

Computer Program and User Documentation Medical Data Update System

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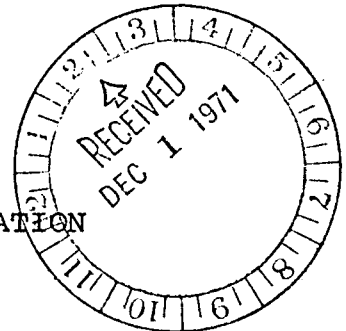
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COMPUTER PROGRAM AND USER DOCUMENTATION
MEDICAL DATA UPDATE SYSTEM

Contract NAS 9-11579

Submitted to the
BIOMEDICAL DATA SYSTEMS OFFICE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
INFORMATION SYSTEMS BRANCH
Houston, Texas



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1.0 SCOPE

The purpose of this volume is to provide the reader with several levels of documentation for this program module of the NASA Medical Directorate Mini-computer Storage and Retrieval System.

The Biomedical Information System Overview (Section 2) describes some of the reasons for the development of the mini-computer storage and retrieval system. It briefly describes all of the program modules which constitute the system.

The General Specifications Section (Paragraph 3.1) describes the purpose and function of the specific program module documented in this volume.

The Technical Specifications (Paragraph 3.2) is oriented to the programmer. It is a technical discussion of the same processing described in general terms in the previous section, but is at a high enough level as not to be redundant with the very detailed analysis described in the Subroutine Section 3.3.

The Subroutine Section (Paragraph 3.3) describes each subroutine in enough detail to permit an in-depth understanding of the routines and facilitate program modifications.

The Program Utilization Section (Paragraph 4.0) may be used as a "Users Guide" and is as non-technical as possible.

To eliminate unnecessary reproduction, the program listings are maintained in a separate document which may be obtained from the VARIAN library of computer programs currently maintained in Building 32 at NASA MSC. In addition, another document is to be developed for the Medical Directorate management. The document will describe the mini-computer system on a higher functional level and will illustrate how the mini-computer storage and retrieval system interfaces with the total directorate data management plan.

2.0 BIOMEDICAL INFORMATION SYSTEM OVERVIEW

For several years, the NASA Medical Directorate has been developing a Medical Information Management System (MEDATA). The System, as implemented at NASA, utilized an off-line IBM 1050 for preparation of data input via paper tape and required card deck runs for retrieval of data from the data files. A new phase of development has been implemented utilizing remote terminals and mini-computers. This section describes the development rationale of the remote terminal and mini-computer approach.

Several features of the old MEDATA system presented serious difficulties to the system user and made the system unresponsive. These deficiencies in the system included:

- Input data prepared on punched paper tape
- No online data input capability with the data base (i.e., no remote data entry)
- Data corrections via punched paper tape
- Preparation of retrieval requests via a punched card system
- 48-hour turnaround time required for retrieval outputs.

To improve the overall responsiveness of the system and eliminate these deficiencies, Philco-Ford developed the Varian/MEDATA Storage and Retrieval System (VMSARS) which utilizes the Varian 620I computer systems in Building 32 or 37.

VMSARS consists of the Medical Data Input System (MDIS), the Medical Data Update System (MDUS), and the Medical Data Tape Retrieval System (MDTRS). The Medical Data Input System (MDIS) is used to input data via a CRT. If updates or reviews are desired, the output of MDIS may be updated on the CRT by the Medical Data Update System (MDUS). The data tape (MDIS or MDUS output) is entered into the CAAD MEDATA system where it is sorted and merged into the appropriate Medical Data File. The updated CAAD MEDATA Medical Data Tape File is sent back to the Varian computer system and used as input for the Medical Data Tape Retrieval System (MDTRS) which processes data retrieval requests from remote terminals. The primary advantages of the VMSARS are as follows:

- Use of state-of-the-art input devices such as CRT's and portable acoustic-coupled teleprocessing terminals. (CRT's operate at 2400 bits per second on the telephone lines.)
- Elimination of paper tapes from the system. (Data storage is on magnetic tape.)
- Online data input from remote input station via the telephone lines.
- Error correction capabilities on CRT. (Limited error checking is performed by the computer.)
- Update capabilities on Varian system before data is entered into the CAAD MEDATA system.

- Ease of creation and updating of background forms.
- Capability of transmitting MEDATA retrievals over telephone lines to CRT or TTY.
- Capability of performing online retrievals.

VMSARS was used for the Flight Crew Health Stabilization Program for three months preceding the launch of Apollo 14 and Apollo 15. A Computer Communications Inc. (CCI) CRT and keyboard and an Execuport Typewriter were installed in the surveillance command post at KSC, and a surveillance master file was created. The VMSARS was used to collect data, perform updates, and retrieve data from the surveillance master file.

The overall system, including the CAAD MEDATA system interface, is illustrated in Figure 2-1. The individual programs are described as follows:

MEDICAL DATA INPUT SYSTEM

The Medical Data Input System (MDIS) is designed to collect data from a CRT input station and store the data on a magnetic tape. The medical questionnaire forms are maintained on magnetic tape and are read into computer memory at run time. The user selects the appropriate form to be displayed on the CRT. As each form is completed, the data is stored on magnetic tape. This tape may be further updated, transmitted to another terminal, or input to the 1108 MEDATA system. Hardcopies of any form are produced at the

user's request. The system requires only one tape unit and operates either via the phone lines or directly online with the computer.

MEDICAL DATA UPDATE SYSTEM

The Medical Data Update System (MDUS) updates any tape created by MDIS. Two tape-drives, a CRT, and printer are required. The old data is read from the MDIS output tape and displayed on the CRT. Changes may be made to the data on the CRT; comments or recommendations may be added to the record, and the new updated record written to the update tape. The updated tape may be either transmitted to another terminal or input to the MEDATA system, or both. Hardcopies of the records are produced if requested by the user. Refer to Figure 2-3 for an illustration of the MDUS components.

MEDICAL DATA TAPE RETRIEVAL SYSTEM (MDTRS)

MDTRS permits the user to make data retrievals from the MEDATA master tapes created by the 1108 MEDATA system. The 1108 system builds the MEDATA master tape from several sources, one of which is the MDIS or MDUS created input tapes. MDTRS outputs preprogrammed retrieval questions from the Varian computer to the requester's CRT or typewriter. The user builds his retrieval request by answering these questions. When the retrieval request is complete, MDTRS searches the MEDATA master tape for the data, formats the selected data for output, and outputs the data to the terminal. The CRT may operate on a private telephone line at 2000 bits per second and the typewriter operates on any commercial telephone line at 300 bits per second. Refer to Figure 2-4 for an illustration of MDTRS components.

2.1 OVERVIEW SUMMARY

In summary, the Varian/MEDATA Storage and Retrieval System provides the user with an online input and retrieval capability previously unavailable. The response time is significantly improved over the old paper tape system. There are still two weak points in the system due to hardware constraints. These are (1) the requirement to update the MEDATA master file on the CAAD 1108 computer system, and (2) the use of tape instead of disk for storage of the data base. A more comprehensive storage and retrieval system is being designed to operate on a Varian 620 mini-computer system utilizing a disk memory storage device and an input/output multiplexing device. The new system will permit immediate update of files, faster response for retrieval requests and multiple terminal users operating simultaneously.

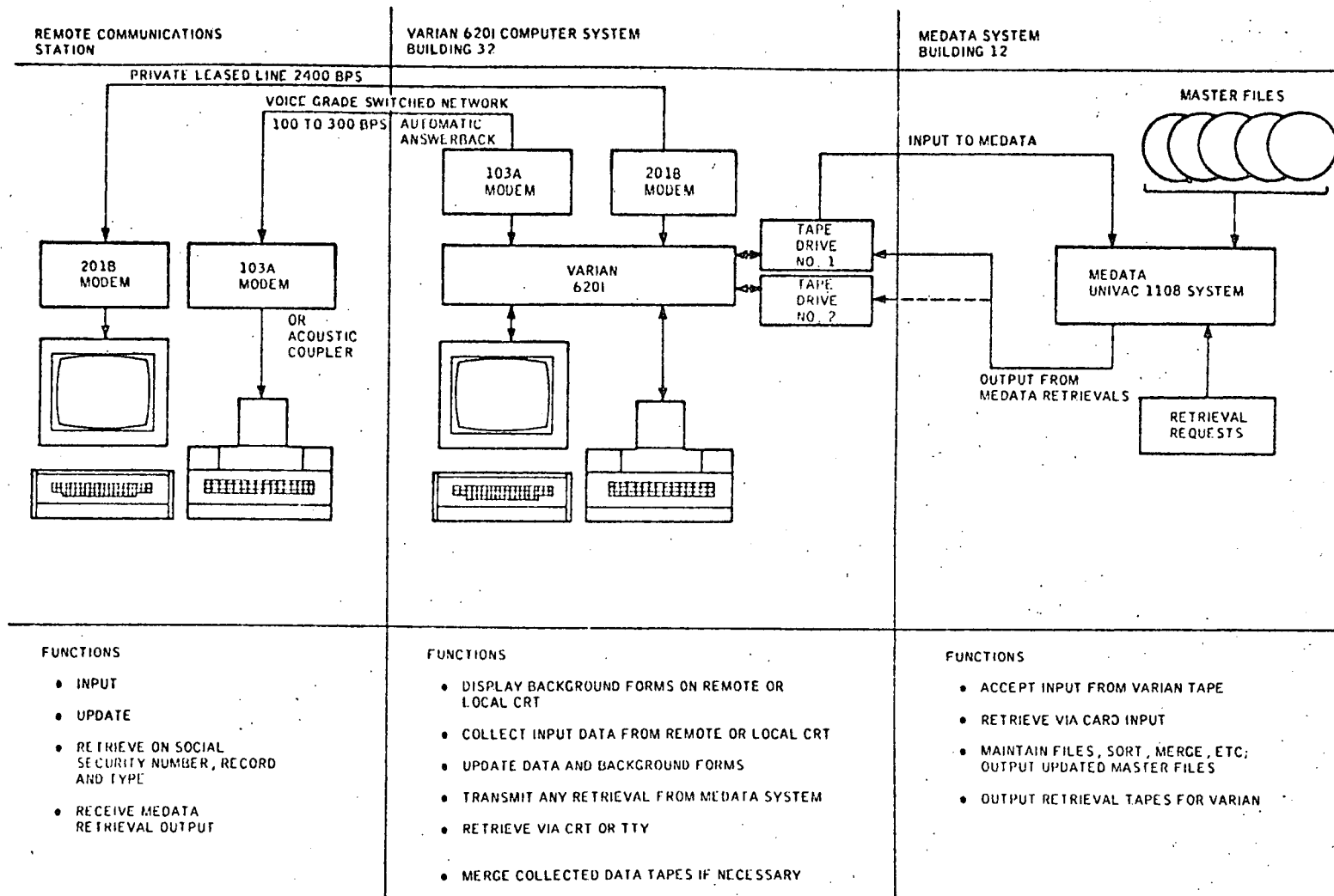
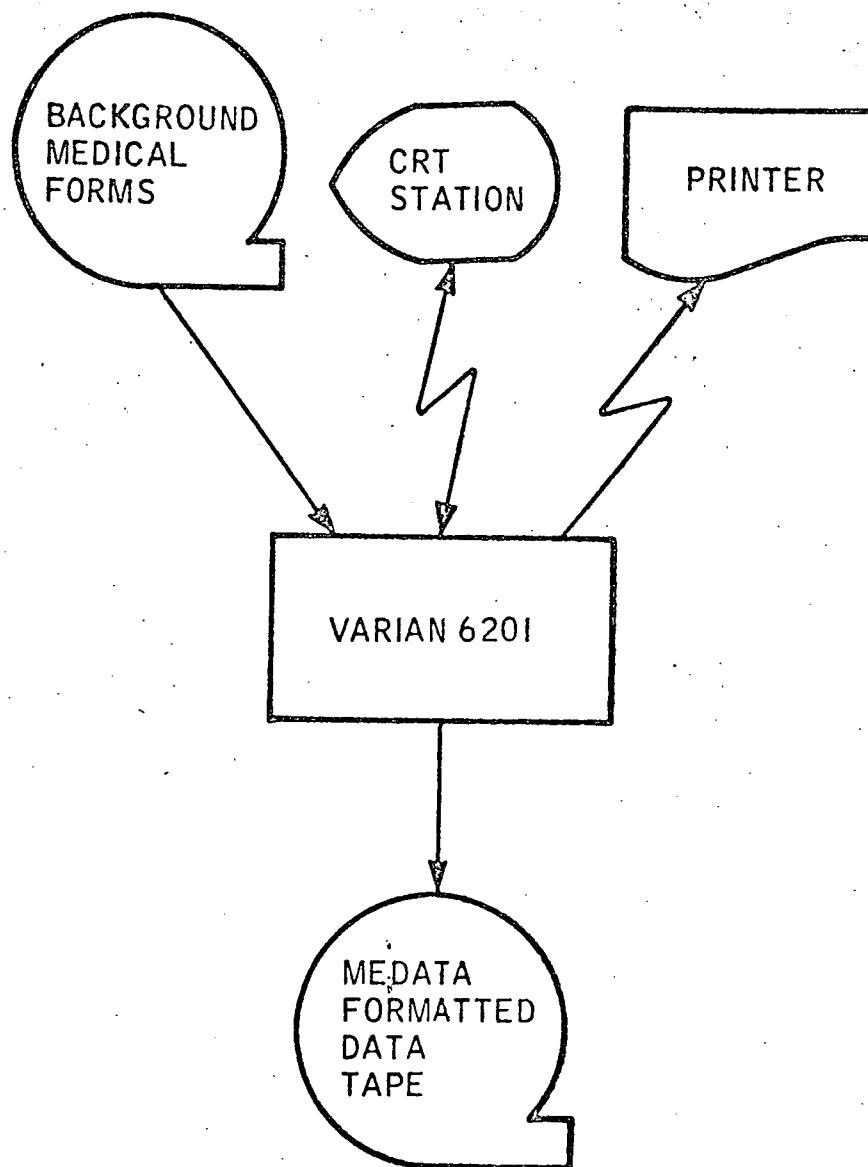
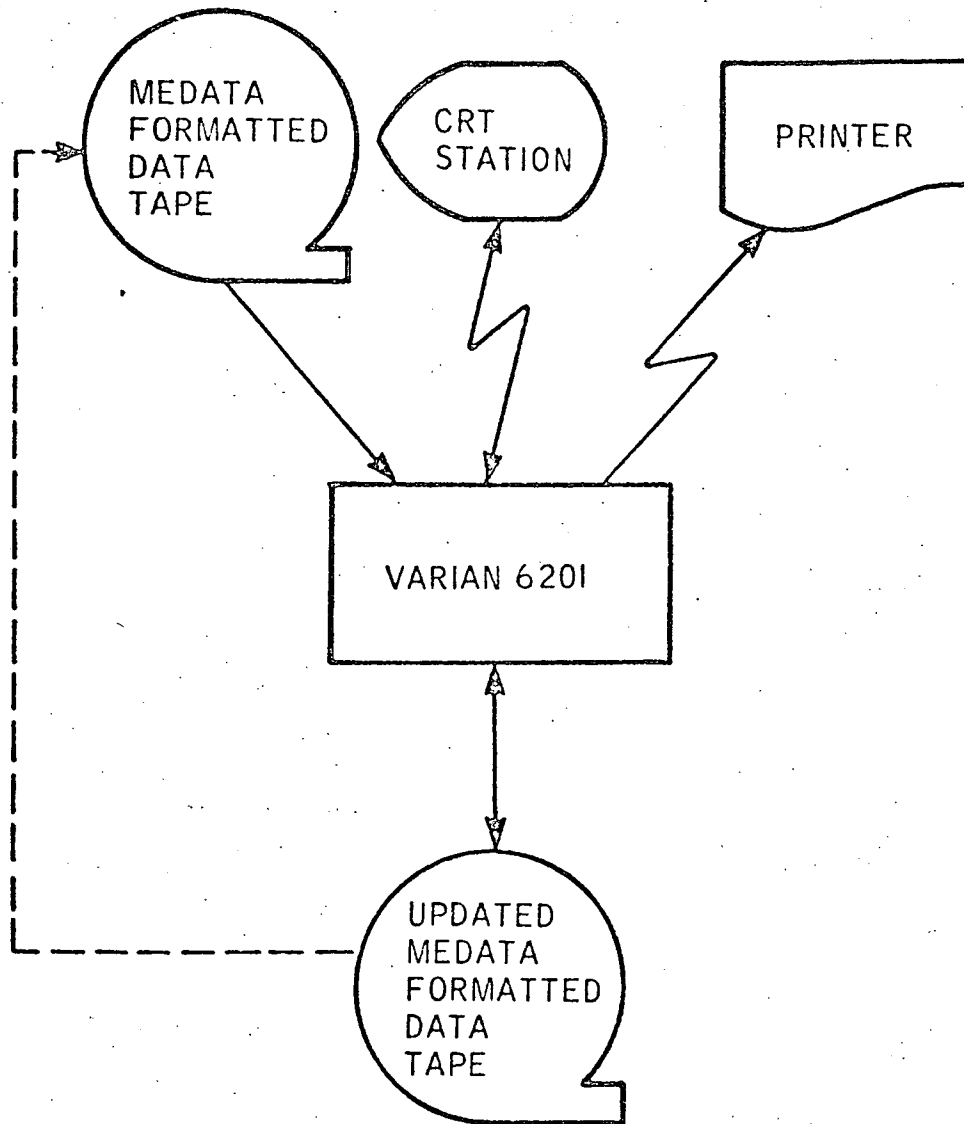


Figure 2-1 Varian/MEDATA Storage and Retrieval System



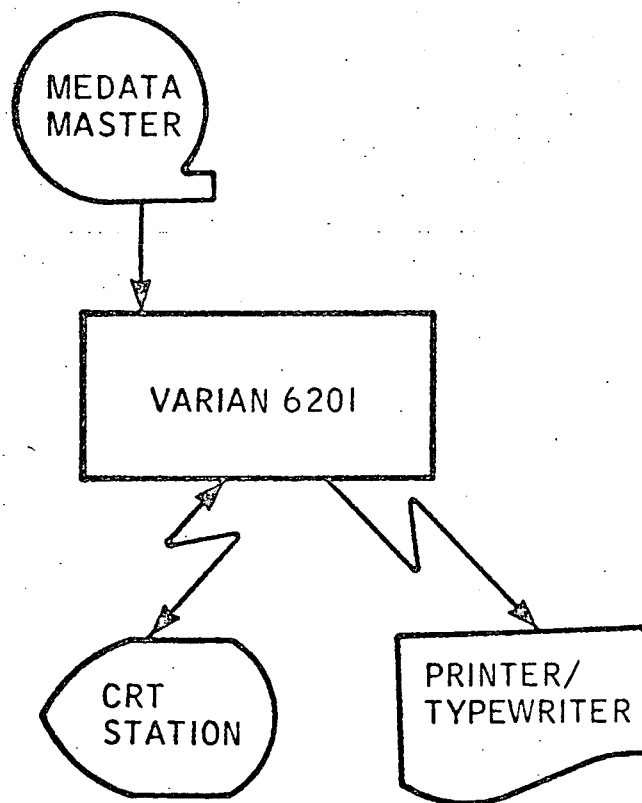
AA20002(A)-1

Figure 2-2 Medical Data Input System



AA20002(A)-2

Figure 2-3 Medical Data Update System



AA20002(A)-4

Figure 2-4 Medical Data Tape Retrieval System (MDTRS)

This document describes in detail one of the three components of VMSARS,
the Medical Data Input System (MDIS).

3.0 MDUS SYSTEM

3.1 GENERAL SPECIFICATIONS

3.1.1 Background

In the fall of 1970, the Medical Data Input System - MDIS - was implemented and put into operation on a Varian 620/i computer at the NASA Manned Spacecraft Center, Houston, Texas (See Section 2.0). There it was viewed and used by many different NASA personnel and NASA contractor personnel; and, although it provided extensive input error correction capabilities, it was noted that should an error get into the system, the only corrective action available was an update through the extremely cumbersome update programs in the CAAD MEDATA System. To partially alleviate this problem, the Medical Data Update System, MDUS, was implemented in December of the same year.

The MDUS permits the user to alter newly entered data before it is added to the Master File via the CAAD MEDATA System. The normal procedure is to input the data using the MDIS, review it, and correct any errors using the MDUS. The updated data is then added to the Master File via MEDATA.

Initially, MDUS was used to input additional data in order to complete an incomplete data record thereby permitting one individual to input the initial part of the data using the MDIS, and another to complete it using the MDUS. This process was utilized during Apollo 14 when physical exami-

nation information was collected and input at Cape Kennedy. Subsequently, at the Manned Spacecraft Center, comments and special instructions were added by the reviewing physician. The updated data tape was transmitted back to Cape Kennedy and then entered into the CAAD MEDATA System. The physician, effectively, was able to partially oversee the physical examination without actually being present at the site of the examination.

3.1.2 Functions of the System

3.1.2.1 Input

The input to the MDUS is of two types: an MDIS data tape and the user CRT updates. The input data tape is created using the input system, MDIS. As each form is read from the input data tape, it is displayed on the CRT and the user may input update information via the keyboard that is connected to the CRT. These inputs may be in the form of additions, deletions, or modifications to the data already on the form.

3.1.2.2 Processing

First, a form is read from tape into the computer and the data within the form is prepared for output to the CRT. If a form is too large to be displayed on the screen all at once, it is displayed in pieces called "pages". As each page is displayed, the user enters his update data. This data is then input, processed, and saved. Once the last page is completed the entire form is output to the tape, and the next form read from the input tape. This procedure continues until the last form has been updated.

3.1.2.3 Output

The updated forms are output to a data tape. The format of this tape is the same as the input tape. A hardcopy print of any updated form is also optionally available on the teletype.

3.2 TECHNICAL SPECIFICATIONS

3.2.1 System Description

The input tape is formatted one form per record. As each record is read and processed, it is output to the CRT in nearly the same format as was originally with the MDIS. The difference in format is that MDUS permits only one question (or heading) per line, whereas the input system MDIS allows two per line in some instances. The processing of the record is performed a page at a time and once the last page has been processed the entire form is written to tape. This procedure is repeated for every form until the last record has been output.

3.2.2 Input

There are two types of input in the MDUS: an MDIS generated magnetic tape and CRT keyboard updates. The tape input is described in detail in Appendix A. The CRT input is initiated via the keyboard connected to the CRT. Transmission from the CRT to the computer is in Block mode, such that an entire screen of data is input rather than one character at a time. The input is

initiated upon receipt by the computer of an interrupt from the keyboard, caused when the user depresses the Interrupt key (INT). Format for the CRT data is found in Appendix B.

There are seven update control options which are available to the user. The desired option is selected by placing in the first two positions of the screen one of the following control codes:

<u>Control Code</u>	<u>Function</u>
DF	Delete this Form. Do not process or output this data to the updated tape.
HF	Hard copy this Form. Print this form on the teletype.
RF	Redisplay Form. Go back to the first page of this form and start over.
RP	Redisplay Page. Redisplay the original data for the current page.
CF	Copy Form. Process and output this page and the remainder of the form without displaying them.
CT	Copy Tape. Process and output the remainder of the tape records without displaying them.
BB	Process this page. Display the next page.

3.2.3 Processing

The processing in the MDUS has two major functions: (1) process the old data for output display to the CRT and (2) process the new data for output

to tape. After a record is read from tape, the subroutine BD00 formats the data for output in pages to the CRT. This processing is mainly composed of saving and translating certain special codes (see Appendices A and B) from the input data. Once the user has completed his changes and the updated data has been input, the subroutine BM00 then reverses the operation of BD00 by restoring those special codes. This updated information is saved in a tape output buffer. As soon as the last page of the record is processed by BM00, the entire new record is output to tape. This procedure will continue until the End-of-File Record (see Appendix A) is read from the input tape. An identical record is then created for output and the program is terminated.

3.2.4 Output

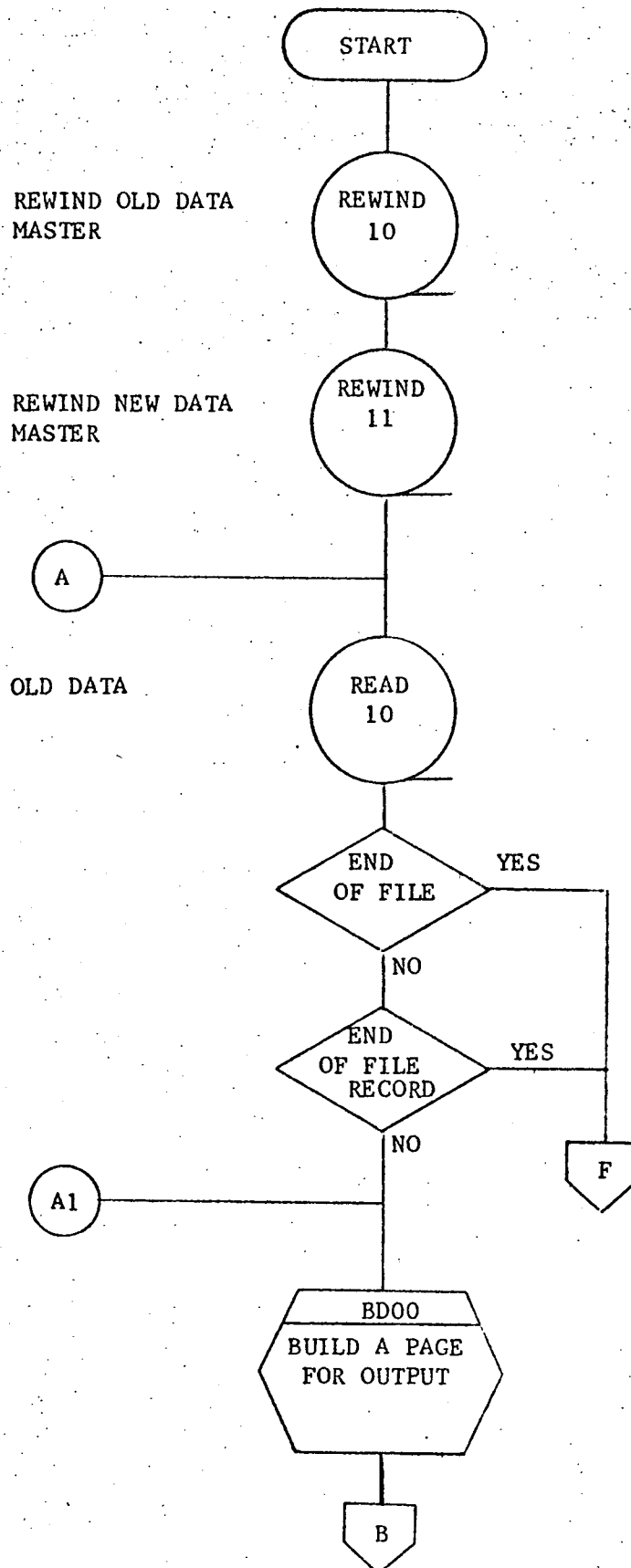
There are three output devices for the MDUS: the magnetic tape, CRT, and teletype. The tape and CRT layouts may be found in Appendices A and B respectively. The teletype format is similar to that of the CRT (see Appendix E).

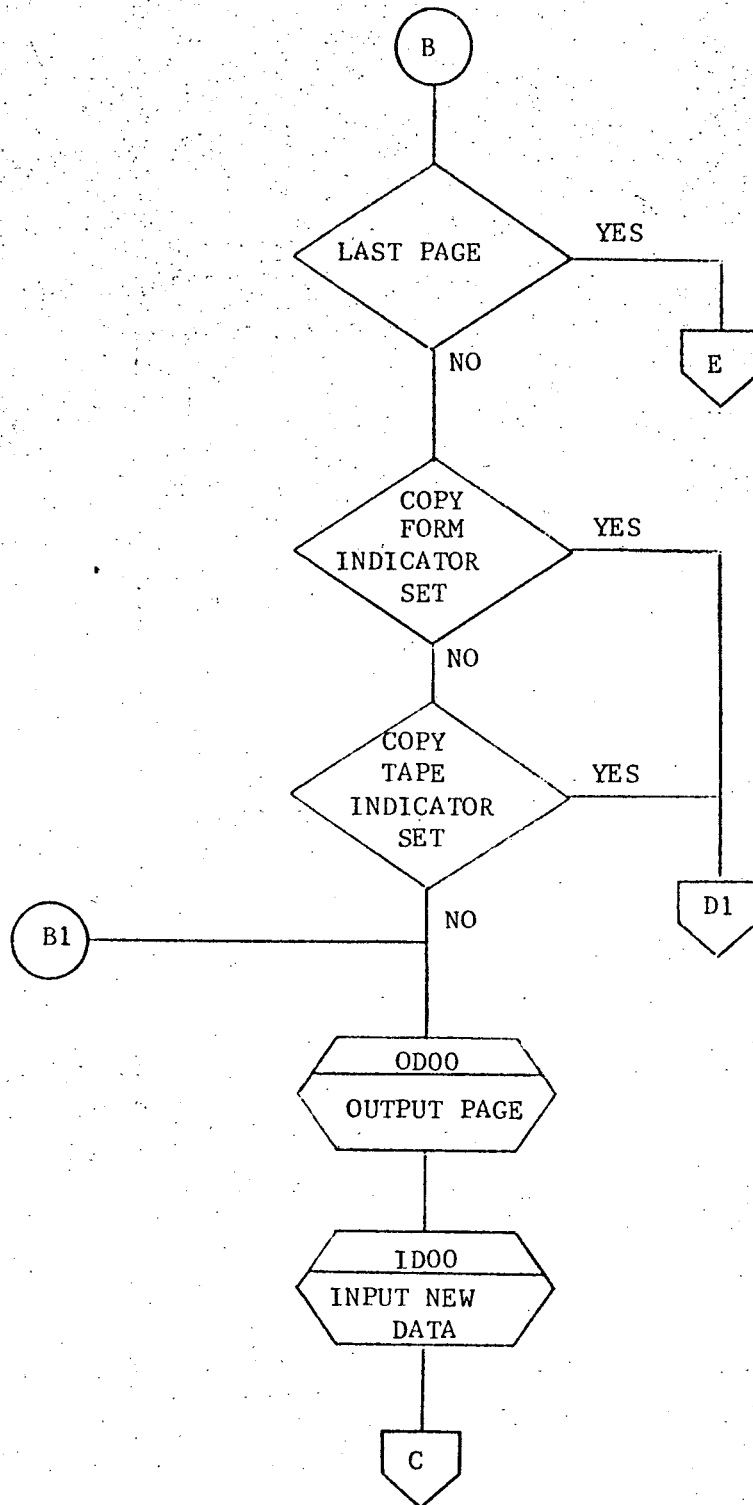
3.2.5 Buffers and Tables

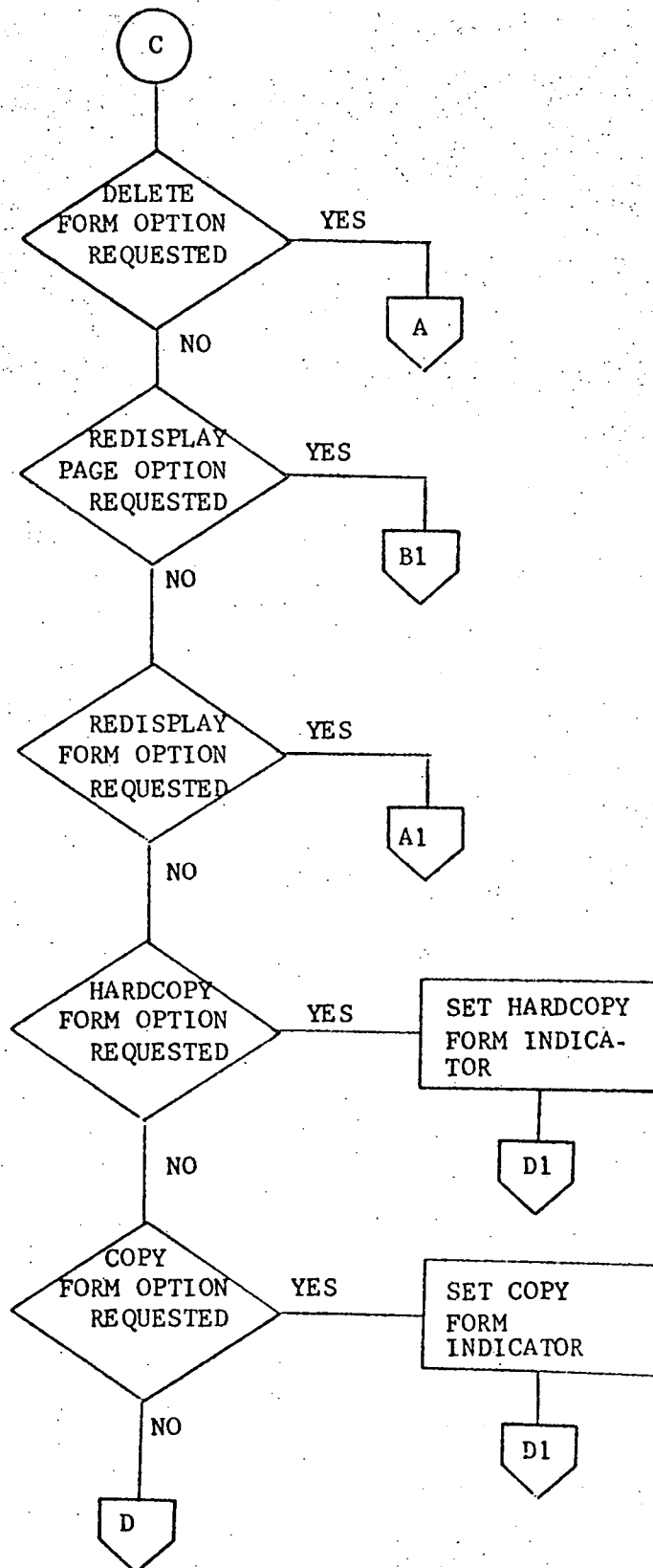
Label	Length (Words)	Contents/Purpose
CRN\$	962	CRT input buffer. Contains the updated data when it is input from the CRT.
CRO\$	962	CRT output buffer. Contains a page of data which is to be output to the CRT.
DPT\$	1	Display output buffer pointer. Used to save the address of the next available location in CRO\$ when building a display page.
FTB\$	1	Form table. Contains the beginning location of the next tape record to be updated.
LTB\$	30	Line Table. A table that describes each line of data on the CRT. See Appendix C.
MPT\$	1	Tape output buffer pointer. Used to save the next available location in MTO\$ when building an updated data record.

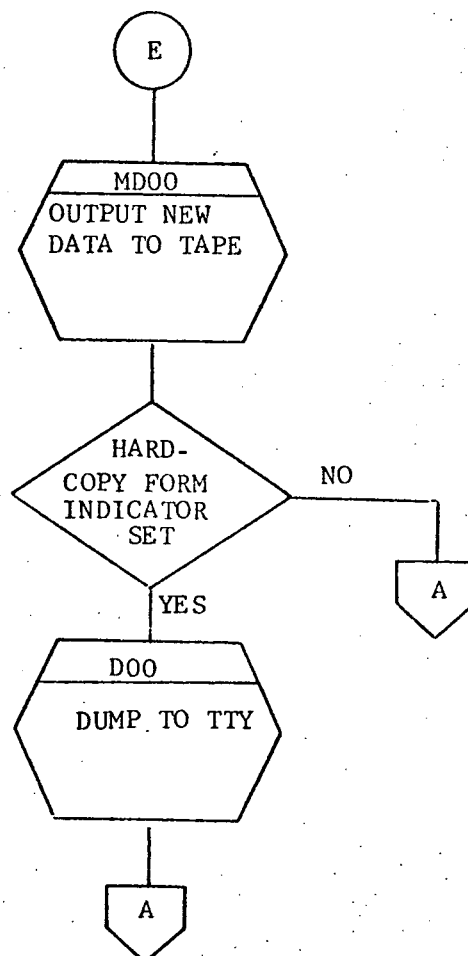
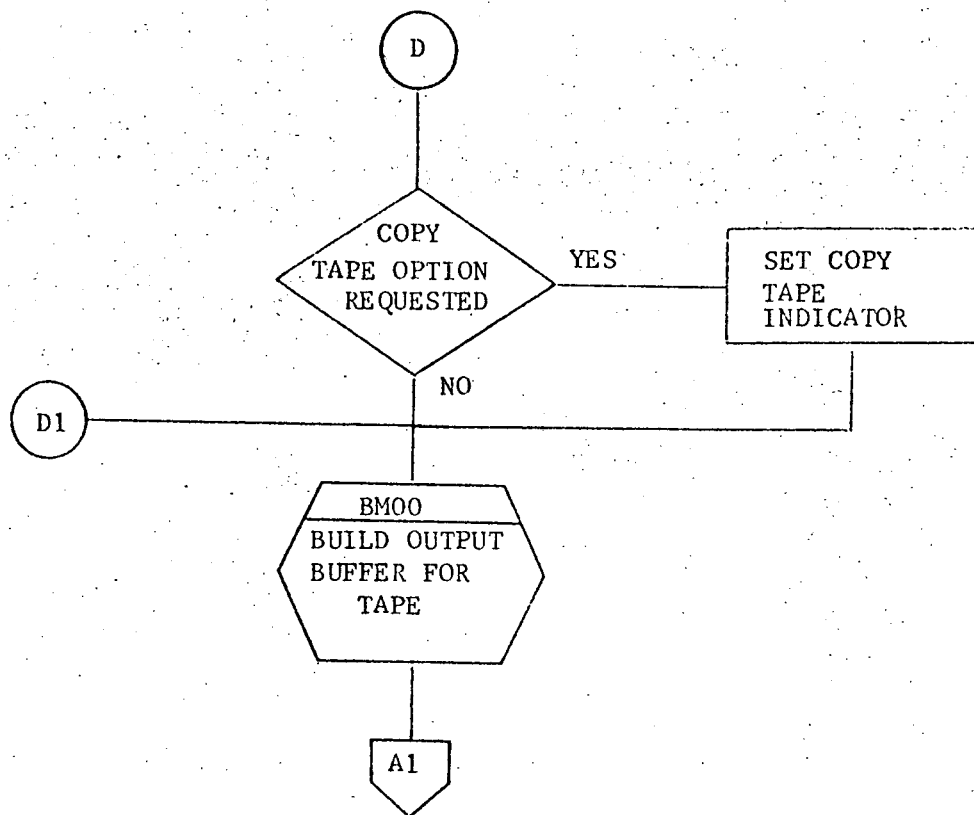
Label	Length (Words)	Contents/Purpose
MTN\$	2880	Tape input buffer. Storage location for record currently being updated.
MTO\$	2880	Tape output buffer. Storage location for updated data record

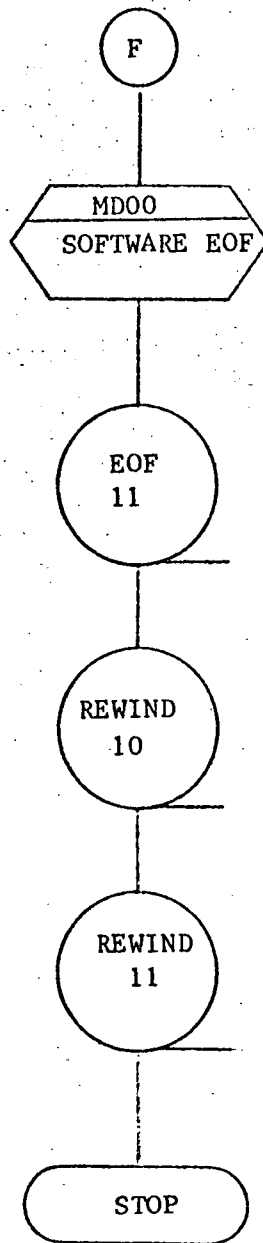
3.2.6 System Flow











3.2.7 Hardware Configuration

Following is a minimum hardware configuration for operation of the MDUS;

- 1 - Varian 620/i computer with 20K of core memory
- 1 - CCI CC-30 Communication Station with controller (CRT)
- 2 - tape drives
- 1 - teletype
- 3 - Buffer Interlace Controllers (BIC)
- 1 - Priority Interrupt Module with the following interrupts.

End of Transmission interrupts on all BIC's.

CRT keyboard interrupt

The two tape drives and the CRT should be connected to separate BIC's.

3.2.8 System Block Diagram

See Figure 3-1.

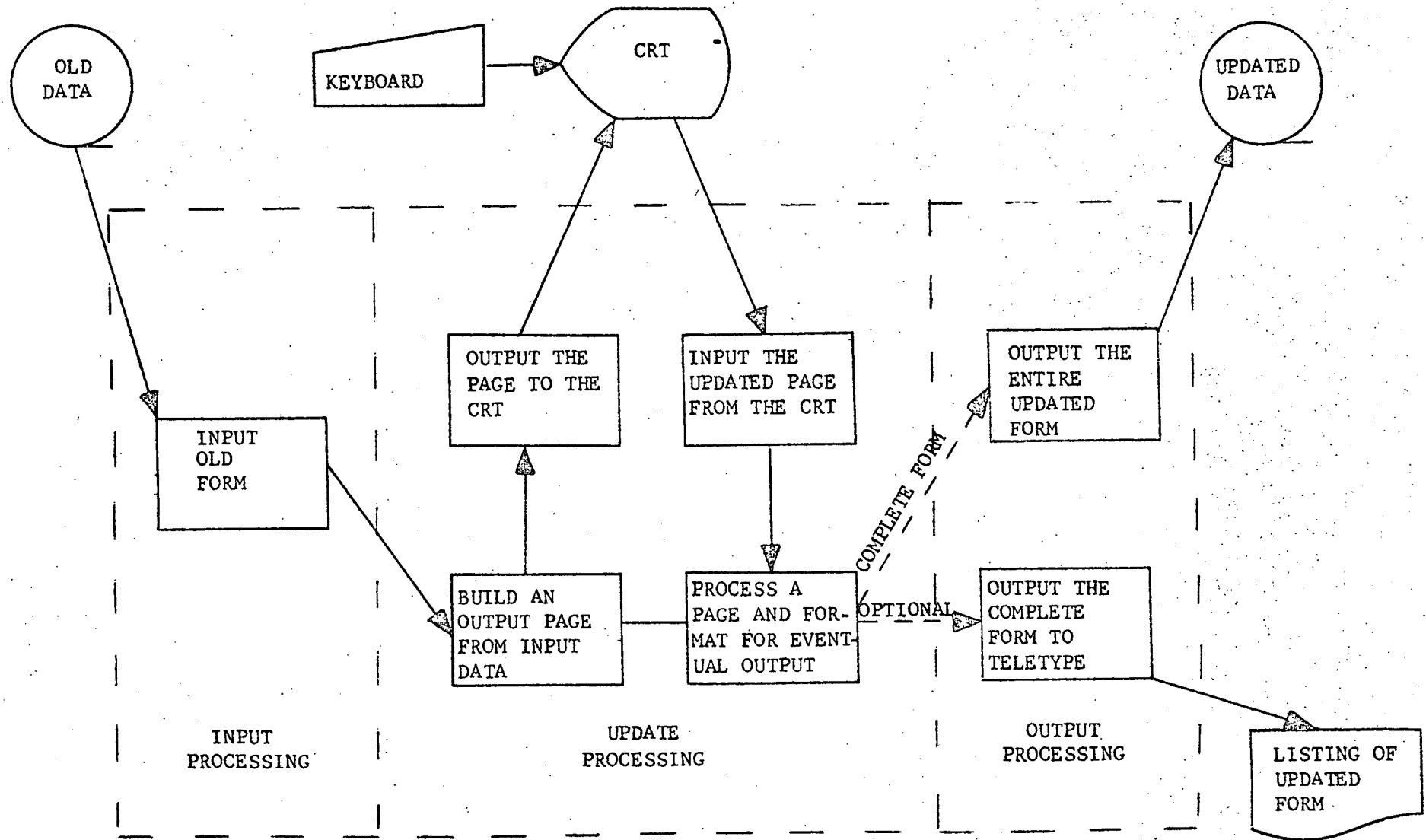


Figure 3-1. MDUS System Block Diagram

3.3 SUBROUTINES

3.3.1 BD00 - Build Display

3.3.1.1 Purpose

The purpose of this subroutine is to format the data input from the magnetic tape master file and stored in the input buffer for eventual output to the CRT.

3.3.1.2 Technical Description

The function of BD00 is to format the input data for output from the CRT output buffer (CRO\$). Since an entire form will usually fill more than one CRT screen, the data is divided into "pages". To mark this division, EOP (end-of-page) characters have been placed at specific places in the input data so that, when one is encountered during processing, control is returned to the calling routine, which then initiates output to the CRT. The next time BD00 is entered, the processing continues at the point of the last EOP character.

Normally, this procedure is repeated until the entire form has been output. However, since a calling routine may desire a new form to be displayed before the previous one has been completely output, the A-register, upon entry, is used as a flag. If it is zero, processing is to continue from the last EOP character. Otherwise, processing will be initiated at the beginning of the input buffer (a new form).

With each page of data BD00 builds a line table (LTB\$). This table associates one word to every line on the CRT. Appendix C explains the contents of each word of the line table.

It should be noted that the first line of all pages subsequent to the first page will be blank due to minor format incompatibilities with MDIS.

The following is a list of special characters and their usage in the input data.

Character	Code	Usage
end-of-block	(244 ₈)	Precedes every heading. Follows every answer. Output as "new line" character.
end-of-record	(337 ₈)	Signals end of processing. Last character in form.
carriage return	(336 ₈)	Indicates more data follows. Output as new line.
end-of-page	(241 ₈)	Indicates the end of a page of data.

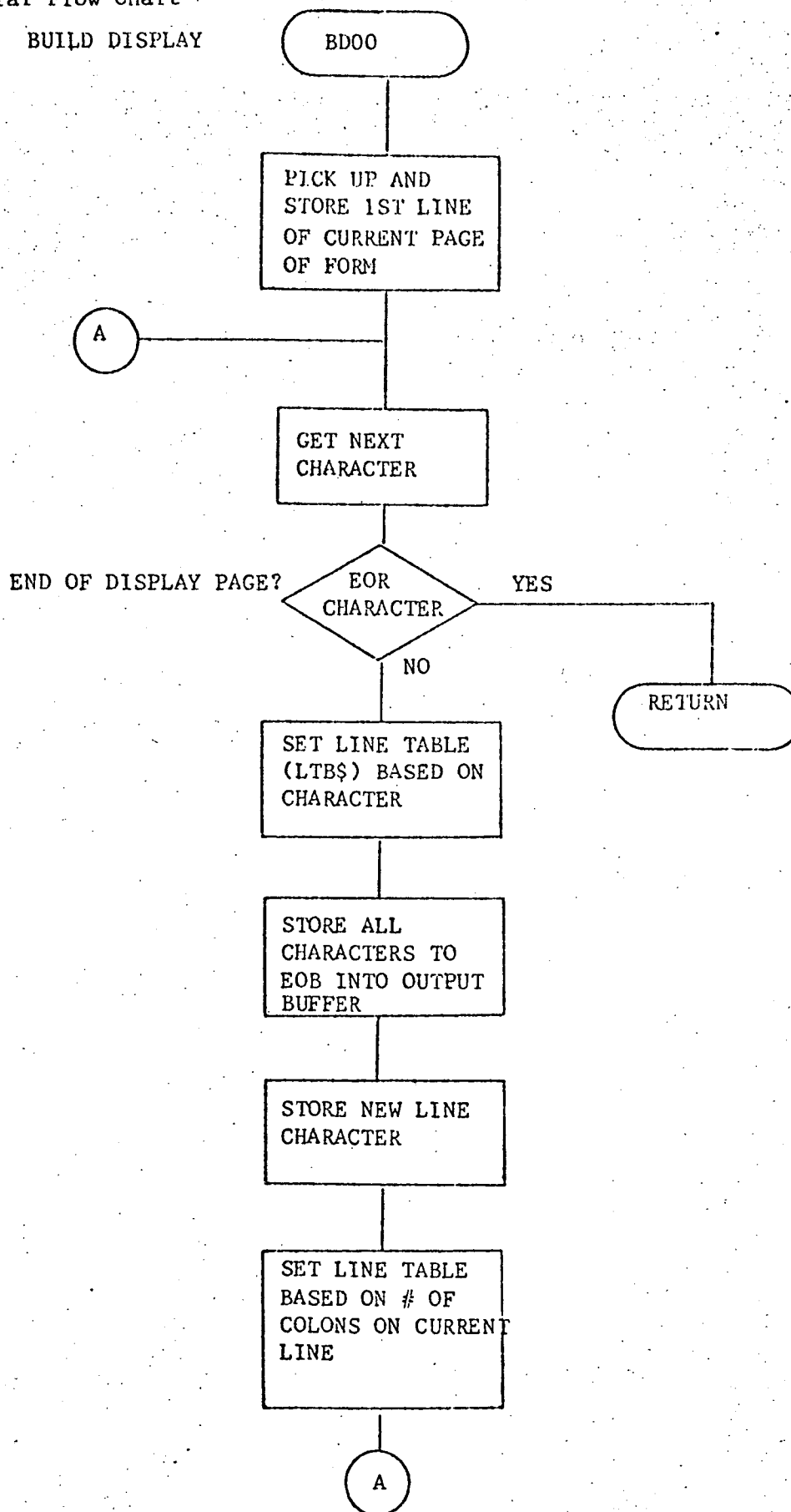
The processing is performed on a character-by-character basis. First, the level code and sequence number (if any) are picked out of the input buffer and saved in a line table word. Codes for blank characters, equal in number to the value of the level code, are then stored in the output buffer. The heading and any answers follow immediately. As each end-of-block character is reached, the procedure is repeated. Once an end-of-page character is encountered, control is returned to the calling routine and the page is output. If a page exceeds the output buffer in length, an error message ("PLEASE SELECT ANOTHER FORM") is output.

3.3.1.2.1 Calling Sequence

Call BD00

<u>Registers</u>	<u>Contents Upon Entry</u>	<u>Contents Upon Exit</u>
<i>h</i>	0 indicates continuation of processing from the last EOP character. 1 indicates begin processing at the beginning of the form.	< 0 indicates output buffer (CRO\$) was exceeded and an error message was output. = 0 indicates that the last page has already been output and updated, and a new form is needed. > 0 indicates a normal return.
<i>B</i>	N/A	N/A
<i>%</i>	N/A	N/A
Overflow	N/A	N/A

3.3.1.2.2 General Flow Chart
BUILD DISPLAY



3.3.1.3 Label Description

3.3.1.3.1 Local

- BDBL - (240₈) blank
- BDB2 - ("FORM ", 12₈, 13₈, 11₈, 11₈, "PLEASE SELECT ANOTHER FORM")
error message output when CRO\$ buffer is exceeded.
- BDCC - colon counter; count the number of colons found on one line.
Indicates no answer, one answer, or two answers on a line.
- BDCH - save location for second character of word; first character
unpacked, and second character saved.
- BDCL - (272₈) colon
- BDCR - (336₈) carriage return
- BDCS - switch used to indicate which half of the next available word
is to be unpacked.
- BDEB - (244₈) end-of-block character
- BDEP - (241₈) end-of-page
- BDER - (337₈) end-of-record
- BDE2 - (38) number of words in BDB2 error message
- BDFP - pointer into tape input buffer (MTN\$) that indicates the next
available word to be unpacked for processing.
- BDLP - line table pointer; pointer to next available word in line table.
- BDNF - (24) maximum number of forms allowed (used with input system only)
- BDNL - (12₈) new line character
- BDPC - position counter; counts the position on a CRT line currently being
filled in CRO\$(1-40).

- BDSC - sequence counters; counts the number of headings having sequence numbers (or the number of headings in ID Section of form).
- BDSV - three temporary save locations
- BDTB - (334₈) tab
- BDTX - (3) end-of-text character (CCI)

3.3.1.3.2 Global

None

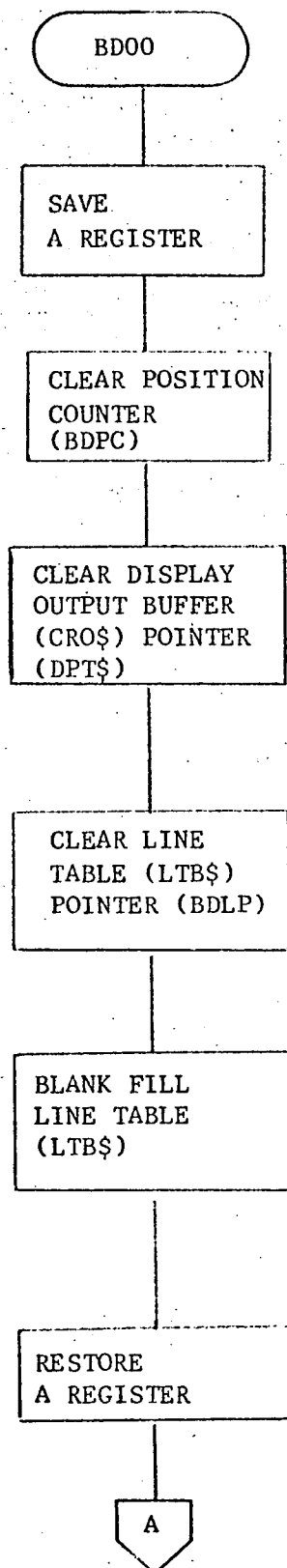
3.3.1.3.3 Entry Point

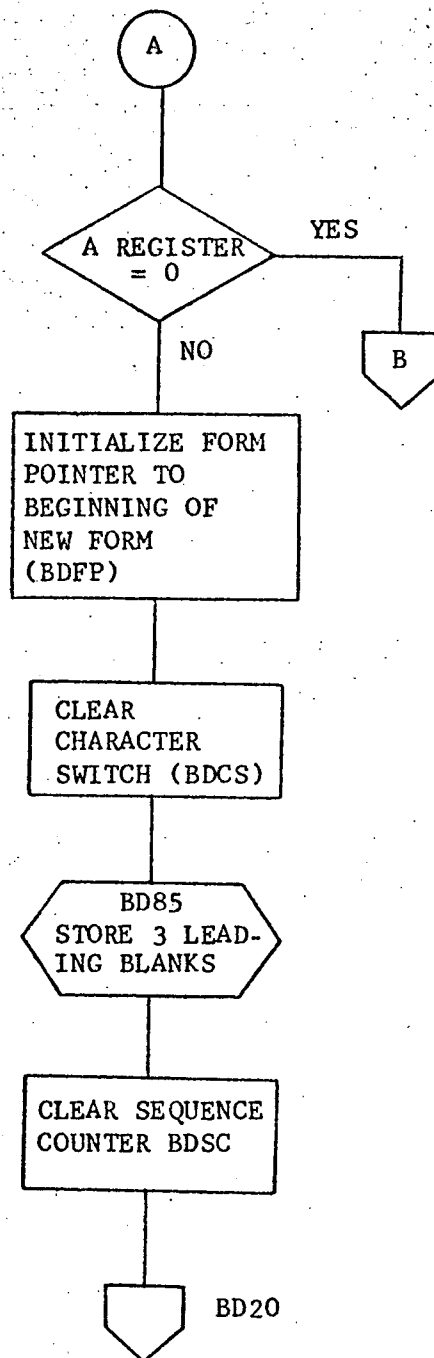
- BD00 - primary entry

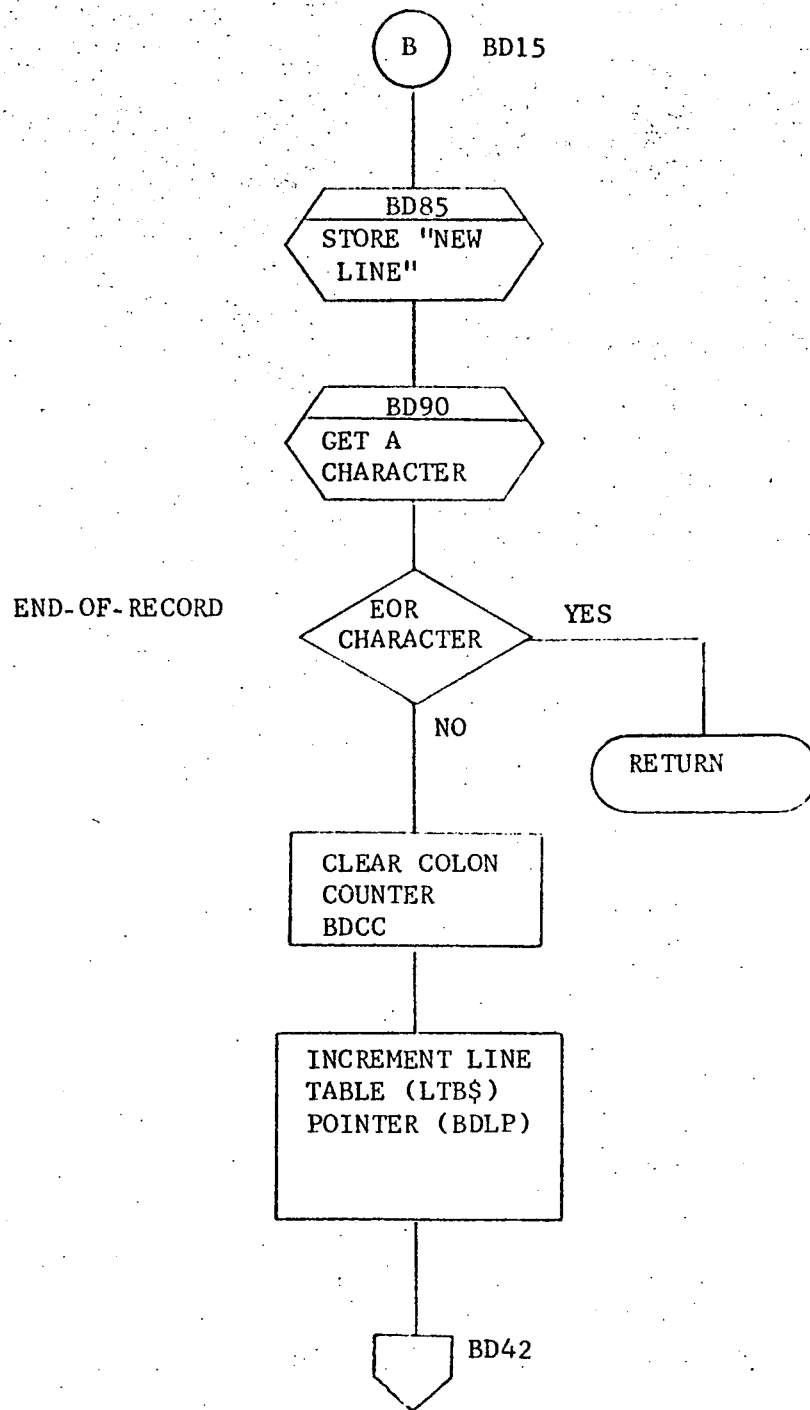
3.3.1.3.4 External References

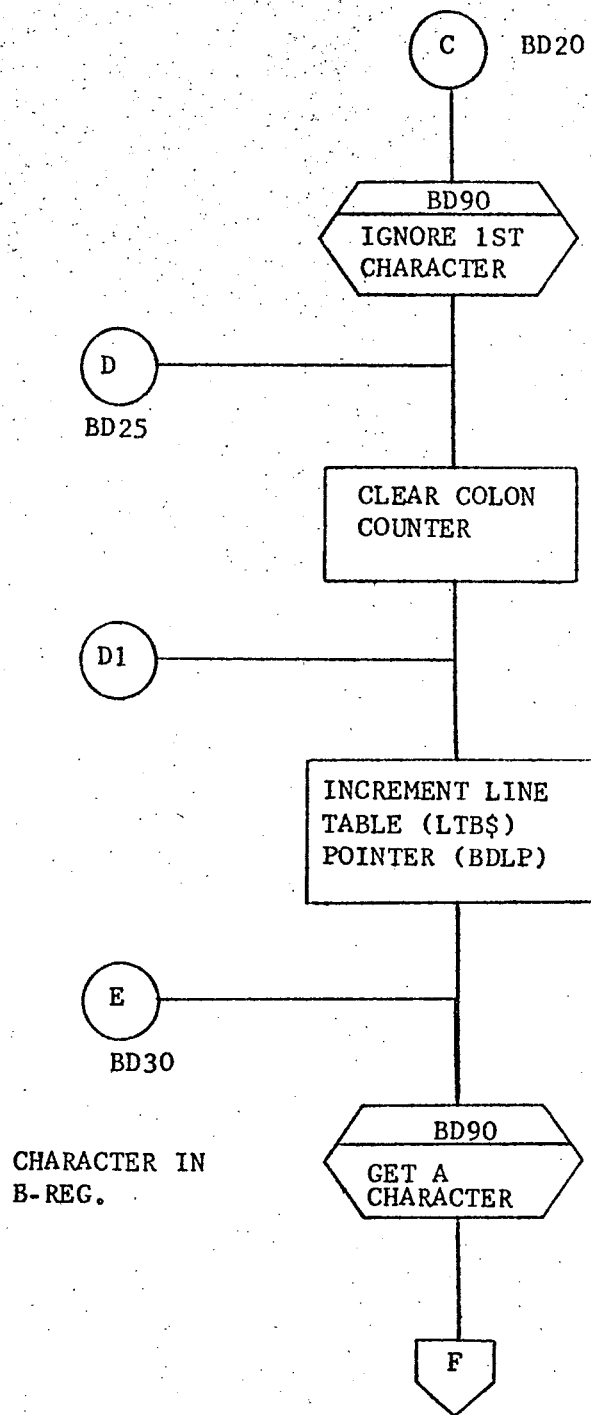
- CRO\$ - display output buffer
- DPT\$ - display pointer; points to next available location relative to CRO\$ for storing output data.
- FTB\$ - forms table; pointer to beginning of form in memory
- LTB\$ - line table; see Appendix C

3.3.1.4 Detailed Flow Chart









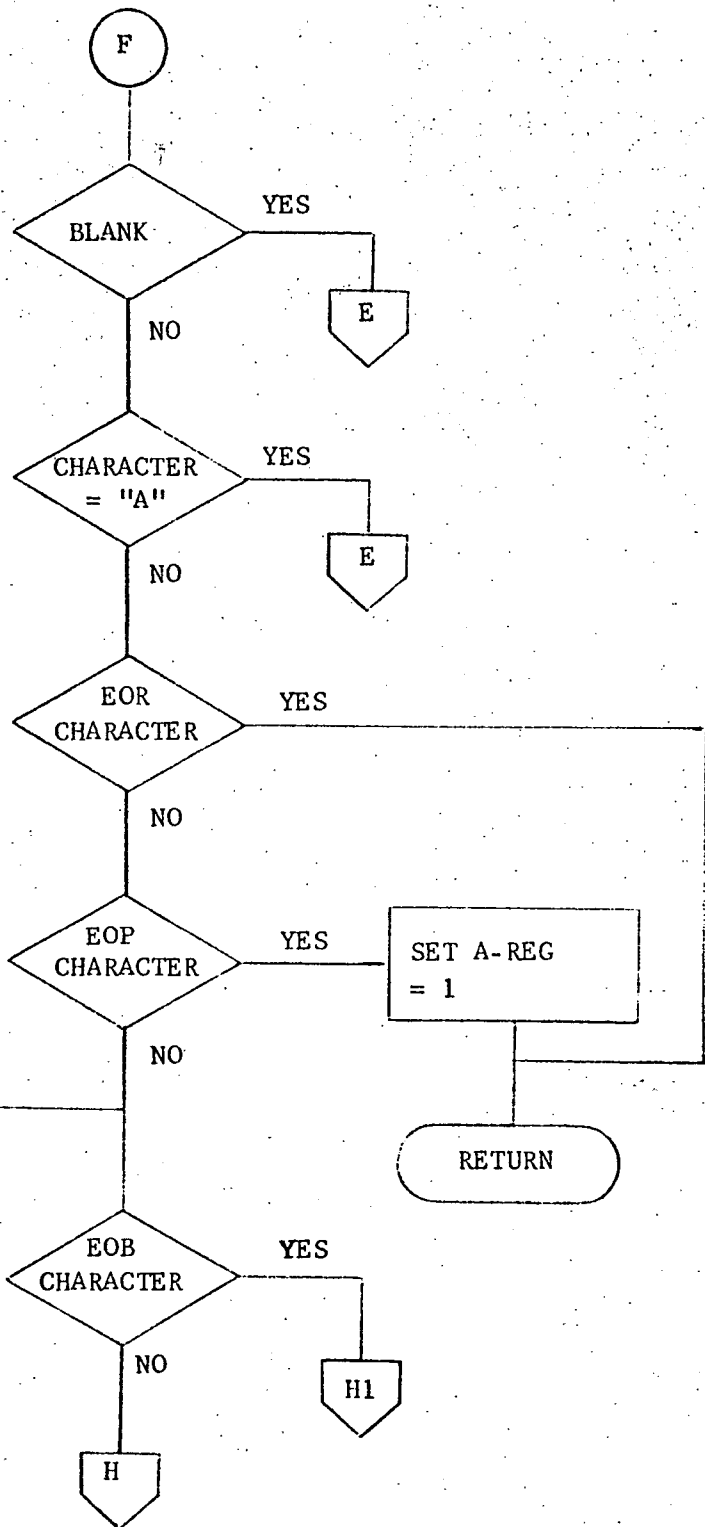
"A" INDICATES
END OF ID SECTION

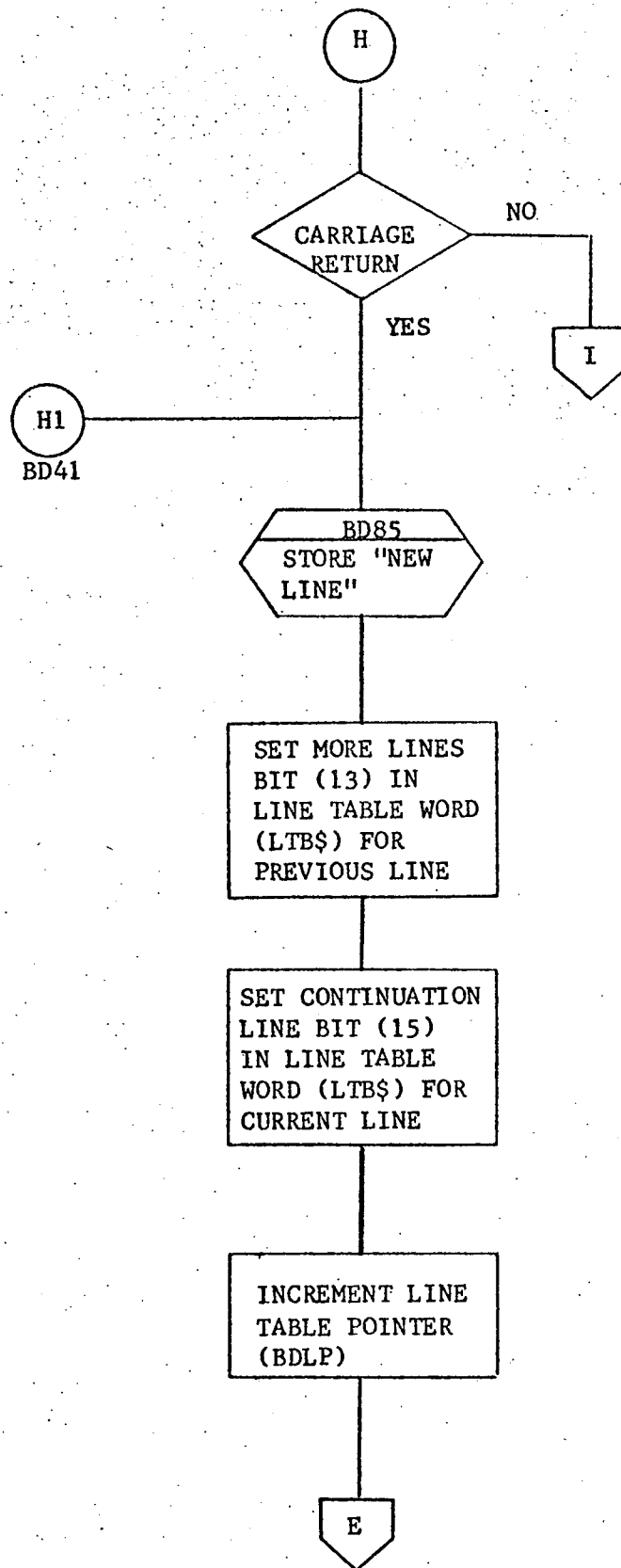
END OF RECORD

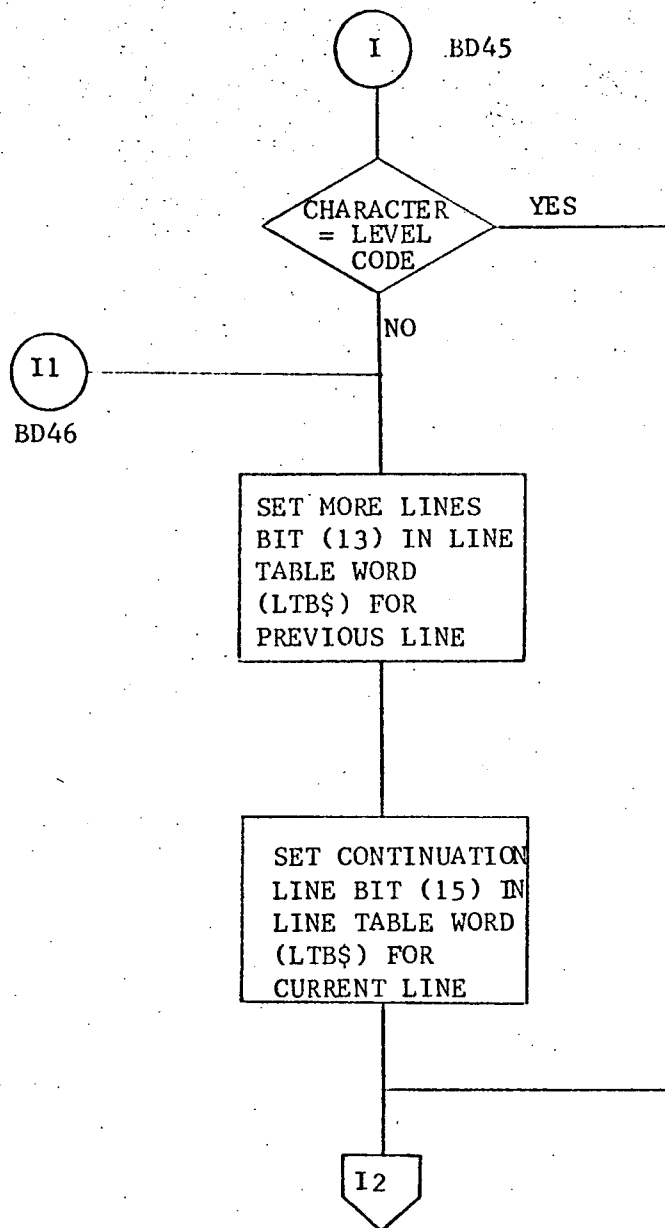
END OF PAGE

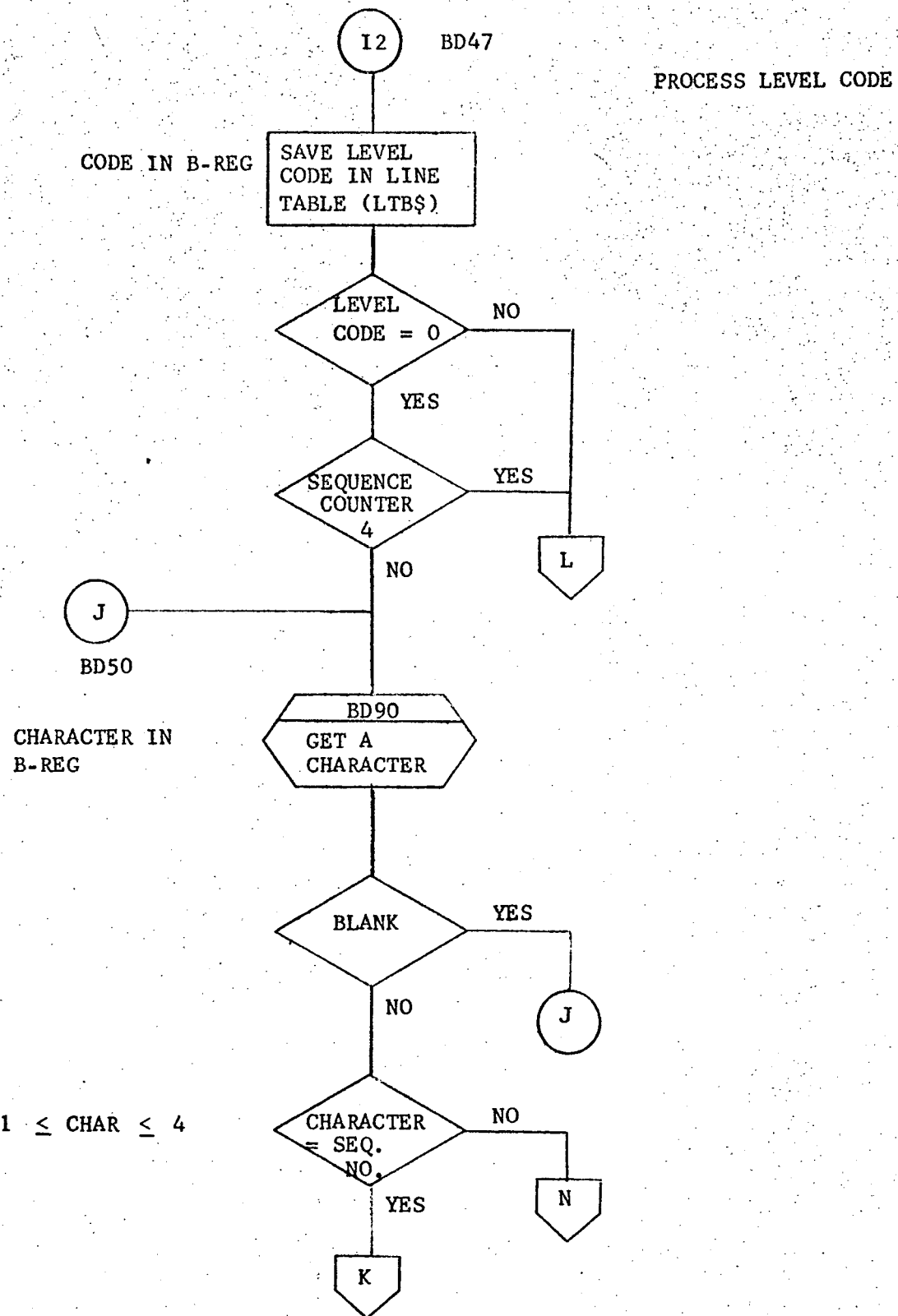
END-OF-BLOCK

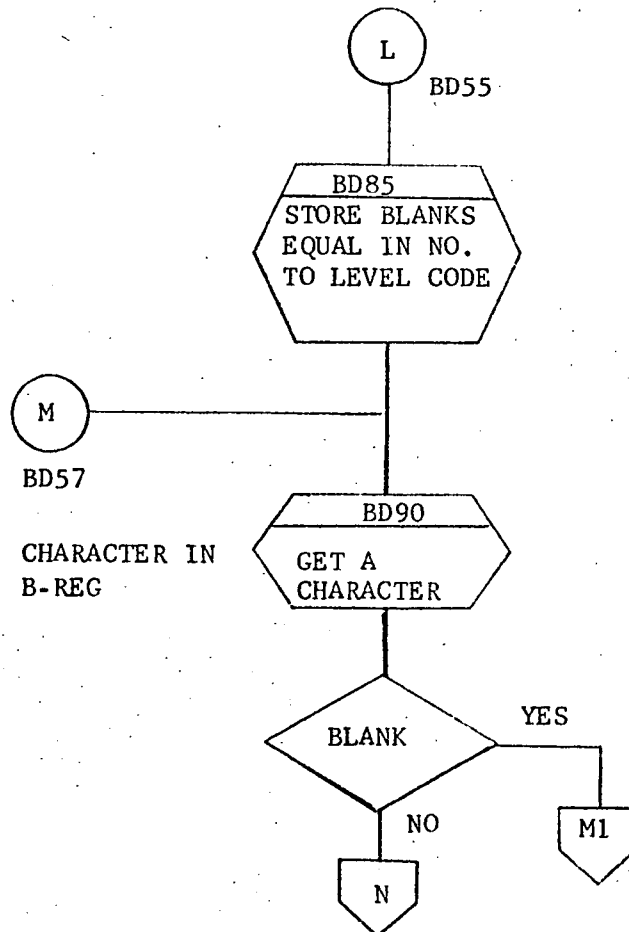
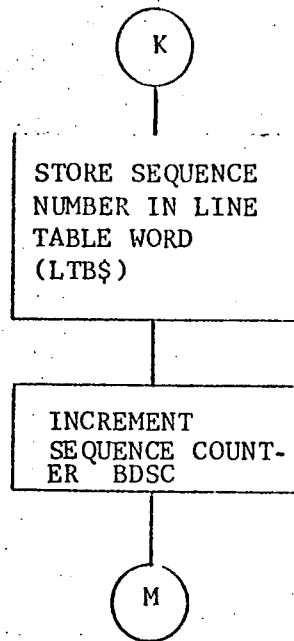
G
BD40



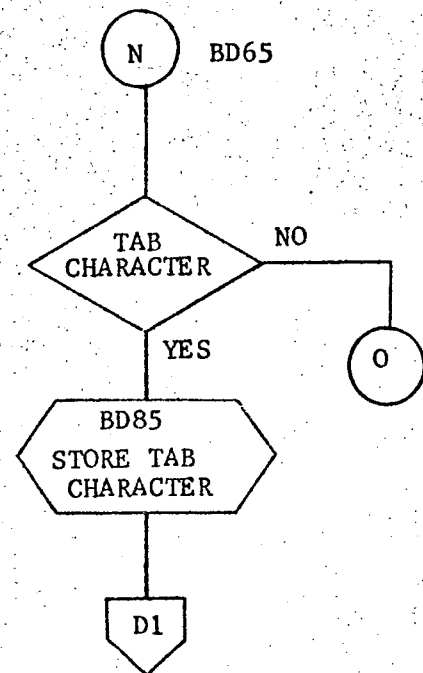
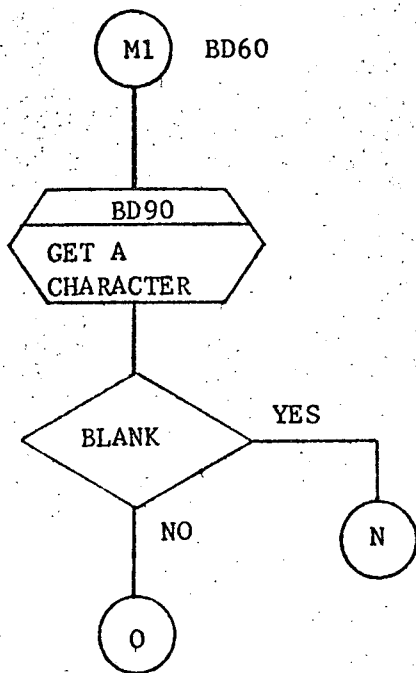




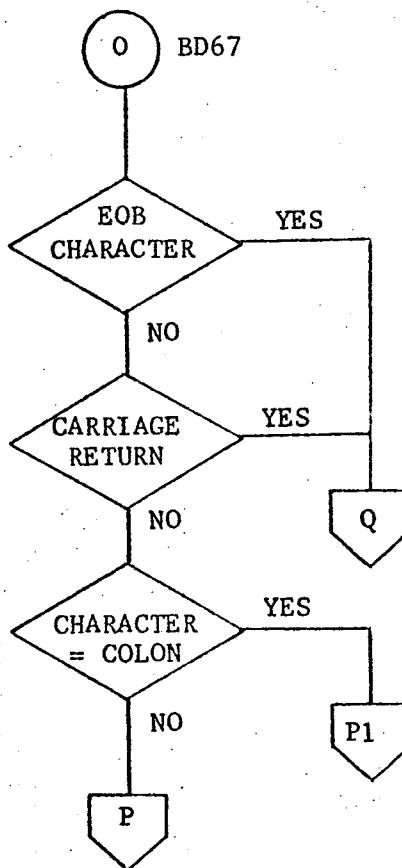


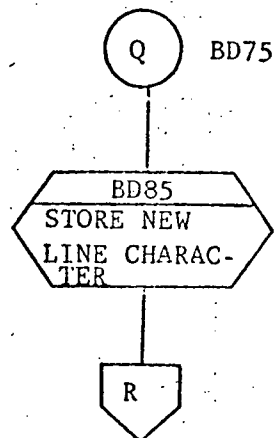
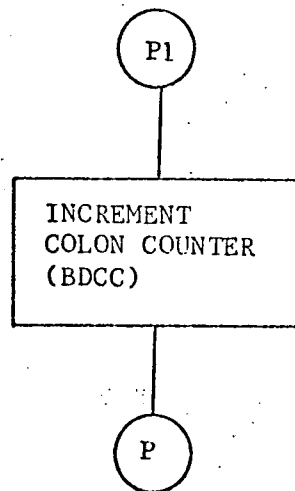
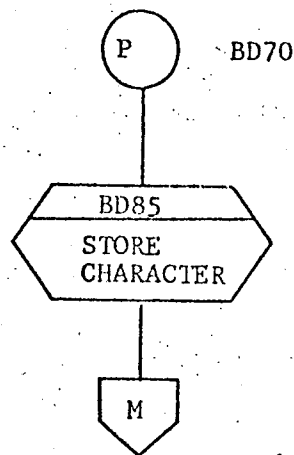


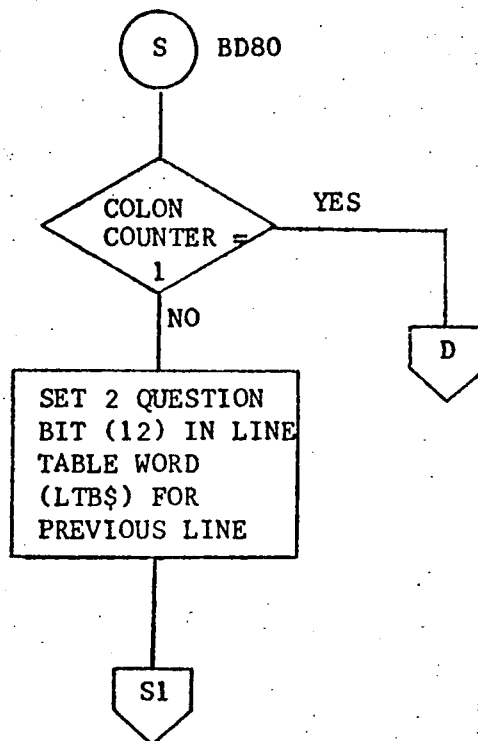
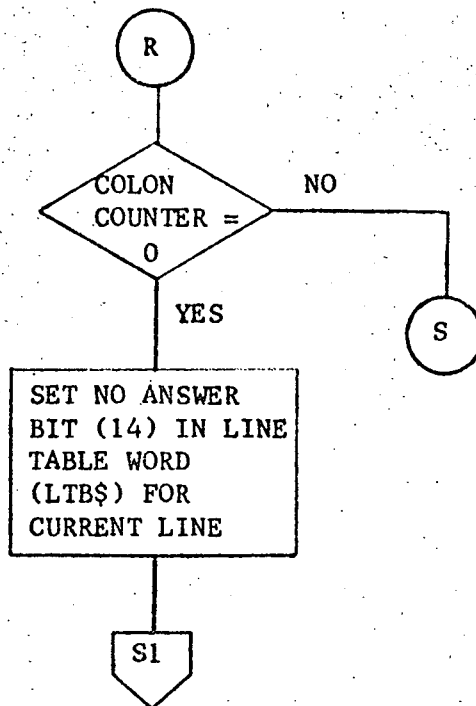
STORE BACKGROUND
INTO OUTPUT BUFFER

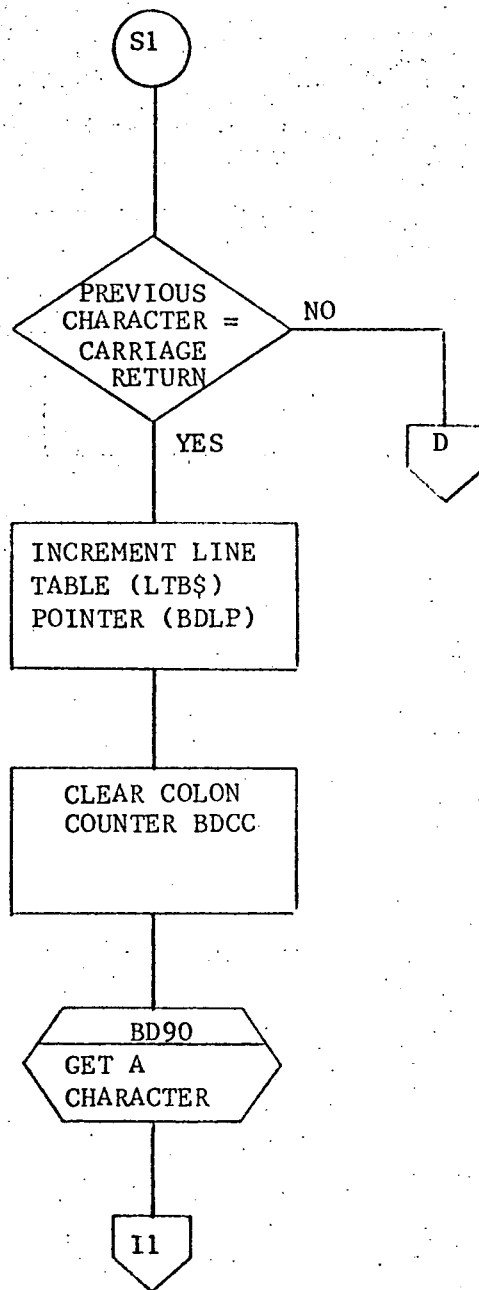


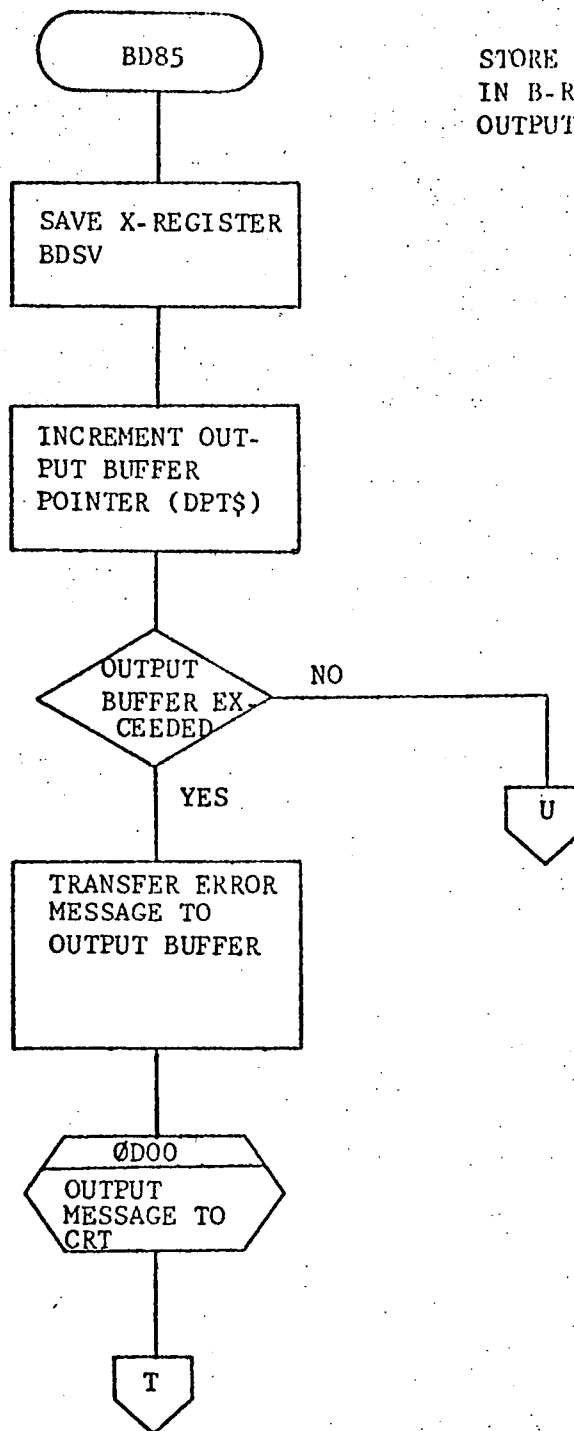
END-OF-BLOCK?



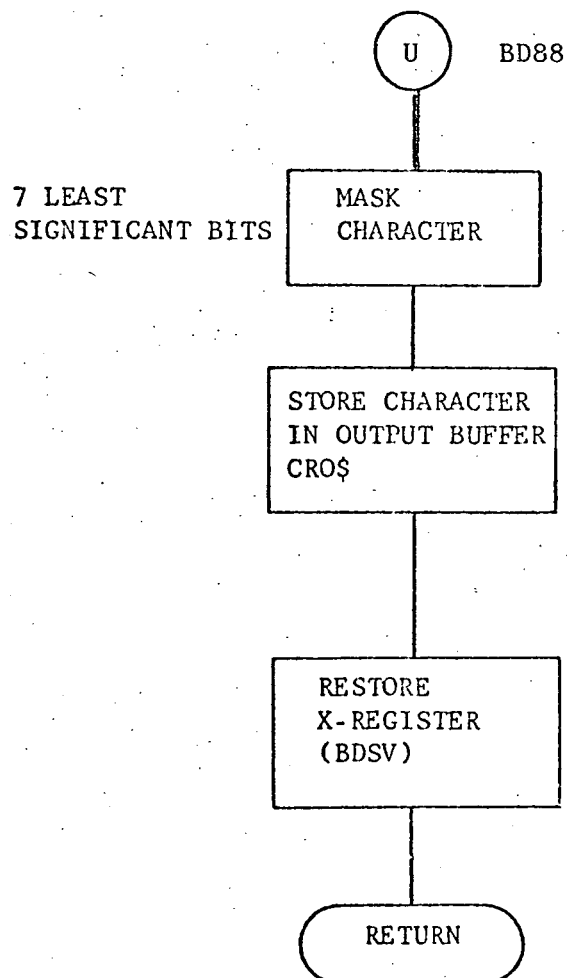
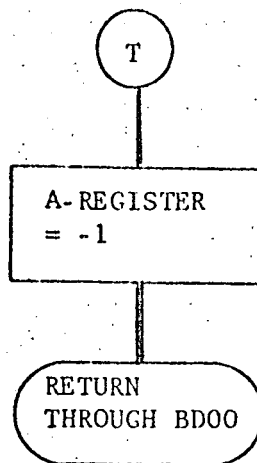


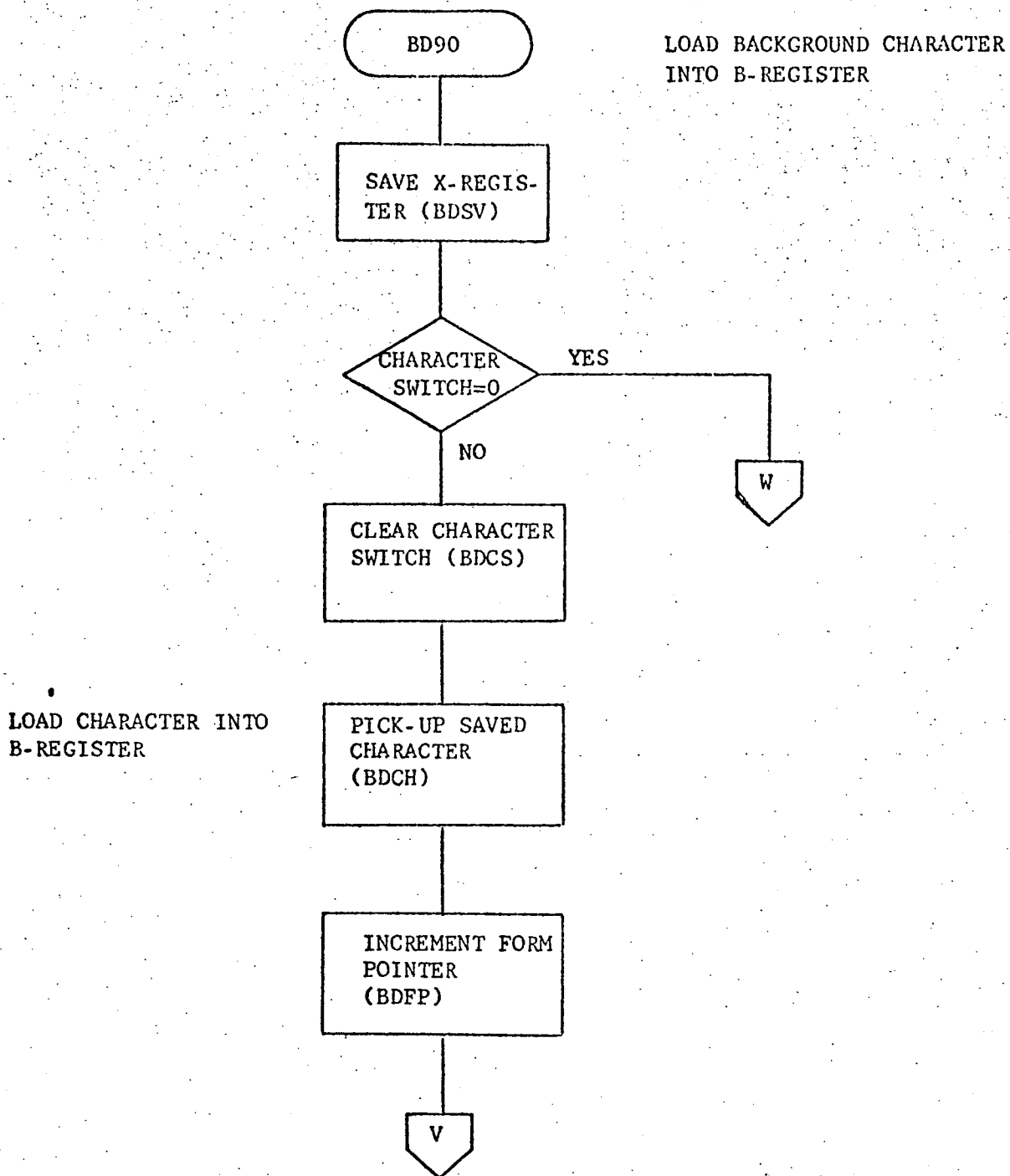


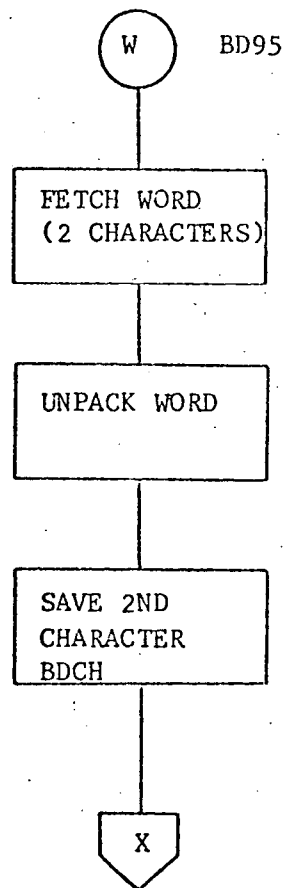
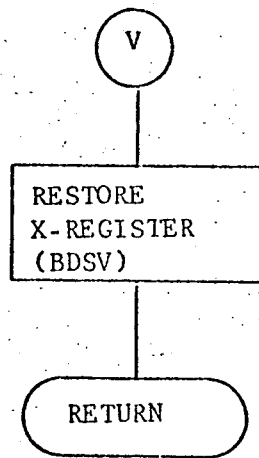


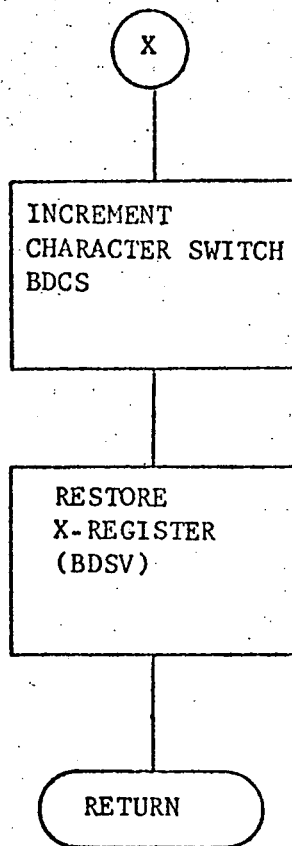


STORE THE CHARACTER,
IN B-REGISTER, INTO
OUTPUT BUFFER









3.3.2 BM00 - Build a MEDATA record

3.3.2.1 Purpose

The purpose of this subroutine is to restore the saved codes (saved by BD00) and format the update information just input by the user for eventual output to the new Master tape.

3.3.2.2 Technical Description

BM00 processes the user update input data which has been stored in an input buffer by performing the following functions:

- restoring the special codes saved by BD00;
- storing user data into the output buffer;
- performing a limited amount of error checking;
- inserting an "A" which is required by MEDATA at the end of the ID section of each form.

The first two points make up the majority of the processing. The special codes that are restored are found in the Line Table, LTB\$ (see Appendix C). These codes are the level codes and the sequence numbers. In general, the remainder of the processing, once the codes are restored, is the fetching of each heading and answer from the display input buffer (CRN\$) and the storing of it into the tape output buffer (MTO\$).

The last two points are special cases that should be described individually.

There are only four headings in a form that have a sequence number. These make up the ID section. The letter "A" must immediately follow this section to indicate the end of identification information. This requirement is levied by MEDATA.

A limited amount of error checking is performed on each heading and answer. The line table (LTB\$) tells whether or not a heading allows an answer. If it does, a colon must be present following the heading. If not present, the A-register is set to the line number (BMLC) on which the error occurred, and control is returned to the calling routine. If the first character following the colon is a left parenthesis, a right parenthesis must also be present. If there is no right parenthesis, the A-register is set to the current line number (BMLC) and the control is returned.

If the buffer overflows when storing data into the tape output buffer (MTO\$), an error message (BUFFER LENGTH ERROR) is output, the A-register set to -1, and control returned to the calling routine.

There are three characters placed in the output data that serve special purposes.

Character	Code	Purpose
end-of-page	(241 ₈)	indicates the end of a CRT screen of data. When the line table word is equal to 4040 ₈ , the last data line has been processed, and the character can then be stored.

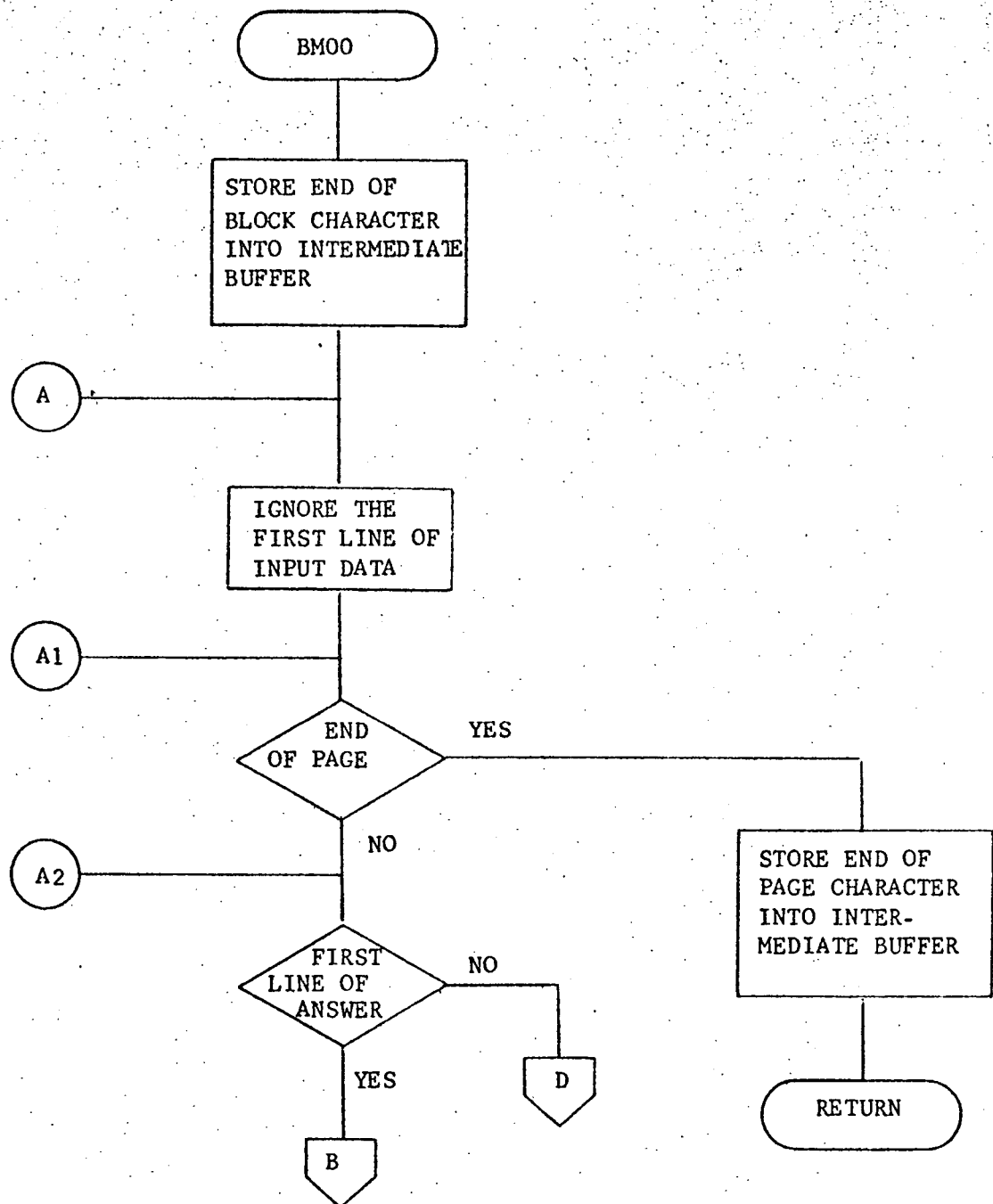
Character	Code	Purpose
end-of-block	(44 ₈)	indicates the end of the answer. When the end of the line is reached, and the line table indicates no more data follows, this character is inserted.
Carriage return	(136 ₈)	indicates the end of a CRT line of data, but more data is to follow on the next line.

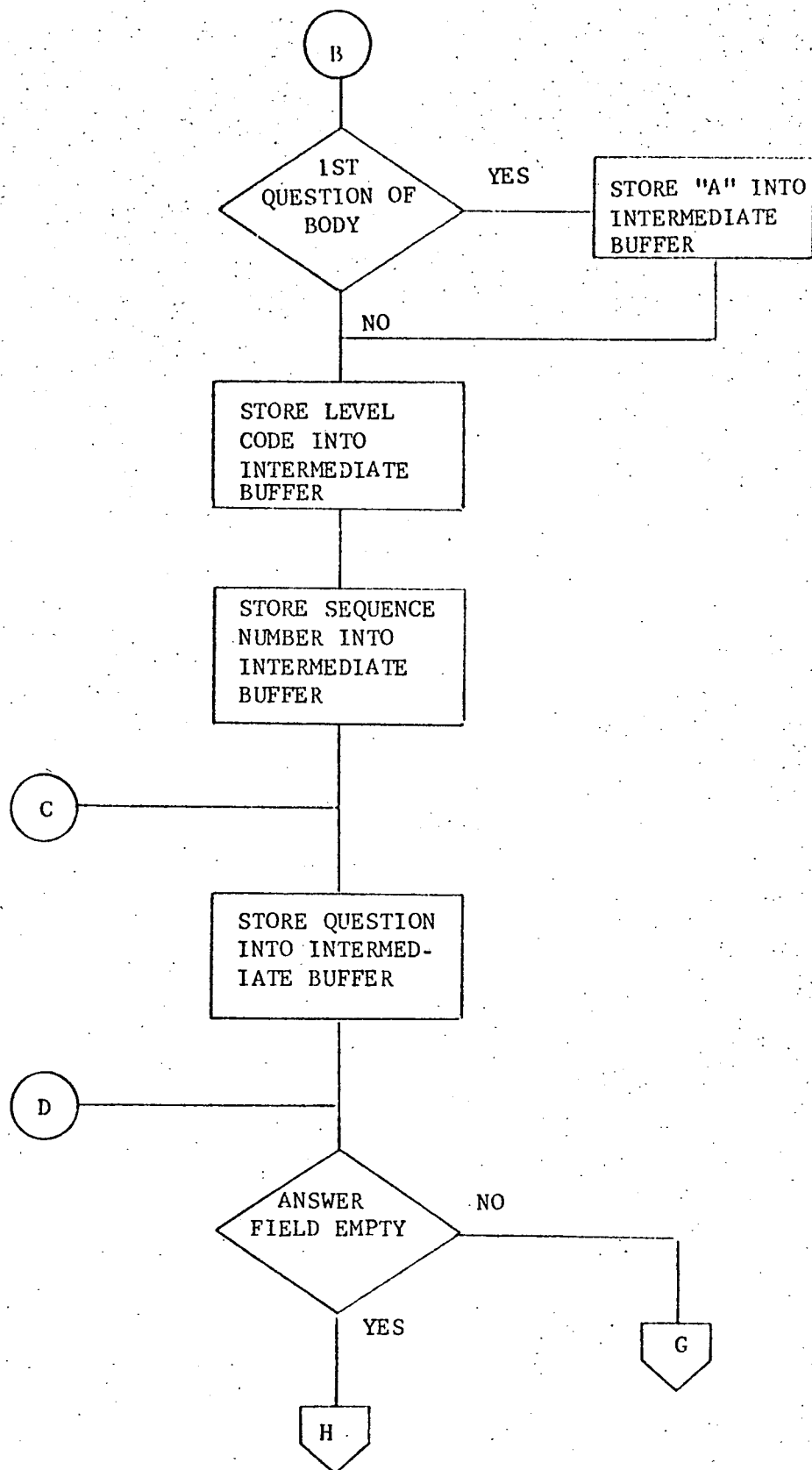
3.3.2.2.1 Calling Sequence

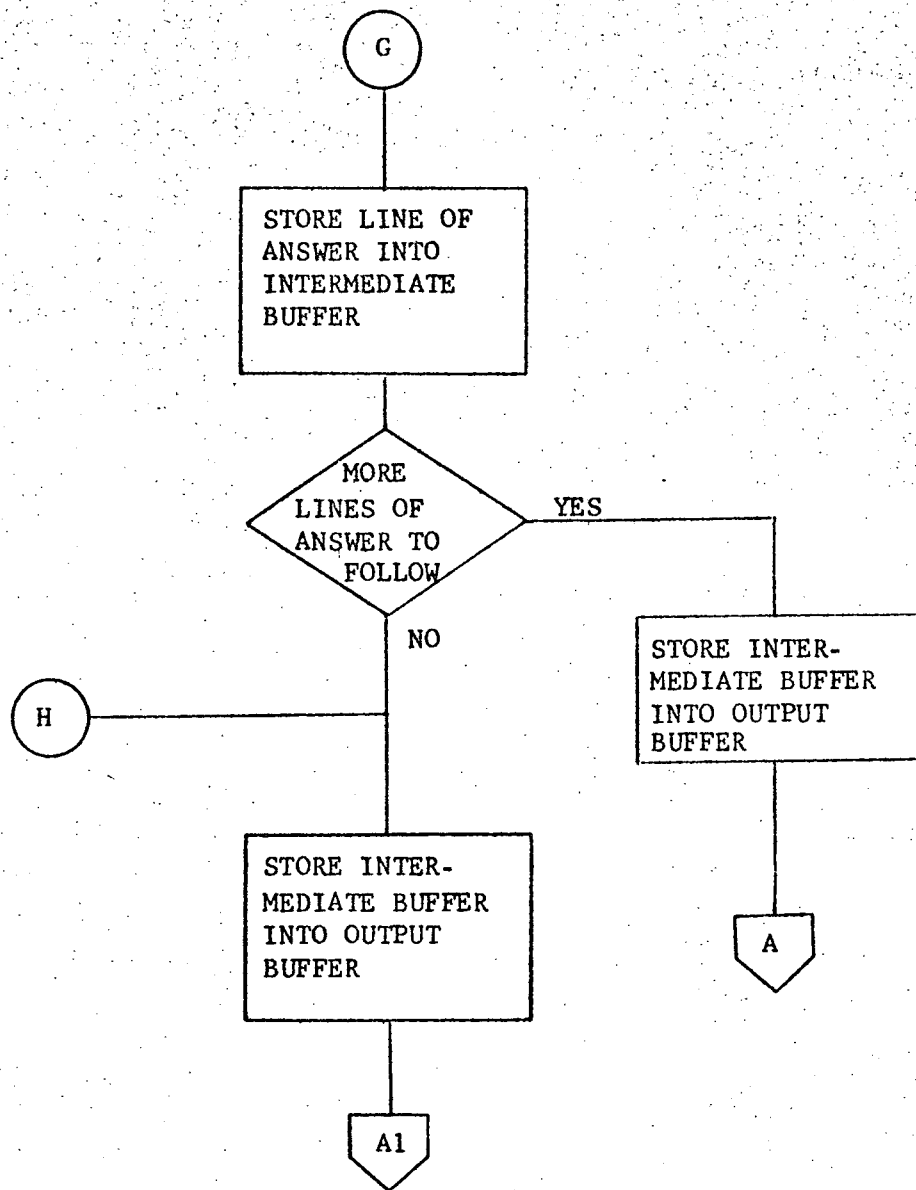
CALL BM00

REGISTER	CONTENTS UPON ENTRY	CONTENTS UPON EXIT
A	= 0 indicates input data is in CRN\$ ≠0 indicates input data is in CRO\$	-1 indicates the output buffer has overflowed. >0 indicates the line number of a user-input error.
B	N/A	N/A
X	N/A	N/A
Overflow	N/A	N/A

3.3.2.2.2 General Flow Chart







3.3.2.3 Label Description

3.3.2.3.1 Local

BMB	('BUFFER LENGTH ERROR') error message
BMBL	(40 ₈) blank
BMCL	(72 ₈) colon
BMCP	(51 ₈) closed parenthesis
BMCR	(136 ₈) carriage return
BMCS	character switch. Indicates into which half of the word the next character is to be packed in the tape output buffer (MTO\$).
BMDP	display pointer. Indicates the location of the next character to be processed from the input buffer (CRN\$).
BME	(19) number of words in the error message BMB.
BMEP	(241 ₈) end-of-page
BMIB	intermediate buffer. 46 word buffer where data is stored prior to being placed in tape output buffer (MTO\$).
BMIF	ID flag. Flag indicates that the heading with a sequence number of four has just been processed and the ID section is complete.
BMIP	intermediate buffer pointer. Indicates next location in intermediate buffer (BMIB) for storing data.
BMLC	line counter. Indicates the line number on the CRT that is currently being processed.
BMLP	line table pointer. Indicates the location in the line table associated with the heading and answer currently being processed.
BMNL	(12 ₈) new line (CCI)

BMOP (50₈) open parenthesis

BMP save location for tape output buffer pointer (MPT\$)

BMPC position counter. Counts the number of character positions on the CRT line that have already been processed.

BMPM storage location containing the maximum number of CRT positions allowed for the heading and answer of the current line being processed (20 or 40).

BMSV two temporary save locations

BMTB (40₈) tab = blank

BMTX (03) end-of-text

3.3.2.3.2 Global

None

3.3.2.3.3 Entry Point

BM00

3.3.2.3.4 External References

CRN\$ CRT input buffer

CRO\$ CRT output buffer

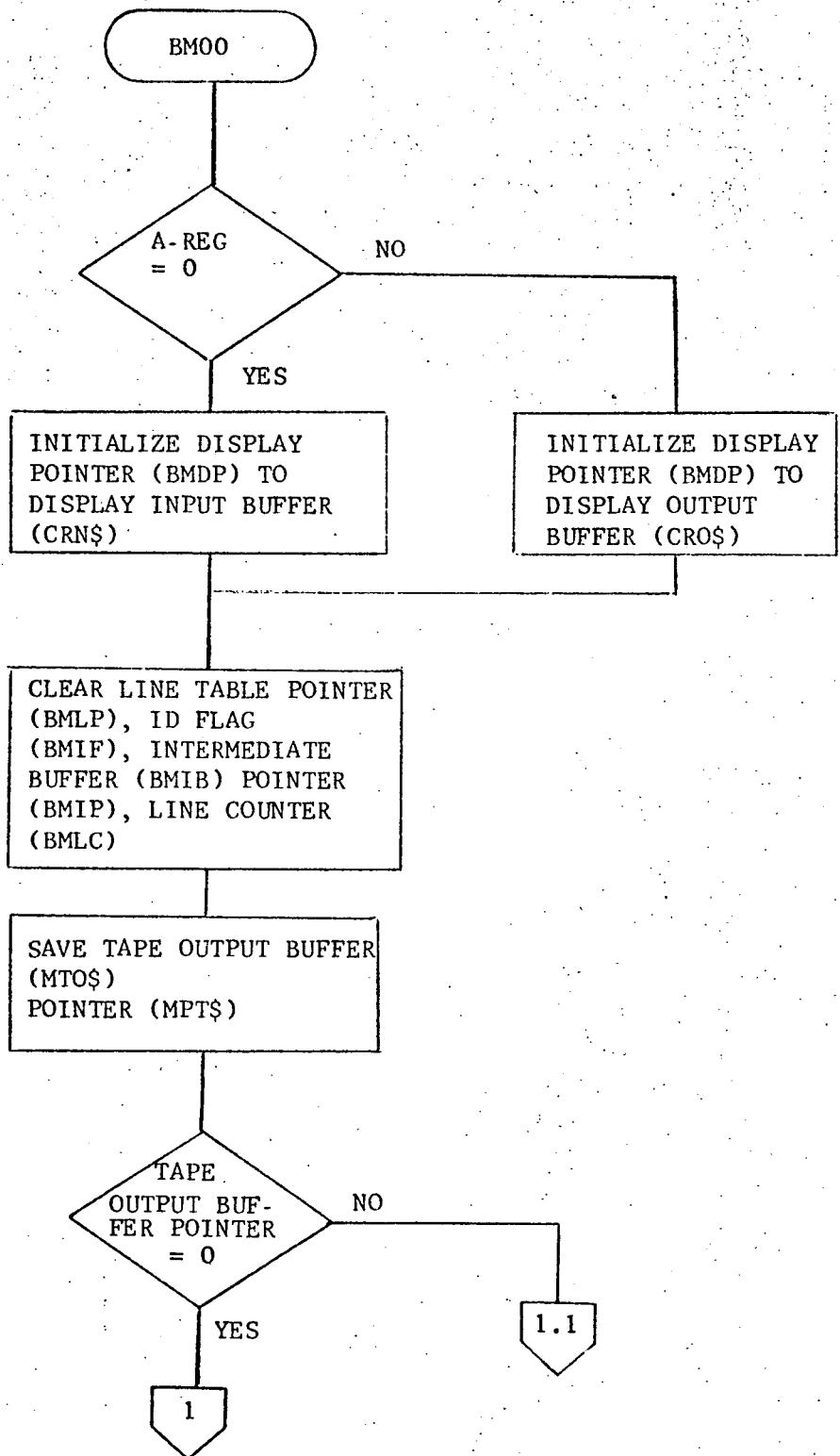
LTB\$ line table (see Appendix C).

MPT\$ tape output buffer pointer. Points to next available location in buffer.

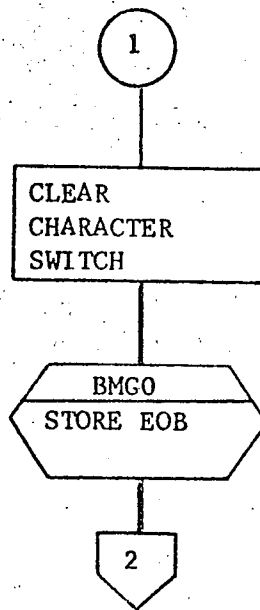
MTO\$ magnetic tape output buffer

OD00 routine to output a buffer (CRO\$) to the CRT

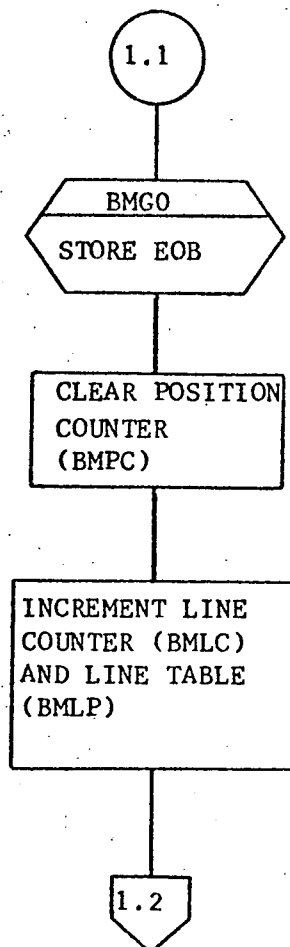
3.3.2.4 Detailed Flow Chart

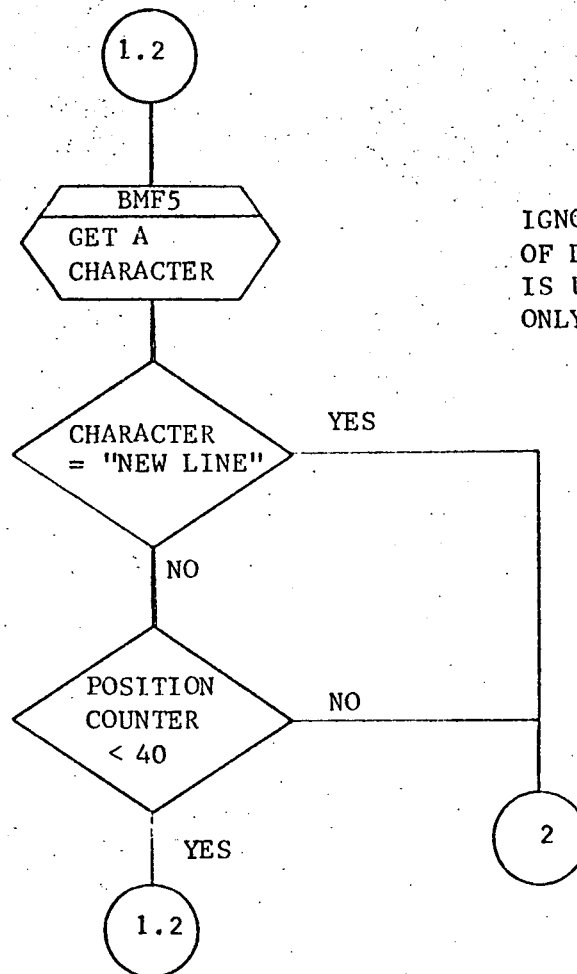


END-OF-BLOCK

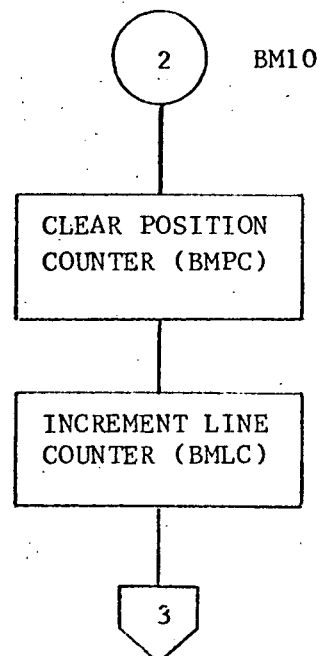


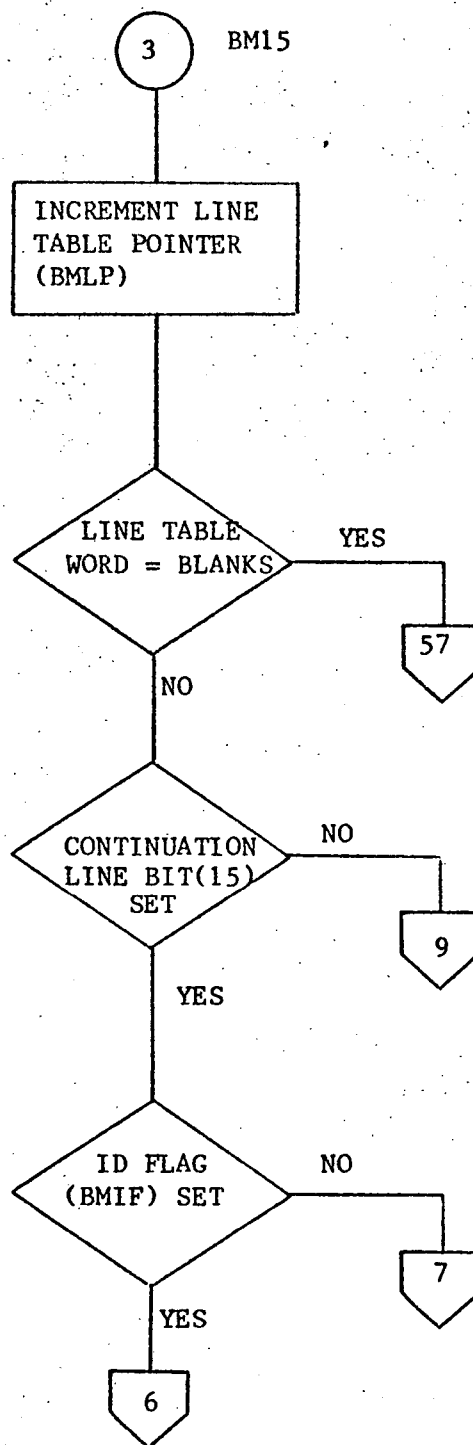
END-OF-BLOCK





IGNORE 1ST LINE
OF DISPLAY. IT
IS USED FOR OPTIONS
ONLY IN THIS CASE

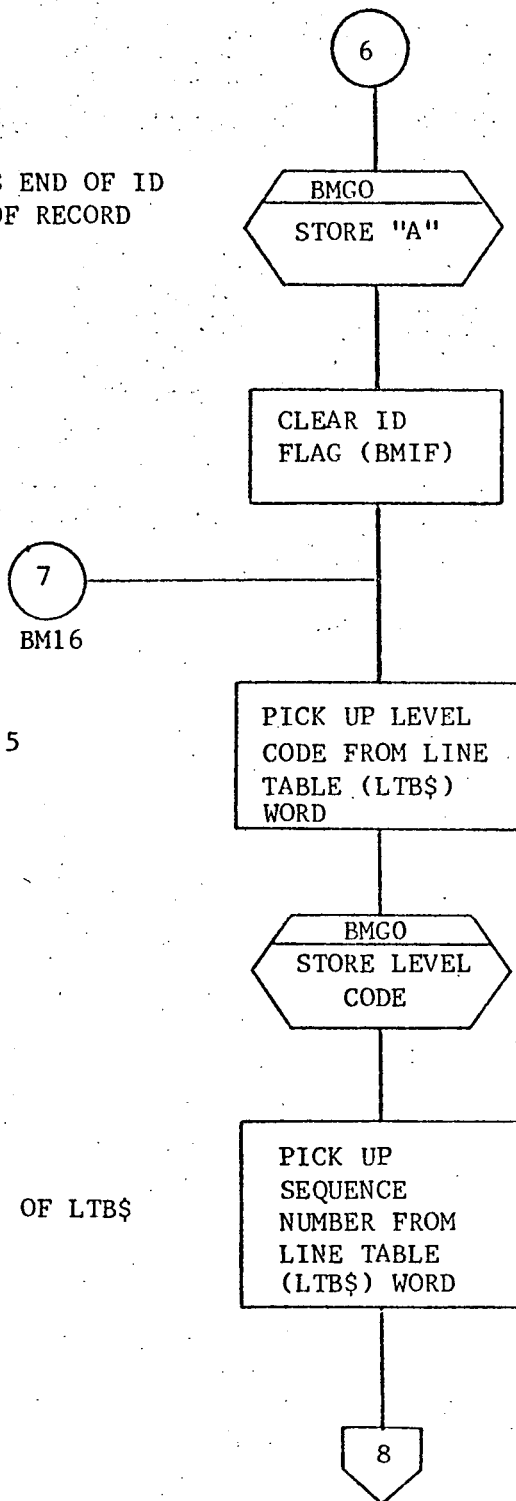


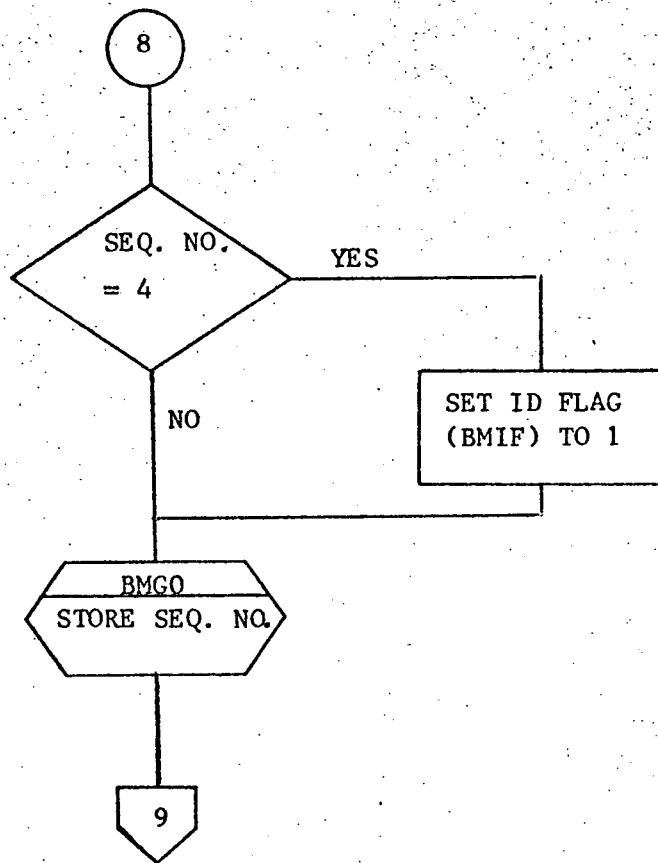


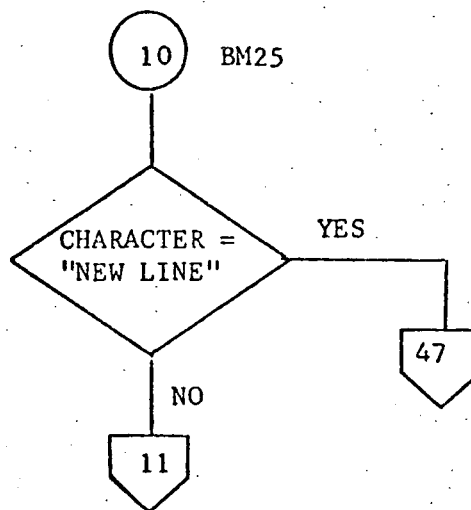
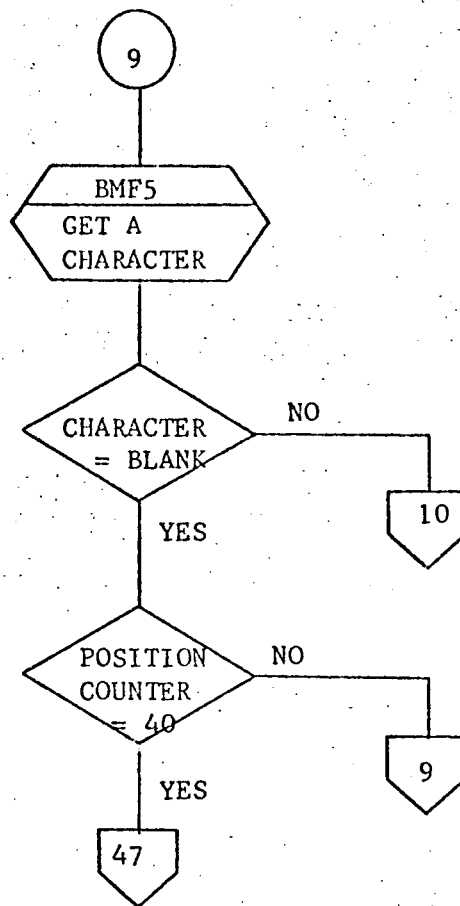
INDICATES END OF ID
SECTION OF RECORD

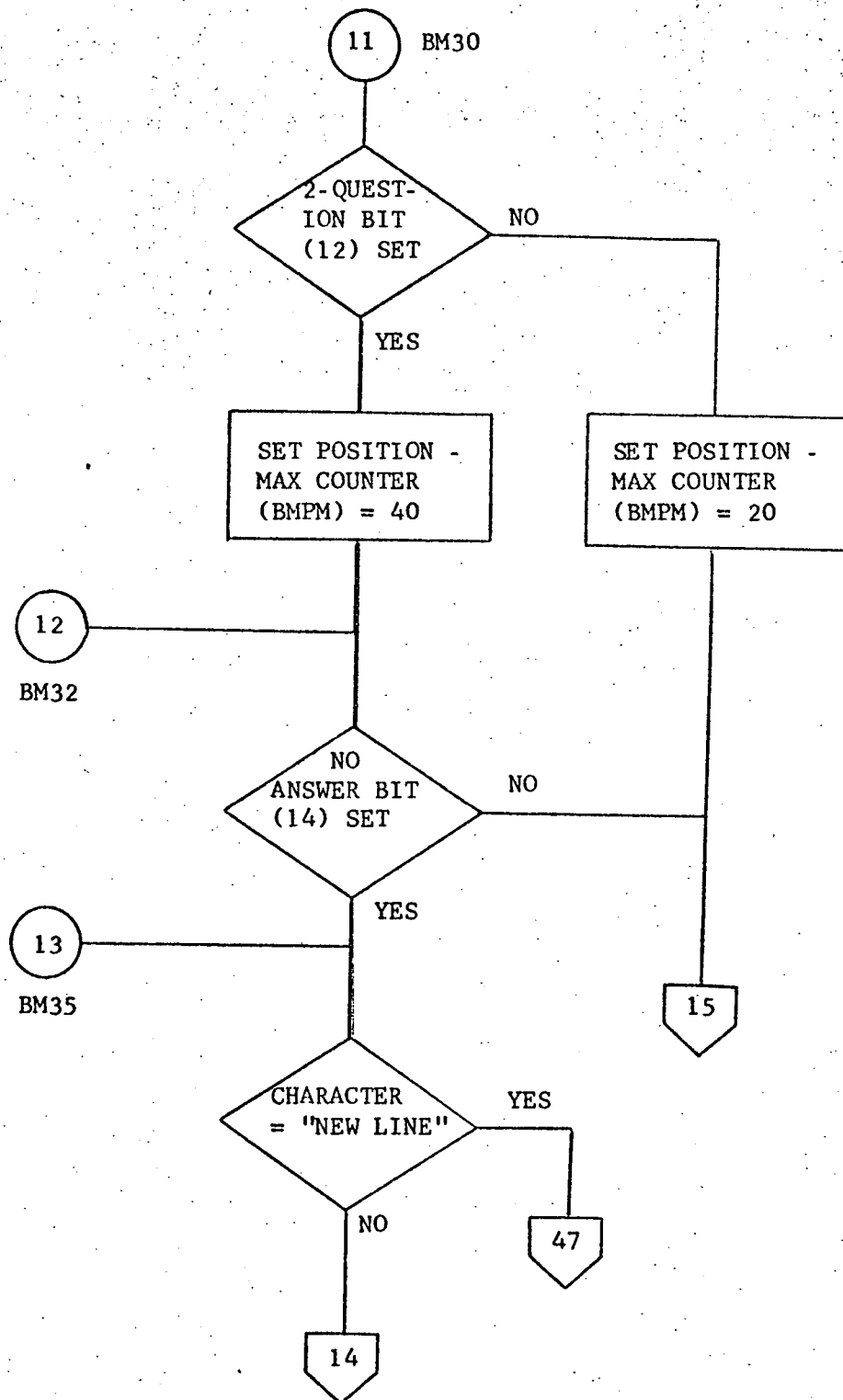
BITS 0 - 5
OF LTB\$

BITS 6-11 OF LTB\$



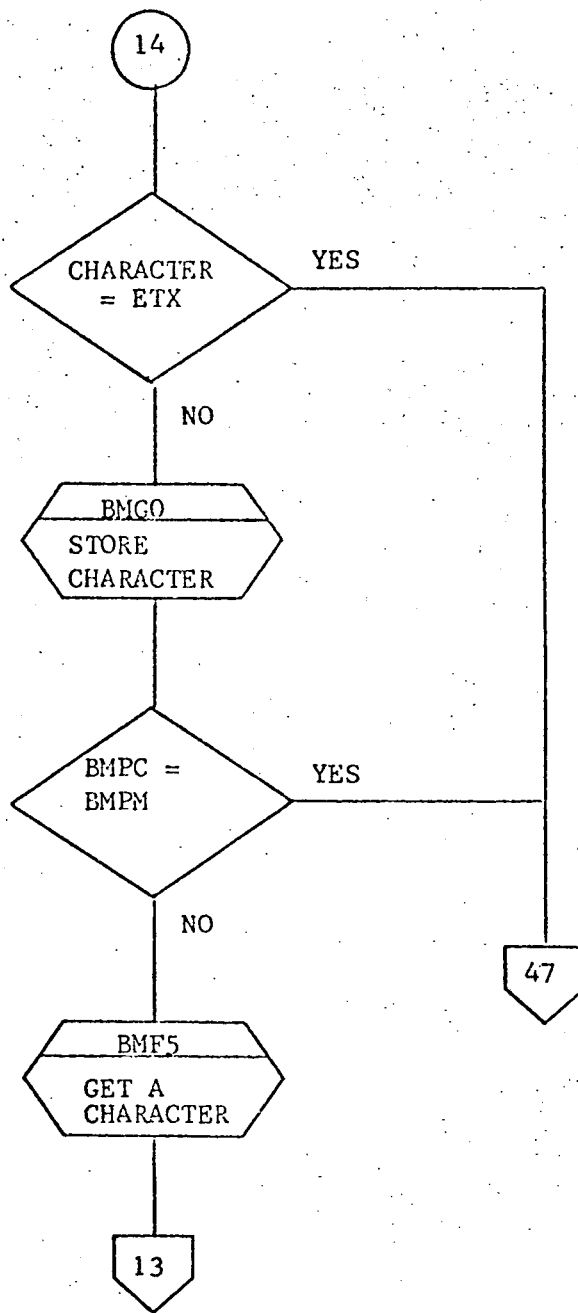


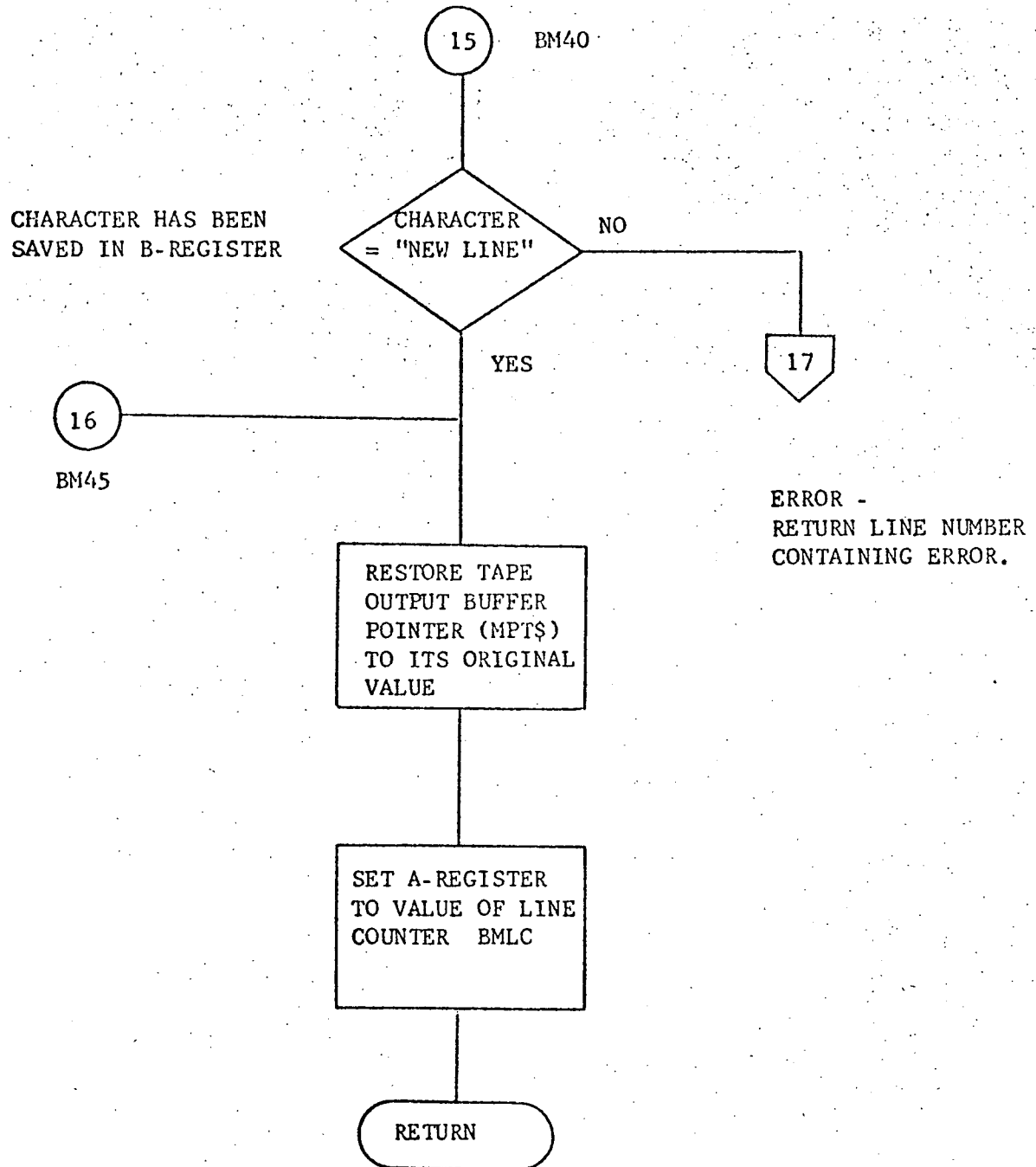




END OF TEXT - LAST
CHARACTER INPUT
FROM DISPLAY

POSITION COUNTER
= POSITION - MAX

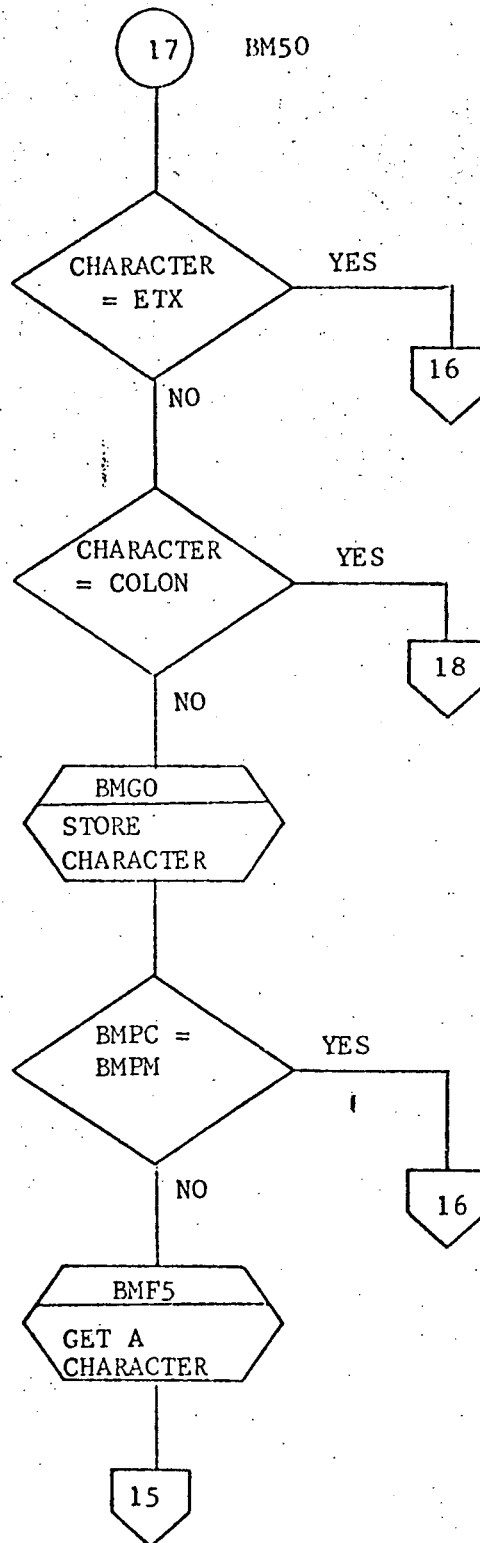


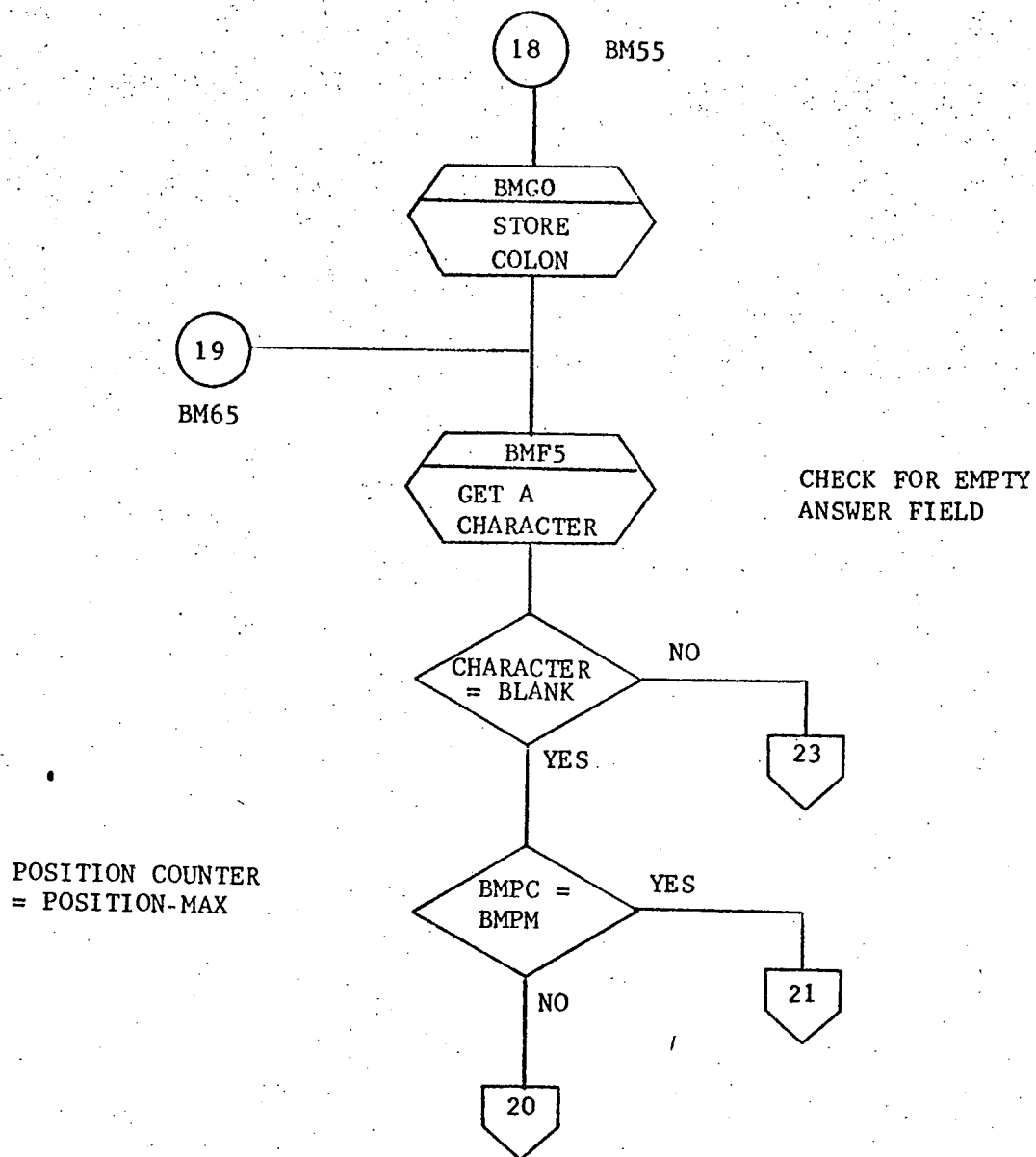


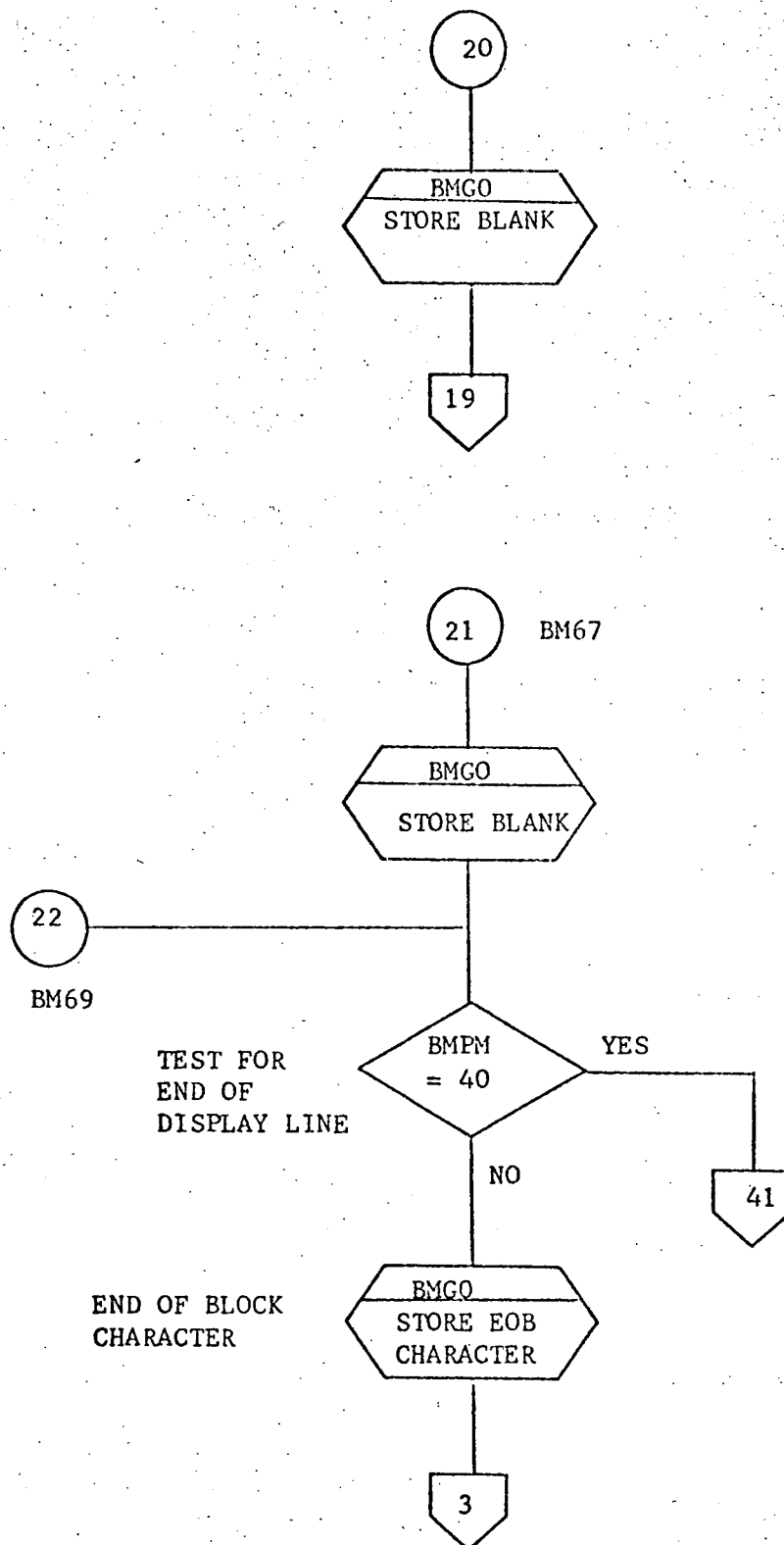
END OF TEXT

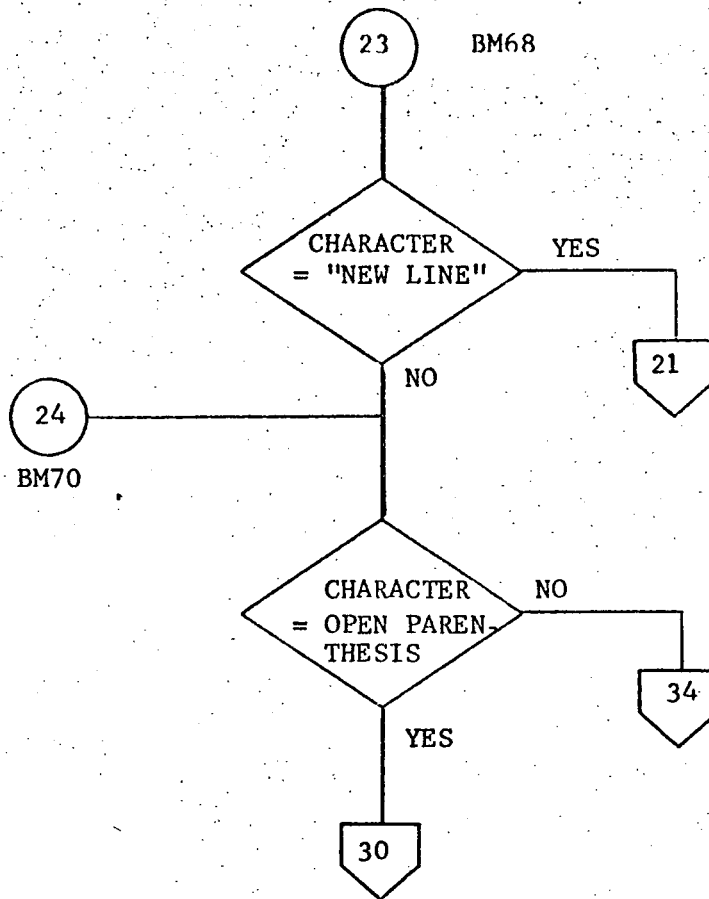
COLON INDICATES
END OF QUESTION
(OR HEADING)

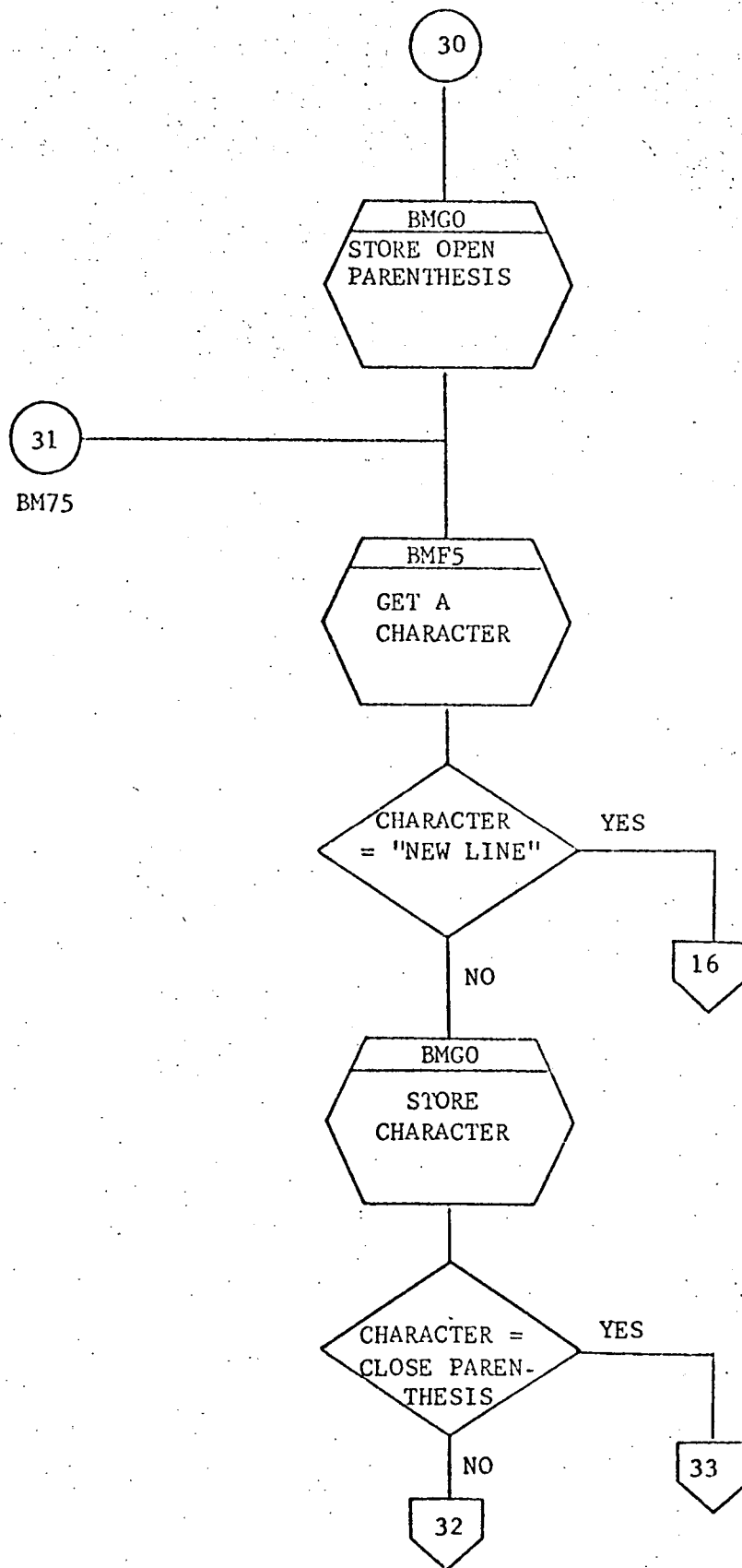
POSITION COUNTER
= POSITION MAX
ERROR



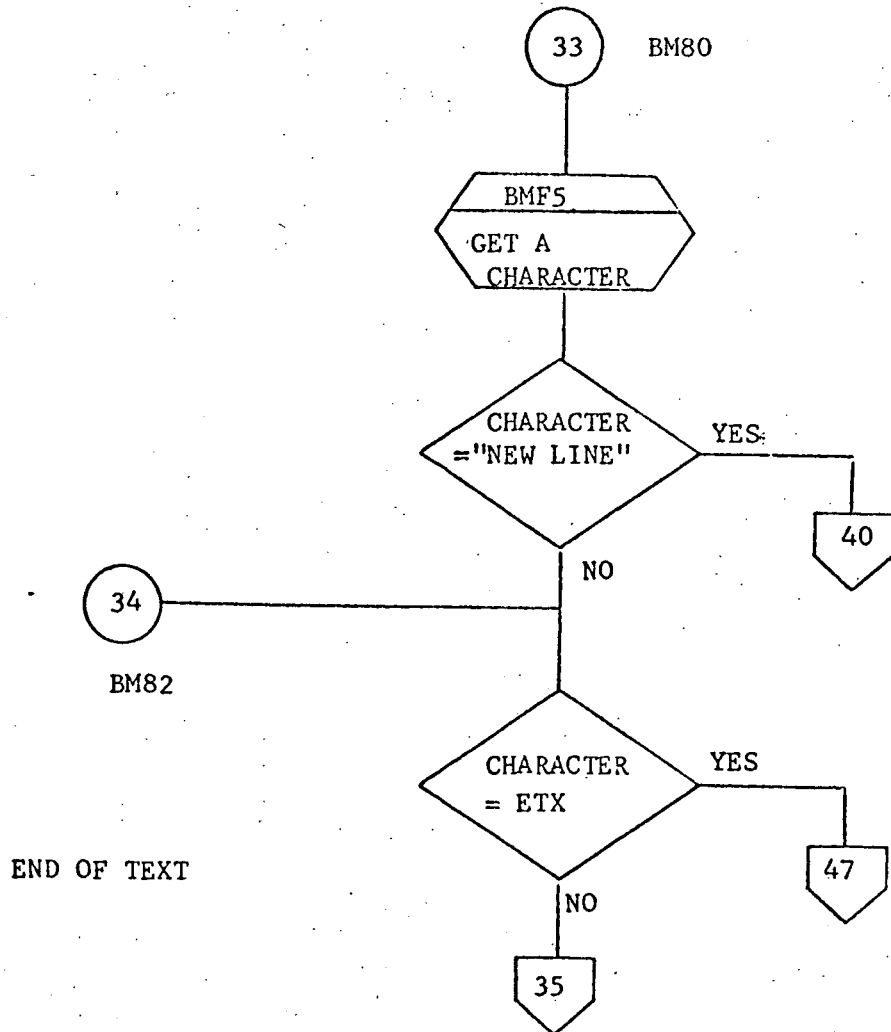
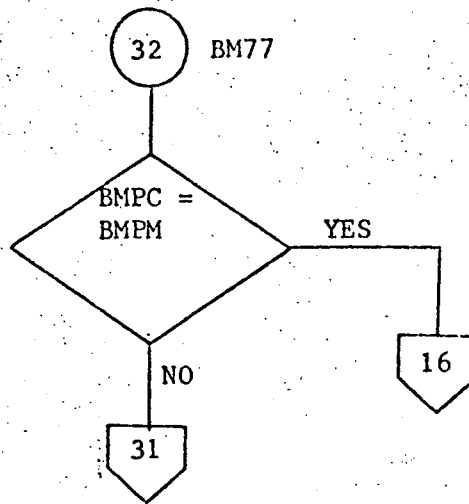




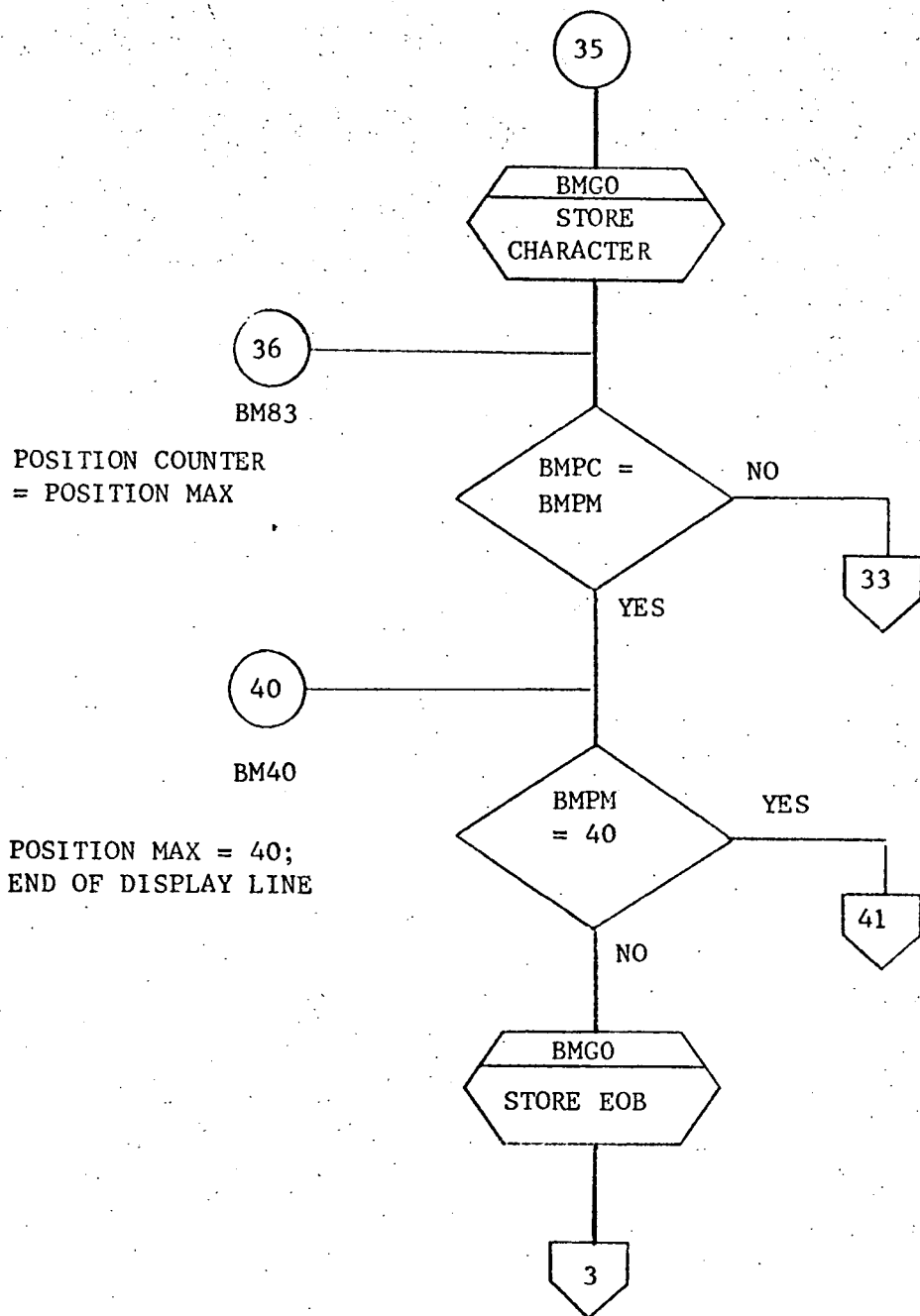


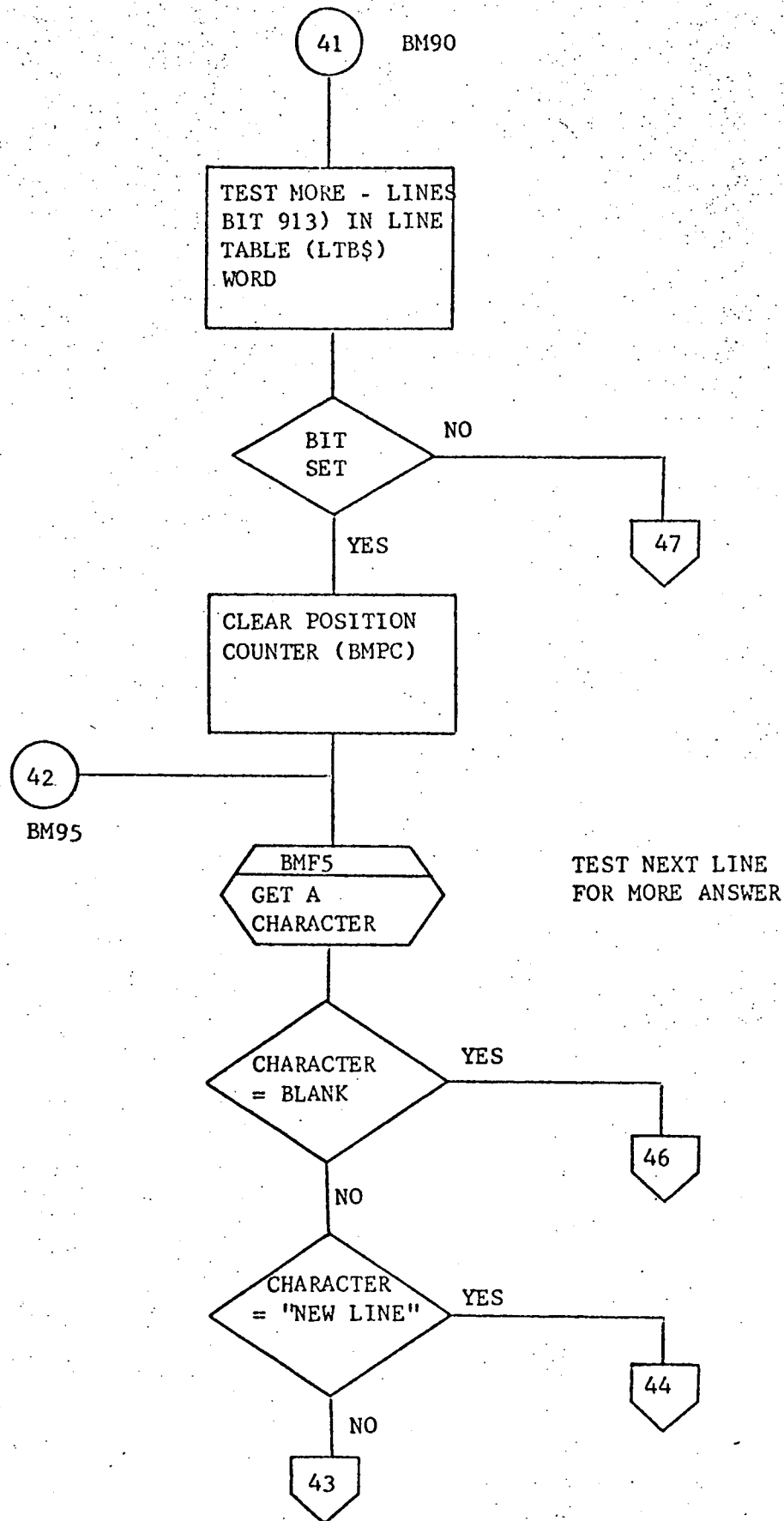


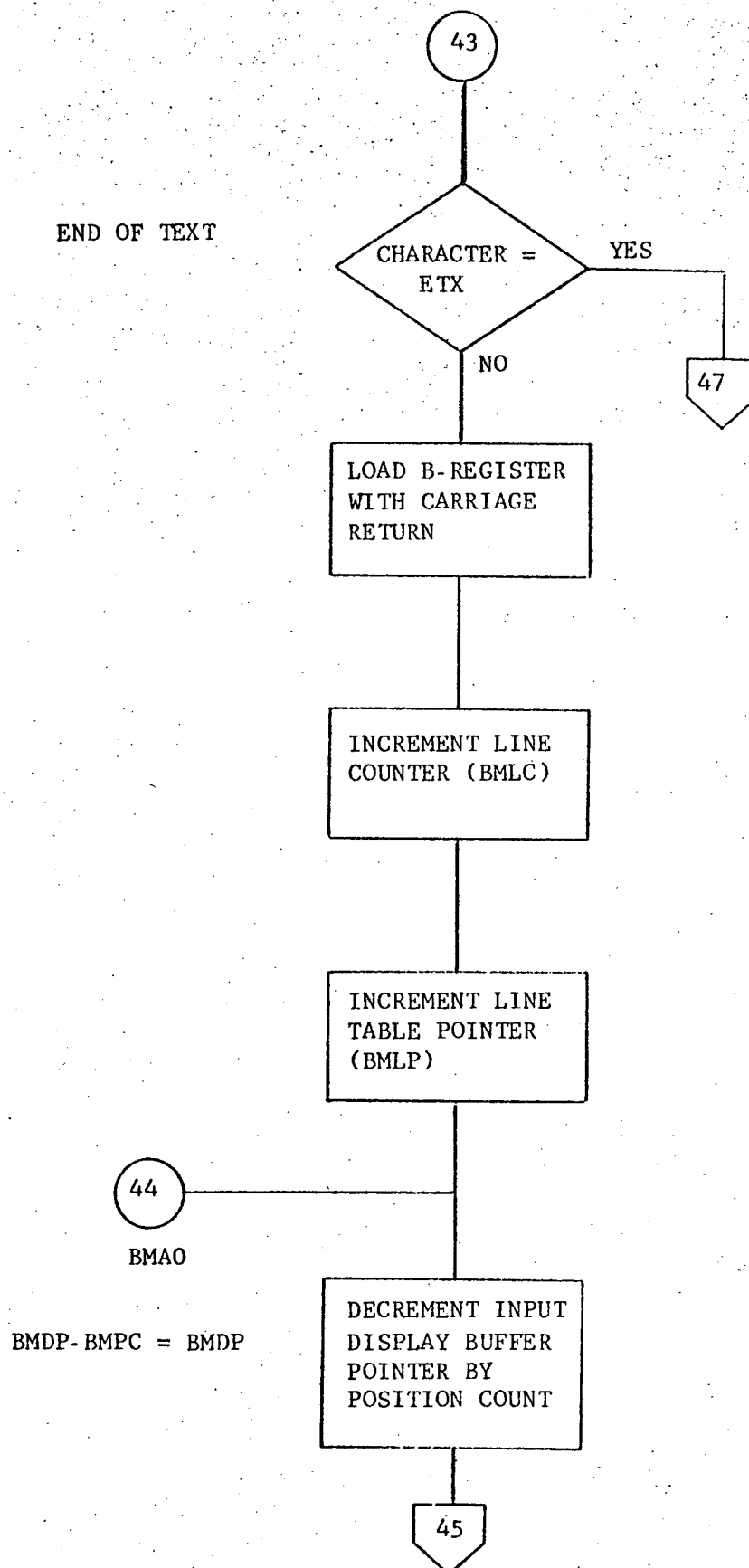
POSITION COUNTER =
POSITION - MAX;
END OF LINE

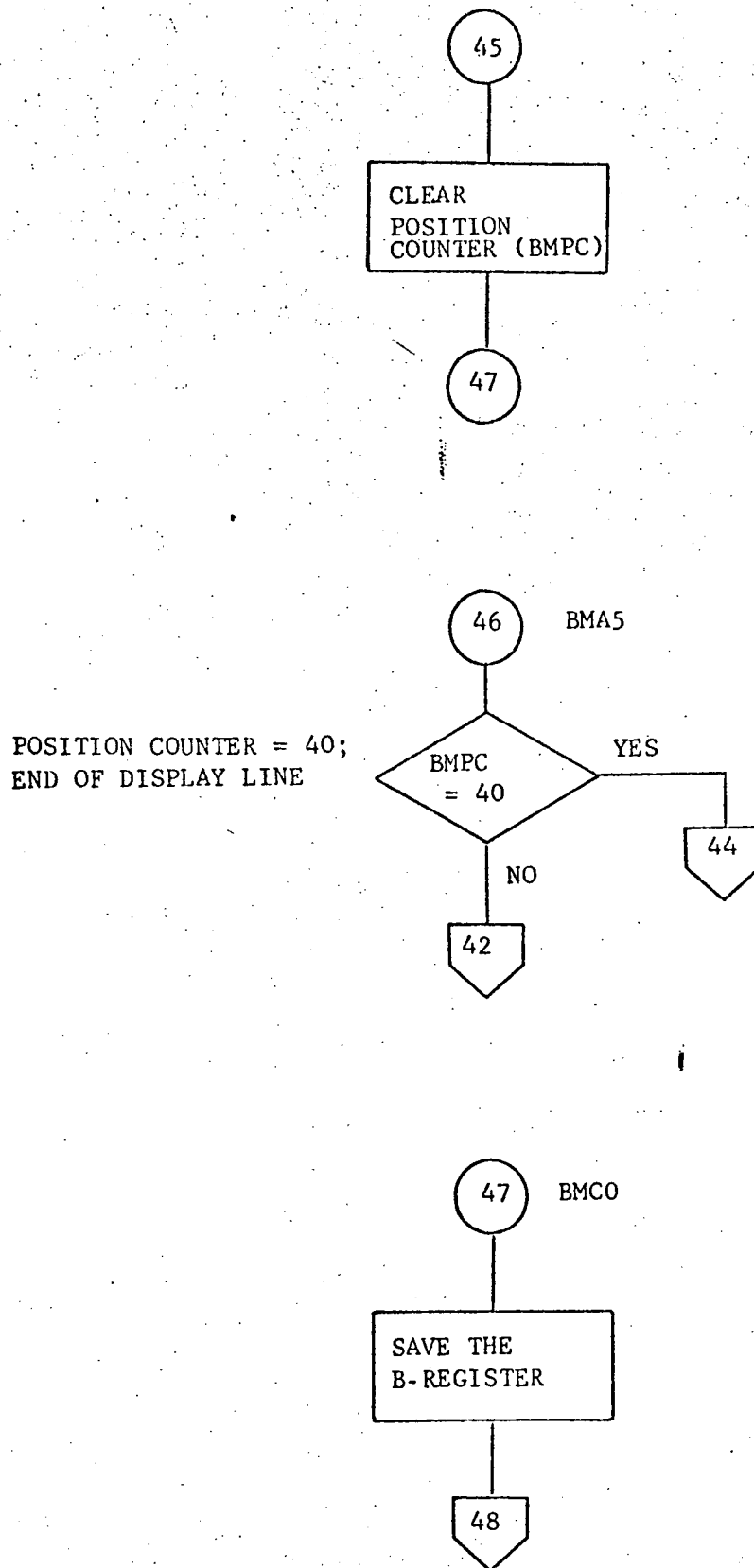


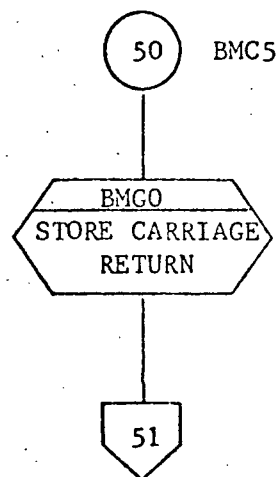
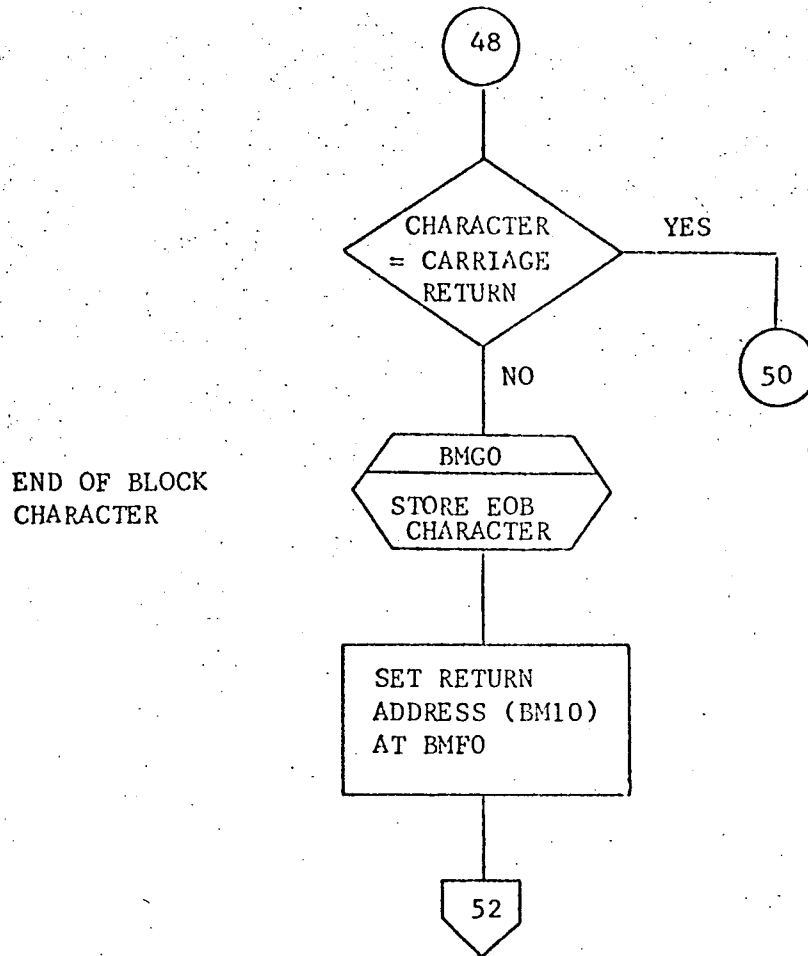
END OF TEXT

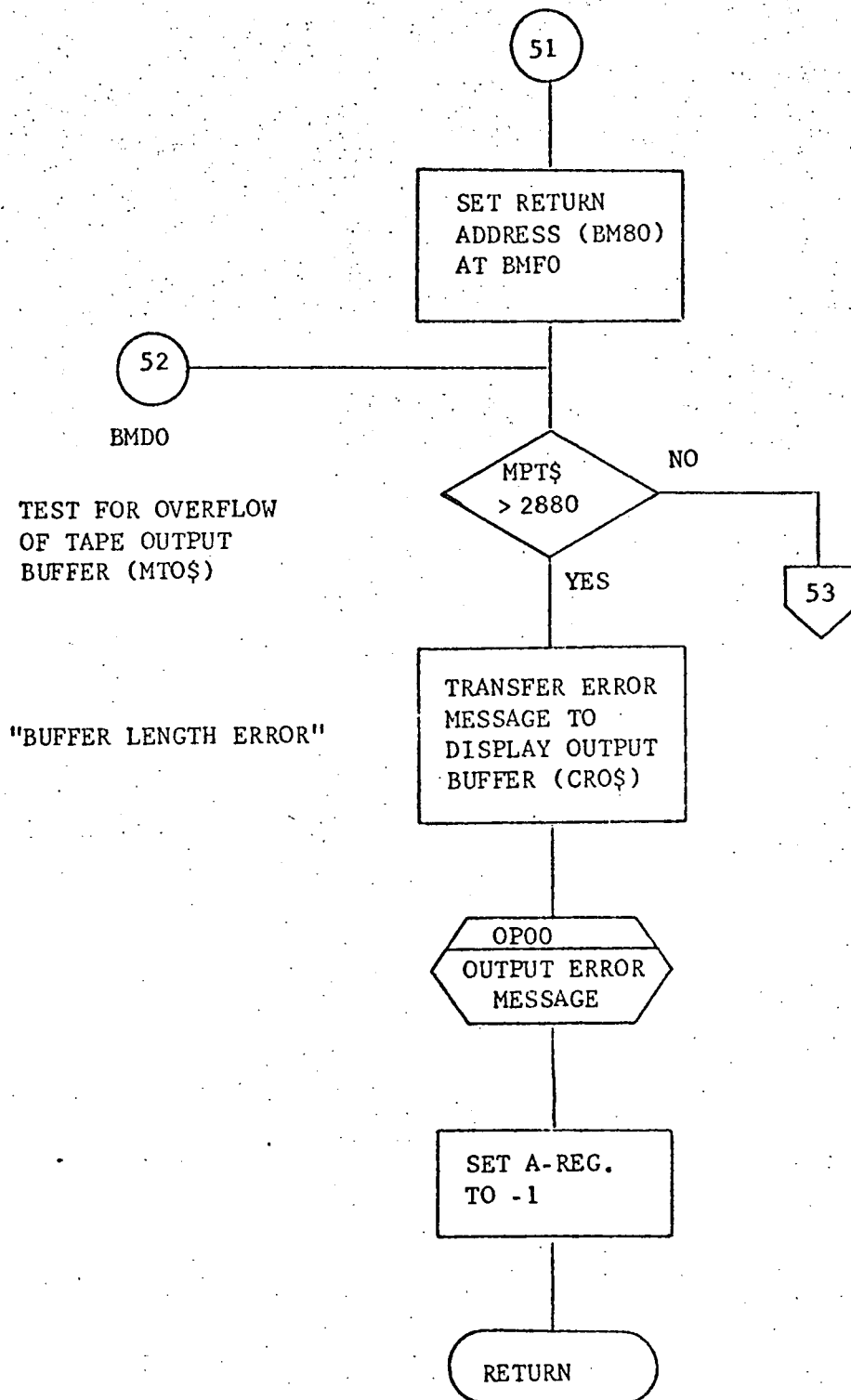


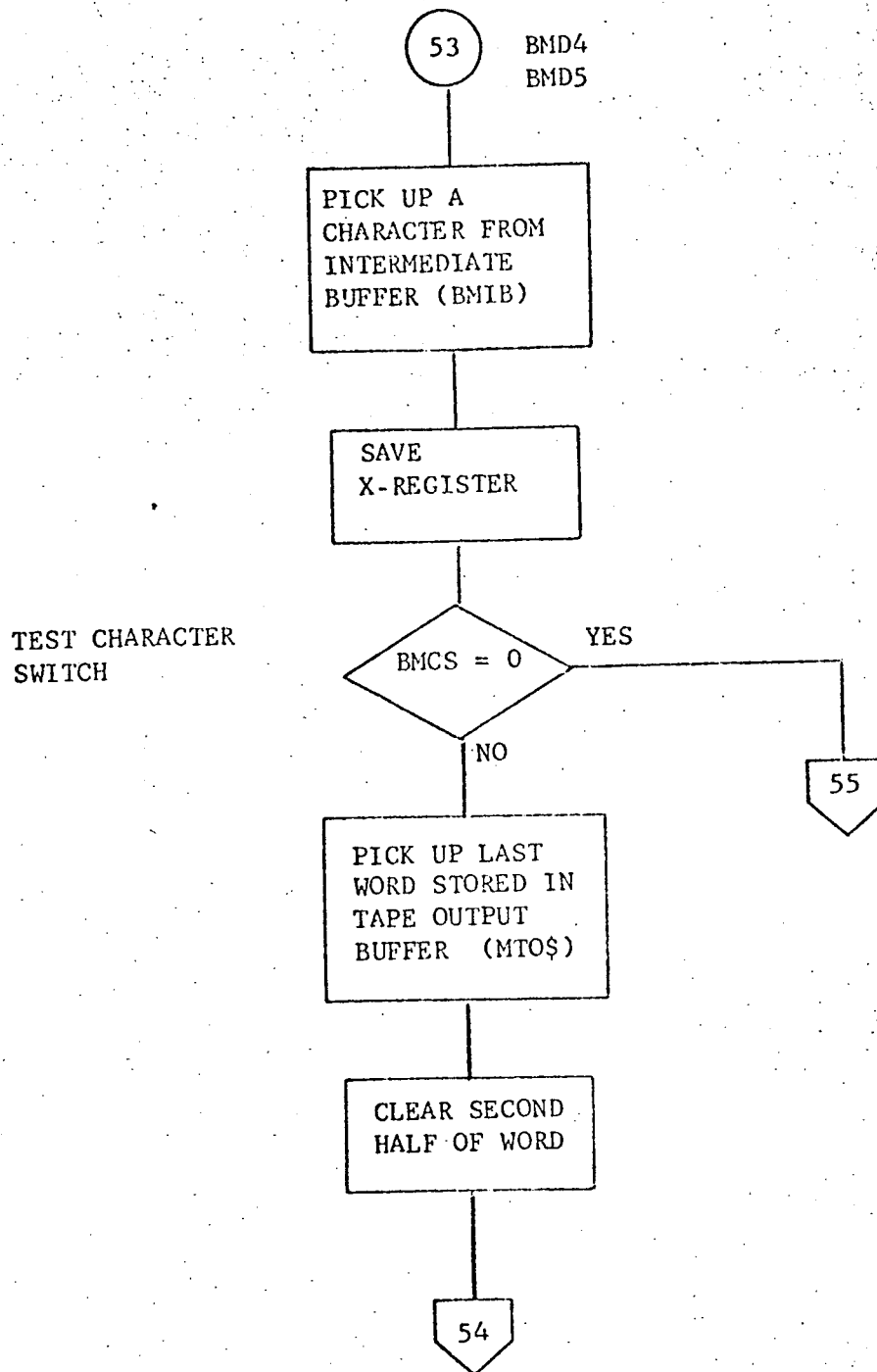


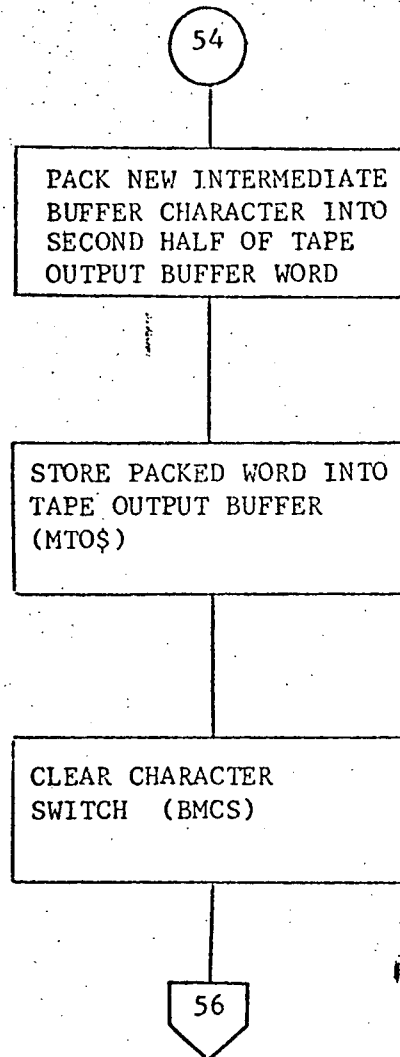


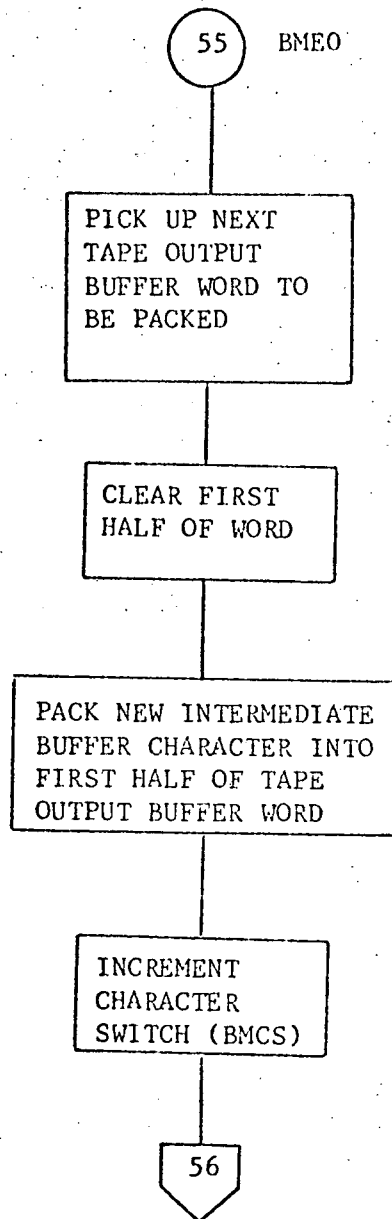


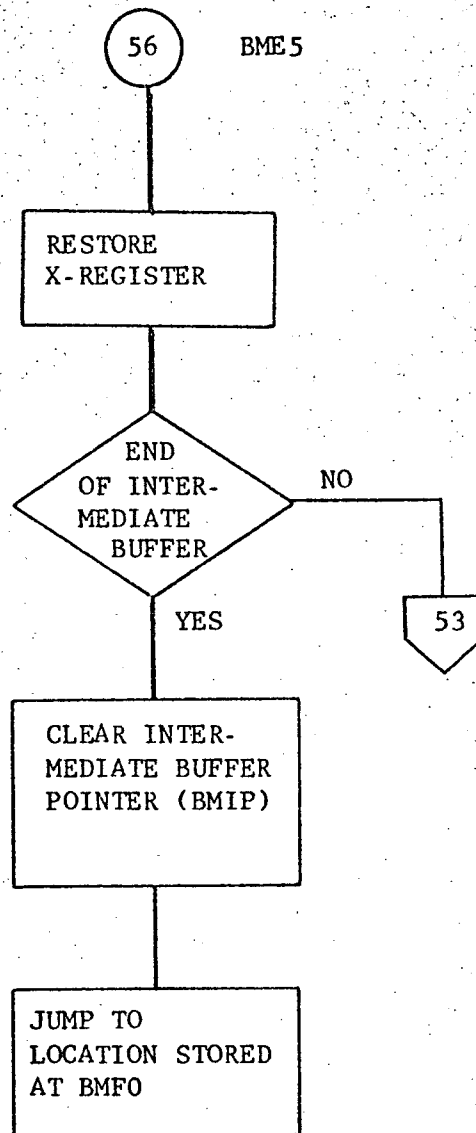




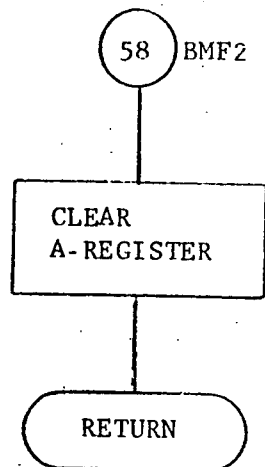
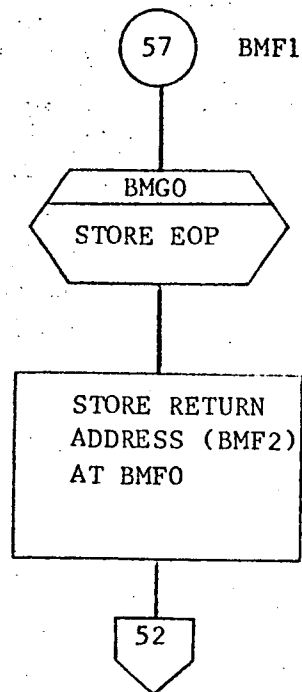


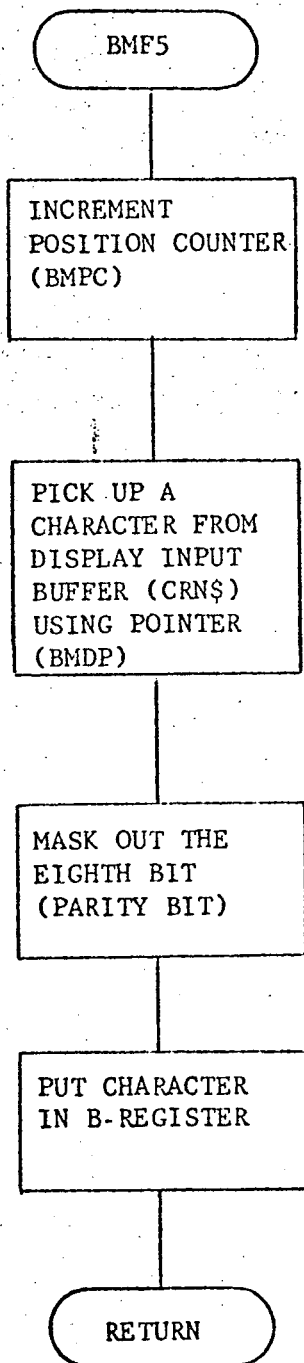


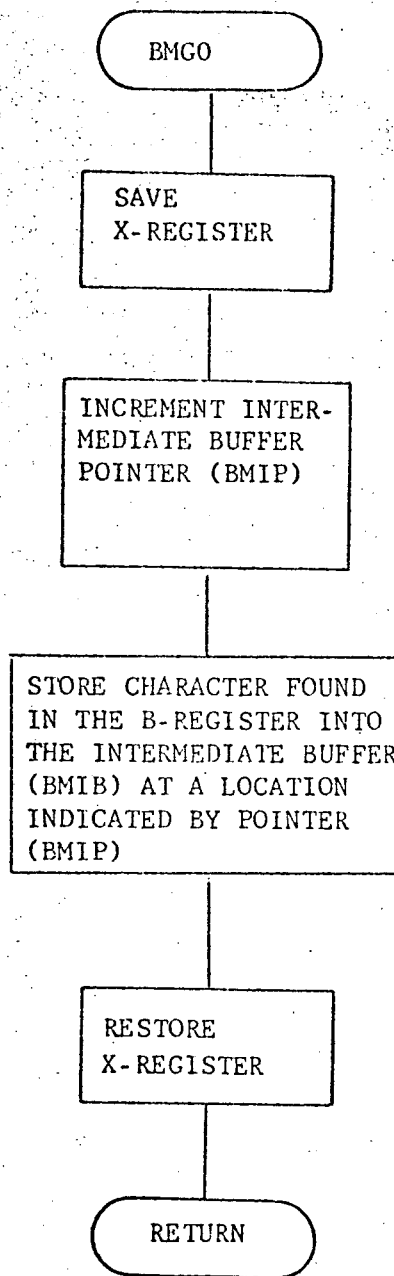




END-OF-PAGE
CHARACTER







STORE CHARACTER
IN INTERMEDIATE
BUFFER

3.3.3 D000 (D00) - Dump to Teletype

3.3.3.1 Purpose

The purpose of this subroutine is to list on the teletype 1) a form already resident in core (D00) or 2) a form that was just written on tape (D000).

3.3.3.2 Technical Description

This subroutine has two entry points. From one entry (D00) the calling routine specifies in the calling sequence the beginning address of the buffer to be printed. This allows output from any location in memory. From the other entry point (D000), the form to be printed is on tape and must be input to the computer before it can be output to the teletype. In both cases, the format of the buffers is the same as the tape format. (See Appendix A). The processing portion of the routine removes all extraneous codes and formats the data similar to the CRT format (See Appendix B). Appendix E has a sample teletype output. A description of the special codes follows and best describes the processing required for each character or character sequence.

Character	Code	Purpose/Processing of Code
end-of-block	(44 ₈)	Signifies the end of the answer. The first one is output as a carriage return and line feed. Any subsequent consecutive such characters are ignored.
end-of-page	(41 ₈)	Signifies the end of page. This character is converted to a carriage return and line feed.

Character	Code	Purpose/Processing of Code
end-of-record	(36 ₈)	This character signals the end of processing (listing).
carriage return	(215)	This character indicates the end of a line of data and also that more data follows. The character is output as a carriage return and line feed.
level code		This is a digit from one to nine. It is output as consecutive blanks. The number of blanks is equal to the value of the level code. (See Appendix A).
sequence number		ignored

3.3.3.2.1 Calling Sequence

CALL OD00 or

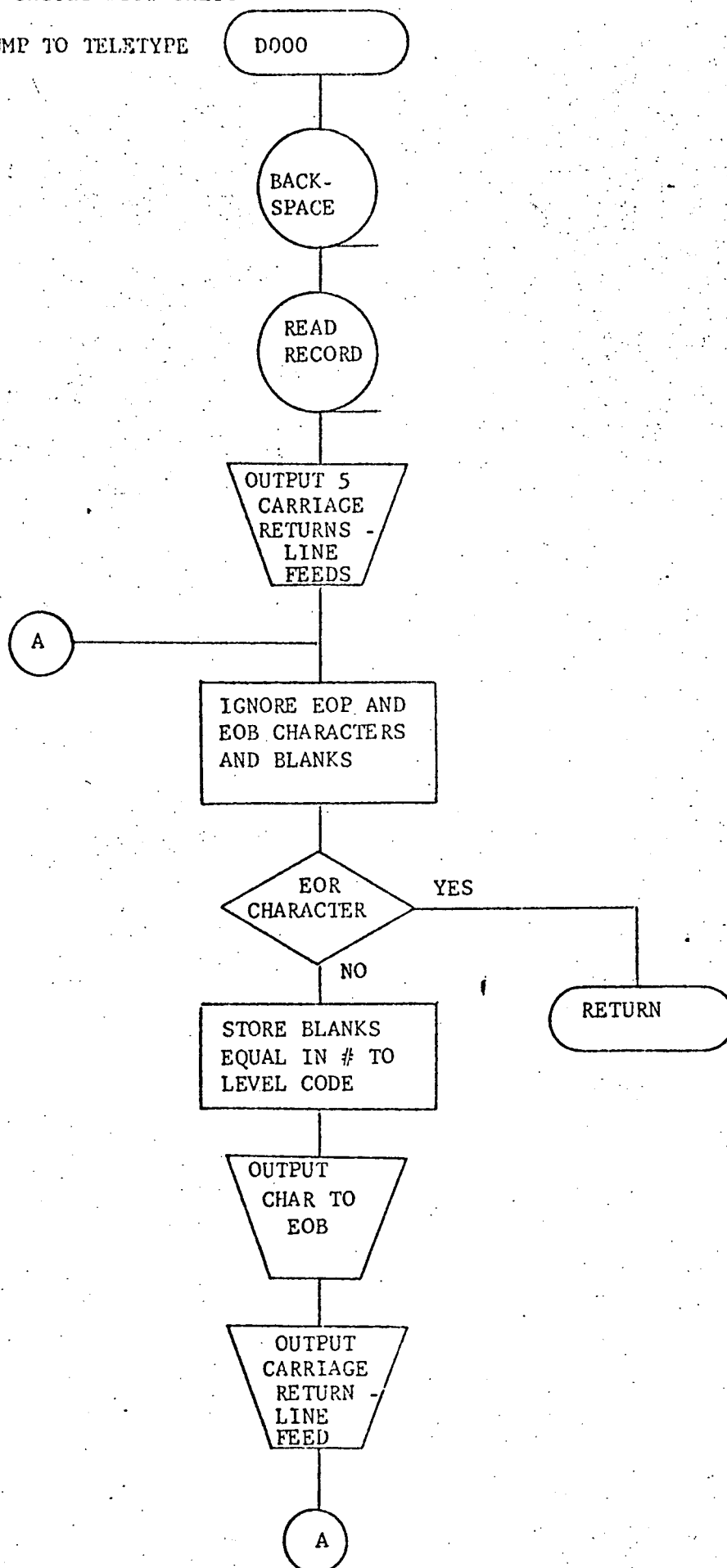
CALL D00,M,N

M is the address of the beginning location of the buffer containing the form, and N is the number of words in the buffer.

REGISTER	CONTENTS UPON ENTRY	CONTENTS UPON EXIT
A	N/A	N/A
B	N/A	N/A
X	N/A	N/A
Overflow	N/A	N/A

8.3.3.2.2 General Flow Chart

DUMP TO TELETYPE



3.3.3.3 Label Description

3.3.3.3.1 Local

DST - the status word used with the tape read

DBUF - save location for beginning address of buffer to be output

DEB - the save location for the ending location +1 of the buffer to be output

DCS - a switch used to determine which character is to be unpacked next.

DSV - save location of the second character of a word containing two characters

DX - save location for X-register in DGET.

3.3.3.3.2 Global

None

3.3.3.3.3 Entry Points

D000 - primary entry point (external)

D00 - primary entry point (external)

D20 - entry point to processing (listing) segment of routine

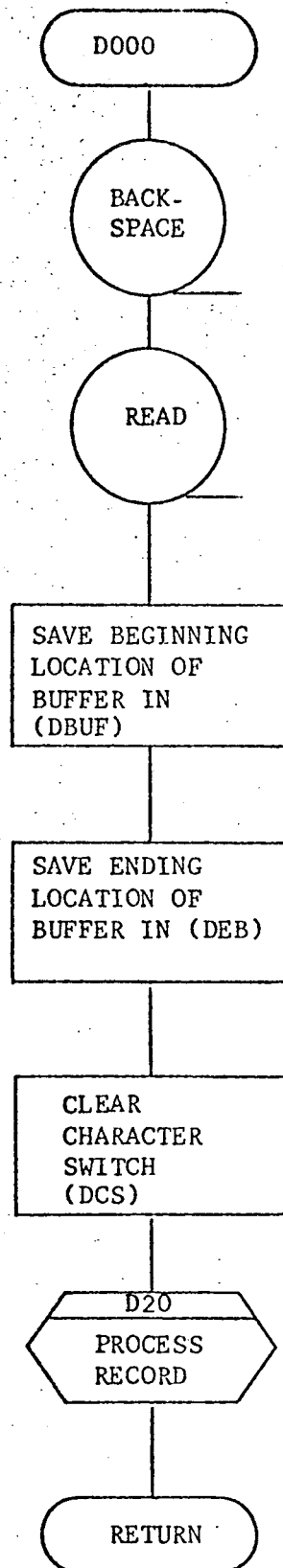
DGET - entry point to a routine that unpacks one character at a time from the buffer.

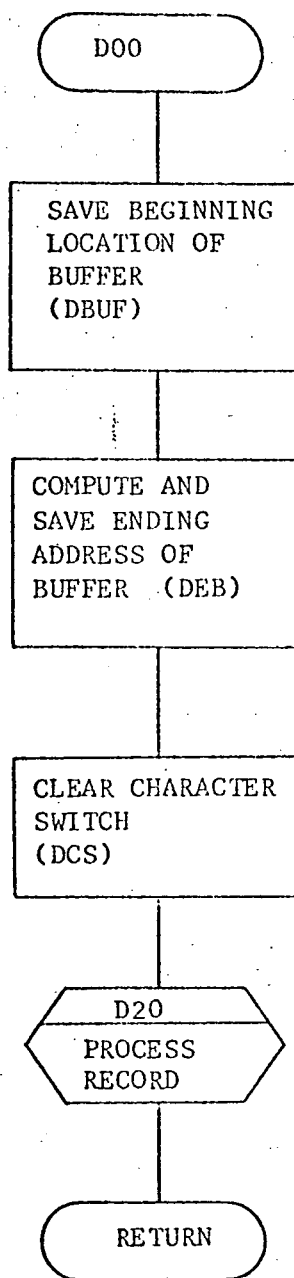
3.3.3.3.4 External References

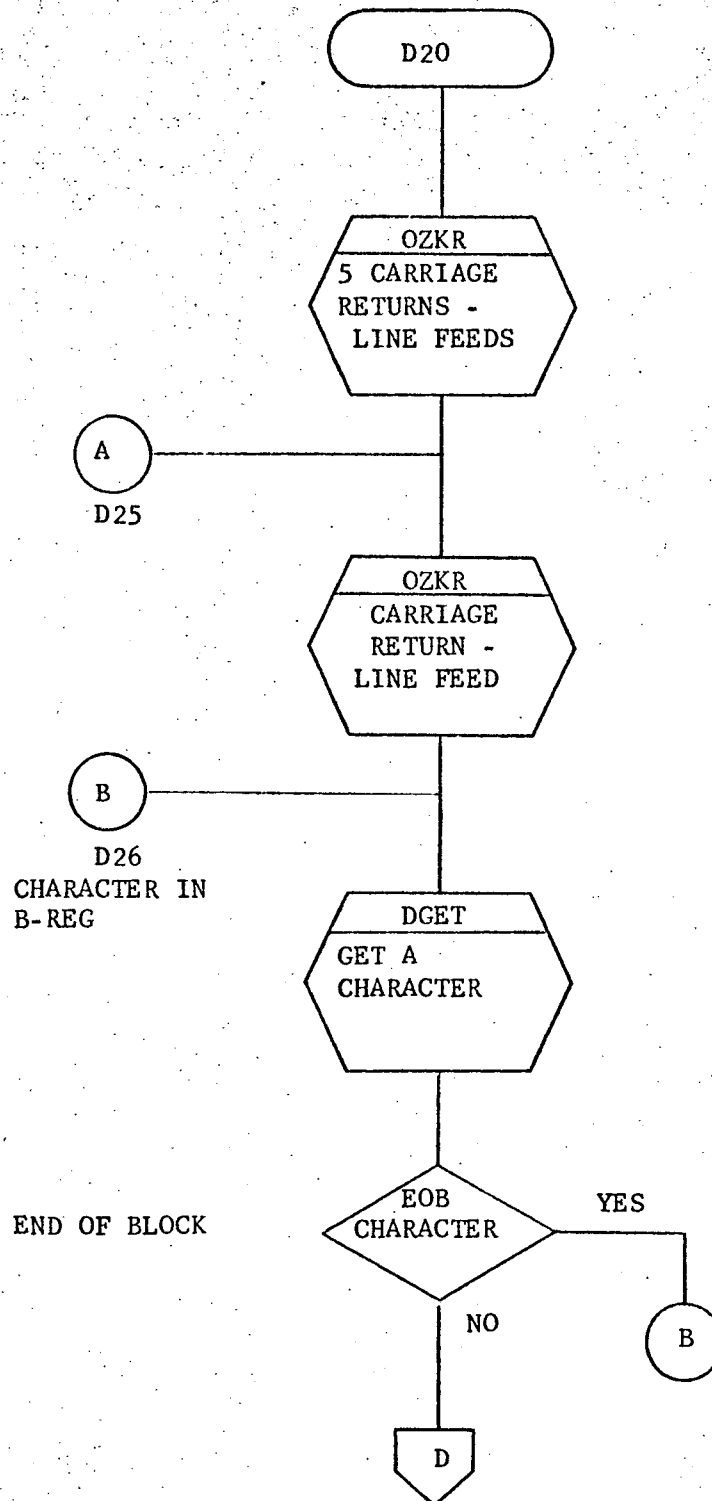
HMOO - tape handler used to manipulate magnetic tape

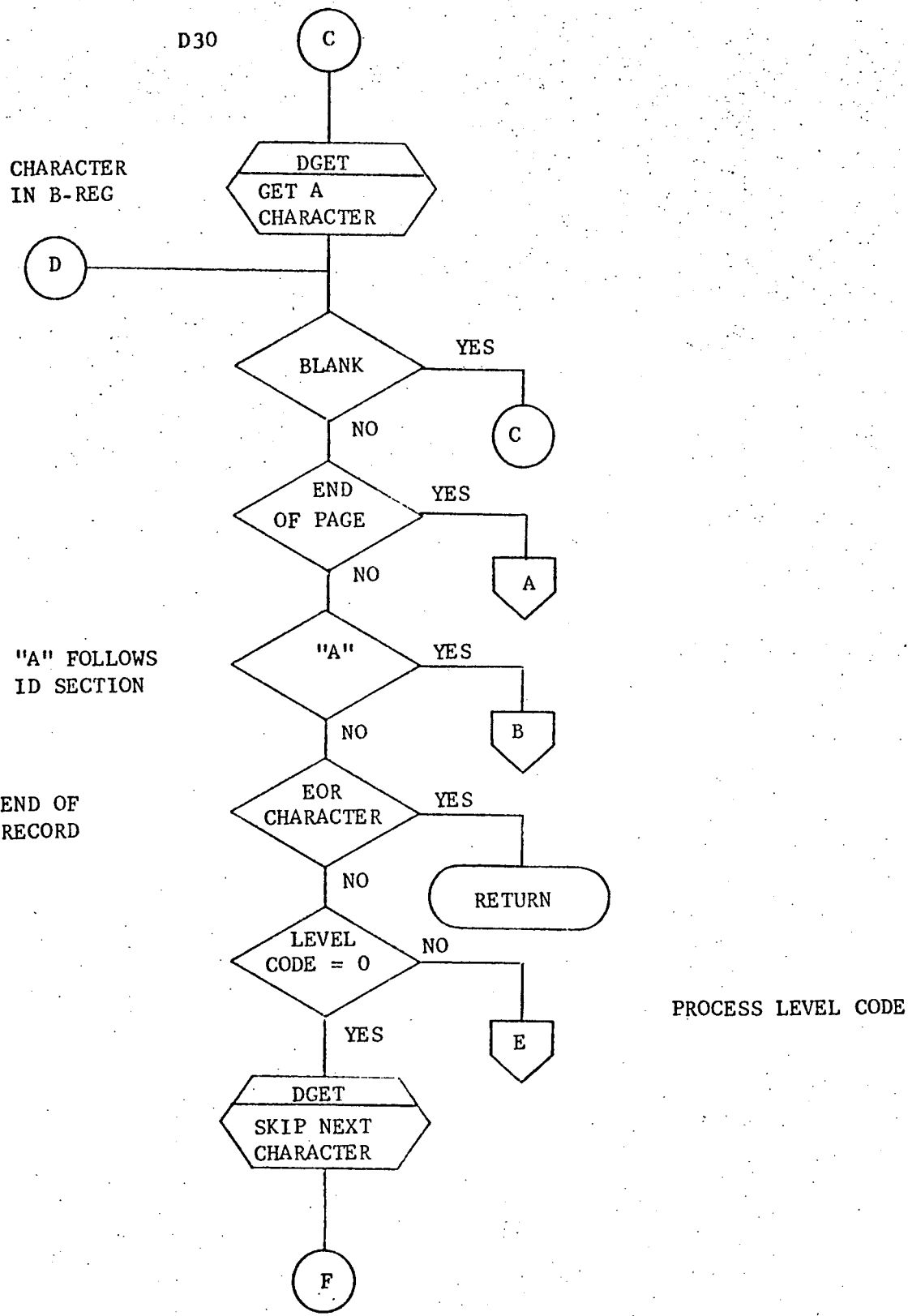
MTO\$ - tape output buffer.

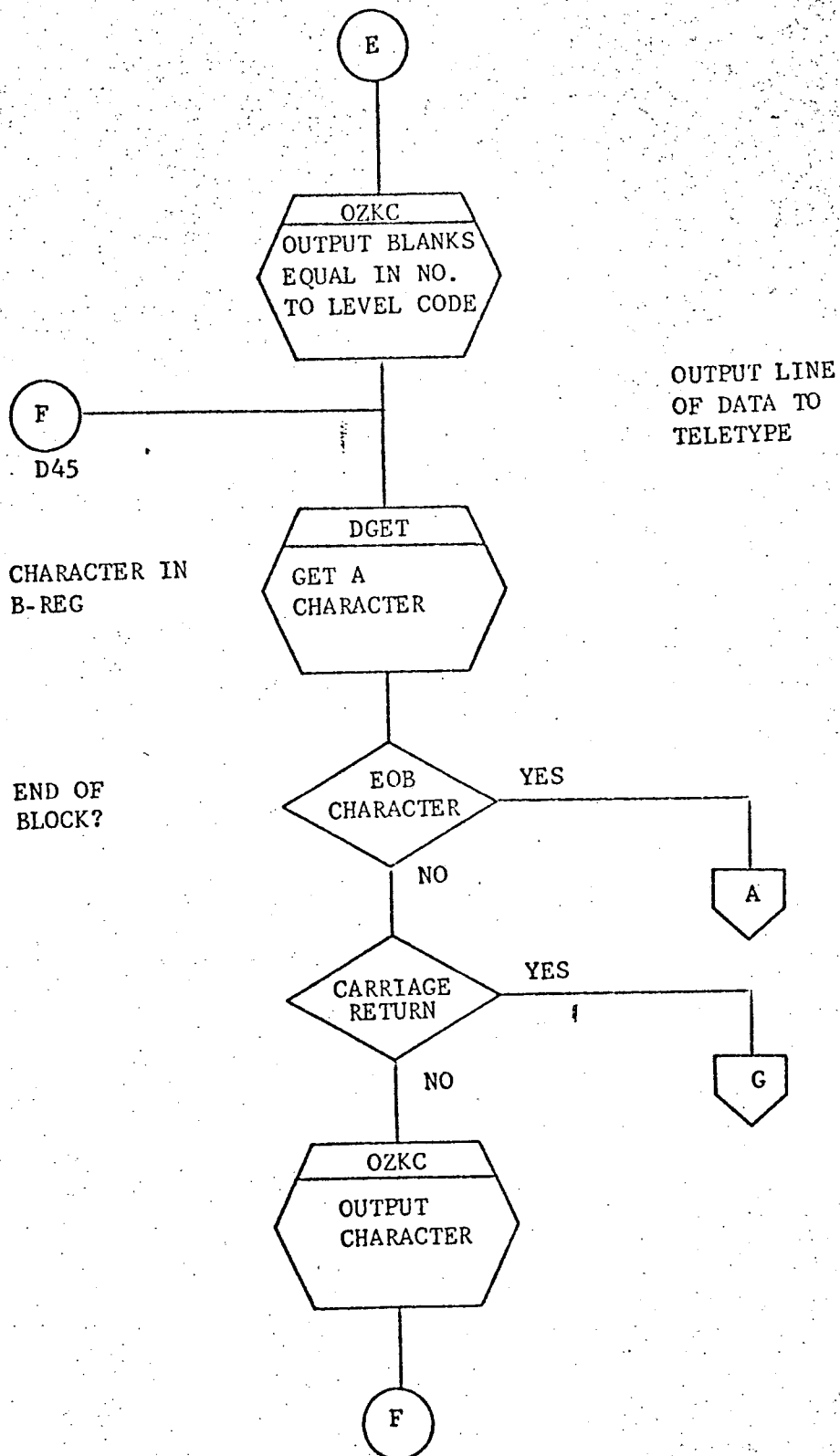
3.3.3.4 Detailed Flow Chart



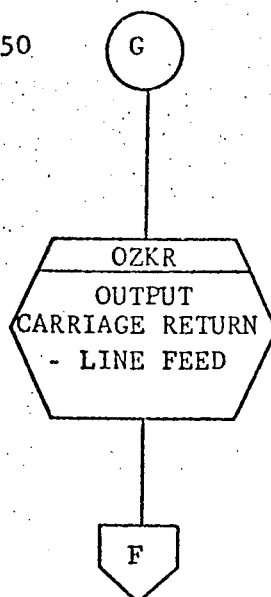


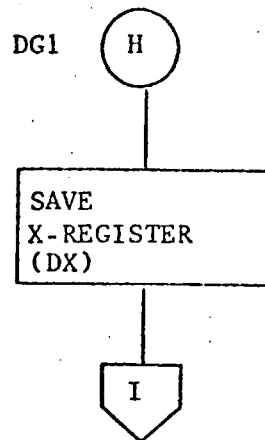
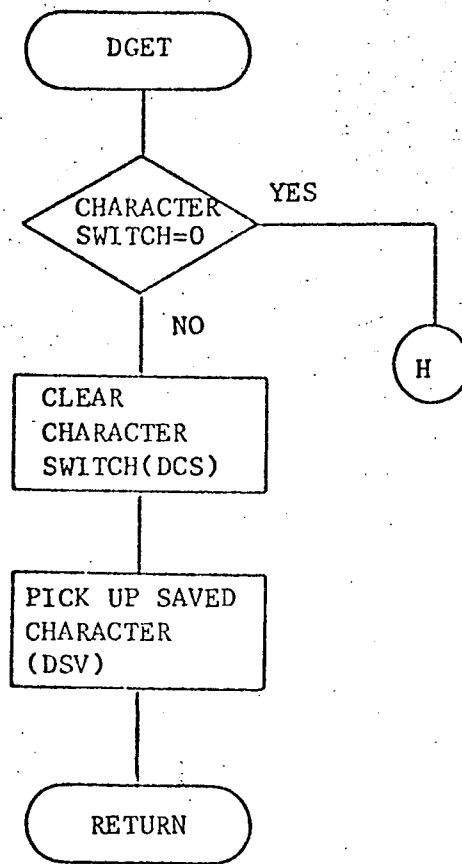


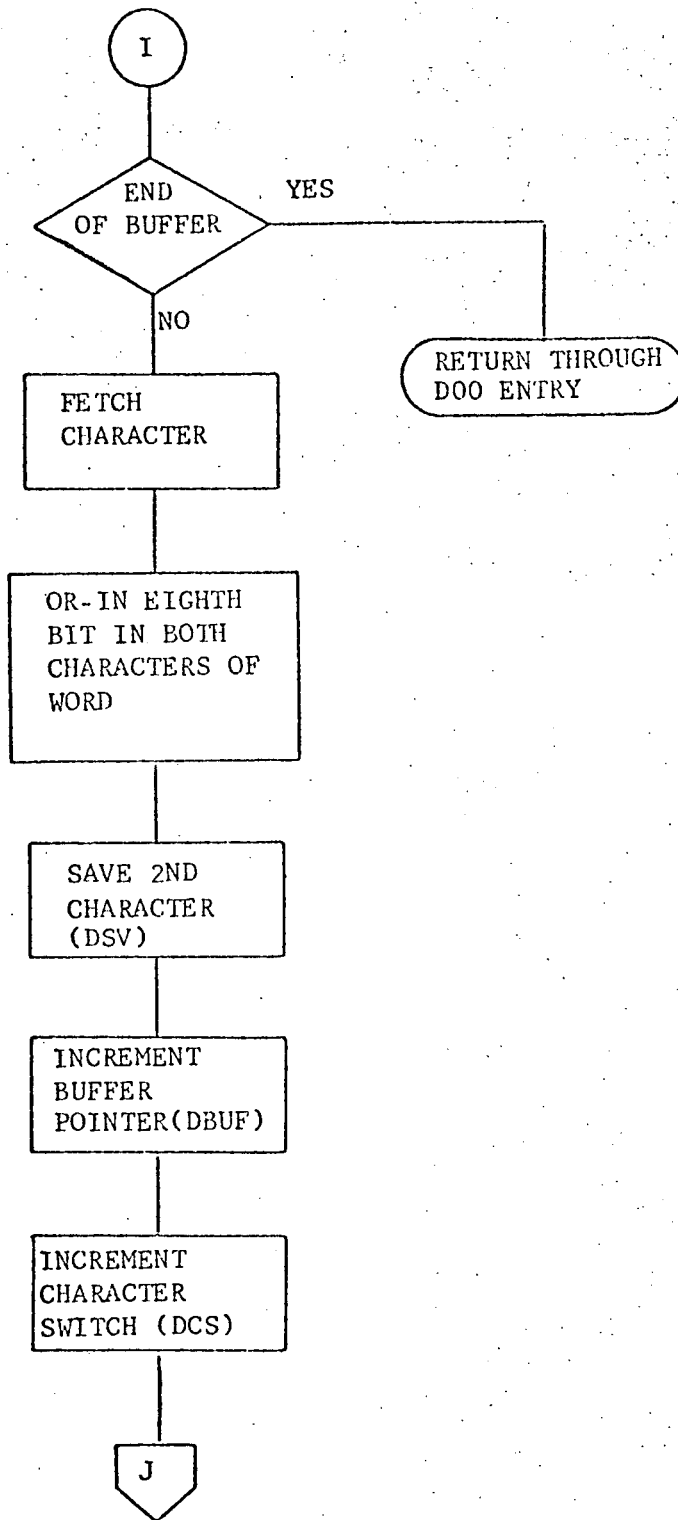


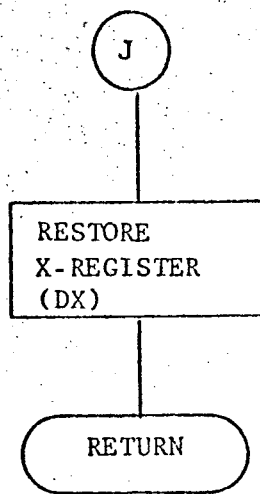


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3.3.4 HCOO - CRT Input/Output Routine

3.3.4.1 Purpose

HCOO is a general purpose CRT input/output routine. The purpose of the routine is to reduce the amount of duplicated effort normally inherent in a programming task when individual users develop their own I/O programming for a commonly used peripheral device. HCOO allows processing in the calling program to take place while the data transfer is occurring. In order to accomplish this, HCOO was designed to return control to the user as soon as the I/O was initiated. The CRT status is made available to the user by HCOO at the completion of the data transfer.

3.3.4.2 Technical Description

HCOO performs three input/output functions: input from the CRT, clear the screen and output to the CRT, and output to the CRT without clearing the screen. In addition to the desired I/O function, the calling program provides HCOO with the address of the data buffer, the number of words to transfer, and a status word for HCOO to update. The calling program must supply in the data buffer the CCI CRT function and control characters necessary to obtain the desired results at the CRT display. Reference the CC-30 Communications Station Reference Manual for a description of these functions and control characters.

All data buffers are transferred by HCOO in a block mode under control of the BIC. The beginning and ending address of the buffer to be transferred are loaded into the BIC initial and final registers by HCOO.

HCOO also sets up the Asynchronous Half Duplex Controller for input or output since this is a one way device only. The Priority Interrupt Module (PIM) is enabled to honor interrupts caused by the BIC End of Transfer and the INT key on the CCI keyboard. If a clear operation is requested by the function argument, a 'halt local I/O' command and a 'clear' control character are sent to the CCI controller on a programmed I/O basis (BIC not used) before the data buffer is output. If input is requested by the calling program, HCOO outputs a 'transmit' control character to the CRT and then sets the Half Duplex Controller up to receive input.

For both input and output, HCOO returns control to the calling program after the BIC transfer has been initiated. HCIN, the interrupt processing subprogram, regains control when the input/output operation is complete, checks for CRT parity error, number of words transferred, etc., and then after setting the user status word, returns to the calling program. (See Calling Sequence for details on STATUS.) The BIC end of transfer interrupt will cause HCIN to regain control on any fixed length data transfer where the calling program knows the exact length of the record. If the length of the record is not known (such as a variable length input), the user must test for completion of transfer by checking for the termination of the CARRIER ON signal at any time for the on-line CRT, or using a time-out routine for the modem CRT. When the user determines that the variable length input is complete, he must call HCIN to get the status and/or number of words transferred. Again, on fixed length records, HCIN will be called automatically when the BIC EOT interrupt occurs.

User interface notes:

- HCOO assumes that the calling program will determine when HCOO should be called to input from the CRT. HCOO facilitates the use of the INT key for this purpose by setting an indicator HCKI when the INT key is depressed. The calling program may then check HCKI at any time to determine if the CRT user desired to input a screen of data.
- There are two control characters that effect the number of characters actually received from the CRT on an input block transfer. They are the new line character (A) and the end of text character (B). If the CRT user at the keyboard is free to use these characters at his own discretion, it is very possible to receive variable length records at the computer. This possibility requires the calling program to do two things in relationship to CRT input and the HCOO routine:
 - (1) The receiving buffer should be assigned a buffer area large enough to contain the maximum size record that could originate from the CRT. The number of words passed in the calling sequence should reflect the maximum buffer size.
 - (2) The calling program must periodically check for termination of input as described above.

3.3.4.2.1 Calling Sequence

CALL HCOO,X,Y,Z,STAT

PARAMETER	FUNCTION
X	Address of the I/O function code X = 0 for input X = 1 for output preceded by a clear operation X = 2 for output with no clear operation
Y	Beginning location of data buffer. If Y is an output buffer, the CRT data must be 7 bit ASCII characters, one character per word right justified. All other bits are ignored. If Y is an input buffer, at the completion of the input operation the buffer will contain 7 bit ASCII characters with the 8th bit containing the parity bit (even). Each character will be packed right justified, one character per word with the rest of the word zero.
Z	Number of words (characters) to transfer.
STAT	Status of I/O operation STAT = -1 I/O in progress STAT = -2 CRT parity error STAT = ≥ 0 I/O successfully completed. Number represents the number of words/characters transferred.

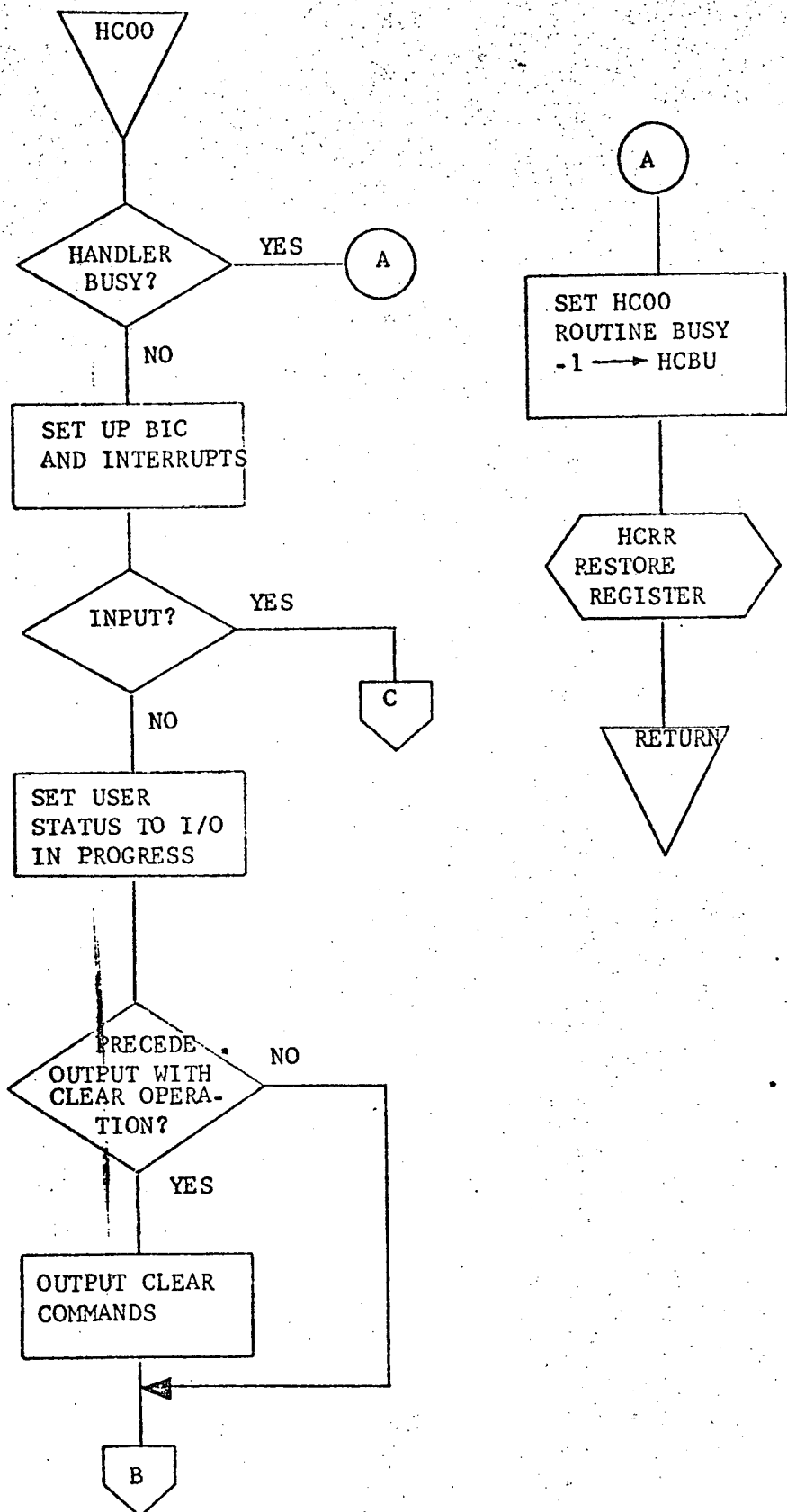
Returns

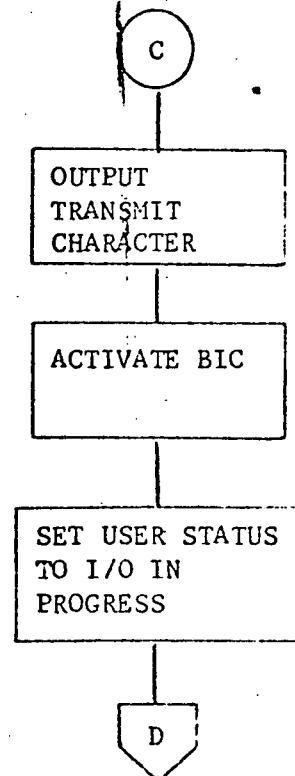
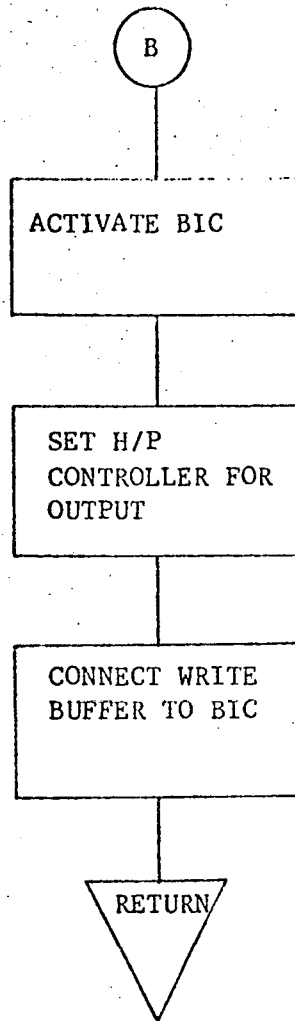
CALL+6 HC00 returns here if a previous I/O request has not been completely processed by HC00. HCIN must have been entered as a result of a BIC EOT interrupt or a call to HCIN for wrap-up of the I/O function.

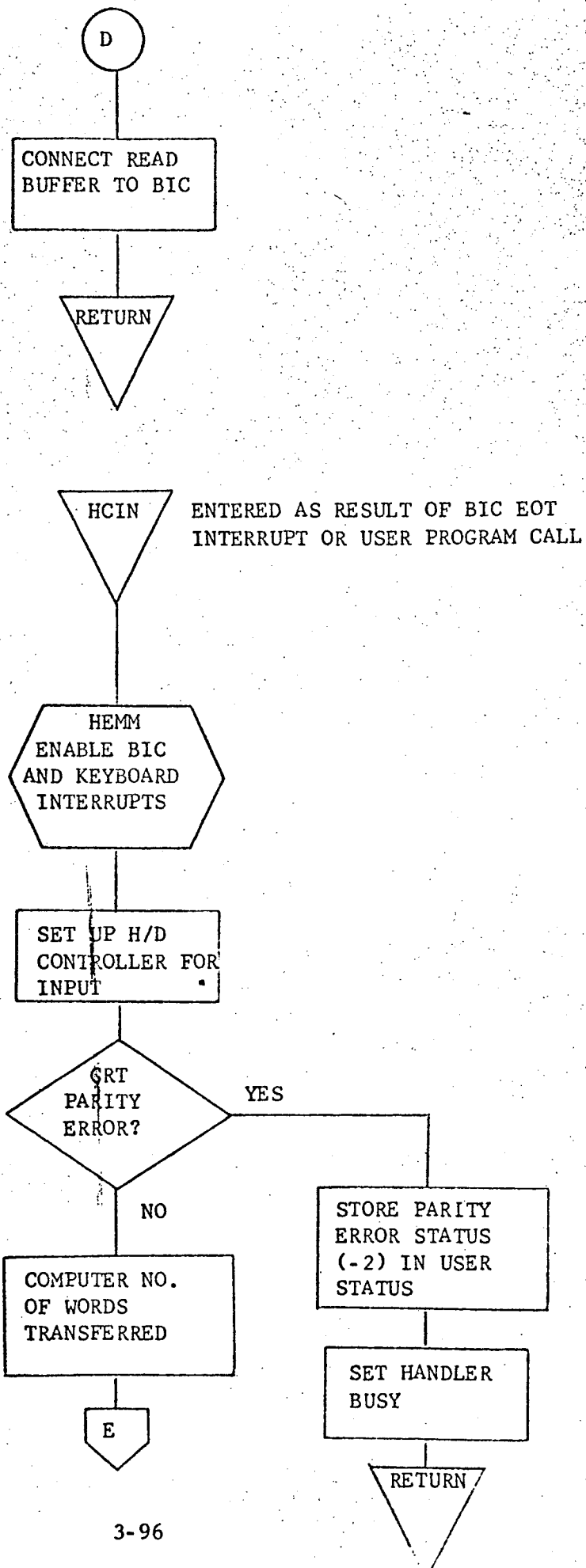
CALL+8 Normal Return. I/O initiated. Calling program must check STAT for completion or determine I/O completion as indicated in the Technical Description.

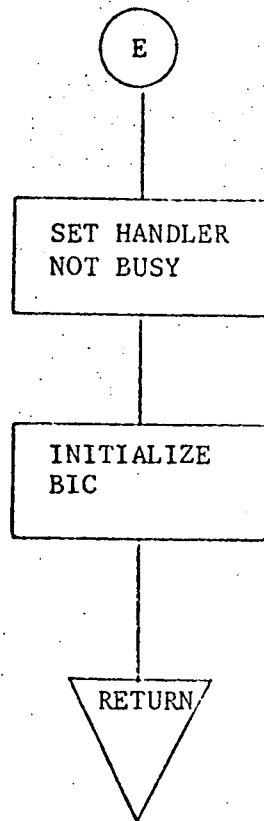
REGISTER	CONTENTS UPON ENTRY	CONTENTS UPON EXIT
A	Saved	Restored
B	Saved	Restored
X	Saved	Restored
Overflow	Not used	Not effected

3.3.4.2.2 General Flow Chart









3.3.4.3 Label Description

3.3.4.3.1 Local

HCA Save area for A-Register

HCB Save area for B-Register

HCBU Handler busy indicator - Set to -1 when HCOO still processing
previous I/O request

HCCL Clear control character output to CCI controller

HCHL Halt Local I/O function output to CCI controller

HCII Indirect address for subroutine arguments

HCIO Input/output function being performed

HCSB Beginning buffer address. Employed later to compute the number of
words transferred.

HCSH SOH control character output to CCI controller

HCTT Transmit control character output to CCI controller

HCX Save area for X-Register

3.3.4.3.2 Global

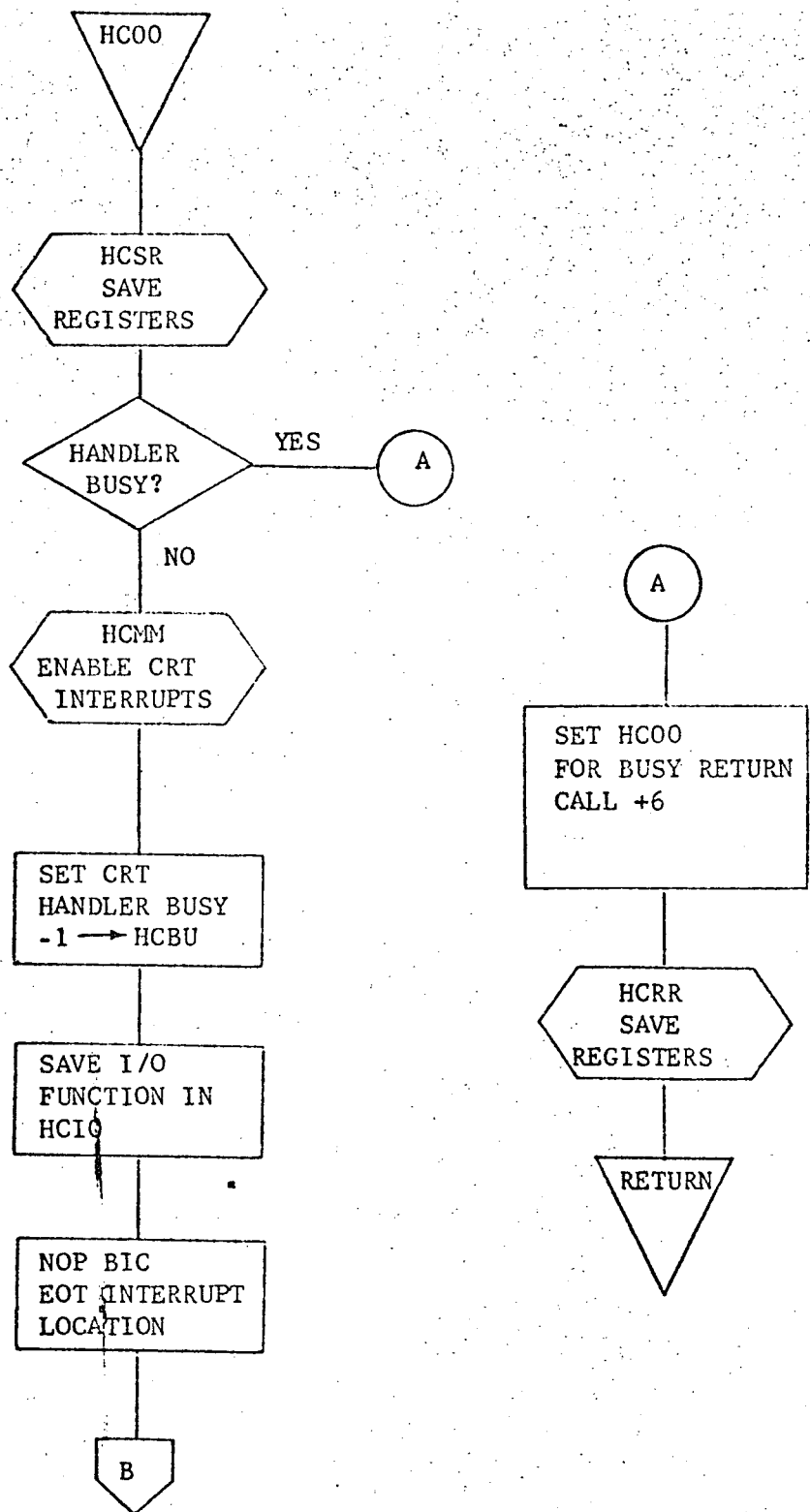
HCKI Indicator which is incremented by 1 when an interrupt is caused by
the INT key being pressed on the CCI keyboard. Used by calling
program to determine if user has requested input of CRT data.

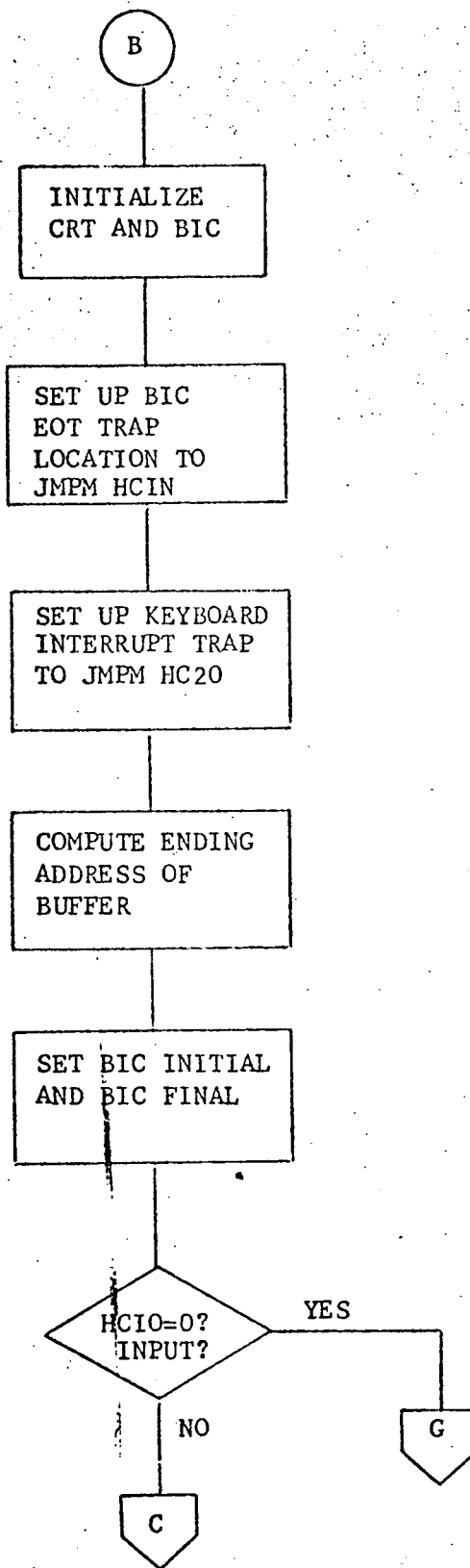
3.3.4.3.3 Entry Points

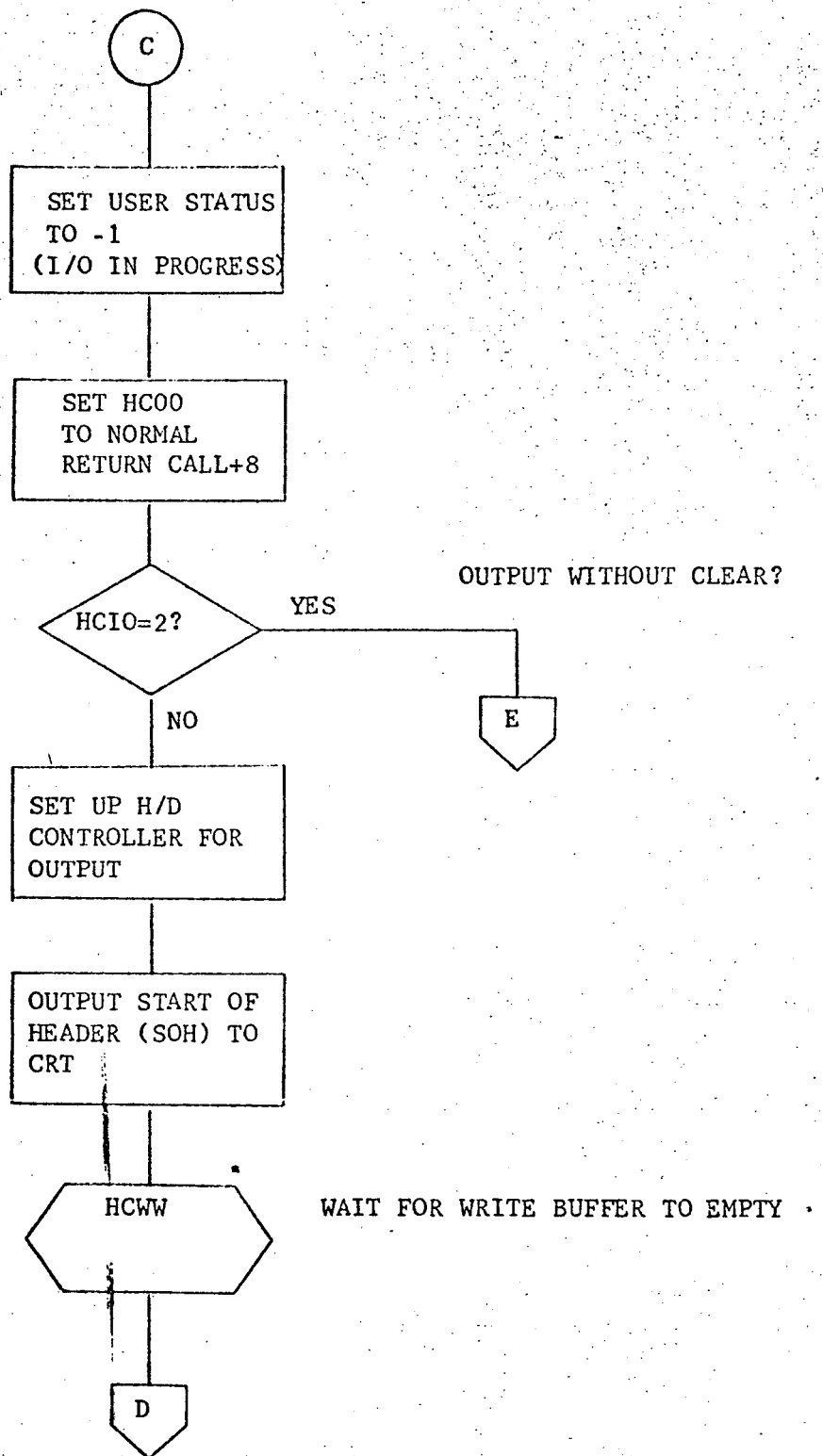
HCIN Entry when calling program has determined I/O is complete and wishes
status of CRT device and/or number of words transferred. (Used only
when variable length records are input.)

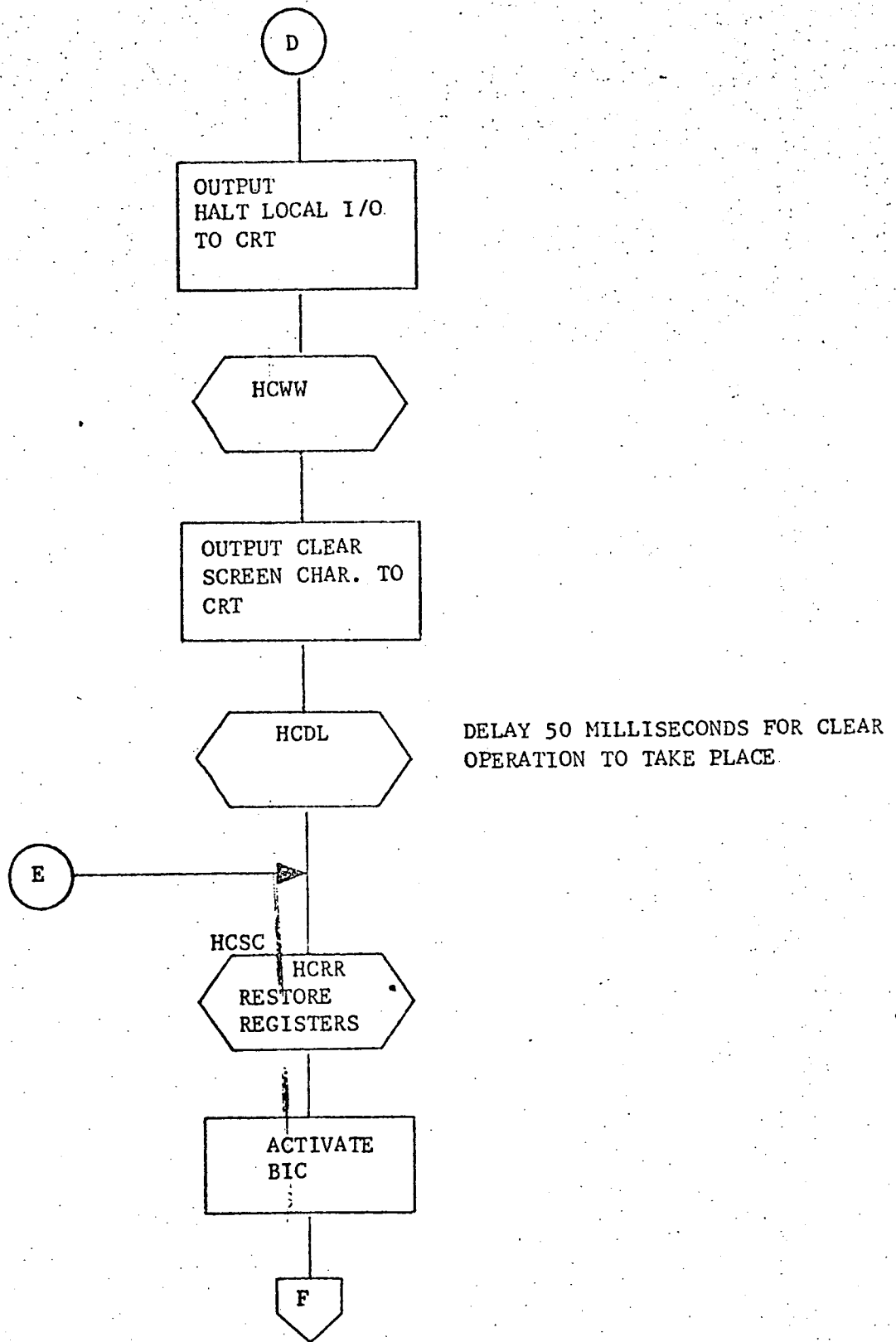
3.3.4.3.4 External References

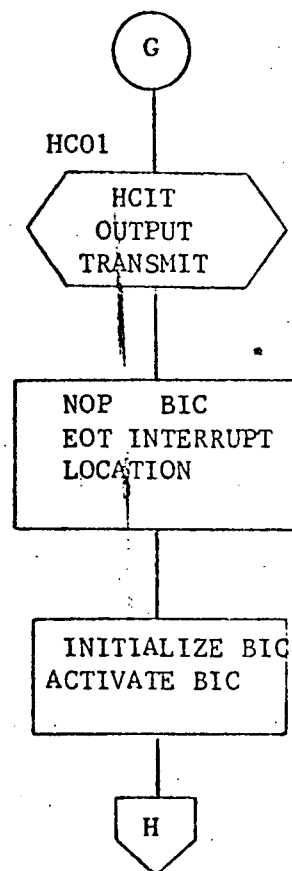
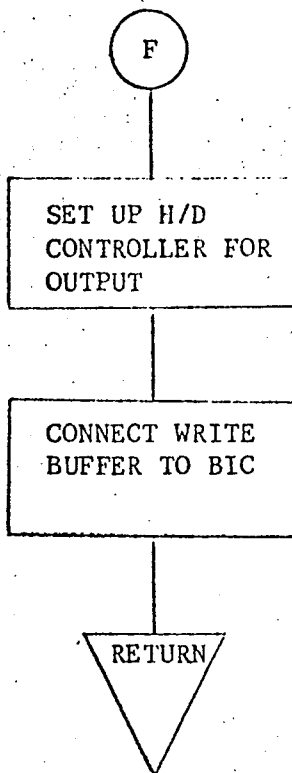
None

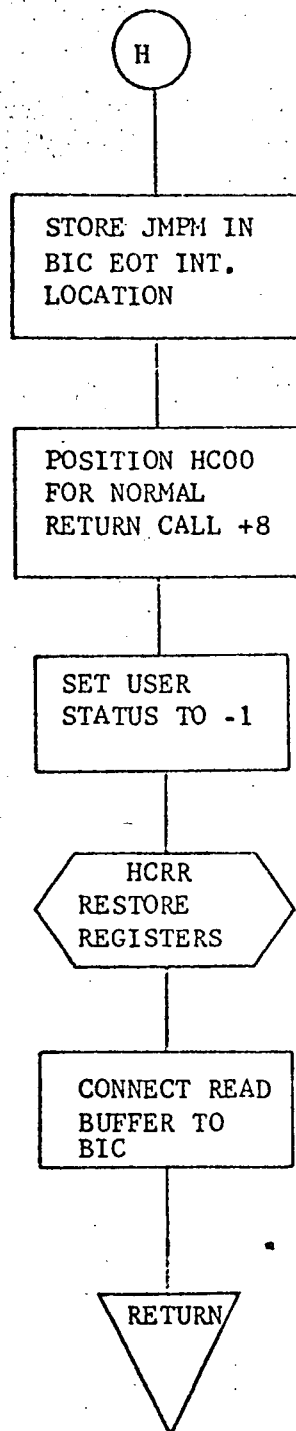




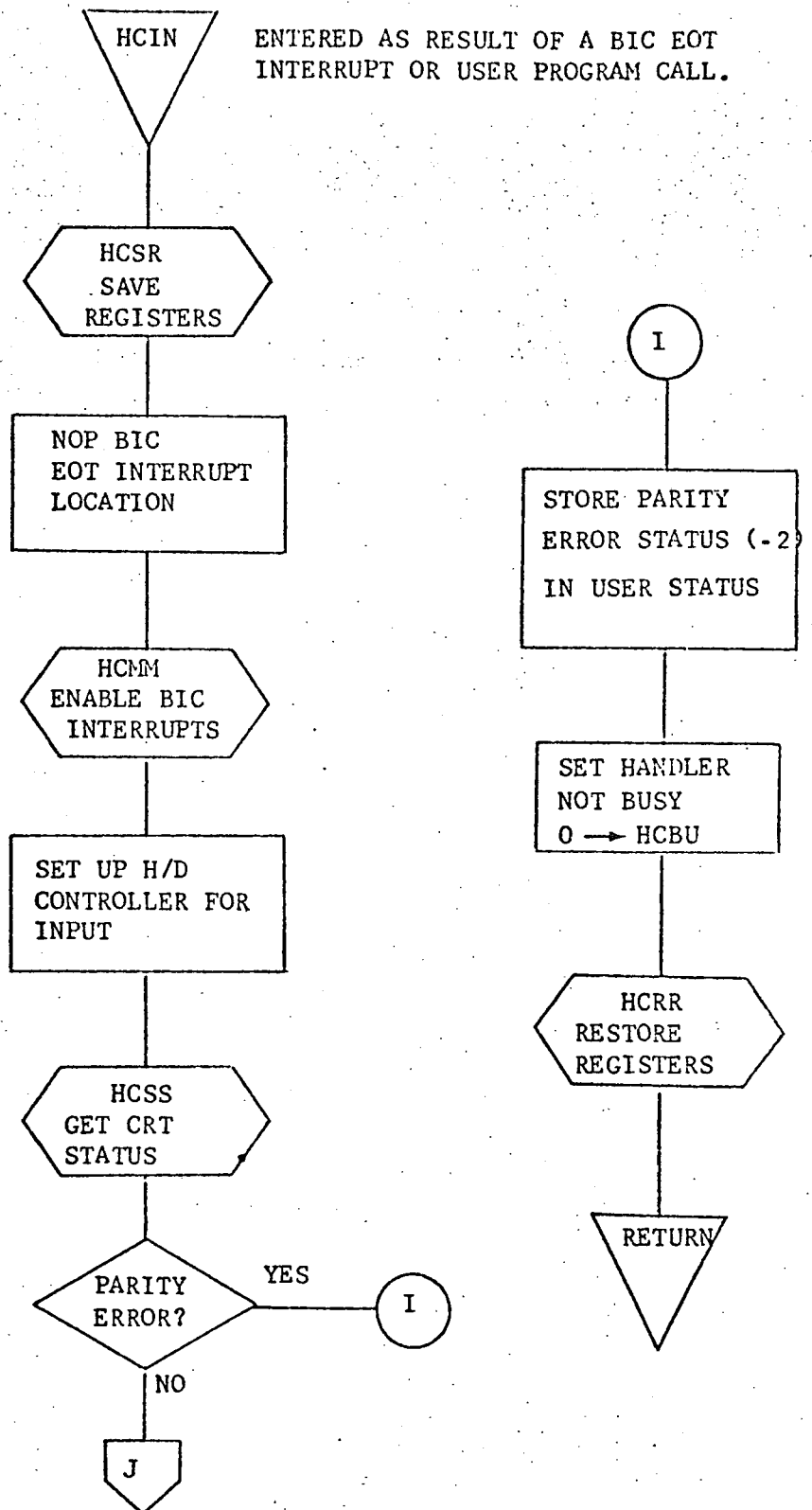


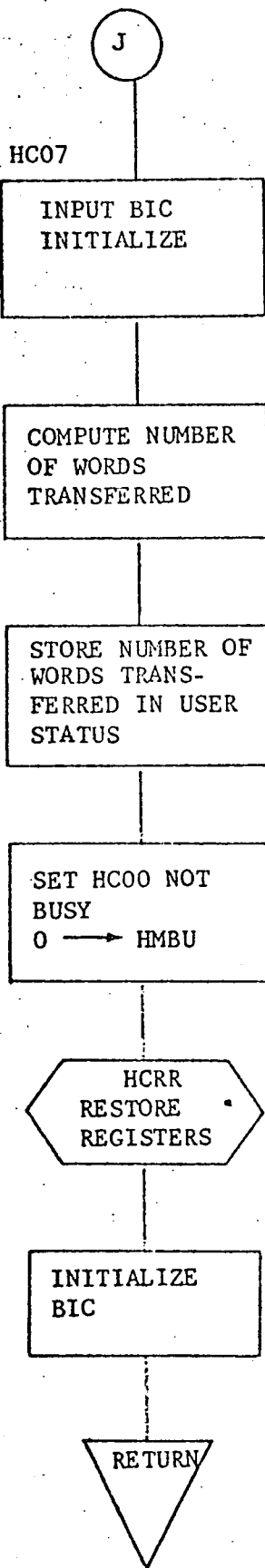






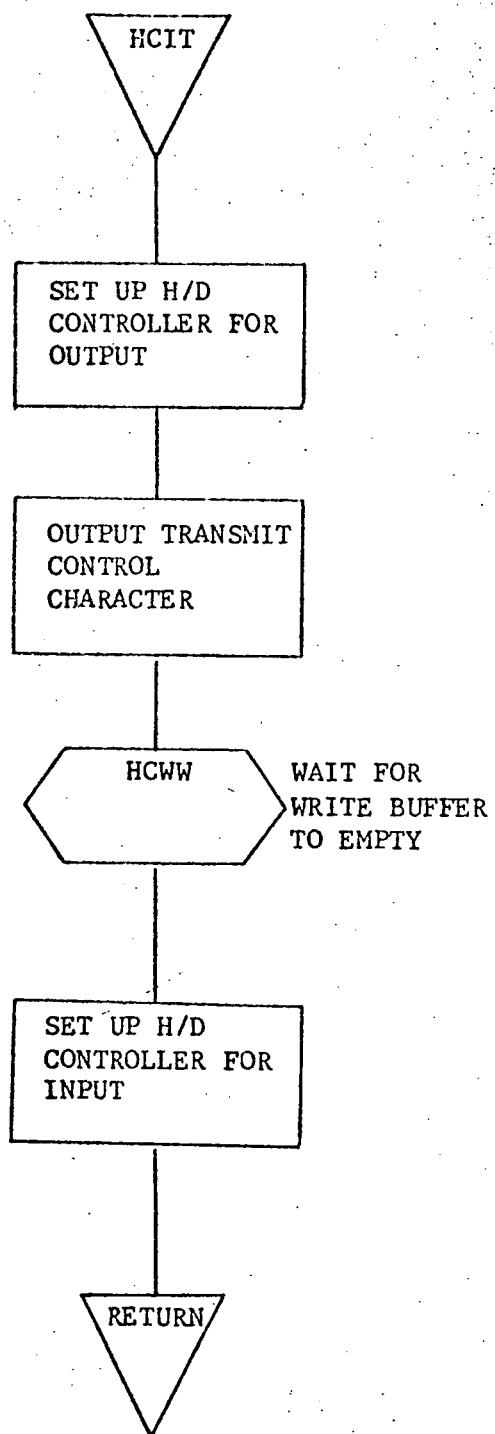
SET USER STATUS TO I/O IN PROGRESS



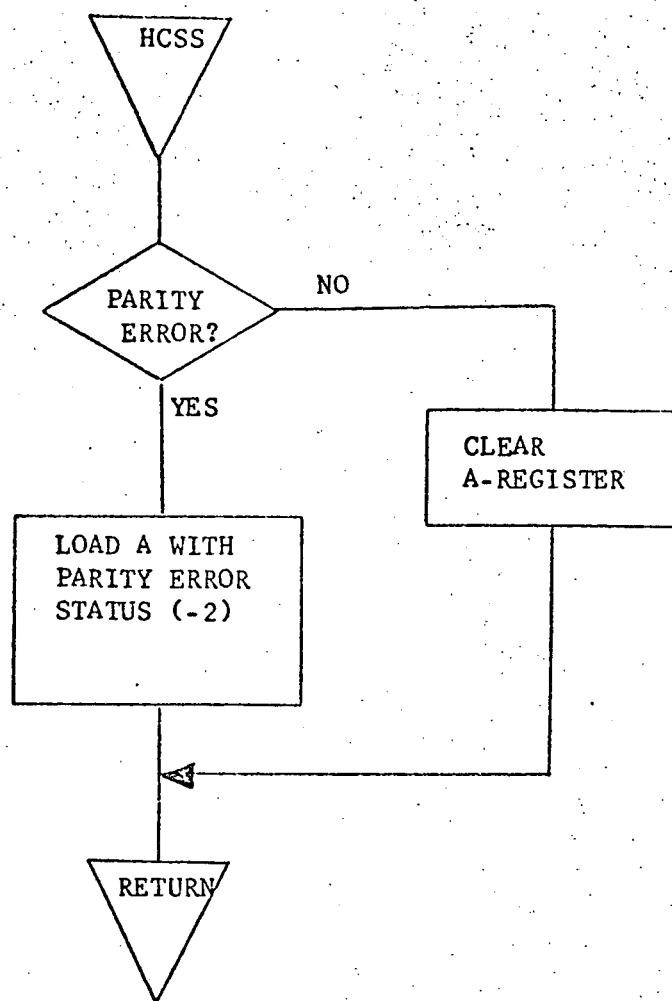


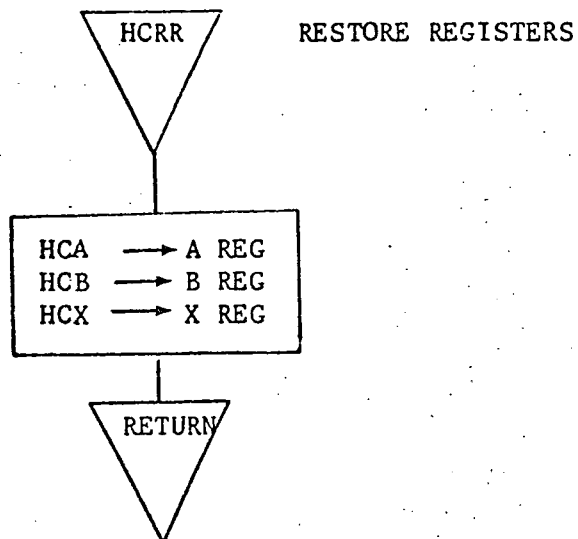
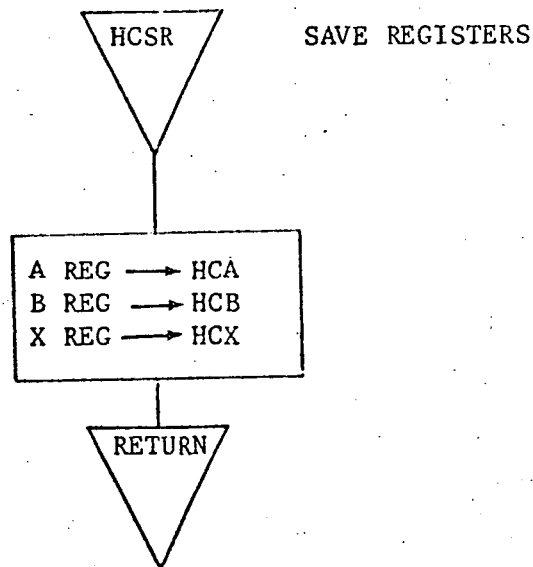
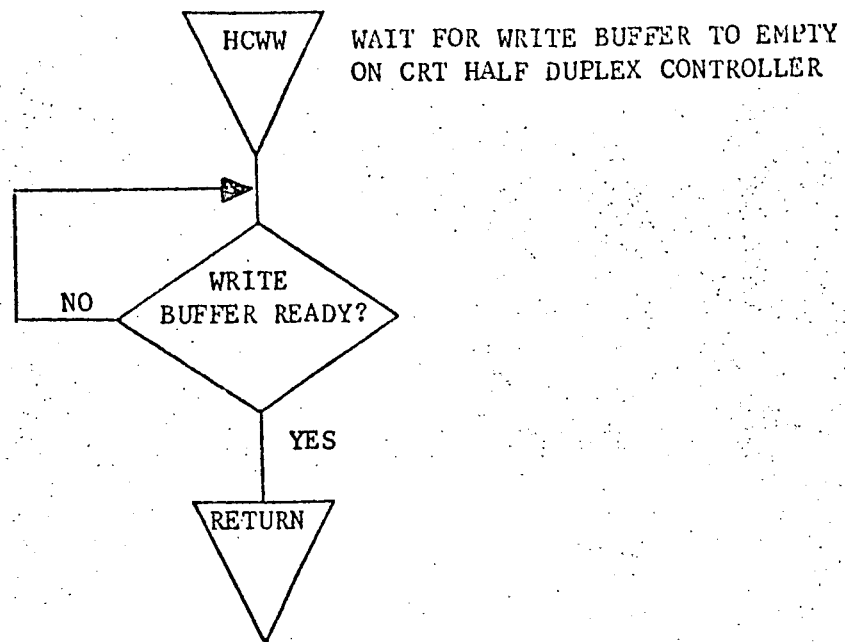
BIC INITIAL CONTAINS THE BUFFER ADDRESS WHERE THE LAST CHARACTER WAS INPUT OR OUTPUT.

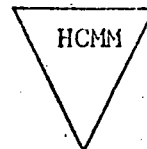
OUTPUT TRANSMIT CHARACTER ROUTINE



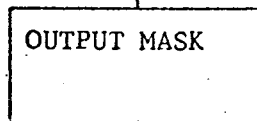
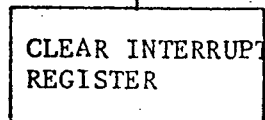
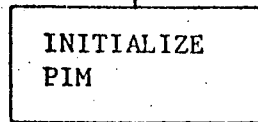
SENSE CRT STATUS ROUTINE



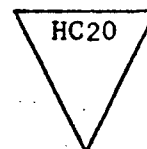
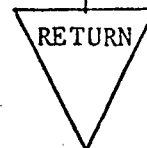
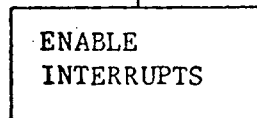




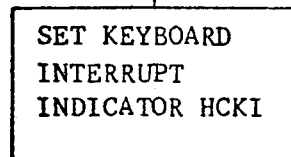
ENABLE BIC EOT AND KEYBOARD
INTERRUPT ON APPROPRIATE PIM'S



OUTPUT MASK TO PIM FOR THE BIC
EOT AND KEYBOARD INTERRUPT.



ENTERED AS RESULT OF A KEYBOARD
INTERRUPT CAUSING A TRAP TO THE
KEYBOARD INTERRUPT LOCATION WHERE
A JMPM TO HC20 IS PERFORMED.



3.3.5 HM00 - Magnetic Tape Handler

3.3.5.1 Purpose

HM00 is a general purpose tape routine capable of handling all available tape functions. The purpose of this routine is to reduce the duplication of effort that is inherent when individual users develop their own coding to handle each specific tape I/O operation. The routine currently does not return control to the calling program until I/O is complete or an error is detected, but as soon as additional interrupts are available on the DOC system, the routine will be modified to allow overlapped processing during tape operations.

3.3.5.2 Technical Description

HM00 allows input or output of variable length tape records. The Model 6201-31 Magnetic Tape System Controller is capable of performing 8 functions (see Calling Sequence 3.3.8.2.1) all of which are handled by HM00. The BIC is used for input and output operations. HM00 first sets up the BIC instructions by using the MTU number received in the call and saves the MTU number for later use in building the actual tape instruction. The starting buffer address is picked up from the call; the ending address is computed by using the number of words to be transferred in the call, and the BIC initial and BIC final addresses are output to the BIC. The tape function is picked up from the arguments and combined with the MTU number to create the tape instruction. The I/O operation is then executed. After completion of the I/O, HM00 checks the status of the MTU and returns that status to the calling program as the fifth parameter of the call.

3.3.5.2.1 Calling Sequence

CALL HM00,A,B,C,D,STAT

PARAMETER

FUNCTION

A	Address of location containing tape function to be performed. 0 = input binary 1 = input BCD 2 = output binary 3 = output BCD 4 = Write End of File 5 = Forward one record 6 = Backspace one record 7 = Rewind
B	Beginning location of buffer (not to exceed (37777_8))
C	Address of location containing number of words to transfer
D	Address of location containing unit number (10_8 or 11_8)
STAT	Address of location containing Status of I/O operation. (Output by HM00 to calling program.)

STAT = ≥ 0 I/O completed successfully. Number indicates number of words transferred.

STAT = -1 User requested I/O still in progress.
(to be implemented)

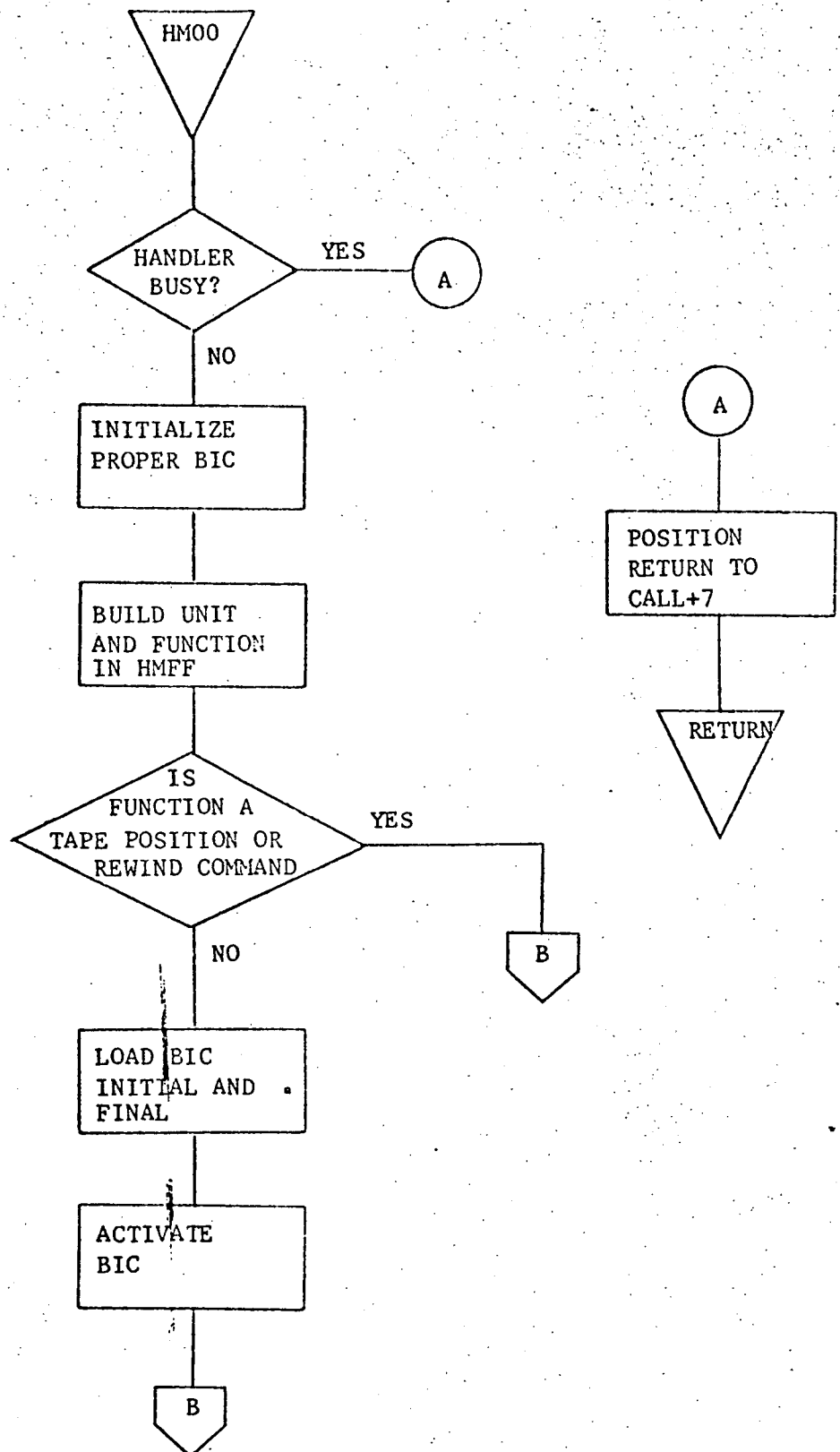
3.3.5.2.1 Calling Sequence (Continued)

PARAMETER	FUNCTION
STAT = -2	End of File
STAT = -3	Tape Error
STAT = -4	End of Tape
STAT = -5	Beginning of Tape

Busy Return	CALL+7
	Handler busy processing a previous I/O request.
Normal Return	Call +9
	Requested I/O complete. User must check STAT for errors or number of words transferred.

REGISTER	CONTENTS UPON ENTRY	CONTENTS UPON EXIT
A	Saved	Same as Entry
B	Saved	Same as Entry
X	Saved	Same as Entry
Overflow	Not effected	Same as Entry

3.3.5.2.2 General Flow Chart



3.3.5.3 Label Description

3.3.5.3.1 Local

HM1 - HM5, HM15	Locations of BIC instructions initialied by HM00
HM01	Location where tape I/O instruction is constructed and executed.
HMA	Save area for A-register.
HMA B	Indirect address for unit number.
HMA3	Initialize BIC 2 instruction. Used for initialization.
HMA4	Initialize BIC 4 instruction.
HMB	Save area for B-register.
HMB A	Beginning address of buffer. Used to compute number of words transferred.
HMBU	Previous I/O in progress (to be implemented).
HMB3	Sense BIC 2 not busy instruction. Used for initialization.
HMB4	Sense BIC 4 not busy instruction. Used for initialization.
HMC3	Set BIC 2 starting address instruction. Used for initialization.
HMC4	Set BIC 4 starting address instruction. Used for initialization.
HMD3	Set BIC 2 final address instruction. Used for initialization.
HMD4	Set BIC 4 starting address instruction. Used for initialization.
HME3	Enable BIC 2 instruction. Used for initialization.
HME4	Enable BIC 4 instruction. Used for initialization.
HMFF	Tape function being performed.

3.3.5.3.1 Local (Continued)

HMF3	Location containing a "load BIC 2 initial register" instruction. Used for initialization.
HMF4	Location containing a "load BIC 4 initial register" instruction. Used for initialization.
HMUN	Unit number.
HMX	Save area for X-register.
HMAX	Indirect argument pointer.

3.3.5.3.2 Global

HM00	Entry point into subroutine.
------	------------------------------

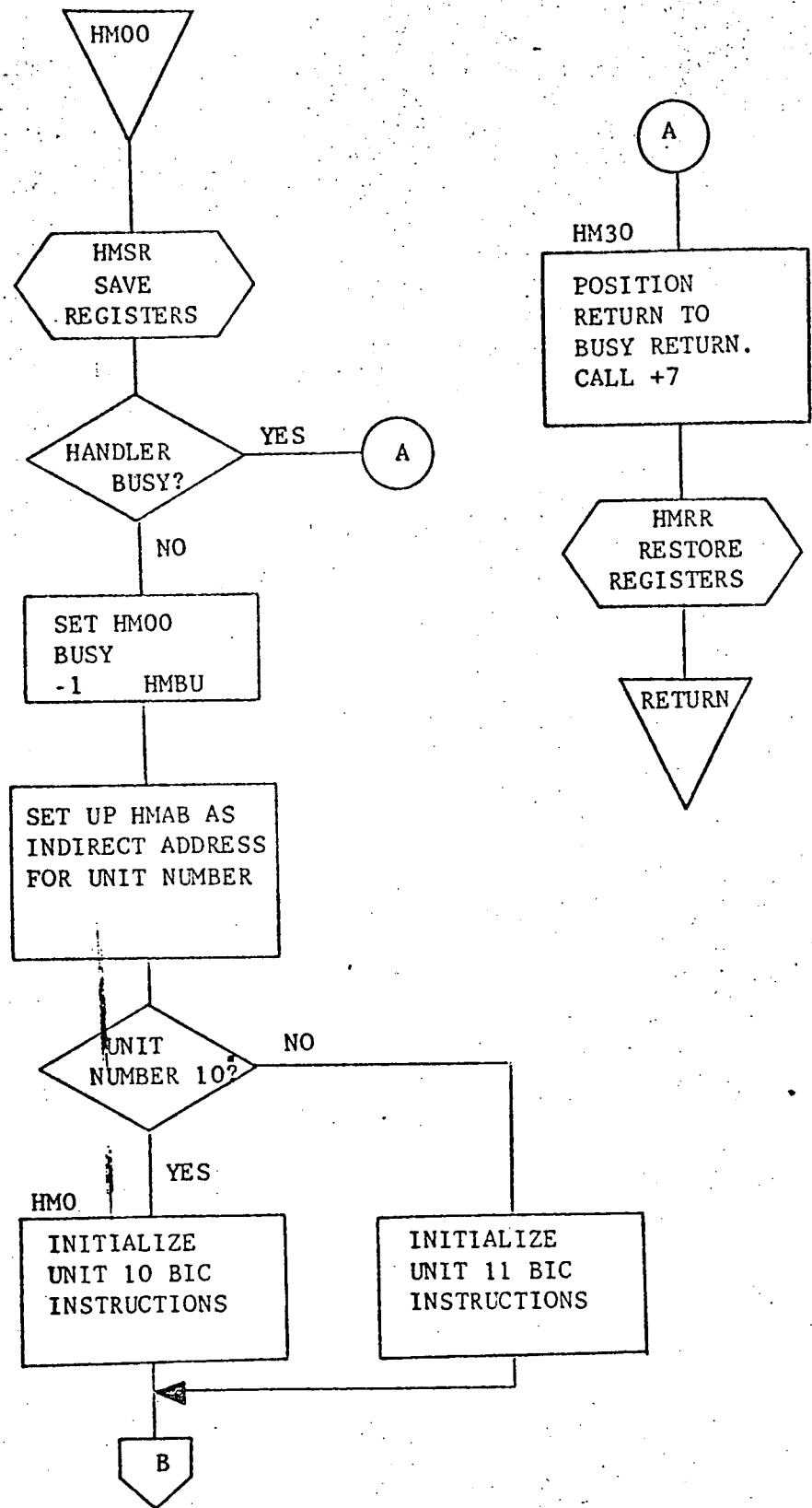
3.3.5.3.3 Entry Points

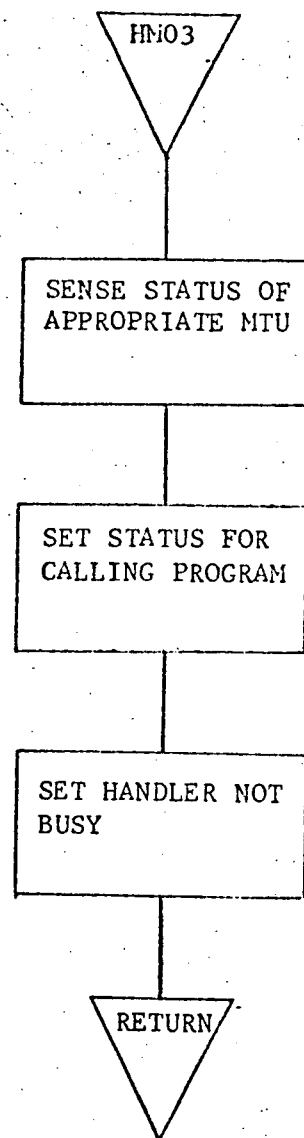
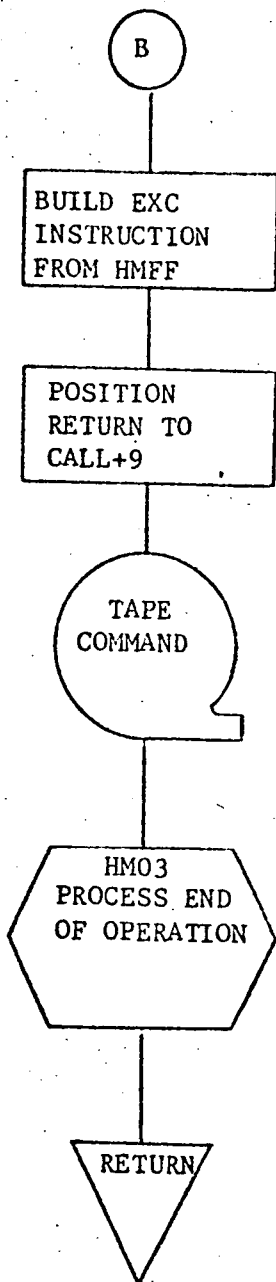
HM00	primary entry point
------	---------------------

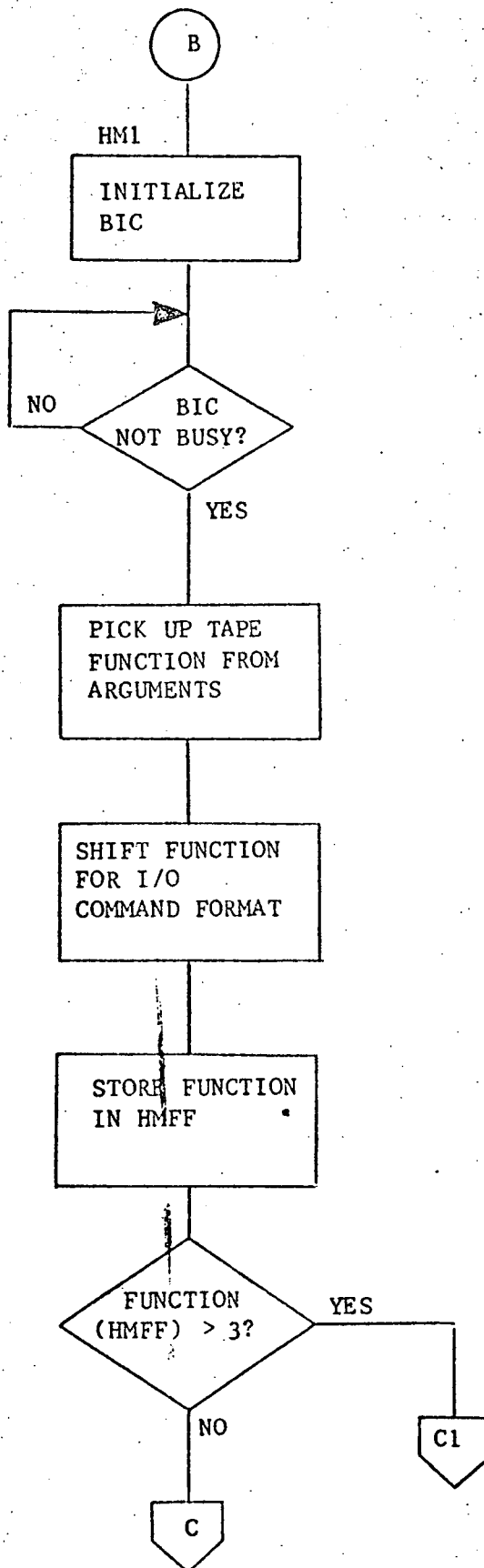
3.3.5.3.4 External References

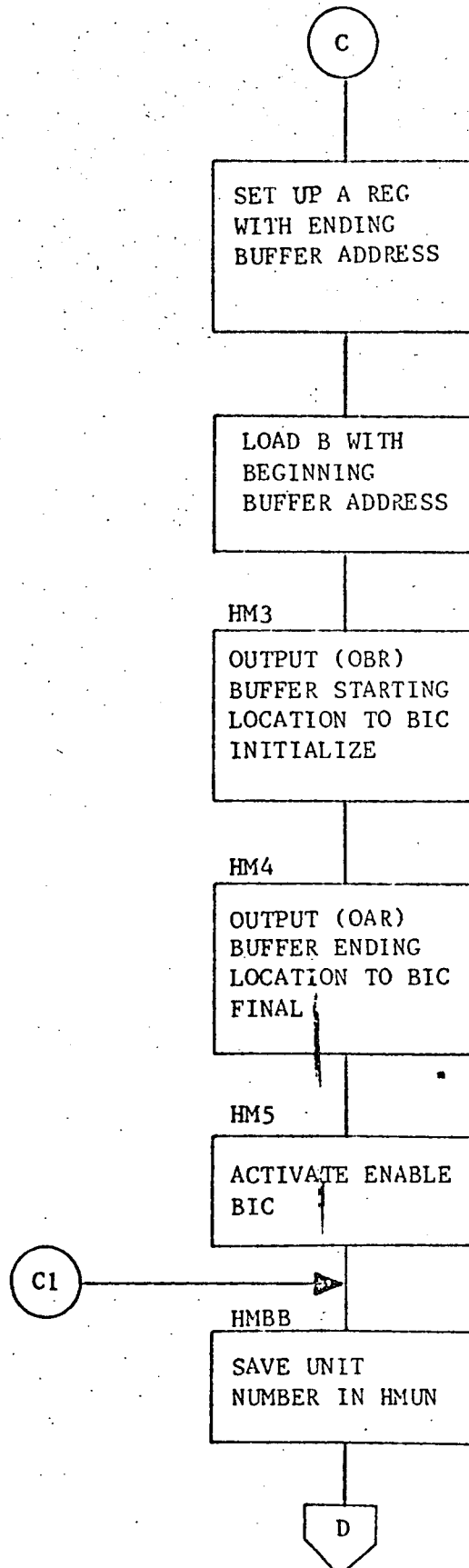
None.

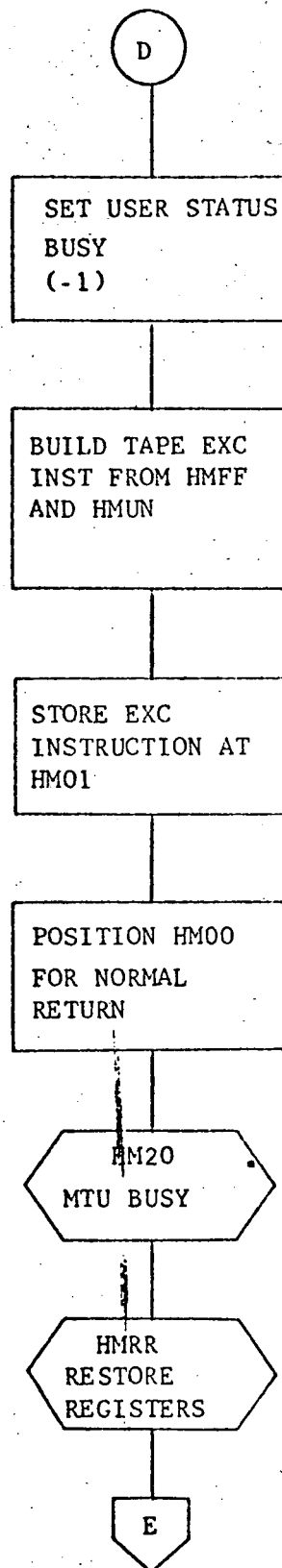
3.3.5.4 Detailed Flow Chart

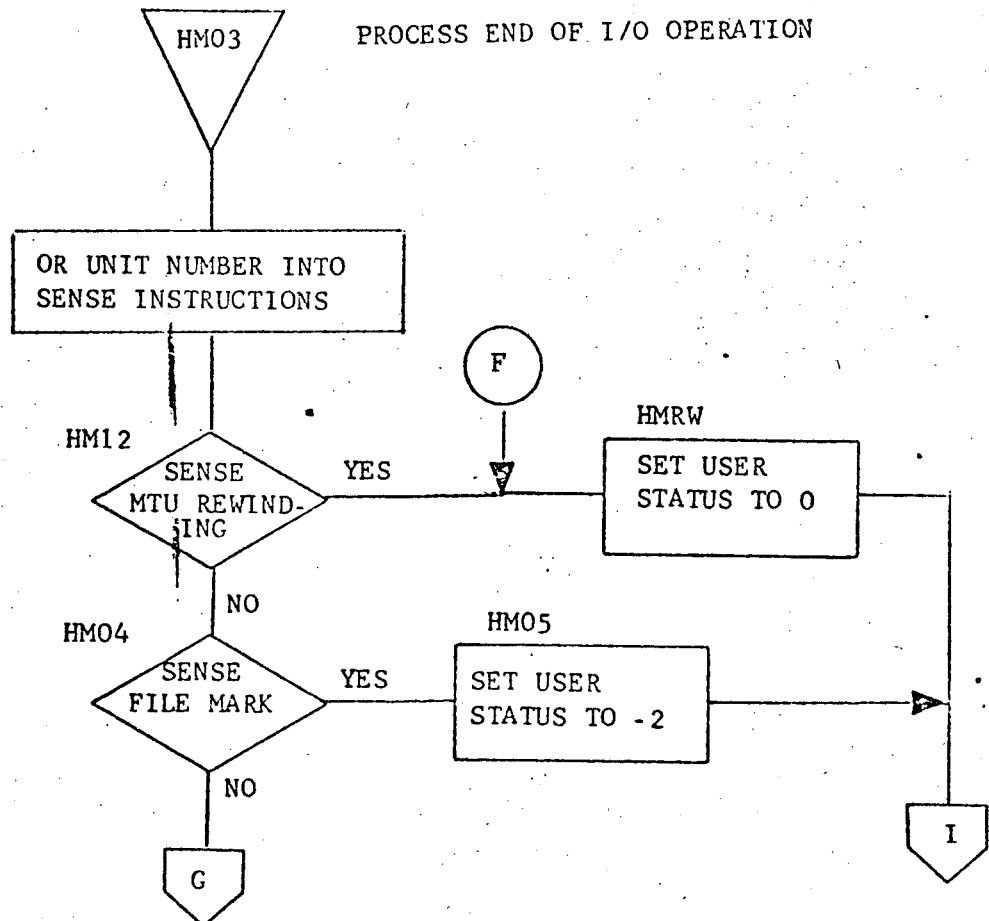
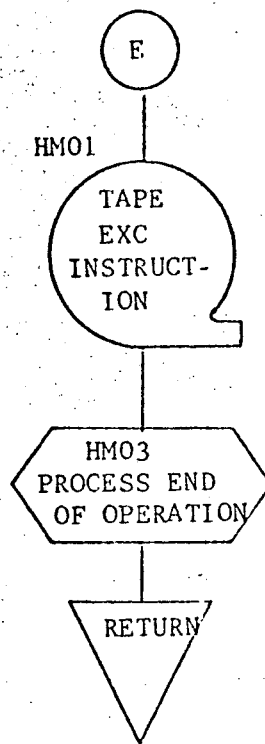


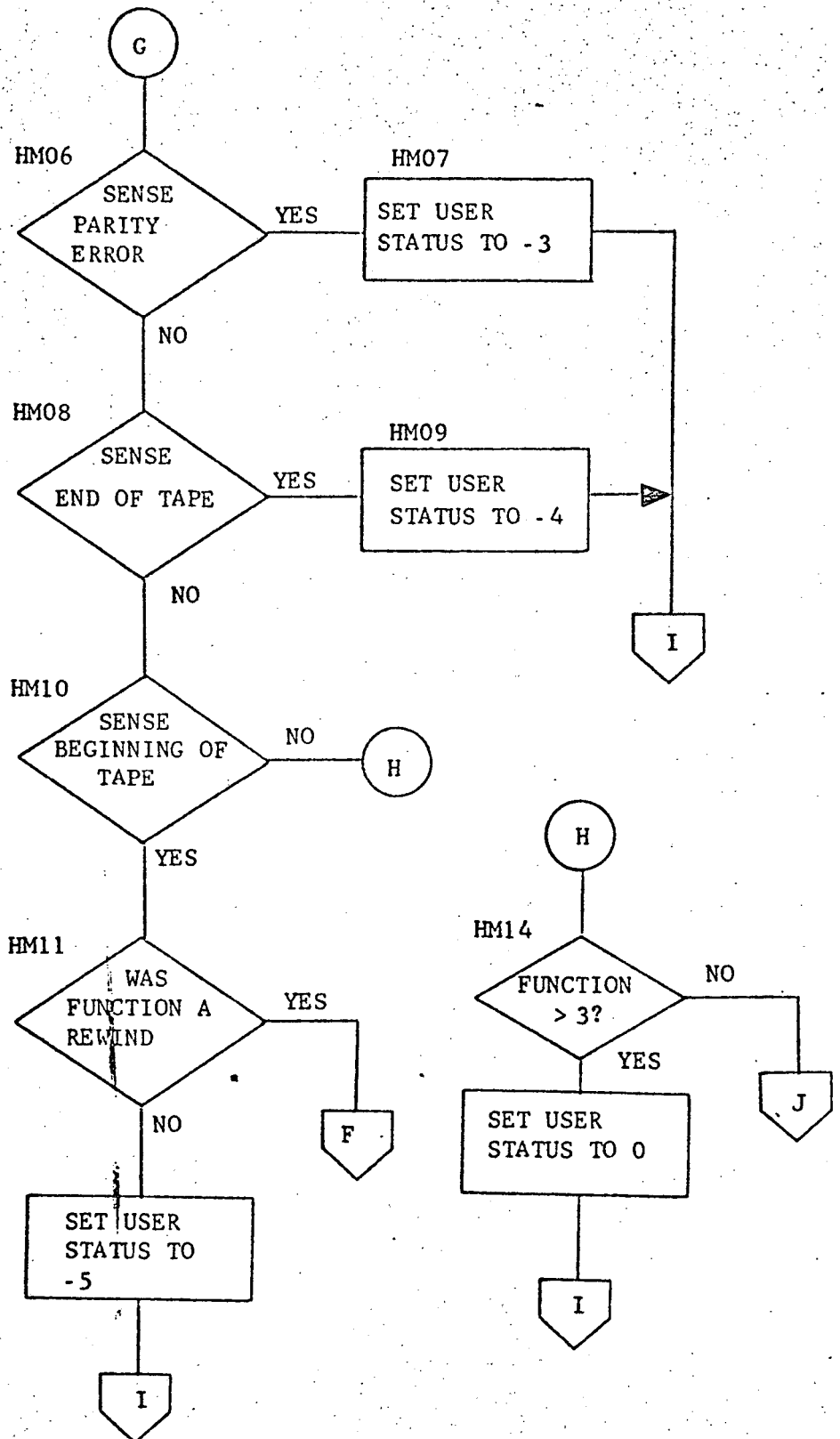


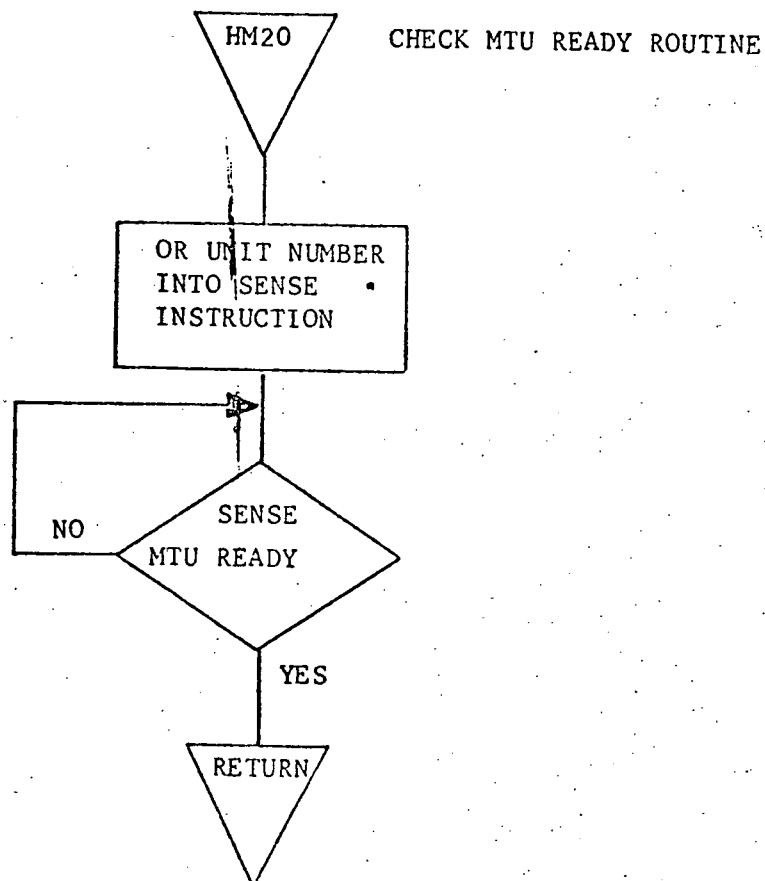
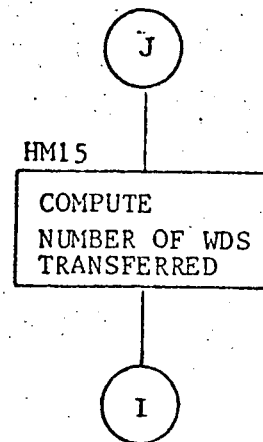
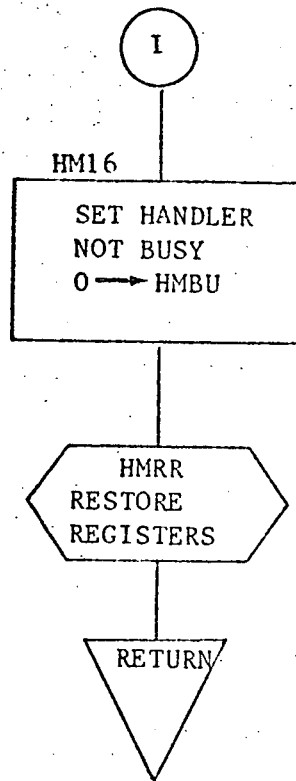


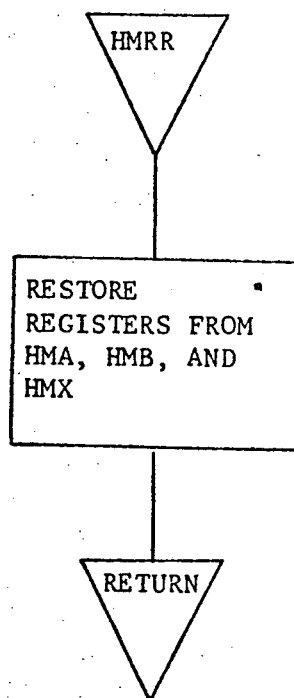
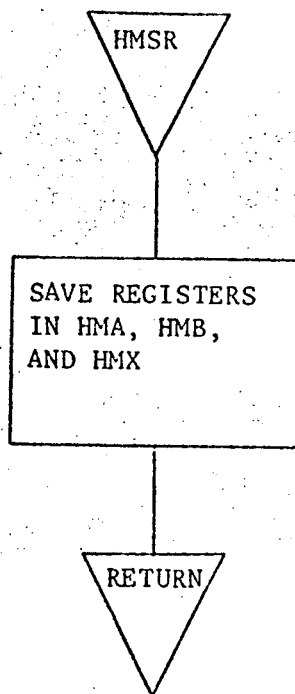












3.3.6 1000 - Input Display

3.3.6.1 Purpose

This routine inputs a complete display from the CRT upon interrupt from the CRT keyboard.

3.3.6.2 Technical Description

This routine calls the CRT handler (HCOO) to input a display to the input buffer. After the routine is called and the arguments are retrieved, a character is input from the CRT controller buffer. This character must be an interrupt character caused by depressing the interrupt key on the CRT keyboard or a transmit (start of text) character caused by depressing the transmit key on the CRT keyboard. An interrupt key will cause the cursor to be positioned to the end of the next heading on the displayed form. A start of text character causes an entire display to be input via routine HCOO. An initial character other than interrupt or transmit is ignored. If the transmission of data from the CRT to the input buffer is unsuccessful, the appropriate message stating the nature of the problem (parity error or device not ready) is output to the teletype.

Once the input buffer is being filled, the method of detecting the end of transmission varies. If the modem is employed, a delay of 4.5 seconds must occur to allow ample time for transmission to be completed. Otherwise, completed transmission may be sensed.

Routine HCIN is called to process the full input buffer. Upon return from HCIN, control is returned to the calling routine.

3.3.6.2.1 Calling Sequence

CALL ID00, NUM

PARAMETER

NUM

FUNCTION

the address of the number of characters to input

REGISTER

CONTENTS UPON ENTRY

CONTENTS UPON EXIT

A

destroyed

B

destroyed

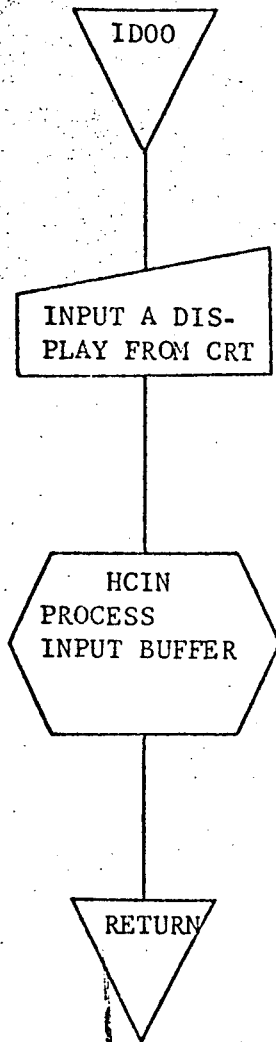
X

destroyed

Overflow

destroyed

3.3.6.2.2 General Flow Chart



3.3.6.3 Label Description

3.3.6.3.1 Local Labels

<u>Symbol</u>	<u>Function</u>
CNT	number of characters to input
HCRT	CRT device address
IDEC	error retry counter
IDRC	address of buffer to be filled
IDWD	number of words to send
ID2	CRT function selector 0 = input 1 = output with clear 2 = output with no clear
SCXX	cursor position indicator; 0 indicates start of new display
STAT	status of I/O operation

3.3.6.3.2 Global Labels

WRDS number of words to input from CRT

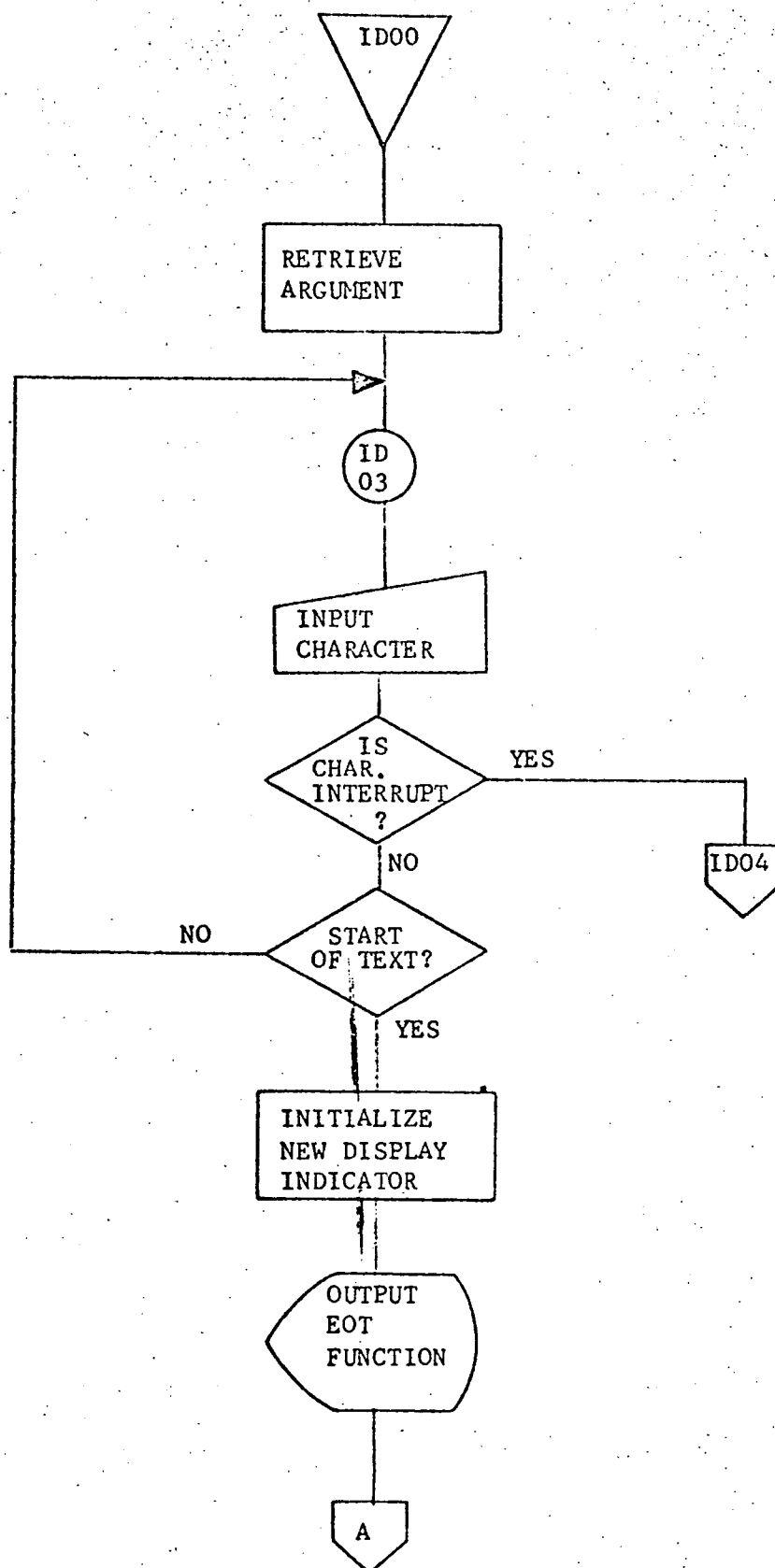
3.3.6.3.3 Entry Points

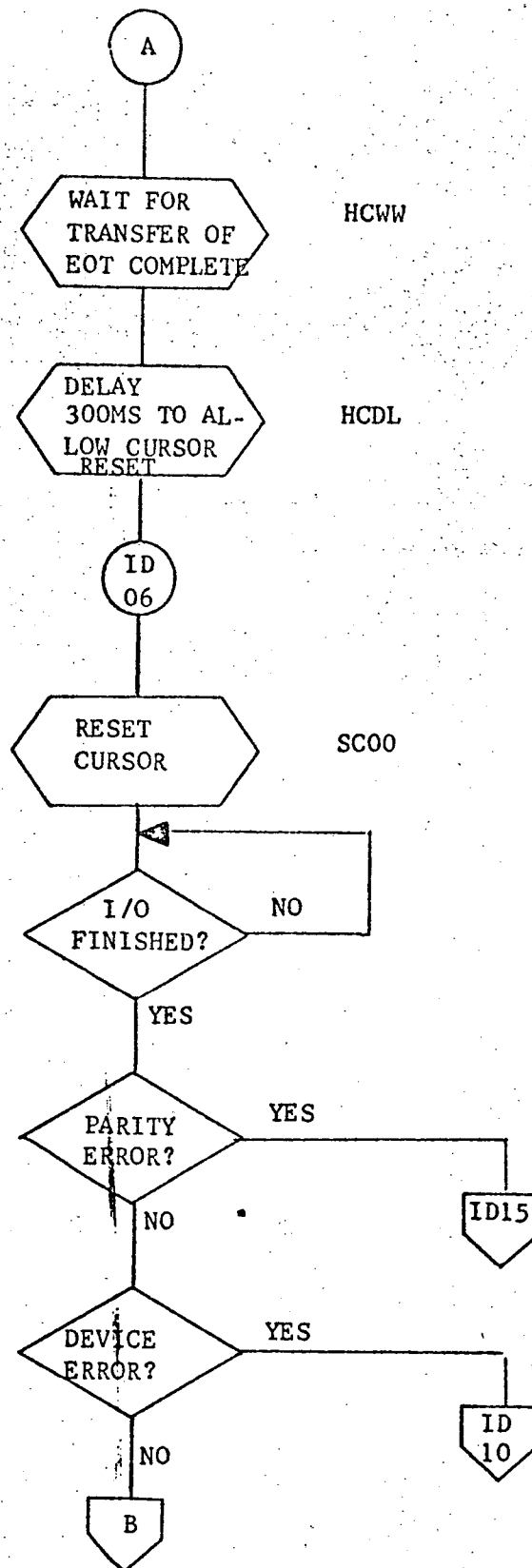
primary entry point ID00

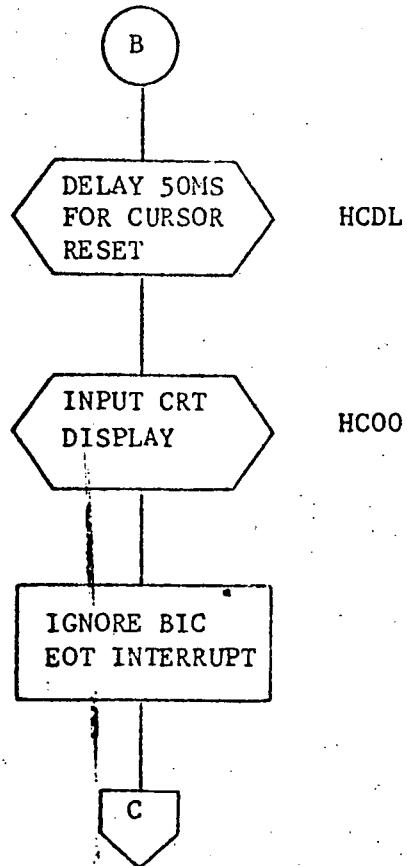
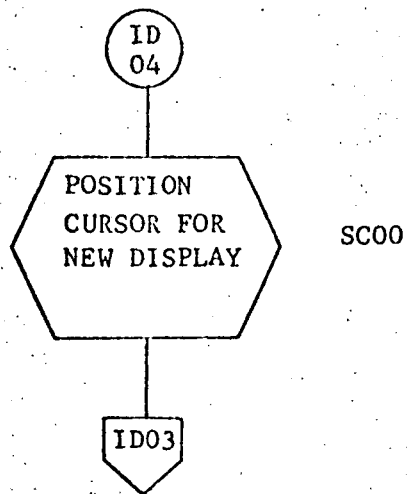
3.3.6.3.4 External References

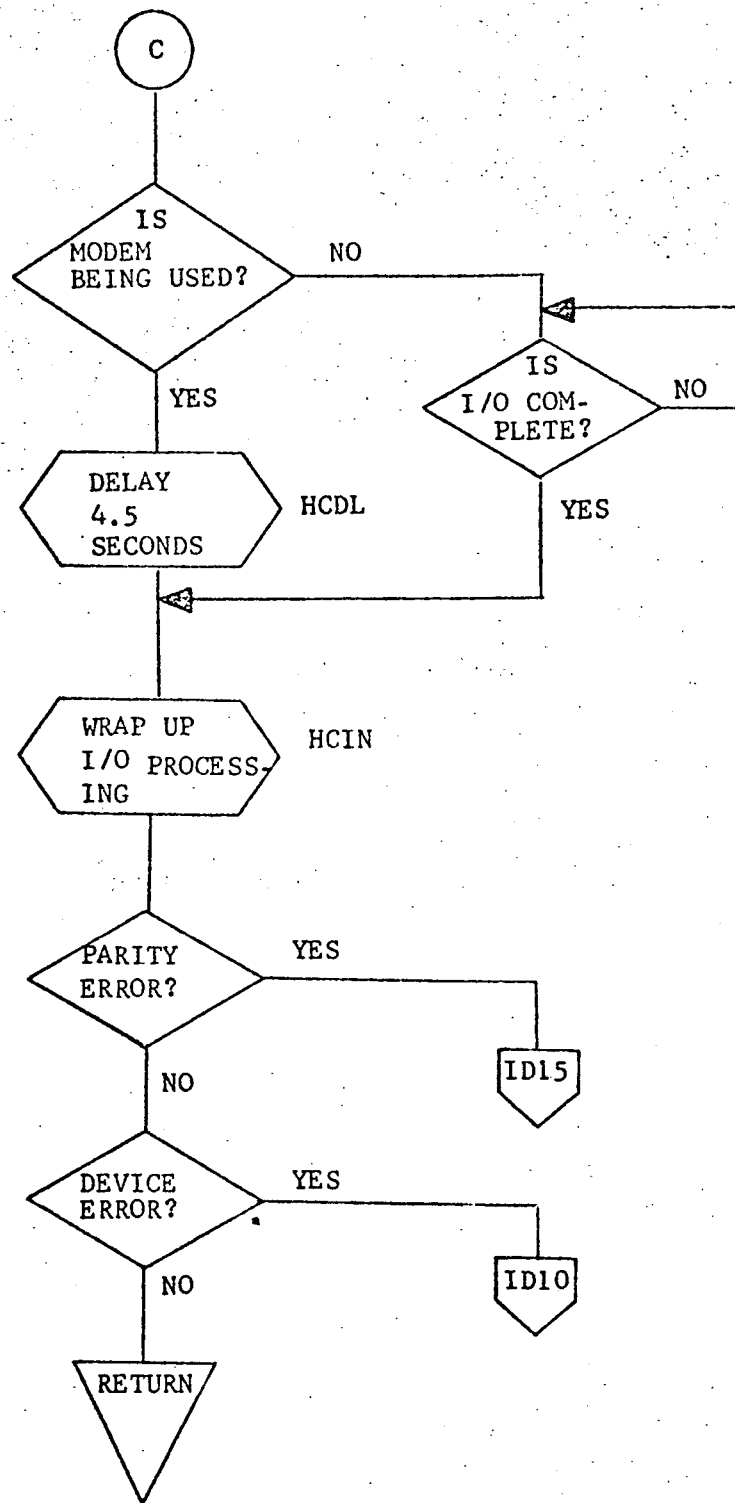
HCDL	delay routine
HCIN	I/O buffer processing routine
HCMH	enable interrupts
HC00	input display routine
HCWW	delay routine for CRT write buffer to empty
OZKA	TTY print message routine
OZKR	carriage return, line feed to TTY
SC00	cursor position routine

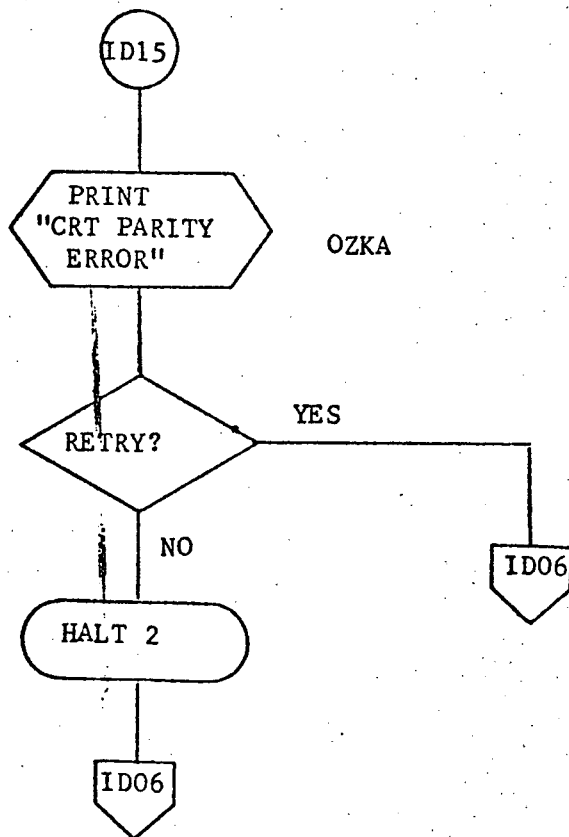
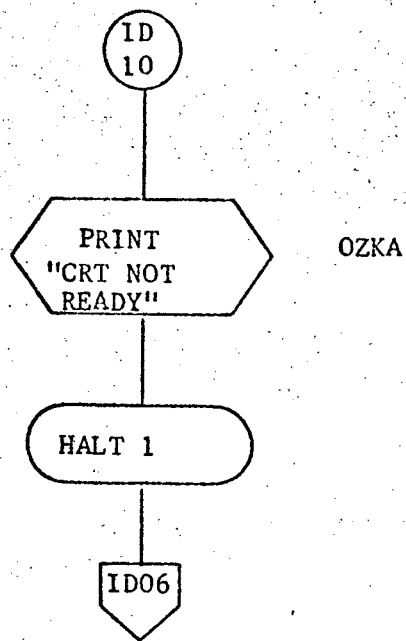
3.3.6.4 Detailed Flow Chart











3.3.7 MD00 - Mag Tape Output Routine

3.3.7.1 Purpose

This routine outputs the contents of the buffer MTO\$ to mag tape unit 10.

3.3.7.2 Technical Description

Immediately upon entry to the routine an attempt to write to the mag tape unit is made. When a successful write occurs, the contents of buffer MTO\$ have been transferred to the tape. When the unit is not ready to write, an appropriate teletype message is output. When the number of words transferred does not equal the requested number, a teletype message is output and the write is attempted again.

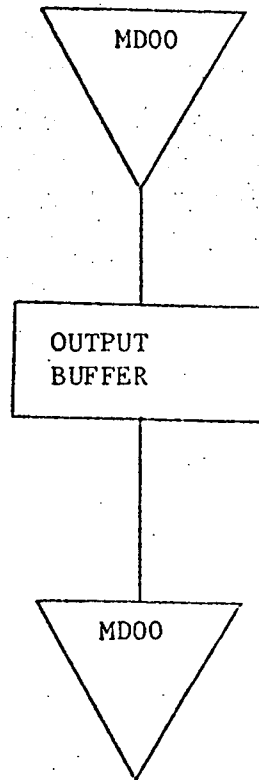
3.3.7.2.1 Calling Sequence

CALL MD00

No arguments are transferred.

Volatile registers are destroyed.

3.3.7.2.2 General Flow Chart



3.3.7.3 Label Description

3.3.7.3.1 Local Labels

Symbol	Function
MDEM	error message buffer for "unit not ready"
MDEQ	error message buffer for "invalid number of words transferred"
MDF	tape handler function - output binary record
MDF1	tape handler function - backspace one record
MDST	tape handler status indicator
MDUN	logical unit number
MDW	number of words to output

3.3.7.3.2 Global Labels

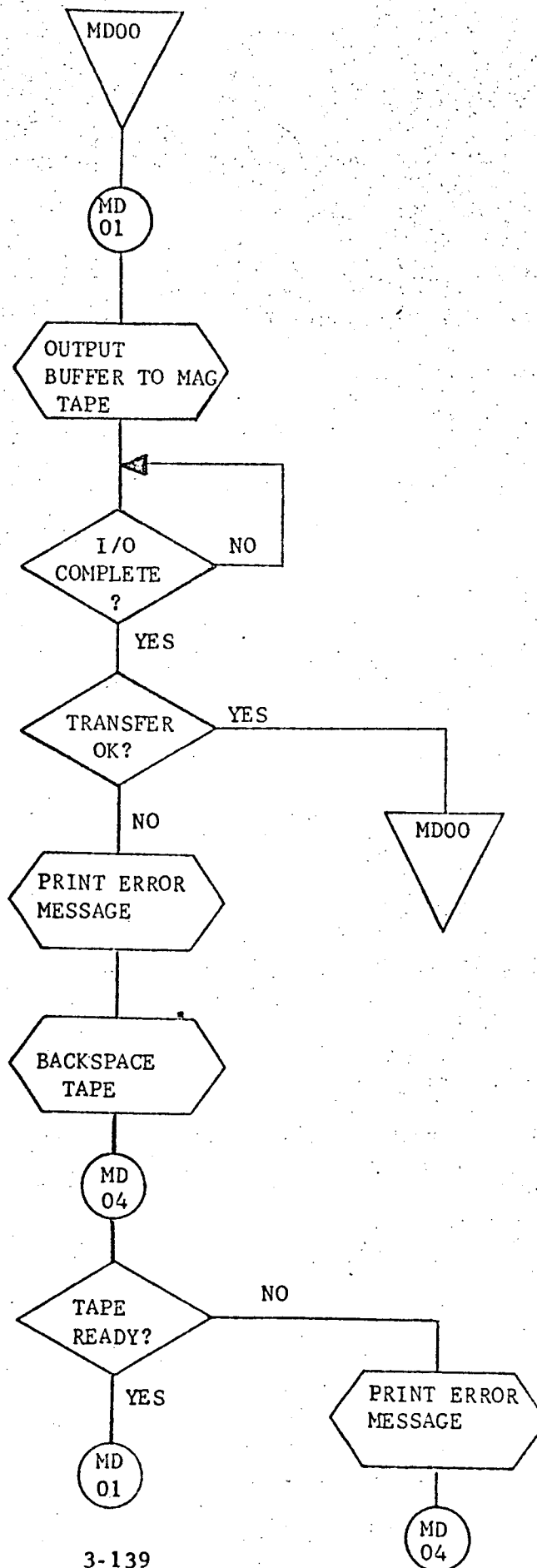
MTOS	tape output buffer
------	--------------------

3.3.7.3.3 Entry Points

Primary entry point - MD00

3.3.7.3.4 External References

HM00	mag tape handler
OZKA	TTY output message
OZKR	TTY carriage return and line feed



3.3.8 OD00 - Output Display

3.3.8.1 Purpose

OD00 is a subroutine whose purpose is to output a buffer (CRO\$) of data to the CRT. This buffer may be any length up to 957 words.

3.3.8.2 Technical Description

Communication with the CRT requires that all message buffers to be transmitted be preceded and followed by special initiation and termination codes respectively. OD00 accepts message buffers from the calling routine, attaches the overhead (initiation and termination codes) information and calls HC00 to clear the screen and output the buffer. (A sample message buffer with the overhead is shown in Figure 3-2.)

The next action is based upon the results of the message transmission.

- If the message transmission is error free, control is returned to the calling routine.
- If the CRT is not ready, the message "CRT NOT READY" is printed at the teletype and the program halts. Depressing the RUN button on the computer console will cause the program to again attempt to output.
- If a parity error occurs, an appropriate error message is typed at the teletype and an automatic retry of the transmission made. The number of retries is unlimited and an error message is given with each attempt.

3.3.8.2.1 Calling Sequence

Call OD00,NO

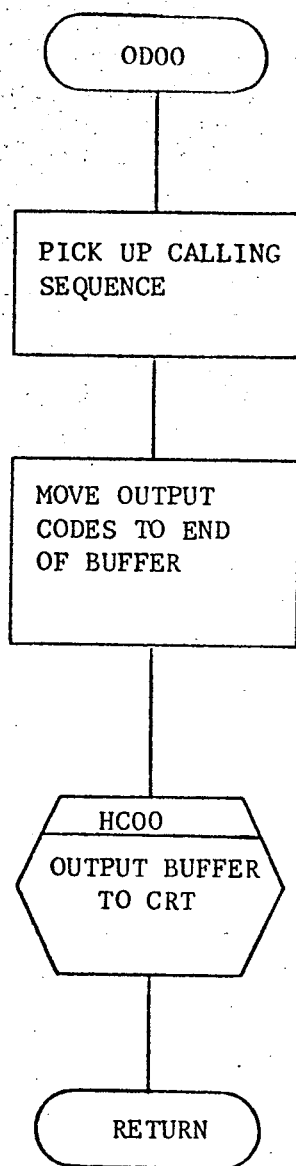
Parameter	Function
No	A memory location whose contents specify the number of words contained in the buffer (CRO\$).

Register	Contents Upon Entry	Contents Upon Exit
A	N/A	N/A
B	N/A	N/A
X	N/A	N/A
Overflow	N/A	N/A

Buffer Character Position	Character	Function
1	SOH	Overhead Initiation Codes
2	Halt Local I/O	
3	SOH	
4	Select Alpha Mode	
5	SOH	
6	Enable Refresh	
7	Cursor Reset	
8	B	Message
9	U	
10	F	
11	F	
12	E	
13	R	
14		
15	L	
16	E	
17	N	
18	G	
19	T	
20	H	
21		
22	E	Overhead Termination Codes
23	R	
24	R	
25	O	
26	R	
27	Cursor Reset	
28	SOH	
29	Enable Transmit	Overhead Termination Codes
30	End of Transmission	
31	End of Transmission	

Figure 3-2 Sample Output Buffer

3.3.8.2.2 General Flow Chart



3.3.8.3 Label Description

3.3.8.3.1 Local

CONU - (12,1,8,4,4) buffer containing termination codes which must follow each buffer that is output to the CRT.

CONV - (12) total number of control codes preceding and following the user's buffer.

CONW - (4) number of control codes less one which follow the output buffer.

NUM - temporary storage location for the address of the number of words in the output buffer.

NUMT - storage location for the total number of words to be output, including all control codes.

X - (1) function code to be passed to HC00 indicating output after clearing CRT screen.

3.3.8.3.2 Global

- CNT - temporary storage location for the address of the number of words to input from the CRT.
- DEV - ("CRT NOT READY") error message output to teletype in the event the CRT device is not ready.
- PARE - ("PARITY ERROR FROM DISPLAY DEVICE") error message output to teletype in the event of a parity error from the CRT.
- STAT - status word from the CRT handler HC00.
- WRDS - storage location for the number of words to input from the CRT.

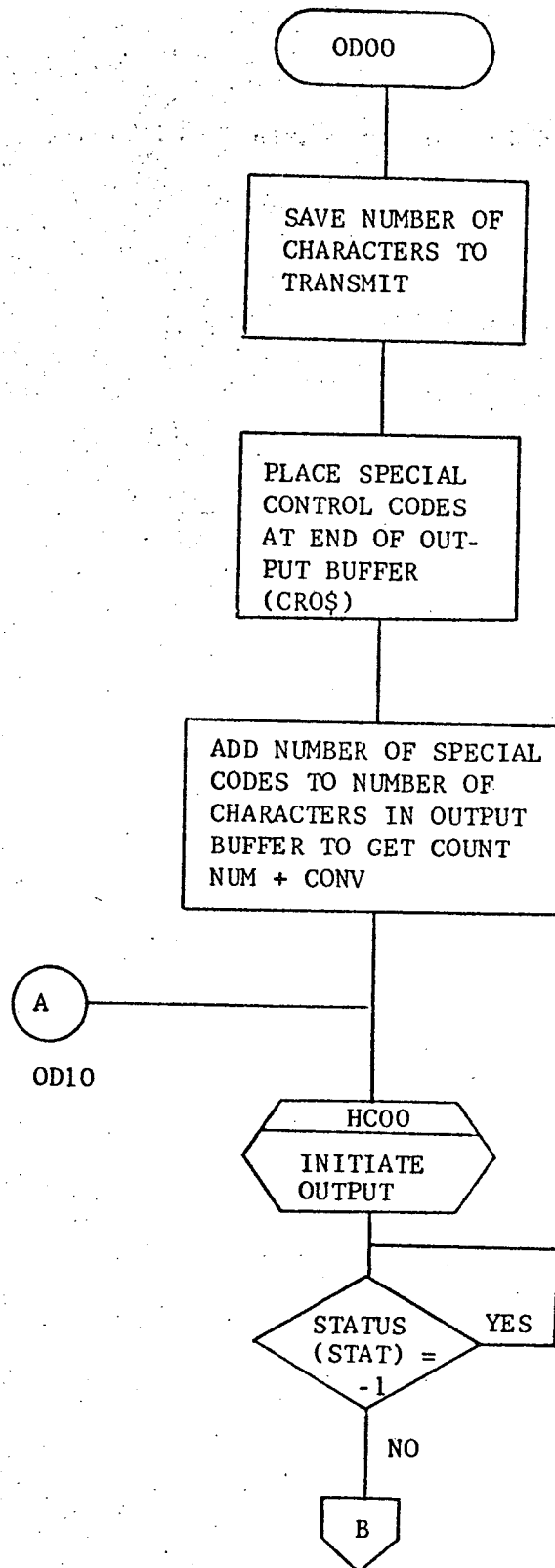
3.3.8.3.3 Entry Point

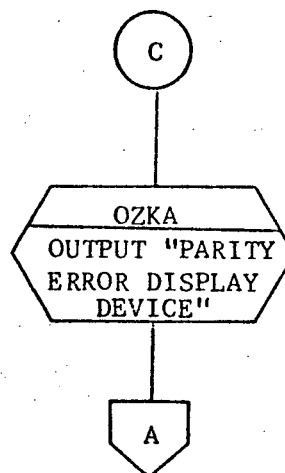
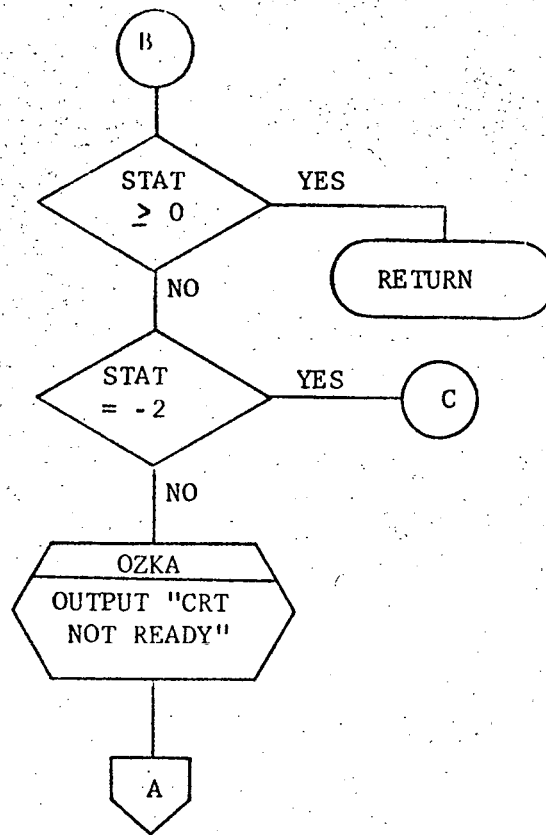
- OD00 - primary entry point.

3.3.8.3.4 External References

- CRO\$ - CRT output buffer
- HC00 - CRT handler for input and output
- OZKA - teletype routine that outputs a buffer to the teletype.
- OZKR - teletype driver to output one carriage return and one line feed.

3.3.8.4 Detailed Flow Chart





3.3.9 OZKA - Print Buffer on TTY

3.3.9.1 Purpose

This routine outputs characters to the ASR-35 teletype.

3.3.9.2 Technical Description

This routine outputs a buffer to the ASR-35 teletype. Each buffer word should contain two eight bit ASCII characters. Both the beginning location to be output and the number of characters to print are specified by the calling routine.

3.3.9.2.1 Calling Sequence

CALL OZKA,START,N

PARAMETER

FUNCTION

START

beginning address to be printed

N

number of characters to print

REGISTER

CONTENTS UPON ENTRY

CONTENTS UPON EXIT

A

Saved

Restored

B

Saved

Restored

X

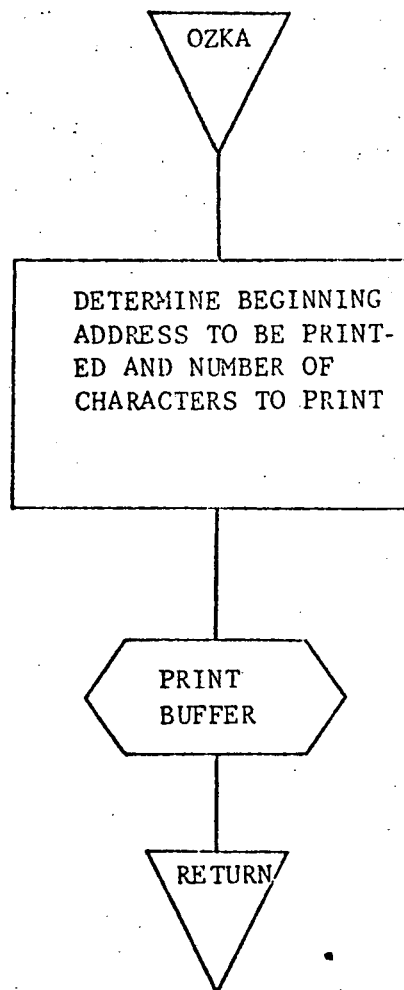
Saved

Restored

Overflow

Destroyed

3.3.9.2.2 General Flow Chart



3.3.9.3 Label Description

3.3.9.3.1 Local Labels

<u>Symbol</u>	<u>Function</u>
OZ\$1	contains address of next word to be output

3.3.9.3.2 Global Labels

<u>Symbol</u>	<u>Function</u>
SAVE	buffer used to save volatile registers

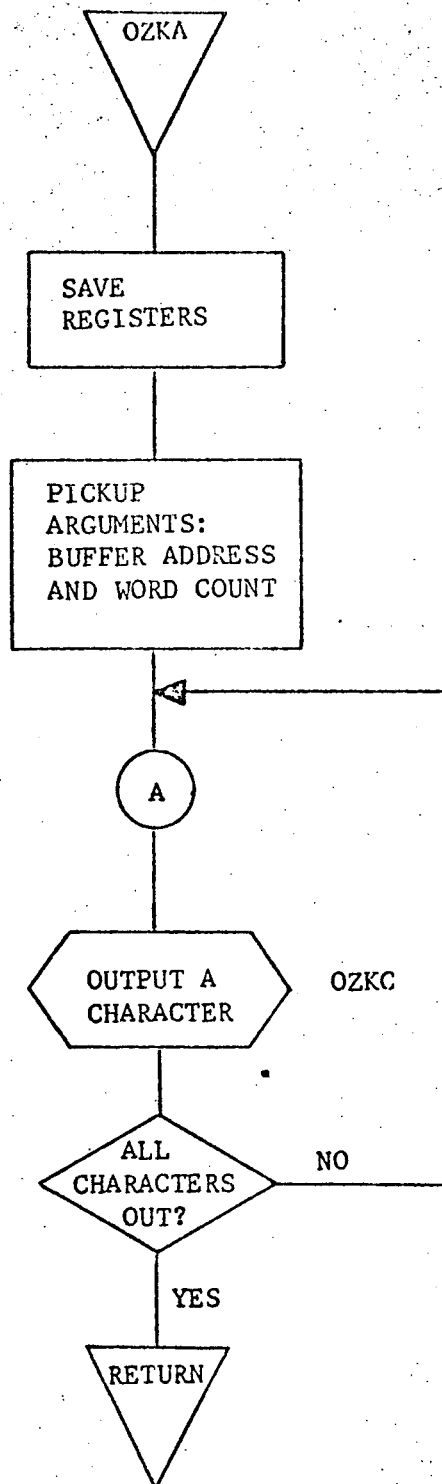
3.3.9.3.3 Entry Point

primary entry point - OZKA

3.3.9.3.4 External References

OZKC - routine which outputs one character to the TTY

3.3.9.4 Detailed Flow Chart



3.3.10 OZKC - Output Character to TTY

3.3.10.1 Purpose

This routine outputs one character to the ASR-35 teletype.

3.3.10.2 Technical Description

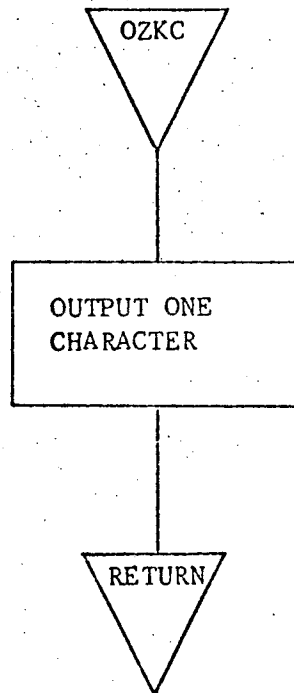
NA

3.3.10.2.1 Calling Sequence

CALL OZKC

The A-register contains the character to be output.

3.3.10.2.2 General Flow Chart



3.3.10.3 Label Description

3.3.10.3.1 Local Labels

None

3.3.10.3.2 Global

None

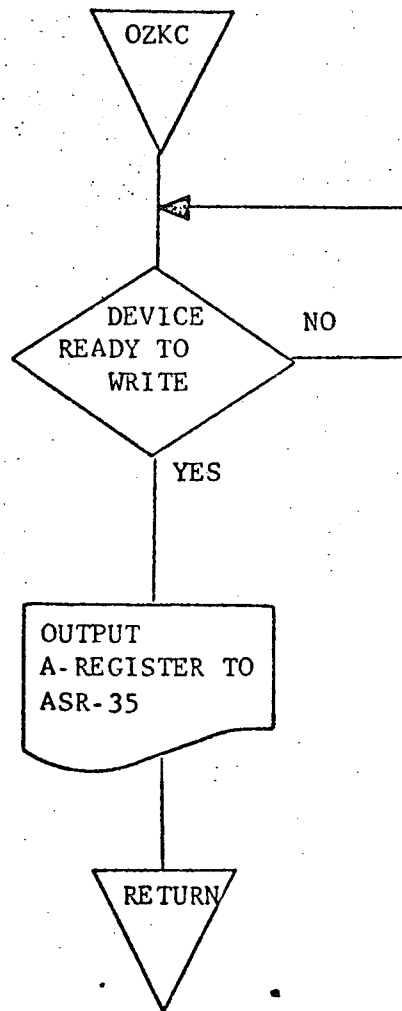
3.3.10.3.3 Entry Point

Primary entry point OZKC

3.3.10.3.4 External References

None

3.3.10.4 Detailed Flow Chart



3.3.11 OZKR - Output Carriage Return and Line Feed.

3.3.11.1 Purpose

This routine outputs a carriage return and a line feed each time it is called.

3.3.11.2 Technical Description

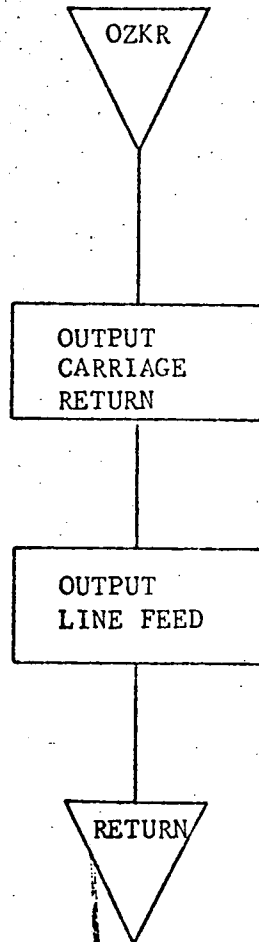
NA

3.3.11.2.1 Calling Sequence

CALL OZKR

No arguments are passed; no registers are used to transfer information.

3.3.11.2.2 General Flow Chart



3.3.11.3 Label Description

3.3.11.3.1 Local

None

3.3.11.3.2 Global

SAVE - used to save the A-register.

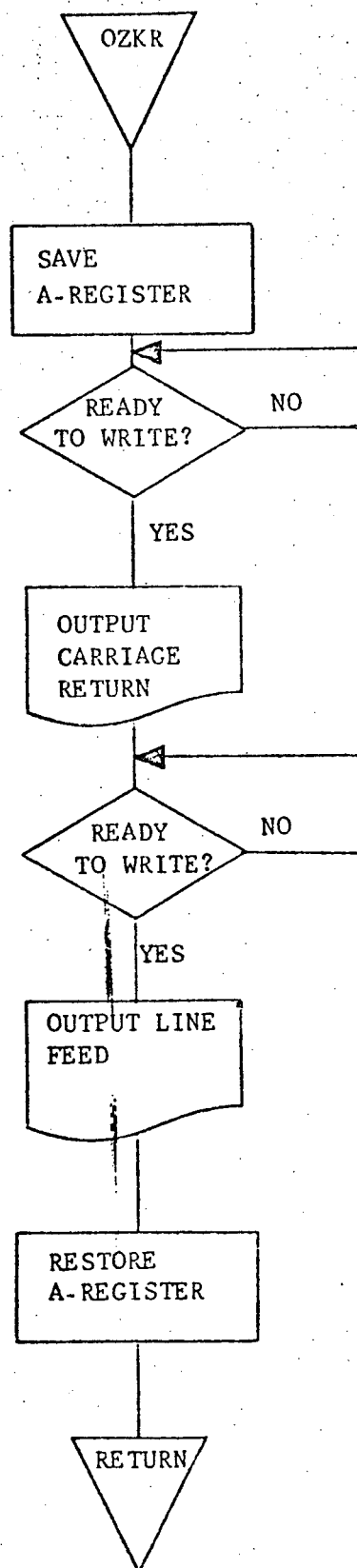
3.3.11.3.3 Entry Point

Primary entry point - OZKR

3.3.11.3.4 External References

None

3.3.11.4 Detailed Flow Chart



3.3.12 PINT - Power Fail - Restart

3.3.12.1 Purpose

This routine provides protection against program failure whenever a physical power failure occurs.

3.3.12.2 Technical Description

When a power failure occurs, the location counter and the volatile registers are saved and a halt occurs. Upon restoration of adequate power, the volatile registers are reinstated and processing resumes at the address specified by the value saved for the location counter.

3.3.12.2.1 Calling Sequence

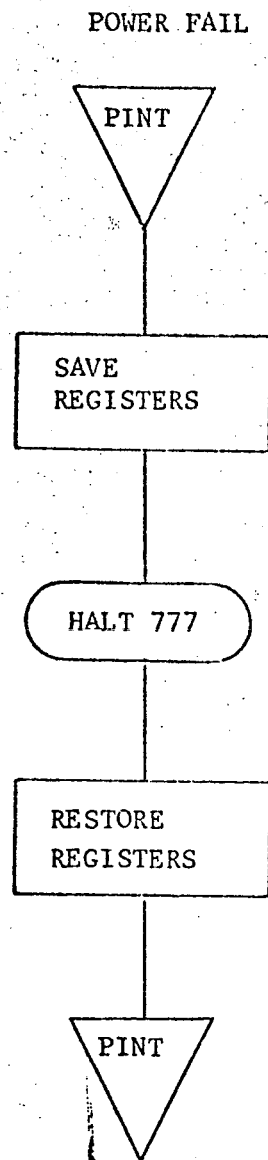
CALL PINT

PARAMETER	FUNCTION
-----------	----------

None	
------	--

REGISTER	CONTENTS UPON ENTRY	CONTENTS UPON EXIT
A	Saved	Restored
B	Saved	Restored
X	Saved	Restored
Overflow	Saved	Restored

3.3.12.2.2 General Flow Chart



3.3.12.3 Label Description

3.3.12.3.1 Local

AR Contents of A-register
BR Contents of B-register
XR Contents of X-register
OF Contents of overflow indicator

3.3.12.3.2 Global

None

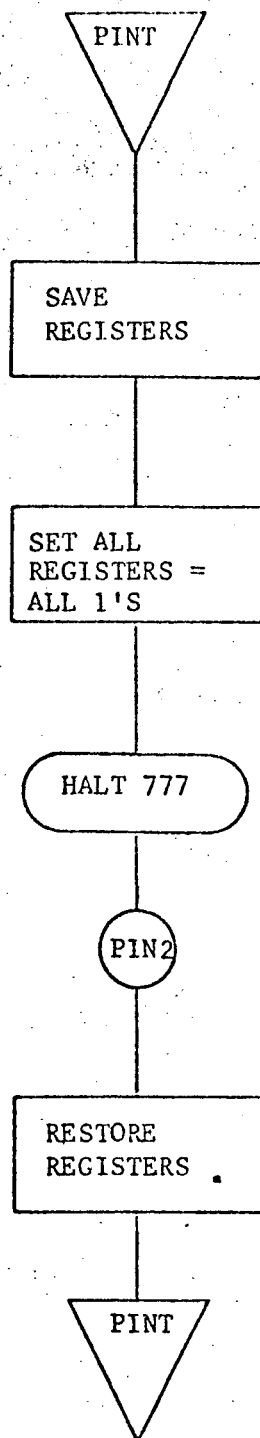
3.3.12.3.3 Entry Points

PINT - entry for power failure

PIN2 - entry for power restoration

3.3.12.3.4 External References

None



3.3.13 UP00 - Update Control Program

3.3.13.1 Purpose

The purpose of this routine is to provide an interface between the user at his terminal and the routines that process the data. This includes accepting user-input control options and calling the appropriate routine to process those options.

3.3.13.2 Technical Description

Both the input data tape and the output scratch tape are positioned to load point. After a record is read from the input tape, the first page of that record is formatted for output by BD00 and then transmitted to the CRT display. At this point the interface with the user begins. There are ten situations that must be dealt with by this control program: six user-input options, three processing errors, and normal update operation.

For normal update operation, the updated data is formatted for eventual output to tape by BM00, and the next page of data is output to the CRT. When all pages of data have been processed, the updated data is output to tape.

The first processing error comes from BD00. If upon return to the control program, the A-register is negative, the old data was found to be in error. An error message is output, and the program halts. If the user depresses the run button on the computer, that record will be ignored and a new one read and processed.

The next two processing errors come out of BM00. If the updated data overflows the tape output buffer, BM00 outputs an error message to the CRT, and returns to the control program with the contents of the A-register equal to -1. The old data is again output and the user is allowed to update the data. If BM00 encounters an error on a specific line of updated data, the A-register, upon return, will be equal to the line number of the error. In this case a message is output and the update data is called for again.

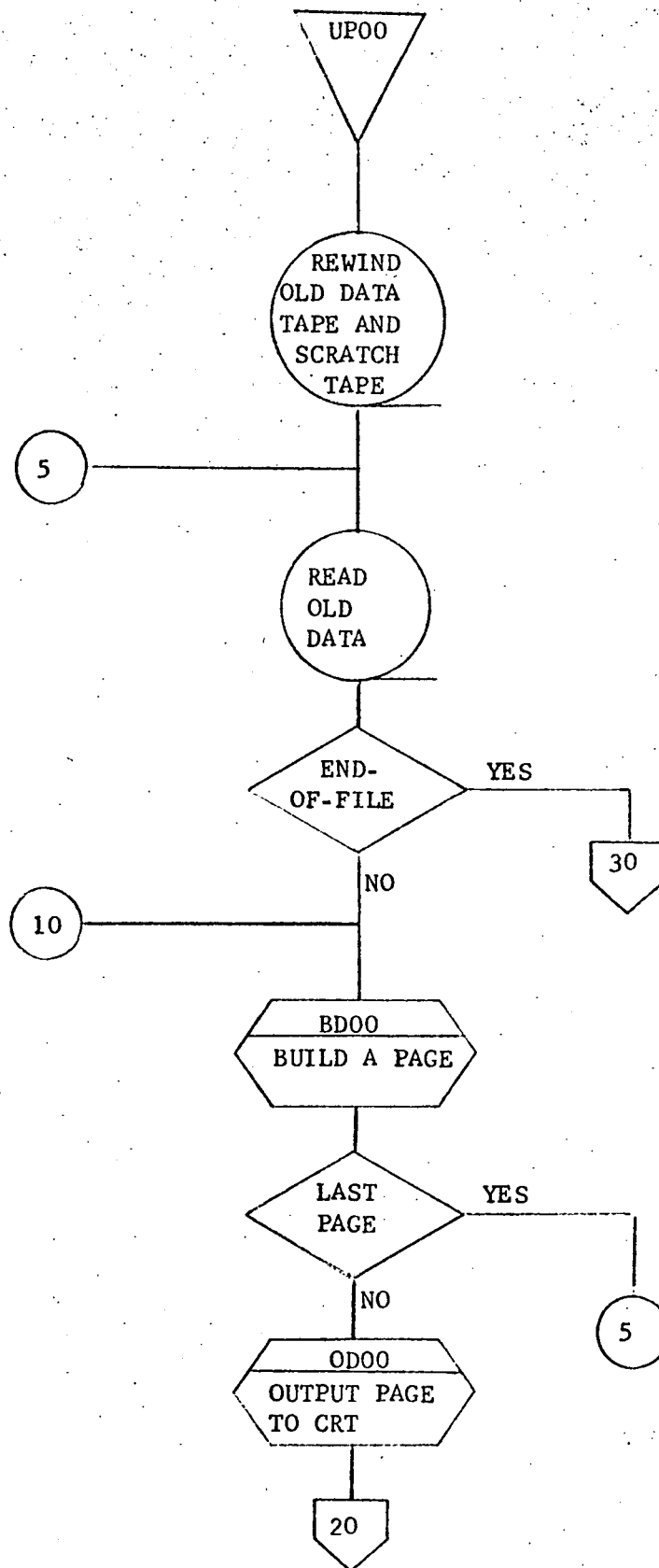
The six user input options and the processing done by UP00 are as follows:

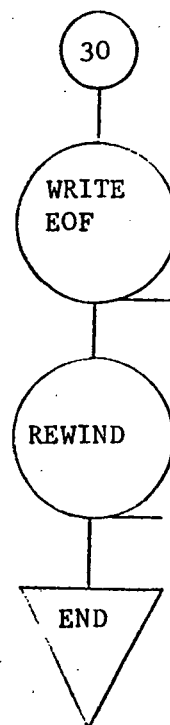
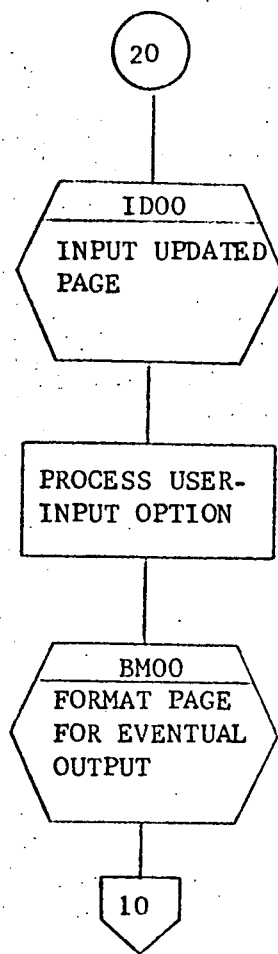
CODE	MEANING	PROCESSING
DF	Delete Form	Clear tape output buffer, read a new record, and begin processing again.
HF	Hardcopy Form	Set a flag and call D00 for a hardcopy of the current updated data when the entire record has been completely updated.
RF	Redisplay Form	Call BD00 instructing it to format the first page of the current form.
RP	Redisplay Page	Call OD00 to output the old data that is in the display output buffer.
CF	Copy Form	Process the remainder of the current form without outputting to the CRT and then output to tape.
CT	Copy Tape	Process the remainder of the current form as in the copy form option and then copy the remainder of the old data tape to the updated data tape.

3.3.13.2.1 Calling Sequence

Not applicable

3.3.13.2.2 General Flow Chart





3.3.13.3 Label Description

3.3.13.3.1 Local Labels

HMBS	(6) tape function - backspace
HMFx	(4) tape function - end-of-file
UPBE	(1, 5, 100 ₈ , 161 ₈ , "BLD ERROR", 14 ₈ , 1, 10 ₈ , 4) Error message output when BD00 detects an error in the tape input data.
UPBN	(17) number of words in the build display error message.
UPCF	copy form option indicator
UPCS	storage location for status from CRT display operation.
UPCT	copy tape option indicator
UPEM	(1, 5, 100 ₈ , 161 ₈ , "OPT ERROR", 14 ₈ , 1, 10 ₈ , 4) Error message output when user-input option code is illegal.
UPHF	Hardcopy form option indicator.
UPLE	(1, 5, 100 ₈ , 161 ₈ , "FMT ERROR", 1, 5, 0, 100 ₈ , 1, 10 ₈ , 4) user error in format of input.
UPLP	flag set to indicate that the current page is the last page of the current form.
UPLW	(20) number of words in user format error message.
UPNC	(28) the number of words in the end-of-job message.
UPNW	(17) the number of words in the option error message.
UPOP	(2) output function without clear for CRT display output.
UPTF	(0) magnetic tape output function.

3.3.13.3.1 Local Labels (Continued)

UPTS storage location for status from tape operation.

UPTW (2880) number of words to transfer on tape input and output.

UPTY ("UPDATE COMPLETE. LOG OUTPUT TAPE.") End of job message sent to teletype.

UPT1 (10₈) tape unit 10.

UPT2 (11₈) tape unit 11.

UPUC (1, 11, 1, 0, 1, 2, 12, "UPDATE COMPLETE", 12,1,8,4,4) message sent to user at end-of-job.

3.3.13.3.2 Global

CONT (1, 11, 1, 0, 1, 2, 12) Special CRT control codes that precede the output buffer.

CRN\$ display input buffer

CRO\$ display output buffer

DPT\$ display output buffer pointer. Pointer to next available location in CRO\$.

IDRC (12) CRT control code for cursor reset.

LTB\$ line table (see Appendix C).

MPT\$ tape output buffer pointer. Pointer to next available location in MTO\$.

MTN\$ tape input buffer (2880 words) - old data.

MTO\$ tape output buffer (2880 words) - updated data.

3.3.13.3.3 Entry Points

None

3.3.13.3.4 External References

BD00 routine that formats the old data for eventual output to CRT.

BM00 routine that formats the updated data for eventual output to tape.

D00 routine that lists a form on the teletype.

HC00 CRT display input/output handler.

HM00 tape input/output handler.

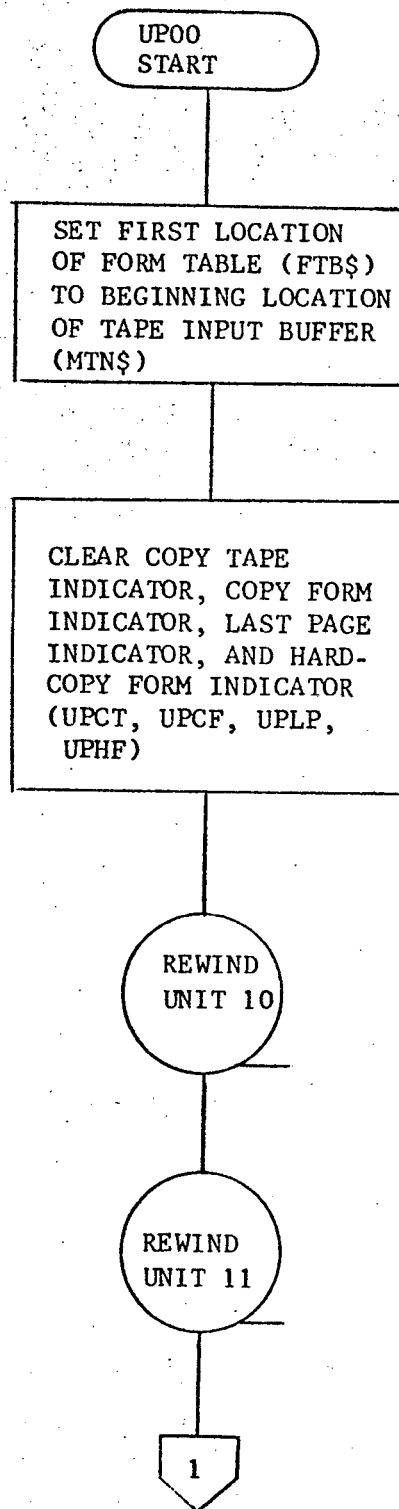
ID00 routine that inputs the updated data from the CRT.

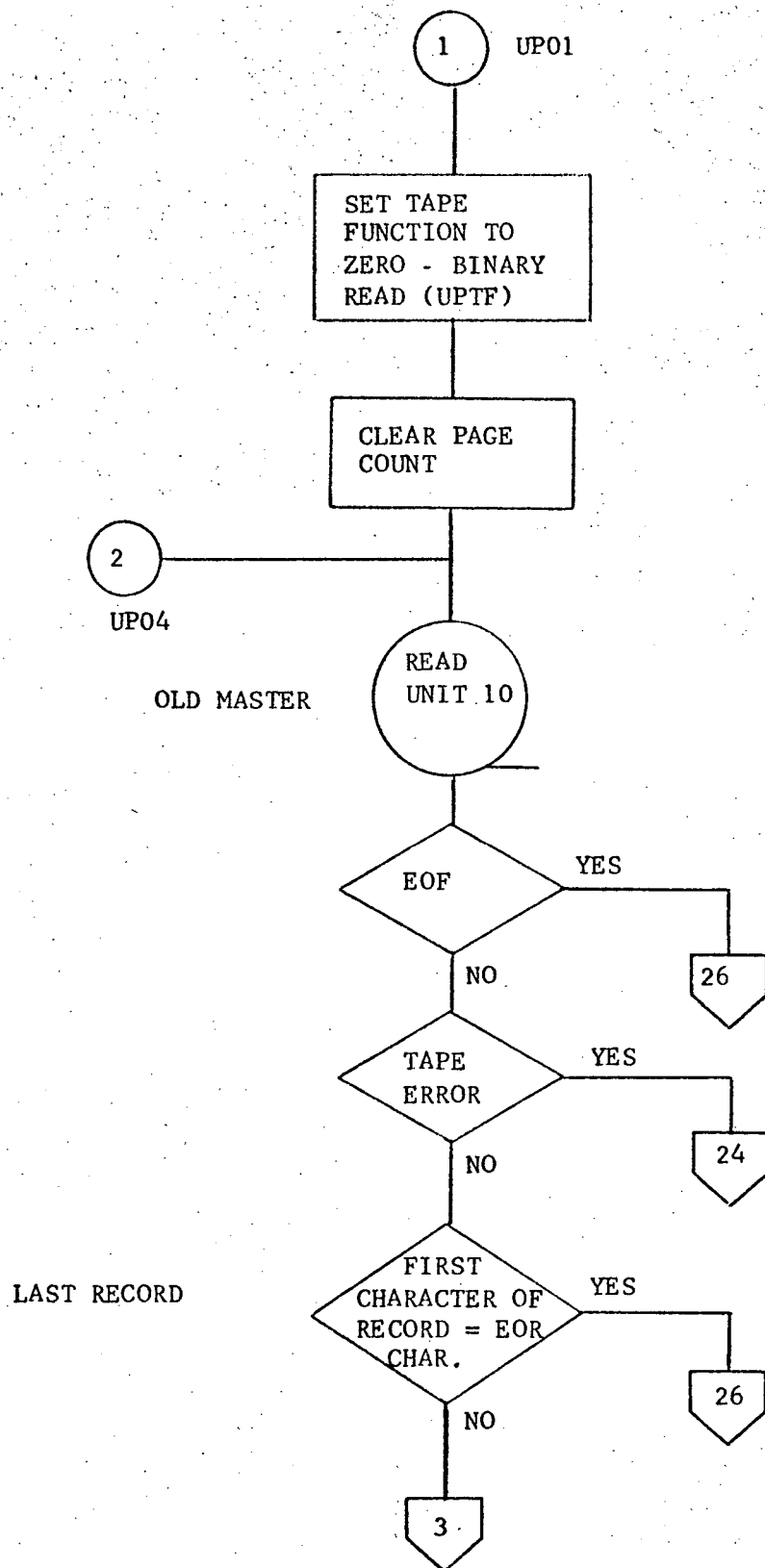
MD00 routine that outputs the updated data to tape.

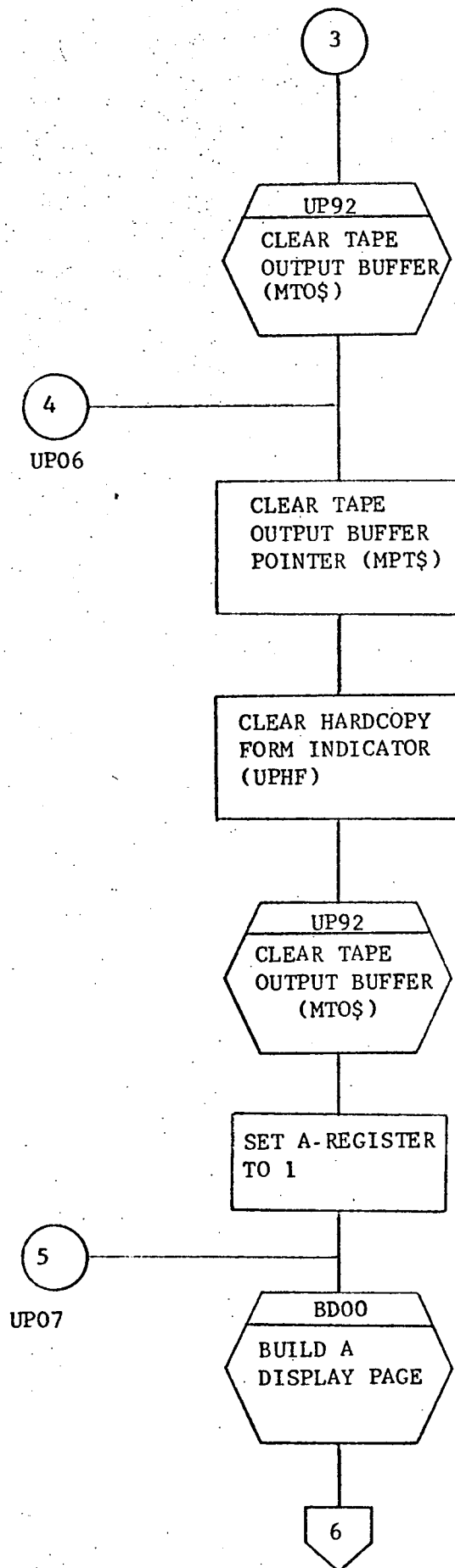
OD00 routine that outputs the data in the CRT output buffer.

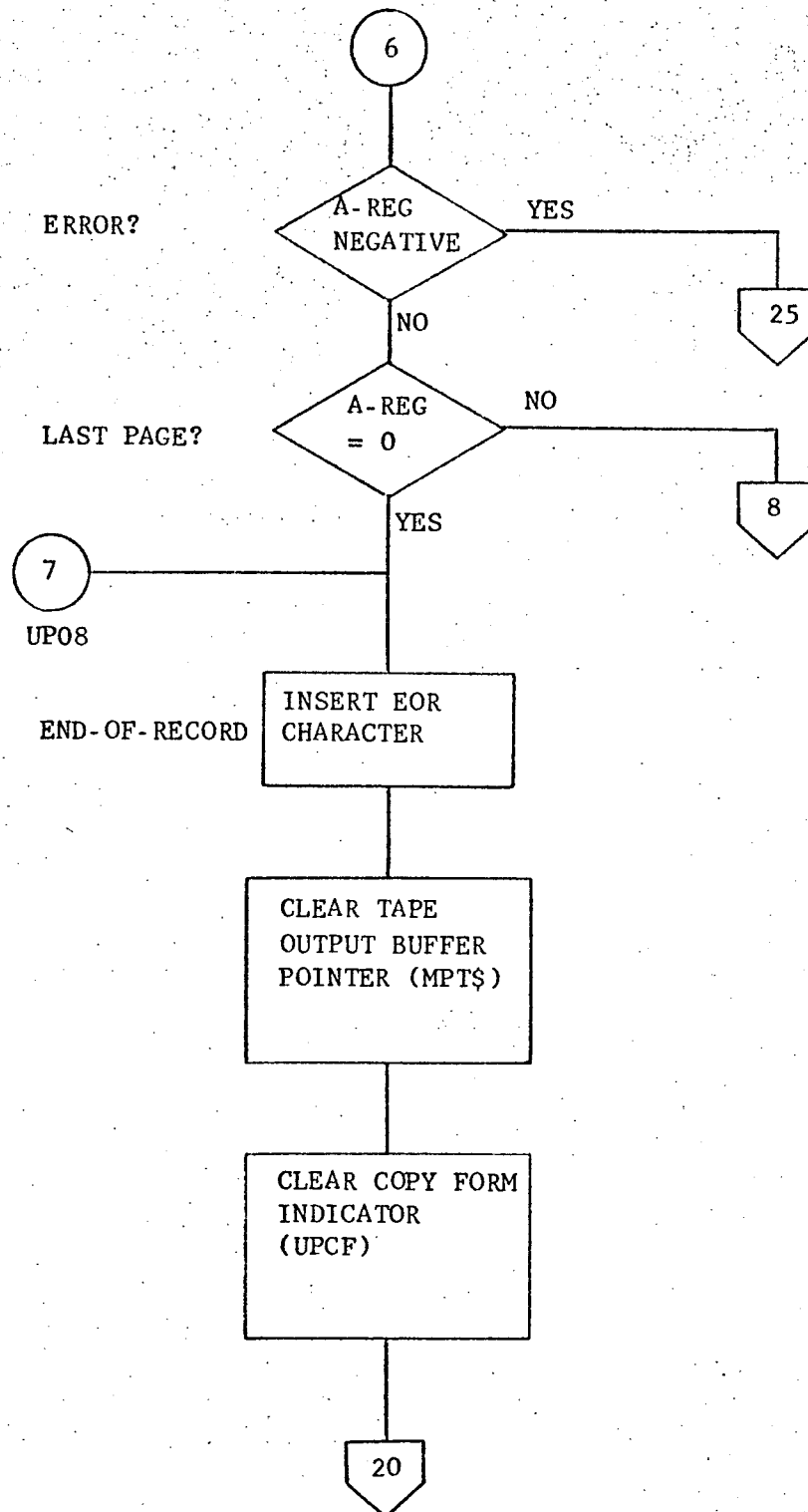
OZKA routine that outputs a buffer to the teletype.

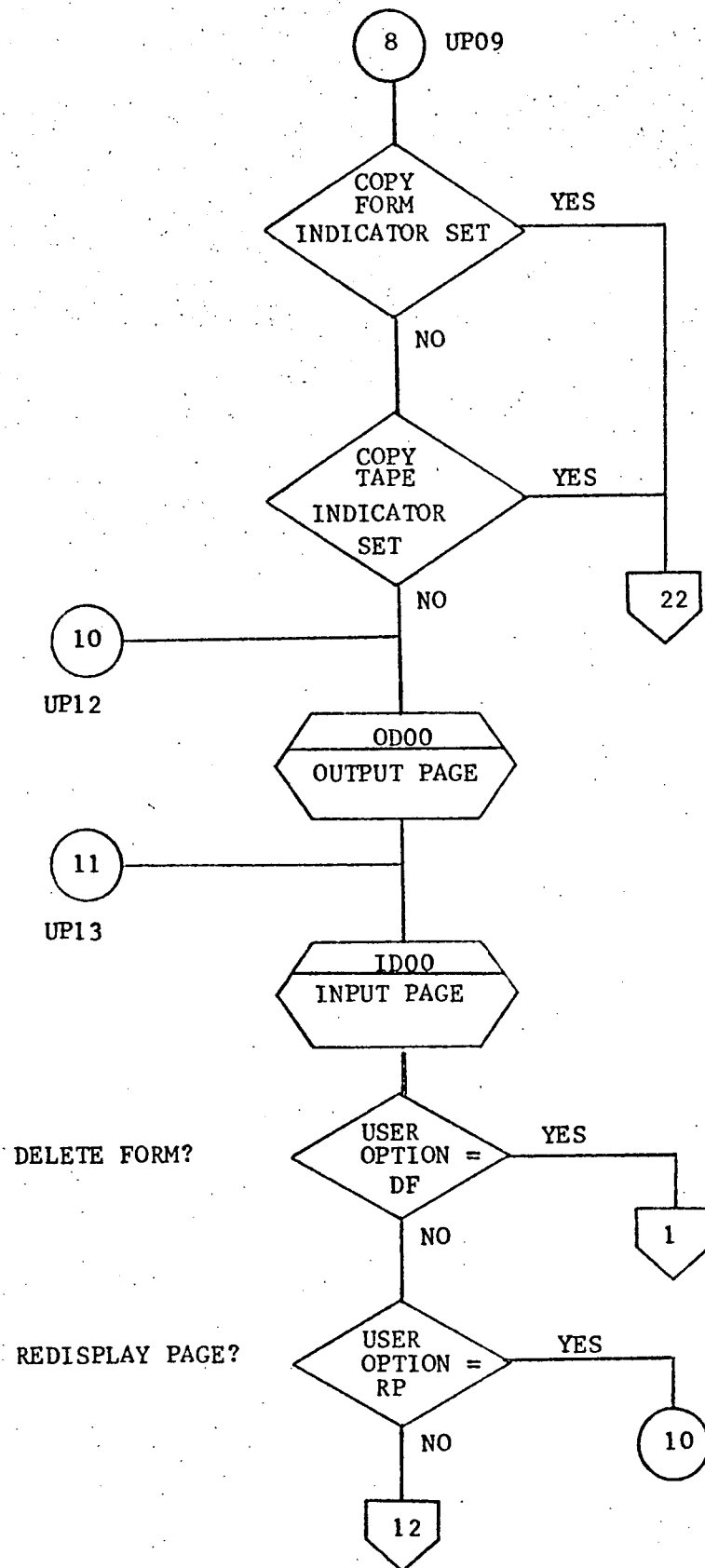
OZKR routine that outputs a carriage return and a line feed to the teletype.

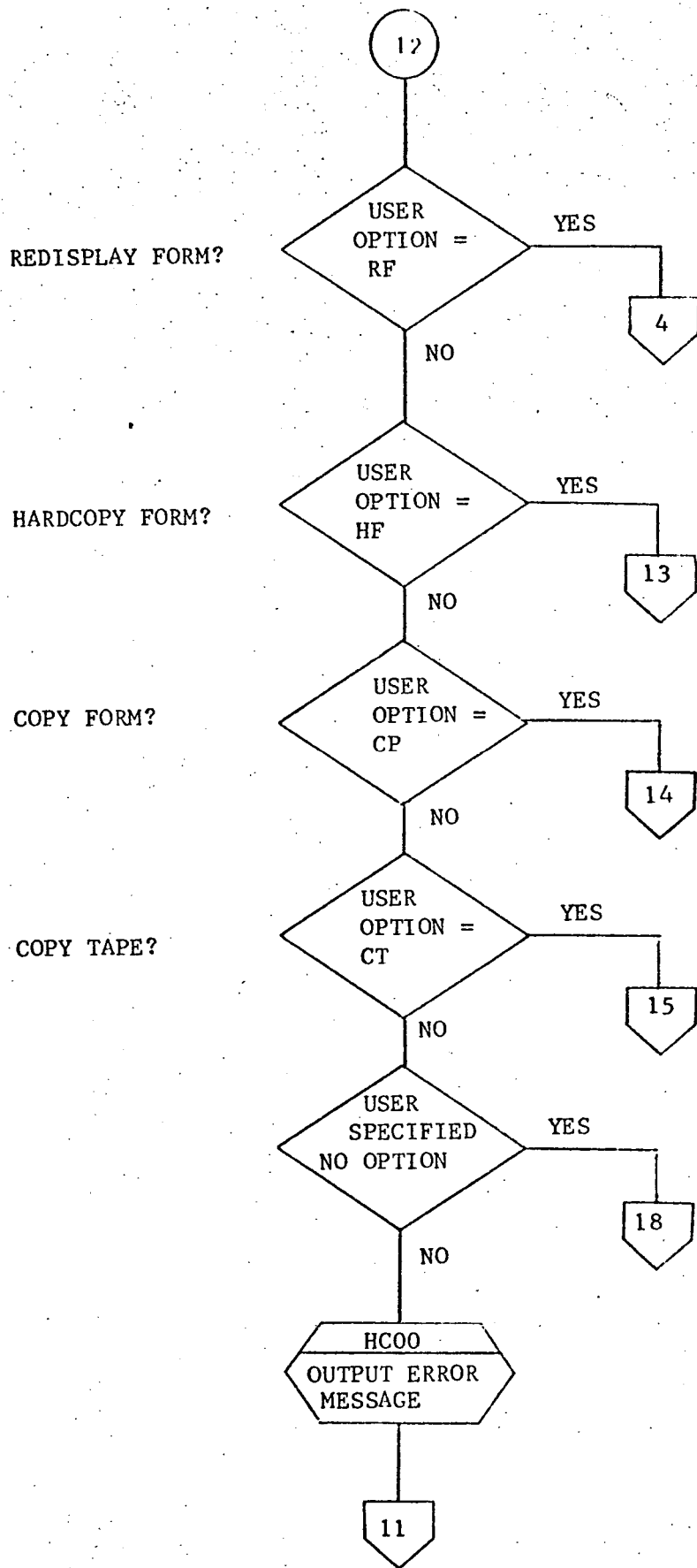


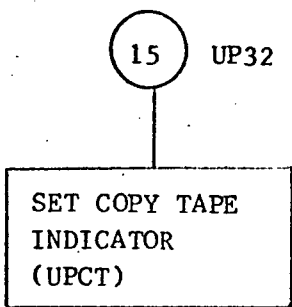
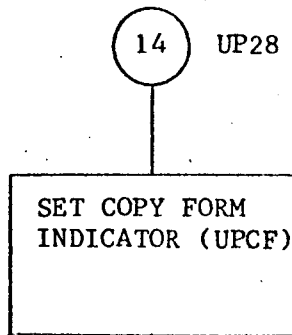
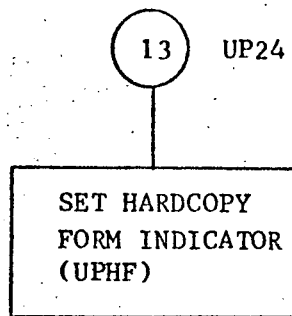


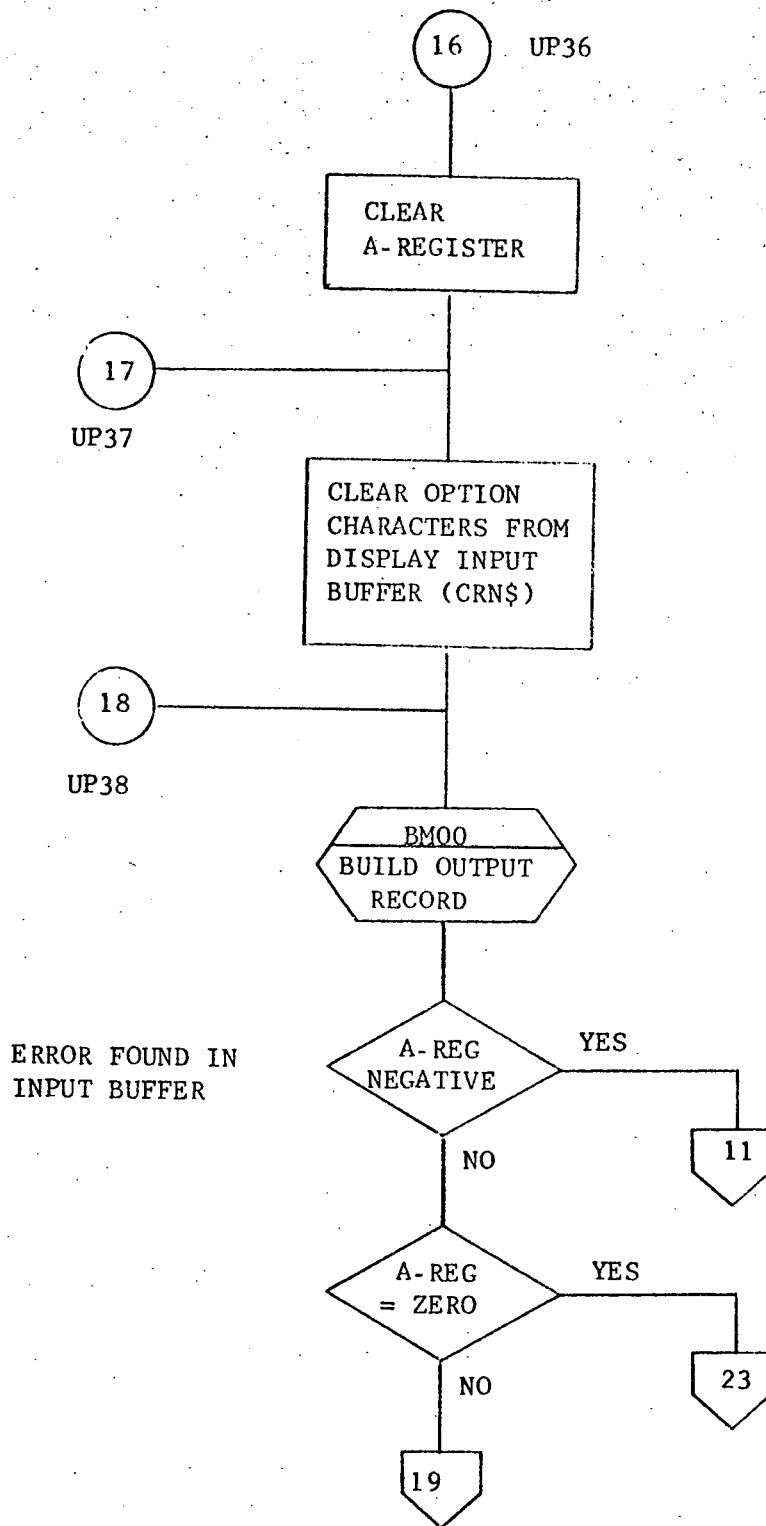


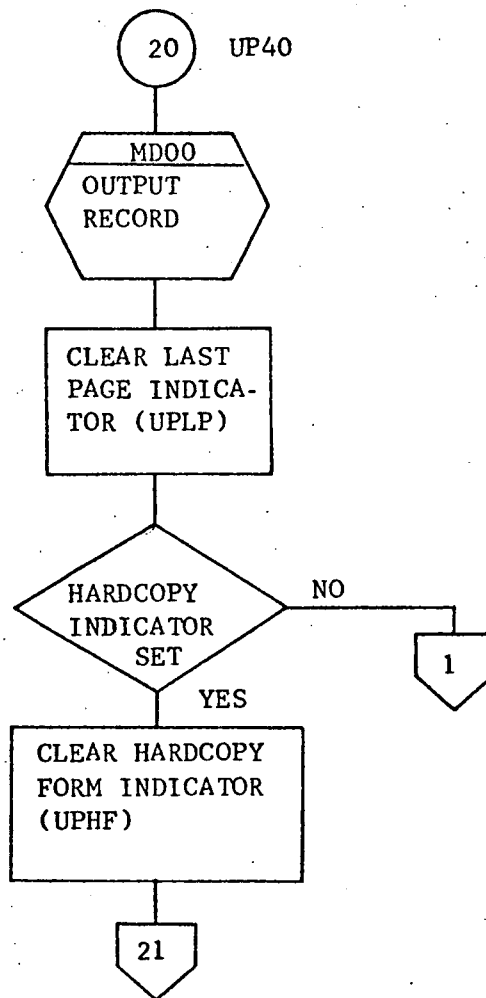
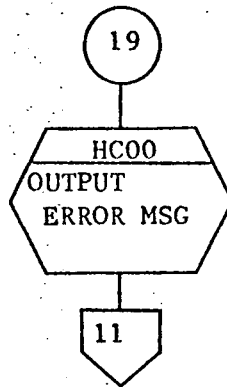




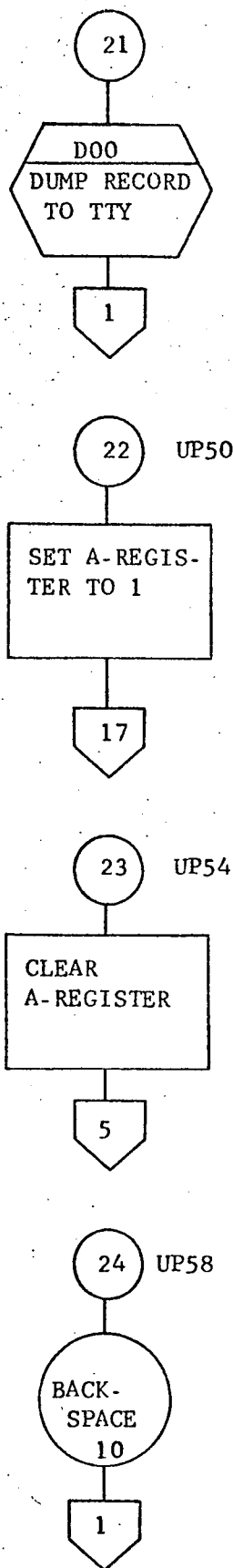


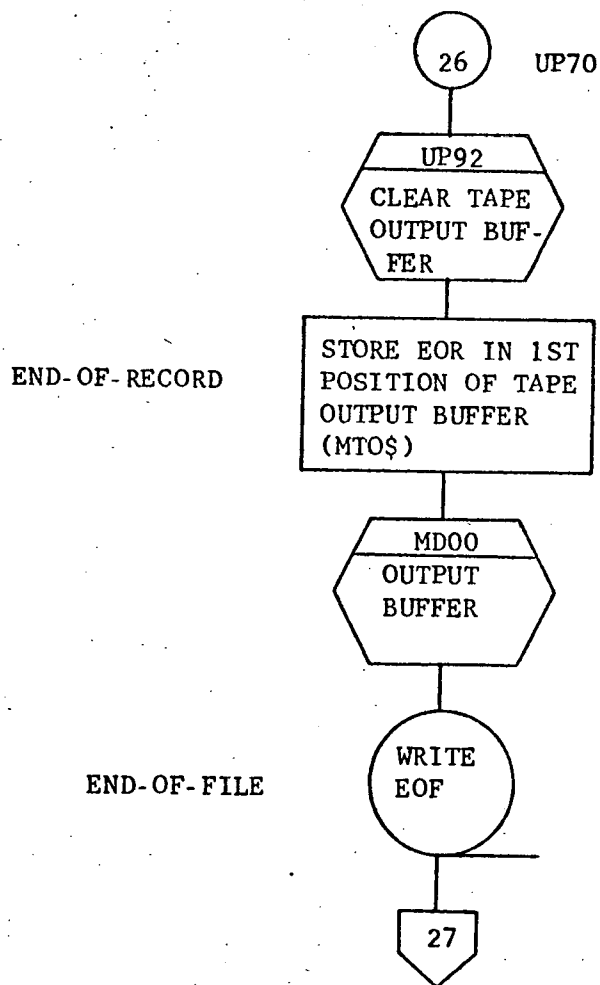
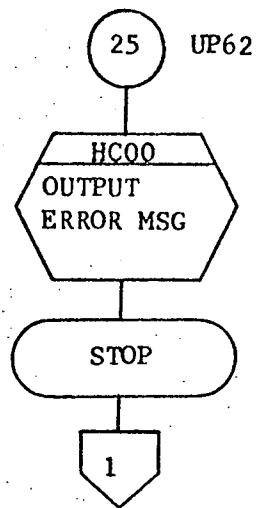


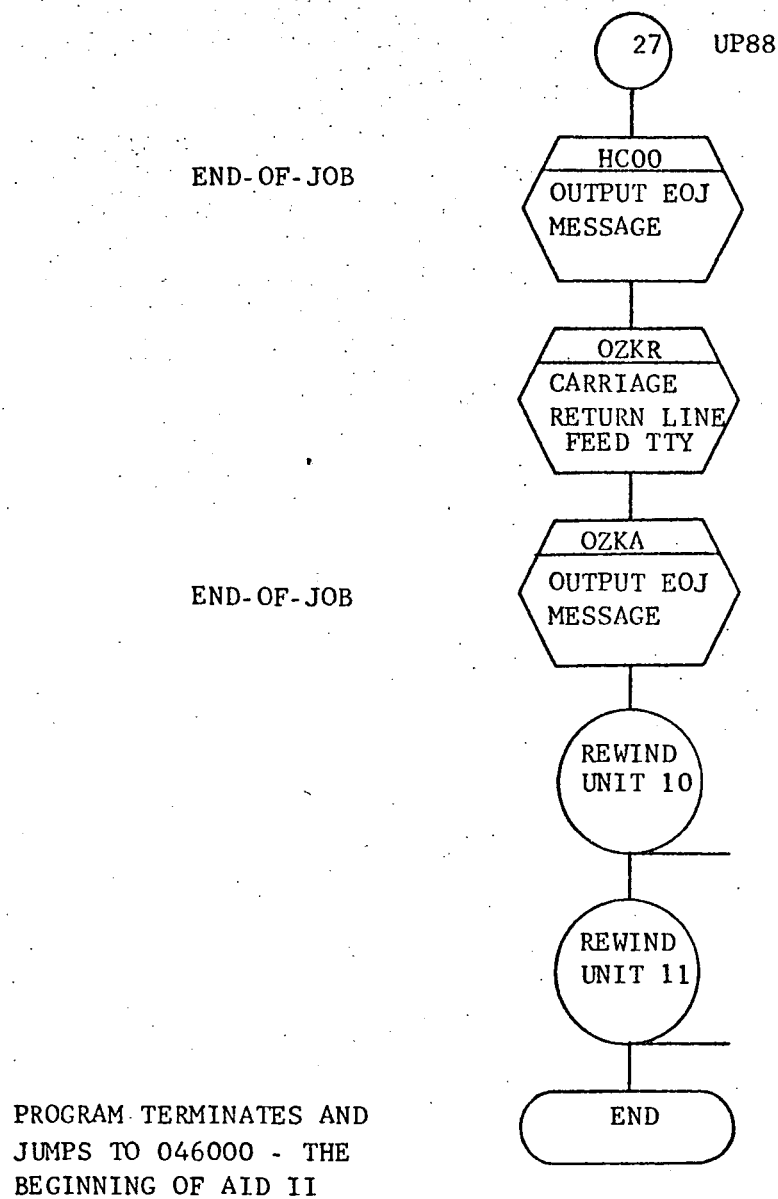


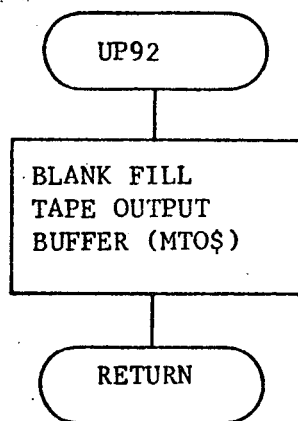


OLD MASTER









4.0 PROGRAM UTILIZATION

The Medical Data Update System (MDUS) is a user oriented medical data update system designed to permit alteration of medical data update entered via the input system (MDIS) before it is sent to the Computation and Analysis Division for incorporation into the UNIVAC 1108 MEDATA system. Normal procedure is to input the data using the Medical Data Input System (MDIS), review the data using MDUS and correct any errors detected. The user also has the capability of deleting and/or adding entire new forms as well as obtaining a hard copy report of the updated data.

4.1 COMPUTER OPERATOR INSTRUCTIONS

The following procedures must be followed by the computer operator in preparing MDUS for use:

MDUS OPERATIONAL SETUP PROCEDURES

- Load the MDUS program from either paper tape or magnetic tape.
- Turn on the CRT. After allowing several seconds for the set to warm up, press the MASTER CLEAR and the CLEAR keys on the keyboard in that order. The cursor will appear on the screen.
- Turn on the Magnetic Tape Units.
- Mount the forms tape and the scratch output tape.
- Begin program execution at location zero (0).

MDUS OPERATIONAL WRAPUP PROCEDURES

- The program will terminate by printing the message "UPDATE COMPLETE. LOG OUTPUT TAPE." Dismount both tapes, label the output tape, and store for future use.

4.2 OPERATIONAL PROCEDURES

After the Operational Setup Procedures have been completed, the first page of data on the tape will appear on the CRT screen. The top line of the screen contains no data; it is reserved for communication between the user and MDUS. Control options are entered on the top line. The desired option is selected by placing in the top left-hand position of the screen one of the following control codes:

<u>Control Code</u>	<u>Function</u>
DF	Delete this Form. Do not process or output this data to the updated tape.
HF	Hard copy this Form. Print this form on the teletype.
RF	Redisplay Form. Go back to the first page of this form and start over.
RP	Redisplay Page. Redisplay the original data for the current page.
CF	Copy Form. Process and output this page and the remainder of the form without displaying them.
CT	Copy Tape. Process and output the remainder of the tape records without displaying them.
BB	Process this page. Display the next page.

As soon as the last page of each form has been processed, the entire form is output to tape. To proceed from page to page, the user must depress the INT key after entering the control code.

4.3 INPUT DESCRIPTION

There are two types of input to the MDUS: An MDIS generated magnetic tape and the CRT keyboard updates. The magnetic tape contains records of previously input medical data which has not yet been processed through the CAAD UNIVAC 1108 MEDATA system. By means of the control functions described in Section 4.2., this data can be modified as required.

4.4 OUTPUT DESCRIPTION

4.4.1 Reports

The system contains the option of obtaining a hard copy of the forms being output to magnetic tape by dumping the data forms out to the on-line Teletype. Hard copies are requested by the "HF" option. (See Section 4.2.).

4.4.2 Tapes

The system creates a magnetic tape containing the updated forms. The newly created tape is then sent to the Building 12 CAAD for incorporation into the MEDATA system.

4.4.3 Messages

4.4.3.1 Diagnostics

MESSAGE	EXPLANATION	CORRECTIVE MEASURE
OPT ERROR	User has specified an illegal option code.	Input another option code.
BLD ERROR	While attempting to format data for output to the CRT an error has been detected.	Press RUN on the computer console. The invalid record will be disregarded.
FMT ERROR	While attempting to format data for output to the CRT an error has been detected.	Press RUN on the computer console. The invalid record will be disregarded.
PLEASE SELECT ANOTHER FORM	An error has been detected in the background form which will not allow the form to be displayed properly. Program halts.	Press RUN on the computer console. The invalid form will be disregarded.
BUFFER LENGTH ERROR	Occurs in the case where the length of the Tape Output Buffer (MTO\$) has been exceeded.	Select an option which will allow you to proceed to the next form.

4.4.3.2 Advisory

MESSAGE

USER ACTION

UPDATE COMPLETE

No user action required. This message, output to the CRT, notifies the user that processing has been completed.

UPDATE COMPLETE
LOG OUTPUT TAPE

Dismount and label the output tape created.

PARITY ERROR FROM
DISPLAY DEVICE

No user action required. Program will retry the I/O operation.

CRT NOT READY

Ready the CRT and press RUN on the computer console.

TAPE UNIT NOT READY

No user action required. Program will retry the I/O operation.

NUMBER OF WORDS
TRANSFERRED IN ERROR

No user action required. This message will occur only in the case of a hardware error. The program will retry the write operation.

4.5 RESTRICTIONS

- Do not use the space bar to position the cursor. If the cursor is under a display character and the user presses "space", it will replace the character with a space. Use the keys which are provided for cursor positioning.

4.5 RESTRICTIONS (Continued)

- A new line character "**␣**" has been placed at the end of each line.

If the user wishes to extend that line, type over the line character and place a new one at the end of the line by pressing the LINE key.

Note that no characters placed after the new line character on any one display line are transmitted to the computer.

APPENDIX A
INPUT AND OUTPUT TAPES
DESCRIPTIONS

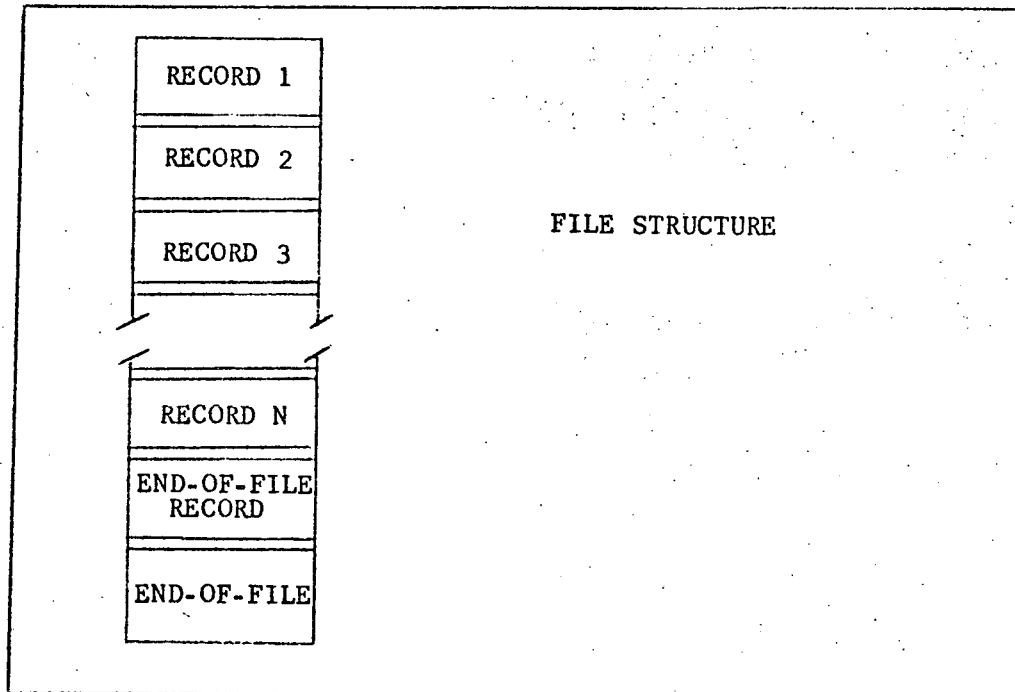


FIGURE A-1 FILE STRUCTURE

FILE

The input and output data tapes are both composed of one multi-record file. As Figure A-1 illustrates, that file is composed of N fixed length records, a software end-of-file record, and a hardware end-of-file mark.

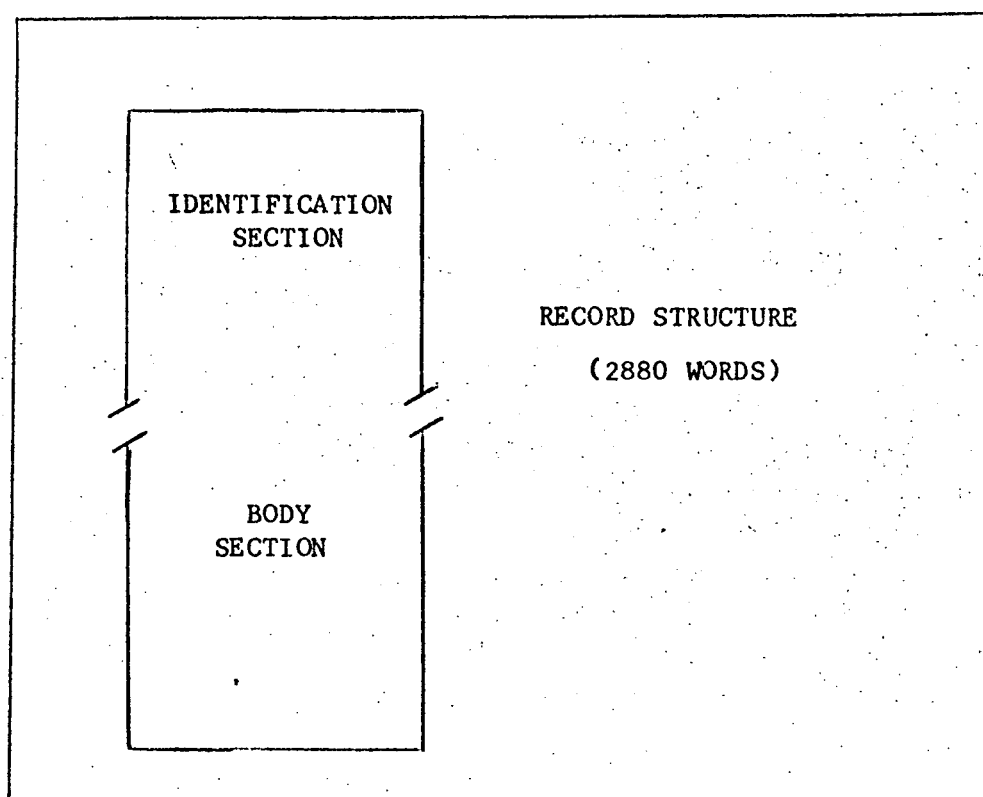


FIGURE A-2 RECORD STRUCTURE

DATA RECORD

Each tape record contains the background data and input data for an entire form. While a record is a fixed length of 5760 ASCII characters, the data for the form may be somewhat shorter, in which case, the remainder of the 2880 word record is blank filled. Figure A-2 shows the record structure.

In general, it is composed of two distinct sections, each of variable length:

- (1) Identification Section
- (2) Body Section

Before a thorough understanding of the tape record format is possible, it is necessary to study the following definitions.

Item	An item is all the data associated with <u>one</u> background question and user's response, as well as the descriptive codes related to the background.
------	---

Level code

This is a one digit code between zero and nine inclusive found within an Item, and it specifies the position or rank in a hierarchical or outline structure of the Item. (i.e., the number of spaces to be indented).

Sequence number

This is a digit from one to four inclusive. It indicates the order in which the ID Items are to be saved on the Master File. The sequence number four must be assigned to Item 4.

Block character

(44g) The purpose of the block or end-of-block character is to separate all Items on a record.

End-of-page character

(241g) This character may follow any Item in the Body Section of the record, and it serves to delimit CRT display data "pages". These pages are the data necessary to fill a CRT screen.

End-of-record

(137g) This character is the last data character of a form. Since the record is fixed length, all words following the end-of-record character are blank filled.

Heading-Answer pair

This is the main component of a data record Item. It will be in one of two forms: Heading and Answer, or Heading alone. If there is an Answer with the Heading, it is preceded by a colon. The number of characters in a Heading plus the value of the level code cannot exceed twenty-four. (Thus, if the level code is four, the Heading cannot exceed twenty characters.) The Answer in the Identification Section cannot exceed seventy-two characters; the Answer in the Body Section may be any length.

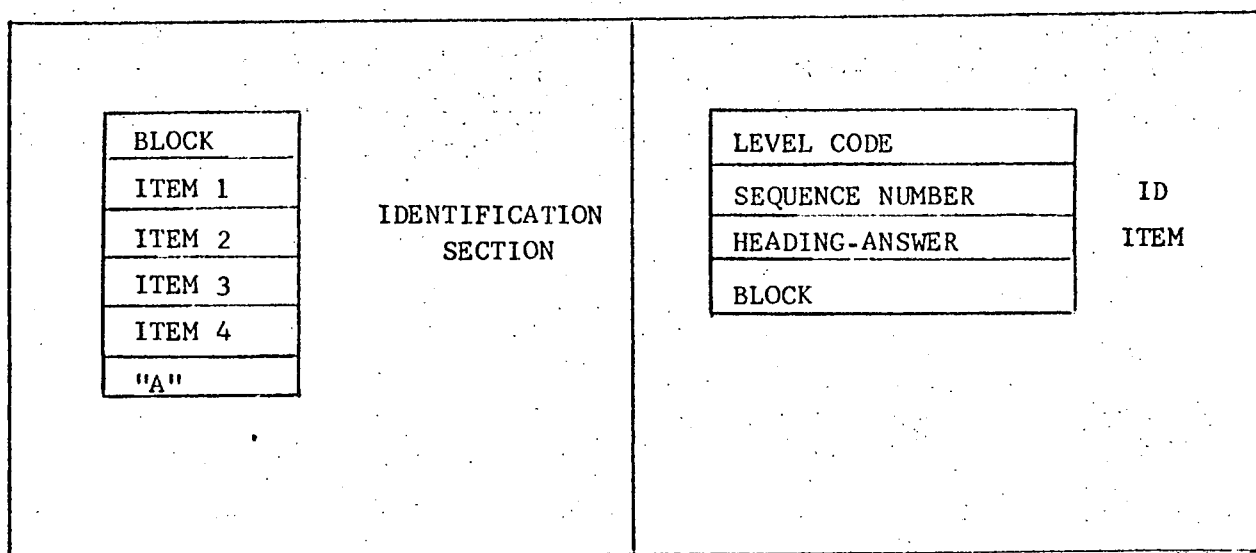


FIGURE A-3 IDENTIFICATION SECTION DESCRIPTION

IDENTIFICATION SECTION

The Identification Section of a data tape record is made up of four Items preceded by a block character, and followed by the alphabetic character "A", as shown in Figure A-3. For each Heading-Answer pair in an Item, there is a level code and a sequence number associated with it. The level code is always zero. All possible sequence numbers (1, 2, 3, 4) must occur in ID Items. They may occur in any order with one exception. Sequence number 4 must be associated with Item 4. The only other restriction in the ID Section is that the Heading associated with Item 4 must be DATE.

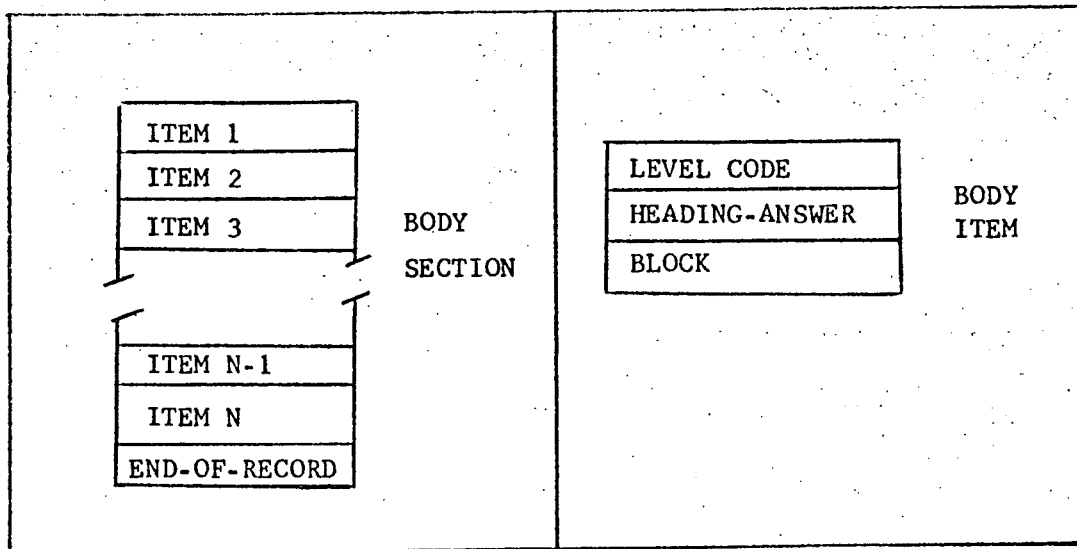


FIGURE A-4 BODY SECTION DESCRIPTION

BODY SECTION

The Body Section consists of a variable number of Items, followed by an end-of-record character. A Body Item is like an ID Item except it contains no sequence number, and its Answer may be any length. If the Answer is longer than one line, a carriage return character is stored at the end of the line.

END-OF-FILE RECORD

The last record on the file is the end-of-file record. It is used as a software end-of-file and consists of an end-of-record character in the first word of the 2880 word record. The remainder of the record is ignored.

Appendix B

CRT Data Format

The data displayed at the CRT is composed of two data types and two special CRT characters. The data types are:

1. Blind headings. A series of 24 or less characters which is used as a descriptor for the heading-answer pairs that follow.
2. Heading-answer pair. This data type is composed of a heading of 24 or less characters and an answer of variable length. The answer field may be filled, or it may be made up of one or more blank lines.

The two special characters are:

1. LINE. (▲) 12₈ This character is found at the end of most lines. Any data following this character and on the same line will be ignored.
2. ETX. (▶) 3₈ This character may be input by the user from the CRT keyboard. Any data following this character, whether it be on the same line or subsequent lines, will not be input to the computer. In the event this character is not displayed by the user, the very last code to be input to the user is this character code. Thus, in all cases, it is the last character to be transmitted.

Appendix C

LTB\$ Line Table Format

Each display line has a corresponding Line Table word. The format of each word is as follows:

<u>Bits</u>	<u>Description</u>
0 - 5	Level code
6 - 11	Sequence number
12	Two question bit. If set, it indicates that the next word contains line table data on a question that is also on the current line.
13	More lines bit. If set, it indicates that the answer field requires more than one line, and the following line is a continuation of that field.
14	No answer bit. If set, it indicates that the current line contains a blind heading.
15	Continuation line bit. If set, it indicates that the current line may contain data that is merely a continuation of the answer field of the previous line.

APPENDIX D

SAMPLE INPUT

SAMPLE TAPE INPUT

```

$
02RECORD: REGISTRY$
03TYPE: IDENTIFICATION$
01SS NO: ██████████
04DATE: 01JUN71 $
AO NAME: $
0 PURPOSE: (71)DEMONSTRATION$
$
0 BLOOD TYPE: $
0 RACE: CAUC$
0 SEX: FEM$
0 HANDEDNESS: LEFT$
0 SHOE SIZE: (7C )$
0 BIRTHDATE: ██████████
0 BIRTHPLACE: ██████████
0 POSITION: $
0 AGENCY: $
0 ORGANIZATIONAL UNIT: $
0 GOVERNMENT SERVICES$
1 MILITARY$
2 FROM: ( )$
2 TO: $
1 CIVILIAN$
2 FROM: (67)$
2 TO: PRESENT$
1$
0 RATING OR SPECIALTY: DIETICIAN$
$
1 TIME IN THIS CAPACITY$
2 TOTAL: ( )HRS$
2 LAST 6 MO: ( )HRS$
0 PRESENT HOME ADDRESS: 1429 LAPLACE$
HOUSTON, TEXAS 77043$
0 NEXT OF KIN: $
1 RELATIONSHIP: $
1 ADDRESS: $
$
0 PHYSIOLOGICAL TRAINING: $
0 OTHER INFORMATION: $
0 COMMENTS: $
$
0 TYPED: JB/NRD
! ←

```

\$ - block character
 ! - end-of-page character
 ← - end-of-record character

This printout shows data by lines.
 On the tape, all data is packed.

D-1

SAMPLE CRT INPUT

RECORD: REGISTRY
TYPE: IDENTIFICATION
SS NO: [REDACTED]
DATE: 01JUN71
NAME: GARD, JANE
PURPOSE: (71) NEW

BLOOD TYPE: O-POS
RACE: CAUC
SEX: FEM
HANDEDNESS: LEFT
SHOE SIZE: (7C)
BIRTHDATE: [REDACTED]
BIRTHPLACE: [REDACTED]

POSITION:
AGENCY:
ORGANIZATIONAL UNIT:
GOVERNMENT SERVICE
MILITARY

FROM: ()
TO:
CIVILIAN

FROM: (67)
TO: PRESENT

APPENDIX E

SAMPLE OUTPUT

SAMPLE TAPE OUTPUT

```

$
02RECORD: REGISTRY$
03TYPE: IDENTIFICATION$
01SS NO: ██████████
04DATE: 01JUN71$
A0 NAME: GARD JANE $
0 PURPOSE: (71)NEW$
$
0 BLOOD TYPE: O-POS $
0 RACE: CAUC$
0 SEX: FEM$
0 HANDEDNESS: LEFT$
0 SHOE SIZE: (7C )$
0 BIRTHDATE: ██████████
0 BIRTHPLACE: ██████████
0 POSITION: $
0 AGENCY: $
0 ORGANIZATIONAL UNIT: $
0 GOVERNMENT SERVICES$
1 MILITARY$
2 FROM: ( )$
2 TO: $
1 CIVILIAN$
2 FROM: (67)$
2 TO: PRESENT$
1 $
0 RATING OR SPECIALTY: DIETICIANS$
$
1 TIME IN THIS CAPACITY$
2 TOTAL: ( )HRS$
2 LAST 6 MO: ( )HRS$
0 PRESENT HOME ADDRESS: 1429 LAPLACE$
HOUSTON, TEXAS 77043$
0 NEXT OF KIN: $
1 RELATIONSHIP: $
1 ADDRESS: $
$
0 PHYSIOLOGICAL TRAINING: $
0 OTHER INFORMATION: $
0 COMMENTS: NOT FOR PUBLIC USE$
$
0 TYPED: JB/NRD
1 ←

```

\$ - block character
 ! - end-of-page character
 ← - end-of-record character

This printout shows data by lines.
 On the tape, all data is packed.

SAMPLE TELETYPE OUTPUT

RECORD: REGISTRY
TYPE: IDENTIFICATION
SS NO: [REDACTED]
DATE: 01JUN71
NAME: GARD, JANE
PURPOSE: (71) NEW
BLOOD TYPE: O-POS
RACE: CAUC
SEX: FEM
HANDEDNESS: LEFT
SHOE SIZE: (7C)
BIRTHDATE: [REDACTED]
BIRTHPLACE: [REDACTED]
POSITION:
AGENCY:
ORGANIZATIONAL UNIT:
GOVERNMENT SERVICE
MILITARY
FROM: ()
TO:
CIVILIAN
FROM: (67)
TO: PRESENT
RATING OR SPECIALTY: DIETICIAN
TIME IN THIS CAPACITY
TOTAL: () HRS
LAST 6 MO: () HRS
PRESENT HOME ADDRESS: 1429 LAPLACE
HOUSTON, TEXAS 77043
NEXT OF KIN:
RELATIONSHIP:
ADDRESS:
PHYSIOLOGICAL TRAINING:
OTHER INFORMATION:
COMMENTS: NOT FOR PUBLIC USE
TYPED: JB/NRD

SAMPLE CRT OUTPUT

RECORD: REGISTRY
TYPE: IDENTIFICATION
SS NO: [REDACTED]
DATE: 01JUN71
NAME:
PURPOSE: (71) DEMONSTRATION

BLOOD TYPE:
RACE: CAUC
SEX: FEM
HANDEDNESS: LEFT
SHOE SIZE: (7C)
BIRTHDATE: [REDACTED]
BIRTHPLACE: [REDACTED]
POSITION:
AGENCY:
ORGANIZATIONAL UNIT:
GOVERNMENT SERVICE
MILITARY
FROM: ()
TO:
CIVILIAN
FROM: (67)
TO: PRESENT