

Burroughs 205

ELECTRONIC DATA PROCESSING SYSTEMS

HANDBOOK

PAPER TAPE SYSTEM

PHOTOELECTRIC READER
HIGH SPEED TAPE PUNCH
MODEL 458 MODIFIED FLEXOWRITER
MODEL 446 TYPEWRITER CONTROL

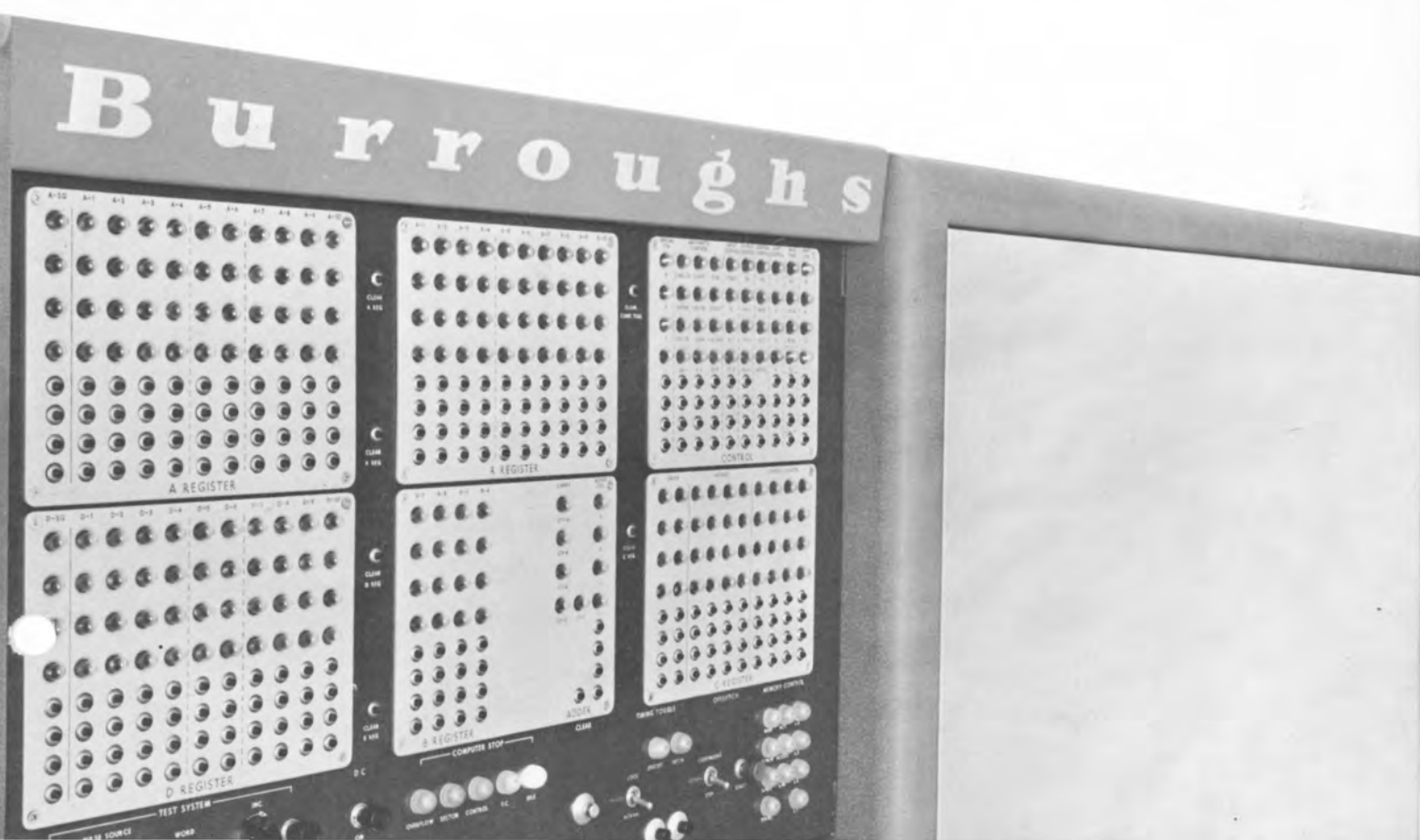


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PAPER TAPE SYSTEM HANDBOOK

GENERAL

One of the DATATRON's flexible input-output media is the Paper Tape System which provides a convenient and economical means of communication with the DATATRON. The system consists of input and output devices which read or punch perforated paper tape and a typewriter which prints out either directly from the computer or from paper tape. All input is decimal and all numeric output is decimal. Upper and lower case alphabetic characters, punctuation marks, and all other symbols on the keyboard may be printed out on the typewriter or punched out on paper tape.

COMPONENTS

Paper tape input equipment for the DATATRON consists of the Photoelectric Reader which is installed in the right desk drawer position of the Control Console, and the Mechanical Reader which is mounted on the left front side of the output typewriter.

Paper tape output equipment for the DATATRON consists of the following:

High Speed Tape Punch which punches paper tape under control of the DATATRON. It is mounted in a separate cabinet and connected to the Control Console by a single cable.

Model 458 Modified Flexowriter for typewritten page or punched paper tape output, or both simultaneously.

Model 446 Typewriter Control, a translator and format control unit which allows easy setting of line, paragraph, and page lengths on the typewriter.

DESCRIPTION OF COMPONENTS

PHOTOELECTRIC READER

The Photoelectric Reader can read information into the DATATRON at a speed of 540 decimal digits per second, or about 45 computer words per second. Operation of the Photoelectric Reader is under the control of commands from the DATATRON, or commands punched in the paper tape. The command which initiates the tape movement comes from the DATATRON, and the command which stops the Photoelectric Reader is punched in the paper tape. Loading of information from the paper tape may be intermittent.

Two types of adapters are available for use on the Photoelectric Reader: a loop adapter and a reel adapter. The loop adapter is used if the paper tape is short enough to be held by the tape bin mounted below the Photoelectric Reader. The reel adapter is used for longer sections of paper tape when the loop adapter is not practical. Each reel can hold about 100 feet of paper tape, enough for about 2000 DATATRON words.

MECHANICAL READER

The Mechanical Reader can read information into the DATATRON at a speed of about 10 characters per second. Because of the Mechanical Reader's slow rate, the preferred means of paper tape input is the Photoelectric Reader.

The Mechanical Reader, mounted on the output typewriter, is an integral part of the Flexowriter. The reading operation is started by a command from the DATATRON. The operation is stopped by a command punched in the paper tape. Intermittent operation is controlled by the DATATRON.

HIGH SPEED TAPE PUNCH

The High Speed Tape Punch operates through the Control Console to reproduce on paper tape the output information coming from the A Register of the DATATRON. The tapes so produced will subsequently serve as input tapes to the typewriter where translation can be effected, or as input tapes to the computer, via the Photoelectric Reader or the Mechanical Reader. Punching occurs at a rate of 60 characters per second. Since the A Register is being used during the punch operation, the DATATRON is not free for other operations.

FLEXOWRITER

The Flexowriter, Figure 1, is an electric typewriter with an integral punch for paper tape and a Mechanical Reader for punched paper tape. As modified for use with the DATATRON, it can be used to perform any of the following functions:

- (1) Type, or simultaneously punch and type information, numeric and alphabetic, received from the A Register of the DATATRON, at a speed of about 10 characters per second.
- (2) Punch information, numeric and alphabetic, received from the A Register of the DATATRON, at a speed of about 14 characters per second.

(3) Type, punch, or simultaneously type and punch information in either the DATATRON or Flexowriter code, received via the Mechanical Reader at a speed of about 10 characters per second.

(4) Reproduce a paper tape from another paper tape automatically, with or without translation from the DATATRON code to the Flexowriter code at a speed of about 10 characters per second.

(5) Punch a paper tape in either DATATRON or Flexowriter code.

Keyboard

The Flexowriter four bank keyboard has a total of 51 key lever positions. There are 42 keys for character operation, and the remaining 9 are for functional operations.

Carriage

The standard carriage accepts a 9-7/8 inch form with a maximum writing line of 8½ inches.

Line Spacing

The Flexowriter is equipped with a 33 tooth ratchet, permitting a line spacing of six lines per inch.

Tabulation

A tabular mechanism is provided with a minimum of two letter spaces between tab settings.

Case Shift

The type basket shifts to select printing between upper and lower case characters, with two shift keys (one for upper case and one for lower case) on each side of the keyboard. Shift key operation is required for shifting in each direction.

Carriage Return

The carriage return function is power operated with line spacing incidental to carriage return operation. Platen indexing is adjustable for single, double, or triple spacing. The left-hand margin can be adjusted in increments of one letter spaces.



Flexowriter. Figure 1

Control Switches

START READ When this switch is depressed, a prepunched paper tape moves through the Mechanical Reader.

STOP READ When this switch is depressed, the Mechanical Reader stops operation.

PUNCH ON When this switch is depressed, each character or function typed on the keyboard or read by the Mechanical Reader is punched in the paper tape by the punch unit.

TAPE FEED When this switch is depressed, blank paper tape feeds through the punch unit, provided the PUNCH ON switch is in the ON position.

CODE DELETE When this switch is depressed, a delete punch is recorded in the paper tape indicating that the associated digit is to be ignored. This punch is an instruction to the Flexowriter only, and is not sensed by the Photoelectric Reader. When the delete code is read by the Mechanical Reader, no character or function operation will occur on the typewriter or be punched by the punch unit for that digit. A paper tape containing a delete punch should not be read into the DATATRON via the Photoelectric Reader since the error will not only remain, but an extra digit will be added to the word.

STOP CODE When this switch is depressed, a stop code is punched in the paper tape. When read by the Mechanical Reader, the paper tape will stop at this point and will move forward again when the START READ switch is depressed.

POWER SWITCH The ON-OFF switch, located on the right front corner of the Flexowriter, must be in the ON position for all operations requiring use of the Flexowriter.

TYPEWRITER CONTROL

The Typewriter Control performs a variety of functions in connection with output from the DATATRON to the paper tape system. Housed in the Flexowriter Desk, it translates; codes; decodes; counts words, lines, and groups of lines; governs page format independently or in cooperation with computer commands; and receives and interprets instructions directly from the DATATRON, or indirectly, via punched paper tape. The Typewriter Control has its own power supply, and can be operated independently of the DATATRON for paper tape preparation, duplication, or transcription.

The operation of the Typewriter Control is automatic, and the operator's only concern will be with the Control Panel settings and the Patch Panel connections.

Typewriter Control Panel

The Typewriter Control Panel, Figure 2, is located on the front of the Flexowriter Desk, and contains the switches that govern page format. The facilities controlled by these switches relieve the programmer of the need to code the DATATRON for format control.



Typewriter Control Panel. Figure 2

These switches and their various functions are:

RESET BUTTON AND INDICATOR The RESET button is used to set the counters and relays of the Typewriter Control to their initial zero positions. When the RESET button is pressed, the RESET INDICATOR will be lighted. The RESET button should always be pressed before starting a program which calls for output to the Flexowriter.

ZERO SUPPRESS If the ZERO SUPPRESS switch is in the ON position, the first digit to be printed will be the first non-zero digit. Only the leading zeros will be suppressed. If this switch is in the OFF position, leading zeros are not suppressed. However, if the printout command calls for a decimal point to replace the sign, there will be no zero suppression for that printout, even though the ZERO SUPPRESS switch may be in the ON position.

SPACE-TAB This is a three position switch: SPACE, OFF, and TAB. The setting of the SPACE-TAB switch determines the horizontal spacing between printouts.

SPACE - When the switch is in this position, a typewriter space will occur between printouts.

OFF - When the switch is in this position, there will be no spacing between printouts.

TAB - When the switch is in this position, the spacing between printouts will be determined by the tab settings.

WORDS/LINE This switch has twenty positions numbered 1 through 20, and determines the number of words to be typed on one horizontal line. When the number of words typed agrees with the switch setting, the typewriter will execute an automatic carriage return with incidental line spacing.

LINES/GROUP This switch has twenty positions numbered 1 through 20, and determines the number of equally spaced lines to be typed in one group on the page. When the number of lines typed in one group agrees with the switch setting, the typewriter will execute two automatic carriage returns with incidental line spacing. This results in a double space between groups.

GROUPS/PAGE This switch has twenty positions numbered 1 through 20, and determines the number of groups to be typed on a page. When the number of groups on the page agrees with the switch setting, and, provided the AUTO STOP switch is ON, further printout will be stopped, and the DATATRON will idle if any printout command comes up for execution before the RESET button is pressed. This provides a delay for changing forms in the typewriter after the pre-determined number of groups has been typed.

GROUPING-COUNTERS This is a three position switch: ON-ON, OFF-OFF, OFF-ON. The function of this switch in each of its positions is:

ON-ON - All counters, and grouping determined by the counters, are active.

OFF-OFF - All counters, and grouping determined by the counters, are inactive.

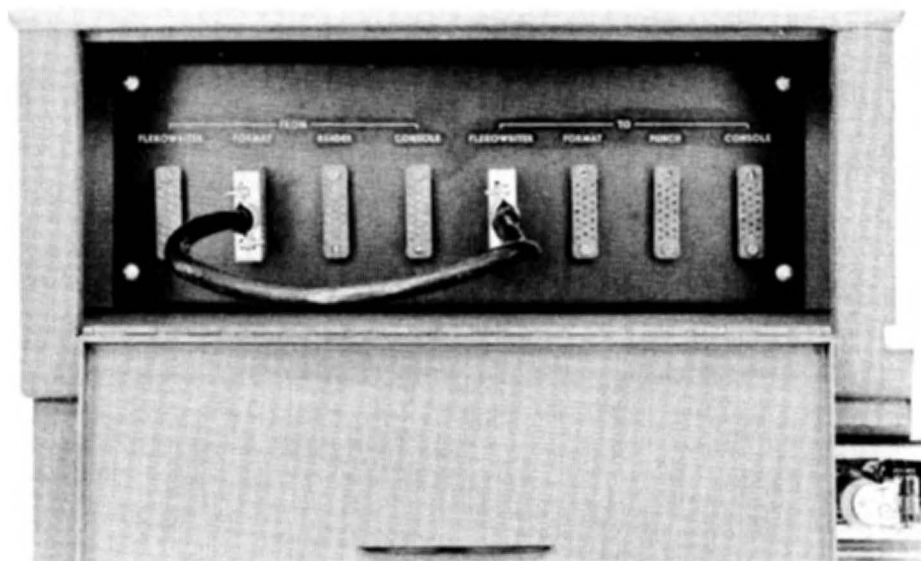
OFF-ON - All counters are active, but the grouping determined by the counters is inactive.

AUTO STOP This switch works in conjunction with the GROUPS/PAGE counter. With AUTO STOP in the ON position, printout will stop after the predetermined number of groups per page have been typed. It is necessary to press the RESET button before further computation and printout can proceed. If AUTO STOP is in the OFF position, printout will not stop at the end of a page.

POWER SWITCH The ON-OFF switch controls the power to the Typewriter Control.

Patch Panel

The Patch Panel, Figure 3, is located on the back of the Typewriter Control, directly behind the Typewriter Control Panel. It is used to set up the Flexowriter facilities for various types of input or output operations.



Patch Panel. Figure 3

The Patch Panel contains eight plugs which are divided into two groups of four each labeled "FROM" and "TO".

Individual labels over each plug refer to the source or destination of information. The "FROM" plugs refer to sources of information, and the "TO" plugs refer to devices where information is being sent. Interconnections between the various plugs are effected by means of patch cords.

All paper tape system information going into or out of the DATATRON passes through the Control Console, and the plugs labeled FROM CONSOLE and TO CONSOLE refer to

information in the DATATRON binary-coded decimal language. Any information going to the plugs labeled FORMAT is translated from DATATRON code to Flexowriter code, and format arrangement is determined by the settings on the Typewriter Control Panel. The plugs labeled PUNCH and READER refer to the Flexowriter Punch and Reader, respectively.

Interconnections on the Patch Panel for various operations are discussed in METHODS OF OPERATION.

CODE SYSTEM

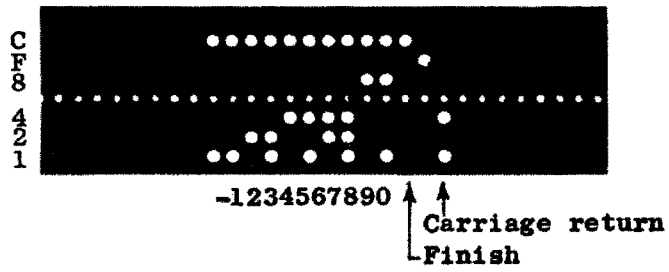
The paper tape readers communicate to the DATATRON through serial digital information read from six parallel channels of a 7/8 inch paper tape. Four tape channels are used for the binary-coded decimal digit, one channel for a clock (C) punch which accompanies each digit of a word, and one channel for the finish (F) punch which furnishes an end-of-word signal to the computer. Each digit of the computer word must be accompanied by a clock punch, since without it, the digit will not be read into the DATATRON. The digit value is punched in the lower four channels, the F and C punches in the fifth and sixth channels, respectively. The seventh channel, which is ignored by the Photoelectric Reader, is used for the delete punch as an instruction to the Flexowriter, and for the parity punch when tape is prepared with the Tape Preparation Unit. (See Tape Preparation Unit Handbook.)

Each standard computer word on the tape occupies 12 digit positions; one for the sign, ten for the binary-coded decimal digits of the word, and one for the finish punch which follows the last digit.

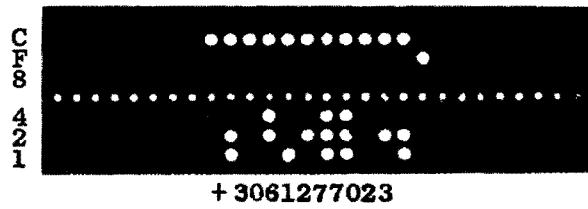
The form of a typical computer word as it would appear on paper tape for input to the DATATRON is illustrated in Figure 4. The last digit punched on the tape shown in Figure 4 is a carriage return code which is convenient for listing the contents of a tape. It causes the words to be printed in columnar form on the typewriter. The carriage return code is not accompanied by a clock punch, and is therefore ignored by the Photoelectric Reader.

The DATATRON uses a four unit binary-code which agrees with the Flexowriter code for purely numeric output. Numeric information from the DATATRON can be punched or typed on the Flexowriter without requiring translation. A typical word of numeric output as it would appear on paper tape is illustrated in Figure 5.

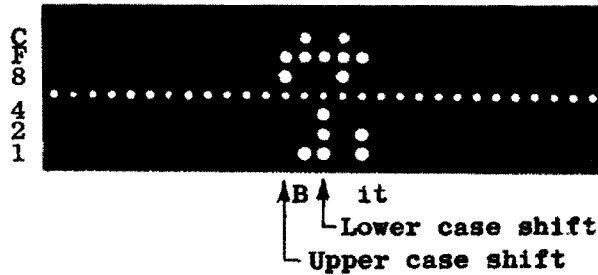
The Flexowriter uses a six unit binary-code which provides 63 possible code combinations. The Flexowriter code, as it would appear on perforated paper tape, is shown in Figure 8. A perforated tape which would be produced by the punch unit when



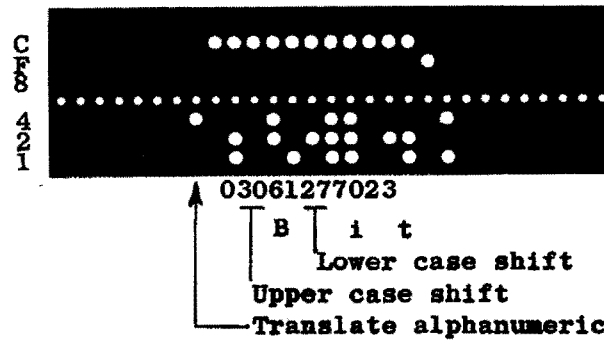
Input Word. Figure 4



Output Word. Figure 5



Translated Word (Flexowriter Code). Figure 6



Untranslated Word (DATATRON Code). Figure 7

operating simultaneously with Flexowriter type bar operation, or when the punch unit is producing tape after translation from the DATATRON code to the Flexowriter code is shown in Figure 6.

For alphanumeric output, it is necessary to translate the DATATRON four unit binary-code into the Flexowriter six unit binary-code. This requires that two adjacent digits of the computer word be used for the representation of one alphanumeric character, three binary units from each computer digit being translated on output into one six unit binary-code. This translation is accomplished by the Typewriter Control. The standard alphanumeric code for DATATRON paper tape input and for alphanumeric Flexowriter output from the computer is given in the following table:

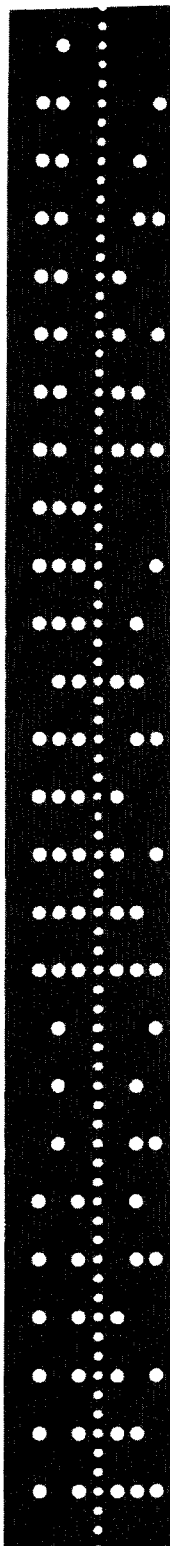
Typewriter Action		Alphanumeric	Typewriter Action		Alphanumeric
L.C.	U.C.	Code	L.C.	U.C.	Code
a	A	20	0)	40
b	B	61	1	½	41
c	C	62	2	&	42
d	D	63	3	/	43
e	E	64	4	\$	44
f	F	65	5	%	45
g	G	66	6	?	46
h	H	67	7	:	47
i	I	70	8	*	50
j	J	71	9	(51
k	K	72	+	=	24
l	L	36	-	-	25
m	M	73	;	:	26
n	N	74	,	,	31
o	O	75	.	."	32
p	P	76	:	"	33
q	Q	77		lower case	27
r	R	21		upper case	30
s	S	22		space	34
t	T	23		color shift	35
u	U	52		ignore	00
v	V	53		back space	01
w	W	54		tab	04
x	X	55		carriage return	05
y	Y	56		stop	07
z	Z	57			

Flex. Card.
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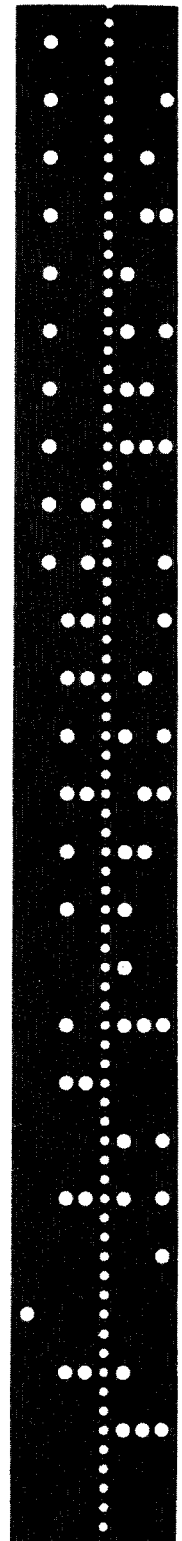
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When alphanumeric output from the DATATRON is punched by the Flexowriter punch unit and the output does not pass through the Typewriter Control, the information appears on the tape in the untranslated DATATRON code. Tape produced with this arrangement

Typewriter Action		Typewriter Action	
L.C.	U.C.	L.C.	U.C.



a	A	0)
b	B	1	½
c	C	2	&
d	D	3	/
e	E	4	\$
f	F	5	%
g	G	6	?
h	H	7	!
i	I	8	*
j	J	9	(
k	K	,	,
l	L	.	.
m	M	-	-
n	N	'	"
o	O	;	:
p	P	+	=
q	Q	Tab	
r	R	Lower case	
s	S	Upper case	
t	T	Carriage return	
u	U	Color shift	
v	V	Back space	
w	W	Delete	
x	X	Space	
y	Y	Stop code	
z	Z	Sprocket holes	



Flexowriter Code. Figure 8

is identical with that produced by the High Speed Tape Punch. The untranslated code, as it would appear on tape for subsequent alphanumeric translation is illustrated in Figure 7.

In the design of the Cardatron system, a numeric code for alphabetic characters and special symbols is utilized in which the pairs of digits are different from those now used in the Paper Tape System. The new Flexowriter code which will be compatible with the Cardatron alphanumeric code can be found in the Cardatron Handbook.

COMMANDS

INPUT

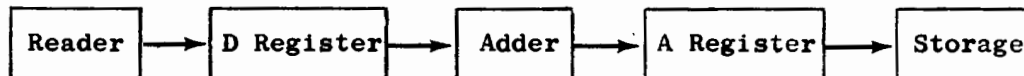
Information is read into the DATATRON from punched paper tape upon the execution of the command:

PTR READ 0000 00 xxxx

When the PTR command is executed, the DATATRON will activate the Photoelectric or Mechanical Reader, as selected by the INPUT SELECTOR Switch on the Control Console. The command is interpreted as:

Read from paper tape, transferring words to consecutive storage cells on the drum starting with xxxx. Stop input and start computation after reading a CU or CUB command (with a 6 or 7 in the sign position).

The flow of information from the paper tape reader into the DATATRON is:



Control of the paper tape reader, B Register modification of input words, and changes in the storage locations of input words are accomplished by control functions on the tape itself. The choice depends upon variations in the first control digit of the word (the sign position) after it is in the D Register.

Input words containing digits other than 0 or 1 in the first control digit position are used for control of the input device and to specify B Register modification of words during input. A 2 or 3 as the first control digit will cause the B Register to be added to the address portion of the word as the word is read into storage. The word in storage will have a positive sign (0) if there was a 2 in the sign column

of the input word; a negative sign (1) if there was a 3 in the sign column.

This is summarized in the following table:

First Control Digit on Input	B Modification on Input	B Modification before Execution	Comments
0	No	No	
1	No	Yes	
2	Yes	No	Sign in storage is 0.
3	Yes	Yes	Sign in storage is 1.

An input word with a 4, 5, 6, or 7 in the first digit position is used to control the input device, and causes the last six digits of the word in the D Register to be read directly into the first six positions of the C Register where it is immediately executed. The effect of each of these control digits appears in the table below.

First Control Digit On Input	Input Device Deactivated ²⁰	B Modification Before Execution
4	No	No
5	No	Yes
6	Yes	No
7	Yes	Yes

As commands with a 4, 5, 6, or 7 in the first control digit are read directly from the input device into the C Register for immediate execution, they never reach the storage drum. The commands most commonly used with these control digits are CU, CUB, PTR, and STOP. (For complete description of these commands, see DATATRON Handbook.)

OUTPUT

Output information from the DATATRON is typewritten on the Flexowriter or punched on paper tape for subsequent transcription on the Flexowriter, upon the execution of the command:

PTW WRITE 000p 03 ffnn

With the OUTPUT SELECTOR Switch on the Control Console set at PAGE, the command is interpreted as:

Write on typewriter, transferring the sign and nn digits from the A Register. Digits ff act as an instruction to the typewriter. Shift the contents (including sign) of the A Register nn +1 places left. The digits shifted out of the left end of the A Register re-enter the right end of the A Register in the same order.

With the OUTPUT SELECTOR Switch on the Control Console set at TAPE, the PTW command is interpreted as:

Punch on paper tape, transferring the sign and nn digits from the A Register. Punch digits ff on tape to act as an instruction to a typewriter. Shift the contents (including sign) of the A Register nn +1 places left. The digits shifted out of the left end of the A Register re-enter the right end of the A Register in the same order.

The digits ff in the first and second positions of the address portion of the command act as format instructions to the typewriter. When output is on punched paper tape, the format instructions are punched in the tape along with the output information for subsequent control of the typewriter during transcription. The first format instruction digit is punched with the F punch. The second format instruction digit is punched preceding the word.

The format instruction digits make it possible to control page format by the computer command word. It is also possible to control format by means of the external switches on the panel of the Typewriter Control which may be set for automatic spacing between words, automatic count of words per line, lines per group, etc. (Refer to TYPEWRITER CONTROL.)

The format instruction digit in the first address position of the PTW command is used to control the action of the counters in the Typewriter Control. The instruction digits and their meanings are as follows:

FIRST ADDRESS
DIGIT

MEANING

0	Count this word in external format counters.
8	Do not count this word in external format counters.




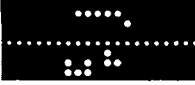






The digit in the second address position of the command word is a format instruction. These instructions, which are sensed and carried out before any other function of the command is executed, are given in the table below.

SECOND ADDRESS
DIGIT

INSTRUCTION

0	None
1	Feed out one character-space of blank tape. This instruction has no effect on the Flexowriter.
2	Suppress the sign digit. Print a decimal point.
3	Suppress the sign digit and substitute a space.
4	Ignore the sign digit. Translate alphanumerically (two A Register digits per alphanumeric character). <i>id old</i>
5	Actuate a carriage return.
6	Actuate the tab key.
7	Stop printout. Idle the computer if any printout command comes up for execution before the Typewriter Control RESET button is pressed.
8	Actuate the space bar.
9	Feed out one character-space of blank tape. This instruction has no effect on the Flexowriter.

Following are examples showing the effect of executing PTW commands with various format instructions:

<u>COMMAND</u>		<u>A REGISTER</u>	<u>EFFECT</u>
PTW 8006	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: -306275
	AFTER	6 3 6 4 1 3 0 6 2 7 5	TAPE: 
PTW 0106	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: -306275
	AFTER	6 3 6 4 1 3 0 6 2 7 5	TAPE: 
PTW 0204	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: .3062
	AFTER	7 5 6 3 6 4 1 3 0 6 2	TAPE: 
PTW 0304	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: (Space) 3062
	AFTER	7 5 6 3 6 4 1 3 0 6 2	TAPE: 
PTW 8410	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: CODE
	AFTER	1 3 0 6 2 7 5 6 3 6 4	TAPE: 
PTW 8503	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: (C/R) -306
	AFTER	2 7 5 6 3 6 4 1 3 0 6	TAPE: 
PTW 8603	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: (TAB) -306
	AFTER	2 7 5 6 3 6 4 1 3 0 6	TAPE: 
PTW 0703	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: (STOPS PRINTOUT)
	AFTER	1 3 0 6 2 7 5 6 3 6 4	TAPE: 
PTW 0804	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: (Space) -3062
	AFTER	7 5 6 3 6 4 1 3 0 6 2	TAPE: 
PTW C904	BEFORE	1 3 0 6 2 7 5 6 3 6 4	PAGE: -3062
	AFTER	7 5 6 3 6 4 1 3 0 6 2	TAPE: 

FORMAT

Format instructions to the Flexowriter are also provided by the command:

PTWF WRITE FORMAT 000p 07 0f00

With the OUTPUT SELECTOR Switch on the Control Console set at PAGE, this command is interpreted as:

Actuate typewriter as directed by digit f.

With the OUTPUT SELECTOR Switch set at TAPE, the command means:

Punch the digit f on paper tape to act as an instruction to a typewriter.

The PTWF command provides a means of controlling page format by internally programmed instructions, independent of the functions available from the Typewriter Control. The command does nothing but carry out the format instruction contained in the second address digit f. These instructions are those given in the table above. The first address digit is not sensed in the execution of this command, and, consequently, the PTWF command has no effect on the counters of the Typewriter Control. The format instructions most frequently used are 1, 5, 6, 7, or 8. If format instructions 2, 3, or 4 are used with the PTWF command, their effect will be exercised on the following PTW command.

It should be noted that if the PTWF command is used for tab operation or carriage return, computation can proceed while the operation is being carried out on the typewriter. However, a tab or carriage return immediately preceding the PTW command or in the PTW command itself can cause a loss of time. When possible, a PTWF command should closely follow the preceding typewriter operation.

METHODS OF OPERATION

INPUT SELECTOR SWITCH

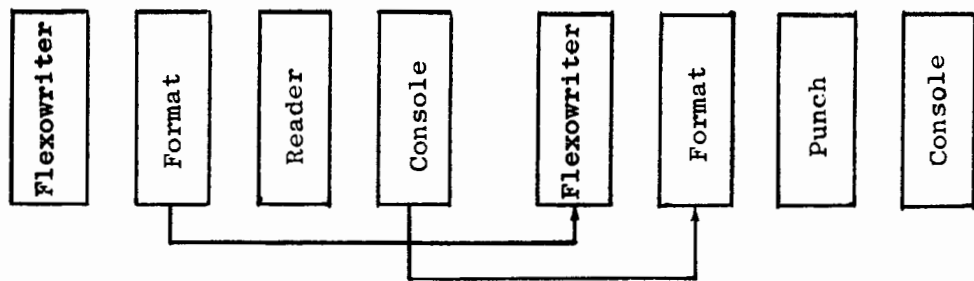
The INPUT SELECTOR Switch on the Control Console (see Control Console Handbook) selects the appropriate reader for paper tape input. With this switch set at OPTICAL READER, the DATATRON will accept information directly from the Photoelectric Reader. With the switch set at MECHANICAL READER, the DATATRON will accept information directly from the Mechanical Reader. Both tape readers start under control of the DATATRON.

OUTPUT SELECTOR SWITCH

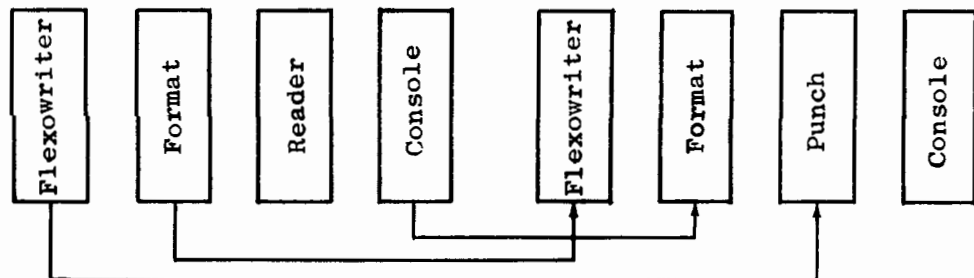
The OUTPUT SELECTOR Switch on the Control Console (see Control Console Handbook) selects the appropriate destination for DATATRON output to the paper tape system. With this switch set at TAPE, the DATATRON will direct output information from the A Register to the High Speed Tape Punch. With the switch set at PAGE, the DATATRON will direct output information from the A Register to the Typewriter Control Patch Panel.

PATCH PANEL CONNECTIONS

The labels of the eight plugs on the Patch Panel are intended to serve as guides in making connections for specific applications. Some examples of Patch Panel connections are:

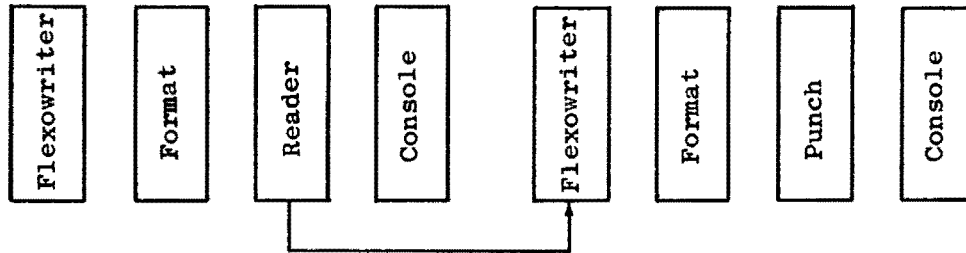


With this arrangement and the OUTPUT SELECTOR Switch set at PAGE, output information from the DATATRON is sent to the Typewriter Control for translation and interpretation of format instructions, and from the Typewriter Control, the information goes to the typewriter.

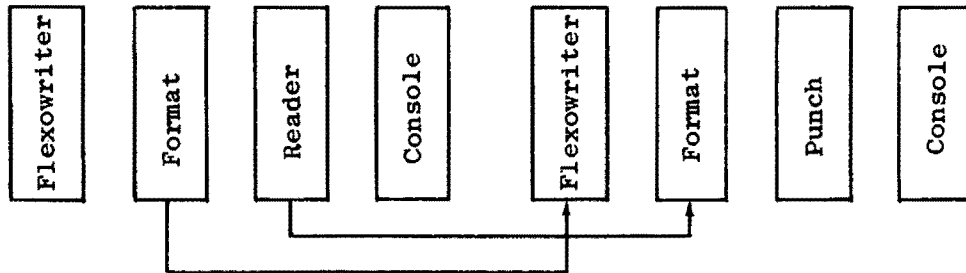


With this arrangement and the OUTPUT SELECTOR Switch set at PAGE, translated output information will be printed and punched at the same time, if the PUNCH ON switch on the Flexowriter is ON. Blank tape can be interspersed between

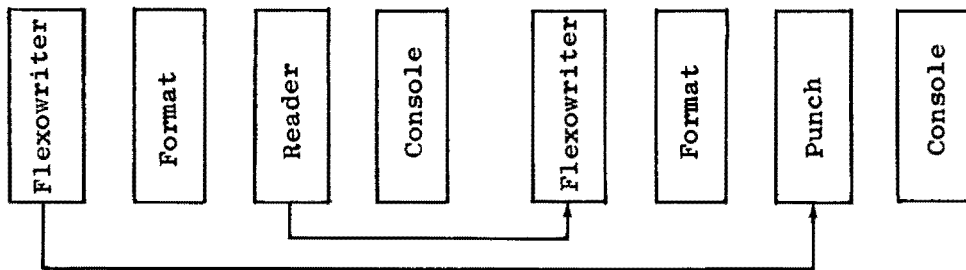
printouts by pressing the Flexowriter TAPE FEED switch.



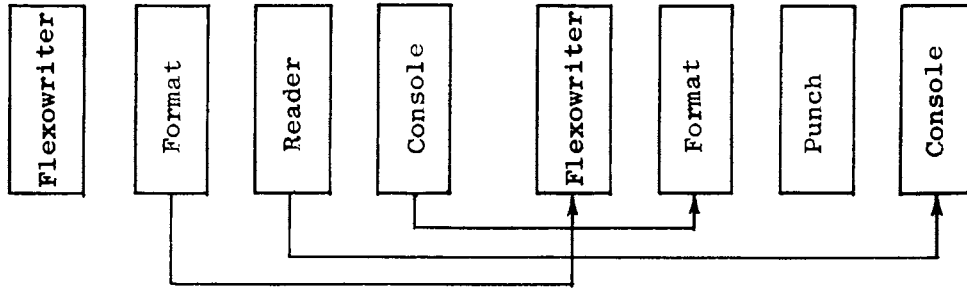
With this arrangement, translated paper tape read by the Mechanical Reader is typed.



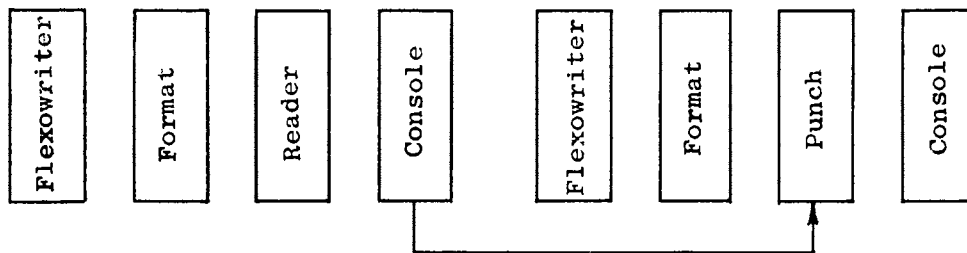
With this arrangement, untranslated paper tape read by the Mechanical Reader is typed. Format instructions punched on the tape are executed, as well as the format control functions determined by the settings of the switches on the Typewriter Control Panel.



With this arrangement, translated paper tape read by the Mechanical Reader is typed, and, simultaneously, a paper tape is reproduced on the punch unit.



With this arrangement and the INPUT SELECTOR Switch set at MECHANICAL READER, information is read into the DATATRON from the Mechanical Reader under control of the DATATRON and commands punched in the paper tape. With the OUTPUT SELECTOR Switch set at PAGE, translated output information is printed on the typewriter.

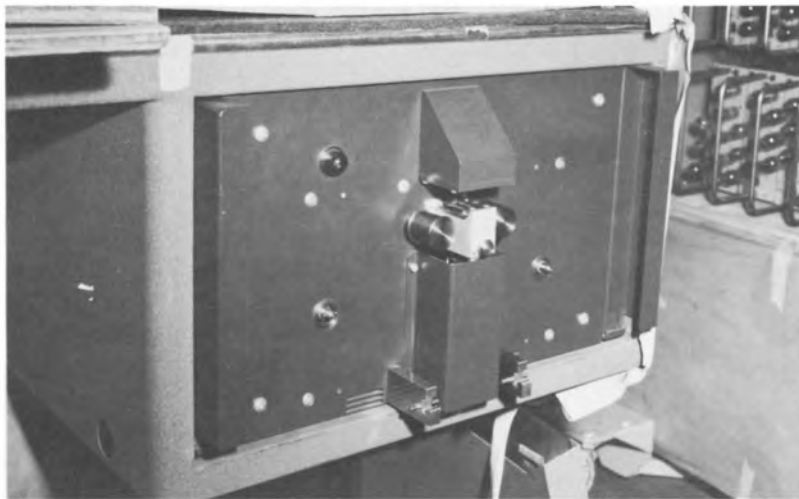


With this arrangement and the OUTPUT SELECTOR Switch set at PAGE, untranslated output information from the DATATRON will be punched on a paper tape. Paper tape produced with this arrangement is identical with that produced by the High Speed Tape Punch.

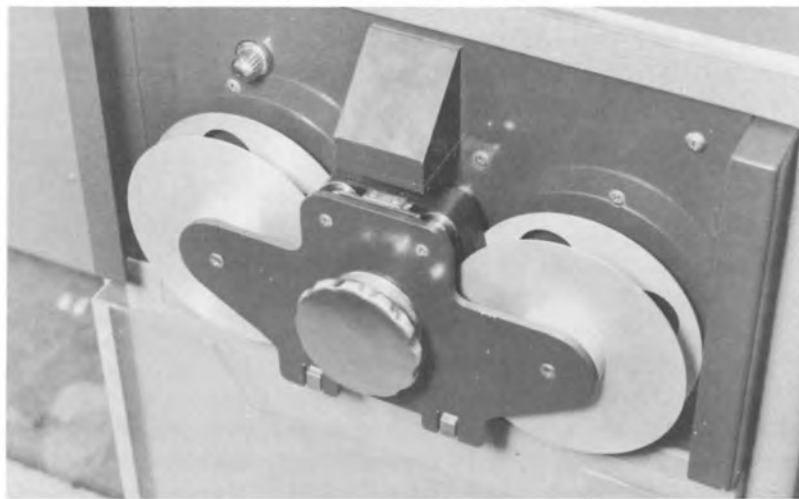
LOADING PAPER TAPE

Photoelectric Reader

The front of the Photoelectric Reader chassis is shown in Figure 9. The two assemblies designed to hold the tape and guide it over the reading head are shown in Figures 10 and 11. Hinge pins on both assemblies fit into brackets at the bottom of the chassis. The larger assembly, the Reel Adapter, Figure 10, is designed for tapes containing roughly 1000 words or more, or frequently used tapes stored on reels. The smaller assembly, the Loop Adapter, Figure 11, is for shorter tapes which are sometimes spliced into loops. Either assembly is conveniently handled by a knob which



Photoelectric Reader. Figure 9



Reel Adapter Figure 10



Loop Adapter. Figure 11

serves to lock it into place on the reader chassis. The movement of the tape, to an observer facing the reader, is from left to right, with the C punches on the side of the tape toward the observer.

To Use the Reel Adapter:

Place the hinge pins of the adapter in the brackets on the reader chassis.

Fit the reels on the drive shaft of the adapter, the loaded reel of tape on the left.

Insert the loose end of the tape from the loaded reel into the slot of the take-up reel so that the tape comes off the bottom of both reels and over the pivoted tape support. Give the take-up reel one or two turns.

Turn the knob counterclockwise and raise the adapter into position and, leading the tape over the raised tape guides, fit the reel into place.

Turn the knob clockwise which locks the adapter in place, lowers the tape guides, and allows the tape to rest on the read head.

To Use the Loop Adapter:

Place the tape in position over the read head.

Place the hinge pins of the adapter in the brackets on the reader chassis.

Turn the knob counterclockwise and push the adapter forward over the tape.

Turn the knob clockwise, which locks the adapter in place.

Give a light tug on the tape on the left side to take out the slack.

Mechanical Reader

When facing the Mechanical Reader from the side of the Flexowriter, the movement of the tape is from left to right, with the C punches on the side of the tape toward the observer.

To Use the Mechanical Reader:

Raise the paper tape hold-down arm.

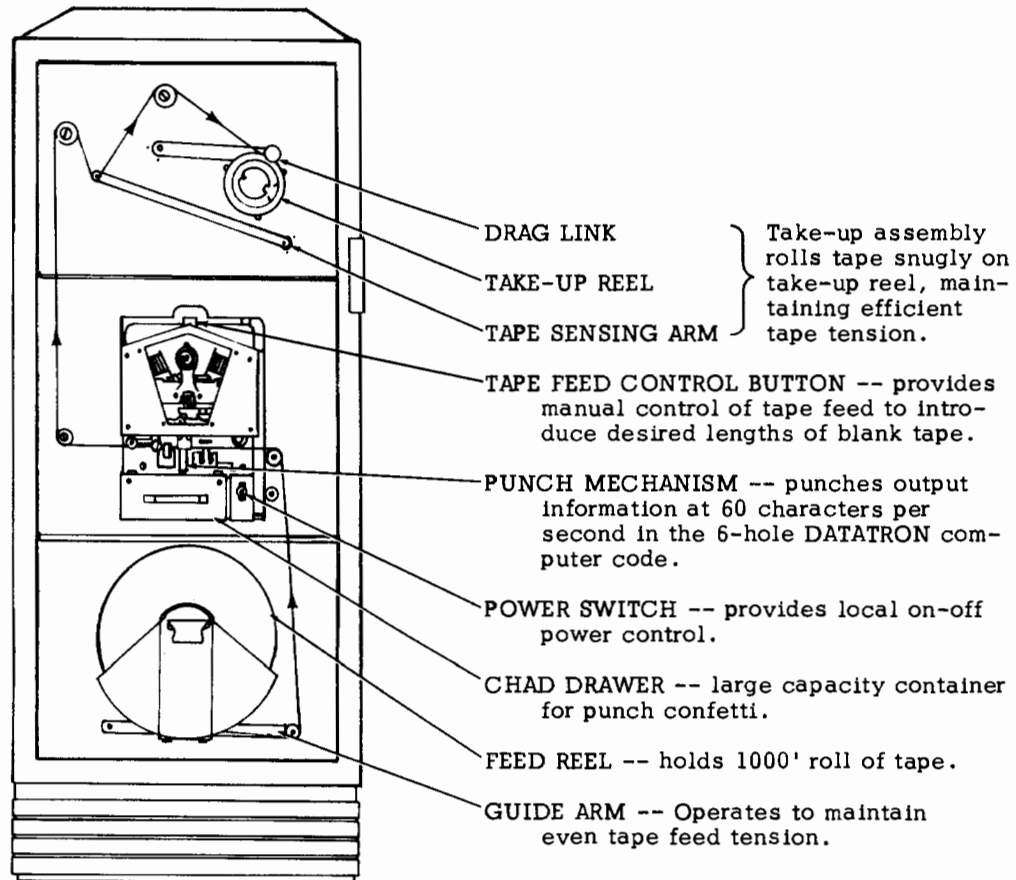
Slide the paper tape under the guide block and engage the feed pinwheel in the paper tape feed holes.

Lower the paper tape hold-down arm.

Thread the paper tape through the guide bracket and underneath the guide lip.

High Speed Tape Punch

To insert a new roll of paper tape in the High Speed Tape Punch, install the roll of paper tape as shown in Figure 12, threading the tape over the guides to the punch as shown by the arrows. To thread the paper tape through the punch mechanism, manually feed the paper tape into the punch pins while operating the tape feed control button. Feed out a sufficient leader to reach the take-up reel, and thread the tape over the guides to the take-up reel as indicated in Figure 12.



High Speed Tape Punch. Figure 12

Flexowriter Punch

To insert a new roll of paper tape in the Flexowriter, install the roll of tape and thread it through the guides to the punch. Move the tape hold-down arm forward, which lifts the paper tape run-out arm, permitting free insertion of the paper tape edgewise into the correct position. Run out blank paper tape by pressing the TAPE FEED switch.

READING A PROGRAM ON PAPER TAPE INTO THE DATATRON

- (1) Press the CLEAR button.
- (2) Set the INPUT SELECTOR Switch to the appropriate paper tape reader (OPTICAL or MECHANICAL).
- (3) Set the BREAKPOINT Switch to the desired position.
- (4) Set the OUTPUT SELECTOR Switch to the desired position. If on PAGE, and external format control is being used, check the Patch Panel connections and press the RESET button on the Typewriter Control Panel.

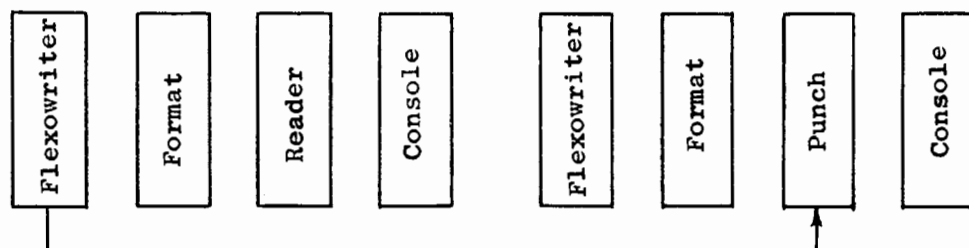
At this time, the DATATRON is standing ready to receive input information. The "Clear" operation placed the PTR command (00 0000) in the C Register, and set the DATATRON to the "Execute" phase.

- (5) Press the CONTINUOUS button. This initiates the read-in from the paper tape which will continue automatically under control of the DATATRON and paper tape command words.

TAPE PREPARATION

The Flexowriter can be used to prepare punched paper tape for input to the DATATRON. This is accomplished as follows:

- (1) Patch Panel connection:



(2) Flexowriter PUNCH ON switch depressed.

As the numerical data and commands for the DATATRON are typed on the numeric keys of the keyboard, the digits are punched by the Flexowriter punch unit with a corresponding clock (C) punch. The finish (F) punch at the end of each computer word is obtained by typing a lower case A. A carriage return after each word has been typed will produce a proof sheet in columnar form which can be used to check for errors punched into the paper tape.

It is advisable to have about 15 inches of blank tape at the beginning of the input tape. This is done by depressing the TAPE FEED switch on the Flexowriter. Later, when the paper tape is used for input, the blank tape allows time for the photocells to warm up and for the tape drive to come up to speed before the reading operation commences. Also, it is sometimes helpful to have blank paper tape at the end and at several intervals throughout the tape to facilitate making corrections or insertions if they become necessary.

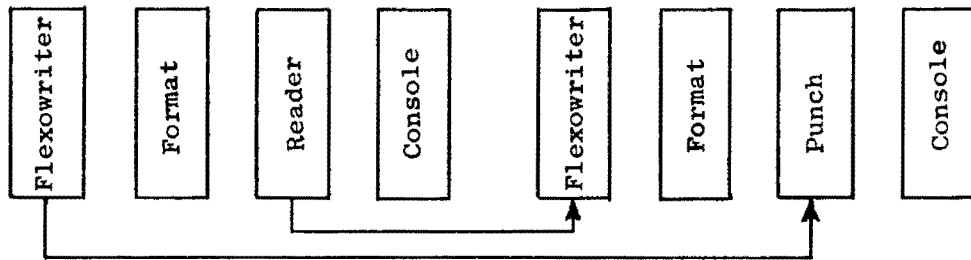
If an error is discovered immediately after the digit is punched, the error may be deleted and the correct digit punched before continuing on. An error is deleted by placing the erroneous character directly under the punch dies and depressing the CODE DELETE switch on the Flexowriter. To delete an entire word, it is necessary to depress the CODE DELETE switch for each character in the word, including the finish (F) punch. When the tape is later reproduced on the Flexowriter, the deletions will be effected into the new tape. A tape containing a delete punch should never be read into the DATATRON by the Photoelectric Reader.

If an error is not discovered until later, it is necessary, when reproducing the tape, to stop the read-in of the old tape at the word to be deleted by means of the STOP READ switch on the Flexowriter and manually punch the correct information via the keyboard. The erroneous word must be manually fed through the Mechanical Reader. Upon depressing the START READ switch, the paper tape reproduction operation will continue.

TAPE DUPLICATION

The Flexowriter can be used to reproduce a paper tape from another prepunched tape. The procedure is as follows:

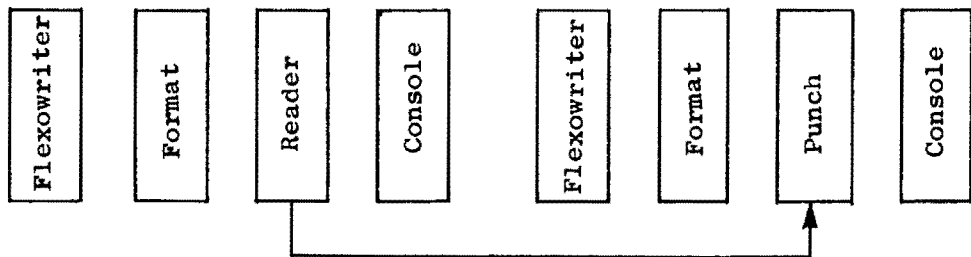
(1) Patch Panel connection:



- (2) Place the leading end of the paper tape which is to be duplicated in the Mechanical Reader. (See Mechanical Reader.)
- (3) Depress the PUNCH ON switch.
- (4) Feed out blank paper tape on the new paper tape by depressing the TAPE FEED switch.
- (5) Press the START READ switch.

The original tape will feed through the Mechanical Reader and a reproduction will be punched by the punch unit. With the above Patch Panel connection, the information will also be printed by the typewriter. If the old tape contained delete punches, those digits will not be punched in the new tape or printed on the page.

This Patch Panel connection eliminates the typewritten page:



RELATIVE CODING

It is sometimes not desirable to make the address parts of command words specific. This condition may arise in the coding of sub-routines or when several sections of a large problem are coded separately and it is not known in advance just where in storage a given section will be placed. The commands may be coded with

relative addresses: that is, the addresses are assigned on the assumption that this section of coding will be stored in consecutive cells beginning with 0000.

Such relative codes may be stored anywhere on the drum for execution. On input, the B Register is used to adjust the address parts of the words to the absolute locations at which the commands are stored. This is accomplished by having a digit 2 or 3 in the first control digit position (the sign position) of those words whose address portions are to be changed. On input, the digit 2 specifies that the contents of the B Register are to be added to the address portion of the word; the digit 2 is removed before the word is stored on the drum, so that the input word will appear in storage with a 0 in the sign position. Similarly, a sign digit 3 specifies that the contents of the B Register are to be added to the address portion of the word; the 3 is changed to a 1 before the word is stored.

Since address parts of command words are usually references to quick access storage locations, it is not necessary to modify such words by the B Register on input. Only if the address part is to refer to a main storage location during the execution is a modification necessary.

The following is an example of coding with relative addresses:

Problem: Printout a block of twenty words starting at any storage location. Assume that it is desirable to be able to place the program for this printout in any convenient storage location.

Solution: Set the B Register manually to 1120, assumed to be the first of the vacant cells where the program will be placed.

Set R1, R2, R3, and R4 manually to 2250, assumed to be the address of the first of the 20 words which are to be printed out.

Read in the following program punched on paper tape:

PROGRAM ON TAPE	PROGRAM IN STORAGE	EFFECT
5 0000 PTR 0000		
0000 2 0000 CAD 0012	1120 0 0000 CAD 1132	Forms a 1 0000 CAD 2250 command in cell 1124.
0001 0 0000 SL 0004	1121 0 0000 SL 0004	
0002 2 0000 STC 0004	1122 0 0000 STC 1124	
0003 2 0000 SB 0007	1123 0 0000 SB 1127	Sets B Register at 0000.
0004 (1 0000 CAD 2250)	1124 (1 0000 CAD 2250)	Prints out the 20 words in columnar form.
0005 0 0000 PTW 0010	1125 0 0000 PTW 0010	
0006 0 0000 PTWF 0500	1126 0 0000 PTWF 0500	
0007 0 0000 IB 0000	1127 0 0000 IB 0000	
0008 0 0000 BA 0000	1128 0 0000 BA 0000	Test for completion of printout of 20 words.
0009 2 0000 SU 0013	1129 0 0000 SU 1133	
0010 2 0000 CNZ 0004	1130 0 0000 CNZ 1124	
0011 0 0000 STOP 0000	1131 0 0000 STOP 0000	Stops the computer.
0012 1 0000 00 0064	1132 1 0000 00 0064	
0013 0 0000 00 0020	1133 0 0000 00 0020	
7 0000 CU 0000		

The 5 in the first control digit of the PTR paper tape command will start loading the program into storage cells starting at the address specified by the contents of the B Register. The 7 in the first control digit of the CU paper tape command will stop the reader and will start the execution of the program with the first command which is located at the address specified by the B Register.

A relatively coded program can be placed in any specified storage location automatically, without a manual setting of the B Register before read-in. For illustration, assume that, as in the foregoing example, the program is to be placed in consecutive storage locations beginning with cell 1120. Attach a tape containing the following commands immediately ahead of the relatively coded program:

	4 0000	PTR	1120	Starts reading the paper tape into cells beginning with address 1120.
1120	0 0000	SB	1121	Executes the B Register setting before reading in the program.
1121	0 0000	PTR	1120	Starts reading the relatively coded program into cells beginning with 1120.
	4 0000	CU	1120	Changes control to execute the command in cell 1120, but does not stop the movement of the paper tape through the reader.

The relatively coded program follows after six inches of blank paper tape which allows time to execute the two commands in cells 1120 and 1121. The program reads in over the commands which were used to set the B Register for control of the read-in operation so that it is not necessary to use two additional storage locations. The program appears in storage exactly as it did in the preceding example.

It is important to note that a relatively coded program which is to be block transferred into a loop must be placed in storage in consecutive locations beginning with an address which is a multiple of 20. If this were not the case, the references within the loop would not correspond to the correct addresses.

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