TX-0 COMPUTER
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OPERATION OF THE OFF-LINE FLEXOWRITERS

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The flexowriter is an electric typewriter with attached paper tape reader and punch mechanisms as illustrated in Figure 1. It is used for preparing, printing, editing and reproducing English program tapes for the TX-0 computer. Binary tapes may also be reproduced. The important operating controls are indicated in Figure 1. Before using the flexowriter, the user should be sure that:

1. an adequate supply of blank paper tape is present.

2. the paper is correctly inserted in the carriage and the paper release lever is in its released position. (toward the user)

3. the reproduce-no-print switch is in the desired position.

4. the seventh code switch is in the desired position.

When finished, the user is expected to turn off the power switch, discard any typescripts or tape which are not needed, and leave the room in a neat condition.

If a user discovers errors made by a flexowriter, he is requested to record these in the log on the TX-0 console stating which flexowriter gave the trouble, the mode of use, and, as accurately as possible, what the error was. If a machine jams or becomes inoperable in some other way, notify the TX-0 staff, or if after hours, leave a note on the machine and make an entry in the log. Under no circumstances are users to attempt repairs of flexowriters!

The Flexowriter Code

For each character of the flexowriter keyboard and each machine function such as carriage return, backspace, and the case shifts, there corresponds a unique two-octal-digit code. These code values are given at the end of this memo ordered in alpha-numeric sequence and by code value. Each

reproduce-no-print switch

paper release lever

carriage release button

punch die block

punch tape hold down

punch manual feed knob

tape guide

reader manual feed knob

reader tape hold down

tape guide

carriage release button

seventh code switch

tape feed switch

code delete switch

stop code switch

power switch

keyboard

ignore stop code switch

punch on switch

stop read switch
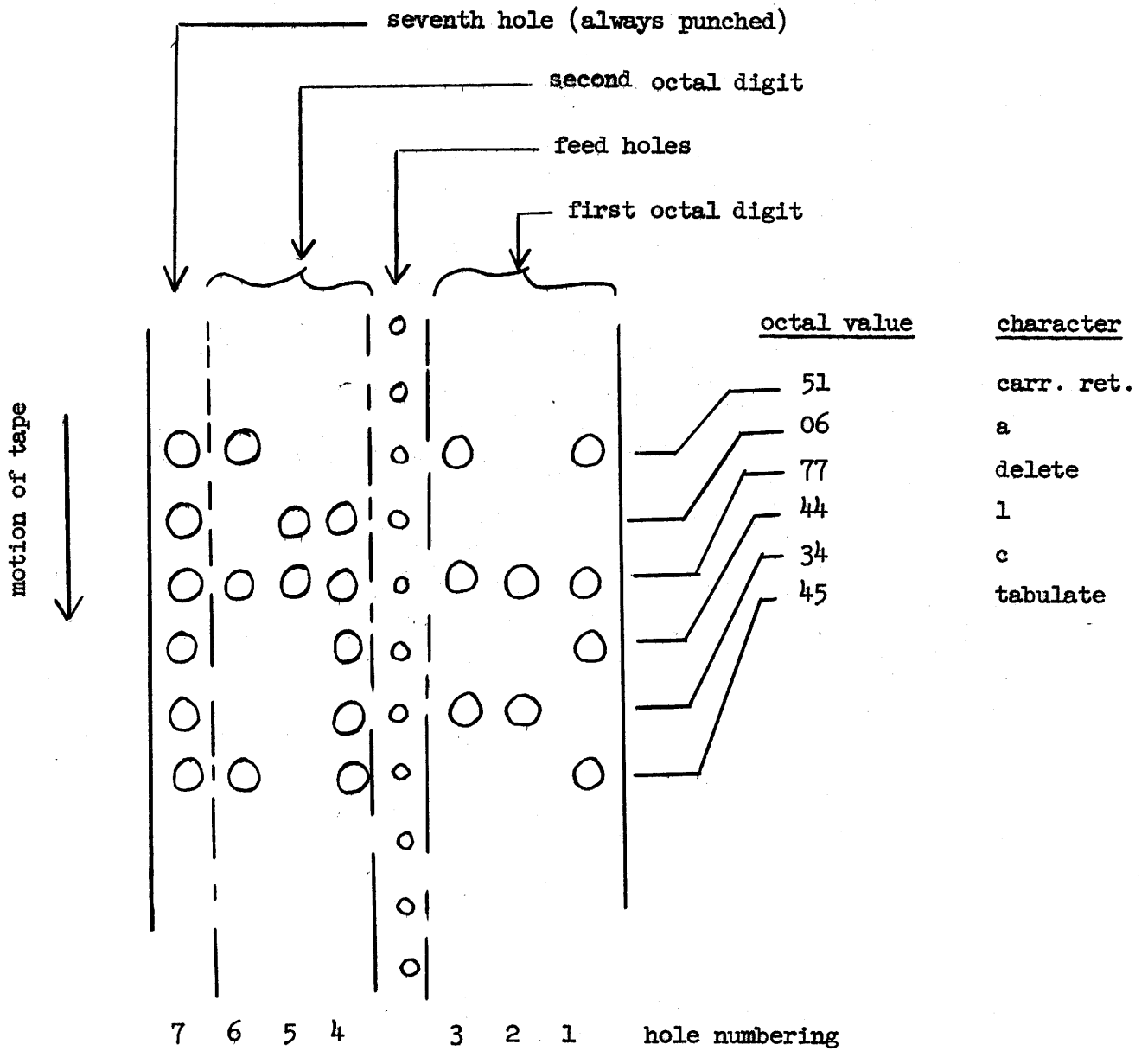
start read switch

FIGURE 1
The Flexowriter

-2-

FIGURE 2

Interpretation of punched tape

octal digit is associated with a group of three hole positions across the
tape as shown in Figure 2. The seventh hole is punched for every character
or machine function, and merely indicates to the TX-0 the presence of infor-
mation as this line -- a line on the tape will be read by the computer if
and only if the seventh hole is punched. The relation between the octal
digit and punching in a group of three hole positions is given in Figure 3.
These illustrations assume that the reader is seated at the flexowriter key-
board with the tape correctly placed in the reader or punch.
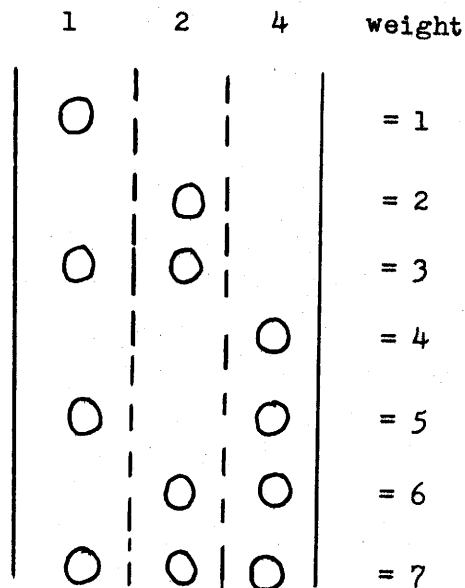

FIGURE 3

Interpretation of a group of three hole positions as an octal digit

Tape Preparation

For preparing a punched paper tape from a manuscript program, the
flexowriter controls should be set as follows:

reproduce-no-print switch   normal print

punch on switch   down

seventh code switch   down

ignore stop code   no effect

The user should first feed approximately six inches of blank tape (by pressing the <u>tape feed switch</u>) before starting to type. If this is not done, it will be difficult if not impossible to place the tape properly in the TX-0 tape reader.

It must be remembered that every key struck by the typist will produce the corresponding coded line on the tape being punched. Hence, if it is desired to move the carriage without punching, it must be done manually by means of the <u>carriage release buttons</u>, or by lifting the <u>punch on switch</u>.

The machine functions <u>carriage return</u>, and <u>tabulate</u> require more time than the other characters and functions, and no interlock is built in to prevent typing during their execution. Therefore, the user must wait after typing a <u>tab</u> or <u>carriage return</u>, or the machine is very apt to jam.

When a typing error is made, the faulty characters may be nullified by using the <u>code delete switch</u>. The last character punched always appears partly emerged from under the <u>punch die block</u>. Turning the <u>manual punch</u> feed knob back one notch will align the last character punched with the punch pins again. Pressing the <u>delete switch</u> will punch all seven holes yielding the character with octal code 77, which is ignored by assembly programs such as MACRO.

If a long section of tape is to be deleted, the following trick is helpful. Move the tape back by means of the punch <u>manual feed knob</u> until the first character to be deleted is aligned with the punch pins. Press the <u>code delete switch</u> and while holding it down, depress the <u>tape feed switch</u>. This will cause a succession of <u>delete</u> characters to be punched without the seventh hole. Thus all typing will have been deleted when the tape emerging from the punch ceases to have the seventh hole punched. Then both switches may be released.

For ease in editing long programs, it is recommended that the program tape be divided into sections each of which is terminated by a stop code followed by several inches of tape feed. A convenient length for a section is one page of typescript. This division makes it possible to edit a tape by duplicating only those sections in which there are changes, and splicing these into the original tape as described later.

Obtaining a Print Out

To print a copy of a program for verification or record the set up is:

reproduce-no-print switch	normal print
punch on switch	up
seventh code switch	no effect
ignore stop code switch	no effect

Place the tape to be printed in the reader mechanism being careful that the tape is properly placed with respect to the tape guides. It is easiest to place the tape in the reader by a lateral motion with the reader tape hold down released. The printing operation is started by pressing and releasing the start read switch. The flexowriter will continue printing the sequence of characters on the tape until the stop switch is depressed or a stop code is encountered on the tape.

Editing a Program Tape

Although a number of editing tricks will save time in certail special cases, the usual editing procedure is to reproduce the portions of the program tape requiring changes, making insertions and deletions as necessary. The controls should be set exactly as for tape preparation, except the ignore stop code switch will have the effect described below.

Place the tape to be edited in the reader as described above, and press the start read switch. The flexowriter will type the contents of the

tape in the reader, which will then be punched into the reproduced tape.

It is important to note the following points. First, blank tape and deletes are ignored by the reader in this mode. Therefore, if tape feed is desired at convenient points in the reproduced tape, it must be inserted manually. This may be done by pressing the start read switch which will stop the duplication, and holding it down while punching tape feed with the tape feed switch. When the start read switch is released, the duplication process will be resumed. Secondly, when a stop code is read, the duplication will automatically stop unless the ignore stop code switch is down. Pressing the start read switch will resume the duplication. In either case the stop code will not be reproduced. If a stop code is to be retained, it must be reinserted manually.

When a point is reached in the duplication where a deletion or insertion is to be made, the quickest and surest way of stopping the reader at a specific point is to press the start read switch. Of course, it must be remembered that the reader will start again unless the stop read switch is held down at the time start read is released. When the reader has stopped, the character over the reader pins is the next character to be read. Thus a deletion may be made by manually advancing the tape in the reader with the reader manual feed knob until the next character to be reproduced is above the reader pins. An alternative procedure is to lift the punch on switch and read the portion to be deleted without punching. This will, of course, give a less useful typescript unless care is taken to cross out all printing not actually punched in the reproduced tape.

Reproducing Without Printing

Straight reproduction of a binary or English program tape may be accomplished with the following set up:

reproduce-no-print switch	reproduce
punch on switch	no effect'
seventh code switch	up
ignore stop code switch	as desired

In this mode, all octal codes will be reproduced exactly including blank tape, stop codes, deletes, and codes to which no typewriter character, or function are assigned, and no typing will occur. It is imperative that the seventh code switch be up, or the seventh hole will be always punched, even when blank tape is being reproduced. If a stop code is read and the ignore stop code switch is up, the flexowriter will punch the stop code before stopping.

Illegal Characters

As far as the flexowriter reader mechanism is concerned, the octal codes designated "not used" in the flexowriter code tables fall into two classes. The codes marked with an "s" in parentheses are equivalent to a stop code; those marked with an "i" are normally ignored and are thus equivalent to delete or blank tape. Both classes of codes will be reproduced exactly in the reproduce-no-print mode, and will not be reproduced in the normal print mode.

Splicing

Splicing of two sections of paper tape may be done with cellophane tape and scissors as follows: Overlap the ends of the two tapes, aligning the feed holes as a check that both tapes are oriented properly. Cut diagonally. Attach a short length of cellophane tape to one end as shown in Figure 4, then press the second end down on the exposed cellophane tape to make a butt joint. A second piece of cellophane tape may be pressed on

top to make a stronger and more permanent splice. Trim the cellophane tape

even with the edges at the paper tape. Splices should only be made where

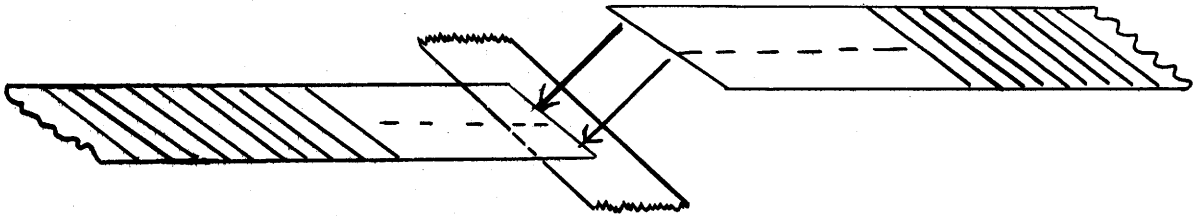there is no information punched in the tape or faulty reading will occur.

FIGURE 6

Making a Splice

FLEXOWRITER CODE

Alphanumerical Sequence

Lower Case	Upper Case	Holes 123456	Octal Value	Lower Case	Upper Case	Holes 123456	Octal Value
a	A	000110	6	0	0	111110	76
b	B	110010	62	1	1	010101	25
c	C	011100	34	2	2	001111	17
d	D	010010	22	3	3	000111	7
e	E	000010	2	4	4	001011	13
f	F	011010	32	5	5	010011	23
g	G	110100	64	6	6	011011	33
h	H	101000	50	7	7	010111	27
i	I	001100	14	8	8	000011	3
j	J	010110	26	9	9	110110	66
k	K	011110	36	|	_	000101	5
l	L	100100	44	space bar		001000	10
m	M	111000	70	=	:	001001	11
n	N	011000	30	+	/	001101	15
o	O	110000	60	color change		010000	20
p	P	101100	54	.	)	010001	21
q	Q	101110	56	,	(	011001	31
r	R	010100	24	-	-	011101	35
s	S	001010	12	back space		100011	43
t	T	100000	40	tabulation		100101	45
u	U	001110	16	carr. return		101001	51
v	V	111100	74	stop		110001	61
w	W	100110	46	upper case		111001	71
x	X	111010	72	lower case		111101	75
y	Y	101010	52	nullify		111111	77
z	Z	100010	42				

FLEXOWRITER CODE

Octal Value

Octal Value	Hole 123456	Lower Case	Upper Case	Octal Value	Hole 123456	Lower Case	Upper Case
0	000000	not used	(i)	40	100000	t	T
1	000001	not used	(i)	41	100001	not used	(s)
2	000010	e	E	42	100010	z	Z
3	000011	8	8	43	100011	back space	
4	000100	not used	(i)	44	100100	l	L
5	000101	|	_	45	100101	tabulation	
6	000110	a	A	46	100110	w	W
7	000111	3	3	47	100111	not used	(s)
10	001000	space bar		50	101000	h	H
11	001001	=	:	51	101001	carr. return	
12	001010	s	S	52	101010	y	Y
13	001011	4	4	53	101011	not used	(s)
14	001100	i	I	54	101100	p	P
15	001101	+	/	55	101101	not used	(s)
16	001110	u	U	56	101110	q	Q
17	001111	2	2	57	101111	not used	(s)
20	010000	color change		60	110000	o	O
21	010001	.	)	61	110001	stop	
22	010010	d	D	62	110010	b	B
23	010011	5	5	63	110011	not used	(s)
24	010100	r	R	64	110100	g	G
25	010101	1	1	65	110101	not used	(s)
26	010110	j	J	66	110110	9	9
27	010111	7	7	67	110111	not used	(s)
30	011000	n	N	70	111000	m	M
31	011001	,	(	71	111001	upper case	
32	011010	f	F	72	111010	x	X
33	011011	6	6	73	111011	not used	(i)
34	011100	c	C	74	111100	v	V
35	011101	-	-	75	111101	lower case	
36	011110	k	K	76	111110	0	0
37	011111	not used	(i)	77	111111	nullify	