IBM

Customer Engineering

Manual of Instruction

1402 Card Read-Punch

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IBM 1402 Card Read-Punch

Contents

This Manual of Instruction covers the mechanical prin-
ciples, electrical principles, electrical circuits, and
special devices of the IBM 1402 Card Read-Punch
Models 1, 2 and 3. Differences between the three models,
although few, are covered within the respective sections.

IBM 1402 Card Read-Punch

The IBM 1402 Card Read-Punch, Models 1, 2, and 3, provide data processing systems with a punch card input and output. The 1402 is equipped with one read feed and one punch feed feeding into a stacker section in the center of the machine. The read feed is located on the right end of the 1402 and the punch feed is on the left end. Each feed has its own drive motor. Five radial stackers are used to accomplish stacking of cards. The card transport system is driven by belts, wherever possible, to reduce noise and machine maintenance.

Functional Units

Read Feed

The read feed is equipped with a 3600 card capacity file feed. Maximum speed of the read feed is 800 cards per minute. Actual card speed is governed by program routing.

Cards are fed through the read feed, nine edge first, face down. The card path is illustrated in the feed schematic diagram (Figure 1-1). As the card passes the first read brushes, 80 columns of the card are read to condition the hole count check planes in the processing unit. The card is then moved past the second read brushes where 80 columns of the card are read and entered into the read area of core storage. At the same time, the check planes are conditioned so that hole count check may be completed.

On Models 1 and 3, after the card passes the second reading station, it comes under control of the continuous running feed rolls. Feed rolls that are clutch-controlled on Models 1 and 3 are shown solid black in Figure 1-1.

For the Model 2, the fourth feed roll is also under control of the read clutch. In Figure 1-1, the additional clutch-controlled feed roll is shaded.

Punch Feed

The 1402 Card Read-Punch will punch cards and check card punching at a maximum rate of 250 cards per minute. Cards are placed in the 1200 card capacity hopper, 12 edge first, face down. Card feeding in the punch feed is illustrated on the left side of Figure 1-1. As the card passes through the punch feed it passes through the following stations:

1. Punch feed read station. At this station data may be read from the card and stored in the processing unit storage, if the special feature Punch Feed Read is installed. NOTE: This feature is available only on Models 1 and 3.

2. Aligner station. This station aligns the card for proper vertical and horizontal punch registration.

3. Punch station. While the card travels through the punch station, it is driven by the intermittent feed rolls. This is the only station where the card is under control of the intermittent feed rolls.

4. Punch check station. After card punching has occurred, the card is read at this station to complete the hole count check.

As soon as the card leaves the punch check brush station, it feeds past the stacker select magnets. The stacker select magnets are controlled by the program. The magnet selected operates a chute blade that directs the card to its assigned stacker.
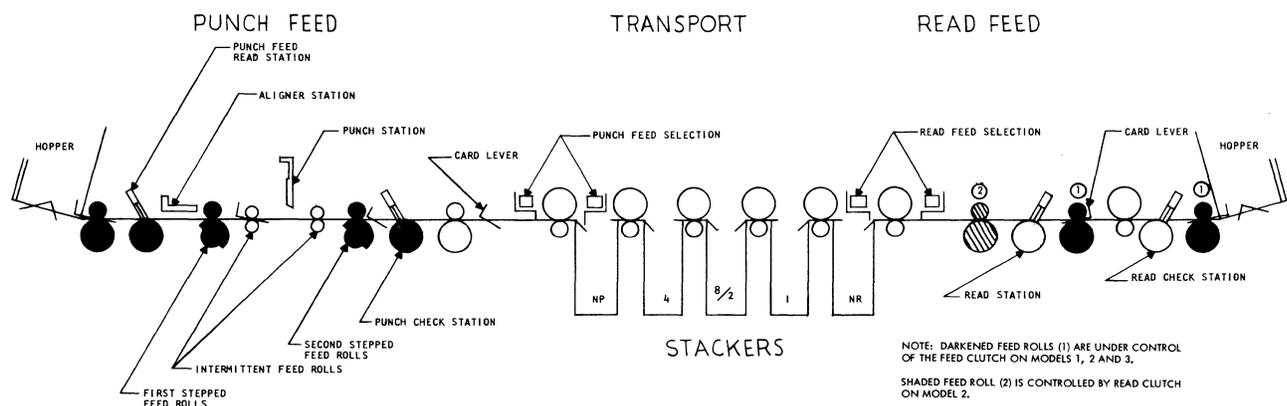
Figure 1-1. IBM 1402 Feed Schematic

Stackers

There are five stackers in the center of the machine. Two of these stackers are assigned to the reader and two are assigned to the punch. The center stacker may receive cards from either unit. However, during any one run, the center stacker must be assigned to one unit only. It cannot be used to collate cards.

Looking at the front of the machine from left to right, the stackers are as follows: Normal punch (NP), stacker 4, stacker 8/2, stacker 1, and normal read (N/R). The 8/2 stacker becomes stacker 2 when program assigned to the read feed, and stacker 8 when program assigned to the punch feed.

Operating Lights and Controls

Models 1 and 3 (Figure 1-2A)

Read Switch: This switch controls the read section of the machine. When this switch is OFF, the read feed is inoperative.

Punch Switch: This switch controls the punch section of the machine. When this switch is OFF, the punch feed is inoperative. Cards can be run into the punch feed with the punch switch OFF by use of the non-process runout punch switch.

Start Switch: This switch causes the read feed motor to start when the read switch is ON. The punch motor will start if the punch switch is ON.

Stop Switch: This switch is used to stop system processing and the 1402. If a program instruction is in process, it is completed before the stop occurs.

Non-Process Runout-Read Switch: This switch is used to run cards out of the read feed. The last two cards run out will not be processed. The read hopper must be empty to make this switch effective.

Non-Process Runout-Punch Switch: This switch is used to run cards out of the punch feed. The last two cards will not be punched. When the punch switch is ON, the hopper must be empty to make this switch effective.

Load Switch: This switch is used to start loading instruction cards. Pressing the load key causes the read feed to operate until the first card has passed the second read brushes. After the card is read at the second read brushes, the program can start and execute the instructions that are punched in the card. Continued operation is under control of programming. When the punch switch is ON, pressing the load key causes the punch drive motor to run.

Check Reset Switch: This switch must be pressed to reset an error indication before the start key can become operative. This switch is operative only when the feed, in error, is empty of all cards.

Power Light: When power is supplied to the 1402, this light is ON.

Reader Stop Light: A feed failure or a card jam in the read feed causes the machine to stop and the reader-stop light to come ON.

Punch Stop Light: A feed failure or a card jam in the punch feed causes the machine to stop and the punch stop light to come ON.

Validity Light: This light comes ON if an invalid character is detected by the system during a read operation.

Reader Check Light: This light comes ON under control of the data processing system when an error is detected during card reading.

Punch Check Light: This light comes ON under control of the data processing system when an error is detected during the punching of a card.

Stacker Light: If any of the five stackers becomes full, the stacker light goes ON and the machine stops.

Transport Light: This light is turned ON by the jam contact. It indicates that a card has jammed in the transport area.

Chip Light: This light is turned ON if either the chip box is full or is not in machine. The light may come ON shortly before the machine stops.

Fuse Light: This light indicates a blown signal fuse in the 1402.
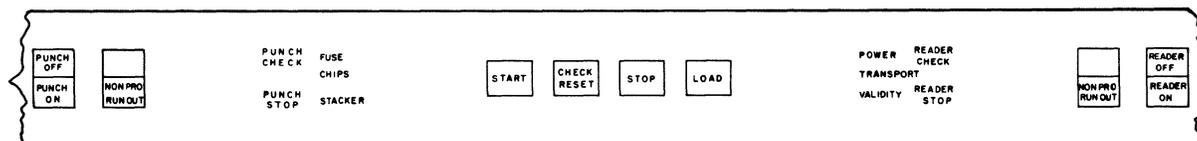
Figure 1-2A. IBM 1402 Model 1 and 3 Operating Controls

Model 2 (Figure 1-2B)

Reader Start Key: Depressing this key causes three cards to be fed into the read feed, and establishes the computer interlocks. The first card is read into the read buffer, and the ready light comes ON. After the initial run in cycles, reader operation is under program control. If the reader has been stopped during program-controlled operation, pressing the start key will establish the computer interlocks and turn ON the reader ready light.

Reader Stop Key: When this key is depressed, the computer interlock is removed, the reader stops, and the ready light goes OFF.

End-of-File Key: The end-of-file (EOF) key is used to establish an end-of-file condition in the processing unit. Cards can be run out by pressing the EOF key and then the start key.

Punch Start: This key is used to cause an initial run-in of two cards in the punch feed. After the initial run-in, computer interlocks are established and the punch ready light is turned ON. When the punch ready light is ON, card feeding and punching are controlled by the program in the processing unit. If the punch unit has been stopped, pressing the start key will re-establish the above-mentioned controls.

Punch Stop: This key stops the punch, removes the computer interlocks, and turns off the ready light.

Power On Light: This light indicates that power is being supplied to the 1402.

Fuse Light: This light indicates a blown signal fuse in the 1402.

Stacker Light: When one or more of the five stackers is filled, the stacker light comes on. When the stacker switch is operated, it will also remove the ready condition from both the reader and the punch unit.

Transport: The transport light comes on when a card jam operates the jam bar switch.

Reader Ready: This light indicates that the computer interlocks have been established and the reader is ready for program-controlled operation.

Reader Stop: This light indicates a feed failure, a card jam in the reader, or a read clutch malfunction.

Reader Check: The reader check light indicates a hole count error, a parity error in the read buffer, or that a buffer timing error has been detected. The read check light will remain on until the next feed command is initiated. During the feed command, data is transferred from buffer to memory.

Validity: This light indicates that an invalid character has been detected during a feed operation. The validity light remains on until the next feed command.

Punch Ready: The punch ready light comes on after the run in cycles are completed, and the computer interlocks have been established.

Punch Stop: The punch stop light indicates a jam in the punch feed area, a mis-feed, or a punch control malfunction.

Punch Check: This light indicates a hole count error, a buffer parity error, or a buffer timing error has been detected.

Functional Switches (Models 1, 2 and 3)

Cover Interlocks: When a cover is opened, the respective interlock switch will open the circuit to the punch motor, reader motor, and run relay.

Punch Magazine Interlock: When the magazine locking lever is opened, this switch opens the circuit to the punch motor and motor start relays.

Lowering Frame Interlock: This switch provides the same function as the magazine interlock when the lowering frame is lowered.

Crank Interlock: This is a manually-operated switch which must be turned off to insert the hand crank for cranking the punch feed. It provides the same function as the magazine interlock while using the hand crank.

Die Interlock: This switch provides the same function as the magazine interlock when the die is removed or improperly located.
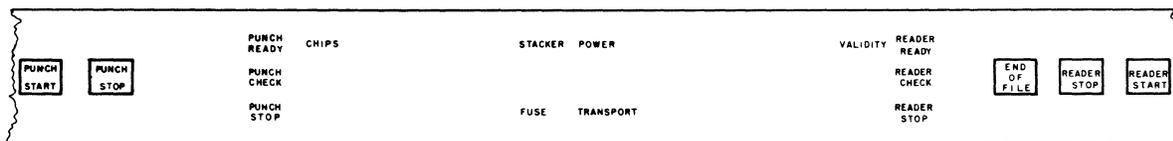
Figure 1-2B. IBM 1402 Model 2 Operating Controls

Stacker Switch: This switch operates when any of the five stackers are filled. When transferred, it opens the circuit to the punch and reader, start and run circuits. It also closes the circuit to the stacker indicating light when transferred.

Jam Bar Switch: When a jam occurs, this switch provides the same function as the stacker switch except that it completes a circuit to the transport light.

Joggle Switch: This switch is operated when the hinged front joggler assembly is opened. It opens the circuit to the reader motor control relay.

Chips 1 and 2 Switches: These switches operate when the chip box is full or removed from the machine. Operation of either switch will open the punch motor circuit, the run circuits, and will light the "chips" indicating lamp.

51-80 Column Device (1402 Models 1, 2, 3)

This feature permits reading and stacking of 51 column cards into pockets NR and 1. The operator performs several operations to convert from 80 to 51-column operation. This feature applies only to the read feed.

To convert a 51-column operation, perform the following steps:

1. Place the auxiliary hopper side plates in the hopper.
2. Interchange 80 and 51-column card weights.
3. Insert auxiliary file aligners in upper part of file feed.
4. Program the read feed to stack in pockets NR and 1 only.
5. Pull the center portions of the radial guides in pockets NR and 1 into their forward detented position.
6. Pull the auxiliary ledges for pockets NR and 1 down and toward the rear of the machine to a detent position. Restore cover.

When pocket N/R is set up for a 51-column operation, a micro switch is operated. This micro switch activates a line to the processing unit that causes addressing to be adapted to the 51 column card format.

The selection mechanism is changed to a new location because of the shorter 51 column card (Figure 7-1). This necessitates a delay circuit for select magnet 2. Three relays are used for this purpose. Instead of stacker 2 magnet picking, when the *Stacker 2* line is brought up, the first delay relay is picked. The first delay relay and RC circuit breaker impulse pick the second delay relay. The second delay picks the third delay relay. When the first delay relay drops out, and the third one is picked, the stacker 2 magnet circuit is completed.

Punch Feed Read (Models 1 and 3)

The Punch Feed Read feature (PFR) adds a set of 80 read brushes to the blank station ahead of the punches in the punch feed (Figure 7-2). With this feature, data may be read from a card and the results of a calculation punched into the same card.

An operation restriction is present when using PFR; no operation code involving the use of the read feed may be programmed in conjunction with the PFR Op code.

The 80 PFR brushes are switched through relay points, as shown in Figure 7-3, so that data read at the punch read brushes enters the read area of processing unit storage. Because the same row bit cores are used for both the second read and the PFR brushes, a PFR operation and a normal read cannot be programmed as a combined punch and read. The punch clutch is energized in the same manner as in the normal punch operation. When the cam impulse picking the clutch

Figure 7-1. 51-80 Column Stacker Select Mechanism
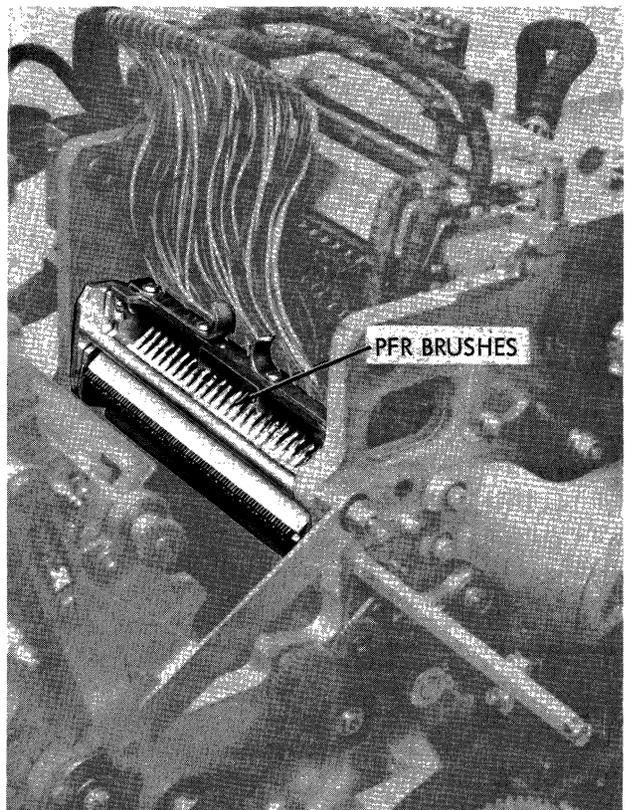
Figure 7-2. Punch Feed Read Brush Location

The general location of mechanical units of the 1402 is shown on Figures 2-1 and 2-2. There are a few mechanical differences in the various Models of the 1402. In general they are as follows:

1. The 1402 Model 3 does not contain power supplies. It receives all of its power from the processing unit.

2. The bulk supply on the Model 2 is 1850 Watts. The bulk supply on the Model 1 is 1250 Watts.

3. The Model 2 contains additional supplies; -12 volt, and a +12 volt DC supply.

4. The Models 1 and 3 use the solar cell circuit breaker.

5. The Model 3 and the Early Card Read feature on the Model 1 use the six-tooth ratchet reader clutch.

6. The 1402 Model 3 uses punch timer (PT) and read timer (RT) relays. The PT and RT relays will stop the punch or read motor if the time between successive punch or read operations is greater than 30 seconds.

Read Feed

Drive Mechanism

A 1/4 hp motor (Figure 2-2) drives the input pulley on the read feed. On the 1402 Models 1 and 3, the following are continuously running:

1. Timer index
2. Clutch ratchet
3. Two contact rolls
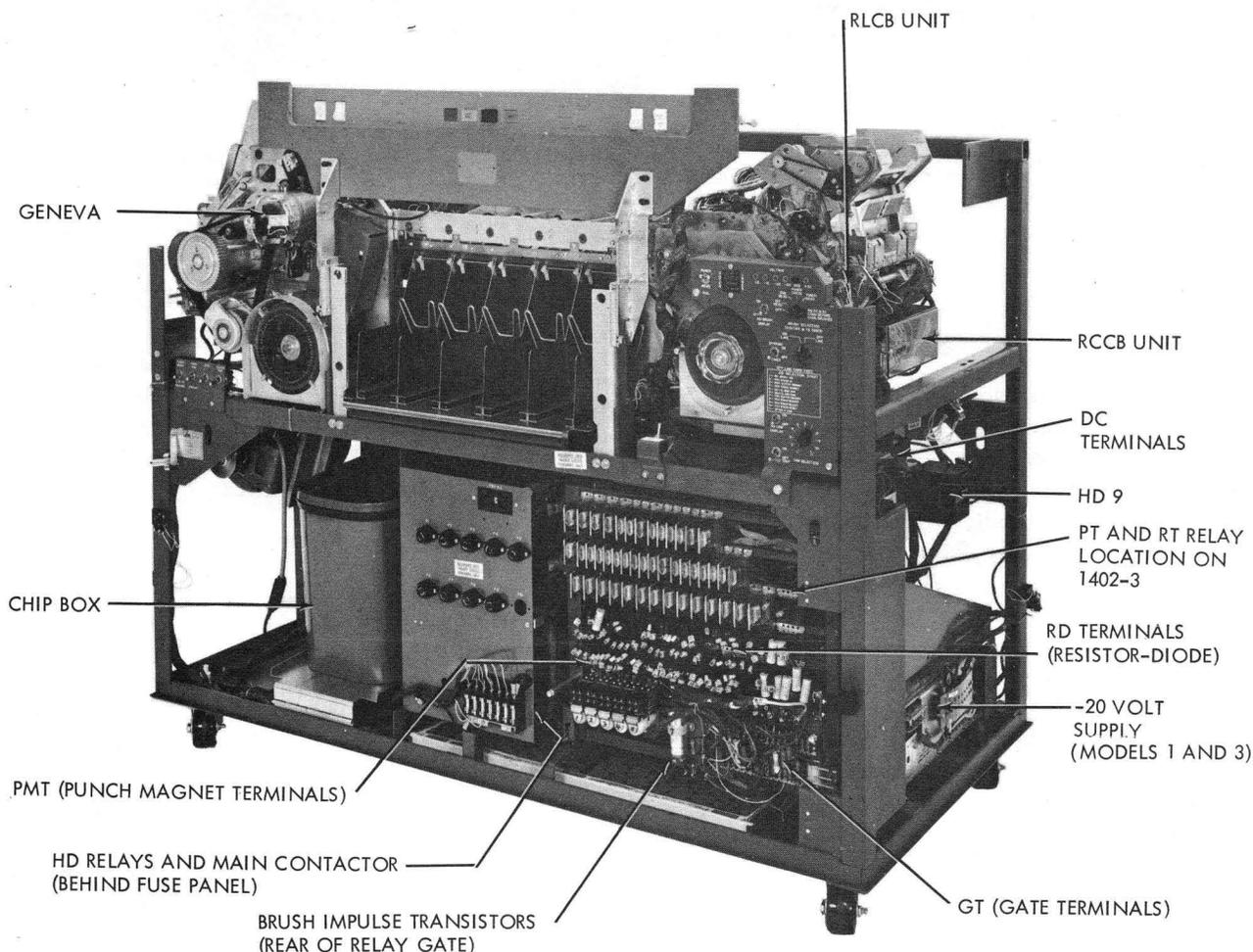
Figure 2-1. IBM 1402 Front View
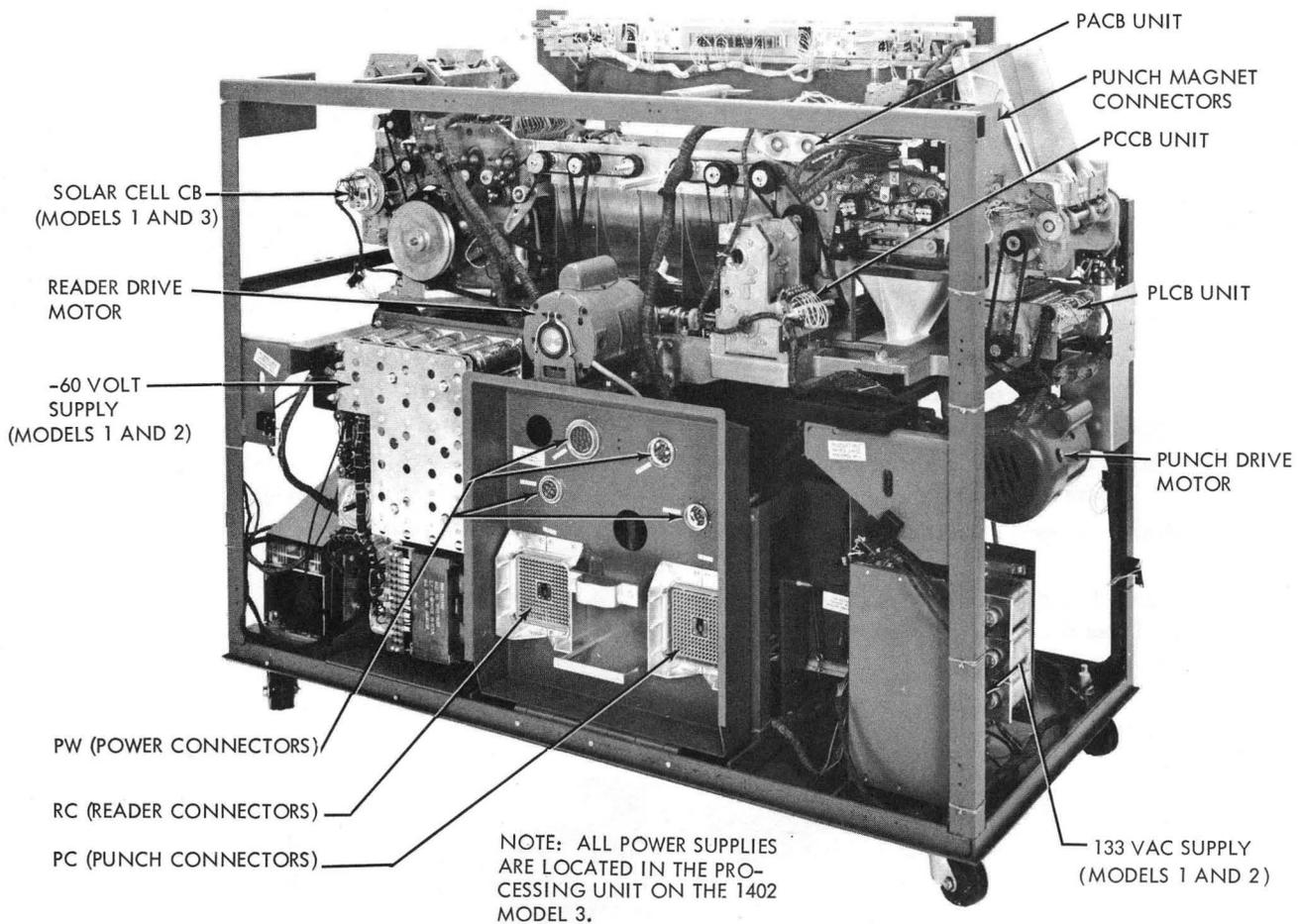
Figure 2-2. IBM 1402 Rear View

4. First feed roll after each contact roll
5. Continuously running CB's (RC) (800 RPM)
6. File feed drive shaft
7. Three transport feed rolls
8. Stacker jogglers for NR, 1, and 8/2 pockets

On the 1402 Model 2 the following are continously running:

1. Timer index
2. Clutch ratchet
3. Two contact rolls
4. First feed roll after the read check brush contact roll
5. Continuously running CB's (RC CB 800 RPM)
6. File feed drive shaft
7. Transport feed rolls
8. Stacker jogglers for NR, 1, and 8/2 stackers

On the 1402 Models 1, 2 and 3 the reader clutch engages to drive the following: (See Figure 1-1)

1. Picker knife cam shaft
2. Feed knives
3. Feed rolls immediately preceding each read brush contact roll

4. First set of feed rolls following the second brush contact roll on Model 2
5. Read latch CB's (RL CB's)
6. Solar cell circuit breaker (SCC B) on Models 1 and 3

Speed

The speed of the 1402 reader, when feeding continuously, is 800 cpm +3 −20. However, the actual number of cards per minute is controlled by the program routing of the processing unit program.

DRIVE ARM
SECURED TO
PULLEY

INTERMEDIATE ARM
PIVOTS ON THIS HUB

DETENT PIVOT

KEEPER HITS
THIS SURFACE

CONTROL STUD

DETENT

DOG
PIVOT

INTERMEDIATE ARM

LATCHES ON
THESE SURFACES

CONTROL STUD

RATCHET

DOG

NOTE: THE 6-TOOTH CLUTCH RATCHET
IS USED ON THE 1402 MODEL 3. THE
6-TOOTH CLUTCH RATCHET IS USED ON
A 1402 MODEL 1 IF IT HAS THE EARLY
CARD READ FEATURE.

Figure 2-3. Reader Clutch Assembly

Read Clutch

The clutch ratchet is continuously running and makes one-half revolution each machine cycle. This ratchet is engaged by a drive dog and detent, which are controlled by a drive arm and an intermediate arm.

The dog and detent are spring loaded to engage the ratchet. The dog and detent pivot on studs that are part of the drive arm and are controlled by studs that are part of the intermediate arm. The intermediate arm pivots on a sleeve that is the hub of the drive arm (Figure 2-3).

DRIVE ARM

DOG

LATCH KEEPER

RATCHET

ECCENTRIC

1/32"

DETENT

ADJUST SCREWS
FOR .020" TO
.022" CLEARANCE
HERE

INTERMEDIATE ARM

LATCH

BACKSTOP

CHECK .001" TO
.003" CLEARANCE
HERE

LOCATING BLOCK

Figure 2-4. Reader Clutch Magnet Assembly

In order to accomplish 600 card per minute feeding on the 1402 Model 3, a six-tooth ratchet assembly is used. With the use of this clutch, the process unit does not have to wait for the mechanics of a normal clutch to position itself for engagement. This necessitates the use of multi-lobe cams to gate the clutch engage impulses and card lever pick, hold, and check circuits.

An Early Card Read feature is available as a special feature on the 1402 Model 1. When the Early Card Read feature is installed, the 1402 Model 1 uses a six-tooth clutch ratchet. The Early Card Read feature is not available for the 1402 Model 2.

A synchronizing switch is installed for timing the brushes or checking the feed. This switch allows the clutch to engage at 315° only.

To see the engaging action of the clutch, assume the clutch is latched as shown in Figure 2-4. Impulsing the magnet, releases the latch and allows the intermediate arm to rotate clockwise in relation to the drive arm. As the intermediate arm moves clockwise, under spring tension created by the dog and detent springs, the dog and detent are allowed to engage the ratchet and rotate the clutch-driven mechanism.

Unless the clutch magnet is impulsed again, the clutch will disengage when the opposite end of the arm strikes the latch. The intermediate arm, having moved clockwise in relation to the drive arm, will strike the latch first. The drive arm continues to move, and in doing so, causes the dog and detent to be cammed away from the ratchet by the motion of the pivot studs in relation to the control studs on the intermediate arm. Inertia carries the drive arm forward to strike the latch, and the keeper falls behind the drive arm to hold the clutch latched.

File Feed (Figure 2-5)

The file feed consists of two basic units:

1. Upper magazine
2. Lower magazine

The upper magazine is the tray which holds up to 3600 cards to be fed into the hopper. This tray is hinged and can be locked at an angle to make the brush area of the machine more accessible.

The lower magazine contains clutch-controlled feed rolls that feed the cards into the hopper. Operation of
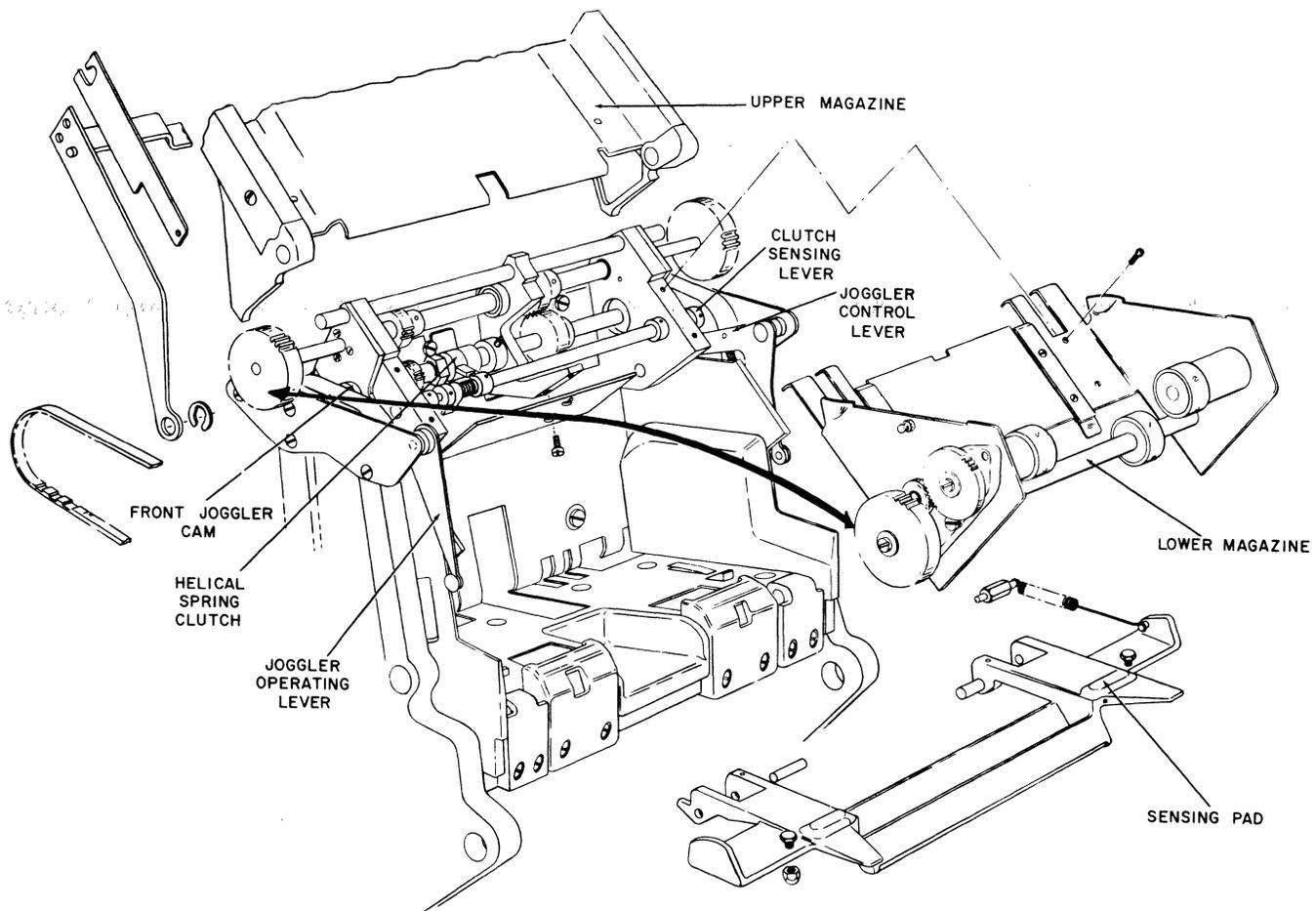
Figure 2-5. File Feed

the helical spring-type feed roll clutch is controlled by the level of the cards in the hopper. Under spring tension, the front joggler applies pressure on the joggler operating lever, causing the lever to follow the contour of the front joggler cam. As the front joggler cam rotates, the front joggler oscillates, joggling the cards into position. If there are sufficient cards in the hopper to cover the sensing pads, the inward travel of the joggler is limited, and the joggler control lever is not allowed to follow the low dwell of the front joggler cam. There will be no clutch action or cards fed down into the hopper at this time.

When the card level drops below the sensing pads, the additional travel of the joggler forces the joggler operating lever to follow the low dwell of the front joggler cam. The tab on the joggler operating lever then will cause the clutch operating lever to rotate counter-clockwise, pivoting the clutch latch out of the step in the clutch sleeve. The helical spring grips the shaft, and the feed rolls are driven. Cards feed until the card level in the hopper again reaches the sensing pads and then the clutch latches.

Cards are front-and-side-joggled in the hopper. Correct operating jogglers produce a deck with straight sides. The front joggler can be opened for insertion or removal of cards or a card weight.

The card weight is designed to pass through the lower magazine into the hopper and must be used to feed the last cards.

The front joggler interlock, mounted under the read hopper prevents machine operation when the front joggler is open.

Hopper and Picker Knives (Figure 2-6)

After cards go from the file feed to the hopper, the picker knives provide the means of moving the cards from the hopper into the first set of feed rolls. A time delay of three to five seconds is allowed for bringing down a sufficient number of cards from the file feed before clutching begins. A picker knife cam assembly is located on a shaft driven under clutch control. Two cam follower arms are clamped to an adjacent shaft that oscillates when the picker knife cams rotate. Two picker knife arms, also clamped to this shaft, move the picker knife blocks.

The picker knives travel in an arc, and not in a flat plane parallel to the card line. For this reason, to obtain the best possible feeding conditions, the knife blocks must travel evenly through the same arc.

Each picker knife block is fixed on its arm. Two Carboloy* pieces are inserted in the block surface to resist wear. The inserts are ground to specifications for knife projection. Replacement of the picker block is required when the insert becomes worn.

*Trade name Carboloy Dept. General Electric Co.
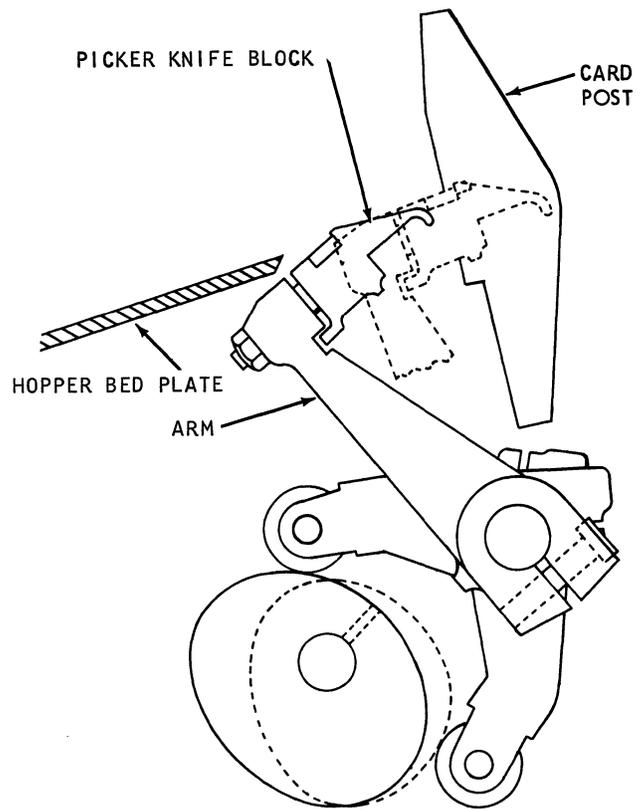
Figure 2-6. Picker Knife Shaft

Transport and Stackers

Transport (Figure 2-7)

The transport mechanism consists of six continuously running feed rolls that move cards from the feeds to the stacker. Three of the feed rolls are under control of the read feed, and three are under control of the punch feed. Cards can go only into three of the five stackers from either feed. The stacker into which the card enters is controlled by the selection mechanism.

Stacker Selection Mechanism (Figure 2-8)

The selection mechanism consists of two chute blades and two control magnets for each of the read and punch feeds. With the select magnets de-energized, the cards enter the stacker nearest the feed; stacker NR for the read, and stacker NP for the punch. If the magnet that depresses the lower of the two chute blades is energized, the cards go into stacker 1 or 4. If the magnet that depresses both chute blades is energized, the cards from either feed can go into stacker 8/2.

A jam bar is installed over the length of the transport mechanism. The bar consists of a spring steel strip located just above the normal card line. Any card that is bent enough to flex the metal strip causes the jam bar

STACKER SELECT MAGNETS (READ FEED)

STACKER SELECT MAGNETS (PUNCH FEED)

JAM STOP SWITCH

JAM BAR
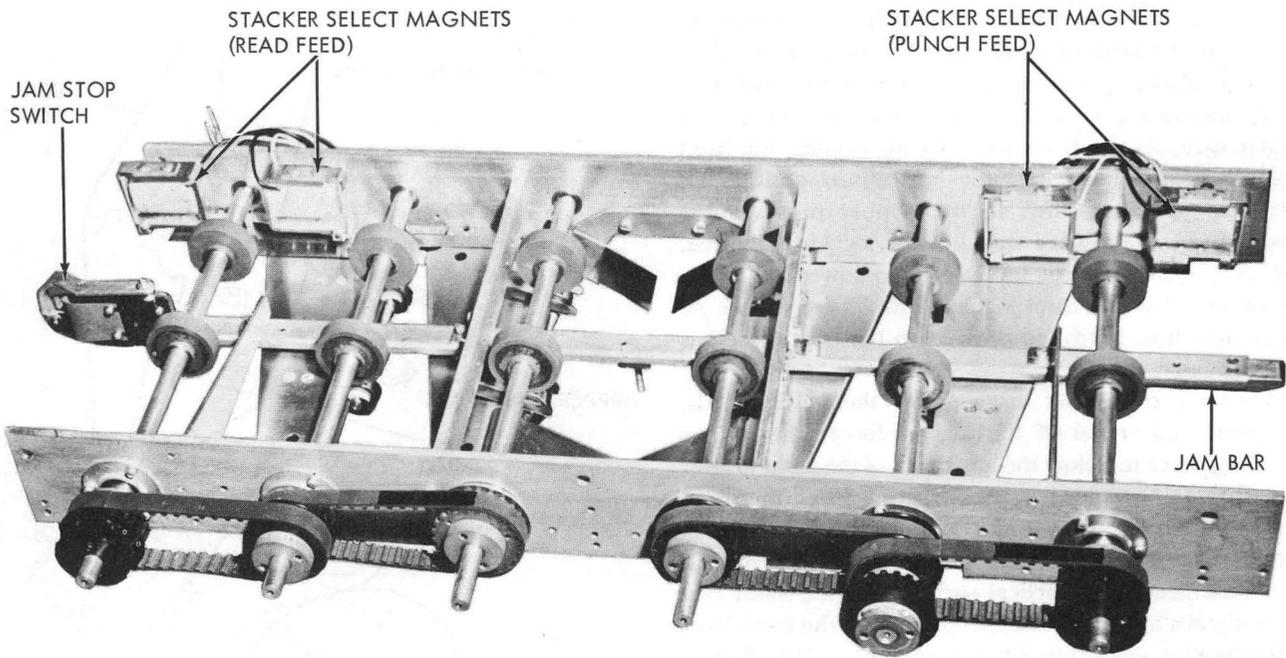
Figure 2-7. Transport Mechanism

PUNCH FEED SELECT MAGNETS

COIL   COIL

READ FEED SELECT MAGNETS

COIL   COIL

PUNCH FEED CARD LINE

READ FEED CARD LINE

| POCKET N/P | POCKET 4 | POCKET 8/2 | POCKET 1 | POCKET N/R |
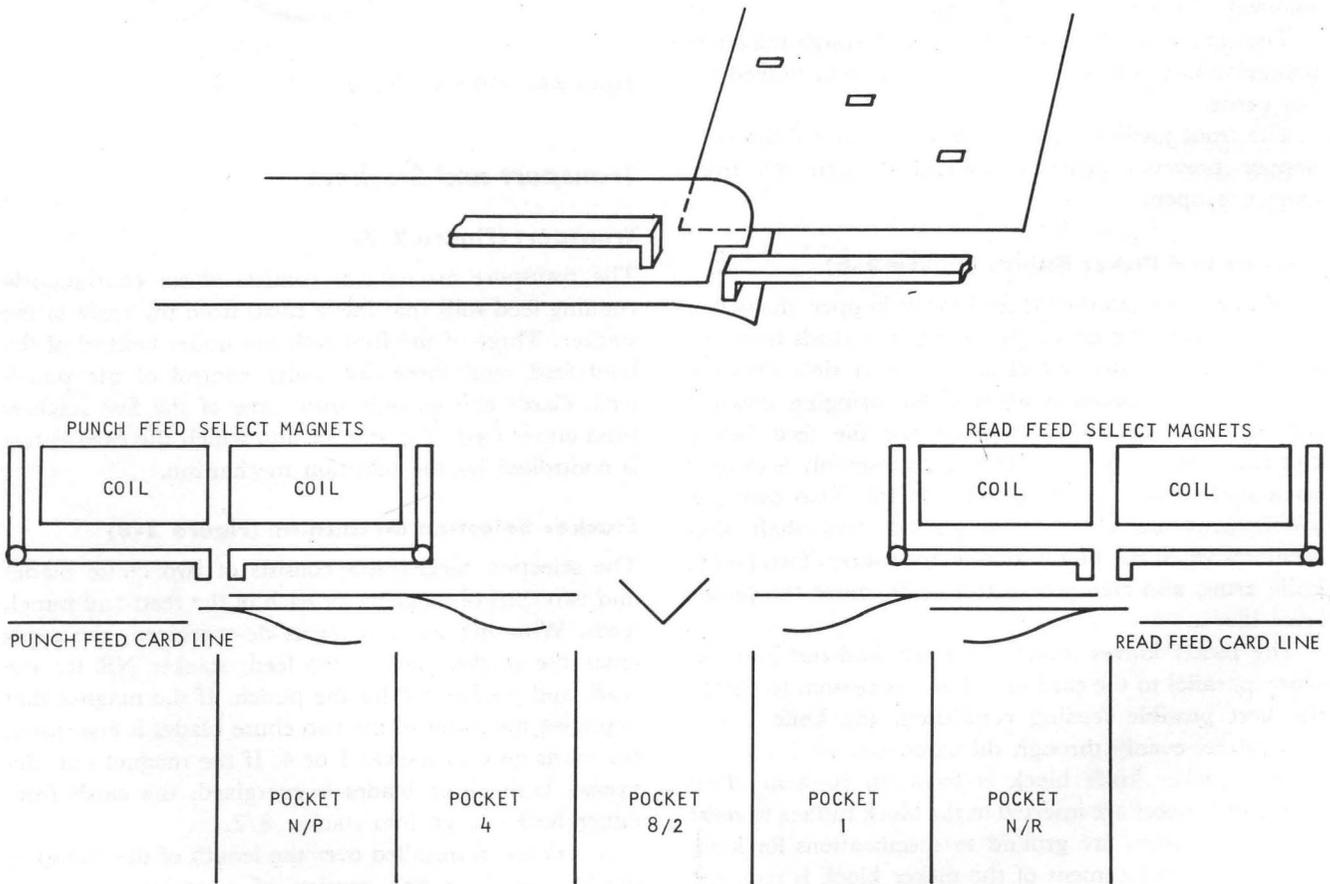
Figure 2-8. Stacker Selection Schematic

2-6

switch to operate. This switch stops the machine and turns on the transport light. A card jam in the feed portion of the machine is detected by the card jam circuits.

Stackers (Figure 2-9)

Radial stackers are used on the 1402. The stacker receives the card horizontally from the transport mechanism. The distance from the top of the radial card guide to the lip of the pivot-and-lever assembly is less than the length of the card. As a result, the front of the card is held by the card restraining lever, and the rear of the card falls, guided by the radial card guide. The radius of the radial guide assembly is such that as the end of the card toward the rear of the machine approaches the bottom, the end of the card toward the front of the machine falls from the restraining lever that has been supporting it.

The card stops with the back edge on the card alignment lever, and the front edge on the card deck support or the card previously stacked. Spring tension supports the card alignment lever until 5 to 30 cards accumulate. Their weight overcomes the spring tension supporting the card alignment lever, and lowers the group of cards onto the card pusher slide. The pusher slide, oscillating front to back, works the bottom of the card deck support. This can continue until the card deck support moves out enough to operate the stacker stop microswitch which stops the machine.

The N/R and 1 stacker jogglers (Figure 2-10) are operated by the read feed, and the N/P and 4 stacker jogglers are operated by the punch feed. The 8/2 stacker joggler is connected to the stacker drive of both the read and punch feeds by means of two helical springs and collars so that it can be operated when either feed is operating.

The card levers on the pivot and lever assembly keep the cards from falling back into the stacker where they might jam the machine.

Punch Feed

Drive Mechanism

A 1/3 hp motor is used to drive the input idler pulley. Through gears and timing belts, the following are kept continuously running:

1. Timer index
2. Clutch ratchet
3. Geneva assembly
4. Intermittent feed rolls
5. Punch unit drive shaft
6. PACB's (1333 1/3 RPM)
7. PCCB's (250 RPM)
8. First feed roll after the punch check brushes
9. Three transport feed rolls
10. Stacker jogglers
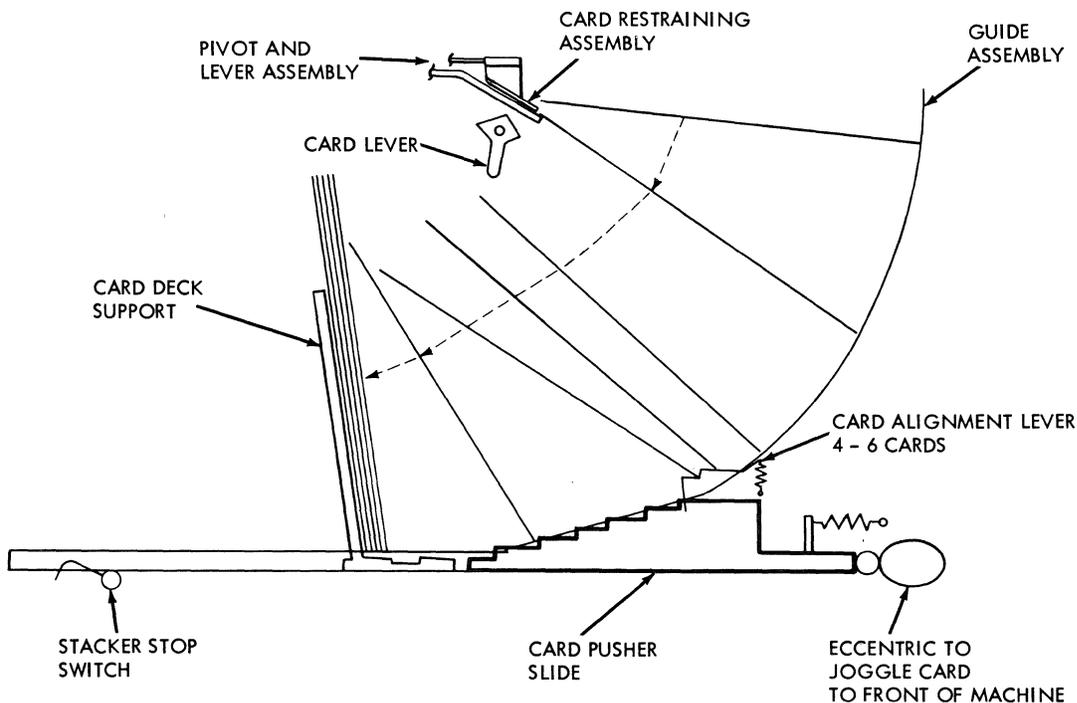
Figure 2-9. Stacker Schematic
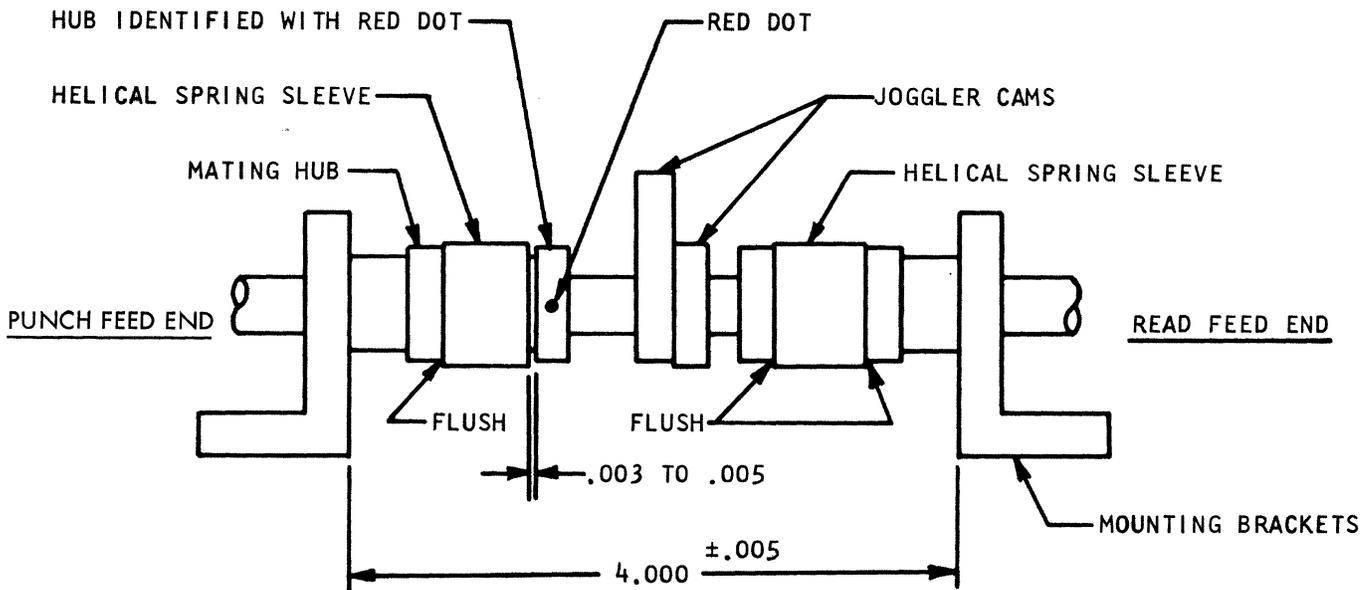
Figure 2-10. Center Stacker Joggler Drive

When the punch clutch engages, power is transmitted to the following:

1. Picker knife cam shaft
2. Feed knives
3. First feed rolls
4. First stepped roll assembly
5. Card aligners
6. Second stepped roll assembly
7. Punch check brush contact roll
8. PLCB's
9. Punch feed read brush contact roll (special feature on 1402 Models 1 and 3).

When the punch clutch latches, the intermittent feed rolls are cammed open and though they continue to turn, they cannot feed a card.

Punch Feed Clutch (Figure 2-11)

The punch clutch used on this machine is a four-tooth ratchet type. The clutch pawl can engage at 315°, 45°, 135°, or 225°. In order to keep the PCCB's (continuously running) in time with the card and the PLCB's (under control of punch clutch), the PCCB's make and break four times for each machine cycle. Therefore, no matter which tooth the pawl engages, the PCCB's will give the same timings in relation to the card being fed. The PACB's (high speed continuously running) make and break for each cycle point. The impulses that are required are filtered out by PLCB's.

NOTE: The synchronous tooth (315°) of the clutch must be used when checking punch transport timings, otherwise all timings will be 90°, 180°, or 270° off from the timings specified. All machines use one particular tooth as the synchronous tooth. This will be the tooth with its driving face opposite the center line of one of the three tapped holes located in the outside collar.
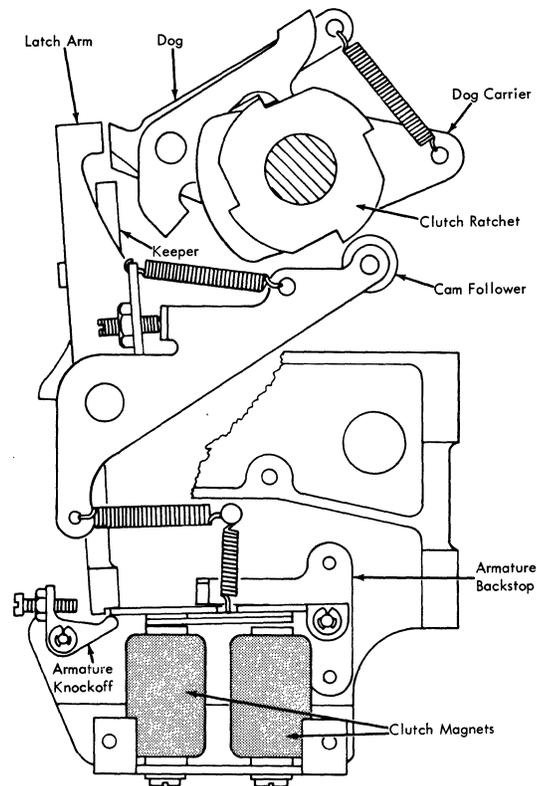
Figure 2-11. Punch Clutch

2-8

Geneva (Figure 2-12)

The purpose of the geneva mechanism is to cause intermittent motion of the card during punching. The geneva mechanism consists of a geneva drive disk and two geneva disks. The geneva drive disk is driven by the punch drive motor. The geneva drive disk imparts intermittent motion to two sets of intermittent feed rolls through the geneva disks.

The intermittent feed rolls control the motion of the card as it passes the punch station. A feed roll opening device cams the intermittent rolls open to receive a card. They are also cammed open at clutch latch time. Therefore, even though the intermittent rolls are being geneva-driven when the punch clutch is latched, they cannot cause card motion.

Hopper and Picker Knives

Refer to hopper and picker knives in the Read Feed section.

Card Guides

There are four card guides that must be kept in proper relationship to the card line. They are located as follows:

1. The first card guides are located just past the first feed rolls. The first upper card guide is removable and is replaced by a brush assembly if the Punch Feed Read feature is on the machine. The first lower card guide is then altered to accommodate a contact roll.

2. The second card guide is located at the first stepped roll.

3. The third card guide is located at the second stepped roll.

4. The punch stacker transport card guide is located between the punch check brushes and the stackers at the sixth feed roll.
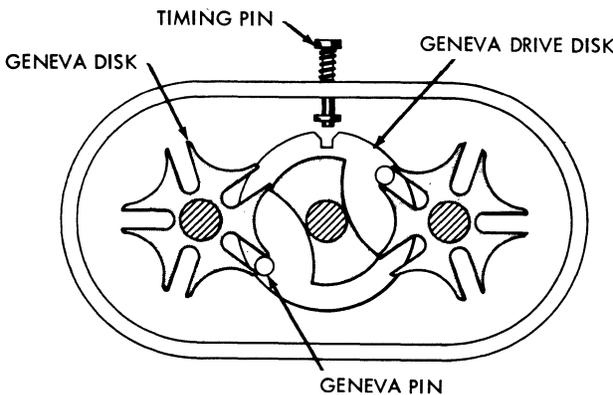
Feed Rolls and Aligner Stations (Figure 2-13)

As the card passes the first upper card guide, it is picked up by the first stepped roll assembly. The lower roll of the assembly is called a stepped roll, because it has a portion of its circumference cut away. When the high dwell of the stepped roll is opposite the upper roll, the card is fed through the rolls into the first intermittent rolls which are cammed open at this time. When the low dwell of the stepped roll is opposite the upper roll, collars on the end of the stepped roll assembly shaft prevent the stepped roll from contacting the card.

During the time that the card is free from the stepped feed roll and the intermittent feed roll, it is aligned to insure correct punching registration (Figure 2-14). The forward aligners contact the trailing edge of the card and move the card up to the centerline of the punches. At the same time, the card is aligned toward the column 80 end by the side aligners. Card pressure fingers are used at the aligner station to prevent snapping or buckling of the card.

After aligning is completed, the first intermittent feed roll closes and the card is fed through the punching station. The second intermittent feed rolls are cammed open as the card is fed into them. They close just before the card leaves the first intermittent feed rolls. After the second intermittent feed rolls close, the first intermittent feed rolls are cammed open. When the first intermittent feed rolls open, the feeding of the card through the punch station is under control of the second intermittent feed rolls. The opening and closing of the intermittent feed rolls prevent buckling or snapping of the card at the punch station.

While punching is being completed, the card is fed into the second stepped roll assembly which is open at this time to receive the card. The second stepped roll assembly is the same as the first. The second stepped feed roll receives the card from the second intermittent

Figure 2-12. Geneva
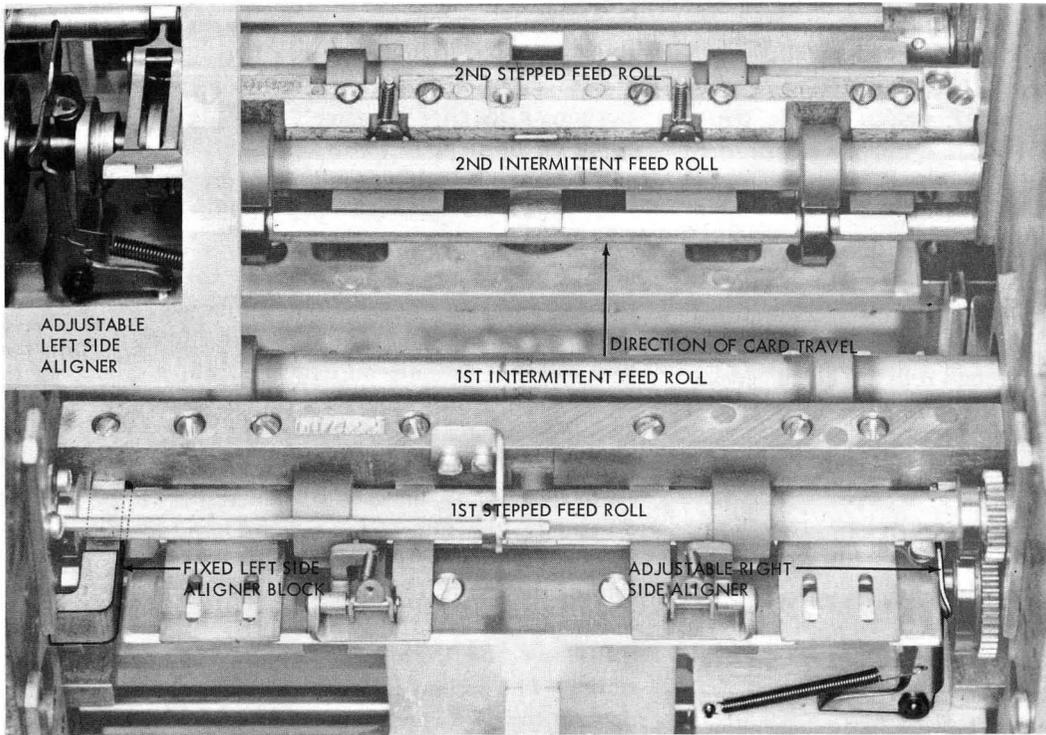
Figure 2-13. Punch Feed Rolls and Aligner Stations
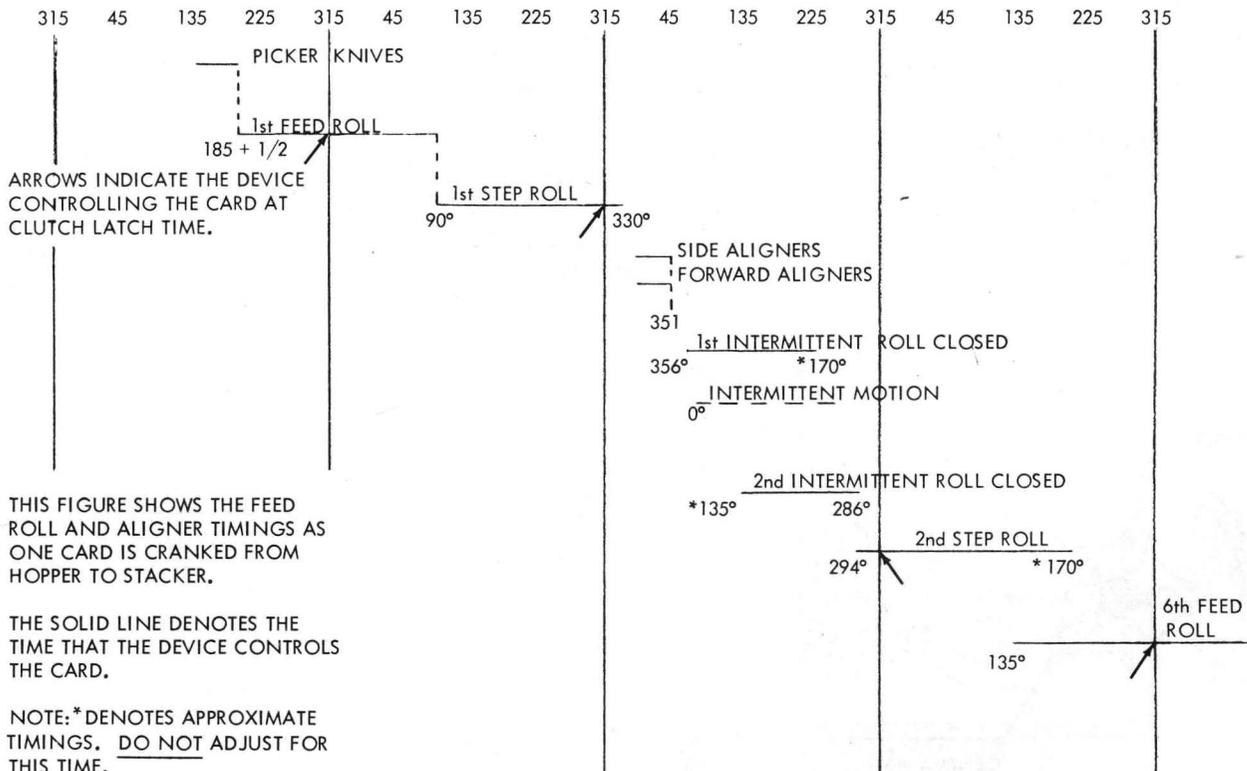
Figure 2-14. Feed Rolls and Aligner Timings

feed roll. The second stepped roll feeds the card past the punch check brushes and into the sixth feed roll. The sixth feed roll will take over control of card-feeding when the second stepped roll comes to the low dwell on its circumference.

Roll Opening Device (Figure 2-15)

The two stepped rolls and the two lower intermittent rolls are mounted on the roll opening device. This assembly may be lowered to facilitate removal of card jams, or for replacement of the die assembly.

The handle in the rear of the machine is pulled out and turned clockwise to lower the device and counter-clockwise to raise the device. An electrical contact interlocks the roll opening device so that the device must be in its UP position before the machine will run.

Punch Feed Timing Belts (Figure 2-16)

Because of the large number of timed drive belts in the punch feed, special attention must be given to the replacement and timing procedures. An important point to remember, when retiming units associated with the punch clutch, is the synchronous tooth of the punch clutch (315°). A study of Figure 2-16 will aid in associating any belt with the different units involved.

NOTE: Darkened belts are controlled by the punch clutch.
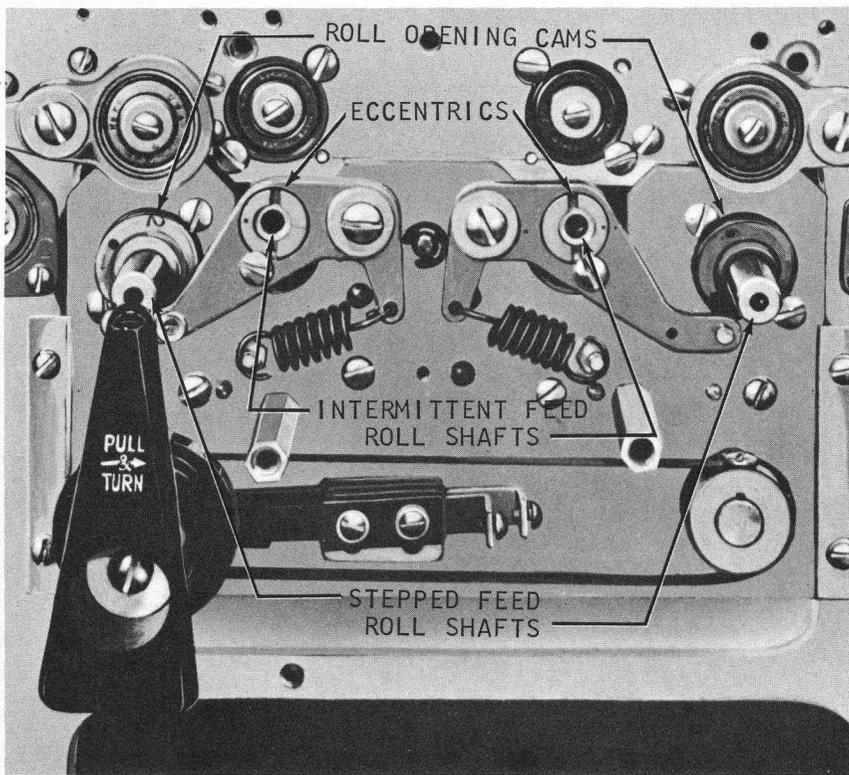
Figure 2-15. Punch Feed Roll Opening Device Rear View

PUNCH INDEX

PUNCH SHAFT

FIRST STEPPED
ROLL

PACB UNIT

FIRST FEED ROLL

FIRST STEPPED FEED
ROLL DRIVE BELT

SECOND STEPPED
ROLL

DRIVE TO
TRANSPORT
MECHANISM

PICKER   KNIFE
CAM   SHAFT

PUNCH FEED CLUTCH

PUNCH UNIT
DRIVE BELT

PLCB UNIT

GENEVA DRIVE

GENEVA
INPUT
PULLEY

INPUT
IDLER
PULLEY

MAIN
DRIVE BELT

LOWER
PULLEY

PCCB
UNIT

CR IDLER SHAFT

NOTE
    DARKENED BELTS ARE UNDER CONTROL
    OF PUNCH FEED CLUTCH

TIMER INDEX

MOTOR PULLEY

Figure 2-16. Punch Feed Timing Belts
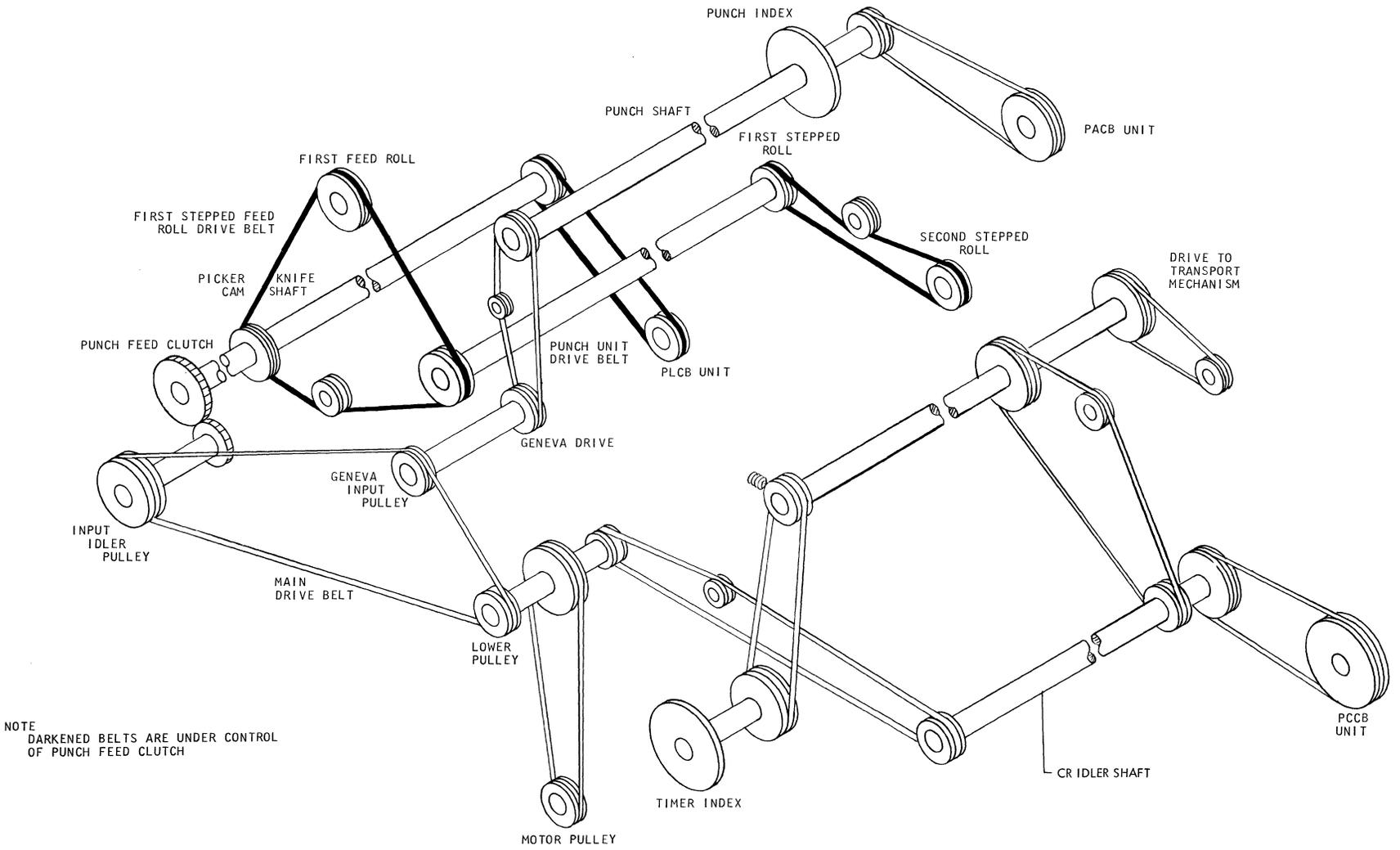
Punch Unit

The entire punch unit (Figure 2-17) can be removed easily from the machine for servicing. It can be separated into two main assemblies as follows:

1. Drive unit (Figure 2-18).
2. Magnet unit (Figure 2-19).

The drive unit can be disassembled into the following units:

1. Punch unit cam shaft (Figure 2-18).
2. Punch bail and setup bail cam follower assembly (Figure 2-18).
3. Stripper assembly (Figure 2-17).

The punch bail and setup bail cam follower assembly consists of:

1. Punch bail and two sets of cam follower arms.
2. Interposer setup bail and two sets of cam follower arms.

The punch magnet unit contains the magnets, latches, interposer links, and interposers. The magnets are connected through miniature multi-terminal connectors to the machine circuits.

The cam shaft in the punch drive unit operates continuously when the motor is running. The three-lobed cams operate the interposer setup bail and the punch

bail three times on each revolution of the punch cam shaft. The punch cam shaft makes 1333 1/3 revolutions per minute.

To see the operation of the punch mechanism, refer to Figure 2-20. The interposer setup bail is a U-shaped channel. A projection on each of the 80 interposer links rides in the channel. As the interposer setup bail moves down, all the interposer links move down, carrying with them the 80 latches. This pulls each armature against its yoke. If punching is to take place, the magnet is energized at this time. Because the armature did not have to be attracted electrically, very little current is required to keep the armature sealed against its yoke. For this reason, the unit is sometimes referred to as a "no-work" punch unit.

When the interposer setup bail moves up, the magnet just energized keeps its latch in the down position. Because the latch is stationary, the upward movement of the interposer setup bail causes the interposer link to pivot, extending the interposer between the punch drive bail and the punch.

The movement of the punch unit cam shaft then causes the punch bail to move down. Only those columns are
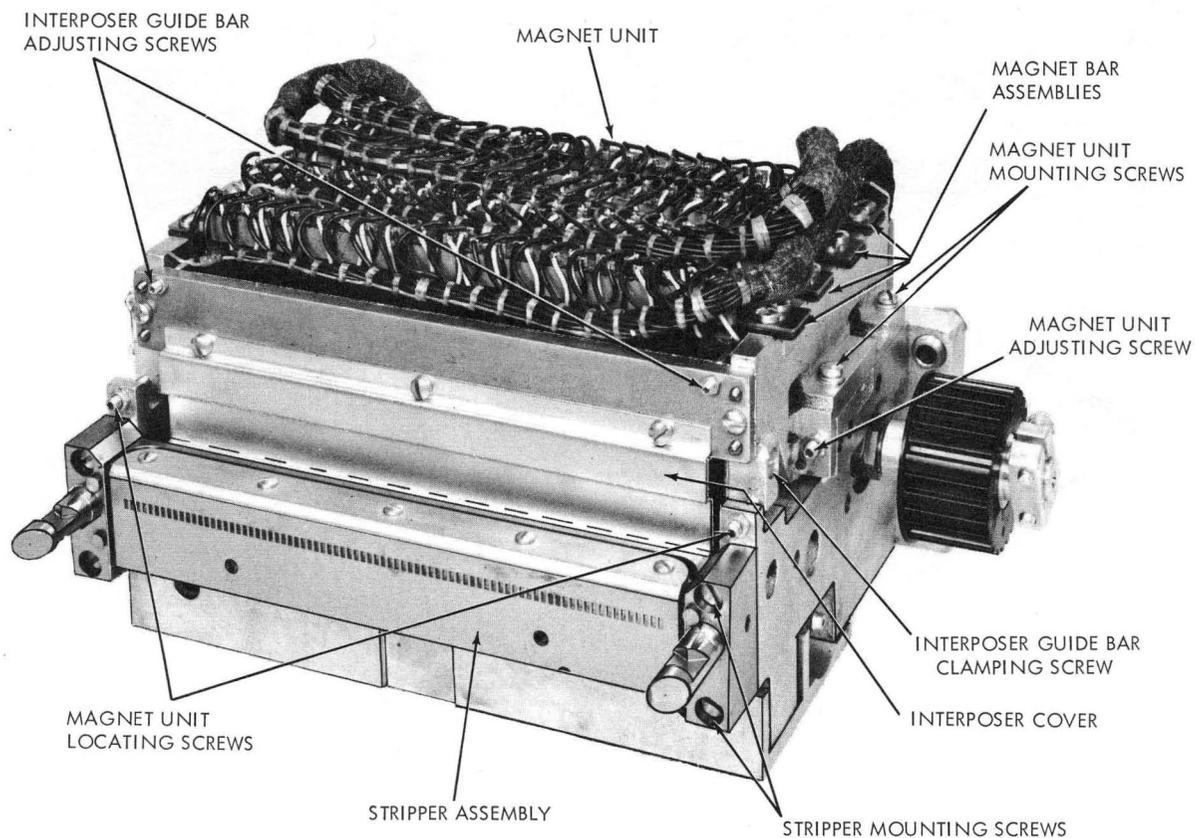
Figure 2-17. Punch Unit

punched that have the interposer between the punch drive bail and the punch. When the punch drive bail pushes the interposer down, the interposer is clamped between the punch and the punch drive bail. With this arrangement, the magnet can be de-energized while the punch is going down rather than waiting until the completion of the punching operation. As the punch bail returns, the interposer is free to be restored by spring tension. On the return stroke of the punch bail, the punch is positively restored by the punch bail.

Figure 2-18. Drive Unit

INTERPOSER LINKS

INTERPOSERS

LATCHES

Figure 2-19. Magnet Unit

Latch

Interposer
Set up Bail

Punch Bail

Punch
Magnet

Interposer Link

Interposer
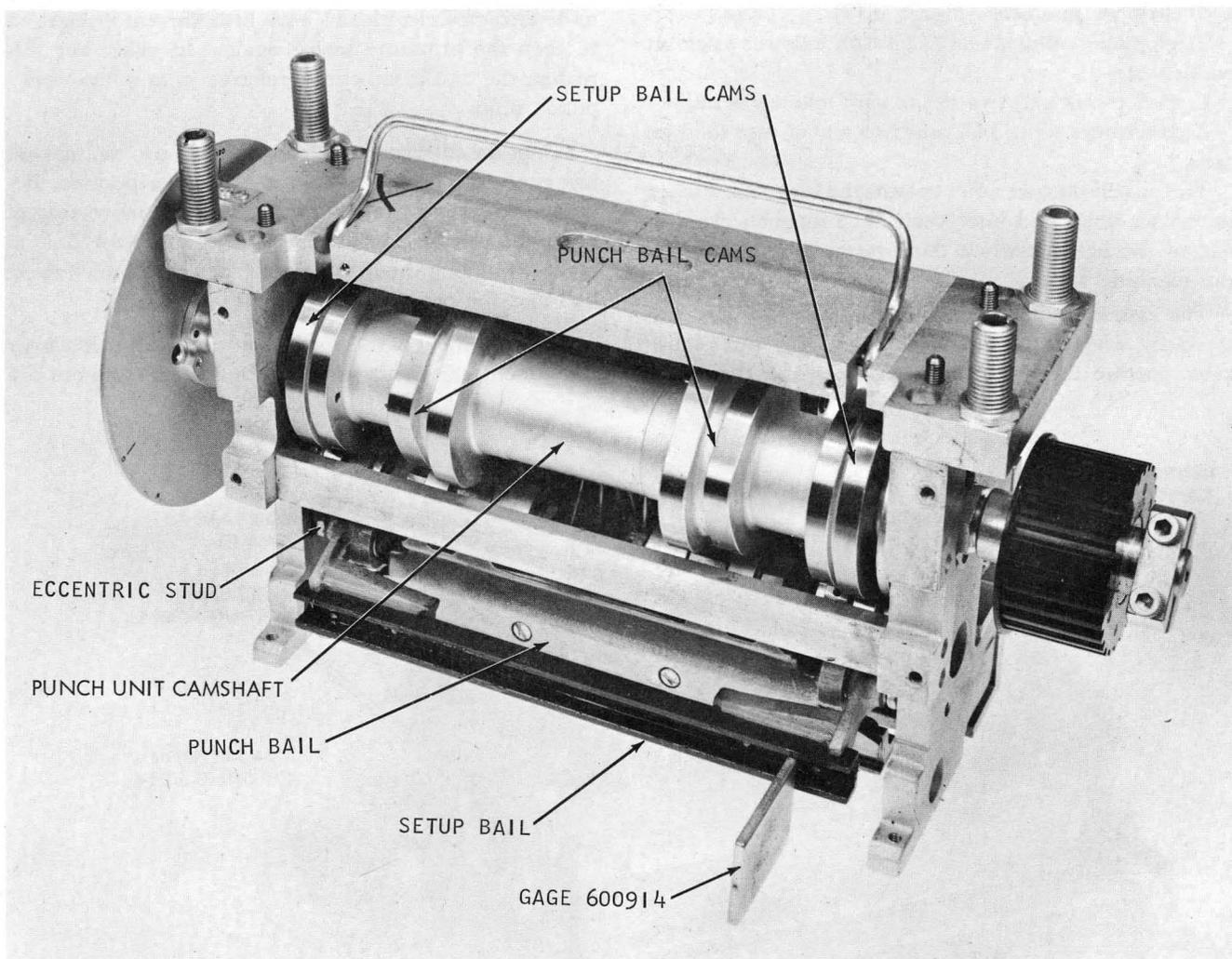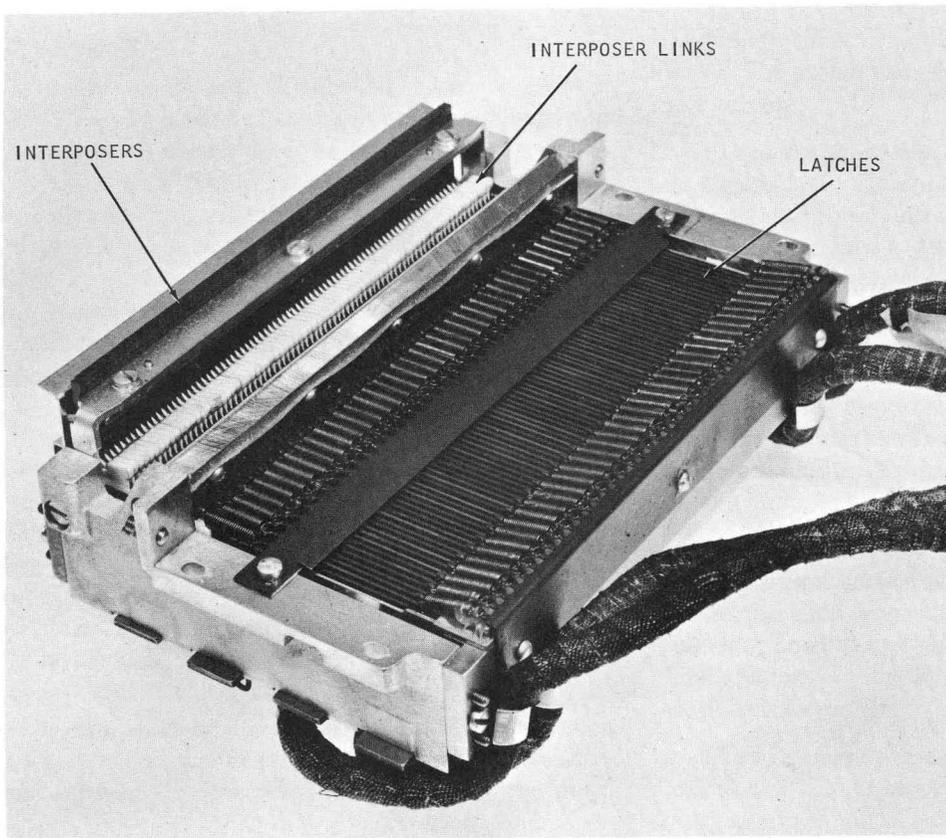
Punch

Punch
Restoring
Bail
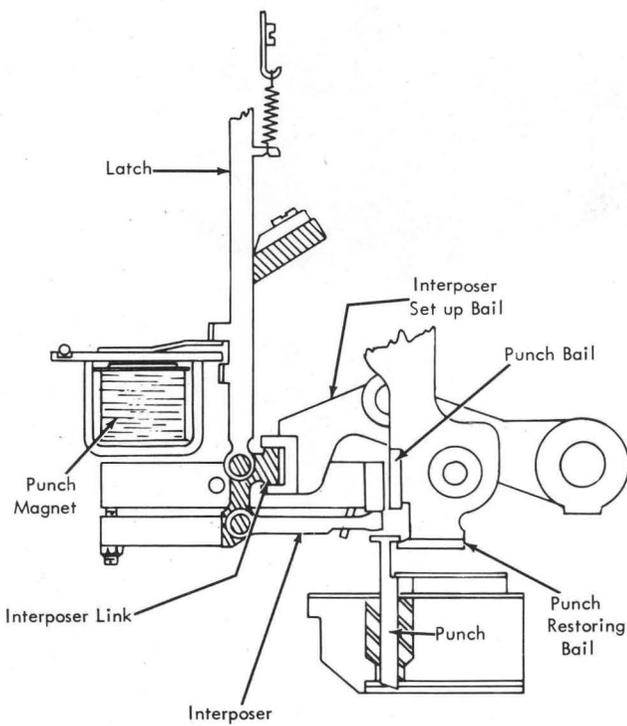
Figure 2-20. Punch Mechanism

Solar Cell Circuit Breaker (Models 1 and 3)

The solar cell circuit breaker (SCCB) unit is located in the reader, on the rear end of the feed knife cam shaft (Figure 3-1). There are three major components in this unit; solar cell, light source and timing disk. With the aid of three transistors and necessary circuitry, the three components provide the 1402 Read Feed with 12 digit impulses.

Principles of Operation

The disk is the only moving part of the SCCB (Figure 3-2, 3-3). As the disk revolves, the slots allow light from the lamp to strike the photo cell. The photo cell emits an impulse when the light beam strikes it. The photo cell impulses are amplified by three transistors. The amplified photo cell impulses feed the base of driver transistors through card lever relay points. When the driver transistors conduct, their output causes the contact roll common brush to shift positive from -20 volts to 0 volts.

Punch Timer and Read Timer Relays

1402 Model 3

The 1402 Model 3 uses circuitry that will allow the reader motor or the punch motor to run continuously if the time interval between successive read or punch operations is less than 30 seconds. The read timer (RT) relay or the punch timer (PT) relay picks when the start relay is picked. The RT or PT relay will also pick when the program in the processing unit calls for a read or punch operation. After one of these timer relays is picked, it will hold through a time delay network. The length of time it holds is adjustable. The RT N/O point is in the hold circuit of the reader motor relay (HD1). The PT N/O point is in the hold circuit of the punch motor relay (HD2).

Voltage Sensitive relay is used for the PT and RT relays (Figure 3-4). This relay has a high resistance coil and requires a very small current to keep the points transferred. A relatively small capacitance in the RC Network can accomplish a long time delay.

Figure 3-1. Solar Cell Circuit Breaker Location
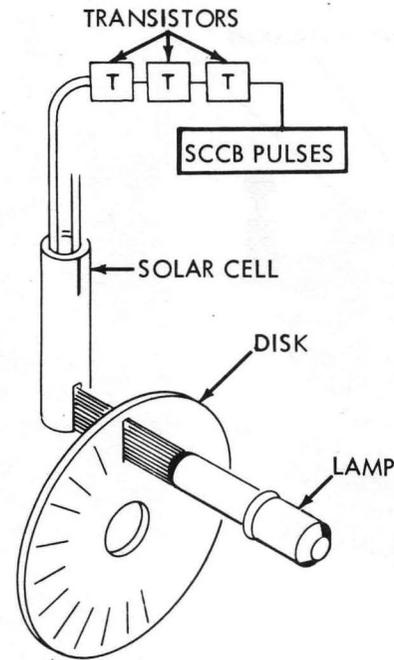
Figure 3-2. Solar Cell Circuit Breaker Schematic

OUTPUT
GROUND
- 20 V
LAMP VOLTAGE
+ 6
- I2

PHOTO CELL
N
P

9 TIME SLOT

DISK

MOUNTING PLATE SCREWS (ADJUSTMENT)

SOLAR CELL

SCRIBE MARK

CELL MOUNTING BLOCK

SOLAR CELL MOUNTING SCREW

TERMINAL BLOCK (SCTB)

LAMP HOLDER

CONTACT STRAP

LAMP

TRANSISTORS

COMPONENT CARD ASSEMBLY

SPINDLE SETSCREWS (ADJUSTMENT)

COVER MOUNTING SCREWS

PLATE TO STUD MOUNTING SET SCREWS (3)

DISK

DISK RETAINING SCREWS
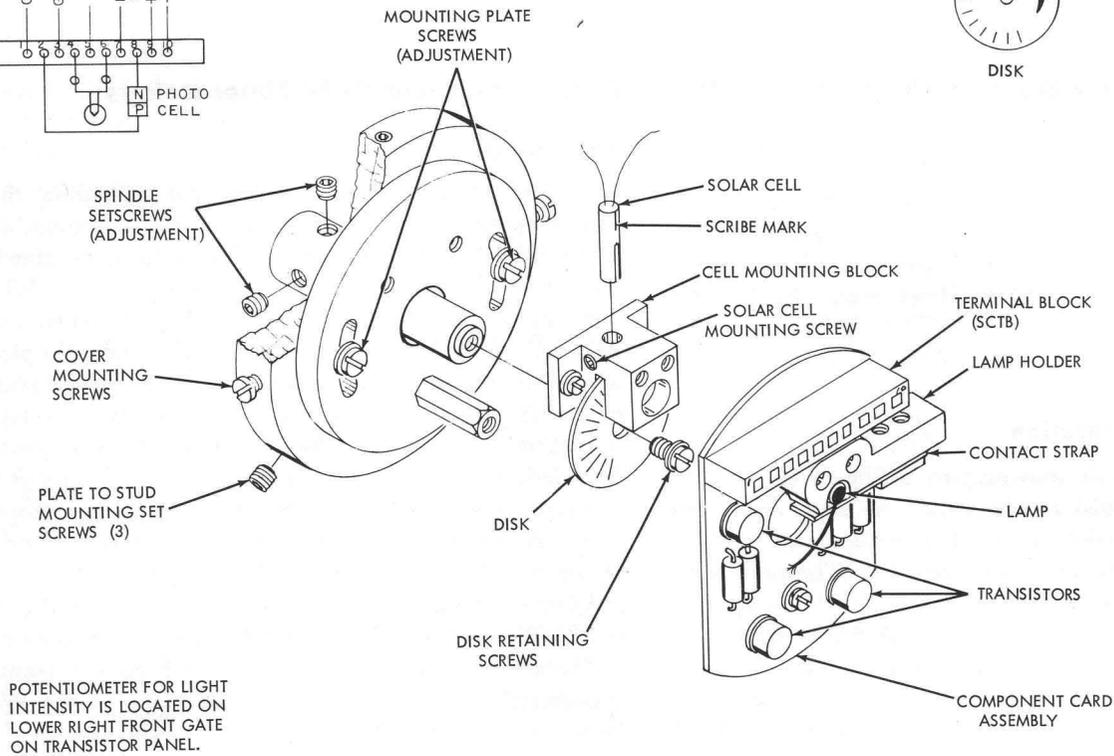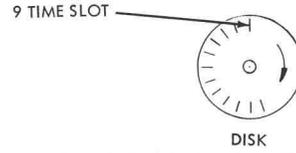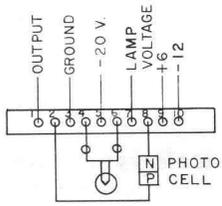
POTENTIOMETER FOR LIGHT INTENSITY IS LOCATED ON LOWER RIGHT FRONT GATE ON TRANSISTOR PANEL.

Figure 3-3. Solar Cell Circuit Breaker Assembly

RELAY POINT

RELAY ARMATURE

SIGMA INSTRUMENT
41F
10000 S-SIL
SO. BRAINTREE 85,

COIL RESISTANCE 10,000 OHMS
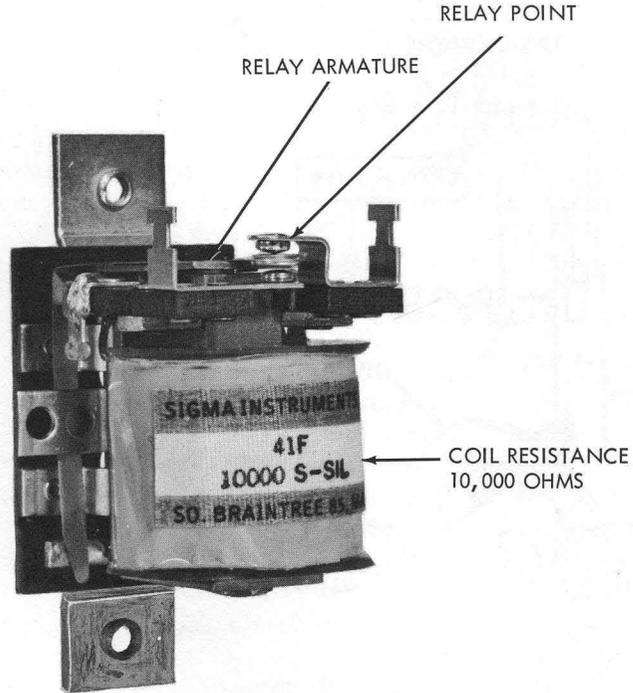
Figure 3-4. Voltage Sensitive Timer Relay (RT or PT)

Power Supply and Interlock Circuits

The 1402 Card Read-Punch is connected to a 3-phase, 208 or 230 v AC source of voltage.

It contains a -20 v supply which is used for read-punch relay and magnet operation. This -20 v is also distributed to the 1401 processing unit. A ferro-resonant bulk supply distributes 133 v AC to the 1401 processing unit. A -60 v supply is distributed to the 1401 for use in printer circuits. Besides these supplies, there is a 115 v transformer which furnishes 115 v AC to the blower motors and convenience outlets for the entire system.

SMS cards control the -20 v power supply. The detailed operation of this power supply is covered in the *Customer Engineering Manual of Instruction of SMS Power Supplies. Form 225-6478.* For general information, such as voltage rating, etc., refer to *1401 Data Processing System Customer Engineering Reference Manual.*

The source voltage is applied to the 115 v transformer through a set of HD8 relay points (Section 1B 1402 Wiring Diagram). HD8 (Section 1A) is energized any time the machine is connected to the source voltage. HD8 is de-energized only when the emergency stop switch is open (located on the 1401 console). This will drop all voltages, including the 115 v at the convenience outlets, by de-energizing the contactor and HD8.

The source voltage is applied to all other units of the 1402 through a contactor. This contactor (Section 1A) is energized by a power-on switch located on the 1401 console. When the contactor is closed, power is supplied to the -20 v supply, -60 v supply, 133 v AC supply, 208 v AC to 1401, and 115 v AC to the blower motors. HD4 (Section 2B) is picked from the processing unit after proper power-on sequence has been completed. (The power-on and off sequences are explained later). HD4 furnishes a hold for the power contactor (Section 1A) after the power-on key is released.

The power-off switch, when operated, will de-energize HD4. Now, the contactor has lost its hold circuit and is de-energized.

NOTE: The -20 volt power supply output is changed to -21 volts by E.C. 804526.

Power-On Sequence

1. (1A) The power-on key energizes the contactor.
2. (1A) The contactor points furnish power to the -20 v and -60 v supplies in the 1402. They also furnish power to the +30 v, +6 v and -12 v supplies in the 1401.
3. HD12 in the 1401 picks when the +6 v and +30 v

are available and supplies the rest of the relays with -20 v (HD15 also picks with HD12 if required).
4. (2B) HD3 picks when the -12 v is available. HD10 and HD11 in the 1401 also pick at this time (HD14 also picks with HD3 if required).
5. The -6 v, -20 v, and +30 v circuits now are available in the 1401.
6. With the -6 v circuits available, DU11 picks in the 1401 (HD13 also picks with DU11 if required).
7. The -36 v circuit now is available in the 1401 if required.
8. With the -36 v circuit available, DU12 picks in the 1401 if required.
9. (2B) HD3 and HD9 now can pick.
10. (1A) HD4 keeps the contactor energized after the power-on key is released. HD9 completes the -60 v sequenced circuits.

The complete power-on sequence takes from .5 to .7 seconds.

Power-Off Sequence

1. (2B) Pressing the power-off key drops HD4 and HD9.
2. HD9 immediately removes the -60 v sequenced from the 1401 circuitry.
3. (1A) HD4 opens the hold circuit to the contactor.
4. Opening the contactor simultaneously de-energizes the DC power supplies.

The power-off sequence takes from .2 to .5 seconds. The power-on and off sequences are needed to energize the 1403 high speed and low speed stop magnets before carriage and chain motors start running. Otherwise, the 1403 could start in a skip or continuous space operation.

Read Feed Circuits

Load Key

The load key causes the 1402 read feed to take three run-in card-feed cycles under program control. The load key sets up a read instruction in the 1401 processing unit, which will enable the read feed to run until a card has passed the read brushes.

1. (4B) R8 (delay) hold coil will be energized through R1-3N, R9-2N and the interlock switches.
2. (5B) The load key (No. 2) will pick DU2; the start relay.
3. (4B) DU2-AU picks R9 through the reader switch ON and the interlock switches. R9 will hold through its own 1 point.

4. (4B) R9-2N opens the circuit to R8. R8 holds through its delay circuit (3K resistor and 7500 mfd capacitor). Adjust for 3 to 5 seconds delay.

5. (4B) R9-2T will pick HD1 (read motor control). HD1 will supply AC voltage to the read-feed drive motor.

6. (4A) With file feed now operating, cards enter the hopper and pick R1.

7. (4B) As soon as R8 drops, R7 picks through R9-3T, R8-1N, and RC3.

First Card-Feed Cycle

1. (6A) The -*T Process Feed* line will be conditioned by RC5, R7-2T, R6-3N, R11-3N, and R11-2N. The -*T Process Feed* line in conjunction with the read instruction, set up in the 1401 processing unit by the load key, activates the -*T Read Clutch* line (6A). The -*T Read Clutch* line will energize the read clutch magnet and R10, the clutch check relay, through RC5.

2. (4A) R2, the No. 1 card-lever relay, will pick and hold on this card-feed cycle.

3. (4A) R6 will pick and hold on this card-feed cycle and all further read-feed cycles.

Second Card-Feed Cycle

1. (6A) The -*T Process Feed* line will be conditioned through RC5, R7-2T, R6-3T, R13-2N, R2-3T, R1-6T, R3-4N, and R11-2N.

2. (6A) The read-feed clutch and R10 will be energized the same as on the previous card-feed cycle.

3. (4A) R3, the No. 2 card lever relay picks and holds on this card-feed cycle.

4. (4A) R11 picks on this cycle and following feed cycles. Its purpose is to detect a failure of CL2 to make.

Third Card-Feed Cycle

For the third card feed cycle the -*T Process Feed* line will be conditioned through RC5, R7-2T, R6-3T, R13-2N, R1-6T, R3-4T, and R11-2T. All other circuits are the same as the second card feed cycle.

After the third card feed cycle, the processing unit will start processing data just read from the card at the second read brushes. All further card feed cycles are under program control.

Start Key Operation

The start key (No. 1) in section 5A starts the read-feed motor as described under Load Key Operation. No card-feed clutch operations are taken until a program instruction calls for one. Any card-feed clutch cycles that are taken use the same circuits described under Load Key Operation.

Card Reading (RLCB Machines)

The first and second read brushes (7A and 8A) provide card digit impulses to the 1401. Each brush station consists of 80 brushes, and is capable of reading any digit in the card.

1. The base of T2 is conditioned for every impulse by R3-5T, RL5 and 6 (odd) or RL7 and 8 (even), and R7-3T.

2. When T2 conducts, ground potential is applied to
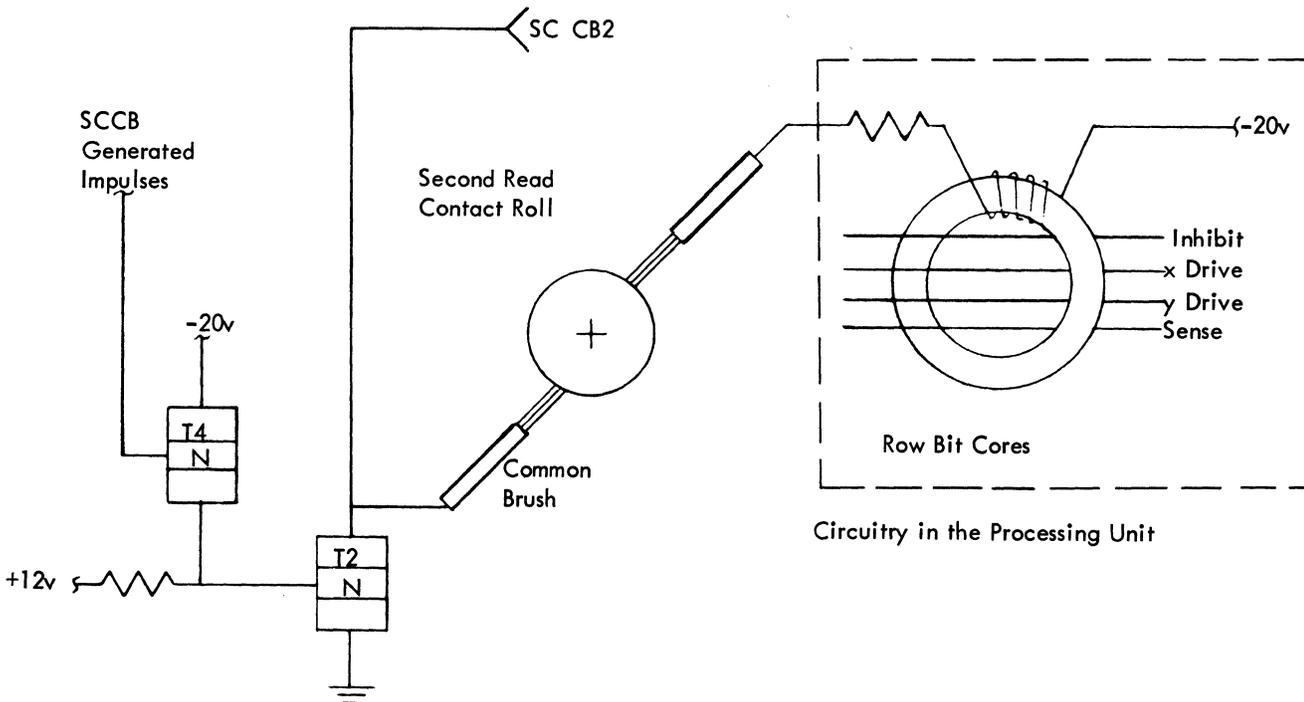
Figure 4-1. Card Reading SCCB Machines

4-2

the common brush. T2 conducting also applies 1/2 write current through all 80 row bit cores.

3. When a hole in the card is sensed by a read brush, 1/2 write current is supplied to the row bit core via T2, common brush, contact roll, read brush, signal cable to the processing unit, terminating resistor, and the -20 volt supply.

Card Reading (SCCB Machines Figure 4-1)

Two sets of reading brushes are used in the reader. The first reading brushes provide full write current to the row bit cores, which are used for checking, in processing unit storage. The second reading brushes provide full write current to read the digits from the card to processing unit storage. Reading a digit at second read is accomplished as follows:

1. Transistor 2 (T2), when conducting, furnishes the digit impulses to the second read contact roll. The base of T2 is conditioned by the output of the solar cell (via T6, T7, T8, card lever relay points, and T5).

2. When T2 conducts, ground potential is applied to the common brush. T2 conducting also activates the *SCCB2* line to the process unit.

3. When a hole in the card is read, ground potential is supplied to the read brush, and full write current flows to the row bit cores in the processing unit core storage.

Reader Non-Process Run-Out

The NPRO key is used to clear the read feed of cards that are not to be processed. The hopper must be empty before this key is effective.
Objective: Start a feed cycle by using the NPRO key.

1. (4B) The read NPRO key (No. 1) will pick R9 through R1-1N, the reader switch ON, and the interlock contacts.

2. (4B) With R9 energized, the HD read motor relay is energized and the read motor started.

3. (5A) The read NPRO key (No. 2) picks R4 and turns on the reader stop light.

4. (4B) R9-3T and RC3 pick R7.

5. (5A) The -*T Not Process Feed* line is conditioned through R4-2T, R6-3N, R7-2T, and RC5.

6. (5A) The -*T Not Process Feed* line can also be conditioned through R6-3T, R13-2N, R2-3, R1-6N, R3-4N, R11-3N, and R4-2T.

7. When the NPRO key is used, the last two cards in the NR stacker have not been processed. The Check Reset key must be used to drop out R4 (Refer to Card Jam Circuits, steps 8-11).

Stop Key Operation

Objective: Allow the read feed to stop when the stop key is depressed. This also will stop the complete system.

1. (3B) The stop key (No. 1) will open the circuit to the motor control relay (R9) causing the read-feed drive motor to stop.

2. (6B) Stop key (No. 2) will activate the -*T Stop Key* line at RC179.

3. The -*T Stop Key* line will condition circuitry in the 1401 which will pick DU3 (6A).

4. (3B) DU3-AU keeps the circuit to R9 open after the stop key is released.

5. The start key is used to re-start the read-feed. The start key will cause DU3 to drop out through the use of the +*U Interlock Stop* line (6A).

Reader Stop Circuits

A card jam is detected when the number one or number two card lever contact remains closed too long during a read-feed cycle.
Objective: Stop the read-feed if a card jam is detected and turn on the reader stop light.

1. (3A) If either card lever remains closed till 158°, R13 (4A) is picked through RD57 or RD58 (4A).

2. (4B) R13 will hold through R13-1 N/O, and RC-1.

3. (4A) R4 is picked through RD-3 (5A), R13-2 N/O, R6-3 N/O, and RC5. R4 holds through R4-1 N/O, and DU4-AU until check reset is depressed. The reader stop light comes on with R4 hold (5A).

4. (4B) R4-5N opens the circuit to R9 causing the read drive motor to stop.

5. (5B) R4-6T activates the -*T Read Jam* line which is used in the 1401.

6. (6A) The R4-2T point allows the cards remaining in the feed to be run out, under control of the NPRO key, by activating the -*T Not Process Feed* line.

7. (7A) R4-4N opens the -*T Brush Impulse CB* line to the 1401.

8. The check reset key must be used to drop out R4 and allow the read-feed to be re-started.

9. (6B) The check reset key picks DU4 through R28-3T and R7-3N to -20 v.

10. (6A) The DU4-AU point opens the hold circuit to R4 and turns off the reader stop light.

11. (5A) The DU4-BU activates the +*U Read Check Reset* line to the 1401.

Clutch Check Circuit

Each time the read clutch magent is energized, R10 is also energized. If the read feed clutch magnet receives an impulse and fails to pick, or a clutch cycle is taken without the clutch receiving an impulse, R10 signals a clutch failure.
Objective: Stop the read-feed drive motor and turn on the reader stop light under the following conditions:

1. When the clutch receives an impulse and fails to unlatch.

a. (5A) R10 is picked by read clutch impulse from the 1401. R10 holds through R10-1T and RC4 (4A).

b. (4A) R13 picks at 158° through RC7, R10-2 N/O, and R6-4 N/C.

c. (3A) R4 picks through R13-3 N/O and R6-4 N/C.

With R4 energized, the read-feed will stop as described under Card Jam.

2. When the clutch unlatches without receiving an impulse.

a. (4A) R6 picks through RL3 because of a card-feed cycle.

b. (4A) R13 picks through RC7, R10-2 N/C and R6-4 N/O.

c. (4A) R4 picks through RD3 (5A), R13-2 N/O and RC-5. With R-4 energized, the read-feed will stop as described under Card Jam.

Punch Feed Circuits

Punch Motor Start and Run

When either the load key or start key is depressed, the punch drive motor will start. If the start key is used, the processing unit is started and normal programming will control feeding. If the load key is used, the processing unit is started and an automatic read-feed cycle is called.

Objective: Cause the punch drive motor to start and continue to run.

1. (10B) R28 is picked when punch motor stops.
2. (10A) Cards in the hopper will pick R21.
3. (6A) DU2 is picked by the load or start key.
4. (10B) R29 and HD2 are picked through interlock contacts, DU2-BU, R31-2 N/C, DU3-BU, chip switches, and punch switch ON. With these two relays picked, the punch drive motor will start.
5. (10B) R29 and HD2 hold through interlock contacts, R29-1 N/O, R21-4 N/O, R31-2 N/C, DU3-BU, chip switches and punch switch ON. The motor will run until this circuit is broken.
6. (10B) R29-2 N/C drops R28.
7. (10B) R27 is picked by R29-3 N/O, R28-1, 2 N/C, PC-1, R21-4 N/O, R31-2 N/C, DU3-BU, chip switches and punch switch ON.
8. (11A) PC-3, 4 send pulse through R27-4 N/O, R31-3 N/C, and out PC178 to signal process unit of the 1402's readiness to take a punch cycle.

Punch Feed Cycles

All normal punch feed cycles are under control of the processing system. If the 1402 is running, a pulse is sent out PC178 (-*T Process Punch*) through R31-3 N/C, R27-4 N/O, PC3, 4 and PL-6. When a punch operation code is de-coded in the operation register, PC178 (-*T Pch Cl Magnet*) goes to ground potential and a

punch cycle will occur (12A). On punch feed run-in, the first punch operation code read at the operations register will cause three feed cycles, unless machine is equipped with PFR (Punch Feed Read). If PFR is installed, only two cycles are normal on run-in.

Card Punching

Any punch magnet can be energized when PA5, 6, 7, and 8 make and its respective +*U Punch Magnet* line is activated from the 1401.

Punch Check Brushes

The punch check brushes are used to read the card after it has been punched. Circuits for the 80 brushes are similar to the circuits described for the read-feed brushes.

Punch Non-Process Run-Out

The NPRO key is used to clear the punch feed of cards. Cards must be removed from the punch hopper before this key is effective.

Objective: Start a punch feed cycle by using the NPRO key.

1. (9B) The punch NPRO key (No. 1) will pick R29 and HD2 through the interlock contacts, R21-1N, chip switches, and the punch switch. The punch feed motor will start with the above relays energized.
2. (11A) The punch NPRO (No. 2) picks R31 hold coil through R27-2N and turns on the punch stop light.
3. (10B) R27 is picked as normal.
4. (12A) -*T Not Process Punch* line is conditioned by R31-3T, R27-4T, PC4, PC3, and PL6. The 1401 will then condition the -*T Punch Clutch Magnet* line and energize the punch clutch.
5. The check reset key must be used to drop out R31. (Refer to Card Jam, steps 5-7)

Stop Key Operation

Objective: Allow the punch feed to stop when the stop key is pressed.

1. (3B) The stop key (No. 1) will open the circuit to R29 and HD2 (10B) causing the punch feed motor to stop.
2. (6B) DU3 will be picked the same as described under Read Stop Key Operation.
3. (9B) DU3-BU will keep the circuit to R29 and HD2 open after the stop key has been released.
4. (5A) The start key will drop out DU3 through the use of the +*U Interlock Stop* line from the 1401 (6A).

Punch Stop Circuits

A card jam or misfeed is detected by the card lever relay points (11A). When a feeding failure is detected, the punch feed is stopped and the punch stop light comes on as follows:

1. A card feed failure that interrupts the pick circuit of a card lever relay allows punch jam relay R39 to pick. For example: if the punch die CL delay R26 is transferred, the punch brush CL R24 would, in normal operation, transfer in the next cycle. A failure to pick R24 would allow R39 (12B) to pick as follows: PL7, R26-4 N/O, R24-3 N/C, to R39 pick coil.

2. R39 holds (11A) via R39-1 N/O, DU4-BL, GT 35 (14A), to the +6 volt supply.

3. Punch stop R31 (12A) picks through the R39-2 N/O, and PL 8.

4. R31 holds (11A) through the R31-1 N/O parallel with R39 hold.

5. R31-2 N/O (9B) drops the motor start (R29) hold.

6. Normal operation is restored by running the cards out of the punch feed using the punch NPRO key, and then pressing the check reset key.

7. (5B) The check reset key will pick DU4 through R28-3T and R7-3N.

8. (11A) The DU4-BL point opens the hold to R31 and turns off the punch stop light.

9. (11A) The DU4-AL point conditions the +U Read Check Reset line to the 1401.

Clutch Check Circuit

Each time the punch clutch magnet is energized, R30 is also energized. If the punch feed clutch magnet receives an impulse and fails to pick, or a clutch cycle is taken without the clutch receiving an impulse, R30 signals a clutch failure.
Objective: Stop the punch feed drive motor.

1. When the clutch receives an impulse and fails to unlatch.

  a. (12A) R30 is picked by the -T Punch Clutch Magnet line from the 1401 and the CB's.

  b. (10B) R30 holds through PL4.

  c. (12A) R31 is picked by R30-4T, PC5, and PL6.

  d. (9B) R31-2N opens the motor relay circuit which stops the punch feed motor. The cards must be removed from the feed, and the check reset key pressed to restore the punch feed to an operating status.

2. If the punch clutch unlatches without receiving an impulse, or if it fails to latch, the punch stop occurs as follows:

  a. (12A) R30 is not picked.

  b. (12A) R39 picks through R30-2 N/O and PL7.

  c. (12A) R31 picks through R39-2 N/O and PL8.

  d. (9B) R31-2 opens the motor relay (R29) hold.

  e. To clear the punch stop; remove the cards from the hopper, run the cards out by pressing the punch NPRO key, and press the check reset key.

Stacker Select Circuits

1. (11B) The stacker card lever picks R37 anytime a card enters the transport unit from the punch feed.

2. (12B) R35 picks on every punch-feed cycle during the time the stacker CL is broken.

3. (12B) R35 pick coil has a hold after R37 picks through R35-2T, R37-3T, R35-1T, PC6, and stacker card lever.

4. (11B) R35 hold coil can energize if the +U Stacker Inhibit line becomes active.

5. (11B) The stacker control relays are picked by the +U Stacker 4 or 8 from the 1401. R33 or 34 will then hold through PL14.

6. (12B) The stacker 4 magnet is picked through R33-2T, after R35 has dropped and the stacker card lever has closed, by PC6 time at 35° to 75°.

7. (12B) R31 will pick through R37-2N and R32-4T if a card was at the punch check brushes but did not reach the stackers on the next punch-feed cycle.

8. (12A) R31 will pick through R35-4N and 32-4T if a punch cycle is taken after a card has been at the punch check brushes and the stacker inhibit (R35) fails to pick.

The following circuit description is written with reference to the IBM 1402-2 Wiring Diagram No. 614100G.

Power Supply

The supply voltage required for the 1402-2 Card Read-Punch (208/230 Volt AC) is furnished by power cable from the processing unit. The power up sequence relays are located in the processing unit. The following power supplies are located in the 1402: (See W/D 614100G sections 1, 2).

An 1840 Watt ferro-resonant bulk supply distributes 133 Volt AC to the processing unit. This bulk supply also furnishes the input power to the DC supplies in the 1402. The output of a -60 Volt DC supply is distributed to the processing unit for use in the printer circuits. A -12 v and a +12 Volt DC supply furnish power to SMS circuits in the processing unit. Detailed information on the operation of these power supplies is covered in the *Customer Engineering Manual of Instruction of SMS Power Supplies, Form 225-6478.*

The 208/230 Volt line power also is supplied to the contacts of the heavy duty relays (HD1 and HD2). HD1, when picked, furnishes 208/230 Volt single phase power to the reader drive motor. HD2, when picked, furnishes 208/230 Volt single phase power to the punch motor.

Read Feed Circuits

Reader Start Circuits

Operating the reader start key feeds three cards into the read feed. The first card is read by the second read brushes into a reader synchronizer. After the initial run in, card reading is under program control.

If the reader has been stopped during program controlled operation, pressing the start key turns on the reader-ready light and allows programmed operation to continue.

Objective: Press start key and run in three cards.

1. Motor Control R9 (4B) picks through joggle switch N/C, RDR start No. 1, 4-5 N/C, reader stop No. 1 on, interlock switches, jam bar switch N/C, stacker switch N/C, DU1-BU N/C and to the -20 Volt supply through signal fuse 2 (SF2).

2. Heavy duty relay, HD1, (4B) picks through 9-2 N/O, interlock switches, jam bar switch N/C, stacker switch N/C, and DU1-BU N/C.

3. Delay relay R8 (4B) hold circuit is opened by R9-2 N/C. The delay relay drop out is delayed by an RC network.

4. Run relay R7 (4B) is picked, when R8 drops out, by the 8-1, 2, N/C, 9-3 N/O, and RC3. A hold circuit is established for the run relay through R7-1 N/O, and RC4.

5. The -W *Not Process Feed* line (6A) activates circuits that bring up the +W *Read Clutch* line. With the +W *Read Clutch* active, the read clutch picks when RC5 makes. The -W *Not Process Feed* line is necessary to accomplish three run-in cycles. Circuits to the -W *Not Process Feed* are as follows:

  a. The first feed cycle via RC5, (5A) 7-2 N/O, 1-6 N/O, 6-3 N/C, 4-2 N/C, 5-2 N/C, and resistor RD20.

  b. The second feed cycle via RC5, 7-2 N/O, 1-6 N/O, 6-3 N/O, 2-3 N/O, 4-2 N/C, 5-2 N/C, and RD20.

  c. The circuit for the third card feed cycle is the same as the preceding step (b). During the third card feed cycle the No. 2 CL delay R5 is transferred. R5-2 N/O prevents a fourth run-in cycle by opening the circuit to the -W *Not Process Feed* line.

6. The -W *Process Feed* line (6A) is activated by the RC5 impulse through R5-2 N/O. At this time, circuits in the processing unit activate the +S *RD Ready* line and the RDR ready light (8B) comes on. Additional reader cycles are under program control.

Reader Stop Key

Operating the reader stop key stops the 1402 and turns off the reader-ready light.

1. The reader stop No. 1 (3A) opens the circuit to the run relay R7, HD1, and R9.

2. Relay 7-2 N/O (5A) opens the circuit to the -W *Process Feed* line. The reader-ready light is turned off by circuits in the processing unit.

Card Reading

Two sets of 80 reading brushes provide card digit impulses to the circuits in the read synchronizer. The first reading brush impulses are used for read checking. The second reading brush impulses are used to enter the characters from cards to the read synchronizer. The second read brushes also read the card to complete the hole count check. Reading a digit at second read is accomplished as follows:

1. The digit impulses from RL CB's 5, 6, 7, and 8 (7A) condition the -W *Brush Impulse CB* line to the read synchronizer. Circuitry in the read synchronizer conditions the -W *BR DR 2* line to the reader.

2. Transistor T2 (8A) is forward biased by the -*W BR DR 2* line through the No. 2 CL R3-4 N/O. The output of T2 serves the following functions:

a. It conditions +Z *One Half WR 2nd Read Brush* line which furnishes one half write current to the row bit cores in the reader synchronizer.

b. It supplies +W digit timed impulses to the second read contact roll. If a brush makes through a hole in the card, its output supplies half write current to a corresponding row bit core in the reader synchronizer. A row bit core is set to on status if it has been conditioned by the +Z *One Half WR 2nd Read Brush* line and a read brush impulse.

End Of File

Objectives: Allow processing of the last three cards by pressing the end of file key and then the start key.

1. The end of file key picks R11 (4B) through the reader start No. 1, 4-5 N/C, reader switch No. 1 ON, interlock switches, and SF1.

2. Relay 11 holds (6A) until the last card has passed second read (Via 11-1 N/O, reader stop No. 2 N/C, and No. 2 CL R 3-3 N/O).

3. Pressing the start key picks the motor control R9 (4B) through reader start No. 1, R4-5 N/C, reader stop No. 1, and the cover interlocks. Relay 9 holds through RC2, and parallel circuit through 6-2 N/O, and 1-2 N/O until the last card has run out.

4. R8, HD1 (4A), and the run relay R7 operate in the normal manner.

5. End of file delay R12 (6A) picks through 11-5 N/O, 7-1 N/O, and RC4.

6. The -*W Process Feed* line (6A) is activated through the 11-4 N/O point after cards have been run out of the hopper.

7. The EOF condition may be reset by pressing the reader stop key or by processing the last card. See R11 hold circuit (6A).

Reader Stop

Objectives: Pick R4 and stop the reader on a failure to feed a card, a card jam or a clutch failure.

1. Reader stops on a failure to feed as follows:

a. Read stop relay R4 picks (4A) through RD 3 (5A) No. 1 CL R2-3 N/C, read feed R6-3 N/O, hopper CL R1-6 N/O, R7-2 N/O, and RC5.

b. R4 holds and picks the reader stop light (6A) through 4-1 N/O, and 1-5 N/O, or a parallel circuit through RL10 (3A).

c. Motor control R9 hold (4B) is opened by the 4-4 N/C point. The 4-5 N/C prevents the end of file relay from being picked (4B), until the stop condition is cleared.

d. The 4-3 N/O (5A) conditions the -*W Read Stop* line (4A).

e. The 4-2 N/C point opens the -*W Process Feed* or the -*W Not Process Feed* line (6A).

f. The 4-6 N/C opens the circuit to the delay relay R8. This prevents a delay when running out cards, after a reader stop condition.

g. The reader stop is cleared by removing the cards from the hopper and pressing the start key.

2. A reader stop occurs if either CL No. 1 or CL No. 2 remains closed too long during a read feed cycle.

a. Relay 4 picks (4A) through RC7, RD56 or RD57, No. 1 or No. 2 CL, RL1, and SF1.

b. The points of R4 are used the same for all reader stops.

3. A reader stop occurs if the clutch fails to latch or fails to unlatch.

a. Whenever the read clutch magnet receives an impulse, R10 picks (5A). R10 holds (4A) through 10-1 N/O, and RC4 (3B).

b. Read feed relay R6 is picked and held when the read latch cams make (4A).

c. R4 (4A) is picked if the clutch fails to latch through R10-2 N/C and R6-4 N/O.

d. R4 (4A) is picked if the clutch fails to unlatch through R10-2 N/O and R6-4 N/C.

Stacker Select

The stacker select magnets for pocket 1 or 2 (5B) are controlled by the program in the processing unit. For example: if stacker 1 is to be used, a +*W Stack 1* line is activated. When RC6 makes, the stacker 1 select magnet is energized.

Punch Circuits

Punch Start

Objectives: Cause two cards to run in and the punch ready light to come ON. The necessary relays, etc., operate as follows:

1. Punch motor start R29 (10B) picks through the punch start key No. 1.

2. Punch motor relay HD2 (10B) picks with R29H.

3. Run delay R28 (10B) is dropped by R29-2 N/C and the delay network.

4. Run relay R27 (10B) is picked by R29-3 N/O, R28-1, 2 N/C, and PC1.

5. -*W Not Process Punch* (12A) is activated for two cycles through Die CL R23-4 N/C, 27-4 N/O, sync switch No. 1, PC3, and PL6.

6. The punch clutch and relay 30 (12A) are picked when the +*W Punch Clutch* line is active. This line is activated by circuits in the processing unit. During the first two cycles, the circuits are controlled by the -*W Not Process Punch.*

7. Die CL relay R23 (10A) picks during the second

card feed cycle. R23-4 N/C (12A) opens the *-W Not Process Punch* line. R23-4 N/O allows the *-W Process Punch* to be activated. After two run in cycles, the ready light comes ON, and punch cycles are program controlled.

Card Punching

Any punch magnet can be energized to cause card punching. If a *+W Punch Magnet (1, 2, 3 etc.)* line (14B) is activated by the processing unit, a corresponding punch magnet will be energized when the punch magnet CB's are made.

Punch Checking

After the card has been punched, it is read by the punch check brushes. The punch check brushes read a card as follows:

1. Transistor T3 (14A) is forward-biased by the punch CB impulses through punch brush CL delay R32-3 N/O.

2. The output of T3 furnishes one-half write current to checking cores in the processing unit. It also furnishes digit impulses to the punch check brush contact roll.

3. If a hole in the card is read by a punch check brush, one-half write current is supplied to a corresponding row bit core in the processing unit. Any core that receives one-half write current from T3 and one-half write current from a punch check brush is set to an ON status.

Punch Emitter

The 1401 Model 2 is equipped with a punch emitter that supplies digit timed impulses to the processing unit. The emitter is active when the run relay is picked, except during a run out operation.

Punch Runout

Cards can be run out of the punch unit by removing the cards from the punch hopper and pressing the start key. Cards that are being run out of the punch feed go into the normal punch (NP) stacker. The first card in the NP stacker is punched but not checked.

Punch run out circuits are as follows:

1. Hopper CL relay R21 (10A) drops when cards are removed from the hopper.

2. Punch feed run out R39 (10B) picks through 21-6 N/C, punch start No. 2, R21-1 N/C, chip switches, and punch stop switch No. 1 ON.

3. R39 holds (10B) through 39-1 N/O, 31-5 N/C (unless a punch stop condition exists), 24-4 N/O (until cards are past the punch check brushes), 22-4 N/C, chip switches, and punch stop switch No. 1 ON.

4. The points of R39 serve the following purposes:

a. R39-1 (10B) holds R39 until cards have run out,

unless a punch stop condition exists.

b. R39-2 N/O (12A) activates *-W Not Process Punch*.

c. R39-3 N/C (13A) opens the circuit to punch check contact roll common.

Punch Stop

The punch stop is an indication of a card jam or a punch clutch malfunction. R31 picks, punch feeding stops, and the punch stop light is lit as follows:

1. In normal use, the card lever relays transfer each punch feed cycle. For example: if the throat card lever is made, the die card lever should be made during the next card feed cycle. Any mis-feeding or jam condition that interrupts this sequence of events will cause a machine stop. To aid in understanding this circuit, assume that there are cards in the punch hopper and a feed cycle occurs without feeding a card.

a. Punch stop R31 (12A) picks through PL8, PL7, 21-2 N/O and 22-3 N/C.

b. R31 holds (12A) through R31-1 N/O and 21-3 N/O.

c. Relay 29 holds and HD2 (10B) are interrupted by 31-5 N/C.

d. R37 pick (10B) is interrupted by R29-3 N/O.

e. *-W Process Punch* line (12A) to the processing unit is opened by R27-4 N/O.

2. If the punch clutch fails to unlatch, R31 will pick as follows:

a. Punch check R30 picks when the punch clutch magnet is energized.

b. R31 picks through R30-4 N/O, PC5, and PL6 which remained closed.

3. If the punch clutch failed to latch, R31 would pick (12A) through PL8, PL7, and R30-2 N/C.

Punch Stacker Select

Program instructions in the processing unit select a stack control relay for the desired stacker; R33 for stacker 4 and R34 for stacker 8. The stacker magnets are energized on the next punch feed cycle.

Stacker No. 4 magnet would be picked as follows:

1. R33 (11B) is picked, when PL14 makes, by the *+W Stacker 4* line from the processing unit. R33 holds through PL14.

2. Stacker CL relay R37 (11B) picks when the card enters the transport.

3. R37-3 N/C (now open) prevents the pick of R35 (12B).

4. Stack magnet 4 (12B) is energized through 33-2 N/O, R35-1 N/C, R37-4 N/O, PC6, and stacker CL contact.

NOTE: If stacker 8 is selected, both stacker select magnets are energized.

The following circuit description refers to Wiring Diagram No. 610600, E.C. 804785.

Power Supply (11.21.01.0, 11.21.02.0)

The Power Supply for the 1402 Model 3 is supplied by the processing unit through a cable using the PW connector. The PW connectors are used for the following purposes:

PW-1	+12v Ground
PW-2	D.C. Ground
PW-3	-20v D.C. line
PW-4	-12v D.C. line
PW-5	-6v D.C. line
PW-6	Frame Ground
PW-7	D.C. Ground
PW-8	+12v D.C. line
PW-9	One leg of 208/230v AC line
PW-10	Not used
PW-11	One leg of 208/230v AC line
PW-12	115v AC line
PW-13	115v AC line
PW-14	-6v Ground
PW-15	-12v Ground

PW-9 and PW-11 feed directly to the mainline switch in the 1402 Model 3. When the mainline switch in the 1402 is turned on, power is supplied immediately to the blower motor on the punch magnet driver gate. These two lines also supply voltage to one side of heavy duty relays 1 and 2 contacts to allow the reader and punch motors to operate under control of HD1 and HD2 respectively.

Read Feed Circuits

Load Key

In normal use, the load key causes the 1402 Model 3 read feed to take three run-in card feed cycles under program control. The load key sets up a read feed instruction in the processing unit which will enable the read feed to run until a card has passed the read brushes.

1. Pressing the load key, picks start relay DU2 (11.21.03.0).

2. Read delay relay RT picks through DU2-AL N/O (11.21.04.0).

3. The -*Y Load Key* (03) is conditioned until R9 picks as a result of pressing the load key.

4. DU2-AU (03) picks motor control relay R9

through reader switch No. 1 ON, stop key and the interlock switches to SF-1 and the -20v source.

5. R9-2 N/C (03) opens circuit to delay relay R8. R8 will now hold through its delay circuits (3K resistor and 7500 MFD capacitor).

6. R9-2 N/O (03) picks HD1 (read motor control relay). The HD1 contacts supply voltage to the read-feed drive motor.

7. With file feed operating, the hopper card lever picks R1 (04).

8. As soon as R8 drops, R7 picks through R9-3 N/O, R8-1, 2 N/C and RC 3 (03).

FIRST CARD FEED CYCLE

1. The -*Y Process Feed* line (06) is conditioned by RC6, R7-2 N/O, R6-3 N/C, R11-3 N/C and R11-2 N/C. The -*Y Process Feed* line, in conjunction with the read instruction set up in the process unit by means of the load key, activates the +*V Rd Clutch* line. The +*V Rd Clutch* line energizes the read clutch and R10, when the first impulse is available from RC6.

2. On the first card feed cycle, the No. 1 card lever relay R2 (04) picks and holds through RL5 and RL6. R2 holds through RC8 and 12-2 N/C points in an overlapping time situation.

3. Read feed relay R6 (04) picks on all read feed cycles.

SECOND CARD FEED CYCLE

1. The -*Y Process Feed* line (06) is conditioned through RC6, R7-2 N/O, R6-3 N/O, R2-3 N/O, R1-6 N/O, R13-2 N/C, R3-4 N/C and R11-2 N/C.

2. The read-feed clutch and R10 (06) are energized through the same circuit as on the first feed cycle.

3. The No. 2 card lever relay R3 (04) picks and holds on this cycle.

4. The No. 1 CL delay R11 (04) picks on this cycle and on each following feed cycle. R11-3 N/O (06) will detect a failure of card lever No. 2 to make.

THIRD CARD FEED CYCLE

1. The -*Y Process Feed* line (06) is conditioned by the same circuit as the preceding, except the R3-4 N/O and R11-2 N/O points are used instead of their normally closed points.

After the third card feed cycle, the processing unit starts processing information just read from the card at the second read brushes. All further card feed cycles are under program control.

Start Key

The start key causes the read-feed drive motor to start, and the program in the processing unit to run. A clutch impulse occurs when there are cards in the hopper, and when a read op code is called for from the processing unit.

NOTE: The load key must be used for program loading.

Card Reading

The card reading circuits in the 1402 Model 3 are similar to the card reading circuits of the 1402 Model 1 (Figure 4-1).

Two sets of reading brushes are used in the reader. The first reading brushes provide full write current to the row bit cores used for checking. The second reading brushes provide full write current to read the digits from the card. Reading a digit at second read is accomplished as follows:

1. Transistor 2 (T2), when conducting, furnishes the digit impulses to the second read contact roll (11.21.08.0). The base of T2 is conditioned by the output of the solar cell (via T6, T7, T8, card lever relay points, and T5).

2. When T2 conducts, ground potential is applied to the common brush. T2 conducting also activates the +*Y SC CB2* line to the process unit.

3. When a hole in the card is read, ground potential is supplied to the read brush and full write current flows to the row bit cores in the processing unit core storage.

Reader-Non-Process Run-Out

The reader-non-process runout (NPRO) switch is used to clear the read feed of cards that are not to be processed. The hopper must be empty before this key is effective.

1. The read NPRO switch No. 1 (03) picks R9 through R1-1N, N/C joggle switch, the reader switch 1 ON, and the interlock contacts.

2. With R9 energized, the read motor relay HD1 (03) is energized, and the read motor started.

3. The reader NPRO switch (key) No. 2 picks R4 (05) through its hold coil, and turns ON the reader stop light.

4. R7 (03) is picked by R9-3 N/O, R8-1, 2 N/C and RC3.

5. The -*Y Non-Process Feed* line (06) is conditioned through R4-2 N/O, R6-3 N/C, R7-2 N/O, RC6, read sync switch, and RL8.

6. The -*Y Non-Process Feed* line (06) may also be conditioned through R4-2 N/O, R11-3 N/C, R3-4 N/C, R13-2 N/C, R1-6 N/C, R2-3 N/C, R6-3 N/O, R7-2 N/O and RC6.

7. After the NPRO switch is used, the last two cards will be in the NR stacker. These cards have not been

processed. Before processing can continue, the check reset key must be used to drop out R4.

Stop Key

The stop key has two purposes: (1) to stop the reader-punch and (2) to stop the complete system.

1. The stop key No. 1 opens the hold circuit to the motor control relay R9 (03) causing the read feed drive motor to stop.

2. Stop Key No. 2 (05) activates the -*Y Stop Key RP* line to the processing unit.

3. The -*Y Stop Key RP* conditions circuitry in the processing unit which picks DU3 (03) through the OFF side of load key No. 2.

4. DU3-AU (03) keeps the circuit to R9 open after the stop key is released.

5. The start key is used to re-start the read feed. Pressing the start key conditions circuitry in the processing unit, and causes DU3 (03) to drop out by deactivating the +*V Inlk Stop* line.

Punch Stop

A card jam is detected when the number one or number two card lever contact remains closed too long during a read feed cycle.

1. If either card lever contact remains closed until 155°, the read stop control R13 (04) picks through RD13 or RD17, the closed card lever, and RL5. R13 holds through RC6.

2. R4 (05) picks through R13-2 N/O (06), R1-6 N/O, R2-3 N/O, R6-3 N/O, R7-2 N/O and RC6. R4 hold and the reader stop light are energized through DU4-AU until check reset is pressed.

3. R4-5 N/C opens circuit to motor control relay R9 (03) causing read feed motor to stop.

4. R4-6 N/O conditions -*Y RD Jam* line (05) to processing unit.

5. R4-2 N/O point (06) allows cards remaining in the read feed to be run out under control of the NPRO key by bringing up the -*Y Non-Process Feed* line to the process unit.

6. R4-4 N/C (07) opens the first and second read contact roll circuits, thus, opening the +*Y SC CB1* and +*Y SC CB2* lines and all brush read lines to the processing unit.

7. Pressing check reset key picks DU4. DU4-AU opens the circuit to R4 hold and reader stop light (05).

8. DU4-BU (05) conditions +*Y RD Check Reset* line to process unit (via 2-4 N/C and 3-3 N/C).

Clutch Check Circuit

Each time the read clutch magnet is energized, R10 is also energized. If the read feed clutch magnet receives an impulse and fails to pick, or a clutch cycle is taken without the clutch receiving an impulse, R10 signals a

clutch failure.

Objective: Stop the read-feed drive motor and turn on the reader stop light under the following conditions:

1. The clutch received an impulse and failed to unlatch.

    a. R10 (06) is picked by read clutch impulse from processing unit. R10 holds (04) through R10-1 N/O, R12-2 N/C and RC8.

    b. R4 picks (05) through R10-2 N/O, RC7 and RL8. With R4 picked the reader will stop as described in Reader Stop Circuits.

2. The clutch unlatched without receiving an impulse.

    a. R10 will not pick (06).

    b. R4 will pick (05) through R10-2 N/C and RL7. This will turn on the reader stop light when R4-1 N/O makes.

    c. R4-5 N/C (03) opens circuit to motor control relay R9 and drop HD2. Read drive motor stops. Lines to processing unit are conditioned as described under PUNCH STOP CIRCUITS.

Punch Feed Circuits

Punch Motor Start and Run

When either the load key or start key is depressed, the punch drive motor will start. If the start key is used, the processing unit is started and normal programming controls feeding. If the load key is used, the processing unit is started and an automatic read-feed cycle is called for.

Objective: Cause punch drive motor to start and continue to run.

1. Run delay R28 (11.21.09.0) picks whenever punch stops (R29 down).

2. Punch hopper C1 R21 is picked (11.21.10.0) by hopper contact.

3. DU2 (03) is picked by start or load key.

4. Punch delay (PT) relay (10) is picked through DU2-AL points.

5. R29 picks (09) through DU2-BU, R31-2 N/C, DU3-BU, chip switches, die and crank interlocks and punch switch No. 1 ON.

6. HD2 picks (09) through R29-4 N/O, PT relay N/O, PL-14 and through punch switch No. 1. The motor will run until this circuit is broken.

7. R29-2 N/C opens run delay R28 pick and hold (09). R28 drops when delay times out.

8. R27 is picked (09) by R29-3 N/O, R28-1, 2, N/C, PC-1, PT relay N/O, R21-4 N/O, R31-2 N/C, DU3-BU, chip switches, die interlocks and punch switch ON.

9. *-Y Process Control* line (11) is conditioned to signal the processing unit that punch is ready as follows: R31-3 N/C, R27-4 N/O and PC5 (296° to 326°).

Punch Feed Cycles

All normal punch feed cycles are under control of the processing system. If the 1402 Model 3 is running, a pulse is sent out PC178 (*-Y Process Control*) through R31-3 N/C, R27-4 N/O and PC5 and PL9. When a punch operation code is read in the operation register, the *+V Punch Clutch Magnet* line (11) is conditioned to ground potential by the processing unit, and a punch cycle occurs. On punch feed run-in, the first punch operation code read at the operations register will cause 3 feed cycles.

Card Punching Circuits (Figure 6-1)

Before each punch digit time (12 through 9), the punch area of process storage (address 101-180) is scanned. If a location in this area of storage contains a bit configuration equal to the digit value of the punch index time, one of the 80 magnet drivers is conditioned. When the punch magnet CBs make, a punch magnet is energized for each magnet driver that is conditioned. The lines, *Punch Drive Tens* and *Punch Drive Units*, are activated in the processing unit from the units and tens address decoding circuits. However, they are active only when a line *+Y Punch Decode Scan* is active. This line is active as a result of an equal comparison between data bits and the digit value of punch index time. Example: Punch magnet driver 53 is selected if lines *-Y Pch Drive T5* and a *-Y Pch Drive U3* are active.

Punch Check Brushes

The punch check brushes are used to read the card after it has been punched. Circuits for the 80 brushes are similar to the circuits covered for the read-feed brushes.

Punch Non Process Run-Out

The NPRO key is used to clear the cards out of the punch feed. Cards must be removed from the punch hopper before this key becomes effective.

To start a punch feed cycle by using NPRO key:

1. The punch NPRO key No. 1 picks R29 (09) through R21-1 N/C, interlocks and punch switch No. 1 ON.

2. The PT relay (10) is picked by the processing unit conditioned *+Y Pch Delay Set* line.

3. Pick HD2 relay (09) through R29-4 N/O, PT relay N/O, PL14, DU3-BU, chip switches, die and crank interlocks and punch switch ON. HD2 starts the punch motor.

4. The NPRO key No. 2 picks R37 H (09) through R27-2 N/C. With R37 picked R37-1 N/O will complete circuit to R31H and the punch stop light.

5. R27 (09) picks through R29-3 N/O and R28-1, 2 N/C, PL14, DU3-BU, chip switches, die and crank interlocks and punch switch ON.
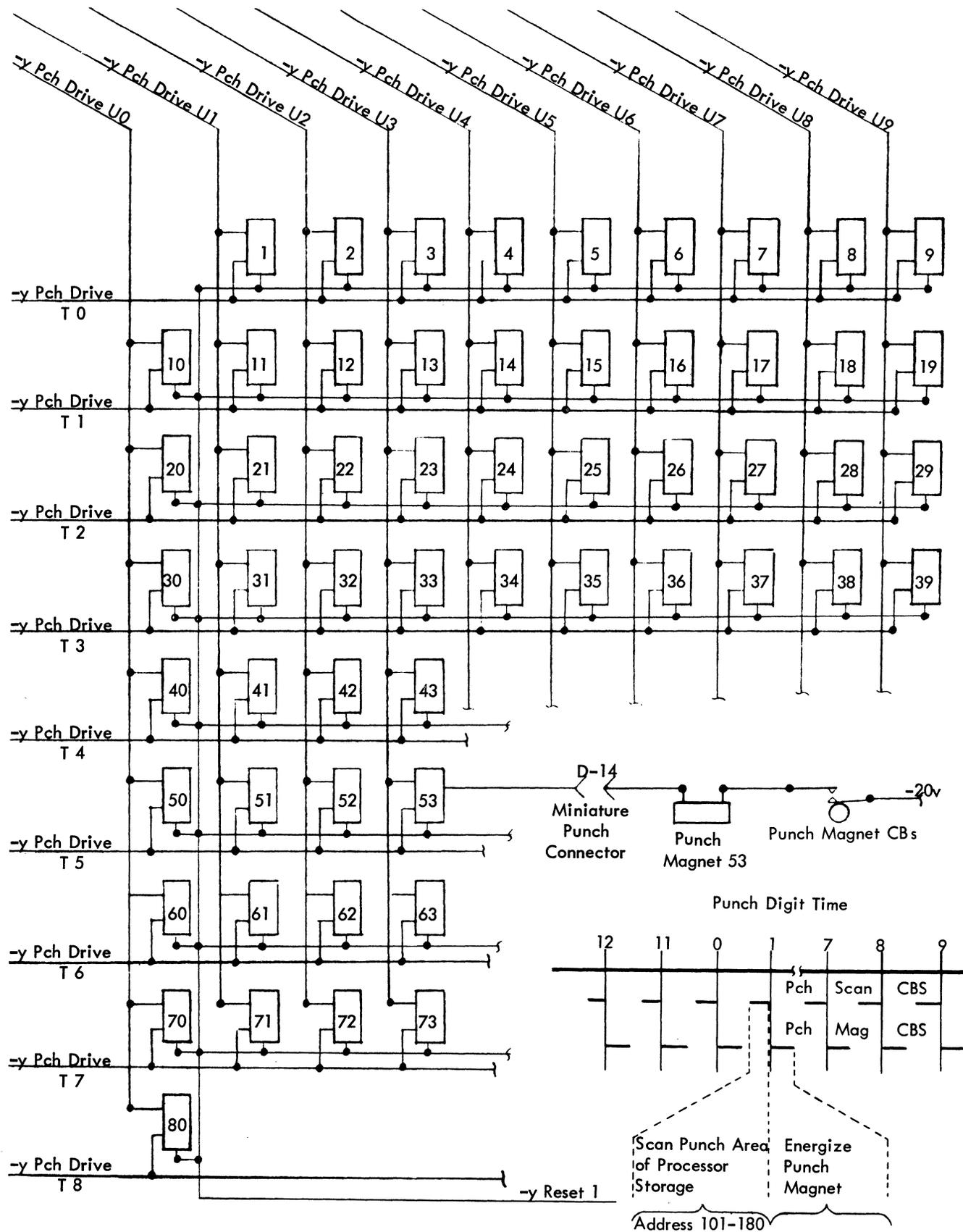
Figure 6-1. Punch Matrix

6. The -*Y Non-Process Control* line (11) is conditioned by R31-3 N/O, R27-4 N/O, PC5 and PL9.

7. As a result of the -*Y Non-Process Control* line being brought up, the process unit will condition the +*V Punch Clutch Magnet* line (11) and energize the punch clutch.

8. Before processing can continue, the check reset key must be used to drop relays 31 and 37 (09).

Stop Key

1. Stop key No. 1 opens the circuits to R29 and HD2 (09) causing the punch motor to stop.

2. Stop key No. 2 conditions the -*Y Stop Key RP* line (05) to the process unit. The processing unit conditions the +*V Interlock Stop* line (04) and allows DU3 to pick.

3. DU3-BU (09) keeps circuit to R29 and HD2 open after stop key is released.

4. The start key sets up lines to the processing unit which de-activates the +*V Interlock Stop* line and DU3 drops.

Punch Stop

A card jam or misfeed is detected by the card lever relay circuits (11.21.09.0). When a feeding failure is detected, the punch feed will be stopped.

1. R31 punch stop relay (09) is picked through the card lever relay points and PL7, if a jam or misfeed occurs. If R31 is picked, the -*Y Punch Jam* line is conditioned. If any CL delay relay picks when it should not, or if any card lever relay fails to pick, a circuit will be available through PL16 and PL17 to pick R31. R31 holds through DU4-BL.

2. R31-2 N/C opens circuit to R29 and HD2 (09) and stops the punch feed drive motor.

NOTE: The cards must be run out of the feed by use of the NPRO key, and then the reset check key must be used to restore the punch feed to operating status.

3. The reset check key will pick DU4 (05) through R28-3 N/O and R7-3 N/C.

4. DU4-AU opens hold to R31 (09) and turns off punch stop light.

5. DU4-BU conditions the +*Y Rd Check Reset* line (05) to the processing unit.

Clutch Check Circuit

Each time the punch clutch magnet is energized, R30

is also energized. If the punch feed clutch magnet receives an impulse and fails to pick, or a clutch cycle is taken without the clutch receiving an impulse, R30 signals a clutch failure.

Objective: Stop the punch feed drive motor under the following conditions:

1. The clutch received an impulse and failed to unlatch.

   a. R30 (11) is picked with the punch clutch by the +*V Punch Clutch Magnet* line from the processing unit when PC5 makes. R30 holds through PL4 (10).

   b. R31 (09) is picked through R30-4 N/O and PC4. When R31-5 N/O point closes the -*Y Punch Jam* line is conditioned to the processing unit.

   c. R31-2 N/C opens the motor relay R29 circuit (09), and stops the punch feed motor. Remove cards from the hopper and press check reset key to restore punch feed to operating status.

2. The clutch unlatched without receiving an impulse.

   a. R30 will not pick (11).

   b. R31 (09) is picked through R30-2 N/C, PL17, and PL16. This circuit also conditions the -*Y Punch Jam* line which will stop the punch feed through the processing unit circuitry.

   c. R31-2 N/C opens the motor relay circuit (09), the punch feed motor stops. The cards must be removed from the hopper and the check reset key pressed to restore the punch feed to operating status.

Stacker Select Circuits

1. The stacker card lever picks R36 (11) each time a card enters the transport unit from the punch feed.

2. The stacker card lever breaks between cards. R35 picks when PL7 is made and the stacker card lever is open.

3. R35 hold coil (11) can energize if the +*V Stacker Inhibit* line becomes active.

4. The stacker control relays R33 and R34 (11) are picked by the +*V Stacker 4 or 8* from the processing unit. R33 or R34 will hold through PL6.

5. The stacker 4 magnet (11) is picked through R33-2 N/O, after R35 has dropped, if the stacker card lever has closed by PC7 time at 35° to 75°.

6. R31 (09) picks through R35-2 N/C and R32-4 N/O if a card was at the punch check brushes but did not reach the stackers on the next punch feed cycle.

7. R31 (09) picks through R35-4 N/C and R32-4 N/O if a punch cycle is taken after a card has passed the punch check brushes, and stacker inhibit R35 fails to pick.

51-80 Column Device (1402 Models 1, 2, 3)

This feature permits reading and stacking of 51 column cards into pockets NR and 1. The operator performs several operations to convert from 80 to 51-column operation. This feature applies only to the read feed.

To convert a 51-column operation, perform the following steps:

1. Place the auxiliary hopper side plates in the hopper.
2. Interchange 80 and 51-column card weights.
3. Insert auxiliary file aligners in upper part of file feed.
4. Program the read feed to stack in pockets NR and 1 only.
5. Pull the center portions of the radial guides in pockets NR and 1 into their forward detented position.
6. Pull the auxiliary ledges for pockets NR and 1 down and toward the rear of the machine to a detent position. Restore cover.

When pocket N/R is set up for a 51-column operation, a micro switch is operated. This micro switch activates a line to the processing unit that causes addressing to be adapted to the 51 column card format.

The selection mechanism is changed to a new location because of the shorter 51 column card (Figure 7-1). This necessitates a delay circuit for select magnet 2. Three relays are used for this purpose. Instead of stacker 2 magnet picking, when the *Stacker 2* line is brought up, the first delay relay is picked. The first delay relay and RC circuit breaker impulse pick the second delay relay. The second delay picks the third delay relay. When the first delay relay drops out, and the third one is picked, the stacker 2 magnet circuit is completed.

Punch Feed Read (Models 1 and 3)

The Punch Feed Read feature (PFR) adds a set of 80 read brushes to the blank station ahead of the punches in the punch feed (Figure 7-2). With this feature, data may be read from a card and the results of a calculation punched into the same card.

An operation restriction is present when using PFR; no operation code involving the use of the read feed may be programmed in conjunction with the PFR Op code.

The 80 PFR brushes are switched through relay points, as shown in Figure 7-3, so that data read at the punch read brushes enters the read area of processing unit storage. Because the same row bit cores are used for both the second read and the PFR brushes, a PFR operation and a normal read cannot be programmed as a combined punch and read. The punch cluch is energized in the same manner as in the normal punch operation. When the cam impulse picking the clutch

Figure 7-1. 51-80 Column Stacker Select Mechanism

Figure 7-2. Punch Feed Read Brush Location

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