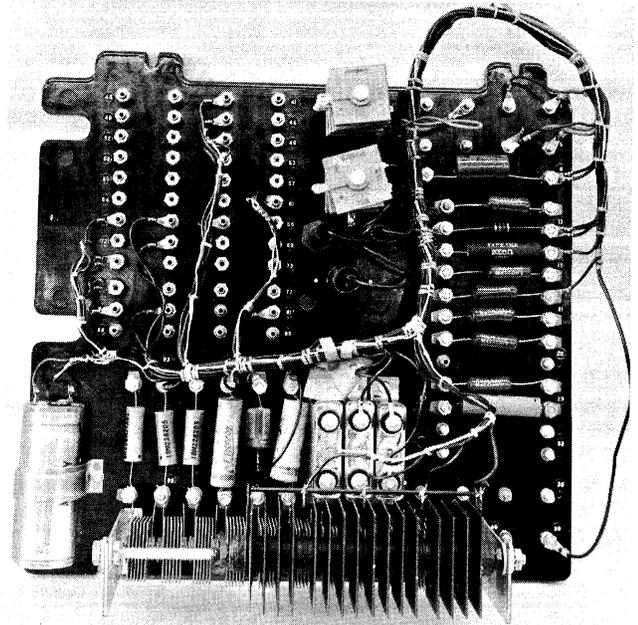


Figure 6. Power Supply for IBM 824-826

3. Voltage across the rectifier output should drop to no lower than 120vdc when a card punch or verifier is operating under maximum loading conditions (card feed).

4. For proper tube operation, the bias supply should be at least 40vdc. Measure between the BIAS and C terminals on tube chassis.

5. Improper voltage at the tube filaments is detrimental to tube life. On all tube machines, filament voltage of 22vac to 25vac should be maintained between FIL 1 and FIL 2 on the tube chassis when the machine is programmed for duplicating. To adjust the voltage, change the tap on the primary side of the filament transformer. Replace defective components to correct for low voltage.

2.1.2 DC Machines Using Dynamotors

SERVICE CHECK

The dc line voltage should not be below 105 volts. The rectifier output should show a voltage rise of about 25% above line input voltage. No figure for the dynamotor ac output is given; it cannot be measured accurately because of its harmonic content. Check the brushes for wear every six months.

2.1.3 Saturable Reactor Supply

SERVICE CHECK

Machines using saturable reactor supplies (Figure 7) should require little servicing except an occasional voltage check; 46-48vdc should exist between power pack terminals 3 and 4.

ADJUSTMENT

Machines using saturable reactor supplies have a variable resistor R3 that should be adjusted for a no-load voltage of 46-48vdc between power pack terminals 3 and 4.

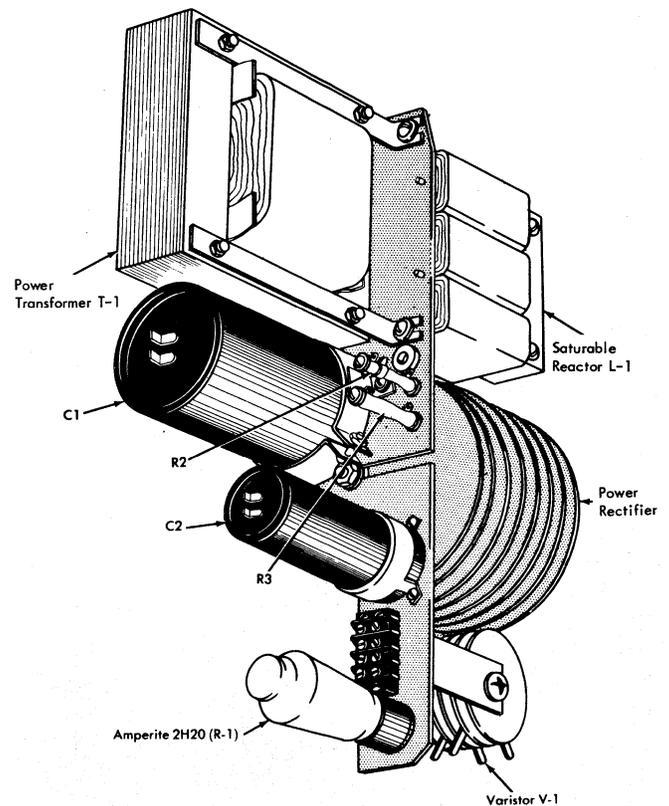


Figure 7. Saturable Reactor Supply

2.1.4 Constant Voltage Transformer Supply

SERVICE CHECK

This power supply is in the IBM 46-47, 65-66, and 834-836. Earlier machines use germanium diode rectifiers (Figure 8); later machines use selenium rectifiers (Figure 9). These supplies require only an occasional voltage check and should be set for 49-50vDC with no load.

ADJUSTMENT

These supplies have taps on the secondary winding to produce 49-50vDC with no load. Selenium rectifier resistance increases with age. To compensate for losses caused by aging, a tap on the secondary of the transformer permits an increase of 5.5 volts in the secondary voltage.

2.1.5 Vacuum Tubes

SERVICE CHECK

To check tube emission in the IBM 24, 26, or 56:

1. Adjust transformer taps for as near as possible to 25VAC between FIL 1 and FIL 2 (Figure 10).
2. Check DC voltage output for 120 volts (minimum) under an operating load. If voltage is low, disconnect the capacitor and take another reading. If the two readings are not appreciably different, a poor capacitor is indicated. Low voltage and a good capacitor indicate that the rectifier should be replaced.

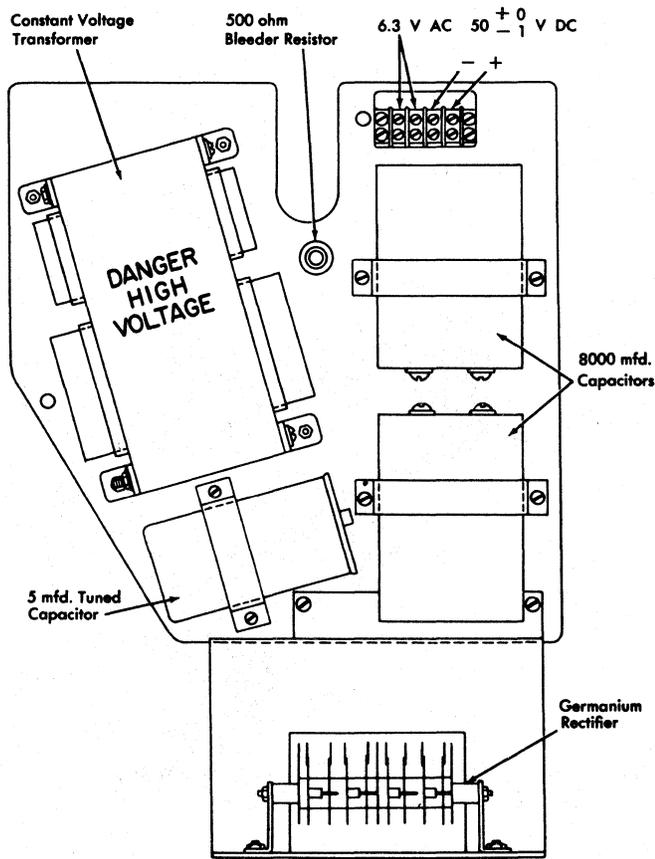


Figure 8. Constant Voltage Transformer Supply (Germanium)

3. Set auto feed switch to OFF. Connect IBM voltmeter plus lead to plus side of line and common lead to plate connection of escape magnet tube. When tubes are at operating temperature, manually pick up relay 1. Keep it up only long enough to obtain a reading. Move each tube into the escape magnet tube position and take a reading. Discard any tube that gives a reading below 67 volts. (Load resistance varies in the tube plate circuits. The 67-volt reading applies only when tubes are in the escape magnet circuit. The operation of the escape magnet, punch clutch magnet, keyboard restore magnets, and escape interlock relay are more critical than other components operated by tubes.)

To check for grid emission:

1. Have card lever relay de-energized and all tubes biased to cut-off.
2. Measure voltage drop across each load: connect one meter lead to plus side of line; touch the other lead successively to the P terminals on tube chassis for the readings. A 2-volt drop is permissible.

REPLACEMENT

Use only glass tubes for replacements; they have longer filament life than metal tubes do.

2.1.6 Relays

Refer to IBM Customer Engineering Reference Manual, Relays, Form 225-5857, for all standard relay adjustments.

High-speed relays (P/N 328273) of the IBM 46-47, 65-66, and 526 resemble other wire contact relays used in IBM equipment. Although the coil numbers are the same, high-speed relays are adjusted to different specifications at the factory. Give special attention to part number when ordering high-speed relays.

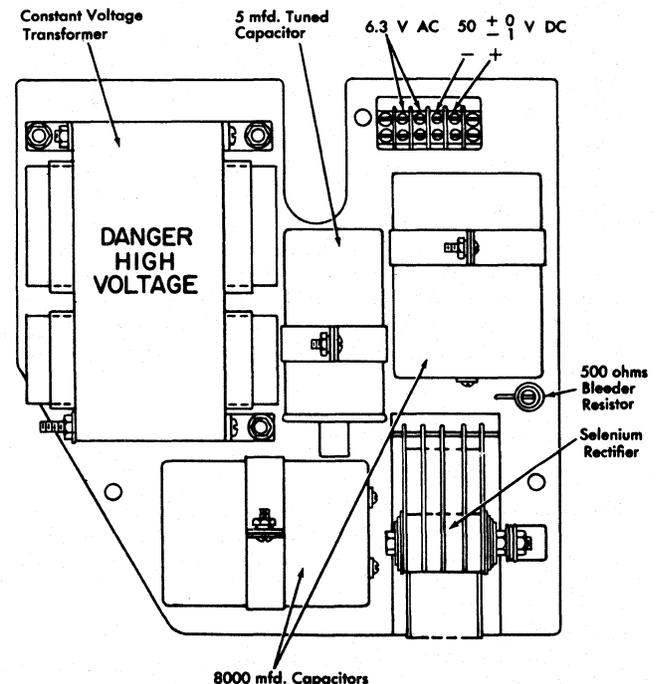


Figure 9. Constant Voltage Transformer Supply (Selenium)

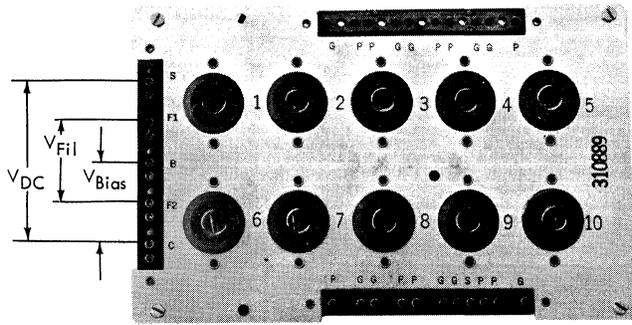


Figure 10. Tube Panel

2.1.7 Polarity Trap Selenium Rectifiers

These rectifiers have a current rating of 3 ma to 5 ma. Use an ohmmeter whenever circuits containing these rectifiers are to be checked. The small selenium rectifiers have their IBM part numbers stamped on them. The rectifiers and their location are in the wiring diagram legend. Check rectifiers by substitution.

2.1.8 Spark Suppressors

Check the spark suppression RC units by substitution, never by running the machine with the spark suppressors removed. The RC units are highly efficient at reducing destructive spark; operation of the machine without spark suppressors may cause considerable damage.

2.2 Drive

2.2.1 Drive Motors and Belts

SERVICE CHECK

The start relay cover can be removed for inspection. Factory lubrication of the motor should last one year, if normal usage is 40 hours per week. Oil sparingly. Check motor speed on DC machines.

ADJUSTMENT

Motor Speed. On DC machines, change position of slider contact on drive motor shunt field series resistor to change speed adjustment. Recheck torque of friction drive after changing motor speed. AC motors are not adjustable.

Belt Tension. Elongated motor mounting holes permit adjustment of belt tension for ¼-inch deflection midway between pulleys. The adjustable drive housing pulley is used to obtain the same tension on punch drive belt.

2.2.2 Reduction Drive

SERVICE CHECK

Check lubricant level annually if drive shows no sign of leaking and at least every six months if there are signs of leakage. (Oil seals are easily replaced.)

The housing and top cover must be removed to check oil level. No timing adjustment is necessary when installing the housing.

REMOVAL AND REPLACEMENT

Pulleys, retainer, and oil seal must be removed from shaft to push the front bearing into position on the IBM 46-47. The tape-reel drive mechanism must also be removed.

1. With worm shaft removed from housing, place front bearings on shaft against the shoulder. Install collar and lock it in place with .008-inch to .013-inch clearance to the bearing. See Figure 11.

2. With front bearing against worm gear shoulder, insert shaft in housing and lock front bearing in place with .003-inch to .005-inch end play of the worm shaft. No timing adjustment is necessary when installing the housing.

3. In the IBM 46-47, replace the tape-reel drive mechanism and check for freedom of operation before running under power.

Machines produced since July, 1956, use a reduction drive that is not encased in a housing (Figure 12). Speed reduction is achieved through external gears. The drive motor operates two belts to drive the punch clutch and to operate the reduction gearing, which operates the continuously running gear train.

2.2.3 Backspace Mechanism

SERVICE CHECKS

When backspacing, good registration should be maintained over a group of 20 consecutive columns.

The actuating arm should be straight and free of binds so that its spring can return it to normal.

ADJUSTMENT

1. Position backspace ratchet with its three screws to cause a card to backspace into column 1 and not into column 88 of program drum. Each backspace should cause escape wheel teeth to move 1¼ teeth past end of armature.

2. Position backspace switch to operate with ¼ inch depression of the actuating arm.

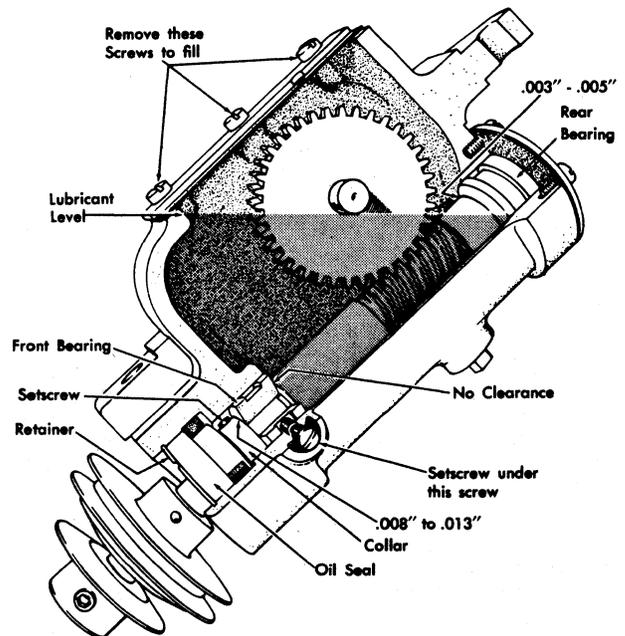


Figure 11. Reduction Drive Adjustment

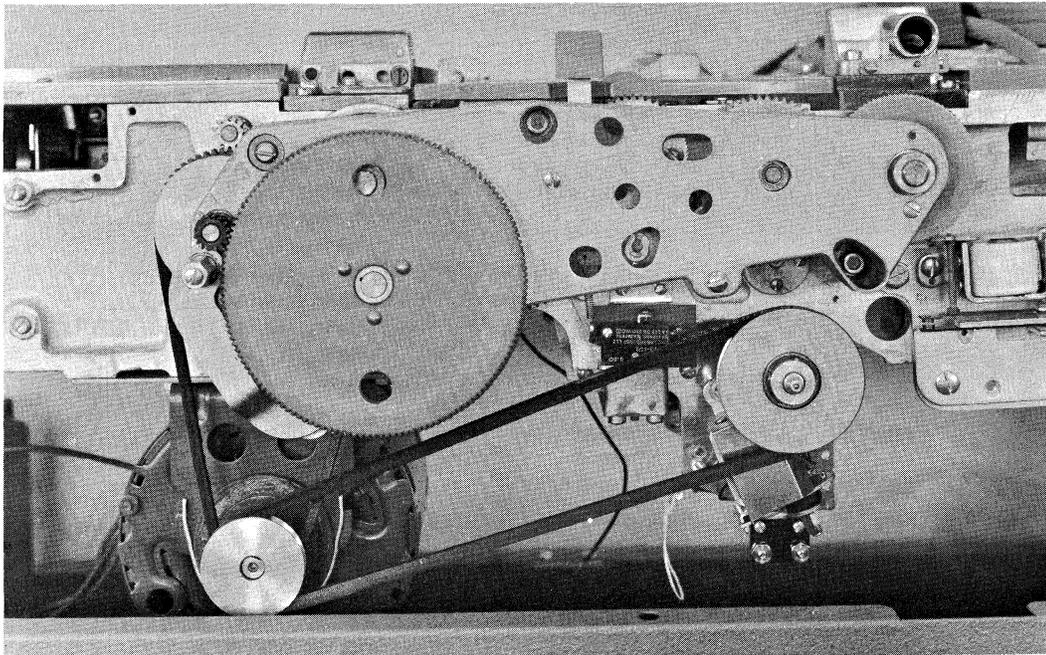


Figure 12. Reduction Gear Drive

2.2.4 Friction Drive

DANGER

When the friction drive on a machine with the high-speed skip device is serviced, the star wheels must be raised. With power ON, there is the possibility of injury if the star wheels initiate a high-speed skip. The friction drive is then bypassed, and the gears are turned directly and at high speed by the high-speed clutch.

SERVICE CHECK

Friction Drive. The drum type friction drive should provide 275 to 325 grams of torque. The graph-alloy type should supply 250 to 375 grams.

To check torque, set index at about column 40 by depressing escapement armature by hand. Hold gram gage in left hand and engage escapement wheel (Figure 13).

NOTE: Machines leaving the factory between July, 1954, and February, 1955, do not have means of engaging the escapement wheel. On these machines, replace the thumb-screw that holds unused blade on gram-gage with a 5-40 screw and engage the program wheel (Figure 14).

Press release key and bring right index finger to bear on the X 10 blade. Gradually release pressure of left hand until only the blade prevents turning of wheel. Read gram gage.

Friction Clutch. Machines leaving the factory since November, 1955, use a drum-type friction clutch. This clutch provides more stable torque than earlier devices, but requires lubrication. For normal use, lubricate at least yearly with medium silicone grease (1/4-ounce tube, P/N 265390; 2-ounce tube, P/N 341016).

ADJUSTMENT (FRICTION DRIVE TORQUE)

Drum Type

1. Manually escape machine until drum adjusting screw is at the top.
2. Turn power off and manually turn belt until hole at top of housing lines up with adjusting screw.

3. Adjust screw for required torque. Turn clockwise to increase torque; a half-turn changes torque about 60 grams. *Graph-Alloy Type.* Adjust by setting spider spring tension.

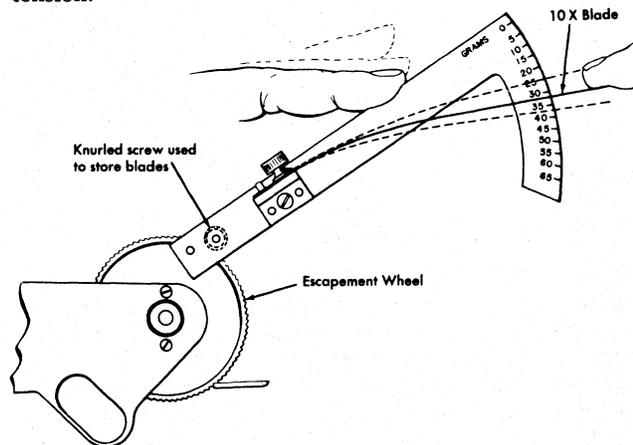


Figure 13. Friction Drive Adjustment

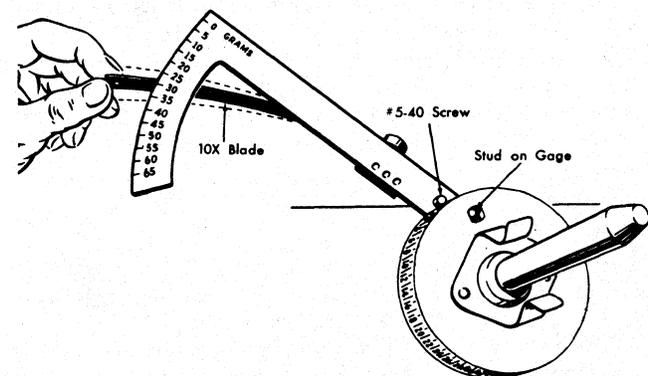


Figure 14. Friction Drive Adjustment

2.2.5 Escapement Unit

SERVICE CHECK

Check the residual on left yoke end for wear; clean dirty points; and lubricate armature pivot. Clean oil and dirt from escapement wheel. Too much torque on friction drive may make escapement armature slow to pull out. The escapement wheel must be kept free of lubricants. Incorrect strap tension or improper make time of the escape armature contact may cause double spacing.

The contact operating pin should be free enough to rotate between the finger tips. A binding or canted operating pin usually indicates poor adjustment of the unit.

Wipe off excess lubricant around escapement armature pivot. Grease at this point picks up dirt and card chips and may cause escapement failures.

ADJUSTMENT

1. Remove escapement magnet unit from machine.
 2. Make adjustments 1 through 7 in Figures 15 and 16.
 3. Replace magnet unit.
 4. Make adjustments 8 and 9 in Figure 16.
- The escapement armature pivot spring must hold the

escapement armature against the yoke at the pivot point as shown at 2, Figure 15. Avoid putting sharp bends in spring straps while forming them. Note that the escapement armature has its top side counterbored .156 inch by .010 inch deep at the hole in which the contact operating pin fits. The counterbore is a mark for the top side of the armature. Machines produced after July, 1954, do not have the counterbored escapement armature. Instead, the out-board edge of the armature is notched at a point near the hole for the operating pin. The end is ground at a 5° angle. The armature must be right side up for proper operation.

Escapement Gearing. Keep escapement gear train lubricated on machines using the drum-type friction clutch; keep it dry where graph-alloy disks are still in use. An oily graph-alloy friction ring and gear assembly (P/N 313428) should be replaced. Keep card chips and other foreign matter out of escapement gears and friction drive. An apparently faulty escapement may be caused by incorrect torque at the friction drive. All gear shafts protruding through gearing bracket must be pulled to the extreme forward position before collars are tightened. Be sure unsealed bearings are capped.

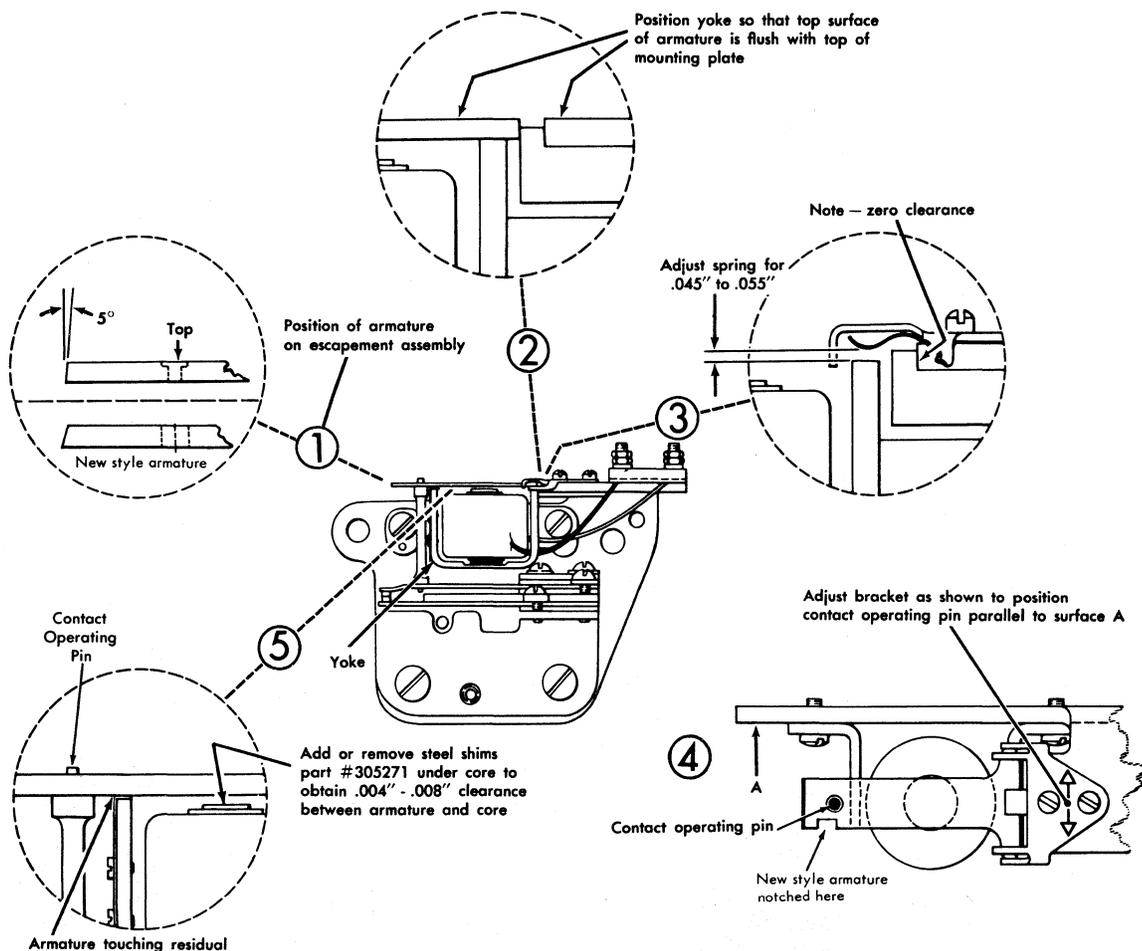


Figure 15. Escapement Adjustment

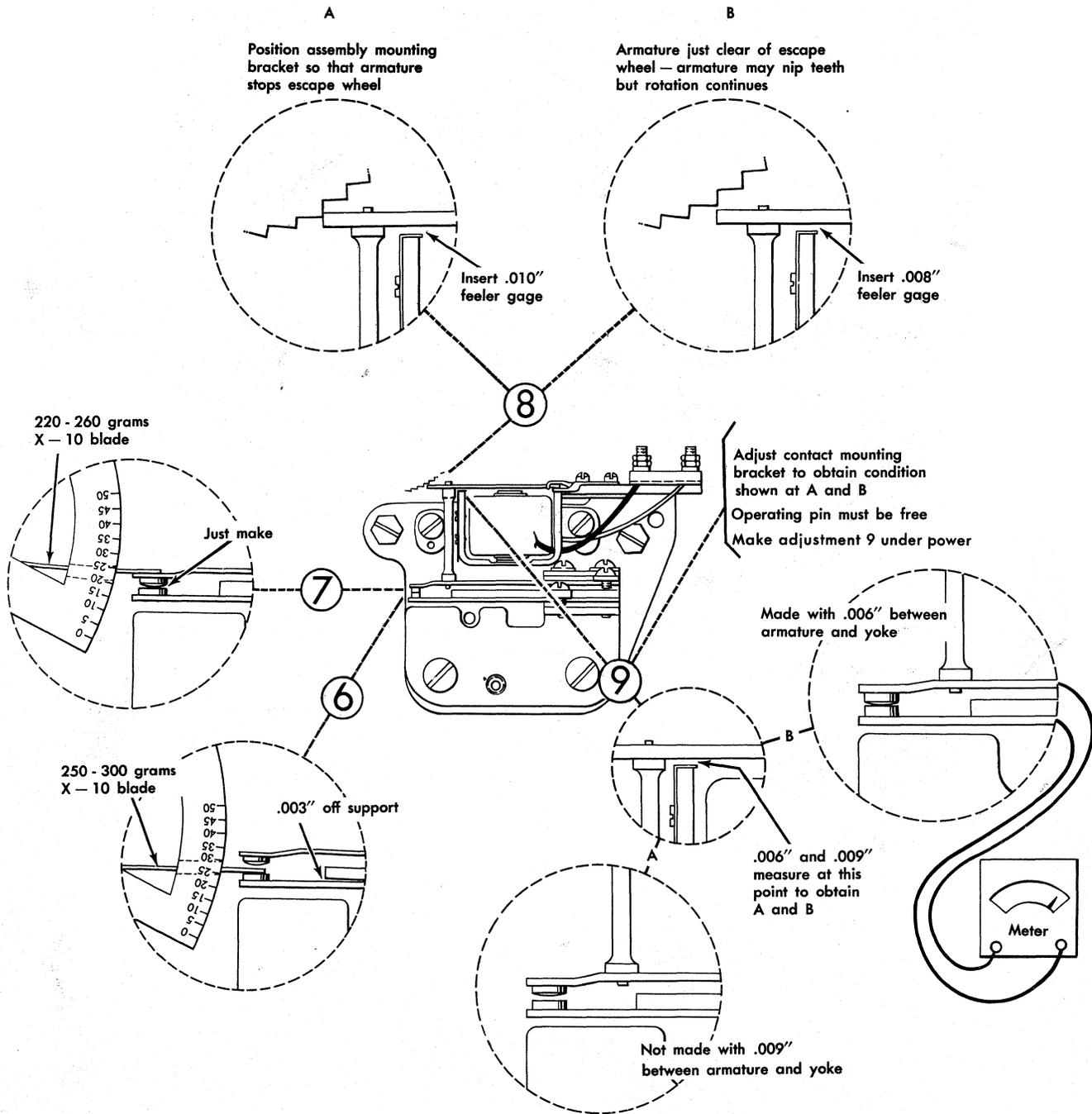


Figure 16. Escapement Adjustment

2.3 Card Feed

2.3.1 Hopper

ADJUSTMENTS

Magazine Springs. Form magazine springs to touch feed bed (1, Figure 17).

Feed Knives. Adjust feed knives with a GO/NO-GO gage for a projection of .004 inch to .0045 inch (2, Figure 17). With CF latch armature engaged with CF cam follower arm, adjust both feed knives evenly to give minimum clearance of .015 inch (.040 inch maximum) from feed knives to top edge of cards in hopper (3, Figure 17).

Throat. Adjust throat block (4) to place crown in direct line with top edge of throat knife. Adjust throat knife (5) for an opening of .008 inch to .010 inch. If throat block is properly adjusted, a .008-inch gage should freely pass in three directions (Figure 17), but a .010-inch gage will not.

Pusher Plate. The card feed pusher plate (6) should be under tension of 4 or 4½ turns of the spring shaft when inserted from rear of hopper.

2.3.2 Feed Clutch

ADJUSTMENTS

1. Adjust magnet yoke adjusting screws (Figure 18) for .032-inch to .036-inch clearance between armature and yoke at the operating end.

2. Form armature spring to exert tension of 100 grams to 120 grams in direction of A (Figure 18) and 230 grams to 250 grams in direction of B.

3. Position CF magnet unit to obtain .010-inch to .014-inch unlatching clearance between armature and CF dog with armature attracted (Figure 19).

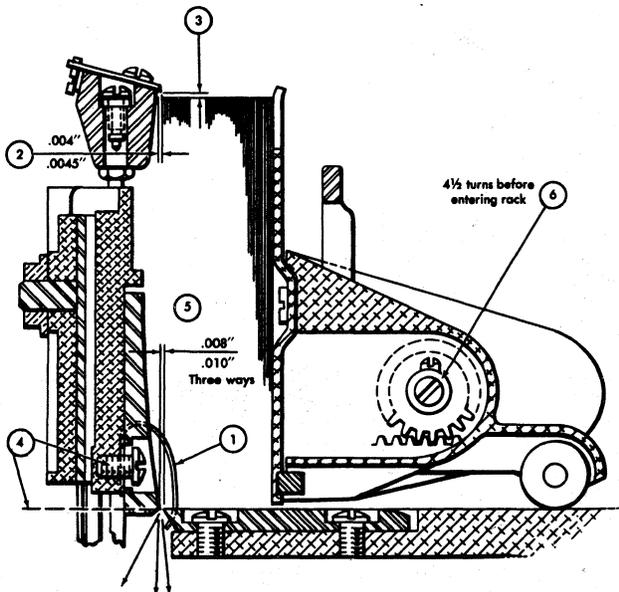


Figure 17. Hopper Adjustment

2.3.3 CF Latch Magnet

ADJUSTMENT (Figure 20)

Yoke and Armature

1. With contacts properly aligned against contact supports, turn armature backstop screw up until stationary contacts rise ½-inch off their supports.

2. Position magnet yoke so that lower arm of yoke strikes armature with a .010-inch gage between armature and magnet core. Tighten screws.

3. Back off backstop screw two full turns.

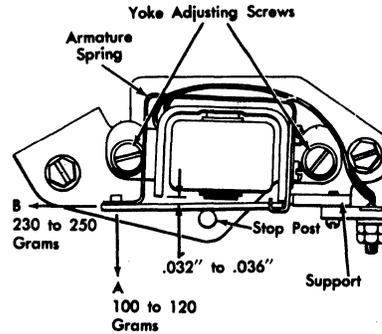


Figure 18. CF Clutch Magnet Adjustment

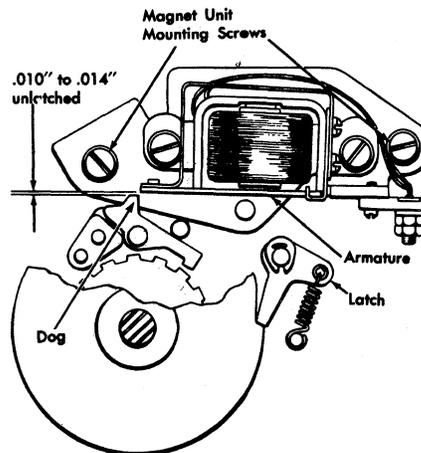


Figure 19. CF Clutch Adjustment

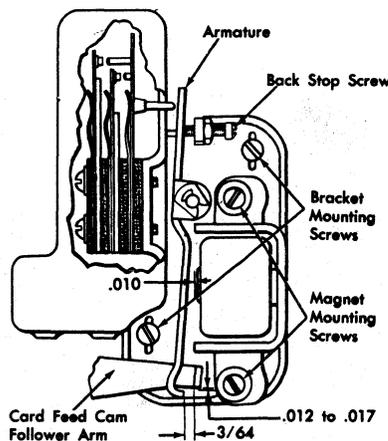


Figure 20. CF Latch Magnet Adjustment

Assembly

1. Provide $\frac{3}{4}$ -inch (.047-inch) clearance from latch magnet armature to ear on CF cam follower arm (Figure 20).

2. At same time, position assembly vertically to provide .012-inch to .017-inch latching clearance from cam follower arm to armature tip when armature is attracted.

2.3.4 Card Aligner Fingers

ADJUSTMENT

Factory adjustment for the card aligner fingers is .020 inch to .040 inch motion ahead of top card rail. This adjustment can be altered by adjusting the eccentric cam follower for maximum forward travel of .055 inch.

The card must snap off the card aligner fingers and into position along the top rail before registration. Otherwise, the first 15 columns may be in correct registration and the rest of the card may be off-registration to the left. To correct this, adjust the pressure rails for 23 grams to 27 grams pressure on a card in the detail bed (Section 2.3.5). Check the front face of the aligner fingers for travel past the upper rail of .040 inch to .055 inch. Up to 10° backward angle should help the card snap off the fingers before it is gripped by the feed wheel.

2.3.5 Pressure Rails

For pressure rail card lever contact adjustments on variable length card machines, see Section 2.13.5.

ADJUSTMENTS

When making the following adjustments, hold the gram gage as shown in Figure 21. In this position, the eyes are free to watch the pressure rail leave the card.

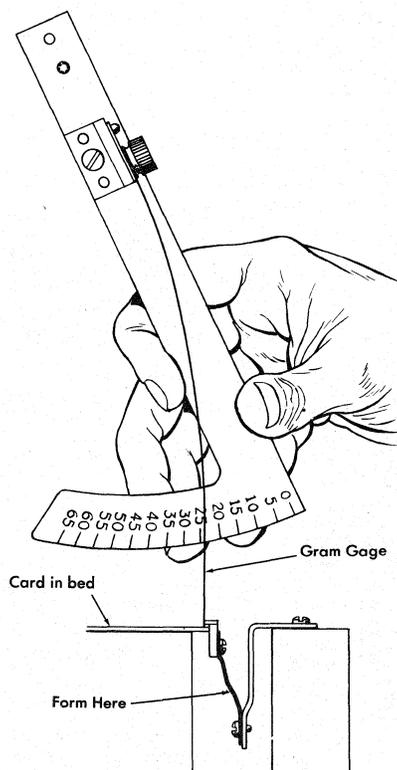


Figure 21. Pressure Rail Adjustment

Pressure Rails (Detail Station)

1. Form pressure rail springs on pressure rails in detail station to exert 23 grams to 27 grams pressure on a registered card.

2. Check tension necessary to move rail away from card evenly. Blade of gage must be held squarely against center of lip on rail.

Pressure Rails (Master Station). For the IBM 526 and 824-826, see Section 2.16; for 534-536, Section 2.17. For other machines with card lever contact:

1. Remove card lever assembly from machine and straighten stationary strap.

2. Hold assembly at the same angle it has in the machine (45°) and form operating strap for a contact air gap of .020 inch minimum (Figure 22).

3. Form stationary strap for minimum contact rise of .025 inch with 23 grams to 27 grams of force applied at center of lip on rail.

4. Install assembly in machine and register a card in master station.

5. Make refinements in card lever adjustment to exert 23 grams to 27 grams of pressure on the registered card with .025-inch minimum contact rise.

NOTE: Machines having pressure rail (Figure 21) in the master station should have 13 grams to 19 grams pressure on a registered card.

2.3.6 Card Bed Card Lever Contact

ADJUSTMENT

1. Form support strap of stationary contact for an .015-inch to .020-inch air gap (Figure 23).

2. Form operating strap to require 5 to 8 grams pressure to close contact points.

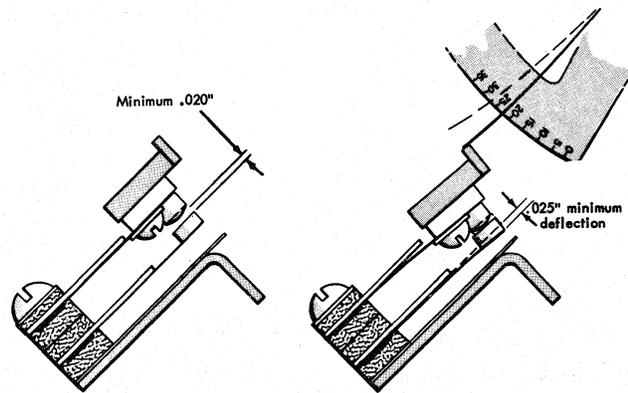


Figure 22. Pressure Rail Card Lever Contact

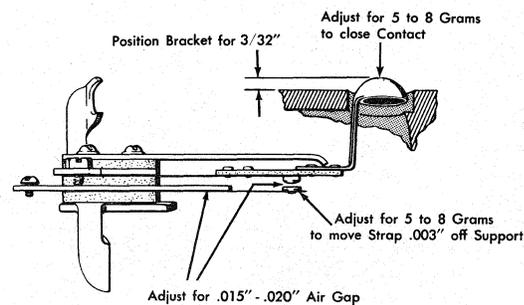


Figure 23. Card Lever Contact Adjustment

3. Form stationary strap to require 5 to 8 grams of pressure to move strap .003 inch off its support.

4. Position contact bracket so that top of the key is $\frac{3}{32}$ inch above bed.

2.3.7 Card Lever Pressure Finger

ADJUSTMENT

1. Form finger spring to obtain 45 to 55 grams of tension toward the bed. Measure at the point over the card lever key, with the pressure finger adjusting screw against its stop.

2. Adjust screw for .015-inch to .020-inch clearance from bottom of finger to bed. If bottom edge is not smooth, stone it.

2.3.8 Card Guides

ADJUSTMENT

Detail Station. Loosen card guide holding screws and position card guide for .020-inch to .024-inch clearance to detail card bed (Figure 24).

Master Station. Position master station card guide to obtain .013-inch to .017-inch clearance to center bed plate (Figure 25).

2.3.9 Card Registration

SERVICE CHECK

Registration should be checked every time the card punch or verifier is serviced. Improve operation of the register and eject arms by lubricating the roller pivots with IBM 6.

ADJUSTMENT (FIGURE 26)

Pusher Pad

1. Adjust pusher pad vertically for .008-inch to .010-inch clearance from top of pad to pusher arm in the registered position (against its adjusting screw). Maintain $\frac{1}{4}$ -inch clearance from side of pad to the arm. At same time, check for at least .008-inch clearance between top of right bed plate and pusher arm (in position shown in Figure 26). If there is not .008-inch clearance, bed plate may be warped.

2. Back away pusher arm stud to be sure it does not interfere with registration; then adjust registration screw for correct registration.

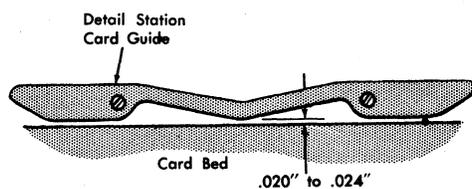


Figure 24. Card Guide, Detail Station

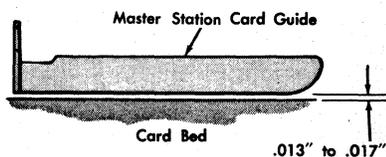


Figure 25. Card Guide, Master Station

3. Set card feed index at 50°; adjust pusher arm stud for .003-inch to .008-inch clearance to pusher arm.

Pusher Arm. For late model machines having die-cast pusher arm assembly (Figure 27):

1. Position card pusher arm stop to .004 inch below upper edge of right bed plate.

2. Back away pusher arm stud to be sure it does not interfere with registration.

3. Set registration adjusting screw for best punching registration.

4. Set card feed index at 50° and adjust pusher arm stud for .003-inch to .008-inch clearance to pusher arm.

Card Pusher Hood Plate: Machines without the new style card pusher hood have a plate to hold the second card in the detail bed and keep it from interfering with the first card. The plate is formed for .015-inch to .020-inch clearance to the bed. Clearance should be checked with the pusher hood installed.

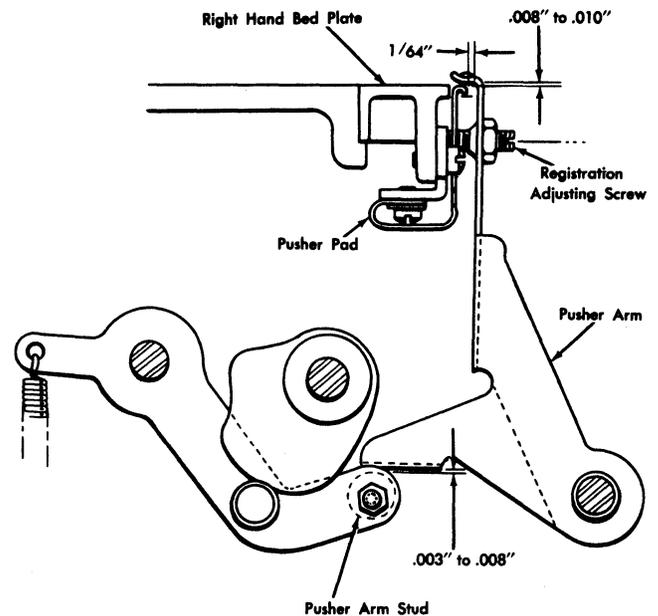


Figure 26. Detail Card Registration

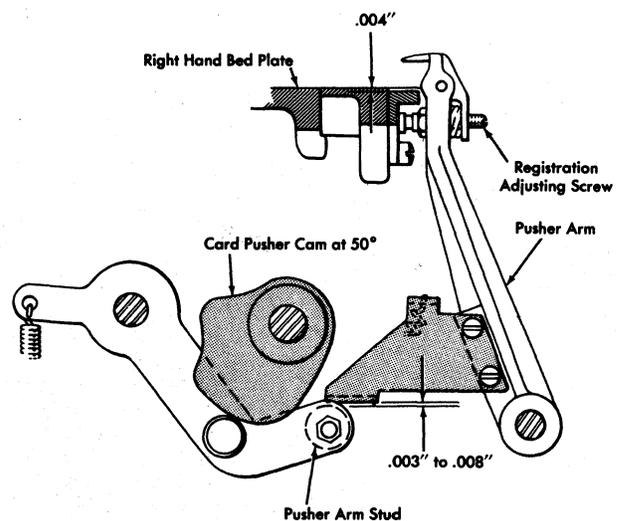


Figure 27. Detail Card Registration (New Style)

2.3.10 Pressure Rolls

ADJUSTMENT (FIGURE 28)

Pressure Roll Opening (Detail Station)

1. Turn card stop cam until cam follower is on high dwell of cam (index at 22° to 45°).
2. Adjust eccentric on stop lever cam arm for .025-inch to .035-inch opening between detail station pressure roll and large feed roll.

Pressure Roll Opening (Master Station). On older machines, the stacker plate may have to be removed to make this adjustment. On later models, the lock screw is accessible if the front rail at the stacker card station is removed.

1. Turn card stop cam until cam follower is on high dwell of cam.
2. Loosen locking screw in release pin arm (pressure roll release lever on newer machines). See Figure 28.
3. Twist release pin arm until there is .025-inch to .035-inch clearance between master station pressure roll and large feed roll.
4. Tighten locking screw.

2.3.11 Card Feed Pressure Roll Springs

SERVICE CHECK

Check for even drag on a card inserted endwise at either side. Rollers should be free of binds, and the two flat springs should be straight when removed from the machine. Misalignment or uneven tension on the pressure roll bar may cause uneven feeding.

2.3.12 Registration

Detail Station. Check pressure rail tension (Section 2.3.5) before making this adjustment.

1. Loosen registration locking screw (Figure 28).
2. Adjust lateral position of detail pressure roll with the registration adjusting screw so that cards feed without walking toward or away from top guide rail.
3. Tighten registration locking screw.

Master Station. The master pressure roll lever pivot is an eccentric.

1. Loosen set screw (Figure 29) and rotate pressure roll lever shaft until card does not pull away from upper rail when spacing.
2. Tighten locking set screw.

2.3.13 Feed Wheels

REMOVAL AND ASSEMBLY

Detail Station. On printing punches, remove chip tube, print head (keeping bushing on the print wires on IBM A print heads), plastic bed plate, and die and stripper; then proceed with steps 1 through 5. On nonprinting punches and verifiers, separate feed wheel and shaft using procedure listed in the following subsection for master feed wheel; then remove die and stripper or verifying frame assembly and proceed with steps 1 through 5.

1. Drive taper pins out of escapement wheel and space gear.
2. Remove collar from escapement wheel shaft.
3. Slide shaft toward rear of machine and slip off escapement wheel and gear.

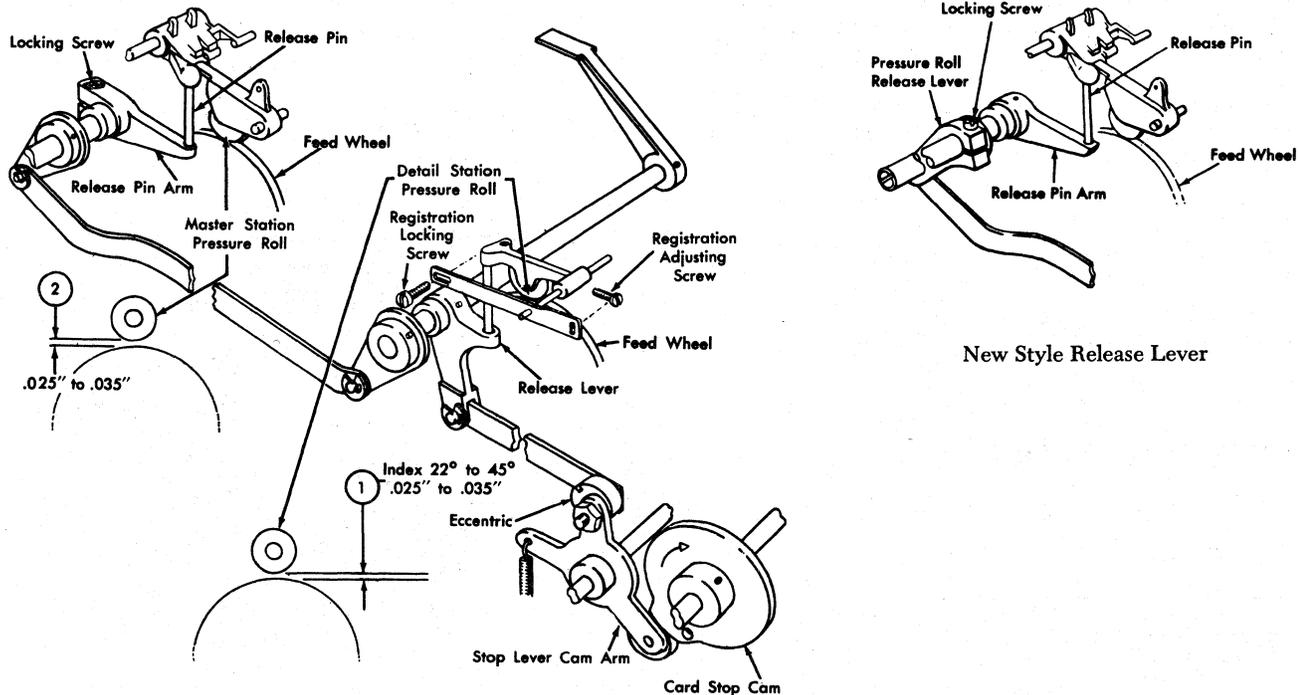


Figure 28. Pressure Roll Adjustment

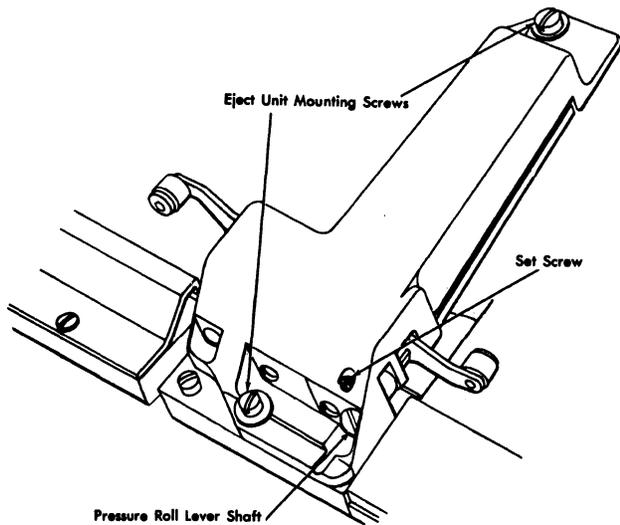


Figure 29. Master Station Registration Adjustment

4. Slide shaft back far enough to insert, by hand, one taper pin. Use this pin to force ball bearing out of the base casting.

5. Pull pin and bearing free of the shaft and slip shaft through to the inside base and out the top.

When replacing these assemblies, pull escapement wheel shaft toward the bearing in the space gearing bracket and lock the collar. There should be little or no end play of the escapement wheel shaft. **NOTE:** Check timing of program cam and sensing contacts and adjustment of back spacer. On the IBM 26, check printing and adjust if necessary.

Master Station. The feed wheel is pressed on as well as pinned to the shaft.

1. Remove eject unit and stacker plate. (Check adjustment of floating card guide so that stacker plate can be replaced in the same position.)

2. Take out pin sensing unit.

3. Withdraw the taper pin holding space gear to feed wheel shaft, but do not remove it from the feed wheel.

4. Remove the three collars and outboard bearing plate. (On some machines, it may be necessary to drive the dowels out through the base. Clearance has been provided for this.)

5. Remove friction drive (the pins will push out).

6. Remove clip from read pressure roll release arm and turn arm so that feed wheel shaft assembly can be pulled to front of the machine for removing bearing and bearing adapter.

7. Pull out feed wheel shaft assembly from the rear.

To reassemble, reverse the removal procedure. Readjust stacker plate and pin bail drive link. Remove end play from each shaft before tightening the three collars.

2.3.14 Card Feed Circuit Breaker

SERVICE CHECK

Replace badly pitted or worn points. Check for worn operating arm rollers.

ADJUSTMENT

1. Align points to make sides and faces of contacts parallel.

2. Adjust stationary contact for .020-inch to .025-inch air gap on high dwell of cam.

2.4 Punch and Verifier

2.4.1 Index Pointer

ADJUSTMENT

With clutch detent back against clutch latch, set index pointer to $345^\circ \pm 2^\circ$. Be sure that pointer clears index wheel.

2.4.2 Interposer Magnet

ADJUSTMENT

1. Position armature pivot plate as shown in Figures 30 and 31.

2. Form armature spring retention hook to lift tip of armature until there is at least $\frac{1}{8}$ -inch free movement to the operating end (Figure 32).

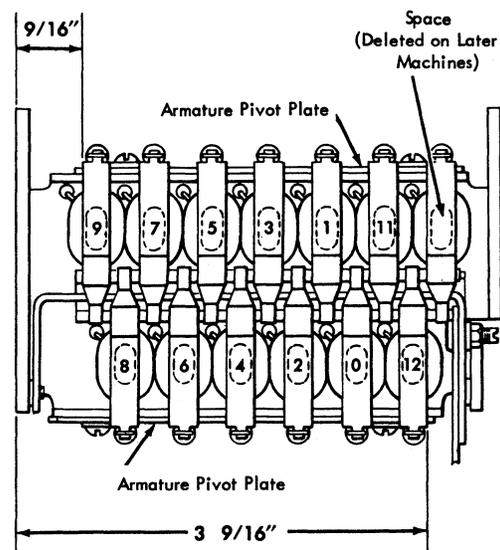


Figure 30. Armature Pivot Adjustment

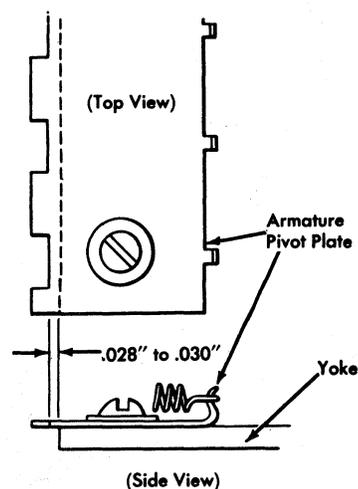


Figure 31. Armature Pivot Adjustment (Side View)

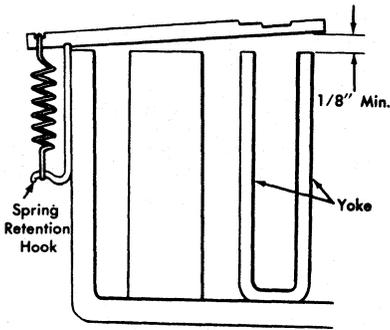


Figure 32. Armature Adjustment

2.4.3 Guide Comb and Bumper

With clutch latched, adjust guide comb and bumper to make bumper portion hold punch operating arms down against punch bail. When interposers are hooked under the bail, there should be .003-inch minimum clearance between bottom of bail and the interposers (Figure 33). Check adjustment by placing the hand on the punch arms to take up any clearance between the top of the punch arms and the guide comb and bumper; then trip all interposer armatures. All positions should latch under the bail.

2.4.4 Interposer Bail Contacts

Bail contact assemblies may be removed after removing the master bed plate or punch or verifier drive unit.

1. Both contact assemblies must have equal tension. Form stationary contact strap to require 30 grams to 35 grams to raise it off its support. Forming should be within the area of the support strap to reflect a true condition. One method of forming the contact strap is to insert a straightened paper clip between the strap and its support. Form contact strap to obtain a point-to-point contact at

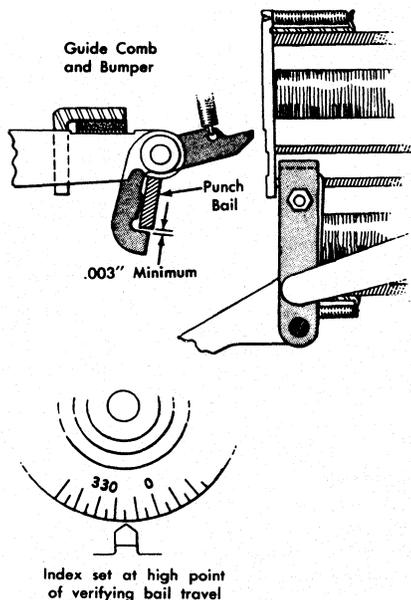


Figure 33. Guide Comb and Bumper

outer tip of support strap. When strap is properly adjusted, a crack of light will appear at tip of support strap during measurement.

2. With contact assemblies removed, form operating strap near the mounting to require 20 grams to 25 grams to close contacts (Figure 34). Place gram gage finger under phenolic pad with 1/4-inch overlap when checking adjustment; 50 grams to 60 grams should then be required to close contact and to raise stationary contact off support strap (Figure 35).

3. Reinstall the contact assemblies and adjust their mounting brackets for .017-inch to .023-inch contact gap with all the armatures restored.

2.4.5 Punch and Verifier Drive

REMOVAL AND REPLACEMENT

Punch Drive Unit (Printing Punch)

1. Remove:
 - a. Chip agitator flexible shaft (loosen set screw at lower end and unthread shaft from gear; shaft has left-hand thread).
 - b. Belt guard and punch drive belt.
 - c. Auxiliary duplicating feature (if present).
 - d. Wires to punch drive unit.
 - e. Two screws in pin-sensing bail drive link.
2. Unhook print drive spring (Figure 36) and trip punch clutch armature to prevent damage to it. Hold index and remove screw with left-hand threads from end of punch shaft. Unscrew grease fitting from mounting plug.
3. Transfer upper end of vertical shift-plate spring to eye in bellcrank to permit passage of print arm. Disengage

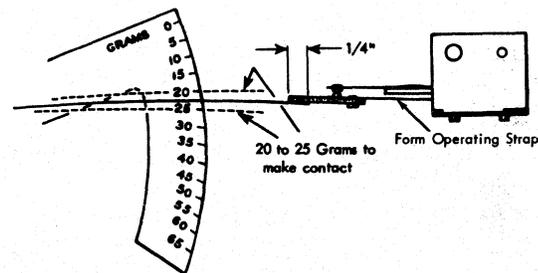


Figure 34. Interposer Bail Contact Adjustment
(See Figure 127 for transfer-type contacts).

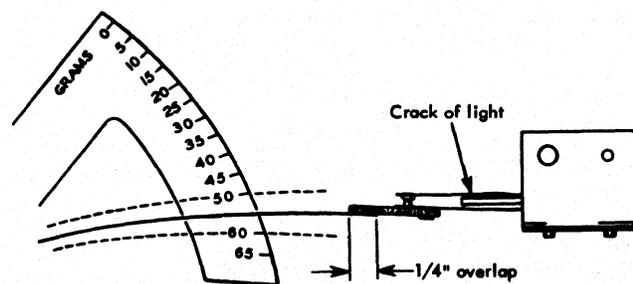


Figure 35. Interposer Bail Contact Adjustment
(See Figure 127 for transfer-type contacts).

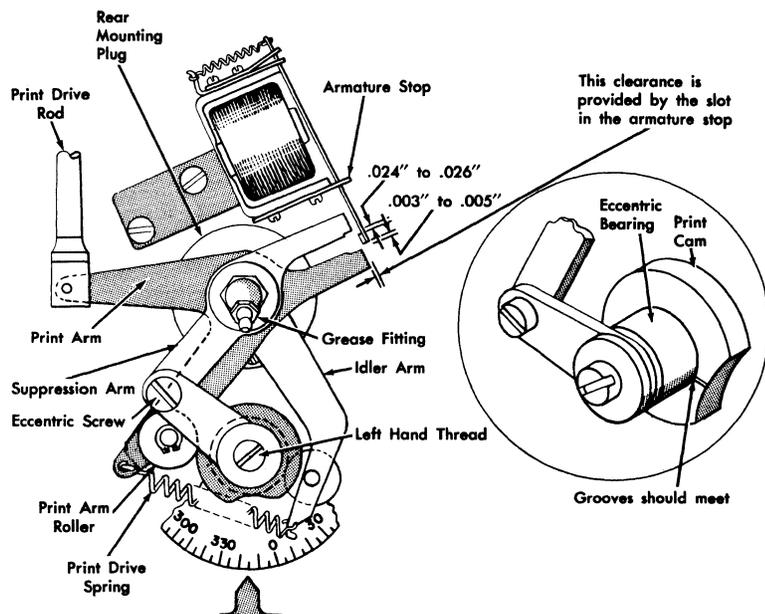


Figure 36. Print Drive Unit

print drive rod from print arm (Figure 36) by prying out on drive rod at lower end.

4. Lift print drive mechanism from rear mounting plug.

5. Remove two screws from each end of drive unit anchor bar.

6. Loosen screw in front mounting plug enough to permit disengaging the plug. Remove rear mounting plug screws.

7. Shake drive unit up and down (bed in vertical position) to free mounting plugs.

8. Turn drive unit clockwise and remove from base.

Before reinstalling drive unit, push punch extensions in as far as possible (by hand). Extend pin bail drive link. Line up groove in eccentric bearing and mark on print cam (Figure 36). Check printing.

Punch Drive Unit (Nonprinting Punch)

1. Remove belt guard and punch drive belt.

2. Loosen set screw in reduction housing gear hub and pull out flexible drive shaft. Use unused position of cable clamp to hold cable out of the way.

3. Remove the wires from punch clutch magnet, punch circuit breakers, and the slip connectors to interposer magnets.

4. Remove the two screws in pin sensing bail drive link. On reassembly, tighten these screws after punch drive unit is fastened into position with links extended.

5. Remove holding screw from inside of punch unit adjusting sleeve. Be sure locknut is tight so that it will not be necessary to readjust punch travel.

6. Pull out on mounting plug above punch clutch after starting it by shaking the punch drive unit. Mounting plug screws need not be completely removed.

7. Remove rear mounting plug. It can be started by pulling up on punch drive unit.

8. Remove the four screws holding anchor bar to base.

It should now be possible to pivot punch drive unit clockwise to slide it out of base and punch extensions.

Before replacing the unit, be sure all punch interposers are resting in center of armature slots. It is easier to re-engage punch operating arms with the punch extensions if they are pushed in flush with lower guide plate.

Verifier Drive Unit

1. Unhook notch drive link.

2. Remove all wires from cables to the unit.

3. Remove V belt and guard.

4. Uncouple sensing pin bail drive link.

5. Place blank card in verifying bed to prevent pin drivers from snapping up when verifying bail is moved away.

6. Remove notch drive spring and assemblies mounted on rear mounting plug. The screw in end of verifier shaft has a lefthand thread. Avoid force that will damage the clutch. Trip clutch if necessary and hold index with a cloth to avoid slippage.

7. Loosen front mounting plug screws. Leave screws holding by several threads to keep plug from falling out. It is not necessary to fully remove front plug.

8. Remove the four screws that hold anchor bar to machine base (two screws at each end of bar).

9. Remove rear mounting plug and shake unit to loosen front plug. Rotate unit clockwise out of base.

To assemble, reverse the procedure. Inspect pin bail drive link adjustment in rear frame.

2.4.6 Clutch Magnet

ADJUSTMENT (FIGURE 37)

1. Position armature stop assembly for .006-inch to .008-inch clearance between armature and yoke with armature attracted.

2. Form armature spring to exert tension in the direction of the arrows in Figure 37. Vertically, the tension should be 140 to 160 grams; horizontally, the tension should be 75 to 150 grams (preferably 140 to 150 grams).

NOTE. Keeper must not bind armature at pivot end. There should be no clearance between the magnet assembly, support bracket, and clutch armature keeper.

3. Attract armature and pivot magnet assembly about its support bracket to obtain .008-inch to .012-inch unlatching clearance to the step on the sleeve. At this point, it is important to check for .005-inch to .015-inch clearance between armature and sleeve (Figure 37). This clearance allows for any roughness on the sleeve that occasionally may strike the armature and cause the clutch to fail to latch up.

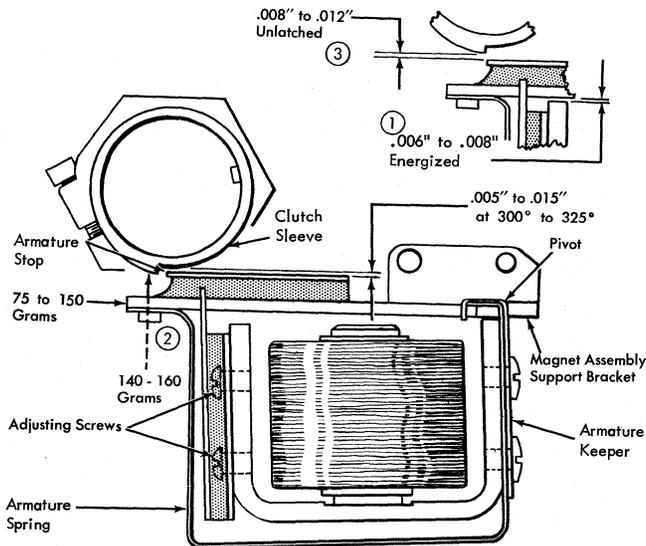


Figure 37. Punch and Verify Clutch Magnet

2.4.7 Punch and Verifier Clutch

SERVICE CHECK

Overthrow. Check clutch overthrow manually at every inspection. It is desirable to obtain 3° to 5° overthrow by hand. Avoid a condition that permits the detent latch to drop in without overthrow. Excessive overthrow however, can cause blank columns to appear in manual fields.

Armature Clearance. Check for armature-to-sleeve clearance of .005-inch to .015-inch (Figure 37). Any roughness on the sleeve may strike armature and cause clutch to fail to latch occasionally.

Timing. In servicing a machine on which correct timing of the clutch has been lost, first investigate the condition of the clutch spring. Forcing the index wheel by hand will usually reveal a broken spring.

Detent Latches. The detent latches installed in all early model machines were steel, bonded to rubber for quiet operation. This part frequently broke, or the bond between rubber and steel sheared. All old-style latches should be replaced with the improved detent latch, P/N 301296. The new style latch is neoprene-cushioned and does not rely on a rubber-steel bond for strength. Machines leaving the factory after May, 1953, are equipped with the new detent latch.

ADJUSTMENTS

Clutch Spring and Collar. (The clutch in the 65-66 Data Transceiver is similar to the error retention clutch in the 56 Verifier except that the 65-66 clutch latches only at 345°. Adjustment procedure for this clutch is outlined under "Verifier Error Retention Clutch Spring and Collar.")

1. With clutch sleeve latched on armature, uncoil spring within sleeve, by means of the adjusting collar, until it is tight within sleeve.

2. Rotate index to 348°, and lock collar.

3. Turn index by hand, and check for an overthrow of 3° to 5° past 345° to permit detent to drop in.

Error Retention Clutch Spring and Collar

1. Shift clutch collar counterclockwise until upper ear of clutch sleeve rests against right edge of notch in clutch collar (Figure 38).

2. Hold collar in position with left hand and shift verifier drive shaft slightly to point at which upper detent overtravels the detent latch by 1/32-inch.

3. Tighten collar clamping screw.

4. Test clutch by manually attracting armature and turning drive shaft; clutch should latch at about 135°. Again trip clutch and turn drive shaft; clutch should latch at 345°.

At each latch point, drive shaft should overtravel detent latch 3° to 5° on verifier index. If touch-up adjustment is necessary, it may be made without removing drive pulley.

REMOVAL AND REPLACEMENT

Clutch Spring and Collar (Removal). The punch clutch assembly for the IBM 65-66 is similar to the error retention clutch on the 56 Verifier. Unlike the 56 clutch, the 65 punch clutch has only one step on the clutch sleeve, and it will latch at just one point in the cycle (345°).

For 24-base machines without the error retention clutch:

1. With clutch latched, remove retaining collar and pulley.

2. Attract clutch armature; sleeve will be free to be pulled off.

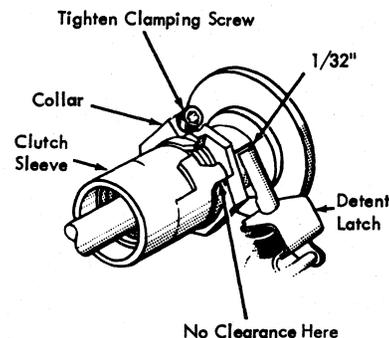


Figure 38. Clutch Adjustment

3. Loosen screw in adjusting collar and remove clutch spring and adjusting collar.

Clutch Spring and Collar (Replacement)

1. Install clutch collar against side of detent.
2. Lubricate clutch spring with IBM 22 and insert it under collar against shoulder on shaft. Avoid scratching or marring spring.
3. Install sleeve over clutch spring and engage stop inside sleeve with other end of clutch spring.
4. Rotate sleeve clockwise to expand spring, and locate pulley inside of spring.
5. Install retaining collar and, when pulley is properly located inside spring, the outer face of collar will be flush with end of shaft.
6. Adjust.

Error Retention Clutch Spring and Collar (Removal). IBM 56 Verifiers leaving the factory after October 1, 1953, are equipped with a later type of verifier clutch (Figure 39). The function of the clutch in relation to the error retention circuits is described in Customer Engineering Manual of Instruction *IBM 56 Verifier*, Form 223-6026.

The clutch adjustment makes the clutch latch properly at either of two points in the verifying cycle. In normal operation, the clutch latches at 345°. With the control switch in test position, if an error occurs, the clutch is required to latch at about 135° of the error cycle.

1. Remove belt from verifier drive pulley.
2. Check to see that clutch is latched. Then remove retaining collar on front end of verifier shaft; slip drive pulley off shaft.
3. Attract clutch magnet armature by hand to allow clutch spring to unwind.
4. Remove clutch sleeve.
5. Loosen collar clamping screw; turn collar to a point at which it clears clutch magnet armature and slip collar off drive shaft.
6. Remove clutch spring. If spring is to be reinstalled, take care not to scratch its surface. Note that spring differs from conventional type in that inboard tip is turned down instead of up.

Error Retention Clutch Spring and Collar (Replacement)

1. Slip spring onto shaft; align turned-down end with slot and work spring into position against shoulder on detent assembly.
2. Install clutch collar and clutch sleeve. See that ear (on sleeve) that aligns with spring stop (Figure 40) engages the notch on collar nearest head of collar clamping screw.

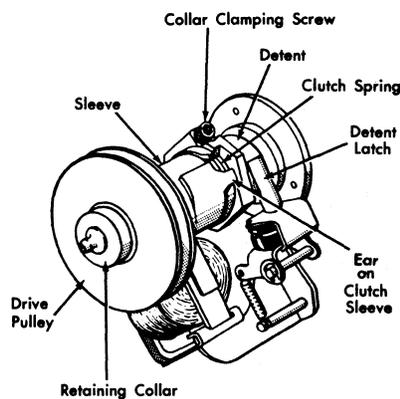


Figure 39. Error Retention Clutch

3. Set index to 345°. Turn sleeve and collar clockwise to a point at which spring stop (on front inner wall of sleeve) engages outboard tip of clutch spring. Continue to turn sleeve and collar clockwise until clutch magnet armature latches on a step on clutch sleeve.

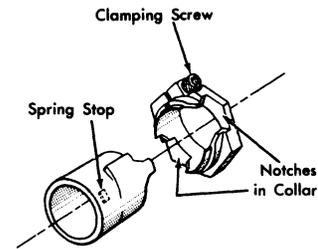


Figure 40. Clutch Sleeve and Collar

2.4.8 Punch and Verify Clutch Assembly (New Style)

All IBM 24-base machines manufactured or reconditioned after September 1961 have a redesigned outboard sleeve and a bondless armature and bumper. The armature may be recognized by the two angle cuts on the latching edge. The sleeve has a different angle on the latch surface which is not readily recognized. The bumper is of a different material and has a new part number as noted in Figure 41.

NOTE: If it becomes necessary to field-convert an old-style punch-drive unit because of worn or defective parts, bills of materials may be ordered. All old-style clutch parts are still obtainable and may be ordered by individual part. The replacement of the old-style front-side frame will necessitate replacing all the parts listed in Figure 41. Also, the replacement of an old-style clutch drive shaft will require a clutch conversion.

ASSEMBLY AND ADJUSTMENT PROCEDURE

The new style split-sleeve clutch is designed to cause less impact on the clutch armature at latch-up time by unwinding the clutch spring earlier.

The components to be adjusted in relation to each other are: the inner sleeve, the outer sleeve, and the spring and clamping collar. The final timing relationship of these parts to the index is fixed by the clamping collar. When the clamping collar is loose, the above parts are free to slip around the shaft.

Three steps are necessary in the new style punch clutch adjustment:

1. The setting of the sleeve latching surface lead distance.
2. The overthrow.
3. A checking procedure to insure steps 1 and 2 were made correctly.

Reach each step completely before performing that particular part of the adjustment. Field evaluations indicate that after the procedure is understood, the adjustment can be made in five minutes or less. Disassembly is not necessary to obtain correct adjustments. Lubricate clutch with IBM 22.

5. Setting of Sleeve Latching Surface Lead Distance

1. Loosen the clamping screw. The clamping collar is a separate piece and can be moved independent of the inner sleeve at this time if it is loose enough.
2. Trip the clutch armature and turn the index wheel (not the drive pulley) forward until the inner and outer sleeve latching surfaces can be observed.
3. Position the clamping screw to an accessible position while holding the two sleeves with their latching surfaces

visible. The verifier clutch has a rivet end showing on the 135° portion of the outer sleeve and must be up as shown in Figure 42.

4. Move the outer sleeve in a clockwise direction against the spring (Figure 43). This sleeve can move very easily in a counter clockwise direction, and give a false indication of the latching surface distances. Therefore, keep the outer sleeve protrusion snug against the end of the spring in a clockwise direction.

Position the inner sleeve latching surface behind the outer sleeve latching surface as shown in Figure 43 below and keep the clamping screw accessible. Punch-clutch lockup is possible if the $\frac{3}{16}$ " is exceeded. Verifier outer sleeve damage is possible if the $\frac{5}{32}$ " is exceeded. Scribe a line on the outer sleeve to indicate the measured overlap. Future production will include an adjustment mark.

5. To prevent binds between the inner and outer sleeves, the clamping collar and inner sleeve must be pushed inward toward the machine base as the clamp is tightened. Now, tighten the clamping screw completely. Don't forget to keep the outer sleeve *snug against the end of the spring* (Figure 43).

Setting of Overthrow. To time the clutch to the index which results in 1° to 3° overthrow, loosen the clamping screw so that the shaft can be turned without disturbing the previously established relationship between the spring, inner and outer sleeves.

6. Loosen the clamping screw approximately $\frac{1}{4}$ turn. This is to allow the shaft to be turned inside the spring with *some resistance* but not so loose that the spring will move inside the inner sleeve.

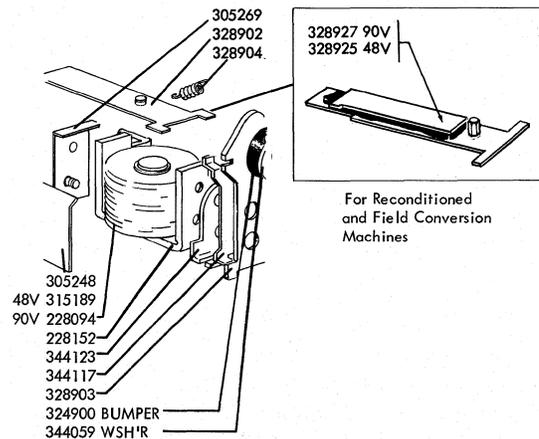


Figure 41. Punch Clutch Adjustment

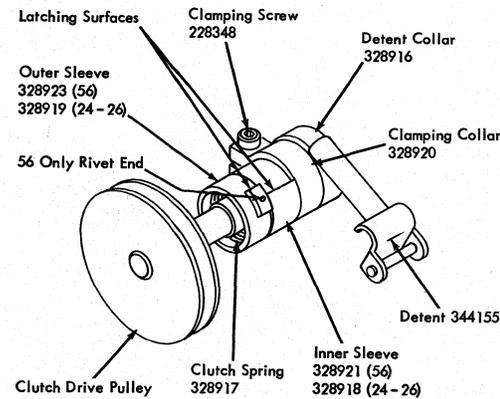


Figure 42. Punch Clutch Adjustment

7. Turn the index wheel forward until the inner and outer sleeve latching surfaces are driven against the armature. If the index cannot be turned beyond this point, the clamp is still too tight. Trip the clutch and turn the index wheel forward to where the clamping screw is accessible. Loosen the clamp a little more and repeat this step.

8. To get the correct overthrow, continue turning the index wheel forward to 347° (not 135°). This is 2° beyond the point where the detent drops into place. While turning the index wheel, hold the inner sleeve against the armature because it has a tendency to move backwards.

The verifier clutch has a rivet end showing on the 135° portion of the outer sleeve and must be up as shown in Figure 42 when setting the overthrow at 347°.

9. If the clamping screw is not accessible, hold the clutch armature in the attracted position, rotate the index until the screw can be tightened. Securely tighten the clamping screw.

Checking Procedure. To determine that the clutch is adjusted properly:

1. Trip the armature and check the outer sleeve lead distance with the clutch unlatched. Punch clutch $\frac{1}{8}$ " to $\frac{3}{16}$ ", verify clutch $\frac{3}{32}$ " to $\frac{5}{32}$ " (punch clutch lockup is possible if the $\frac{3}{16}$ " is exceeded. Verifier outer sleeve damage is possible if the $\frac{5}{32}$ " is exceeded).

2. While the clutch is unlatched, turn the drive pulley forward (do not use the index wheel) until the outer sleeve hits the armature and the index stops. This should be 325°

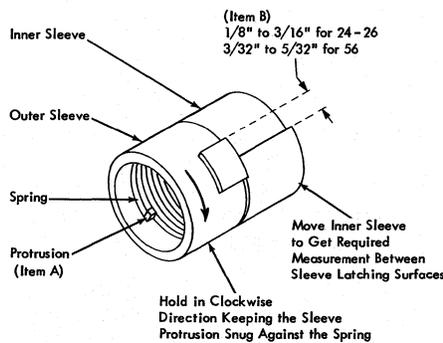


Figure 43. Punch Clutch Adjustment

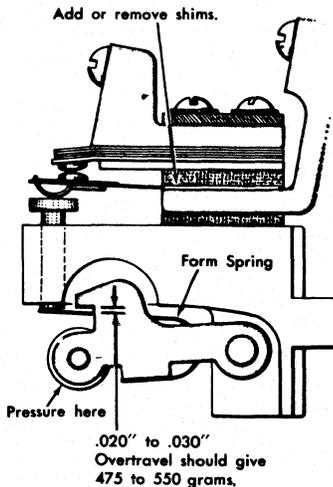


Figure 44. High-Speed Circuit Breaker

± 10 for the punch clutch. The verify clutch has two latch points and should stop at $115^\circ \pm 10$ or $325^\circ \pm 10$.

If these requirements are not satisfied, repeat the adjustment for the setting of the sleeve lead distance.

3. Check the overthrow for 1° to 3° with the clutch latched at 345° and the verify clutch at both 345° and 135° . If this check is not satisfied, repeat the overthrow adjustment.

Replace the clamp, P/N 328920, if the clamp faces meet when tightened. Replace the clutch spring, P/N 328917, if the spring becomes distorted.

Once this adjustment procedure is read and understood the following summary can be used to make the adjustments:

1. Loosen the clamping screw and position the sleeves and collar to an accessible location using the index wheel.
2. Hold the outer sleeve against the spring tip and set the inner sleeve for the proper lead. The verifier sleeve should have the rivet up at this time.
3. Tighten the collar to where the index can be turned with some friction after the sleeves are stopped by the armature.
4. Turn the index wheel to 347° and tighten the clamp securely.
5. Follow the checking procedure.

2.4.9 High-Speed CB Assembly

SERVICE CHECK

Check for binds in rollers, operating pins, and plungers. Inspect cam surfaces for irregularities due to wear or dirt. Wipe cam surfaces clean before adding new lubricant. Replace all weak springs and worn cam followers. If an abrasive tool is used in removing burned spots, check the contact make and break timing.

ADJUSTMENT

1. Remove CB assembly from machine. Shim for .027-inch to .032-inch contact air gap with plunger seated against frame (Figure 44).
2. Form operating strap to require 100 grams to 150 grams of pressure, at tip of strap, to close contact.
3. Form cam follower spring to require 475 grams to 550 grams of pressure to close contacts with .020-inch to .030-inch overtravel of cam follower.
4. Install CB assembly in machine but do not completely tighten holding screw. Turn CB to low dwell and turn adjusting screw to obtain .017-inch to .023-inch contact air gap.

REMOVAL AND REPLACEMENT

High-Speed Cams

1. Remove notching cam if machine is a verifier.
2. Remove pin from index and slip it off shaft.
3. Unhook knockoff bail arm and pin drive link springs.
4. Drive taper pins from the two mechanical cam assemblies.
5. Loosen set screws in all circuit breaker cams.
6. Slide shaft toward clutch end until end of shaft clears rear bearing. It may be necessary to shift clutch magnet assembly to allow clutch collar to pass clutch magnet armature. Remove desired cam.

2.5 Punch

2.5.1 Die and Stripper

SERVICE CHECK

A crayon or pencil deposit sometimes forms on the underside of the die and can cause a drag on the card resulting in off-registration punching. These deposits can be removed with a feeler gage.

A convenient method of lubricating the porous bronze punch guides is to multiple-punch several columns of an oiled IBM card.

ADJUSTMENT

Die and stripper clearance is set at .020-inch to .026-inch on nonprinting punches. On printing punches, clearance should be .012-inch to .017-inch. Shims have been provided to increase die and stripper clearance on nonprinting machines originally set at .012-inch to .017-inch. With these shims, it is unnecessary to completely separate the die and stripper.

.003-inch shim—front, P/N 313280

.003-inch shim—rear, P/N 313509

REMOVAL AND REPLACEMENT

Printing Punch. Die and stripper are removed as follows:

1. Remove:
 - a. Printing head—keep bushing on end of print wires on IBM A print heads (older style). See Section 2.10.
 - b. Chip tube by taking out two screws (Figure 45). Be careful not to lose the pressure roll spring.
 - c. Front rails.
 - d. Plastic bed plate.
 - e. Punch extension cover, nuts, and springs.

CAUTION

On reassembly, do not force the nuts tightly against the shoulder; this can cause the extension to break off.

- f. Horizontal shift spring.
 - g. Three mounting screws.
2. Pull print interposer assembly from punch extensions.

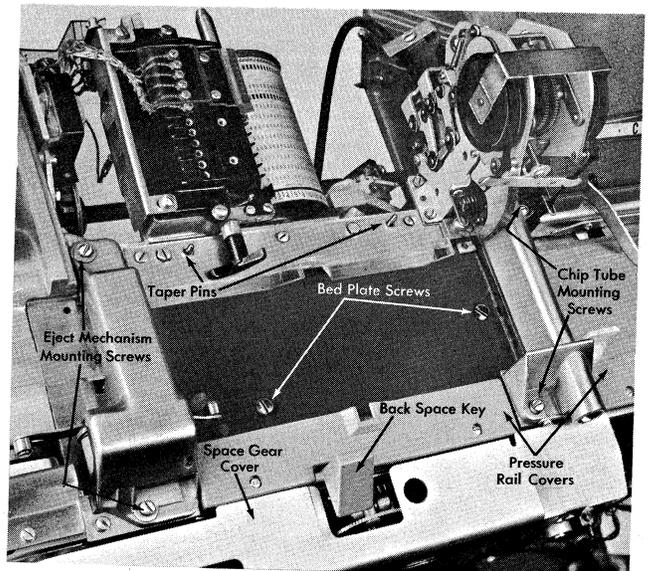


Figure 45. Punch Bed (Front View)

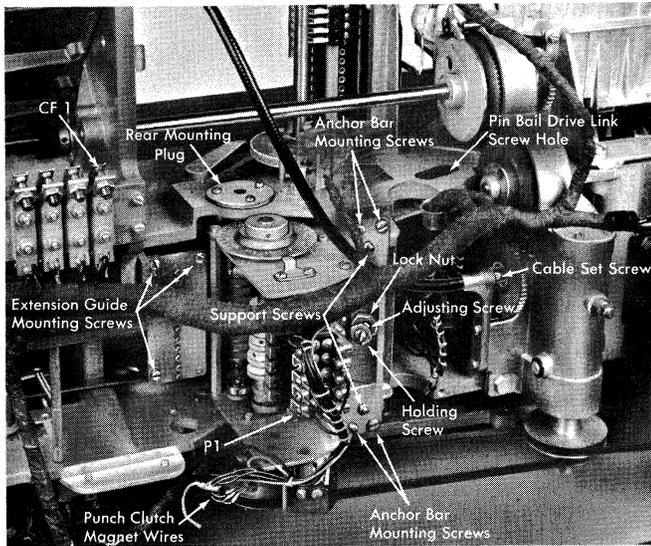


Figure 46. Punch Bed (Bottom View)

CAUTION

Keep horizontal shift slide compressed.

3. Remove bottom punch extension guide plate. Lift each punch extension over punch arm and push it into the die.
4. Remove the two die mounting screws.
5. With left hand on punch extensions, remove unit from base.

Nonprinting Punch. Remove die and stripper. If punch drive unit is in machine:

1. Remove lower punch extension guide (Figure 46). With two or three 2-inch pieces of card between die and stripper, push punches into the die.
2. Loosen clamp on flexible cable.
3. Remove chip tube by taking out two screws (Figure 45). Be careful not to lose the pressure roll spring.
4. Lift out release pin from die.
5. Remove front pressure rail covers at punch and read stations (Figure 45).
6. Remove plastic guide from top of rear rail. The guide is flexible enough to be removed without pulling pins if care is used.

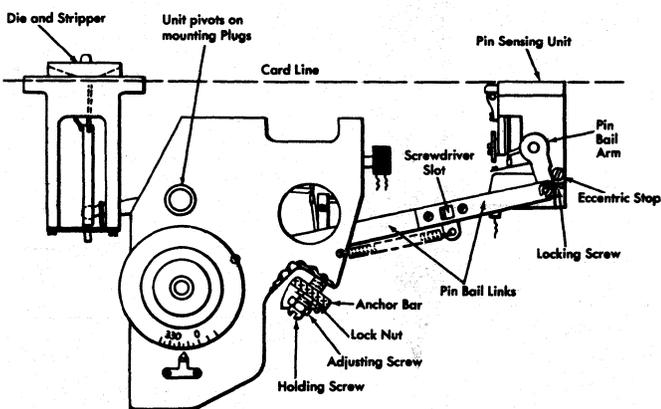


Figure 48. Punch Penetration Adjustment

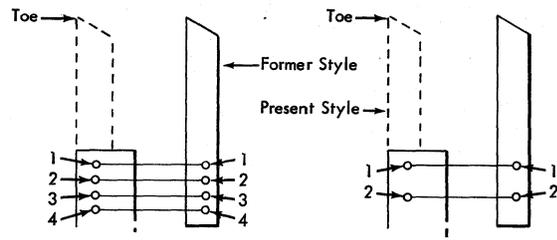


Figure 47. Punch and Extension

7. Remove space gearing cover.
 8. Remove the two black-headed screws in read station bed plate and lift plate out to right.
 9. Back out the two holding screws and lift out die and stripper assembly being careful not to pull punches out as the extensions are pulled past interposer arms.
- Do not separate die and stripper unnecessarily. Clear all card chips away from these assemblies when replacing them on the machine.

2.5.2 Punches

ADJUSTMENTS

Punch Penetration (Printing Punch). Satisfactory punching should result from the print magnet yoke adjustment given in the Print Unit section. On machines without adjustable penetration (Figure 47) the yoke adjustment must be altered and the printing pressure readjusted if additional penetration is needed.

Two different die and stripper clearances have been used. Some machines have an opening of .020-inch to .026-inch. Current machines are set at .012-inch to .017-inch. On the .020-inch to .026-inch die and stripping machines, the number 2 hole is used as a starting point (Figure 47). Current machines use the number 1 hole as a starting point. As the retaining pin is moved to the next higher numbered hole, .010-inch more punch penetration is obtained. **NOTE:** Always insert the retaining pin in identically numbered holes in both the extension and punch.

Punch Penetration (Nonprinting Punches). This method of adjustment (Figure 48) eliminates partially punched holes during the setup process. The heel of the lowest punch must enter the die .015-inch to .020-inch.

1. On an IBM 65, throw the single cycle switch on.
2. Loosen: support screws in anchor bar; holding screws in pin bail links; drive unit adjusting screw lock nut; holding screw.
3. At 345° (punch index) trip all punch interposer armatures. It can be done electrically:
 - a. Disconnect escape magnet to prevent spacing when interposers are tripped.
 - b. Operate detail station card lever.
 - c. With an interposer bail contact lead, energize each magnet.
4. With index turned to 126° (punches up) turn the drive-unit adjusting screw in until a .010-inch gage passes between lowest punch and the die. The punch adjustment holding screw must be tightened after each trial.
5. Remove feeler gage and back off two turns on adjusting screw. Tighten lock nut.
6. Turn in the two support screws until they rest against drive unit side frames; then tighten lock nuts.
7. With the punch clutch latched, extend the pin bail drive links; additional travel, when needed, should not exceed 1/8 turn of the adjusting screw (.003-inch) per step.

REMOVAL AND REPLACEMENT

Punch Removal (Printing Punch)

1. Remove punch extension covers, nuts, and springs.
2. Move vertical shift spring to the hole in vertical shift bell crank; then unhook horizontal shift spring.
3. Remove the three mounting screws and pull print interposer assembly from the punch extensions.

CAUTION

Keep the horizontal shift slide compressed.

4. Remove punch extension lower guide. Punches may be pulled out by lifting each extension over its operating arm.

Punch Replacement (Printing Punch). To reinstall the assemblies, slip extension guide plate off print interposer unit and place it over the extensions first. The extensions will then be equally spaced, and the yokes will locate themselves freely to the extension. When the interposer unit is being replaced on the extension, the yokes should be in their lowest operating position and held there by spring or finger pressure on the slides.

Note that the toe of the punch is toward the front of the machine. Be sure that the retaining pin head is on the same side as the pin retaining plate. Support the punch and extension on a 6-inch scale to aid in reassembly.

CAUTION: When removing the interposer unit, notice that the screw over the 9-punch drive is shorter than the other screws. Be sure to re-install the short screw in this same position. One of the longer screws in this position will bind the drive unit.

Punches (Nonprinting Punch)

1. Tilt punch bed to vertical position and remove the three screws holding punch extension lower guide plate.
2. Slide plate off its guide pins and punch extensions (Figure 47). Any punch is accessible by lifting extension over associated punch operating arm and pulling it straight out.

When replacing punch assembly, check to see that retaining pin head is on same side as pin retaining plate. Toe of punch should be toward front of machine. Inserting punch into stripper is easier if it is supported on a 6-inch scale (hold with a rubber band).

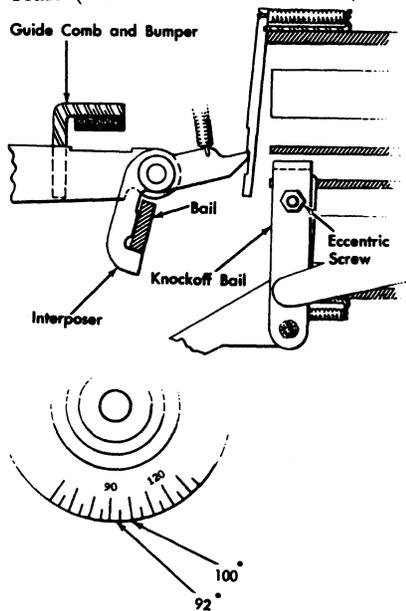


Figure 49. Interposer Relatching Adjustment

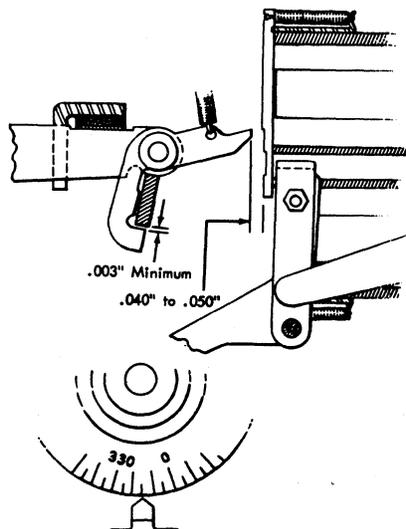


Figure 50. Unlatched Clearance Check

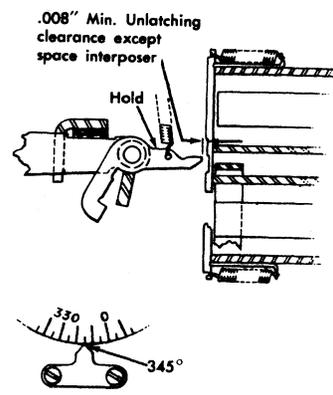


Figure 51. Armature Unlatching Clearance

2.5.3 Pin Bail Drive Link

ADJUSTMENT

1. Loosen the two holding screws in link.
2. Insert screwdriver blade in square hole between holding screws. After punch clutch is latched at 345°, extend pin operating arm until it rests against its stop screw.
3. Tighten holding screws while holding link extended.

2.5.4 Punch Interposer Magnet Assembly

The position of the magnet unit affects three interrelated adjustments: unlatching clearances, relatching of interposers in their armature notches, and knockoff bail.

1. Install magnet unit with reasonable unlatching clearance as a preliminary step. Make screws friction-tight and restore all but four interposers across unit. While manually rotating index clockwise, position magnet unit so that the unlatched interposers in their downward motion start to enter their armature notches at 92° and all are in the notches by 100°. Space interposer movement varies from that of the other interposers, but it should be in its armature notch no later than 100° (Figure 49).

2. The heels of the latching end of the interposers have been ground away to avoid contact with the opposite side of the notch in the armatures. Shift the magnet unit toward or away from the interposers to obtain .040-inch to .050-inch clearance (Figure 50). On units with interposers that are not ground away, this clearance is to be .025-inch to .030-inch.

The preceding adjustment should result in minimum unlatching clearance of .008-inch for each interposer except the space interposer, which can have a minimum of .005-inch unlatching clearance (Figure 51).

3. Adjust eccentric screw on knockoff bail (Figure 49) to cause bail to meet an attracted armature at both ends of unit between 13° and 20°. If the eccentricity is insufficient, inspect cam follower for wear. It may be necessary to pivot entire magnet unit about armature latching point to bring bail closer to armatures.

4. Momentarily attract each armature electrically. The spring should cause the armature to fall away from the core. If the armatures hang up when the pick circuit is broken, they should be replaced; the residual magnetism causes excessive wear on the knockoff bail.

2.5.5 Flexible Shaft and Agitator

Field tests have shown, in a very high percentage of cases, that keypunch machines will function reliably with the flexible shaft and agitator removed. Therefore, follow this procedure when a broken flexible shaft is found:

1. Remove the broken shaft and agitator.
2. Remove the agitator housing.
3. Examine the housing and remove all burrs in the chip tube transport area.
4. Clean the housing in a cleaning solvent to remove oil, dust, etc.
5. Replace the housing.

NOTE: If chip jamming occurs, re-installation of a cable and agitator may be necessary.

2.6 Verifier

2.6.1 Verifier Drive Unit

SERVICE CHECK

Troubles that result from wear or from poor lubrication are often difficult to analyze. The lubrication schedule recommended for the verifier drive unit should be followed as closely as possible. See Section 3. Because of the high speed of the verifier drive shaft, excess lubricant is apt to be thrown off. Lubricate sparingly and wipe off excess oil and grease for cleaner operation.

ADJUSTMENT

Test drive unit timing before readjustment. Sometimes only a slight change is necessary to correct a condition and considerable time will be saved by avoiding unnecessary alterations. The timing adjustment corresponds to the punch penetration adjustment on the IBM 24 and is made with the adjusting screw in the anchor bar (Figure 52).

1. Remove the notching assembly.
2. Hold a flat object over all verifying pin openings and turn index to 50°. Remove the object; pins should remain latched down (Figure 53).
3. Turn verifier shaft slowly and watch for the last pin to pop up between 180° and 195°. If machine does not

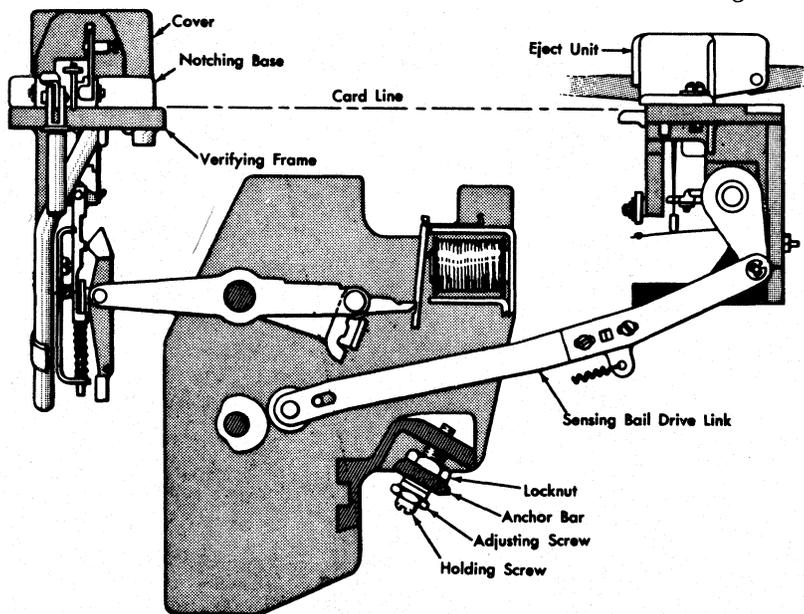


Figure 52. Verifier Drive Unit Timing

meet these timings, remake anchor bar adjustment.

Verifier Drive Unit Anchor Bar. When the preceding test shows that drive unit must be retimed, or when a new verifier drive unit is installed:

1. Remove notching base (assembly above bed at verifying station).
2. Loosen screws of the sensing bail drive link, and the two support screws in anchor bar.
3. Loosen lock nut and holding screw, and turn adjusting screw to obtain correct timing (Figure 52).
4. Remake notch drive link adjustment, tighten drive unit support screws lightly, and extend bail drive links. If a new unit is being installed, continue with steps 5 through 9.
5. Back off adjusting screw about two turns after installing unit and anchor bar.

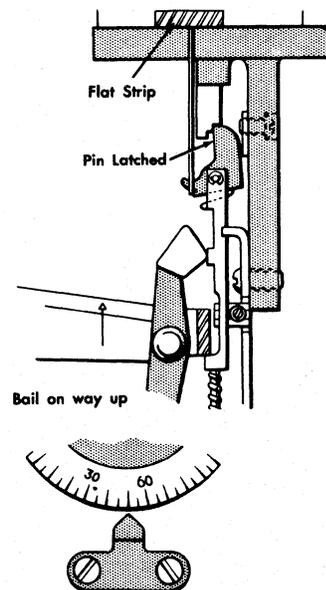


Figure 53. Drive Unit Timing

6. Hold flat object over verifying pins while turning machine by hand to about 70° of verifier index. Remove flat object; pins should stay latched down.

7. Turn index to 190° and hold it there. Turn the adjusting screw in until last pin has snapped up; then tighten holding screw. Turn machine through a cycle, again latching out the pins to be sure adjustment has not changed.

8. Remake notch drive link adjustment, tighten the two support screws lightly against side frames, and extend bail drive links.

9. Tighten adjusting screw lock nut.

2.6.2 Verifying Frame Assembly

SERVICE CHECK

The verifying frame mechanism must be kept clean and free of binds for best operation. Pin latches must pivot freely in the ends of the pin drivers and latch springs must not bind in the spring slots. Oil should be kept off the upper section of the verifying pin. An accumulation of dirt or card dust at the point where the pin extends through the base may erroneously latch out the verifying pin and cause a false error indication. A weak latch spring may cause false error lights in a similar manner. The lubrication schedule suggested (Section 3) should be varied to meet individual machine requirements.

ADJUSTMENT

Latch Spring. The latch spring should extend to $\frac{3}{4}$ -inch. Measure across the open end when spring is removed from pin driver.

Pin Driver Retainer. Adjust pin driver retainer for minimum clearance of .005-inch to .007-inch at closest point between retainer and pin drivers (Figure 54) to permit free movement of pin drivers.

Pin Latch Stop. Adjust the pin latch stop for a clearance between the latch side of the block and the latches of .002-inch to .005-inch (Figure 55).

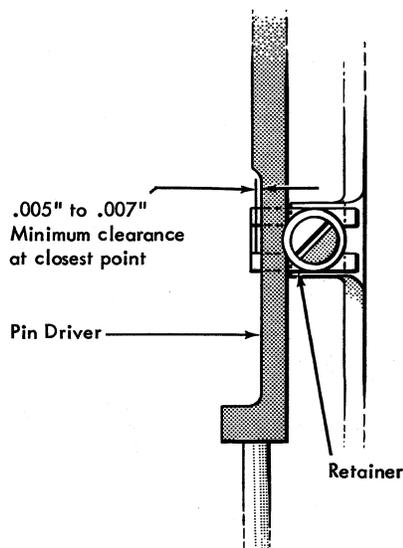


Figure 54. Pin Driver Retainer

REMOVAL AND REPLACEMENT

Verifying Frame Removal

1. Register a blank card in verifying station, trip verifier clutch and turn index to about 100° by hand. This will raise bail to its highest point for maximum clearance to pin drivers.

2. Remove eject mechanism and covers over the pressure rails at both card stations.

3. Remove bed plate. It is necessary to remove only the two screws in bed plate itself; the plate is not held by upper guide rail. Watch for brass shims that may be under right end of bed plate. Take care not to bend pressure rail springs at front edge of bed plate.

4. Remove spring clip from stud at lower end of notch drive link and disengage link from cam follower arm.

5. Remove spacing gear cover and four screws holding verifying frame to base.

6. Tilt lower end of unit away from verifying bail to clear pin drivers to remove verifying frame assembly. On some machines, the error chip tube may have to be removed; it has one holding screw accessible from base bottom. Later machines have the base cut out. When pin drivers are free of the bail, the unit is free. The eject pin will also be free and should be lifted out.

Verifying Frame Replacement. The unit is replaced by reversing the removal procedure with the following precautions:

1. Place a piece of blank card through the verifying card path. This insures that all pin drivers will remain in their lower guide.

2. Be sure chip tubes are tight against bottom of dies; check tightness even if chip tubes have not been removed.

3. Keep spring on solenoid plunger by closing the top loop. Take care not to damage the contacts; they operate below the bell crank.

4. When all pin driver assemblies are installed, latch them into place against pin latch stop, which holds them until pin driver retainer is positioned.

NOTE: To install the verifier frame assembly P/N 268784, which uses a ball-bearing pressure roll, it may be necessary to replace it with a new card-guide rail P/N 311434 and a new shield-pressure rail right P/N 311435.

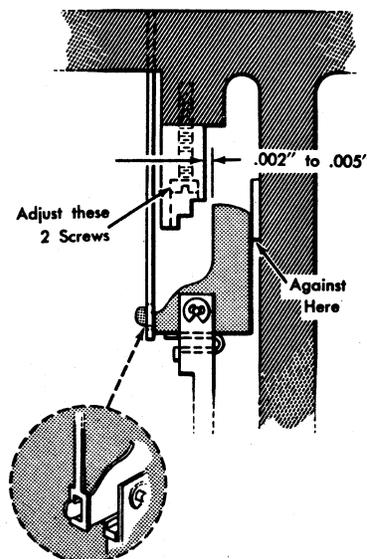


Figure 55. Pin Latch Stop

2.6.3 Verifier Interposer Magnet Assembly

ADJUSTMENT

Positioning the magnet unit affects three interrelated adjustments: unlatching clearances, interposer relatching in their armature notches, and knockoff bail.

1. Install magnet unit with reasonable unlatching clearance as a preliminary step. Make screws finger tight and restore all but four interposers across unit. Manually rotate index clockwise; unlatched interposers, in their downward motion, should start to enter their armature notches at 65° and all should be in their notches by 73°. On the IBM 56 without error retention, interposers should enter notches at 73° and all should be in the notches by 84° (Figure 56). The space interposer movement varies from that of other interposers but may not be later than 90°.

2. Shift interposer magnet unit to obtain unlatching clearance of .003-inch to .012-inch measured between tip of each interposer and its attracted armature (Figure 57). NOTE: The optimum setting for unlatching clearance within the stated limits depends to a large degree on operating voltage. Where the machine must operate much of the time at low voltage, a tendency toward minimum unlatching clearance will afford a greater safety factor. A typical malfunction due to low voltage is failure to trip an interposer while successively verifying a digit. The odd interposer positions normally fail first.

3. Adjust eccentric screw in knockoff bail to cause bail to meet an attracted armature at both ends of the unit between 355° and 2°. If the eccentricity is insufficient, inspect cam follower for wear. It may be necessary to pivot entire magnet unit about armature latching point to bring bail closer to armatures.

4. When an armature is attracted electrically, its spring should cause the armature to fall away from the core. If

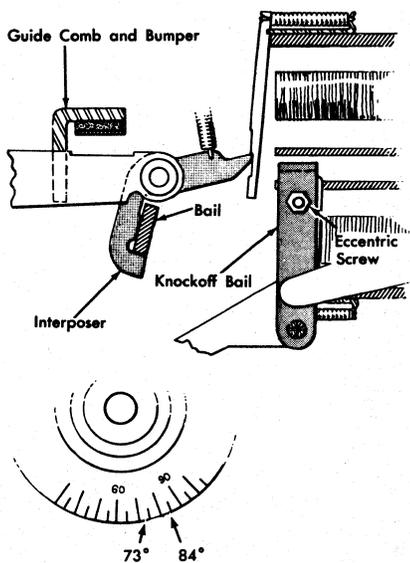


Figure 56. Magnet Unit Adjustment

armatures hang up when pick circuit is broken, they should be replaced; the residual magnetism causes excessive wear on the knockoff bail.

REMOVAL AND REPLACEMENT

Interposer Magnet Unit Coil. When replacing coils, leave slack in the wire leads to prevent yokes from cutting through the insulation. Coils are held to cores by cement (P/N 261096). Upper and lower armatures are interchangeable.

Interposer Bail Contacts. Bail contact assemblies may be removed after removing master bed plate or drive unit.

Armature Knockoff Bail. With drive unit removed from machine:

1. Remove knockoff bail return spring.
2. Remove the 13 interposer magnet armatures and return springs.
3. Unhook interposer springs.
4. Spring knockoff bail off its pivots and then work it out past the CB's.

Pin Drive Link Assembly. With knockoff bail removed from drive unit:

1. Remove clip and washer from link guide stud.
2. Unhook drive link spring; link can now be removed by prying slightly to get link off stud. Turn link around corner of magnet assembly to a position where there is enough clearance for the bent ear to clear the parts.

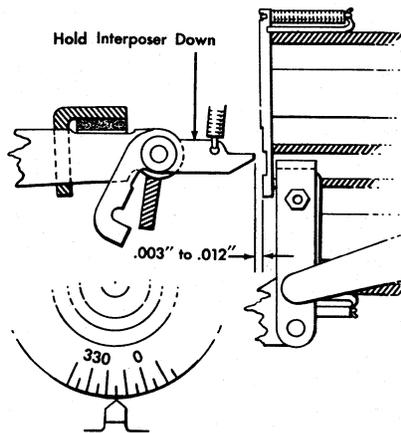


Figure 57. Interposer Unlatching Clearance

2.6.4 Verifying Contacts

SERVICE CHECK

Inspect contacts for pits and burns, but do not attempt to adjust contacts with the unit in the machine. Faulty alignment, insufficient air gap, and weak strap tension are possible sources of false error light trouble.

ADJUSTMENT

Bail Operated Type. Machines built since July 15, 1955, have a contact assembly consisting of two contacts and a bail. With the assembly removed:

1. Form contact support strap of the follow strap to obtain a follow of contact points of .010-inch to .015-inch.
2. Form tension strap 1 so that, with tension of operated strap removed, a force of 5 grams to 10 grams (at

point B, Figure 58) lifts the follow strap from its support at C.

3. Form tension strap 2 so that a force of 40 grams $\pm 5-0$ grams (applied at point A, Figure 58) will just open contact.

4. Install assembly with .010-inch to .025-inch clearance between operating pads on error cams and contact bail.

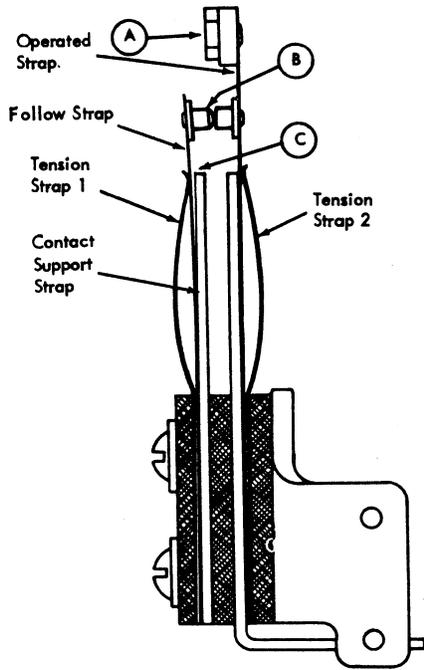


Figure 58. Verifying Contact

Multicontact Assembly Type

1. Loosen holding screws and align the two steel contact straps and the center stiffener spring.

2. Form operating point support spring to require 30 grams to 40 grams to break the N/C contacts.

3. Form stiffener spring to require 25 grams to 45 grams to lift N/O contact off its support. Normally open contacts should have .012-inch to .018-inch air gap.

4. Position contact assembly for .005-inch to .010-inch clearance to plastic pad on bottom of error cam. NOTE: Machines with the 11-12 eliminate feature have new-style multiple contacts. Set clearance between the operating straps and error cams at .010-inch to .025-inch.

2.6.5 Notching Drive

ADJUSTMENT

Notch Drive Magnet

1. Form notch drive magnet armature so that a straight edge contacts the three points shown in Figure 59. Armature should be free of binds and free to move across yokes. It should not bind in retainer.

2. Shim core for an armature-to-core air gap of .006-inch to .008-inch with armature attracted. Use .003-inch steel shims.

3. Form armature spring for tensions indicated in Figure 59.

4. Position armature retainer on yoke opposite interposer block for maximum armature travel without binds.

5. Position entire magnet bracket for .008-inch to .010-inch clearance between armature at rest and end of suppress arm; at same time, there must be .003-inch to .005-inch clearance between interposer block on the armature and inside cut of the notch drive arm. This step must be

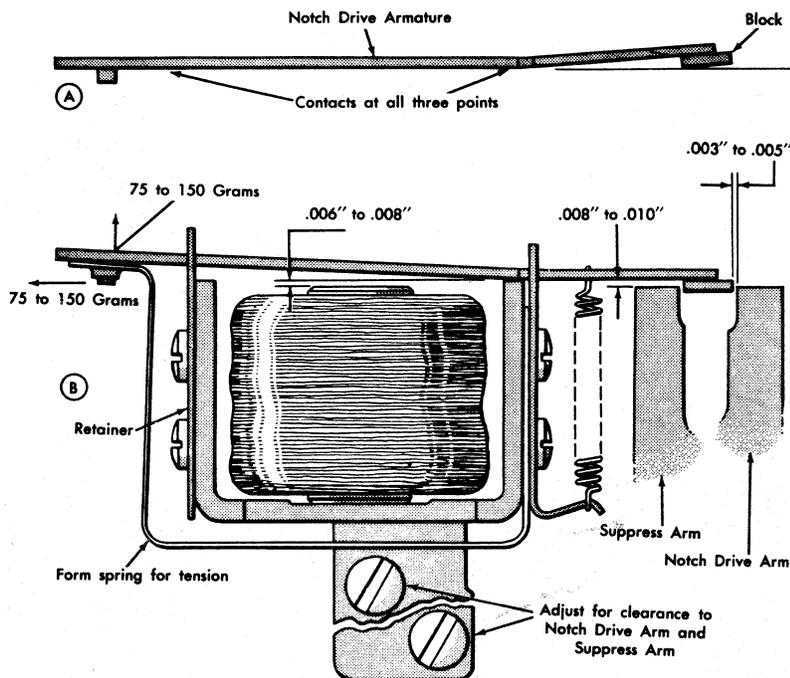


Figure 59. Notch Drive Magnet

checked every time drive unit is readjusted at the anchor bar. It may be necessary to move suppress arm to perform this step.

Notch Suppression Eccentric

1. The high side of eccentric bushing, on back end of verifier cam shaft, contains a groove that should line up at 345° with the mark near center of the low dwell of notch drive cam. The left-hand threaded screw in end of shaft must be loosened to position bushing.

2. Trip verifier clutch and turn drive unit index to 245° (Figure 60). Adjust eccentric screw in suppress arm for .010-inch to .012-inch clearance to interposer block on armature. When loosening or tightening screw in end of shaft, take care to avoid damaging clutch spring on other end of shaft. Each time drive unit is readjusted by the screw in the anchor bar, this adjustment must be checked.

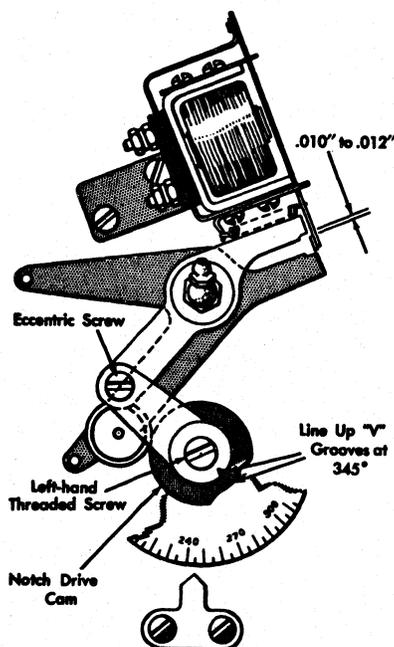


Figure 60. Notch Drive Unit

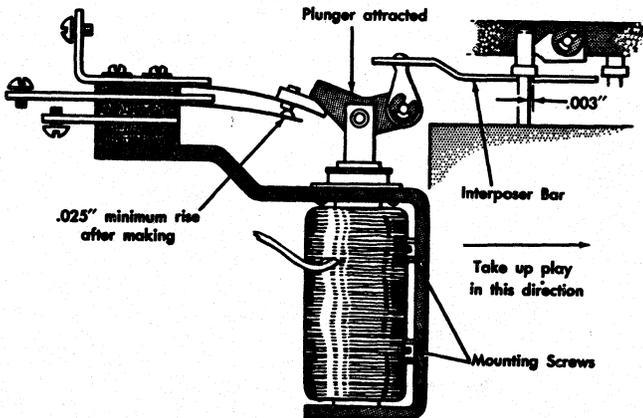


Figure 61. Last Column Notch Solenoid

Redesigned Notch Drive. Machines manufactured after May, 1959, have a simplified notch drive mechanism. A notch drive solenoid (Figure 62) replaces the old-style drive unit shown in Figure 60.

1. Form the notch drive contact bracket, P/N 311730, to permit the contact to open when the plunger travels .070" but not to open when the plunger travels .050".

2. The N/C contact strap should have .015-inch to .020-inch air gap when the operating points are transferred.

Do not attempt to turn plunger guide adjusting screws. These screws are adjusted and pinned at the factory.

The notch drive contacts have been eliminated on later machines.

2.6.6 Last Column Notch Solenoid

ADJUSTMENT

Solenoid. The notching base cover must be removed to adjust the solenoid. The position of the plunger controls the operation of the notching punch interposer.

1. Loosen solenoid mounting screws and attract plunger until it seats against its rubber-mounted stop.

2. Take up play in linkage of interposer bar toward front of machine and position magnet bracket vertically for .003-inch clearance between error punch and interposer bar (Figure 61).

3. Form stationary contact support for minimum air gap of .025-inch and minimum rise after making of .025-inch.

Notch Drive Link. On every clutch cycle that does not cause notching, the punches are driven upward by the suppress arm, armature block, and eccentric bushing. Because punch motion is opposite to the direction of notching, a clearance must be provided by adjustment. Always check upward punch clearance each time the verifier drive unit is adjusted at the anchor bar.

1. With the verifier clutch latched, unhook notch drive link and lift notch lever arm to make both punches seat on the cover.

2. With punches held as in step 1, adjust notch drive link until bottom stud passes freely into hole in notch drive arm.

3. Shorten link ¼ turn for suppression clearance; test machine. If additional travel is needed, shorten link by ¼ turn, but do not shorten link by more than ¾ turn.

Notching Punches. Notching punches are selectively fitted and are not interchangeable. Machines prior to the AP suffix contain .141-inch diameter punches. Later machines have .109-inch punches. Parts are not stocked for the large punch mechanism. For replacements, order the entire notching base and verifying frame (P/N 313740).

2.7 Pin Sense Station

2.7.1 Pin Sensing Unit

SERVICE CHECK

Improper insertion of master cards by the operator can cause incorrect reading. If the card is pushed in so far that it is pressed against read feed and idler rolls and, at the

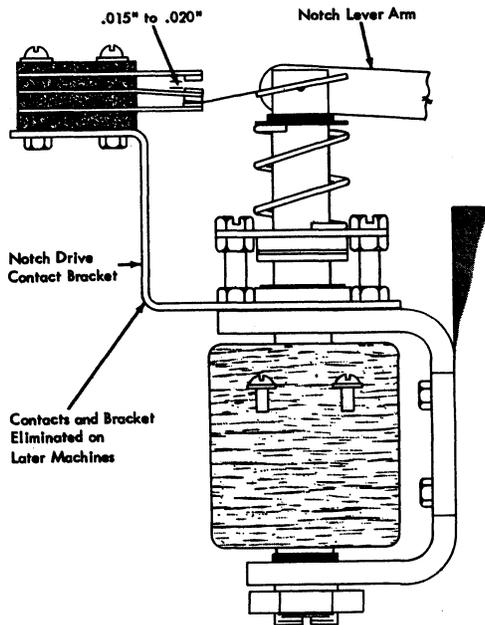


Figure 62. Solenoid Drive Unit

same time, is pulled away from the top guide rail, it will stay in this position after being registered. Most punching in the first third of the card will fail to read and some punching in the rest of the card may also be left out.

Card Sensing Contacts. Inspect contacts for burning. Clean out card particles and lint. One broken contact in a pair causes intermittent failures to read.

Sensing Pins. Check that sensing pins operate separately. Pins sticking together cause reading failures by forcing both pins to enter the hole at the same time.

Pin Bail Drive Link. Inspect guide stud in the rear frame for wear. Adjust link and lubricate stud if necessary.

Card Lever. Clean out any accumulation of card dust around the card lever.

ADJUSTMENT

Contact pressure, throat gap, and contact gap adjustments are made with unit removed from base.

Contact Pressure. Before installing a new contact molding, preform contact straps (Figure 63). A cylinder is helpful in forming contacts evenly. Insert cylinder evenly between contacts and molding and press toward left side of molding to increase tension. Adjust contact pressure on each point for 20 grams to 30 grams.

Throat Gap

1. Place eject unit in normal operating position on pin sensing assembly. Hold together with screws if necessary.
2. Shim throat plate (bottom of eject unit) to adjust throat gap for .012-inch to .020-inch clearance (Figure 64). Check .012-inch clearance at closest point and .020-inch clearance at widest point. Replace throat plates worn beyond these dimensions. The .004-inch shim is P/N 121397, and the .010-inch shim is P/N 49901.

Registration. Production machines after June 1964 have an adjustable throat plate assembly to allow proper regis-

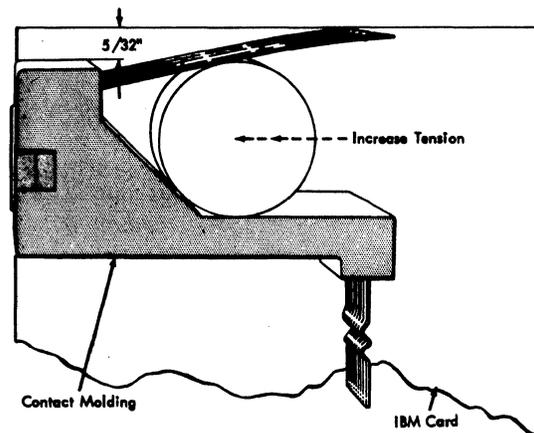


Figure 63. Sensing Pin Contact Adjustment

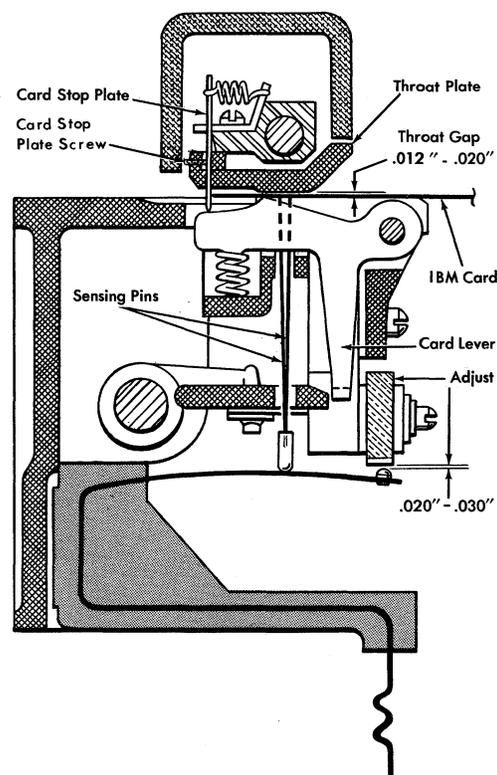


Figure 64. Pin Sensing Adjustment

tration of the card at the read station. This assembly is available for field replacement also.

Adjustment of the card register plate is obtained with the card stop plate screw (Figure 64).

Contact Gap

1. Insert blank card and let pins rest against it.
2. Remove contact cover (some machines do not have cover) and adjust common contact bar for minimum air gap of .015-inch and a maximum gap of .035-inch (Figure 64).

A quick, accurate check of contact adjustment can be made with the unit in the machine. Loosen $\frac{1}{4}$ turn, the two screws holding the eject unit. Place an .008-inch gage

under front edge of eject unit and tighten front screw to level the unit (Figure 65). All positions should duplicate correctly without picking up extra punching. This insures at least .015-inch air gap of the sensing pin contacts.

CAUTION

On the printing machines, do not allow machine to punch more than two multipunched columns or the code plate may be damaged.

Pin Bail Arm Eccentric. Normally, it is unnecessary to alter factory adjustment on pin bail arm eccentric stop. If it is necessary: loosen locking screw, and adjust eccentric to stop pin bail arm when sensing pins are retracted .010-inch to .015-inch below surface of separators. Tighten locking screws.

Card Lever. With pin bail arm against its stop, position card lever to clear pin bail by .005-inch to .010-inch.

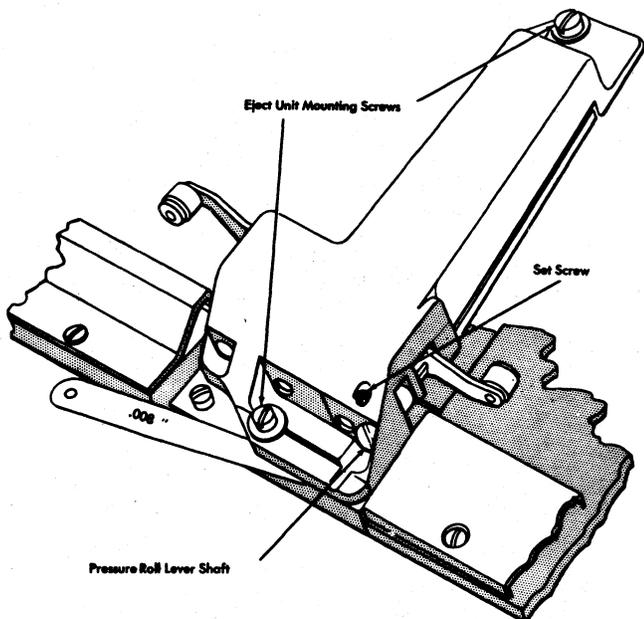


Figure 65. Check on Sensing Pin Contact Adjustment

REMOVAL AND REPLACEMENT

Pin Sensing Unit

1. Remove eject mechanism from top of pin sensing unit. Pick out release pin that operates eject mechanism.

2. Remove the three screws holding eject front rail, the two screws beneath this rail, and the two screws holding stacker plate to stacker assembly near stacker switch. The plate is now free to be removed. (When reassembling, check adjustment of traveling card guide before tightening screws.)

3. Disconnect pin bail drive link at its coupling screws (Figure 48) through hole in rear of punch bed (Figure 46). Do not remove spring from link to drive unit rear frame.

4. Remove the screw holding the sensing pin cable clamp.

5. Remove the two screws in top of pin sensing unit and lift out unit from top of base.

6. With long-nose pliers, pull out common wire to sensing contact strip; then slip off connections to individual terminals. Note that cable is fanned out from rear of machine forward.

7. Reinstall unit in machine with punch index at 345°. Extend pin bail link to bring pin bail arm up against stop. Check to see that P5 makes after and breaks before pin contacts. Be careful that plastic dust cover does not bind the 9 sensing contact.

Sensing Pin

1. Remove pin sensing unit from machine.

2. Trip card lever and place pin sensing unit upside down.

3. Remove plastic dust cover for sensing pin contacts.

4. Remove the two screws holding contact assembly to frame and lift it off. This exposes operating ends of sensing pins. Use care to avoid moving contact bail because it is possible to lift all sensing pins out of the separator; considerable time is needed to replace them.

2.7.2 Card Stop Cam

ADJUSTMENTS

1. Loosen set screws on index shaft bevel gear.

2. With the CF clutch latched, rotate card stop cam to a point where cam follower is at the approach but is not up on rise of cam.

3. Lock set screws.

4. Check timing by watching eject and register arms to be sure that they do not start down again at the end of the CF cycle. On later machines, the beveled gears are spot-marked at the factory so that this timing can be regained after removal of the feed by simply lining up the marks.

2.8 Eject Unit

ADJUSTMENT

Pressure Roll Registration. Loosen locking set screw (Figure 28) and adjust pressure roll lever shaft to align pressure roll with feed roll and cause proper feeding through read station.

Pressure Roll Opening. For pressure roll opening see "Pressure Roll Adjustments" (Section 2.3).

Throat. Add or remove shims for a throat clearance of .012-inch to .020-inch.

Register Arm Tension

1. Tip bed to vertical and turn CF index to 30°.

2. Insert strip of card between rolls.

3. Form paper clip to hook under arm just inside roller, and hook other end in hole of X10 blade.

4. Form long end of spring to require 250 grams to 325 grams to free the card.

Eject Arm Tension. Repeat the preceding procedure for the eject arm, but obtain tension of 450 grams to 525 grams for the red eject rolls. On the new-style black eject rolls, tension should be 250 grams to 325 grams.

Eject Card Guide. The plastic guide should clear stacker plate by at least 1/4-inch. It can be raised by filing eject casting slightly or by shimming right end of guide. Forming the plastic is unsatisfactory because, even if heat is used, the plastic returns to normal.

2.9 Stacker Unit

Use caution when servicing machines that have a stacker plate main-line switch. Exposed leads occur where the insulation has pulled away from the switch body if the stacker plate is dropped or otherwise mishandled.

2.9.1 Card Lifter Assembly

SERVICE CHECK

Make sure that card lifter is free of binds.

ADJUSTMENT

Form card lifter plate so that at 15° of a CF cycle there is .006-inch to .020-inch clearance between upper edge of lifter fingers and front surface of card aligning bar.

2.9.2 Stacker Assembly

ADJUSTMENT

NOTE: Check wiring diagram for exact timings on machines with special features such as variable card feed or high-speed skip.

Stacker. With card feed index latched at 0°, time stacker with teeth that provide the closest measurement to $4\frac{11}{16}$ inches from upper cut in stacker drum to front edge of base for the standard machine (Figure 66). The distance is $4\frac{1}{8}$ inches for high-speed skip machines. This distance should be measured before removal of unit to prevent changing other adjustments that might be affected because of a change in timing. Be sure to measure distance to edge of base and not to stacker bed plate.

Traveling Card Guide. Adjust traveling card guide bumper to put vertical surface of traveling card guide in line with top rail and not more than .005-inch above it. This position can be determined by laying a straightedge (.0125-inch to .018-inch thickness gage) along edge of top card rail and extending it into stacker (Figure 68).

Bumper. Adjust lower bumper (Figure 67) to deaden stacker noise. It must permit traveling card guide to drop below outer circumference of the two stacker drums.

Number 1 Opener Cams. Adjust Number 1 opener cams (Figure 66) so that gripper fingers close evenly at 92°.

Card Pusher Cam. The cam is mounted by screws in elongated holes on stacker drive gear. Position cam so that gripper fingers grip $\frac{3}{16}$ -inch of the card (Figure 67). Check under power. On later machines, the card pusher is an integral part of the operating arm and works through an arc.

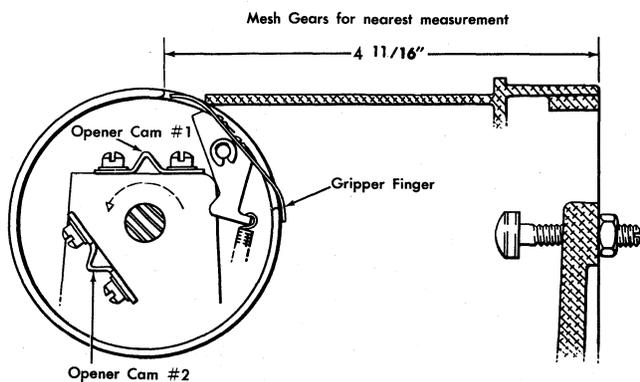


Figure 66. Stacker Timing

Number 2 Opener Cams. The number 2 opener cams (Figure 66) are positioned so that card is released when fully stacked but before it is damaged. Check under power.

Stacker Bed Plate (Standard Machines)

1. Register a card in master station and space it about half-way through.

2. Position stacker bed plate for .025-inch to .030-inch clearance from bottom of card to narrow rail on bottom of bed plate (Figure 68).

Stacker Bed Plate (Offset Stack Machines)

1. Place a metal card gage (P/N 450036) in position of last stacked card. Adjust stacker bed plate so that stacker drum surface is .005-inch to .010-inch below bottom surface of card gage. Mounting holes may be enlarged if necessary to make this adjustment.

2. Adjust center portion of stacker bed plate so that it is .001-inch to .005-inch below bottom surface of card gage.

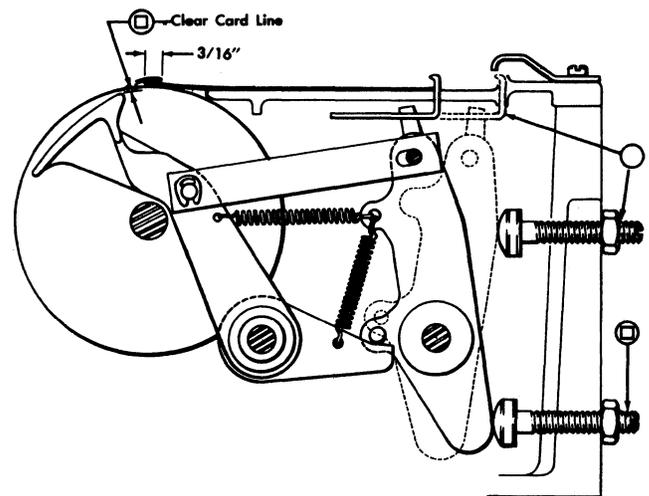


Figure 67. Stacker Adjustment

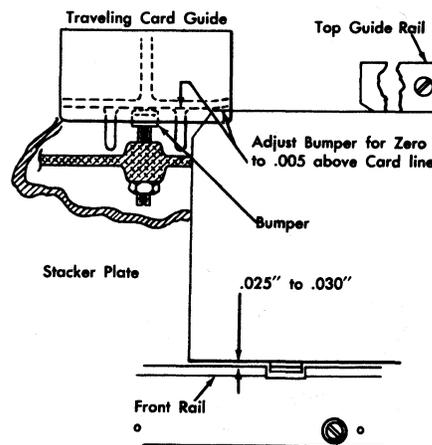


Figure 68. Stacker Adjustment

Offset Stack Magnet (Standard Card Length)

1. Adjust armature retainer (Figure 69) for .055-inch to .065-inch armature-to-core clearance when magnet is de-energized. When magnet is energized, armature-to-core clearance should be .005-inch to .015-inch.

2. Adjust armature so that, when attracted to coil, it seats on armature retainer with a .005-inch minimum clearance between armature and yoke.

3. Position magnet assembly so that, in de-energized position, the top of offset stack tab is $\frac{1}{4}$ -inch to $\frac{1}{2}$ -inch below card bed surface. In the energized position, it should be $\frac{1}{2}$ -inch to $\frac{1}{2}$ -inch above the card bed surface. The offset stack tab must be centered in the slot so that there is no bind when tab is moved up and down or from side to side.

Offset Stack Magnet (Variable Card Length). The offset stack magnet on the variable length card device (VLDC) differs from the one for the 80-column machines in that it has two armature extensions instead of one. The extension is spring-connected to the armature. If the eject stop is raised for short card feed, the extension rises when the magnet is energized.

1. Adjust armature retainer for .060-inch to .070-inch armature-to-core clearance (Figure 69).

2. Loosen the two screws in magnet support (Figure 70).

3. Adjust magnet assembly so that top of armature extension (or extensions for VLDC) is $\frac{1}{2}$ -inch below surface of stacker plate when magnet is de-energized.

4. Adjust magnet assembly so that top of extension is at least $\frac{1}{8}$ -inch above the stacker plate when the magnet is energized.

Offset Stacker Pressure Finger. Form offset stacker pressure finger to exert 10-grams to 30-grams pressure on card bed surface.

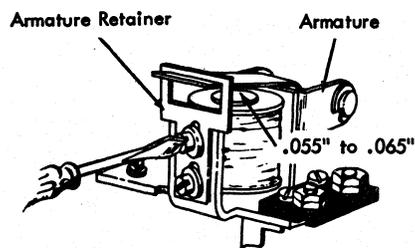


Figure 69. Offset Stack Magnet Adjustment

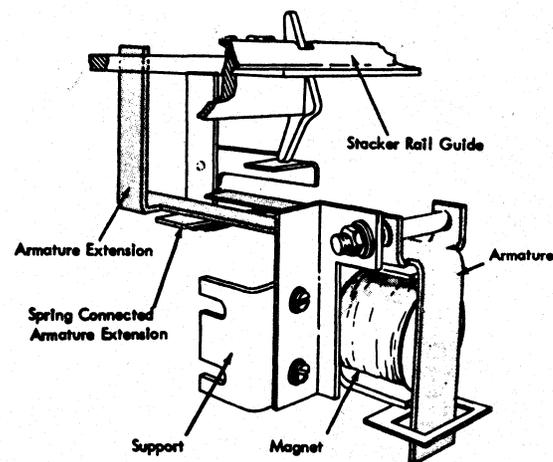


Figure 70. Offset Stack Magnet

2.10 Program/Auxiliary Drum Unit

SERVICE CHECK

Card Life. The program card should be changed daily when usage is heavy. The sensing wheels, in correct adjustment, should graze the surface of the program card. Improper tension on the program sensing arms shortens program card life. Worn program cards may result in elusive failures.

Drum Interchangeability. Determine interchangeability by checking all drums against a master drum. Replace worn gripper cam shafts.

Drum Eccentricity

1. Mount a program card with 4's punched at about 15-column intervals.

2. Space to the columns preceding the punched ones and observe the distance from star wheel to hole. Variation in the star wheel to hole distance is an indication of drum eccentricity and should not exceed .003-inch.

Sensing Wheels. Wheels must pivot freely. Check for oxide deposit on pivots and for proper lubrication. Sensing arm lever must be free on its pivot shaft.

Sensing Contacts. Contacts should seldom require adjustment. Machines manufactured after February 11, 1958, have their sensing contacts set with an electronic device. When trouble is suspected in this area, remember that there are several possible sources of trouble inside and outside of the sensing unit which may make this adjustment erratic and unstable. Check the following points before adjusting the sensing contacts; it may save a callback.

1. Inspect wires and contact screw heads for pits and lumps.

2. Make certain that program drum shaft adjustable yoke is not loose.

3. Check for wear between end of shaft in program drum and hole in column indicator wheel that locates and seats drum.

4. Check for excessive play in the escapement gear train; this can be done with power off.

5. Test friction drive torque.

6. Be sure that the plastic safety cover is installed over the terminals.

Service time on these contacts is greatly reduced if the method outlined in the adjustment section is closely followed.

ADJUSTMENT

Common Contact Plate. The plate is adjusted to require 35-grams to 45-grams pressure—measured at the star wheel hub—to lift each star wheel off of the program card. Excessive tension on the short arm is relieved by a .022-inch cut from the common contact plate.

Contact Molding

1. Prepare a program card (Figure 71) and check registration.

2. Place card on drum (Figure 72) and install drum on machine.

3. Position contact molding so that sensing arm levers clear aligner fingers, and star wheels evenly approach one of the multipunched columns.

Sensing Contacts

1. Disconnect wires from sensing contact and connect ohmmeter across contact.

2. Space machine until star wheel associated with sensing contact is fully in a hole.

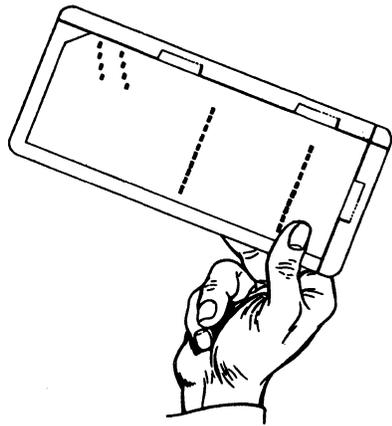


Figure 71. Program Sensing Contacts Adjustment

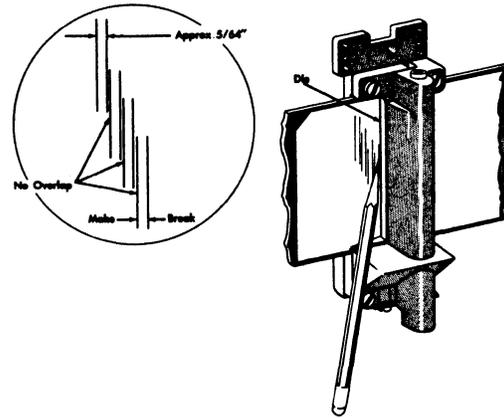


Figure 73. Program Sensing Contacts Adjustment

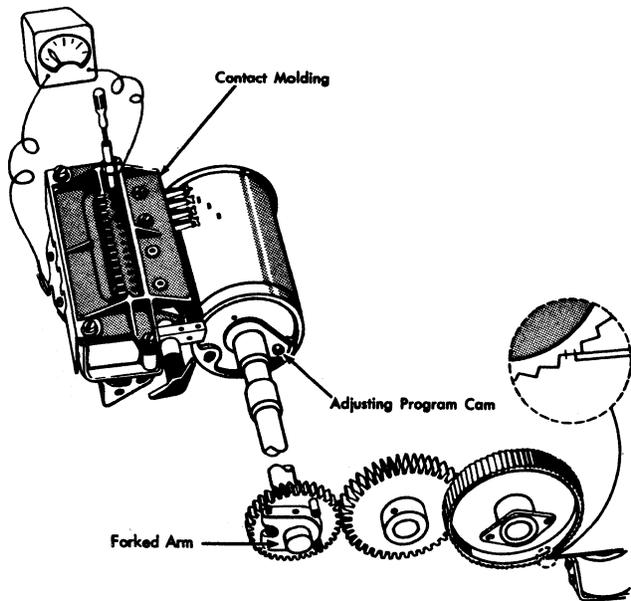


Figure 72. Program Sensing Contacts Adjustment

3. Set adjusting screw for an additional $\frac{3}{8}$ turn past initial point of contact ($\frac{5}{8}$ additional turn for strap-type sensing contact).

To check sensing contact adjustment:

1. Register a blank card face down in punch station.
2. Prepare program card as indicated in Figure 71 and check registration.
3. Remove power from machine and connect ohmmeter across the 12 position sensing contact (Figure 72).
4. Depress escapement armature and turn machine over by hand until contact makes.
5. Mark card as shown in Figure 73.
6. Turn machine over until contact breaks and again mark card. Be sure pencil is sharp, and held at the same angle each time a mark is made.
7. Repeat procedure for 11, 0, and 1 positions.
8. Distance between make and break marks should be about $\frac{1}{4}$ -inch. There must be no overlap between positions. Vary sensing contact adjustment to obtain proper distance, but do not vary by more than $\frac{1}{4}$ turn of the adjusting screw.

Forked Arm. This adjustment affects timing of the program cam contacts. Adjust program cam contacts whenever forked arm adjustment is changed.

1. Remove power from machine and connect ohmmeter across the 12 position sensing contact.
2. Depress escapement armature and turn machine over by hand until contact just breaks.
3. Adjust forked arm to make escapement armature overlap escapement wheel by $\frac{1}{8}$ to $\frac{1}{3}$ tooth (Figure 72).

Program Cam Contacts. These contacts must be retimed according to wiring diagram whenever forked arm adjustment is changed. On later machines, move adjustable program cam. On older machines, shift lever bracket to retime program cam contacts. Figure 74 shows the adjustments.

Program Drum Interlock Arm (Split Hub)

1. Raise star wheels.
2. Rotate interlock arm on serrated shaft to operate program handle switches with .002-inch to .005-inch travel remaining before switch plungers bottom.
3. Lower star wheels.
4. Position interlock arm along the serrated shaft for .015-inch to .020-inch clearance to back end of program card.

REMOVAL AND REPLACEMENT

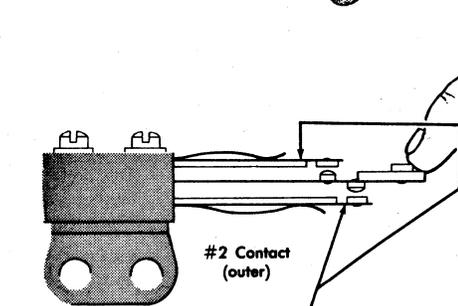
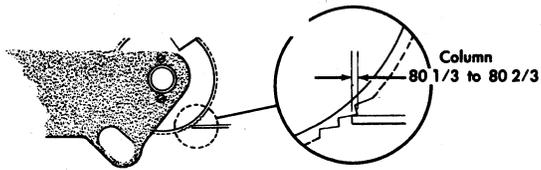
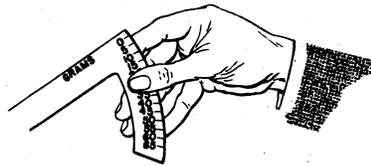
Program Sensing Unit. Remove program sensing unit as an assembly by taking out the two screws holding unit to base casting. On machines where plastic top plate that supports sensing wheel arms is not pinned, scribe a line along its left edge to insure proper relocation; contact duration and timing are easily lost by removing the top plate. When assembly is reinstalled on base, the shoulder on sensing unit should seat firmly on base; a locator pin insures proper lateral placement. Check timing of contacts after reinstalling unit.

Sensing Contact Straps. Loosen the common plate screws so that tension is taken off contacts. Be careful not to bend contacts while removing or installing.

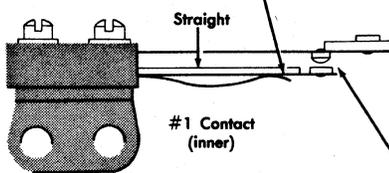
Program Shaft Assembly. No timing need be observed when installing a program shaft assembly. When installing auxiliary duplicate (verifying) assembly, it must be timed to the program index. Punch a card in column 1 and place it on the auxiliary drum. With program index at column 1, install unit so that star wheels are reading column 1.

- ① Register a card. Space to column 80. Hold escape wheel as below. Punch a key. Watch for the timing of the card to card skip as controlled by the #1 contact.

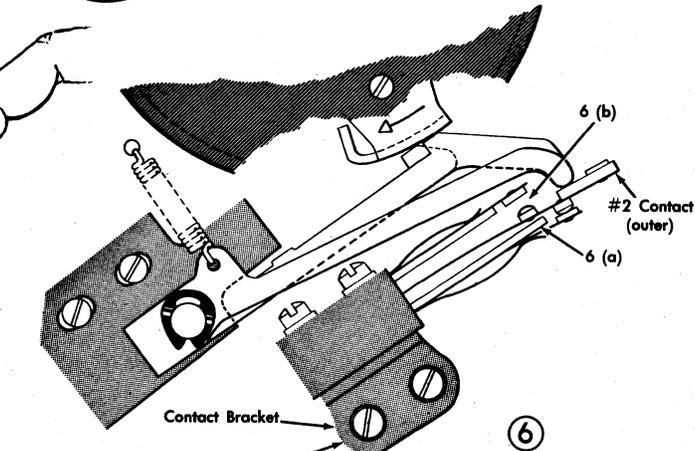
Refer to the machine wiring diagram to check or readjust the program cam contact timings.



- ② 15 grams minimum towards support strap.



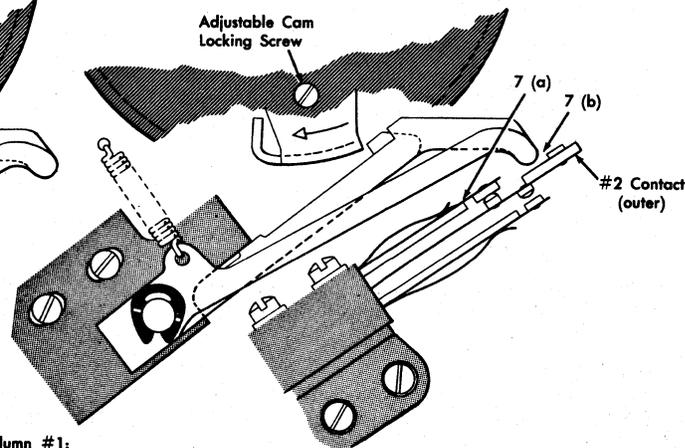
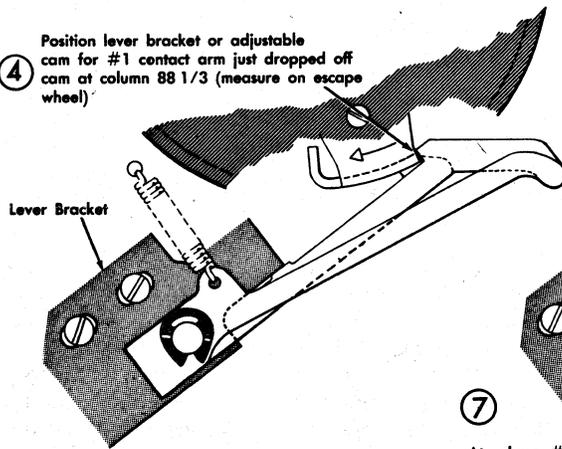
- ③ .020" to .040" air gap (#1 contact only). Form operating strap.



- ⑤ To obtain proper make time, position contact bracket with program index at column 86 for a .015" to .025" rise of #1 contact stationary strap from its support strap.

At column 86, form the support straps of the #2 contact for:
 (a) .015" to .025" rise of the N/O contact from its support strap.
 (b) .020" minimum air gap of the N/C contact.
 This will result in the proper make timing of the #2 contact.

- ④ Position lever bracket or adjustable cam for #1 contact arm just dropped off cam at column 88 1/3 (measure on escape wheel).



At column #1:

- (a) Adjust the tension on #2 contact operated strap for .005" to .025" rise of the N/C contact from its support.
 (b) Turn the lever bracket for .015" clearance (#2 contact only) of the arm to the contact pad.

Figure 74. Program Cam Contact Adjustment

2.11 Print Unit

The IBM A print unit (in machines produced before December 1, 1954) contains wires of .012-inch diameter. The newer IBM B print unit uses stainless steel wires of .009-inch diameter. These wires are *not* interchangeable. Whenever the wire guide assembly requires replacement, the IBM B print unit should be installed.

2.11.1 Print Unit Assembly

SERVICE CHECK

Code Plate Lubrication. Keep oil or grease away from back of code plate because they cause printing failures.

Code Plate Projections. Broken or missing projections can be determined easily for one specific character. A test of other characters will usually determine if it is a shifting error or a bind.

Code Plate Return Springs. The code plate return plungers are now made so that they do not come apart. On older plungers, check to be sure that they are in place before operating the machine. If the machine is run without one plunger, broken wires or code plate projections will result.

Code Plate Alignment Test (Vertical)

1. Loosen vertical fixed-stop locking screw.
2. While printing an H, back off on adjusting screw until extra wires print. Mark position of screw slot and turn screw in until failure occurs at other extreme of adjustment. Mark position of screw slot and turn the screw to mid-point between the two marks. The marks indicate critical limits of adjustment and mid-point represents maximum safety factor. An H is suggested because it tests maximum vertical shift for an alphabetic character.
3. Tighten locking screw.

Code Plate Alignment Test (Horizontal)

1. Loosen horizontal fixed-stop locking screw.
2. While printing 3's, back out slowly on adjusting screw. If code plate is in true vertical alignment with the rows of print wires, all wires printing the 3 will drop out simultaneously because code plate is being moved to its neutral position by adjusting screw. If a corner of number disappears first, adjust vertical shift guide plate bracket, using the aligning tools.
3. Repeat vertical test procedure using the *horizontal* adjusting screw while printing an H.
4. Tighten locking screw.

Code Plate Shifting Test. To determine which way the code plate should be shifted for correct printing:

1. Trace Figure 75.
2. Place the tracing over Figure 76 and shift it for a particular character (see Figure 85).

If printing troubles occur, this method may help determine whether the trouble is broken wires or a damaged code plate.

Printing Interposers. Figure 77 locates the print interposers, rollers and slides. Each unit of cam action equals .020-inch motion to its slide. A -1 cam has a .010-inch cut from both sides of the interposer, resulting in a .020-inch motion. A +4 interposer moves the slide .080-inch. Use Figure 77 as a guide to reassemble the print interposer assembly. In later machines, the + or - values are etched on the interposer faces. (The ratio of motion of the slides to the code plate is 10 to 11.)

ADJUSTMENT

NOTE: Adjustment of one component unit often affects

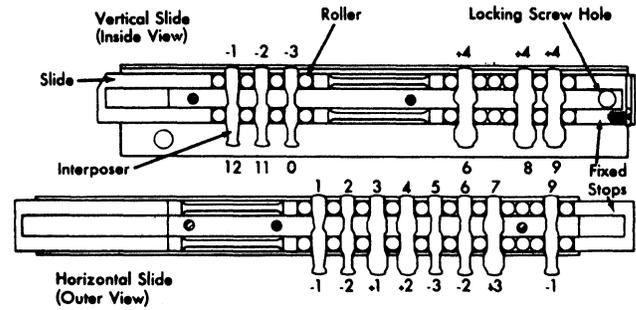


Figure 77. Print Interposer Assembly

another unit. Units should be adjusted in the order in which they appear in following text.

Punch Drive and Print Yoke. Clearance between the yokes and guides should be .015-inch to .020-inch (Figure 78); it is obtained by adjusting the punch drive unit. The clearance results in rollers contacting print interposers a minimum of .015-inch above the start of cam action. Because the clearance cannot be measured, it is obtained as follows:

1. Oil (IBM 6) the print interposers.
2. Remove belt guard and punch drive belt to take load off drive unit.

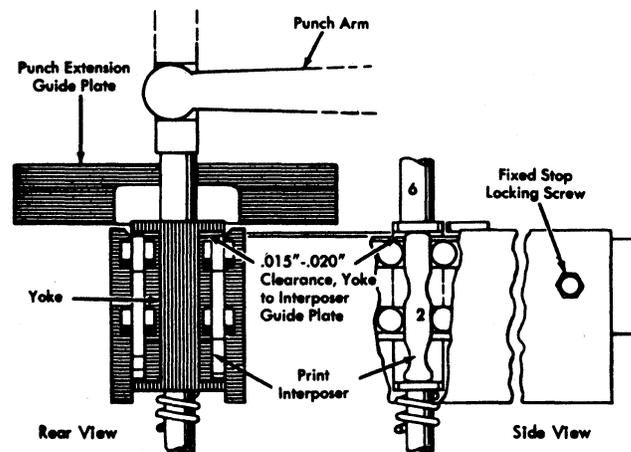


Figure 78. Punch Drive and Yoke Adjustment

3. Loosen the two screws in pin bail drive link.
4. Loosen adjusting screw lock nut, holding screw, and two support screws in drive anchor bar (Figure 48). Unhook print drive spring.
5. Rotate drive unit counterclockwise with punch clutch latched until yokes can be felt to bottom on their inner guides. Turn adjusting screw in until it touches the casting; then back off one full turn and tighten lock nut and holding screw. The two support screws should be turned in until they rest against side frames. This procedure may be varied on machines without adjustable punches (Figure 79) to a maximum of 1½ turns for proper punch penetration.
6. Reassemble the machine and test punch penetration with standard codes.

NOTE: Extend and tighten the pin bail drive link during reassembly.

Code Plate Clearance

1. Start with one .003-inch shim (P/N 305243) and two .007-inch shims (P/N 228296) between the pressure plate and the shim retaining plate (Figure 80). **NOTE:** No oil or

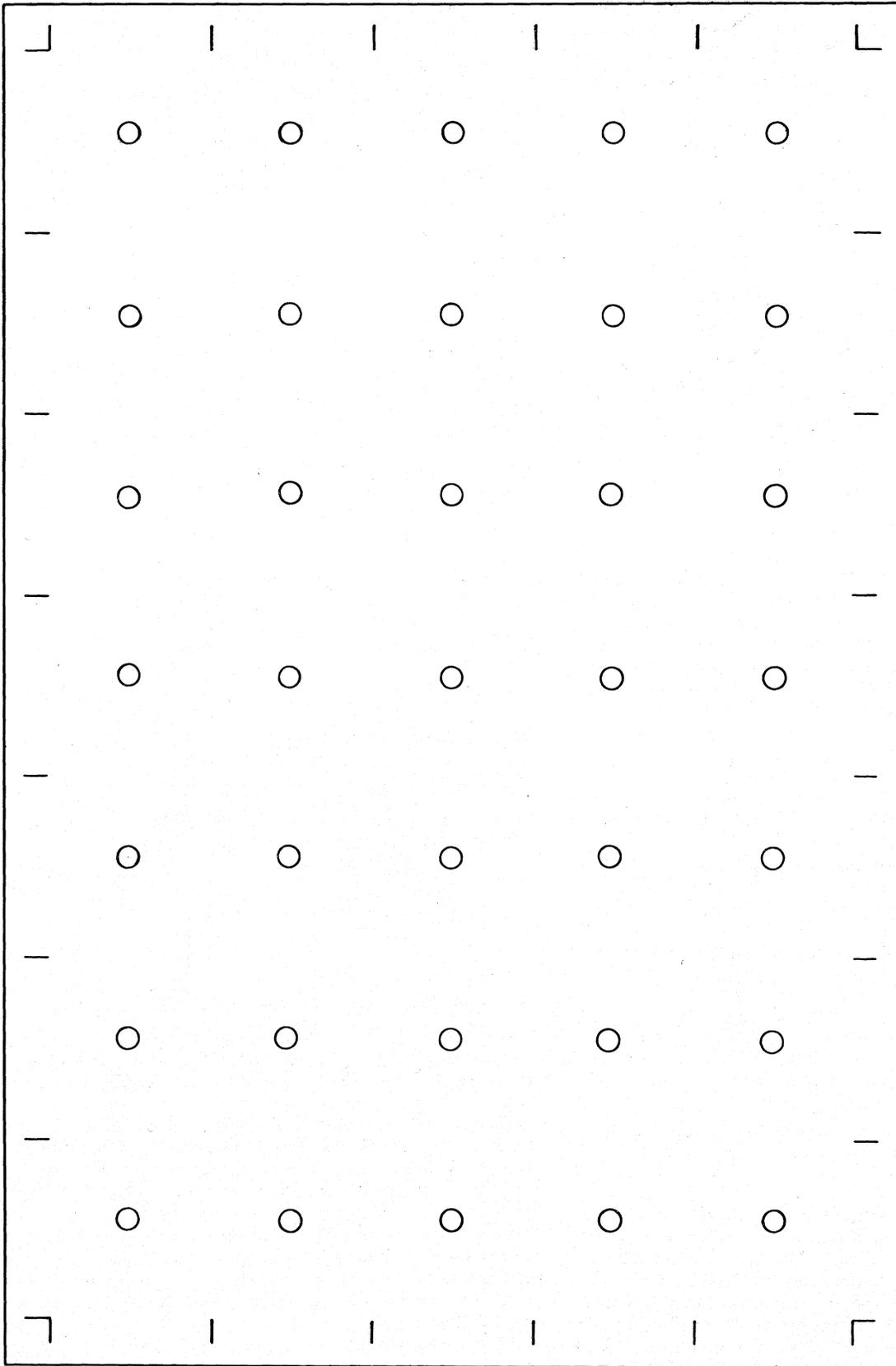


Figure 75. Overlay for Figure 76.

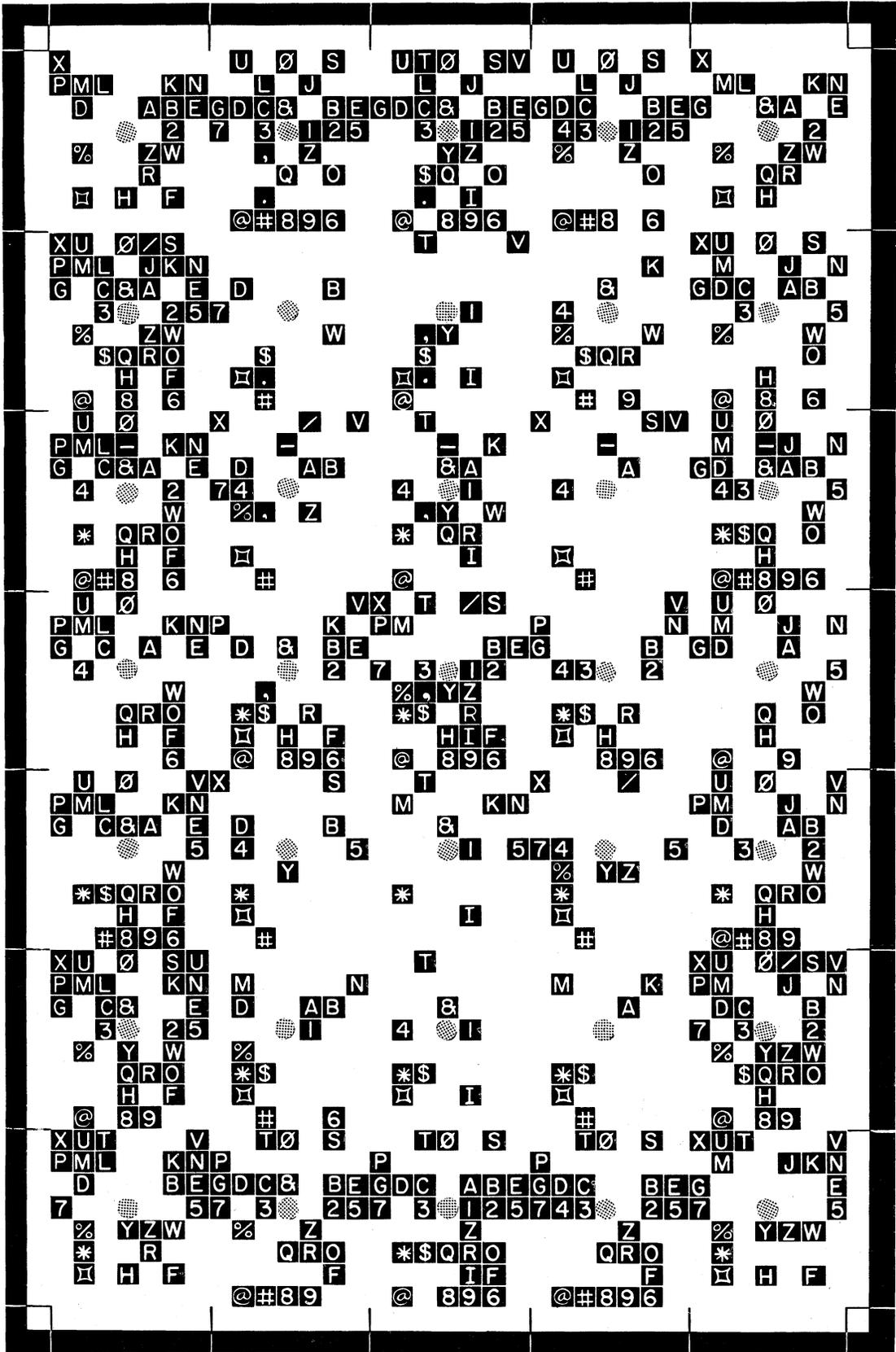


Figure 0 (zero) is shown Ø
 Letter O is shown O

Figure I (one) is shown I
 Letter I is shown I

Figure 76. Code Plate Chart

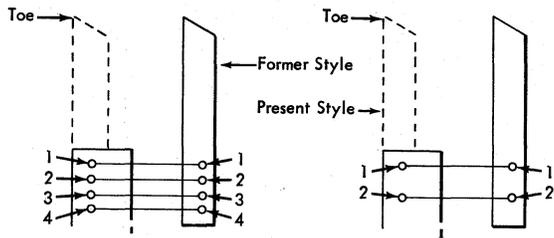


Figure 79. Punch and Extension

grease is to be on code plate or shim retaining plate because shifting troubles result.

2. Turn the three large pressure plate adjusting nuts counterclockwise until snug (Figure 80). Lock in this position.

3. Check for code plate clearance to wires of .028-inch to .030-inch. Add or remove code plate shims if necessary.

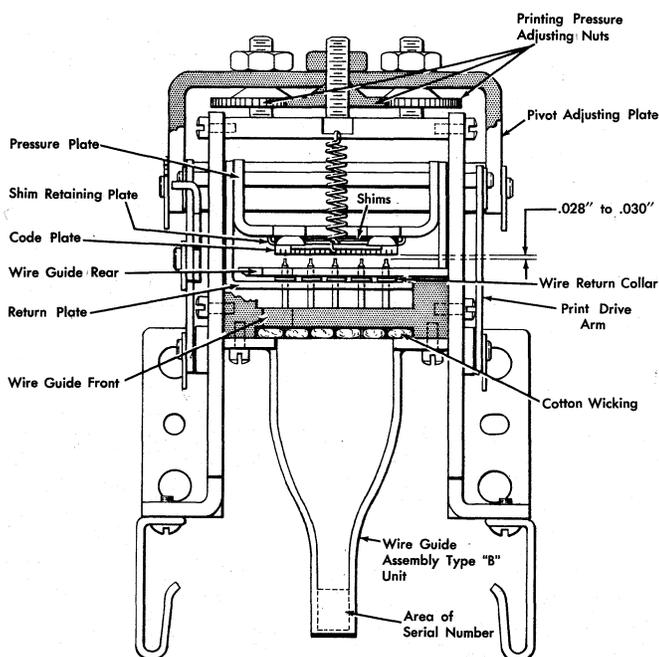


Figure 80. Printing Adjustment

Code Plate Alignment (Without Code Plate Stops)

1. Loosen stop adjustment locking screws (Figure 81).
2. Insert code plate aligning tools.
3. Unhook vertical and horizontal shift springs.
4. Back out the two stop adjusting screws so that shifting mechanism does not hold code plate (Figure 82).
5. If aligning tools are not loose, loosen screw holding lower vertical shift guide plate bracket and position upper vertical shift guide plate bracket to obtain equal clearance of vertical shift plate to each side of print head and no bind on aligning tools.
6. Position lower guide plate bracket for no bind on aligning tools.
7. Adjust and lock vertical stop adjusting screw for no binds on aligning tools (vertical shift spring connected).

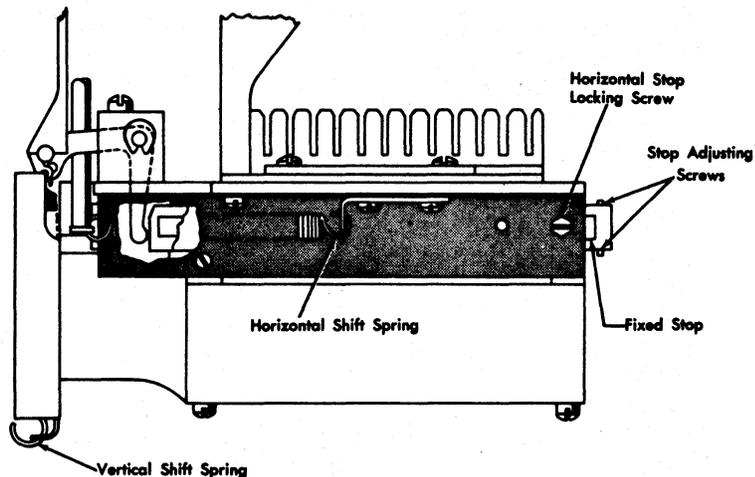


Figure 81. Print Interposer Assembly

8. Adjust and lock horizontal stop adjusting screw for no binds on aligning tools (horizontal shift spring connected).
9. Remove aligning tools.

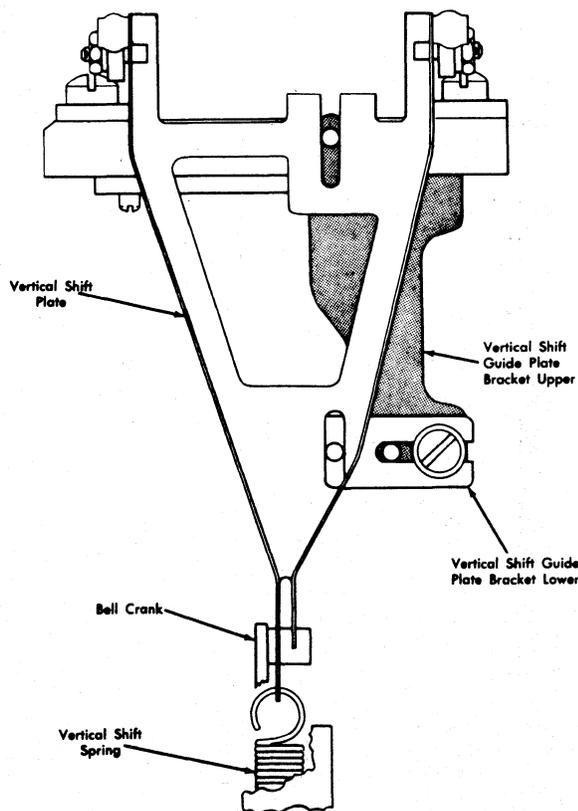


Figure 82. Code Plate Adjustment

3. Readjust horizontal shift using an H. Turn in slowly
- Code Plate Alignment (With Code Plate Stops)**
1. Code plate is aligned with punch clutch latched up. Loosen locking screws of vertical drive-rod guide plate (Figure 83).
 2. Loosen stop adjustment locking screws and back off horizontal and vertical stop adjusting screws (Figure 84).
 3. Unhook horizontal shift spring. Take tension off vertical shift spring by backing off knurled thumb screw (Figure 83).

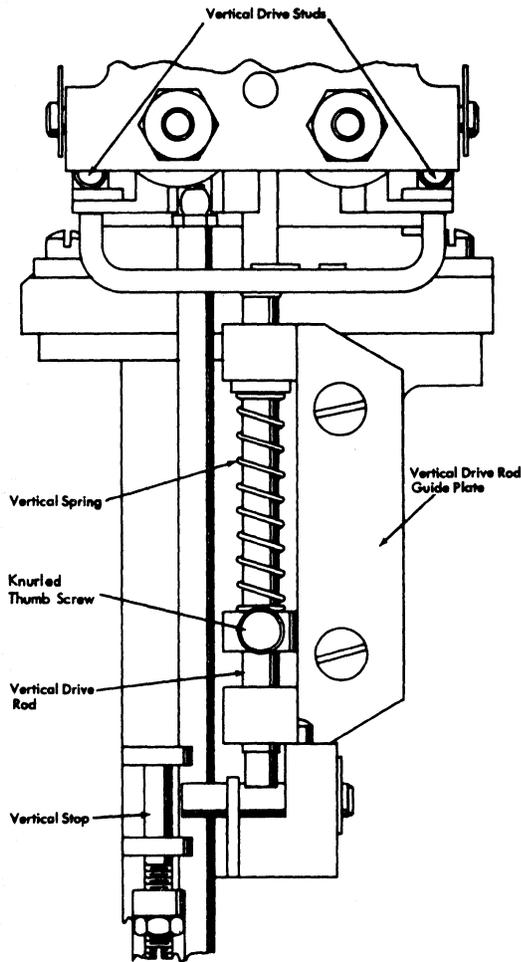


Figure 83. Vertical Drive Rod Assembly

Tighten locking nut.

4. Insert code-plate aligning tools.
5. Position both vertical drive studs within code plate slots and tighten locking screws of vertical drive-rod guide plate (Figure 83).
6. Hook up horizontal shift spring and turn horizontal adjusting screw (on left from front of machine) until code-plate aligning rods are free.
7. Restore tension to vertical shift spring and tighten knurled screw into groove in vertical drive rod. Turn vertical adjusting screw until code-plate aligning tools are free.
8. Remove aligning tools.

Figure 85 is a guide to wires used for printing each character; it can be used to determine when extra wires are being picked up in printing. If extra wires are printed, refine the code plate alignment (without code plate stops), steps 7 and 8:

1. Loosen locking screw and adjust vertical shift adjusting screw in a direction to produce the least number of extra wires picked up. Adjust screw in small steps while printing zeros and 8's (0, 8, 0, 8 . . .). Tighten the locking screw.

2. Loosen horizontal fixed stop locking screw. While printing 3's, back out slowly on adjusting screw. If code plate is in true vertical alignment with the rows of print wires, all wires printing the 3 will drop out simultaneously because the code plate is being moved to its neutral position by the adjusting screw. If a corner of the number disappears first, readjust vertical shift guide plate bracket using aligning tools.

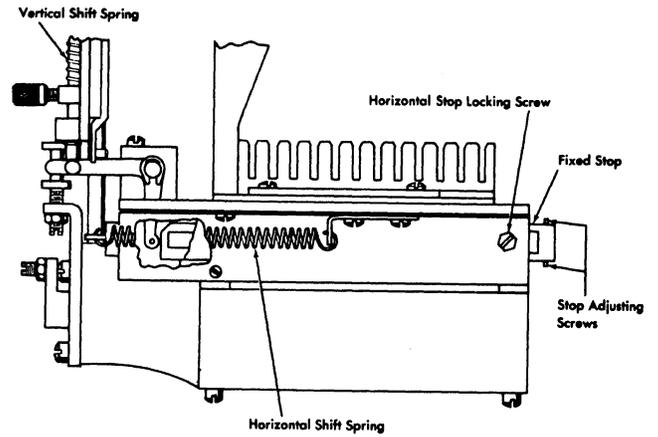


Figure 84. Print Interposer Assembly

3. Readjust horizontal shift using an H. Turn in slowly on adjusting screw until the H is as clear as possible. Keep turning until additional wires start appearing. Mark this position. Back out slowly on screw past clearest possible H until extra wires start reappearing. Mark this position. Turn screw to mid-point; this is the best possible adjustment. Tighten locking screw.

3. Readjust horizontal shift using an H. Turn in slowly on adjusting screw until the H is as clear as possible. Keep turning until additional wires start appearing. Mark this position. Back out slowly on screw past clearest possible H until extra wires start reappearing. Mark this position. Turn screw to mid-point; this is the best possible adjustment. Tighten locking screw.

4. Before releasing machine to customer, duplicate while printing 500 cards punched A, space, B, space, and so on. Use all characters.

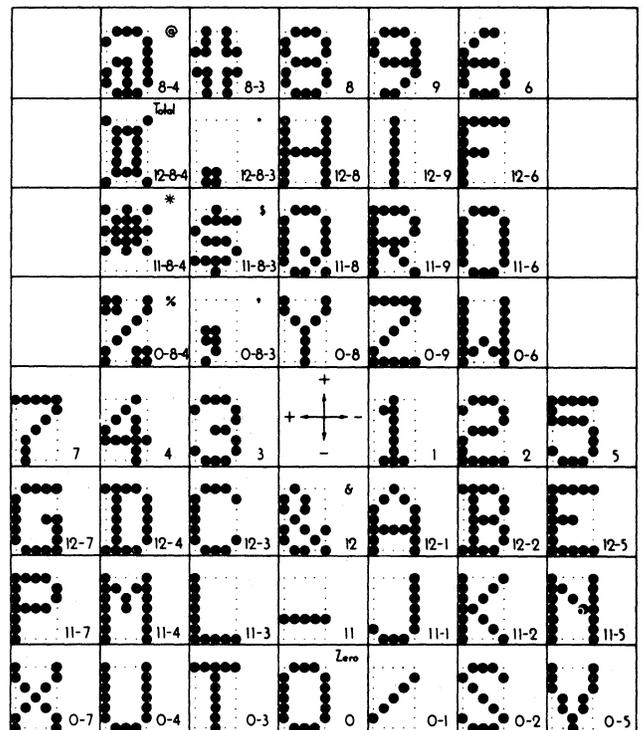


Figure 85. Character Patterns

Punches	Direction		Character
	H	V	
3,7	+4		3,7
8		+4	8
1,5	-4		1,5
12,0		-4	12,0

Figure 86. Test Patterns

Code Plate Stops

1. Adjust bracket so that horizontal stop clears stud on horizontal shift lever and vertical stop is parallel to end of stud on vertical shift lever. Tighten screws.
2. Turn both adjustable stops to get clearance between stops and studs of $\frac{1}{8}$ inch in the plus direction. The stud is then nearly centered between stops.
3. Unhook heavy spring to the print cam follower. Set punch index at 133° .
4. Remove cover from punch extensions and manually push punches 3 and 7 to extreme upward position. Turn adjustable stop to just touch horizontal shift lever stud. Tighten locking nut.
5. To adjust vertical stop, manually push punch 8 to extreme upward position. Turn adjustable stop to just touch vertical shift lever stud. Tighten locking nut.
6. Check under power by duplicating punches shown in Figure 86. Correct setting of code plate stops prints the characters shown.
7. Stops must be checked and readjusted each time the blank position of the code plate is altered.

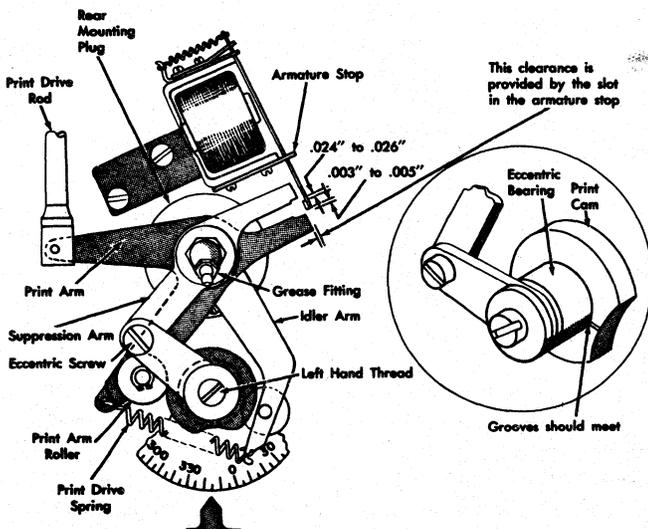


Figure 87. Print Drive Unit

Printing Pressure

1. Turn in evenly on the three adjusting nuts (Figure 80), $\frac{1}{4}$ turn at a time, until printing is obtained. Snug up lock nuts after each step and space before punching to prevent damage to wires. A practical test to show up uneven printing can be obtained by disengaging the ribbon feed pawl and printing an H until the printing grows faint. Too much printing pressure will make the machine noisy and cause marks to appear when spacing.

2. Print arm roller (Figure 36) must be free to lift .010-inch off cam during print suppression to reduce noise and wear on cam. Check clearance with print drive spring removed. The lifting motion drives wire collars .005-inch closer to wire guide plate than their normal return after printing. If necessary, remove code plate shims and readjust printing pressure to maintain enough clearance to prevent wire return collars from striking wire guide rear (Figure 80). Code plate to wire clearance should now be .028-inch to .030-inch.

Print Drive

1. Loosen left-hand thread screw (Figure 87) at rear of punch shaft and position eccentric to line up its groove with mark on print cam.

2. Attract print suppression armature and, with punch clutch latched, adjust eccentric screw (Figure 87) in eccentric drive link for .024-inch to .026-inch clearance between suppress arm and block on armature.

3. Unhook print spring and make sure that print arm roller can be lifted .010-inch off cam. If the clearance is unobtainable, check step 2 of the "Printing Pressure" adjustment.

Ribbon Feed Pawl. Adjust ratchet stop pawl eccentric to cause ribbon feed pawl to feed one tooth per print cycle.

Print Suppress Magnet (Figure 88)

1. Armature should be flat within .005-inch.
2. Adjust and form ears of armature pivot so that armature lies flat against both yokes.
3. Check for .006-inch to .008-inch air gap between armature and core when armature is attracted. Shim core, if necessary, using steel shims (P/N 305271).
4. Form ears of armature return spring (flat spring) to require 15-grams to 30-grams pressure to move each ear from armature; sides must be within 5-grams of each other. Improper adjustment causes print suppression troubles.

5. Adjust armature retainer squarely for .035-inch to .037-inch air gap between armature and residual with magnet de-energized. Armature must not drag on side of retainer.

6. Attract armature and position magnet bracket so that armature contacts suppress arm and interposer block clears side of print arm by .003-inch to .005-inch (Figure 88).

REMOVAL AND REPLACEMENT

Print Head

1. Remove ribbon spools. Slip them together and place under card lever pressure finger. Leave ribbon under die.
2. Transfer vertical shift plate spring to hole in bell crank (Figure 82).
3. Unscrew gear at upper end of flexible shaft (left-hand thread).
4. Remove chip tube on IBM A print units only; now lift bushing out of die with print wires.
5. Pull print drive rod (Figure 89) out of print arm. (On some units, it may be easier to remove right horseshoe clip and slide drive rod over, instead of disconnecting drive rod from stud.) Remove the four screws holding print head

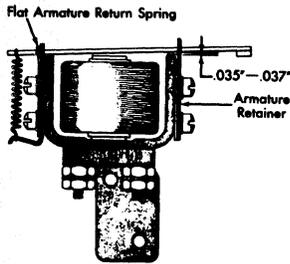


Figure 88. Print Suppression Magnet Adjustment

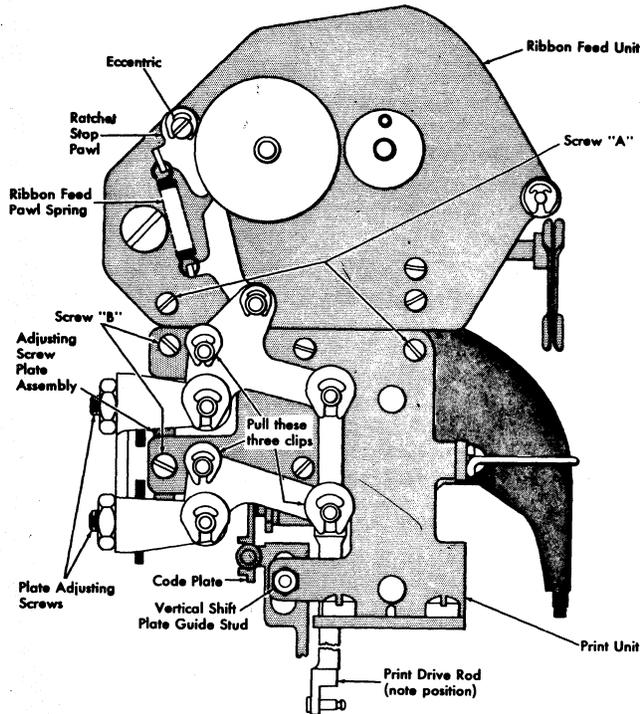


Figure 89. Print Head Removal

to stripper; lift print head off guide pins and clear off base. (Keep bushing on end of wires in IBM A print unit.)

Print Wire Unit

1. Pull three clips (Figure 89) and withdraw the three shafts.
2. Note position of pressure plate for reassembly. The end with the wide cut-out portion goes toward ribbon feed unit.
3. Remove the two screws (B, Figure 89) from each side. Note that adjusting screw plate assembly will pivot slightly about its two dowel screws.
4. Remove pressure plate operating linkage.
5. After reassembly, the impression may be lighter at one end of the character. To correct this condition, first try shifting the adjusting screw plate. If the condition is not corrected, repeat the adjustment procedure.

Print Wire. Single wires can be replaced. Be sure that collar portion of the wire, which extends through guide plate, is same size as the one being replaced.

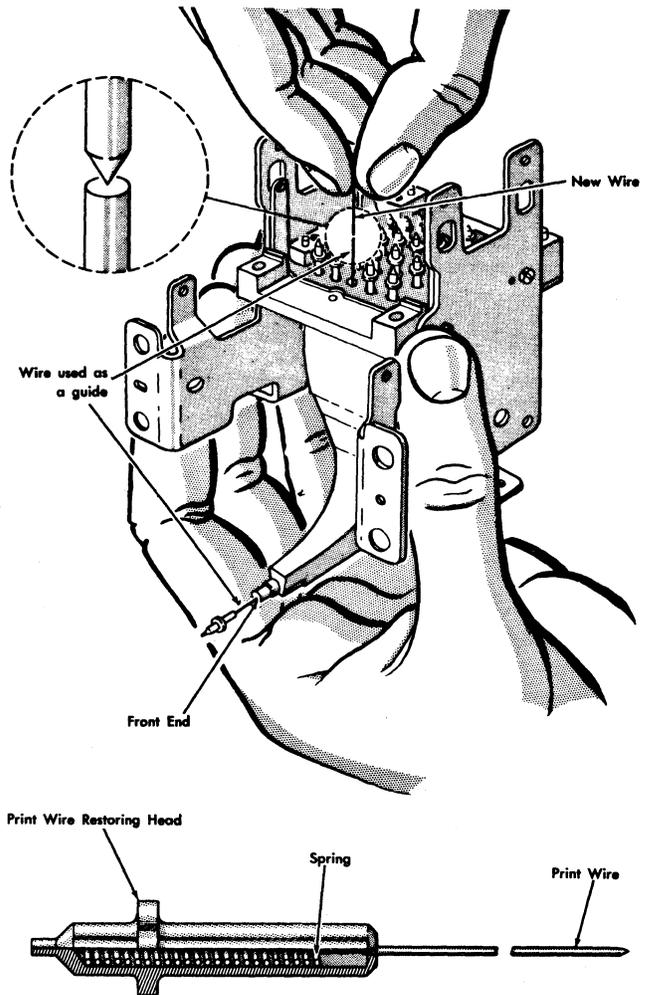


Figure 90. Print Wire Replacement

CAUTION

Do not disturb cotton wicking around print wires.

1. Remove the four holding screws and lift off rear wire guide plate (Figure 80). On IBM A print unit, it is necessary to drive out the four taper pins from front side.
2. Pull out desired wire for inspection. Be sure to replace it in the same position—all wires have a different length. If print wire has pulled out of its head, a new wire may be inserted from front end and the wire pushed up enough to pull it out.

NOTE: Apply IBM 6 oil to any print wire before installing it in the IBM B print unit. Usually a new wire can be installed without difficulty by inserting it in the hole from which the old wire was removed. Lightly stone the edge of the new wire to remove any burrs. Do not make the wire pointed. If trouble is experienced, it is then necessary to insert another wire, used as a guide, from the front end. In this procedure, the end of the new wire should be pointed. (If a new wire is used as a guide, stone its end flat.) Then, using first wire as a guide, push the new wire into unit as shown in Figure 90. Reinstall rear guide plate and pull all wires back against it. Cut off end of wire as close as possible to wire guide and carefully stone it even with the other wires. Oil cotton wicking with IBM 6.

Code Plate

1. Remove print head from machine.
2. Unhook ribbon feed pawl spring. Remove the two

screws (A, Figure 89) from each side.

3. Remove ribbon feed unit by lifting it off print unit.

4. Remove the two vertical shift plate guide studs and vertical shift plate.

5. Set print unit on plate adjusting screws; this will prevent code plate shims from getting out of place.

6. Unhook code plate return springs. To prevent damage to print wires, move pressure plate back away from them. Code plate may now be withdrawn.

CAUTION

Code plate return springs on some early machines may fly out if caution is not used when removing code plate. When reinstalling code plate, see that shims do not get out of position. Keep oil and grease off code plate back and shim retaining plate; it will cause shifting troubles. When replacing code plate return plungers, replace plungers in matched pairs only; they must be balanced within 10 grams of each other.

2.12 Keyboard

2.12.1 Keyboard Assembly

SERVICE CHECK

Permutation Bar Guide. If wear of the cast metal permutation bar guide (P/N 219282) causes trouble, order B/M 270902 to replace these parts with a steel guide.

Key Stem Retaining Wire. If the metal wire breaks, replace it with a nylon wire to prevent shorts and grounds in the keyboard.

Contacts. Keyboard contacts should be inspected for air gap, tension, and contact rise. Check contact surfaces for nodes and pits due to burning. Insufficient air gap of latch contacts can cause false error indications. Note condition of these contacts, particularly if keyboard has been jarred or dropped.

The 824-826 keyboard is identical to the 24-26 keyboard except for the keyboard restore magnet contact strap. This

strap has had a stiffener added to speed its operation. This limits the possibility of losing information because a keyboard restore magnet contact is sluggish in closing.

ADJUSTMENT (Figure 91)

Bail Contacts. With bail contact assemblies out of machine, form each contact strap to require a pressure of 9-grams to 11-grams to close points (measure at contact point). Position contact plates for contact air gap of .015-inch to .025-inch with all latch assemblies restored.

Latch Contacts. Form operated strap to require 18-grams to 24-grams pressure to close contacts. Measure at contact pad. Pivot contact assembly mounting bar to obtain .015-inch to .025-inch contact air gap across unit. Stationary contacts may be formed for individual air gap.

Restoring Bail Contacts. Form operating strap to require 48-grams to 52-grams pressure to open contacts. Position contact bracket for .002-inch to .010-inch clearance between movable strap and operating insulator disk on restoring bail; it is very important to have clearance between contact strap and disk. When all restoring magnet adjustments are made correctly, restoring bail contacts should have a minimum of .010-inch air gap when restoring magnets are energized. NOTE: It is important that restoring bail contacts open before the latch or bail contacts.

Keystem Contacts. The N/O contacts should have a $\frac{1}{32}$ -inch minimum air gap. The N/C contacts must open with minimum pressure at end of strap of 15-grams and with minimum movement of stationary strap when opening of $\frac{1}{4}$ -inch.

1. When MP key is depressed $\frac{1}{2}$ -inch, $\pm\frac{1}{4}$ -inch, the upper contact must break. Further depression of $\frac{1}{2}$ -inch will cause lower contact to make.

2. MP/Er contact should have minimum air gap of $\frac{1}{32}$ -inch and require minimum force of 15-grams to operate.

3. Alph and Dup key contacts must close when their key is depressed $\frac{1}{2}$ -inch, $\pm\frac{1}{32}$ -inch. If operator's palm strikes Alph key, increase contact air gap.

4. Alph and Ver key contacts must close when keys are depressed $\frac{1}{2}$ -inch, $\pm\frac{1}{32}$ -inch. If operator's palm strikes Alph key, increase contact air gap.

5. The Num contact must open when key is depressed $\frac{1}{32}$ -inch, $\pm\frac{1}{4}$ -inch.

Contact Bails. When a new bail (Figure 92) is installed, form all tabs on each bail for zero to .005-inch clearance to associated operation ears on permutation bar, with latch assemblies in restored position. This may be checked on a keyboard with its covers removed. Check tension required to just open a closed bail contact for each key operating that

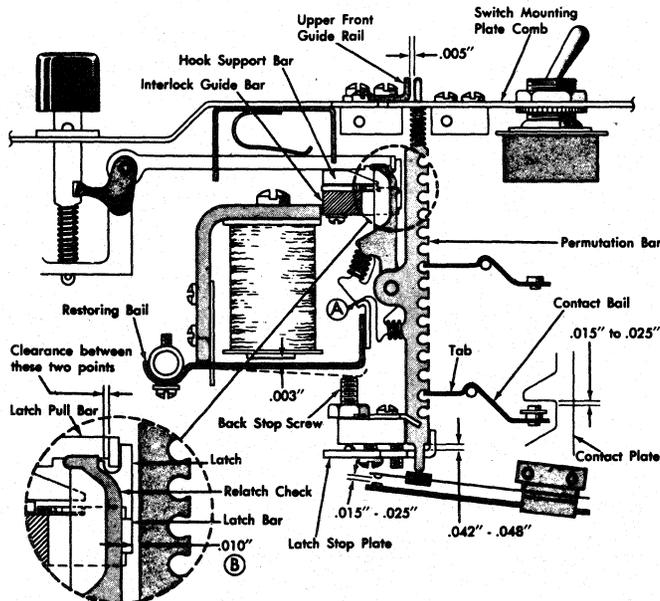


Figure 91. Keyboard Adjustment

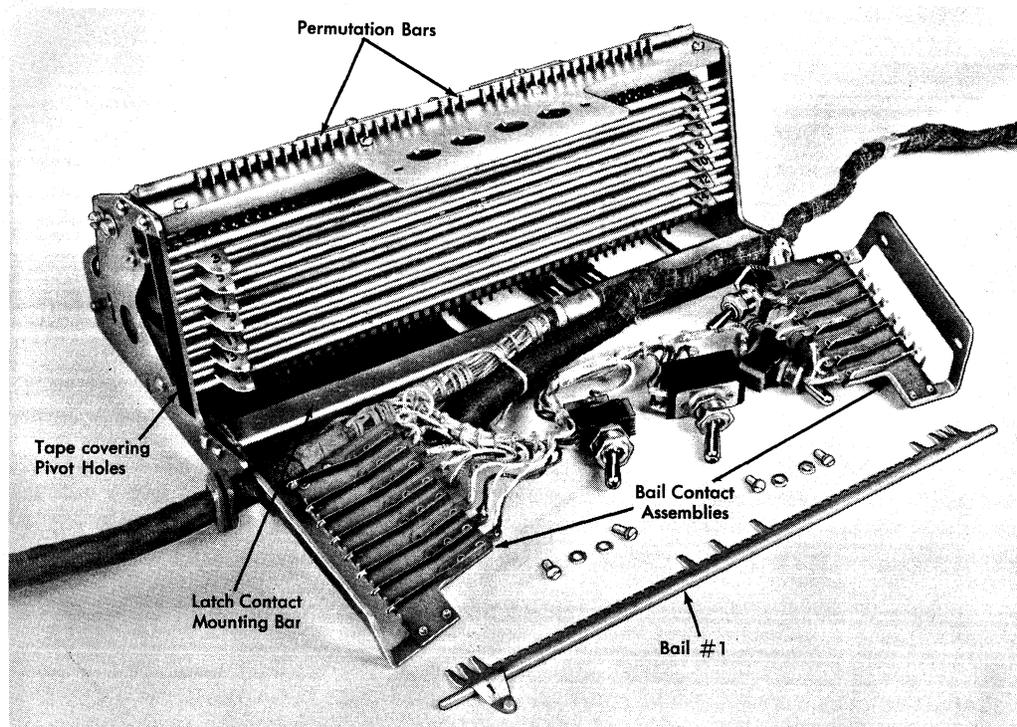


Figure 92. Keyboard Permutation Unit

bail; tension should be at least 15-grams. Bail contact air gap and tension on operated strap will affect this tension and should be checked before a measurement is attempted.

Hook Support Bar. Bar must be parallel with interlock guide bar, directly beneath it, along their longest edges, within .008-inch. This is to prevent binding the latch.

Permutation Bar. Adjust the four setscrews positioning latch stop plate to allow bars to drop .042-inch to .048-inch. Measure on a bar near each holding screw. To measure, lay a 6-inch rule across top of permutation bars. If bar whose travel is to be measured is lower than the 6-inch rule, measure this amount and add it to the .042-inch to .048-inch given above. Trip latch and measure distance that top of this bar is below edge of rule.

Restoring Magnet

1. With all latch assemblies restored, insert .003-inch gage between armature and magnet core and hold them sealed. Position magnet brackets evenly until restoring bail meets all latches at A, Figure 91. This should result in .010-inch maximum overtravel of latching point with gage removed.

2. With magnets de-energized, adjust the two backstop screws for clearance between each armature and its magnet core of .030-inch, measured at centerline of core. (Use special .030-inch gage issued to measure clearance between feed and idler roll on this machine.)

3. Check adjustment of permutation bar travel and adjustments 1 and 2 by tripping, one at a time, several latches across unit. Clearance between closest tripped latch and restoring bail should be at least .002-inch. Remake adjustments if this condition is not present.

4. Adjust restoring bail pivots so that restoring bail operates freely but has a minimum of clearance in the pivots.

Upper Permutation Support. Note that die-cast supports are not adjustable.

1. Loosen the two end screws in upper front guide rail and the four screws holding switch mounting plate comb.

2. Position comb for .010-inch, $\pm .005$ -inch, clearance between latch bar and permutation bars (B, Figure 91).

3. Position upper front guide rail evenly for .005-inch clearance to permutation bars.

Key Unit

1. Loosen the four screws (Figure 93) that hold key unit to permutation unit.

2. Position key unit evenly for clearance of latch pull bar to latch; see inset, Figure 91. Pressure of 65-grams to 85-grams should trip any key operating a latch assembly and interlock disk (except the space key which should be tripped by 85-grams to 110-grams). See Figure 94. Keys that do not operate latch assemblies should travel $\frac{5}{32}$ -inch with 55-grams to 70-grams pressure applied to them.

REMOVAL AND REPLACEMENT

To remove keyboard from machine, first pull out wire plugs in terminal panel. With combination keyboard, wires will be filled in solid, starting from top of panel. With numeric keyboard, note vacant hubs before removing cable, even though cable forms are laced out for each location. (For machine with terminal posts only.)

Covers

1. Remove rubber base ring; on later machines remove two screws to release bottom cover.

2. Remove four screws to release top cover from keyboard unit; on older style unit, top two screws hold toggle switch plate; for newer units, top two screws are more accessible and a spring plate latches over toggle switch

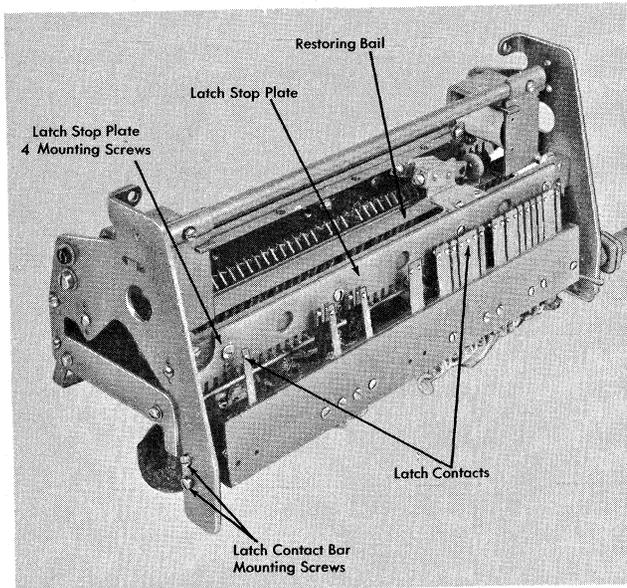


Figure 93. Keyboard Permutation Unit

mounting plate. This spring plate must be depressed to clear switch mounting plate for removal of keyboard unit.

3. Remove ground wire.

When replacing the keyboard cover on units with dummy keys, hold keys in place with cellophane tape until unit is assembled. Replace base cover and base ring by placing ring on bottom cover first. Curled edge of bottom cover faces out.

Key Unit. To separate keyboard into its major units, remove the four screws as shown in Figure 95. Be careful when sliding key unit out of permutation unit: the Y pull bar may hook on center support screw. It is not necessary to remove any wires if the removal is merely for inspection. Untie nylon key stop wire at end where it is fastened to permutation unit. **NOTE:** Do not oil or grease hook ends of latch pull bars. On reassembly, check clearance of latch to pull bar (Figure 91).

Key Stem

1. Remove nylon retaining wire to free desired key stem. (Use a follow wire to aid reassembly.)

2. Lift key from unit while end of latch pull rod is held up and clear of latch. Be careful that key stem spring does not drop into unit. Refer to Figure 91.

3. Reassemble unit. Hold latch pull rod free of latch and allow key stem bell crank to rotate into key stem. Be sure spring is assembled on key stem.

4. Test the position for binds.

Contact Bails

1. Remove toggle switches from mounting plate.

2. Remove the two bail contact assemblies shown in Figure 92. Each assembly is held by two screws and may be shimmed away from side frame. Note the position of these shims.

CAUTION

As each bail contact assembly is removed, cover pivot end of contact bails with cellulose acetate tape to keep bails from falling out.

3. Punch a hole in cellophane tape and remove desired contact bail.

Latch Assembly

1. Separate key and permutation units.

2. Remove wires from all key stem contacts and the two restoring magnets (Figure 95).

3. Loosen the two mounting screws and remove restoring bail contact assembly.

4. Remove restoring bail by taking out one screw from one of the pivots and turning pivot block away from armature.

5. Remove the two bail contact assemblies shown in Figure 92.

6. Remove toggle switches from mounting plate.

7. Remove contact bails; they are numbered 1 to 15, top to bottom (Figure 92).

8. Remove latch contact mounting bar.

9. Remove the four screws from latch stop plate (Figure 93).

10. Remove the two springs on latch assembly to be taken out. The longer spring belongs between latch and relatch check lever.

11. Remove center support screw from upper latch assembly guide (Figure 95).

12. Set unit on its back. Hold hook support bar (Figure 95) while removing the three screws that hold it. Also, remove pivot screw.

13. Still holding hook support bar, set permutation unit right side up.

14. Slide off hook support bar, exposing interlock disks.

15. Lift out interlock disks adjacent to latch assembly to be removed. Latch is free to come out of bottom. Note carefully the difference between release key latch and other latch assemblies. Release key latch is cut away at point where latch would contact interlock disks. Release key is

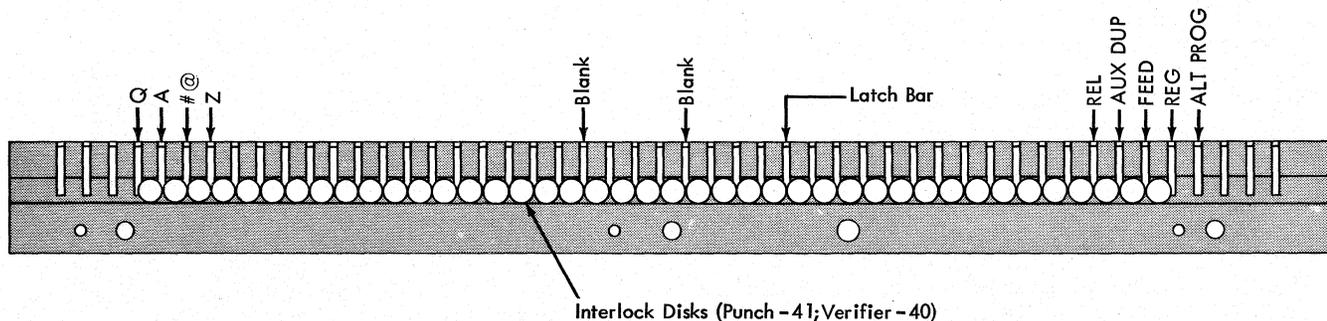


Figure 94. Keyboard Interlock Disks

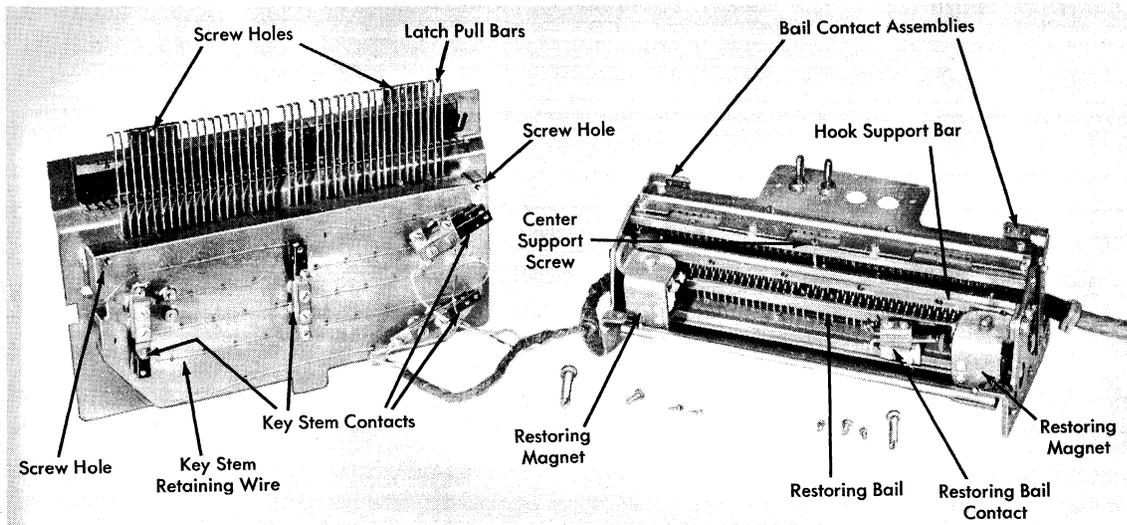


Figure 95. Keyboard Permutation Units

not interlocked. Figure 94 shows the correct position of the 41 interlock disks for the IBM 24-26 keyboard. A numeric keyboard has 17 interlock disks.

CAUTION

When an interlock is removed, all latches tripped off latch bar can fly out. All parts in direct contact with interlocks, including latches that strike interlocks, must be free of oil or grease.

After reassembly, check all adjustments. When replacing contact bails, stand permutation unit on one end after covering pivot holes with tape to keep contact bails from falling out.

Latch Pull Bar

1. Separate key and permutation units; see "Key Unit."
2. To replace a pull bar in top row, remove key stem in the defective position. If defective latch pull bar is not in top row, remove all key stems and top plate.
3. Remove defective latch pull bar from pivot rod (a follow rod will aid in reassembly).
4. Replace top plate and key stems. Check clearance of latch to pull bar (Figure 91).

2.12.2 Keyboard Lubrication

Lubrication should be applied at the discretion of the customer engineer, based on machine usage and local conditions. See Figure 96.

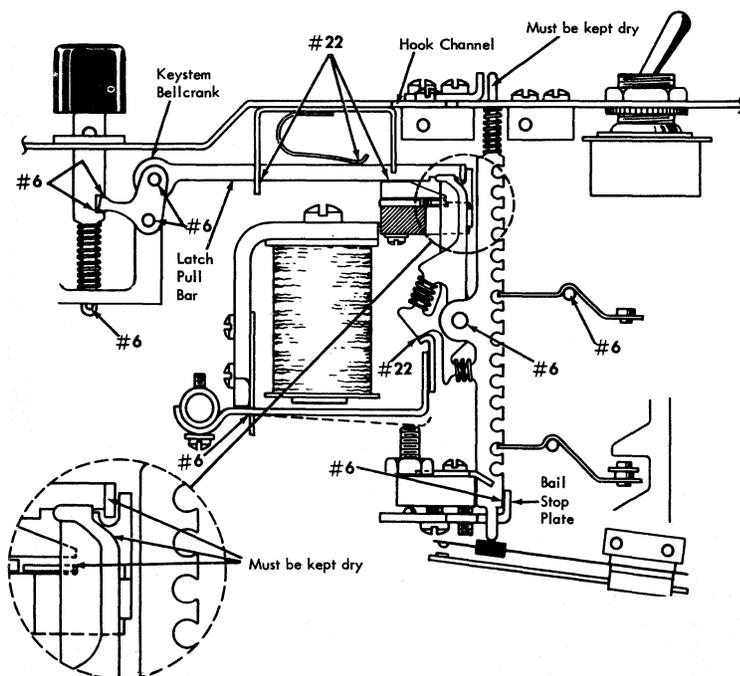


Figure 96. Keyboard Lubrication

2.13 Special Features

2.13.1 Self-Checking Number Device

This device may be installed on IBM 24 and IBM 26 punches (alternating current). It permits punching and verification of numeric codes in the same operation. The device is controlled by a toggle switch and special punching in the program card. The adjustments and preventive maintenance procedures applying to tubes and relays in the standard machine also apply to this device.

2.13.2 Alternate Program Device

Machines can be equipped to use the lower half of the same program card for an entirely different "alternate" program. This program is substituted for the normal program by a single key stroke at any time in a given card cycle. Program card punching for normal and alternate programs is:

NORMAL PROGRAM	FUNCTION	ALTERNATE PROGRAM
12, 11, or 0	Start manual field	4, 5, or 6
12	Field definition	4
11	Start auto-skip	5
0	Start auto-duplication	6
1	Alphabetic control	7
2	Zero print	8
3	Print suppression	9

2.13.3 Auxiliary Duplication Device

This device allows key-controlled duplication, into the detail card, of fields of information from a card on the auxiliary drum. The auxiliary drum is similar to a program drum. Adjustments for this device are in Section 2.10.

2.13.4 Card Reverse Stacker

This device allows customers to reverse the order of the punched cards for verification purposes. This section describes procedures peculiar to the card reverse stacker; items common to the regular stacker are in Section 2.9.

ADJUSTMENTS

Traveling Card Guide. Adjust card guide so that traveling card guide clears stacker drum shaft by $\frac{1}{8}$ inch when operating cam follower is on high dwell of cam. Adjust traveling card guide bumper screw so that card clears traveling card guide by .000-inch to .010-inch.

Stacker Clearance. Adjust card-reverse pivot brackets (Figure 97) so that a minimum clearance exists between left side rail of stacker and card reverse box when reverse unit is locked in operating position.

Stacker Tension. Adjust compression spring lock nuts with card reverse unit in horizontal position (45° up from operating position) so that a $2\frac{1}{2}$ -pound force is required to rotate unit downward.

Feed Roll Tension. Adjust spring mounting block so that a minimum force of 500-grams to 700-grams applied to either end of feed roll shaft, at a point adjacent to feed roll, raises feed roll .010-inch above stacker drum.

Idler Rolls. Position idler shaft so that idler rolls just touch card reverse belts but revolve freely.

Bumpers. Check to see that bumper screws of stacker allow quiet operation. Card pushers must clear card line.

2.13.5 Variable Length Card Device

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. Card feed latch time is changed to 70° .
6. Two auxiliary transport rolls are added.

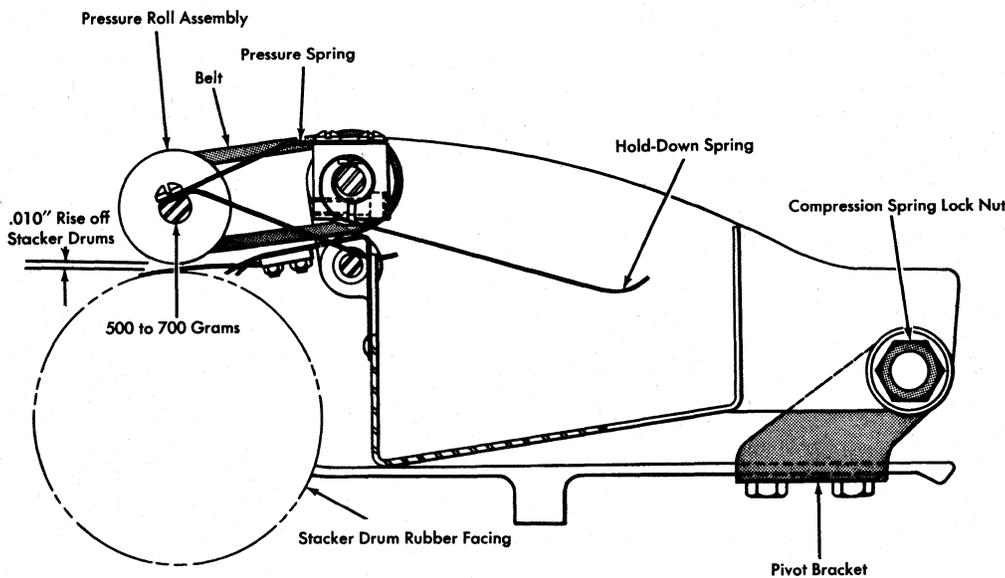


Figure 97. Card Reversing Stacker

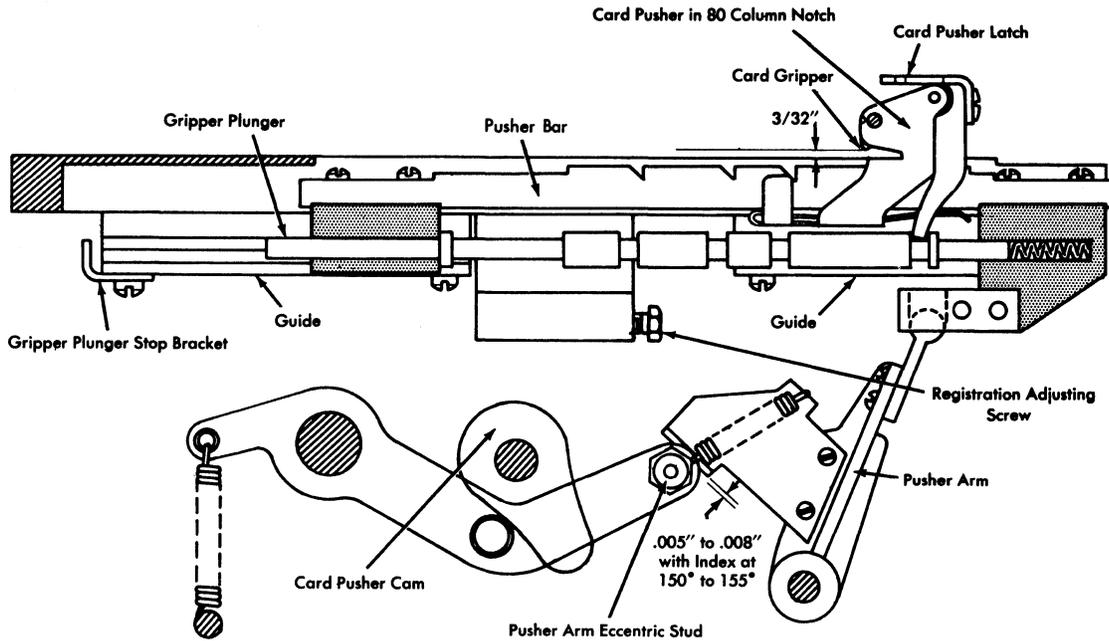


Figure 98. Card Pusher Registration Assembly

ADJUSTMENT

This section describes procedures peculiar to the variable length card feed; items common to ordinary feeds are in Section 2.3.

Pusher Card Guide. Form the spring next to its mounting screw for the following conditions:

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

Card Registration Assembly

1. Adjust guides so that pusher bar moves freely without excessive play (Figure 98).
2. Mount registration assembly on machine with 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 entire travel.
4. Form card gripper so that it is $\frac{1}{2}$ -inch above pusher block and, when moved against block, it makes contact squarely.
5. With pusher-arm eccentric stud backed away, position registration adjusting screw for correct registration by using a card of any length.
6. Adjust the pusher-arm eccentric stud for .005-inch to .008-inch clearance to the pusher arm with card feed index at 150° to 155° .
7. Adjust gripper plunger travel (by moving its stop bracket) to grip a card at registration position so that 100-grams \pm 25-grams are required to pull it free. When making this adjustment, check to be sure that plunger is positioned to extreme left. Entire assembly may then be removed and replaced without affecting registration.

Stacker Unit

1. With the card feed index at 70° , time stacker with teeth that provide closest measurement to $4\frac{1}{8}$ -inch \pm $\frac{1}{16}$ -inch from upper cut in stacker drum to front edge of base.
2. Adjust opener cams 1 so that gripper fingers just close evenly at $153^\circ \pm 5^\circ$.

3. Adjust opener cams 2 so that card is released when fully stacked but before it is damaged.

Program Cam Contacts. These contacts are timed to standard adjustments. The 52-, 61- and 67-column cam extensions are carried by the 81st column cam and require no further timing adjustments.

Pressure Rolls. Feed wheels at detail station are to be open .035-inch to .040-inch when cam roller is on high point of cam. Feed wheels at master station are to be open .030-inch to .035-inch at the same time. See Section 2.3.10 for method of adjustment.

Eject Unit. With card stop cam roller on high point of cam, the register and eject rolls should exert 250-grams to 325-grams pressure on feed rolls. See Section 2.8 for method of checking and adjusting tension.

Detail Station Card Lever Contact. The right pressure rail operates the detail station card lever contact.

1. With card lever assembly removed from machine and stationary strap straight, contact should have .015-inch to .020-inch air gap (Figure 99). Make adjustment with

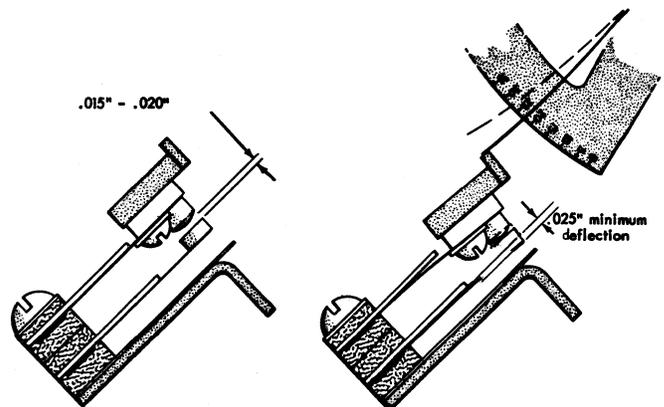


Figure 99. Detail Station Card Lever Contact

assembly held at 45° angle (same angle at which it rests in machine).

2. Stationary strap must be adjusted so that, with force of 23-grams to 27-grams applied at center of lip on the rail, contacts are closed with a minimum deflection of .025-inch.

Auxiliary Eject Pressure Roll. Form auxiliary eject operating arm where it passes over stacker card guide to allow .015-inch to .020-inch clearance between pressure roll and its feed roll (Figure 100). This adjustment must be made when cam follower is on high dwell, which is between 169° and 64°.

Auxiliary Eject Feed Roll (Continuously Running). Adjust auxiliary eject roll flush with stacker bed surface by positioning roll shaft bracket (Figure 100). Bracket is mounted to front of main base casting by two screws. During adjustment, maintain slight (but not excessive) backlash to drive gears.

Auxiliary Eject Cam. Adjust auxiliary eject cam to cause auxiliary eject pressure roll to contact continuously running roll at 74° to 78° on index. Screws that position cam are accessible through slot in stacker plate to left of stacker drum.

Auxiliary Transport Mechanism. Auxiliary transport housing (Figure 101) should pivot freely on program shaft.

1. Shim magnet to obtain armature-to-core clearance of .004 inch to .008 inch, with armature sealed against yoke (Figure 102).

2. Position idler roll .009-inch to .012-inch above read station bed plate by moving idler roll mounting plate (Figure 103).

3. Adjust the two armature stop screws to allow armature travel of .008-inch to .010-inch measured between yoke and each armature end (Figure 102).

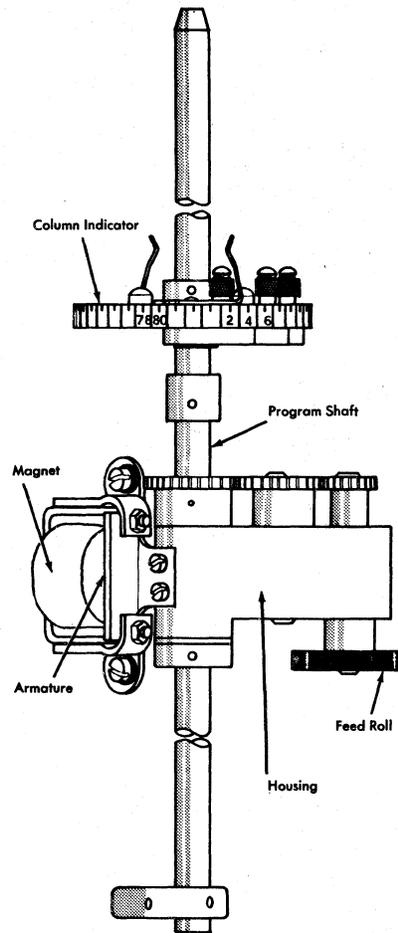


Figure 101. Auxiliary Card Transport

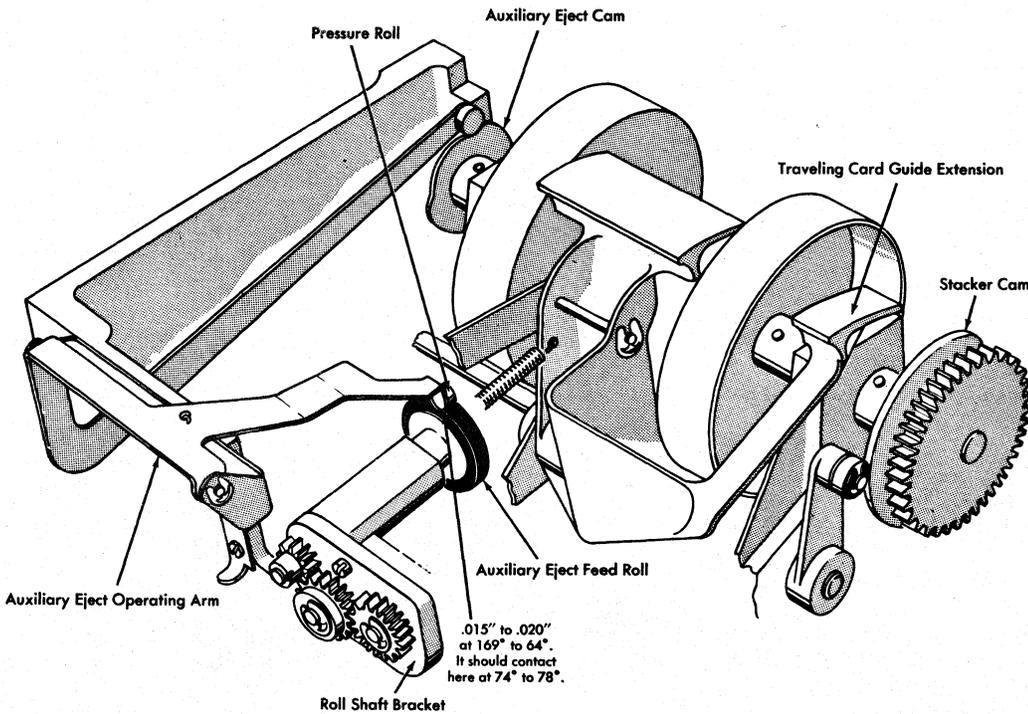


Figure 100. Auxiliary Eject Mechanism

4. Move magnet assembly up or down mounting bracket to obtain .014-inch to .017-inch clearance between feed roll and its idler roll (Figure 103).

5. Recheck armature adjustment.

6. Position idler roll bracket over feed roll so that it does not skew a card when auxiliary transport magnet operates.

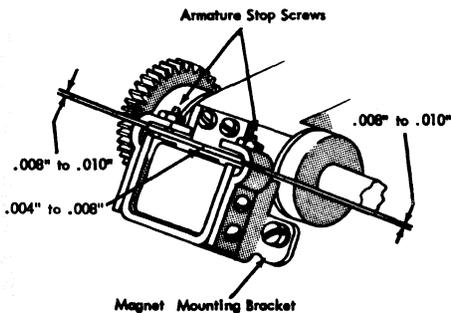


Figure 102. Auxiliary Transport Adjustment

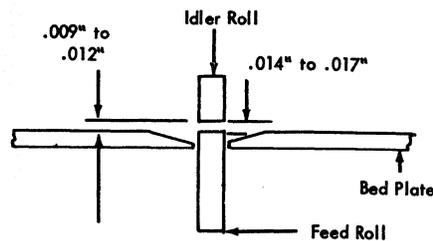


Figure 103. Auxiliary Feed and Idler Roll Adjustment

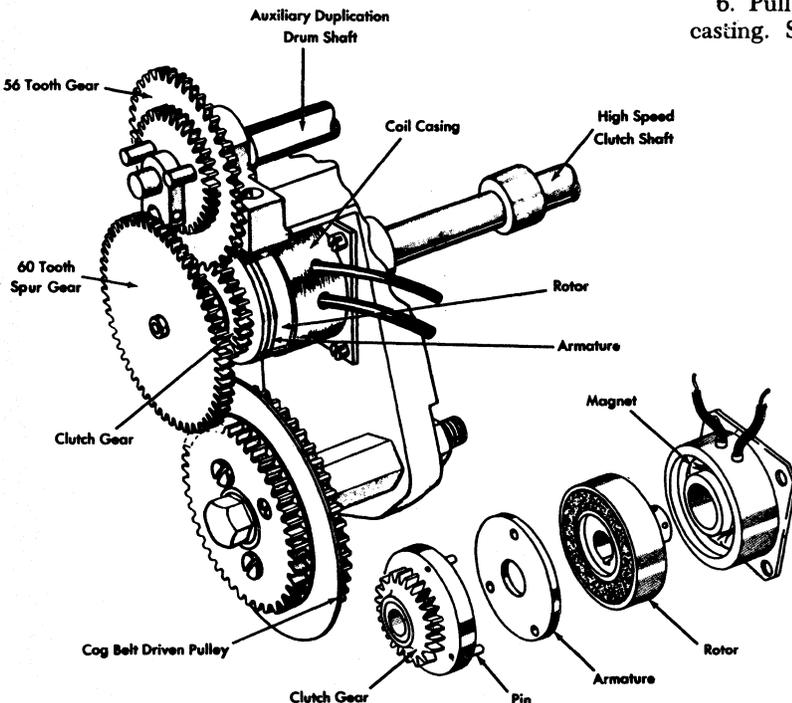


Figure 104. High-Speed Clutch

Mutilated-Card Feed

1. A notched throat knife replaces standard throat knife, and opening is adjusted for clearance of .010-inch to .011-inch.

2. Card lifter must rotate freely on shaft. Form to obtain clearance to card bed of .013-inch to .045-inch at 15° of CF index. Adjust master station card guide for clearance to card bed of .025-inch to .030-inch.

3. Adjust eject unit throat clearance for .020-inch to .026-inch.

4. Adjust plastic guide that projects from eject unit so that it is positioned above stacker bed plate 1/2-inch to 5/8-inch.

5. Spring tension of card-feed pusher plate should not exceed 6 1/2 turns of spring shaft.

2.13.6 High-Speed Skip

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

Stacker. For high-speed skip machines, adjust gripper fingers to close evenly at 187°.

ADJUSTMENT

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

1. Remove large cog belt drive pulley (Figure 104) 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 set screws 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 set screws (inside magnetic clutch housing) that hold clutch armature to shaft.

8. Adjust clutch armature to provide .010-inch \pm .002-inch, clearance between armature and clutch. For this adjustment, use two feeler gages, one on each side of shaft. Tighten set screws. 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 set screws 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, the auxiliary duplication shaft must be timed to 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.

2.14 IBM 46-47 Tape to Card Punch

Special service checks, the print magnet and two additional features — the card column emitter and the tape read unit — are covered in this section. Other maintenance procedures, lubrication schedules, and adjustments for the IBM 46-47 are the same as for the 24-26.

The column emitter is also a component of the IBM 526 Printing Summary Punch and the IBM 834-836 Control

Units; maintenance procedures for this feature apply to these machines also.

This machine cannot be programmed for a gangpunch operation following duplication.

2.14.1 46-47 Base Machine

SERVICE CHECK

Printing Test for IBM 47 Without Keyboard. The tape reader unit partially covers the hole in the machine base through which the adjusting screws are reached. Because some IBM 47 machines are not equipped with a keyboard, the following procedure permits these machines to punch automatically with the reader removed. This method is useful in adjusting printing and also in adjusting the escapement unit, which is more accessible when the reader unit is removed.

1. Remove tape reader unit, but leave reader cable connected.

2. Insert tape with any desired punching code in reader, over reader pins. Trip reader control magnet and turn gear until pins read holes in tape.

3. Wire control panel to tape read on and off in column 1. Wire card column 2 to ALPH DUP. Wire column 80 to release. Wire chosen tape codes standard character tape exit to card entry. Wire program exit to program entry for field definition. (The purpose of tape read wiring in column 1 is to permit either automatic punching or pulse key operation to process cards.)

4. Install program card with field definition pattern to define field between column 2 and column 79.

5. Place master card, containing characters to be printed, in front of cards in hopper.

Plastic Test Tapes. A plastic test tape (P/N 328298), containing all of intelligible codes possible in IBM 8-channel binary-code tape, is sent with each IBM 46-47 machine leaving the factory. Model 1 machines (5-channel and 8-channel) also have a plastic test tape (P/N 308343) containing all codes possible in 5-channel telegraphic tape. (See Figures 105 and 106.)

The 8-channel plastic test tape is coded in the order shown in section 56 of wiring diagram 328300, repeated ten times.

The 5-channel plastic test tape is coded as follows: letters shift code, alphabet A-Z, space, figures shift code, numerals 0-9, carriage return code and line feed code. This is repeated ten times in the tape.

5-Channel Tape Test. Use the following board wiring to test the 5-channel tape-to-card functions:

1. Jackplug the 5-channel hubs (1 wire).
2. Wire tape-read on (TR ON) from card column 1.
3. Jackplug the card-entry hubs space, 1 through 9,

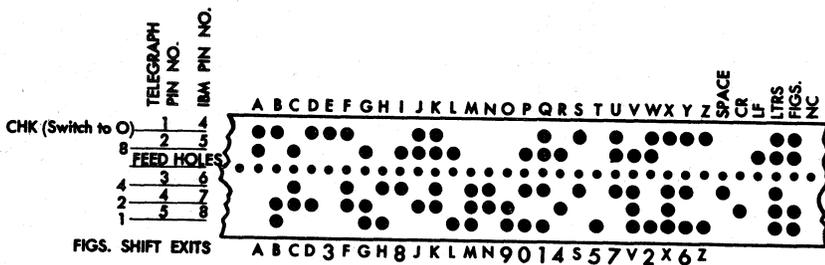


Figure 105. Telegraph Printer Code

and 0 to the corresponding 5-channel figures shift exits (11 wires).

4. Wire card column 28 to *figure exit*.
5. Wire card column 38 to *release*.

No program card is necessary. The cards will punch A through Z, space, and zero through nine followed by a release. The tape information is repeated ten times.

Test Control Panel. Figure 107 illustrates a control panel and program card usable for testing operation of the IBM 46-47. The test panel is not intended as a trouble shooting

device, but should prove useful when installing a machine, and when testing a machine after an extensive inspection.

The test control panel is wired to test as many machine functions as possible without using complex wiring. The wiring may be changed to check selectors, distributors, and program exits other than those shown.

The majority of 46-47 machines in the field are capable of processing IBM 8-channel binary-code tape. Therefore, the test control panel is wired for this type of tape. This panel is designed primarily for testing functional operations, (tape reading, duplicating, skipping, and so on)

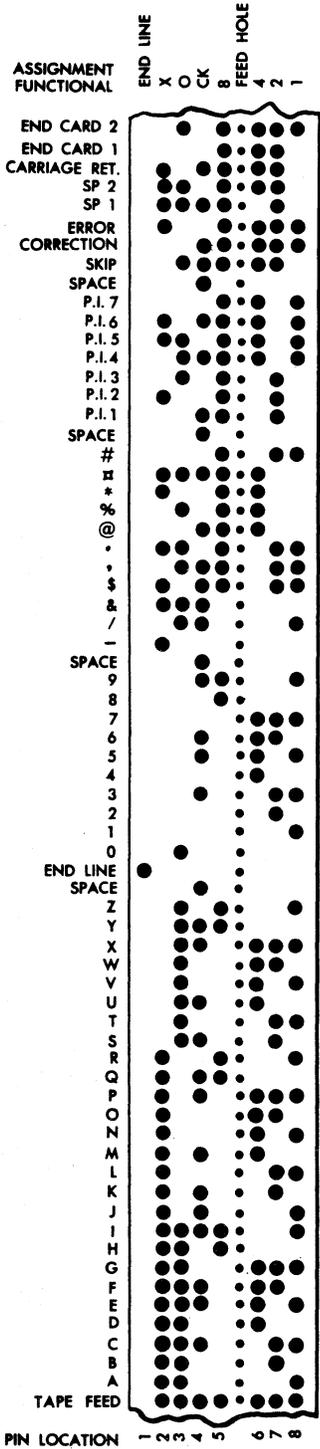
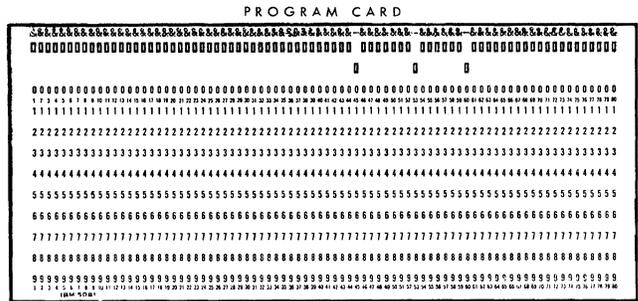


Figure 106. Eight-Channel Tape Code



46-47 TEST CONTROL PANEL TO BE USED WITH PLASTIC TEST TAPE

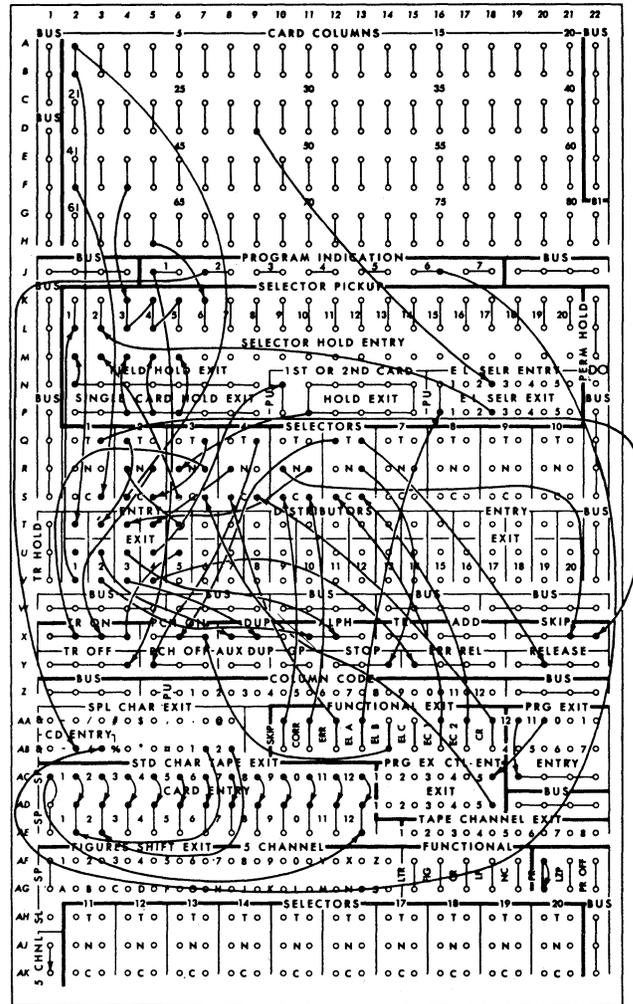
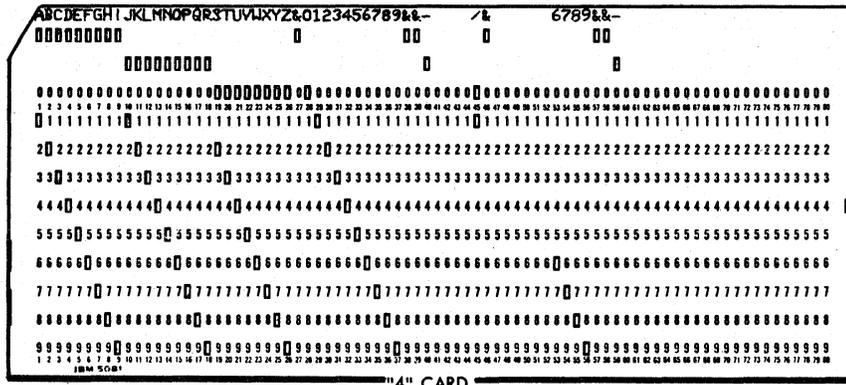
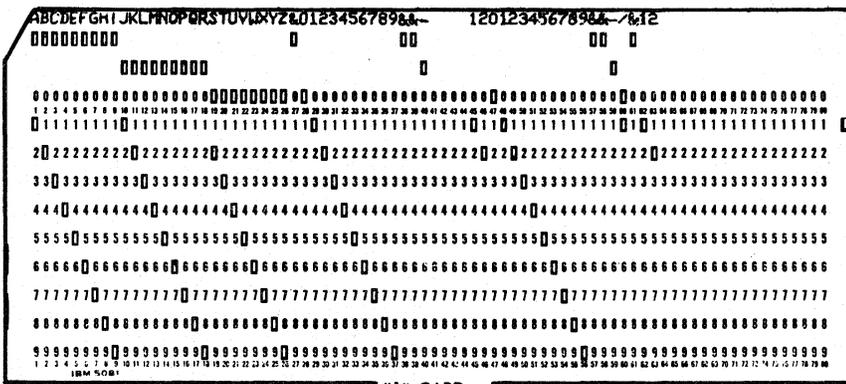


Figure 107. Test Control Panel



CARD COL	OPERATION	CARD COL	OPERATION
1.	TR ON from card column 1 through selector 2 normal. Pick up selector 1. Selector 1 holds through field hold until column 45.	45.	Program channel 11 wired to TR ON through selector 3 normal.
28.	EL-A picks EL selector. Card column 28 picks selector 2 as memory selector through selector 3 normal. Selector 2 has first or second card hold.	47.	Skip from tape code through selector 5 normal.
40.	PI-1 wired to TR OFF. PI-2 punches on "X" and turns tape reading off.	53.	Program channel 11 wired to TR ON through selector 3 normal. Correction code wired to ALPHA DUP through selector 5 normal.
41.	SKIP is wired from card column 41 through selector 1 transferred.	60.	Program channel 11 wired to TR ON through selector 3 normal. Error code wired through selector 4 normal to ERROR RELEASE.
43.	Selectors 3, 4, and 5 are not picked on this card because of skip.	81.	Auto space.
		82.	Punch "4." Card-to-card skip to column 1 of next card.



CARD COL	OPERATION	CARD COL	OPERATION
1.	Card column 1 wired to ALPHA DUP through selector 2 transferred. Pick selector 1. Field hold for selector 1.	59.	PI-1 wired to TR OFF; PI-2 punches "X" and turns tape reading off.
43.	Card column 43 picks selectors 3, 4, and 5. Single card hold for selectors 3, 4, and 5. Drop selector 2 when selector 3 picks.	60.	Program channel 11 wired to TR ON through selector 3 transferred and selector 2 normal.
45.	Program channel 11 wired to TR ON through selector 3 transferred and selector 2 normal.	64.	Card column 64 picks selector 6. No hold on selector 6. CR wired to PCH OFF through selector 4 transferred. EC-1 wired to PCH ON through selector 6 transferred. EC-2 wired to release through selector 6 transferred.
47.	CR wired through selector 4 transferred to PCH OFF. EL-B wired to PCH ON.	81.	Auto space.
		82.	Punch "1." Card-to-card skip to column 1.

Figure 108. Result Cards

rather than any specific application. Functional operation remains the same, regardless of the source of the tape being processed.

Result Cards. Figure 108 shows the two types of cards that should result from running the 8-channel plastic test tape using the test control panel. Ten cards are produced for each run of the tape: first, a 4 card (Figure 108), then a 1 card; then a 4 card, and so on. The first 4 card is blank in columns 53-59, because, for the first card, this field is alphabetic duplication with a blank card at the master station.

Figure 108 also shows a detailed breakdown of the progress of the card, column by column. This breakdown should help in checking functional operation, program exits, and other features.

2.14.2 Print Magnet

ADJUSTMENT

1. Form print magnet armature so that a straight edge contacts the three points shown in A, Figure 109. Armature should be free of binds and free to move across yokes. It should not bind in retainer.
2. Shim core for an armature-to-core air gap of .006-inch to .008-inch with armature attracted. Use .003-inch steel shims.
3. Form armature spring for tensions indicated in Figure 109.
4. Position armature retainer on yoke opposite interposer block for maximum armature travel without binds.
5. Position entire magnet bracket (Figure 110) first for .003-inch to .005-inch clearance between end of armature block and inside edge of print arm (with armature in normal de-energized position).
6. With magnet energized, rotate punch drive shaft to 126°. Holding magnet energized, shift magnet bracket to

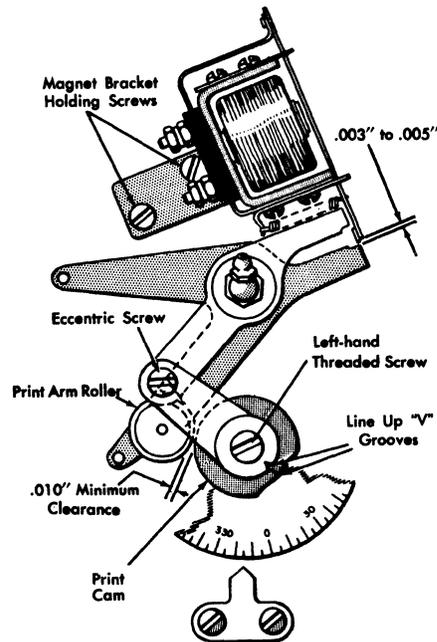


Figure 110. Print Magnet Adjustment

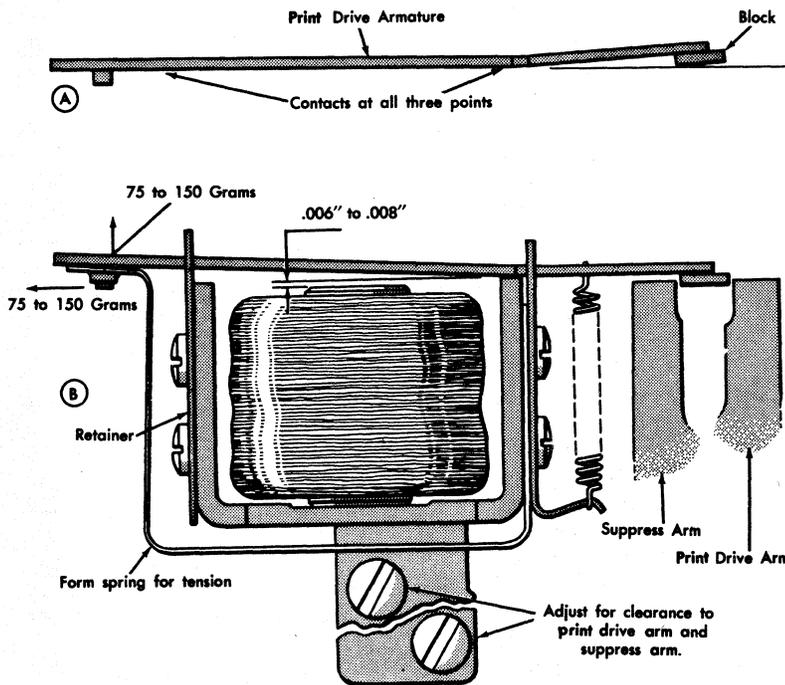


Figure 109. Print Magnet

obtain .003-inch to .005-inch clearance between bottom of armature block and print suppress arm (Figure 111). Tighten holding screws in bracket and recheck step 5.

7. De-energize magnet and, with punch clutch latched, adjust eccentric screw in lower end of suppress arm to obtain .024-inch to .026-inch clearance between inside edge of armature block and suppress arm (Figure 112).

8. Check for .010-inch minimum free clearance between print arm roller and print cam (Figure 110). This clearance must be held. If printing is too heavy, or if smudging occurs when spacing, remove shims from code plate to correct the condition.

2.14.3 Card Column Emitter Assembly

The card column emitter assembly consists of the emitter molding (emitter stator) and the emitter finger assembly (emitter rotor).

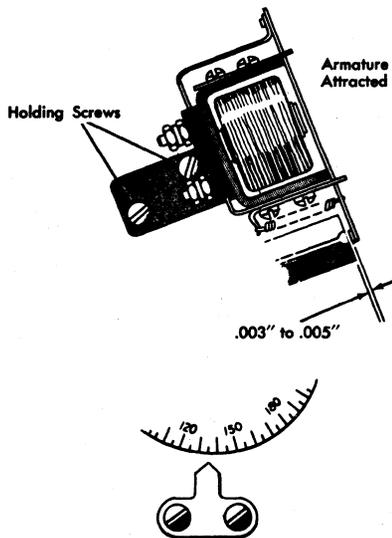


Figure 111. Print Drive

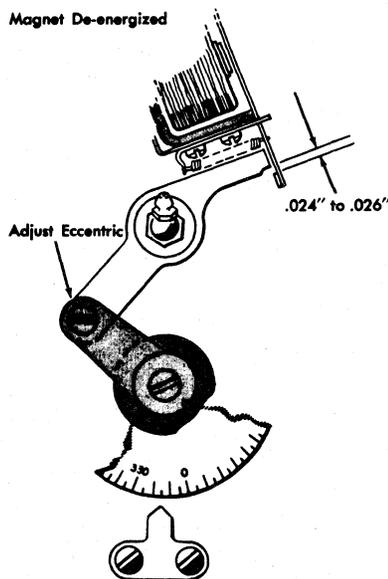


Figure 112. Print Drive

SERVICE CHECK

Emitter Stator. The surface of the emitter stator is very smooth and should not be cleaned except for wiping with a clean cloth when emitter stator is removed. If it is necessary to clean emitter stator under extreme conditions, use only very fine crocus cloth. Clean with a motion following general direction of path of the rotor fingers.

Emitter Rotor. A felt wiper is held against the stator surface by an extra arm of the emitter rotor assembly. Two small projections on this arm and slight tension on the arm are the only things holding the wiper against the emitter. Care should be used not to drop this felt wiper when the emitter stator is removed.

The felt wiper is saturated with IBM 17. Remove the excessive grease adhering to the surface of the wiper when installing it. Replace the felt wiper every six months.

For the most satisfactory operation, the three rotor contact arms should exert 40-grams to 45-grams tension against the stator surface, measured at the contact. Minimum allowable tension is 30 grams; maximum is 70 grams. This measurement should be made with a gram gage and a volt-ohmmeter. Actual tension of each contact is determined by averaging gram readings at make and break of each contact. Emitter rotor assembly should be replaced in case of wear or if there is less than 30-grams tension on the rotor contact arms. Excessive tension accelerates wear.

ADJUSTMENT

Emitter Rotor. Emitter rotor finger contacts must be repositioned after removal of the emitter rotor assembly or after retiming the program drum.

Emitter Rotor Contact Tension. If a replacement rotor assembly is not available and rotor finger tension must be adjusted, remove emitter rotor assembly. Do not attempt to adjust this tension with emitter rotor assembly in machine. Place emitter rotor assembly on a flat surface and form arms *only at the bend line*. Do not use pliers to make this adjustment. Be sure that the tension is equal within ± 10 grams on both outer fingers when adjustment is completed.

Emitter Rotor Contact Position

1. Position program drum in column 1.
2. Open control panel door to remove DC voltage from emitter assembly.
3. Loosen nut holding emitter rotor assembly to shaft, but leave nut finger-tight.
4. Leave machine power on to keep torque on friction drive. Turn emitter rotor assembly until outer contact is resting on column 1 emitter spot.

Shift emitter rotor assembly so that contact tracks a path within .005-inch of the radial centerline of emitter spot (Figure 113). Also shift this assembly so that contact rests within .010-inch of diametric centerline of emitter spot.

Check this adjustment on at least four spots around circumference of stator, for both inner and outer contact arms. The dental mirror aids in checking this adjustment. If any variation is found, readjustment may be necessary to obtain best operating position. When this adjustment has been properly made, the contact resting on an emitter stator spot will be fully on each spot.

Tighten nut holding emitter rotor assembly to shaft, but do not exert too much force when tightening it; the pheno-

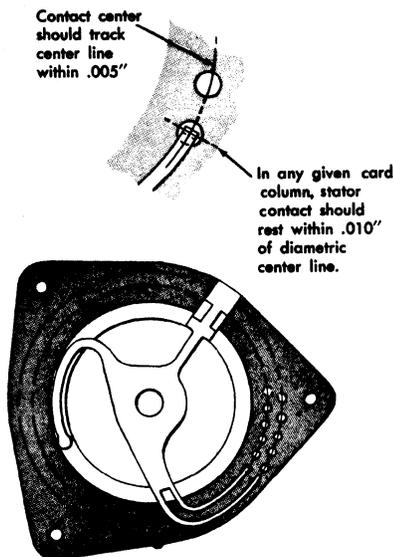


Figure 113. Card Column Emitter Adjustment

lic washers may break if too much force is used. Recheck adjustment at several spots around circumference after tightening nut.

REMOVAL AND REPLACEMENT

Emitter Stator. Take care not to drop felt wiper when removing stator. Do not strain or sharply bend any of the wires. When installing the stator, be sure that locating pins do not extend past rear surface of mounting bracket. Note that there is a projection on bottom of emitter stator at column 41 for wiring reference if emitter stator is replaced.

2.14.4 Tape Read Unit

Some early 46-47 machines (initial production) have a tape reader that differs from the tape reader used on later (production) machines. Initial production tape readers are readily identified by a feed knob at the end of the pin wheel shaft. If there is a difference in specification, adjustments are given for both initial production readers and production readers.

SERVICE CHECK

Tape Sensing Levers and Contacts

1. Check that contact levers do not bind in interposer guide comb, that plastic contact operators on ends of contact levers are properly engaged, and that tape sensing contacts are clean and have proper air gap and rise.

2. With no tape in reader, the first tape sensing contact to break should open between 173° and 179° on punch drive index. No contact should make later than 0°. This timing is adjusted at the factory by meshing proper teeth of drive and driven gear. Spot marks are scribed on gears. Changing gear mesh by one tooth changes timing 5°.

Reading Pins

1. Inspect for sticking or binding reader pins and for wear on the ends, especially if chadless tape is being used.

2. Check guide block assembly for wear in reader pin guide holes.

Interposer Springs. Check interposer springs for even tension and for proper location in mounting bracket.

Tape Feed. Check for:

1. Minimum overthrow when feeding.
2. Binding pin wheel when covers are in place.
3. Proper vertical and horizontal alignment of reader pins to a tape that has been checked for correct registration.
4. Correct operation of tape tension and tape run-out contacts.
5. Proper recession of reader pins into guide block before tape feeds.
6. Proper latching and unlatching of feed pawl operating arm. If feed pawl operating arm fails to latch, it may be peened on end near cam roller. This gives arm more travel past hook on feed pawl latch and, thus, more re-latching clearance.

ADJUSTMENT

Control Magnet Assembly

1. Form control magnet armature assembly to obtain .018-inch to .021-inch clearance between armature and core when magnet is de-energized (Figure 114).

2. Set adjusting screw in control arm to provide .002-inch to .005-inch unlatching clearance between control arm and interposer bail (Figure 115). This should provide .040-inch to .050-inch latching overlap when magnet is de-energized.

3. Form stop arm on control magnet armature assembly to allow free motion of .002-inch to .006-inch when armature knockoff roller is on high dwell of its cam (Figure 116).

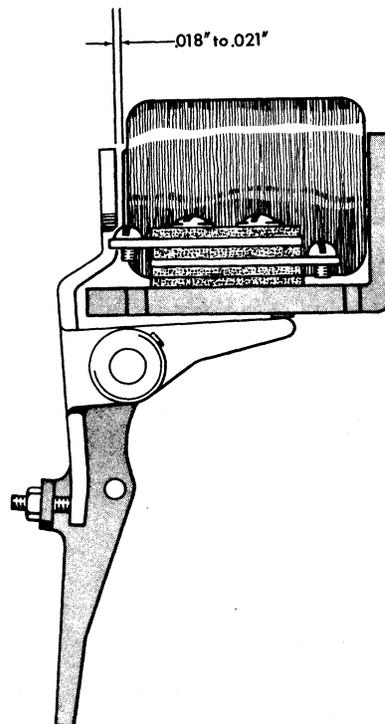


Figure 114. Control Magnet

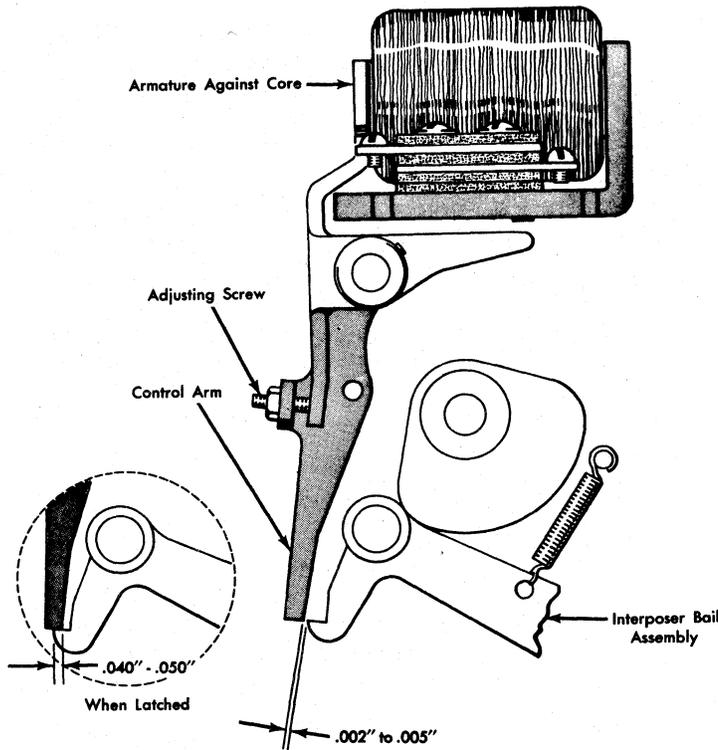


Figure 115. Control Arm Adjustment

Tape Sensing Lever and Contacts

1. With reader pins against blank tape, form stationary contact supports to obtain .018-inch to .023-inch air gap between the eight sensing contact points.
2. Sensing pin bail contacts should have minimum air gap of .018-inch when unit is latched.
3. With plastic contact operators removed, form movable contact straps so that pressure of 75 grams to 90 grams is required to break movable contact from stationary contact (Figure 117). Pressure of 20 grams to 25 grams

- grams on each stationary strap should break the contact. Adjustment is checked most easily by removing contact lever and bracket assembly.
4. With plastic contact operators in place, form each stationary strap so that it is lifted a minimum of .005-inch from its support when contacts make.

Tape Support Lid

1. Clearance between tape support lid and pin guide block should be .010-inch to .021-inch (Figure 118).
2. Tape hold-down curve should clear pin wheel circumference by .005-inch to .010-inch.
3. Latch should fully seat itself by spring pressure when tape support lid is closed.

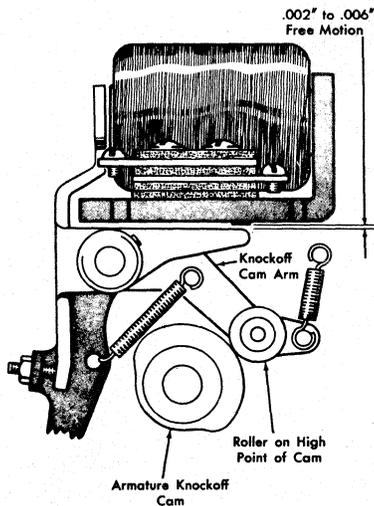


Figure 116. Magnet Armature Knock-Off

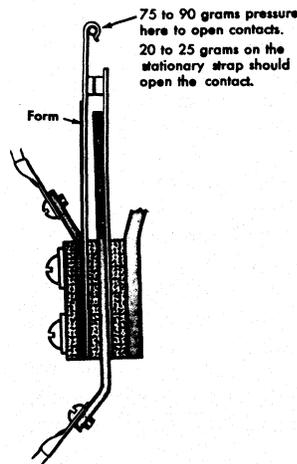


Figure 117. Sensing Contact Adjustment

Tape Feed

1. Position a tape (punched in good registration) so that holes in tape are concentric with reader pins. Tape may be positioned laterally by pin wheel detent eccentric (Figure 119). Tape may be positioned vertically by adjustable tape guide arm and

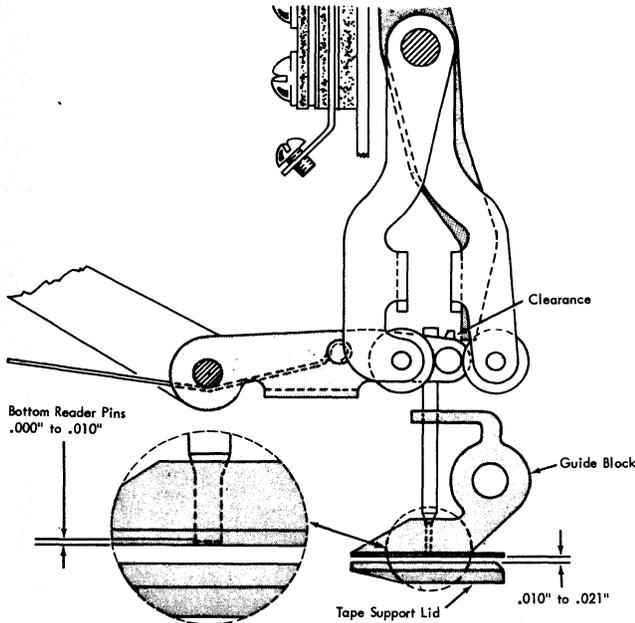


Figure 118. Reader Pin Interposer Clearance

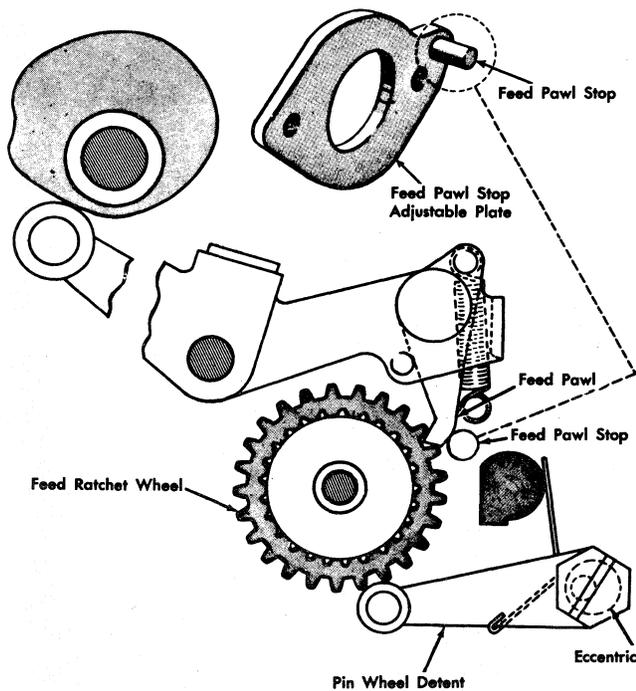


Figure 119. Tape Feed Adjustment

by positioning tape table in oversized holes (Figure 120). In production machines, tape is positioned vertically by use of pin wheel adjusting set screws (Figure 121). Proper lateral tape registration should be 120 holes in 12 inches, + .020-inch. The center line of the feed holes should be .394-inch, + .005-inch, from lower edge of tape (nearest fractional equivalent is 25/64, which equals .3906-inch). Lateral tape registration may be checked with a scale or the tape gage (P/N 460005).

2. Adjust feed pawl stop plate (Figure 119) so that feed ratchet wheel advances just one full tooth with no overthrow.

3. Reader pins should be flush with surface of guide block or recessed a maximum of .010-inch before tape is

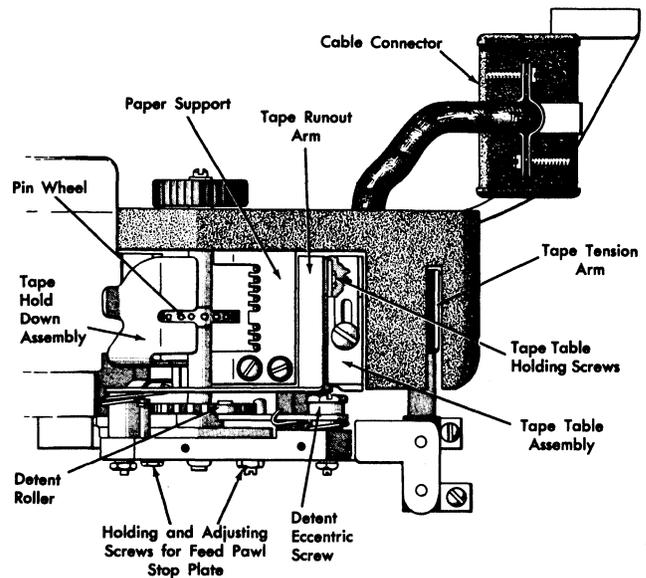


Figure 120. Tape Registration Adjustment

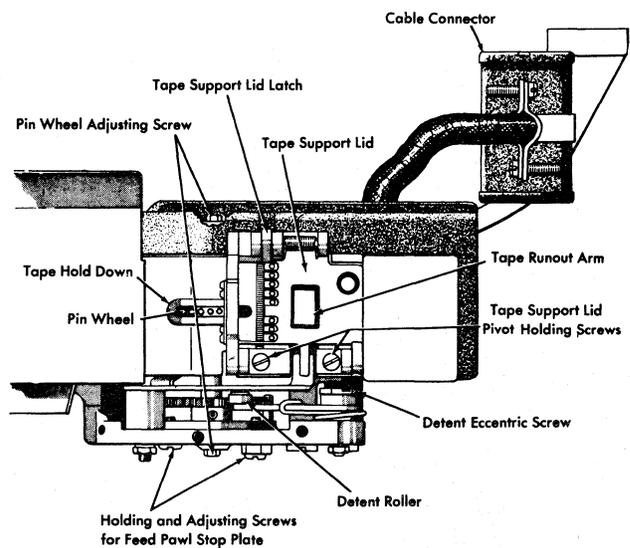


Figure 121. Tape Registration Adjustment

advanced and when reader unit is latched up (Figure 118). This is not readily adjustable except by peening or stoning control arm where interposer bail latches.

4. With reader unit latched up, the hook of feed pawl latch should have a full bite on lip of tape feed yoke arm (Figure 122). With reader unit unlatched, tape feed yoke should move past latched position .007-inch to .015-inch when on highest dwell of cam. There should be .001-inch to .006-inch free movement of the latch at this time. Curved end of feed latch assembly that rests against contact lever bail assembly may be formed to obtain this clearance.

Tape Tension Arm and Contact, Early Machines. Tape tension arm should protrude $\frac{1}{2}$ -inch above base casting. Force of 80 grams to 90 grams applied on center of arm should cause tape tension contact to just break.

Tape Tension Arm and Contact, Later Machines. Pressure of 20 grams to 30 grams should just open contact. Contacts should close with stationary strap overthrow of .010-inch. Pressure of 450 grams to 540 grams against spring should just open contact. Operating strap may be formed to get this value.

Tape Run-Out Contact, Early Machines. Form stationary contact support of tape run-out contact (Figure 123) to obtain .020-inch to .030-inch air gap when contact is open (no tape in reader). Contact should be made with a rise of .005-inch when tape is in reader.

Tape Run-Out Contact, Later Machines. Contact should have .012-inch to .017-inch air gap with no tape in ma-

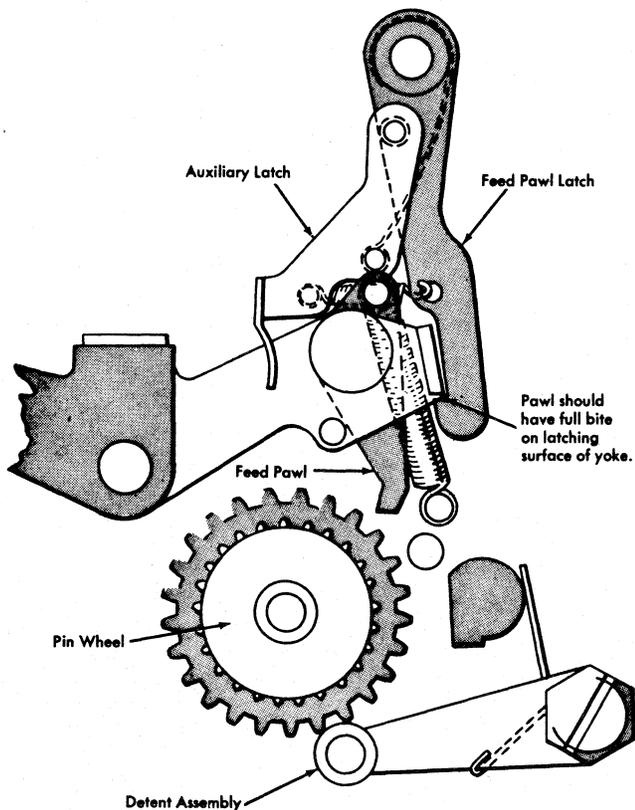


Figure 122. Feed Pawl Latch Bit

chine and with tape support lid closed. Minimum pressure of 38 grams on contact straps should open contact. Contact should be made with a rise of .005 inch from its support when tape is in reader.

Tape Rewind Assembly and Drive

1. Position driven gear for rewind assembly for .015-inch backlash.

2. Adjust rear rewind flexible cable clamp bracket so that cable centers in its casing.

3. Adjust front flexible cable bracket so that flexible cable revolves freely without rubbing against edge of casing. Set minimum clearance of .015-inch between flexible shaft hub and bearing. (Figure 124).

4. Move entire rewind assembly by shifting bracket in its slotted holes to point where rewind shaft centers in hole through reading board.

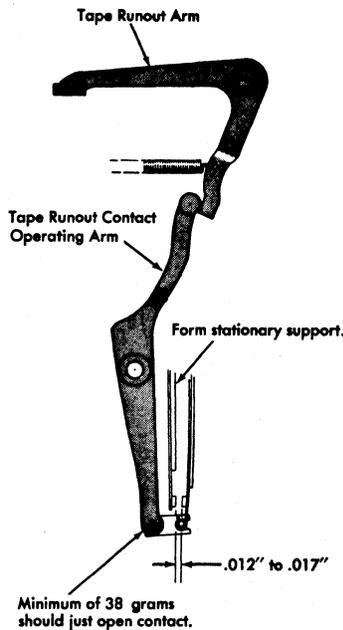


Figure 123. Tape Run-out Assembly

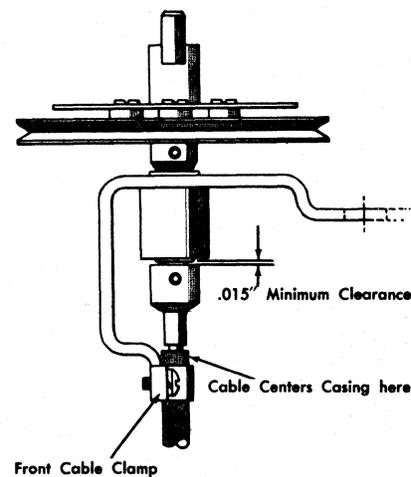


Figure 124. Tape Rewind

REMOVAL AND REPLACEMENT

Tape Read Unit Assembly, Removal. The drive gear on the punch drive shaft is held in position by a key and set screw. Take care not to drop key when removing gear. If key is dropped, it usually falls into chip box; empty chip box before removing gear to lessen chance of losing key.

1. Remove machine top cover and tilt bed.
2. Disengage tape reader Jones plug and remove gear guard.
3. Remove the three holding screws that hold reader unit bracket to machine base. Take out unit.

Tape Read Unit Assembly, Replacement

1. Latch punch clutch and tape reading unit.
2. Align scribe marks on drive and driven gears and fix unit to base with holding screws.
3. Position unit bracket for a .005-inch to .010-inch wink between gear teeth and lock in place with holding screws.
4. Connect Jones plug and replace gear guard and machine covers.

Contact Assembly

1. Remove tape reading unit.
2. Unlatch control arm and turn driven gear until reader pins are fully extended; this unlatches feed pawl latch.
3. Loosen the two screws holding plastic contact cover. Slide cover off contact assembly.
4. If contact assembly is to be separated from remainder of unit, remove leads to control magnet and remove cable clamp. Remove the two large screws that hold contact assembly to inner block. Slide contact assembly free. In handling the contact assembly, be careful not to dislodge plastic contact operators or their holding pins.

Reading Pins

1. Remove contact assembly.
2. Remove interposer guide comb by removing two holding screws.
3. Any reading pin may now be removed by disengaging it from its interposer and sliding it free.

Interposer Bail Assembly, Removal (Early Machines). Early tape readers are recognized by a feed knob at the end of the pin wheel shaft.

1. Remove contact assembly.
2. Remove feed-knob mounting screw and washer. Loosen set screw and remove feed knob and spacer.
3. Scribe a timing mark across power shaft and driven gear. Loosen the two set screws holding gear, and remove gear.
4. Remove guide-block dowel screw near feed knob.
5. Remove the two magnet yoke mounting screws near control magnet terminal block.
6. Remove outer set screw and loosen inner set screw used to lock pivot shaft in guide block. Guide block may now be removed, freeing one end of power shaft, pivot shaft, pin wheel shaft and mounting shaft for control arm and armature.
7. Remove the two screws holding front cover plate.
8. Remove the two screws holding chip guide and tape stripper to inner casting; be careful not to bend the inter-

poser springs resting in spring bracket attached to tape stripper. Remove interposer springs.

9. Loosen one end of tape feed pawl spring, control arm spring, interposer bail assembly spring; remove tape door hold spring.

10. Disengage each interposer from its associated reader pin, or remove the two screws holding pin guide block to inner block and remove entire pin-guide block assembly. The detent spring exerts pressure against pin-guide block assembly; be careful when removing the screws.

11. Remove power shaft. Be careful not to bend any roller arms. Control arm may be removed for inspection at this point. Be careful not to lose shims.

12. Elements are located on pivot shaft in the following order (from lower part of shaft upward): lower pivot of tape hold down; washer; lower pivot of tape feed arm; spacer; upper pivot of tape hold down; lower pivot of interposer bail assembly; 1, 2, and 4 interposers; upper pivot of tape feed arm; 8, check, 0, X, and EL interposers; upper pivot of interposer; upper pivot of interposer bail assembly. When the set screw on the pivot shaft spacer is loosened, the elements may be removed in order.

Interposer Bail Assembly, Removal (Later Machines)

1. Remove contact assembly.
2. Loosen the two set screws holding driven gear. Remove gear, being careful not to lose key. (With gear keyed to power shaft, no timing marks are necessary.)
3. Remove guide-block dowel screw near tape door latch.
4. Remove the two magnet-yoke mounting screws near control magnet terminal block.
5. Unlatch tape door. Loosen set screw holding control arm pivot shaft. Guide block may now be removed, freeing one end of power shaft, pivot shaft, pin wheel shaft, and mounting shaft for control arm and armature.

6. Remove the two screws holding front cover plate.

7. Remove the two screws holding chip guide and tape stripper to inner casting. Note that interposer springs rest in spring bracket attached to tape stripper. Remove interposer springs.

8. Remove tape feed pawl spring and interposer bail assembly spring. Remove pivot screw of tape run-out arm.

9. Disengage each interposer individually from its associated reader pin, or remove the two screws holding pin guide block to inner block and remove entire pin guide block assembly. The detent spring exerts pressure against pin guide block; be careful when removing the screws.

10. Remove power shaft. Control arm may be removed for inspection at this time.

11. Elements are located on pivot shaft in the following order (from lower part of shaft upward): spacer with set screw; lower pivot of tape feed arm; spacer; lower pivot of interposer bail assembly; 1, 2, and 4 interposers; upper pivot of tape feed arm; 8, check, 0, X, and EL interposers; upper pivot of interposer bail assembly. Elements on the pivot shaft may be removed in order.

Interposer Bail Assembly, Replacement (All Machines).

To assemble the unit, reverse the general order of removal. If an interposer bail or some related part is renewed, correct clearances may not exist. In that case, some stoning and peening on the proper member must be done so that

the reader unit functions properly. Observe the following precautions on assembly:

1. There should be at least .010-inch overtravel of hook on interposer bail past latching surface of control arm when interposer bail is on high point of cam (Figure 125).
2. When interposer bail is latched on control arm, the pin contact lever bails should hold all contact levers beyond latch surface of interposer (Figure 126). This clearance is necessary to allow free movement of reader pins and interposers when sensing tape and when being restored.
3. With interposer bail assembly on low dwell of cam and with no tape in reader unit, the end of each contact lever should clear its interposer by at least .008-inch (Fig-

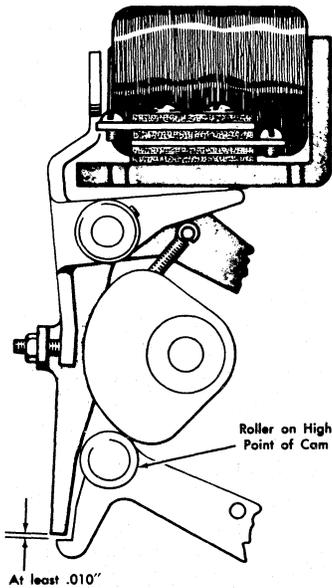


Figure 125. Latching Clearance

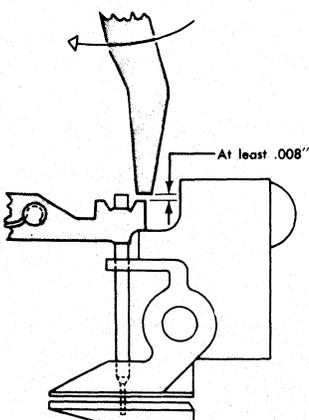


Figure 126. Contact Lever Clearance

ure 119). This may be checked by pushing each pin back into guide block until its interposer strikes contact lever.

4. Make certain that all springs are firmly seated.
5. When refitting contact assembly, be certain that all reader pin contact levers are in proper slot in interposer guide comb.
6. Make certain that cam followers line up squarely with corresponding cams and that control arm lines up squarely with latch on interposer bail assembly.
7. Be certain that tape stripper is under lip of tape bed.
8. Operate unit by hand, checking for proper operation of reading pins and contacts before testing under power.

Interposer-Bail Contacts

Remove the bail contact assemblies from the drive unit. Adjust each assembly as shown in Figure 127. After the contacts have been adjusted and installed, check for even pressure against the interposer bail (preferably within 5 grams).

Use the following procedure as a final check. With the punch clutch latched, trip interposer 7. The n/o interposer-bail contacts will close immediately. While turning the punch shaft, unlatch the punch clutch and hold the interposer magnet armature in the attracted position. The rear n/o interposer bail contact will break at about 75° and must make again, not later than 178°. Check the front interposer-bail contact in the same manner by using interposer 1.

2.15 IBM 65-66 Data Transceiver

Preventive maintenance procedures, lubrication schedules, and adjustments for the 65-66 Data Transceiver are the same as for the IBM 24-26.

Reference information for the IBM 67-68 Signal Units is in Customer Engineering Reference Manual, Form 225-6574.

2.16 IBM 526 Printing Summary Punch

Procedures for the IBM 526 are the same as for the 24-26 except for the following items.

ALPHABETIC SWITCH

To punch alphabetic information the alphabetic summary punch switch must be wired to the summary punch switch on the control panel. Otherwise extra zeros and and dropping zone punches will result.

2.16.1 Relays (High Speed)

The wire contact relays (P/N 328273) used in some circuits closely resemble other wire contact relays used in IBM equipment. The coil numbers are the same, but the high-speed relays are adjusted to different specifications at the factory. Give special attention to part number when ordering high-speed relays.

ADJUSTMENT

The following adjustments apply only to machines having old-style, high-speed relays 8 and 9. Machines leaving the factory at G level contain high-speed wire-contact relays 76 and 77.

Relay 8

1. Adjust spring arm so that spring exerts 17-grams tension measured at contact points.

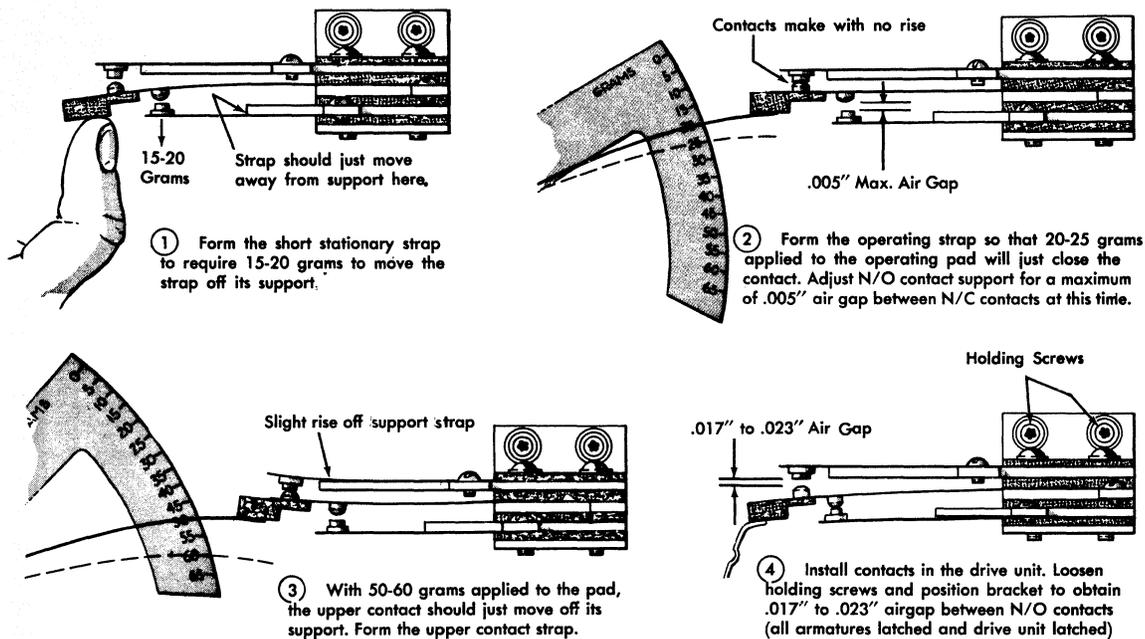


Figure 127. Interposer Bail Contacts

2. Set pivot screws for minimum end play in armature pivot without causing armature to bind.

3. Adjust armature stop screw for .005-inch gap between armature and core when armature is energized.

4. Adjust armature backstop screw for .008-inch air gap between contact points.

Relay 9

1. Set spring arm so that spring exerts 35-grams to 38-grams tension, measured at contact points.

2. Remaining adjustments are the same as 2, 3, and 4 for relay 8.

2.16.2 Card Column Emitter Assembly

See Section 2.14.3.

2.16.3 Program Sensing Contacts

REMOVAL AND REPLACEMENT

Before removing the contact, the common plate screws must be loosened and tension taken off contacts. Use care not to bend contact strap during removal or replacement. On replacement, it is necessary to depress formed end slightly to be able to insert it through the common plate.

NOTE: On later machines with new common contact bar, the strap can be removed by sliding the contact strap sideways when the program drum is removed and the star-wheels are down.

2.16.4 Read Card Lever Contact

SERVICE CHECK

Read card lever contact should have at least .025-inch air gap without card in read station.

With card in read station, non-operating strap should have .020-inch to .030-inch rise.

Read pressure rail left (read card lever contact) should exert 21-grams to 25-grams force against a card in the bed. For earlier machines without metal card guide extending

to right from eject unit, pressure rail should exert 13-grams to 17-grams force. Read pressure rail left should touch bed plate without card in read station.

REMOVAL

Read station bed plate must be removed to remove card lever contact.

2.17 IBM 534-536 Card Punch

Preventive maintenance procedures, lubrication schedules, and adjustments for the IBM CARDATYPE® 534-536 card punch are the same as for the 24-26 except for the following items.

2.17.1 Read Card Lever Contact

SERVICE CHECK

Read card lever contact should have .015-inch to .020-inch air gap without card in read station (Figure 128).

With card in read station, the nonoperating strap should have .025-inch minimum rise.

Read pressure rail left (read card lever contact) should exert a force of 21 grams to 25 grams against a card in the bed.

Read pressure rail left should touch bed plate without card in read station.

REMOVAL

Read station bed plate must be removed to remove card lever contact.

2.17.2 Program Sensing Contacts

See section 2.16.3.

2.18 IBM 824-826 Typewriter Card Punch

Preventive maintenance procedures, lubrication schedules, and adjustments are the same for the IBM 824-826 Type-

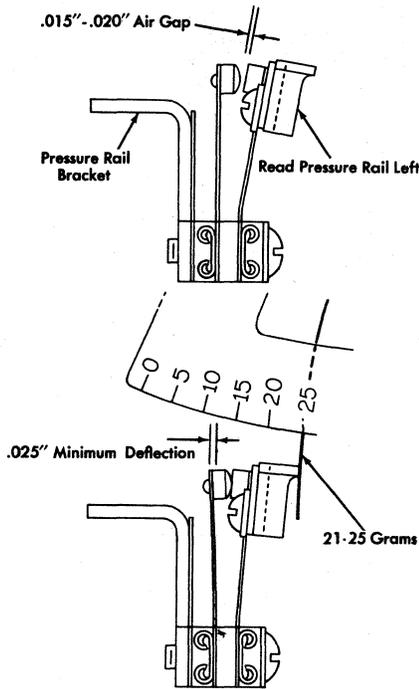


Figure 128. Contact Adjustment

writer Card Punch as for the 24-26 except for the following items.

2.18.1 Read Card Lever Contact

See section 2.16.4.

2.18.2 Keyboard

The 824-826 keyboard is identical to the 24-26 keyboard except for the keyboard restore magnet contact strap. The strap has had a stiffener added to speed its operation; this limits the possibility of losing information because of a sluggish keyboard restore magnet contact.

2.19 IBM 834-836 Control Unit

Preventive maintenance procedures, lubrication schedules, and adjustments for the IBM 834-836 Control Units are the same as for the 24-26 with the exception of emitter timing.

Position IBM 834-836 emitter rotor assembly so contact finger is on column 0 (zero) emitter spot when program drum is in column 1.

Maintenance procedures for card column emitter are in Section 2.14.

2.20 IBM 24, 26 Card Punches, Models 5 and 6

The IBM 24, 26 Card Punches, Models 5 and 6 form a vital link in the assembly of customer data. Data may be transferred currently in small groups for rapid updating or it may be *batched* for scheduled transmissions. In either case it may create major problems, if troubles prevent transmission. While the nature of most terminal installations does not warrant preventive-maintenance routines, the installation, nevertheless, should be completely checked when trouble occurs.

With parts of the system physically separated, it is necessary that the areas be checked independently. Test routines aid in locating troubles without having a line connection. After a complete checkout, a short transmission test should prove the effectiveness of the operation. Occasional trouble may require transmission with other units to prove the area of failure. During line connections, information can be obtained from the remote area with the telephone.

The communications-channel equipment represents a separate area of responsibility but care must be taken not to *side-step* a transmission problem. Experience has shown that it may be difficult to evaluate trouble when both *dirty contacts* and *line noise* are involved. Good cooperation must be maintained between these areas to provide good customer relations. A failure in any part of the system represents customer *down time*.

Telephone company equipment consists of the 401A or 401E Transmitter and the 401F Receiver; normal use of these phones should be possible when the IBM equipment is not attached. The telephone equipment should be installed simultaneously with or prior to the IBM equipment. The 401A, 401E, and 401F are normally connected through a type D terminal connector.

2.20.1 Maintenance Routine

TRANSLATOR UNIT

The maintenance routine for the translator unit involves the use of the IBM equipment only. The control panel located on the top of the translator contains the controls necessary for simulating an operation. The lower portion of the panel contains three switches not used for data transmission. Used as a group, they provide all of the bit combinations that can be received from a terminal unit. The purpose of these switches is:

Simulator Switch. This is a spring-return center-off switch used to key the settings of the test-selector switches into the translator. Moving the switch to the left enters the function set in the left test-selector switch. When moved to the right, the switch enters the character set by the combination of the two test-selector switches. If the test-selector switches are not set to enter a valid signal, no entry is made. Each operation of the simulator switch enters the code setup in the test-selector switches.

Left Test Selector Switch. This is a rotary switch used to enter function signals and the zone portion of character codes. The function positions include the normal *register*, *check*, *end*, *operator*, and in addition provide for the two special codes. In the zone positions the switch supplies the *zero*, *11*, and *12* punches for alphabetic and special characters. For entry of digits, this switch should be set to its numeric (NUM) position.

Right Test Selector Switch. This is a rotary switch used to enter digits and the digit portion of alphabetic characters. It provides for the ten digits including zero, which enters the A4-B2 numeric zero code. Two additional switch positions provide for the zone-only codes by supplying the guard signals and a *function* position, which has no connections.

A simulated entry can be made at any time the translator-punch is in READY status. The ACTIVE lamp need not be lighted, because a line connection is not needed for manual operation. The digits are entered one at a

time to fill the allotted data areas. The REGISTER function must be keyed at the proper point or points to make the in-step checks and to validate and release the card. The validation X-punch is placed in the programmed positions for fields of correct length with no detected errors. An invalid register causes the card to release without the X-punch. The operation can be continued for several cards followed by the END function to simulate a complete transmission.

RECEIVER UNIT

The receiver unit is the responsibility of the communications-channel supplier. It contains the necessary line amplifiers and limiters to feed the tuned tank circuits that sense the bit tones. This circuit combination provides for recognition between data signals and noise. The transmitted guard tones play an active part at this point by forcing limiter action to block out noise. When no signals are on the line, the receiver becomes very sensitive to noise.

The outputs of the individual tank circuits pick relays to provide the data bit output. Translator power feeds through the relay points to provide the output for the translator bit relays. The inherent mechanical delay of the relays provides the first step in the integration of the data signals. Further steps are taken in the translator with the bit relays and the cycle delays.

The receiver contains, in addition, the necessary circuits for line control. Operating in connection with translator signals, they provide the automatic connect and disconnect feature. In effect, the receiver answers the incoming call and connects the translator, if the punch is in ready status. When the transmission is completed, the end signal effects a telephone hang-up condition. An oscillator in the receiver provides for the answerback tone when keyed by the translator.

CE SERVICE SWITCH

A CE service switch is located on the translator control panel under the cover. The switch is arranged so that replacing the cover forces the setting to normal. When in the ON position, the translator circuits are modified to retain the conditions causing an error indication. Operation is normal until an error is detected by the checking circuits. The error picks the CE relay to effect the following conditions.

1. All picked data relays are held.
2. The data power circuits to both the receiver and the simulator switches are opened to prevent picking more data relays.
3. The pick circuit of the end-cycle relay is blocked to prevent operation of the cycle ring. The signal relays were allowed to drop, when the data power circuits were opened.
4. The punch circuits are allowed to operate in the normal manner.

The hold condition can be released by momentarily opening either the CE switch or the translator power switch.

PUNCH UNIT

Preventive maintenance on the punch unit should be the same as for the standard IBM 24/26 Punches. With the translator switch set to OFF, the punch performs all of the functions of the standard punch.

2.20.2 Lubrication

The translator unit requires no lubrication other than that required by the relays. The timer cams and motor should not be lubricated.

The punch unit is lubricated in accordance with the procedure outlined in the lubrication chart in this manual.

2.20.3 Translator-Unit Adjustments

TIMER

The timer unit should be replaced if wear or mechanical damage is evident. Minor adjustments can be made, if it is felt that trouble can be averted by the repair. Any repair normally should be limited to contact adjustment. The following adjustments, except for the *answerback duration*, are presented primarily for inspection purposes.

Sector Stop Bracket. Check sector lift for engagement in the drive wheel with the first 1 to 2 teeth meshed, when the magnet is energized (Point A, Figure 129).

Magnet Positioning. With the timing sector fully engaged in the drive wheel, check the magnet cores for .002-inch to .008-inch clearance to the armature (Point B, Figure 129).

Pulse Contact. On a low cam dwell, check for contact point air gap of .010 inch to .015 inch (Point C, Figure 129). During the rise to a high cam dwell, check for .010-inch to .015-inch movement after the points close (Point D, Figure 129).

Duration Contact. When the actuator is clear of the operated strap, check for a minimum air gap of .010 inch between contact points (Point E, Figure 129). Contact rise, when operated, depends on declutching conditions.

Answerback Duration. Locate the actuator stud in the timing sector to produce the desired answerback signal (2 to 4 seconds). The signal must be long enough to allow feeding the new card and moving it to the first transmitted column.

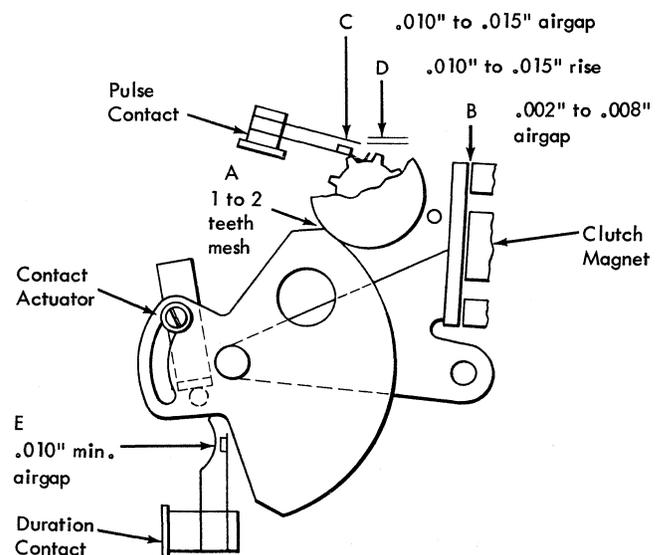


Figure 129. Timer Adjustments

Power Supply Voltage. The nominal no-load voltage of the translator dc supply is 50 ± 2 volts. The transformer taps should be adjusted for this value for the average line voltage.

2.20.4 Punch-Unit Adjustments

All adjustments for the punch should be maintained at the same values as a standard IBM 24 and 26.

Contents

3.1	DIAGNOSTIC APPROACH	69	3.4	SPECIFICATIONS	71
3.2	COMMON TROUBLES AND CAUSES	69	3.4.1	Drive Motor Specifications	71
3.2.1	Noisy Machine	69	3.4.2	Shaft Speed	72
3.2.2	Card Feeding Troubles	69	3.5	INSTALLATION PROCEDURE	72
3.2.3	Faulty Registration	69	3.5.1	24-26 Card Punch, 56 Verifier	73
3.2.4	Punching Troubles	70	3.5.2	27-28 Card Proof Punch	73
3.2.5	Sluggish Keyboard	71	3.5.3	46-47 Tape to Card Punch	73
3.2.6	Smudged Printing	71	3.5.4	65-66 Data Transceiver	73
3.2.7	Notching Troubles	71	3.5.5	526 Printing Summary Punch	73
3.2.8	Items that Affect Printing	71	3.5.6	534-536 Card Punch	73
3.2.9	Test for Broken Print Wire or Code Plate Projection	71	3.5.7	824-826 Typewriter Card Punch	73
			3.5.8	834-836 Control Unit	74
			3.5.9	24-26, Models 5 and 6	74

3.1 Diagnostic Approach

The customer engineer is responsible for developing an effective troubleshooting approach. A logical approach to obtaining diagnostic information can substantially reduce the over-all diagnostic time required on service calls.

An aid to developing this logical diagnostic approach is in Customer Engineering Reference Manual, *Diagnostic Techniques* — 24, 26, 56, (Form 223-6765). The manual gives specific information for localizing trouble on the 24, 26, and 56 machines, but the basic procedures apply to all machines.

The following section may also be of help in reducing time on trouble calls.

3.2 Common Troubles and Causes**3.2.1. Noisy Machine
Punch Clutch**

1. Insufficient lubrication will cause the punch clutch to make a metallic noise.

2. Nipping punch clutches can be determined by visual inspection. If numbers on punch index can be read during auto-duplication, clutch is nipping. Possible cause is excessive torque on friction drive. If escapement armature takes too long to pull out, clutch is not impulsed early enough and will latch up.

3. Dry punch clutches may produce a shrill squeal.

Relay Cover. Relay cover rattles can be reduced by slightly curving panel out at center.

Belt Guard. Guard becomes noisy if not properly installed. Loose drive belt may slap against guard. Plastic guards cannot be formed; file away material above mounting holes to bring bottom out.

Punches. Excessive punch penetration or punches in need of oil may produce noise. See Lubrication Chart.

Stacker Bumpers. Improper adjustment of stacker bumpers may contribute to high noise level.

Printing Pressure. Excessive printing pressure is noise-producing. With IBM B style print wires and phenolic platen there is little embossing to indicate excessive pressure.

Friction Drive. Old style friction drives may squeal or chatter and should be replaced with drum type mechanism.

Signal Buzzer. Buzzer intensity can be adjusted by screw in its case (65-66).

3.2.2 Card Feeding Troubles**IRREGULAR FEEDING**

Deflector Springs. Irregular card feeding may result from breakage of small steel deflector springs in card magazine. Instruct operators to use care in removing damaged cards from upper feed roll to protect this part.

Feed Roll and Pressure Roll Slippage. Slippage between feed roll and pressure roller can cause uneven feeding, usually accompanied by squeaking noise. Check pressure springs for even tension and lubricate pressure roller bearings with IBM 6. (Oil sparingly to avoid getting oil on the roller surface.)

AUTO-FEED FAILURE

On machines prior to 24-11696 PM and 26-10011 MM, the card feed armature stop post is steel and must be insulated with cellulose acetate tape 700, which serves as a residual and prevents auto-feed failure. This tape is recommended because of its durability. Machines built after these numbers have plated brass posts. These posts look like the steel posts; check machine numbers if the posts are suspected of causing auto-feed failure.

LAST-CARD FEEDING FAILURES

If the last card fails to feed from the hopper, washer (P/N 22066) should be added between pusher casting and pressure plate to permit pressure plate to be more self-aligning. A final check should be made to determine best operating condition by feeding cards both from a full hopper and from one with a few cards.

3.2.3 Faulty Registration

Card registration should be checked every time the card punch is serviced.

Card Aligner Fingers. If correct punching occurs for the first 15 to 20 columns and the remainder of the card is off-gage to the left, check to be sure that card is completely

out from under upper rail when it is registered. If card goes back under upper rail after aligner fingers are retracted, card may be gripped by feed wheel so that the card strikes upper rail to left of die. To correct this, see adjustment for card aligner fingers (Section 2.3.4).

Card Pusher Arm. Poor registration can be caused by insufficient clearance between card pusher arm and eccentric stud on cam follower. For card pusher arm adjustment, see "Card Registration" (Section 2.3.9).

Card Lever Pressure Finger. Poor registration may be caused by a card lever pressure finger that is too close to the bed.

Card Pusher Adjusting Screw. After adjusting card registration on machines with old style card pusher, check to see that card pusher adjusting screw aligns with slot in pusher pad. Erratic registration may result if pusher rubs against edge of slot. This applies only to old-style card pusher.

Crayon or Pencil Deposits. A crayon deposit sometimes forms on underside of die and causes drag on card, resulting in off-registration punching. These deposits can be removed with a feeler gage.

Punches. Excessive punch penetration or sticking punches can cause off-registration punching. Avoid separating die and stripper unnecessarily; this can cause sticking punches.

Pressure Rails. It should not be necessary to put other than standard tensions on the pressure rails. A bind on the card or incorrect pressure roll alignment may make it appear that the rails are out of adjustment. The rails cannot be adjusted correctly without using a gram gage.

Pressure Roll Arm. Improper pressure roll arm tension causes failure to register master cards. Check to see if rubber rollers are glazed. Glaze on rubber rolls can be removed and the frictional properties improved by holding an ordinary pencil eraser against the roll while it is in motion.

3.2.4 Punching Troubles

FAILURE TO PUNCH 2's OR 3's

Failure to punch 2's or 3's, unless they occur consecutively, may be caused by friction between interposer and armature. Apply IBM 22 at latching surfaces. Weak armature springs may cause extraneous punching. A heavier spring, P/N 27084, is now used.

PUNCH CLUTCH OPERATION

The correct operation of the punch clutch may be affected by one of the following, as well as by the adjustments outlined under 2.4 *Punch and Verifier*.

1. A rounded latching surface of the armature P/N 328902 may result in intermittently failing to latch the punch clutch. Replacement of the armature is recommended.

2. Damage to the punch clutch spring P/N 328917 and blown motor fuses may result if the in-board sleeve and the collar do not fit tightly together. This results in the spring stop on the out-board sleeve and in the spring tip not overlapping properly to allow the spring to slip past the stop. The spring then contracts and attempts to drive the clutch while it is latched. A limited number of collars were beveled on the wrong side and may cause this. Replacement of the collar and spring is recommended.

3. Extra punch-clutch cycles may result if the armature latch surface is not parallel with the sleeve latch surfaces. A

slight forming of the magnet yoke is recommended to accomplish this alignment.

EXTRA PUNCHING, MANUAL OPERATION

Possible causes of extra punching are:

1. The escapement contact, making too soon, causes a punch cycle before card is advanced.

2. Insufficient air gap of keyboard latch contacts; be careful not to rest keyboard on anything that will bend bottom cover against contacts.

3. Punch interposer not relatching or knock-off bail cam follower worn. Lighter knock-off bail spring is now being used to reduce wear of bail.

PICKING UP STRAY 9's

Picking up stray 9's when duplicating can be caused by an eject unit throat plate being bent up at the 9 end.

SKIPPING WHILE DUPLICATING

Insufficient air gap of interposer bail contacts causes skipping of columns while duplicating. Bouncing of interposer bail contacts and escape contact can cause information to appear one column early as well as in proper column. This is also caused by weak tension on stationary strap. Make both front and rear contact adjustments equal to prevent whipping of the bail.

DOUBLE PUNCHING

Insufficient air gap at latch contacts can cause double punching to appear in a single column.

EXTRANEOUS PUNCHING

Latch. Failure of a latch to restore may cause extraneous punching. Check the pivot on the latch assembly for a bind and oil it.

CAUTION

Do not oil interlock disks.

Alph Key. A combination of the location of ALPH and close contacts can cause extraneous punches to appear in a column along with desired information. It is attributed to operators striking the ALPH key with the heel of the hand when working in the numerical shift. Increase the ALPH key air gap to eliminate this condition.

DASH-SKIP KEY SKIPS BUT DOES NOT PUNCH

When there is lack of clearance between the phenolic pad on the restoring bail and the operating strap, contact will break earlier than desired. It may result in skipping, without punching an X, with dash-skip key. Set the contacts for a minimum clearance to pad of .002-inch.

FAILURE TO DUPLICATE CORRECTLY

Registration. Incorrect insertion of master cards can cause incorrect duplication. If card is pushed in so far that it is pressed against read feed rolls and idler rolls and, at the same time, is pulled away from top guide rail, it stays in this position after being registered. Most of the punching in the first third of card is not sensed properly.

P5 Intermittent or complete failure of sensing unit can result from P5 being out of time. Arcing sensing pin contacts may be caused by P5.

Print Relay. Duplicating failures may result if print relay is interchanged with one of higher resistance. This is possible because the print relay pick coil and hold coil are of equal resistance (about 625 ohms) and are in series with the interposer magnets. Failure to duplicate 8's and

9's only may be caused on the 24-26 by one of the following:

1. Relay with high-resistance hold coil being substituted for R31.
2. High-voltage rectifier with low output voltage (below 120vdc).
3. High-emission tube in position 10 causing a large voltage drop across print relay hold coil. This produces too low a voltage for proper operation of interposer magnets.

3.2.5 Sluggish Keyboard

The source of this trouble is often outside the keyboard. Poor adjustment of punch/verifier latch or escapement assembly may result in a time lag between a key depression and the accompanying clutch cycle. Binding or sticking permutation bar gives a similar effect for an individual key.

3.2.6 Smudged Printing

Ribbon. Avoid adjusting printing pressure with a dry or worn ribbon; this can result in smudged printing.

Print Cam. Worn or undersize print cam results in smudging cards. Replace defective cams. Print cams are now made to operate 7° later than former ones. This gives an additional safety factor in operation of code plate.

3.2.7 Notching Troubles

Punch. Worn punch will not cut card cleanly and may not detach chip from card.

Suppress Arm Eccentric Screw. Poor adjustment of suppress arm eccentric screw may cause either failure to suppress notching, or failure to notch when notching is desired.

Punch Interposer Bar. Worn punch interposer bar frequently causes round embossing or ok punches in middle of card. Punches appear about three columns to right of a column that should have been error notched.

3.2.8 Items that Affect Printing

Chip Tube Position (IBM A print head). Housing helps position wire that extends through guide closures. Exchanging or repositioning chip tube may affect printing.

Print Wires. Single wires can be replaced. Be sure collar portion of wire, which extends through guide plate, is same size as one being replaced. Bent print wires require immediate attention. Serious damage to unit results from prolonged operation with bent wires. A precut set of 35 wires is not available because the wires are ground in a tool jig after assembly. If units become troublesome or worn, replace wire guide assembly with the IBM B unit.

Printing Pressure, Platen Smudging

1. Avoid adjusting for printing pressure with a dry or worn ribbon.
2. Thin platen requires print wires to extend farther than normal into card path and cause smudging. Replace thin platens and check platen and printing pressure adjustments. Remove any burrs from platen.
3. Worn or undersize print cam results in smudging cards. Replace defective cams. Print cams are now made to operate 7° later than former ones; this gives an additional safety factor in operation of code plate.

4. Insufficient clearance between eccentric drive link and washer on end of shaft places extra load on punch drive unit; it sometimes shows up by causing clutch latching failures.

Electrical. Both pick coil and hold coil of print relay should be of equal resistance (about 625 ohms). The coils are in series with interposer magnets. If the relay is interchanged with one of higher resistance, duplicating failures result. Failure to duplicate only 8's and 9's may be caused by one of the following:

1. Relay with a high-resistance hold coil being substituted for R31.
2. High-voltage rectifier with a low output voltage (below 120vdc).
3. High-emission tube in position 10 causing a large voltage drop across the print relay hold coil; this produces too low a voltage for proper operation of interposer magnets.

3.2.9 Test for Broken Print Wire and/or Code Plate Projection

Use the following procedure to help determine if printing troubles are caused by broken wires or a broken code plate:

1. Register a card in the punch station.
2. Strike the character M.
3. Backspace, and with multipunch and numeric keys pressed, strike the numeric keyboard 12 through 9. This produces a rectangle of 35 dots (5 x 7).
4. Strike the same keys allowing the card to space.
5. Examine the printing for missing dots.
 - a) Missing dots in the rectangle (a result of steps 1-3) indicate the broken wires.
 - b) Missing dots in the printed characters (a result of step 4) indicate broken code plate projections.

3.3 Lubrication

Lubrication should be applied at the discretion of the customer engineer, who can best determine machine usage and local conditions.

Lubricants should be applied in small quantities directly on the points of wear. See Lubrication Chart. Avoid using excessive quantities of oil or "grease banks" in an effort to lower inspection frequency. The high speeds at which some units of the machines operate tend to throw off excess lubricant and make cleaning more difficult.

Take care to keep lubricants off:

1. Friction drive with graphalloy disks.
2. Escapement wheel and gearing where graphalloy disks are used.
3. Stacker card pushers.
4. Plastic moldings used for a bearing surface.
5. Pressed metal gears that are now being used on 24-base machines. These parts, made from powdered iron with a bronze binder or from powdered bronze, are impregnated with lubricant. They can be identified by their dull finish and should not be stored in paper containers. With few exceptions, under normal usage, they should not require additional lubricant for four years.

3.4 Specifications

Machine size, weight, current requirements, and heat dissipation vary according to the optional features installed

on the machine. This information is not included in this manual; if it is required, see the installation planning section of the *IBM Data Processing Sales Manual*.

3.4.1 Drive Motor Specifications

Some machines have a 1/20 HP motor with an internal starting switch. Other machines have a 1/12 HP motor. Both motors use an external start relay.

For the 115 volt, 50/60 cycle General Electric motor,

the start relay (P/N 305267) picks up on 5.1 amperes and drops out on 4.35 amperes. Stamped on this relay should be the manufacturer's catalog number of 91251-47, or 91252-47, or an approved equivalent.

For the 115 volt, 50/60 cycle Westinghouse motor, the start relay (P/N 313904) picks up on 4.0 amperes and drops out on 3.4 amperes. Stamped on this relay should be manufacturer's catalog number of 91252-85 or an approved equivalent.

Area	LUBRICATION CHART Item	IBM Lubricant			
		6	17	22	
Base	Punches and stripper	X			
	Sensing pin bail shaft bearings; saturate the wicks after removing eject unit	X			
	Sensing pin bail arm stud	X			
	Star wheel pivots; oil sparingly and wipe off excess	X			
	Idler wheel on belt tensioner; avoid excess lubrication	X			
	Punch retainer pins	X			
	Eject unit mechanism (sparingly); keep oil off continuously running rubber feed rolls	X			
	Stacker gripper block pivots and stacker linkages	X			
	Drive motor	X			
	Card column emitter; saturate felt wiper; wiper should be immersed in grease for at least 24 hours before it is installed; keep at least one new wiper immersed in grease and ready for installation; remove excess grease adhering to surface of wiper when installing it	X			
	Escapement gear train (except escape wheel) where drum-type friction drive is used		X		
	Reduction drive gear train		X		
	Flexible shaft		X		
	Pressure roll release pins (ends)		X		
	Punch arm ends and guide comb on stripper end		X		
	Card gripper cams		X		
	Stacker cam, follower, and gearing		X		
	Escapement armature pivot (sparingly)		X		
	Reduction drive housing		X		
	Program cam		X		
	Drum-type friction drive; lubricate with DC 44 medium silicone grease (P/N 341016)		X		
	Card Feed	Card feed circuit breaker rollers and pivots	X		
		Card feed knife linkage	X		
Card feed pressure roller pivots			X		
Card feed clutch			X		
Card pusher stop cams, and followers			X		
Variable Length Card Feed	Card feed latch magnet pivot		X		
	Porous bronze slide for registration pusher bar	X			
Punch Drive	Gripper plunger in registration mechanism	X			
	All gear shafts in auxiliary transport housing	X			
	Offset stack magnet armature pivot	X			
	Pusher arm socket		X		
	Program cam and cam extensions		X		
	Cam follower rollers	X			
	Circuit breaker rollers	X			
	Interposer pivots	X			
	Felt spacers on punch operating arm pivot	X			
	Punch clutch spring		X		
Verifier Drive	Knockoff bail cam follower; lift off cam		X		
	Punch interposers at latching points		X		
	Punch drive bail bottom (film of grease)		X		
	Sensing pin bail link guide stud		X		
	Punch operating arms at punch extensions		X		
	Cam follower rollers	X			
	Circuit breaker rollers (check for binds)	X			
	Notch drive cam follower	X			
Paper Tape Read Unit	Error cam pivots and guide comb (sparingly)	X			
	Interposer pivots and felt washers	X			

Area	LUBRICATION CHART Item	IBM Lubricant			
		6	17	22	
Verifier Drive Cont'd	Notch drive armature block			X	
	Verifier clutch spring; at least every 3 months; lubricate more often if possible			X	
	Knockoff bail cam follower			X	
	Pin sensing bail drive link stud			X	
	Rear mounting plug grease fitting			X	
	Error cams at pin driver lands (sparingly)			X	
	Verifying bail (thin film)			X	
	Notch drive spring loops			X	
	Interposer at latch points			X	
	Verifying pins at latches			X	
	Latch springs			X	
Print Unit	Notch drive arm at rear mounting; has plug-type grease fitting (older machines only)			X	
	Print interposers, yokes, and rollers; tip punch bed to vertical and let oil run through unit	X			
	Eccentric bearing and eccentric screw in suppression arm	X			
	Cotton wicking ahead of front wire guide plate	X			
	Rear mounting plug-type grease fitting			X	
	Print drive spring ends			X	
	Print suppress armature at pivot end and on interposer block			X	
	Ribbon reverse mechanism			X	
	Code plate linkage; keep lubricant off code plate			X	
	Print drive linkage on print head			X	
	Print cam follower roller			X	
	Verifying Frame	Verifying pin latch pivots (sparingly)	X		
		Sliding surfaces of pin drivers and latch springs			X
		Pin driver lands			X
Notching Drive	Pressure roll release pin ends			X	
	Eccentric bearing and eccentric adjusting screw in notch suppress arm	X			
	Notching punch lever pivots	X			
	Notching bellcrank	X			
	Notching interposer bar and punches	X			
Keyboard (See Figure 96)	Notch drive armature block			X	
	A sharp pointed instrument (large needle or scriber) is useful in lubricating with IBM 6. Avoid using excess oil				
	Key stem at bellcrank and retaining wire	X			
	Key stem bellcrank pivots	X			
	Permutation bar pivot	X			
	Bail contact pivots	X			
	Permutation bar at bail stop plate	X			
	Restoring magnet armature pivot	X			
	Hook channel at points of contact with latch pull bar			X	
	Restoring bail where it contacts latches			X	
Paper Tape Read Unit	All bearings, pivots, and pivot shafts	X			
	Interposer bail studs			X	
	Tape feed arm latch			X	
	Mechanical cam surfaces			X	
	Interposer return-spring bracket			X	
	Control arm latching point			X	
	Detent wheel			X	
	Feed pawl stop stud			X	

3.4.2 Shaft Speed

Motors of printing and non-printing punches operate at the same speed. The nonprinting punch (and verifier) cam shaft pulley has an outside diameter of $2\frac{7}{32}$ -inches, and rotates at 1200 RPM. The printing punch pulley has an outside diameter of $2\frac{3}{8}$ -inches and rotates at 1080 RPM.

3.5 Installation Procedure

1. Remove top cover and take out shipping bolts that lock bed in place.
2. Rotate bed and inspect base for oil leakage from drive housing.
3. Check friction drive gear train to be sure it is free of obstruction.
4. Inspect unit for loose wires, relays, or tubes.
5. Check belts for $\frac{1}{4}$ -inch deflection midway between pulleys.
6. Compare voltage rating on machine with source voltage to be used.

3.5.1 24-26 Card Punch, 56 Verifier

1. Connect power and adjust power supply.
2. Check friction drive torque.
3. Test machine functions thoroughly.

3.5.2 27-28 Card Proof Punch

1. Remove shipping plate that locks carriage in adding machine:
 - a. Disconnect the Elco.
 - b. Remove shipping screws that hold adding machine to the IBM 27. Lift out adding machine.
 - c. Remove adding machine base (4 screws).
 - d. Remove shipping plate and replace base.
2. Before replacing adding machine, install four positioning pins into recess of reading board. Place adding machine onto pins and check that platen knob is free in spot of top cover. Also observe that top cover does not interfere with paper tape feed. Plug in the Elco connector.
3. Test machine for normal functions: punching from storage, direct entry, and so on.
4. If machine is an IBM 28, test by printing each digit.

3.5.3 46-47 Tape to Card Punch

Casters must be installed in mounting holes in base and not in the shipping holes.

DANGER

One caster must be mounted in hole under control panel enclosure or machine will tip if someone leans on reading board.

1. Install a test control panel.
2. After installing the 2H20 tube, turn on main line switch and set adjustable resistor R3 to obtain 46 to 48 volts DC between power pack terminal posts 3 and 4 on machines having a saturable reactor-type supply. On machines having constant voltage transformer supply, use one of three secondary taps to obtain 49-50 volts DC with no load.
3. Check friction drive torque, adjust if necessary.
4. Replace machine covers. Inspect tape reels for damage in shipping; install tape reels, and a test tape.

5. Test machine thoroughly in tape reading, duplication, skipping, and gang punching. Test the machine in pulse operation. Five-channel telegraph codes and eight-channel binary tape codes are shown in Figures 105 and 106, respectively. If the machine has a keyboard, throw the KP-AUTO switch to KP and test the 24.

6. An IBM 47 should be checked for sufficient lubrication of felt wick in wire guide assembly. Check printing of each digit, character, and special character.

3.5.4 65-66 Data Transceiver

Arrangements have been made with telephone companies to check complete line for loss characteristics and proper connection. *No transceiver should be installed until this check has been made.*

1. Unpack machines and check for visual damage.
2. Inspect punch unit for loose wires and relays. Remove shipping bolts that lock punch bed.
3. Inspect signal unit for loose pluggable units and loose wires on edge connectors. Check test operate selector wafer for shipping damage. See that RX and RS relays are fully seated.
4. Check customer's line voltage and compare against machine name plate specification. Adjust transformers in signal unit to correspond to input voltage by means of the switch taps. The regulated DC supply should deliver 46-48 volts (Federal) or 49-50 volts (Sola).
5. Remove power and connect signal unit to punch with Elco connector. Make sure that it fits snugly.
6. Apply power to machine and allow it to warm up for a few minutes before making further adjustments.
7. Check signal unit adjustments as outlined in Customer Engineering Reference Manual, *IBM 67-68 Data Transceiver*, Form 223-6635.
8. Attach telephone or telegraph line cord. See instruction for connection in the "Signal Unit" sections of the 67-68 manual. Insert plug into receptacle provided by telephone or telegraph company.
 - a. Telegraph machines: If the unit has a polar-duplex switch, check to see that it is set to DUPLEX; then adjust bias. Test by sending and receiving START, EOT, and TEL.
 - b. Telephone machines: Set receive levels; then make final adjustment for phasing (while receiving N or level set transmit from the remote location).

Receive a series of repeated STARTS and manually vary receive level T pad to determine range over which STARTS can be properly received. There should be a five-step range for ABC machines and a minimum of three steps for AGC units. Inadequate range may result from a faulty receiving strip, notably an unbalanced VA-1.

9. Punch and duplicate a group of test cards including all characters and special characters that customer may use. Transmit the deck, receive it, and compare results.

10. When customer applications are apt to be complex, a more rigorous final test program can be used. Detail cards may be punched in every column with different combinations of punches or they may be punched with one digit in all columns for first test. However, if trouble is indicated on a final test, simplify the test program as much as possible for trouble analysis. Use the simplest program that will reveal the failure.

11. If line trouble is indicated in the installation test, see that telephone or telegraph companies are notified as promptly as possible.

3.5.5 526 Printing Summary Punch

1. Front left caster mounts under control panel frame.
2. Front right caster mounts in hole farthest to rear of machine.
3. Rear left caster mounts in hole farthest to rear of machine.
4. Rear right caster mounts in hole farthest to rear of machine.
5. Connect power and adjust power supply.
6. Check friction drive torque.
7. Test all machine functions.

3.5.6 534-536 Card Punch

1. Connect power and check voltages.
2. Check friction drive torque.
3. Test machine functions thoroughly.

3.5.7 824-826 Typewriter Card Punch

1. Connect power and check voltages.
2. Connect typewriter and check carriage for freedom of travel without excessive play or binds. Check platen to see that it is held rigidly, yet is free to rotate when detent is released. Check for loose parts on carriage, particularly margin rack and tab rack. Observe condition of carriage tension and return tapes.
3. Operate all typewriter keys in lower case to test typing function. Insert paper during this test to check impression and alignment.
4. Test all card punch functions from card punch keyboard.
5. With typewriter in shift, test functions of typewriter and card punch together.

3.5.8 834-836 Control Unit

1. Connect power and check voltages.

2. Connect typewriter and check carriage for freedom of travel without excessive play or binds. Check platen to see that it is held rigidly, yet is free to rotate when detent is released. Check for loose parts on carriage, particularly margin rack and tab rack. Observe condition of carriage tension and return tapes.

3. Operate all typewriter keys in lower case to test typing functions. Insert paper during this test to check impression and alignment.

4. Test all card punch functions from card punch keyboard.

5. Test machine thoroughly in tape reading, duplication, skipping, and typing.

6. Make sure casters are installed in caster mounting holes and not in the holes used for shipping bolts.

3.5.9 24-26, Models 5 and 6

Use normal procedure to prepare the punch for operation. Inspect the translator for shipping damage and remove shipping ties. Check the translator-punch operation, including duration of answerback, with the simulator switches provided on the translator.

The attachment cord plug can now be attached to the receiver 401F and the punch made ready. A call placed to the punch from any phone should cause the automatic connect and disconnect device to operate, causing first the answer light to glow followed by the active light. A continuous answerback tone signal is sent to the terminal during the answer period. Hanging up the calling phone should cause a card to be released and the active light to be extinguished. (The time for this to result depends on the telephone company. It usually occurs within a few seconds).

Perform a system check to an existing[†] transmitting station, checking all digits and functions.

Alternate Program Device	50	Notch Drive, Redesigned	32
Auxiliary Duplication Device	50	Notch Solenoid, Last Column	32
Backspace Mechanism	11	Offset Stacker	35, 36
Base	7	Pin Bail Drive Link, Punch	27
Basic Power Supply	7	Pin Sense Card Lever	34
Belt Tension, Drive Motor	11	Pin Sense Station	32
Card Aligner Fingers	16	Polarity Traps, Selenium Rectifier	11
Card Column Emitter Assembly, IBM 46-47	58	Power Supply, Basic	7
Card Column Emitter Assembly, IBM 526	65	Pressure Rails	16
Card Feed	15	Pressure Rolls	18
Card Feed Clutch	15	Pressure Roll Springs, Card Feed	18
Card Feed Latch Magnet	15	Print Drive Unit	44
Card Guides	17	Print Head	44
Card Lever Contact, Card Bed	16	Printing Interposers	39
Card Lever, Pin Sense	34	Printing Pressure	44
Card Lever Pressure Finger	17	Print Magnet, IBM 46-47	57
Card Lifter Assembly	35	Print Suppress Magnet	44
Card Pusher	17	Print Unit	39
Card Registration	17	Print Wire Unit	45
Card Reverse Stacker	50	Print Yoke	40
Card Stop Cam	34	Program Auxiliary Drum Unit	36
Chart, Scheduled Maintenance	5	Program Cam Contacts	37
Charts, Lubrication	20	Program Sensing Contacts, IBM 526	65
Circuit Breakers, Card Feed	19	Program Sensing Contacts, IBM 534 and 536	65
Circuit Breakers, High-Speed	25	Program Sensing Contacts, Standard Machines	36
Cleaning	5	Punch	25
Clutch, Card Feed	15	Punches	26
Clutch, Friction	12	Punch and Verifier	19
Clutch, High-Speed Skip	53	Punch Clutch	22
Clutch Magnet, Punch and Verifier	22	Punch Clutch Assembly, New Style	23
Code Plate, Adjustments	39, 42, 43	Punch Die and Stripper	25
Code Plate, Removal	45	Punch Drive, Removal	20
Code Plate, Service Check	39	Punch Guide Comb and Bumper	20
Common Troubles and Causes	69	Punch Interposer Magnet Assembly	27
Constant-Voltage Transformer Supply	10	Pusher Arm, Card	17
Diagnostic Approach	69	Pusher Plate, Hopper	15
Die, and Stripper, Punch	25	Read Card Lever Contact, IBM 526	65
Drive	11	Read Card Lever Contact, IBM 534 and 536	65
Drive Motors	11, 71	Read Card Lever Contact, IBM 824 and 826	66
Dynamotors, DC Machines	9	Reduction Drive	11
Eject Unit	34	Registration, Punch and Verifier	18
Escapement Unit	13, 14	Relays, Standard	10
Feed Clutch	15	Relays, High-Speed, IBM 526	64
Feed Knives	15	Ribbon Feed Pawl	44
Feed Wheels	18	Safety	4, 5
Friction Clutch	12	Saturable Reactor Supply	9
Friction Drive	12	Scheduled Maintenance	5
Guide Comb and Bumper, Punch	20	Self-Checking Number Device	50
High-Speed Skip	53	Service Aids - General	69
Hopper	15	Servicing Procedures	7
IBM 24-26 Models 5 and 6	66	Spark Suppressors	11
IBM 46-47 Tape to Card Punch	54	Special Features	50
IBM 65-66 Data Transceiver	64	Specifications, Machine	71
IBM 526 Printing Summary Punch	64	Stacker Assembly	35
IBM 534-536 Card Punch	65	Stacker, Card Reverse	50
IBM 824-826 Typewriter Card Punch	65	Stacker, Offset	35, 36
IBM 834-836 Control Unit	66	Stacker Unit	35
Index Pointer, Punch and Verifier	19	Tape Read Unit, IBM 46-47	59
Installation Procedures	72	Throat, Hopper	15
Interposer Bail Contacts	20, 30, 64	Translator Unit Adjustments	68
Interposer Magnet, Punch and Verifier	19	Troubles, Common	69
Interposer Magnet Assembly, Verifier	30	Vacuum Tubes	10
Keyboard	46	Variable-Length Card Device	50
Keyboard, IBM 824-826	66	Verifier	28
Keyboard Lubrication	49	Verifier Clutch	22
Last Column Notch Solenoid	32	Verifier Clutch Assembly, New Style	23
Lubrication	71	Verifying Contacts	30
Lubrication Charts	72	Verifier Drive Unit, Adjustment	28
Magazine Springs, Hopper	15	Verifier Drive Unit, Removal	21
Magnet, Print Suppress	44	Verifier Interposer Magnet Assembly	30
Maintenance Routine, IBM 24-26, Models 5 and 6	66	Verifying Frame Assembly	29
Notching Drive	31		

102672890

IBM 24 Printed in U. S. A. 225-6535-5

IBM

International Business Machines Corporation

Field Engineering Division

112 East Post Road, White Plains, N. Y. 10601