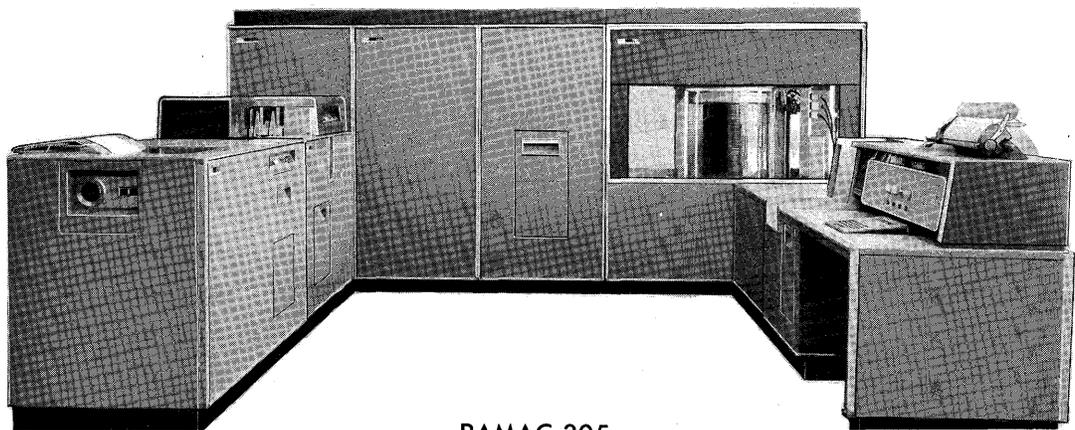




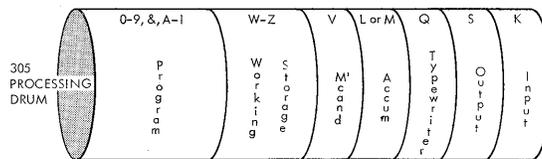
## RAMAC<sup>®</sup> 305 REFERENCE SUMMARY

The information contained in this summary is intended as an aid for the more experienced programmer and operator. It is condensed from the IBM RAMAC 305 Reference Manual (Form No. A26-3502). Reference should be made to that manual when more complete information is required.



RAMAC 305

## 305 PROCESS DRUM TRACKS



Additional printer output track: T  
 Additional processing tracks: U / . #  
 Paper Tape Input track: \$

## VALID TRACK ADDRESSES

	FROM	TO
Accumulator		
Add		L
Subtract		M
Read out and reset	M	
Read out	L	
Multiplicand	V	V99
Multiplier	*	N99
Input Track	K	K
Output Track		
(Standard Machine)	S	S
Disk Memory	R99	R99
Address Register	*	J
Character Selector		-99
Inquiry Track	Q	Q
Magnetic Core Unit	-99	<u>b</u> 99
Punch Output Track	S	S
Printer Output Track		
(Special Feature)	T	T
Paper Tape Input		
(Special Feature)	\$	\$

\* Invalid Address

## INVALID TRANSFER INSTRUCTIONS

M to R  
 R to J  
 J to Any Track

## COMPARING EXCEPTIONS

The following chart illustrates both valid and invalid track addresses for compare, field compare, and combined compare.

		COMPARE					
		J	L	M	R	V	—
FROM		No	Yes	Yes	Yes	Yes	Yes
TO		No	No	No	No	*	No

\* Yes, if TO = V99 and NO. of CHAR. = 00

NOTE: During field compare, TO address determines field compare selectors affected.

## MULTIPLICATION

### Basic Rules of Multiplication

Maximum number digits in multiplier cannot exceed 11\*.  
 Maximum number digits in multiplicand cannot exceed 9.  
 Maximum number digits in product cannot exceed 20.  
 Product is developed in accumulators 0 and 1.

### Location of Product

Units position of product is 8 plus number of digits in multiplier, minus number of positions to be dropped from product.

\* One low-order position of the product will be lost for each digit in the multiplier beyond 11.

### Instruction Explanation

- Position multiplicand on multiplicand track.  
 xxxV99zz    xxx — Track and units position of multiplicand.  
                   zz — Number of digits in multiplicand.
- Execute automatic multiplication.  
 yyyN99zz    yyy — Track and units position of multiplier.  
                   zz — Number of digits in multiplier.

### Half Adjustment

The position to half-adjust can be determined by using the following formula:  
 (09) — (the number of decimals to be dropped = position to half-adjust).

NOTE: Accumulators 0 and 1 should be reset prior to initiating automatic multiplication.

### Speed

The following formula may be used to compute the time required for multiplication (includes 30 ms for loading multiplicand).

$$60 + 10(n - 1) = \text{time in milliseconds.}$$

n = number of multiplier digits.

## AUTOMATIC DIVISION

### Basic Rules of Division

- Maximum number digits in dividend cannot exceed 19.
- Maximum number digits in divisor cannot exceed 9.
- Maximum number digits in quotient cannot exceed 19.
- Maximum number digits in divisor plus maximum number digits in quotient cannot exceed 20.

### Location of Quotient

Units position of quotient is in L19.

### Location of Remainder

Units position of remainder in L08 minus number of digits in excess of 11. (Number of digits in remainder equal number of digits in divisor.)

### Instruction Explanation

1. Position dividend in accumulators 0 and 1.  
 xxxLyyzb5 xxx — Track and units position of dividend.  
 yy — Maximum whole number digits in quotient plus 8. (Cannot exceed 19.) Maximum whole number digits in quotient is maximum digits in dividend minus minimum digits in divisor plus one.  
 zz — Number of digits in dividend.
2. Position divisor on multiplicand track.  
 xxxV99yy xxx — Track and units position of divisor.  
 yy — Number of digits in divisor. (Including added zeros.) If number of digits of quotient exceeds 11, zeros must be added to right of divisor equal to number in excess of 11 before execution of this instruction.
3. Execute automatic division.  
 L09P99xx xx — Twice the number of digits in quotient.

### Half Adjustment

Increase the number of digits in quotient by one in instruction (3) above, add 5 to L19 after execution of instruction, and read quotient from position L18. Remainder is also positioned one position to the left. (Do not exceed basic rules of division.)

NOTE: If number of digits in quotient desired exceeds maximum whole number of digits, then additional digits are decimal figures.

### Speed

The following formula may be used to compute the time required for division (includes 30 ms for positioning dividend plus 30 ms for loading divisor).

$$100 + 20(n - 1) = \text{time in milliseconds.}$$

n = number of quotient digits.

## OPERATING SPEEDS

<i>370 Printer Output</i>		
80 positions	(29 LPM)	2050 ms/line
60 positions	(36.5 LPM)	1640 ms/line
40 positions	(50 LPM)	1200 ms/line
20 positions	(84 LPM)	720 ms/line
<i>Punch Output</i>	(100 CPM max.)	600 ms/card
<i>Card Feed Input</i>	(125 CPM max.)	480 ms/card
<i>Typewriter Output</i>		
Automatic Typing		100 ms/character
Manual Typing (average)		200 ms/character
Tabulations (average)		300 ms/tab
Carriage Returns (average)		1000 ms/return

### Disk Storage Timing

Seek time disk to disk:		
800 ms/max.	600 ms/avg.	400 ms/min.
Seek time track to track, same disk:		
250 ms/max	175 ms/avg.	100 ms/min.
Seek time record-to-record, same track:		
50 ms		
Transfer disk to drum track:		
80 ms/max.	55 ms/avg.	30 ms/min.
Transfer drum to disk:		
130 ms/max.	105 ms/avg.	80 ms/min.

### Other Operating Speeds

Track-to-track transfer on drum	30 ms
Control panel test	additional 20 ms
Record advance	additional 30 ms
Skip-to-record	additional 30 ms
Addressing Address Register	additional 20 ms
Cycle Delay	additional 30 ms

NOTE: If Program Exit Overlap is installed, certain instructions which normally require 50 ms for execution may be completed in 30 ms.

## FEATURE SUMMARY

Features of the RAMAC 305 are summarized below. For each feature, the table indicates the number of units included in the standard machine, the units in which each optional addition may be made and the maximum available capacity.

305 FEATURES	Standard	Increment	Maximum
Character selectors	3*	3	6
Distributors	100	20	120
Selectors	10	10	40
323 FEATURES	Standard	Increment	Maximum
Co-Selectors	0	4**	20**
Pilot Selectors	0	5†	10†
Digit Selector	1	1	2
Offset Stacker	0	1	1
DPBC positions	20	10	80
370 FEATURES	Standard	Increment	Maximum
Co-Selectors	4**	4**	12**
Pilot Selectors	0	5†	10†
Skip Stops	6	5	11

\*One 48-position character selector standard.

\*\*5-position

†2-position

# CONSOLE READING AID

# READ, WRITE, AND ALTER SUMMARY

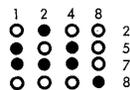
The following diagrams show the sequence of operations with the test lock On or Off.

DIGIT	ZONES		CHAR.
	X	0	
NO DIGIT	●	●	—
	●	●	&
	●	●	O
1	●	●	A
	●	●	J
	●	●	/
	●	●	1
2	●	●	B
	●	●	K
	●	●	S
	●	●	2
	●	●	C
3	●	●	L
	●	●	T
	●	●	3
	●	●	D
4	●	●	M
	●	●	U
	●	●	4
	●	●	E
5	●	●	N
	●	●	V
	●	●	5
	●	●	F
6	●	●	O
	●	●	W
	●	●	6
	●	●	G
7	●	●	P
	●	●	X
	●	●	7
	●	●	H
8	●	●	Q
	●	●	Y
	●	●	8
	●	●	I
9	●	●	R
	●	●	Z
	●	●	9
	●	●	.
11	●	●	\$
	●	●	,
	●	●	#
	●	●	π
12	●	●	*
	●	●	%
	●	●	@
	X	0	

## CONSOLE READING AID

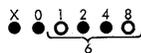
The Console Reading Aid (On Left) is designed to help the operator decipher the binary coded instruction lights more quickly and easily. It should be used in the following manner:

1. Mentally arrive at the sum of the numeric lights glowing. For example:



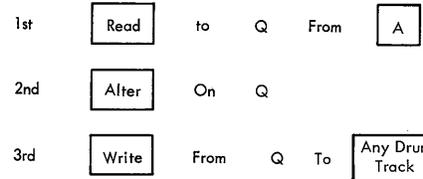
2. Refer to the chart for the digit which corresponds to this sum. (left hand column)
3. Find the proper zone lights opposite this digit.
4. Follow across to the number, letter, or special character represented by these lights.

In the following example; the X, 0, 2, and 4 lights are glowing:

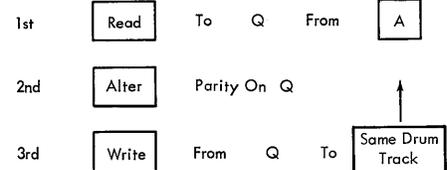


Because the numeric lights total 6, the zone lights opposite the digit 6 on the chart should be checked for a matching condition. The matching zone pattern (an X and 0 in this example) should then be followed across to the character represented, which in this case is the letter F.

## Test Lock On



## Test Lock Off

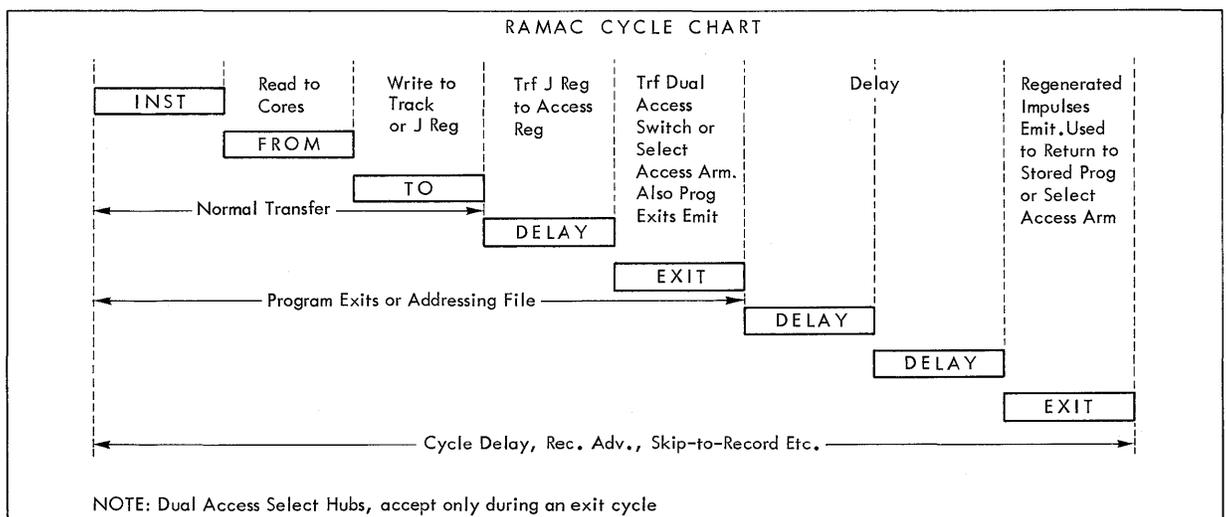


## TEST LOCK FUNCTIONS

The following is a resume of console keyboard operations with the Test Lock ON and with it OFF.

	Test Lock ON	OFF
Make disk file inquiries during processing .....	No	Yes
Make disk file inquiries when not processing .....	No	Yes
Make drum track inquiries during processing .....	No	No
Make drum track inquiries when not processing .....	Yes	Yes
Alter a record in the disk storage file .....	No	No
Alter a drum track record .....	Yes	No
Read from drum track "M" (clear accumulators) .....	Yes	No
Correct parity errors .....	No	Yes

NOTE: Any inquiries directed to the disk storage file during processing will be replied to only as provided for in the program.



NOTE: Dual Access Select Hubs, accept only during an exit cycle

RAMAC Cycles Timing Chart

# Console Operating Procedures

## START-STOP PROCEDURES

### Starting the Machine After a Power-Off Condition

1. Depress the Power-on key at the console. After the console lights have turned on, depress the Reset key.
2. Depress the printer Start key.
3. Hold the punch Start key down until cards stop feeding and the Ready light is on.
4. Depress any Control Impulse buttons that are required by the program.
5. Place the Control Selector switch to the desired mode of operation.
6. Place the desired data or program load cards in the reader hopper.
7. If a new program is to be loaded, depress the Program Load button. If the program is already in the machine, depress the reader Start key.

### Restarting the Same Job

To restart the same job, place cards in the feed and depress the reader start key.

### Starting or Stopping at a Specific Program Step

#### To Start:

1. Set the Program Selector switches to the desired program step.
2. Set the Control Selector switch to the desired mode of operation—RUN, SINGLE OPERATION, etc.
3. Depress the Program Set key.
4. Depress Program Start.

#### To Stop:

1. Set the Program Selector switches to the desired program step.
2. Set the Control Selector switch to CONTROL STOP.

## INQUIRIES

### Inquiries—File Information When Not Processing

1. The Test Lock must be off.
2. The machine must be reset—depress Reset.
3. Depress the desired Format key.
4. Key in the desired five-digit address.

### Inquiries—File Information During Processing

#### ITI Off:

1. Test Lock must be off.
2. Control Selector switch should be set to RUN.
3. Depress the desired Format key.
4. Inquire light comes on immediately.
5. Key in the record address.

#### ITI On:

1. The Test Lock must be off.
2. The Control Selector switch should be set to RUN.
3. Depress the desired Format key.

4. When the program reaches the step which tests the Inquiry IN hub, the Inquiry light will turn on and the program will stop. (The Cycle lights will show continuous Delay and Exit cycles.)
5. When the Inquiry light turns on, key in the five-digit address.

### Inquiries—Drum Information When Not Processing

1. The Test Lock may be either on or off.
2. The Control Selector switch is set on RUN.
3. Depress the Read key (read to "Q").
4. Depress the desired character key on the keyboard.

## ALTERATIONS TO DRUM TRACKS

### Altering Part of the Information on a Drum Track

1. The Test Lock must be on.
2. Depress the Read key.
3. Select the proper track by depressing the corresponding character key.
4. Depress the Alter key to place the keyboard in a condition to type on the Q track.
5. Duplicate the track information on the typewriter track by holding down the DUP key. Duplicate up to the position to be changed.
6. Type the new information.
7. Depress the Clear key after all alterations have been completed.
8. Depress the Write key.
9. Depress any desired track key except R.

### Altering a Complete Drum Track

1. The Test Lock must be on.
2. Clear the Q track. This may be accomplished by depressing the Read key, the Space bar, and the Clear key in this order.
3. Depress the Alter key to place the keyboard in a condition to type on the Q track.
4. Type the desired information.
5. Depress the Clear key if typing less than 100 characters.
6. Depress the Write key.
7. Select the desired track by depressing the corresponding character key.

## TESTING PROCEDURES

### Testing Typewriter Control Panel Formats

1. Inquiry format
  - a. Depress the Reset key.
  - b. Turn the selector control switch to FORMAT TEST.
  - c. Depress the appropriate Format key (1, 2, or 3).
  - d. Key in the desired file address.
  - e. Depress the Program Start key one time for each cycle of operation on the typewriter control panel program.

2. Document-printing format
  - a. Reset the process unit.
  - b. The test record must be on the typewriter track.
  - c. Turn the Selector Control switch to **FORMAT TEST**.
  - d. Depress the Program Start key one time for each cycle of operation on the typewriter control panel program.

## Program Testing

Method 1 executes a program, one step at a time; method 2 executes several program steps or a complete routine before stopping.

### METHOD 1

1. The Test Lock should be off.
2. The File Interlock switch on the process control panel should not be plugged. By leaving this switch unplugged, it is impossible to destroy a file record.
3. Turn the program selector switches so that they correspond to the first program that is to be executed, and place the control selector on **CONTROL STOP**.
4. Place program load cards in the machine, and proceed through a normal program load routine.
5. After the processing unit has stopped on the first program, turn the Control Selector switch to **SINGLE OPERATION**.
6. When the Program Start key is depressed, the machine will perform one program step at a time.
7. If the operator wishes to examine a track at any time, it is necessary only to depress the Keyboard Read key, and then type out the desired track by depressing the corresponding character key.

**NOTE:** Because the File Interlock switch is not jack-plugged during this procedure, each time the program attempts to write onto the disk storage, the machine will stop and the File light will glow. Operation may be resumed by depress-

ing the Check Reset key, setting the program selector switches to the next program step, depressing Program Set, and then Program Start.

### METHOD 2

1. The Test Lock should be off.
2. The File Interlock switch on the process control panel should not be plugged. By leaving this switch unplugged, it is impossible to destroy a file record.
3. Turn the program selector switches so that they correspond to the first program that is to be executed, and place the control selector on **CONTROL STOP**.
4. After the processing unit has stopped on the initial step of the first routine, place the program selector on the first step of the second routine.
5. At this point, the operator can investigate the tracks that have been affected to determine if everything is in order. This may be accomplished by depressing the Keyboard Read key and selecting the proper track.

**NOTE:** Because the File Interlock switch is not jackplugged during this procedure, each time the program attempts to write onto the disk storage, the machine will stop and the File light will glow. Operation may be resumed by depressing the Check Reset key, setting the program selector switches to the next program step, depressing Program Set, and then Program Start.

## Track Clearing

Clearing a track to blanks or the accumulator track to zero can be accomplished by using the console keyboard as follows:

1. Turn the Test Lock on.
2. Depress Read and Space. This writes blanks on the Q track. The Q track can now be used to blank out other tracks (e.g., track W) by depressing Write and the appropriate character key (W in this case).

To reset the accumulator track, depress Read and M.

# Error Correction Procedures

## PROCESSING ERRORS

### Parity Check Stop

#### Console Indication:

1. Processing stops (Red Stop light on).
2. Parity light on.

#### Cause:

Improper character transfer within the processing unit.

#### Restart Procedure:

1. If the parity check occurred on the INSTRUCTION cycle, the machine will stop with the INSTRUCTION CYCLE light on. The operator may attempt the transfer again by depressing Check Reset and then Program Start. This is possible because no information has actually transferred and the records in the machine have not been affected.
2. If the parity check occurred on the FROM CYCLE, the machine will stop with the FROM CYCLE light on. Depressing Check Reset and Program Start may be all that is necessary unless an accumulator read-out and reset instruction is involved. If read-out and reset has occurred, the accumulator has been reset to zero. The accumulator data is retained in the magnetic-core unit and can be used as an aid to reconstruction. It will normally be necessary to restart the program at some previous instruction so that the accumulation can be built up again. If an error persists on a track to track transfer, it is an indication that the source data is incorrect.

To correct an invalid character occurring on the FROM cycle, providing an accumulator operation is not involved, the following procedure may be used:

- a. Depress the Check Reset key.
  - b. Read the track that contains the parity error. All 100 characters on the track are typed, and if the track contains an error, it will be automatically underlined.
  - c. After the full track has been typed, depress the alter key. This will cause the typewriter to space across the page and stop under the first invalid character.
  - d. Type any corrections that are required.
  - e. Depress the clear key after the last correction has been completed.
  - f. Depress the write key.
  - g. Depress program start.
3. If the parity check occurred on the TO cycle, the machine will stop with the TO CYCLE light on. Depressing Check Reset and Program Start is all that is necessary unless a read-in to an accumulator is involved. If an accumulation has occurred, transferred data is in the magnetic-core unit. Depress Check Reset and make an inquiry of the core unit. It may be possible to correct the error by comparing the accumulator data with the core information and the source record. However, if this is not possible, the program should be restarted at some previous step where the accumulator is reset and the accumulation can be started over again.

### Clock Error Stop

#### Console Indication:

1. Processing Stops (Red Stop light on).
2. CLOCK light on.

#### Cause:

Some phase of machine timing is out of step.

#### Restart Procedure:

1. Make a note of the program step involved.  
NOTE: The console may not indicate the error, until the

following program step. Therefore, the restart procedure must include at least the step on which the error is indicated and also the preceding step.

2. Depress the Reset key, *not* the Check Reset.
3. Investigate the TO address track of both the error step and preceding program step to be sure data was not written in the wrong place.
4. If either or both of these steps are accumulator operations, it may be necessary to restart at a position in the program where the accumulator is reset and the accumulation can begin again.
5. Investigate the program steps which are to be re-executed to insure that information will not be lost or duplicated. For example, a slide operation, feed a card, punch a card, etc.
6. Set the Program Selector to start at the restart point, and press program set.
7. Start the program by depressing Program Start.

### File Check Stop

#### Console Indication:

1. Processing Stops (Red Stop light on).
2. File Check light on.

#### Cause:

Record just stored on disk file does not agree with source data on drum.

NOTE: Accumulator read-out and reset to the file is invalid and will always cause a File Check stop. If the FILE hubs on the process panel are not wired, a File Check stop will occur on every file write operation.

#### Restart Procedure:

1. Depress Check Reset.
2. Depress Program Start.
3. If the error persists, the information can be retained by typing out the disk storage record and the drum track that is the source of the record being transferred. After the error condition has been corrected, the data can be re-entered on the drum track and the program restarted at an instruction that will transfer the record to disk storage.

### Feed Check Stop

#### Console Indication:

1. Processing Stops (Red Light on).
2. Feed Check light on.

#### Cause:

Misfeed in the card reader. A check is made as the cards leave and arrive at each feed station. Therefore, any jam should affect only one card that has not been processed.

#### Restart Procedure:

1. Depress Reader Stop.
2. Remove the cards from the feed hopper.
3. Remove any jammed cards from the feed.
4. Run out the remaining cards by depressing the Non-Process Runout key.
5. Restart by placing the last three cards (two cards if the card failed to feed from the feed hopper into the feed unit) in front of the remaining cards that are to be processed.
6. Depress the Reader Start key to run the cards in.

### Read Check Stop

#### Console Indication:

1. Processing Stops (Red Stop light on).
2. Read Check light on.

*Cause:*

An error in reading or recoding the input card.

*Restart Procedure:*

1. Depress Reader Stop.
2. Remove the cards from the feed hopper.
3. Depress Non-Process Runout to clear the feed station.

NOTE: The card in error is the third card from the back of the deck in the stacker, after the cards are run out.

4. The last three cards to run out of the machine were not processed; therefore, place these three cards in front of the remaining cards that are to be processed. Then depress the Reader Start Key to run cards into the reader.

## Interlocked Track (Input or Output)

*Console Indication:*

1. Processing Stops (Red Stop light on).
2. Interlock light on.
3. Select light for interlock device on (Reader, Printer, Punch or Type).

*Cause:*

Programming has called for a transfer *to* or *from* the K track before the last feed operation has been completed, or it has called for a transfer *to* the output track before the last Print or Punch operation is completed.

*Restart Procedure:*

1. Determine if the interlock is due to running out of cards or paper. If so, replenish the cards or paper and depress the corresponding input or output Start key.
2. If the interlock is due to an input or output error condition:
  - a. Depress the console Check Reset key to drop out the interlocked instruction.
  - b. Process through a normal track investigation procedure as described in *Console Operating Procedures*.

## PRINTER ERRORS

### Print Check Error (Parity or Print Setup Error)

*Console Indication:*

Depends on printer control panel wiring.

1. Δ-N. Stop: No console indication.
2. Δ-Stop or Stop.
  - a. Processing stops on the next transfer-to-output instruction (Red Stop light on).
  - b. Interlock light on.
  - c. Select Printer light on.

*Printer Indication:*

1. Δ-N. Stop.
  - a. Check light on.
  - b. Delta printed in the left margin of the line in error.
  - c. Printer continues to print.
2. Δ-Stop.
  - a. Check light on.
  - b. Delta printed in the left margin of the line in error.
  - c. Printing stops after the error line is completed.
3. Stop: Same as Δ-Stop, but no delta is printed.

*Cause:*

1. A parity error was sensed during the transfer from the output track to the printer.
2. The print stick may not have been set up properly.

*Restart Procedure:*

1. Δ-Stop and Stop. Depress Printer Check Reset key.

- a. Try printing the line again by depressing the Print Repeat Switch.

NOTE: If the printer is in an MLP operation, the Print Repeat switch must be depressed for each line of the MLP.

- b. If the error appears again, investigate the output track (see *Console Operating Procedures*).
- c. If the document is for internal purposes, the error line may be crossed out or all delta lines disregarded during future use of the document. Other documents may have to be redone either by reprocessing or off-line typing.

NOTE: Reprocessing will not be practical in most instances because of file updating.

2. Δ-N. Stop.

- a. At the end of the run, examine the output documents for deltas, and make manual corrections where necessary.
- b. The Check light will remain on until the Check Reset key on the printer is depressed.

## Form Light

*Console Indication:*

1. Processing stops on the next transfer-to-output instruction (Red Stop light on).
2. Interlock light on.
3. Select Printer light on.

*Printer Indication:*

Form light on.

*Cause:*

Bottom of last form is 1½ inches from print stick.

*Restart Procedure:*

1. Successive depressions of the printer Start key will cause the printer to print another line in order to complete the last form.
2. Insert new forms and align to first printing line.
3. Depress the printer Start key.

## PUNCH ERRORS

### Punch-Parity Error Stop

*Console Indication:*

1. Processing stops on the next transfer-to-output instruction (Red Stop light on).
2. Interlock light on.
3. Select Punch light on.

*Punch Indication:*

1. Punch stops at the end of the punch cycle.
2. Parity light on.

*Cause:*

One or more of the 100 positions of the output track (including those not being punched) failed to pass the parity check.

*Restart Procedures:*

In general, the operator should try to punch the card again. If the error continues, either of the following procedures may be used.

*Restart Without Clearing the Feed—Correct Later*

1. Depress the 380 Console Check Reset key.
2. Read the output track. All 100 characters on the output track are typed, and, if the track contains an error, it will be automatically underlined.
3. Depress Program Start.

4. Remove the cards from the punch stacker to facilitate finding the error card, and depress the punch Check Reset and Start keys. The second card to reach the stacker is the card in error, and it may be corrected manually.

*Correct the Error, then Restart*

1. Depress the 380 Console Check Reset key.
2. Read the output track.
3. After the full track has been typed, depress the Alter key.
4. Type any corrections that are required.
5. Depress the Clear key after the last correction has been completed.
6. Depress the Write key.
7. Depress Program Start.
8. Remove the cards from the 323 Punch hopper, and depress the Punch Check Reset key. Run the remaining cards out of the machine with the Start key.
9. Remove the error card, which will be the second card into the stacker.
10. Place the last correct punched card in front of the input deck if gangpunched data must be saved. (The first card in on a run-in is not punched.) The corrected output track information punches into a new card and programming proceeds.

### Punch Feed-Check Stop

*Console Indication:*

1. Processing stops on the next transfer-to-output instruction (Red Stop light on).
2. Interlock light on.
3. Select Punch light on.

*Punch Indication:*

Feed Check light on.

*Cause:*

Full stacker, an empty hopper, or a feed failure.

*Restart Procedures:*

- A. Empty Hopper or Full Stacker.
  1. Place cards in the hopper or remove cards from the stacker.
  2. Depress the Punch Start key.
- B. Feed Failure—Misfeed from Hopper.
  1. Remove cards from hopper.
  2. Depress Start key to clear feed.
  3. Remove the last punched card. The last punched card will be repunched because the information concerning this card is retained on the output track.
  4. Replace the unpunched cards in the hopper. If necessary, a gangpunch master card precedes these cards.
  5. Depress the Start key.
- C. Feed Failure—to Feed Into Punch Brush Station.
  1. Remove the cards from the hopper.
  2. Remove any damaged cards and clear the feed.

3. Remove the last punched card (this may be the damaged card). The last punched card will be repunched because the information concerning this card is retained on the output track.
4. Replace the cards in the hopper. If necessary, a gangpunch master card precedes these cards.
5. Depress the Start key.

### DPBC Error Stop

*Console Indication:*

1. Processing stops on the next transfer-to-output instruction (Red Stop light on).
2. Interlock light on.
3. Select Punch light on.

*Punch Indication:*

DP & BC light.

*Cause:*

Either a double-punch or a blank-column error (or both) has occurred. When this type of error is signaled, the card in error has passed the punch brush station. The error can indicate that either the output punching is incorrect, or that an error occurred in a gangpunched field.

*Restart Procedures:*

If the output punching is at fault, it may be necessary to reconstruct the output because the information in error has been replaced on the output track with the succeeding record. This can usually be accomplished by investigating the file or processing drum tracks, or by checking the printed document. In some cases it may be desirable to carry, in the program, the output data on a working track for one additional punch cycle. Then the operator can investigate the working track and correct the card manually.

If the DPBC stop was caused by gangpunching, the feed must be cleared and the operation restarted.

Two methods for restarting the punch after a DPBC stop are:

METHOD 1

*No Gangpunched Fields Checked for DPBC*

1. Depress the punch Check Reset key.
2. Depress the punch Start key. Continuous operation will be resumed. The first card to reach the stacker after depressing the Start key is the card in error. It must be corrected manually.

METHOD 2

*Gangpunched Field Checked for DPBC*

1. Remove the cards from the feed hopper and stacker.
2. Depress Check Reset.
3. Depress the Start key to clear the feed. The first card into the stacker is in error and must be corrected manually. The second card is not in error, but will be repunched on the run-in.
4. Place the last correct card in front of the deck (for master gangpunch information) and run the cards in with the Start key. The first card in is not punched.

# Control Panel Summary

EACH SECTION of the control panels is assigned a number under which the hubs are briefly described. Shaded areas indicate special features.

## Process Control Panel (Figure 1)

1. **Program Exits.** These hubs emit an impulse whenever the corresponding program exit occurs in an instruction. The impulse is used to make tests on the control panel, and to transfer program control to the first step of a new sequence of instructions. When one of these hubs emits, the program sequence is halted, and must be restarted by impulsing program advance or by impulsing program entries.

When Program Exit Split is installed, either the upper or lower exit hubs of a group will emit depending on which control hub was impulsed last.

2. **Dual Access.** These hubs provide control over the mode of Dual Access operation. When the C (common) hub is not wired to the SEL (select) hub, the access arms operate in the automatic sequence mode. With the C hub wired to the SEL hub, either the 0 (zero) or 1 hub may be impulsed from a Program Exit, Cycle Delay or any other impulse originating on the 305 panel, except CI (control impulses), and the upper hub of the Inquiry ON switch. The corresponding access unit will then accept all J, Record Advances, Skip-To-Record, and R instructions until the other access unit hub is impulsed. If the C hub is permanently wired to either access unit hub (0 or 1) the system will then function as a single access system using this unit.

3. **DPIS (Dual Process Interlock Suspend).** When the PU hub of DPIS is impulsed by either system in Dual System Control, it suspends the interlock that prevents reading or writing a record until the arm of the other system has moved from this same address. When the PU hub is impulsed on one process control panel, it suspends the interlock for both systems; however, only the system initiating the suspension can re-establish the interlock by impulsing the DO hub. If PU has been impulsed on both systems, the DO hub on both process control panels must be impulsed. When a system impulses PU, it cannot write in the file; a write instruction causes a file check. A light on the console of each system indicates when the interlock is suspended for that system.

4. **ALC (Automatic Last Card).** If the ALC switch is not plugged (when the cards have run out of the card reader hopper, and the last card has passed the second reading brushes), the card reader will stop. The operator may depress the Reader Start key, and feed the last cards to the stacker. Just after the operator depresses the Start key, the last card selector transfers.

If the ALC switch is plugged, the card reader will feed cards for one additional cycle before stopping. During this additional cycle the last card selector transfers, and any last-card routines that have been programmed utilizing the last card selector can be completed. The cards may then be fed into the stacker by depressing the Reader Start key.

5. **Inquire.** The pair of hubs marked ON form a switch that is jackplugged if manual inquiries to the disk records are to be allowed during processing.

The IN-OUT hubs form an interlock that is wired to allow the console to take control of the access arm at a time when it will not countermand the stored program instructions. The inquire interlock is wired in the program at a point where the access arm

has completed its use of the record. If the arm is about to be moved by the program, no harm will be done if the operator moves the access arm to some other record to make an inquiry. When the record has been obtained for the operator, the stored program resumes control and moves the arm to the next record required.

A program exit wired into the IN hub emerges immediately from the OUT hub if no inquiry has been set up at the console or is delayed if an inquiry is set up. The impulse from the OUT hub is wired to initiate the next program step.

6. **ITI (Inquiry-Type Interlock).** The typewriter may be used to make inquiries to the disk records as described in item 5. The typewriter may also be used as a secondary output printer by addressing the output record to Q track and impulsing TYPE on the control panel (see item 33). If both of these uses occur in the same program, the inquiry-type interlock must be jackplugged to prevent an inquiry from taking place while the typewriter is under program control.

7. **File Interlock.** This interlock is provided so that new programs may be tested without changing the information on the disks. When a program has been checked out, this switch is wired to allow the disk records to be changed. All operations except writing on the disks may be performed with the interlock off. A write operation will cause a file check.

8. **Accumulator Sign.** Each accumulator has an associated selector that shows its sign. By using a program exit impulse, a test may be made to determine if an accumulator is positive, stands at zero, or is negative.

9. **Accumulator Overflow.** Whenever an accumulator overflows (tries to accumulate a number beyond its capacity), a path is established between each IN hub and its YES hub. These paths remain set up until the accumulator overflow selector is dropped out by impulsing DO. A normal path is established between the IN hub and the corresponding NO hubs when the selector is dropped out or when no overflow has occurred.

10. **Character Selectors.** The character selectors provide a way of analyzing any character on a drum track. The position to be analyzed is entered into this unit by an instruction with hyphen (-99) as the TO address. Any character entered establishes test paths between each IN hub and the exit hubs corresponding to the character entered.

Four distinct paths are set up on the basic machine. Three of the paths are arranged so that a test impulse entered into the IN hub emerges from the hubs corresponding to the IBM card code of the character being tested. In the fourth path, an impulse wired into the IN hub emerges from one of the 48 exit hubs representing the specific letters, numbers, and special characters (including blank). The test paths remain set up until another character is addressed to the unit.

The special feature X no-X and 0 no-0 bit selectors provide analysis for the presence or absence of these bits in the character sent to the character selector.

11. **Blank Transmission.** A 6 in the tenth position of an instruction causes the Blank Transmission selector to reset to a NO condition. If the information transferred from the core storage during the execution of the instruction is all zeros or blanks, the selector will transfer to a YES condition and the BLANK light on the 380 Console will be turned on. The selector will remain transferred and the light will remain on until another instruction with a 6 is read.

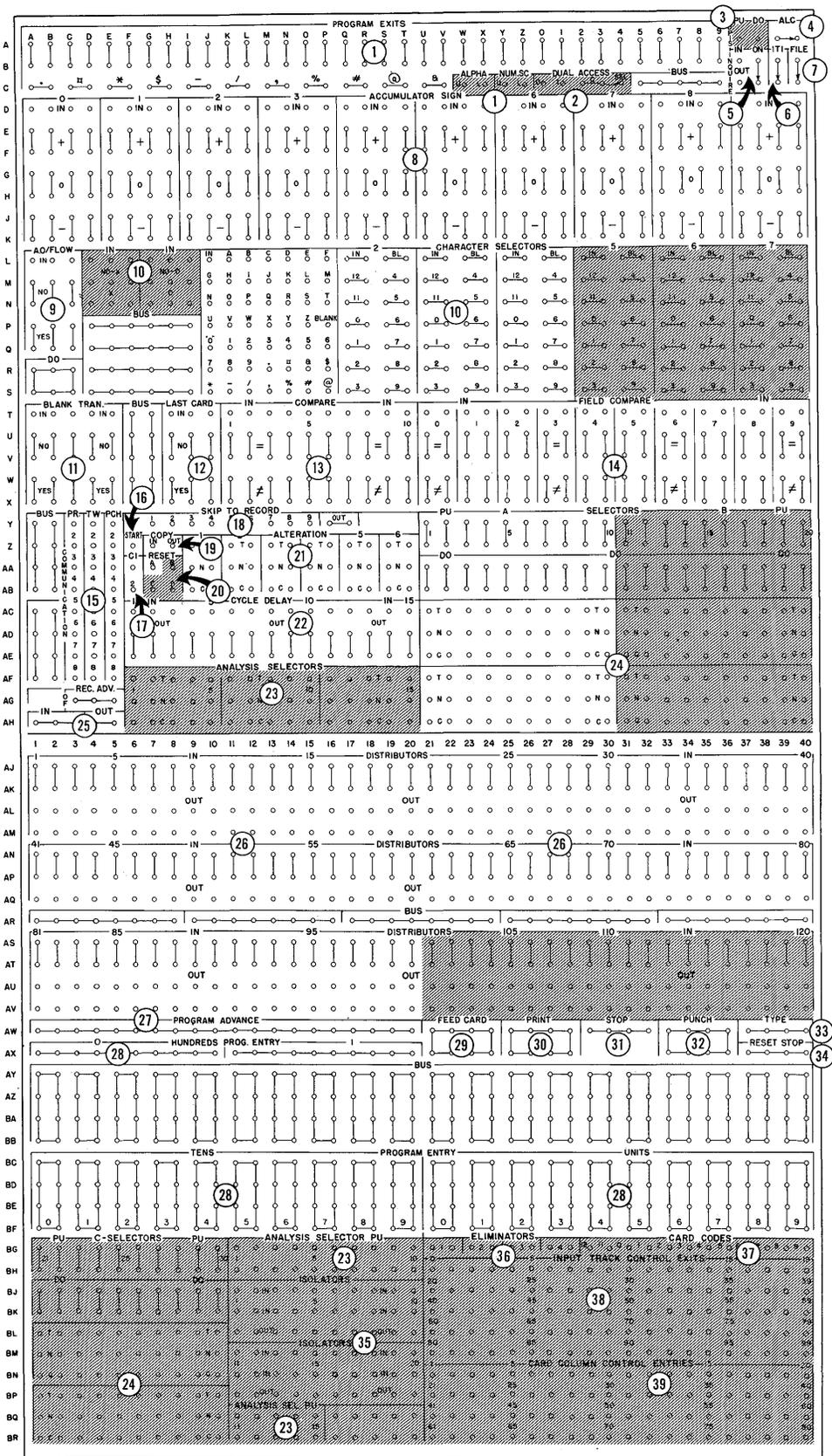


Figure 1. 305 Process Control Panel

12. **Last Card.** This selector is used to control machine operation on the run-out. Normally, a path exists between each IN hub and the NO hub beneath it. When the cards have run out of the card reader hopper, and the last card has passed the second reading brushes, if no more cards are to be entered, the operator may depress the Reader Start key and feed the last cards to the stacker. After the Start key has been depressed to initiate an additional feed cycle, the last card selector transfers. The program control may be wired through this selector to control the last card routine.

13. **Compare.** This selector stores the result of the last programmed comparison. A path is set up between each IN hub and the = (equal) hub beneath it whenever the two fields are exactly equal, and between the IN hubs and their  $\neq$  (not equal) hubs when the two fields fail to compare. These paths remain set up until another programmed comparison is made.

14. **Field Compare.** The field compare device is provided to allow, with one instruction, from one to ten fields on the track specified by the FROM address to be individually compared with the fields of a track specified by the TO address. The FROM address may refer to a process drum track, a disk track, or the core unit. The TO address may specify any process drum track other than the accumulator track. Neither the core unit nor the disk file may be used as the TO address. A 2 code is placed in the tenth position of the instruction to cause automatic field comparing. The results of a field comparison will be indicated in the ten selectors associated with the field compare device.

15. **Communication.** These hubs are connected to the correspondingly numbered hubs of the communication section on the printer, console (TW), and punch control panels, they allow for signal communication between the machine units.

16. **Start.** When the first input card after any run-out except non-process run-out has been read and checked, an impulse is emitted from this hub. This impulse is used in the same manner as a Program Exit impulse to start the stored program at the desired instruction.

17. **CI (Control Impulse).** Two buttons are provided on the operator's panel at the console to allow a control impulse to be emitted on the control panel. This allows the operator to pick up or drop out selectors, or initiate other functions from the console. These impulses are emitted from the correspondingly numbered CI hubs on the control panel.

18. **Skip-To-Record.** When one of the numbered hubs associated with Skip-To-Record is impulsed, the access arm remains on the same disk and track, but the disk address register is advanced so that the units position of the disk address corresponds to the number of the hub impulsed.

After the corresponding address has been set up in the address register, the OUT hub emits. This impulse is wired to restart the program. Normally, this device will be used in conjunction with field compare.

19. **Copy.** When the COPY IN hub is impulsed, the machine automatically transfers the contents of the input track to track I of the program storage tracks. If the input card is punched with instructions, this records instructions 190-197 on track I. The IN hub may be impulsed from the START hub.

When the transfer to track I is completed, the OUT hub emits an impulse that is wired to start the stored program at any step. Usually it is wired to start the program at step 190.

20. **Reset.** When impulsed, this hub causes the corresponding group of ten selectors to be dropped out.

21. **Alteration.** A row of switches on the operator's panel at the console is provided to allow various changes to be made in the program setup by changing the settings of the switches. On the control panel, these switches are wired in a manner similar to

selectors. Program exit impulses wired into the IN hubs emerge from the N (normal) hub of the same vertical row if the corresponding toggle switch is in the normal position. They emerge from the T (transferred) hub if the toggle switch is transferred.

22. **Cycle Delay.** These units provide a delayed impulse that may be used for control functions, such as the pickup and dropout of selectors. An impulse wired into the cycle delay IN hub emerges from the OUT hub thirty milliseconds later, where it may pick up or drop out selectors after the control impulse has ended. Whenever Cycle Delay is impulsed, programming must be advanced by the delayed OUT impulse. Additional Cycle Delay hubs may be located at AF-AH, 6-20 if Input Analysis selectors are not installed.

23. **Analysis Selectors.** These selectors analyze designated input card columns for specific codes. Two PU hubs are connected to each selector. One PU hub is wired from the Input Track Control Exit to be tested for the code; and the other hub is wired from the CARD CODE to be detected. When both PU hubs receive the same digit impulse, the selector transfers and remains transferred until the next feed card instruction. A blank column can be detected by wiring both PU hubs from the same INPUT TRACK CONTROL EXIT; transmission of any card code causes the selector to transfer.

24. **Selectors.** Latch-type selectors are furnished to provide for storage and control of operations. Each selector position has a COMMON, NORMAL, and TRANSFERRED hub. The COMMON hub is connected to the NORMAL hub until the selector is picked up by impulsing the PICKUP hub. Then the COMMON hub is connected to the TRANSFERRED hub until the DROPOUT hub is impulsed. Group D selectors may be added at BG-BR, 11-20 if Input Analysis Selectors and Isolators are not installed.

25. **Record Advance.** These hubs advance the address in the address register one sector per impulse. This feature is used mainly to obtain additional sectors where a record is spread over more than one sector. When the IN hubs are impulsed, the address in the address register is advanced one sector on the same track. When the advance is completed, the OUT hubs emit an impulse that is wired to restart the program. When the advance goes from sector 9 to sector 0, the O/F hub emits instead of the OUT.

26. **Distributors.** Impulses that are used to initiate several functions are wired through distributors that serve the same function as split wires but prevent possible back circuits. An impulse wired into the IN hub of a distributor is available at the associated OUT hubs, but impulses cannot travel between OUT hubs, or from an OUT hub to the IN hub. Any impulse except that from the OUT hub of another distributor may be wired through a distributor.

27. **Program Advance.** The stored program sequence is halted when the control is brought to the control panel as an electrical impulse. To restart the program at the next higher step, the Program Exit impulse is wired to impulse Program Advance.

28. **Program Entry.** When the program control has been brought to the control panel on a program exit, a new program sequence may be started by impulsing the appropriate program entries.

The hundreds program entry is impulsed only when it is desired to change program steps from steps below number 100 to steps above 100, or vice versa.

The new program step is set up by impulsing the tens and units hubs that correspond to the number of the program step desired. Distributors should be used.

Program Entry Isolation removes the common connections between the entry hubs, and internally connects a distributor in series with each hub. This eliminates the requirement for wiring a distributor in series with each entry hub.

29. **Feed Card.** Impulsing these hubs causes the card reader to feed a card past each station. The card passing first reading is automatically coded and recorded on one input track, while the card passing second reading is checked against the recording on the other input track that was recorded from that card on the previous card-feed cycle. When the card passing second reading has been checked, its input track is made available to the processing unit.

30. **Print.** Impulsing these hubs causes the printer to print from the output track. Format control on the printer determines the arrangement of the printing.

31. **Stop.** When these hubs are impulsed, the program will stop. If the program is advanced with the same program exit which impulsed STOP, the program may be restarted by depressing the Program Start key.

32. **Punch.** Impulsing these hubs causes the 323 Punch to punch from the output track. Wiring on the punch control panel determines which columns are punched.

33. **Type.** Impulsing these hubs causes the console typewriter to print the information recorded on the Q track. Format control on the typewriter control panel determines the arrangement in which this information is typed.

34. **Reset Stop.** These hubs may be impulsed from a stored program exit impulse when processing is to be halted. Impulsing these hubs resets the processing unit and places the machine in an inquiry-only mode of operation so that inquiries may be made. Restart by depressing the Reader Start key with cards in the hopper and the feed clear.

35. **Isolators.** Two IN hubs and one OUT hub in each Isolator permit two similar impulses to be combined without interaction between the two sources. The IN hubs of the Isolator are used to combine two Card Codes or two Input Track Control Exits. The OUT hub then emits the two impulses in the sequence in which they were received. The OUT hub of one Isolator should not be wired to the IN hub of another because connecting two Isolators in this manner decreases the reliability of the OUT impulse.

36. **Eliminators.** Four Eliminators, with two entry hubs each, are used to prevent the writing of a specific card code on the input track. The Input Track Control Exit is split-wired to the Card Column Entry to be screened and to one hub of the Eliminator. The other hub of the Eliminator is then wired from the specific CARD CODE to be eliminated.

37. **Card Codes.** These hubs emit card code impulses in the same sequence as the corresponding codes read from the input card. These hubs must not be split-wired; when two or more are wired to the same entry, they must be wired through an ISOLATOR.

38. **Input Track Control Exits.** Each of these 100 hubs selects the card column to be written in a specific track location by an impulse wired to the corresponding Card Column Control Entry hub. Any track position not wired will be blank.

39. **Card Column Control Entries.** These 80 hubs receive impulses from the Input Track Control Exits to indicate to which track position each card column will be sent. Any card column not wired to an Input Track Control Exit will not send data to the input track.

## Printer Control Panel (Figure 2)

1. **Print Control Exits.** These hubs emit control impulses as the printer is positioned to print the corresponding positions of the print line. Each hub emits one impulse per line printed; for example, hub five emits an impulse every time print position five is being set up. These impulses are wired to initiate functions such as zero suppression, X-elimination, etc.

2. **Distributors.** Impulses that are used to initiate several functions are wired through distributors that serve the same function as split wires but prevent possible back circuits. An impulse wired into the IN hub of a distributor is available at the associated OUT hubs, but impulses cannot travel between OUT hubs, or from an OUT hub to the IN hub. Any impulse except that from the OUT hub of another distributor may be wired through a distributor.

3. **Analyzers.** When a record has been transferred to the output track, and PRINT on the process control panel has been impulsed by a control code, the printer prepares to print a line. However, before the print mechanism moves from the home position, the output track may be analyzed.

By wiring from the ACI hubs of an analyzer to an output track position, the digit or character in that position of the output track will condition the analyzer so that the Analyzer Exits will emit in IBM code. The 2 exit emits for a 2, the 12 and 1 exits emit for an A, etc. If ACI is not wired to an output track position, BLANK will emit on each print cycle except MLP 2, 3, and 4.

4. **MLP (Multiple-Line Print).** The MLP function controls the printing of multiple lines from a single output record. The START hub corresponding to the number of lines desired is impulsed from an Analyzer Exit. The MLP I hubs then emit an impulse at the beginning of the corresponding MLP line, in sequence 1, 2, 3, and 4, up to the number of lines desired. (If the special MLP Repeat feature is installed, the additional MLP I hubs 5 through 8 emit in sequence for the corresponding repeat lines.) These exit impulses can be wired to pick up Line Program or Co-selectors to control the format on the corresponding print line.

MLP RPT. (Multiple-Line Print Repeat). Impulsing the IN hub serves to hold the 370 in MLP status after the initial MLP lines are printed, and initiates printing of the first repeat line. The OUT hub emits an impulse during the early analysis portion (same time as Analyzer A and B) of the first repeat line, and is wired to MLP START to select the number of additional MLP lines.

5. **Line Program Impulse.** This impulse is available during the analysis portion of the print cycle. It is, however, inactive if MLP START has been previously impulsed. During an MLP operation, the MLP IMPULSE hubs emit, and the LINE PROGRAM IMPULSE hubs are inactive.

6. **Line Program Selectors.** The line program selectors are provided to allow format control of the information being printed from the output track. Each selector has eleven positions; ten of these are grouped near the output track and an eleventh position of each selector is near the control section. Each position has a COMMON hub, a NORMAL hub, and five TRANSFERRED hubs. The COMMON hub is connected to the NORMAL hub until one of the five pickup hubs is impulsed, usually from the MLP I hubs. Then the COMMON hub is connected to the correspondingly numbered TRANSFERRED hub above it. The selectors remain transferred until the line is printed and drop out as the print head returns to the home position.

7. **Skip-To.** These hubs are impulsed from Analyzer Exits or from 305 control impulses wired through communication channels to cause the tractor to feed the paper in the printer to the corresponding hole in the control tape. In the carriage control tape, channels 1-6 stop the corresponding skips. Channel 12 in the control tape causes an impulse to be emitted from the OF (Overflow hub) that may be wired to advance the paper to the first printing line on the following form.

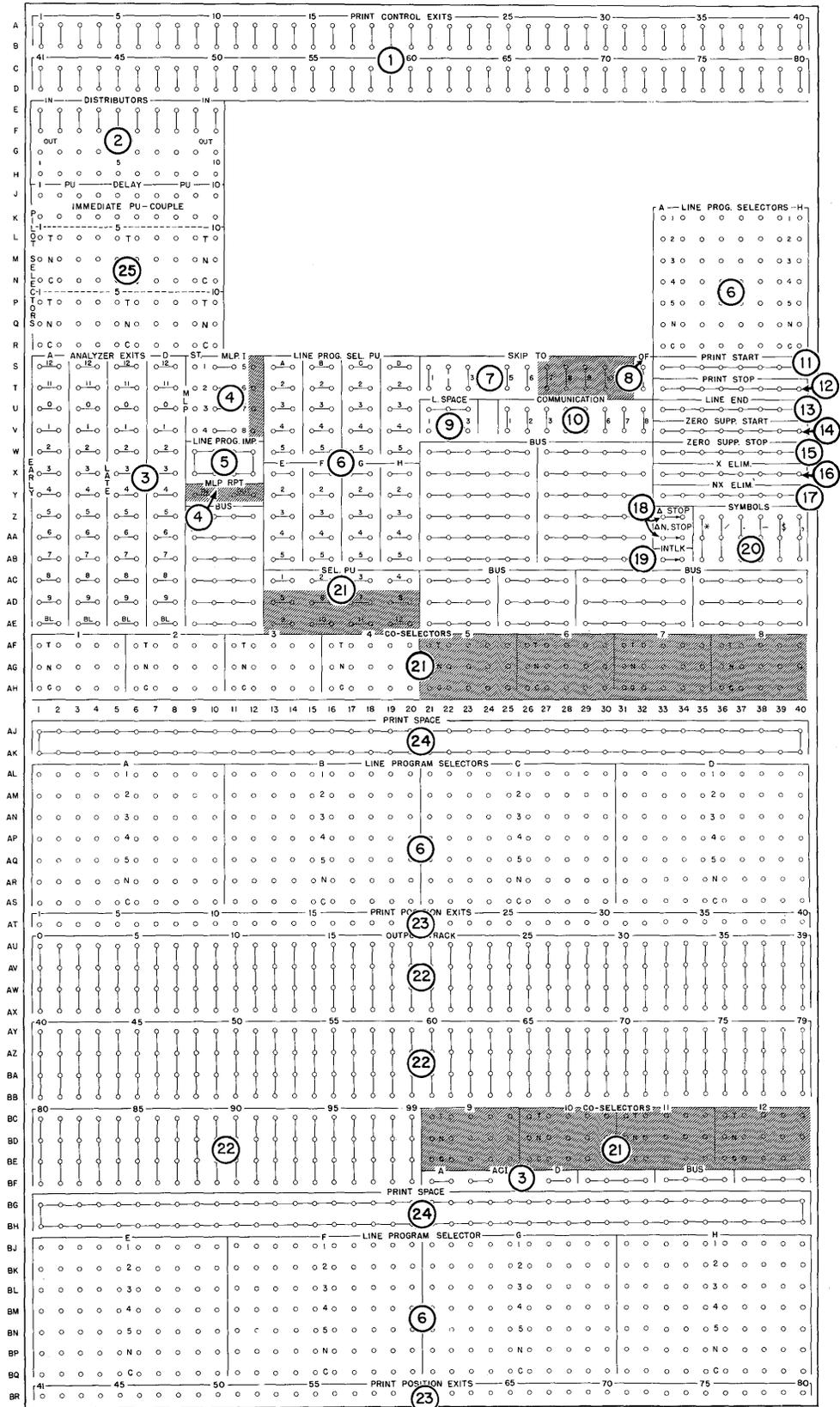


Figure 2. 370 Printer Control Panel



8. **OF (Overflow).** When a hole is sensed in the 12 channel of the carriage control tape, during the analysis portion of a print cycle, it causes an impulse to be emitted from these hubs. The impulse may be wired to cause the paper to be skipped to the first line of the following form by impulsing one of the skip-to hubs, and placing a hole in the control tape in that channel to stop the tape at the proper place. The OF impulse may also be wired through communication channels to the processing control panel, where it may pick up a selector that is tested in the course of the program to determine if the overflow condition exists. Then steps in the program can decide whether to complete the form or start the following form. If the printing is to overflow to the next form, the processing unit can, by control codes wired through communication channels, control the overflow skip.

9. **Line Space.** To allow variable spacing, the space control impulses are wired on the control panel. A jackplug may be inserted between one of the numbered hubs and the space hub above it to cause single, double, or triple spacing. Alternatively, the space control wiring may be selected to allow variable spacing.

10. **Communication.** These hubs connect to the correspondingly numbered hubs on the 305 Process Control Panel to allow signal communication between the processing unit and the printer.

11. **Print Start.** These hubs are impulsed from Print Control Exits to start printing at any desired column as the print head moves across the paper. Once the printing is started, the machine will continue to print until printing is turned off by impulsing Print Stop. In this way, printing can be turned on and off several times in the course of printing a line to give added flexibility in format control. The Print Control Exit for the first column of each field to be printed is wired to these hubs.

12. **Print Stop.** These hubs are impulsed from the Print Control Exit of the first position not to be printed, to turn printing off, if other information is to be printed later on the same line. Impulsing these hubs causes printing to be suppressed until Print Start is impulsed.

13. **Line End.** These hubs are wired from the Print Control Exit of the position after the last position to be printed on a line to cause the printing to stop and the print head to return to the home position. This allows the length of the printing line to be controlled. Variable printing lengths are possible by wiring Line End through selectors.

14. **Zero Suppression Start.** These hubs are wired from the Print Control Exit of the high-order position of a field to eliminate the printing of zeros to the left of significant digits. When these hubs have been impulsed, the print unit spaces over positions containing zeros until a significant digit (1-9) is encountered and printed; then all zeros to the right of the significant digit are printed.

15. **Zero Suppression Stop.** Once Zero Suppression Start has been impulsed, zero suppression will continue until a significant digit (not zero) is encountered and printed or until it is ended by impulsing these hubs from the Print Control Exit of the first position not to be suppressed.

16. **X-Eliminate.** Negative numbers are recorded on the output track (as on all other processing tracks) by an X-bit over the low-order position. For example, the amount 125 stands on the output track at 12N. The X-eliminate and NX-eliminate hubs allow the printer to read the X-punch or the digit punch from an output track position to separate the signed character into its sign and digit components. These hubs are impulsed from Print Control Exits to cause only the digit portion of the character being set up to be printed.

17. **NX-Eliminate.** These hubs are impulsed from the Print Control Exits to allow only the sign portion of a character to be printed (item 16).

18. **Δ (Delta).** When the two hubs labeled Δ STOP are jackplugged, if a print setup error occurs, the machine will print a Δ in the left-hand margin opposite the line in error and the machine will stop.

When the two hubs labeled Δ N. STOP are jackplugged, the machine will print a Δ, but will not stop when a print setup error occurs.

If neither Δ STOP nor Δ N. STOP are plugged, the machine will stop, but a Δ will not be printed if a print setup error occurs.

19. **INTLK (Interlock).** These hubs must be jackplugged before any printing operation can be initiated. The printer will not operate if these hubs are left unplugged.

20. **Symbols.** These hubs are wired from the Print Control Exits to cause the corresponding symbol to be printed. These symbols may be selected through the line program selectors.

21. **Co-selectors.** These selectors may be used to supplement the line program selectors. Each co-selector has five positions, and each position has a COMMON, a NORMAL and a TRANSFERRED hub. Normally, a connection exists between the COMMON and the NORMAL hub, but when the PICKUP hub is impulsed, this connection is broken and a connection is made between the COMMON and the TRANSFERRED hub in the same vertical column. Co-selectors may be picked up in the same manner as the line program selectors, and they remain transferred for the entire print line.

22. **Output Track.** At each printing position, the output track is read in its entirety, but only one character is selected for printing. This selection is made by wiring the hub corresponding to the output track position desired to the Print Position Exit corresponding to the printing position where the character is to print.

23. **Print Position Exits.** These hubs are wired from the output track (item 22) to cause the corresponding positions to be set up to print information on the output track. For example, to print position ten of the output track in print position 50, Output Track position 10 is wired from Print Position Exit 50.

24. **Print Space.** All print positions that are not wired from the output track should be wired to these hubs. This indicates to the checking circuits that the printer is not to print in the corresponding column, and allows the checking circuits to detect any position that was wired to print and failed to set up correctly.

25. **Pilot Selectors.** These selectors may be used to control printer functions based on Program Exit impulses received through communication channels, or from 370 impulses.

**IMMEDIATE PICKUP:** Selectors transfer immediately when impulsed from Analyzer A, B, C, or D Exits, Space, Overflow, MLP I Exits 1-4 (special feature MLP Repeat, MLP I exits 5-8), or a program Exit. (The program exit used must also impulse Print on the process control panel, and normally should not be used to impulse 370 functions directly — these functions should be controlled by the pilot selector.)

**DELAY PICKUP:** Accepts the same impulses as immediate pickup to transfer the selector for the following line, or lines, if MLP Exception: the couple exit of another pilot selector. When a program exit is used to impulse delay pickup, the selector transfers immediately on the first line after the program exit.

**COUPLE EXIT:** When the delay pickup hub is used, the immediate pickup hub becomes a Couple Exit.

**Drop-out:** The selectors normally drop out at the end of the line, or in the case of MLP, at the end of the last MLP line. They may be dropped out manually by depressing the Printer Reset key. Depressing the Printer Check Reset key does not drop-out the pilot selectors; they remain transferred and allow the selectors to provide the same control for all Print Repeat lines.

## Punch Control Panel (Figure 4)

1. **Output Track.** These hubs emit the IBM codes of the information on the output track. These exits may be wired to the punch magnets to cause punching. This allows any of the 100 output track positions to be punched into any of the 80 card columns.

2. **Digit Selector.** The DI hub at the top of the panel emits a series of impulses which are timed for punching the digits 12 through 9. If the DI hub is wired to the C hub beneath it, the digit selector becomes a digit emitter with a 12 impulse available at the 12 hub, an 11 impulse available at the 11 hub, etc. If an output track position is wired to the C hub, whatever digit or character appears at that output track position will be made available in IBM code at the numbered hubs of the digit selector.

3. **Sign Conversion.** Within the system, the 12 holes are coded by a combination of X and 0-bits. Also, sign control on negative fields is maintained by carrying an X-bit over the low-order position. If the low-order position of a field is zero and the field is negative, a 12-hole would be punched if this position were wired directly to a punch magnet. The sign conversion hubs are provided so that the 12-impulse available from the output track may be converted to the X/0 code desired for these positions.

In use, the low-order position of any numerical field that may be negative is wired from the output track to an IN hub and from the corresponding OUT hub to the punch magnet. If a 12-code is emitted from this position of the output track, it is punched as X/0. Any other negative number is overpunched with an X. Positive numbers pass through without conversion.

4. **Column Splits.** This is a 10-position selector that is automatically controlled to transfer between X and 0 time as the card is punched. This allows the 12 and X zones to be removed from columns and punched into other columns.

5. **Co-selectors.** As a special device, up to five groups of four 5-position Co-selectors may be installed to allow changes in punching format for different types of cards. Each selector is a five-position selector with two common pickup hubs. Each position has a C (common), N (normal) and a T (transferred) hub. The common hub is connected to the normal hub until the selector is picked up by impulsing the pickup hub. Then the common is connected to the transferred hub.

When the pickup is impulsed, the selector transfers immediately, and will remain transferred for the remainder of the punch cycle.

The Co-selector pickup hubs may be impulsed from any digit impulse, Half-After-Zero, (0-5), Pilot Selector COUPLE, or from the Punch Repeat OUT hubs; however, they should not be impulsed by a 305 Program Exit wired through a Communication Channel. Co-selectors must be used if it is necessary to select BC DET CONTROL wiring when controlling DPBC checking for different card formats, as well as the DPBC STOP, OFFSET, and BC OFF switches.

6. **Punch Magnets.** These hubs are entries to the 80 punch magnets that punch the correspondingly numbered columns of the card. These magnets are wired from the output track positions that are to be punched.

7. **Punch Brushes.** On the punch cycle after a card is punched, it passes a set of 80 reading brushes that read back the information that has been punched so that it may be given the double-punch blank-column check. These hubs are the exits for the reading on this cycle. The information may also be gang-punched back into the following card.

8. **DP & BC Det Entry.** These hubs may be wired from the punch brushes to check individual columns for double punching or lack of punching. This is particularly valuable in numerical

fields, where every position must have one and only one hole. If the machine detects multiple punches or lack of a hole in any column wired, it will stop the machine if the control is wired to do so. The DPBC light on the punch unit is turned on to indicate the reason the machine stopped.

9. **BC Det Entry or GP Exit.** If the column being checked is wired into DP & BC DET ENTRY, the first impulse to enter the DP & BC DET ENTRY emerges from these hubs, from which it may be wired to a punch magnet for gangpunching.

If a column in which double punching is permissible is to be checked for blanks, these hubs are used as an entry. The first impulse to enter these hubs emerges from the DP & BC DET ENTRY hubs.

10. **BC Det Control.** If no checking for blank columns is to be done, the Blank Column OFF switch (item 12) must be wired. To check a field for blank columns, wire the field to the ENTRY or EXIT of the DP & BC. If any one field is to be checked, wire it to the left-hand entry positions and, in the blank-column detection control row, wire from the right-hand column of the field to the last position in the row. Several fields can be entered as one field for checking purposes.

11. **DPBC Stop.** When these hubs are jackplugged, the machine will stop if a DPBC error occurs. This switch may be selected if co-selectors are used.

12. **BC Off (Blank Column Off).** These hubs must be jackplugged to turn the blank column detection feature off when no punched columns are to be checked for blank columns.

13. **Offset.** When the Offset Stacking Feature (special device) is installed, the DPBC Offset switch may be plugged to offset an error card rather than stop. It is also possible to offset different types of cards so that they may be easily distinguished from the main group of cards when removed from the stacker. This switch may be selected; however, co-selectors must be used.

14. **INT (Interlock).** Whenever the punch is to be used to punch output cards for the processing unit, this control panel switch must be jackplugged.

15. **Gangpunch.** When this control panel switch is jackplugged, the 323 Punch is removed from the control of the processing unit and may be used as an independent gangpunch.

16. **Communication.** These hubs are connected to the correspondingly numbered hubs labeled PCH on the process control panel.

17. **Punch Repeat.** When an impulse is wired to Punch Repeat IN (P or D), one additional card will automatically be punched from the same output track data.

If selectors are used, two cards with different formats can be obtained from the single output track. Without selectors, two identical cards are punched.

When Punch Repeat has been impulsed, the OUT hub on the Punch Control Panel will emit just prior to punching time of the second card. This impulse may be wired to the D pickup of pilot selectors or to co-selector pickups to control the punching for the second card.

A program exit wired through a communication channel for the purpose of impulsing punch repeat must be wired to the P (program exit) pickup. Also, the program exit that is wired to punch repeat must be the same program exit that is wired to PUNCH on the Process Control Panel.

Digits or couple exits used to impulse punch repeat must be directed to the D (digit) pickup for correct operation. As in the case of the P pickup when the D pickup of punch repeat has been impulsed, the OUT hub will emit just prior to punching time of the second card.

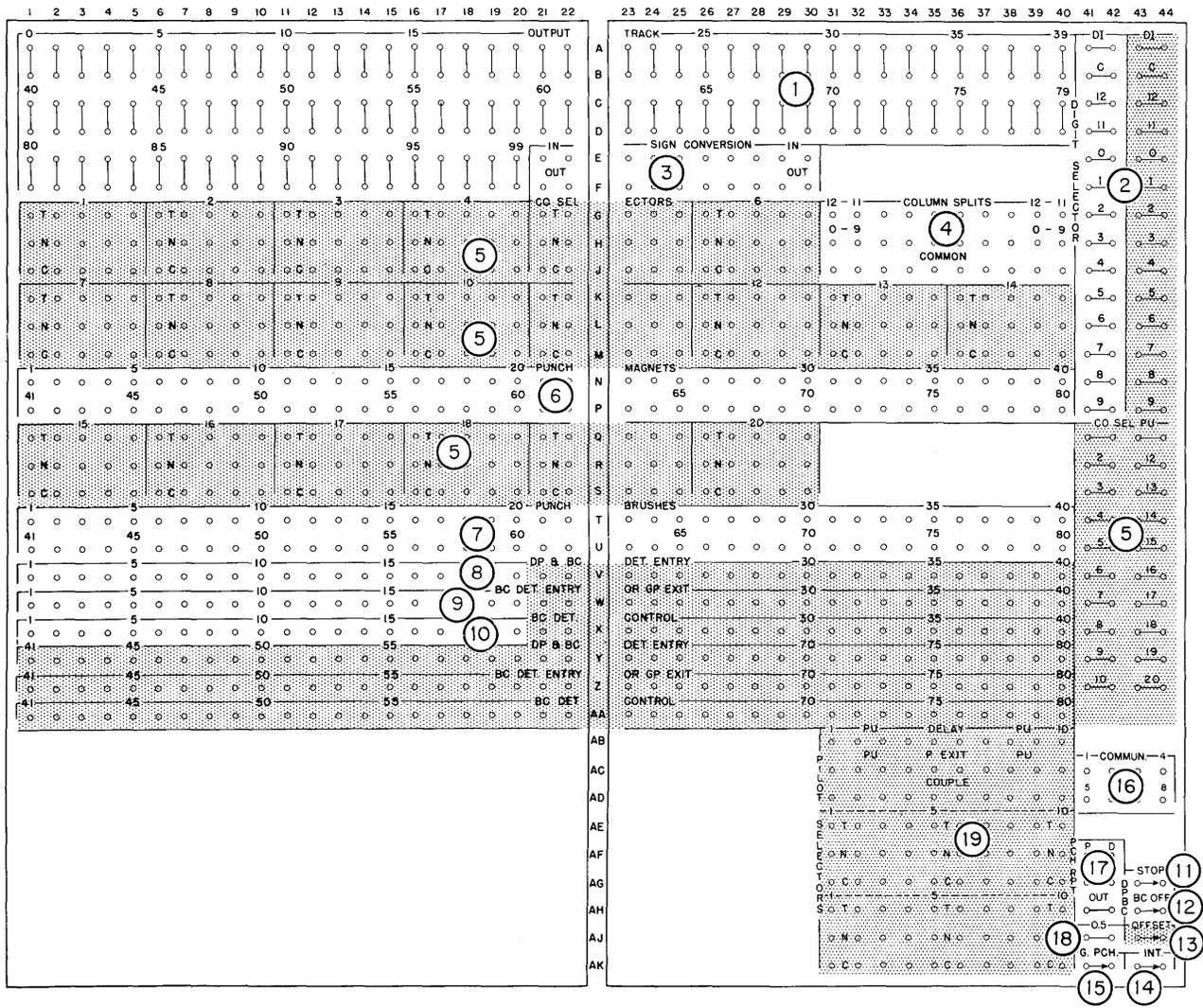


Figure 4. 323 Punch Control Panel

More than one additional card can be punched by impulsing Punch Repeat IN on successive punch cycles. The number of additional punch cycles can be controlled by the use of pilot selectors.

Punch Repeat will maintain its proper status during error restart procedures.

**18. Half-After-Zero (0.5).** This hub emits an impulse after zero time but before one time. It may be used to transfer selectors so that only the digits 1-9 are punched, or to separate the zone and numerical punching of alphabetic fields so that they can be wired for DPBC detection.

**19. Pilot Selectors.** Two groups of five 2-position pilot selectors may be installed as a special feature.

If a program exit is wired through a communication channel for the purpose of impulsing a pilot selector, the program exit must be wired to the P EXIT pickup. Improper operation will result if a program exit is wired to any other selector pickup. When the P EXIT pickup is impulsed, the selector will transfer immediately and will remain transferred for the duration of the associated punch cycle. The program exit that is wired to the P EXIT pickup must be the same program exit that is wired to PUNCH on the Process Control Panel.

It is possible to impulse the P EXIT pickup from a digit impulse; however, if an output error should occur, the selector will remain transferred throughout a run-out and run-in procedure. On a run-out and run-in procedure the last punched card is repunched on the run-in, and because the selector would be transferred during the repunching of the last punched card, operations such as split column control would not function properly.

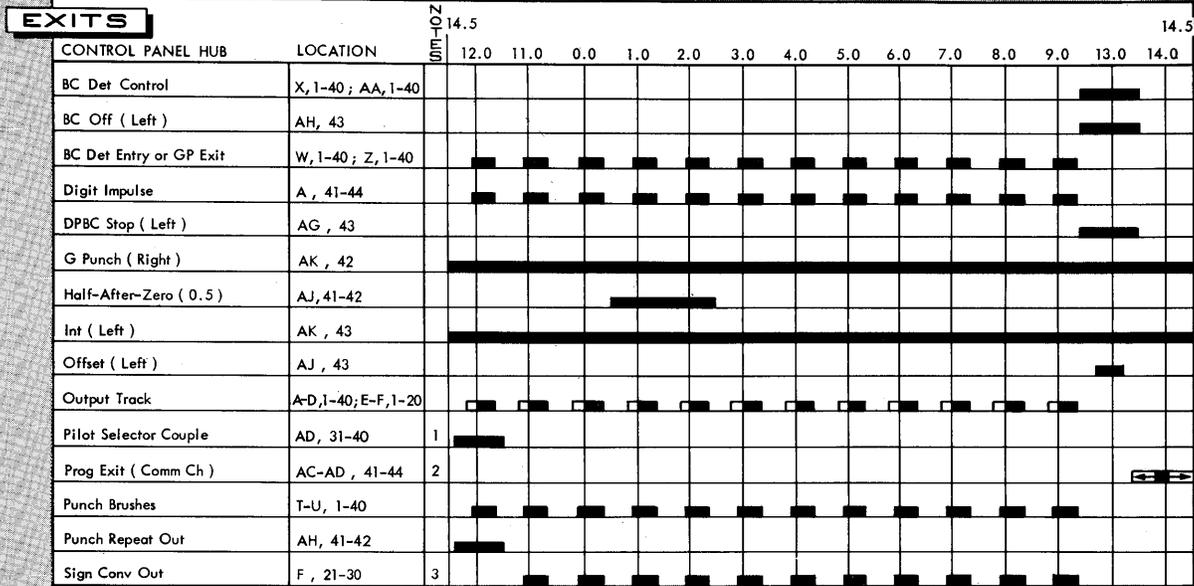
The DELAY pickup may be wired from any digit impulse, COUPLE, or from the Punch Repeat OUT hub. It cannot be impulsed by a program exit wired through a communication channel. When the DELAY pickup is impulsed, the selector will transfer one punch cycle later, and will remain transferred for one cycle. In the event of an output error, selector control will be automatically maintained.

Associated with each pilot selector is a COUPLE hub. If a pilot selector is transferred by impulsing the P EXIT pickup from a program exit, the COUPLE hub will emit just prior to punching time for that card. If a selector is picked up by impulsing the DELAY pickup, the COUPLE exit will emit one cycle later just prior to punching time.

If it is desirable to expand the number of available positions

# TIMING CHART, 323 PUNCH

- EXIT  
 VARIABLE LENGTH  
 EXIT: Begins anywhere in light area,  
 always lasts to end of dark area.
- FIXED LENGTH  
 EXIT: But may occur anywhere within  
 area indicated by arrow.



- NORMAL ENTRY  
 OTHER ENTRY

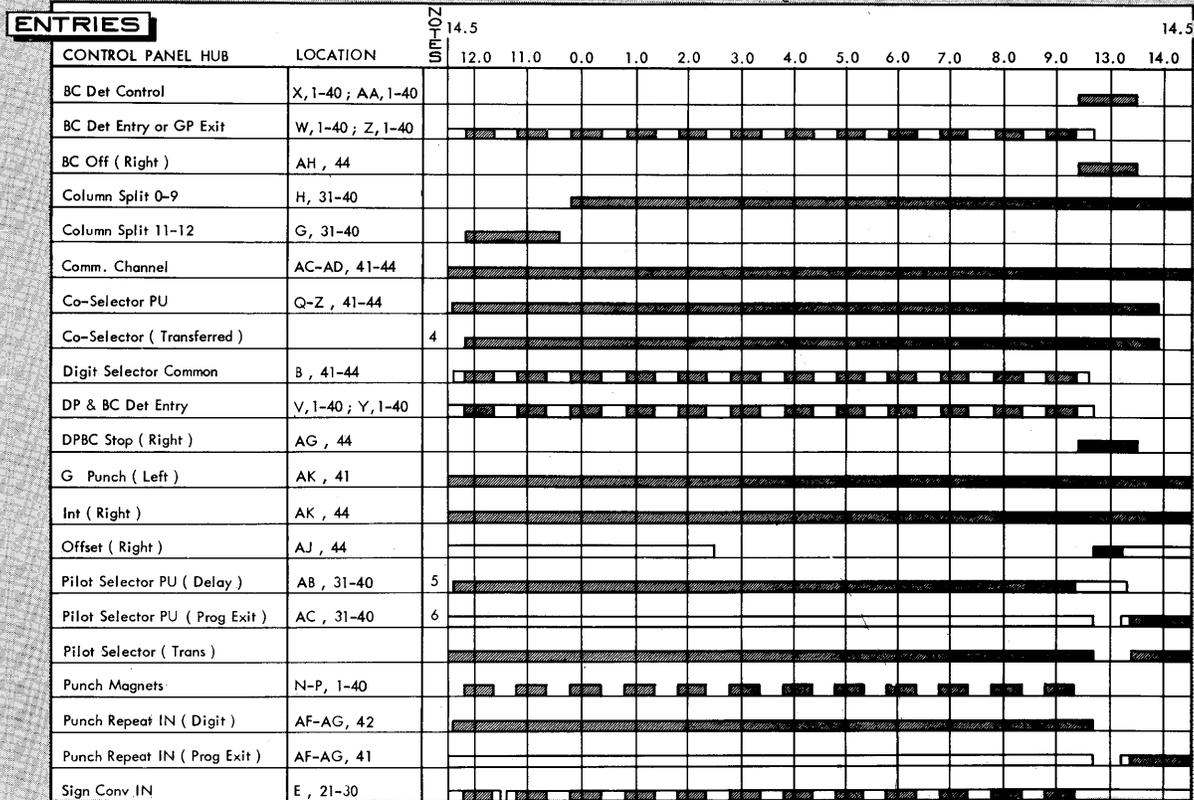


Figure 5. 323 Punch Timing Chart

of a pilot selector, the COUPLE exit may be wired to a co-selector pickup. The co-selector will then function in the exact manner as the pilot selector. COUPLE may also be wired to the DELAY pickup of another pilot selector to cause it to transfer one cycle later.

## Typewriter Control Panel (Figure 6)

1. **Column Control Exits.** When the typewriter is being used for inquiries or for printing an auxiliary document, these hubs sequentially emit impulses that coincide with the reading of the corresponding position of the typewriter Q track. These impulses control the format of the information being printed.

The first Q track position to be read is controlled by wiring the Column Control Entry (item 13). Subsequently, the machine reads succeeding positions until the control is transferred elsewhere. This arrangement allows the typewriter to type fields from the typewriter track in any order.

If at any time the program unit or the column control delay are turned on, the column control exits stop emitting, but the same sequential position is held, unless the Column Control Entry is impulsed to transfer control to another position. When the Program ON hubs are impulsed, column control is turned off until Column Control ON is impulsed. When Column Control Delay is impulsed, on the following cycle an impulse is emitted from the CCD hub, and then column control is turned on again automatically.

2. **Program Exits.** When Program On is impulsed, these hubs sequentially emit impulses when the typewriter is being used for inquiries or for printing an auxiliary document. These impulses are used for typewriter control and to type constants, legends and special characters not on the typewriter track. Until the program is turned off by impulsing Column Control On, the program advances through steps 0-4 in levels A-E. When the program is first turned on after the final dropout of the previous operation, Program Exit A0 will emit, followed by A1, A2, A3, A4, B0, B1, B2, etc. The program impulses may be started at another point by impulsing Program Entries (item 12).

3. **Digit Selector.** It is sometimes desirable to know the contents of a certain typewriter track position so that format control may be altered on the basis of the character coding. When the PU hub is impulsed from a Column Control EXIT, the character in that position is analyzed and emitted in IBM code from the hubs labelled 12-9. While this is taking place, the printing of the character is suppressed.

4. **CCD (Column Control Delay).** When Column Control Delay is impulsed, the CCD hubs emit an impulse that may be used for spacing or other functions. Column control is suspended for the cycle on which these hubs emit. After one cycle, the column control resumes from the step after the one on which the control was impulsed (item 21).

5. **Column Split (X-NX).** When Column Split is impulsed (item 24), on the next cycle column control is suspended and either the X or NX-hub will emit. The X-hub emits if the character being analyzed by the column split device contained an X-bit. If no X-bit was present, the NX-hub emits.

6. **"0" TR (Zero Transfer).** Whenever the zero transfer feature is turned on by impulsing Zero Sup On, (Item 22), a zero read from the typewriter track is not printed, but an impulse is emitted from these hubs. This impulse may be wired to Space (Item 20) to maintain vertical column alignment.

7. **100 (Type 100).** Impulsing these hubs causes all 100 characters to be typed from the typewriter track, in position sequence, without format control.

8. **Format.** These hubs emit control impulses when the corresponding format key is depressed on the keyboard. The impulses from these hubs may be used to set selectors to establish format control for three different types of inquiries and to start the typewriter control panel program.

9. **Type.** When the TYPE hubs are impulsed on the process control panel, the typewriter TYPE hubs emit an impulse that may be used to control format for lines typed out under stored program control and to start the typewriter control panel program.

10. **Selectors.** Ten 2-position selectors are provided to facilitate format control. Normally a connection exists between each c hub and the N hub above it. When an impulse is wired to the PU hub this connection is broken and the c hub is connected to the r hub above it. This connection remains until the DO (dropout) hub is impulsed.

11. **Distributors.** Impulses that are used to initiate several functions are wired through distributors that serve the same function as split wires but prevent possible back circuits. An impulse wired into the IN hub of a distributor is available at the associated OUT hubs, but impulses cannot travel between OUT hubs, or from an OUT hub to the IN hub. Any impulse except that from the OUT hub of another distributor may be wired through a distributor.

12. **Program Entry (Also item 2).** To establish the beginning of a sequence of program impulses, one LEVEL hub and one STEP hub are impulsed in the same manner that the PROGRAM ENTRIES are impulsed on the process control panel. The program unit is turned on automatically by impulsing Program Entry without impulsing Program On.

13. **Column Control Entry.** To establish the beginning of a sequence of column control (item 1), one TENS and one UNITS hub are impulsed in the same manner that the PROGRAM ENTRIES are impulsed on the process control panel. Column control is turned on automatically by impulsing Column Control Entry without impulsing Column Control On.

NOTE: Column Control Entry must not be impulsed at the same time as Column Split.

14. **Type Only.** When these hubs are impulsed from program exits or CCD, the corresponding characters are typed.

15. **Clear.** Impulsing these hubs causes the typing to stop and the carriage to return.

16. **Column Control On.** These hubs are impulsed to restore the typewriter to column control after program control has been used, if it is desired to restart from the track position after the last position used previously. Column control is turned on automatically if a column control entry is made. Program control is turned off.

17. **Program On.** These hubs are impulsed to place the typewriter under program control. Column control is turned off. Program control is turned on automatically when a program entry is made.

18. **Carriage Return.** Impulsing these hubs causes the typewriter carriage to return to the left margin.

19. **Tabulate.** Impulsing these hubs causes the carriage to tabulate to the next tab stop.

20. **Space.** Impulsing these hubs causes the typewriter to space one space.

21. **Column Control Delay (Item 4).** When these hubs are impulsed, column control is suspended for one cycle, during which an impulse is emitted from the CCD hub (item 4). Column control resumes control immediately after this cycle, continuing from the column after the column that was wired to impulse the delay.

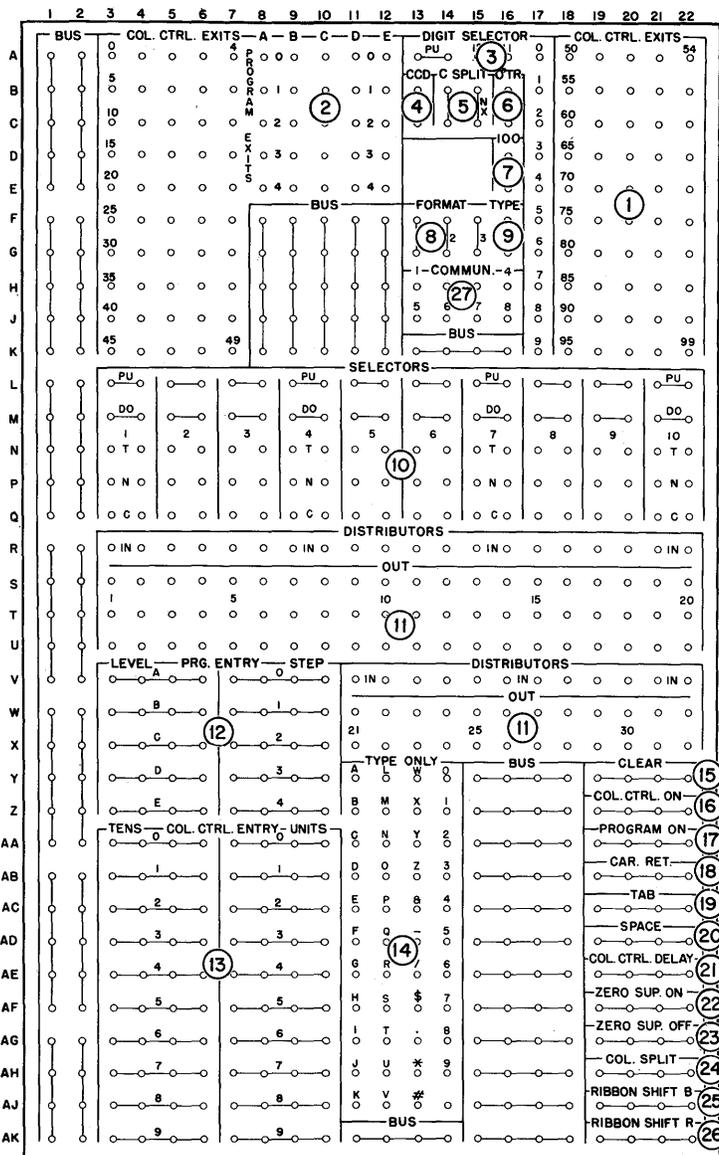


Figure 6. 380 Console Control Panel

22. Zero Suppression On (Also item 6). When this hub is impulsed, if a zero is read from the typewriter track it will not be typed, but an impulse will be emitted from the 0 TR hubs (item 6) which may be wired to cause spacing or some other function. The printing of zeros is resumed when the OFF hub is impulsed (item 23) or when a character other than zero is read from the track. This arrangement allows the zeros in the high-order position of fields to be suppressed. Zero Suppression On is impulsed one position before it is to become active.

23. Zero Suppression Off. These hubs are impulsed to turn the zero suppression feature off when it is desired to print zeros to the left of significant digits, and the feature has been turned on by previous wiring. Zero Suppression Off occurs immediately.

24. Column Split. Impulsing these hubs causes the column split device to analyze the character being typed for the presence

or absence of an X-bit. On the next cycle, column control is automatically suspended and the Column Split X or NX-hub will emit. When Column Split is impulsed from a Column Control Exit, the corresponding Q track character will type only as a numerical digit. Column Split must not be impulsed at the same time as Column Control Entry.

25. Ribbon Shift Black. Impulsing this hub causes the typewriter to type through the black portion of a two-color ribbon.

26. Ribbon Shift Red. Impulsing this hub causes the typewriter to type through the red portion of a two-color ribbon.

27. Communication. These hubs connect to the correspondingly numbered hubs labeled TW on the 305 Process Panel to allow signal communication between the processing unit and the console.

# Load Rating Chart

ALL CONTROL PANEL EXITS may be loaded to a maximum rating of 60 load units with the following exceptions:

- (1) 305 — Distributors — 30 max.
  - Inquiry Out — 30 max.
  - Start — 30 max.
- (2) 370 — Distributors — 30 max.
  - MLP I Exit — 30 max.

- (3) 380 — Distributors — 30 max.

To insure that electrical limits are not being exceeded, reference can be made to the Load Rating Table shown in Figure 7. Add the individual load rating for each function associated with an exit to be sure the maximum allowable load is not exceeded. Also, be sure that each distributor exit is not overloaded.

CONTROL PANEL	LOAD	CONTROL PANEL	LOAD	Print Space	1
ENTRY HUB	RATING	ENTRY HUB	RATING	Print Start	2
— 305 —		— 323 —		Print Stop	12
Accumulator Drop Out	3	BC Det Control	2	Skip to Hubs	3
Accumulator Overflow IN	0+	BC Det Entry	2	Symbols	12
Accumulator Sign IN	0+	Column Splits	0+	X Eliminate	2
Blank Transmission IN	0+	* Co-selector PU	2	Zero Supp Start	3
Char Sel Alpha IN	0+	Digit Selectors	0+	Zero Supp Stop	3
Char Sel Numeric IN	0+	DP & BC Det Entry	3		
Comm Channel (Print)	0+	* Pilot Selectors (D)	2	CONTROL PANEL	LOAD
Comm Channel (Punch)	0+	* Pilot Selectors (P)	3	ENTRY HUB	RATING
Compare IN	0+	Punch Magnets	10	— 380 —	
Cycle Delay	6	Punch Repeat IN (P&D)	2	Carriage Return	2
Distributors	0+	Sign Conversion IN	2	Clear	2
* DPIS DO	6			Col Ctrl Delay	2
* DPIS PU	6	CONTROL PANEL	LOAD	Col Ctrl Entry	2
* Dual Access Sel	0+	ENTRY HUB	RATING	Col Ctrl On	2
* Dual Access 0 and 1	0+	— 370 —		Column Split	4
Feed Card	3	Comm Channels	0+	Comm Channel	0+
Field Compare IN	0+	Co-selector PU	2	Digit Selector PU	2
Hundreds Program Entry	1	Distributors	0+	Distributors	0+
Inquire IN	5	Line End	8	Program Entry	2
Last Card IN	0+	Life Prog. Sel. PU	3	Program On	2
Print	5	Line Space	8	Ribbon Shift B	2
Program Advance	2	* MLP RPT IN	3	Ribbon Shift R	2
* Program Exit Split DO	3	MLP Start 1	2	Selector DO	3
* Program Exit Split PU	3	MLP Start 2	3	Selector PU	3
Punch	3	MLP Start 3	4	Space	8
Record Advance IN	5	MLP Start 4	6	Tab	2
Reset	3	NX Eliminate	2	Type 100	2
Reset Stop	3	* Pilot Selector PU (D)	2	Type Only	4
Selector PU	3	* Pilot Selector PU (I)	3	Zero Suppress Off	2
Selector DO	3	Output Track	1	Zero Suppress On	3
Skip-To-Record	6				
Stop	1				
Tens Program Entry	1				
Type	5				
Units Program Entry	2				

NOTE:

When a load rating of 0+ is shown, the load is determined by the final use of the function. For example, assume a panel impulse is wired to accumulator overflow IN, overflow NO is wired to Program Advance, and YES is wired to type and Units and Tens Entry. The load rating for the NO condition is 0+2=2. For YES, 0+5+2+1=8.

\* Special Features

Figure 7. Load Rating Chart



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