IDENTIFICATION: MAGNETIC TAPE READ-WRITE IA: (MTU-1) Subroutine

AUTHOR: A. W. England, PBC

ACCEPTED: 18 November 1961

PURPOSE: To write one long line (256 sectors) of information on magnetic tape in a binary format using four characters for each word from memory, or to read information written in this same format from magnetic tape.

RESTRICTIONS:

1. This program is written for use only with the MTU-1 tape unit (Potter Models 3280 or 910) for Ampex FR400.

2. The output block size must be exactly 256 words (1024 characters).

3. Information written on tape by this routine can always be read by the input section of the routine; however, information written by some other device or program should be controlled and checked carefully to ensure that when read by this program, the input rate does not exceed 2600 characters/second.

STORAGE: Two long lines are needed for the subroutine. Line A contains the entire output section of the routine and part of the input. Line B contains the major portion of the input section, which occupies all but 16 sectors of the line; sector 004 and each successive 16th sector after 004 are vacant.

The following sectors of line A are available: 001, 022, 033, 035, 043-44 046-47, 053, 055 066-70, 072-76, 112, 123-24, 135, 146, 170, 172-76, 212, 223-24, 231-33, 235, 252, 255-56, 266-70, 272-74, 301, 314, 323, 327, 331, 335, 342-46, 350, 361, 371, 374.

Line 04 is used to hold the information before output and after input. Lines 00 and 17 are used for temporary storage during both input and output.

TIMING:

The output rate is approximately 1300 characters/second, whereas the input section of the routine will handle information at a rate up to 2600 characters/second.

The output routine writes four characters (one full word) on the tape during each memory recirculation. Since each record of information on tape has 256 words, it requires 786.5 ms to write this information, plus 75 ms to form a gap on the tape. The total time required to move each record of information is about 862 ms.

The time for input is essentially the same as output except for any time saved by not having to wait for the entire gap to pass the read head.

USE:

1. Writing

In order to output on magnetic tape, it is first necessary to move line A, which contains the write section of the subroutine, to its proper command line. The write section does not require line B of the program for its operation.

The long line to be written on tape must be relocated to line 04 and the C register must be loaded with a return command. Control should then be transferred to line A sector 142 of the subroutine. When the contents of line 04 have been written on the tape, control will be returned to the user's program by execution of the return command. At the time of return, the contents of lines 00, 04 and 17, will have been destroyed.

2. Reading

The input operation of the subroutine requires both lines A and B of the program. After positioning lines A and B, line 04 should be cleared of any pertinent information, since the read routine will load this line with the block of information from the tape.

3. Spacing

This operation requires only line A and will space the tape forward or backward any number of blocks without reading these blocks. The calling sequence is to load C with a return command, load A with the number of

USE (cont.):

blocks to space, a "1" or a "0" will cause only one block to be spaced, and transfer to sector 103 line A for reverse and sector 203 line A for forward.

4. Testing

The subroutine has several small routines in it for testing the operation of the tape unit under manual control. There is a routine which begins with a HLT in sector 242 of line A which will cause line A to be transferred to line 04 and then written on tape. It will do this continuously until the BREAKPOINT switch is depressed.

There is also a routine beginning at 303 line A which will read one block after another until the BREAKPOINT switch is depressed. If jump line 00 is false, this will cause the program to hang up between blocks. One additional routine with two entrances will space the tape forward or backward until the BREAKPOINT switch is depressed. The entrances are sector 114 of line A for reverse and sector 214 of line A for forward.

5. Selection of Tape Unit

This subroutine was written to control tape unit No. 1, however, this may be changed by replacing certain PTU commands in line A. These are the START commands in sectors 012 and 142, which presently refer to line $21)_8$ for unit No. 1. For units 2 through 6, line numbers $22)_8$ through $26)_8$, respectively, should be used.

METHOD:

1. Output

The tape is first started and allowed to run for 75 ms in order to provide a gap. During the 75 ms, line 17 is filled with the first 16-word block from line 04 by means of the DUMP process. After the 75 ms has elapsed, the first word is picked up from line 17 with an IAM command. This word is written on the tape as four characters, the first character consisting of four bits and the next three each consisting of six bits. A parity bit is not generated, so a "one" bit is always written in the seventh position.

METHOD (cont.):

After writing the fourth character, the next word is picked up from line 17 and the process continues. After writing the third character of the 15th word, the DUMP process is initiated at such a time that the 16th word is moved from line 17 to line 00 without disturbing the commands previously stored in line 00. The last character of the 15th word is written and the last word is picked up from line 00. While this last word is being written, line 17 is filling with the next 16-word block from line 04.

When the third character of the 15th word in the last block has been written, the overflow indicator will be turned on. Then, after the first three characters of the last word have been output, the overflow is tested. Since overflow is on, A DIU command is executed to reset $\overline{\text{Rf}}\ \overline{\text{Tf}}$. This condition can then be sensed by a TES command with a line address of $36)_8$. As part of the initializing steps, an RFU was given to set Rf Tf. When the last character has been output, $\overline{\text{Rf}}\ \overline{\text{Tf}}$ is tested, the tape handler is stopped, and control exists from the subroutine by means of the return command.

2. Input

For input, the characters from the tape are assembled into words in the A register, with the B register used for indicating the end of a word and the C register used the the end of a block of 16 words. To begin, the B and C registers are loaded with their respective counters and the tape started. In order to determine the start of information on the tape, part of the program in line A tests for an input signal every 16 sectors. When a signal is detected control goes to line B where a cyclic program loads the characters into the A register and tests the sign of the B register to determine if the word is complete. If the word is not complete, the contents of the A and B registers are shifted left six bit positions to allow for the next character, and the program waits in a cyclic loop for the next clock signal. When the word is complete, it is stored in line 00 with an IAM command and the word counter is again loaded in the B register.

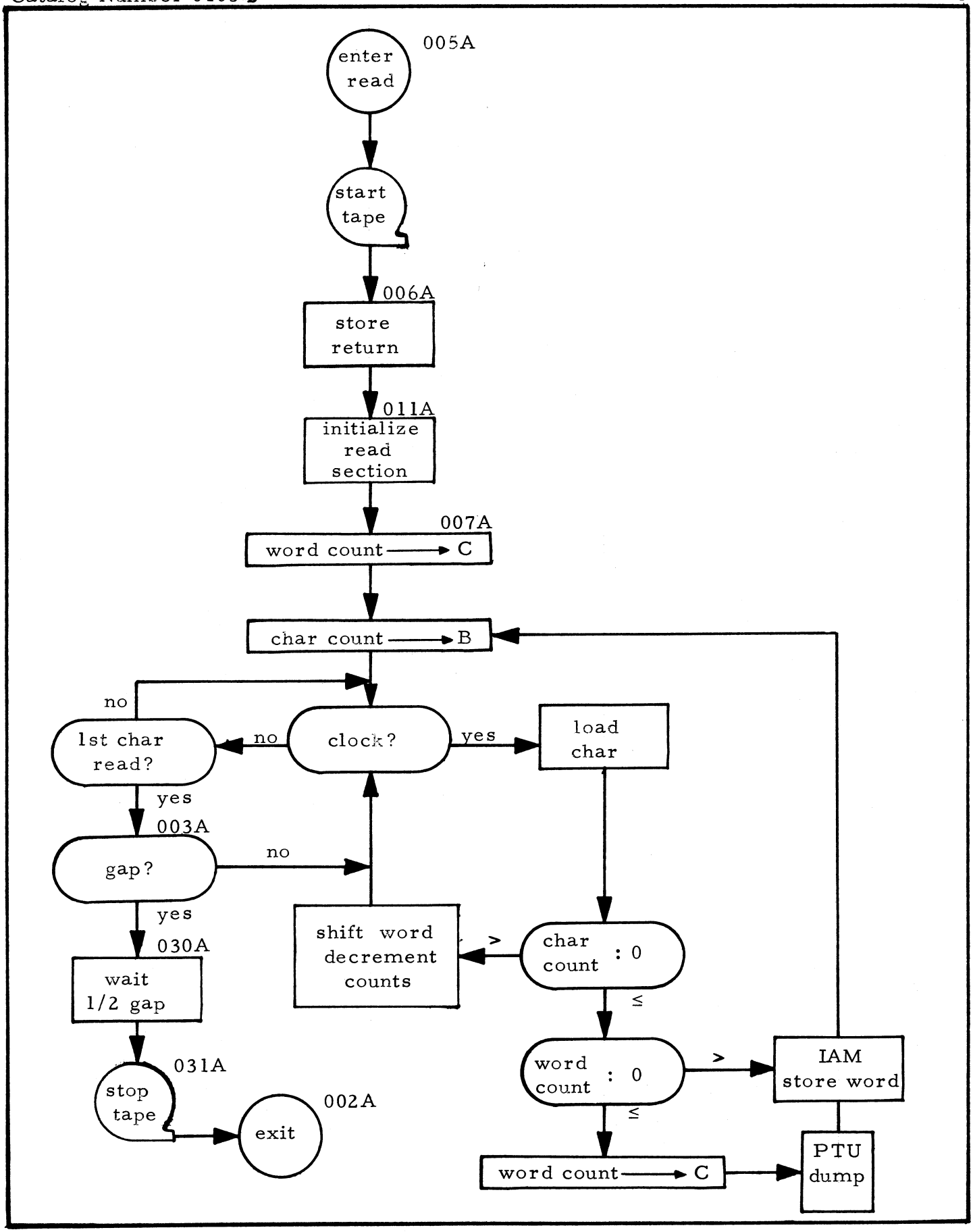
METHOD (cont.): After loading the third character of the 15th word, the C register will go negative and a DUMP will be set up. When the next IAM is performed, to place the last word in line 00, the DUMP will be executed, and line 00 will go to line 17 and then to line 04.

If, at the beginning of a machine memory circulation, no pulse is detected from the tape, control is transferred to line A, where the signal from the tape handler, indicating the gap, is tested. If the signal is not present, control returns to line B; however, if the test indicates the presence of the gap, the tape unit is stopped and control exits from the subroutine.

Flow Diagram

MAGNETIC TAPE READ-WRITE IA: (MTU-1)

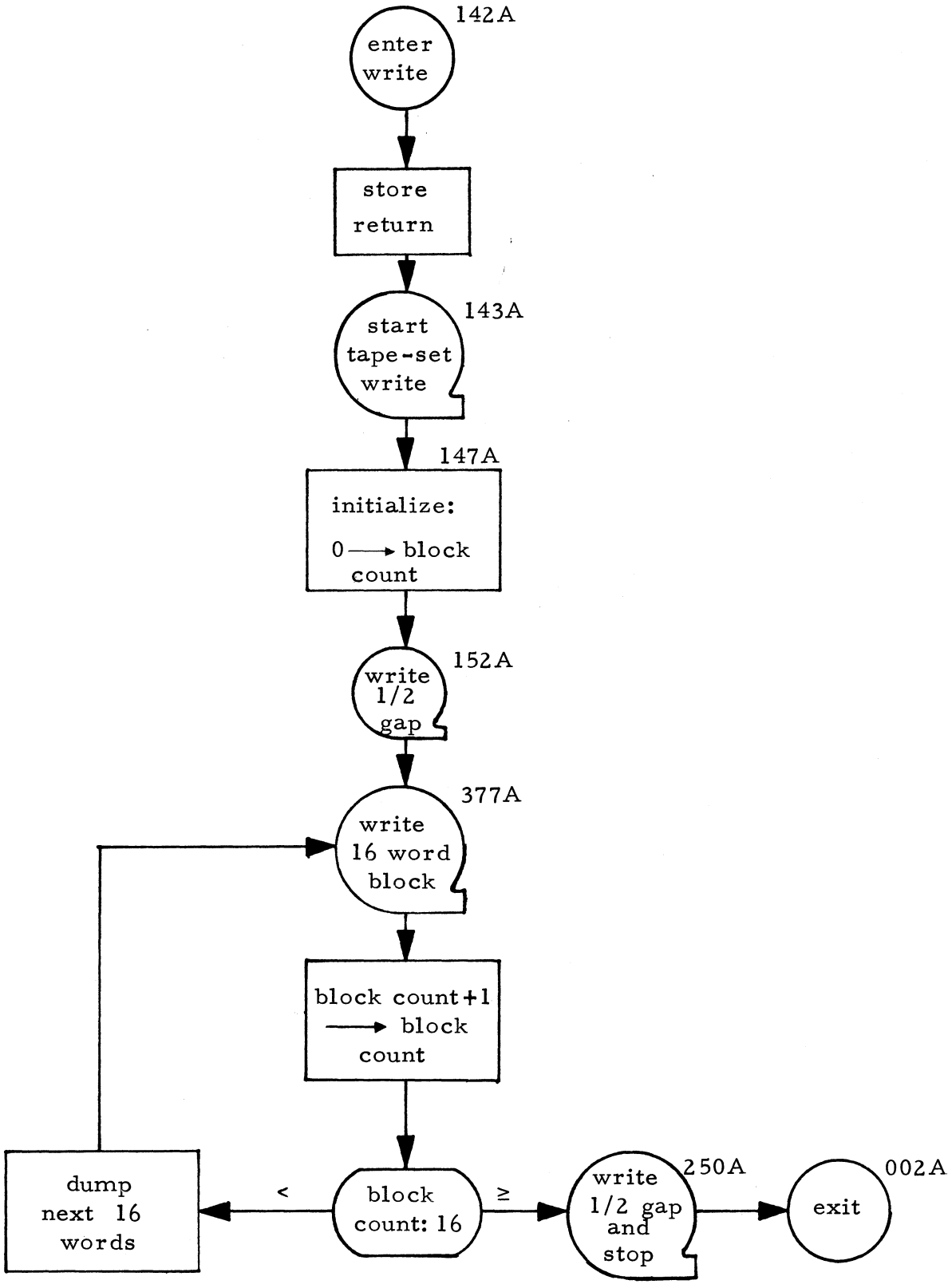
Catalog Number 0103 B



Flow Diagram

MAGNETIC TAPE READ-WRITE IA: (MTU-1)

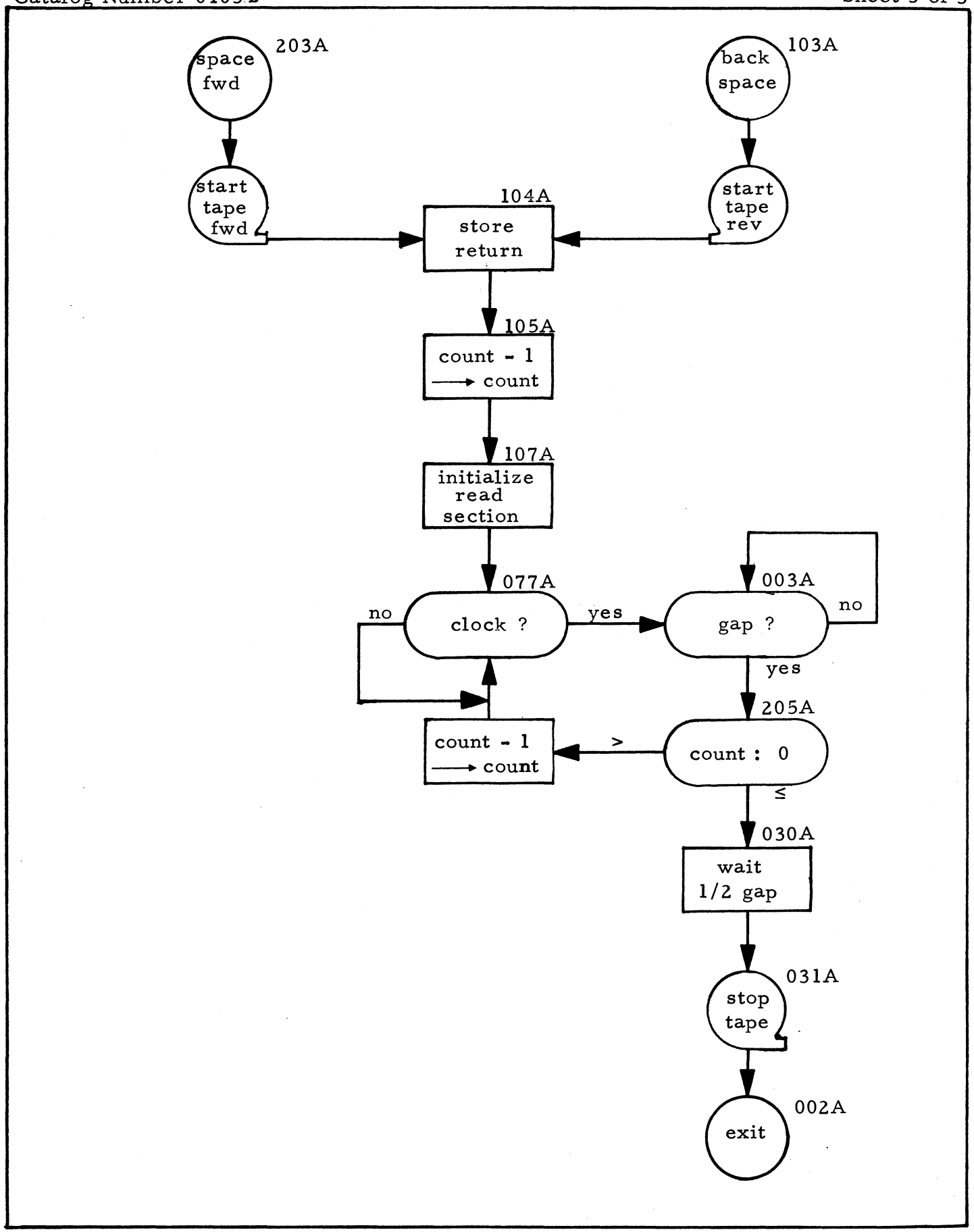
Catalog Number 0103B



Flow Diagram

MAGNETIC TAPE READ-WRITE IA: (MTU-1)

Catalog Number 0103.B



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PB 250 PROGRAM LISTING

PROBLEM Magnetic Tape Read-Write Subroutine IA (MTU-1) **IDENT NUMBER** 0103 B

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PROGRAMMER A. W. England **DATE** 18 Nov 61

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
14202$	002 1002;	ENTER	STC	EXIT	
	330S7021;		PTU	START	
33002$	131S7020;		PTU	WRITE	
13102$	132S0402;		LDC		
	-7777777		OCT		
	144S6400;		WOC	RESET	Initialize
14402$	145 7006;		PTU	DUMP	
	147S2500;		IAM		
14702$	150 4304;		CLB		
	000 1237;		STB	I. R.	
	000 5304;		RFU		
	154S0402;		LDC		
15402$	+0011320		OCT		
	367 3402;		TCN		Write half of the gap
	155S2100;		LSD		
36702$	372S0402;		LDC		
37202$	-0000072		OCT		
	377S7502;		TOF		
37702$	020S2517;		IAM		
02002$	021S0301;		ROT		
02302$	024S0201;		IBC		
02502$	032S2110;		SLT	4	
03202$	033S1000;		STC	OUT	
03402$	035S0201;		IBC		
03602$	041S4301;		CLB		
04202$	045S2110;		SLT	2	Prepare 1st character

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PROBLEM Magnetic Tape Read-Write Subroutine IA (MTU-1) **IDENT NUMBER** 0103 B

PAGE 2 **OF** 9

PROGRAMMER A. W. England **DATE** 18 Nov 61

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
04502$	050S1602;		DPA		
05002$	102S3702;		TRU		
	075S6200;		WOC		
	054S2500;		IAM	OUT	
05402$	055S1200;		STB	RET	
05602$	060S0302;		ROT		
06202$	070S4502;		CLA		
07102$	073S3700;		TRU	OUT	1st char.
10202$	111S2110;		SLT	6	
11102$	112S1200;		STB	TEMP	
11302$	121S4303;		CLB		
12202$	125S2110;		SLT	2	
12502$	126S1602;		DPA		
	202S3702;		TRU		Prepare 2nd char.
	175S6200;		WOC		
	133S1100;		STA	OUT	
13402$	135S1200;		STB	RET	
13602$	152S0600;		LDB	TEMP	
15302$	170S4504;		CLA		
17102$	173S3700;		TRU	OUT	2nd char.
20202$	211S2110;		SLT	6	
21102$	212S1200;		STB	TEMP	
21302$	221S4305;		CLB		
22202$	225S2110;		SLT	2	

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
22502$	226S1602;		DPA		
	277S3702;		TRU		Prepard 3rd char.
	275S6200;		WOC		
	233S1100;		STA	OUT	
23402$	235S1200;		STB	RET	
23602$	252S0600;		LDB	TEMP	
25302$	270S4506;		CLA		
27102$	273S3700;		TRU	OUT	3rd char.
27702$	310S2110;		SLT	8	
31002$	311S1402;		ADD		Prepare 4th char.
	375S6200;		WOC		
	313S1100;		STA	OUT	
31402$	322 7502;		TOF	LAST	
	332 3402;		TCN	NORM	
	324S3702;		TRU	DUMP	
32202$	323S5007;	LAST	DIU		
32402$	325S0502;	DUMP	LDA		
	014S3702;		TRU		Set DUMP
	347S7006;		PTU	DUMP	
33202$	333S0502;	NORM	LDA		
	377S3702;		TRU		
	335S1100;		STA	RET	Set RETURN for normal case
33602$	367S4307;		CLB		

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PROBLEM Magnetic Tape Read-Write Subroutine IA (MTU-1) **IDENT NUMBER** 0103B

PROGRAMMER A. W. England **DATE** 18 Nov 61

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
34702$	350S4310;		CLB		
35102$	352S0402;		LDC		
	-0000077		OCT		
	355S1100;		STA		
35602$	360S2500;		IAM	WD. 16	Increment block
36002$	361S0537;		LDA	I. R.	Count & set RETURN for
36202$	363S1402;		ADD	$ + 1	DUMP case
	+0000002		OCT		
	365S5602;		CAM	$ + 1	
	-7076140		OCT		
	367S1137;		STA	I. R.	
37002$	373S3700;		TRU	OUT	4th char.
01402$	250 7736;		TES	DONE	
	017S0500;		LDA	WD. 16	
25002$	254S6400;	DONE	WOC	RESET	
25402$	263S0402;		LDC		
26202$	264S2100;		LSD	1	Write half of the gap
	-0000013		OCT		
	262 3402;		TCN		
	002S7017;		PTU	STOP	Exit

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
00502$	200 7021;	READ	PTU	START	
	002 1002;		STC	EXIT	
	012 0402;		LDC		
	013 0602;		LDB		Initialize
	063S0502;		LDA		
	-0000423		OCT		
	+0000010		OCT		
01602$	021 7733;		TES	CLOCK	
	037S3702;		TRU		Test for 1st clock
02102$	023S3703;		TRU		Repeats 16 times
03702$	041 7733;		TES	CLOCK	
	057S3702;		TRU		
	043S3703;		TRU		
05702$	061 7733;		TES	CLOCK	
	077S3702;		TRU		
	063S3703;		TRU		
07702$	101 7733;		TES	CLOCK	
	117S3702;		TRU		
	103S3703;		TRU		
11702$	121 7733;		TES	CLOCK	
	137S3702;		TRU		
	123S3703;		TRU		
13702$	141 7733;		TES	CLOCK	
	157S3702;		TRU		
	143S3703;		TRU		

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
15702$	161 7733;		TES	CLOCK	
	177S3702;		TRU		
	163S3703;		TRU		
17702$	201 7733;		TES	CLOCK	
	217S3702;		TRU		
	203S3703;		TRU		
21702$	221 7733;		TES	CLOCK	
	237S3702;		TRU		
	223S3703;		TRU		
23702$	241 7733;		TES	CLOCK	
	257S3702;		TRU		
	243S3703;		TRU		
25702$	261 7733;		TES	CLOCK	
	275S3702;		TRU		
	263S3703;		TRU		
27502$	300 7733;		TES	CLOCK.	
	317S3702;		TRU		
30002$	303S3703;		TRU		
31702$	321 7733;		TES	CLOCK	
	337S3702;		TRU		
	323S3703;		TRU		
33702$	341 7733;		TES	CLOCK	
	354S3702;		TRU		
	343S3703;		TRU		

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PROBLEM Magnetic Tape Read-Write Subroutine IB (MTU-1) **IDENT NUMBER** 0103 B

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PROGRAMMER A. W. England **DATE** 18 Nov 61

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
35402$	357 7733;		TES	CLOCK	
	375S3702;		TRU		
35702$	363S3703;		TRU		
37502$	000 7733;		TES	CLOCK	
	016S3702;		TRU		
00002$	003S3703;		TRU		
00302$	024 7732;		TES	GAP	Test for GAP
	020S3703;		TRU		
02402$	027S0402;		LDC		
02602$	030S2100;		LSD		Wait half the GAP time before stopping
	-0000007		OCT		
	026 3402;		TCN		
	002S7017;		PTU	STOP	
06302$	027S0402;		LDC		
	024 1102;		STA		Initialize cont.
	076S5702;		CIB		

PROBLEM Magnetic Tape Read-Write Subroutine I (MTU-1) **IDENT NUMBER** 0103B

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PROGRAMMER A. W. England **DATE** 18 Nov 61

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
24202$	244S0027;		HLT		
	251 7735;		TBP		
	245S7104;	START	MCL	04	
	246S0402;		LDC		Write continuous
	243S3702;		TRU		
	142S3702;		TRU		
25102$	000S3701;		TRU	O.U.P.	
30202$	251 7735;	BEGIN	TBP		
	304S0402;		LDC		
	306S3702;		TRU		
	005S3702;		TRU		Read continuous
	302 7700;		TES	00	
	306S3702;		TRU		

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PB 250 PROGRAM LISTING

PROBLEM Magnetic Tape Read-Write Subroutine I (MTU-1) **IDENT NUMBER** 0103 B

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PROGRAMMER A. W. England **DATE** 18 Nov 61

LOCATION	INSTRUCTION	SYMBOLIC LOCATION	SYMBOLIC OP	SYMBOLIC ADDRESS	REMARKS
10302$	104 7011;	START	PTU	REV.	Set up space routine
	002 1002;		STC	EXIT	
	132 1402;		ADD	- 1	
	204 1102;		STA	TALLY	
	210 0502;		LDA		
	063S4303;		CLB		
20302$	104S7021;	START	PTU	FWD.	Count blocks
	+0000000	TALLY	STG		
	132 1402;		ADD	- 1	
	063 3502;		TAN		
	106S3702;		TRU		
	204S0502;		LDA	TALLY	
11402$	115S0502;	AUTO. R.	LDA		Test routine for space
	103S3702;		TRU		
	162S1102;		STA		
21402$	215S0502;	AUTO. F.	LDA		
	203S3702;		TRU		
	162S1102;		STA		
16302$	164S0402;		LDC		
	166S3702;		TRU		
	161S4504;		CLA		
	251 7735;		TBP		
	163S3702;		TRU		

IDENTIFICATION: MAGNETIC TAPE READ-WRITE IA: (MTU-1) Subroutine

PURPOSE: To write one long line (256 sectors) of information on magnetic tape in a binary format using four characters for each word from memory, or to read information written in this same format from magnetic tape.

RESTRICTIONS:

1. This program is written for use only with the MTU-1 tape unit (Potter Models 3280 or 910) for Ampex FR400.

2. The output block size must be exactly 256 words (1024 characters).

3. Information written on tape by this routine can always be read by the input section of the routine; however, information written by some other device or program should be controlled and checked carefully to ensure that when read by this program, the input rate does not exceed 2600 characters/second.

STORAGE: Two long lines are needed for the subroutine. Line A contains the entire output section of the routine and part of the input. Line B contains the major portion of the input section, which occupies all but 16 sectors of the line; sector 004 and each successive 16th sector after 004 are vacant.

The following sectors of line A are available: 001, 022, 033, 035, 043-44 046-47, 053, 055 066-70, 072-76, 112, 123-24, 135, 146, 170, 172-76, 212, 223-24, 231-33, 235, 252, 255-56, 266-70, 272-74, 301, 314,323, 327, 331, 335, 342-46, 350, 361, 371, 374.

Line 04 is used to hold the information before output and after input. Lines 00 and 17 are used for temporary storage during both input and output.

TIMING:

The output rate is approximately 1300 characters/second, whereas the input section of the routine will handle information at a rate up to 2600 characters/second.

The output routine writes four characters (one full word) on the tape during each memory recirculation. Since each record of information on tape has 256 words, it requires 786.5 ms to write this information, plus 75 ms to form a gap on the tape. The total time required to move each record of information is about 862 ms.

The time for input is essentially the same as output except for any time saved by not having to wait for the entire gap to pass the read head.

USE:

1. Writing

In order to output on magnetic tape, it is first necessary to move line A which contains the write section of the subroutine, to its proper command line. The write section does not require line B of the program for its operation.

The long line to be written on tape must be relocated to line 04 and the C register must be loaded with a return command. Control should then be transferred to line A sector 142 of the subroutine. When the contents of line 04 have been written on the tape, control will be returned to the user's program by execution of the return command. At the time of return, the contents of lines 00, 04 and 17, will have been destroyed.

2. Reading

The input operation of the subroutine requires both lines A and B of the program. After positioning lines A and B, line 04 should be cleared of any pertinent information, since the read routine will load this line with the block of information from the tape.

3. Spacing

This operation requires only line A and will space the tape forward or backward any number of blocks without reading these blocks. The calling sequence is to load C with a return command, load A with the number of

USE (cont.):

blocks to space, a "1" or a "0" will cause only one block to be spaced, and transfer to sector 103 line A for reverse and sector 203 line A for forward.

4. Testing

The subroutine has several small routines in it for testing the operation of the tape unit under manual control. There is a routine which begins with a HLT in sector 242 of line A which will cause line A to be transferred to line 04 and then written on tape. It will do this continuously until the BREAKPOINT switch is depressed.

There is also a routine beginning at 303 line A which will read one block after another until the BREAKPOINT switch is depressed. If jump line 00 is false, this will cause the program to hang up between blocks. One additional routine with two entrances will space the tape forward or backward until the BREAKPOINT switch is depressed. The entrances are sector 114 of line A for reverse and sector 214 of line A for forward.

5. Selection of Tape Unit

This subroutine was written to control tape unit No. 1, however, this may be changed by replacing certain PTU commands in line A. These are the START commands in sectors 012 and 142, which presently refer to line $21)_8$ for unit No. 1. For units 2 through 6, line numbers $22)_8$ through $26)_8$, respectively, should be used.

METHOD:

1. Output

The tape is first started and allowed to run for 75 ms in order to provide a gap. During the 75 ms, line 17 is filled with the first 16-word block from line 04 by means of the DUMP process. After the 75 ms has elapsed, the first word is picked up from line 17 with an IAM command. This word is written on the tape as four characters, the first character consisting of four bits and the next three each consisting of six bits. A parity bit is not generated, so a "one" bit is always written in the seventh position.

METHOD (cont.): After writing the fourth character, the next word is picked up from line 17 and the process continues. After writing the third character of the 15th word, the DUMP process is initiated at such a time that the 16th word is moved from line 17 to line 00 without disturbing the commands previously stored in line 00. The last character of the 15th word is written and the last word is picked up from line 00. While this last word is being written, line 17 is filling with the next 16-word block from line 04.

When the third character of the 15th word in the last block has been written, the overflow indicator will be turned on. Then, after the first three characters of the last word have been output, the overflow is tested. Since overflow is on, A DIU command is executed to reset $\overline{\text{Rf}}\ \overline{\text{Tf}}$. This condition can then be sensed by a TES command with a line address of $36)_8$. As part of the initializing steps, an RFU was given to set Rf Tf. When the last character has been output, $\overline{\text{Rf}}\ \overline{\text{Tf}}$ is tested, the tape handler is stopped, and control exists from the subroutine by means of the return command.

2. Input

For input, the characters from the tape are assembled into words in the A register, with the B register used for indicating the end of a word and the C register used the the end of a block of 16 words. To begin, the B and C registers are loaded with their respective counters and the tape started. In order to determine the start of information on the tape, part of the program in line A tests for an input signal every 16 sectors. When a signal is detected control goes to line B where a cyclic program loads the characters into the A register and tests the sign of the B register to determine if the word is complete. If the word is not complete, the contents of the A and B registers are shifted left six bit positions to allow for the next character, and the program waits in a cyclic loop for the next clock signal. When the word is complete, it is stored in line 00 with an IAM command and the word counter is again loaded in the B register.

METHOD (cont.): After loading the third character of the 15th word, the C register will go negative and a DUMP will be set up. When the next IAM is performed, to place the last word in line 00, the DUMP will be executed, and line 00 will go to line 17 and then to line 04.

If, at the beginning of a machine memory circulation, no pulse is detected from the tape, control is transferred to line A, where the signal from the tape handler, indicating the gap, is tested. If the signal is not present, control returns to line B; however, if the test indicates the presence of the gap, the tape unit is stopped and control exits from the subroutine.