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NEW ILLINOIS COMPILER AND ASSEMBLER PROGRAMMING SYSTEM

SYSTEM MANUAL

Edited by

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ERL

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CHAPTER 1. INTRODUCTION

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1. INTRODUCTION

1.1 Introduction

The purpose of this manual is to describe the components of the system program library and its principle of operation. Those ancillary programs such as the update programs that are not used directly by the user, but are required to maintain or modify the system, are described in Chapter 5.

Chapter 1 outlines the program packages that constitute the system. Later chapters give fuller details and program listing of these packages. The reader should be aware that system programs are typcially subject to continual change so that the program listings are almost certainly out of date before being reproduced, and therefore should only be viewed as presenting the flavor of the program. Copies of the latest version can be referenced in the Computer Laboratory.

1.2 Allocation of Memory Devices

In order to gain machine efficiency it is desirable that as often as possible programs within the machine are under some system control. When a program is under system control it must be obeyed in the presence of a monitor program. This monitor program will check for legality all input/output orders and continuously monitor certain internal conditions such as overflow and external conditions such as input/output and special register interrupts, typewriter requests, the clock, etc. A program run under system control must perform all input/output via requests to the monitor program. In doing so, the input/output unit or register is addressed logically, that is by a number which is assigned a physical significance by the monitor. The monitor program is table-driven in the sense that it converts logical numbers to absolute unit addresses by means of table lookout. These tables may be changed at any time by an authorized program, thus providing automatic relocation of input/output units.

During the system operation, the various sections of core storage will be allocated to the system and one or more users. Any user may have a maximum of seven-and-a-half thousand words of core storage. Every eight-thousand-word module of core storage will contain a 512 word monitor program occupying the high address locations. It is possible that several very short programs may be stacked in each seven-and-a-half-thousand-word core. If more than one core is available then, additional core area will be allocated to the most frequently used system programs such as the Scheduler described below. If remote consoles are to be used then the basic program to service these will also exist in some of this extra memory. The remainder of the core will be divided between various uses active at the given time. In all cases the 512 monitor program will be directly addressable by the user although it is always memory protected so that the user may not change it.

The next level of storage is the drum. This will be used for high use system programs, back-up storage for the monitor and then for the users. The user will be assigned a suitable number of sections of the drum consecutively addressed. He refers to these by the logical sector numbers, 0 through N; the monitor will automatically relocate these sector numbers to the appropriate physical address and monitor N, the limit of the drum available to that user.

Tape units will be assigned to the system and the user by the logical unit number. The logical unit numbers are 0, 1 and up. Units 0 through 5 inclusive are assigned permanently to the system. The user may use tapes numbers 6 up to a suitable limit.

The assignments of the first six logical numbers are as follows:

Tape 0 is the system tape.

Tape 1 is the library tape.

Tape 2 is a spare tape for the system which probably will be used to store hold-over programs and also for dump of the disc file for long-term storage.

Tape 3 is the system input tape which is loaded off-line by the 1401 or similar machine and it contains the input for batch processing or background load.

Tape 4 is the output tape destined for a printer or punch via the 1401 or similar computer. In the case of FORTRAN which refers to punched and printed outputs separately, logical tape number 5 will be used for punched output. Physically this is equivalent to logical tape 4. The logical number 5 may not be used by a user except in FORTRAN.

The disc file will be used for storage of other system programs, retained user programs and user working area. (By a user program is meant the totality of orders obeyed once the assembly or compilation of a program has started until the final execution of the program has been completed.) Thus user storage areas on drum and tape will be used by the assembler and compiler.

1.3 Main System Program Packages

1.3.1 Monitor

This is the 512-word core block present at all times that this system is in the machine. Its major constituents are the system input/output programs which handle all transfers to and from the input/output tapes and the system auxiliary program which handles all other auxiliary storage transfers. Additional programs monitor overflow and various other external conditions. These are described in Chapter 2.

1.3.2 The Load Procedure Program

Each core load, that is, each portion of program which occupies the memory for a given time is headed by a loader 256 words long which takes care of loading that program into core. This is done in such a way that only that area of core which is actually used by the program is changed. For this purpose the core is divided into 256 word blocks and the program must be a multiple of 256 words. After having loaded the program the load procedure program then transfers to the program at the appropriate point, setting or not setting interrupt as desired. In loading the program it has put a block on an area the drum reserved for the monitor which contains a table of exits. The termination of execution of a given program is determined either by a transfer by a program to SYSTEM or SYSERR, or determined by the monitor in the case of too much output, reading past the end of the input tape, or illegal machine conditions of various kinds. When any one of these conditions occurs an exit is made in such a way that the table of exits on the drum for this given program is consulted. An entry corresponding to the termination condition indicates which program is to be obeyed next. This program may either be on the drum, disc or tape. This program is then fetched, loaded by means of its self-loading feature into the core in only those locations which it occupies, and handed control. In some special cases, such as the dump program which is brought into play at the termination of execution of a user program, it is necessary first to save the contents of core for a later analysis. This is done in an appropriate area of the drum reserved for the monitor.

1.3.3 The Batch Processor

This is the supervisory program for background load processing. It accepts jobs via the "SYSIØ" program in card images, examines control card images and calls on the appropriate translation and loading programs. Control is initially handed to it by the scheduler along with information about the amount of core space available for the job. It returns control to the scheduler on termination of a job unless such control was assumed by the scheduler in the event of gross machine errors.

During execution it communicates to the scheduler information about its time and output requirements and program ID information.

1.3.4 Assembler and Compilers

These programs basically read the input from the system input tape and possibly from the disc file and produce output in the form of relocatable binary card images and possibly listings on the system output tape. They may occupy several passes. Data from one pass is handed on to the next via core, drum or tape units and fast registers 5 through 7. After the final pass the binary card images are left either on the tape or drum in a known position and control is returned to the Scheduler.

1.3.5 The Loader

This program reads binary card images from both the input tape, if they exist there, and from the area of drum or tape where they were placed by assembly or compilation programs and forms a core load image on the drum. Several such loads may be formed. Each load is prepared with his own load procedure program in a standard fashion. It then hands control to the load procedure program for the first core load. This Loader program will also take care of reading in the relocatable binary forms of the referenced and undefined library programs if they exist. This program is the final one to be obeyed before the user program is actually executed.

1.3.6 System Error Program

This is in fact several programs located on various places on the system tape. One of these programs is called in any time an error condition which causes termination of the execution of any phase of the program is encountered. The best-known such case is of course, the case of an illegal order or the call of the system error program by the user program during execution. The program called in, in this case, will give a dump of the user area of memory and other information helpful to the programmer in debugging his program. However, system error is also called by the assembler, for example, when it encounters a condition that prevents compilation or assembly from continuing. Such conditions are too many errors, tables full, machine malfunctions, etc. In this case a dump of the memory would be of no significance to the user. Instead an appropriate error message is printed and as much diagnostic information as possible is obtained for the user. For example, if a program fails because the error table overflows during assembly, the user should be told where this occurred, what were the earlier entries, how many errors had been encountered during assembly so far and if possible given as detailed a listing of the program as possible. The fact that System Error represents several programs presents no problem since exit to system error is made by means of the exit table which is different for each core load. This exit table will determine which system error program is called.

1.3.7 The Scheduler

This is a master control program for time-sharing purposes. In simple batch processing it is extremely short, handling only accounting and initialization of batch jobs. In a time-sharing environment, however, it can consist of many parts that are brought into core (from the drum) as the need arises.

1.4 The Sequencing of System Programs from Tape, Drum and Disc

When the exit is made from any given program via an exit table it will find in its table information about the next program to be obeyed. This information will be an indication of whether this program is on drum, tape or disc and the location on drum, tape or disc of the first block of the program. The first block of the program contains information which determined where the other blocks are. If this program is on the system tape then it is first necessary to advance or backspace the tape to the starting point. Similarly, if it is on disc file it will be necessary to position the read heads on the disc in order to fetch the program. In order to prevent delays while this is done, each program that is loaded contains an address of the next most likely program to be obeyed. This is stored in the monitor area and, whenever time permits, the monitor will attempt to position the tape or disc heads to the required location. To do this, the monitor always maintains a record of where the system tape is, where the appropriate heads on the disc file area and where it is desired that they next be positioned.

3. TRANSLATION PROGRAMS

This chapter describes the assembly and compilation packages available on ILLIAC II.

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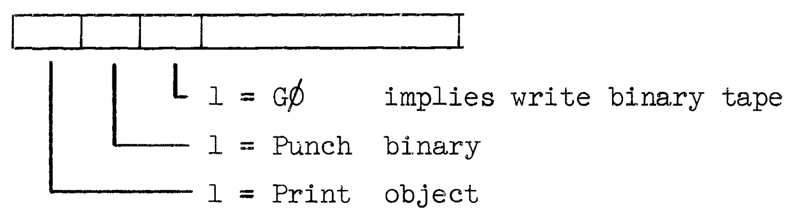
Programmed by:	H. Jarosch T. Slivinski F. Schaffer J. Aaron C. W. Gear
Description by:	C. W. Gear

3.1 NICAP Pass I

Pass I is a single-core load which processes the source card images in order to extract a table of used or defined names. During this process the names are replaced by a 13-bit internal form, the address of their table entry, which saves further table searching. The card is condensed into an internal form, intermediate language, in order to reduce the time of subsequent passes. If the object is to be listed, the card images are also packed, 25 per record, onto drum for the first 100 cards, and then onto tape 6. These images are read back during Pass III for listing purposes.

3.1.1 Input to Pass I

NICAP Pass I is entered by the Scheduler when a nondollar card is next on the input tape and the last $ control card governing translation was a $ NICAP card. On entry M15 contains



The input is assumed to be handed over by SYSIØ in card images.

3.1.2 Output from Pass I

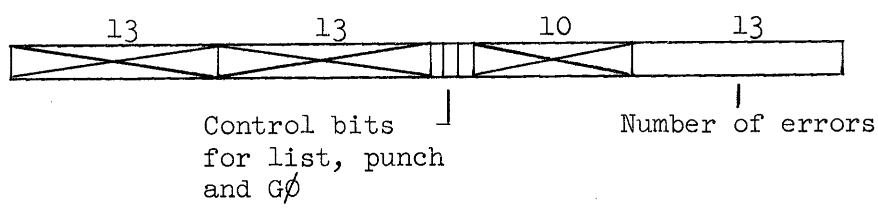
Pass I makes an exit to SYSTEM or SYSERR when a card without a dollar in column 1, and with G, Ø and blank in columns 8, 9 and 10 is read. If a card with a $ in column 1 or a binary card is sensed beforehand, an exit to MØNITØR is made without reading the card.

SYSTEM Exit

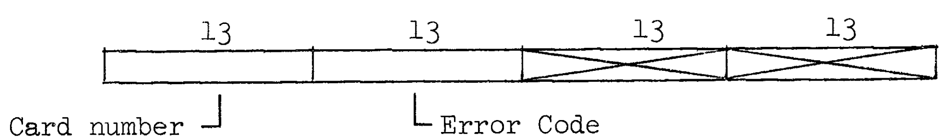
When the normal exit to SYSTEM is made, the state of the program area is

Core

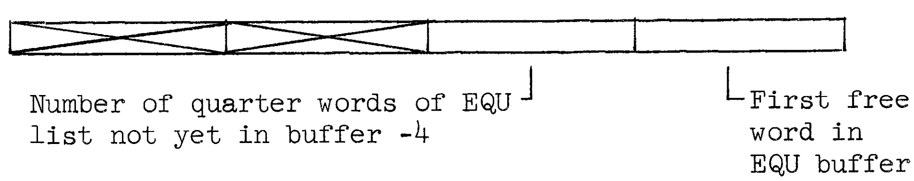
Location 0:



Locations 1-255: Error list. One error per word. Format is



Location 256:



Locations 257-510: EQU list. A packed string of 13-bit characters in IL, except that only the whole words are here.

Location 511: The remaining quarters (0 to 3) of the EQU list, right justified.

Location 512:

		LNT	IL

-Number of entry points

-Number of CALLED names

First core location of name table

Drum block containing first IL block

Locations LNT-7679: Name table in Pass II format:

13	13	1	3	1	1	2	3	2	13
0	0		0	0	X	X	X	0	X

0 = Location not used for name

1 = Relative address (only set for CALLED names)

State of construction:
- 0 Unknown still
- 1, 2 } Not possible at this stage
- 3 Known absolutely

Value (set for F0-F7, M0-M15 and CALLED names not defined in the program

Type:
- 0 Symbol
- 1 Fast Register
- 2 Modifier
- 3 Label
- 7 Not defined

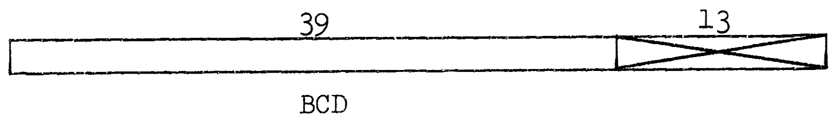
Drum Block 0

Word 0: A repeat of location 512.

Words 1-255: The first group of words in this block is the set of entry points, one word per entry. Format is

39	13
BCD name	Internal name

The next group is the set of CALLed names not defined. The format is:



The rest of block 0 is not used.

Drum Blocks 1 to 4 Inclusive

If a listing is required the first 100 cards are put here, 25 cards per block in the first 250 words of each block. The remainder of the cards are put on tape 6 in a similar format. At least one extra block is written on tape 6.

Drum Blocks 5 to (IL-1)

The BCD names used by the program are stored here in a (1-1) memory map of the core name table. This determines the number of blocks. The BCD name is in the first three quarters, the last quarter contains the type bits if not a CALLed name, and a sign bit if it is a CALLed name.

Drum Blocks IL to ?

The intermediate language is packed into quarter words in this part of the drum.

Tape Unit 6

Tape Unit 6 (logical) contains cards packed 25 per block after the first 100 if a listing is called for. At least one extra block is written for buffering purposes.

SYSERR Exit

If too many entries are made in:

a) the name table,

b) EQU buffer,

c) Error list,

d) CALL list, or

e) the Entry list

the program skips to the GØ card and then exits to SYSERR with the code 1, 2, 3, 4 or 5 respectively in M1.

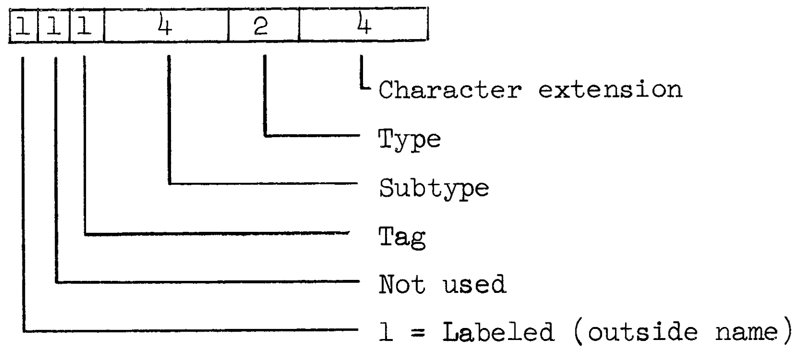
Since the last block has not necessarily been written, F7 contains the control word from the program which puts cards onto the drum and tape 6. M5 is 0 or -1 if the next block is to go on tape 6; M5 is I-6 if the next block is to go on drum block I, I = 1, 2, 3 or 4. M2 contains the card number at which the failure occurred.

3.1.3 The Intermediate Language

The intermediate language is oriented towards the 13-bit byte. Each source card produces a string of bytes of IL called a statement which is packed into a buffer to be loaded onto the drum. An exception to this is the EQU type card which puts the main string of bytes in the EQU buffer, and puts a single byte in the IL buffer which indicates the presence of a card.

Each statement begins with a reference byte which indicates the type of order, address construction, etc. It can be followed by zero or more additional bytes.

3.1.3.1 The Reference Byte



The above figure shows the reference byte. The first bit is a one if the source card contains a name in the location field (columns 1 to 6), a zero otherwise. If it is a one, then the next IL byte is the internal form of the name.

The next field that should be examined is the byte field which specifies the card type. Three cases are used:

01	Order
10	Pseudo Order
11	Control

Card Types

The control type indicates that a card has been read which affects the listing in Pass III in some way, but does not directly produce intermediate language. The cards that do this are ENTRY and the four EQU type cards.

Control subtypes recognized by Pass III for listing purposes are:

0	Set a switch so that no card's images are read for listing.
1	Reset this switch.
5	List a card image without assembling any program.

3.1.3.1.1 Pseudo Orders

If a card is a pseudo order, then the only other field that may have meaning is the character extension field which is used to control the address in BES, BSS, ØRG, GØ, DECQ and ØCTQ. This is described in Section 3.1.3.1.3 below.

The next byte of a pseudo order (after the name byte if there is one) is the "order." This has the format

5	5	3
P	C	Q

P is the pseudo order type. Types allowed and the meaning of the other fields are:

0	FIL	The two least significant bits of Q are the quarter word to be set.
1	FLD	Q is the word/quarter word to be set. (0 = even boundary, 4 = odd boundary).
2 3	BSS BES	C and Q are not used. An address follows this as determined by the character extension. See below for the construction.
4	ØRG	Similar to BSS.
5	CØMMØN	Has a number in the next byte.
6	GØ	Similar to BSS.
7	ERASE	Has a number in the next byte.
8	ASSIGN	C is the number of assigned names (≤ 31). C bytes follow, each containing one internal name.
9	CALL	C and Q are not used. One further byte follows which is taken to the internal name CALLed.
10	DECQ	C is the number of quarter words to be assembled. Each one of those quarters is in the regular address construction described below, so may take one or more bytes as determined by the character extension. The first quarter to be assembled gets its character extension from the reference byte. Subsequent quarter word constructions use a leading byte with another character extension. An example is given in Section 3.1.3.1.3.

11	IØP	This is identical to DECQ except that a FIL is performed initially
12	ØCTQ	This is misleading since it does not now correspond to the ØCTQ card which assembles into a DECQ! It is used, however, by FORTRAN. C is the number of quarter words assembled ($\leq$ 31). These C quarters follow the pseudo operation byte. They are already in binary.
14	CHR	This is identical to ØCTQ except that a FIL is performed first.
15	DEC	This is identical to CHR.
28 29 30 31	EQUS EQUF EQUT EQUL	These go into the EQU buffer rather than the IL buffer. One additional byte precedes the pseudo order and contains the card number on which the EQU appears. C is the number of bytes in the address which has normal construction, while Q is used in EQUL only to indicate a quarter word displacement to the address.

3.1.3.1.2 Orders

Order type cards use the subtype field to determine the address construction and to check for the legality of various possibilities. First, however, the tag field is examined. If it is a 1, then the next byte (after the outside name if there is one) is used to provide the internal name of a modifier or fast register for the order. The next byte is the order itself in various stages of construction, and finally comes the address, if there is one. The character is used to control its construction except for subtypes 0 and 1 which are special cases.

Subtypes of Orders

0 Short order, no address. The order is in the order byte and requires no further modification, except possibly the addition of a tag.

1 Long order, fixed address. This is similar to 0 except that the order is long so that an additional byte contains the already calculated address.

2 The address should start with a label, in which case the quarter word part will be added to the C field and the carry added back into the address. This results from any type of jump order except JLH.

3 The address should not start with a label. The order will always be long, even if the address if just a modifier. This results from such orders as

```
LDM 7,A
```

and

```
CAD 9,2,B
```

4 Short order will take the address mod 64 and put it in the B,C fields. Only useful for SSR orders.

5 Short order without an address. Results from an STR A,3. A may only be a fast register, and not F1.

6 Similar to 5, but F1 is legal. Results from a CAD A,3.

7 Similar to 5, but results from an LFR A or an SFR A.

8 This may be a long or a short order. If the address field contains only modifiers, ATN's and SFN's are compiled, and a short order is produced in later passes. Otherwise 2 is added to the C field and it is made into a long order. Results from order such as CAM 8,A.

12, 13, 14 These are followed by an address which may

a) involve no numbers (just modifiers)
b) involve numbers
c) be a fast register name

In case (a) a short order is compiled, in case (b) a long order is compiled with the address construction 8,3,N if there is no suitable positively-used modifier or with the construction M,2,N if there is such a modifier M. In case (c) the construction F,3, is used.

The three types 12, 13 and 14 correspond to CAE, STR and CAD type order respectively. In the former, case (c) is illegal; in type 13, F1 is illegal.

15 This is similar to case 3 except that it arises from order like LFR F,A. The distinction is made in order to check that F is a register name.

3.1.3.1.3 The Address Field

The address field consists of one or more bytes which are a (1-1) translation of the source card. Each number is represented in the 13 bits of one byte. Each name is represented in its 13-bit internal form. Operations are coded into three bits of a byte. In order to tell what the next byte is, two processes are used.

a) If the last byte was a name or number, the next byte is an operation.

b) A character extension occupies four bits of an operation byte to tell what the next byte is.

6	3	4

Character extension
Operation

The Operation Byte

The codes for operations are:

0	+
1	-
2	*
3	/
4	)
5	(

The codes for the character extension are:

0	Integer follows
1	Open bracket follows
2	Name follows
4	Operation byte follows
8	Integer which is last byte follows

10	Name which is last byte follows
12	This is the last byte

The character extension for the first byte is in the reference byte.

Examples:

L CAD A + M1*9

would appear as

11622	Reference: Outside name, order type 14, extension 2
(L)	Outside name in internal form (the address of the table entry)
10200	CAD order in octal
(A)	Internal form of A
00002	+, name follows
(M1)	
00050	*, final number follows
00011	9

DECQ 9/A,7

assembles as

00040	Pseudo order, number follows
05020	Type 10 (DECQ), two quarters long.
00011	9
00072	/, last name follows
(A)	
00010	Character extension for next quarter: last number follows
00007	7

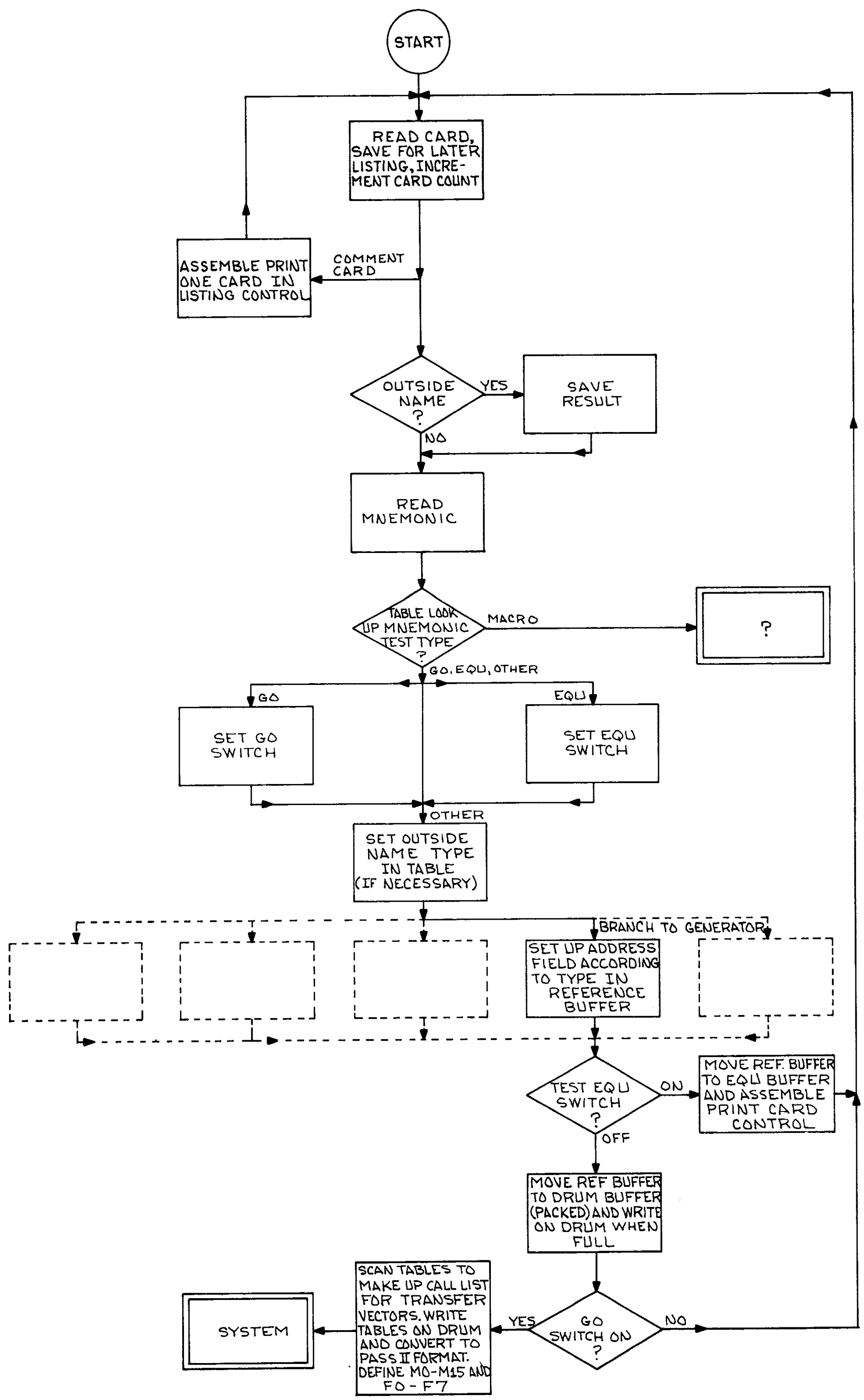
3.1.4 Errors

Pass I recognizes a number of errors which are listed in the error buffer. The code listed for the errors is 512 + n where

n is	In case of	The action taken is
1	Illegal character in address	An illegal "order" 17700 is assembled
2	Character in column 7	An illegal "order" 17700 is assembled
3	Name is longer than six digits, or appears in numeric field	Use integer 0 instead
4	B field number greater than 15	Use mod 16
5	C field number is larger than 3	Use mod 4
6	Even C field in CAN type order	Make next odd number
7	Too many left or right parentheses	Address field set to integer 0
8	Period used in other than CAD type order	Ignore period
9	Illegal comma in address field	Ignore comma
10	Address field specified for short order, e.g., CAD 9,1,17	Ignore address field
11	Illegal address for FIL or FLD	Use mod 4 or 8 respectively
12	Illegal use of fast registers	Continues
13	Undefined mnemonic	Assemble illegal "order" 17700
14	Illegal character in location field	Ignore name in location field
15	Illegal number in SSR type	Use mod 64
16	Address runs beyond column 72	Assemble illegal "order" 17700
17	Pseudo order has too many address bytes	Assemble illegal "order" 17700
18	EQU has no name in location field	Ignore
19	ENTRY card has error in address field name	Skip it

3.1.5 The Program Flow

The over-all flow schematic is given below.



When a name is found in the location columns of other than a MACRØ, it is looked up in the name table and its control bits are set according to the type of the name. Six bits are reserved for this. Codes used are:

000000	Undefined (has only appeared in an address before)
100000	Symbol (set by pseudos except DECQ, ØCTQ, EQU, CALL, FIL and FLD)
101000	Register (set by EQUF)
110000	Modifier (set by EQUM)
111000	Label (set by orders, EQUL, DECQ, CALL, ØCTQ, FIL and FLD)
000100	Name used in a CALL but not yet defined. Nondefinition will lead to a transfer vector.

The mnemonic is identified by looking it up in a table in a similar manner. When it is found, a second table is consulted for details of the order. The entry in this second table is found by adding a fixed amount to the address of the entry in the first table. The second table starts at the address MENTRY. Its format is

```
0 1 2        12 13       25 26       38 39       51
|__|__________|___________|___________|___________|
 L 01  Order              Branch address   L Order bits for order,
   10  Pseudo order        to generator      type that should be
   11  Macro                                 set in location name
                                             control in case of
                                             pseudo
```

The first two bits are consulted to find out the type. If the outside name flag is on, orders set the name to be a label whereas pseudo orders use the first three bits of the last quarter to determine the name type.

The order bits are saved for assembly, and then a branch to the address in quarter 2 is made. Note that quarter word 1 is not used for the mnemonic information. It does, however, contain information for recoding the input character during INPUT described later.

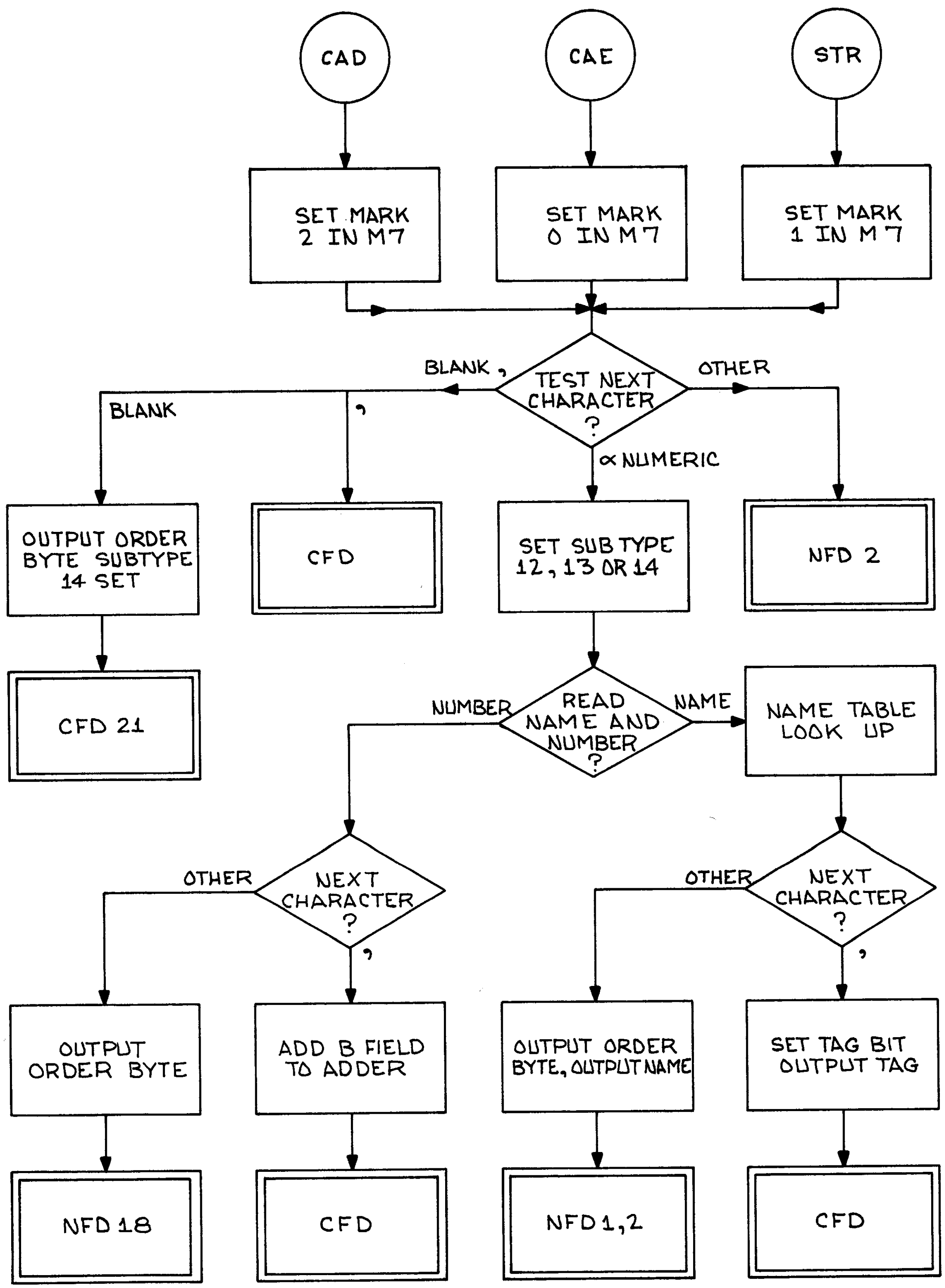
The generators test the address field for the various types of address constructions allowed and generate suitable intermediate language. The bulk of this work is done by two pieces of program. CFD (C field) is transferred to by orders and constructions that might have a C field after the B field has been taken care of. For example, CAM type order must have a B field and may have a C field. NFD (N field) takes care of the N field of orders and generates the variable address in intermediate language.

Handling the Predefined Names M0-M15 and F0-F7

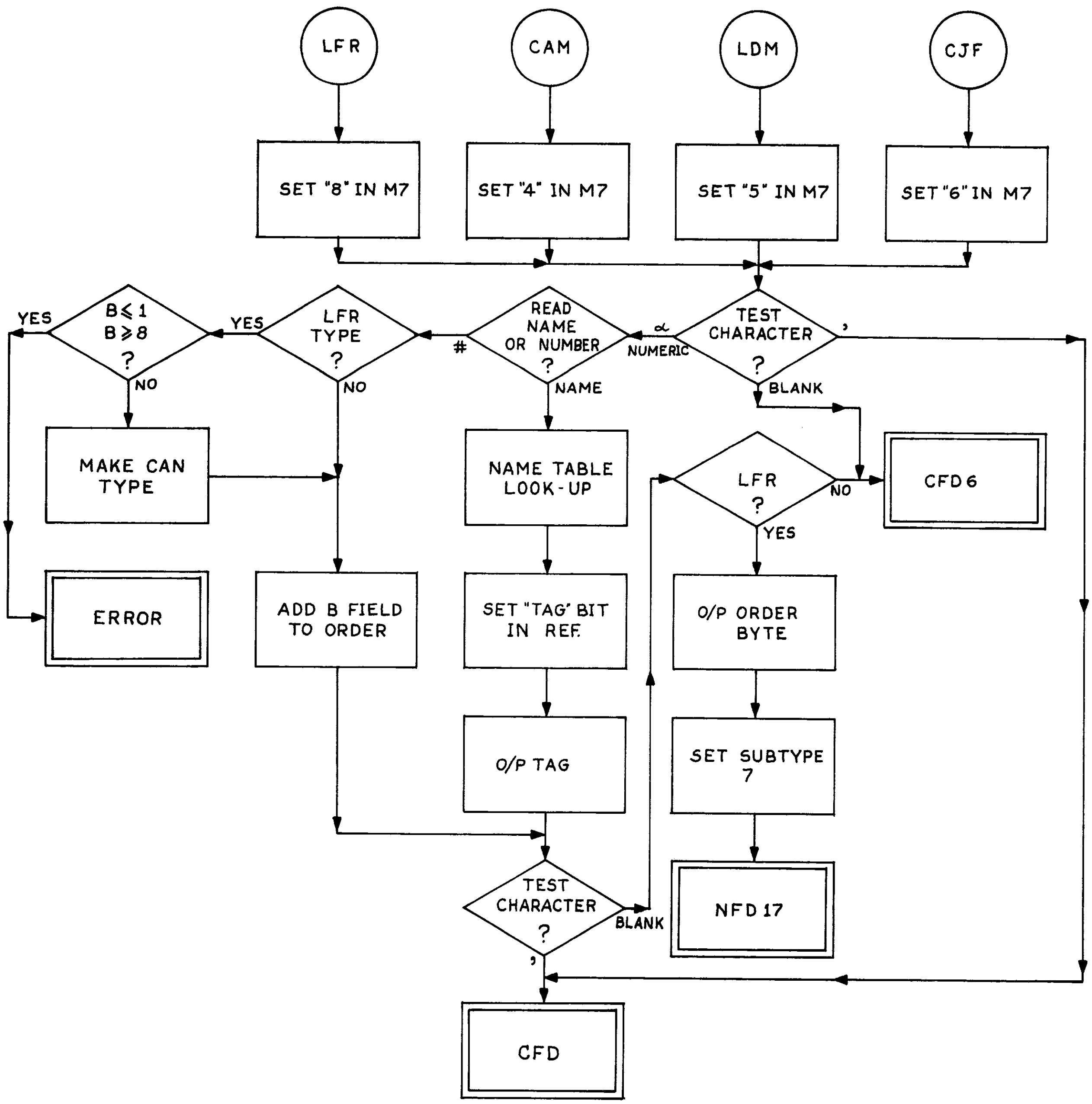
These names are in the name table when it is loaded from tape. At the end of Pass I, a program enters their values in the appropriate locations of the table in Pass II format. They are treated as any other name by the rest of the Assembler.

3.1.5.1 Flow Charts of the Generators

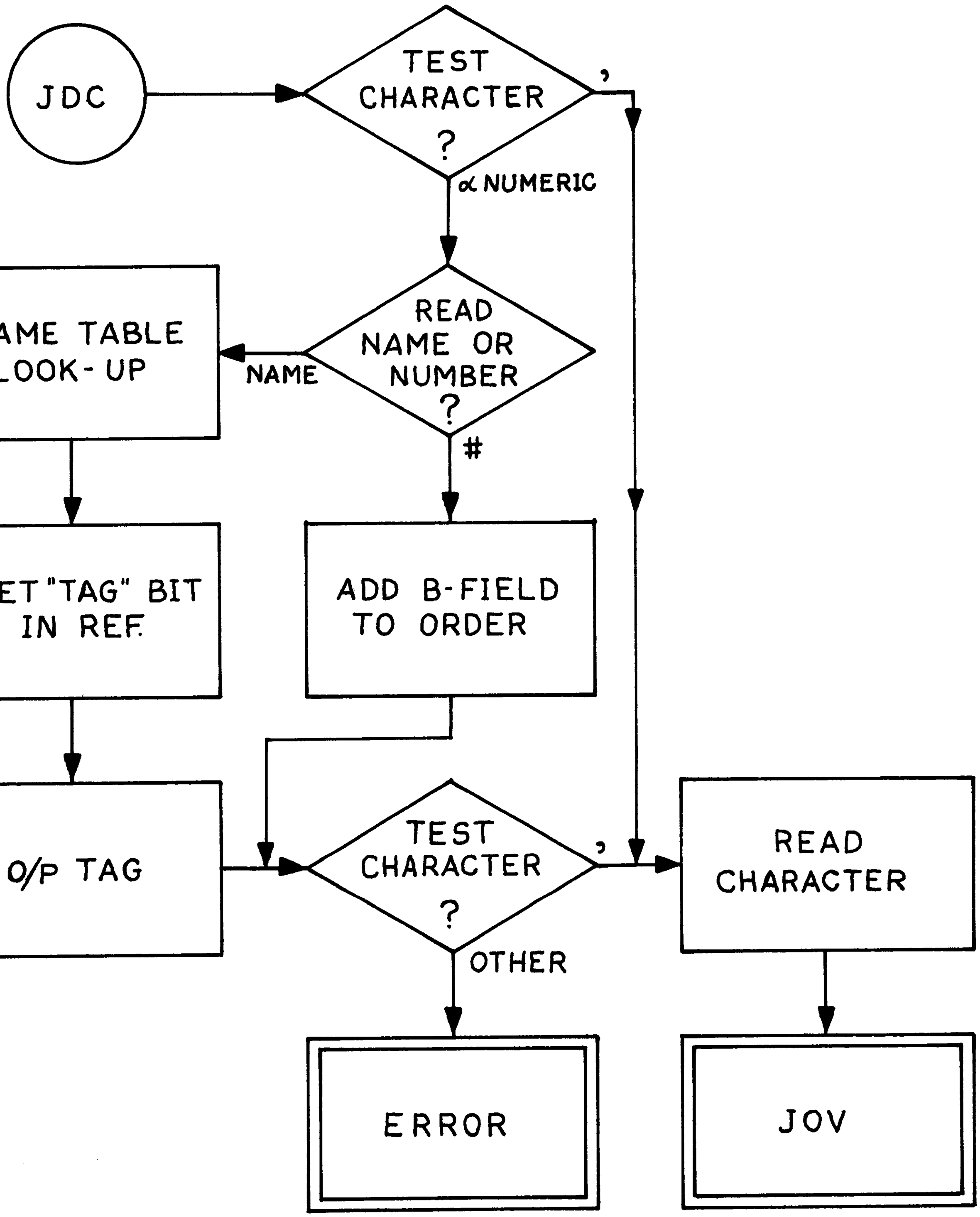
CAD, CAE and STR Type Instructions



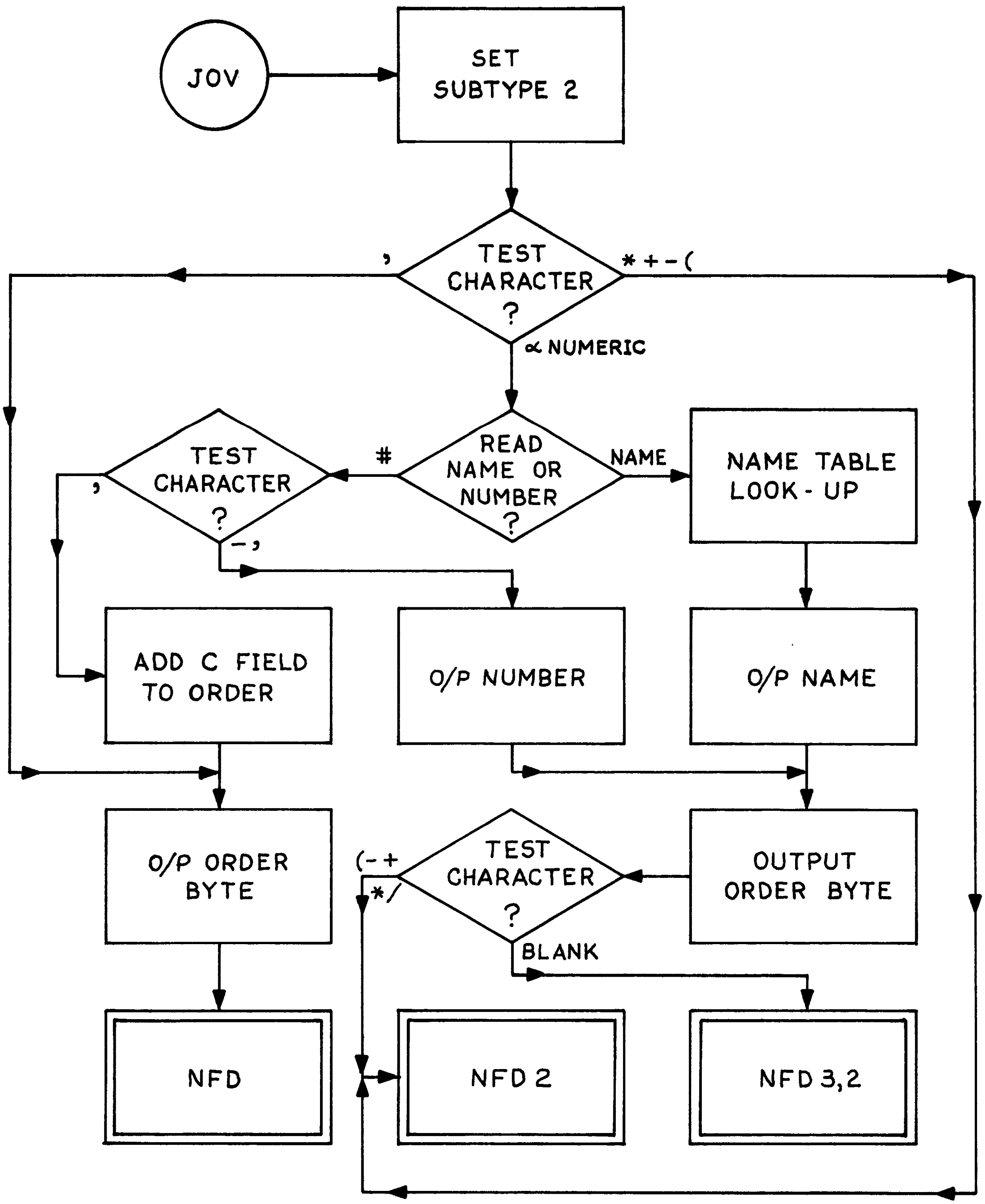
CAM type


LFR
CAM
LDM
CJF
SET "8" IN M7
SET "4" IN M7
SET "5" IN M7
SET "6" IN M7
B ≤ 1
B ≥ 8
?
YES
NO
LFR
TYPE
?
YES
NO
READ
NAME
OR NUMBER
?
#
NAME
TEST
CHARACTER
?
α
NUMERIC
,
BLANK
MAKE CAN
TYPE
NAME TABLE
LOOK-UP
LFR
?
NO
YES
CFD 6
ERROR
ADD B FIELD
TO ORDER
SET "TAG" BIT
IN REF.
O/P ORDER
BYTE
O/P TAG
SET SUBTYPE
7
TEST
CHARACTER
?
BLANK
,
NFD 17
CFD

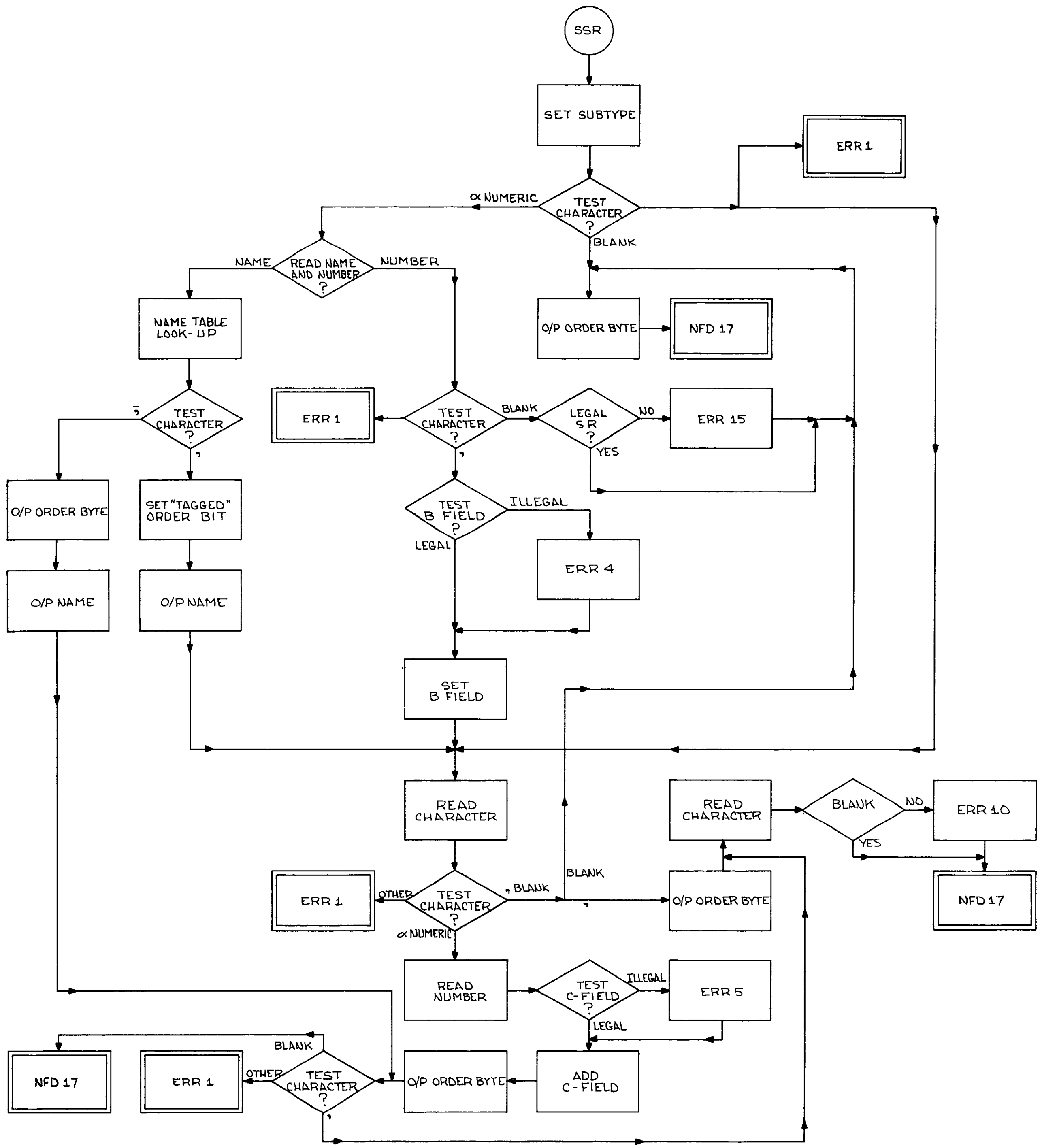
JDC type


JDC
TEST CHARACTER ?
,
α NUMERIC
READ NAME OR NUMBER ?
NAME
#
NAME TABLE LOOK-UP
SET "TAG" BIT IN REF.
ADD B-FIELD TO ORDER
O/P TAG
TEST CHARACTER ?
,
OTHER
READ CHARACTER
ERROR
JOV

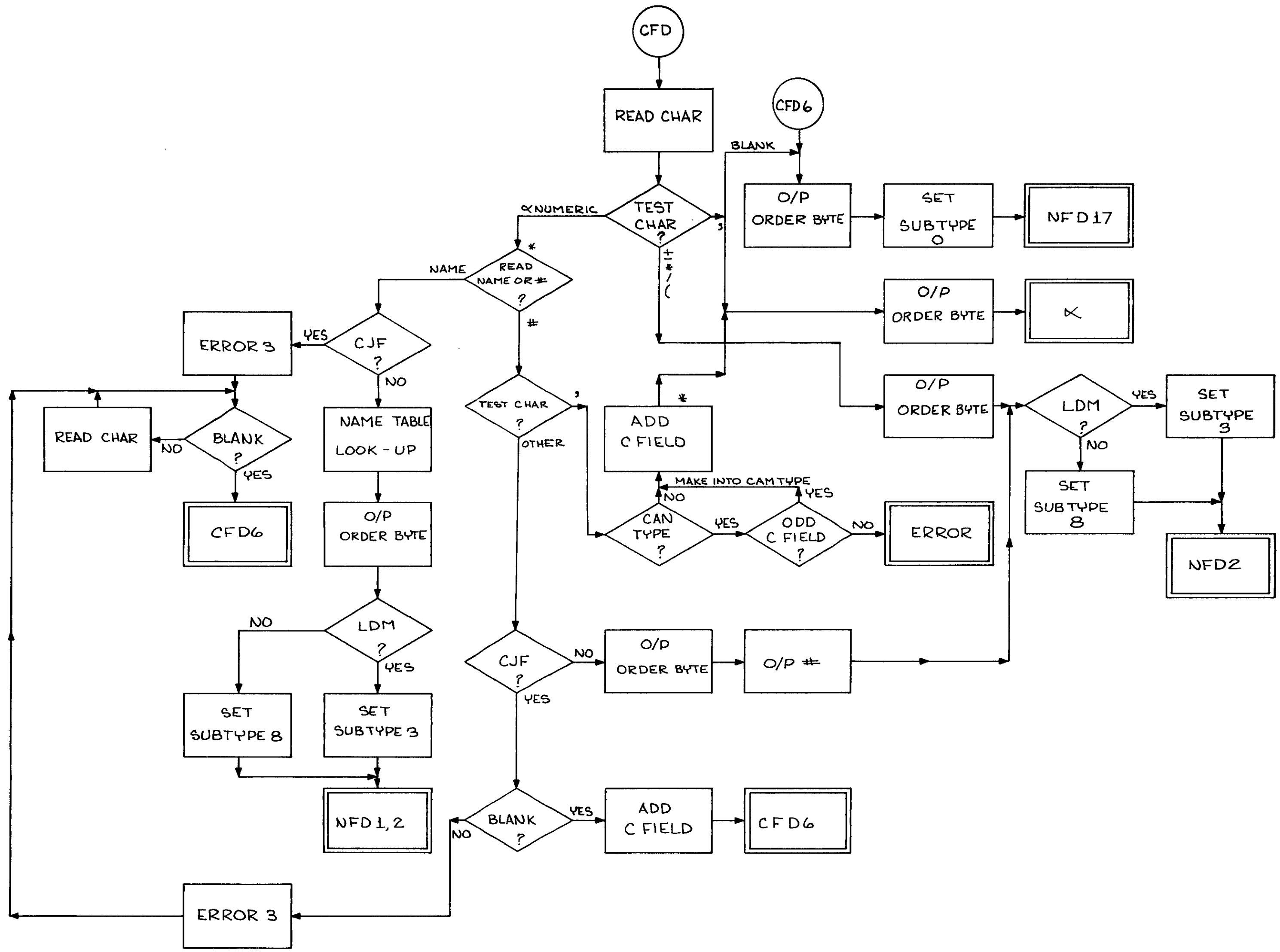
JOV type

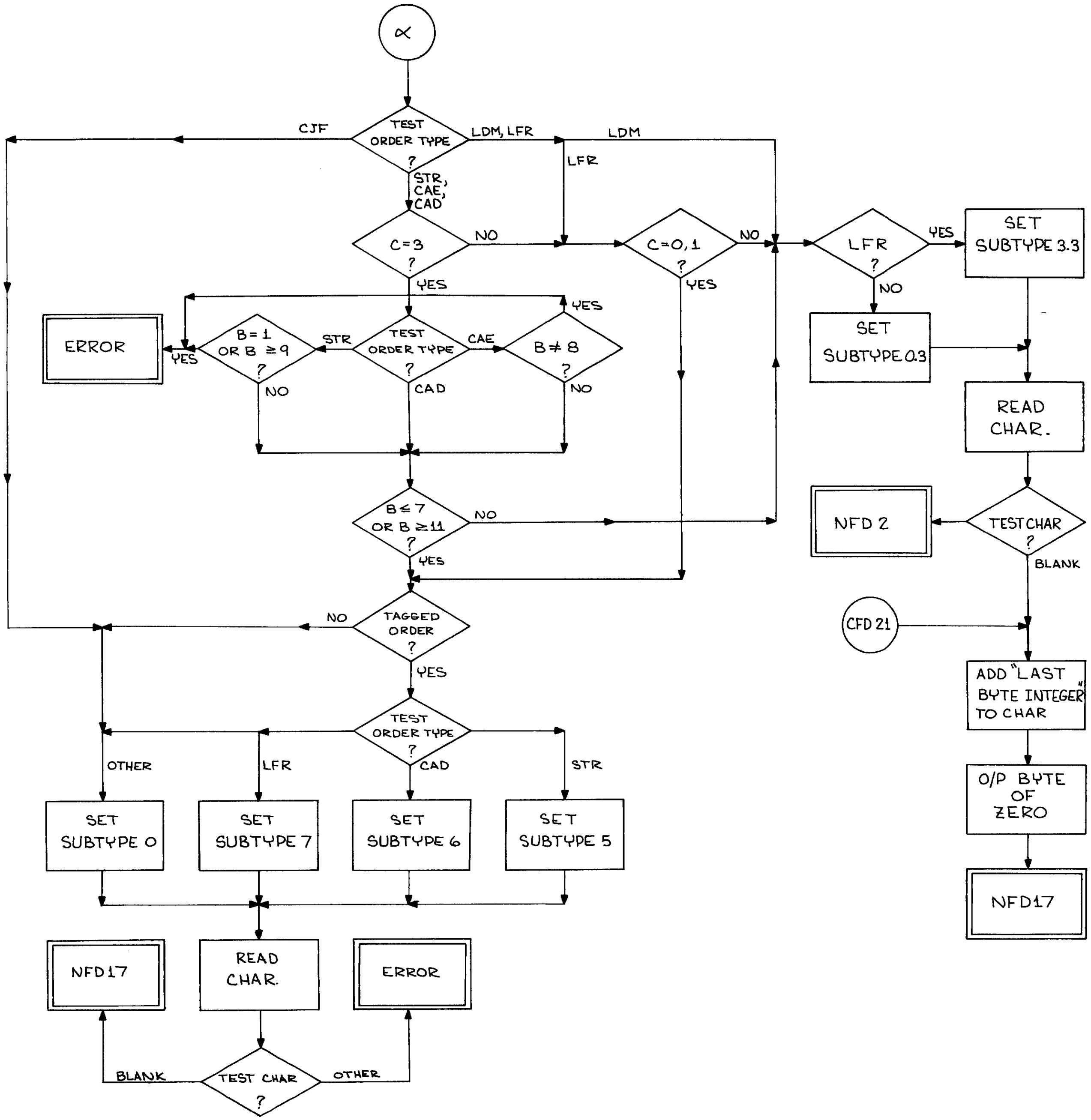

JOV
SET SUBTYPE 2
TEST CHARACTER ?
,
* + - (
α NUMERIC
READ NAME OR NUMBER ?
#
NAME
NAME TABLE LOOK - UP
TEST CHARACTER ?
,
-,
ADD C FIELD TO ORDER
O/P NUMBER
O/P NAME
O/P ORDER BYTE
TEST CHARACTER ?
(- +
*/
BLANK
OUTPUT ORDER BYTE
NFD
NFD 2
NFD 3,2

SSR type


SSR
SET SUBTYPE
ERR 1
α NUMERIC
TEST CHARACTER ?
BLANK
NAME
READ NAME AND NUMBER ?
NUMBER
NAME TABLE LOOK-UP
O/P ORDER BYTE
NFD 17
TEST CHARACTER ?
ERR 1
TEST CHARACTER ?
BLANK
LEGAL SR ?
NO
YES
ERR 15
O/P ORDER BYTE
SET "TAGGED" ORDER BIT
TEST B FIELD ?
ILLEGAL
LEGAL
ERR 4
O/P NAME
O/P NAME
SET B FIELD
READ CHARACTER
READ CHARACTER
BLANK
NO
YES
ERR 10
NFD 17
ERR 1
OTHER
TEST CHARACTER ?
, BLANK
BLANK
O/P ORDER BYTE
α NUMERIC
READ NUMBER
TEST C-FIELD ?
ILLEGAL
LEGAL
ERR 5
BLANK
NFD 17
ERR 1
OTHER
TEST CHARACTER ?
O/P ORDER BYTE
ADD C-FIELD

C FIELD

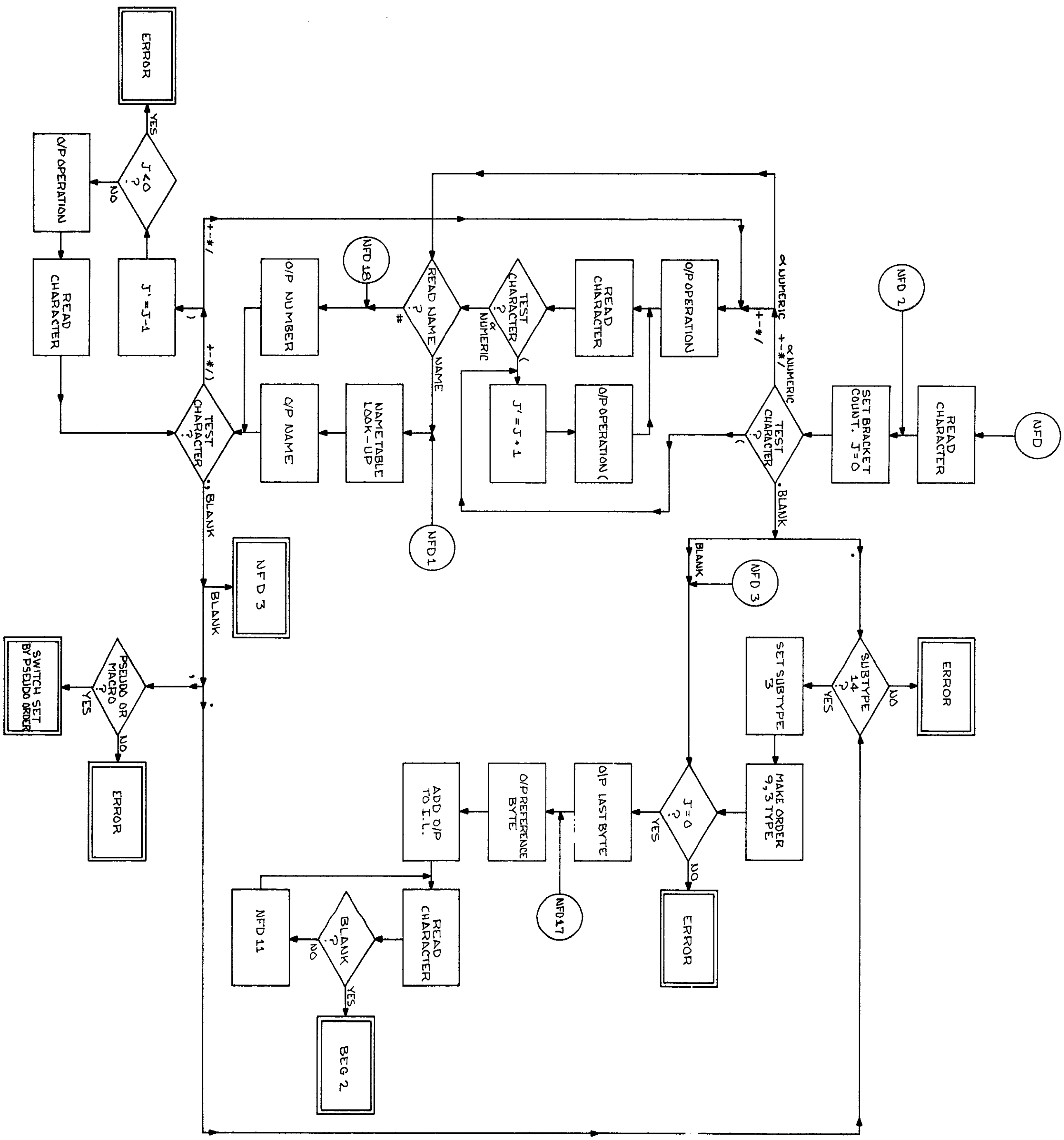

CFD
READ CHAR
TEST CHAR ?
∝NUMERIC
BLANK
CFD6
O/P ORDER BYTE
SET SUBTYPE 0
NFD17
±*/(
O/P ORDER BYTE
∝
READ NAME OR # ?
NAME
*
#
CJF ?
YES
NO
ERROR 3
NAME TABLE LOOK-UP
O/P ORDER BYTE
READ CHAR
BLANK ?
NO
YES
CFD6
LDM ?
NO
YES
SET SUBTYPE 8
SET SUBTYPE 3
NFD 1,2
TEST CHAR ?
OTHER
ADD C FIELD
MAKE INTO CAM TYPE
CAN TYPE ?
ODD C FIELD ?
ERROR
O/P ORDER BYTE
LDM ?
SET SUBTYPE 3
SET SUBTYPE 8
NFD2
CJF ?
O/P ORDER BYTE
O/P #
BLANK ?
ADD C FIELD
CFD6
ERROR 3

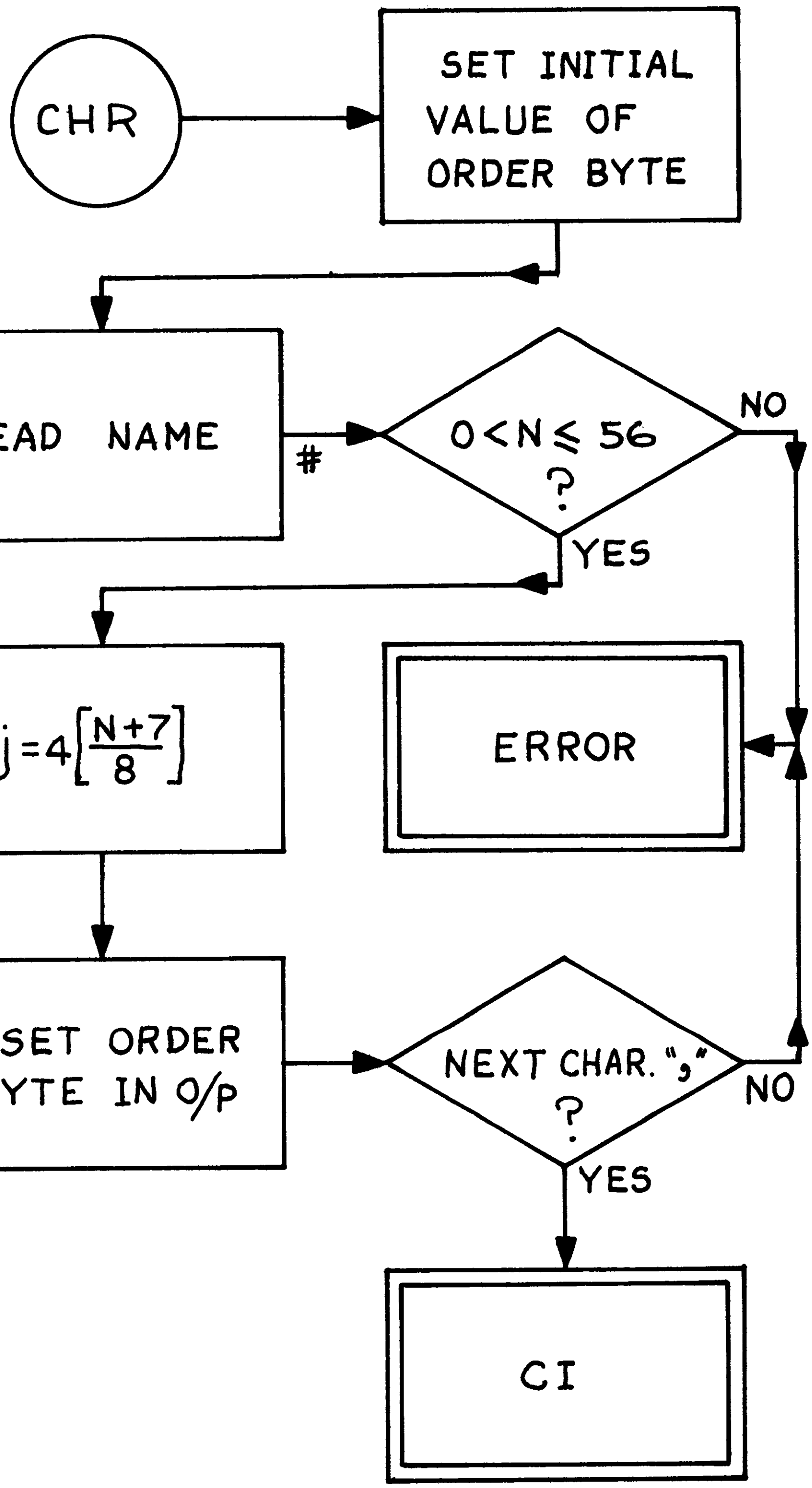


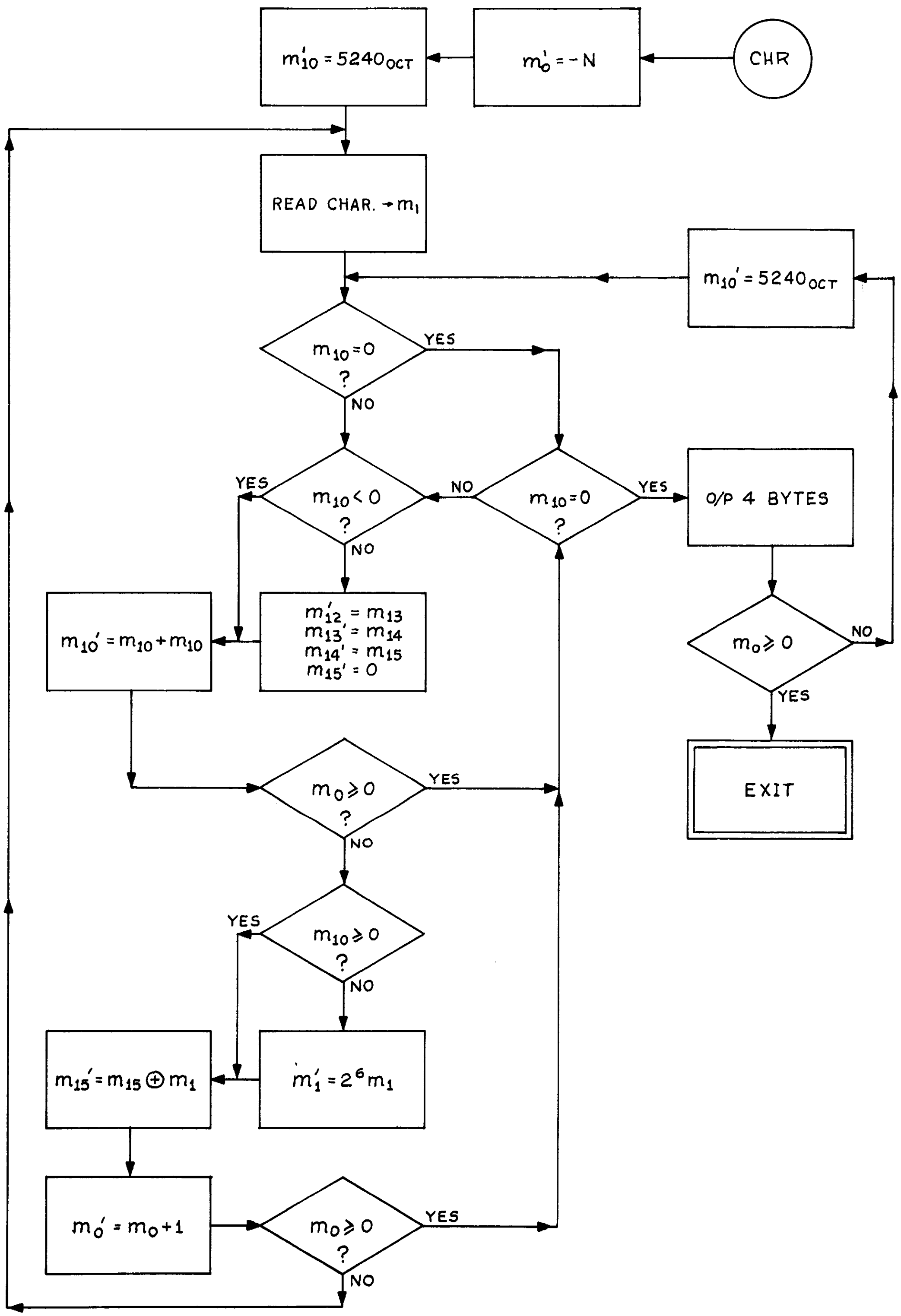
C FIELD (Cont'd)

N FIELD

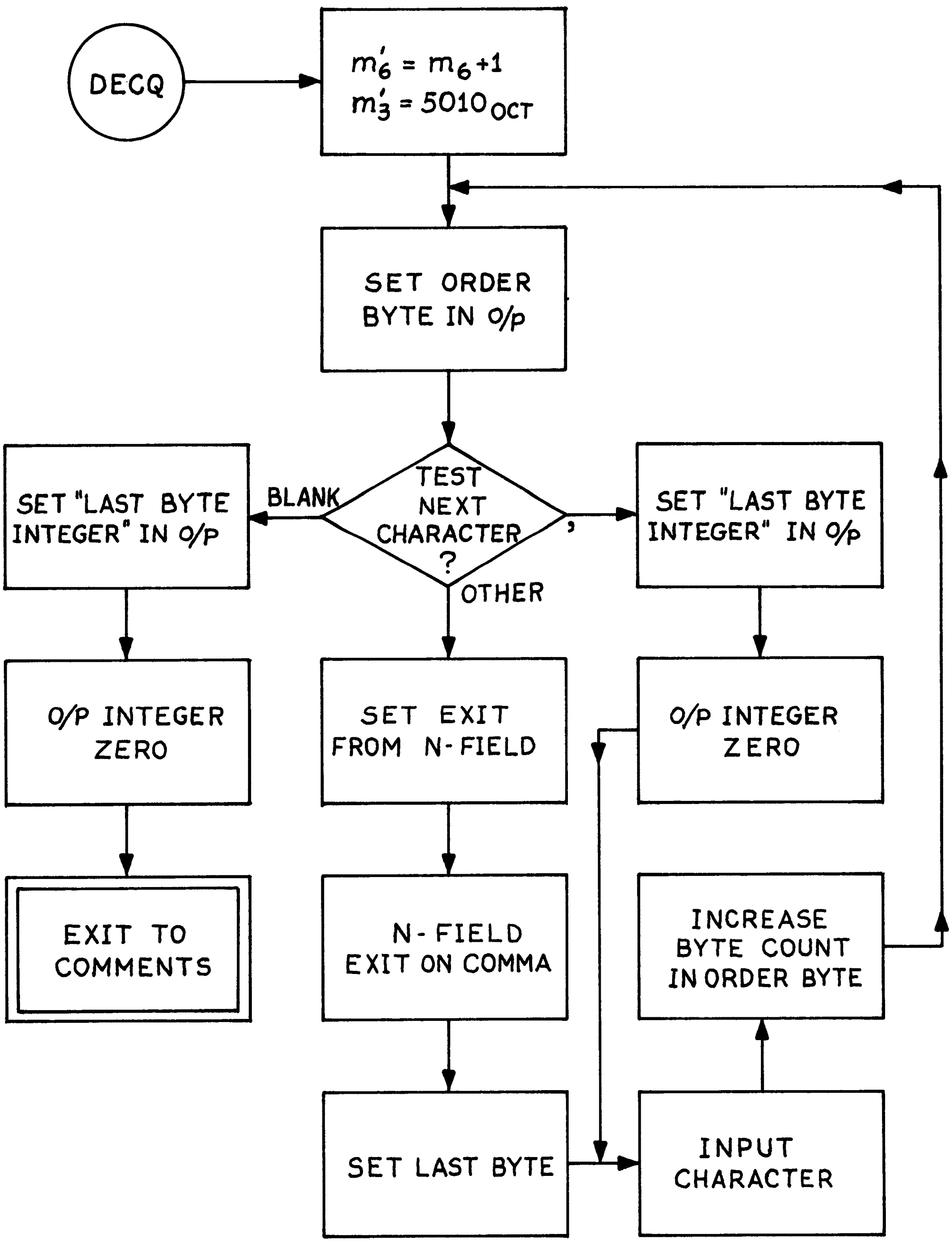
ØRG, GO, BSS, BES, EQUF, EQUL, EQUM and EQUS all make direct use of the NFD program to produce an address with normal construction.

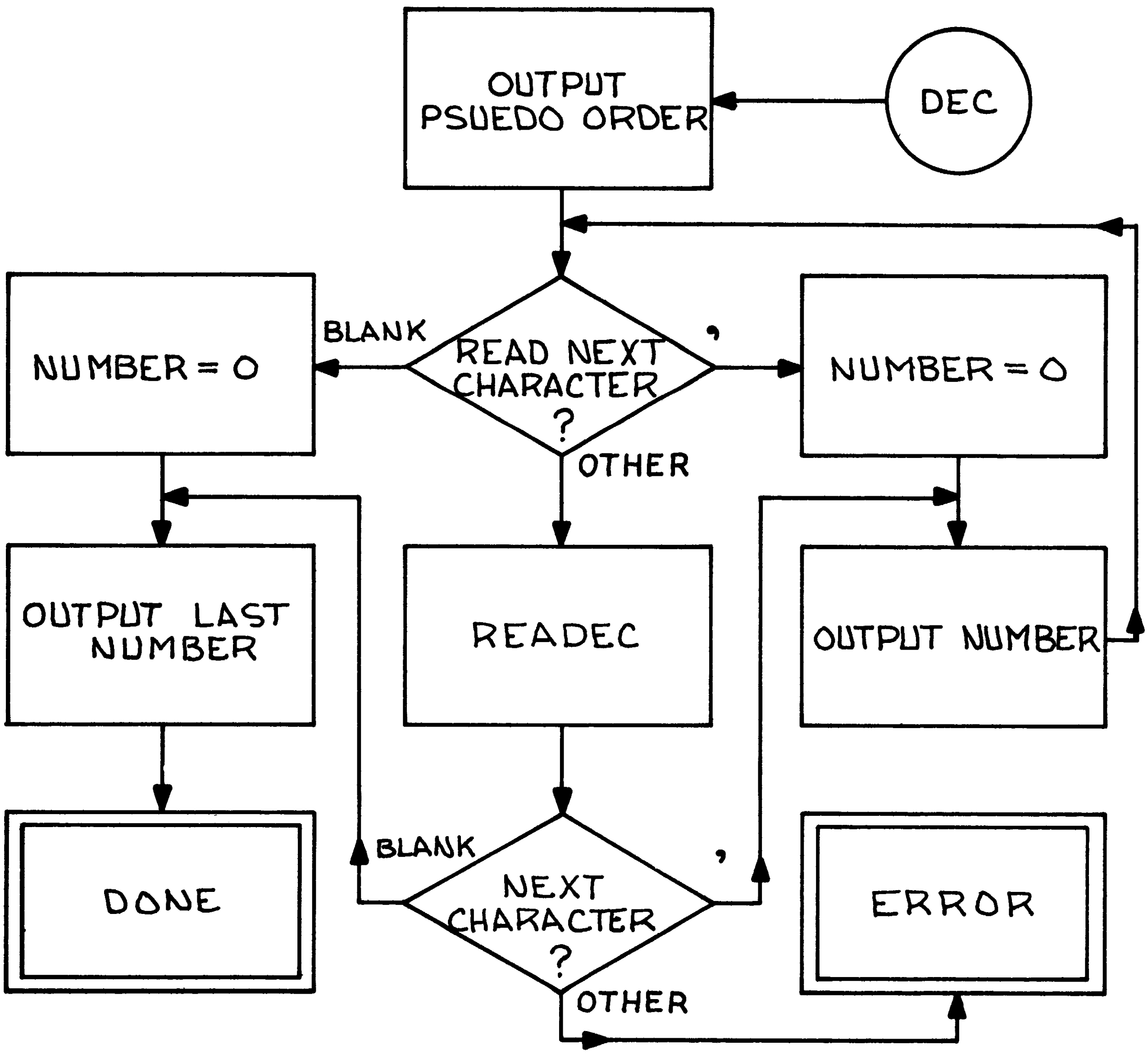


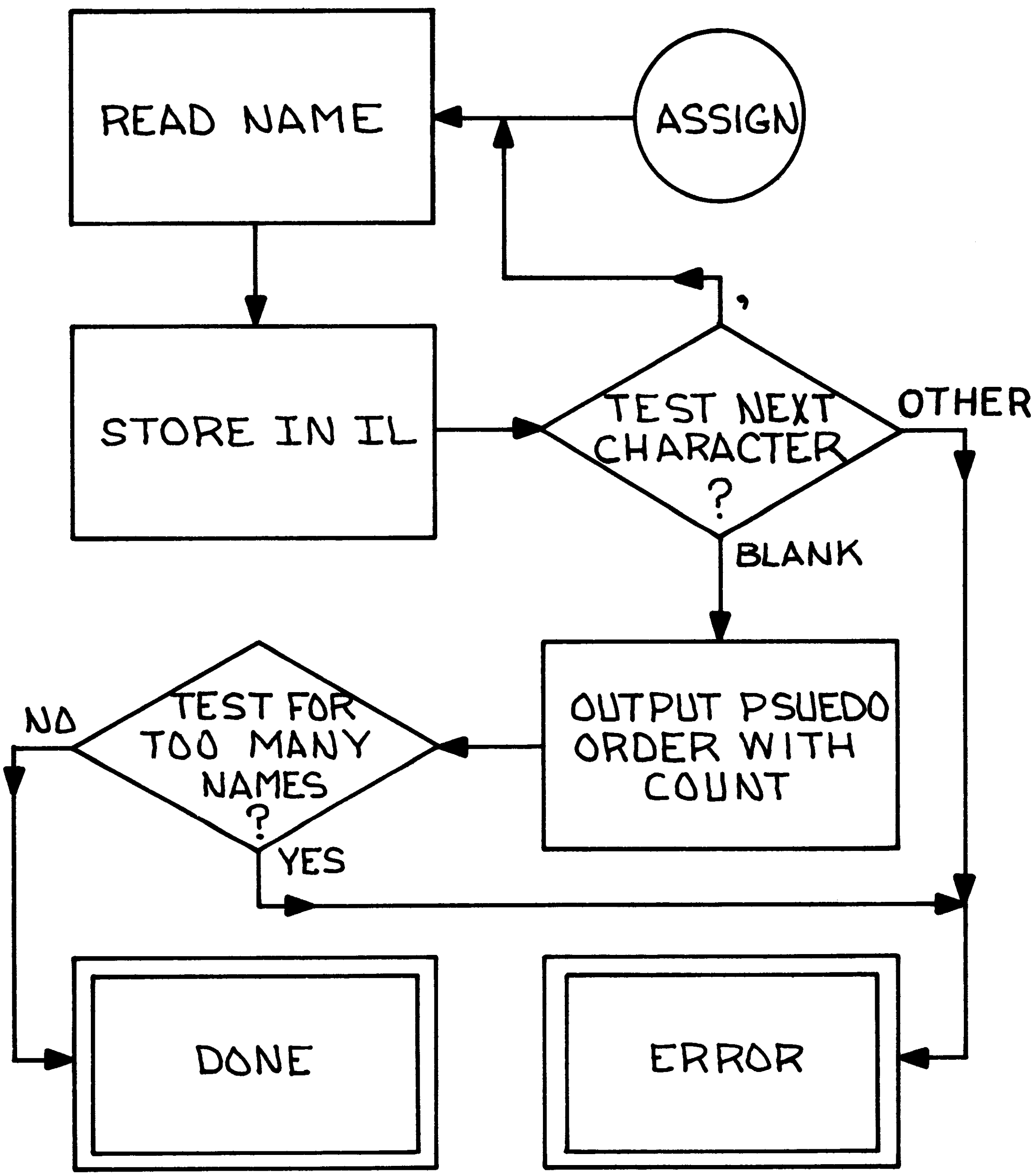

CHR
SET INITIAL VALUE OF ORDER BYTE
READ NAME
#
0<N≤56 ?
NO
YES
$j=4\left[\frac{N+7}{8}\right]$
ERROR
SET ORDER BYTE IN O/P
NEXT CHAR. "," ?
NO
YES
CI


CHR
m'0 = -N
m'10 = 5240OCT
READ CHAR. → m1
m10 = 0 ?
YES
NO
m10 < 0 ?
YES
NO
m10 = 0 ?
NO
YES
O/P 4 BYTES
m0 ≥ 0
NO
YES
EXIT
m10' = 5240OCT
m12' = m13
m13' = m14
m14' = m15
m15' = 0
m10' = m10 + m10
m0 ≥ 0 ?
YES
NO
m10 ≥ 0 ?
YES
NO
m1' = 2^6 m1
m15' = m15 ⊕ m1
m0' = m0 + 1
m0 ≥ 0 ?
YES
NO

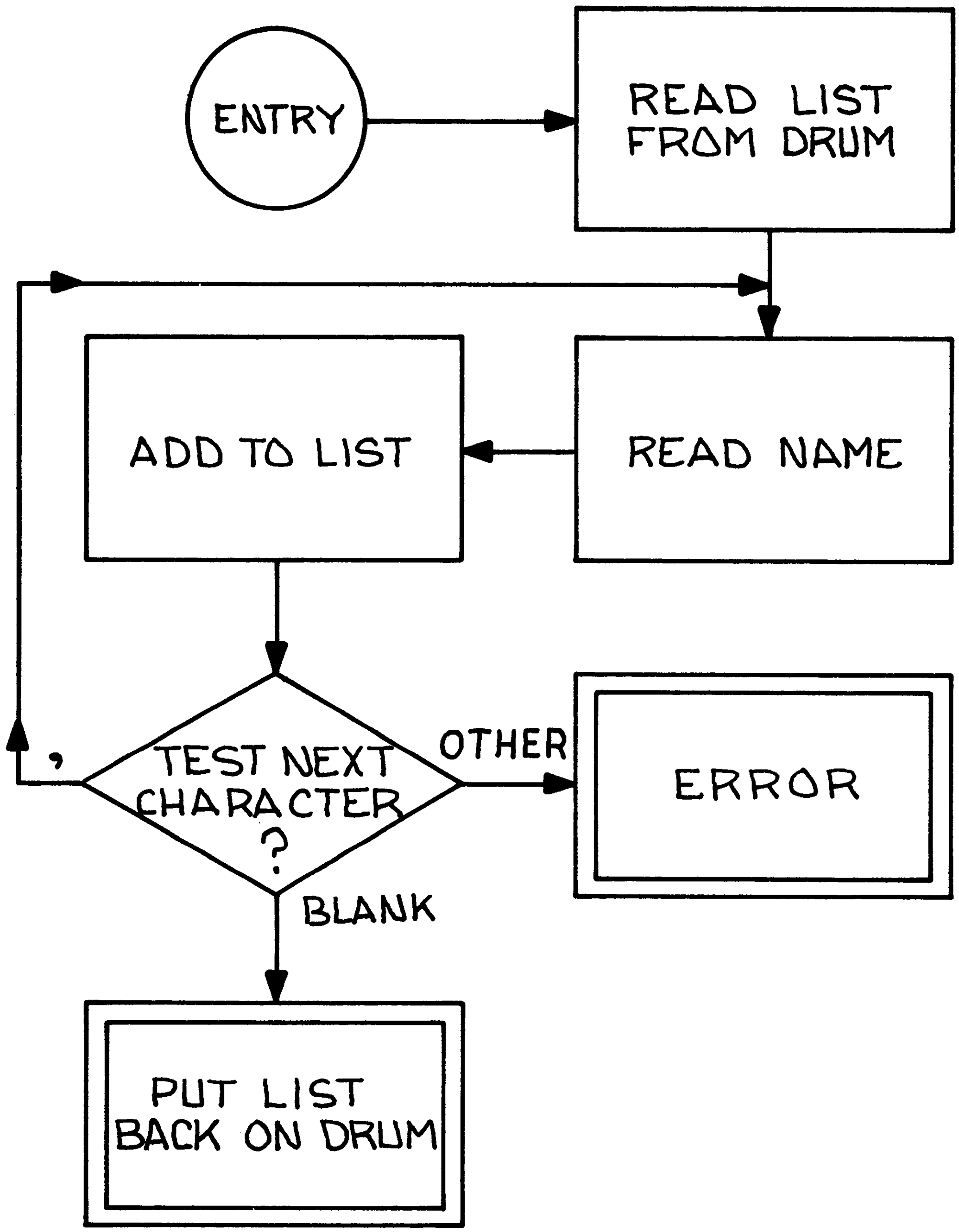
OCTQ is identical to DECQ except that the subroutine READNM which reads, names and numbers is modified to convert base 8 rather than base 10.




OUTPUT PSUEDO ORDER
DEC
BLANK
READ NEXT CHARACTER ?
,
NUMBER = 0
NUMBER = 0
OTHER
OUTPUT LAST NUMBER
READEC
OUTPUT NUMBER
DONE
BLANK
NEXT CHARACTER ?
,
ERROR
OTHER


READ NAME
ASSIGN
,
STORE IN IL
TEST NEXT CHARACTER ?
OTHER
BLANK
OUTPUT PSUEDO ORDER WITH COUNT
TEST FOR TOO MANY NAMES ?
NO
YES
DONE
ERROR

ENTRY


ENTRY
READ LIST FROM DRUM
ADD TO LIST
READ NAME
TEST NEXT CHARACTER ?
,
OTHER
ERROR
BLANK
PUT LIST BACK ON DRUM

3.1.5.2 Subroutines Used

IOSYS

Each time that this program is called, a card is read from the input media. If the print object bit is on, then the image is also saved in a 25-card block and put on drum (the first 100 cards) or tape 6. Use of this subroutine also resets the INPUT subroutine to column 1 of the new card.

INPUT

Each use of this subroutine reads the next character from the source card image up to column 72. The character is recoded and put in M1. An attempt to read beyond column 72 causes an error to be listed.

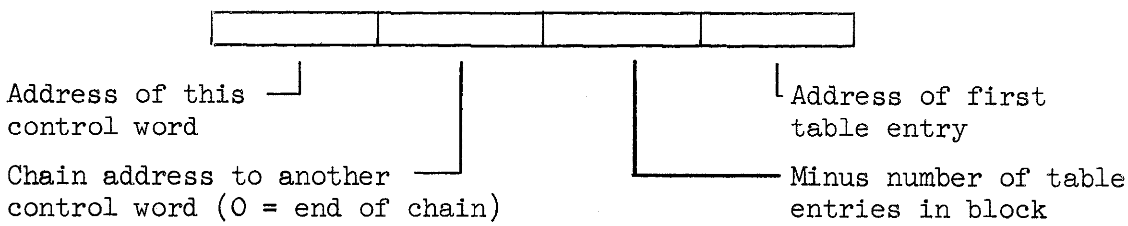
READNM

This program is responsible for reading in names and numbers. It uses INPUT to read characters. When it is called, the first character to be read is in M1. This should be an alphanumeric character. READNM reads until it finds a nonalphanumeric character. It then exits. M0 has been increased by one for each character read. The next character is in M1 on exit. If a number (all numeric characters) was read, exit is to M3 + 2. If a name was read, exit is to M3 if M0 $<$ 0, to M3 + 1 if M0 $\geq$ 0. M0 normally contains -7 on entry, so that the exit to M3 + 1 corresponds to a name of more than six characters. If a name was read it appears in BCD, left justified in M12, M13, and M14. M15 contains the mod 64 sum of the BCD characters.

MTLU and NTLU

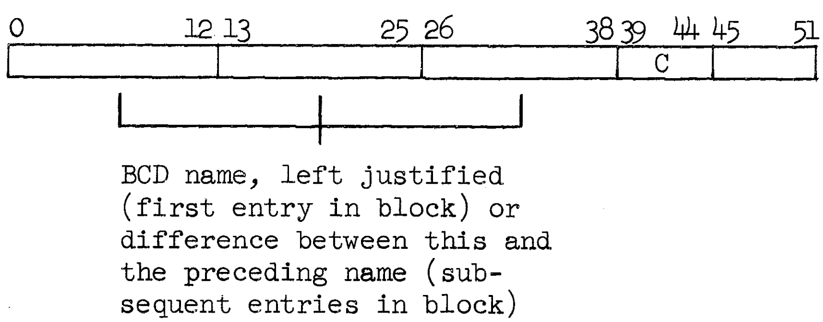
Mnemonic table look-up and name table look-up are two entries to a subroutine which searches for the appearance of the name in F7 in the mnemonic or name table. If the name is not there, MTLU exits to 2,M3 - 1 instead of the usual exit to M3. NTLU enters the name under these circumstances. The entry in the table is in F7 on exit, while its address is in M0.

The NAME table and the MNEMONIC table are split into 64 and 16 subtables respectively. This is done on the basis of the table number which is the mod 64 or the mod 16-bit character sum. Each subtable has one or more control words. The first one for each table is stored in a base address plus table number. It has the format



The entries of the table are arranged in blocks addressed from this control word. The mnemonic table has one block for each subtable, so the chain address of the first control word is empty. The name table uses blocks of 16 words. Each time that a block is full, another block and another control word are chained to the last control word until the memory is full. Full memory causes a SYSERR exit.

The entries in each block are stored as differences. That is, the first entry in each block contains the actual value of the name or mnemonic, but subsequent entries contain the difference between this entry and the preceding one.



The six bits marked C are ignored in the table search, and are used by Pass I for control information.

The control words and the table areas for the mnemonic table are located below those of the name table. This fact is used by the program when an entry cannot be found. If it is in the mnemonic table area, an error exit is made. The name table occupies the area of memory between the top of the program and the highest available location.

OUTPUT

The output routine takes the quarter-word bytes, packed one per word, from locations REF, REF + 1, ..., REF + M6 - 1 and packed them into the drum buffer area. When this area is full, the buffer is written onto the next slot on the drum.

ERR1, ERR2, ..., etc.

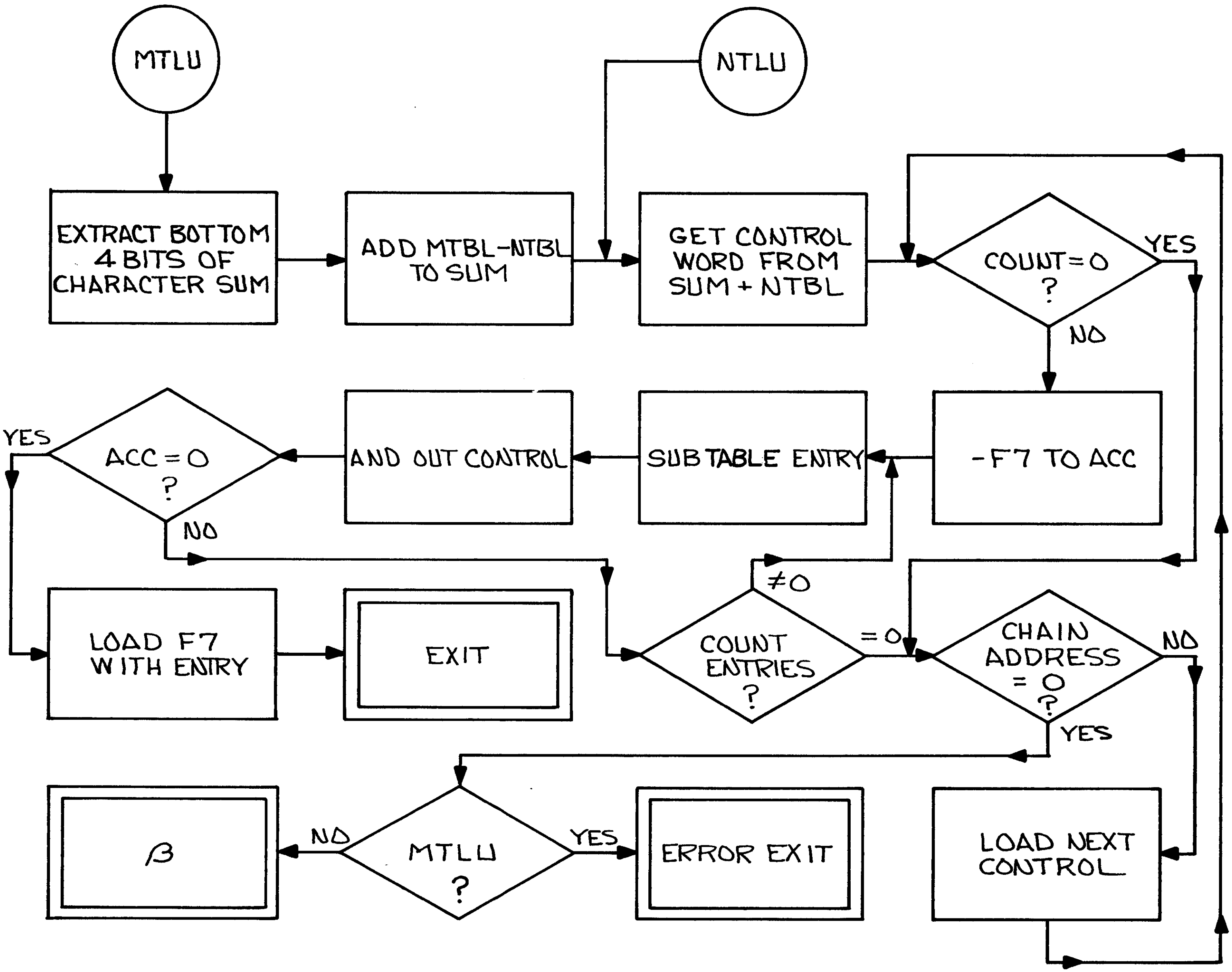
The error programs are, in some cases, subroutines; in other cases, programs that take control and then return to the scan of the next card. All of them list an error in the error buffer with its number and the current card counter number.

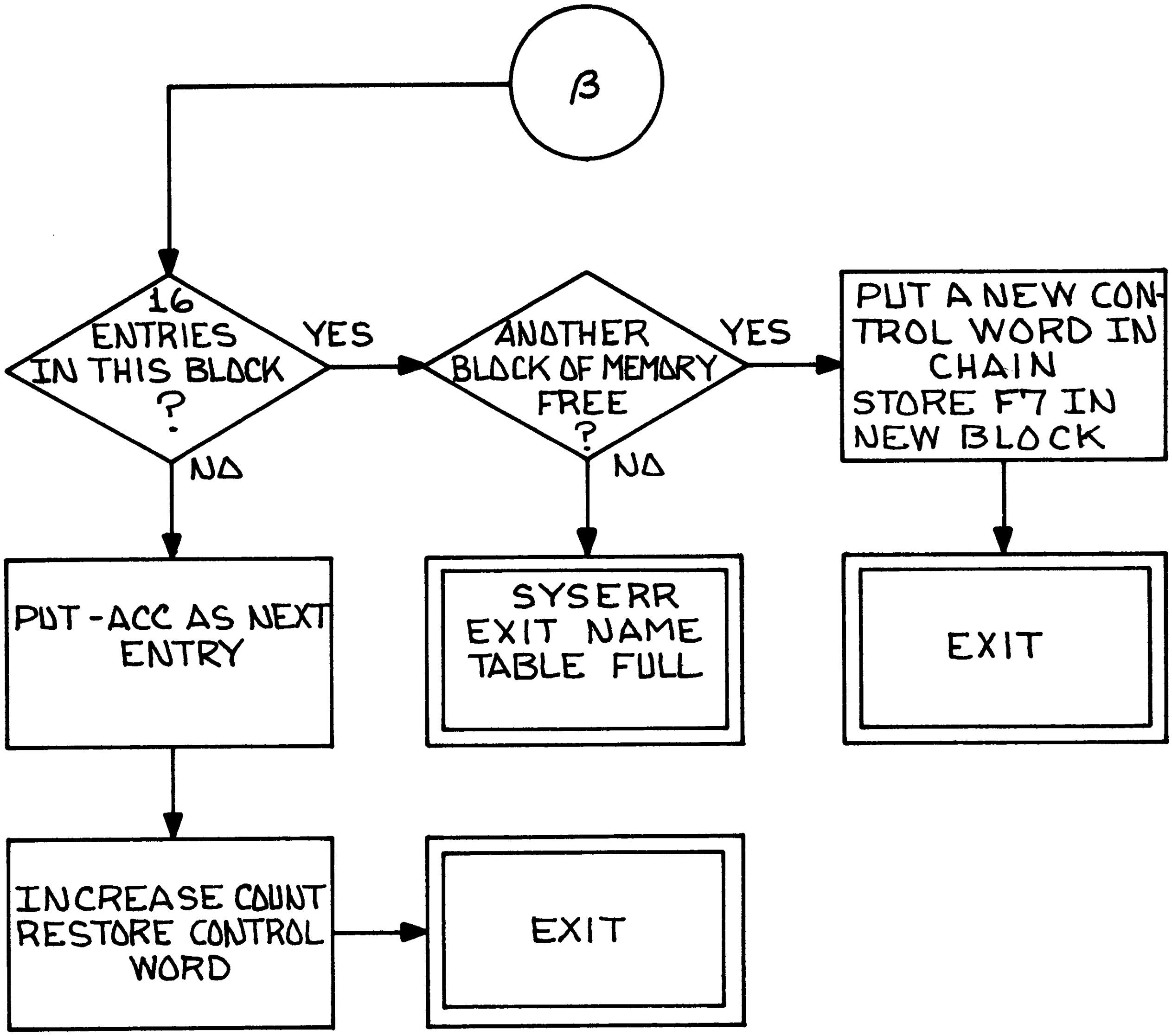
ADB

Adds byte of an address field to the REF buffer according to the state of various control bits described below. This program has four entries, ADB, ADB1, ADB2 and ADB3 corresponding to outputting an operation byte, a name, a number, and to setting the end of the address field. The purpose of the program is to take care of making up the character extension bits in an earlier byte. This may be just one byte earlier, or may be in the reference byte.

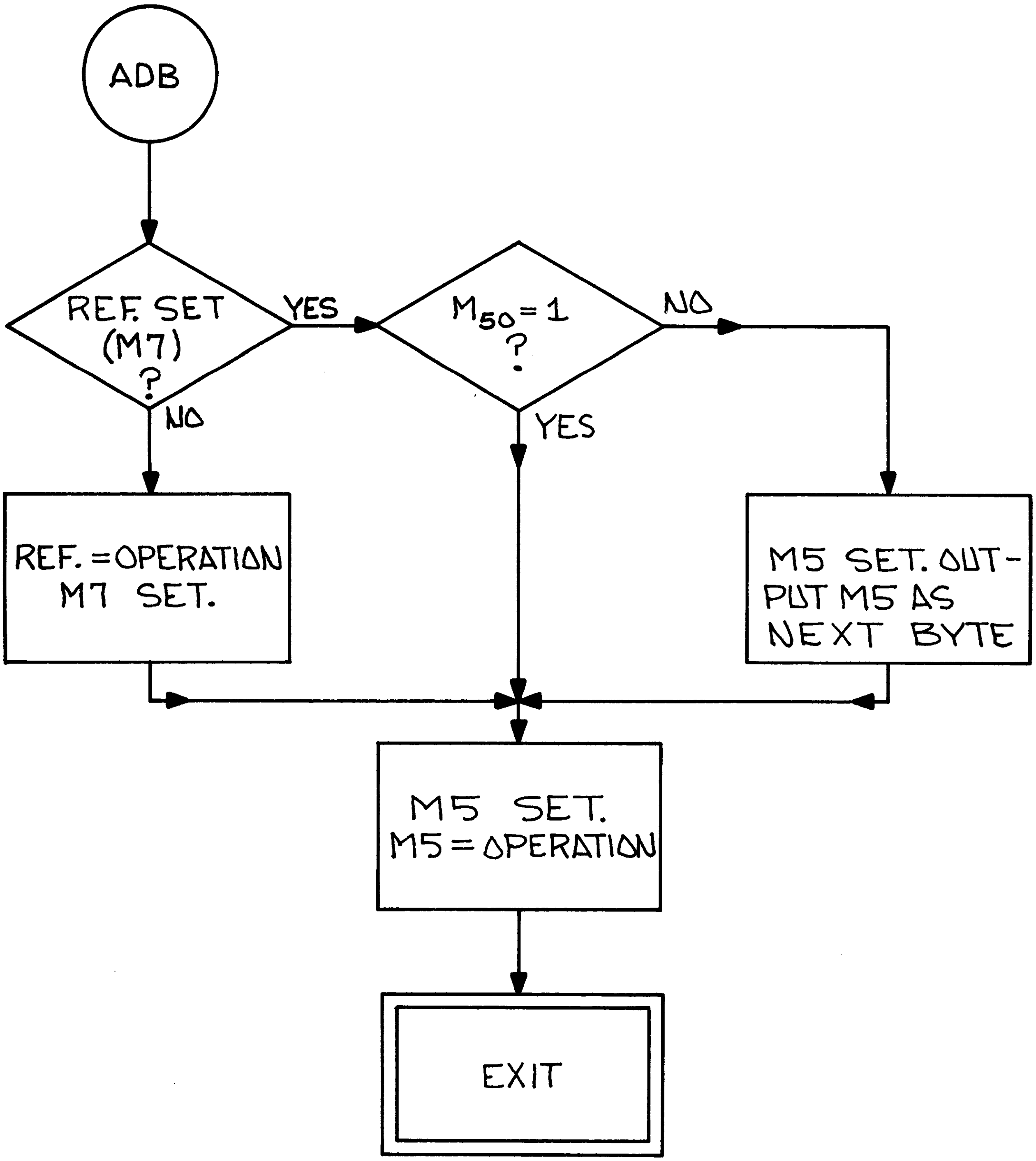
M7 bit 1 is turned on when the character extension of the reference byte (which is held in M7 until the end of the address field) has been set. M5 bit 1 is set to a 1 when an operation byte is output into the address field. This means that the "last" indicator does not go into the reference character extension. When an operation byte is handed to ADB for output, it is saved in

M5, and M5 bit 0 is set to 0 to signify this. When the extension byte is added, the character extension for it can be added to M5 before it is output.

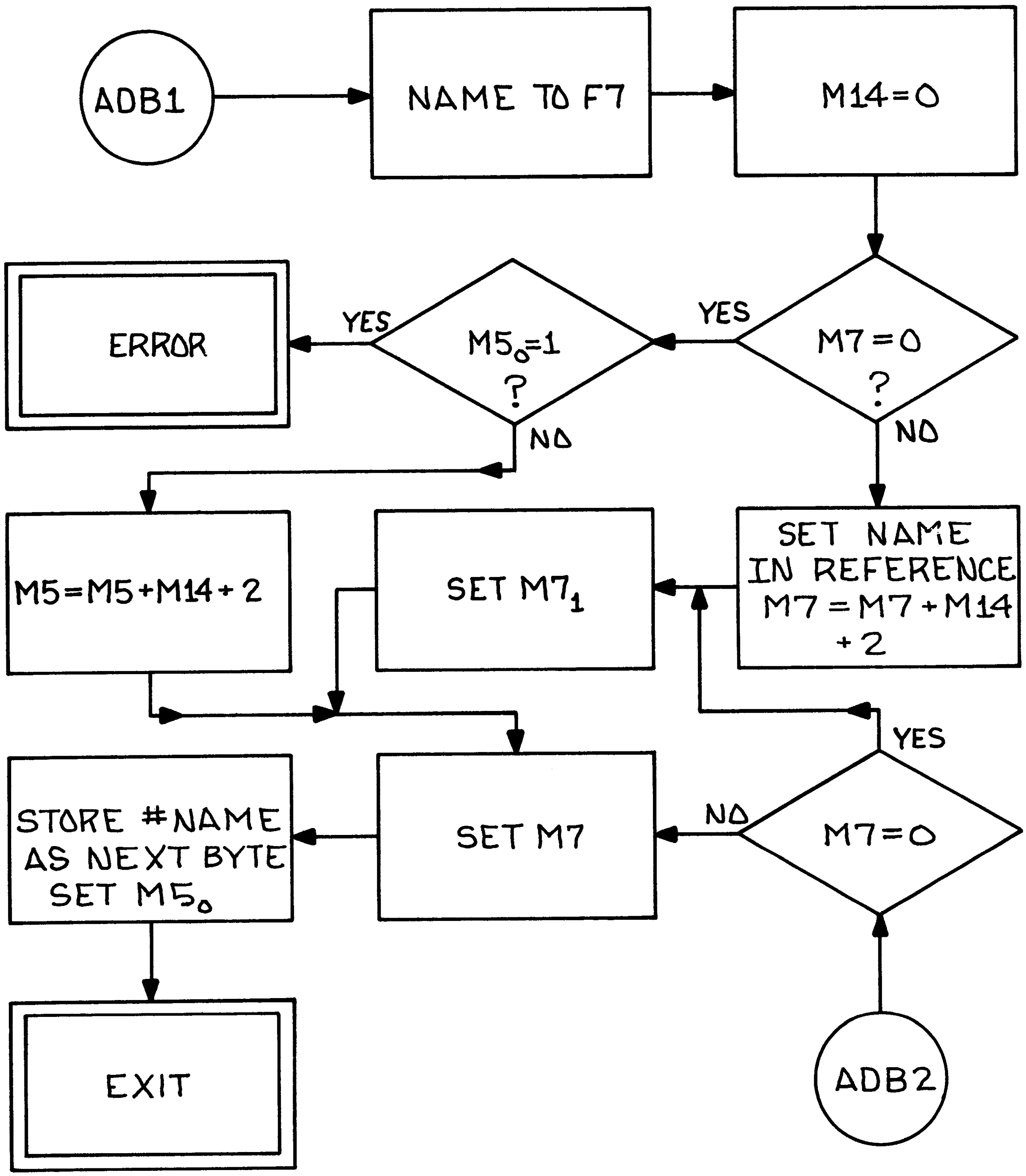



β
16 ENTRIES IN THIS BLOCK ?
YES
NO
ANOTHER BLOCK OF MEMORY FREE ?
YES
NO
PUT A NEW CONTROL WORD IN CHAIN
STORE F7 IN NEW BLOCK
PUT -ACC AS NEXT ENTRY
SYSERR EXIT NAME TABLE FULL
EXIT
INCREASE COUNT
RESTORE CONTROL WORD
EXIT

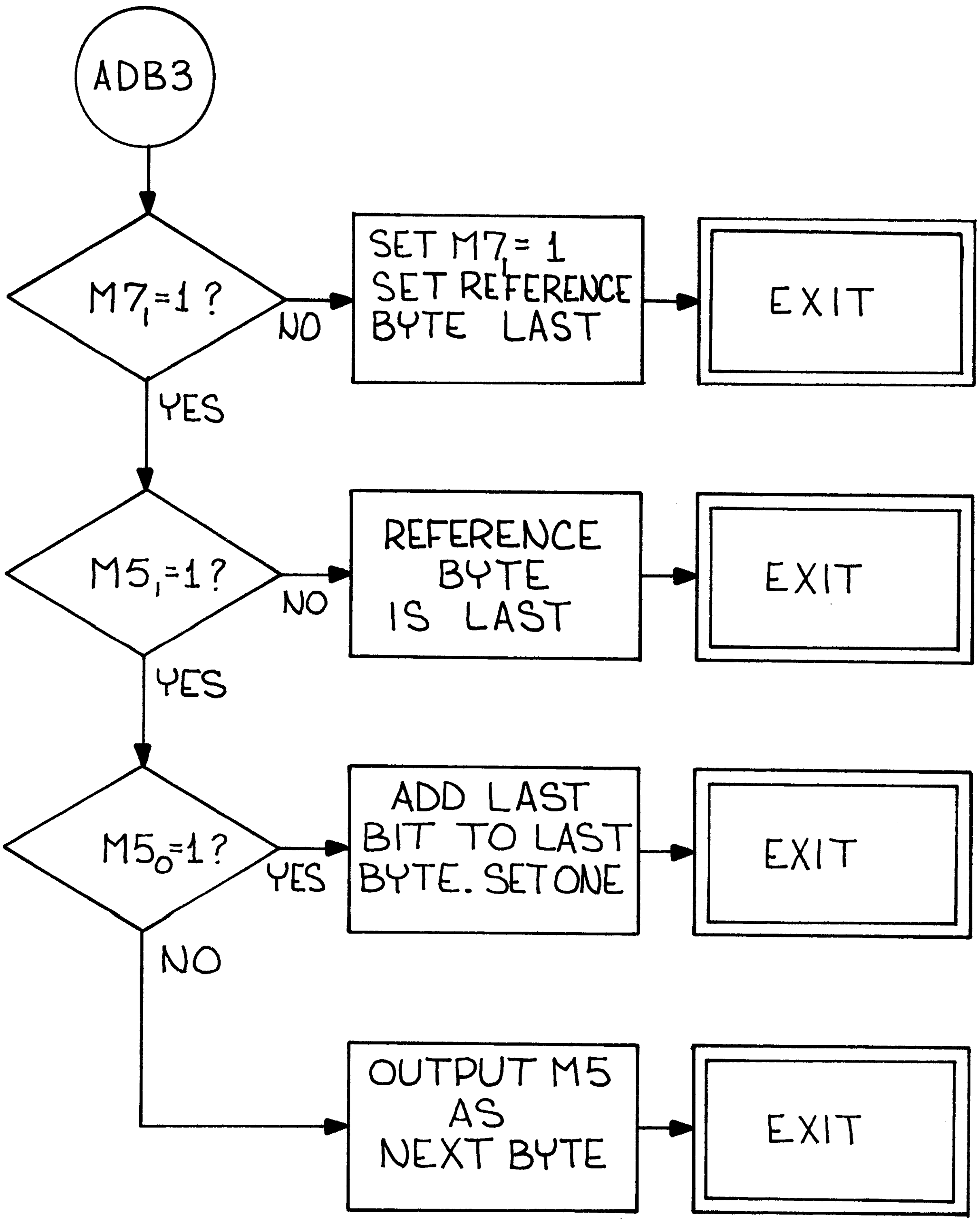
SUBROUTINE ADB (ADD BYTE)



SUBROUTINES ADB1 AND ADB2



SET END INDICATOR



3.1.5.3 Major Use of Modifiers in Pass I

M0 is used during the READNM subroutine to count characters. It is set to -7 before being called so that READNM can make an error exit if a name is larger than six characters.

M1 is used to return the latest character read from the INPUT subroutine.

M5 bit 0 is used to indicate that an operation byte of IL is being saved in M5 until the character extension is set. A zero indicates this fact.

M5 bit 1 is set to a one when an operation byte is output into an address field.

M5 bits 2-12 contain the next operation byte of IL. M5 is cleared at the start of each address field.

M6 is set to REF at the start of each card. It contains the address of the next word of the REF buffer to be used to output IL.

M7 contains a skeleton of the reference byte being constructed. The type, and outside name bits are set initially, and the subtype and character extension bits are set as soon as they are known. In the initial stages of the construction of an order, marks are set in the character extension according to the type.

M7 bit 1 is used to indicate that the character extension of the reference byte has been inserted.

M9 is used as a left-minus-right parenthesis counter in the N field scan. It must not become negative, and must be 0 at the end of the scan.

F7 is used to hold the name in table look-ups.

```
 49012C W GEAR
       NICAP PASS 1      JAN 1,1965                    TAS          P1 0001
       ORG     10                                                   P1 0002
       LFR     7,NLU2                                               P1 0003
       CAM     14,2560+385                                          P1 0004
       SFR     7,NLU2                                               P1 0005
       CSM     8,8                                                  P1 0006
XC1    LFR     7,M8+8+XC                                            P1 0007
       ANN     12,63*64                                             P1 0008
       CAM     9                                                    P1 0009
       ANN     13,63*64                                             P1 0010
       ADM     9                                                    P1 0011
       ANN     14,63*64                                             P1 0012
       ADM     9                                                    P1 0013
       CRM     9,6                                                  P1 0014
       ANN     12,63                                                P1 0015
       ADM     9                                                    P1 0016
       ANN     13,63                                                P1 0017
       ADM     9                                                    P1 0018
       ANN     14,63                                                P1 0019
       ADM     9                                                    P1 0020
       ANN     9,63                                                 P1 0021
       CAM     15                                                   P1 0022
       CALL    NTLU            PREDEFINE FAST REGISTERS F0-F7       P1 0023
       CAM     15,4096+1024+256                                     P1 0024
       SFR     7,M0                                                 P1 0025
       CJU     8,XC1                                                P1 0026
       CSM     8,16                                                 P1 0027
XC2    LFR     7,M8+XC+24                                           P1 0028
       ANN     12,63*64                                             P1 0029
       CAM     9                                                    P1 0030
       ANN     13,63*64                                             P1 0031
       ADM     9                                                    P1 0032
       ANN     14,63*64                                             P1 0033
```

```
         ADM     9
         CRM     9,6
         ANN     12,63
         ADM     9
         ANN     13,63
         ADM     9
         ANN     14,63
         ADM     9
         ANN     9,63
         CAM     15
         CALL    NTLU                      PREDEFINE MODIFIERS MO-M15
         CAM     15,4096+2048+256
         SFR     7,MO
         CJU     8,XC2
         CSM     8,(A-B-1)/2
XC4      LFR     7,A+M8+M8
         ANN     12,63*64
         CAM     9
         ANN     13,63*64
         ADM     9
         ANN     14,63*64
         ADM     9
         CRM     9,6
         ANN     12,63
         ADM     9
         ANN     13,63
         ADM     9
         ANN     14,63
         ADM     9
         ANN     9,63
         CAM     15
         CALL    MTLU                      DEFINE MNEMONICS
         LFR     7,A+M8+M8+1
         LDM     13,MENTRY+MO-MA
```

```
         SFR    7,MO+MENTRY-MA      ENTER BINARY INFORMATION IN MENTRY TABLEP1 0068
         CJU    8,XC4                                                      P1 0069
         LFR    7,NLU2                                                     P1 0070
         CAM    14,3584+256+17                                             P1 0071
         SFR    7,NLU2                                                     P1 0072
         STR    0                   DUMMY STORE TO COMPLETE PREVIOUS D.C. STP1 0073
         HLT                                                               P1 0074
XC       CHR    8,F0                NAMES FOR INITIALISATION OF            P1 0075
         CHR    8,F1                NAME TABLE                             P1 0076
         CHR    8,F2                                                       P1 0077
         CHR    8,F3                                                       P1 0078
         CHR    8,F4                                                       P1 0079
         CHR    8,F5                                                       P1 0080
         CHR    8,F6                                                       P1 0081
         CHR    8,F7                                                       P1 0082
         CHR    8,M0                                                       P1 0083
         CHR    8,M1                                                       P1 0084
         CHR    8,M2                                                       P1 0085
         CHR    8,M3                                                       P1 0086
         CHR    8,M4                                                       P1 0087
         CHR    8,M5                                                       P1 0088
         CHR    8,M6                                                       P1 0089
         CHR    8,M7                                                       P1 0090
         CHR    8,M8                                                       P1 0091
         CHR    8,M9                                                       P1 0092
         CHR    8,M10                                                      P1 0093
         CHR    8,M11                                                      P1 0094
         CHR    8,M12                                                      P1 0095
         CHR    8,M13                                                      P1 0096
         CHR    8,M14                                                      P1 0097
         CHR    8,M15                                                      P1 0098
         ORG    257                                                        P1 0099
B        BSS    1                                                          P1 0100
         CHR    8,ORN               MNEMONIC FOR ENTRY IN TABLE            P1 0101
```

```
OCTQ    4000,0       CODE-4000 MEANS ORDER,2ND QUARTER IS NOTP1 0102
DECQ    CAN          BRANCH ADDRESS FOR ORDER TYPE           P1 0103
OCTQ    04601        ORDER BITS-IF ORDER.                    P1 0104
CHR     8,ORM                                                P1 0105
OCTQ    4000,0                                               P1 0106
DECQ    CAM                                                  P1 0107
OCTQ    04600                                                P1 0108
CHR     8,NON                                                P1 0109
OCTQ    4000,0                                               P1 0110
DECQ    CAN                                                  P1 0111
OCTQ    04401                                                P1 0112
CHR     8,NOM                                                P1 0113
OCTQ    4000,0                                               P1 0114
DECQ    CAM                                                  P1 0115
OCTQ    04400                                                P1 0116
CHR     8,SEQ                                                P1 0117
OCTQ    4000,0                                               P1 0118
DECQ    STR                                                  P1 0119
OCTQ    13200                                                P1 0120
CHR     8,EOM                                                P1 0121
OCTQ    4000,0                                               P1 0122
DECQ    CAM                                                  P1 0123
OCTQ    06600                                                P1 0124
CHR     8,SRM                                                P1 0125
OCTQ    4000,0                                               P1 0126
DECQ    STR                                                  P1 0127
OCTQ    14300                                                P1 0128
CHR     8,LRS                                                P1 0129
OCTQ    4000,0                                               P1 0130
DECQ    CAE                                                  P1 0131
OCTQ    14500                                                P1 0132
CHR     8,NOT                                                P1 0133
OCTQ    4000,0                                               P1 0134
DECQ    CAD                                                  P1 0135
```

```
OCTQ   10400
CHR    8,TNO
OCTQ   4000,0
DECQ   JOV
OCTQ   05644
CHR    8,NDV
OCTQ   4000,0
DECQ   CAD
OCTQ   12200
CHR    8,SEX
OCTQ   4000,0
DECQ   CJS
OCTQ   13700
CHR    8,JZM
OCTQ   4000,0
DECQ   CJU
OCTQ   03500
CHR    8,STR
OCTQ   4000,0
DECQ   STR
OCTQ   12400
CHR    8,TLP
OCTQ   4000,0
DECQ   JOV
OCTQ   05670
CHR    8,GO
OCTQ   10000,0          CODE FOR PSEUDO ORDER
DECQ   GO
OCTQ   10000            TYPE OF NAME DEFINED IF APPEARING IN
CHR    8,CNN            LOCATION CPLUMNS
OCTQ   4000,0
DECQ   CAN
OCTQ   02401
CHR    8,CJZ
```

```
OCTQ    4000,0                                  P1 0170
DECQ    CJU                                     P1 0171
OCTQ    03700                                   P1 0172
CHR     8,SRS                                   P1 0173
OCTQ    4000,0                                  P1 0174
DECQ    CAE                                     P1 0175
OCTQ    14700                                   P1 0176
CHR     8,SFN                                   P1 0177
OCTQ    4000,0                                  P1 0178
DECQ    CAE                                     P1 0179
OCTQ    04100                                   P1 0180
CHR     8,FLD                                   P1 0181
OCTQ    10000,0                                 P1 0182
DECQ    FLD                                     P1 0183
OCTQ    16000                                   P1 0184
CHR     8,TEI                                   P1 0185
OCTQ    4000,0                                  P1 0186
DECQ    JOV                                     P1 0187
OCTQ    05600                                   P1 0188
CHR     8,CNM                                   P1 0189
OCTQ    4000,0                                  P1 0190
DECQ    CAM                                     P1 0191
OCTQ    02400                                   P1 0192
CHR     8,SIA                                   P1 0193
OCTQ    4000,0                                  P1 0194
DECQ    CJS                                     P1 0195
OCTQ    13300                                   P1 0196
CHR     8,TZ                                    P1 0197
OCTQ    4000,0                                  P1 0198
DECQ    JOV                                     P1 0199
OCTQ    05624                                   P1 0200
CHR     8,DEC                                   P1 0201
OCTQ    10000,0                                 P1 0202
DECQ    DEC                                     P1 0203
```

```
OCTQ    10000                                   P1 0204
CHR     8,JPM                                   P1 0205
OCTQ    4000,0                                  P1 0206
DECQ    CJU                                     P1 0207
OCTQ    07400                                   P1 0208
CHR     8,JLH                                   P1 0209
OCTQ    4000,0                                  P1 0210
DECQ    CAE                                     P1 0211
OCTQ    05400                                   P1 0212
CHR     8,NAN                                   P1 0213
OCTQ    4000,0                                  P1 0214
DECQ    CAN                                     P1 0215
OCTQ    04501                                   P1 0216
CHR     8,ANN                                   P1 0217
OCTQ    4000,0                                  P1 0218
DECQ    CAN                                     P1 0219
OCTQ    04701                                   P1 0220
CHR     8,TLN                                   P1 0221
OCTQ    4000,0                                  P1 0222
DECQ    JOV                                     P1 0223
OCTQ    05674                                   P1 0224
CHR     8,STF                                   P1 0225
OCTQ    4000,0                                  P1 0226
DECQ    STR                                     P1 0227
OCTQ    13000                                   P1 0228
CHR     8,LDM                                   P1 0229
OCTQ    4000,0                                  P1 0230
DECQ    LDM                                     P1 0231
OCTQ    07100                                   P1 0232
CHR     8,CSN                                   P1 0233
OCTQ    4000,0                                  P1 0234
DECQ    CAN                                     P1 0235
OCTQ    02501                                   P1 0236
CHR     8,CJF                                   P1 0237
```

```
OCTQ    4000,0                P1 0238
DECQ    CJS                   P1 0239
OCTQ    05700                 P1 0240
CHR     8,ASSIGN              P1 0241
OCTQ    10000,0               P1 0242
DECQ    ASSIGN                P1 0243
OCTQ    10000                 P1 0244
CHR     8,NAM                 P1 0245
OCTQ    4000,0                P1 0246
DECQ    CAM                   P1 0247
OCTQ    04500                 P1 0248
CHR     8,DAV                 P1 0249
OCTQ    4000,0                P1 0250
DECQ    CAD                   P1 0251
OCTQ    14200                 P1 0252
CHR     8,CSE                 P1 0253
OCTQ    4000,0                P1 0254
DECQ    CAE                   P1 0255
OCTQ    11500                 P1 0256
CHR     8,STN                 P1 0257
OCTQ    4000,0                P1 0258
DECQ    STR                   P1 0259
OCTQ    12700                 P1 0260
CHR     8,AND                 P1 0261
OCTQ    4000,0                P1 0262
DECQ    CAD                   P1 0263
OCTQ    10500                 P1 0264
CHR     8,TP                  P1 0265
OCTQ    4000,0                P1 0266
DECQ    JOV                   P1 0267
OCTQ    05630                 P1 0268
CHR     8,ANM                 P1 0269
OCTQ    4000,0                P1 0270
DECQ    CAM                   P1 0271
```

```
OCTQ    04700          P1 0272
CHR     8,ADE          P1 0273
OCTQ    4000,0         P1 0274
DECQ    CAE            P1 0275
OCTQ    11300          P1 0276
CHR     8,ADN          P1 0277
OCTQ    4000,0         P1 0278
DECQ    CAN            P1 0279
OCTQ    06701          P1 0280
CHR     8,CALL         P1 0281
OCTQ    10000,0        P1 0282
DECQ    CALL           P1 0283
OCTQ    16000          P1 0284
CHR     8,JNM          P1 0285
OCTQ    4000,0         P1 0286
DECQ    CJU            P1 0287
OCTQ    03400          P1 0288
CHR     8,CAN          P1 0289
OCTQ    4000,0         P1 0290
DECQ    CAN            P1 0291
OCTQ    02701          P1 0292
CHR     8,ATN          P1 0293
OCTQ    4000,0         P1 0294
DECQ    CAE            P1 0295
OCTQ    02100          P1 0296
CHR     8,SBN          P1 0297
OCTQ    4000,0         P1 0298
DECQ    CAN            P1 0299
OCTQ    06501          P1 0300
CHR     8,BES          P1 0301
OCTQ    10000,0        P1 0302
DECQ    BES            P1 0303
OCTQ    10000          P1 0304
CHR     8,TO           P1 0305
```

```
OCTQ    4000,0                                        P1 0306
DECQ    JOV                                           P1 0307
OCTQ    05640                                         P1 0308
CHR     8,STU                                         P1 0309
OCTQ    4000,0                                        P1 0310
DECQ    STR                                           P1 0311
OCTQ    13400                                         P1 0312
CHR     8,SBE                                         P1 0313
OCTQ    4000,0                                        P1 0314
DECQ    CAE                                           P1 0315
OCTQ    11100                                         P1 0316
CHR     8,CAE                                         P1 0317
OCTQ    4000,0                                        P1 0318
DECQ    CAE                                           P1 0319
OCTQ    11700                                         P1 0320
CHR     8,ADM                                         P1 0321
OCTQ    4000,0                                        P1 0322
DECQ    CAM                                           P1 0323
OCTQ    06700                                         P1 0324
CHR     8,JUM                                         P1 0325
OCTQ    4000,0                                        P1 0326
DECQ    CJU                                           P1 0327
OCTQ    07500                                         P1 0328
CHR     8,CSM                                         P1 0329
OCTQ    4000,0                                        P1 0330
DECQ    CAM                                           P1 0331
OCTQ    02500                                         P1 0332
CHR     8,ADD                                         P1 0333
OCTQ    4000,0                                        P1 0334
DECQ    CAD                                           P1 0335
OCTQ    11200                                         P1 0336
CHR     8,JDC                                         P1 0337
OCTQ    4000,0                                        P1 0338
DECQ    CJU                                           P1 0339
```

```
OCTQ    05600                  P1 0340
CHR     8,CJU                  P1 0341
OCTQ    4000,0                 P1 0342
DECQ    CJU                    P1 0343
OCTQ    07700                  P1 0344
CHR     8,STC                  P1 0345
OCTQ    4000,0                 P1 0346
DECQ    STR                    P1 0347
OCTQ    12600                  P1 0348
CHR     8,TN                   P1 0349
OCTQ    4000,0                 P1 0350
DECQ    JOV                    P1 0351
OCTQ    05614                  P1 0352
CHR     8,CST                  P1 0353
OCTQ    4000,0                 P1 0354
DECQ    CAD                    P1 0355
OCTQ    10100                  P1 0356
CHR     8,SBM                  P1 0357
OCTQ    4000,0                 P1 0358
DECQ    CAM                    P1 0359
OCTQ    06500                  P1 0360
CHR     8,SUB                  P1 0361
OCTQ    4000,0                 P1 0362
DECQ    CAD                    P1 0363
OCTQ    11000                  P1 0364
CHR     8,CAM                  P1 0365
OCTQ    4000,0                 P1 0366
DECQ    CAM                    P1 0367
OCTQ    02700                  P1 0368
CHR     8,CAD                  P1 0369
OCTQ    4000,0                 P1 0370
DECQ    CAD                    P1 0371
OCTQ    10200                  P1 0372
CHR     8,EQUF                 P1 0373
```

```
OCTQ    10000,0                                         P1 0374
DECQ    EQUF                                            P1 0375
OCTQ    12000                                           P1 0376
CHR     8,TNOR                                          P1 0377
OCTQ    4000,0                                          P1 0378
DECQ    JOV                                             P1 0379
OCTQ    05654                                           P1 0380
CHR     8,LAL                                           P1 0381
OCTQ    4000,0                                          P1 0382
DECQ    CAD                                             P1 0383
OCTQ    14100                                           P1 0384
CHR     8,TU                                            P1 0385
OCTQ    4000,0                                          P1 0386
DECQ    JOV                                             P1 0387
OCTQ    05620                                           P1 0388
CHR     8,CAT                                           P1 0389
OCTQ    4000,0                                          P1 0390
DECQ    CAD                                             P1 0391
OCTQ    10300                                           P1 0392
CHR     8,SAM                                           P1 0393
OCTQ    4000,0                                          P1 0394
DECQ    STR                                             P1 0395
OCTQ    13500                                           P1 0396
CHR     8,SSC                                           P1 0397
OCTQ    4000,0                                          P1 0398
DECQ    STR                                             P1 0399
OCTQ    11400                                           P1 0400
CHR     8,CSB                                           P1 0401
OCTQ    4000,0                                          P1 0402
DECQ    CAD                                             P1 0403
OCTQ    10000                                           P1 0404
CHR     8,ORG                                           P1 0405
OCTQ    10000,0                                         P1 0406
DECQ    ORG                                             P1 0407
```

```
OCTQ    10000          P1 0408
CHR     8,SAL          P1 0409
OCTQ    4000,0         P1 0410
DECQ    STR            P1 0411
OCTQ    13600          P1 0412
CHR     8,BSS          P1 0413
OCTQ    10000,0        P1 0414
DECQ    BSS            P1 0415
OCTQ    10000          P1 0416
CHR     8,CJS          P1 0417
OCTQ    4000,0         P1 0418
DECQ    CJS            P1 0419
OCTQ    05500          P1 0420
CHR     8,ASC          P1 0421
OCTQ    4000,0         P1 0422
DECQ    STR            P1 0423
OCTQ    11600          P1 0424
CHR     8,EQUM         P1 0425
OCTQ    10000,0        P1 0426
DECQ    EQUM           P1 0427
OCTQ    14000          P1 0428
CHR     8,JSB          P1 0429
OCTQ    4000,0         P1 0430
DECQ    CJU            P1 0431
OCTQ    07600          P1 0432
CHR     8,CAJ          P1 0433
OCTQ    4000,0         P1 0434
DECQ    CAJ            P1 0435
OCTQ    7700           P1 0436
CHR     8,CHR          P1 0437
OCTQ    10000,0        P1 0438
DECQ    CHR            P1 0439
OCTQ    10000          P1 0440
CHR     8,EQUL         P1 0441
```

```
OCTQ    10000,0                     P1 0442
DECQ    EQUL                        P1 0443
OCTQ    16000                       P1 0444
CHR     8,OCTQ                      P1 0445
OCTQ    10000,0                     P1 0446
DECQ    OCTQ                        P1 0447
OCTQ    16000                       P1 0448
CHR     8,DECQ                      P1 0449
OCTQ    10000,0                     P1 0450
DECQ    DECQ                        P1 0451
OCTQ    16000                       P1 0452
CHR     8,EQUS                      P1 0453
OCTQ    10000,0                     P1 0454
DECQ    EQUS                        P1 0455
OCTQ    10000                       P1 0456
CHR     8,TZP                       P1 0457
OCTQ    4000,0                      P1 0458
DECQ    JOV                         P1 0459
OCTQ    05610                       P1 0460
CHR     8,MPY                       P1 0461
OCTQ    4000,0                      P1 0462
DECQ    CAD                         P1 0463
OCTQ    12000                       P1 0464
CHR     8,TRA                       P1 0465
OCTQ    4000,0                      P1 0466
DECQ    JOV                         P1 0467
OCTQ    05604                       P1 0468
CHR     8,EQN                       P1 0469
OCTQ    4000,0                      P1 0470
DECQ    CAN                         P1 0471
OCTQ    06401                       P1 0472
CHR     8,TOR                       P1 0473
OCTQ    4000,0                      P1 0474
DECQ    JOV                         P1 0475
```

```
OCTQ    05650          P1 0476
CHR     8,FIL          P1 0477
OCTQ    10000,0        P1 0478
DECQ    FIL            P1 0479
OCTQ    16000          P1 0480
CHR     8,VID          P1 0481
OCTQ    4000,0         P1 0482
DECQ    CAD            P1 0483
OCTQ    12300          P1 0484
CHR     8,LOR          P1 0485
OCTQ    4000,0         P1 0486
DECQ    CAD            P1 0487
OCTQ    10600          P1 0488
CHR     8,XCH          P1 0489
OCTQ    4000,0         P1 0490
DECQ    STR            P1 0491
OCTQ    12500          P1 0492
CHR     8,DIV          P1 0493
OCTQ    4000,0         P1 0494
DECQ    CAD            P1 0495
OCTQ    12100          P1 0496
CHR     8,LFR          P1 0497
OCTQ    4000,0         P1 0498
DECQ    LFR            P1 0499
OCTQ    07000          P1 0500
CHR     8,LIN          P1 0501
OCTQ    4000,0         P1 0502
DECQ    CAE            P1 0503
OCTQ    06000          P1 0504
CHR     8,SIF          P1 0505
OCTQ    4000,0         P1 0506
DECQ    STR            P1 0507
OCTQ    13100          P1 0508
CHR     8,ORB          P1 0509
```

```
OCTQ    4000,0          P1 0510
DECQ    CAE             P1 0511
OCTQ    06100           P1 0512
CHR     8,EQM           P1 0513
OCTQ    4000,0          P1 0514
DECQ    CAM             P1 0515
OCTQ    06400           P1 0516
CHR     8,CRN           P1 0517
OCTQ    4000,0          P1 0518
DECQ    CAN             P1 0519
OCTQ    02601           P1 0520
CHR     8,TZN           P1 0521
OCTQ    4000,0          P1 0522
DECQ    JOV             P1 0523
OCTQ    05634           P1 0524
CHR     8,CRM           P1 0525
OCTQ    4000,0          P1 0526
DECQ    CAM             P1 0527
OCTQ    2600            P1 0528
CHR     8,EON           P1 0529
OCTQ    4000,0          P1 0530
DECQ    CAN             P1 0531
OCTQ    06601           P1 0532
CHR     8,SFR           P1 0533
OCTQ    4000,0          P1 0534
DECQ    LFR             P1 0535
OCTQ    03000           P1 0536
CHR     8,ENTRY         P1 0537
OCTQ    10000,0         P1 0538
DECQ    ENTRY,0         P1 0539
CHR     8,SSR           P1 0540
OCTQ    4001,0          P1 0541
DECQ    SSR             P1 0542
OCTQ    07300           P1 0543
```

```
CHR      8,SSN
OCTQ     4001,0
DECQ     SSR
OCTQ     07200
CHR      8,POD
OCTQ     4001,0
DECQ     CAE
OCTQ     06200
CHR      8,PID
OCTQ     4001,0
DECQ     CAE
OCTQ     02300
CHR      8,FBF
OCTQ     4001,0
DECQ     CAE
OCTQ     04200
CHR      8,IBT
OCTQ     4001,0
DECQ     CAE
OCTQ     02200
CHR      8,BLS
OCTQ     4000,0
DECQ     BLS
OCTQ     10700
CHR      8,FIN
OCTQ     4000,0
DECQ     LF2
OCTQ     10700
CHR      8,BBF
OCTQ     4001,0
DECQ     CAE
OCTQ     04300
CHR      8,ASN
OCTQ     4001,0
```

```
         DECQ     SSR                                                 P1 0578
         OCTQ     03200                                               P1 0579
         CHR      8,HLT                                               P1 0580
         OCTQ     4001,0                                              P1 0581
         DECQ     SSR                                                 P1 0582
         OCTQ     6300                                                P1 0583
         CHR      8,COMMON                                            P1 0584
         OCTQ     10000,0                                             P1 0585
         DECQ     COMMON                                              P1 0586
         OCTQ     10000                                               P1 0587
         CHR      8,ERASE                                             P1 0588
         OCTQ     10000,0                                             P1 0589
         DECQ     ERASE                                               P1 0590
         OCTQ     10000                                               P1 0591
         CHR      8,QIN                                               P1 0592
         OCTQ     4000,0                                              P1 0593
         DECQ     CAE                                                 P1 0594
         OCTQ     6000                                                P1 0595
         CHR      8,DECQL                                             P1 0596
         OCTQ     10000,0                                             P1 0597
         DECQ     DECQL                                               P1 0598
         OCTQ     10000                                               P1 0599
         CHR      8,OCTQL                                             P1 0600
         OCTQ     10000,0                                             P1 0601
         DECQ     OCTQL                                               P1 0602
         OCTQ     10000                                               P1 0603
         CHR      8,TAI                                               P1 0604
         OCTQ     4000,0                                              P1 0605
         DECQ     JOV                                                 P1 0606
         OCTQ     5600                                                P1 0607
A        BSS      1                                                   P1 0608
         ORG      768                                                 P1 0609
         CALL     SYSAUX                                              P1 0610
         DECQ     1056,0,0,1030      REWIND TAPE 6                    P1 0611
```

```
        LFR     4,MAKE
        SFR     4,MAKEUP            STORE EQU BUFFER CONTROL
        CAM     0
        SFR     4,ILBUF+256
        CALL    SYSAUX
        DECQ    WRITE,ILBUF+256,0,0
        CAM     14,M15
        SFR     7,ERRBUF            STORE CONTROL
        LFR     6,IT+4
        CAM     11,M15
        SFR     6,IT+4
        TRA     BEG2
        FIL
MAKE    DECQL   0,0,-4,MAKEUP+1
        ORG     1024
IOSYS   SFR     4,IOSYS1
        SFR     5,IOSYS1+1
        LFR     5,IT+4
        JZM     4,IOSYS2+1          NO WAITING
        CALL    SYSAUX
IOSYS2  DECQL   WAIT,0,0,0
        CAM     4                   SET NO WAIT
        CALL    SYSIO
        DECQ    READND,ILBUF+256,GOBOY,GOBOY
        LFR     4,IOSYS2+2
        CAM     3,M1
        CAM     0,-2
        CAM     1,-4
        CAM     2,-9
        SFR     4,IT+3
        JPM     7,IOSYS3            NO LISTING
        LFR     4,IOSYS2+2          INCREMENT BUFFER
        ADM     1,10
        SFR     4,IOSYS2+2
```

```
       CJU    5,IOSYS3          NOT LAST IN BUFFER          P1 0646
       CAM    1,ILBUF+256                                   P1 0647
       SFR    4,IOSYS2+2                                    P1 0648
       CAM    4,1               SET WAIT MARK               P1 0649
       JZM    6,IOSYS4          ON TAPE                     P1 0650
       LFR    4,IOSYS4+1                                    P1 0651
       ADM    3,1               INCREMENT DRUM SECTOR       P1 0652
       SFR    4,IOSYS4+1                                    P1 0653
       CJU    6,IOSYS4          STILL ON DRUM               P1 0654
       CAM    3,1030            CHANGE TO TAPE 6            P1 0655
       SFR 4,IOSYS4+1                                       P1 0656
       LFR    4,IOSYS2                                      P1 0657
       CAM    3,1030                                        P1 0658
       SFR    4,IOSYS2                                      P1 0659
IOSYS4 CALL   SYSAUX                                        P1 0660
       DECQ   WRITE,ILBUF+256,0,0                           P1 0661
       CSM    5,25              RESET BUFFER COUNT          P1 0662
IOSYS3 SFR    5,IT+4            SAVE CONTROL                P1 0663
       LFR    4,IOSYS1                                      P1 0664
       LFR    5,IOSYS1+1                                    P1 0665
       JLH    M3                                            P1 0666
IOSYS1 BSS    2                                             P1 0667
LBERR  CAM    4,6                                           P1 0668
SERR   CALL   IOSYS                                         P1 0669
       CSM    5,8                                           P1 0670
SERR1  CALL   INPUT                                         P1 0671
       CJU    5,SERR1                                       P1 0672
       CSM    0,7                                           P1 0673
       CALL   READNM            READ NAME                   P1 0674
       TRA    SERR2                                         P1 0675
       FIL                      NAME                        P1 0676
       TRA    SERR              LONG                        P1 0677
       FIL                      NAME                        P1 0678
       TRA    SERR              NUMBER                      P1 0679
```

```
         FIL
SERR2    SBM      12,3558
         JUM      12,SERR
         JUM      13,SERR                NOT GO
         LFR      6,IT+4                 CONTROL FOR SYSERR LISTING
SERR3    LDM      7,COUNT
         CAM      2,M7
         CAM      1,M4                   EXIT CODE
         TRA SYSERR                      EXIT
         FIL
BEG2     LFR      04,2,COUNT
         ADM      03,2,1
         SFR      04,2,COUNT             INCREMENT CARD NUMBER
         FIL
BEG3     LFR      7,MAC12                RESET N-FIELD EXIT
         SFR      07,2,NFD22
         CALL     IOSYS
         LFR      7,RD6A
         CAM      15,10                  SET FOR DECIMAL CONVERSION
         SFR      7,RD6A
         JDC      00,0,CDSTRT
         FIL
ERROR    JSB      3,,ERR1
         FIL
MTLU     ANM      15,15                  EXTRACT MOD 16
         ADM      15,MTBL-NTBL           ADJUST TABLE BASE
NTLU     SFR      5,NLU10+1              SAVE F5
         LFR      5,M15+NTBL             LOAD CONTROL WORD
         CAM      15                     CLEAR M15
         CSB      F7                     -SEARCHEE
         JZM      6,NLU14                NO ENTRIES
         LFR      2,NLU9                 MASK
NLU1     ADD      7,1,                   ADD NEXT ENTRY
         AND      F2                     EXTRACT
```

```
         TZ     NLU7          FOUND                    P1 0714
         CJU    6,NLU1        COUNT                    P1 0715
         JZM    5,NLU2        END OF CHAIN             P1 0716
         LFR    5,M5          NEXT BLOCK               P1 0717
         CSB    F7                                     P1 0718
         TRA    NLU1          REPEAT                   P1 0719
NLU2     SBM    4,NTBL                                 P1 0720
         JPM    4,NLU4        NAME TABLE               P1 0721
NLU3     LFR    5,NLU10+1                              P1 0722
         TRA    2,M3-1        ERROR EXIT               P1 0723
NLU4     LFR    5,M4+NTBL     RELOAD CONTROL           P1 0724
NLU5     ADM    6,15                                   P1 0725
         JNM    6,NLU8        BLOCK FULL               P1 0726
         SAM    F2                                     P1 0727
         CSB    F2            NEGATE                   P1 0728
         SAM    F7            SET UP F7                P1 0729
         SFN    6,-15                                  P1 0730
NLU6     CAM    0,M7                                   P1 0731
         SAM    M0            STORE DIFFERENCE         P1 0732
         SBM    6,16          REDUCE M16               P1 0733
         SFR    5,M4          UPDATE CONTROL WORD      P1 0734
         LFR    5,NLU10+1     RESTORE F5               P1 0735
         JLH    M3            EXIT                     P1 0736
NLU7     CAM    0,M7-1        SET M0                   P1 0737
         LFR    7,M0          F7=ENTRY                 P1 0738
         ORM    15,256        NAME IS USED             P1 0739
         SFR    7,M0                                   P1 0740
         LFR    5,NLU10+1                              P1 0741
         JLH    M3            EXIT                     P1 0742
NLU8     SFR    6,NLU10+2     SAVE F6                  P1 0743
         LFR    6,NLU10                                P1 0744
         SBM    11,LLPB                                P1 0745
         JPM    11,NLU13                               P1 0746
         CAM    4,TABFUL                               P1 0747
```

```
         TRA    SERR                    NAME TABLE FULL                          P1 0748
NLU13    CAM    5,M9                    NEW CHAIN                                P1 0749
         SBM    6,15                    RESET COUNT                              P1 0750
         SFR    5,M4                    RESTORE CONTROL                          P1 0751
         ATN    9,1,                                                             P1 0752
         CAM    4                       NEW CONTROL                              P1 0753
         CAM    5                       END OF CHAIN                             P1 0754
         CAM    6,15                    COUNT IS ONE                             P1 0755
         CAM    7,M11+LLPB              RESET M7=ADDRESS                         P1 0756
         ADM    11,LLPB-16              DECREASE BY 16                           P1 0757
         SFR    6,NLU10                                                          P1 0758
         LFR    6,NLU10+2                                                        P1 0759
         CAD    F7                                                               P1 0760
         TRA    NLU6                                                             P1 0761
NLU14    ADM    6,15                                                             P1 0762
         CAD    F7                                                               P1 0763
         TRA    NLU6                                                             P1 0764
NLU9     DECQL  -1,-1,-1,0              MASK FOR NAME                            P1 0765
NLU10    DECQL  0,NTBL+1024+64,0,TOP-16       FREE MENORY COUNTER                P1 0766
         BSS    2                                                                P1 0767
READNM   SFR    04,2,RD13               SUBROUTINE TO READ INTEGERS AND NAMES    P1 0768
         SFR    06,2,RD13+1             ON ENTRY, FIRST CHARACTER IS IN M1       P1 0769
         CAM    15,,                    SUM OF CHARACTERS IS STORED IN M15       P1 0770
         CAM    08,,                                                             P1 0771
         CSM    09,2,3                                                           P1 0772
         CSM    10,2,1366               CHARACTER COUNTER BINARY 01010101......  P1 0773
         CAD    15,3,                   INTEGER IS FORMED IN ACCUMALATOR         P1 0774
         FIL                                                                     P1 0775
RD6      JNM    01,0,RD7                BRANCH ON NON-ALPHAN CHARACTER           P1 0776
         JNM    08,0,RD3                BRANCH IF PREVIOUS ALPHA                 P1 0777
         CRM    01,2,12                                                          P1 0778
         JPM    01,0,RD2                BRANCH IF ALPHA                          P1 0779
         CRM    01,2,1                  NUMBER...                                P1 0780
RD6A     MPY    09,3,10                 INTEGER CONVERSION,DECIMAL TO BINARY     P1 0781
```

```
         ANM    01,3,63                                              P1 0782
         CAM    3,-11                                                P1 0783
         CJU    3,RD2A            CODE                               P1 0784
         CAM    3,-10             CORRECT ZERO                       P1 0785
RD2A     ADD    M3+10.                                               P1 0786
         JDC    00,0,RD3                                             P1 0787
RD2      CSM    08,2,1            SET ALPHA SWITCH                   P1 0788
         CRM    01,2,1                                               P1 0789
RD3      ATN    01,,                                                 P1 0790
         ADM    15,,              FORM CHARACTER SUM                 P1 0791
         JNM    10,0,RD4          JUMP IF LEFT HALF                  P1 0792
         ANM    01,3,63                                              P1 0793
         ADM    14,,              ADD RIGHT HALF                     P1 0794
         JDC    00,0,RD5                                             P1 0795
RD4      ATN    13,,              SHIFT LEFT 13 PLACES               P1 0796
         CAM    12,,                                                 P1 0797
         ATN    14,,                                                 P1 0798
         CAM    13,,                                                 P1 0799
         ANM    01,3,63                                              P1 0800
         CAM    14,,                                                 P1 0801
         CRM    14,2,7            PUT IN LEFT HALF                   P1 0802
         ADM    09,2,1            INCREMENT                          P1 0803
RD5      CRM    10,2,1            LEFT/RIGHT SWITCH                  P1 0804
         ADM    00,2,1            CHARACTER COUNTER                  P1 0805
         CAM    03,2,RD6                                             P1 0806
         JDC    00,0,INPUT        ENTER INPUT SUBROUTINE,RETURN TO RD6 P1 0807
RD7      LDM    03,2,RD13         GET EXIT ADDRESS                   P1 0808
         JNM    08,0,RD8          NAME IF ALPHA READ                 P1 0809
         LFR    06,2,RD13+1                                          P1 0810
         JLH    03,2,2            NUMBER EXIT                        P1 0811
RD8      JNM    00,0,RD9          IF MO IS POSITIVE, NAME IS TOO LONG P1 0812
         LFR    06,2,RD13+1                                          P1 0813
         JLH    03,2,1            ILLEGAL NAME EXIT                  P1 0814
RD9      JNM    10,0,RD11                                            P1 0815
```

```
RD11    JZM     09,0,RD10                                            P1 0816
RD12    ATN     13,,          SHIFT NAME UNTIL LEFT JUSTIFIED        P1 0817
        CAM     12,,                                                 P1 0818
        ATN     14,,                                                 P1 0819
        CAM     13,,                                                 P1 0820
        CAM     14                                                   P1 0821
        CJU     09,0,RD12                                            P1 0822
RD10    ANM     15,2,63       EXTRACT MOD 64 CHARACTER SUM           P1 0823
        LFR     06,2,RD13+1                                          P1 0824
        JLH     03,,          LEGAL NAME EXIT                        P1 0825
RD13    BSS     2                                                    P1 0826
INPUT   SFR     5,IT          SUBROUTINE TO READ NEXT CARD CHARACTER P1 0827
        SFR     7,IT+1                                               P1 0828
        LFR     5,IT+3                                               P1 0829
        JZM     6,INPUT1      END OF CARD                            P1 0830
INPUT2  LFR     7,M7          LOAD 8 CHARS                           P1 0831
        ORB     M5                                                   P1 0832
        CAM     1,M12         QUARTER WORD                           P1 0833
        CRM     1,6                                                  P1 0834
        CJU     4,INPUT3      LEFT HALF                              P1 0835
        CAM     4,-2          RESET HALF WORD COUNT                  P1 0836
        CJZ     5,INPUT4      END OF WORD                            P1 0837
INPUT5  CRM     1,7                                                  P1 0838
INPUT3  ANM     1,63          EXTRACT CHARACTER                      P1 0839
        SFR     5,IT+3                                               P1 0840
        LFR     5,IT                                                 P1 0841
        LFR     7,IT+1                                               P1 0842
        LDM     1,M1+MENTRY   CODE CONVERSION                        P1 0843
        JLH     M3            EXIT                                   P1 0844
INPUT4  ADM     7,1                                                  P1 0845
        CAM     5,-4                                                 P1 0846
        ADM     6,1           INCREMENT WORD COUNT                   P1 0847
        TRA     INPUT5                                               P1 0848
INPUT1  CAM     9,16          EXCEEDED COLUMN 72 TYPE ERROR          P1 0849
```

```
       JSB    3,2,ERR1                                               P1 0850
IT     BSS    3                                                      P1 0851
       DECQ   -2,-4,-9,RDBUF     STARTING FORD FOR CARD COUNTER      P1 0852
       DECQ   0,-25,-5,0                                             P1 0853
       DECQ   ILBUF,-4,-256,DRUM  IL BUFFER COUNTER                  P1 0854
DRUM   EQUS   1+(TOP-NA)/256+4                                       P1 0855
TEMP1  BSS    1                  OUTSIDE NAME SAVED HERE             P1 0856
TEMP2  BSS    2                  MNEMONIC INFORMATION SAVED HERE     P1 0857
       FIL                                                           P1 0858
ASSIGN CAM    4,2,2048              OCT4000                          P1 0859
       ADM    06,2,1             ASSIGN PSEUDO-OP                    P1 0860
ASS6   JNM    01,0,ASS5          NO ALPHA-NUM CHARACTER              P1 0861
       CSM    00,2,7                                                 P1 0862
       JSB    03,0,READNM        READ FIRST NAME                     P1 0863
       FIL                                                           P1 0864
       JDC    00,0,ASS1          NAME IS ONLY LEGAL EXIT             P1 0865
       FIL                                                           P1 0866
       JDC    0,,TOM4                                                P1 0867
       FIL                                                           P1 0868
TOM4   JSB    3,,ERR14                                               P1 0869
       FIL                                                           P1 0870
       JDC    00,0,ASS7                                              P1 0871
ASS1   JSB    03,0,NTLU          NAME TABLE LOOK UP                  P1 0872
       FIL                                                           P1 0873
       JNM    15,0,ASS4          BRANCH IF ALREADY DEFINED           P1 0874
       ORM    15,2,4096             OCT10000                         P1 0875
       ATN    00,,                                                   P1 0876
       SFR    07,2,0             DEFINE AS SYMBOL                    P1 0877
ASS4   ATN    00,,                                                   P1 0878
       CAM    03,,                                                   P1 0879
       ATN    06,1,              NAME TO IL                          P1 0880
       SFR    04,,                                                   P1 0881
       ADM    04,2,8                                                 P1 0882
ASS7   ANM    01,2,63                                                P1 0883
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        SBM    01,2,COMMA                                      P1 0884
        JZM    01,0,ASS2         COMMA, READ NEXT NAME         P1 0885
        ADM    01,2,COMMA-BLANK                                P1 0886
        JZM    01,0,ASS3         BLANK, O.K.                   P1 0887
ASS5    JSB    03,0,ERR1         OTHER CHARACTERS ARE ERRORS   P1 0888
ASS2    JSB    03,0,INPUT                                      P1 0889
        FIL                                                    P1 0890
        JDC    00,0,ASS6                                       P1 0891
ASS3    ATN    04,,                                            P1 0892
        CAM    15,,                                            P1 0893
        JPM    7,ASS3A           NO OUTSIDE NAME               P1 0894
        ATN    1                                               P1 0895
ASS3A   SFR    07,2,REF+1        STORE PSEUDO ORDER            P1 0896
        JDC    00,0,NFD17                                      P1 0897
        FIL                                                    P1 0898
ENTRY   LFR    6,IT+5                                          P1 0899
        LFR    5,ENT1                                          P1 0900
        CAM    7,M11                                           P1 0901
        SFR    5,ENT1                                          P1 0902
        CAM    4,READ                                          P1 0903
        SFR    5,ENT2                                          P1 0904
        CALL   SYSAUX            SAVE IL                       P1 0905
ENT1    DECQL  WRITE,ILBUF,0,0                                 P1 0906
        CALL   SYSAUX            LOAD CONTROL BLOCK TOO        P1 0907
        DECQ   READ,ILBUF,0,0    IL BUFFER                     P1 0908
        CALL   SYSAUX                                          P1 0909
        DECQ   WAIT,0,0,0        WAIT UNTIL LOADED             P1 0910
        LFR    6,ILBUF           FIRST (CONTROL) WORD          P1 0911
        JPM    1,ENT5A                                         P1 0912
ENT5    ANM    1,63                                            P1 0913
        JZM    1,ENT4                                          P1 0914
        CALL   INPUT                                           P1 0915
ENT5A   CSM    0,7                                             P1 0916
        CALL   READNM                                          P1 0917
```

```
         SFR     7,TEMP1                                        P1 0918
         TRA     ENT3                                           P1 0919
         TRA     ENT6               NOT A NAME                  P1 0920
         FIL                                                    P1 0921
ENT6     SFR     6,TS1              DITTO.                      P1 0922
         CAM     9,19               THEREFORE ERROR TYPE 19     P1 0923
         JSB     3,3,ERR4+1                                     P1 0924
         FIL                                                    P1 0925
         TRA     ENT5               READ NEXT NAME              P1 0926
ENT3     CALL    NTLU               NAME TABLE LOOK UP          P1 0927
         LFR     7,TEMP1                                        P1 0928
         CAM     15,M0              ENTRY-NAME, EXTERNAL INTERN P1 0929
         ATN     8,1,                                           P1 0930
         SFR     7,ILBUF+1                                      P1 0931
         CAM     9,M8-256                                       P1 0932
         JNM     9,ENT5             TEST FOR NOT TOO MANY ENTRIES P1 0933
         CAM     4,5                CODE FOR TOO MANY ENTRIES   P1 0934
         TRA     SERR               TOO MANY ENTRYS             P1 0935
ENT4     SFR     6,ILBUF            STORE CONTROL               P1 0936
         CALL    SYSAUX                                         P1 0937
         DECQ    WRITE,ILBUF,0,0    WRITE BACK ON DRUM          P1 0938
         CALL    SYSAUX             RESTORE IL                  P1 0939
ENT2     BSS     1                                              P1 0940
         CALL    SYSAUX                                         P1 0941
         DECQ    WAIT,0,0,0                                     P1 0942
REM      CAM     7,368                                          P1 0943
         SFR     5,REF                                          P1 0944
         CAM     6,REF+1                                        P1 0945
         CALL    OUTPUT                                         P1 0946
         TRA     BEG2                                           P1 0947
         FIL                                                    P1 0948
OCTQ     LFR     7,RD6A                                         P1 0949
         CAM     15,8               SET FOR OCTAL CONVERSION    P1 0950
         SFR     7,RD6A                                         P1 0951
```

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         TRA   DECQ                                                   P1 0952
         FIL                                                          P1 0953
DEC      CAM   12,,             DECIMAL CARD                          P1 0954
         CAM   13,,                                                   P1 0955
         CAM   14,,                                                   P1 0956
         CAM   15,,             CLEAR F7                              P1 0957
         ADM   06,2,1                                                 P1 0958
         CAM   3,2,3872            OCT7440 NOTE                       P1 0959
DEC1     JPM   7,,TOM6                                                P1 0960
         ATN   08,3,1                                                 P1 0961
TOM6     SFR   4,2,REF+1        STORE PSEUDO ORDER                    P1 0962
         ANM   01,3,63                                                P1 0963
         CAM   03,2,-BLANK      LEAD CHARACTER BLANK = 0              P1 0964
         JZM   03,0,DEC3                                              P1 0965
         ADM   3,2,BLANK-COMMA                                        P1 0966
         JZM   03,0,DEC4        LEAD CHARACTER COMMA                  P1 0967
         JSB   03,0,READEC      READ NEXT NUMBER                      P1 0968
         FIL                                                          P1 0969
         JSB   03,0,ERROR       ERROR EXIT                            P1 0970
         FIL                                                          P1 0971
         STR   07,3,            STORE IN F7                           P1 0972
         ANM   01,3,63                                                P1 0973
         CAM   03,2,-COMMA                                            P1 0974
         JZM   03,0,DEC4        LAST CHARACTER IS COMMA               P1 0975
         ADM   03,2,COMMA-BLANK                                       P1 0976
         JZM   03,0,DEC3        OR BLANK                              P1 0977
         JSB   03,0,ERR1        OTHERS ARE ERRORS                     P1 0978
DEC2     JSB   03,0,INPUT       READ NEXT CHARACTER                   P1 0979
         FIL                                                          P1 0980
         JPM   7,,TOM7                                                P1 0981
         ATN   08,3,1                                                 P1 0982
TOM7     LDM   3,2,REF+1        INCREMENT PSEUDO ORDER COUNT          P1 0983
         ADM   3,2,32                                                 P1 0984
         ANN   3,256                                                  P1 0985
```

```
         CAM    2                                                  P1 0986
         JUM    2,DEC1                                             P1 0987
         CAM    9,17          TOO MANY NUMBERS                     P1 0988
         JSB    3,2,ERR1                                           P1 0989
DEC3     CSM    03,2,4        OUTPUT NUMBER (FINAL)                P1 0990
         ORB    03,,                                               P1 0991
         ADM    12,1,                                              P1 0992
         CAM    11,,                                               P1 0993
         ATN    06,1,                                              P1 0994
         SFR    06,0,                                              P1 0995
         CJU    03,2,DEC3                                          P1 0996
         JDC    00,0,NFD3                                          P1 0997
DEC4     CSM    03,2,4        OUTPUT NUMBER (NOT LAST)             P1 0998
         ORB    03,,                                               P1 0999
         ADM    12,1,                                              P1 1000
         CAM    11,,                                               P1 1001
         ATN    06,1,                                              P1 1002
         SFR    06,0,                                              P1 1003
         CJU    03,2,DEC4                                          P1 1004
         CAM    12,,          CLEAR F7                             P1 1005
         CAM    13,,                                               P1 1006
         CAM    14,,                                               P1 1007
         CAM    15,,                                               P1 1008
         JDC    00,0,DEC2                                          P1 1009
         FIL                                                       P1 1010
OCTQL    LFR    7,RD6A                                             P1 1011
         CAM    15,8                                               P1 1012
         SFR    7,RD6A                                             P1 1013
         FIL                                                       P1 1014
DECQL    CAM    3,256                                              P1 1015
         ATN    3,0                                                P1 1016
DECQ     CAM    3,2568                                             P1 1017
         ADM    6,1           DECIMA                               P1 1018
         CAM    05,,                                               P1 1019
```

```
DQ2    CAM    09,,
       JPM    7,,TOM8
       ATN    08,3,1
TOM8   SFR    4,2,REF+1            STORE PSEUDO ORDER
       SBM    01,2,COMMA+4096
       JZM    01,0,DQ3             LEAD COMMA
       ADM    01,2,COMMA-BLANK
       JZM    1,DQ5A               BLANK FIELD IN DECQ
       ADM    1,2,BLANK+4096       RESET M1
       CAM    04,2,DQ1             SET EXIT TO DQ1
       TRA    NFD2A                GO TO NAME FIELD READ
       FIL
DQ1    JSB    03,0,ADB3            OUTPUT LAST BYTE
       FIL
       CAM    05,2,4096
       CAM    01,2,COMMA+4096
       JSB    03,0,ADB             OUTPUT NEXT CHARACTER EXTENSION
       FIL
DQ4    JSB    03,0,INPUT           READ NEXT CHARACTER
       FIL
       JPM    7,,TOM9
       ATN    08,3,1
TOM9   LDM    3,2,REF+1
       ADM    03,2,8
       ANN    3,248
       CAM    2,-248
       JUM    2,TOM100
       CAM    9,17                 TOO MANY FIELDS IN DECQ
       JSB    3,2,ERR1
DQ3    ADM    1,COMMA-BLANK
DQ5A   ADM    1,BLANK-4096         RESET M1
       CAM    0                    INTEGER ZERO
       CAM    4,DQ1                EXIT TO DQ1
       TRA    1,NFD18              GO TO NAME FIELD READ
```

```
TOM100 CAM    2
       TRA    DQ2
       FIL
CHR    CAM    11,2,3584          OCT7000 CHR PSEUDO-OP
       CSM    00,2,7
       JSB    03,0,READNM        READ NUMBER OF CHARACTERS
       FIL
       JSB    03,0,ERR1
       FIL
CHR2   JSB    03,0,ERR1
       FIL
       SIA    00,,               NUMBER TO MO
       JNM    00,0,CHR2          TESTS FOR LESS THAN 0
       JZM    0,CHR2             0
       SBM    0,2,57
       JPM    00,0,CHR2          AND GREATER THAN 56
       ADM    0,2,64
       ANM    0,3,248               OCT370
       CAM    03,,
       CRM    03,3,11
       ADM    11,,
       ATN    06,1,
       SFR    06,,               OUTPUT PSEUDO ORDER
       SBM    01,2,COMMA+4096
       JUM    01,0,CHR9          NOT COMMA,ERROR
       CAM    0,7-M0             CHARACTER COUNT
       ANN    0,-8
       CAM    9                  WORD COUNT
       SBM    9,M0+1
       CAM    15
       CAM    10,-2
       CAM    11
       JZM    0,NFD17            NO CHARACTERS
CHR4   CALL   INPUT              READ CHARACTER
```

```
CHR7    ANN     1,63
        ADM     15              ADD TO M15
        CRM     15,7
        CJU     10,CHR5         LEFT HALF
        CAM     10,-2
        CRM     15,6
        ATN     6,1,
        SFR     7               OUTPUT IL BYTE
        CAM     15
CHR5    JUM     11,CHR6
        CJU     0,CHR4          CHARACTER COUNT
        CAM     1               BLANK
        CAM     11,1
CHR6    CJU     9,CHR7          FINISH LAST WORD
        TRA     NFD17
CHR9    JSB     03,0,ERR1
        FIL
EQUL    SFR     5,NFD22
        LFR     5,IT+3
        CAM     14,-1
        CAM     15,M1
EQUL3   ADM     14,1
        CALL    INPUT           CHECK IF NEXT CHAR IS COMMA
        ANN     1,63
        CAM     3
        JZM     3,EQUL1         BLANK,NO COMMA
        SBM     3,COMMA
        JUM     3,EQUL3         NOT COMMA
        JUM     14,EREQUL       INCORRECT Q-WORD
        FIL
EQUL1A  ANN     15,63
        CAM     9,-4
        JPM     9,EREQUL        RANGE OF Q-WORD IS TOO LARGE
        CALL    INPUT
```

```
        CAM    3,7940+M9                                     P1 1122
        TRA    EQUL2                                         P1 1123
EQUL1   SFR    5,IT+3          RESET INPUT COUNT             P1 1124
        CAM    3,7936                                        P1 1125
        CAM    1,M15                                         P1 1126
EQUL2   LFR    5,NFD22                                       P1 1127
        JDC    0,2,EQUM                                      P1 1128
EREQUL  CAM    15                                            P1 1129
        SFR    6,TS1                                         P1 1130
        CAM    3,EQUL1A                                      P1 1131
        CAM    9,5                                           P1 1132
        JDC    0,3,ERR4+1                                    P1 1133
        FIL                                                  P1 1134
EQUS    CAM    3,2,7168           OCT16000  SET PSEUDO OPS   P1 1135
        JDC    0,2,EQUM                                      P1 1136
        FIL                                                  P1 1137
EQUF    CAM    3,2,7424           OCT16400                   P1 1138
        JDC    0,2,EQUM                                      P1 1139
        FIL                                                  P1 1140
EQUM    CAM    3,2,7680           OCT17000                   P1 1141
        CAM    9,18                                          P1 1142
        JPM    7,2,ERR1         NO NAME IN EQU PSEUD/        P1 1143
        LDM    15,2,COUNT                                    P1 1144
        ATN    06,1,                                         P1 1145
        SFR    07,,            OUTPUT CARD NUMBER TO IL      P1 1146
        LFR    07,2,EQU2                                     P1 1147
        SFR    07,2,NFD22      SET EXIT FROM N-FIELD         P1 1148
        ATN    06,1,                                         P1 1149
        SFR    04,,            OUTPUT PSEUDO OP              P1 1150
        JDC    00,0,NFD2       GO TO N-FIELD                 P1 1151
        FIL                                                  P1 1152
EQU2    JDC    00,0,EQU1                                     P1 1153
        FIL                                                  P1 1154
EQU1    JSB    03,0,OPEQU      OUTPUT IL TO EQU BUFFER       P1 1155
```

```
         FIL                                                                P1 1156
         LFR      07,2,MAC12        RESET N-FIELD EXIT                       P1 1157
         SFR      07,2,NFD22                                                 P1 1158
         JDC      00,0,NFD22        OUTPUT IL BYTE INDICATING ONE CARD       P1 1159
OPEQU    SFR      04,2,T8           EQU OUTPUT SUBROUTINE                    P1 1160
         SFR      07,2,T9                                                    P1 1161
         LFR      04,2,MAKEUP                                                P1 1162
         ATN      06,,                                                       P1 1163
         CSM      00,2,-REF         NUMBER OF BYTES                          P1 1164
         SFR      05,2,REF          REFERENCE                                P1 1165
         LDM      07,2,REF+3                                                 P1 1166
         SBM      6,REF+36                                                   P1 1167
         CAM      9,17                                                       P1 1168
         JPM      6,2,ERR1          ADDRESS  TOO LONG                        P1 1169
         CRM      06,3,10                                                    P1 1170
         ADM      7,249             LENGTH OF ADDRESS TO PSEUDO OF EQU       P1 1171
         SFR      05,2,REF+3                                                 P1 1172
         CAM      04,,                                                       P1 1173
         LFR      07,2,MAKEWD                                                P1 1174
OP1      ATN      13,,              SHIFT LEFT 13 BITS                       P1 1175
         CAM      12,,                                                       P1 1176
         ATN      14,,                                                       P1 1177
         CAM      13,,                                                       P1 1178
         ATN      15,,                                                       P1 1179
         CAM      14,,                                                       P1 1180
         ATN      04,1,                                                      P1 1181
         LDM      15,2,REF          INSERT NEXT BYTE                         P1 1182
         CJU      02,0,OP2          NOT LAST QUARTER                         P1 1183
         ATN      03,1,                                                      P1 1184
         SFR      07,,                                                       P1 1185
         CSM      02,2,4                                                     P1 1186
OP2      CJU      0,OP1             NOT LAST BYTE                            P1 1187
OP3      SFR      07,2,MAKEWD                                                P1 1188
         SFR      04,2,MAKEUP       STORE EQU COUNTER BACK                   P1 1189
```

```
         SBM    3,MAKEWD                                                P1 1190
         CAM    4,EQU                                                   P1 1191
         JPM    3,SERR             TOO MANY EQU TYPES                   P1 1192
         LFR    04,2,T8                                                 P1 1193
         LFR    07,2,T9                                                 P1 1194
         CAM    7,2,368               OCT560  REFERENCE FOR SINGLE CARD PASP1 1195
         SFR    05,2,REF                                                P1 1196
         CAM    06,2,REF+1                                              P1 1197
         JLH    03,,               EXIT                                 P1 1198
T8       BSS    1                                                       P1 1199
T9       BSS    1                                                       P1 1200
         FIL                                                            P1 1201
ERASE    CAM    3,512              OCT 01000                            P1 1202
         ATN    3,0                                                     P1 1203
COMMON   CAM    3,1280                                                  P1 1204
         ATN    6,1,                                                    P1 1205
         SFR    4                                                       P1 1206
         JNM    1,ERR1                                                  P1 1207
         CSM    0,7                                                     P1 1208
         CALL   READNM                                                  P1 1209
         TRA    ERR1                                                    P1 1210
         FIL                                                            P1 1211
         TRA    ERR1                                                    P1 1212
         FIL                                                            P1 1213
         SIA    0,,                                                     P1 1214
         CAM    3,M0                                                    P1 1215
         ATN    6,1,                                                    P1 1216
         SFR    4                                                       P1 1217
         ANM    1,63                                                    P1 1218
         JZM    1,2,NFD3           BLANK IS NEXT                        P1 1219
         TRA    ERR1                                                    P1 1220
         FIL                                                            P1 1221
ORG      CAM    3,2,1024              OCT2000 ORG PSEUDO ORDER          P1 1222
ORG1     ATN    06,1,                                                   P1 1223
```

```
         SFR      04,,
         ANN      1,63
         CAM      3
         JUM      3,NFD2
         CAD      15,3,
         TRA      NFD18
         FIL
BSS      CAM      3,2,512            OCT1000  BSS PSEUDO
         JDC      00,0,ORG1
         FIL
BES      CAM      3,2,768            OCT1400  BES PSEUDO
         JDC      00,0,ORG1
         FIL
GO       CAM      3,2,1536           OCT3000  GO PSEUDO
         LFR      07,2,GO1
         SFR      07,2,BEG3       OVERWRITE BEGINNING OF
         ANN      1,63
         CAM      12
         JZM      12,GOBOY1
         JDC      00,0,ORG1       CARD TO EXIT TO GO2
         FIL
GO1      JDC      00,0,GO2
         FIL
FLD      CAM      3,2,256            OCT400   FLD PSEUDO
         JDC      00,1,FIL
FIL      CAM      03,,            FIL PSEUDO
         ATN      06,1,
         SFR      04,,
         JNM      01,0,NFD17      IF NOT ALPHA-NUM, GO TO N FIELD
         CSM      00,2,7          OUTPUT
         JSB      03,0,READNM
         FIL
         JSB      03,0,ERR1
         FIL
```

```
         JSB    03,0,ERR1                                              P1 1258
         FIL                                                           P1 1259
         SIA    00,,           ONLY INTEGER IS LEGAL                   P1 1260
         JNM    00,0,FLD1                                              P1 1261
         ATN    06,,                                                   P1 1262
         LDM    15,2,-1                                                P1 1263
         CRM    15,2,9                                                 P1 1264
FLD2     JPM    15,,TOM10                                              P1 1265
         SBM    00,2,4                                                 P1 1266
TOM10    SBM    0,2,4          TEST FOR LEGAL ADDRESS                  P1 1267
         JPM    00,0,FLD1                                              P1 1268
         JPM    15,,TOM11                                              P1 1269
         ADM    00,2,4                                                 P1 1270
TOM11    CRM    15,2,4                                                 P1 1271
         ATN    00,2,4                                                 P1 1272
         ADM    15,,                                                   P1 1273
         ATN    06,,                                                   P1 1274
         SFR    07,2,-1        ADD TO PSEUDO ORDER BITS 10-12          P1 1275
         JDC    00,0,NFD17                                             P1 1276
FLD1     JSB    03,0,ERR11                                             P1 1277
         FIL                                                           P1 1278
         JDC    00,0,FLD2                                              P1 1279
CDSTRT   CAM    06,2,REF+1     INITIALISE M6= IL OUTPUT COUNT          P1 1280
         CAM    07,,           CLEAR REFERENCE                         P1 1281
         CAM    9                                                      P1 1282
         CAM    5              CLEAR NEXT BYTE AND INDICATOR           P1 1283
         CSM    00,2,7         SET LOCATION FIELD COUNT                P1 1284
CDS2     JSB    03,0,INPUT     READ FIRST CHARACTER                    P1 1285
         FIL                                                           P1 1286
         ANN    1,63                                                   P1 1287
         CAM    3,-44                                                  P1 1288
         JZM    3,REM                                                  P1 1289
         JPM    01,0,CDS3      ALPHA-NUM                               P1 1290
         ANM    01,3,63                                                P1 1291
```

```
         CAM    03,2,-BLANK                                     P1 1292
         JZM    03,0,CDS1         BLANK O.K.                    P1 1293
         JSB    03,0,ERR14                                      P1 1294
         FIL                                                    P1 1295
CDS1     CJU    00,0,CDS2         COUNT THROUGH LOCATION FIELD  P1 1296
         JDC    00,0,RDM          GO TO READ MNEMONIC           P1 1297
CDS3     JSB    03,0,READNM       READ NAME                     P1 1298
         FIL                                                    P1 1299
         JDC    00,0,CDS5         ONLY NAME LEGAL               P1 1300
         FIL                                                    P1 1301
         JSB    03,0,ERR2                                       P1 1302
         FIL                                                    P1 1303
         JSB    03,0,ERR14                                      P1 1304
CDS6     JSB    03,0,INPUT        READ NEXT CHARACTER           P1 1305
         FIL                                                    P1 1306
         ANM    01,3,63                                         P1 1307
         CAM    03,,                                            P1 1308
         SBM    03,2,BLANK                                      P1 1309
         JZM    03,0,CDS4         BLANK O.K.                    P1 1310
         JSB    03,0,ERR1                                       P1 1311
CDS4     CJU    00,0,CDS6         COUNT THROUGH LOCATION FIELD  P1 1312
         JDC    00,0,RDM                                        P1 1313
CDS5     SFR    07,2,TEMP1        SAVE NAME IN TEMP1            P1 1314
         ORM    7,2,4096             OCT10000  SET OUTSIDE NAME BIT   P1 1315
         CJU    6,2,CDS6          INCREMENT M6, ALWAYS JUMP     P1 1316
RDM      CSM    00,2,7            COUNT FOR MNEMONIC FIELD      P1 1317
         JSB    03,0,INPUT        READ FIRST CHARACTER          P1 1318
         FIL                                                    P1 1319
         ANM    1,3,6144             OCT14000                   P1 1320
         CAM    03,,                                            P1 1321
         JZM    3,,TOM12          ALPHA CHARACTER O.K.          P1 1322
         JSB    03,0,ERR1                                       P1 1323
TOM12    JSB    3,,READNM         READ MNEMONIC                 P1 1324
         FIL                                                    P1 1325
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         SFR    04,2,W1          SAVE COUNT OF NMEMONIC FIELD          P1 1326
         JDC    00,0,RDM1        IF NAME-ONLY LEGAL CASE               P1 1327
         FIL                                                           P1 1328
         JSB    03,0,ERR13                                             P1 1329
         FIL                                                           P1 1330
         JSB    03,0,ERR13                                             P1 1331
         FIL                                                           P1 1332
RDM1     JSB    03,0,MTLU        TABLE LOOK UP                         P1 1333
         JSB    03,0,ERR13       NOT PRESENT                           P1 1334
         ADM    0,MENTRY-MA                                            P1 1335
         ATN    00,,                                                   P1 1336
         LFR    07,,             GET BINARY INFORMATION FROM MENTRY    P1 1337
         ANN    12,1                                                   P1 1338
         CAM    3                                                      P1 1339
         JZM    3,RDM1A          NOT PROTECTED ORDER                   P1 1340
         SFR    6,REF+1                                                P1 1341
         LFR    6                                                      P1 1342
         ANM    10,8                                                   P1 1343
         CRN    10,3                                                   P1 1344
         EOM    3                                                      P1 1345
         JUM    3,ERR1           ILLEGAL PROTECTED ORDER               P1 1346
         LFR    6,REF+1                                                P1 1347
         ANM    12,8190                                                P1 1348
RDM1A    JPM    12,RDM4                                                P1 1349
         CRN    12,12                                                  P1 1350
         CAM    03,,                                                   P1 1351
         JNM    03,0,RDM15       MACRO ORDER                           P1 1352
RDM4     JPM    07,0,RDM2        NO OUTSIDE NAME                       P1 1353
         SFR    07,2,TEMP2                                             P1 1354
         LFR    07,2,TEMP1                                             P1 1355
         JSB    03,0,NTLU        TABLE LOOK UP NAME                    P1 1356
         FIL                                                           P1 1357
         JNM    15,0,RDM9        PREVIOUSLY DEFINED                    P1 1358
         LFR    07,2,TEMP2                                             P1 1359
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         JNM    12,0,RDM10          PSEUDO ORDER
         CAM    3,2,7168               OCT16000  SET LABEL BITS
RDM11    ATN    00,,
         LFR    07,,                NAME
         ATN    03,,                SET TYPE BITS
         ADM    15,,
         ATN    00,,
         SFR    07,,                STORE IN TABLE
RDM9     LFR    07,2,TEMP2          ORDER BITS
         ATN    00,,
         CAM    03,,                OUTSIDE NAME TO IL
         SFR    4,REF+1
RDM2     ANM    12,3,6144              OCT14000
         CAM    03,,
         CRM    03,3,7
         ADM    07,,                CARD TYPE TO REFERENCE
         SFR    07,2,TEMP2
RDM6     LDM    00,2,W1             COUNT OF MNEMONIC FIELD
         ANM    01,3,63
         CAM    03,2,-BLANK         TEST FOR BLANK
         JZM    03,0,RDM5
         JDC    00,2,RDM7           ON TO ADDRESS FIELD
RDM5     JSB    03,0,INPUT          READ NEXT CHARACTER
         FIL
         CJU    00,2,RDM6           COUNT THROUGH NMEMONIC FIELD
         JDC    00,2,RDM7
RDM7     JSB    03,0,INPUT          READ NEXT CHARACTER
         FIL
         JLH    M14                 BRANCH TO TYPE SUBPROGRAM
RDM10    ATN    15,,                NAME TYPE BITS TO NAME TABLE
         CAM    03,,
         JDC    00,0,RDM11
         FIL
NFD      JSB    03,0,INPUT          N-FIELD READ CHAR
```

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        FIL                                                      P1 1394
NFD2    CAM     09,,              CLEAR PARENTHESIS COUNT        P1 1395
        CAM     05,,                                             P1 1396
NFD2A   JPM     1,0,NFD8          ALPHA-NUM                      P1 1397
        CRM     01,3,12                                          P1 1398
        CAM     03,,                                             P1 1399
        JNM     03,0,NFD4         OPERATION TYPE                 P1 1400
        ANM     01,3,63                                          P1 1401
        CAM     03,2,-BLANK                                      P1 1402
        JZM     03,0,NFD3         BLANK (END OF ADDRESS)         P1 1403
        ADM     03,2,BLANK-PERIOD                                P1 1404
        JZM     03,0,NFD12        PERIOD                         P1 1405
        ADM     03,2,PERIOD-OPENBR                               P1 1406
        JZM     03,0,NFD5         OPEN BRACKET                   P1 1407
        JSB     03,0,ERR1         OTHERS ILLEGAL                 P1 1408
NFD4    JSB     03,0,ADB          ADD OPERATION TO OUTPUT        P1 1409
        FIL                                                      P1 1410
NFD14   JSB     03,0,INPUT        READ NEXT CHAR                 P1 1411
        FIL                                                      P1 1412
        JPM     01,0,NFD8         ALPHA-NUM                      P1 1413
        ANM     01,3,63                                          P1 1414
        CAM     03,2,-OPENBR                                     P1 1415
        JZM     03,0,NFD5         OR OPEN BRACKET MAY FOLLOW OPERATION  P1 1416
        JSB     03,0,ERR1                                        P1 1417
NFD5    ADM     09,2,1            INCREASE BRACKET COUNT         P1 1418
        JSB     03,0,ADB4                                        P1 1419
        FIL                                                      P1 1420
        JDC     00,0,NFD14        GO TO NEXT ITEM                P1 1421
NFD8    CSM     00,2,7            NEXT CHAR COUNTER              P1 1422
        JSB     03,0,READNM       READ NAME                      P1 1423
        FIL                                                      P1 1424
        JDC     00,0,NFD1         NAME                           P1 1425
        FIL                                                      P1 1426
        JDC     00,0,NFD21        ERROR                          P1 1427
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         FIL                                                           P1 1428
         JDC     00,0,NFD18          NUMBER                            P1 1429
NFD1     JSB     03,0,NTLU           NAME TABLE LOOK UP                P1 1430
         FIL                                                           P1 1431
NFD1A    JSB     3,,ADB1             NAME TO IL STREAM                 P1 1432
         FIL                                                           P1 1433
NFD10    JPM     01,0,NFD16          NEXT CHARACTER ALPHA-NUM=ERROR    P1 1434
         CRM     01,3,12                                               P1 1435
         CAM     03,,                                                  P1 1436
         JNM     03,0,NFD4           OPERATION                         P1 1437
         ANM     01,3,63                                               P1 1438
         CAM     03,2,-BLANK         OR BLANK                          P1 1439
         JZM     03,0,NFD3                                             P1 1440
         ADM     03,2,BLANK-PERIOD OR PERIOD                           P1 1441
         JZM     03,0,NFD12                                            P1 1442
         ADM     03,2,PERIOD-COMMA                                     P1 1443
         JZM     03,0,NFD6           OR COMMA                          P1 1444
         ADM     03,2,COMMA-CLOSBR OR CLOSE BRACKET ARE LEGAL AFTER    P1 1445
         JZM     03,0,NFD9           NAME OR NUMBER                    P1 1446
         JSB     03,0,ERR1                                             P1 1447
NFD9     SBM     09,2,1              DECREASE BRACKET COUNT            P1 1448
         JNM     09,0,NFD15          ERROR IF NEGATIVE                 P1 1449
         JSB     03,0,ADB            ADD TO IL STREAM                  P1 1450
         FIL                                                           P1 1451
         JSB     03,0,INPUT          READ NEXT CHARACTER               P1 1452
         FIL                                                           P1 1453
         JDC     00,0,NFD10                                            P1 1454
NFD3     JUM     09,0,NFD15          ERROR IF BRACKET COUNT NOT ZERO   P1 1455
         JSB     03,0,ADB3           OUTPUT LAST BITS IN IL            P1 1456
         FIL                                                           P1 1457
NFD17    ATN     07,,                                                  P1 1458
         CAM     11,,                                                  P1 1459
         SFR     06,2,REF            OUTPUT REFERENCE                  P1 1460
         FIL                                                           P1 1461
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NFD22  JSB   03,0,OUTPUT       OUTPUT ILSTREAM TO IL BUFFER     P1 1462
       FIL                                                      P1 1463
NFD11  TRA   BEG2              RETURN FOR NEXT CARD             P1 1464
NFD6   ANM   7,3,48               OCT60                         P1 1465
       CAM   03,,                                               P1 1466
       CRM   03,2,6                                             P1 1467
       JNM   03,0,NFD7                                          P1 1468
       JSB   03,0,ERR9                                          P1 1469
       FIL                                                      P1 1470
       JDC   00,0,NFD20                                         P1 1471
NFD12  ANM   7,3,960              OCT1700                       P1 1472
       CAM   03,2,-896                                          P1 1473
       JZM   03,0,NFD19                                         P1 1474
       JSB   03,0,ERR8                                          P1 1475
       FIL                                                      P1 1476
       JDC   00,0,NFD3                                          P1 1477
NFD19  ANM   7,2,7231             OCT16077                      P1 1478
       ADM   7,2,192              OCT300                        P1 1479
       CAM   03,2,1                                             P1 1480
       JPM   07,0,NFD13                                         P1 1481
       ADM   03,2,1                                             P1 1482
NFD13  ATN   03,,                                               P1 1483
       LFR   07,2,REF                                           P1 1484
       ADM   15,2,39            OCT47                           P1 1485
       ATN   03,,                                               P1 1486
       SFR   07,2,REF                                           P1 1487
NFD20  JSB   03,0,INPUT                                         P1 1488
       FIL                                                      P1 1489
       ANM   01,3,63                                            P1 1490
       CAM   03,2,-BLANK                                        P1 1491
       JZM   03,0,NFD23                                         P1 1492
       JSB   03,0,ERR1                                          P1 1493
NFD23  CRM   07,3,12                                            P1 1494
       CAM   03,,                                               P1 1495
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        JNM    03,0,NFD3                                      P1 1496
        ADM    07,2,8                                         P1 1497
        CAM    03,,                                           P1 1498
        ATN    06,1,                                          P1 1499
        SFR    04,,                                           P1 1500
        JDC    00,0,NFD17                                     P1 1501
NFD16   JSB    03,0,ERR1                                      P1 1502
NFD15   JSB    03,0,ERR7                                      P1 1503
        FIL                                                   P1 1504
        JDC    00,0,NFD17                                     P1 1505
NFD7    JUM    9,NFD15                                        P1 1506
        JLH    M4                                             P1 1507
NFD18   SIA    00,,                                           P1 1508
        JSB    03,0,ADB2                                      P1 1509
        FIL                                                   P1 1510
        JDC    00,0,NFD10                                     P1 1511
NFD21   JSB    03,0,ERR3                                      P1 1512
        FIL                                                   P1 1513
        JDC    00,0,NFD18                                     P1 1514
OUTPUT  SFR    7,IT                                           P1 1515
        SFR    6,IT+1                                         P1 1516
        SFR    5,IT+2                                         P1 1517
        LFR    6,IT+5                                         P1 1518
        CAM    5,REF                                          P1 1519
        CSM    6,M6-MTBL                                      P1 1520
        JNM    6,LBERR                                        P1 1521
        SBM    6,MTBL-REF                                     P1 1522
OUTPT2  LFR    7,M8             NEXT BUFFER WORD              P1 1523
        CAM    12,M13                                         P1 1524
        CAM    13,M14                                         P1 1525
        CAM    14,M15                                         P1 1526
        ATN    5,1,                                           P1 1527
        LDM    15,0                                           P1 1528
        SFR    7,M8                                           P1 1529
```

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        CJU    9,OUTPT1         NOT FOURTH QUARTER                   P1 1530
        CAM    9,-4                                                  P1 1531
        ADM    8,1                                                   P1 1532
        CJU    10,OUTPT1        NOT END OF BUFFER                    P1 1533
        CAM    10,-256                                               P1 1534
        LFR    7,OUTPT3                                              P1 1535
        CAM    13,M8-256                                             P1 1536
        ATN    11,1,                                                 P1 1537
        CAM    15                                                    P1 1538
        SFR    7,OUTPT3                                              P1 1539
        CAD    F4                                                    P1 1540
        CALL   SYSAUX                                                P1 1541
OUTPT3  DECQL  WRITE,0,0,0                                           P1 1542
        CAM    8,ILBUF                                               P1 1543
        CALL   SYSAUX                                                P1 1544
        DECQ   WAIT,0,0,0                                            P1 1545
        SAM    F4                                                    P1 1546
OUTPT1  CJU    6,OUTPT2                                              P1 1547
        SFR    6,IT+5                                                P1 1548
        LFR    5,IT+2                                                P1 1549
        LFR    6,IT+1                                                P1 1550
        LFR    7,IT                                                  P1 1551
        JLH    M3                                                    P1 1552
ADB     CRM    07,3,12          SUBRT. -ADD OPERATION PROM M0 TO IL STREP1 1553
        CAM    15,,                                                  P1 1554
        JNM    15,0,ADB14       JUMP IF REFERENCE CHARACTER EXTENSION ALP1 1555
        ADM    07,2,4           SET OTHERWISE SET TO OPERAND         P1 1556
ADB15   ORM    7,2,2048            OCT4000  CHAR. EXT SET IN M7      P1 1557
ADB5    CAM    05,2,1           M5 IN USE BIT IN BIT1                P1 1558
        ANN    1,448            EXTRACT OPERATION CODE               P1 1559
        ADM    05,,                                                  P1 1560
        CRM    05,2,2                                                P1 1561
        JLH    03,,             EXIT                                 P1 1562
ADB14   JNM    05,0,ADB5        LAST BYTE WAS NAME/NUMBER            P1 1563
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ADB17  ADM  05,2,4        SET OPERATION EXT. IN PREVIOUS CHARACTERP1 1564
       ORM  05,2,2048                                             P1 1565
       ANM  5,3,2047         OCT3777                              P1 1566
       CAM  11,,                                                  P1 1567
       ATN  06,1,         OUTPUT LAST BYTE                        P1 1568
       SFR  06,,                                                  P1 1569
       JDC  00,0,ADB5                                             P1 1570
ADB1   ATN  00,,                                                  P1 1571
       LFR  07,,          GET NAME FROM TABLE                     P1 1572
ADB19  CAM  14,,          NOT DUMMY                               P1 1573
       JDC  00,0,ADB20                                            P1 1574
ADB21  CAM  14,2,1        DUMMY BIT                               P1 1575
ADB20  CRM  07,3,12                                               P1 1576
       CAM  15,,                                                  P1 1577
       JNM  15,0,ADB6     REF ALREADY SET                         P1 1578
       ATN  14,,                                                  P1 1579
       ADM  07,,                                                  P1 1580
       ADM  07,2,2        NAME BIT SET                            P1 1581
ADB9   ORM  7,2,2048         OCT4000    REFERENCE SET             P1 1582
ADB8   ATN  00,,                                                  P1 1583
       CAM  11,,                                                  P1 1584
       ATN  06,1,         OUTPUT NAME/NUMBER TO IL STREAM         P1 1585
       SFR  06,,                                                  P1 1586
       ANM  5,2,2048         OCT4000                              P1 1587
       ADM  5,2,4096         OCT10000  SET NAME/NUMBER WAS LAST BYP1 1588
       JLH  03,,          EXIT                                    P1 1589
ADB6   JPM  05,0,ADB10    NOT NAME/NUMBER AS PREVIOUS BYTE        P1 1590
       JSB  03,0,ERROR                                            P1 1591
ADB10  ATN  14,,                                                  P1 1592
       ADM  05,2,2        NEXT EXT                                P1 1593
ADB7   ANM  5,3,2047         OCT3777                              P1 1594
       CAM  11,,                                                  P1 1595
       ATN  06,1,         OUTPUT PREVIOUS OPERATION TO IL STREAM  P1 1596
       SFR  06,,                                                  P1 1597
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         JDC    00,0,ADB8                                          P1 1598
ADB2     CRM    07,3,12            OUTPUT NUMBER TO IL STREAM      P1 1599
         CAM    15,,                                               P1 1600
         JPM    15,ADB9            REF ALREADY SET                 P1 1601
         JPM    05,0,ADB7          NOT NAME/NUMBER AS LAST BYTE    P1 1602
         JSB    03,0,ERROR                                         P1 1603
ADB3     CRM    07,3,12            OUTPUT LAST BYTE                P1 1604
         CAM    15,,                                               P1 1605
         JNM    15,0,ADB12         REFERENCE ALREADY SET           P1 1606
         ORM    7,2,2048              OCT4000   IF NOT, SET        P1 1607
         ADM    07,2,12            FINAL BYTE CODE                 P1 1608
         JLH    03,,               EXIT                            P1 1609
ADB12    CRM    05,2,12                                            P1 1610
         JPM    05,0,ADB18         NO BYTE IN M5                   P1 1611
         CRM    05,2,1                                             P1 1612
         JNM    05,0,ADB13         NAME/NUMBER LAST                P1 1613
         ANM    5,2,2047              OCT3777                      P1 1614
         CAM    15,M5-64                                           P1 1615
         JZM    15,ADB12A          CLOSED BRACKET                  P1 1616
         CAM    11,M5+8                                            P1 1617
         ATN    6,1,                                               P1 1618
         SFR    6                                                  P1 1619
         SFN    M5+12                                              P1 1620
ADB12A   CAM    11,M5+12                                           P1 1621
         ATN    6,1,                                               P1 1622
         SFR    6                                                  P1 1623
         JLH    M3                                                 P1 1624
ADB13    ATN    06,,                                               P1 1625
         LDM    11,2,-2            LAST BYTE BUT ONE               P1 1626
         ADM    11,2,8             HAS LAST BIT SET IN CHR EXT     P1 1627
         ATN    06,,                                               P1 1628
         SFR    06,2,-2                                            P1 1629
         JLH    03,,               EXIT                            P1 1630
ADB4     CRM    07,3,12            ADD OPEN BRACKET TO IL          P1 1631
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          CAM     15,,                                           P1 1632
          JNM     15,0,ADB16                                     P1 1633
          ADM     07,2,1                                         P1 1634
          JDC     00,0,ADB15                                     P1 1635
ADB16     JNM     05,0,ADB5                                      P1 1636
          SBM     05,2,3                                         P1 1637
          JDC     00,0,ADB17                                     P1 1638
ADB18     ADM     07,2,8          SET LAST IN REFERENCE EXTENSION P1 1639
          JLH     03,,                                           P1 1640
          FIL                                                    P1 1641
JDC       JPM     01,0,JDC1                                      P1 1642
          ANM     01,3,63                                        P1 1643
          CAM     03,2,-COMMA                                    P1 1644
          JZM     03,0,JDC3                                      P1 1645
          JSB     03,0,ERR1       NOT COMMA, NO B FIELD ERROR    P1 1646
JDC1      CSM     00,2,7                                         P1 1647
          JSB     03,0,READNM     READ B FIELD                   P1 1648
          FIL                                                    P1 1649
          JDC     00,0,JDC2                                      P1 1650
          FIL                                                    P1 1651
          JSB     03,0,ERR3                                      P1 1652
          FIL                                                    P1 1653
          JDC     00,0,JDC4       NUMERIC B FIELD                P1 1654
JDC6      JSB     03,0,ERR1                                      P1 1655
JDC2      JSB     03,0,NTLU       LOOK UP MODIFIER               P1 1656
          FIL                                                    P1 1657
          ORM     7,2,1024           OCT2000  SET TAG BIT        P1 1658
          ATN     00,,                                           P1 1659
          CAM     03,,                                           P1 1660
          ATN     06,1,                                          P1 1661
          SFR     04,,            OUTPUT TAG                     P1 1662
JDC5      ANM     01,3,63                                        P1 1663
          CAM     03,2,-COMMA                                    P1 1664
          JUM     03,0,JDC6       ERROR, NO COMMA AFTER B        P1 1665
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JDC3    JSB     03,0,INPUT                                                     P1 1666
        FIL                                                                    P1 1667
        JDC     00,0,JOV                                                       P1 1668
JDC4    SIA     00,,                                                           P1 1669
        JNM     00,0,JDC7          NEGATIVE B FIELD                            P1 1670
        SBM     00,2,16                                                        P1 1671
        JPM     00,0,JDC7          B GREATER THAN 15                           P1 1672
JDC8    LDM     15,2,TEMP2                                                     P1 1673
        CRM     00,3,11                                                        P1 1674
        ADM     15,2,61            INSERT B FIELD MOD 16                       P1 1675
        SFR     07,2,TEMP2                                                     P1 1676
        JDC     00,0,JDC5                                                      P1 1677
JDC7    JSB     03,0,ERR4                                                      P1 1678
        FIL                                                                    P1 1679
        JDC     00,0,JDC8                                                      P1 1680
        FIL                                                                    P1 1681
JOV     ADM     7,2,128               OCT200    SET SUB TYPE 2 ALPHA NUMERICP1 1682
        JPM     01,0,JOV1                                                      P1 1683
        ANM     01,3,63                                                        P1 1684
        CAM     03,2,-COMMA                                                    P1 1685
        JZM     03,0,JOV10                                                     P1 1686
        ADM     03,2,COMMA-PLUS                                                P1 1687
        JZM     03,0,NFD2                                                      P1 1688
        ADM     03,2,PLUS-MINUS                                                P1 1689
        JZM     03,0,NFD2                                                      P1 1690
        ADM     03,2,MINUS-OPENBR                                              P1 1691
        JZM     03,0,NFD2                                                      P1 1692
        JSB     03,0,ERR1          ILLEGAL ADDRESS                             P1 1693
JOV1    CSM     00,2,7                                                         P1 1694
        JSB     03,0,READNM        READ NAME/NUMBER                            P1 1695
        FIL                                                                    P1 1696
        JDC     00,0,JOV2                                                      P1 1697
        FIL                                                                    P1 1698
        JSB     03,0,ERR3                                                      P1 1699
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         FIL                                        P1 1700
         JDC     00,0,JOV3                          P1 1701
JOV2     JSB     03,0,NTLU        NAME LOOK UP      P1 1702
         FIL                                        P1 1703
         ADM     06,2,1                             P1 1704
         JSB     03,0,ADB1        OUTPUT NAME       P1 1705
         FIL                                        P1 1706
JOV5     LDM     03,2,TEMP2                         P1 1707
         ATN     06,,                               P1 1708
         SFR     04,2,-2          OUTPUT ORDER      P1 1709
         ANM     01,3,63                            P1 1710
         CAM     03,2,-BLANK                        P1 1711
         JZM     03,2,NFD3                          P1 1712
         ADM     03,2,BLANK-OPENBR                  P1 1713
         JZM     03,0,NFD2        END OF ADDRESS    P1 1714
         ANM     1,3,6144            OCT14000       P1 1715
         CAM     03,,                               P1 1716
         SBM     3,2,6144            OCT14000       P1 1717
         JZM     3,,NFD2A                           P1 1718
         JSB     03,0,ERR1                          P1 1719
JOV3     ANM     01,3,63                            P1 1720
         CAM     03,2,-COMMA      COMMA NEXT        P1 1721
         JZM     03,0,JOV6                          P1 1722
         SIA     00,,             N FIELD           P1 1723
         ADM     06,2,1                             P1 1724
         JSB     03,0,ADB2        OUTPUT NUMBER     P1 1725
         FIL                                        P1 1726
         JDC     00,0,JOV5                          P1 1727
JOV6     SIA     00,,                               P1 1728
         JNM     00,0,JOV9        C TOO SMALL       P1 1729
         SBM     00,2,4                             P1 1730
         JPM     00,0,JOV9        C TOO LARGE       P1 1731
JOV4     LDM     15,2,TEMP2                         P1 1732
         ATN     00,,                               P1 1733
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         ADM    15,2,4            ADD TO ORDER MOD 4               P1 1734
JOV11    ATN    06,1,                                              P1 1735
         SFR    07,,              OUTPUT ORDER                     P1 1736
         JDC    00,0,NFD                                           P1 1737
JOV9     JSB    03,0,ERR5                                          P1 1738
         FIL                                                       P1 1739
         JDC    00,0,JOV4                                          P1 1740
JOV10    LDM    15,2,TEMP2        LOAD ORDER TO M15                P1 1741
         JDC    00,0,JOV11                                         P1 1742
         FIL                                                       P1 1743
SSR      JPM    1,,SSR1           SSR TYPE, ALPHA NUMBERIC         P1 1744
         ANM    01,3,63                                            P1 1745
         CAM    03,2,-COMMA                                        P1 1746
         JZM    03,0,SSR2                                          P1 1747
         ADM    03,2,COMMA-BLANK                                   P1 1748
         JZM    03,0,SSR3                                          P1 1749
         JSB    03,0,ERR1                                          P1 1750
SSR1     CSM    00,2,7                                             P1 1751
         JSB    03,0,READNM                                        P1 1752
         FIL                                                       P1 1753
         JDC    00,0,SSR5                                          P1 1754
         FIL                                                       P1 1755
         JSB    03,0,ERR3                                          P1 1756
         FIL                                                       P1 1757
         ANM    01,3,63                                            P1 1758
         CAM    03,2,-COMMA       COMMA FOLLOWS NUMBER             P1 1759
         JZM    03,0,SSR4                                          P1 1760
         ADM    03,2,COMMA-BLANK                                   P1 1761
         JZM    03,0,SSR7         OR BLANK                         P1 1762
         JSB    03,0,ERR1                                          P1 1763
SSR4     SIA    00,,              NUMBER TO B FIELD                P1 1764
         JNM    00,0,SSR8                                          P1 1765
         SBM    00,2,16                                            P1 1766
         JPM    00,0,SSR8                                          P1 1767
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SSR11  LDM    03,2,TEMP2                                    P1 1768
       CRM    00,3,11                                       P1 1769
       ADM    03,2,61                                       P1 1770
       SFR    04,2,TEMP2                                    P1 1771
SSR2   JSB    03,0,INPUT          READ C FIELD              P1 1772
       FIL                                                  P1 1773
       JNM    01,0,SSR15          NOT ALPHA NUMERIC         P1 1774
       CSM    00,2,7                                        P1 1775
       JSB    03,0,READNM         READ                      P1 1776
       FIL                                                  P1 1777
SSR9   JDC    00,0,SSR9+1                                   P1 1778
       FIL                                                  P1 1779
       JSB    03,0,ERR3                                     P1 1780
       FIL                                                  P1 1781
       SIA    00,,                NUMBER TO MO              P1 1782
       JNM    00,0,SSR12          C TOO SMALL               P1 1783
       SBM    00,2,4                                        P1 1784
       JPM    00,0,SSR12          C TOO BIG                 P1 1785
SSR13  LDM    03,2,TEMP2                                    P1 1786
       ATN    00,,                                          P1 1787
       ADM    03,2,4                                        P1 1788
       ATN    06,1,                                         P1 1789
       SFR    04,,                STORE ORDER               P1 1790
SSR14  ANM    01,3,63                                       P1 1791
       CAM    03,2,-COMMA                                   P1 1792
       JZM    03,0,SSR17                                    P1 1793
       ADM    03,2,COMMA-BLANK    COMMA OR BLANK O.K.       P1 1794
       JZM    03,0,NFD17                                    P1 1795
       JSB    03,0,ERR1                                     P1 1796
SSR3   LDM    03,2,TEMP2                                    P1 1797
       ATN    06,1,                                         P1 1798
       SFR    04,,                OUTPUT ORDER              P1 1799
       JDC    00,0,NFD17          EXIT                      P1 1800
SSR8   JSB    03,0,ERR4                                     P1 1801
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         FIL                                                          P1 1802
         JDC     00,0,SSR11                                           P1 1803
SSR5     JSB     03,0,NTLU          LOOK UP NAME                      P1 1804
         FIL                                                          P1 1805
         ANM     01,3,63                                              P1 1806
         CAM     03,2,-COMMA                                          P1 1807
         JUM     03,0,SSR6                                            P1 1808
         ORM     7,2,1024             OCT2000   SET TAG BIT           P1 1809
         ATN     00,,                                                 P1 1810
         CAM     03,,                                                 P1 1811
         ATN     06,1,                                                P1 1812
         SFR     04,,               OUTPUT ORDER                      P1 1813
         JDC     00,0,SSR2                                            P1 1814
SSR10    JSB     03,0,ERR15                                           P1 1815
         FIL                                                          P1 1816
         JDC     00,1,SSR7                                            P1 1817
SSR7     SIA     00,,                                                 P1 1818
         JNM     00,0,SSR10                                           P1 1819
         SBM     00,2,64                                              P1 1820
         JPM     00,0,SSR10         SINGLE NUMBER LARGER THAN 63      P1 1821
         LDM     03,2,TEMP2                                           P1 1822
         ATN     00,,                                                 P1 1823
         ADM     03,2,64            ADD TO ORDER MOD 64               P1 1824
         JDC     00,2,SSR3                                            P1 1825
SSR6     LDM     03,2,TEMP2                                           P1 1826
         ATN     06,1,                                                P1 1827
         SFR     04,,               OUTPUT ORDER                      P1 1828
         ORM     7,264                                                P1 1829
         JSB     03,0,ADB1                                            P1 1830
         FIL                                                          P1 1831
         JDC     00,0,SSR14                                           P1 1832
SSR12    JSB     03,0,ERR5                                            P1 1833
         FIL                                                          P1 1834
         JDC     00,0,SSR13                                           P1 1835
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SSR15  ANM   01,3,63                P1 1836
       CAM   03,2,-BLANK            P1 1837
       JZM   03,0,SSR3              P1 1838
       ADM   3,2,BLANK-COMMA        P1 1839
       JZM   03,0,SSR16             P1 1840
       JSB   03,0,ERR1              P1 1841
SSR16  LDM   03,2,TEMP2             P1 1842
       ATN   06,1,                  P1 1843
       SFR   04,,                   P1 1844
SSR17  JSB   03,0,INPUT             P1 1845
       FIL                          P1 1846
       ANM   01,3,63                P1 1847
       CAM   03,2,-BLANK            P1 1848
       JZM   03,0,NFD17             P1 1849
       JSB   03,0,ERR10             P1 1850
       FIL                          P1 1851
       JDC   00,0,NFD17             P1 1852
       FIL                          P1 1853
LF2    CSM   0,7                    P1 1854
       CALL  READNM                 P1 1855
       TRA   FINAME                 P1 1856
       FIL                          P1 1857
       TRA   ERRFIN                 P1 1858
       FIL                          P1 1859
       SIA   0,                     P1 1860
       CAM   3,M0-8                 P1 1861
       JPM   3,ERRFIN               P1 1862
       ADM   3,7                    P1 1863
       JZM   3,ERRFIN               P1 1864
FIN1   ANN   1,63                   P1 1865
       CAM   3                      P1 1866
       JUM   3,ERRFIN               P1 1867
       LDM   3,TEMP2                P1 1868
       CRN   0,11                   P1 1869
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       ADM    3,3                                              P1 1870
       ATN    6,1,                                             P1 1871
       SFR    4                                                P1 1872
       TRA    NFD17                                            P1 1873
FINAME CALL   NTLU                                             P1 1874
       ORM    7,1028                                           P1 1875
       CAM    3,MO                                             P1 1876
       ATN    6,1,                                             P1 1877
       SFR    4                                                P1 1878
       CAM    0                                                P1 1879
       TRA    FIN1                                             P1 1880
ERRFIN CAM    9,21                                             P1 1881
       JDC    0,2,ERR1                                         P1 1882
       FIL                                                     P1 1883
CAD    ADM    07,2,2          SET MARKS FOR ORDER TYPES        P1 1884
       JDC    00,0,CAE                                         P1 1885
STR    ADM    07,2,1                                           P1 1886
       JDC    00,0,CAE                                         P1 1887
BLS    ADM    7,8                                              P1 1888
       TRA    CAE                                              P1 1889
LFR    ADM    07,2,8                                           P1 1890
       JDC    00,2,CAM                                         P1 1891
CAN    ADM    07,2,7                                           P1 1892
       JDC    00,2,CAM                                         P1 1893
LDM    ADM    07,2,5                                           P1 1894
       JDC    00,2,CAM                                         P1 1895
CJF    ADM    07,2,6                                           P1 1896
       JDC    00,2,CAM                                         P1 1897
CAE    ANM    1,3,6144           OCT14000                      P1 1898

       CAM    03,,                                             P1 1899
       JPM    03,0,CAD1       INITIAL NAME                     P1 1900
       SBM    3,2,6144           OCT14000                      P1 1901
       JZM    03,0,CAD7       OPERATION MEANS N FIELD          P1 1902
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         ANM    01,3,63                                     P1 1903
         CAM    03,2,-BLANK                                 P1 1904
         JZM    03,0,CAD6                                   P1 1905
         ANM    7,8183           OCT17767                   P1 1906
         ADM    3,2,BLANK-COMMA                             P1 1907
         JZM    03,0,CFD                                    P1 1908
         JDC    00,0,CAD7                                   P1 1909
CAD1     CSM    00,2,7                                      P1 1910
         ANM    7,8183           OCT 17767                  P1 1911
         JSB    03,0,READNM      READ NAME                  P1 1912
         FIL                                                P1 1913
         JDC    00,0,CAD2                                   P1 1914
         FIL                                                P1 1915
         JSB    03,0,ERR3                                   P1 1916
         FIL                                                P1 1917
         JDC    00,0,CAD3                                   P1 1918
CAD2     JSB    03,0,NTLU        LOOK UP                    P1 1919
         FIL                                                P1 1920
         ATN    01,,                                        P1 1921
         CAM    05,,                                        P1 1922
         ANM    05,2,63                                     P1 1923
         SBM    05,2,COMMA                                  P1 1924
         JZM    05,0,CAD4        COMMA MEANS NAME IS B FIELD P1 1925
         LDM    03,2,TEMP2                                  P1 1926
         ATN    06,1,                                       P1 1927
         SFR    04,0,            OUTPUT ORDER               P1 1928
         CAM    05,,                                        P1 1929
         CAM    09,,                                        P1 1930
         ANM    07,3,3                                      P1 1931
         CAM    03,,                                        P1 1932
         CRM    03,3,7                                      P1 1933
         ADM    7,2,768              OCT1400                P1 1934
         ANM    7,2,8176             OCT17760               P1 1935
         JDC    00,2,NFD1                                   P1 1936
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CAD4    ORM     7,2,1024            OCT2000  SET TAG BIT
        ATN     00,,
        CAM     03,,
        ATN     06,1,             OUTPUT TAG
        SFR     04,0,
        JDC     00,0,CFD          NOW LOOK FOR C FIELD
CAD3    ANM     01,3,63
        CAM     03,2,-COMMA       TEST FOR COMMA, MEANS B FIELD
        JZM     03,0,CAD5
        LDM     03,2,TEMP2
        ATN     06,1,             OUTPUT ORDER
        SFR     04,,
        CAM     09,,
        CAM     05,,
        ANM     07,3,3
        CAM     03,,
        CRM     03,3,7
        ADM     7,2,768             OCT1400
        ANM     7,2,8176
        JDC     00,0,NFD18        GO TO N FIELD
CAD5    SIA     00,,
        JNM     00,0,CAD8
        SBM     00,2,16
        JPM     00,0,CAD8         TEST B FIELD IN RANGE
CAD9    LDM     15,2,TEMP2
        CRM     00,3,11
        ADM     15,2,61           ADD TO ORDER
        SFR     07,2,TEMP2
        JDC     00,0,CFD          AND LOOK FOR C FIELD
CAD6    LDM     15,2,TEMP2
        CRN     7,4
        CAM     3
        JNM     3,BLS1
CAD61   ATN     6,1,
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         SFR    07,,                                              P1 1971
         ANM    7,2,7216              OCT16060                    P1 1972
         ADM    7,2,896               OCT1600                     P1 1973
         JDC    00,0,CFD21          SET TYPE 14  LOOK FOR C FIELD P1 1974
BLS1     ANM    7,8183                                            P1 1975
         ANM    15,8191-63                                        P1 1976
         ADM    15,7                                              P1 1977
         ATN    6,1,                                              P1 1978
         SFR    7                                                 P1 1979
         ANN    7,4096                                            P1 1980
         CAM    7,16                                              P1 1981
         SFR    5,REF                                             P1 1982
         TRA    NFD17                                             P1 1983
CAD7     LDM    03,2,TEMP2                                        P1 1984
         ATN    06,1,               OUTPUT ORDER                  P1 1985
         SFR    04,,                                              P1 1986
         ANM    7,8183                                            P1 1987
         ANM    07,3,3                                            P1 1988
         CAM    03,,                                              P1 1989
         CRM    03,3,7                                            P1 1990
         ADM    7,2,768               OCT1400                     P1 1991
         ANM    7,2,8176              OCT17760                    P1 1992
         JDC    00,0,NFD2           AND GO TO N FIELD             P1 1993
CAD8     JSB    03,0,ERR4                                         P1 1994
         FIL                                                      P1 1995
         JDC    00,0,CAD9                                         P1 1996
CFD      JSB    03,0,INPUT          C FIELD TEST START            P1 1997
         FIL                                                      P1 1998
         JPM    01,0,CFD1           ALPHA NUMERIC                 P1 1999
         CRM    01,3,12                                           P1 2000
         CAM    03,,                                              P1 2001
         JNM    03,0,CFD15          OPERATION MEANS N FIELD       P1 2002
         ANM    01,3,63                                           P1 2003
         CAM    3,-COMMA                                          P1 2004
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         JZM    03,0,CFD4           COMMA MEANS C FIELD              P1 2005
         ADM    03,2,COMMA-OPENBR                                    P1 2006
         JZM    03,0,CFD15                                           P1 2007
         ADM    3,OPENBR                                             P1 2008
         CAD    15,3,                                                P1 2009
         JZM    3,CFD40             BLANK                            P1 2010
         JSB    03,0,ERR1                                            P1 2011
CFD1     CSM    00,2,7                                               P1 2012
         JSB    03,0,READNM         READ NAME                        P1 2013
         FIL                                                         P1 2014
         JDC    00,0,CFD36          NAME                             P1 2015
         FIL                                                         P1 2016
         JSB    03,0,ERR3                                            P1 2017
         FIL                                                         P1 2018
CFD40    ANN    1,63                NUMBER..........                 P1 2019
         CAM    03,2,-COMMA                                          P1 2020
         JUM    03,0,CFD32          NOT COMMA                        P1 2021
         SIA    00,,                                                 P1 2022
         JNM    00,0,CFD5           C FIELD RANGE TEST               P1 2023
         ANM    07,3,15                                              P1 2024
         CAM    03,2,-7                                              P1 2025
         JZM    03,0,CFD16                                           P1 2026
CFD17    SBM    00,2,4                                               P1 2027
         JPM    00,0,CFD5                                            P1 2028
         LDM    15,2,TEMP2                                           P1 2029
         ATN    00,,                                                 P1 2030
         ORM    15,2,4              ADD TO ORDER                     P1 2031
         JDC    00,2,CFD4                                            P1 2032
CFD3     JSB    03,0,NTLU           LOOK UP NAME                     P1 2033
         FIL                                                         P1 2034
         CAM    09,,                                                 P1 2035
         CAM    05,,                                                 P1 2036
         JDC    00,0,CFD7                                            P1 2037
CFD4     LDM    15,2,TEMP2                                           P1 2038
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         ATN    06,1,                                           P1 2039
         SFR    07,,           OUTPUT ORDER                     P1 2040
         CRM    07,3,3                                          P1 2041
         CAM    03,,                                            P1 2042
         JNM    03,0,CFD18     TEST FOR CAN,LDM AND CJF TYPES   P1 2043
         CRM    03,2,1                                          P1 2044
         JNM    03,0,CFD20     TEST FOR LFR TYPE                P1 2045
         ANM    15,3,3                                          P1 2046
         CAM    03,2,-3                                         P1 2047
         JUM    03,0,CFD14                                      P1 2048
         ANM    07,3,3                                          P1 2049
         CSM    03,,                                            P1 2050
         JZM    03,0,CFD38                                      P1 2051
         CJZ    03,0,CFD10                                      P1 2052
         CJZ    03,0,CFD11                                      P1 2053
CFD9     JSB    03,0,ERR12                                      P1 2054
         FIL                                                    P1 2055
         JDC    00,0,CFD11                                      P1 2056
CFD38    ANM    15,3,60                                         P1 2057
         CAM    03,2,-32                                        P1 2058
         JUM    03,0,CFD9                                       P1 2059
         JDC    00,0,CFD11                                      P1 2060
CFD10    ANM    15,3,60                                         P1 2061
         CAM    03,2,-4                                         P1 2062
         JZM    03,0,CFD9                                       P1 2063
         SBM    03,2,32                                         P1 2064
         JPM    03,0,CFD9                                       P1 2065
CFD11    ANM    15,3,60                                         P1 2066
         CAM    03,2,-32                                        P1 2067
         JNM    03,0,CFD12                                      P1 2068
         SBM    03,2,12                                         P1 2069
         JPM    03,0,CFD12                                      P1 2070
         JDC    00,0,CFD19                                      P1 2071
CFD28    JSB    03,0,INPUT                                      P1 2072
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         FIL                                              P1 2073
         ANM    01,3,63                                   P1 2074
         CAM    03,2,-BLANK                               P1 2075
         JZM    03,0,NFD17                                P1 2076
         JSB    03,0,ERR10                                P1 2077
         FIL                                              P1 2078
         JDC    00,0,NFD17                                P1 2079
CFD13    ANM    7,2,7216          OCT16060                P1 2080
         JDC    00,0,NFD17                                P1 2081
CFD14    CJZ    03,0,CFD19                                P1 2082
         JDC    00,0,CFD12                                P1 2083
CFD19    ANM    07,3,8                                    P1 2084
         CAM    03,,                                      P1 2085
         JZM    03,0,CFD22                                P1 2086
         ANM    7,2,7216          OCT16060                P1 2087
         ADM    7,2,960           OCT1700                 P1 2088
         JDC    00,0,CFD23                                P1 2089
CFD22    ANM    7,2,7216          OCT16060                P1 2090
         ADM    7,2,192           OCT300                  P1 2091
CFD23    JSB    03,0,INPUT                                P1 2092
         FIL                                              P1 2093
         SBM    01,2,BLANK+4096                           P1 2094
         JZM    01,0,CFD21                                P1 2095
         ADM    1,2,BLANK+4096                            P1 2096
         JDC    00,0,NFD2                                 P1 2097
CFD21    ADM    07,2,8                                    P1 2098
         CAM    03,,                                      P1 2099
         ATN    06,1,                                     P1 2100
         SFR    04,,                                      P1 2101
         JDC    00,0,NFD17                                P1 2102
CFD18    ANM    07,3,3                                    P1 2103
         CSM    03,,                                      P1 2104
         JZM    03,0,CFD20                                P1 2105
         CJZ    03,0,CFD19                                P1 2106
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         CJZ    03,0,CFD27                                        P1 2107
         JSB    03,0,ERROR                                        P1 2108
CFD20    ANM    15,3,3                                            P1 2109
         CAM    03,2,-3                                           P1 2110
         JZM    03,0,CFD19                                        P1 2111
         JDC    00,0,CFD14                                        P1 2112
CFD5     JSB    03,0,ERR5                                         P1 2113
         FIL                                                      P1 2114
         JDC    0,0,CFD17+1                                       P1 2115
CFD6     LDM    15,2,TEMP2                                        P1 2116
         ATN    06,1,                                             P1 2117
         SFR    07,,                                              P1 2118
         ANN    7,7                                               P1 2119
         CAM    3,-5                                              P1 2120
         JUM    3,CFD13          NOT LDM                          P1 2121
         CAD    15,3,                                             P1 2122
         TRA    CFD68                                             P1 2123
CFD7     LDM    03,2,TEMP2                                        P1 2124
         ATN    06,1,                                             P1 2125
         SFR    04,,             OUTPUT ORDER                     P1 2126
         ANM    07,3,7                                            P1 2127
         CAM    03,2,-5                                           P1 2128
         JUM    03,0,CFD31       NOT LDM ORDER                    P1 2129
         ANM    7,2,7216            OCT16060                      P1 2130
         ADM    7,2,192             OCT300   SET LDM SUBTYPE 3    P1 2131
         JDC    00,2,NFD1        GO TO N FIELD                    P1 2132
CFD31    CRM    07,3,4                                            P1 2133
         CAM    03,,                                              P1 2134
         JPM    03,0,CFD30                                        P1 2135
         ANM    7,2,7216            OCT16060                      P1 2136
         ADM    7,2,960             OCT1700                       P1 2137
         JDC    00,2,NFD1                                         P1 2138
CFD30    ANM    7,2,7216            OCT16060                      P1 2139
         ADM    7,2,512             OCT1000                       P1 2140
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        JDC    00,2,NFD1                       P1 2141
CFD8    LDM    03,2,TEMP2                      P1 2142
        ATN    06,1,                           P1 2143
        SFR    04,,                            P1 2144
CFD68   SIA    00,,                            P1 2145
        JSB    03,0,ADB2                       P1 2146
        FIL                                    P1 2147
CFD34   CAM    09,,                            P1 2148
        ANM    07,3,7                          P1 2149
        CAM    03,2,-5                         P1 2150
        JUM    03,0,CFD29                      P1 2151
        ANM    7,2,7216       OCT16060         P1 2152
        ADM    7,2,192        OCT300           P1 2153
        JDC    00,2,NFD2                       P1 2154
CFD29   ANM    7,2,7216       OCT16060         P1 2155
        ADM    7,2,512        OCT1000          P1 2156
        JDC    00,2,NFD2                       P1 2157
CFD16   CRM    00,2,1                          P1 2158
        JNM    00,0,CFD35                      P1 2159
        JSB    03,0,ERR6                       P1 2160
        FIL                                    P1 2161
        JDC    00,0,CFD17                      P1 2162
CFD35   SBM    07,2,3                          P1 2163
        SIA    00,,                            P1 2164
        JDC    00,0,CFD17                      P1 2165
CFD12   ANM    7,3,1024       OCT2000          P1 2166
        CAM    03,,                            P1 2167
        JZM    03,0,CFD27                      P1 2168
        ANM    07,3,15                         P1 2169
        CAM    03,2,-8                         P1 2170
        JZM    03,0,CFD24                      P1 2171
        ADM    03,2,6                          P1 2172
        JZM    03,0,CFD25                      P1 2173
        ADM    03,2,1                          P1 2174
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         JZM     03,0,CFD26                                P1 2175
CFD27    ANM     7,2,7216            OCT16060              P1 2176
         JDC     00,0,CFD28                                P1 2177
CFD24    ANM     7,2,7216            OCT16060              P1 2178
         ADM     7,2,448             OCT700                P1 2179
         JDC     00,0,CFD28                                P1 2180
CFD25    ANM     7,2,7216            OCT16060              P1 2181
         ADM     7,2,384             OCT600                P1 2182
         JDC     00,0,CFD28                                P1 2183
CFD26    ANM     7,2,7216            OCT16060              P1 2184
         ADM     7,2,320             OCT500                P1 2185
         JDC     00,0,CFD28                                P1 2186
CFD32    ANM     07,3,7                                    P1 2187
         CAM     12,2,-6                                   P1 2188
         JUM     12,0,CFD8                                 P1 2189
         ADM     03,2,COMMA-BLANK                          P1 2190
         JZM     03,0,CFD33                                P1 2191
         JSB     03,0,ERR3                                 P1 2192
         FIL                                               P1 2193
         JDC     00,0,CFD37                                P1 2194
CFD33    SIA     00,,                                      P1 2195
         JNM     00,0,CFD5                                 P1 2196
         SBM     00,2,4                                    P1 2197
         JPM     00,0,CFD5                                 P1 2198
         LDM     15,2,TEMP2                                P1 2199
         ATN     00,,                                      P1 2200
         ADM     15,2,4                                    P1 2201
         JDC     00,2,CFD6                                 P1 2202
CFD15    LDM     03,2,TEMP2                                P1 2203
         ATN     06,1,                                     P1 2204
         SFR     04,,                                      P1 2205
         CAM     05,,                                      P1 2206
         JDC     00,0,CFD34                                P1 2207
CFD36    ANM     07,3,7                                    P1 2208
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         CAM    03,2,-6                                      P1 2209
         JUM    03,0,CFD3                                    P1 2210
         JSB    03,0,ERR3                                    P1 2211
         FIL                                                 P1 2212
CFD37    ANM    01,3,63                                      P1 2213
         CAM    03,2,-BLANK                                  P1 2214
         JZM    03,0,CFD6                                    P1 2215
         JSB    03,0,INPUT                                   P1 2216
         FIL                                                 P1 2217
         JDC    00,0,CFD37                                   P1 2218
         FIL                                                 P1 2219
CAM      ADM    07,2,4            SET CAM MARK               P1 2220
         ANM    01,3,63                                      P1 2221
         CAM    03,2,-BLANK                                  P1 2222
         JZM    03,0,CAM10        NO ADDRESS                 P1 2223
         ADM    03,2,BLANK-COMMA                             P1 2224
         JZM    03,0,CAM15        ZERO MODIFIER              P1 2225
         JPM    01,0,CAM1         ALPH NUMERIC               P1 2226
         JSB    03,0,ERR1                                    P1 2227
CAM1     CSM    00,2,7                                       P1 2228
         JSB    03,0,READNM       READ NAME                  P1 2229
         FIL                                                 P1 2230
         JDC    00,0,CAM2                                    P1 2231
         FIL                                                 P1 2232
         JSB    03,0,ERR3                                    P1 2233
         FIL                                                 P1 2234
         JDC    00,0,CAM4                                    P1 2235
CAM2     JSB    03,0,NTLU         LOOK UP NAME FOR TAG       P1 2236
         FIL                                                 P1 2237
         ORM    7,2,1024             OCT2000  TAG BIT SET    P1 2238
         ATN    00,,                                         P1 2239
         CAM    03,,                                         P1 2240
         ATN    06,1,                                        P1 2241
         SFR    04,,              OUTPUT TAG                 P1 2242
```

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CAM3   ANM   01,3,63                                           P1 2243
       CAM   03,2,-BLANK         END OF ADDRESS                P1 2244
       JZM   03,0,CAM9                                         P1 2245
       ADM   3,2,BLANK-COMMA                                   P1 2246
       JZM   03,0,CFD            COMMA LEGAL                   P1 2247
       JSB   03,0,ERR1                                         P1 2248
CAM4   SIA   00,,                NUMBER TO B FIELD             P1 2249
       JNM   00,0,CAM5           TEST RANGE                    P1 2250
       CRM   07,3,4                                            P1 2251
       CAM   03,,                                              P1 2252
       JNM   3,CAM6              LFR TYPE HAS RESTRICTED RANGE P1 2253
CAM8   SBM   00,2,16                                           P1 2254
       JPM   00,0,CAM5                                         P1 2255
CAM11  LDM   15,2,TEMP2                                        P1 2256
       CRM   00,3,11                                           P1 2257
       ADM   15,2,61                                           P1 2258
       SFR   07,2,TEMP2          ADD TO ORDER                  P1 2259
       JDC   00,0,CAM3                                         P1 2260
CAM5   JSB   03,0,ERR4                                         P1 2261
       FIL                                                     P1 2262
       JDC   00,0,CAM11                                        P1 2263
       CAM   03,2,-2                                           P1 2264
       JPM   03,0,CAM14                                        P1 2265
       JPM   3,CAM14                                           P1 2266
CAM6   ATN   00,,                                              P1 2267
       LDM   3,2,TEMP2                                         P1 2268
       SBM   3,1536              SFR                           P1 2269
       JZM   3,CAM12                                           P1 2270
CAM7   JSB   03,0,ERR12                                        P1 2271
       FIL                                                     P1 2272
       JDC   00,0,CAM12                                        P1 2273
CAM14  SBM   03,2,6                                            P1 2274
       JPM   03,0,CAM7                                         P1 2275
CAM12  SBM   07,2,4                                            P1 2276
```

```
        JDC   00,0,CAM8
CAM9    ANM   07,3,8
        CAM   03,,
        JZM   3,CFD6            NOT LFR TYPE
        LDM   15,2,TEMP2
        ATN   06,1,             OUTPUT ORDER
        SFR   07,,
        ANM   7,2,7216             OCT16060
        ADM   7,2,448              OCT1700
        JDC   00,0,NFD17
CAM10   CRM   07,3,4
        CAM   03,,
        JPM   03,0,CFD6         NOT LFR TYPE
        LDM   03,2,TEMP2
        SBM   3,2,1536             OCT3000
        JZM   03,0,CFD6         TEST FOR SFR
        JSB   03,0,ERR12        LFR 0  ILLEGAL
        FIL
        JDC   00,0,CFD6
CAM13   LDM   15,2,TEMP2
        SBM   15,3,1536            OCT3000
        JZM   15,0,CAM14        TEST FOR SFR
        JDC   00,0,CAM7         LFR 0 AGAIN
CAM15   LDM   03,2,TEMP2
        SBM   3,2,3584             OCT7000
        JUM   03,0,CFD
        JSB   03,0,ERR12        LFR 0 AGAIN
        FIL
        JDC   00,0,CFD
        FIL
CALL    JNM   01,0,ERR1         CALL PSEUDO ORDER
        CSM   00,2,7
        JSB   03,0,READNM       READ NAME
        FIL
```

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         JDC    00,0,CAL1                                    P1 2311
         FIL                                                 P1 2312
         JSB    03,0,ERR1                                    P1 2313
         FIL                                                 P1 2314
         JSB    03,0,ERR1                                    P1 2315
CAL1     JSB    03,0,NTLU         ONLY NAME LEGAL            P1 2316
         FIL                                                 P1 2317
         JNM    15,0,CAL2                                    P1 2318
         ORM    15,768            SET CALLED AND USED BITSS  P1 2319
         ATN    00,,                                         P1 2320
         SFR    07,,              PUT BACK IN TABLE          P1 2321
CAL2     CAM    3,2,2304             CT4400   .CALL ORDER BITS P1 2322
         ATN    06,1,                                        P1 2323
         SFR    04,,              OUTPUT                     P1 2324
         JSB    03,0,ADB1                                    P1 2325
         ANM    01,3,63           OUTPUT NAME                P1 2326
         CAM    03,2,-BLANK                                  P1 2327
         JZM    03,2,NFD3         BLANK MUST FOLLOW          P1 2328
         JSB    03,0,ERR1                                    P1 2329
ERR1     CAM    09,2,1            ERR1 PROGRAM               P1 2330
         CAM    06,2,REF+1        ASSEMBLES 17700 ORDER      P1 2331
         ANM    7,2,4096             OCT10000                P1 2332
         ADM    07,2,16                                      P1 2333
         CAM    10,M3                                        P1 2334
         JPM    7,TOM14                                      P1 2335
         LFR    7,TEMP1                                      P1 2336
         CALL   NTLU                                         P1 2337
         JNM    15,ERR102                                    P1 2338
         CAM    15,7168                                      P1 2339
         SFR    7,M0                                         P1 2340
ERR102   CAM    3,M0                                         P1 2341
         ADM    6,1                                          P1 2342
         SFR    4,REF+1                                      P1 2343
TOM14    CAM    3,-64             ILLEGAL ORDER              P1 2344
```

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         ATN    06,1,                                                  P1 2345
         SFR    04,,                                                   P1 2346
         LFR    07,2,COUNT                                             P1 2347
         ATN    15,,                                                   P1 2348
         CAM    08,,                                                   P1 2349
         ADM    9,2,4608          OCT11000                             P1 2350
         ATN    14,1,                                                  P1 2351
         SFR    06,,                                                   P1 2352
         SFR    07,2,COUNT                                             P1 2353
         SBM    14,ERRBUF+256                                          P1 2354
         JNM    14,NFD17                                               P1 2355
         CAM    4,ERR                                                  P1 2356
         TRA    SERR                                                   P1 2357
ERR2     CAM    09,2,2          TYPE 2, AS 1                           P1 2358
         JDC    00,2,ERR1                                              P1 2359
ERR4     CAM    09,2,4          TYPE 4, IS A SUBROUTINE,THEREFORE      P1 2360
         SIA    00,,                                                   P1 2361
         ANM    00,2,15         IT CONTINUES ASSEMBLY                  P1 2362
         SBM    00,2,16                                                P1 2363
         ADM    9,2,4608          OCT11000                             P1 2364
         SFR    07,2,TS2                                               P1 2365
         LFR    07,2,COUNT                                             P1 2366
         ATN    15,,                                                   P1 2367
         CAM    08,,                                                   P1 2368
         ATN    14,1,                                                  P1 2369
         SFR    06,,                                                   P1 2370
         SFR    07,2,COUNT                                             P1 2371
         SBM    14,ERRBUF+256                                          P1 2372
         JNM    14,ERR4A                                               P1 2373
         CAM    4,ERR                                                  P1 2374
         TRA    SERR            TOO MANY ERRORS                        P1 2375
ERR4A    LFR    6,TS1                                                  P1 2376
         LFR    07,2,TS2                                               P1 2377
         JLH    03,,                                                   P1 2378
```

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ERR5    CAM   09,2,5          TYPE 5, AS 4                  P1 2379
        SIA   00,,                                          P1 2380
        ANM   00,2,3                                        P1 2381
        SBM   00,2,4                                        P1 2382
        JDC   0,3,ERR4+1                                    P1 2383
ERR6    CAM   9,2,518            OCT1006  TYPE 6 AS 4       P1 2384
        SBM   07,2,3                                        P1 2385
        SIA   00,,                                          P1 2386
        ADM   00,2,1                                        P1 2387
        JDC   0,1,ERR4+2                                    P1 2388
ERR7    CAM   09,2,7          TYPE 7 ,AS 4                  P1 2389
        CAM   06,2,REF+2                                    P1 2390
        JPM   7,,TOM15                                      P1 2391
        ADM   06,2,1                                        P1 2392
TOM15   ANM   7,3,1024           OCT2000                    P1 2393
        CAM   02,,                                          P1 2394
        JZM   2,,TOM16                                      P1 2395
        ADM   06,2,1                                        P1 2396
TOM16   ANM   7,2,8176           OCT17760                   P1 2397
        ADM   07,2,8                                        P1 2398
        CAM   15,,                                          P1 2399
        ATN   06,1,                                         P1 2400
        SFR   07,,                                          P1 2401
        JDC   0,3,ERR4+1                                    P1 2402
ERR8    SFR   06,2,TS1        TYPE 8, AS 4                  P1 2403
        CAM   09,2,520                                      P1 2404
        JDC   0,1,ERR4+2                                    P1 2405
ERR9    SFR   06,2,TS1        TYPE 9, AS 4                  P1 2406
        CAM   09,2,521                                      P1 2407
        JDC   0,1,ERR4+2                                    P1 2408
ERR10   CAM   09,2,522        TYPE 10, AS 4                 P1 2409
        JDC   0,1,ERR4+2                                    P1 2410
ERR11   CAM   09,2,523        TYPE 11, AS 4                 P1 2411
        SIA   00,,                                          P1 2412
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        JNM     15,,TOM17                                               P1 2413
        ANM     00,2,3                                                  P1 2414
TOM17   ANM     0,2,7                                                   P1 2415
        JDC     0,1,ERR4+2                                              P1 2416
ERR12   SFR     06,2,TS1            TYPE 12, AS 4                       P1 2417
        CAM     09,2,12                                                 P1 2418
        JDC     0,3,ERR4+1                                              P1 2419
ERR3    SFR     06,2,TS1            TYPE 3, AS 4                        P1 2420
        CAM     09,2,3                                                  P1 2421
        CAD     15,3,                                                   P1 2422
        JDC     0,3,ERR4+1                                              P1 2423
ERR13   CAM     09,2,13             TYPE 13, AS 1                       P1 2424
        JDC     00,2,ERR1                                               P1 2425
ERR14   CAM     09,2,526            TYPE 14, AS 4                       P1 2426
        JDC     0,1,ERR4+2                                              P1 2427
ERR15   CAM     09,2,15             TYPE 15, AS 4                       P1 2428
        SIA     00,,                                                    P1 2429
        ANM     00,2,63                                                 P1 2430
        JDC     0,3,ERR4+1                                              P1 2431
ERR20   CAM     9,532                                                   P1 2432
        JDC     0,1,ERR4+2                                              P1 2433
TS1     BSS     1                                                       P1 2434
TS2     BSS     1                                                       P1 2435
COUNT   DECQL   0,0,ERRBUF+1,0      CARD AND ERROR COUNTER              P1 2436
READEC  CAD     15,3,               DECIMAL NUMBER CONVERSION (FL.PT.)  P1 2437
        SFR     05,2,RDC32                                              P1 2438
        SFR     06,2,RDC32+1                                            P1 2439
        SFR     07,2,RDC32+2                                            P1 2440
        LFR     05,2,RDC2                                               P1 2441
        LFR     06,2,RDC2                                               P1 2442
        LFR     07,2,RDC3                                               P1 2443
        ATN     03,,                                                    P1 2444
        ADM     06,0,                                                   P1 2445
        FIL                                                             P1 2446
```

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RDC4     ATN     01,,                                         P1 2447
         CAM     05,0,                                        P1 2448
         ANM     01,2,63                                      P1 2449
         JZM     1,RDC18           BLANK                      P1 2450
RDC4B    SBM     1,2,10                                       P1 2451
         JUM     1,RDC4A                                      P1 2452
         CAM     1,-10                                        P1 2453
RDC4A    JNM     1,RDC14                                      P1 2454
         SBM     1,17                                         P1 2455
         JZM     01,0,RDC18                                   P1 2456
         SBM     01,2,5                                       P1 2457
         JZM     01,0,RDC6                                    P1 2458
         SBM     01,2,16                                      P1 2459
         JZM     01,0,RDC5                                    P1 2460
         SBM     01,2,5                                       P1 2461
         JZM     01,0,RDC12                                   P1 2462
         SBM     01,2,6                                       P1 2463
         JZM     01,0,RDC13                                   P1 2464
         JDC     00,0,RDC30                                   P1 2465
RDC5     JUM     12,0,RDC9                                    P1 2466
         JUM     09,0,RDC9                                    P1 2467
         CAM     11,2,1                                       P1 2468
         JDC     00,0,RDC7                                    P1 2469
RDC6     JUM     12,0,RDC10                                   P1 2470
         JUM     09,0,RDC10                                   P1 2471
         CSM     11,2,1                                       P1 2472
RDC7     CAM     09,2,1                                       P1 2473
         CAM     13,0,                                        P1 2474
RDC8     CAM     03,2,RDC4                                    P1 2475
         JDC     00,0,INPUT                                   P1 2476
RDC9     JZM     14,0,RDC30                                   P1 2477
         CAM     10,2,1                                       P1 2478
         JDC     00,0,RDC11                                   P1 2479
RDC10    JZM     14,0,RDC30                                   P1 2480
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        CSM   10,2,1                                   P1 2481
RDC11   CAM   14,0,                                    P1 2482
        CAM   12,2,1                                   P1 2483
        JDC   00,0,RDC8                                P1 2484
RDC12   JUM   12,0,RDC30                               P1 2485
        CAM   12,2,1                                   P1 2486
        JDC   00,0,RDC8                                P1 2487
RDC13   JUM   15,0,RDC30                               P1 2488
        JUM   12,0,RDC30                               P1 2489
        CAM   15,2,1                                   P1 2490
        JDC   00,0,RDC8                                P1 2491
RDC14   JUM   12,0,RDC16                               P1 2492
        JZM   13,0,RDC15                               P1 2493
        CAM   11,2,1                                   P1 2494
        CAM   09,2,1                                   P1 2495
        CAM   13,0,                                    P1 2496
RDC15   STC   02,3,                                    P1 2497
        MPY   09,3,10                                  P1 2498
        XCH   02,3,                                    P1 2499
        MPY   09,3,10                                  P1 2500
        ADD   02,3,                                    P1 2501
        ATN   01,,                                     P1 2502
        ADD   09,3,10                                  P1 2503
        JZM   15,0,RDC8                                P1 2504
        ADM   08,2,1                                   P1 2505
        JDC   00,0,RDC8                                P1 2506
RDC16   JZM   14,0,RDC17                               P1 2507
        CAM   10,2,1                                   P1 2508
        CAM   14,0,                                    P1 2509
RDC17   CRM   04,2,10                                  P1 2510
        CRM   04,3,2                                   P1 2511
        ATN   01,,                                     P1 2512
        ADM   04,2,10                                  P1 2513
        JDC   00,0,RDC8                                P1 2514
```

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RDC18  JNM   10,0,RDC23                P1 2515
       ATN   04,,                      P1 2516
       SBM   08,0,                     P1 2517
       JPM   08,0,RDC24                P1 2518
       ATN   08,,                      P1 2519
       CSM   04,0,                     P1 2520
       STC   02,3,                     P1 2521
       LFR   03,2,RDC1                 P1 2522
       JDC   00,0,RDC20                P1 2523
RDC19  MPY   03,3,                     P1 2524
       XCH   02,3,                     P1 2525
       MPY   03,3,                     P1 2526
       ASC   02,3,                     P1 2527
RDC20  SBM   04,2,13                   P1 2528
       JPM   04,0,RDC19                P1 2529
       ADM   04,2,13                   P1 2530
       CSM   08,2,4                    P1 2531
RDC21  CRM   04,2,1                    P1 2532
       JPM   04,0,RDC22                P1 2533
       MPY   08,2,RDC1                 P1 2534
       STC   00,3,                     P1 2535
       CAD   01,3,                     P1 2536
       MPY   02,3,                     P1 2537
       ADD   00,3,                     P1 2538
       STC   02,3,                     P1 2539
RDC22  CJU   08,0,RDC21                P1 2540
       ADD   02,3,                     P1 2541
       JDC   00,0,RDC29                P1 2542
RDC23  ATN   04,,                      P1 2543
       ADM   08,0,                     P1 2544
RDC24  LFR   03,2,RDC1                 P1 2545
       JDC   00,0,RDC26                P1 2546
RDC25  DIV   03,3,                     P1 2547
       SRM   02,3,                     P1 2548
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        XCH     02,3,
        DIV     03,3,
        ADD     02,3,
RDC26   SBM     08,2,13
        JPM     08,0,RDC25
        ADM     08,2,13
        CSM     04,2,4
RDC27   CRM     08,2,1
        JPM     08,0,RDC28
        DIV     04,2,RDC1
        SRM     02,3,
        STR     00,3,
        CAD     01,3,
        VID     02,3,
        ADD     00,3,
RDC28   CJU     04,0,RDC27
RDC29   CAM     03,2,1
        JPM     11,0,RDC31
        STC     02,3,
        STN     00,3,
        SUB     02,3,
        JDC     00,0,RDC31
RDC30   CAM     03,0,
RDC31   ATN     06,,
        ADM     03,0,
        ATN     05,,
        ADM     01,0,
        LFR     05,2,RDC32
        LFR     06,2,RDC32+1
        LFR     07,2,RDC32+2
        JLH     03,0,
        FIL
        OCTQ    05000,00000,00000,00002
        OCTQ    03100,00000,00000,00004
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```
        OCTQ    04704,00000,00000,00007
        OCTQ    02765,16040,00000,00016
RDC1    OCTQL   04430,04716,05200,00026
RDC2    OCTQL   0,0,0,0
RDC3    OCTQL   0,1,1,0
RDC32   BSS     3
GOBOY   CALL    ERR20
        CSM     5,10
        LFR     4,IOSYS2+2
        CAM     4,M1
        CAM     7,GOWORD
GOWD1   ATN     7,1,
        LFR     4
        ATN     4,1,
        SFR     4
        CJU     5,GOWD1
GOBOY1  CAM     3,2088
        SFR     4,REF
        CAM     3,1536
        CAM     6,REF+1
        ATN     6,1,
        SFR     4
        LFR     4,END2
        SFR     4,END
        TRA     OUTPT4+1
GOBOY2  LFR     4,END1
        SFR     4,END
        LFR     4,ILBUF+256
        CSM     3,M1
        CAM     6,REF+2
        ATN     6,1,
        SFR     4
        CALL    OUTPUT
        LFR     4,END3
```

```
         SFR    4,OUTPT4+1                                      P1 2617
         TRA    GO2                                             P1 2618
         FIL                                                    P1 2619
MAC12    JSB    03,0,OUTPUT                                     P1 2620
         FIL                                                    P1 2621
GO2      CAM    6,REF+3           FINAL EXIT FOR GO             P1 2622
         CALL   OUTPUT                                          P1 2623
         LFR    6,IT+5                                          P1 2624
         LFR    7,OUTPT4                                        P1 2625
         CAM    15,M11                                          P1 2626
         SFR    7,OUTPT4                                        P1 2627
         CALL   SYSAUX                                          P1 2628
OUTPT4   DECQL  WRITE,ILBUF,0,0   WRITE LAST IL BLOCK ON DRUM   P1 2629
         LFR    6,IT+4                                          P1 2630
         LFR    7,GOA1                                          P1 2631
         CSM    7,2                                             P1 2632
GOA3     CAM    15,1030           TAPE 6 CODE                   P1 2633
         JZM    10,GOA2           ONTO TAPE 6                   P1 2634
         CJZ    10,GOA2                                         P1 2635
         CAM    15,M10+5          DRUM CODE, LAST BLOCK         P1 2636
GOA2     SFR    7,GOA1                                          P1 2637
         CALL   SYSAUX                                          P1 2638
GOA1     DECQL  WRITE,ILBUF+256,0,0                             P1 2639
         CJU    7,GOA3                                          P1 2640
         CALL   SYSAUX            READ BLOCK OF TRANS VECT  DRUM P1 2641
         DECQ   READ,ILBUF+256,0,0                              P1 2642
         CALL   SYSAUX                                          P1 2643
         DECQ   1056,0,0,1030     REWIND TAPE 6                 P1 2644
         CALL   SYSAUX                                          P1 2645
         DECQ   WAIT,0,0,0                                      P1 2646
         LFR    7,ILBUF+256                                     P1 2647
         CSM    12,M12            MINUS NO. ENTRY POINTS        P1 2648
         CAM    14,1-M12+ILBUF+256                              P1 2649
         CAM    13                                              P1 2650
```

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         CSM     0,64                                                  P1 2651
CTB2     LFR     5,NTBL+64+M0         FIRST CONTROL WORD               P1 2652
         TRA     CTB4A                                                 P1 2653
CTB7     ADM     13,-1                INCREMENT ENTRY COUNT            P1 2654
         ATN     14,1,                                                 P1 2655
         SFR     6                                                     P1 2656
         CAM     2,-M13-1+4096                                         P1 2657
         ORM     2,1                                                   P1 2658
         CAM     15,M14-ILBUF-513                                      P1 2659
         JNM     15,CTB5                                               P1 2660
         CAM     4,CALLS                                               P1 2661
         TRA     SERR3                                                 P1 2662
CTB9     ADM     15,4096              SET CALL MARK                    P1 2663
         CAM     14,4332                                               P1 2664
         LFR     4,INPUT              THIS SAVES USED BIT IN CALLED PREVIOUS P1 2665
         SFR     7,INPUT              CURRENT CALLED NAME              P1 2666
         ANM     3,1                  SEE IF LAST CALLED WAS ODD       P1 2667
         JZM     3,CTB10              LAST BIT IS CORRECT              P1 2668
         ANM     15,8190              RESET CALLED BIT                 P1 2669
         SFR     7,INPUT                                               P1 2670
         TRA     CTB10                                                 P1 2671
CTB3     LFR     5,M5                 NEXT CONTROL WORD                P1 2672
CTB4A    CAD     15,3,                                                 P1 2673
         SAM     M4                   CLEARS CONTROL WORD              P1 2674
         JZM     6,CTB6               NO ENTRIES                       P1 2675
CTB4     LFR     6,M7                 TABLE ENTRY                      P1 2676
         CAM     1,M11                                                 P1 2677
         CAM     11                                                    P1 2678
         ADD     F6                                                    P1 2679
         SAM     F6                   RECONSTRUCT NAME                 P1 2680
         ANN     1,3328                                                P1 2681
         CAM     2                                                     P1 2682
         CRM     2,8                                                   P1 2683
         JNM     1,CTB5               DEFIMED                          P1 2684
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        CRM     1,10
        JNM     1,CTB7              CALLED
        CAM     2,28
CTB5    CAM     11,M2
        ATN     7,1,
        SFR     6
        CJU     6,CTB4
        JUM     5,CTB3
CTB6    CJU     0,CTB2
        CAM     14,NA               FINAL SCAN OF NAME TABLE
        CAM     15,5+(TOP-NA)/256 TO CONVERT TO PASS 2 FORMAT
        SFR     7,ILBUF+256
        CALL    SYSAUX
        DECQ    WRITE,ILBUF+256,0,0
        CSM     4,(TOP-NA)/256
        LFR     7,GO2A
        CAM     13,NA
GO2B    CAM     15,M4+(TOP-NA)/256+5
        SFR     7,GO2A
        CALL    SYSAUX
GO2A    DECQ    WRITE,0,0,0
        ADM     13,256
        CJU     4,GO2B
        CSM     4,TOP-NA
        CAM     5,NA
CTB8    LFR     7,M5
        JNM     15,CTB9             CALLED BUT NOT DEFINED
        JUM     12,CTB11
        JUM     13,CTB11
        JZM     14,CTB10
CTB11   CAM     14,M15+4096
        CAM     15
CTB10   CAM     12
        CAM     13
```

```
         ANM    14,8190          REMOVE UNUSED BIT                  P1 2719
         ATN    5,1,                                                P1 2720
         SFR    7                RESTORE IN TABLE                   P1 2721
         CJU    4,CTB8                                              P1 2722
         CAM    0,NA+16*46                                          P1 2723
         CSM    1,1                                                 P1 2724
         CSM    2,10                                                P1 2725
         CSM    3,11                                                P1 2726
         CSM    4,16                                                P1 2727
         CAM    5                                                   P1 2728
SET1     LFR    7,M0             DEFINE MODIFIERS                   P1 2729
         CAM    15,M5                                               P1 2730
         ADM    14,96                                               P1 2731
         SFR    7,M0                                                P1 2732
         ADM    5,4                                                 P1 2733
         CJZ    3,SET13                                             P1 2734
         CJZ    2,SET12                                             P1 2735
         CJU    1,SET11                                             P1 2736
         ADM    0,-1                                                P1 2737
SET13    ADM    0,-11*16+1                                          P1 2738
SET12    ADM    0,16                                                P1 2739
SET11    ADM    0,16                                                P1 2740
         CJU    4,SET1                                              P1 2741
         CAM    0,NA                                                P1 2742
         CSM    1,1                                                 P1 2743
         CSM    2,8                                                 P1 2744
         CAM    5                DEFINE REGISTERS                   P1 2745
SET2     LFR    7,M0                                                P1 2746
         CAM    15,M5                                               P1 2747
         ADM    14,96                                               P1 2748
         SFR    7,M0                                                P1 2749
         ADM    5,4                                                 P1 2750
         CJU    1,SET21                                             P1 2751
         ADM    0,54*16                                             P1 2752
```

```
SET21   ADM     0,16                                                    P1 2753
        CJU     2,SET2                                                  P1 2754
        FIL                                                             P1 2755
END     LFR     7,MAKEUP                                                P1 2756
        FIL                                                             P1 2757
        LDM     03,2,NLU10                                              P1 2758
        CAM     13,15+M3                                                P1 2759
        SFR     07,2,MAKEUP                                             P1 2760
        LFR     7,ILBUF+256                                             P1 2761
        SFR     7,ILBUF                                                 P1 2762
        LFR     07,2,COUNT          SET COUNT ERRORS IN LOC. 0          P1 2763
        ATN     14,,                                                    P1 2764
        CAM     15,2,-1                                                 P1 2765
        LDM     14,ERRBUF                                               P1 2766
        SFR     07,2,ERRBUF                                             P1 2767
ENDOF1  TRA     SYSTEM              DONE                                P1 2768
        FIL                                                             P1 2769
RDM8    TRA     ERROR                                                   P1 2770
        FIL                                                             P1 2771
RDM15   TRA     ERROR                                                   P1 2772
        FIL                                                             P1 2773
CAJ     TRA     CJU                                                     P1 2774
        FIL                                                             P1 2775
END1    LFR     7,MAKEUP                                                P1 2776
        FIL                                                             P1 2777
END2    TRA     GOBOY2                                                  P1 2778
        FIL                                                             P1 2779
END3    TRA     END                                                     P1 2780
        FIL                                                             P1 2781
CJU     TRA     JDC                                                     P1 2782
        FIL                                                             P1 2783
CJS     TRA     CJF                                                     P1 2784
W1      BSS     1                                                       P1 2785
GOWORD  CHR     40,****** GO CARD INSERTED BY NICAP TO FIRS             P1 2786
```

```
         CHR      40,T LOCATION AFTER TRANSFER VECTORS ******                  P1 2787
REF      BSS      1                                                            P1 2788
         ORG      1976+204                                                     P1 2789
MTBL     DECQL    MTBL,0,0,MA                                                  P1 2790
         DECQ     MTBL+1,0,0,MA1                                               P1 2791
         DECQ     MTBL+2,0,0,MA2                                               P1 2792
         DECQ     MTBL+3,0,0,MA3                                               P1 2793
         DECQ     MTBL+4,0,0,MA4                                               P1 2794
         DECQ     MTBL+5,0,0,MA5                                               P1 2795
         DECQ     MTBL+6,0,0,MA6                                               P1 2796
         DECQ     MTBL+7,0,0,MA7                                               P1 2797
         DECQ     MTBL+8,0,0,MA8                                               P1 2798
         DECQ     MTBL+9,0,0,MA9                                               P1 2799
         DECQ     MTBL+10,0,0,MA10                                             P1 2800
         DECQ     MTBL+11,0,0,MA11                                             P1 2801
         DECQ     MTBL+12,0,0,MA12                                             P1 2802
         DECQ     MTBL+13,0,0,MA13                                             P1 2803
         DECQ     MTBL+14,0,0,MA14                                             P1 2804
         DECQ     MTBL+15,0,0,MA15                                             P1 2805
MA       BSS      3                                                            P1 2806
MA1      BSS      9                                                            P1 2807
MA2      BSS      8                                                            P1 2808
MA3      BSS      4                                                            P1 2809
MA4      BSS      7                                                            P1 2810
MA5      BSS      3                                                            P1 2811
MA6      BSS      7                                                            P1 2812
MA7      BSS      12                                                           P1 2813
MA8      BSS      11                                                           P1 2814
MA9      BSS      15                                                           P1 2815
MA10     BSS      16                                                           P1 2816
MA11     BSS      5                                                            P1 2817
MA12     BSS      7                                                            P1 2818
MA13     BSS      10                                                           P1 2819
MA14     BSS      14                                                           P1 2820
```

```
MA15    BSS     4                                                            P1 2821
        BSS     18                                                           P1 2822
MENTRY  OCTQL   0,10000,0,0        BLANK          CHARACTER TABL8E           P1 2823
        OCTQ    0,04001,0,0        1                                         P1 2824
        OCTQ    0,04002,0,0        2                                         P1 2825
        OCTQ    0,04003,0,0        3                                         P1 2826
        OCTQ    0,04004,0,0        4                                         P1 2827
        OCTQ    0,04005,0,0        5                                         P1 2828
        OCTQ    0,04006,0,0        6                                         P1 2829
        OCTQ    0,04007,0,0        7                                         P1 2830
        OCTQ    0,04010,0,0        8                                         P1 2831
        OCTQ    0,04011,0,0        9                                         P1 2832
        OCTQ    0,04012,0,0        0                                         P1 2833
        OCTQ    0,10013,0,0        =                                         P1 2834
        OCTQ    0,10014,0,0        .                                         P1 2835
        OCTQ    0,15,0,0                                                     P1 2836
        OCTQ    0,16,0,0                                                     P1 2837
        OCTQ    0,17,0,0                                                     P1 2838
        OCTQ    0,20,0,0                                                     P1 2839
        OCTQ    0,14321,0,0        /                                         P1 2840
        OCTQ    0,22,0,0           S                                         P1 2841
        OCTQ    0,23,0,0           T                                         P1 2842
        OCTQ    0,24,0,0           U                                         P1 2843
        OCTQ    0,25,0,0           V                                         P1 2844
        OCTQ    0,26,0,0           W                                         P1 2845
        OCTQ    0,27,0,0           X                                         P1 2846
        OCTQ    0,30,0,0           Y                                         P1 2847
        OCTQ    0,31,0,0           Z                                         P1 2848
        OCTQ    0,32,0,0                                                     P1 2849
        OCTQ    0,10033,0,0        ,                                         P1 2850
        OCTQ    0,10534,0,0        (                                         P1 2851
        OCTQ    0,35,0,0                                                     P1 2852
        OCTQ    0,36,0,0                                                     P1 2853
        OCTQ    0,37,0,0                                                     P1 2854
```

```
         OCTQ    0,14140,0,0     -                          P1 2855
         OCTQ    0,41,0,0        J                          P1 2856
         OCTQ    0,42,0,0        K                          P1 2857
         OCTQ    0,43,0,0        L                          P1 2858
         OCTQ    0,44,0,0        M                          P1 2859
         OCTQ    0,45,0,0        N                          P1 2860
         OCTQ    0,46,0,0        O                          P1 2861
         OCTQ    0,47,0,0        P                          P1 2862
         OCTQ    0,50,0,0        Q                          P1 2863
         OCTQ    0,51,0,0        R                          P1 2864
         OCTQ    0,52,0,0                                   P1 2865
         OCTQ    0,14053,0,0     $                          P1 2866
         OCTQ    0,14254,0,0     *                          P1 2867
         OCTQ    0,55,0,0                                   P1 2868
         OCTQ    0,56,0,0                                   P1 2869
         OCTQ    0,57,0,0                                   P1 2870
         OCTQ    0,14060,0,0     +                          P1 2871
         OCTQ    0,61,0,0        A                          P1 2872
         OCTQ    0,62,0,0        B                          P1 2873
         OCTQ    0,63,0,0        C                          P1 2874
         OCTQ    0,64,0,0        D                          P1 2875
         OCTQ    0,65,0,0        E                          P1 2876
         OCTQ    0,66,0,0        F                          P1 2877
         OCTQ    0,67,0,0        G                          P1 2878
         OCTQ    0,70,0,0        H                          P1 2879
         OCTQ    0,71,0,0        I                          P1 2880
         OCTQ    0,72,0,0                                   P1 2881
         OCTQ    0,10073,0,0     .                          P1 2882
         OCTQ    0,10474,0,0     ,                          P1 2883
         OCTQ    0,75,0,0                                   P1 2884
         OCTQ    0,76,0,0                                   P1 2885
         OCTQ    0,77,0,0                                   P1 2886
         ORG     2496                                       P1 2887
NTBL     DECQL   NTBL,0,0,NA                                P1 2888
```

```
DECQ    NTBL+1,0,0,NA+16*1                    P1 2889
DECQ    NTBL+2,0,0,NA+16*2                    P1 2890
DECQ    NTBL+3,0,0,NA+16*3                    P1 2891
DECQ    NTBL+4,0,0,NA+16*4                    P1 2892
DECQ    NTBL+5,0,0,NA+16*5                    P1 2893
DECQ    NTBL+6,0,0,NA+16*6                    P1 2894
DECQ    NTBL+7,0,0,NA+16*7                    P1 2895
DECQ    NTBL+8,0,0,NA+16*8                    P1 2896
DECQ    NTBL+9,0,0,NA+16*9                    P1 2897
DECQ    NTBL+10,0,0,NA+16*10                  P1 2898
DECQ    NTBL+11,0,0,NA+16*11                  P1 2899
DECQ    NTBL+12,0,0,NA+16*12                  P1 2900
DECQ    NTBL+13,0,0,NA+16*13                  P1 2901
DECQ    NTBL+14,0,0,NA+16*14                  P1 2902
DECQ    NTBL+15,0,0,NA+16*15                  P1 2903
DECQ    NTBL+16,0,0,NA+16*16                  P1 2904
DECQ    NTBL+17,0,0,NA+16*17                  P1 2905
DECQ    NTBL+18,0,0,NA+16*18                  P1 2906
DECQ    NTBL+19,0,0,NA+16*19                  P1 2907
DECQ    NTBL+20,0,0,NA+16*20                  P1 2908
DECQ    NTBL+21,0,0,NA+16*21                  P1 2909
DECQ    NTBL+22,0,0,NA+16*22                  P1 2910
DECQ    NTBL+23,0,0,NA+16*23                  P1 2911
DECQ    NTBL+24,0,0,NA+16*24                  P1 2912
DECQ    NTBL+25,0,0,NA+16*25                  P1 2913
DECQ    NTBL+26,0,0,NA+16*26                  P1 2914
DECQ    NTBL+27,0,0,NA+16*27                  P1 2915
DECQ    NTBL+28,0,0,NA+16*28                  P1 2916
DECQ    NTBL+29,0,0,NA+16*29                  P1 2917
DECQ    NTBL+30,0,0,NA+16*30                  P1 2918
DECQ    NTBL+31,0,0,NA+16*31                  P1 2919
DECQ    NTBL+32,0,0,NA+16*32                  P1 2920
DECQ    NTBL+33,0,0,NA+16*33                  P1 2921
DECQ    NTBL+34,0,0,NA+16*34                  P1 2922
```

```
          DECQ   NTBL+35,0,0,NA+16*35                                P1 2923
          DECQ   NTBL+36,0,0,NA+16*36                                P1 2924
          DECQ   NTBL+37,0,0,NA+16*37                                P1 2925
          DECQ   NTBL+38,0,0,NA+16*38                                P1 2926
          DECQ   NTBL+39,0,0,NA+16*39                                P1 2927
          DECQ   NTBL+40,0,0,NA+16*40                                P1 2928
          DECQ   NTBL+41,0,0,NA+16*41                                P1 2929
          DECQ   NTBL+42,0,0,NA+16*42                                P1 2930
          DECQ   NTBL+43,0,0,NA+16*43                                P1 2931
          DECQ   NTBL+44,0,0,NA+16*44                                P1 2932
          DECQ   NTBL+45,0,0,NA+16*45                                P1 2933
          DECQ   NTBL+46,0,0,NA+16*46                                P1 2934
          DECQ   NTBL+47,0,0,NA+16*47                                P1 2935
          DECQ   NTBL+48,0,0,NA+16*48                                P1 2936
          DECQ   NTBL+49,0,0,NA+16*49                                P1 2937
          DECQ   NTBL+50,0,0,NA+16*50                                P1 2938
          DECQ   NTBL+51,0,0,NA+16*51                                P1 2939
          DECQ   NTBL+52,0,0,NA+16*52                                P1 2940
          DECQ   NTBL+53,0,0,NA+16*53                                P1 2941
          DECQ   NTBL+54,0,0,NA+16*54                                P1 2942
          DECQ   NTBL+55,0,0,NA+16*55                                P1 2943
          DECQ   NTBL+56,0,0,NA+16*56                                P1 2944
          DECQ   NTBL+57,0,0,NA+16*57                                P1 2945
          DECQ   NTBL+58,0,0,NA+16*58                                P1 2946
          DECQ   NTBL+59,0,0,NA+16*59                                P1 2947
          DECQ   NTBL+60,0,0,NA+16*60                                P1 2948
          DECQ   NTBL+61,0,0,NA+16*61                                P1 2949
          DECQ   NTBL+62,0,0,NA+16*62                                P1 2950
          DECQ   NTBL+63,0,0,NA+16*63                                P1 2951
NA        BSS    1                                                   P1 2952
TOP       EQUS   4096                                                P1 2953
LLPB      EQUS   3615                                                P1 2954
PLUS      EQUS   48                                                  P1 2955
MINUS     EQUS   32                                                  P1 2956
```

```
ILBUF   EQUS   512                                    P1 2957
RDBUF   EQUS   1024                                   P1 2958
MAKEWD  EQUS   511                                    P1 2959
READND  EQUS   3                                      P1 2960
BLANK   EQUS   0                                      P1 2961
PERIOD  EQUS   59                                     P1 2962
OPENBR  EQUS   28                                     P1 2963
CLOSBR  EQUS   60                                     P1 2964
COMMA   EQUS   27                                     P1 2965
ERRBUF  EQUS   0                                      P1 2966
TABFUL  EQUS   1                                      P1 2967
EQU     EQUS   2                                      P1 2968
ERR     EQUS   3                                      P1 2969
CALLS   EQUS   4                                      P1 2970
SYSIO   EQUS   7939                                   P1 2971
MAKEUP  EQUS   256                                    P1 2972
READ    EQUS   0                                      P1 2973
WRITE   EQUS   1+511                                  P1 2974
WAIT    EQUS   256                                    P1 2975
SYSERR  EQUS   7937                                   P1 2976
SYSTEM  EQUS   7936                                   P1 2977
SYSAUX  EQUS   7938                                   P1 2978
TRACE   EQUS   4161                                   P1 2979
        GO     10                                     P1 2980
                                                      P1 2981
```

3.2 NICAP Pass II

Pass II is primarily concerned with solving the name table and calculating the length of the program when assembled; to do this, the subroutine SBSOLV (also called FRANK) is used. This program repeatedly scans the EQU list until no more EOU's can be evaluated. It then exits, to the address in M3 if all EOU's have now been evaluated, otherwise to the address in M2. SBSOLV is used before and after Pass II proper. If any EQU remains unsolved after Pass II, an exit is made to SYSERR.

Exits can also be made to SYSERR if the EQU list, the name table or the error list becomes full. Otherwise a final exit to SYSTEM is made, by which time all names in the table will have been defined. Pass II scans the intermediate language, deciding where each order would go in memory if it were to be assembled. In this way it can assign to each name that appears in the location field of a card a memory address.

The input to Pass II is as described in "Output from Pass I." Pass II is copied if memory in those areas occupied by the Pass I program, and therefore does not overwrite the name table or the error and EQU lists.

3.2.1 Output from Pass II

Pass II exits via SYSERR with M1 containing:

- 257 if the name table is filled,
- 258 if the EQU list if filled,
- 259 if the error list is filled,
- 260 if the EQU list cannot be solved, and
- 261 if there is a machine malfunction;

otherwise an exit is made to SYSTEM. The only change in the storage areas is that core location 512 is no longer significant, the name table now has every name as defined as it ever will be and F7 contains in M15 the number of erasable locations used, in M14 the top address used by the program and in M13 the length of the common area.

3.2.2 The Location Counter

Any time that an ORG, FLD, BES or BSS is encountered for which the address field cannot be calculated because not all of the names appearing in it are known absolutely, the location counter is made relative to a new name which is defined as a symbol with value equal to the first control group which will follow the pseudo instruction. This value is defined by forming an EQUS statement in the EQU list.

To do this, the following words are used:

12	25	29	31	33	36	38	51
CDCN	CH		REL	SN	TN	QL	WL

Name Table Entry in Pass II

CDCN is the card number on which this name is defined. WL is the word value of the name if it is a symbol or label, and is four times the numerical value if it is a modifier or a fast register. TN is a type code which indicates the type of name:

		Octal Value
000	Symbol	0
001	Register	4
010	Modifier	10
011	Label	14
100 101 110	Not used	
111		34

SN is the state of construction code:

00	Unknown
*01	Known relatively
10	Defined in an EQU statement generated by Pass II
11	Known absolutely

*In the relative case the chain address CHN points to the next member of the chain. The last member of the chain has the code 01 in SN, the first member of the chain is an EQU statement. Thus an EQU statement may be chained to a series of names. When the EQU statement is evaluated between Pass II and Pass III, its value is added to the WN groups of each name in the chain.

REL: two bits for relocation

00	No relocation
01	Program
10	Common
11	Erasable

As EQU statements are generated during Pass II, separate bytes are stored in locations OUTLST-1, OUTLST, ..., etc., in the first quarter-word positions. When another card that changes the relativiser of the location counter is read, the final chain address from the location counter, CH, is stored in the first quarter word of OUTLST + 1. The second quarter of this location contains a 13-bit new name that can be used as the next relativiser. Use of the EQUTT subroutine stores the EQU statement in the EQU list, enters the name in the table and decreases the new name address by 1. EQUTT makes use of the control word MAKEUP.

...	NMFREE	QEQU	WEQU

MAKEUP

WEQU and 4 + QEQU are the word and quarter-word locations of the next EQU statement in the EQU list. NMFREE is the address of the next free location for a new name.

The FLD pseudo operation will also cause a new relativiser to be generated if the location counter was previously relative. This will be one of the two EQU statements with type codes 4 or 12, the former indicating round even values up, and the latter meaning round add values up.

The pseudo operation GO which signals the end of Pass II also enters the EQUTT subroutine if the location counter is relative. It then stores a final reference byte of all zero which indicates the end of the EQU list.

The location counter and the statement counter (used for numbering errors) are held in the word LOCAT.

SC	CH	LQ	LW

LW — Word location

LQ — Quarter-word location

CH — 0 ≡ Absolute
$\neq$ 0 ≡ Relative to the name which appears at the end of the chain through the name table started from CH

SC — Statement Counter

3.2.3 Program Sections and Subroutines

The general flow is indicated in sections 3.2.1 and 3.2.2. The boxes in double lines are given in more detail in subsequent diagrams. During the address computation of an order with a complex address structure, the routine ADCOMP is used. This is a routine essentially similar to the ADCOMP routine in Pass III which constructs the final orders in binary. In Pass II this routine needs only to decide how many quarter words are required to generate the address at execution time in order that it may keep track of the location counter. For a general description of ADCOMP, the reader is referred to the Pass III description.

SBCOMP is a subroutine version of ADCOMP that is used by the pseudo orders which need addresses calculated. It therefore makes a subroutine exit if the reference in M5 indicates that it is a pseudo order. Also pseudo orders cause it to make a different exit if a name is not yet defined absolutely when it is used. This exit is via the address "UNKNWN."

If a modifier is encountered in SBCOMP, it is treated as illegal, and an address of zero is used instead.

The Use of Modifiers and Temporary Storage in Pass II

(For the use of modifiers and registers during SBCOMP and ADCOMP see the Pass III description.)

Subroutine entry is always made via M3.

Input always reads into M4.

A name from a location field is put into M6.

Generally, a name table entry is read into F4.

"LOCAT" is read into F7 generally. It stays there during the execution of most pseudo orders.

M5 always holds the reference byte, except that the character extension bits contain the extension bits last read. For the format of the reference, see the description of the intermediate language.

The order currently being processed is stored in COMMON + 2 during ADCOMP. This is in the first quarter, the third quarter contains the order type code in the first four bit positions.

During ADCOMP, the top level of the operation push down is held in F7. The address of the second level plus one is held in M8. M11 is used as a push down pointer for the M list and M10 is used as a counter for the number of modifiers in the top level of the M list.

M6 contains a count of the number of open brackets minus the number of close brackets that have been read.

As in Pass III, the flow chart for ADCOMP uses the notation:

TO	Top operation in push down (in M14)	
TLV	Value of top operand in push down	
TL	Top operand type in push down (in M12 ..	Number .. 0 Tag ..... 1 ACC ..... -4096)
TLV	Top level value (in M13, top bit is sign for tags and ACC)	
SO	Second level operation in push down	
SL	Second level operand type	
SLV	Second level operand value	

3.2.4 Subroutines

The subroutines INPUT and LOOKM are identical to those of the same name in Pass III and are described there. The purposes of the various subroutines are:

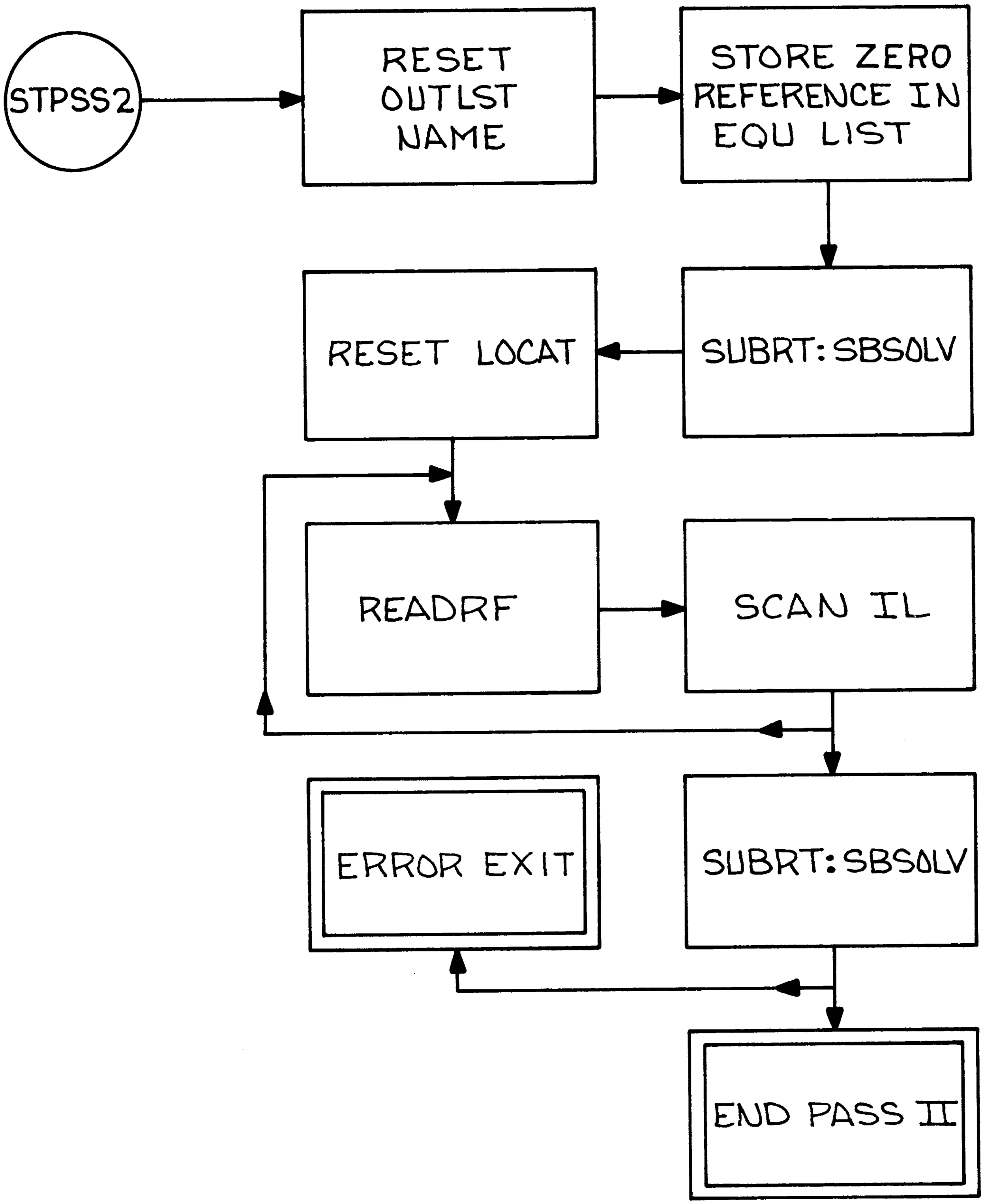
EQUTT	Packs the output EQU statement from locations OUTLST, OUTLST + 1, etc., into the EQU list
FILL	Increases the location counter to the next word boundary
SBSOLV	Attempts to substitute in table for all names defined in the EQU list
INPUT	Reads the next byte of intermediate language into M4
LOOKM	Examines the top level of the M list for a modifier used positively. If none exists it exits to M3 + 1; otherwise it puts the first such in M2 and removes it from the list.
LSTORE	Increases the location counter by two quarter words if the accumulator is already in use in the address calculation object program. (M7 contains a count of the number of times it appears in the push down.)
MOUT	Increases the location counter by a number of quarter words equal to the number of modifiers in the top level of the M list
NAMEL	Enters the name held in M6 into the name table with value equal to the current location counter
OUT1	Increases the location counter by a quarter word
OUT2	Increases the location counter by two quarter words
PST1	This is used whenever the level of the incoming operation is less than the current top level operation.
PTT1	This is used whenever a closing bracket is read and the top level M list is nonempty.
SBCOMP	Calculates the numerical value of an address of a pseudo order
SBERR	Lists an error for future printing

3.2.5 Errors of Pass II

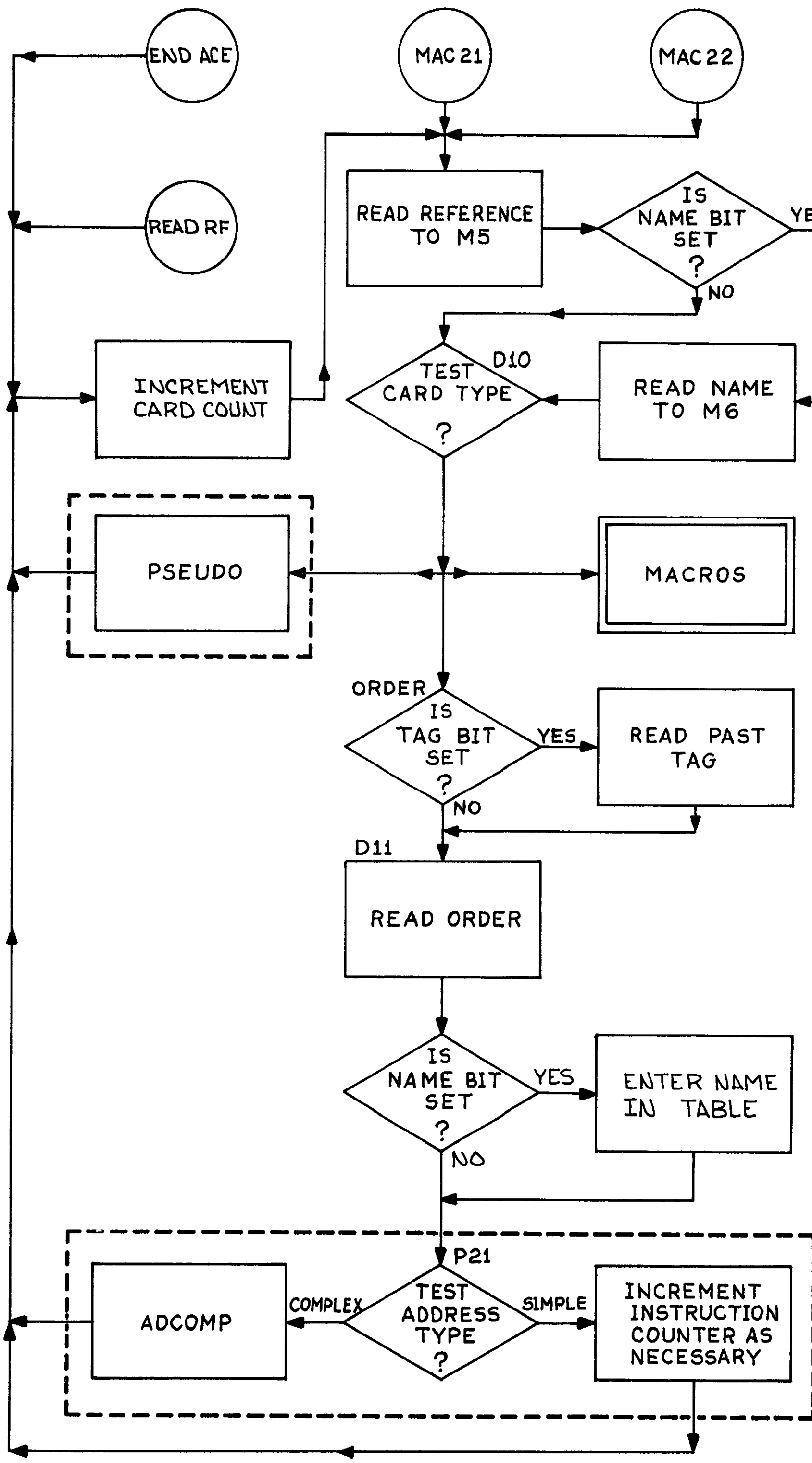
Error No.	Description	Used in SBSOLV?	Fatal?
0	Symbols for Label		No
1	Label for Symbol	No	No
2	F0 illegal	No	No
3	F1 illegal	No	No
4	All F illegal		No
5	All M illegal		
6	Label or Symbol as tag		
7	Modifier in pseudo op	No	
8	Undefined name	No	
9	Doubly-defined name		
10	First byte of L address nonname		No
11	F for M		
12	M for F		
13	> 1 address byte in modifier or Fast Register		
14	Too large integer address for M or F		
16	Illegal relocation		No

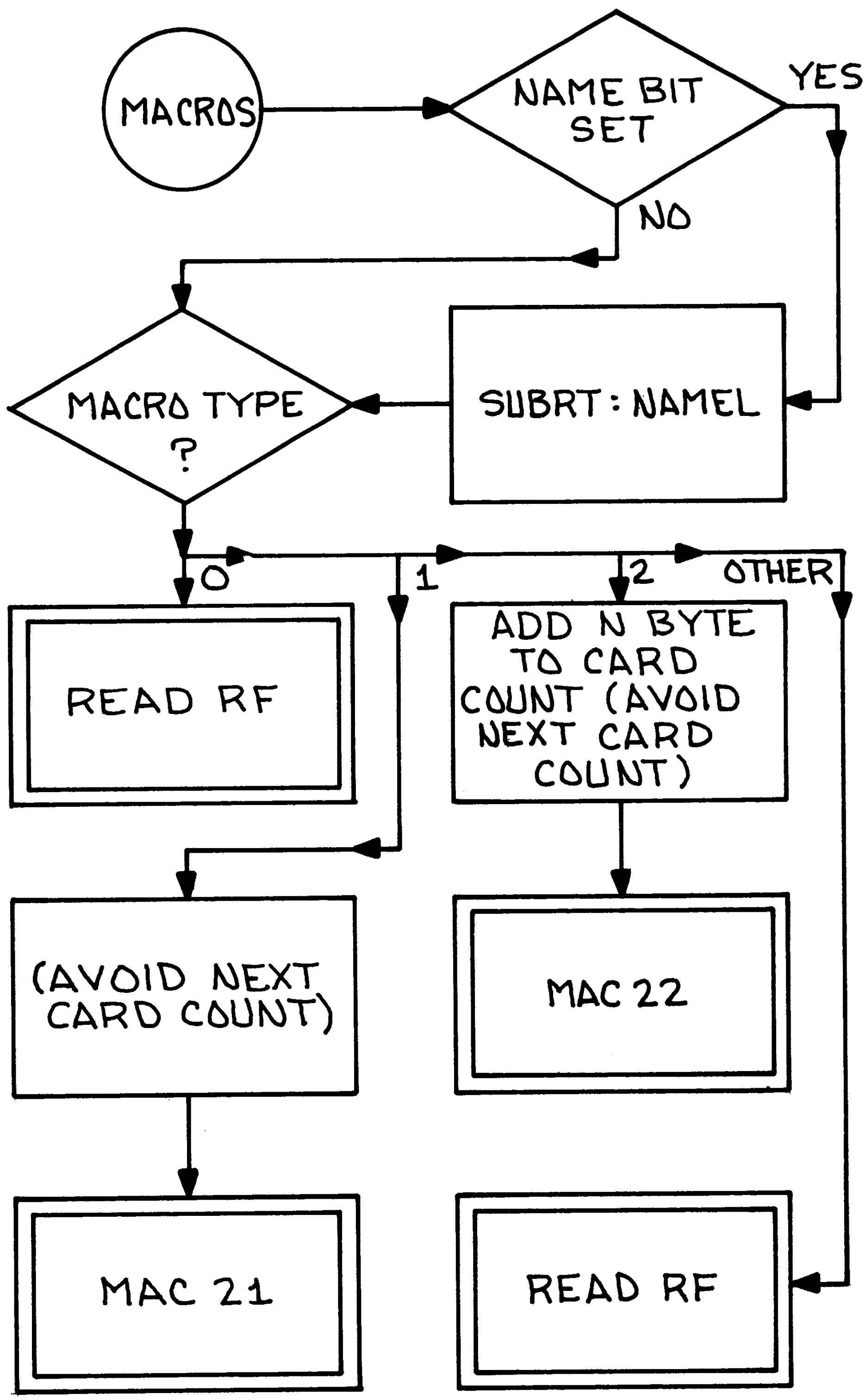
3.2.6 Pass II Flow Diagrams

START PASS 2

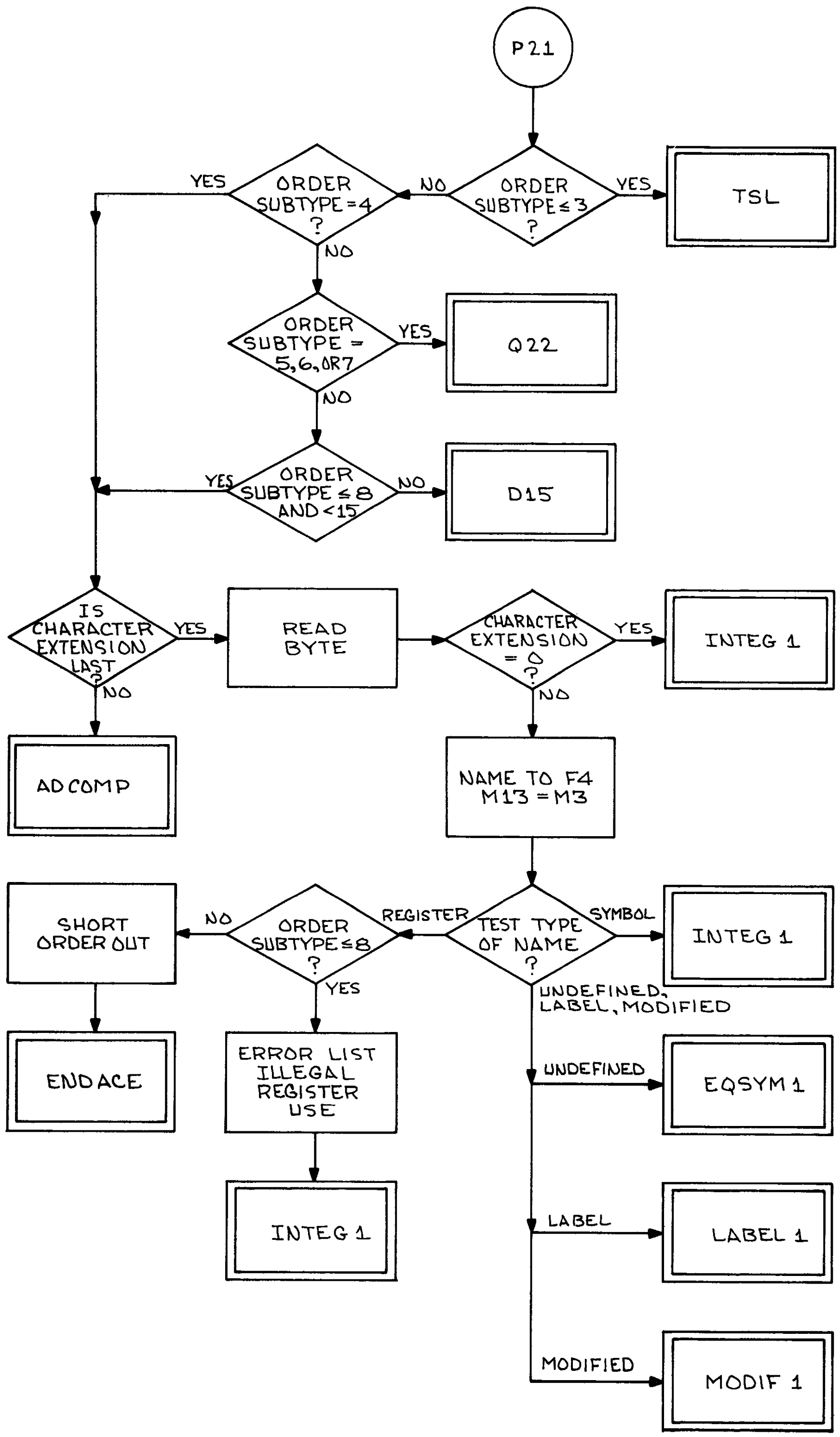


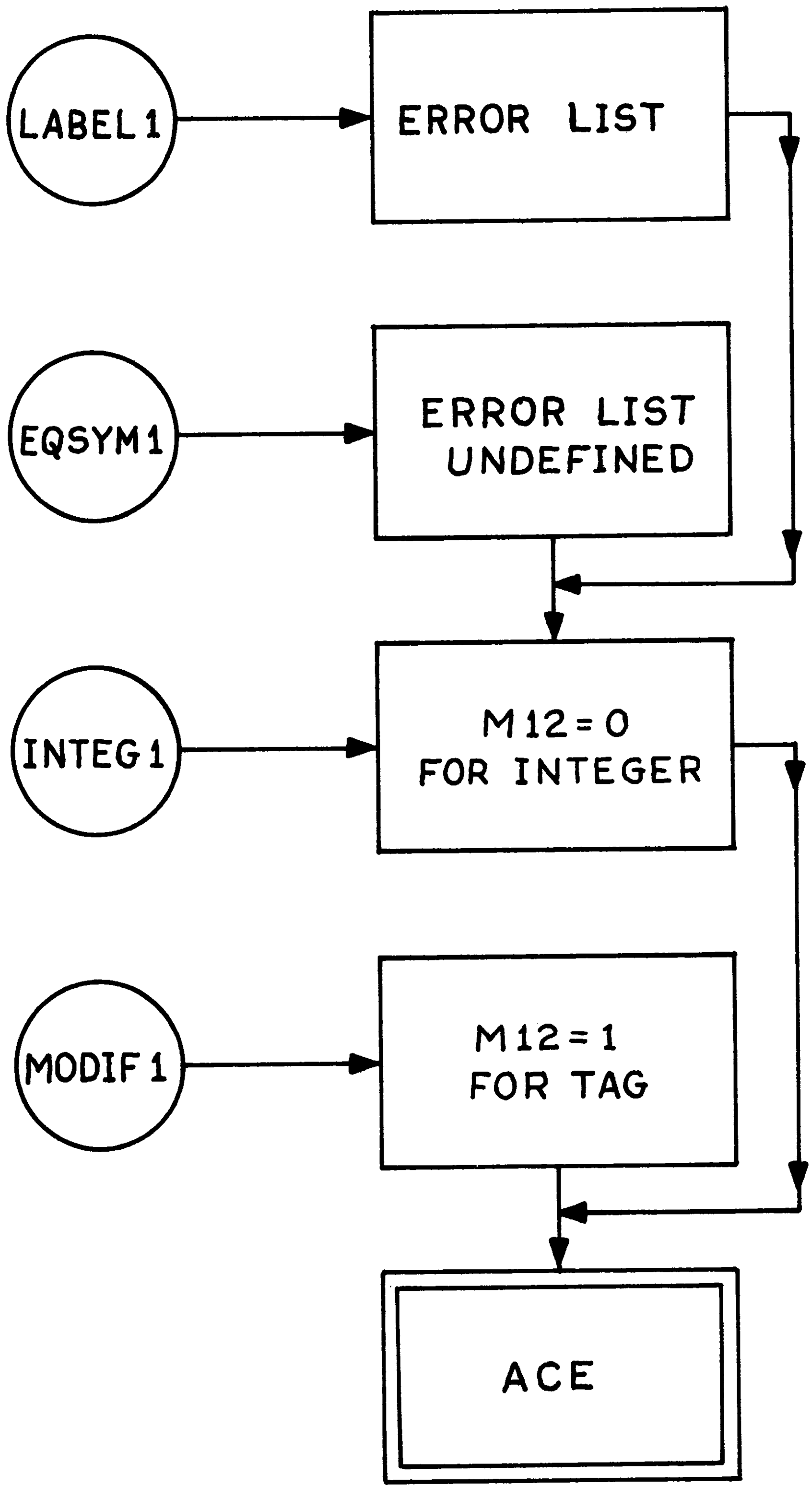
GENERAL FLOW OF IL SCAN

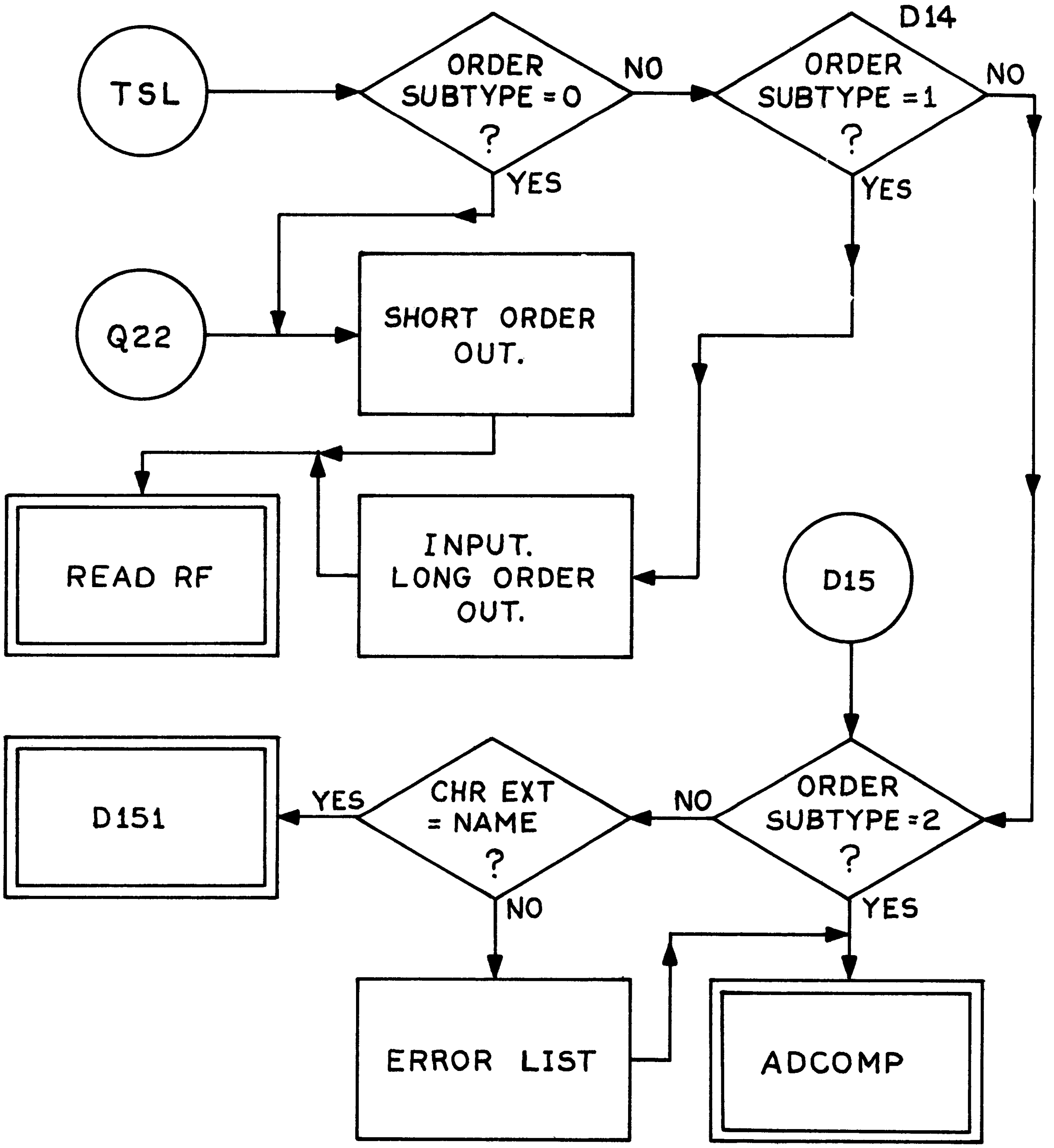


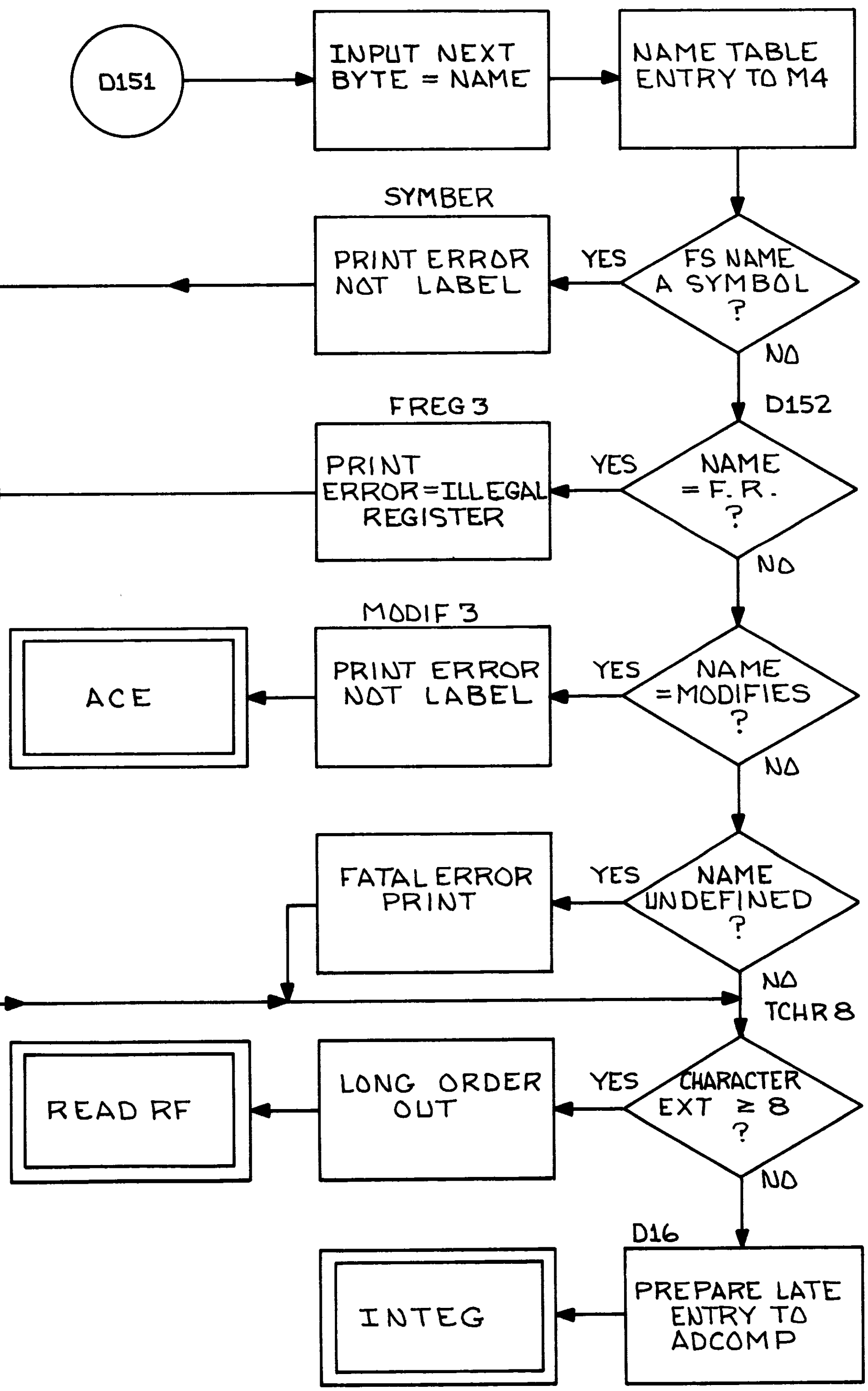

MACROS
NAME BIT SET
YES
NO
SUBRT: NAMEL
MACRO TYPE ?
0
1
2
OTHER
READ RF
ADD N BYTE TO CARD COUNT (AVOID NEXT CARD COUNT)
(AVOID NEXT CARD COUNT)
MAC 22
MAC 21
READ RF

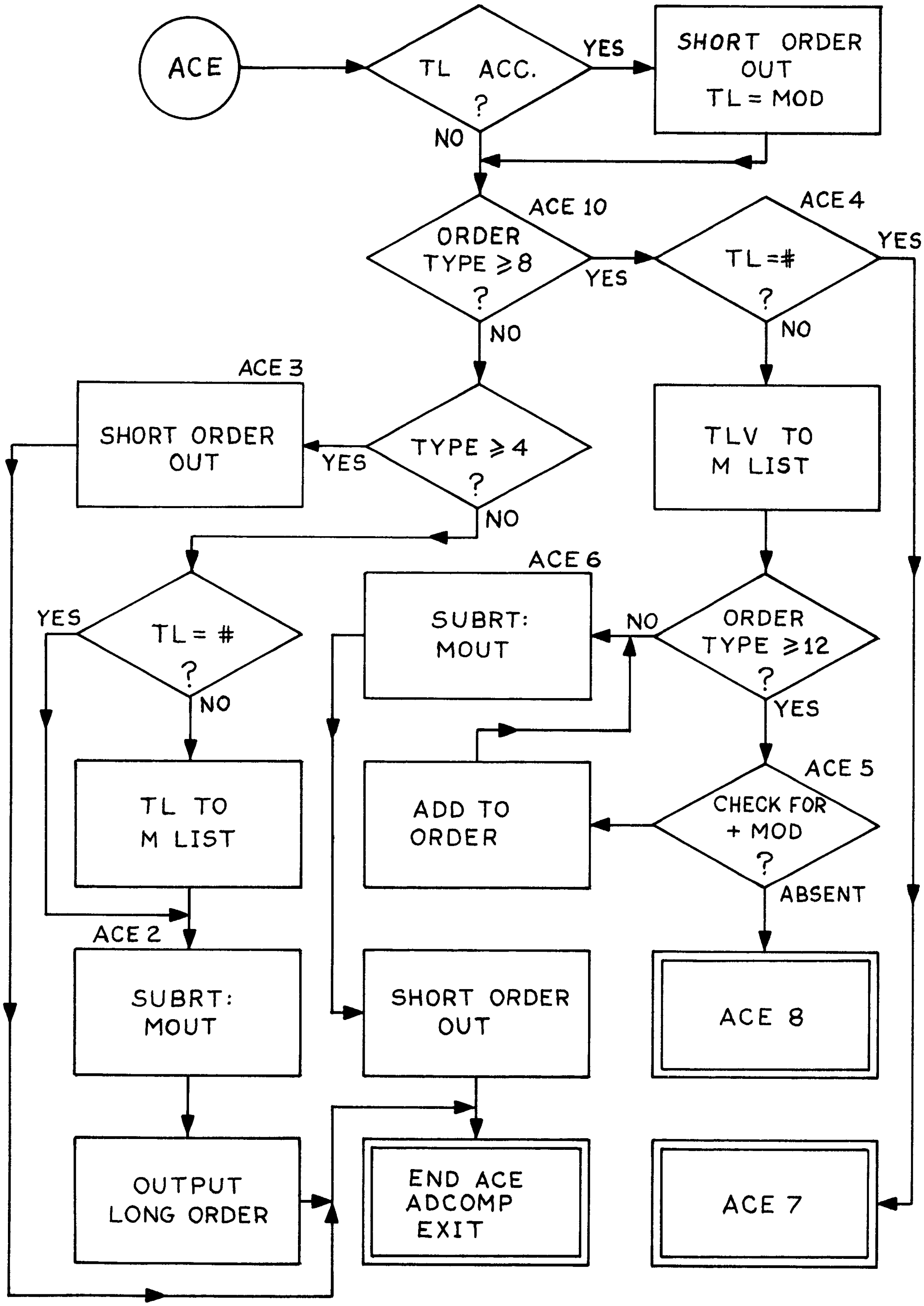
ADDRESS TYPE DECODE

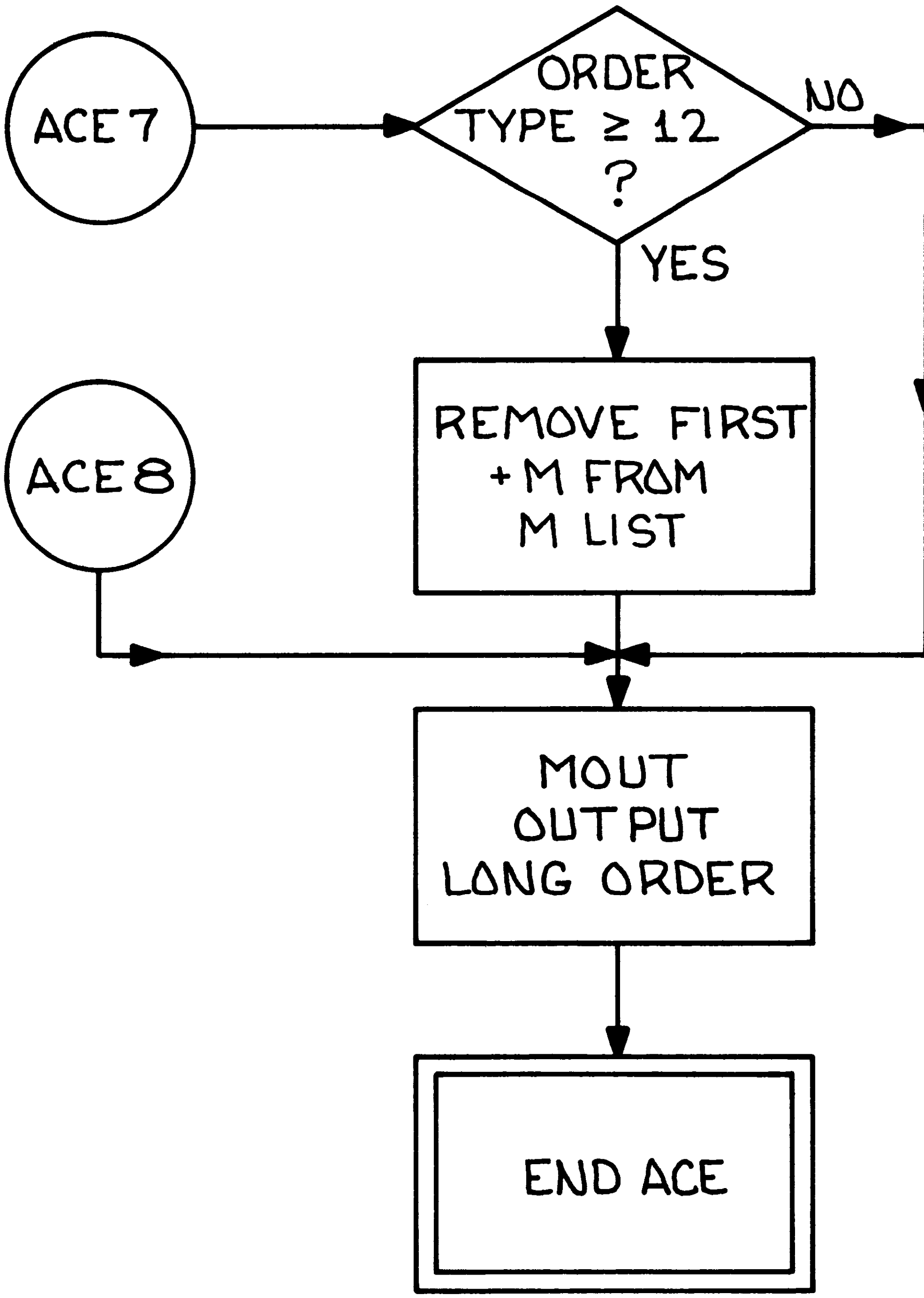


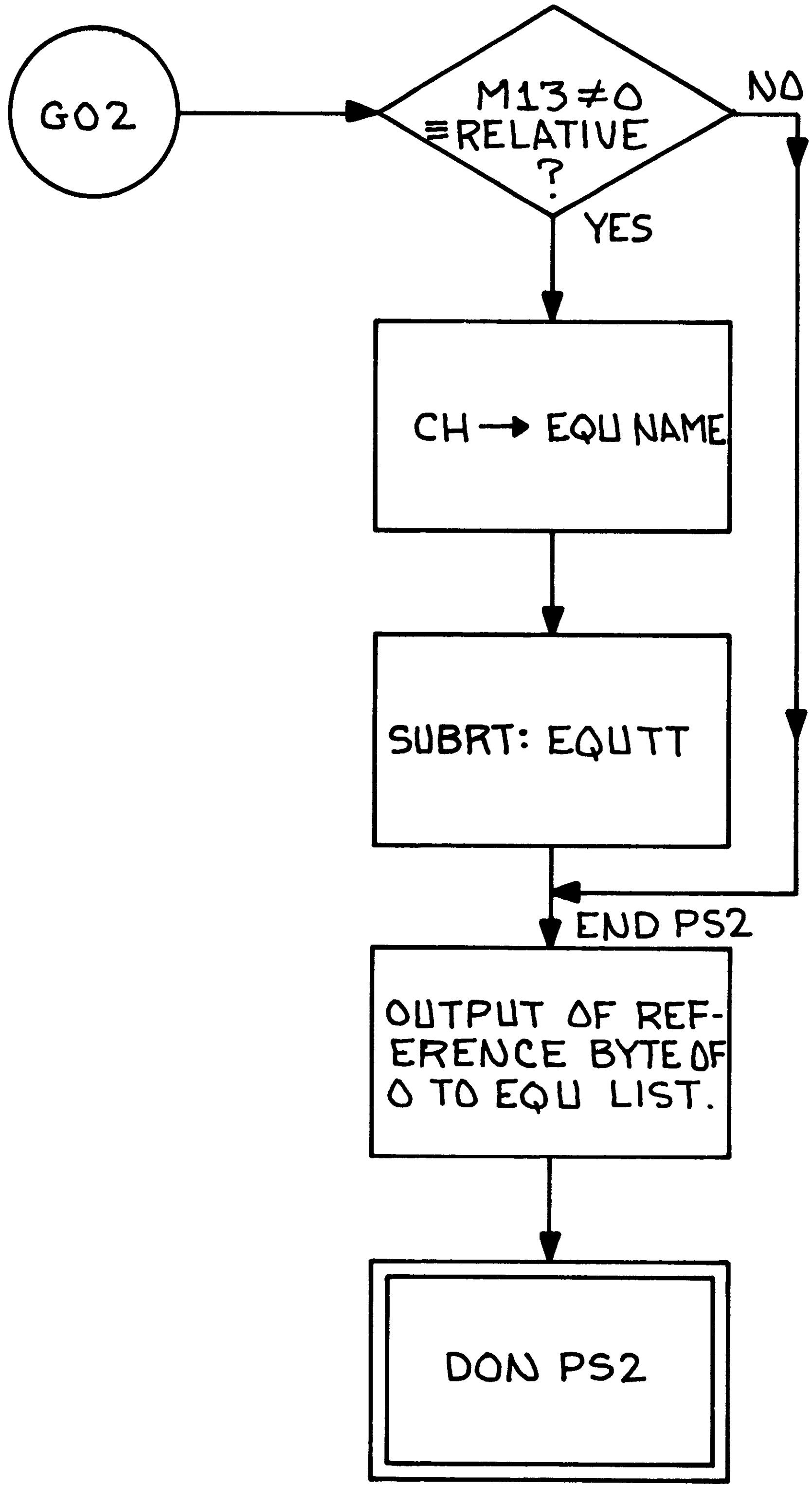

LABEL 1
ERROR LIST
EQSYM 1
ERROR LIST
UNDEFINED
INTEG 1
M 12 = 0
FOR INTEGER
MODIF 1
M 12 = 1
FOR TAG
ACE

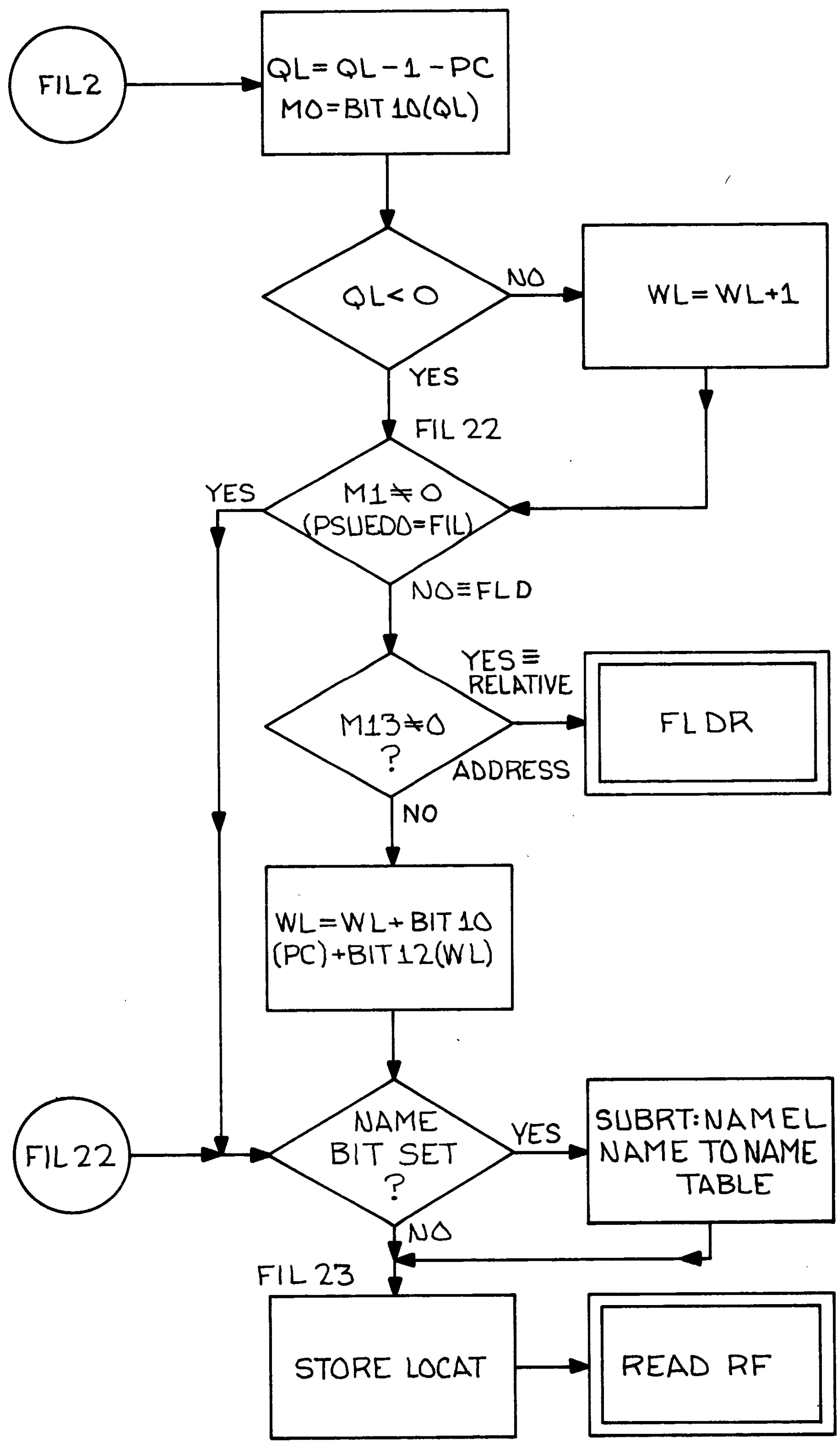

TSL
ORDER SUBTYPE = 0 ?
NO
YES
D14
ORDER SUBTYPE = 1 ?
NO
YES
Q22
SHORT ORDER OUT.
READ RF
INPUT. LONG ORDER OUT.
D15
D151
YES
CHR EXT = NAME ?
NO
ORDER SUBTYPE = 2 ?
NO
YES
ERROR LIST
ADCOMP


D151
INPUT NEXT BYTE = NAME
NAME TABLE ENTRY TO M4
SYMBER
PRINT ERROR NOT LABEL
YES
FS NAME A SYMBOL ?
NO
D152
FREG 3
PRINT ERROR=ILLEGAL REGISTER
YES
NAME = F. R. ?
NO
MODIF 3
ACE
PRINT ERROR NOT LABEL
YES
NAME =MODIFIES ?
NO
FATAL ERROR PRINT
YES
NAME UNDEFINED ?
NO
TCHR 8
READ RF
LONG ORDER OUT
YES
CHARACTER EXT ≥ 8 ?
NO
D16
INTEG
PREPARE LATE ENTRY TO ADCOMP

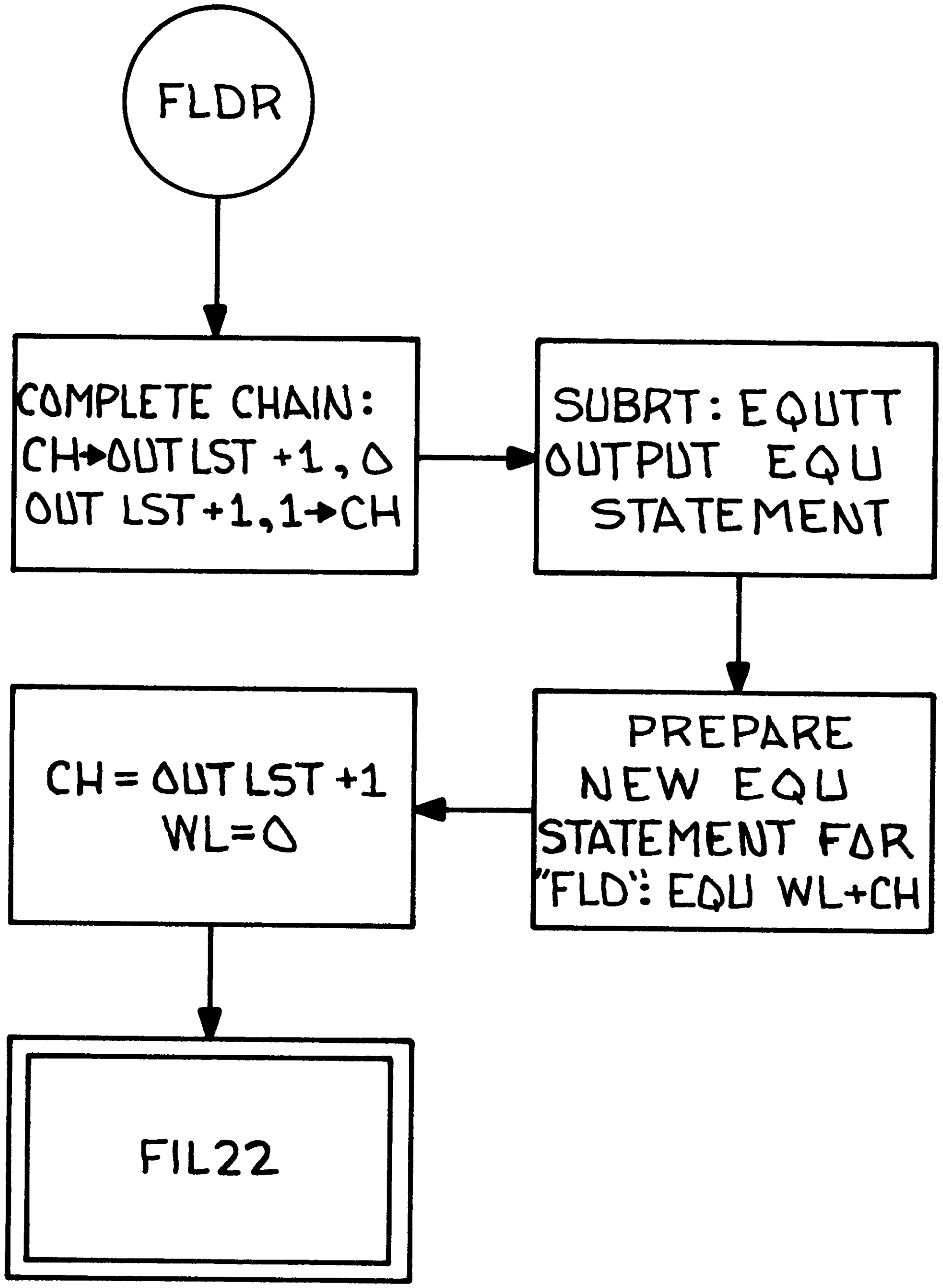

ACE
TL ACC. ?
YES
SHORT ORDER OUT TL = MOD
NO
ACE 10
ORDER TYPE ≥ 8 ?
YES
ACE 4
TL =# ?
YES
NO
NO
ACE 3
SHORT ORDER OUT
YES
TYPE ≥ 4 ?
NO
TLV TO M LIST
ACE 6
YES
TL = # ?
NO
SUBRT: MOUT
NO
ORDER TYPE ≥ 12 ?
YES
ACE 5
TL TO M LIST
ADD TO ORDER
CHECK FOR + MOD ?
ABSENT
ACE 2
SUBRT: MOUT
SHORT ORDER OUT
ACE 8
OUTPUT LONG ORDER
END ACE ADCOMP EXIT
ACE 7

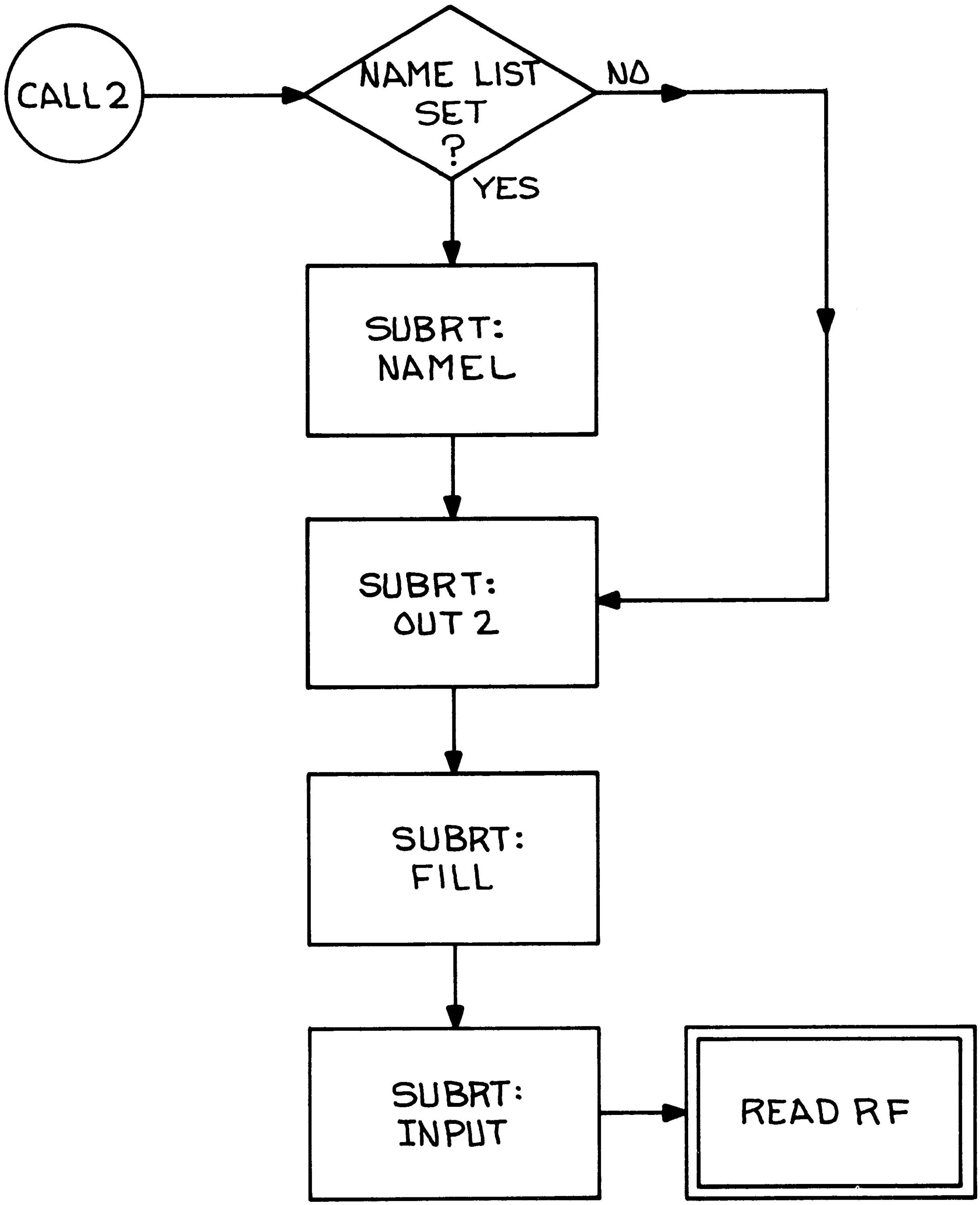

ACE 7
ORDER TYPE ≥ 12 ?
NO
YES
ACE 8
REMOVE FIRST +M FROM M LIST
MOUT OUTPUT LONG ORDER
END ACE

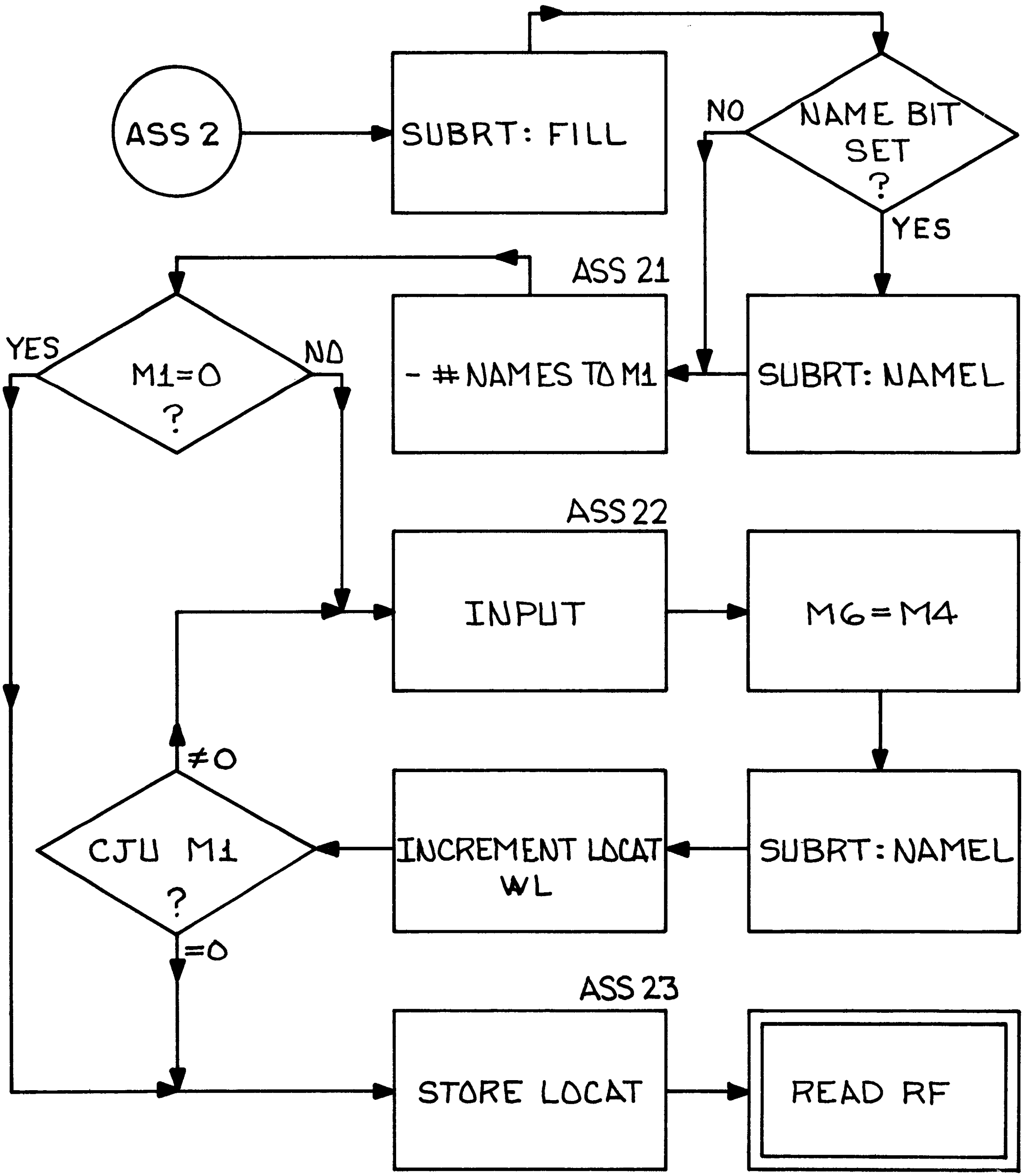

GO2
M13≠0
≡RELATIVE
?
NO
YES
CH → EQU NAME
SUBRT: EQUTT
END PS2
OUTPUT OF REFERENCE BYTE OF
0 TO EQU LIST.
DON PS2

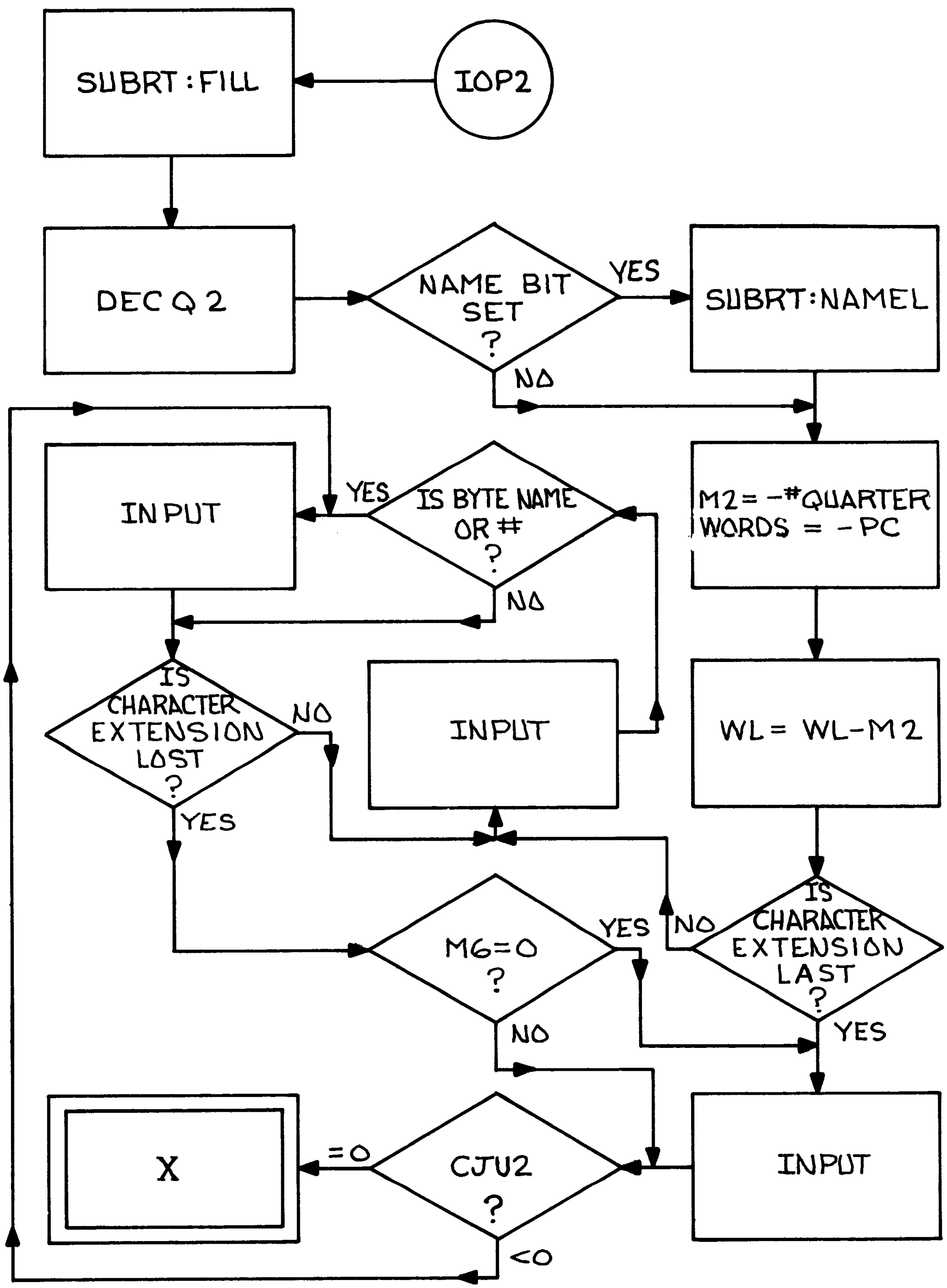


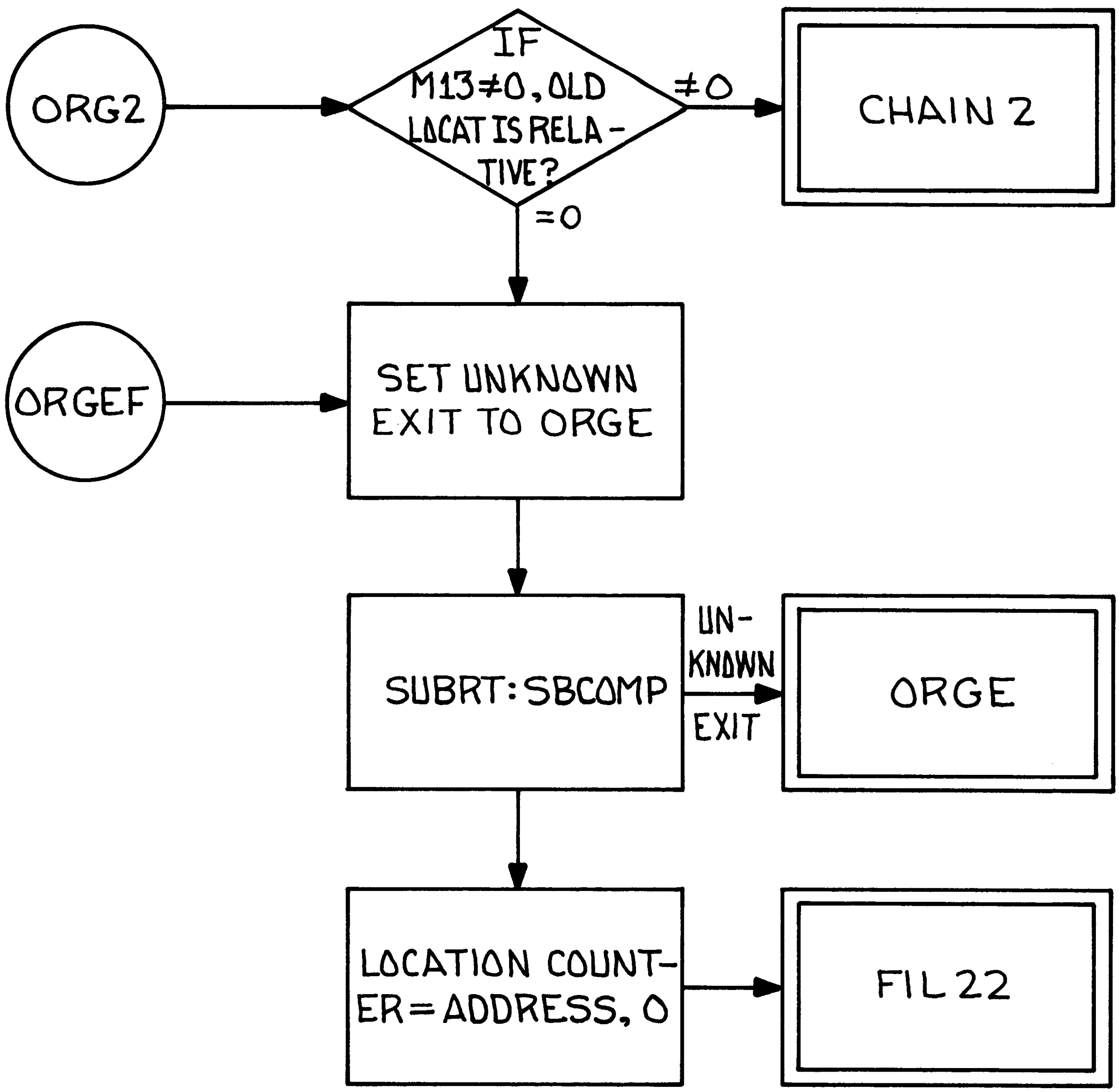
FIL2
QL=QL-1-PC
MO=BIT 10(QL)
QL<O
NO
WL=WL+1
YES
FIL 22
YES
M1≠O
(PSUEDO=FIL)
NO≡FLD
YES≡
RELATIVE
M13≠O
?
ADDRESS
FLDR
NO
WL=WL+BIT 10
(PC)+BIT 12(WL)
FIL22
NAME
BIT SET
?
YES
SUBRT:NAMEL
NAME TO NAME
TABLE
NO
FIL 23
STORE LOCAT
READ RF

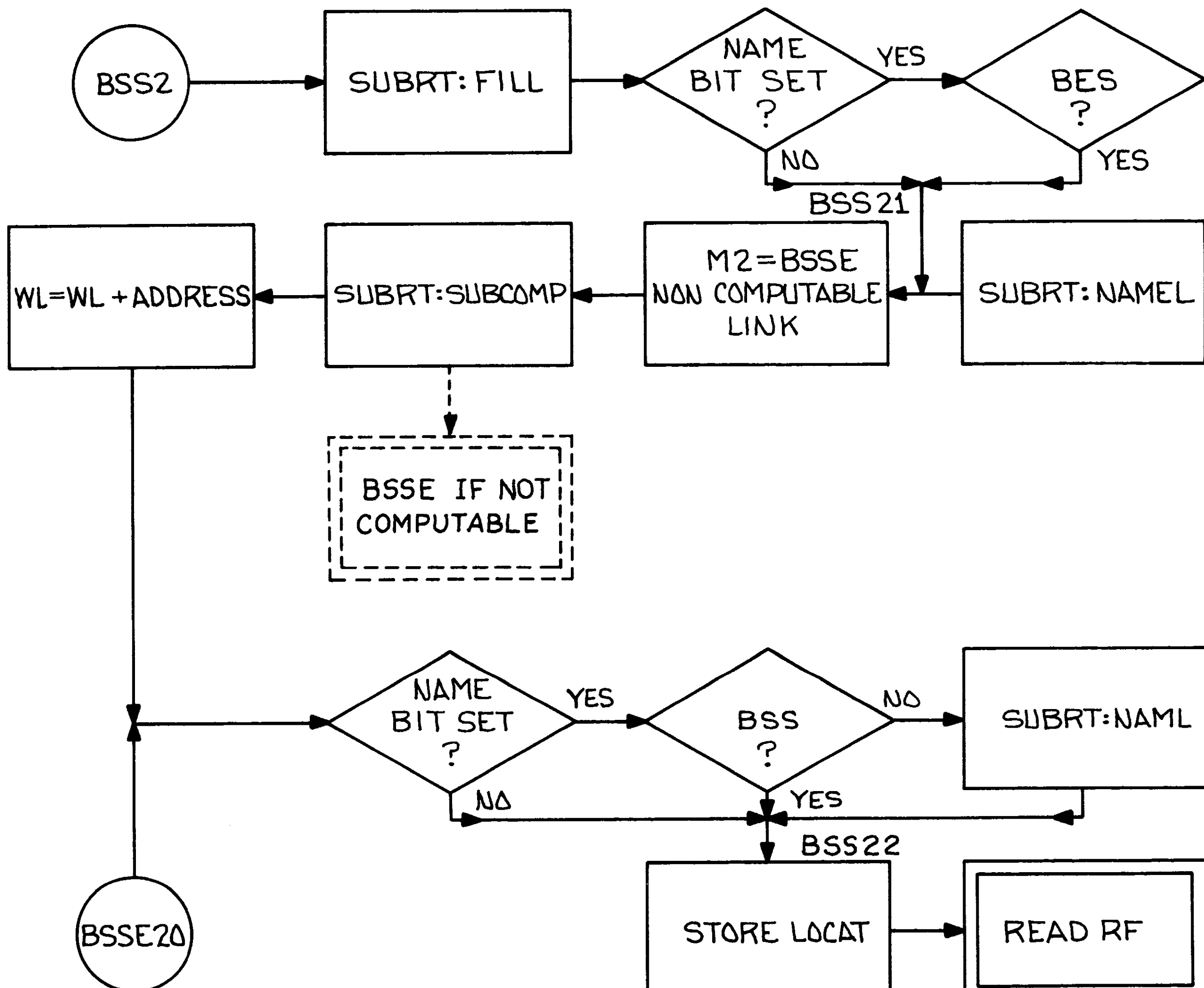

FLDR
COMPLETE CHAIN: CH→OUT LST +1, 0 OUT LST +1, 1→CH
SUBRT: EQUTT OUTPUT EQU STATEMENT
PREPARE NEW EQU STATEMENT FOR "FLD": EQU WL+CH
CH = OUT LST +1 WL=0
FIL22

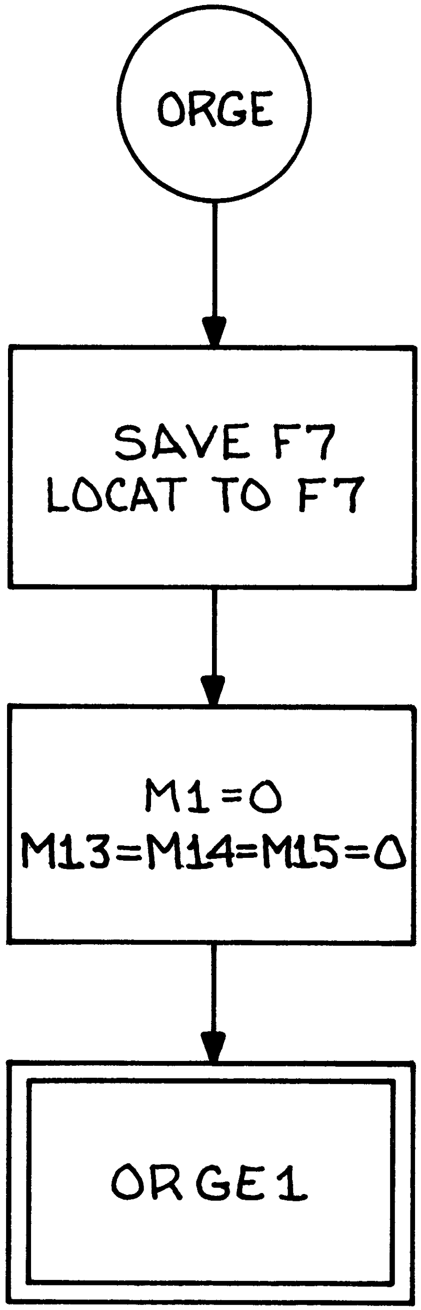

CALL 2
NAME LIST SET ?
NO
YES
SUBRT: NAMEL
SUBRT: OUT 2
SUBRT: FILL
SUBRT: INPUT
READ RF

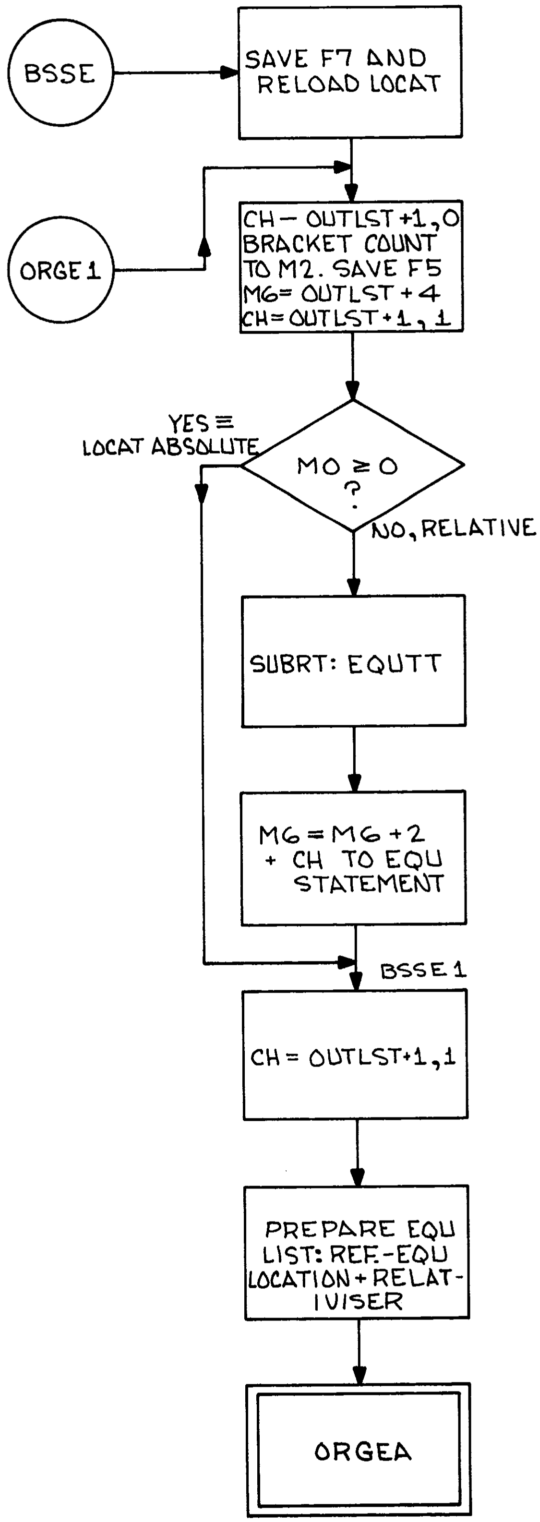

ASS 2
SUBRT: FILL
NAME BIT SET ?
NO
YES
ASS 21
SUBRT: NAMEL
- # NAMES TO M1
M1=0 ?
YES
NO
ASS 22
INPUT
M6=M4
SUBRT: NAMEL
INCREMENT LOCAT WL
CJU M1 ?
≠0
=0
ASS 23
STORE LOCAT
READ RF


SUBRT:FILL
IOP2
DEC Q 2
NAME BIT SET ?
YES
SUBRT:NAMEL
NO
INPUT
YES
IS BYTE NAME OR # ?
NO
M2= -#QUARTER WORDS = -PC
IS CHARACTER EXTENSION LOST ?
NO
INPUT
WL= WL-M2
YES
M6=0 ?
YES
NO
IS CHARACTER EXTENSION LAST ?
NO
YES
X
=0
CJU2 ?
INPUT
<0

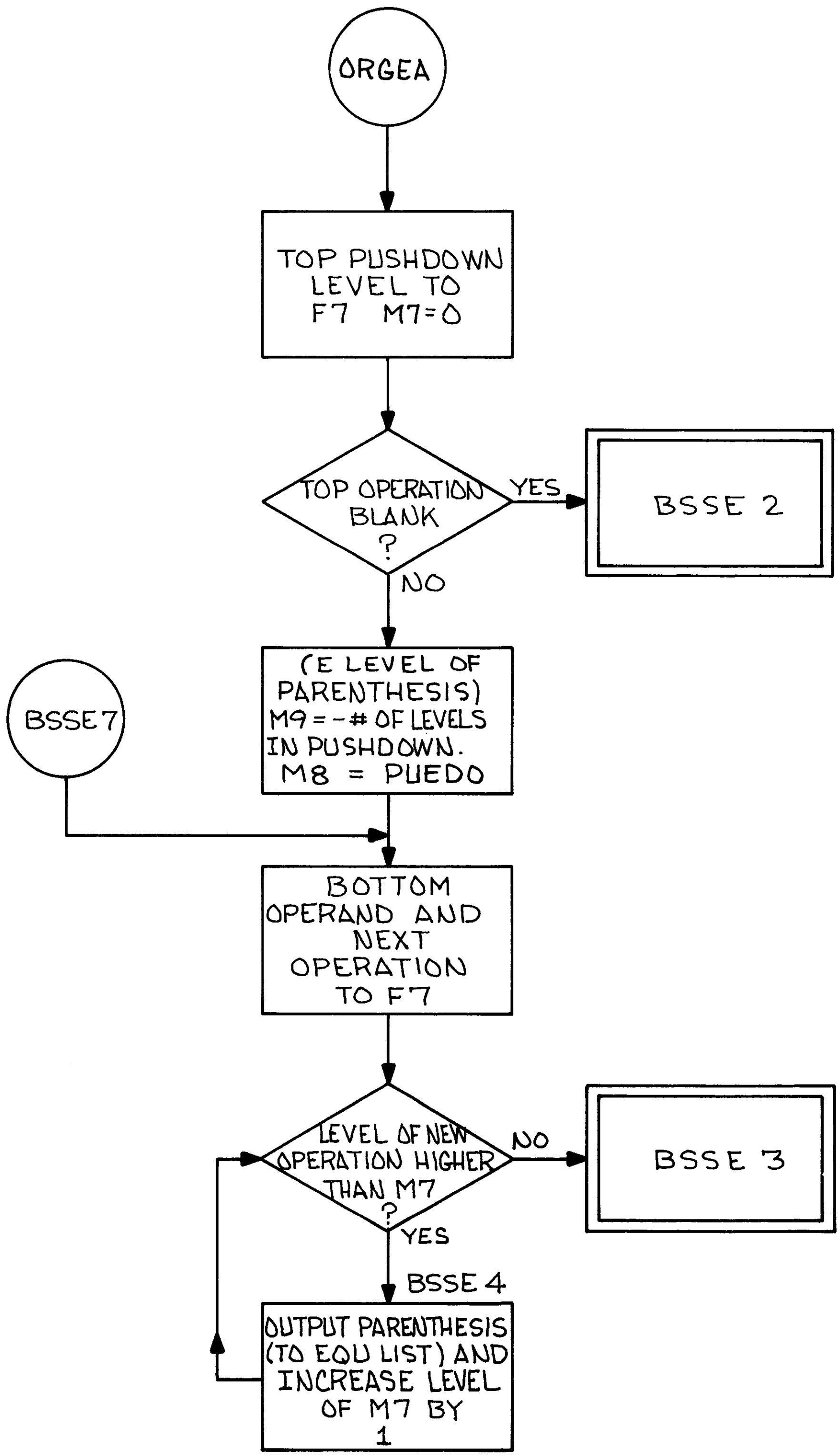

ORG2
IF M13≠0, OLD LOCAT IS RELA-TIVE?
≠0
CHAIN 2
=0
ORGEF
SET UNKNOWN EXIT TO ORGE
SUBRT: SBCOMP
UN-KNOWN EXIT
ORGE
LOCATION COUNT-ER=ADDRESS, 0
FIL22


BSS2
SUBRT: FILL
NAME BIT SET ?
YES
BES ?
NO
NO
YES
BSS21
M2=BSSE NON COMPUTABLE LINK
SUBRT: NAMEL
SUBRT: SUBCOMP
WL=WL+ADDRESS
BSSE IF NOT COMPUTABLE
NAME BIT SET ?
YES
BSS ?
NO
SUBRT: NAML
NO
YES
BSS22
STORE LOCAT
READ RF
BSSE20

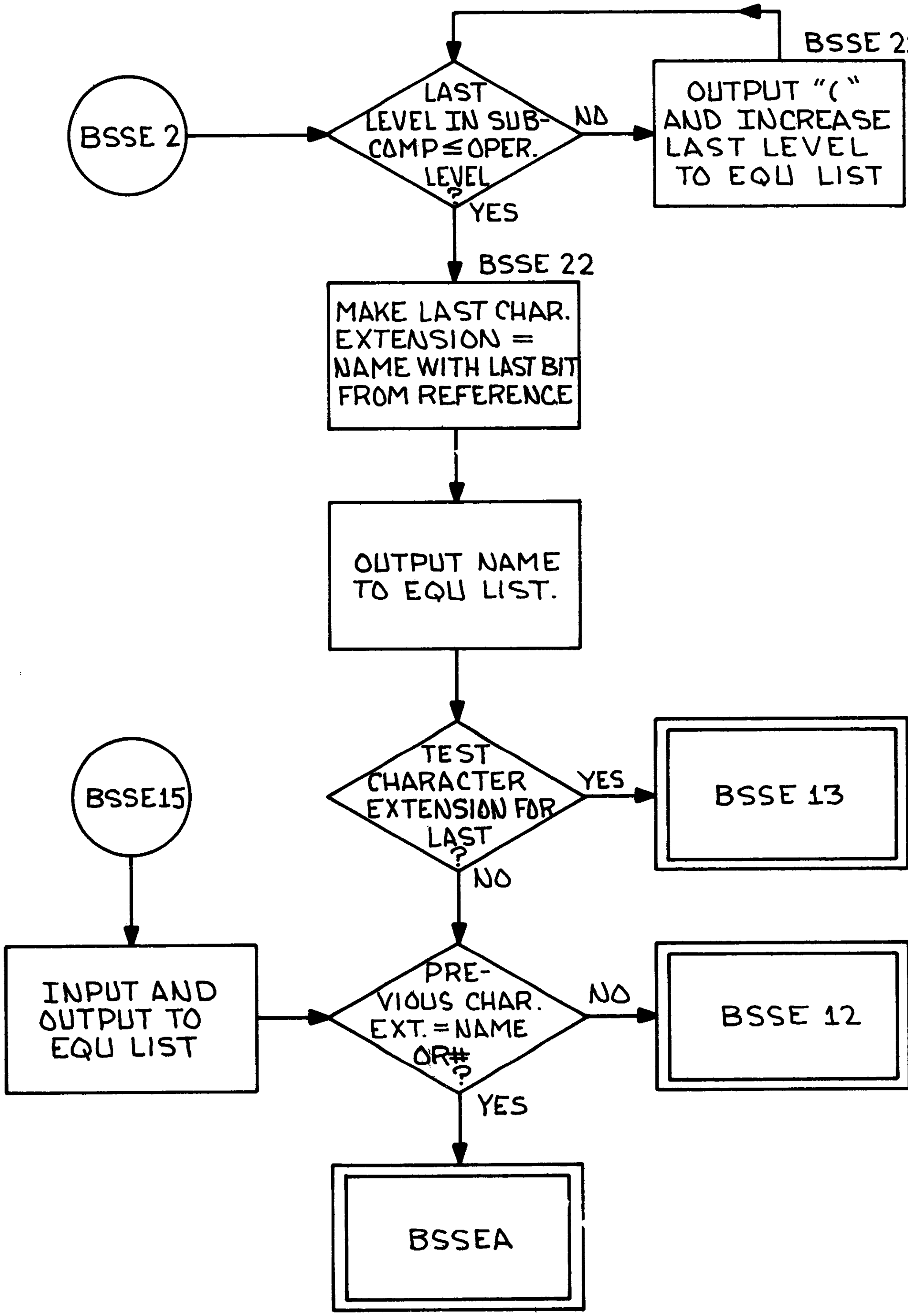

ORGE
SAVE F7
LOCAT TO F7
M1=0
M13=M14=M15=0
ORGE1

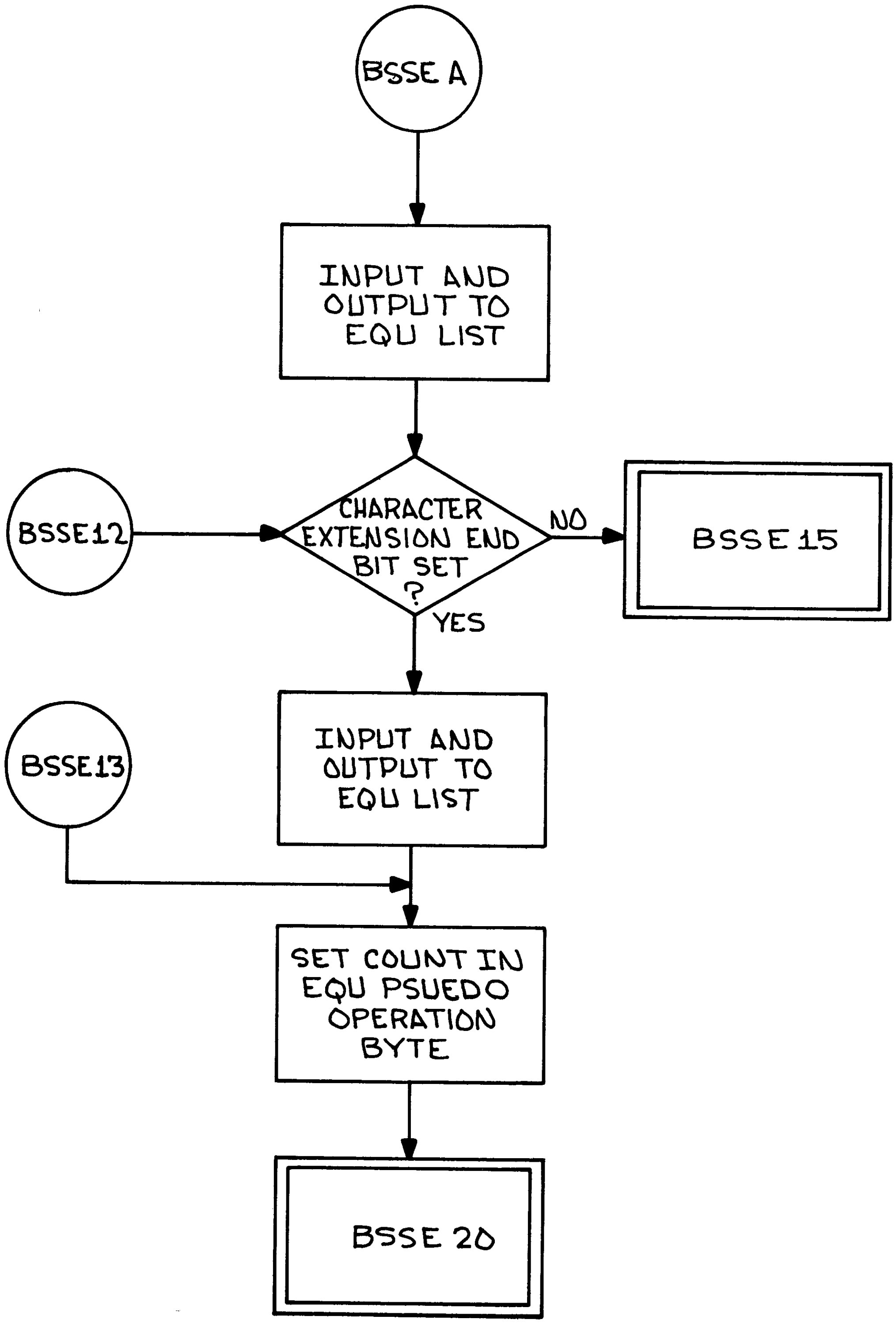


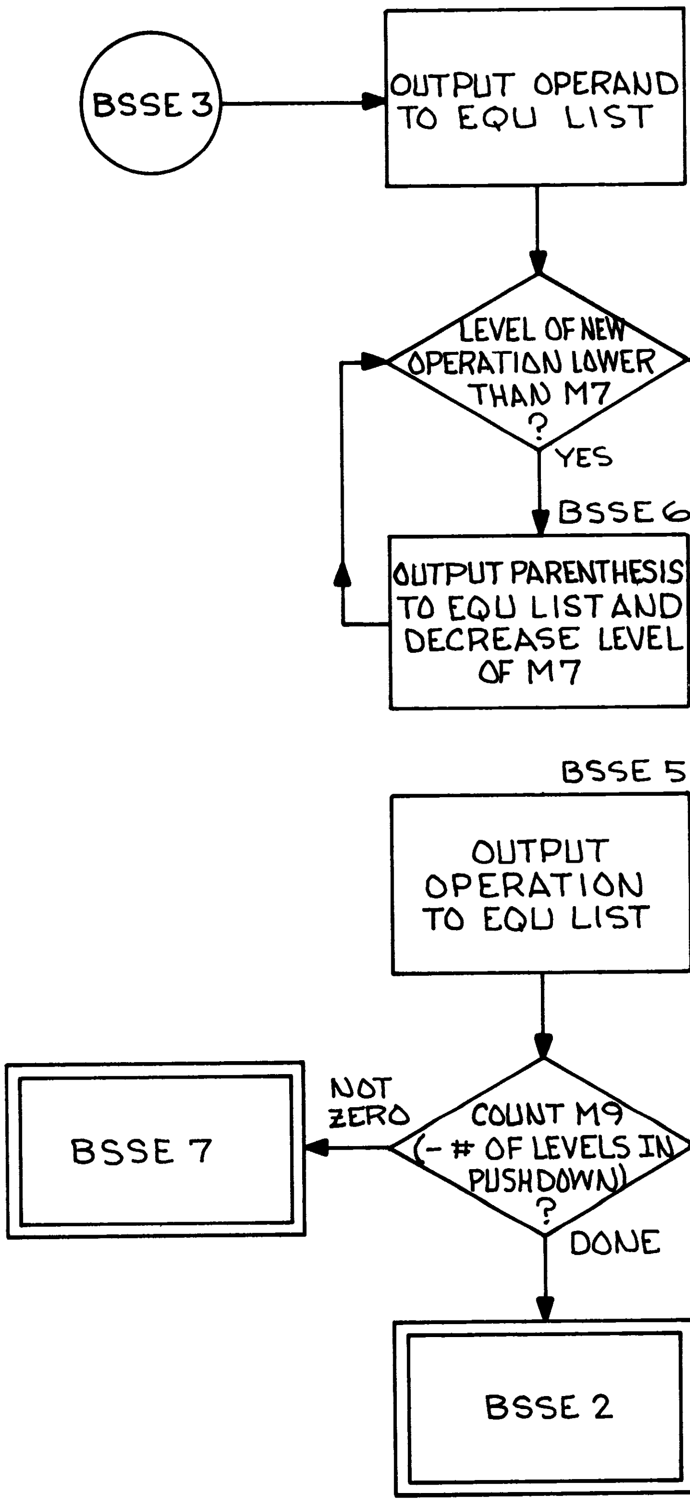
BSSE
SAVE F7 AND RELOAD LOCAT
ORGE 1
CH — OUTLST +1, 0 BRACKET COUNT TO M2. SAVE F5 M6= OUTLST + 4 CH=OUTLST+1, 1
YES ≡ LOCAT ABSOLUTE
M0 ≥ 0 ?
NO, RELATIVE
SUBRT: EQUTT
M6 = M6 + 2 + CH TO EQU STATEMENT
BSSE 1
CH = OUTLST+1, 1
PREPARE EQU LIST: REF.-EQU LOCATION + RELAT-IVISER
ORGEA

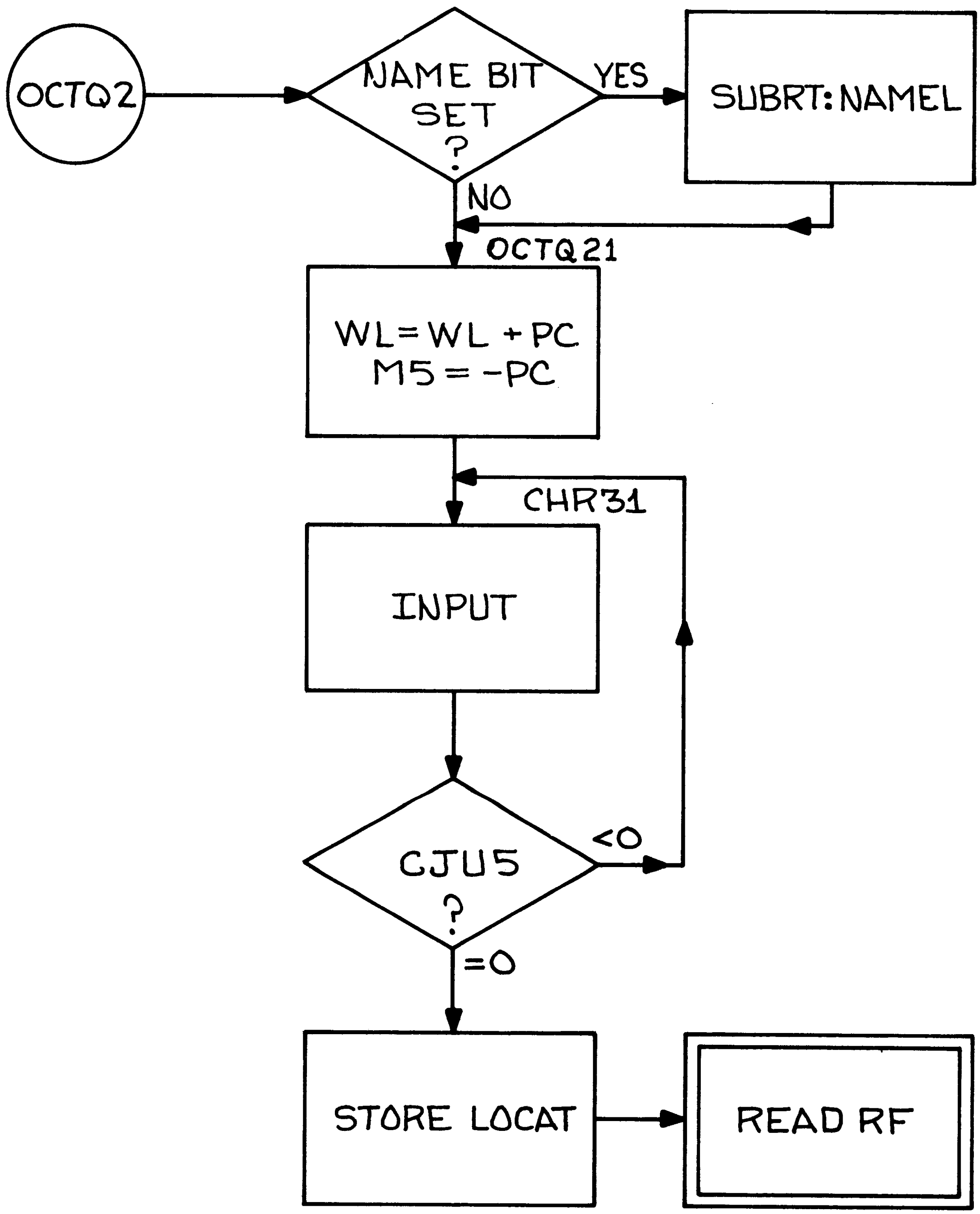


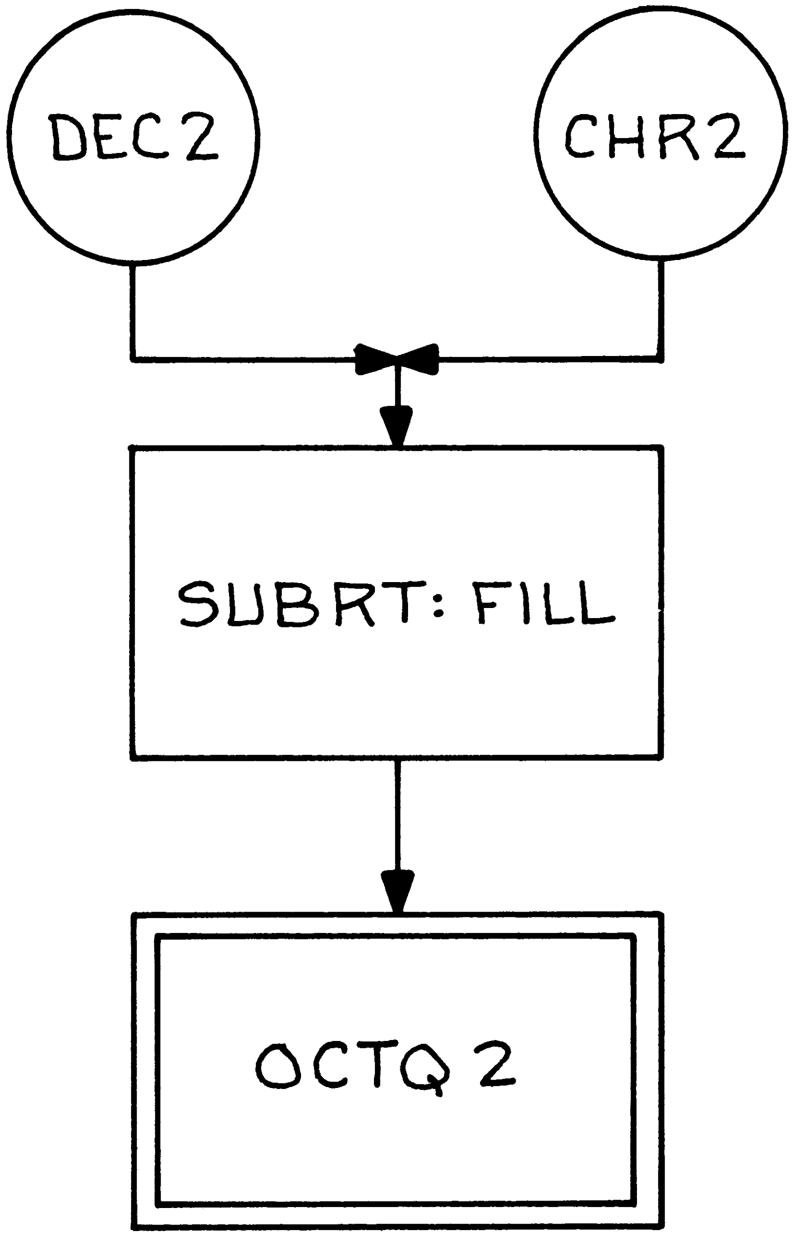
ORGEA
TOP PUSHDOWN LEVEL TO F7 M7=0
TOP OPERATION BLANK ?
YES
BSSE 2
NO
(E LEVEL OF PARENTHESIS) M9 = -# OF LEVELS IN PUSHDOWN. M8 = PUEDO
BSSE7
BOTTOM OPERAND AND NEXT OPERATION TO F7
LEVEL OF NEW OPERATION HIGHER THAN M7 ?
NO
BSSE 3
YES
BSSE 4
OUTPUT PARENTHESIS (TO EQU LIST) AND INCREASE LEVEL OF M7 BY 1

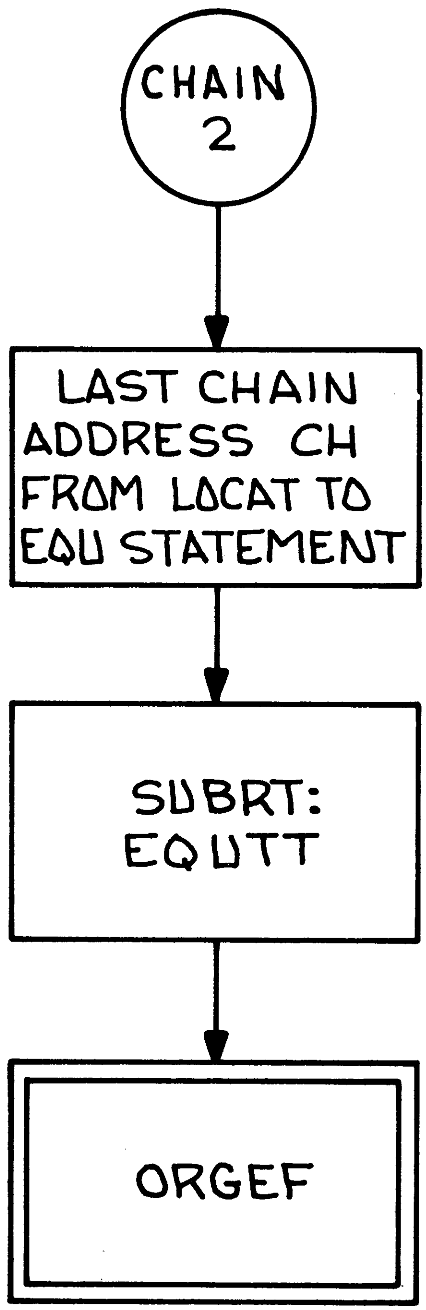

BSSE 2
LAST LEVEL IN SUB-COMP ≤ OPER. LEVEL ?
NO
YES
BSSE 21
OUTPUT "(" AND INCREASE LAST LEVEL TO EQU LIST
BSSE 22
MAKE LAST CHAR. EXTENSION = NAME WITH LAST BIT FROM REFERENCE
OUTPUT NAME TO EQU LIST.
TEST CHARACTER EXTENSION FOR LAST ?
YES
BSSE 13
NO
BSSE15
INPUT AND OUTPUT TO EQU LIST
PRE-VIOUS CHAR. EXT. = NAME OR # ?
NO
BSSE 12
YES
BSSEA


BSSE A
INPUT AND OUTPUT TO EQU LIST
BSSE12
CHARACTER EXTENSION END BIT SET ?
NO
BSSE 15
YES
BSSE13
INPUT AND OUTPUT TO EQU LIST
SET COUNT IN EQU PSUEDO OPERATION BYTE
BSSE 20

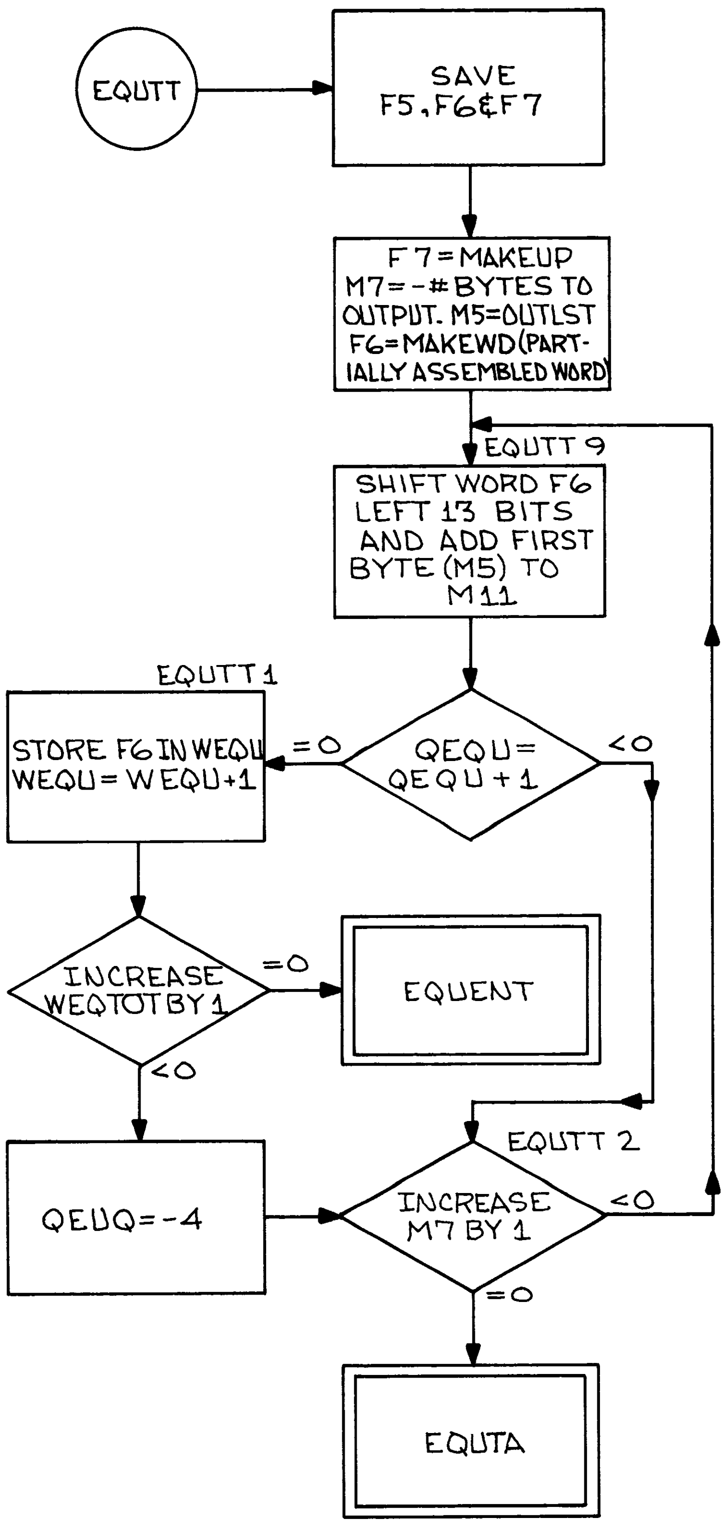

BSSE 3
OUTPUT OPERAND TO EQU LIST
LEVEL OF NEW OPERATION LOWER THAN M7 ?
NO
YES
BSSE 6
OUTPUT PARENTHESIS TO EQU LIST AND DECREASE LEVEL OF M7
BSSE 5
OUTPUT OPERATION TO EQU LIST
COUNT M9 (- # OF LEVELS IN PUSHDOWN) ?
NOT ZERO
BSSE 7
DONE
BSSE 2

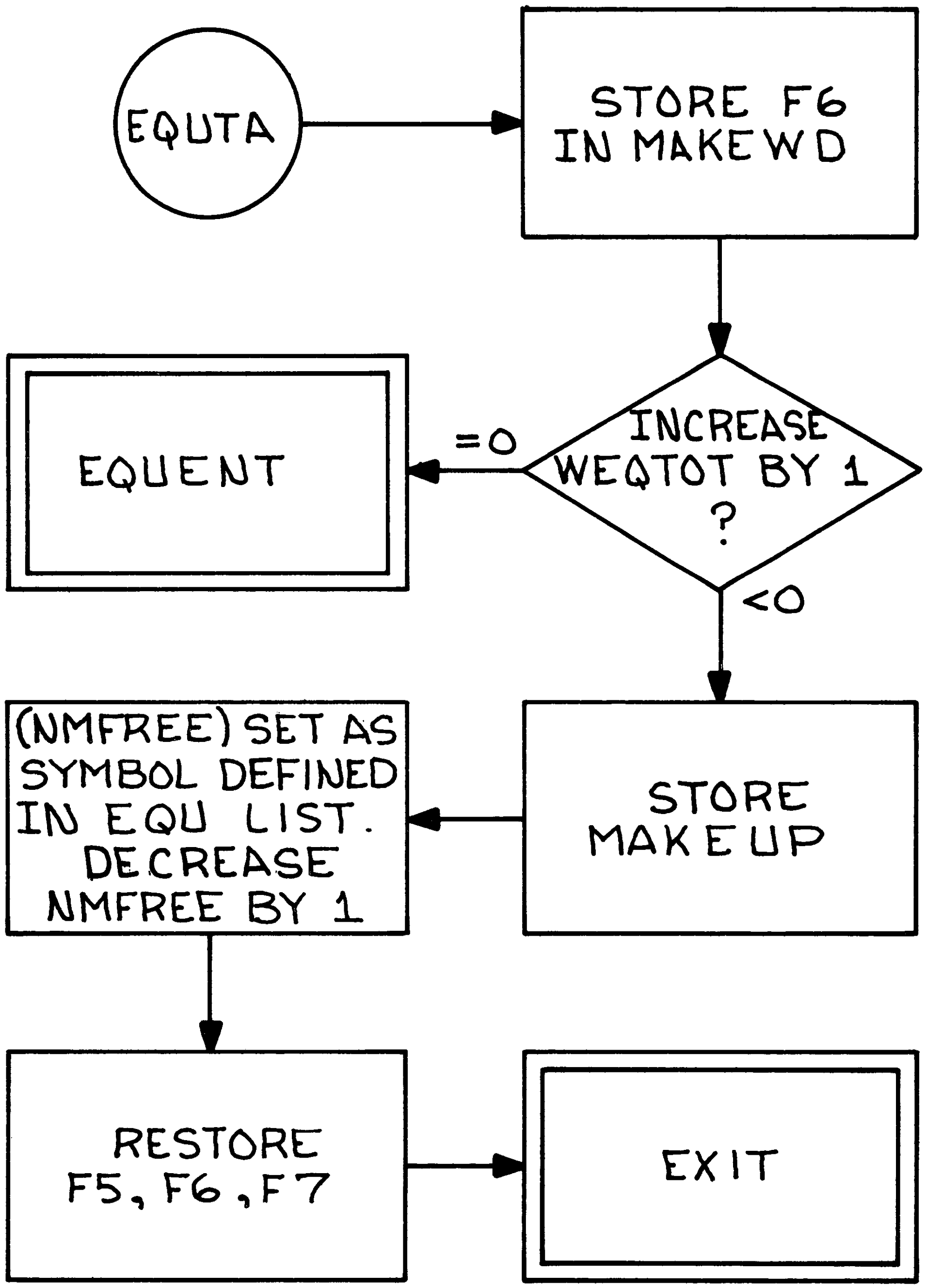

OCTQ2
NAME BIT SET ?
YES
SUBRT: NAMEL
NO
OCTQ21
WL = WL + PC
M5 = −PC
CHR31
INPUT
CJU5 ?
<0
=0
STORE LOCAT
READ RF


DEC2
CHR2
SUBRT: FILL
OCTQ 2

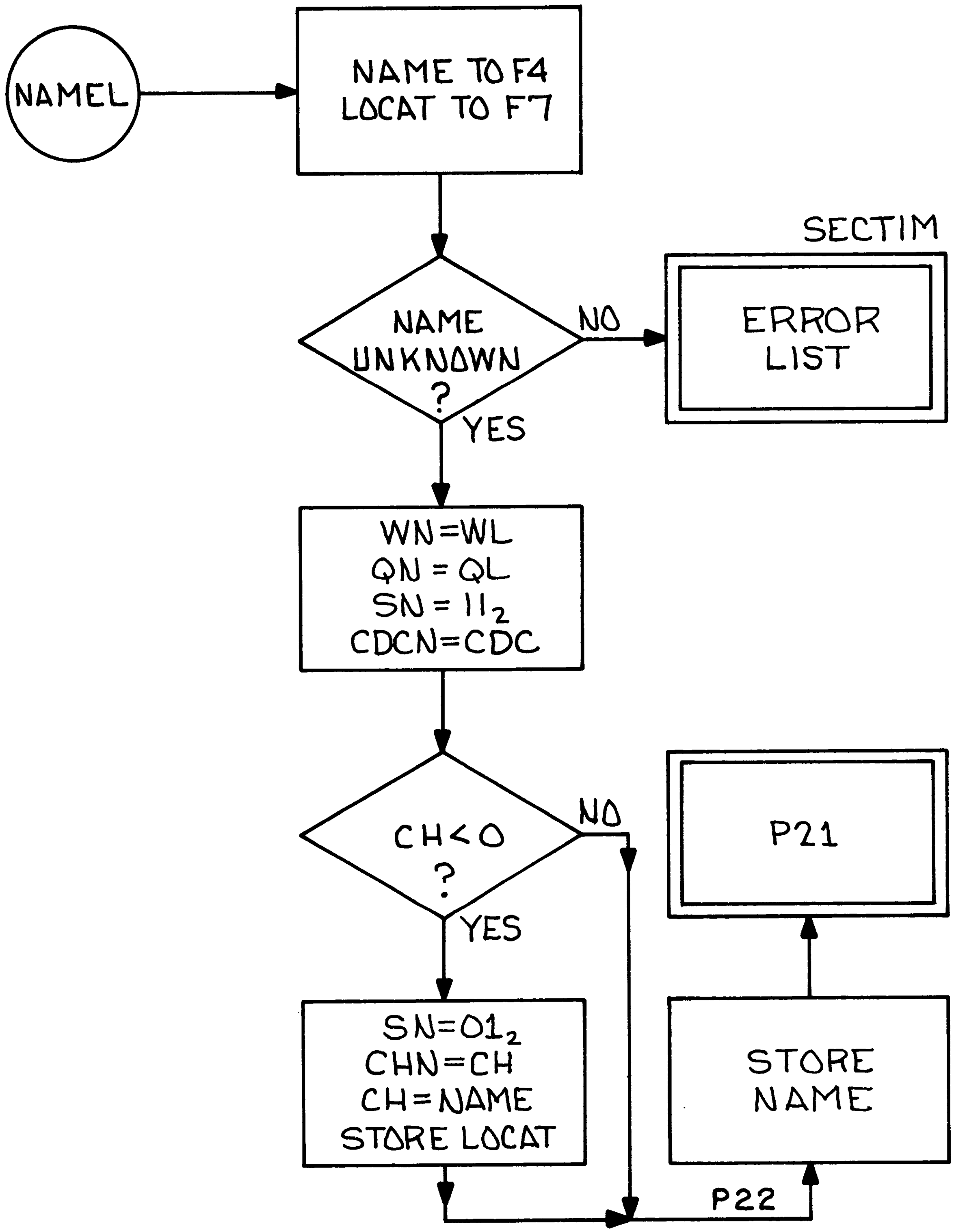

CHAIN 2
LAST CHAIN ADDRESS CH FROM LOCAT TO EQU STATEMENT
SUBRT: EQUTT
ORGEF

SNBRT EQUTT

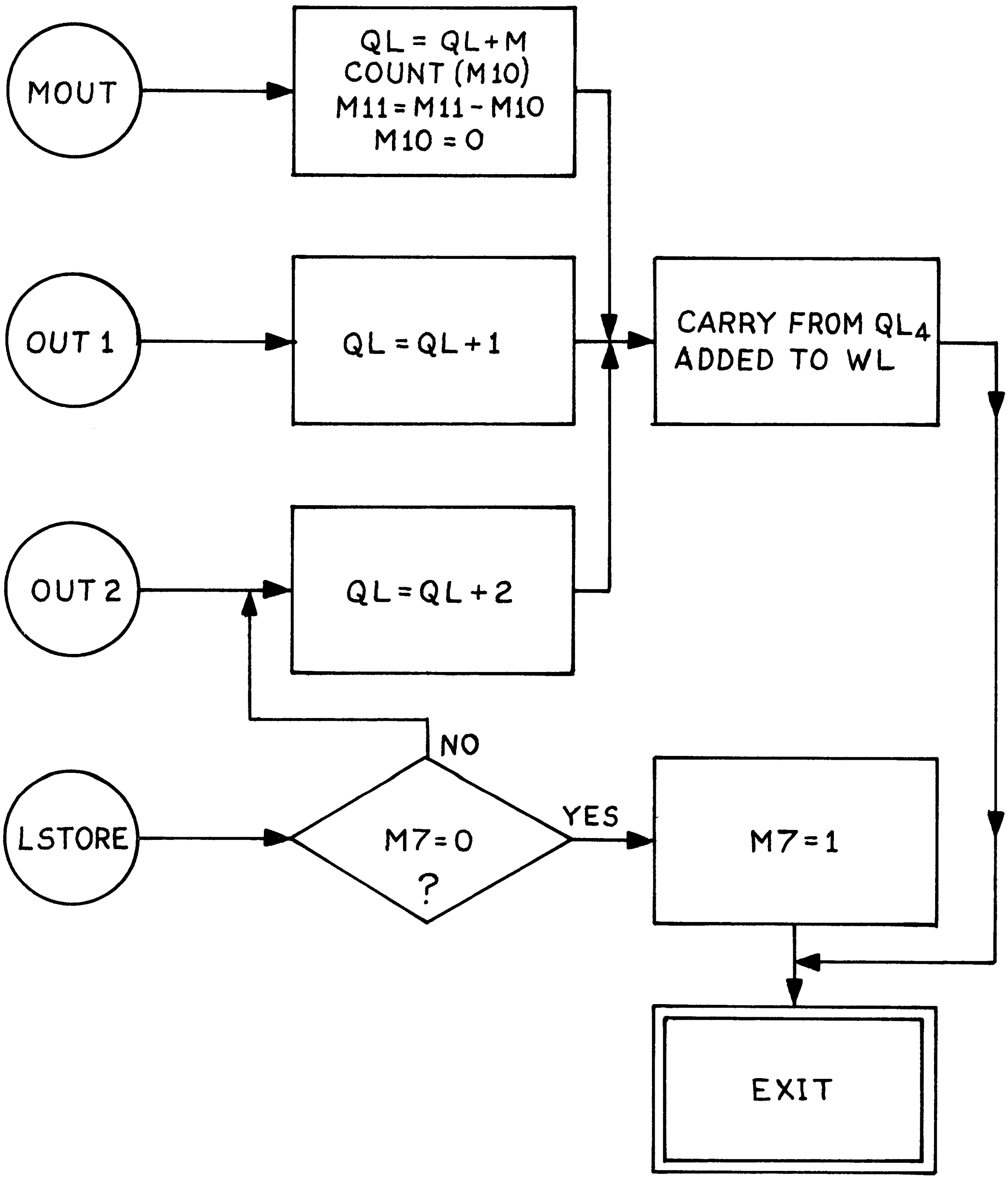

EQUTT
SAVE F5, F6 & F7
F7=MAKEUP M7=-# BYTES TO OUTPUT. M5=OUTLST F6=MAKEWD (PARTIALLY ASSEMBLED WORD)
EQUTT 9
SHIFT WORD F6 LEFT 13 BITS AND ADD FIRST BYTE (M5) TO M11
EQUTT 1
STORE F6 IN WEQU WEQU=WEQU+1
=0
QEQU= QEQU+1
<0
INCREASE WEQTOT BY 1
=0
EQUENT
<0
QEUQ=-4
EQUTT 2
INCREASE M7 BY 1
<0
=0
EQUTA

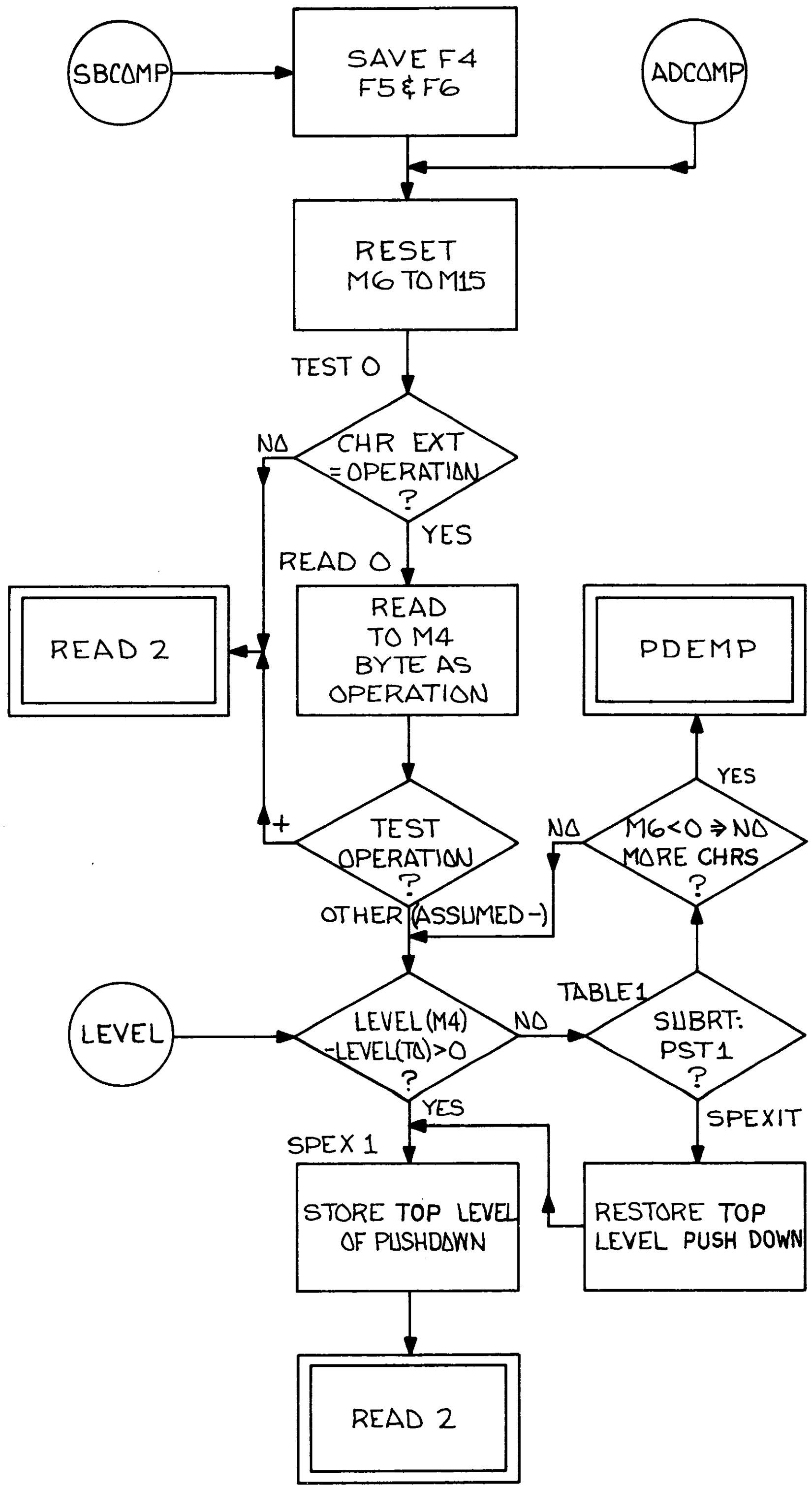

EQUTA
STORE F6 IN MAKEWD
INCREASE WEQTOT BY 1 ?
=0
EQUENT
<0
STORE MAKEUP
(NMFREE) SET AS SYMBOL DEFINED IN EQU LIST. DECREASE NMFREE BY 1
RESTORE F5, F6, F7
EXIT

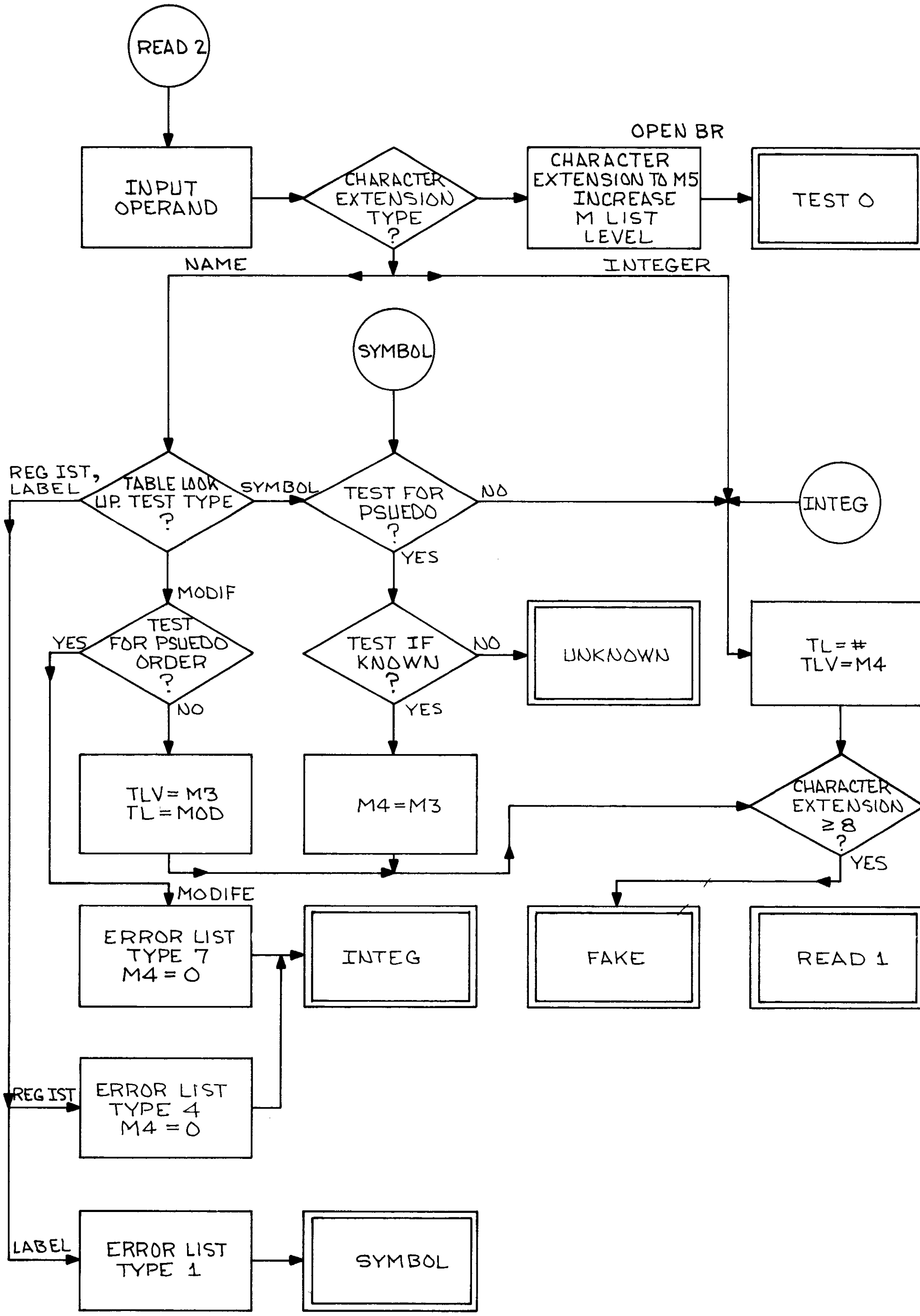
ENTER NAME IN NAME TABLE



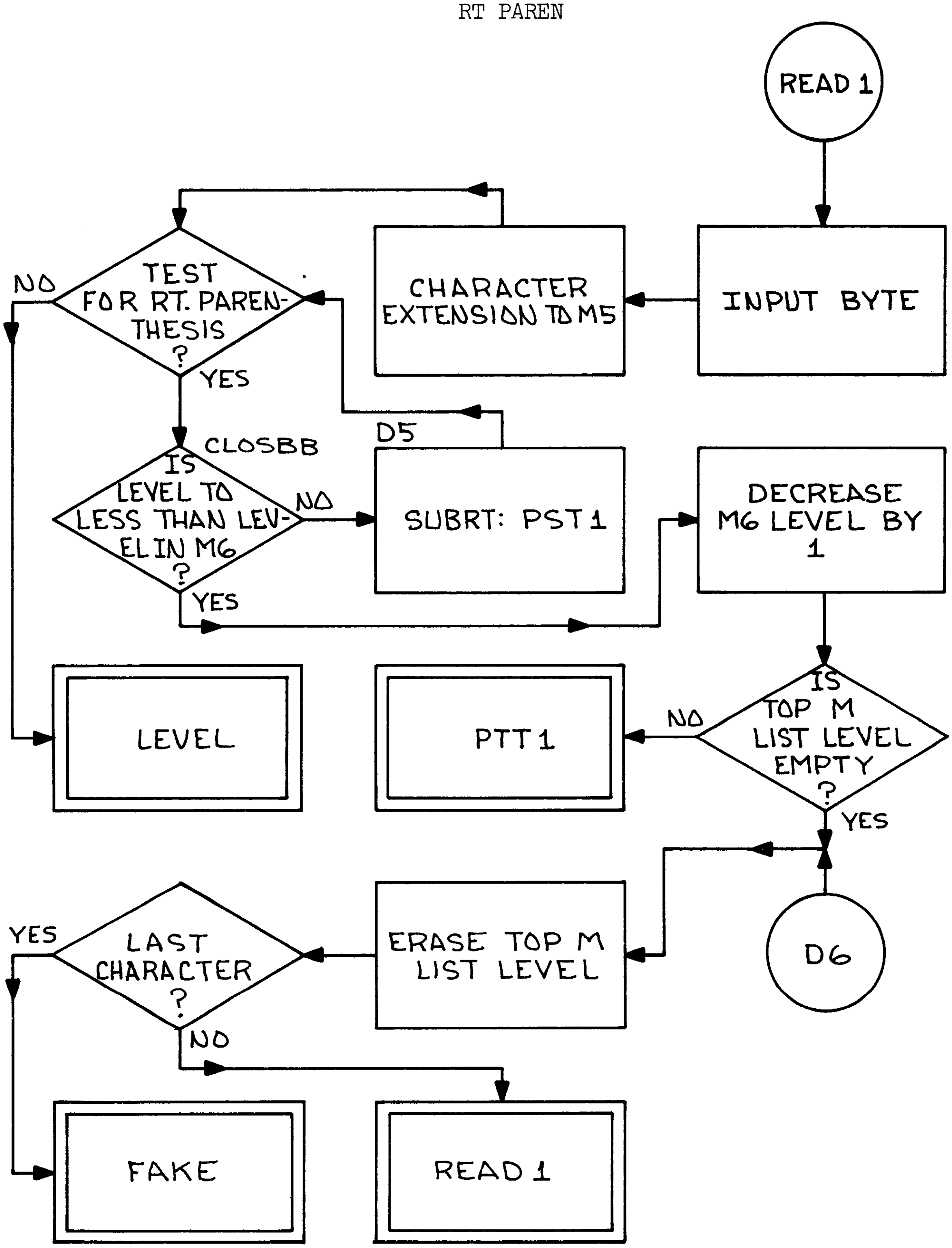
SUBRTS: MOUT, OUT1, OUT2, LSTORE




SBCOMP
SAVE F4 F5 & F6
ADCOMP
RESET M6 TO M15
TEST 0
CHR EXT = OPERATION ?
NO
YES
READ 0
READ 2
READ TO M4 BYTE AS OPERATION
PDEMP
YES
+
TEST OPERATION ?
NO
M6<0 ⇒ NO MORE CHRS ?
OTHER (ASSUMED -)
TABLE1
LEVEL
LEVEL(M4) -LEVEL(T0)>0 ?
NO
SUBRT: PST1 ?
YES
SPEXIT
SPEX 1
STORE TOP LEVEL OF PUSHDOWN
RESTORE TOP LEVEL PUSH DOWN
READ 2


READ 2
INPUT OPERAND
CHARACTER EXTENSION TYPE ?
OPEN BR
CHARACTER EXTENSION TO M5 INCREASE M LIST LEVEL
TEST 0
NAME
INTEGER
SYMBOL
REG IST, LABEL
TABLE LOOK UP. TEST TYPE ?
SYMBOL
TEST FOR PSUEDO ?
NO
INTEG
YES
MODIF
TEST FOR PSUEDO ORDER ?
YES
NO
TEST IF KNOWN ?
NO
UNKNOWN
YES
TL = #
TLV = M4
TLV = M3
TL = MOD
M4 = M3
CHARACTER EXTENSION ≥ 8 ?
NO
YES
MODIFE
ERROR LIST TYPE 7 M4 = 0
INTEG
FAKE
READ 1
REG IST
ERROR LIST TYPE 4 M4 = 0
LABEL
ERROR LIST TYPE 1
SYMBOL

RT PAREN


READ 1
INPUT BYTE
CHARACTER EXTENSION TO M5
TEST FOR RT. PAREN-THESIS ?
NO
YES
CLOSBB
D5
IS LEVEL TO LESS THAN LEV-EL IN M6 ?
NO
YES
SUBRT: PST 1
DECREASE M6 LEVEL BY 1
LEVEL
PTT 1
IS TOP M LIST LEVEL EMPTY ?
NO
YES
D6
ERASE TOP M LIST LEVEL
LAST CHARACTER ?
YES
NO
FAKE
READ 1

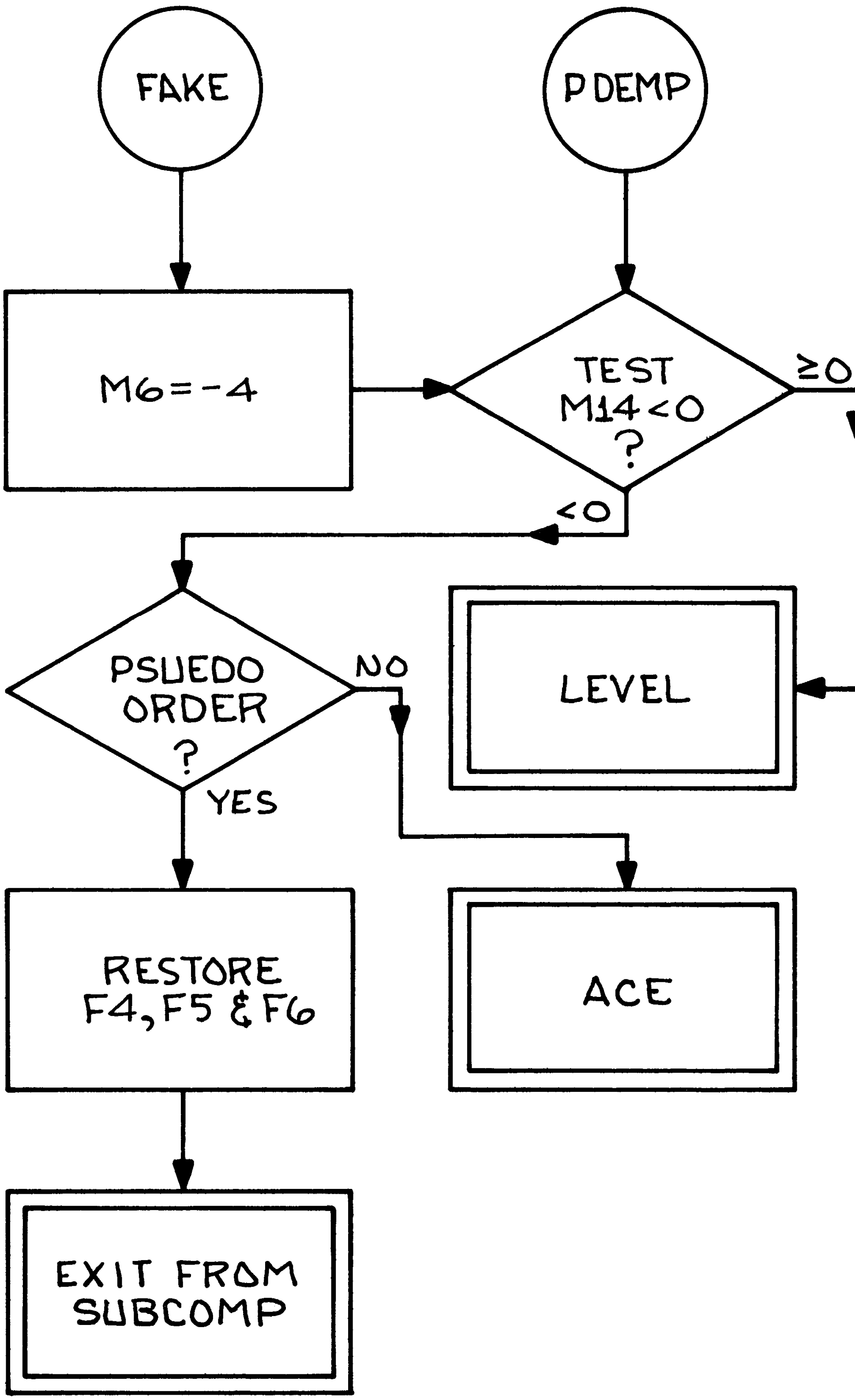
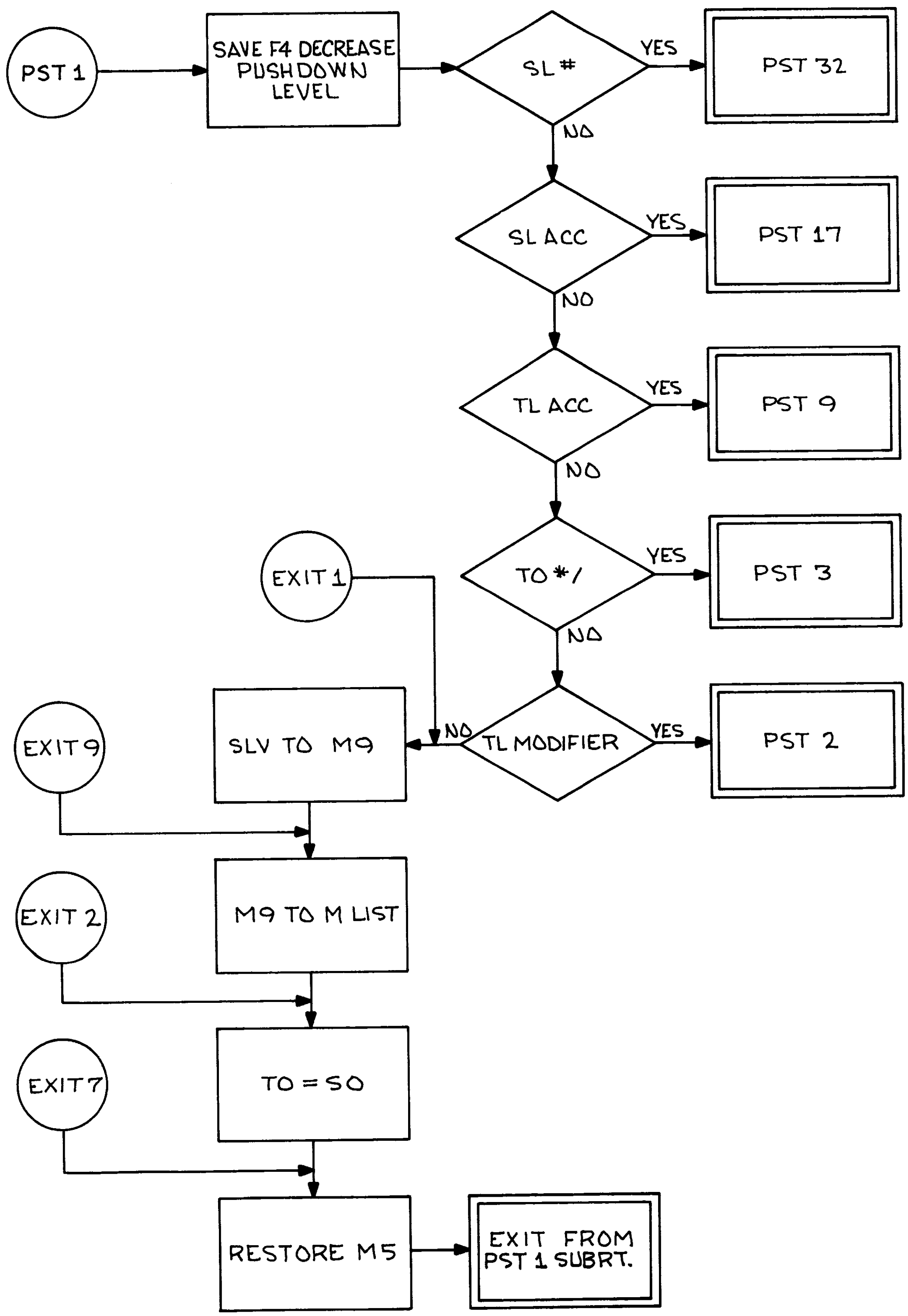
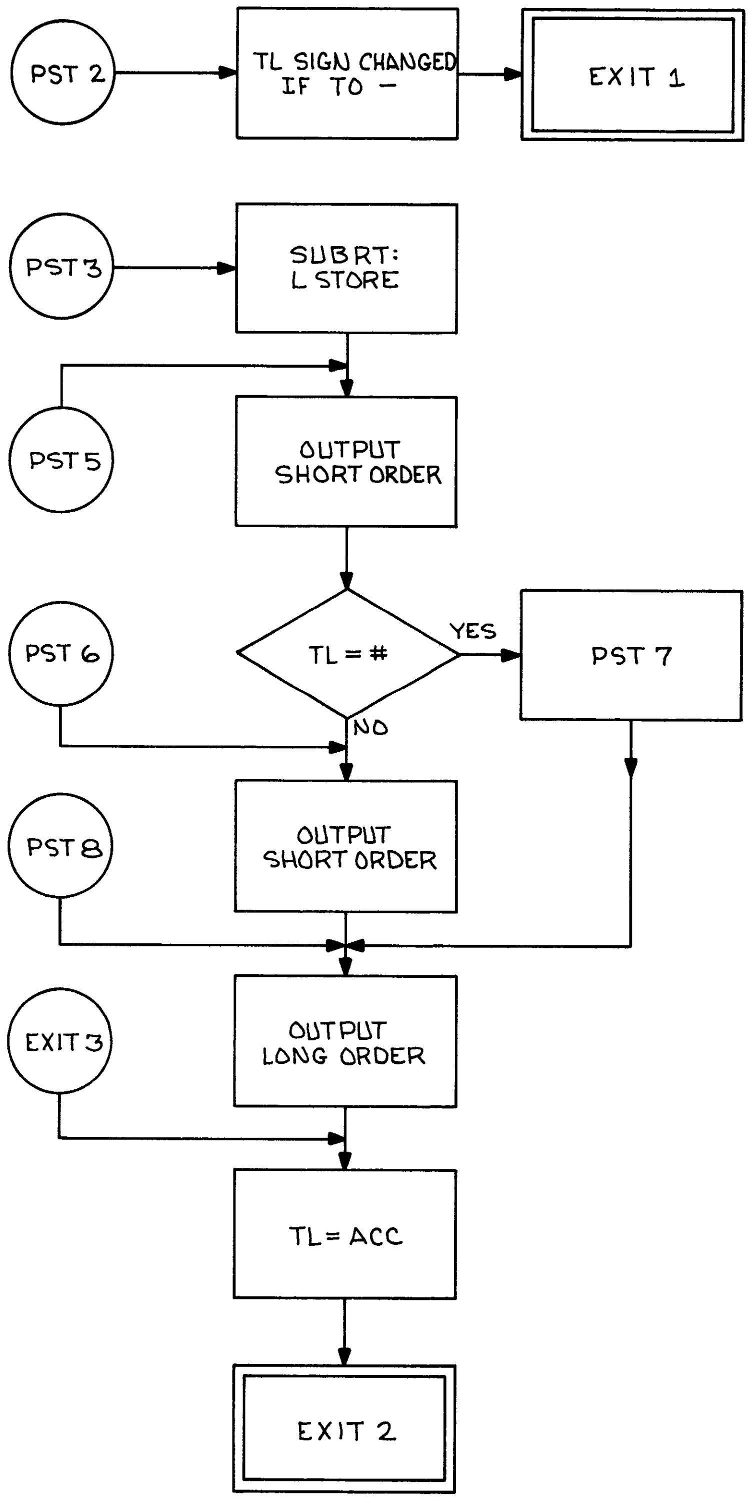
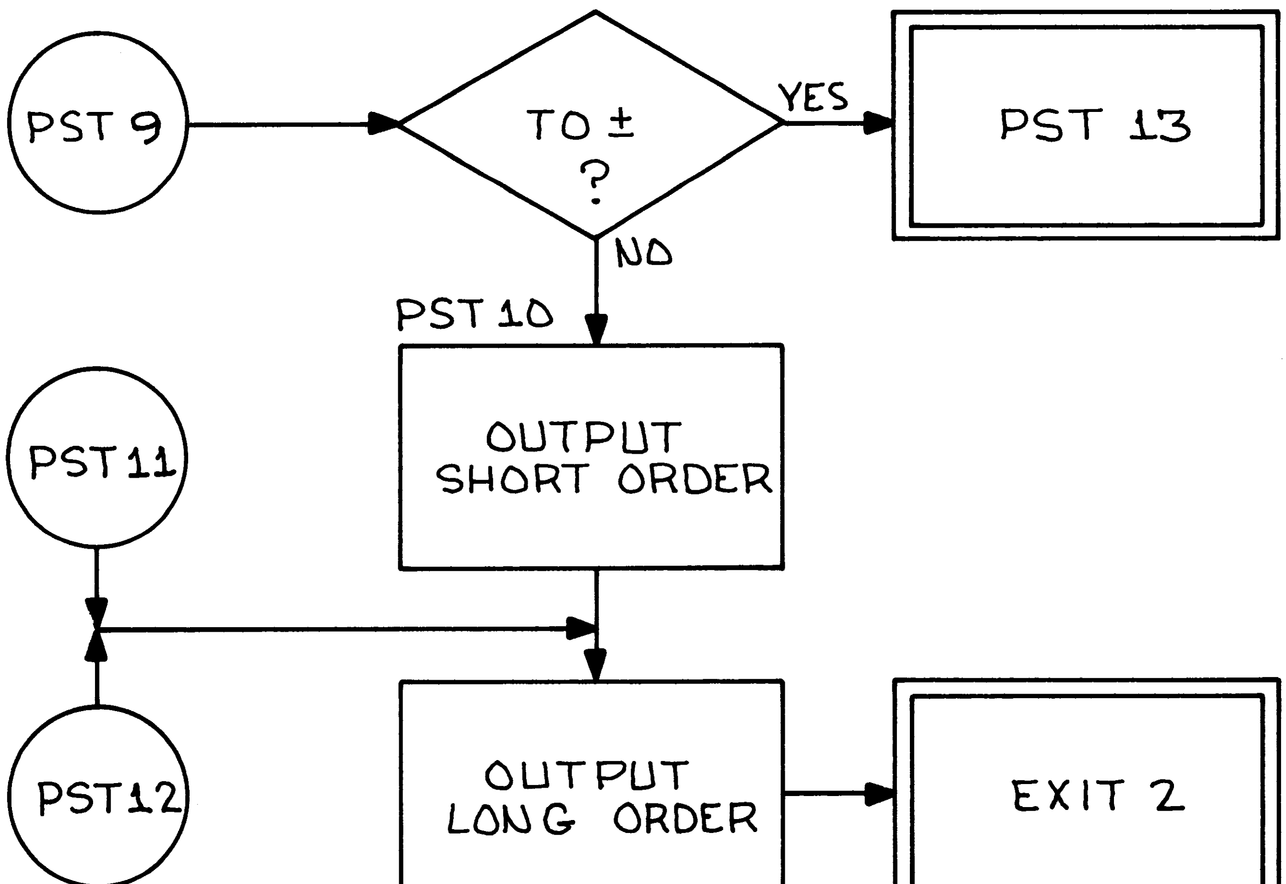

FAKE
PDEMP
M6=-4
TEST
M14<0
?
≥0
<0
PSUEDO
ORDER
?
NO
YES
LEVEL
RESTORE
F4, F5 & F6
ACE
EXIT FROM
SUBCOMP

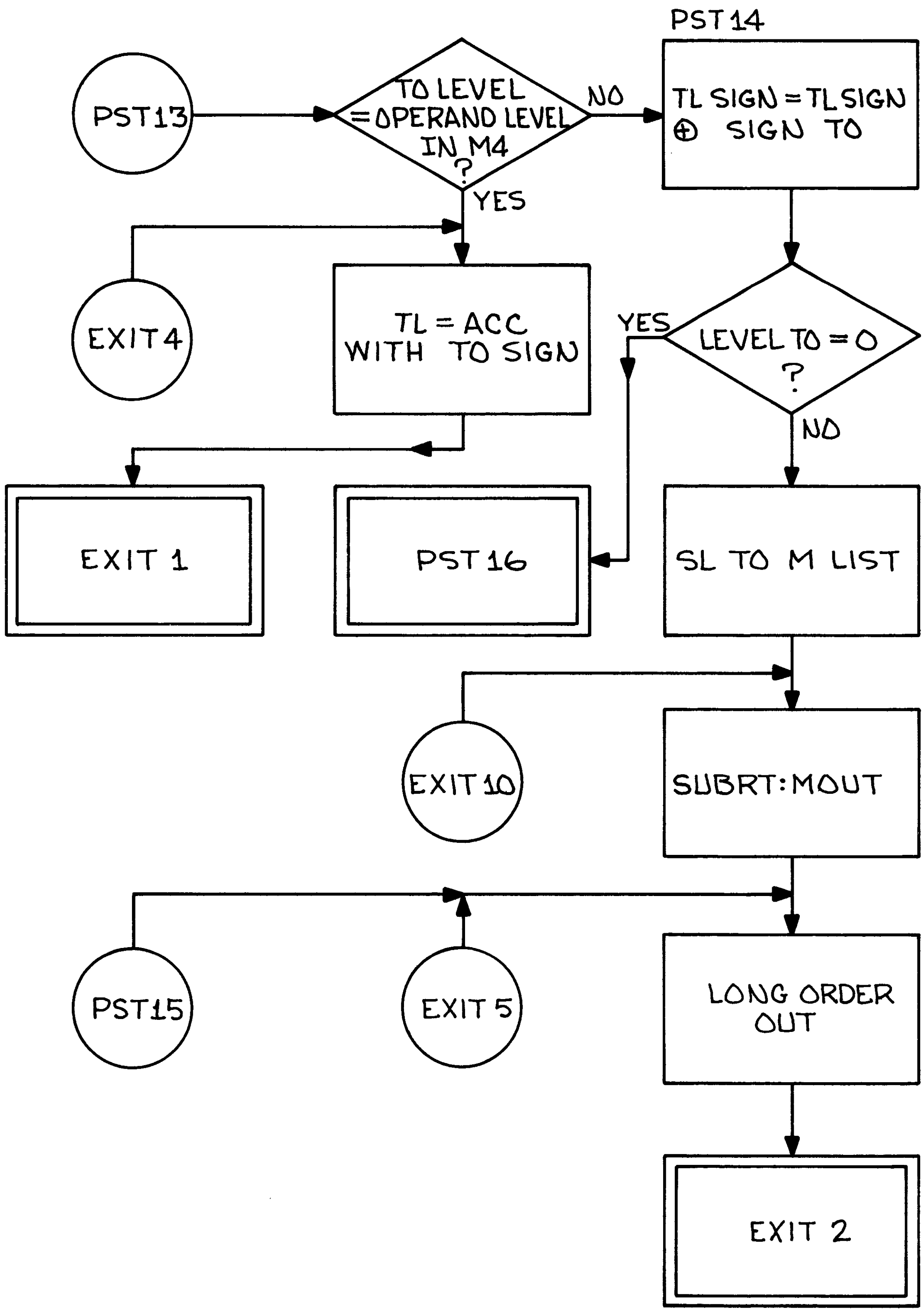
TABLE 1

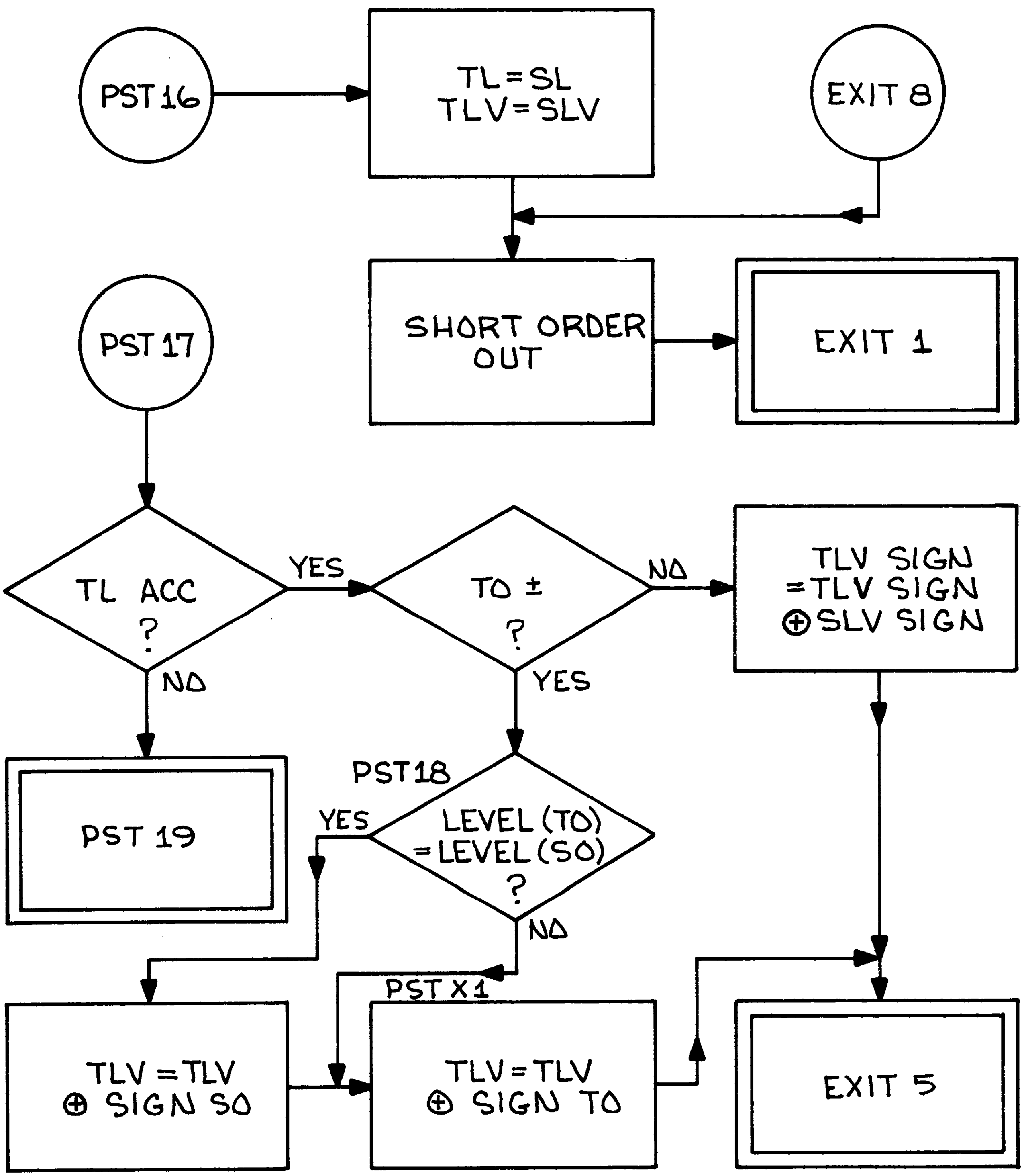

PST 1
SAVE F4 DECREASE PUSHDOWN LEVEL
SL #
YES
PST 32
NO
SL ACC
YES
PST 17
NO
TL ACC
YES
PST 9
NO
EXIT 1
TO */
YES
PST 3
NO
EXIT 9
SLV TO M9
NO
TL MODIFIER
YES
PST 2
EXIT 2
M9 TO M LIST
EXIT 7
TO = SO
RESTORE M5
EXIT FROM PST 1 SUBRT.

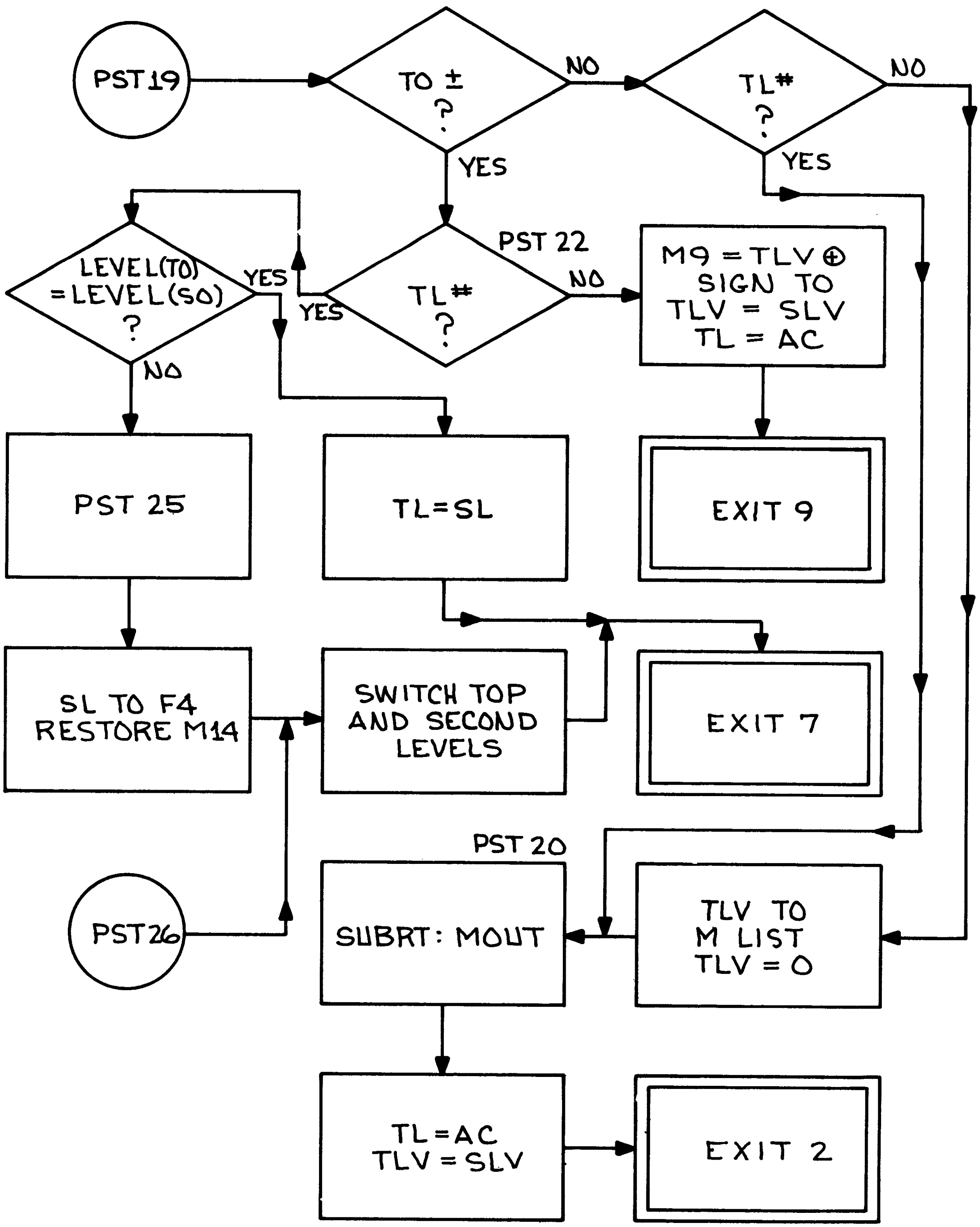


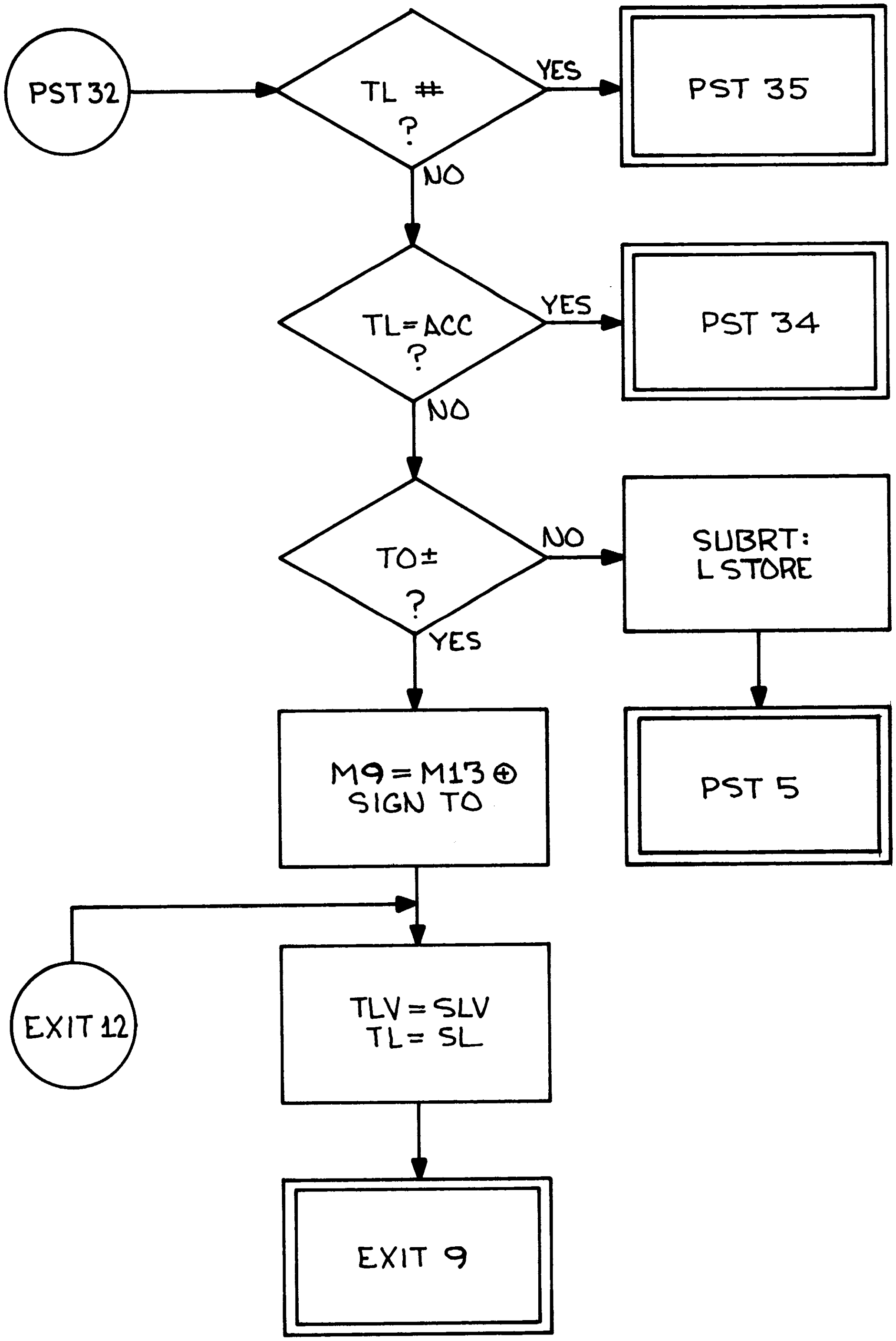
PST 2
TL SIGN CHANGED IF TO —
EXIT 1
PST 3
SUBRT: L STORE
PST 5
OUTPUT SHORT ORDER
PST 6
TL = #
YES
NO
PST 7
PST 8
OUTPUT SHORT ORDER
EXIT 3
OUTPUT LONG ORDER
TL = ACC
EXIT 2


PST 9
TO ±
?
YES
PST 13
NO
PST 10
OUTPUT
SHORT ORDER
PST 11
PST 12
OUTPUT
LONG ORDER
EXIT 2

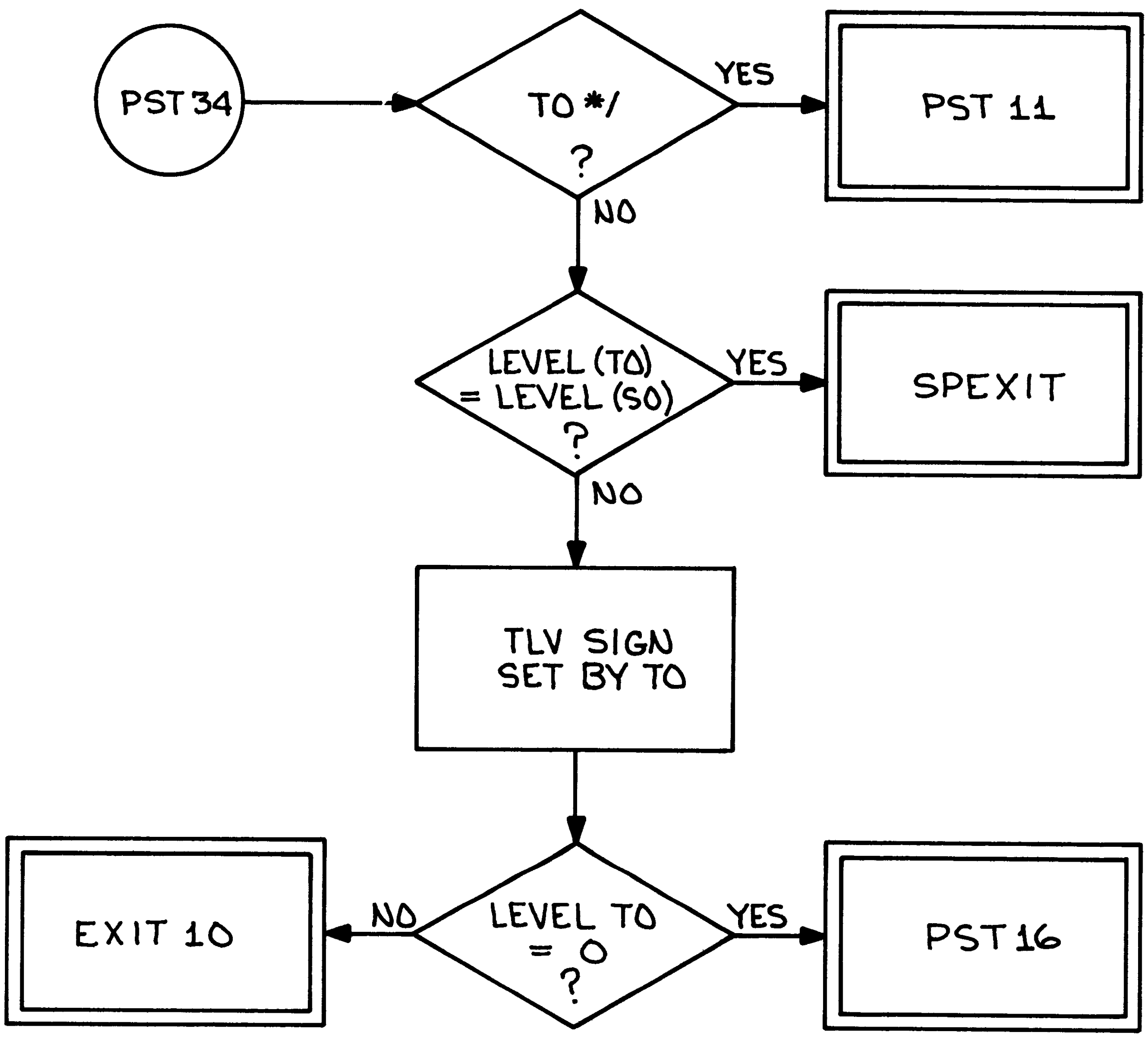

PST14
PST13
TO LEVEL = OPERAND LEVEL IN M4 ?
NO
TL SIGN = TL SIGN ⊕ SIGN TO
YES
EXIT4
TL = ACC WITH TO SIGN
YES
LEVEL TO = 0 ?
NO
EXIT 1
PST16
SL TO M LIST
EXIT 10
SUBRT: MOUT
PST15
EXIT 5
LONG ORDER OUT
EXIT 2

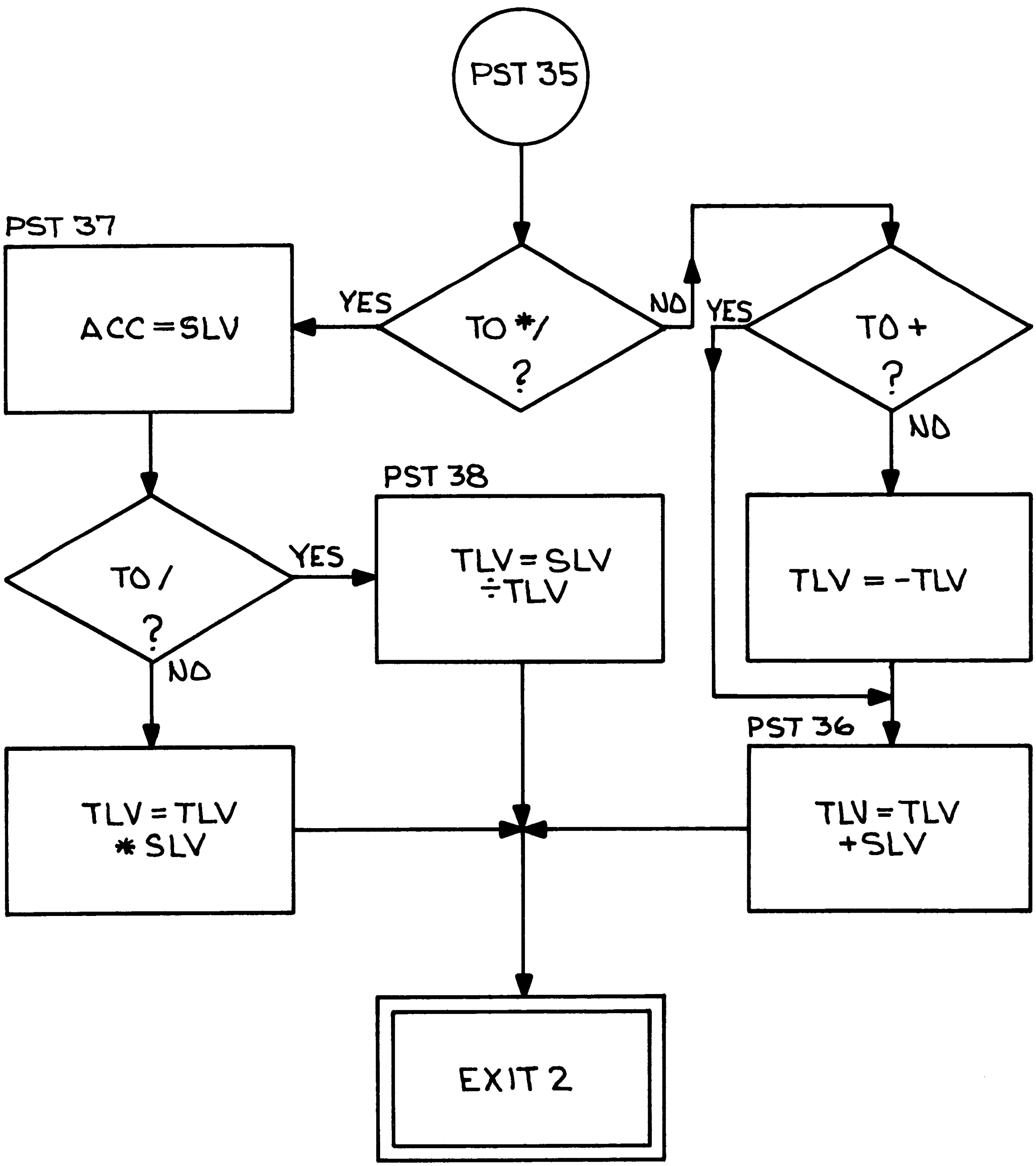

PST 16
TL = SL
TLV = SLV
EXIT 8
SHORT ORDER OUT
EXIT 1
PST 17
TL ACC ?
YES
NO
TO ± ?
NO
YES
TLV SIGN = TLV SIGN ⊕ SLV SIGN
PST 19
PST 18
LEVEL (TO) = LEVEL (SO) ?
YES
NO
PST X1
TLV = TLV ⊕ SIGN SO
TLV = TLV ⊕ SIGN TO
EXIT 5


PST 19
TO ± ?
NO
YES
TL# ?
NO
YES
PST 22
TL# ?
YES
NO
LEVEL(TO) = LEVEL(SO) ?
YES
NO
M9 = TLV ⊕ SIGN TO
TLV = SLV
TL = AC
PST 25
TL=SL
EXIT 9
SL TO F4
RESTORE M14
SWITCH TOP AND SECOND LEVELS
EXIT 7
PST 20
PST 26
SUBRT: MOUT
TLV TO M LIST
TLV = 0
TL=AC
TLV=SLV
EXIT 2



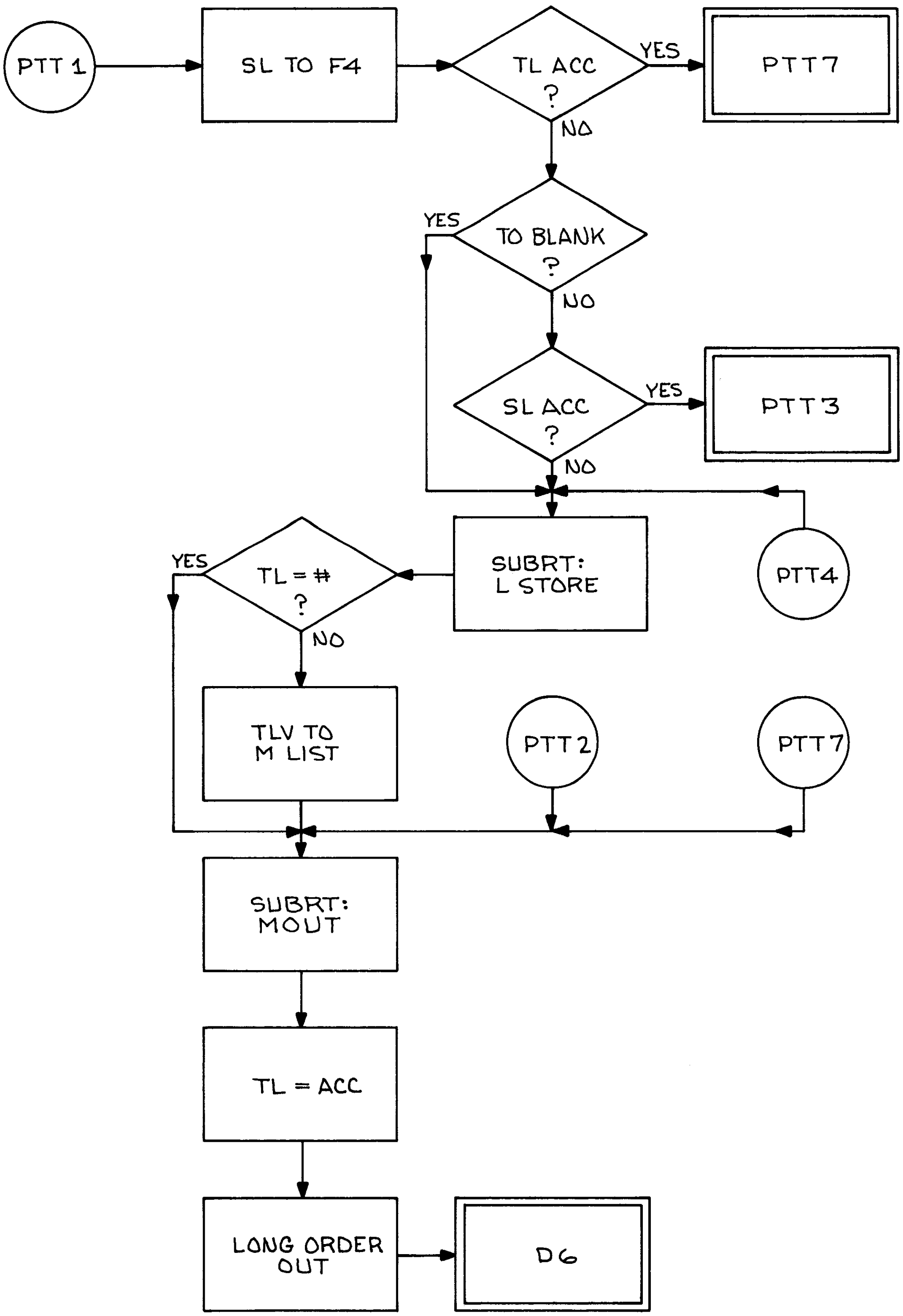
PST 32
TL ≠ ?
YES
PST 35
NO
TL = ACC ?
YES
PST 34
NO
TO ± ?
NO
SUBRT: L STORE
PST 5
YES
M9 = M13 ⊕ SIGN TO
EXIT 12
TLV = SLV
TL = SL
EXIT 9

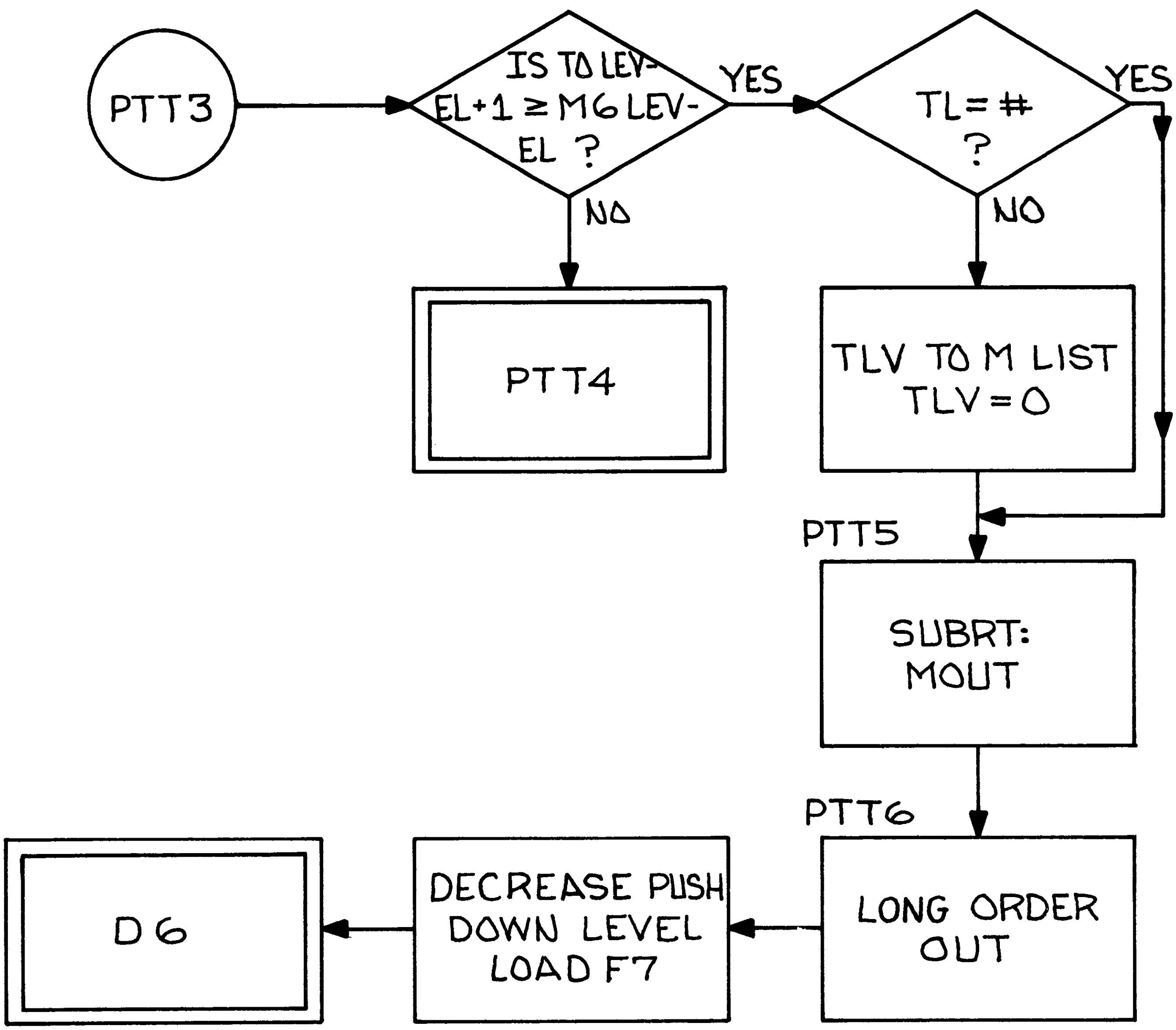

PST 34
TO */
?
YES
PST 11
NO
LEVEL (TO)
= LEVEL (SO)
?
YES
SPEXIT
NO
TLV SIGN
SET BY TO
LEVEL TO
= 0
?
NO
EXIT 10
YES
PST 16



PST 35
PST 37
ACC = SLV
YES
TO */ ?
NO
YES
TO + ?
NO
TO / ?
YES
NO
PST 38
TLV = SLV ÷TLV
TLV = -TLV
PST 36
TLV = TLV * SLV
TLV = TLV +SLV
EXIT 2

TABLE 2


PTT 1
SL TO F4
TL ACC ?
YES
NO
PTT7
TO BLANK ?
YES
NO
SL ACC ?
YES
NO
PTT3
SUBRT: L STORE
PTT4
TL = # ?
YES
NO
TLV TO M LIST
PTT 2
PTT 7
SUBRT: MOUT
TL = ACC
LONG ORDER OUT
D6


PTT3
IS TO LEV-
EL+1 ≥ M6 LEV-
EL ?
YES
NO
PTT4
TL = #
?
YES
NO
TLV TO M LIST
TLV = 0
PTT5
SUBRT:
MOUT
PTT6
LONG ORDER
OUT
DECREASE PUSH
DOWN LEVEL
LOAD F7
D6

3.2.7 Characteristics of "SBSOLV"

1. Closed subroutine with link in M3.

2. Exits:

   JLH M3 if all EQU statements are evaluated

   JLH M2 if it is not possible to evaluate all EQU statements.

3. Subroutines used:

   SBERR

   INPUT

   SBCOMP

4. Assumes:

   (a) location "PARAM" which must be defined contains the following information:

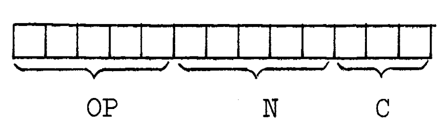
EQLIST
-4
-256
-1

   where "EQLIST" is the first word in the list of EQU statements.

   (b) There are three consecutive temporary storage locations beginning with the address "TEMP" which must be defined.

   (c) The first quarter word after the end of the last EQU statement is zero.

   (d) In the "operation byte" of an EQU statement:



   the five bits defined by N give the number of bytes <u>in the address</u> of the EQU statement.

Results: (a) If it is possible to evaluate the address of an EQU statement, that statement is deleted by setting the sign bit of its reference byte to 0.

(b) The card number of the EQU statement being processed is loaded into the first quarter word of the location "LOCAT" which must be defined.

(c) When a name table entry is defined by an EQU statement, the "state of construction" bits are set to 11 and the address is added into the last quarter word.

Treatment of address constructions, errors:

(a) EQUS

(1) a 13-bit address is computed

(2) an address with L represents a possible (nonfatal) error: the c field of L is ignored.

(3) an address with M or F is considered a fatal error; the tag is replaced by zero.

(b) EQUL C, ...

(1) a 15-bit address is computed

(2) if the first N-field byte is L, then the c field of L is added to C mod 4 and the overflow is added to the N address. In all other cases, the N field defines a 13-bit address.

(3) if the first N-field byte is not a name (integer, bracket, +, ...) there is a possible error (considered nonfatal)

(4) N field begins with S, possible (nonfatal) error
N field begins with M or F, fatal error and the tag is replaced by zero.

(c) EQUM

(1) If the address contains more than one byte, it is considered a fatal error and all except the first byte are ignored.

Treatment of First Byte

(2) if the first byte is not a name or integer, → fatal error, set address ≡ 0.

(3) F: fatal error, but F is used as M.

(4) S or L: fatal error, set address ≡ 0

(5) integer: fatal error if $\geq$ 16, address is set ≡ 0

(d) EQUF:

(1) same as EQUM

(2) same as EQUM

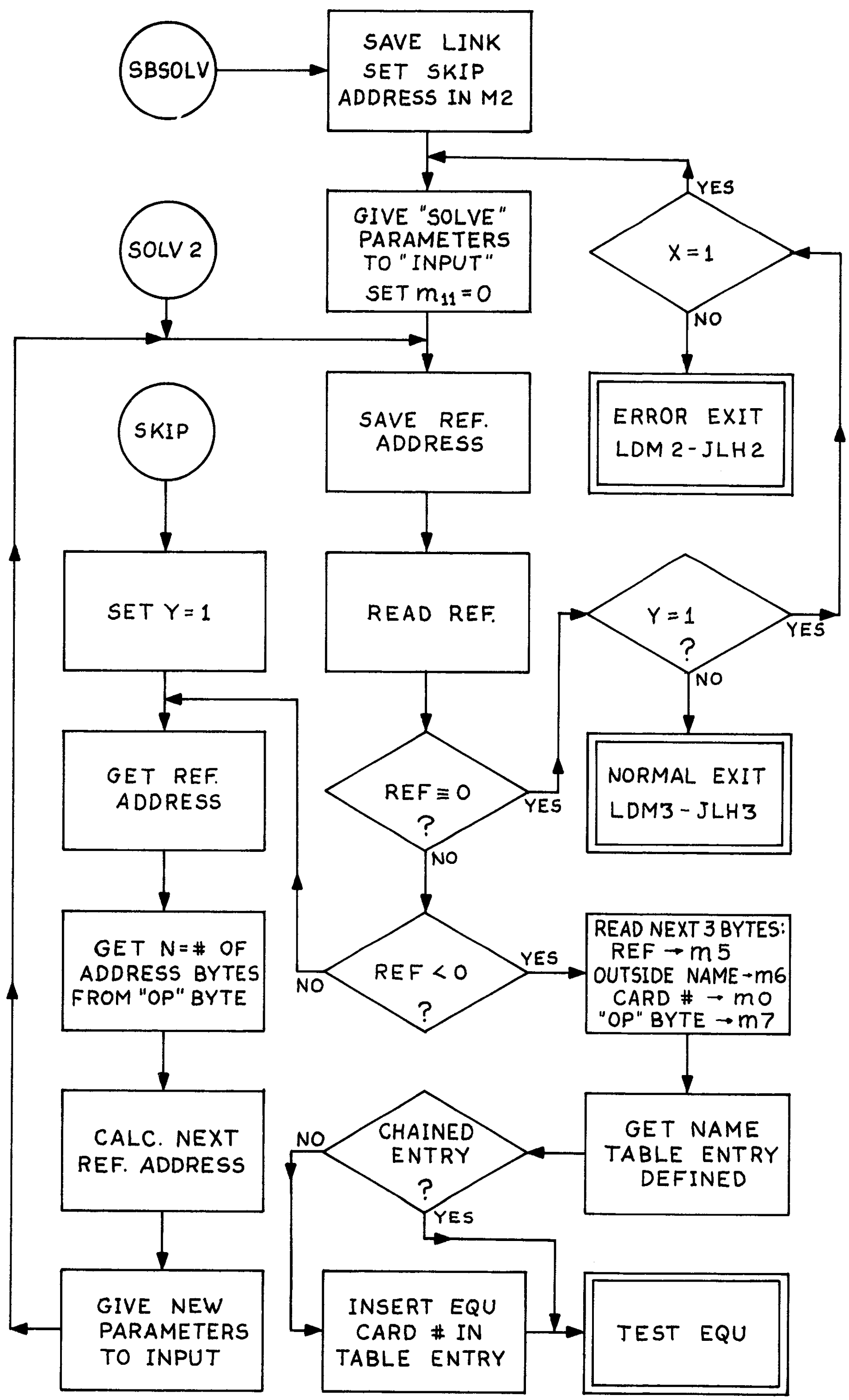
(3) M: fatal error but mask out left-most "B" bit and use as F

(4) same as EQUM

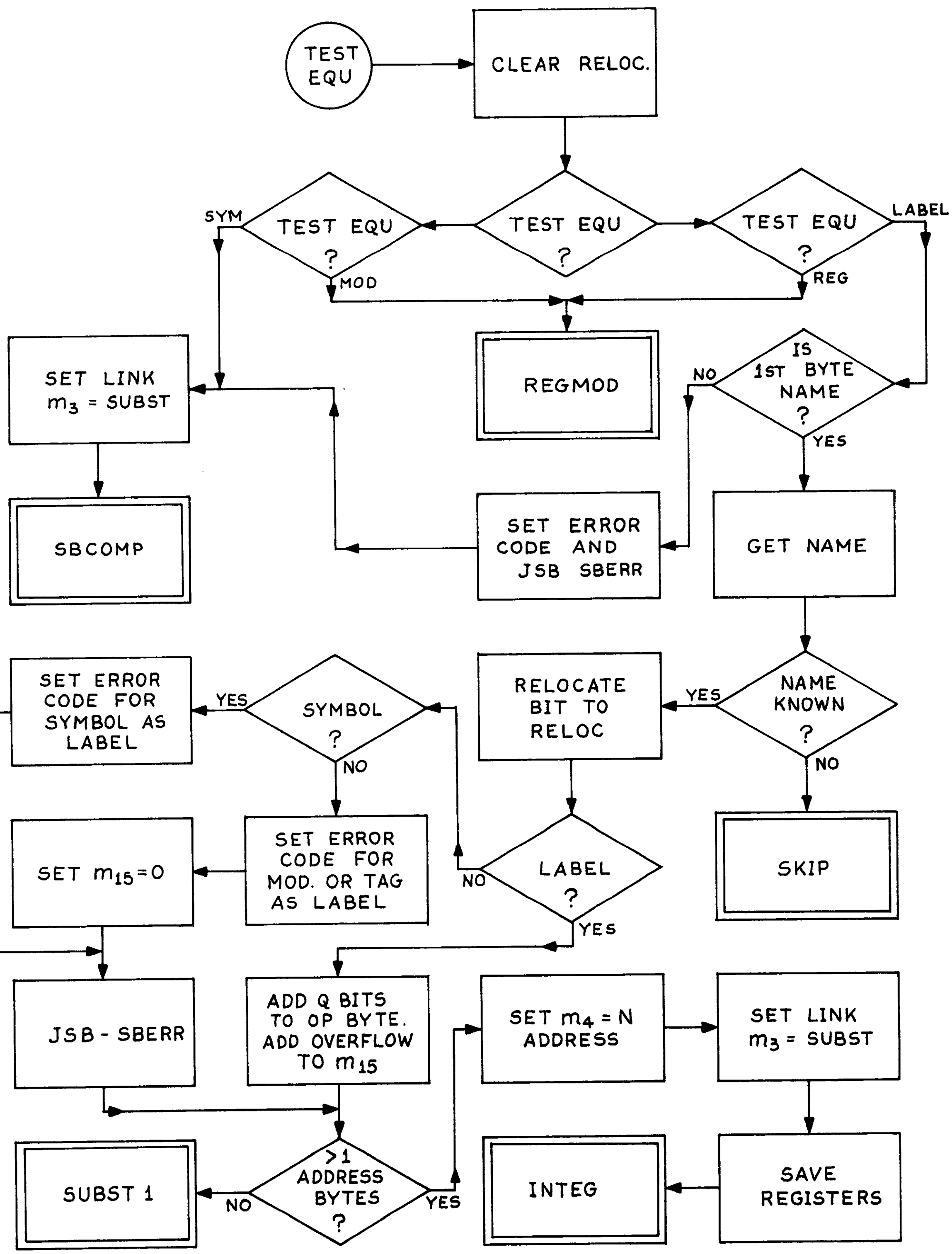
(5) integer: fatal error if $\geq$ 8, set address ≡ 0

If an EQU statement defines a name which is already known absolutely, the previous value stands and an error is indicated (doubly defined, fatal). For each EQU (except chaining EQU's) the EQU card number is inserted into the name table entry which it defines.

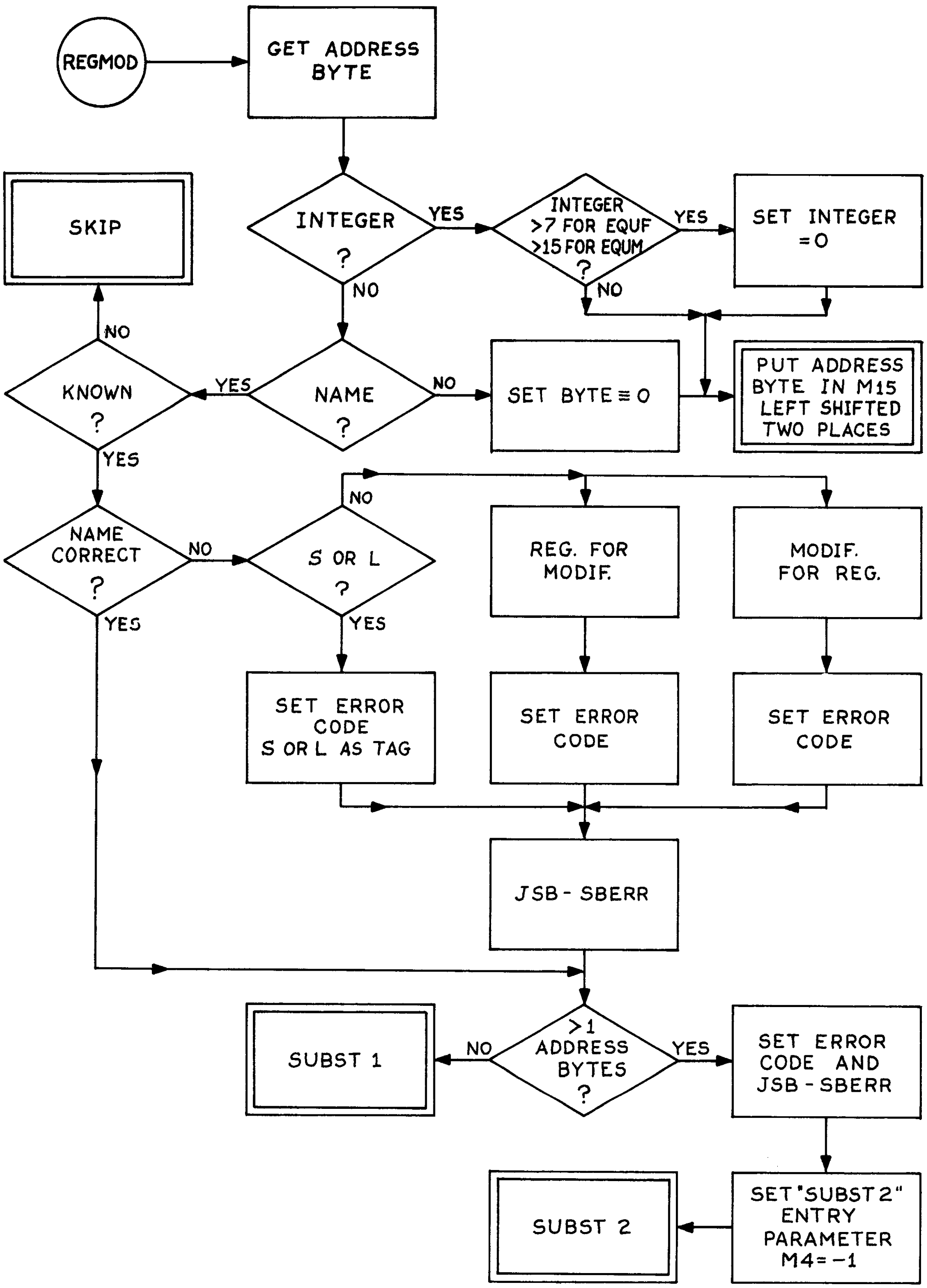
sbsolv


SBSOLV
SAVE LINK SET SKIP ADDRESS IN M2
GIVE "SOLVE" PARAMETERS TO "INPUT" SET $m_{11}=0$
X = 1
YES
NO
ERROR EXIT LDM 2-JLH2
SOLV 2
SKIP
SAVE REF. ADDRESS
SET Y = 1
READ REF.
Y = 1 ?
YES
NO
NORMAL EXIT LDM3-JLH3
GET REF. ADDRESS
REF ≡ 0 ?
YES
NO
GET N=# OF ADDRESS BYTES FROM "OP" BYTE
REF < 0 ?
NO
YES
READ NEXT 3 BYTES: REF → m5 OUTSIDE NAME → m6 CARD # → mo "OP" BYTE → m7
CALC. NEXT REF. ADDRESS
CHAINED ENTRY ?
NO
YES
GET NAME TABLE ENTRY DEFINED
GIVE NEW PARAMETERS TO INPUT
INSERT EQU CARD # IN TABLE ENTRY
TEST EQU

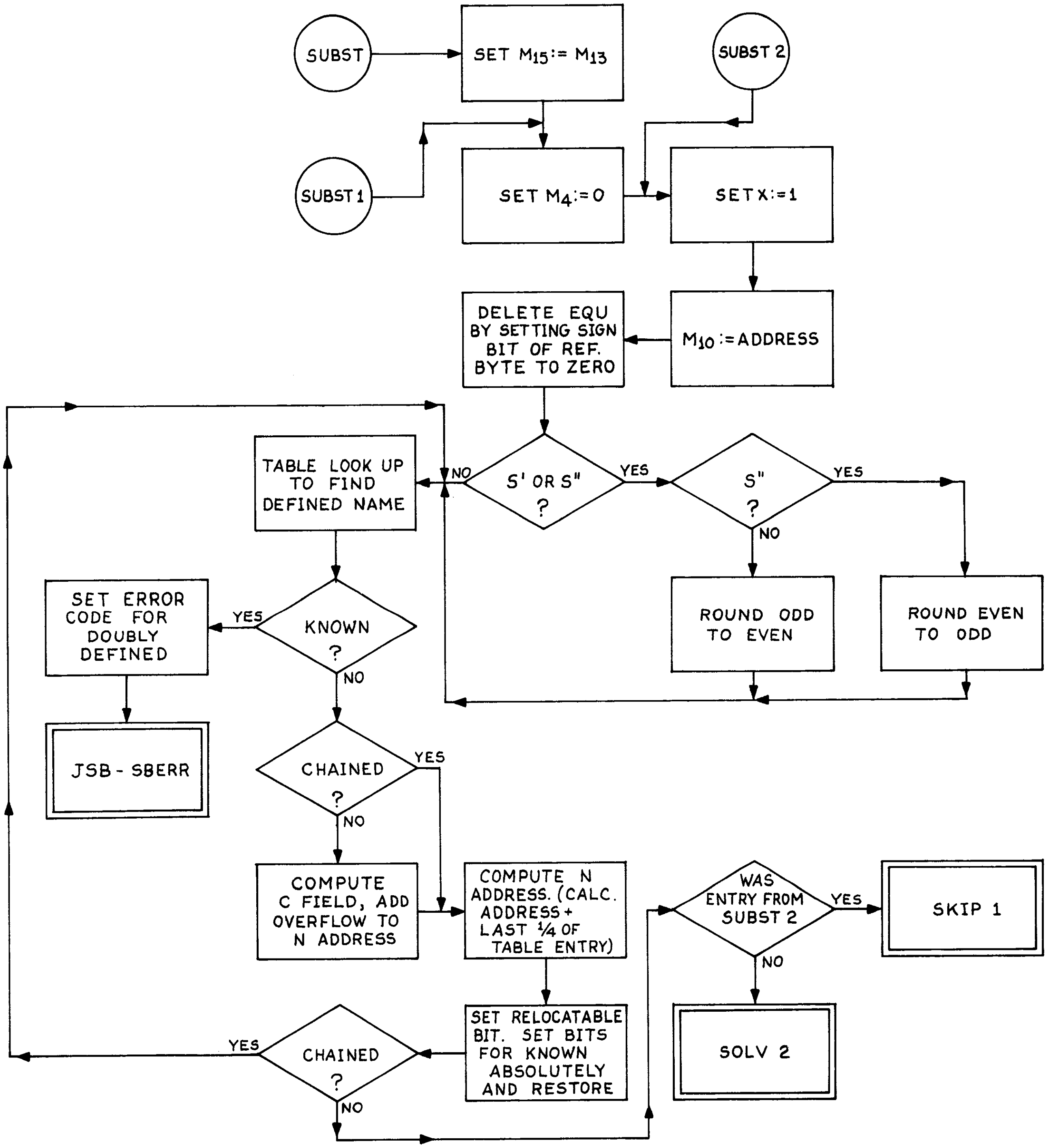
sbsolv


TEST EQU
CLEAR RELOC.
TEST EQU ?
TEST EQU ?
TEST EQU ?
SYM
MOD
REG
LABEL
REGMOD
SET LINK m_3 = SUBST
SBCOMP
IS 1ST BYTE NAME ?
NO
YES
SET ERROR CODE AND JSB SBERR
GET NAME
NAME KNOWN ?
YES
NO
SKIP
RELOCATE BIT TO RELOC
SYMBOL ?
YES
NO
SET ERROR CODE FOR SYMBOL AS LABEL
SET ERROR CODE FOR MOD. OR TAG AS LABEL
SET m_{15}=0
LABEL ?
NO
YES
JSB - SBERR
ADD Q BITS TO OP BYTE. ADD OVERFLOW TO m_{15}
SET m_4 = N ADDRESS
SET LINK m_3 = SUBST
>1 ADDRESS BYTES ?
NO
YES
SUBST 1
INTEG
SAVE REGISTERS

sbsolv


REGMOD
GET ADDRESS BYTE
INTEGER ?
YES
NO
INTEGER >7 FOR EQUF >15 FOR EQUM ?
YES
NO
SET INTEGER =0
SKIP
NO
KNOWN ?
YES
NAME ?
YES
NO
SET BYTE ≡ 0
PUT ADDRESS BYTE IN M15 LEFT SHIFTED TWO PLACES
NAME CORRECT ?
NO
YES
S OR L ?
NO
YES
REG. FOR MODIF.
MODIF. FOR REG.
SET ERROR CODE S OR L AS TAG
SET ERROR CODE
SET ERROR CODE
JSB - SBERR
SUBST 1
NO
>1 ADDRESS BYTES ?
YES
SET ERROR CODE AND JSB - SBERR
SUBST 2
SET "SUBST 2" ENTRY PARAMETER M4=-1

sbsolv


SUBST
SET M_{15} := M_{13}
SUBST 2
SUBST 1
SET M_4:=0
SET X:=1
DELETE EQU BY SETTING SIGN BIT OF REF. BYTE TO ZERO
M_{10} :=ADDRESS
TABLE LOOK UP TO FIND DEFINED NAME
NO
S' OR S" ?
YES
S" ?
YES
NO
ROUND ODD TO EVEN
ROUND EVEN TO ODD
SET ERROR CODE FOR DOUBLY DEFINED
YES
KNOWN ?
NO
JSB - SBERR
CHAINED ?
YES
NO
COMPUTE C FIELD, ADD OVERFLOW TO N ADDRESS
COMPUTE N ADDRESS. (CALC. ADDRESS + LAST ¼ OF TABLE ENTRY)
WAS ENTRY FROM SUBST 2
YES
SKIP 1
NO
SOLV 2
SET RELOCATABLE BIT. SET BITS FOR KNOWN ABSOLUTELY AND RESTORE
YES
CHAINED ?
NO

```
 49012C W GEAR
       NICAP  PASS  2    JAN 1,1965                       TAS
       ORG    1024
DRUMWD EQUS   7946
TUTRAN EQUS   7947
SYSTAP EQUS   7680
CHKFL  EQUS   1096
BCKSPR EQUS   1064
SYSAUX EQUS   7938
SYSERR EQUS   7937
READ   EQUS   0
WAIT   EQUS   256
WRITE  EQUS   512
LOAD   EQUS   7945
SYSIO  EQUS   7939
WTM    EQUS   1104
REWIND EQUS   1056
SYSTEM EQUS   7936
MPROGR LFR    7,INSTOR+1
       LDM    15,512
       ADM    15,2
       SFR    7,INSTOR+1
       LFR    6,512
       CSM    11,M9
       CAM    10
       CAM    9
       SFR    6,LOCAT
       LFR    6,STG1
       CAM    11,M15-2
       SFR    6,STG1
       ADM    9,256
       ADM    11,1
       SFR    6,STG1+2
       CALL   SYSAUX
```

```
STG1    DECQ    READ,ILBUF1,0,0
        CALL    SYSAUX
        BSS     1
        TRA     STPSS2
EQUENT  CAM     1,258
        TRA     ERROR
ERRFUL  CAM     1,259
        TRA     ERROR
EQUWRG  CAM     1,260
        TRA     ERROR
WRONG   CAM     1,257
ERROR   LFR     7,LOCAT
        CAM     2,M12
        CALL    SYSERR
SBSOLV  SFR     04,2,TEMP
        CAM     02,2,SKIP
SOLV1   LFR     07,2,PARAM
        SFR     07,2,INSTOR
        CAM     11,,
SOLV2   LFR     07,2,INSTOR
        SFR     07,2,TEMP+1
        JSB     03,0,INPUT
        FIL
        JUM     04,0,SOLV3
        LFR     7,INSTOR+1
        SFR     7,INSTOR
        LFR     4,TEMP
        JPM     11,,SOLV4           FINISHED
        CRM     11,2,12
        JNM     11,,SBSOLV          EQU SOLVED ON LAST SCAN
        CAM     3,M2                NOT SOLVED EXIT ADDRESS
SOLV4   JLH     M3                  EXIT FROM EQU SOLUTIONS
SOLV3   JNM     04,0,SOLV5
        JDC     00,0,SKIP1
```

```
        FIL                                              P2   68
SKIP    ORM     11,2,4096          OCT10000              P2   69
SKIP1   LFR     07,2,TEMP+1                              P2   70
        ADM     13,2,7                                   P2   71
        ANM     13,3,4                                   P2   72
        CAM     08,,                                     P2   73
        JZM     08,0,SOLV22                              P2   74
        CRM     08,2,2                                   P2   75
        ATN     08,,                                     P2   76
        ADM     12,,                                     P2   77
        ATN     08,,                                     P2   78
        ADM     14,,                                     P2   79
        ANM     13,2,3                                   P2   80
SOLV22  SFR     06,2,TEMP+2                              P2   81
        ATN     12,,                                     P2   82
        LFR     06,,                                     P2   83
        ORB     13,,                                     P2   84
        ATN     08,,                                     P2   85
        CAM     08,,                                     P2   86
        ANM     8,2,248            OCT370                P2   87
        CRM     08,3,3                                   P2   88
        ADM     13,2,1                                   P2   89
        ANM     13,3,-4                                  P2   90
        CAM     08,,                                     P2   91
        JZM     08,0,SOLV21                              P2   92
        CRM     08,2,2                                   P2   93
        ATN     08,,                                     P2   94
        ADM     12,,                                     P2   95
        ATN     08,,                                     P2   96
        ADM     14,,                                     P2   97
        ANM     13,2,3                                   P2   98
SOLV21  SBM     13,2,4                                   P2   99
        SFR     07,2,INSTOR                              P2  100
        LFR     06,2,TEMP+2                              P2  101
```

```
        JDC    00,0,SOLV2                                      P2  102
SOLV5   ATN    04,,                                            P2  103
        CAM    05,,                                            P2  104
        JSB    03,0,INPUT                                      P2  105
        FIL                                                    P2  106
        ATN    04,,                                            P2  107
        CAM    06,,                                            P2  108
        JSB    03,0,INPUT                                      P2  109
        FIL                                                    P2  110
        ATN    04,,                                            P2  111
        CAM    00,,                                            P2  112
        JSB    03,0,INPUT                                      P2  113
        FIL                                                    P2  114
        ATN    04,,                                            P2  115
        CAM    07,,                                            P2  116
        LFR    07,2,LOCAT                                      P2  117
        ATN    00,,                                            P2  118
        CAM    12,,                                            P2  119
        SFR    07,2,LOCAT                                      P2  120
        ATN    06,,                                            P2  121
        LFR    07,,                                            P2  122
        ANM    14,3,96                                         P2  123
        CAM    08,2,-64                                        P2  124
        JZM    00,0,SOLV23                                     P2  125
        ATN    00,,                                            P2  126
        CAM    12,,                                            P2  127
        ATN    06,,                                            P2  128
        SFR    07,,                                            P2  129
SOLV23  ANM    7,3,768             OCT1400                     P2  130
        CAM    08,,                                            P2  131
        CAD    15,3,                                           P2  132
        SAM    RELOC                                           P2  133
        CRM    08,2,9                                          P2  134
        JPM    08,0,SYMMOD                                     P2  135
```

```
         CRM    08,2,1                                                P2  136
         JPM    08,0,REGMOD                                           P2  137
         ANM    05,3,3                                                P2  138
         CAM    08,2,-2                                               P2  139
         JZM    08,0,SOLV11                                           P2  140
         CAM    1,2,1034          OCT2012                             P2  141
         JSB    03,0,SBERR                                            P2  142
         FIL                                                          P2  143
         JDC    00,0,SYMLAB                                           P2  144
SOLV11   JSB    03,0,INPUT                                            P2  145
         FIL                                                          P2  146
         ATN    04,,                                                  P2  147
         LFR    07,,                                                  P2  148
         ANM    14,3,96                                               P2  149
         CAM    08,2,-96                                              P2  150
         JZM    08,0,SOLV6                                            P2  151
         JLH    02,,                                                  P2  152
SOLV6    ANM    14,3,12                                               P2  153
         CAM    08,2,-12                                              P2  154
         CAD    F6                                                    P2  155
         LFR    6,RELOC                                               P2  156
         ANN    14,384                                                P2  157
         EOM    9                                                     P2  158
         SFR    6,RELOC                                               P2  159
         NOM    9,M14                                                 P2  160
         JUM    9,SOLV9A                                              P2  161
         SFR    4,SBR1                                                P2  162
         CAM    1,1040                                                P2  163
         CALL   SBERR                                                 P2  164
         LFR    4,SBR1                                                P2  165
SOLV9A   SAM    F6                                                    P2  166
         JZM    08,0,SOLV7                                            P2  167
         ADM    08,2,12                                               P2  168
         JUM    08,0,SOLV8                                            P2  169
```

```
         CAM    1,2,1024          OCT2000                              P2  170
         JDC    00,0,SOLV9                                             P2  171
SOLV8    CAM    15,,                                                   P2  172
         SBM    08,2,4                                                 P2  173
         CAM    1,2,5124          OCT12004                             P2  174
         JZM    08,0,SOLV9                                             P2  175
         ADM    01,2,1                                                 P2  176
SOLV9    JSB    03,0,SBERR                                             P2  177
         FIL                                                           P2  178
         JDC    00,0,LALATE                                            P2  179
SOLV7    ANM    14,3,3                                                 P2  180
         ADM    07,,                                                   P2  181
         ANM    07,3,4                                                 P2  182
         CAM    08,,                                                   P2  183
         JZM    08,0,LALATE                                            P2  184
         CRM    08,3,2                                                 P2  185
         ADM    15,,                                                   P2  186
         ANM    07,2,-5                                                P2  187
LALATE   ANM    05,3,15                                                P2  188
         CAM    08,2,-10                                               P2  189
         JZM    8,SUBST1        LAST BYTE                              P2  190
         CAM    4,M15           SET UP INTEGER AS THOUGH BYTE READ     P2  191
         CAM    03,2,SUBST                                             P2  192
         SFR    4,COMMON-1      TEMPORARY STOTAGE FOR SBCOMP           P2  193
         SFR    05,2,COMMON-2                                          P2  194
         SFR    06,2,COMMON-3                                          P2  195
         CAM    06,,                                                   P2  196
         CAM    07,,                                                   P2  197
         TRA    INTEG           LATE ENTRY TO SBCOMP                   P2  198
SYMMOD   CRM    08,2,1                                                 P2  199
         JNM    08,0,REGMOD                                            P2  200
SYMLAB   CAM    03,2,SUBST                                             P2  201
         JDC    00,0,SBCOMP                                            P2  202
REGMOD   JSB    03,0,INPUT                                             P2  203
```

```
         FIL                                                       P2  204
         ANM    05,3,7                                             P2  205
         CAM    09,,                                               P2  206
         JUM    09,0,SOLV10                                        P2  207
         CSM    10,2,16                                            P2  208
         JNM    08,0,SOLV19                                        P2  209
         CSM    10,2,8                                             P2  210
SOLV19   ATN    04,,                                               P2  211
         ADM    10,,                                               P2  212
         JNM    10,0,SOLV20                                        P2  213
         CAM    1,2,5134                OCT12016                   P2  214
         JSB    03,0,SBERR                                         P2  215
         FIL                                                       P2  216
         CAM    04,,                                               P2  217
SOLV20   CRM    04,3,11                                            P2  218
         CAM    15,,                                               P2  219
         JDC    00,0,SOLV14                                        P2  220
SOLV10   SBM    09,2,2                                             P2  221
         JZM    09,0,SOLV12                                        P2  222
         CAM    15,,                                               P2  223
         JDC    00,0,SOLV17                                        P2  224
SOLV12   ATN    04,,                                               P2  225
         LFR    07,,                                               P2  226
         ANM    14,3,96                                            P2  227
         CAM    10,2,-96                                           P2  228
         JZM    10,0,SOLV13                                        P2  229
         JLH    02,,                                               P2  230
SOLV13   ANM    14,3,12                                            P2  231
         CAM    09,,                                               P2  232
         JZM    09,0,SOLV15                                        P2  233
         SBM    09,2,12                                            P2  234
         JZM    09,0,SOLV15                                        P2  235
         CRM    08,3,9                                             P2  236
         SBM    09,2,-12                                           P2  237
```

```
         JZM    09,0,SOLV14
         CAM    1,2,5131            OCT12013
         JNM    09,0,SOLV16
         ADM    01,2,1
         ANM    15,2,28
         JDC    00,0,SOLV16
SOLV15   CAM    15,,
         CAM    1,2,5126            OCT12006
SOLV16   JSB    03,0,SBERR
         FIL
SOLV14   ANM    05,3,15
         CAM    08,2,-8
         JPM    08,0,SUBST1
SOLV17   CAM    1,2,5133            OCT12015
         JSB    03,0,SBERR
         FIL
         CSM    04,2,1
         JDC    00,0,SUBST2
         FIL
SUBST    CAM    15,M13          RETURN FROM SBCOMP
SUBST1   CAM    04,,
SUBST2   ORM    11,2,2048           OCT4000
         ATN    15,,
         CAM    10,,
         SFR    06,2,TEMP+2
         LFR    06,2,TEMP+1
         ATN    08,,
         LFR    07,,
         ORB    09,2,4
         ANM    12,2,4095           OCT7777
         ATN    08,,
         SFR    07,,
         LFR    06,2,TEMP+2
         JNM    07,0,SUBST3
```

```
        CRM     07,2,12                                                   P2   272
        JPM     07,0,SUBST4                                               P2   273
        ANM     10,3,1                                                    P2   274
        ADM     10,,                                                      P2   275
        JDC     00,0,SUBST5                                               P2   276
SUBST4  CRM     10,3,1                                                    P2   277
        ADM     08,,                                                      P2   278
        JNM     08,0,SUBST5                                               P2   279
        ADM     10,2,1                                                    P2   280
SUBST5  CRM     07,2,1                                                    P2   281
SUBST3  ATN     06,,                                                      P2   282
        LFR     07,,                                                      P2   283
        ANM     14,3,96                                                   P2   284
        CAM     08,2,-96                                                  P2   285
        JUM     8,SUBST6            NOT PREVIOUSLY DEFINED NAME           P2   286
        CAM     1,2,5129               OCT12011                           P2   287
        JSB     03,0,SBERR                                                P2   288
        FIL                                                               P2   289
        JDC     00,0,SUBST7                                               P2   290
SUBST6  ADM     08,2,64                                                   P2   291
        JZM     8,SUBST8            CHAINED                               P2   292
        ANM     14,3,3                                                    P2   293
        ADM     07,,                                                      P2   294
        ANM     14,2,8188              OCT17774                           P2   295
        ANM     07,3,3                                                    P2   296
        ADM     14,,                                                      P2   297
        CRM     07,2,2                                                    P2   298
        ANM     07,3,1                                                    P2   299
SUBST8  ATN     10,,                                                      P2   300
        ADM     15,,                                                      P2   301
        ORM     14,2,96                                                   P2   302
        CAD     F6                                                        P2   303
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        ANN     9,384                                                     P2   305
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        SFR    07,,                                       P2   309
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        CAM    15                                         P2   329
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I11     BSS    3                                         P2  343
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        ATN    06,,                                      P2  351
        CAM    05,,                                      P2  352
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        JSB    03,0,FRANK                                P2  360
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        SFR    4,LOCAT                                   P2  364
        JDC    00,0,READRF                               P2  365
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        FIL                                              P2  368
        CAM    12,2,1                                    P2  369
        CAM    06,,                                      P2  370
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        CAM    13,,                                      P2  373
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        ANM    05,3,8                                     P2  375
        CAM    15,,                                       P2  376
        LFR    06,2,CC2                                   P2  377
        JUM    15,0,ACE                                   P2  378
        JDC    00,0,MODIF                                 P2  379
OUT1    SFR    04,2,COMMON+4                              P2  380
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        ANM    02,3,2047                                  P2  384
        ADM    03,,                                       P2  385
        CRM    02,2,11                                    P2  386
        ANM    02,2,3                                     P2  387
        SFR    04,2,LOCAT                                 P2  388
        LFR    04,2,COMMON+4                              P2  389
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OUT2X   LFR    04,2,LOCAT                                 P2  392
        ADM    02,2,2                                     P2  393
        JDC    00,0,OUT1X                                 P2  394
MOUT    SFR    04,2,COMMON+4                              P2  395
        LFR    04,2,LOCAT                                 P2  396
        ATN    10,,                                       P2  397
        ADM    02,,                                       P2  398
        SFN    10,,                                       P2  399
        ADM    11,,                                       P2  400
        CAM    10,,                                       P2  401
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        SFR    04,2,COMMON+4                              P2  404
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        SBM    3,M7                                       P2  407
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        JLH   03,,                                                   P2  412
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        CAD   15,3,                                                  P2  416
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MAC21   JSB   03,0,INPUT                                             P2  418
        FIL                                                          P2  419
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        JSB   03,0,INPUT                                             P2  423
        FIL                                                          P2  424
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        CAM   06,,                                                   P2  426
D10     ANM   05,3,32                                                P2  427
        CAM   03,,                                                   P2  428
        JZM   03,0,ORDER                                             P2  429
        ANM   05,3,16                                                P2  430
        CAM   03,,                                                   P2  431
        JZM   03,0,PSEUDO                                            P2  432
        JDC   00,0,MACROS                                            P2  433
ORDER   ANM   5,3,1024            OCT2000                            P2  434
        CAM   02,,                                                   P2  435
        JZM   02,0,D11                                               P2  436
        JSB   03,0,INPUT                                             P2  437
        FIL                                                          P2  438
D11     JSB   03,0,INPUT                                             P2  439
        FIL                                                          P2  440
D12     CRM   05,3,10                                                P2  441
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        CAM   14,,                                                   P2  442
        ATN   04,,                                                   P2  443
        CAM   12,,                                                   P2  444
        SFR   07,2,COMMON+2                                          P2  445
        JPM   05,0,P21                                               P2  446
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        LFR   04,,                                                   P2  448
        LFR   07,2,LOCAT                                             P2  449
        ANM   2,3,96             OCT140                              P2  450
        CAM   07,,                                                   P2  451
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        CAM   01,,                                                   P2  461
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        CAM   13,,                                                   P2  463
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P22     ATN   06,,                                                   P2  465
        SFR   04,,                                                   P2  466
P21     ANM   5,3,960            OCT1700                             P2  467
        CSM   03,2,-255                                              P2  468
        JPM   03,0,TSL                                               P2  469
        CJZ   03,0,Q21                                               P2  470
        ADM   03,2,192                                               P2  471
        JPM   03,0,Q22                                               P2  472
        ADM   03,2,448                                               P2  473
        JPM   03,0,Q21                                               P2  474
        LFR   07,2,COMMON+2                                          P2  475
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         CAM    14,2,1536          OCT3000                P2  476
         SFR    07,2,COMMON+2                             P2  477
         JDC    00,0,D15                                  P2  478
Q21      ANM    05,3,8                                    P2  479
         CAM    03,,                                      P2  480
         JZM    03,0,ADCOMP                               P2  481
         JSB    03,0,INPUT                                P2  482
         FIL                                              P2  483
         ANM    05,3,7                                    P2  484
         CAM    03,,                                      P2  485
         JZM    03,0,INTEG1                               P2  486
         SBM    03,2,3                                    P2  487
         JZM    3,,WRONG                                  P2  488
         ATN    04,,                                      P2  489
         LFR    04,,                                      P2  490
         ATN    03,,                                      P2  491
         CAM    13,,                                      P2  492
         ANM    02,3,28                                   P2  493
         CAM    03,,                                      P2  494
         JZM    03,0,INTEG1                               P2  495
         CRM    03,2,2                                    P2  496
         SBM    03,2,4                                    P2  497
         JPM    03,0,EQSYM1                               P2  498
         CJZ    03,0,LABEL1                               P2  499
         CJZ    03,0,MODIF1                               P2  500
         ANM    5,3,960            OCT1700                P2  501
         CAM    03,2,-513                                 P2  502
         JNM    03,0,Q211                                 P2  503
         JSB    03,0,OUT1                                 P2  504
         FIL                                              P2  505
         JDC    00,0,ENDACE                               P2  506
Q211     CAM    1,2,5124           OCT12004               P2  507
         JSB    03,0,SBERR                                P2  508
         FIL                                              P2  509
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        JDC    00,0,INTEGl                                  P2   510
MODIF1  ATN    08,3,1                                       P2   511
INTEG1  CAM    12,,                                         P2   512
        CSM    14,2,4                                       P2   513
        LFR    06,2,CC2                                     P2   514
        JDC    00,0,ACE                                     P2   515
TSL     ANM    5,3,192             OCT300                   P2   516
        CAM    03,,                                         P2   517
        JUM    03,0,D14                                     P2   518
Q22     JSB    03,0,OUT1                                    P2   519
        FIL                                                 P2   520
        JDC    00,0,READRF                                  P2   521
D14     ANM    5,3,128             OCT200                   P2   522
        CAM    03,,                                         P2   523
        JUM    03,0,D15                                     P2   524
        JSB    03,0,INPUT                                   P2   525
        FIL                                                 P2   526
        JSB    03,0,OUT2                                    P2   527
        FIL                                                 P2   528
        JDC    00,0,READRF                                  P2   529
D15     ANM    05,3,64                                      P2   530
        CAM    03,,                                         P2   531
        JUM    03,0,ADCOMP                                  P2   532
        ANM    05,3,2                                       P2   533
        CAM    03,,                                         P2   534
        JUM    03,0,D151                                    P2   535
        CAM    1,2,5120            OCT12000                 P2   536
        JSB    03,0,SBERR                                   P2   537
        FIL                                                 P2   538
        JDC    00,0,ADCOMP                                  P2   539
D151    JSB    03,0,INPUT                                   P2   540
        FIL                                                 P2   541
        ATN    04,,                                         P2   542
        LFR    04,,                                         P2   543
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        CRM    02,2,2                                      P2  544
        ANM    02,3,7                                      P2  545
        CSM    15,,                                        P2  546
        JUM    15,0,D152                                   P2  547
SYMBER  CAM    1,2,5120            OCT12000                P2  548
        JSB    03,0,SBERR                                  P2  549
        FIL                                                P2  550
        JDC    00,0,TCHR8                                  P2  551
D152    CJZ    15,0,FREG3                                  P2  552
        CJZ    15,0,MODIF3                                 P2  553
        CJZ    15,0,TCHR8                                  P2  554
        CAM    1,2,1032            OCT2010                 P2  555
        JSB    03,0,SBERR                                  P2  556
        FIL                                                P2  557
TCHR8   ANM    05,3,8                                      P2  558
        CAM    03,,                                        P2  559
        JZM    03,0,D16                                    P2  560
        JSB    03,0,OUT2                                   P2  561
        FIL                                                P2  562
        JDC    00,0,READRF                                 P2  563
D16     CAM    06,,                                        P2  564
        CAM    07,,                                        P2  565
        LFR    06,2,CC2                                    P2  566
        LFR    07,2,CC3                                    P2  567
        JDC    00,0,INTEG                                  P2  568
SBCOMP  SFR    04,2,COMMON-1                               P2  569
        SFR    05,2,COMMON-2                               P2  570
        SFR    06,2,COMMON-3                               P2  571
ADCOMP  CAM    06,,                                        P2  572
        CAM    07,,                                        P2  573
        LFR    06,2,CC2                                    P2  574
        LFR    07,2,CC3                                    P2  575
TESTO   ANM    05,3,15                                     P2  576
        CAM    15,2,-4                                     P2  577
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        JUM    15,0,READ2                         P2
READ0   JSB    03,0,INPUT                         P2
        FIL                                       P2
        ANM    05,2,8176                          P2
        ANM    4,3,15             OCT17           P2
        ADM    05,,                               P2
        ANM    4,2,8176           OCT17760        P2
        CRM    04,2,4                             P2
        JZM    04,0,READ2                         P2
        CAM    12,,                               P2
        CAM    13,,                               P2
        JDC    00,0,LEVEL                         P2
LEVEL   SFN    04,,                               P2
        CSM    15,2,2                             P2
        JNM    15,0,D3                            P2
        ADM    06,2,2                             P2
D3      ANM    14,3,8190          OCT17776        P2
        CAM    15,,                               P2
        SFN    06,,                               P2
        ADM    15,,                               P2
        ANM    6,2,8188           OCT17774        P2
        JPM    15,0,TABLE1                        P2
SPEX1   ATN    08,1,                              P2
        SFR    07,0,                              P2
        ATN    06,,                               P2
        ATN    04,,                               P2
        CAM    14,,                               P2
READ2   JSB    03,0,INPUT                         P2
        FIL                                       P2
        ANM    5,3,3              OCT0            P2
        CSM    15,,                               P2
D4      JZM    15,0,INTEG                         P2
        CJZ    15,0,OPENBR                        P2
        CJZ    15,0,NAME                          P2
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        TRA    WRONG                                    P2  612
SPEXIT  ADM    08,2,1                                   P2  613
        JDC    00,0,SPEX1                               P2  614
INTEG   CAM    12,,                                     P2  615
        ATN    04,,                                     P2  616
        CAM    13,,                                     P2  617
PUTF7   ANM    05,3,15                                  P2  618
        CAM    15,2,-8                                  P2  619
        JNM    15,0,READ1                               P2  620
FAKE    CAM    06,2,-4                                  P2  621
        CAM    04,,                                     P2  622
PDEMP   JPM    14,0,LEVEL                               P2  623
        ANM    05,3,48                                  P2  624
        CAM    15,2,-32                                 P2  625
        JUM    15,0,ACE                                 P2  626
        LFR    04,2,COMMON-1                            P2  627
        LFR    05,2,COMMON-2                            P2  628
        LFR    06,2,COMMON-3                            P2  629
        JLH    03,,                                     P2  630
ACE     JPM    12,0,ACE10                               P2  631
        JSB    03,0,OUT1                                P2  632
        FIL                                             P2  633
        CAM    12,2,1                                   P2  634
ACE10   LFR    04,2,COMMON+2                            P2  635
        JNM    02,0,ACE4                                P2  636
        CRM    02,2,12                                  P2  637
        JNM    02,0,ACE3                                P2  638
        JZM    12,0,ACE2                                P2  639
        ATN    11,1,                                    P2  640
        SFR    07,,                                     P2  641
        ADM    10,2,1                                   P2  642
ACE2    JSB    03,0,MOUT                                P2  643
        FIL                                             P2  644
        JSB    03,0,OUT2                                P2  645
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         FIL                         P2  646
         JDC    00,0,ENDACE          P2  647
ACE3     JSB    03,0,OUT1            P2  648
         FIL                         P2  649
         JDC    00,0,ENDACE          P2  650
ACE4     CRM    02,2,12              P2  651
         JZM    12,0,ACE7            P2  652
         ATN    11,1,                P2  653
         SFR    07,,                 P2  654
         ADM    10,2,1               P2  655
         JNM    02,0,ACE5            P2  656
ACE6     JSB    03,0,MOUT            P2  657
         FIL                         P2  658
         JSB    03,0,OUT1            P2  659
         FIL                         P2  660
         JDC    00,0,ENDACE          P2  661
ACE5     JSB    03,0,LOOKM           P2  662
         FIL                         P2  663
         JDC    00,0,ACE6            P2  664
         FIL                         P2  665
         JDC    00,0,ACE8            P2  666
ACE7     JPM    02,0,ACE8            P2  667
         JSB    03,0,LOOKM           P2  668
         FIL                         P2  669
         JDC    00,0,ACE8            P2  670
         FIL                         P2  671
ACE8     JSB    03,0,MOUT            P2  672
         FIL                         P2  673
         JSB    03,0,OUT2            P2  674
         FIL                         P2  675
         JDC    00,0,ENDACE          P2  676
READ1    JSB    03,0,INPUT           P2  677
         FIL                         P2  678
         ANM    05,2,8176            P2  679
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         ADM    05,,                                                    P2   681
         ANM    4,2,8176            OCT17760                            P2   682
         CRM    04,2,4                                                  P2   683
         ANM    04,3,4                                                  P2   684
         CAM    15,,                                                    P2   685
         JUM    15,0,CLOSBR                                             P2   686
         JDC    00,0,LEVEL                                              P2   687
NAME     ATN    04,,                                                    P2   688
         LFR    04,,                                                    P2   689
         CAD    F6                                                      P2   690
         LFR    6,RELOC                                                 P2   691
         ANN    2,384                                                   P2   692
         EOM    9                                                       P2   693
         SFR    6,RELOC          SET RELOCATE BIT FOR THIS ADDRESS CONSTRP2   694
         NOM    9,M2                                                    P2   695
         ANM    9,384            CHECK FOR DOUBLE RELOCATION            P2   696
         JUM    9,NAM1           O.K.                                   P2   697
         SFR    4,SBR1                                                  P2   698
         CAM    1,1040           ERROR TYPE 16                          P2   699
         CALL   SBERR                                                   P2   700
         LFR    4,SBR1                                                  P2   701
NAM1     SAM    F6                                                      P2   702
         CRM    02,2,2                                                  P2   703
         ANM    02,3,7                                                  P2   704
         CSM    00,,                                                    P2   705
         JZM    00,0,SYMBOL                                             P2   706
         CJZ    00,0,REGIST                                             P2   707
         CJZ    00,0,MODIF                                              P2   708
         CJZ    00,0,LABEL                                              P2   709
         JDC    00,0,EQUSYM                                             P2   710
SYMBOL   ANM    05,3,48                                                 P2   711
         CAM    15,2,-32                                                P2   712
         JUM    15,0,INTEG                                              P2   713
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        ANM    02,3,24                                      P2  714
        CAM    15,2,-24                                     P2  715
        JUM    15,0,UNKNWN                                  P2  716
        ATN    03,,                                         P2  717
        CAM    04,,                                         P2  718
        JDC    00,0,INTEG                                   P2  719
MODIF   ANM    05,3,48                                      P2  720
        CAM    15,2,-32                                     P2  721
        JZM    15,0,MODIFE                                  P2  722
        ATN    03,,                                         P2  723
        CAM    13,,                                         P2  724
        CAM    12,2,1                                       P2  725
        JDC    00,0,PUTF7                                   P2  726
OPENBR  ADM    06,2,4                                       P2  727
        ANM    04,3,15                                      P2  728
        ADM    05,2,-1                                      P2  729
        CAM    10,,                                         P2  730
        ATN    11,1,                                        P2  731
        SFR    06,,                                         P2  732
        JDC    00,0,TESTO                                   P2  733
D5      CAM    15,2,-4                                      P2  734
        JSB    03,0,PST1                                    P2  735
        FIL                                                 P2  736
CLOSBR  ANM    14,3,8190           OCT17776                 P2  737
        CAM    15,,                                         P2  738
        SFN    06,,                                         P2  739
        ADM    15,,                                         P2  740
        JPM    15,0,D5                                      P2  741
        SBM    06,2,4                                       P2  742
        JZM    10,0,D6                                      P2  743
PTT1    ATN    08,2,-1                                      P2  744
        LFR    04,,                                         P2  745
        JNM    12,0,PTT7                                    P2  746
        JNM    14,0,PTT4                                    P2  747
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         JNM     00,0,PTT3                                   P2   748
PTT4     JSB     03,0,LSTORE                                 P2   749
         FIL                                                 P2   750
         ATN     13,,                                        P2   751
         CAM     01,,                                        P2   752
         CAM     13,,                                        P2   753
         JZM     12,0,PTT2                                   P2   754
         ATN     01,,                                        P2   755
         CAM     09,,                                        P2   756
         ADM     10,2,1                                      P2   757
         ATN     11,1,                                       P2   758
         SFR     06,,                                        P2   759
         CAM     01,,                                        P2   760
PTT2     JSB     03,0,MOUT                                   P2   761
         FIL                                                 P2   762
         CAM     12,2,4096                                   P2   763
         JSB     03,0,OUT2                                   P2   764
         FIL                                                 P2   765
D6       SBM     11,2,2                                      P2   766
         ATN     11,1,                                       P2   767
         LDM     10,0,0                                      P2   768
         ANM     05,3,8                                      P2   769
         CAM     15,,                                        P2   770
         JZM     15,0,READ1                                  P2   771
         JDC     00,0,FAKE                                   P2   772
PTT3     SFN     06,2,2                                      P2   773
         ATN     14,,                                        P2   774
         CAM     03,,                                        P2   775
         JNM     03,0,PTT4                                   P2   776
         JZM     12,0,PTT5                                   P2   777
         ATN     13,,                                        P2   778
         CAM     09,,                                        P2   779
         ADM     10,2,1                                      P2   780
         ATN     11,1,                                       P2   781
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        SFR     06,,                                P2  782
        CAM     13,,                                P2  783
PTT5    JSB     03,0,MOUT                           P2  784
        FIL                                         P2  785
PTT6    JSB     03,0,OUT2                           P2  786
        FIL                                         P2  787
        SBM     08,2,1                              P2  788
        ATN     08,,                                P2  789
        LFR     07,,                                P2  790
        JDC     00,0,D6                             P2  791
TABLE1  JSB     03,0,PST1                           P2  792
        FIL                                         P2  793
        JNM     06,0,PDEMP                          P2  794
        JDC     00,0,LEVEL                          P2  795
PST1    SFR     04,2,COMMON+1                       P2  796
        SBM     08,2,1                              P2  797
        ATN     08,,                                P2  798
        LFR     04,,                                P2  799
        CRM     14,2,2                              P2  800
        JZM     00,0,PST32                          P2  801
        JNM     00,0,PST17                          P2  802
        JNM     12,0,PST9                           P2  803
        JNM     14,0,PST3                           P2  804
        CRM     14,2,12                             P2  805
        JUM     12,0,PST2                           P2  806
EXIT1   ATN     01,,                                P2  807
        CAM     09,,                                P2  808
EXIT9   ADM     10,2,1                              P2  809
        ATN     11,1,                               P2  810
        SFR     06,,                                P2  811
EXIT2   ATN     02,,                                P2  812
        CAM     14,,                                P2  813
EXIT7   LDM     03,2,COMMON+1                       P2  814
        JLH     03,,                                P2  815
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PST2    ANM     14,3,4096                                P2  816
        EOM     13,,                                     P2  817
        JDC     00,0,EXIT1                               P2  818
PST3    JSB     03,0,LSTORE                              P2  819
        FIL                                              P2  820
PST4    JSB     03,0,OUT1                                P2  821
        FIL                                              P2  822
PST5    JSB     03,0,OUT2                                P2  823
        FIL                                              P2  824
        JZM     12,0,PST7                                P2  825
PST6    JSB     03,0,OUT1                                P2  826
        FIL                                              P2  827
PST7    CRM     14,2,12                                  P2  828
PST8    JSB     03,0,OUT2                                P2  829
        FIL                                              P2  830
EXIT3   CAM     13,,                                     P2  831
        CAM     12,2,4096                                P2  832
        JDC     00,0,EXIT2                               P2  833
PST9    JPM     14,0,PST13                               P2  834
PST10   JSB     03,0,OUT1                                P2  835
        FIL                                              P2  836
PST12   JSB     03,0,OUT2                                P2  837
        FIL                                              P2  838
        JDC     00,0,EXIT2                               P2  839
PST13   JUM     15,0,PST14                               P2  840
EXIT4   CRM     14,2,12                                  P2  841
        ANM     14,3,4096                                P2  842
        CAM     13,,                                     P2  843
        JDC     00,0,EXIT1                               P2  844
PST14   ANM     14,3,2047                                P2  845
        CAM     03,,                                     P2  846
        CRM     14,2,12                                  P2  847
        ANM     14,3,4096                                P2  848
        EOM     13,,                                     P2  849
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        JZM    03,0,PST16                                  P2   850
        ATN    01,,                                        P2   851
        CAM    09,,                                        P2   852
        ADM    10,2,1                                      P2   853
        ATN    11,1,                                       P2   854
        SFR    06,,                                        P2   855
EXIT10  JSB    03,0,MOUT                                   P2   856
        FIL                                                P2   857
PST15   JSB    03,0,OUT2                                   P2   858
        FIL                                                P2   859
        JDC    00,0,EXIT2                                  P2   860
PST16   ATN    00,,                                        P2   861
        CAM    12,,                                        P2   862
        ATN    13,,                                        P2   863
        CAM    07,,                                        P2   864
        ATN    01,,                                        P2   865
        CAM    13,,                                        P2   866
EXIT8   JSB    03,0,OUT1                                   P2   867
        FIL                                                P2   868
        ATN    07,,                                        P2   869
        CAM    01,,                                        P2   870
        CAM    07,,                                        P2   871
        JDC    00,0,EXIT1                                  P2   872
PST17   JPM    12,0,PST19                                  P2   873
        SBM    07,2,1                                      P2   874
        JPM    14,0,PST18                                  P2   875
        ATN    01,,                                        P2   876
        EOM    13,,                                        P2   877
        JDC    00,0,EXIT5                                  P2   878
PST18   ANM    02,3,8190                                   P2   879
        CAM    15,,                                        P2   880
        ANM    14,3,8190                                   P2   881
        SBM    15,,                                        P2   882
        JUM    15,0,PSTX1                                  P2   883
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         ANM    02,3,1                                          P2   884
         CAM    15,,                                            P2   885
         CRM    15,3,1                                          P2   886
         EOM    13,,                                            P2   887
PSTX1    CRM    14,2,12                                         P2   888
         ANM    14,3,4096                                       P2   889
         EOM    13,,                                            P2   890
         JDC    00,0,EXIT5                                      P2   891
PST19    JPM    14,0,PST22                                      P2   892
         JZM    12,0,PST20                                      P2   893
         ATN    13,,                                            P2   894
         CAM    09,,                                            P2   895
         ADM    10,2,1                                          P2   896
         ATN    11,1,                                           P2   897
         SFR    06,,                                            P2   898
         CAM    13,,                                            P2   899
PST20    JSB    03,0,MOUT                                       P2   900
         FIL                                                    P2   901
         CRM    14,2,12                                         P2   902
         ATN    01,,                                            P2   903
         CAM    09,,                                            P2   904
PST21    CAM    12,2,4096                                       P2   905
         ATN    09,,                                            P2   906
         CAM    13,,                                            P2   907
         JSB    03,0,OUT2                                       P2   908
         FIL                                                    P2   909
         JDC    00,0,EXIT2                                      P2   910
PST22    JZM    12,0,PST23                                      P2   911
         CRM    14,2,12                                         P2   912
         ANM    14,3,4096                                       P2   913
         EOM    13,1,                                           P2   914
         CAM    09,,                                            P2   915
         ATN    01,,                                            P2   916
         CAM    13,,                                            P2   917
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         CAM    12,2,4096
         JDC    00,0,EXIT9
PST23    CRM    14,2,11
         ANM    14,3,8188
         SBM    02,,
         ANM    02,2,8190
         JUM    02,0,PST25
PST24    ATN    08,,
         LFR    07,,
         JDC    00,0,EXIT7
PST25    ATN    08,,
         LFR    04,,
         CRM    14,2,1
PST26    ATN    01,,
         CAM    13,,
         CAM    00,,
         CAM    12,2,4096
         CRM    14,2,12
         ANM    14,2,8190
         ATN    08,1,
         SFR    04,,
         JDC    00,0,EXIT7
PST32    JZM    12,0,PST35
         JNM    12,0,PST34
         JPM    14,0,PST33
         JSB    03,0,LSTORE
         FIL
         JDC    00,0,PST5
PST33    CRM    14,2,12
         ANM    14,3,4096
         EOM    13,,
         ATN    13,,
         CAM    09,,
EXIT12   ATN    01,,
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          CAM     13,,                P2  952
          ATN     00,,                P2  953
          CAM     12,,                P2  954
          JDC     00,0,EXIT9          P2  955
PST34     JNM     14,0,PST11          P2  956
          CRM     14,2,11             P2  957
          JZM     15,0,SPEXIT         P2  958
          ANM     14,3,8188           P2  959
          CAM     03,,                P2  960
          CRM     14,2,1              P2  961
          ANM     14,3,4096           P2  962
          EOM     13,,                P2  963
          JZM     03,0,PST16          P2  964
          JDC     00,0,EXIT10         P2  965
PST35     JNM     14,0,PST37          P2  966
          CRM     14,2,12             P2  967
          JPM     14,0,PST36          P2  968
          SFN     13,,                P2  969
          CAM     13,,                P2  970
PST36     ATN     01,,                P2  971
          ADM     13,,                P2  972
          JDC     00,0,EXIT2          P2  973
PST37     CRM     14,2,12             P2  974
          ATN     01,,                P2  975
          CAD     09,3,0              P2  976
          JNM     14,0,PST38          P2  977
          ATN     13,,                P2  978
          MPY     09,3,0              P2  979
PST39     SIA     00,,                P2  980
          ATN     00,,                P2  981
          CAM     13,,                P2  982
          JDC     00,0,EXIT2          P2  983
PST38     ATN     13,,                P2  984
          DIV     09,3,0              P2  985
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       JDC    00,0,PST39          P2  986
LOOKM  SFN    10,,                P2  987
       CAM    09,,                P2  988
       JZM    09,0,MLOOK5         P2  989
MLOOK1 SBM    11,2,1              P2  990
       ATN    11,,                P2  991
       LFR    05,,                P2  992
       JPM    05,0,MLOOK2         P2  993
       CJU    09,0,MLOOK1         P2  994
       ATN    10,,                P2  995
       ADM    11,,                P2  996
MLOOK5 JLH    03,2,1              P2  997
MLOOK2 ATN    05,,                P2  998
       CAM    02,,                P2  999
       ATN    09,,                P2 1000
       SFN    10,2,1              P2 1001
       CAM    09,,                P2 1002
       JDC    00,0,MLOOK3         P2 1003
MLOOK4 ATN    11,2,1              P2 1004
       LFR    05,,                P2 1005
       ATN    11,1,               P2 1006
       SFR    05,,                P2 1007
MLOOK3 CJU    09,0,MLOOK4         P2 1008
       SBM    10,2,1              P2 1009
       JLH    03,,                P2 1010
PSEUDO LFR    7,LOCAT             P2 1011
       CALL   INPUT               P2 1012
       ANN    4,7936              P2 1013
       CAM    3                   P2 1014
       CRN    3,8                 P2 1015
       CSM    3                   P2 1016
       CAM    1,M3+1              P2 1017
       JZM    3,FIL2              P2 1018
       CJZ    3,FIL2              P2 1019
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        CAM    1,M3+2                                                 P2 1020
        CJZ    3,BSS2                                                 P2 1021
        CJZ    3,BSS2                                                 P2 1022
        CJZ    3,ORG2                                                 P2 1023
        CJZ    3,COMMN2                                               P2 1024
        CJZ    3,GO2                                                  P2 1025
        CJZ    3,ERASE                                                P2 1026
        CJZ    3,ASS2                                                 P2 1027
        CJZ    3,CALL2                                                P2 1028
        CJZ    3,DECQ2                                                P2 1029
        CJZ    3,IOP2                                                 P2 1030
        CJZ    3,OCTQ2                                                P2 1031
        ADM    3,1                                                    P2 1032
        CJZ    3,CHR2                                                 P2 1033
        CJZ    3,DEC2                                                 P2 1034
        JDC    0,,WRONG                                               P2 1035
FILL    ADM    14,2,3                                                 P2 1036
        CRM    14,2,2                                                 P2 1037
        ANM    14,3,1                                                 P2 1038
        ADM    15,,                                                   P2 1039
        CAM    14,,                                                   P2 1040
        JLH    03,,                                                   P2 1041
NAMEL   LFR    6,M6              TBLE LOOK UP                         P2 1042
        ANM    10,3,96              OCT140                            P2 1043
        CAM    07,,                                                   P2 1044
        JUM    7,SECTM           DOUBLY DEFINED NAME                  P2 1045
        CAM    11,M15            SET WORD LOCATION                    P2 1046
        ADM    10,M14+224        SET WORD QUARTER PLUS RELOC. AND DEFINEDP2 1047
        ATN    12,,                                                   P2 1048
        CAM    08,,                                                   P2 1049
        JZM    13,NAMEL1         ABSOLUTE LOCATION COUNTER            P2 1050
        ANM    10,2,8127            OCT17677                          P2 1051
        ATN    13,,                                                   P2 1052
        CAM    09,,                                                   P2 1053
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        CAM    13,M6              CHAINED NAME                 P2 1054
NAMEL1  ATN    06,,                                            P2 1055
        SFR    06,,                                            P2 1056
        JLH    03,,                                            P2 1057
FIL2    ANM    04,3,3                                          P2 1058
        SBM    14,2,1                                          P2 1059
        JNM    14,0,FIL21                                      P2 1060
        ADM    15,2,1                                          P2 1061
FIL21   ANM    04,3,3                                          P2 1062
        CAM    14,,                                            P2 1063
        JUM    01,0,FIL22                                      P2 1064
        JUM    13,ELDR            RELATIVE LOCATION COUNTER    P2 1065
        CRM    04,2,2                                          P2 1066
        ATN    15,,                                            P2 1067
        EOM    04,,                                            P2 1068
        ANM    04,3,1                                          P2 1069
        ADM    15,,                                            P2 1070
FIL22   JPM    05,0,FIL23                                      P2 1071
        JSB    03,0,NAMEL                                      P2 1072
        FIL                                                    P2 1073
FIL23   SFR    07,2,LOCAT                                      P2 1074
        JDC    00,0,READRF                                     P2 1075
BSS2    JSB    03,0,FILL                                       P2 1076
        FIL                                                    P2 1077
        JPM    05,0,BSS21                                      P2 1078
        JZM    01,0,BSS21                                      P2 1079
        JSB    03,0,NAMEL                                      P2 1080
        FIL                                                    P2 1081
BSS21   SFR    07,2,LOCAT                                      P2 1082
        CAM    02,2,BSSE                                       P2 1083
        JSB    03,0,SBCOMP                                     P2 1084
        FIL                                                    P2 1085
        ATN    13,,                                            P2 1086
        CAM    00,,                                            P2 1087
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         LFR     07,2,LOCAT                                             P2 1088
         ATN     00,,                                                   P2 1089
         ADM     15,,                                                   P2 1090
BSSE20   JPM     05,0,BSS22                                             P2 1091
         JUM     01,0,BSS22                                             P2 1092
         JSB     03,0,NAMEL                                             P2 1093
         FIL                                                            P2 1094
BSS22    SFR     07,2,LOCAT                                             P2 1095
         LFR     6,RELOC                                                P2 1096
         JZM     9,READRF           NO RELOCATION  O.K.                 P2 1097
         CAM     1,1041             ERROR TYPE 17                       P2 1098
         CALL    SBERR                                                  P2 1099
         TRA     READRF                                                 P2 1100
IOP2     JSB     03,0,FILL                                              P2 1101
         FIL                                                            P2 1102
DECQ2    JPM     05,0,DECQ21                                            P2 1103
         JSB     03,0,NAMEL                                             P2 1104
         FIL                                                            P2 1105
DECQ21   CRM     04,3,3                                                 P2 1106
         CAM     02,,                                                   P2 1107
         ANM     02,3,31                                                P2 1108
         CSM     02,,                                                   P2 1109
         SFN     02,,                                                   P2 1110
         ADM     14,,                                                   P2 1111
         CRM     14,2,2                                                 P2 1112
         ANM     14,3,2047                                              P2 1113
         ADM     15,,                                                   P2 1114
         CRM     14,2,11                                                P2 1115
         ANM     14,2,3                                                 P2 1116
         ANM     05,3,15                                                P2 1117
         CAM     06,2,-8                                                P2 1118
         JPM     6,DECQ23           LAST BYTE IS NEXT                   P2 1119
DECQ25   ANN     6,5                                                    P2 1120
         CAM     3                                                      P2 1121
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       JUM    3,DECQ24         OPERATION/PARENTESIS      P2 1122
       CALL   INPUT                                      P2 1123
       ANN    6,2                                        P2 1124
       CAM    3                                          P2 1125
       JZM    3,DECQ24         INTEGER                   P2 1126
       LFR    6,M4                                       P2 1127
       ANM    10,28                                      P2 1128
       JZM    10,DECQ24                                  P2 1129
       ADM    10,8179                                    P2 1130
       CAM    1,1+1024                                   P2 1131
       CJZ    10,DECQ29                                  P2 1132
       ADM    1,6                                        P2 1133
DECQ29 CALL   SBERR                                      P2 1134
DECQ24 CALL   INPUT                                      P2 1135
DECQ22 ANM    04,3,15                                    P2 1136
       CAM    06,2,-8                                    P2 1137
       JNM    06,0,DECQ25                                P2 1138
       ADM    6,-4                                       P2 1139
       JPM    6,,DEQ23A                                  P2 1140
DECQ23 CALL   INPUT                                      P2 1141
       ANN    6,2                                        P2 1142
       CAM    3                                          P2 1143
       JZM    3,DEQ23A         INTEGER                   P2 1144
       LFR    6,M4                                       P2 1145
       ANM    10,28                                      P2 1146
       JZM    10,DEQ23A                                  P2 1147
       ADM    10,8179                                    P2 1148
       CAM    1,1+1024                                   P2 1149
       CJZ    10,DECQ28        LABEL                     P2 1150
       ADM    1,6                                        P2 1151
DECQ28 CALL   SBERR                                      P2 1152
DEQ23A CJU    2,,DECQ24                                  P2 1153
       SFR    07,2,LOCAT                                 P2 1154
       JUM    01,0,READRF                                P2 1155
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         JSB   03,0,FILL                                                       P2 1156
         FIL                                                                   P2 1157
         SFR   07,2,LOCAT                                                      P2 1158
         JDC   00,0,READRF                                                     P2 1159
ASS2     JSB   03,0,FILL                                                       P2 1160
         FIL                                                                   P2 1161
         JPM   05,0,ASS21                                                      P2 1162
         JSB   03,0,NAMEL                                                      P2 1163
         FIL                                                                   P2 1164
ASS21    CRM   04,3,3                                                          P2 1165
         CAM   01,,                                                            P2 1166
         ANM   01,3,31                                                         P2 1167
         CSM   01,,                                                            P2 1168
         JZM   01,0,ASS23                                                      P2 1169
ASS22    JSB   03,0,INPUT                                                      P2 1170
         FIL                                                                   P2 1171
         ATN   04,,                                                            P2 1172
         CAM   06,,                                                            P2 1173
         JSB   03,0,NAMEL                                                      P2 1174
         FIL                                                                   P2 1175
         ADM   15,2,1                                                          P2 1176
         CJU   01,0,ASS22                                                      P2 1177
ASS23    SFR   07,2,LOCAT                                                      P2 1178
         JDC   00,0,READRF                                                     P2 1179
ORG2     JUM   13,CHAIN2           ORIGIN PSEUDO TRA IF RELATIVE LOCATION CP2 1180
ORGEF    CAM   02,2,ORGE                                                       P2 1181
         JSB   03,0,SBCOMP                                                     P2 1182
         FIL                                                                   P2 1183
         ATN   13,,                                                            P2 1184
         CAM   15,,                                                            P2 1185
         LDM   12,2,LOCAT                                                      P2 1186
         CAM   13,,                                                            P2 1187
         CAM   14,,                                                            P2 1188
         JDC   00,0,FIL22                                                      P2 1189
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OCTQ2  JPM    05,0,OCTQ21                                           P2 1190
       JSB    03,0,NAMEL                                            P2 1191
       FIL                                                          P2 1192
OCTQ21 CRM    04,2,3                                                P2 1193
       ANM    04,3,31                                               P2 1194
       ADM    14,,                                                  P2 1195
       CRM    14,2,2                                                P2 1196
       ANM    14,3,2047                                             P2 1197
       ADM    15,,                                                  P2 1198
       CRM    14,2,11                                               P2 1199
       ANM    14,2,3                                                P2 1200
       ANM    04,3,31                                               P2 1201
       CSM    05,,                                                  P2 1202
CHR31  JSB    03,0,INPUT                                            P2 1203
       FIL                                                          P2 1204
       CJU    05,0,CHR31                                            P2 1205
       SFR    07,2,LOCAT                                            P2 1206
       JDC    00,0,READRF                                           P2 1207
CHR2   JSB    03,0,FILL                                             P2 1208
       FIL                                                          P2 1209
       JDC    00,0,OCTQ2                                            P2 1210
SECTM  SFR    04,2,COMMON+2                                         P2 1211
       CAM    1,2,5129          OCT12009  NOTE                      P2 1212
       ATN    08,,                                                  P2 1213
       CAM    00,,                                                  P2 1214
       JSB    03,0,SBERR                                            P2 1215
       FIL                                                          P2 1216
       LFR    04,2,COMMON+2                                         P2 1217
       JLH    03,,                                                  P2 1218
SECTIM ATN    06,,                                                  P2 1219
       CAM    04,,                                                  P2 1220
       CAM    1,2,5129          OCT12009  NOTE                      P2 1221
       JSB    03,0,SBERR                                            P2 1222
       FIL                                                          P2 1223
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         JDC     00,0,P21                                               P2 1224
REGIST   CAM     1,2,5124           OCT12004                            P2 1225
         JSB     03,0,SBERR                                             P2 1226
         FIL                                                            P2 1227
         CAM     04,,                                                   P2 1228
         JDC     00,0,INTEG                                             P2 1229
FREG3    CAM     1,2,5124           OCT12004                            P2 1230
         JSB     03,0,SBERR                                             P2 1231
         FIL                                                            P2 1232
         JDC     00,0,TCHR8                                             P2 1233
EQSYM1   CAM     1,5128          OCT 12010                              P2 1234
         JSB     03,0,SBERR                                             P2 1235
         FIL                                                            P2 1236
         JDC     00,0,INTEG1                                            P2 1237
LABEL1   CAM     1,1025          LABEL INSTED OF SYMBOL                 P2 1238
         JSB     03,0,SBERR                                             P2 1239
         FIL                                                            P2 1240
         JDC     00,0,INTEG1                                            P2 1241
LABEL    CAM     1,1025          LABEL INSTED OF SYMBOL                 P2 1242
         JSB     03,0,SBERR                                             P2 1243
         FIL                                                            P2 1244
         LFR     4,M4                                                   P2 1245
         CRM     2,2                                                    P2 1246
         JDC     00,0,SYMBOL                                            P2 1247
MODIFE   CAM     1,5127                                                 P2 1248
         JSB     03,0,SBERR                                             P2 1249
         FIL                                                            P2 1250
         CAM     04,,                                                   P2 1251
         JDC     00,0,INTEG                                             P2 1252
EQUSYM   CAM     1,2,5128           OCT12010                            P2 1253
         JSB     03,0,SBERR                                             P2 1254
         FIL                                                            P2 1255
         CAM     04,,                                                   P2 1256
         JDC     00,0,INTEG                                             P2 1257
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UNKNWN LFR    04,2,COMMON-1                                          P2 1258
       JLH    02,,                                                   P2 1259
CHAIN2 ATN    13,,                                                   P2 1260
       CAM    00,,                                                   P2 1261
       SFR    04,2,OUTLST                                            P2 1262
       JSB    03,0,EQUTT                                             P2 1263
       FIL                                                           P2 1264
       JDC    00,0,ORGEF                                             P2 1265
       FIL                                                           P2 1266
BSSE   SFR    07,2,COMMON+2                                          P2 1267
       LFR    07,2,LOCAT                                             P2 1268
ORGE1  ATN    13,,                                                   P2 1269
       CAM    00,,                                                   P2 1270
       ATN    06,,                                                   P2 1271
       CAM    02,,                                                   P2 1272
       LDM    06,2,COMMON-2                                          P2 1273
       SFR    05,2,COMMON-4                                          P2 1274
       CAM    06,2,OUTLST+4                                          P2 1275
       LDM    13,0,OUTLST                                            P2 1276
       JZM    0,BSSE1             ABSO9LUTE LOCATION COUNTER         P2 1277
       SFR    04,2,OUTLST                                            P2 1278
       JSB    03,0,EQUTT                                             P2 1279
       FIL                                                           P2 1280
       ATN    13,,                                                   P2 1281
       CAM    00,,                                                   P2 1282
       SFR    04,2,OUTLST+5                                          P2 1283
       CAM    00,2,2                                                 P2 1284
       SFR    04,2,OUTLST+4                                          P2 1285
       ADM    06,2,2                                                 P2 1286
BSSE1  LDM    13,2,OUTLST                                            P2 1287
       CAM    0,2,4128              OCT10040                         P2 1288
       SFR    04,2,OUTLST-1                                          P2 1289
       ATN    15,,                                                   P2 1290
       CAM    00,,                                                   P2 1291
```

```
         SFR     04,2,OUTLST+3                        P2 1292
         CAM     15,,                                 P2 1293
         SFR     07,2,LOCAT                           P2 1294
         CAM     00,,                                 P2 1295
         ATN     06,1,                                P2 1296
         SFR     04,,                                 P2 1297
         LFR     07,2,COMMON+2                        P2 1298
         CAM     07,,                                 P2 1299
         JNM     14,0,BSSE2                           P2 1300
         ATN     08,,                                 P2 1301
         SFR     07,,                                 P2 1302
         SFN     08,,                                 P2 1303
         CAM     09,2,PUDO                            P2 1304
         CAM     08,2,PUDO                            P2 1305
BSSE7    ATN     08,1,                                P2 1306
         LFR     07,,                                 P2 1307
         ATN     08,,                                 P2 1308
         LDM     14,2,0                               P2 1309
         ANM     14,3,4092                            P2 1310
         SBM     07,,                                 P2 1311
         JPM     07,0,BSSE3                           P2 1312
BSSE4    ATN     06,,                                 P2 1313
         LDM     00,2,-1                              P2 1314
         ADM     00,2,1                               P2 1315
         ATN     06,,                                 P2 1316
         SFR     00,2,-1                              P2 1317
         CAM     00,,                                 P2 1318
         ATN     06,1,                                P2 1319
         SFR     04,,                                 P2 1320
         ADM     07,2,4                               P2 1321
         JNM     07,0,BSSE4                           P2 1322
BSSE3    ATN     13,,                                 P2 1323
         CAM     00,,                                 P2 1324
         ATN     06,1,                                P2 1325
```

```
        SFR    04,,                                    P2 1326
        JZM    07,0,BSSE5                              P2 1327
        CAM    0,2,68              OCT104              P2 1328
BSSE6   ATN    06,1,                                   P2 1329
        SFR    04,,                                    P2 1330
        SBM    07,2,4                                  P2 1331
        JUM    07,0,BSSE6                              P2 1332
BSSE5   ANM    14,3,3                                  P2 1333
        CAM    00,,                                    P2 1334
        CRM    00,2,9                                  P2 1335
        ATN    06,1,                                   P2 1336
        SFR    04,,                                    P2 1337
        ANM    14,3,4092                               P2 1338
        CAM    07,,                                    P2 1339
        CJU    09,0,BSSE7                              P2 1340
BSSE2   ATN    02,,                                    P2 1341
        SBM    07,,                                    P2 1342
        JPM    07,0,BSSE22                             P2 1343
BSSE21  ATN    06,,                                    P2 1344
        LDM    00,2,-1                                 P2 1345
        ADM    00,2,1                                  P2 1346
        ATN    06,,                                    P2 1347
        SFR    04,2,-1                                 P2 1348
        CAM    00,,                                    P2 1349
        ATN    06,1,                                   P2 1350
        SFR    04,,                                    P2 1351
        ADM    07,2,4                                  P2 1352
        JNM    07,0,BSSE21                             P2 1353
BSSE22  ATN    06,,                                    P2 1354
        LDM    00,2,-1                                 P2 1355
        ADM    00,2,2                                  P2 1356
        ANM    05,3,8                                  P2 1357
        ADM    00,,                                    P2 1358
        ATN    06,,                                    P2 1359
```

```
        SFR     04,2,-1                                 P2 1360
        ATN     06,1,                                   P2 1361
        SFR     05,,                                    P2 1362
        ANM     05,3,15                                 P2 1363
        CAM     07,2,-8                                 P2 1364
        JPM     07,0,BSSE13                             P2 1365
        ANM     07,2,5                                  P2 1366
        JDC     00,0,BSSE16                             P2 1367
BSSE15  ANM     07,2,5                                  P2 1368
        JSB     03,0,INPUT                              P2 1369
        FIL                                             P2 1370
        ATN     06,1,                                   P2 1371
        SFR     05,,                                    P2 1372
BSSE16  JUM     07,0,BSSE12                             P2 1373
        JSB     03,0,INPUT                              P2 1374
        FIL                                             P2 1375
        ATN     06,1,                                   P2 1376
        SFR     05,,                                    P2 1377
BSSE12  ANM     04,3,15                                 P2 1378
        CAM     07,2,-8                                 P2 1379
        JNM     07,0,BSSE15                             P2 1380
        JSB     03,0,INPUT                              P2 1381
        FIL                                             P2 1382
        ATN     06,1,                                   P2 1383
        SFR     05,,                                    P2 1384
BSSE13  SBM     06,2,OUTLST-899                         P2 1385
        JZM     3,FIL2                                  P2 1386
        CRM     06,3,10                                 P2 1387
        CAM     00,,                                    P2 1388
        SFR     04,2,OUTLST+2                           P2 1389
        LFR     07,2,LOCAT                              P2 1390
        LFR     05,2,COMMON-4                           P2 1391
        JDC     00,0,BSSE20                             P2 1392
        FIL                                             P2 1393
```

```
ORGE    SFR   07,2,COMMON+2                              P2 1394
        LFR   07,2,LOCAT                                 P2 1395
        CAM   01,,                                       P2 1396
        CAM   13,,                                       P2 1397
        CAM   15,,                                       P2 1398
        CAM   14,,                                       P2 1399
        JDC   00,0,ORGE1                                 P2 1400
FLDR    ANM   04,3,4                                     P2 1401
        CAM   00,,                                       P2 1402
        ATN   13,,                                       P2 1403
        CAM   04,,                                       P2 1404
        LDM   13,2,OUTLST                                P2 1405
        SFR   05,2,OUTLST                                P2 1406
        JSB   03,0,EQUTT                                 P2 1407
        FIL                                              P2 1408
        CAM   4,2,4130             OCT10042              P2 1409
        SFR   05,2,OUTLST-1                              P2 1410
        CRM   00,2,4                                     P2 1411
        EOM   0,2,3096                                   P2 1412
        SFR   04,2,OUTLST+2                              P2 1413
        ATN   13,,                                       P2 1414
        CAM   04,,                                       P2 1415
        SFR   05,2,OUTLST+3                              P2 1416
        CAM   04,2,8                                     P2 1417
        SFR   05,2,OUTLST+4                              P2 1418
        ATN   15,,                                       P2 1419
        CAM   04,,                                       P2 1420
        SFR   05,2,OUTLST+5                              P2 1421
        LDM   13,2,OUTLST                                P2 1422
        CAM   15,,                                       P2 1423
        JDC   00,0,FIL22                                 P2 1424
EQUTT   SFR   07,2,COMMON-1                              P2 1425
        SFR   06,2,COMMON-2                              P2 1426
        SFR   05,2,COMMON-3                              P2 1427
```

```
         LFR    07,2,MAKEUP                                      P2 1428
         LDM    04,2,OUTLST+2                                    P2 1429
         CRM    04,2,3                                           P2 1430
         ANM    04,3,31                                          P2 1431
         CSM    07,2,4                                           P2 1432
         CAM    05,2,OUTLST-1                                    P2 1433
         LFR    06,2,MAKEWD                                      P2 1434
EQUTT3   ATN    09,,                                             P2 1435
         CAM    08,,                                             P2 1436
         ATN    10,,                                             P2 1437
         CAM    09,,                                             P2 1438
         ATN    11,,                                             P2 1439
         CAM    10,,                                             P2 1440
         ATN    05,1,                                            P2 1441
         LDM    04,2,0                                           P2 1442
         ATN    04,,                                             P2 1443
         CAM    11,,                                             P2 1444
         CJZ    14,0,EQUTT1                                      P2 1445
EQUTT2   CJU    07,0,EQUTT3                                      P2 1446
         SFR    06,2,MAKEWD                                      P2 1447
         SBM    13,2,1                                           P2 1448
         SFR    07,2,OUTLST                                      P2 1449
         ATN    13,,                                             P2 1450
         CAM    12,2,-NMEND                                      P2 1451
         JNM    12,0,EQUENT                                      P2 1452
         SFR    07,2,MAKEUP                                      P2 1453
         LDM    12,2,LOCAT                                       P2 1454
         CAM    15,,                                             P2 1455
         CAM    14,2,64                                          P2 1456
         ATN    13,2,1                                           P2 1457
         SFR    07,,                                             P2 1458
         LFR    07,2,COMMON-1                                    P2 1459
         LFR    06,2,COMMON-2                                    P2 1460
         LFR    05,2,COMMON-3                                    P2 1461
```

```
        JLH     03,,                                                P2 1462
EQUTT1  ATN     15,1,                                               P2 1463
        SFR     06,,                                                P2 1464
        SFN     15,,                                                P2 1465
        CAM     12,2,EQUEDD                                         P2 1466
        JNM     12,0,EQUENT                                         P2 1467
        CAM     14,2,-4                                             P2 1468
        JDC     00,0,EQUTT2                                         P2 1469
GO2     JZM     13,ENDPS2           GO PSEUDO   TRA IF ABSOLUTE LOCATION COUP2 1470
        CAM     0,M13               OTHERWISEFINISH UP LAST EQU     P2 1471
        SFR     04,2,OUTLST                                         P2 1472
        JSB     03,0,EQUTT                                          P2 1473
        FIL                                                         P2 1474
ENDPS2  LFR     07,2,MAKEUP                                         P2 1475
        LFR     06,2,MAKEWD                                         P2 1476
ENDPS3  ATN     09,,                                                P2 1477
        CAM     08,,                                                P2 1478
        ATN     10,,                                                P2 1479
        CAM     09,,                                                P2 1480
        ATN     11,,                                                P2 1481
        CAM     10,,                                                P2 1482
        CAM     11,,                                                P2 1483
        CJU     14,0,ENDPS3                                         P2 1484
        ATN     15,,                                                P2 1485
        SFR     06,,                                                P2 1486
        JDC     00,0,DONPS2                                         P2 1487
        FIL                                                         P2 1488
MACROS  JPM     05,0,MAC1                                           P2 1489
        LFR     07,2,LOCAT                                          P2 1490
        JSB     03,0,NAMEL                                          P2 1491
        FIL                                                         P2 1492
        SFR     07,2,LOCAT                                          P2 1493
MAC1    ANM     5,2,960             OCT1700                         P2 1494
        CRM     05,3,6                                              P2 1495
```

```
         CSM    04,,                                                 P2 1496
         JZM    04,0,READRF                                          P2 1497
         CJZ    04,0,MAC21                                           P2 1498
         CJU    04,0,READRF                                          P2 1499
         JSB    03,0,INPUT                                           P2 1500
         FIL                                                         P2 1501
         LFR    07,2,LOCAT                                           P2 1502
         ATN    04,,                                                 P2 1503
         ADM    12,,                                                 P2 1504
         JDC    00,0,MAC22                                           P2 1505
CALL2    JPM    05,0,CALL21                                          P2 1506
         LFR    07,2,LOCAT                                           P2 1507
         JSB    03,0,NAMEL                                           P2 1508
         FIL                                                         P2 1509
         SFR    07,2,LOCAT                                           P2 1510
CALL21   JSB    03,0,OUT2                                            P2 1511
         FIL                                                         P2 1512
         LFR    7,LOCAT                                              P2 1513
         JSB    03,0,FILL                                            P2 1514
         FIL                                                         P2 1515
         JSB    03,0,INPUT                                           P2 1516
         FIL                                                         P2 1517
         TRA    BSS22                                                P2 1518
SBERR    SFR    07,2,SBERR1                                          P2 1519
         SFR    4,2,COMMON+4                                         P2 1520
         SFR    5,SBERR1+1                                           P2 1521
         LDM    00,2,LOCAT                                           P2 1522
         LFR    07,,                                                 P2 1523
         LFR    5,M15                LASTERROR                       P2 1524
         EOM    4,M0                                                 P2 1525
         JUM    4,SBERRS             DIFFERENT CARD                  P2 1526
         EOM    5,M1                                                 P2 1527
         JUM    5,SBERRS             NOT SAME ERROR                  P2 1528
         TRA    SBERRB                                               P2 1529
```

```
SBERRS SBM    15,255                                                   P2 1530
       JPM    15,ERRFUL                                                P2 1531
       ADM    15,2,256                                                 P2 1532
       ATN    15,,                                                     P2 1533
       SFR    04,,                                                     P2 1534
       SFR    07,,                                                     P2 1535
SBERRB LFR    7,SBERR1                                                 P2 1536
       LFR    5,SBERR1+1                                               P2 1537
       LFR    4,2,COMMON+4                                             P2 1538
       JLH    03,,                                                     P2 1539
DONPS2 CAM    02,2,EQUWRG                                              P2 1540
       LFR    7,LOCAT                                                  P2 1541
       CALL   FILL                                                     P2 1542
       SFR    7,SBR1+1          SAVE LOCATION COUNTER FOR PROGRAM LENGTHP2 1543
       JSB    03,0,FRANK                                               P2 1544
       FIL                                                             P2 1545
       LFR    6,SBR1+1                                                 P2 1546
       LFR    7,MAXTMP                                                 P2 1547
       JZM    9,FIXED           ABSOLUTE LOCATION COUNTER              P2 1548
FIXED  CAM    14,M11            SET TOP WORD ADDRESS IN MAXTMP         P2 1549
       LFR    6,ERCOM                                                  P2 1550
       CAM    10,M9-M15                                                P2 1551
       JNM    10,ERCOM1                                                P2 1552
       CAM    15,M9                                                    P2 1553
ERCOM1 CAM    13,M8             COMMON                                 P2 1554
       SFR    7,MAXTMP                                                 P2 1555
       LFR    07,2,ERRBUF                                              P2 1556
       SFN    15,,                                                     P2 1557
       CAM    14,2,1                                                   P2 1558
       JPM    14,0,SWAPR3                                              P2 1559
       CAM    15,2,1                                                   P2 1560
SWAPR2 ATN    14,,                                                     P2 1561
       CAM    13,,                                                     P2 1562
       ATN    15,2,1                                                   P2 1563
```

```
         CAM    12,,                                                P2 1564
         ATN    15,,                                                P2 1565
         LFR    06,,                                                P2 1566
SWAPR1   ATN    12,1,                                               P2 1567
         LFR    05,,                                                P2 1568
         SFN    08,,                                                P2 1569
         ATN    04,,                                                P2 1570
         CAM    02,,                                                P2 1571
         JPM    02,0,SWAPR4                                         P2 1572
         CAD    05,3,                                               P2 1573
         ATN    12,2,-1                                             P2 1574
         SFR    06,,                                                P2 1575
         SAM    06,3,                                               P2 1576
SWAPR4   CJU    13,0,SWAPR1                                         P2 1577
         ATN    15,1,                                               P2 1578
         SFR    06,,                                                P2 1579
         CJU    14,0,SWAPR2                                         P2 1580
SWAPR3   LFR    7,MAXTMP         PICK UP PROGRAM LENGTH             P2 1581
         CALL   SYSTEM                                              P2 1582
COMMN2   JPM    5,COMM21         NO OUTSIFE NAME                    P2 1583
         LFR    6,M6                                                P2 1584
         ANN    10,96                                               P2 1585
         CAM    7                                                   P2 1586
         JUM    7,SECTM          DOUBLY EEFINED                     P2 1587
         CAM    8,M12            CARD NUMBER                        P2 1588
         LFR    7,ERCOM                                             P2 1589
         CAM    11,M12                                              P2 1590
         ADM    10,352           COMMON RELOC AND DEFINED           P2 1591
         SFR    6,M6                                                P2 1592
COMM21   LFR    7,ERCOM                                             P2 1593
         CALL   INPUT                                               P2 1594
         ADM    12,M4                                               P2 1595
         SFR    7,ERCOM                                             P2 1596
         TRA    READRF                                              P2 1597
```

```
ERASE   JPM     5,ERASE1                                              P2 1598
        LFR     6,M6                                                  P2 1599
        ANN     10,96                                                 P2 1600
        CAM     7                                                     P2 1601
        JUM     7,SECTM             DOUBLY DEFINED                    P2 1602
        CAM     8,M12               CARD NUMBER                       P2 1603
        LFR     7,ERCOM                                               P2 1604
        CAM     11,M13                                                P2 1605
        ADM     10,480              ERASEABLE RELOC-DEFINED NAME      P2 1606
        SFR     6,M6                                                  P2 1607
ERASE1  LFR     7,ERCOM                                               P2 1608
        CALL    INPUT                                                 P2 1609
        ADM     13,M4                                                 P2 1610
        SFR     7,ERCOM                                               P2 1611
        TRA     READRF                                                P2 1612
ERCOM   BSS     1                                                     P2 1613
LOCAT   BSS     1                                                     P2 1614
ZERO    DECQ    0,0,0,0                                               P2 1615
CC2     DECQ    PUDO,,,MLIST                                          P2 1616
CC3     DECQ    ,,-4,0                                                P2 1617
        ASSIGN  MAXTMP,RELOC                                          P2 1618
SBR1    BSS     2                                                     P2 1619
SBERR1  BSS     2                                                     P2 1620
PARAM   DECQ    EQLIST,-4,256,4096                                    P2 1621
ENDACE  TRA     READRF                                                P2 1622
DEC2    TRA     CHR2                                                  P2 1623
PST11   TRA     PST12                                                 P2 1624
FRANK   TRA     SBSOLV                                                P2 1625
EXIT5   TRA     PST15                                                 P2 1626
PTT7    TRA     PTT2                                                  P2 1627
        DECQ    0,0,0,0                                               P2 1628
MLIST   BSS     20                                                    P2 1629
PUDO    BSS     20                                                    P2 1630
        BSS     5                                                     P2 1631
```

```
COMMON BSS     5                                                              P2 1632
       BSS     5                                                              P2 1633
       BSS     1                                                              P2 1634
OUTLST BSS     50                                                             P2 1635
ILBUF1 EQUS    512                                                            P2 1636
MAKEUP EQUS    256                                                            P2 1637
MAKEWD EQUS    511                                                            P2 1638
ERRBUF EQUS    0                                                              P2 1639
EQUEDD EQUS    510                                                            P2 1640
EQLIST EQUS    257                                                            P2 1641
NMEND  EQUS    3328                                                           P2 1642
       GO      768                                                            P2 1643
```

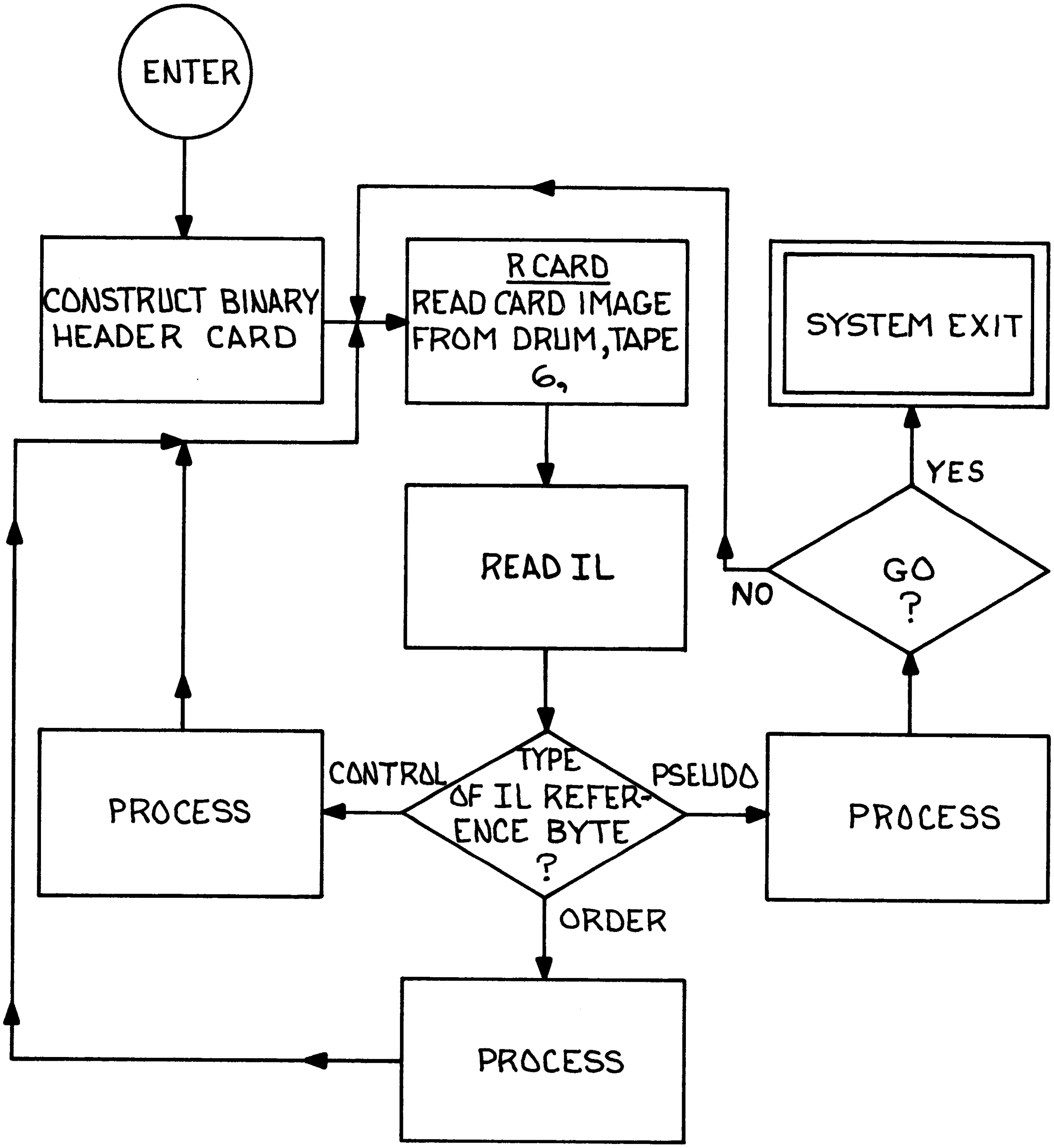
Programmed by:	J. Nievergelt T. Slivinski C. W. Gear
Description by:	T. Slivinski

3.3 NICAP Pass III

3.3.1 The Input to Pass III and Output from Pass III

The input to Pass III is contained on the drum, core memory and tape 6 from passes 1 and 2.

In the case of too many errors or machine malfunction, Pass III exits to SYSERR with M1 containing 514 and 513 respectively. Otherwise exit is to SYSTEM. Tape 7 has the binary card images, 12 cards per record copied after whatever was there before. The last block has a sign bit in word 240 of the block. Drum block 0 has the header card(s) (up to 12 in number allowed). Otherwise drum and core storage is unchanged in the meaningful areas. The listing and binary cards are sent out via SYSIØ.


ENTER
CONSTRUCT BINARY HEADER CARD
R CARD
READ CARD IMAGE FROM DRUM, TAPE 6,
SYSTEM EXIT
YES
GO ?
NO
READ IL
TYPE OF IL REFERENCE BYTE ?
CONTROL
PSEUDO
ORDER
PROCESS
PROCESS
PROCESS

3.3.2 Description

Pass III is primarily concerned with outputting the assembled source program in the form of a listing and a binary deck. If the control card $ PRINT OBJECT is present in the source deck, Pass III will cause a listing to be output. If the control card $ PUNCH OBJECT is included in the user's deck, Pass III will cause a binary deck, equivalent to the original program to be punched. In any case, Pass III will construct this binary deck and copy it onto Tape 7, to be used for future loading of the source program. Processing for orders and pseudo operations includes:

1) assembling the quarter words of machine code
2) detecting errors
3) printing out the assembled instruction
4) producing binary image of assembled instruction and putting them on tape 7.

The internal flow in Pass III can be summarized as follows: the BCD card image is read from Drum or Tape 6. It is then placed in the print buffer for future listing (if a listing is desired). At this time, the decimal card count is also inserted into the buffer, and, if an error has been identified on this card by either Passes I or II, an asterisk is inserted. Next the reference byte of the Intermediate Language Statement is read and tested. If it is a control "begin," a switch is set which inhibits the listing; if it is a control "end," the switch is reset. At this time further implementation has not begun of the MACRO commands which will use these options. If the reference byte is an order the next byte is read and the subtype extracted. The necessary addresses are calculated and machine code is generated in quarter words. As these are formed, they are output into the print buffer via subroutines and placed into binary cards. If during assembly, an error is detected, an asterisk is inserted into the print buffer. The initial quaeter word of each word output into the buffer causes the octal and decimal location to be generated. When either an IL statement (one card) has been completed, or the four quarter words of the buffer have been filled, the contents of the buffer are listed. When the card has been assembled, control again returns to RCARD and another card is read.

Pseudo commands are treated in the same way, with the exception of GØ. GØ causes the assembly to end, and the binary output to be completed and transferred to tape. Control then passes to a subroutine (SWAP) which reorders the error list and then transfers to SYSTEM.

3.3.3 Control Words Used in Pass III

CWPR

0		13		26		39	
α			Card count	β	Error count	γ	

α = 1, No listing

β = 1, MACRO (inhibit listing)

γ = 1, Print buffer not empty

CWDR

					Q-word-4		Word of location counter

BINCD1

α	β			Q word		Word		Card

α = 0, No punched binary deck ($ PUNCH OBJECT not present)

B = 0, No output of binary tape (program is not to be executed)

BINCD2

			Group of 3		Q word		Word

BINCD1 and BINCD2 control the assembling of binary card images in core. BINCD1 controls the last 56 columns while BINCD2 controls columns 11 to 24 where the relocate bits are stored.

RELOC

0		13		17	18		26		30	31		39	
				α^T	β^T				α	β			Location of binary card

α, β are relocation bits.

α^T, β^T are temporary bits of relocation.

RELOCT

RELOCT = RELOC except Q = LC - 20.

RDCON

	Wait bit		Location in buffer		Card buffer count		Drum (-) or tape (0)

Word used in SBRD to determine where card images will be put.

INSTOR

Word Location		Q W-4 Location		Location in 256 Block		Count

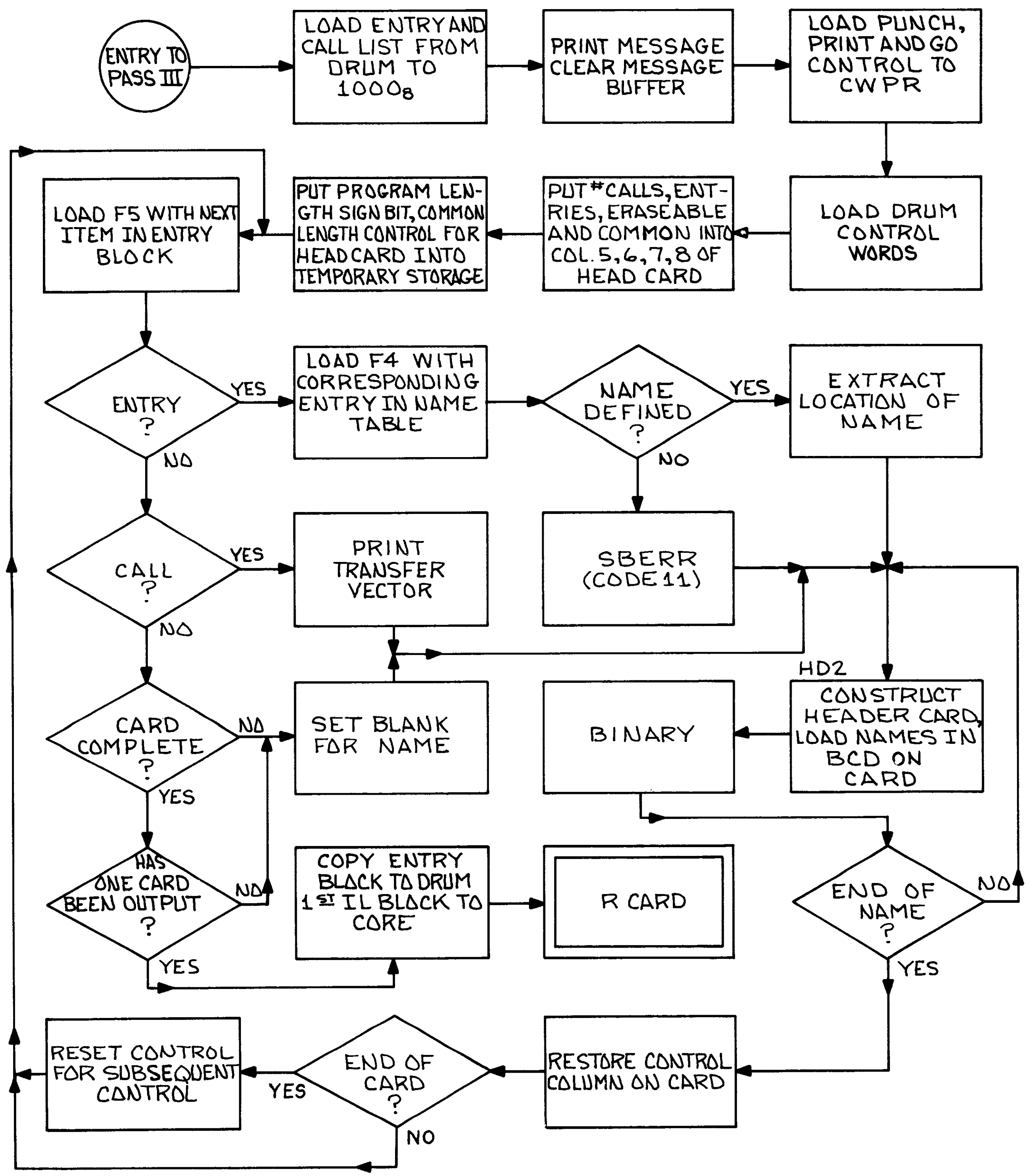
Word used in input to determine where next IL byte will be read from.

The FORMAT of the listing is as follows (132 characters per line):

Columns	1- 4	Decimal Card Number
Column	5	Error Indication
Columns	6- 8	Blank
Columns	9-12	Decimal Location
Column	13	Blank
Columns	14-19	Octal Location
Column	20	Dividor (*)
Column	21	Blank
Column	22-26	Octal Quarter Words
Columns	30-34	
Columns	38-42	
Columns	46-50	
Columns	53-132	Card Image

3.3.4 Initialization of Pass III

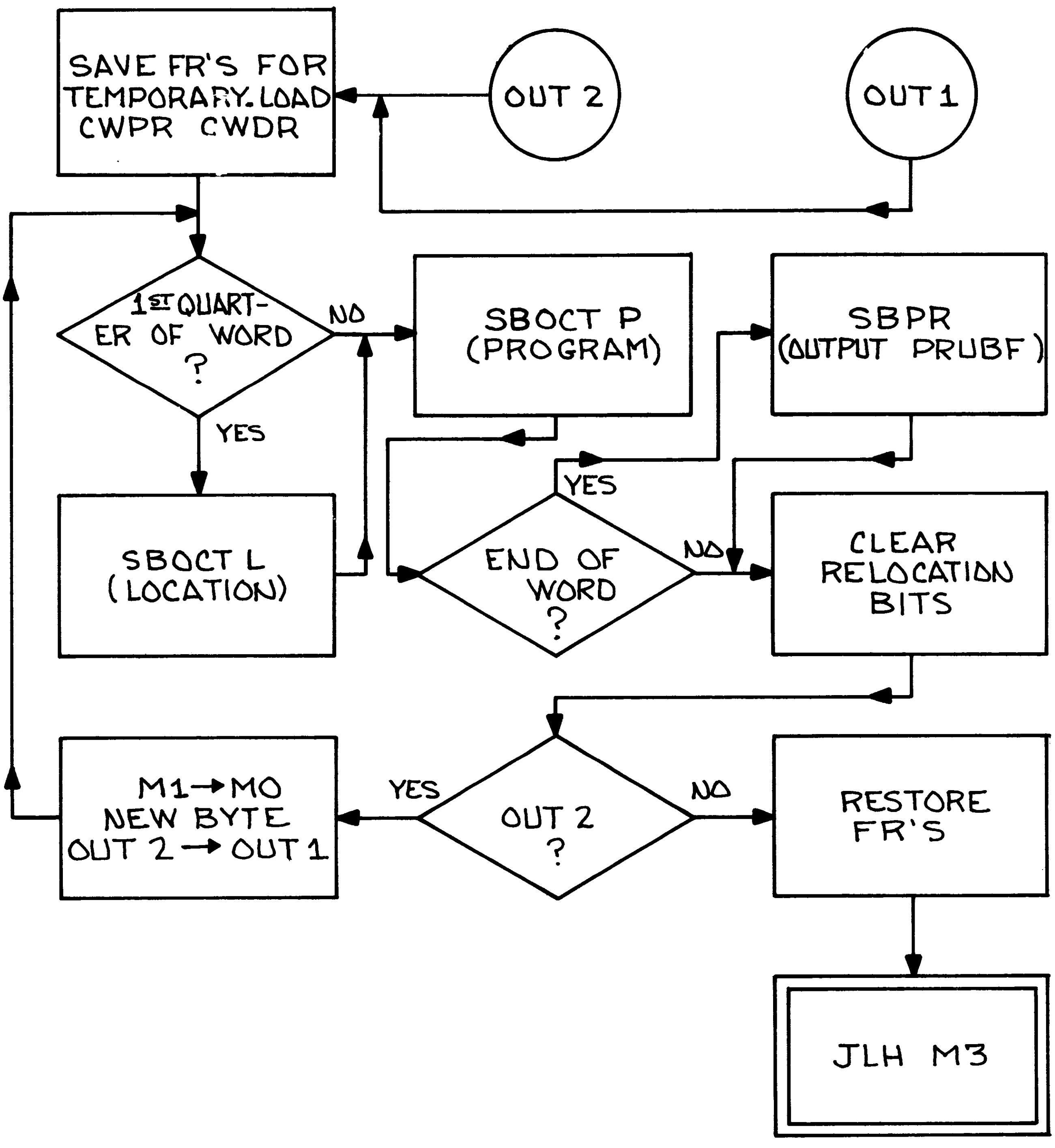
On initial entry to Pass III, it loads control words CWPR, CWDR, constructs header card and loads first IL block from drum to core.



3.3.5 Subroutines of Pass III

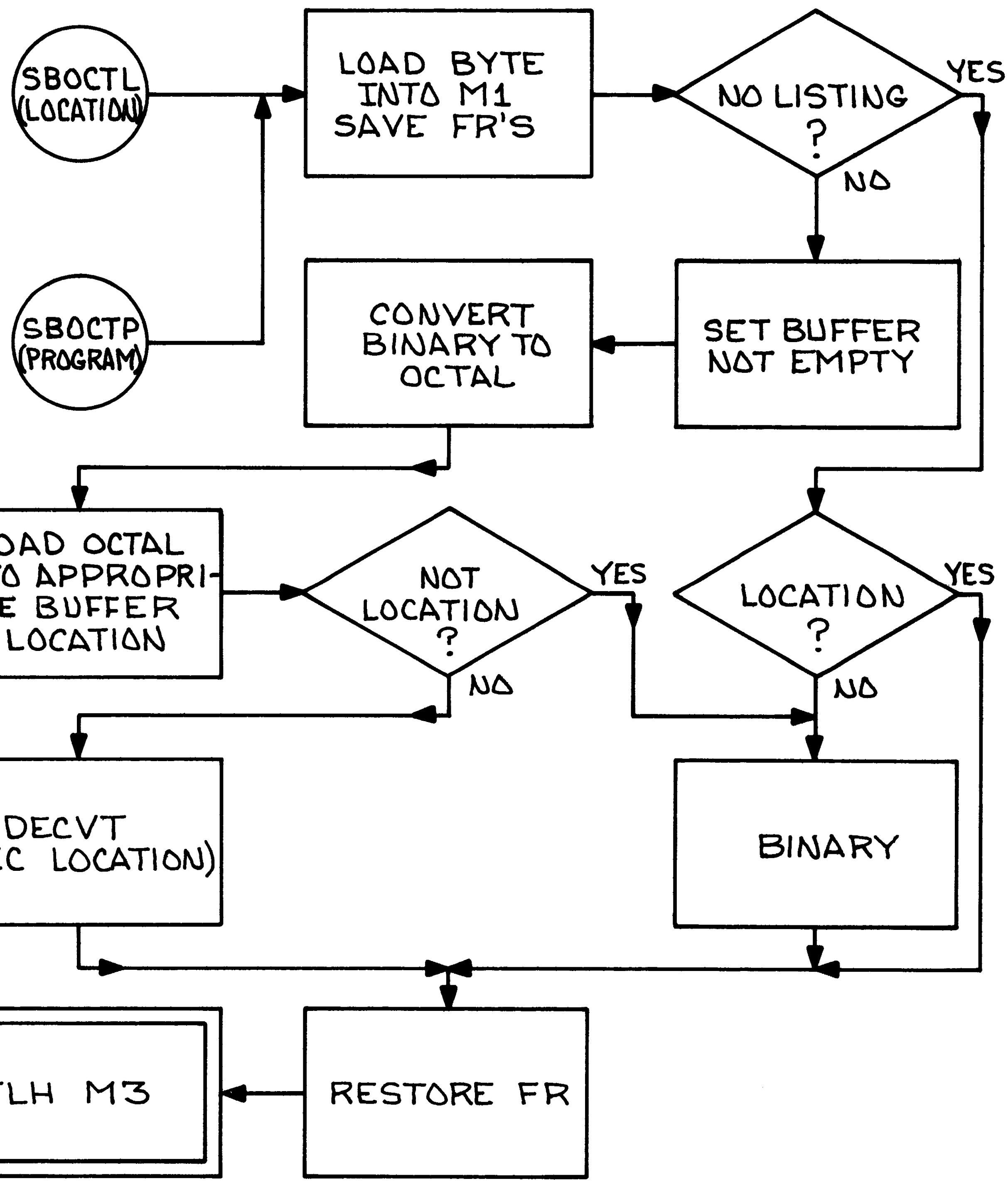
OUT1 and OUT 2

Output (1 or 2) bytes; link in M3 byte in M0; second in M1; print buffer if word is completed.



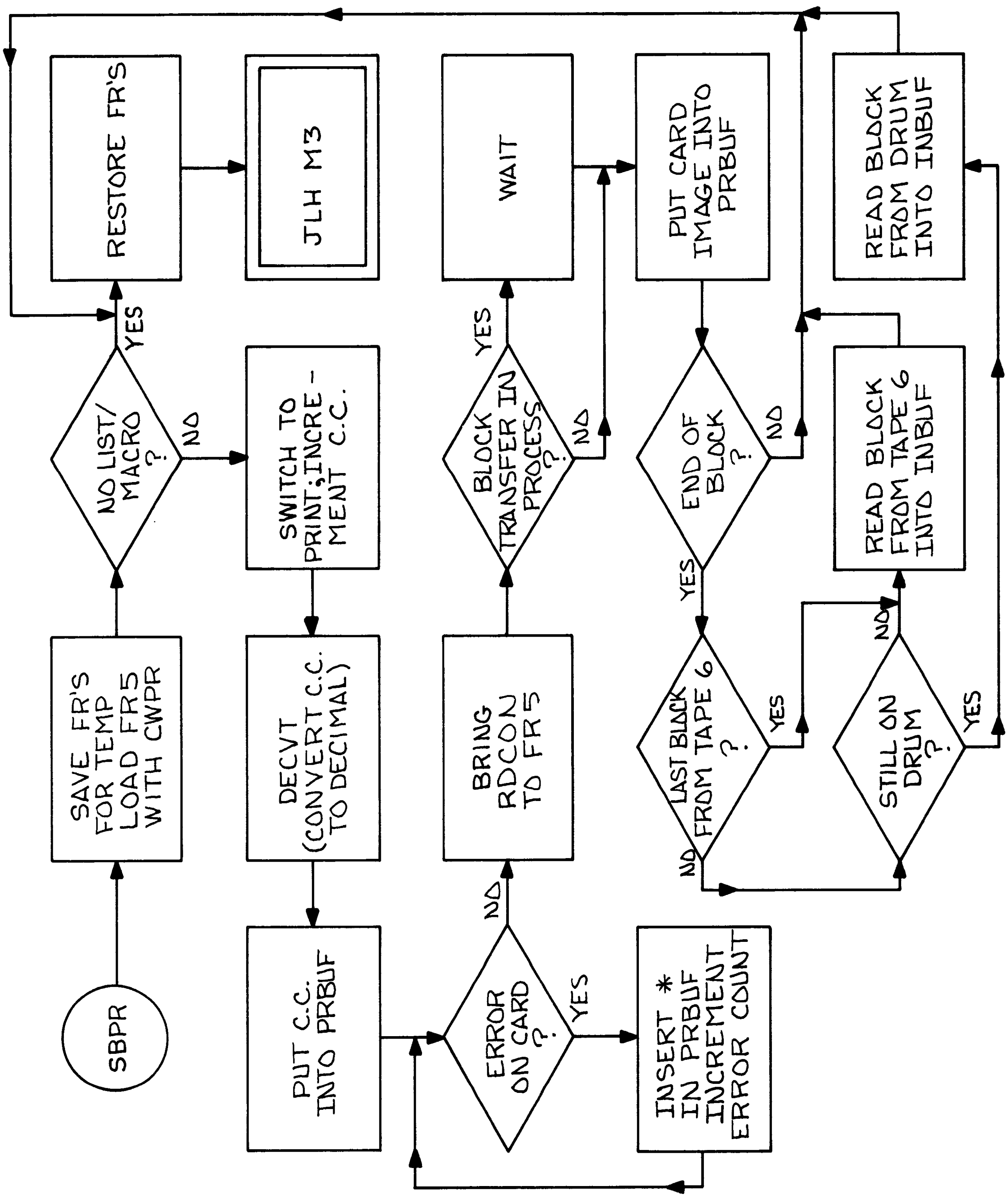
SBOCTL and SBOCTP

Convert location or program byte to octal and place in appropriate location in PRBUF. Also convert location to Decimal; Program Byte is sent to binary with byte in MO. Only entry is from OUT1/2, BESS and MPROG.



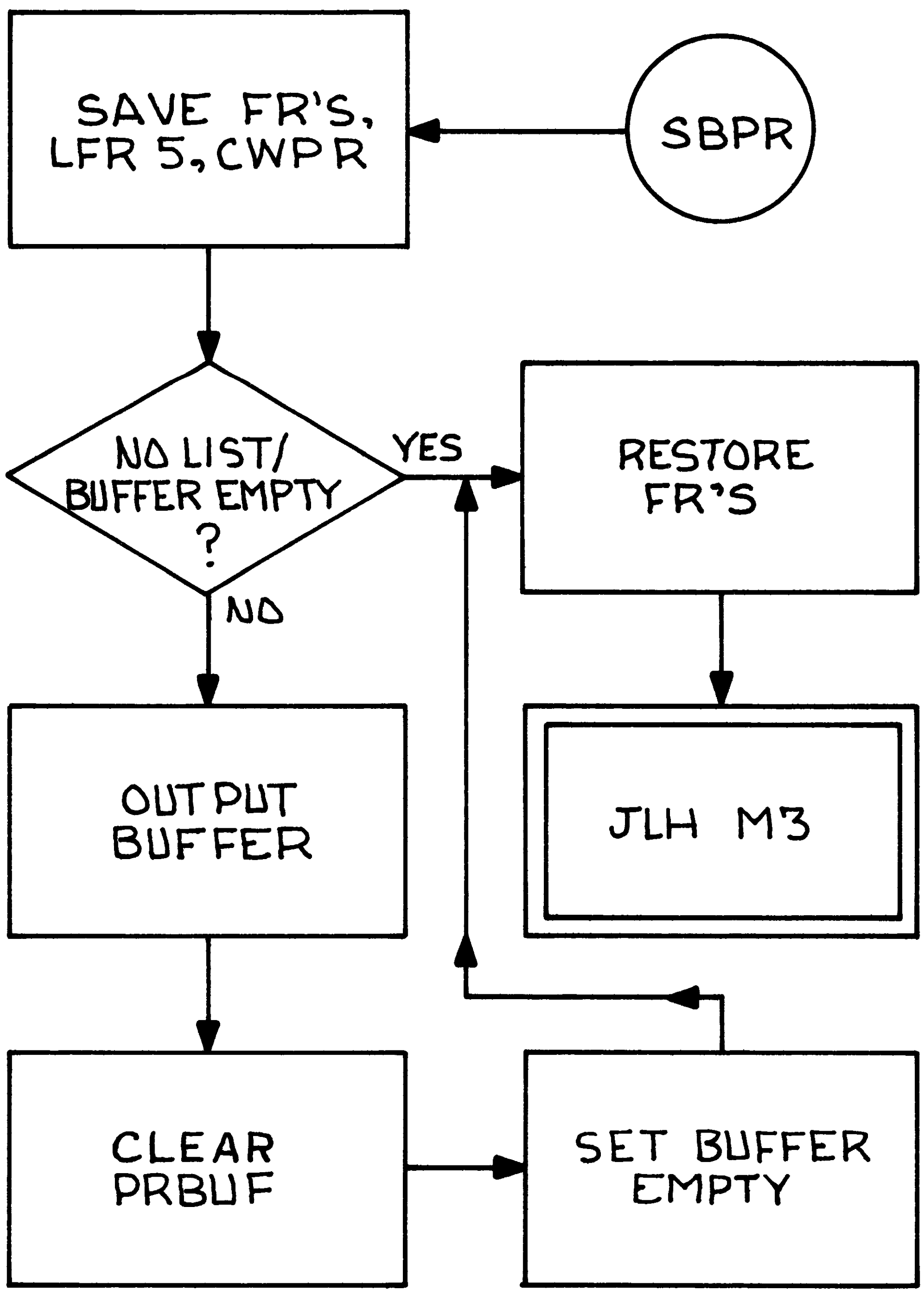
SBRD

Read card images from Drum/Tape 6 and put into PRBUF; put decimal card count into PRBUF; if Pass I or II error on card, put * into PRBUF.



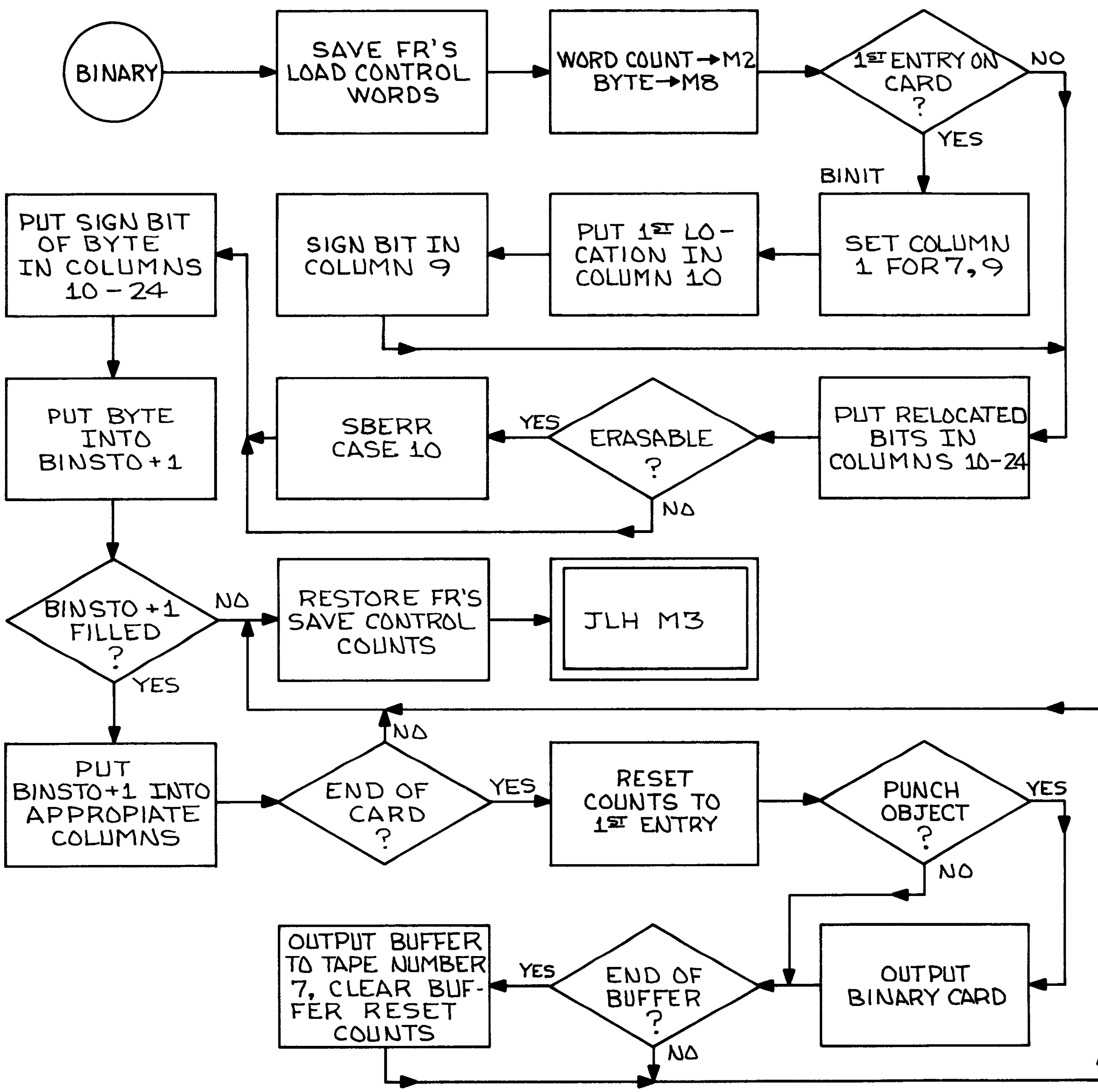
SBPR

Output PRBUF, printing it as one line; also puts * between octal location and first Q word.



BINARY

Produces binary cards if punch object bit is on, and binary card images on tape 7; puts RELOC bits on cards. For card description see manual Chapter 1; CALLed from BESS, natural sequence in SBOCT; link in M3, character is in MO.



Subroutines Continued

SBERR

Deals with errors detected during Pass III. It causes an asterisk to be inserted into the print buffer and enters the card number and type of error into the error list. If the total number of errors exceed 256, it transfers to SYSERR with assembly terminated. When it is entered, the error code is in M1 and the link is in M3.

INPUT

Causes the next byte of Intermediate Language to be loaded into M4. If the block has been read, it causes a new block to be read from the drum. The control word which contains the locations of next byte is INSTØR. Link is in M3.

SBCOMP

Calculates the numerical value of an address of a pseudo order. Link is in M3, result is in M13.

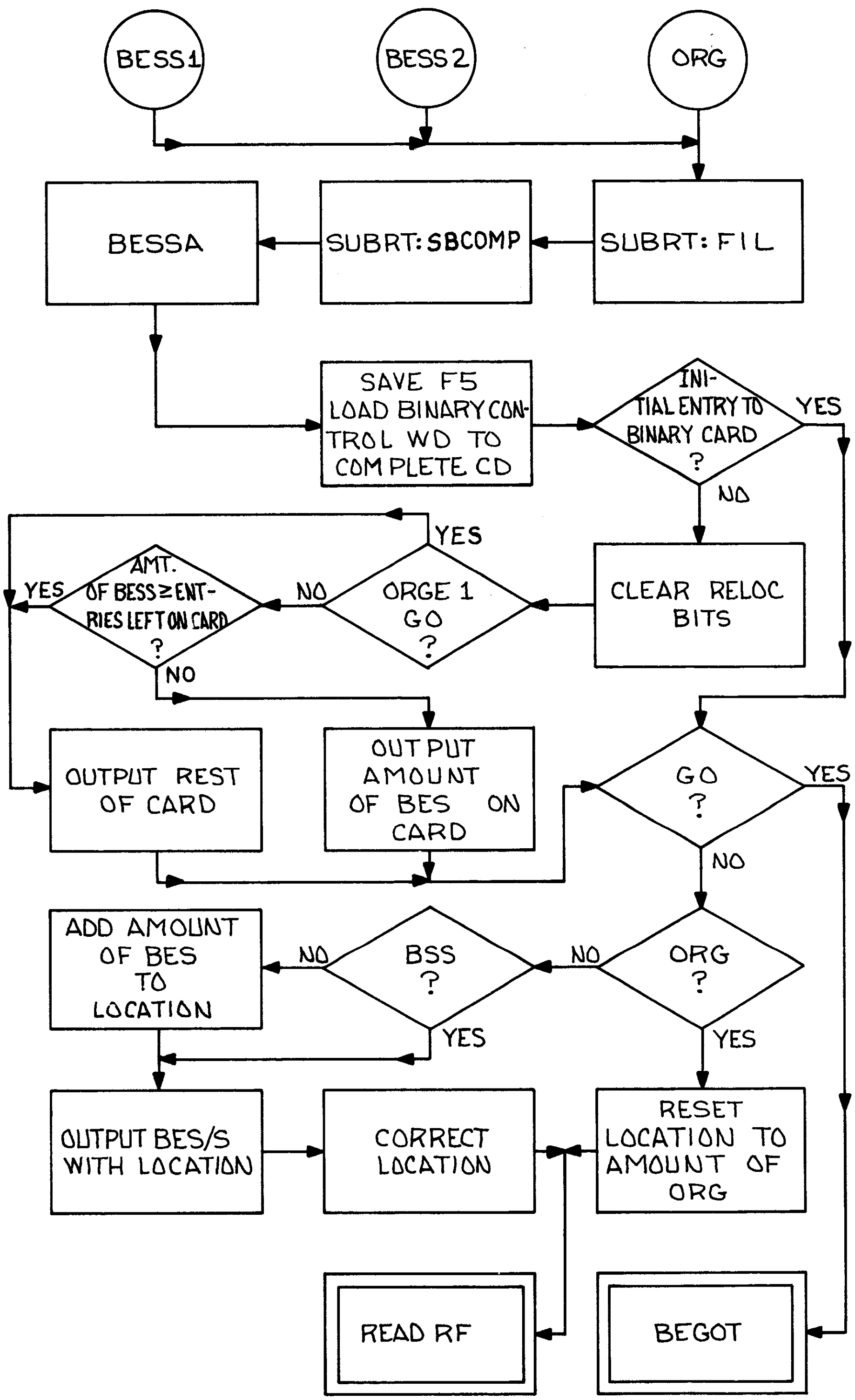
ADCOMP

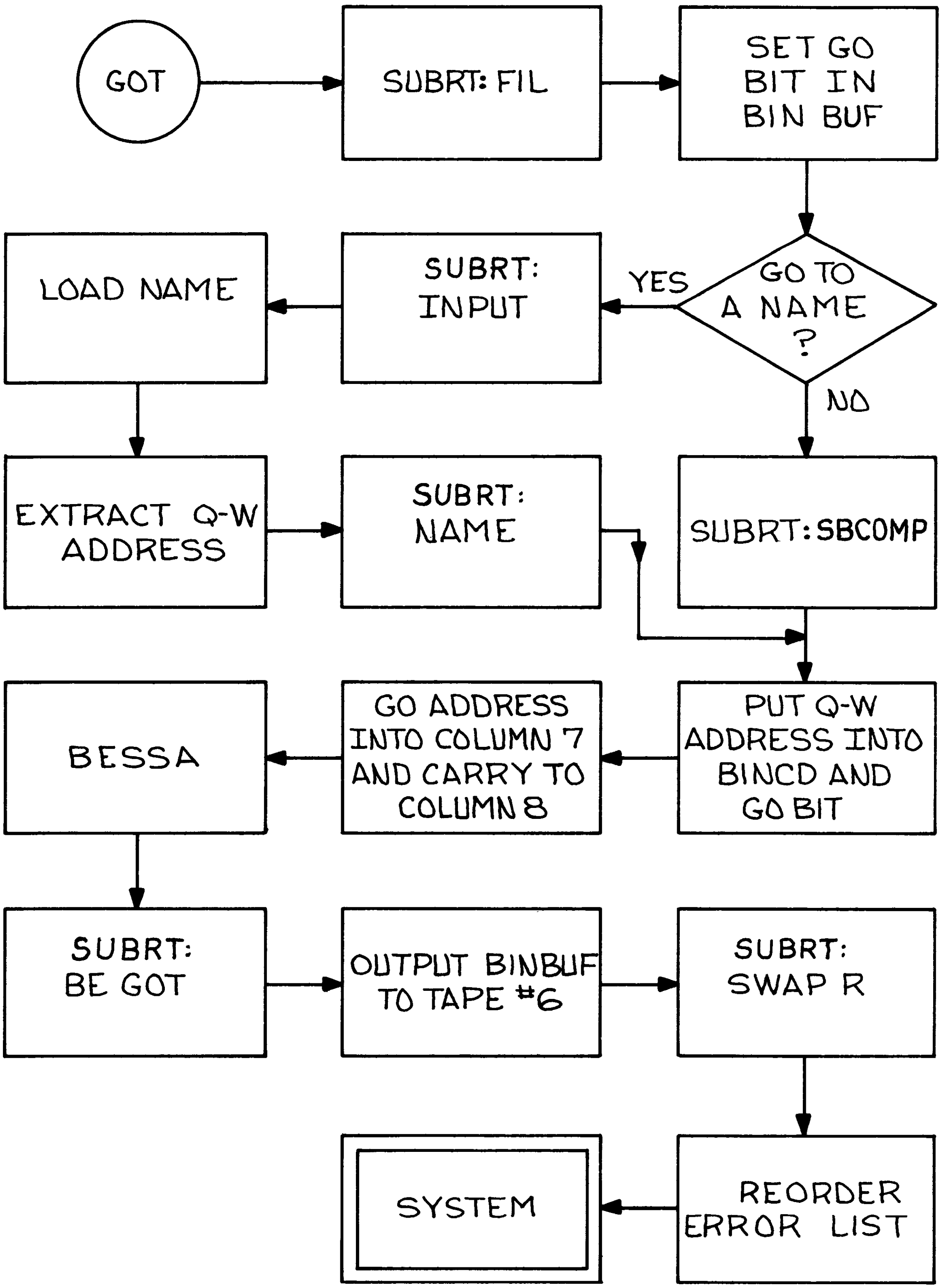
ADCOMP is identical to SBCOMP except that it calculates the value of an address of an order and is not a closed subroutine.

3.3.6 Pseudo Orders

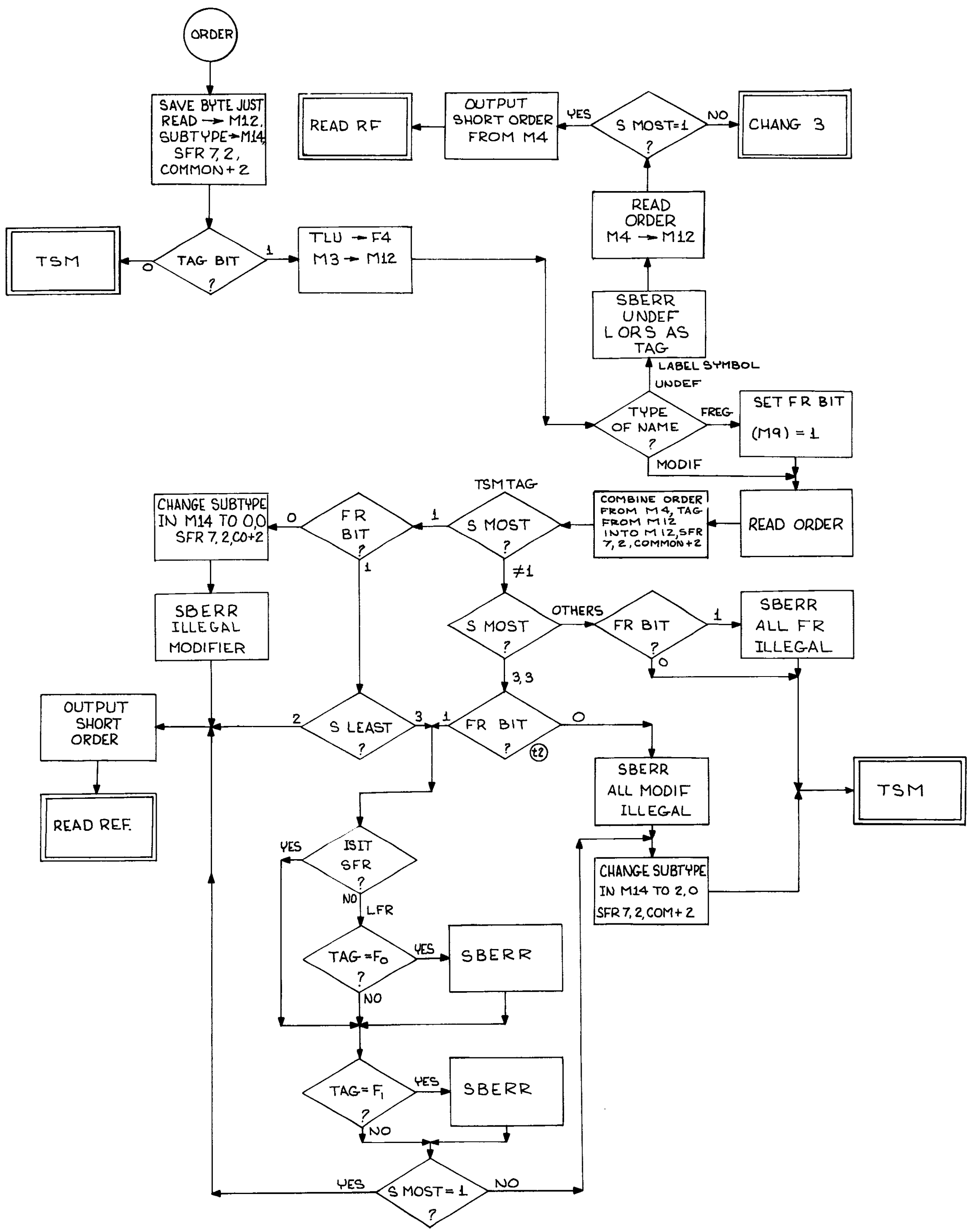
When a reference byte has been recognized as denoting a pseudo operation, control transfers to PSEUDO, which determines which type of pseudo operation it is:

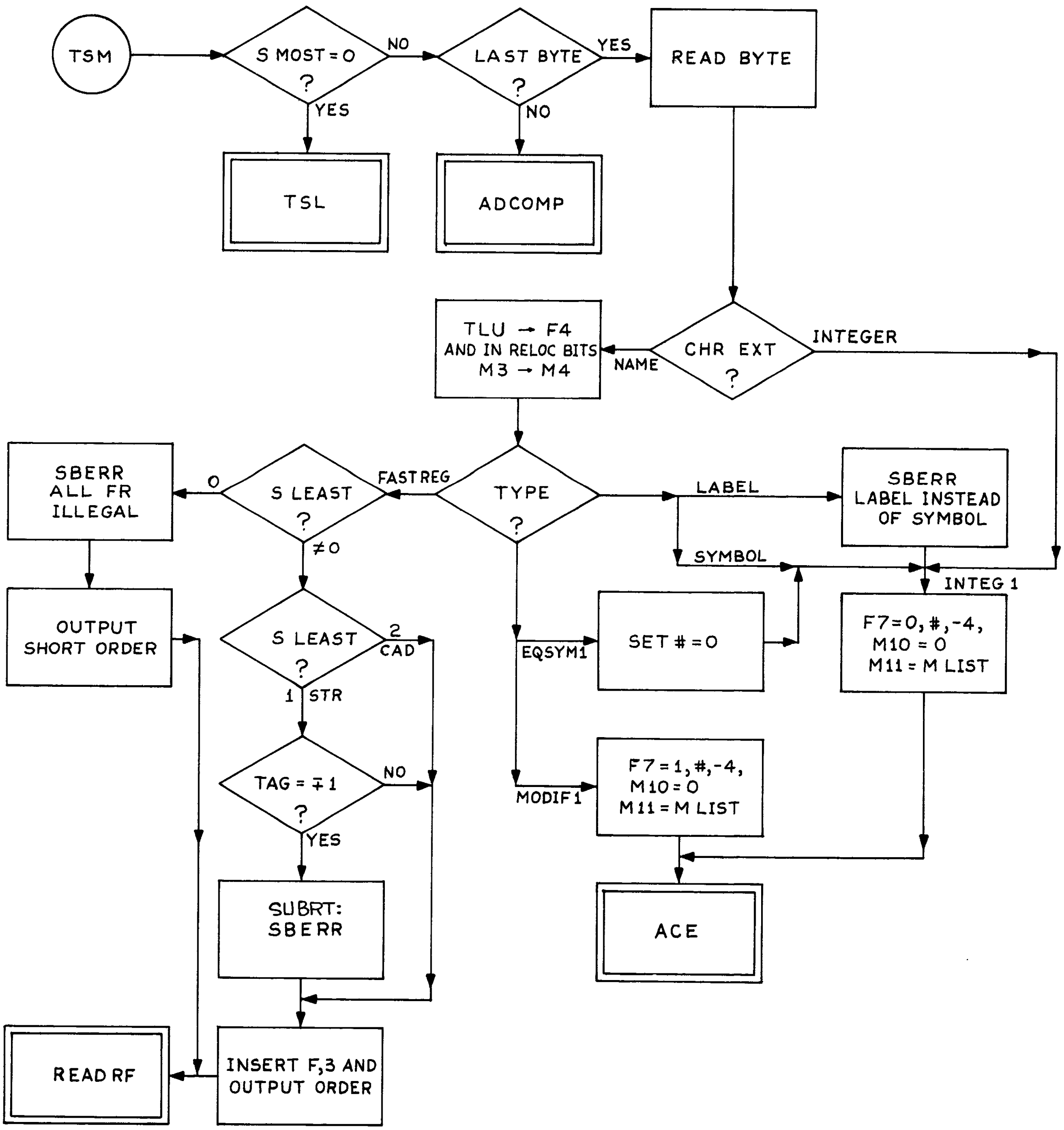
Mnemonic	Routine Used
FIL	FIL
FLD	FLD
BSS	BESS1
BES	BESS2
ORG	ORG
COMMON	COMMON1
GO	GOT
ERASE	ERASE
ASSIGN	ASSIGN
CALL	CALL
DECQ	DECQ
IO	---
OCTQ	OCTQ
DEC	DECHR
CHR	CHR


BESS1
BESS2
ORG
BESSA
SUBRT: SBCOMP
SUBRT: FIL
SAVE F5 LOAD BINARY CONTROL WD TO COMPLETE CD
INITIAL ENTRY TO BINARY CARD ?
YES
NO
CLEAR RELOC BITS
ORGE 1 GO ?
YES
NO
AMT. OF BESS ≥ ENTRIES LEFT ON CARD ?
YES
NO
OUTPUT REST OF CARD
OUTPUT AMOUNT OF BES ON CARD
GO ?
YES
NO
ORG ?
NO
YES
BSS ?
NO
YES
ADD AMOUNT OF BES TO LOCATION
OUTPUT BES/S WITH LOCATION
CORRECT LOCATION
RESET LOCATION TO AMOUNT OF ORG
READ RF
BEGOT

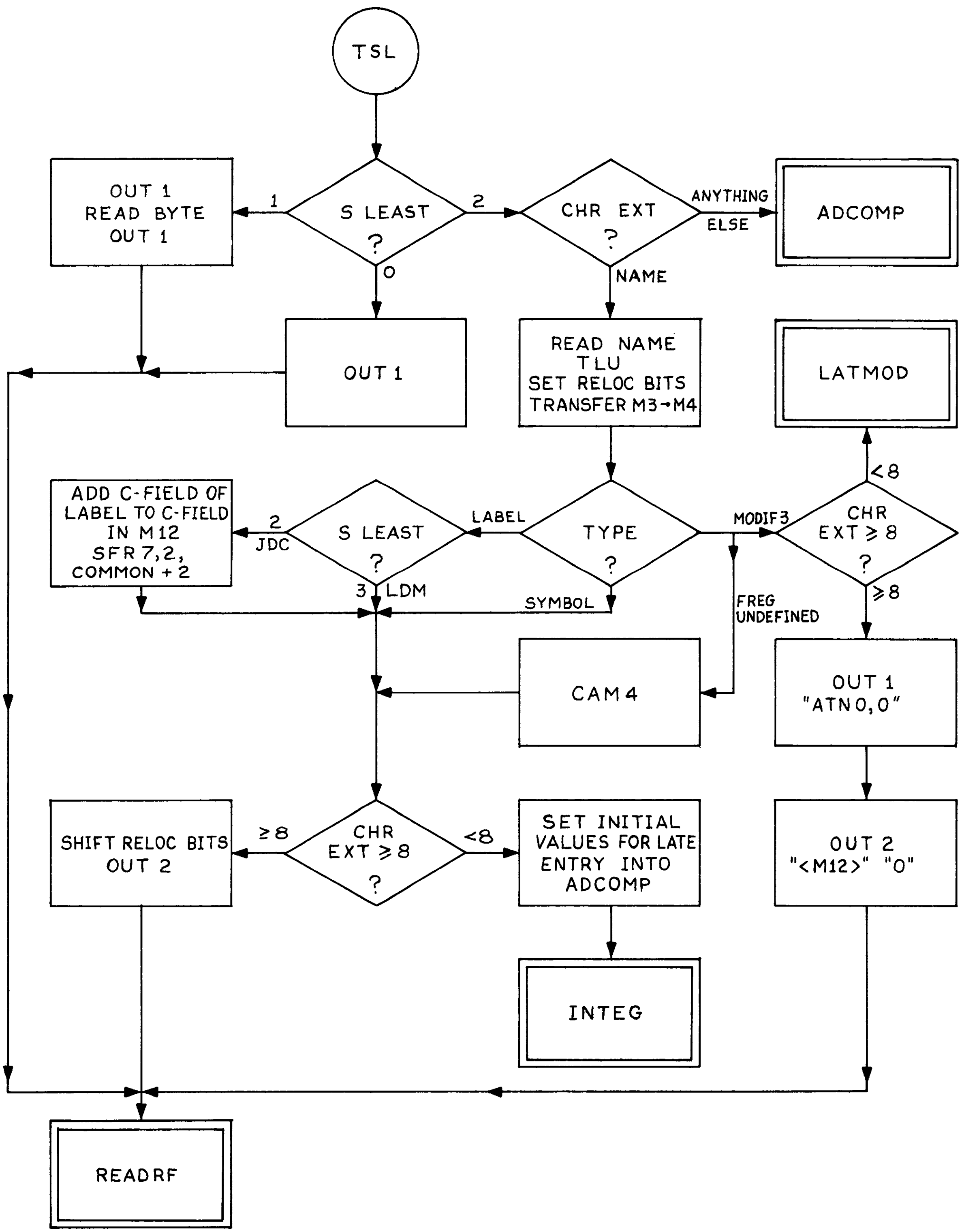

GOT
SUBRT: FIL
SET GO BIT IN BIN BUF
GO TO A NAME ?
YES
NO
SUBRT: INPUT
LOAD NAME
EXTRACT Q-W ADDRESS
SUBRT: NAME
SUBRT: SBCOMP
PUT Q-W ADDRESS INTO BINCD AND GO BIT
GO ADDRESS INTO COLUMN 7 AND CARRY TO COLUMN 8
BESSA
SUBRT: BE GOT
OUTPUT BINBUF TO TAPE #6
SUBRT: SWAP R
REORDER ERROR LIST
SYSTEM

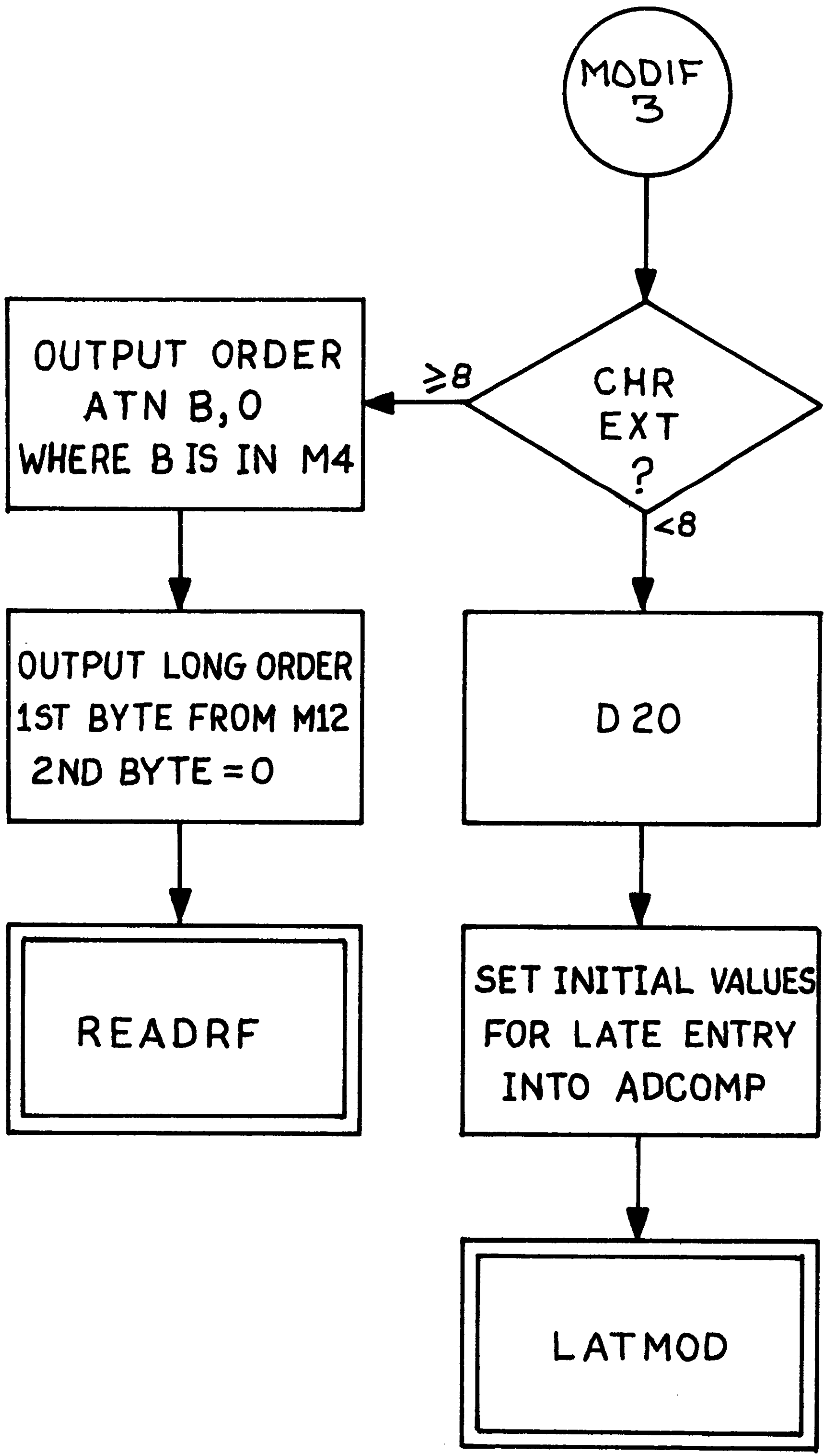
3.3.7 Orders

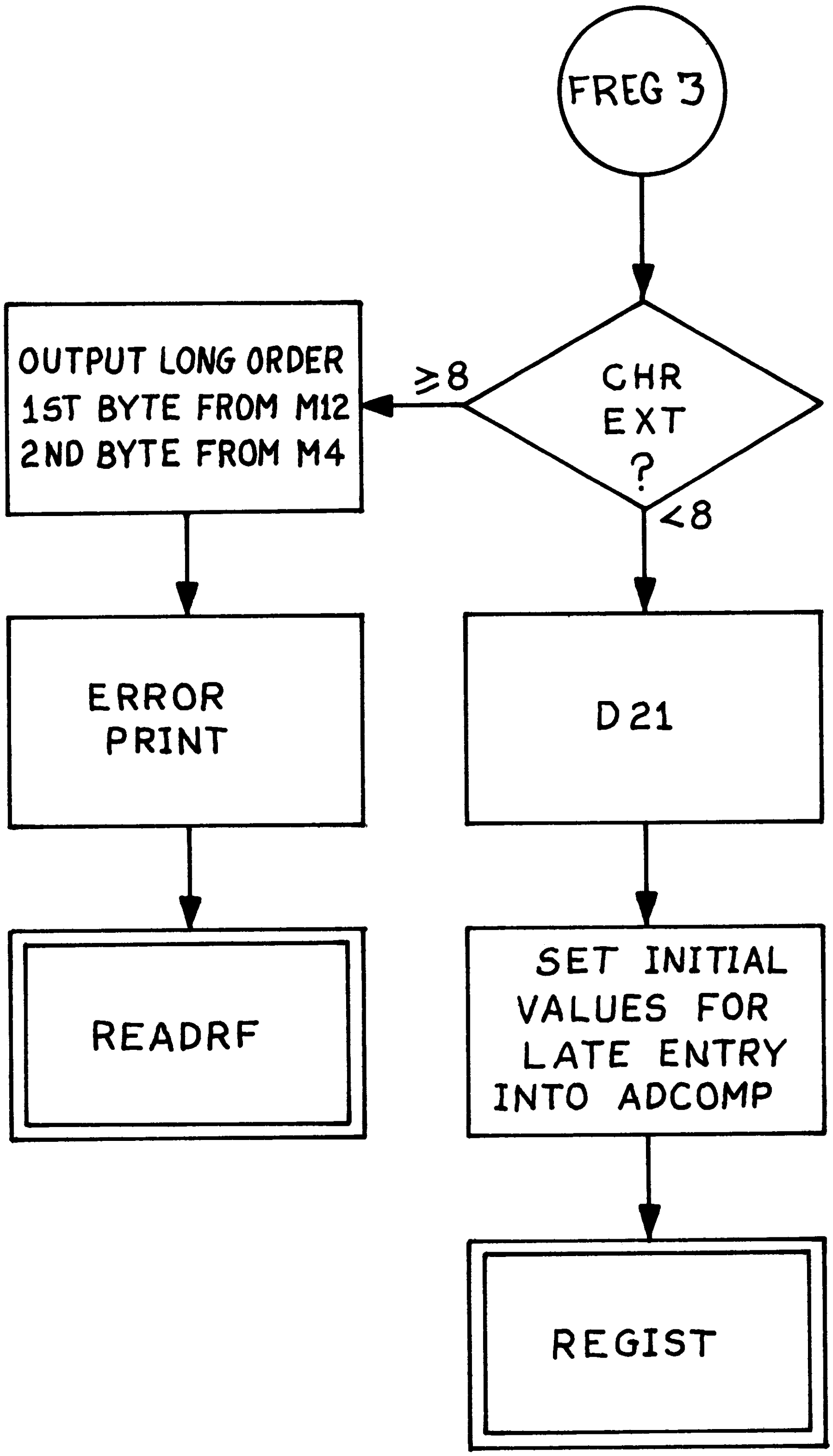

ORDER
SAVE BYTE JUST READ → M12, SUBTYPE→M14, SFR 7, 2, COMMON+2
READ RF
OUTPUT SHORT ORDER FROM M4
YES
S MOST=1 ?
NO
CHANG 3
READ ORDER M4 → M12
TSM
TAG BIT ?
0
1
TLU → F4 M3 → M12
SBERR UNDEF L OR S AS TAG
LABEL SYMBOL
UNDEF
TYPE OF NAME ?
FREG
SET FR BIT (M9) = 1
MODIF
TSM TAG
CHANGE SUBTYPE IN M14 TO 0,0 SFR 7, 2, CO+2
FR BIT ?
S MOST ?
COMBINE ORDER FROM M4, TAG FROM M12 INTO M12, SFR 7, 2, COMMON+2
READ ORDER
≠1
SBERR ILLEGAL MODIFIER
S MOST ?
OTHERS
FR BIT ?
SBERR ALL FR ILLEGAL
3,3
OUTPUT SHORT ORDER
2
S LEAST ?
3
FR BIT ?
READ REF.
SBERR ALL MODIF ILLEGAL
TSM
IS IT SFR ?
YES
NO
LFR
CHANGE SUBTYPE IN M14 TO 2, 0 SFR 7, 2, COM+2
TAG = F0 ?
SBERR
TAG = F1 ?
S MOST = 1 ?



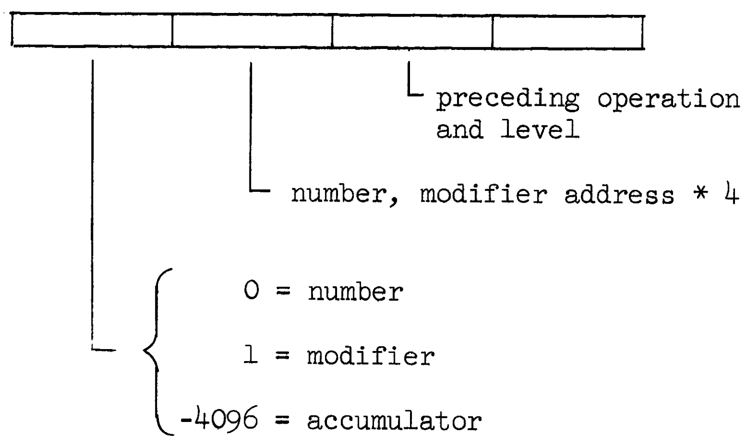
TSM
S MOST = 0 ?
NO
YES
LAST BYTE ?
YES
NO
READ BYTE
TSL
ADCOMP
TLU → F4
AND IN RELOC BITS
M3 → M4
CHR EXT ?
NAME
INTEGER
SBERR
ALL FR
ILLEGAL
0
S LEAST ?
FASTREG
TYPE ?
LABEL
SBERR
LABEL INSTEAD
OF SYMBOL
≠0
SYMBOL
INTEG 1
OUTPUT
SHORT ORDER
S LEAST ?
2
CAD
1
STR
EQSYM1
SET # = 0
F7=0, #, -4,
M10 = 0
M11 = M LIST
TAG = ∓1 ?
NO
YES
MODIF 1
F7 = 1, #, -4,
M10 = 0
M11 = M LIST
SUBRT:
SBERR
ACE
READ RF
INSERT F,3 AND
OUTPUT ORDER


TSL
S LEAST ?
OUT 1
READ BYTE
OUT 1
OUT 1
CHR EXT ?
ANYTHING ELSE
ADCOMP
NAME
READ NAME
TLU
SET RELOC BITS
TRANSFER M3→M4
LATMOD
ADD C-FIELD OF LABEL TO C-FIELD IN M12
SFR 7,2,
COMMON + 2
JDC
S LEAST ?
LABEL
TYPE ?
MODIF3
CHR EXT ≥ 8 ?
SYMBOL
LDM
FREG UNDEFINED
CAM4
OUT 1
"ATN 0,0"
SHIFT RELOC BITS
OUT 2
CHR EXT ≥ 8 ?
SET INITIAL VALUES FOR LATE ENTRY INTO ADCOMP
OUT 2
"<M12>" "0"
INTEG
READRF


MODIF 3
CHR EXT ?
≥8
OUTPUT ORDER ATN B,0 WHERE B IS IN M4
OUTPUT LONG ORDER 1ST BYTE FROM M12 2ND BYTE = 0
READRF
<8
D 20
SET INITIAL VALUES FOR LATE ENTRY INTO ADCOMP
LATMOD

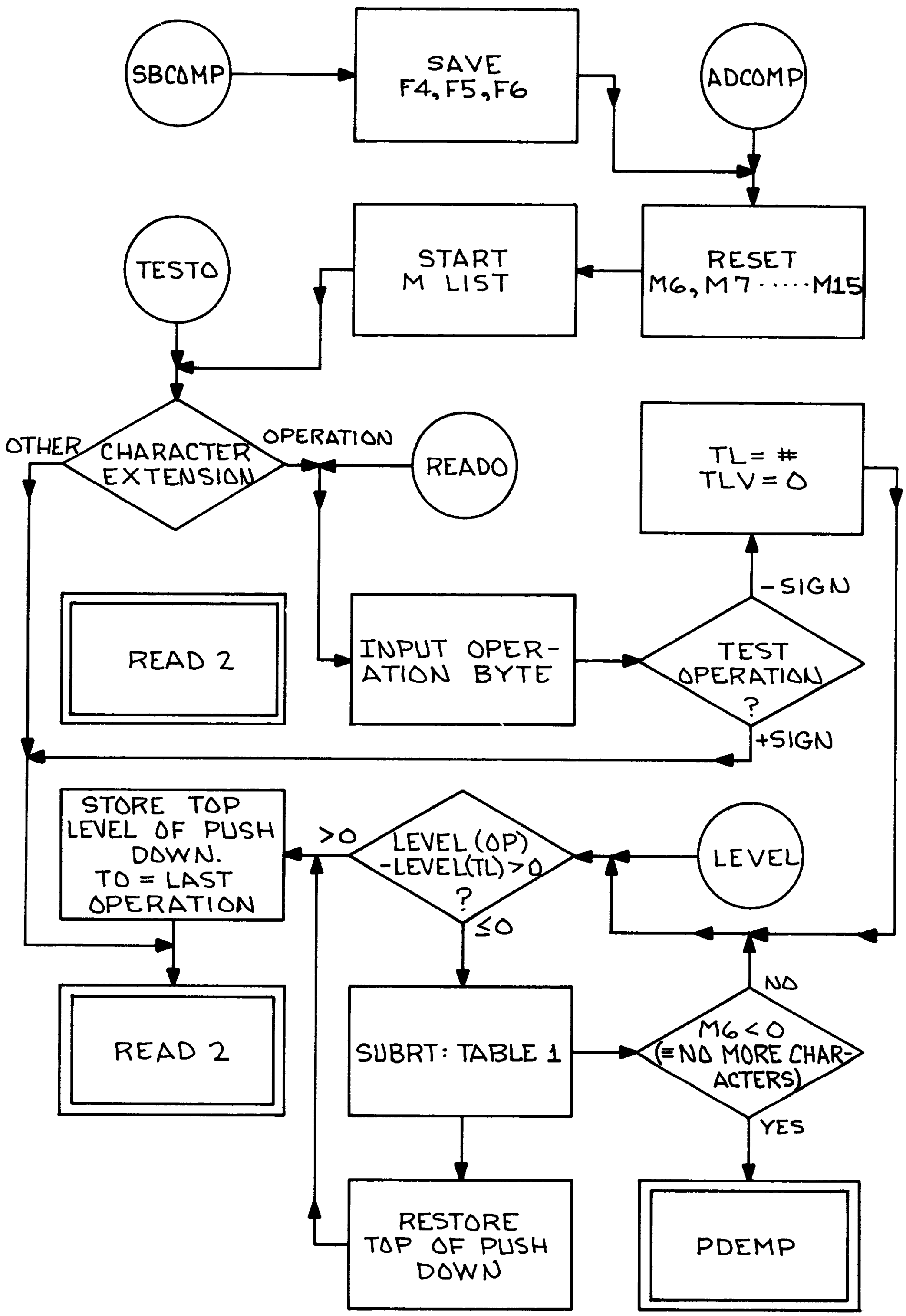

FREG 3
CHR EXT ?
≥8
<8
OUTPUT LONG ORDER 1ST BYTE FROM M12 2ND BYTE FROM M4
ERROR PRINT
READRF
D21
SET INITIAL VALUES FOR LATE ENTRY INTO ADCOMP
REGIST

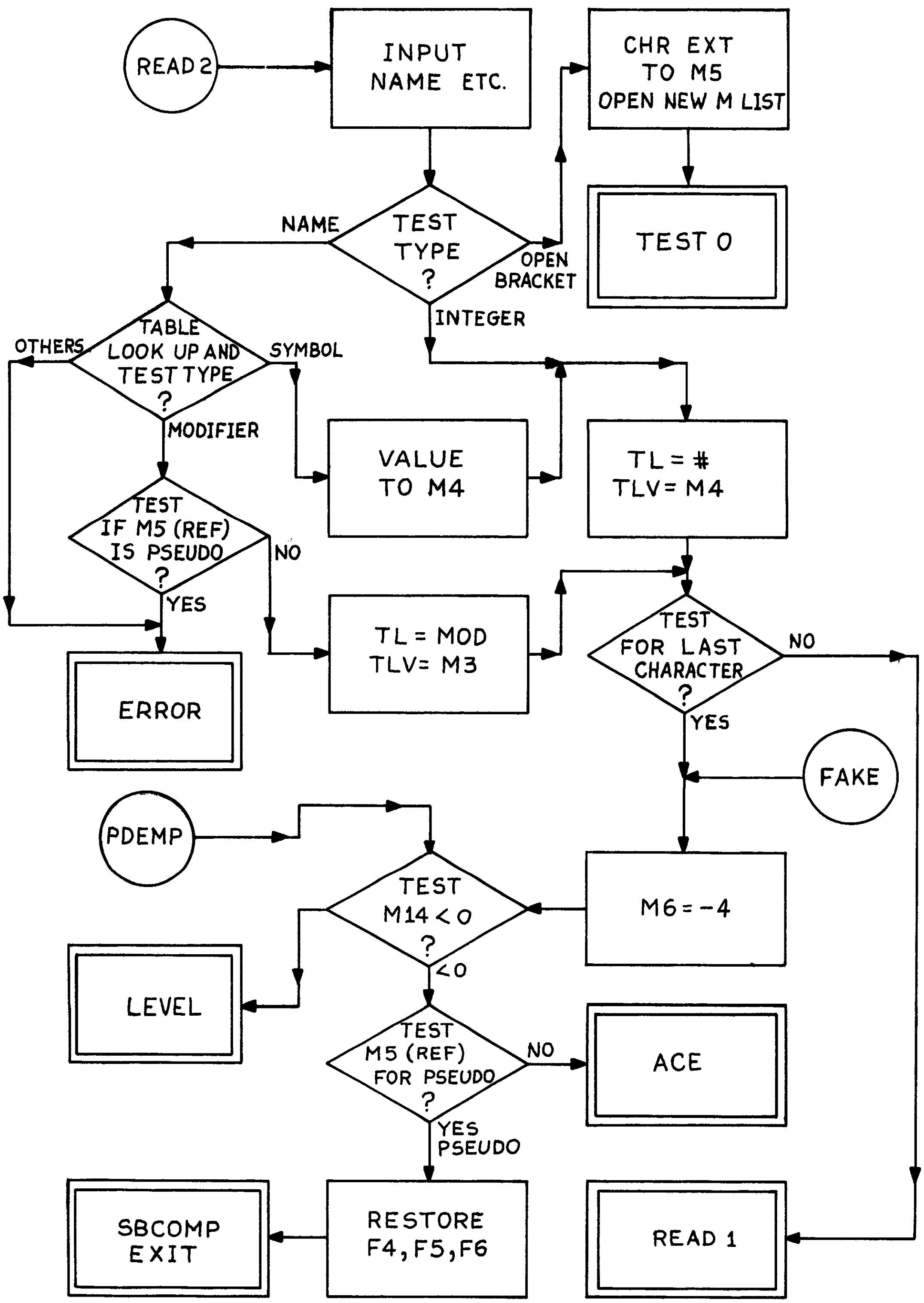
In the SBCOMP and ADCOMP flow charts that follow, a push down is maintained. The top level is in F7 and lower levels are in memory addressed to the top by a pointer in M8. The format of the push down is:

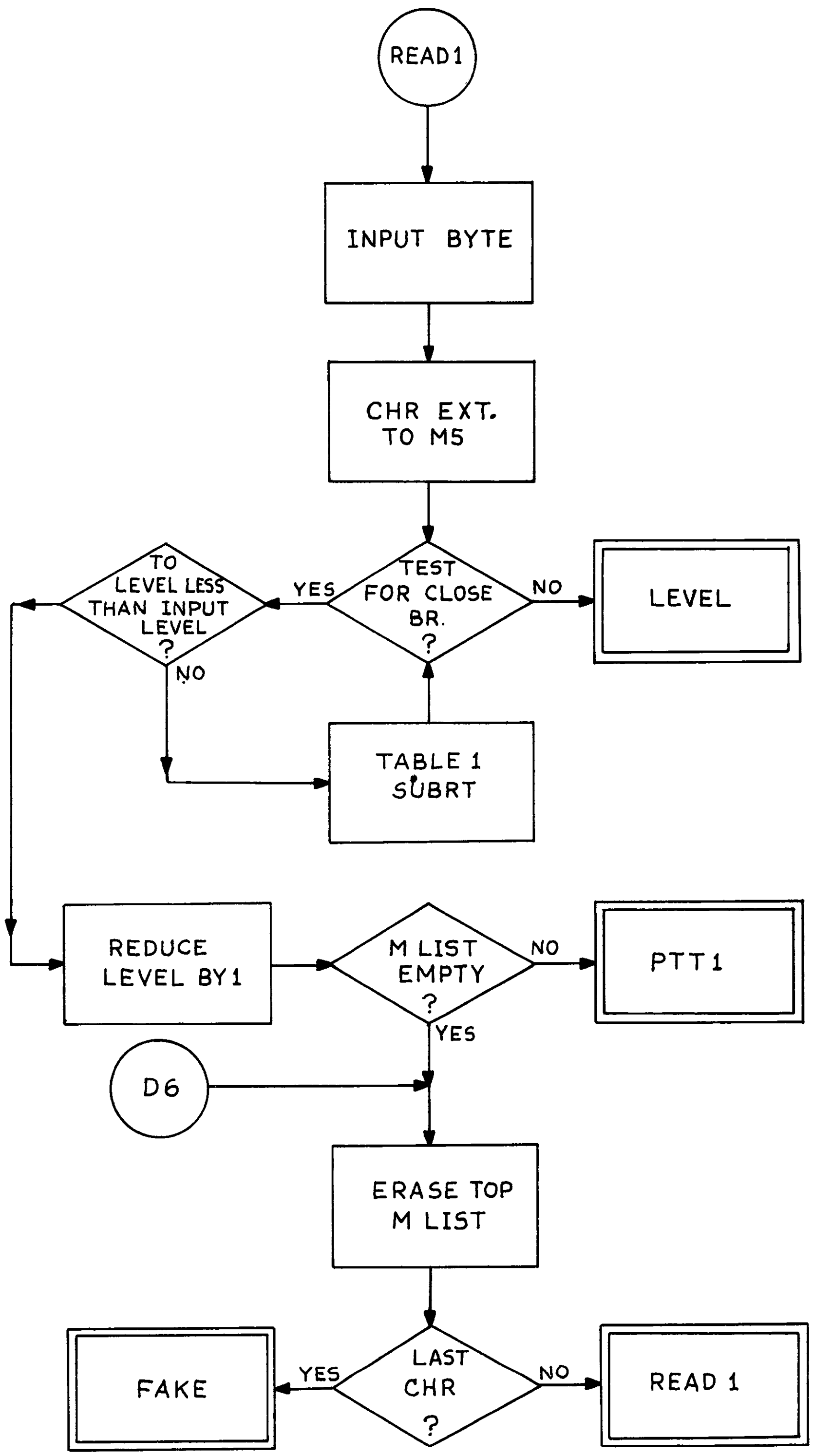


The abbreviations TL and SL are used for Top Level and Second Level of this push down. TLV means the value of the Top Level, level (TL) refers to the precedence level of the operation in the top level of the stack. An M list is also referred to in the chart. This is a stack of modifier addresses and modifier signs pointed to by M11. These are used to generate ATN's and SFN's when MØUT is CALLed. LØØKM scans the list to find a positively used modifier, and removes it if found.

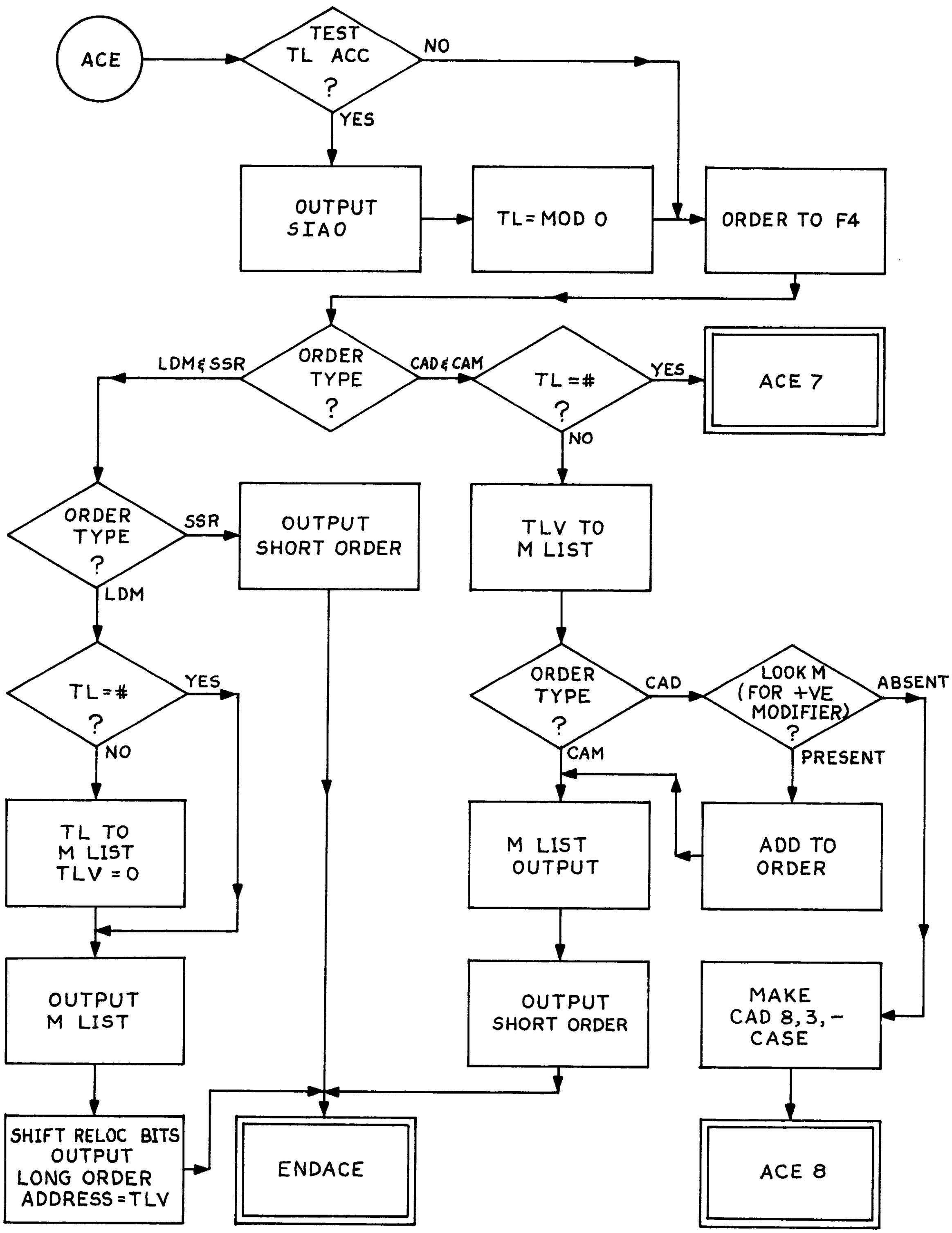
For a description of the general method behind this program, see "Address Compilation in the ILLIAC II Assembler," C. W. Gear, Computer Journal, 6, 4 (January, 1964).


SBCOMP
SAVE F4, F5, F6
ADCOMP
TESTO
START M LIST
RESET M6, M7 ····· M15
OTHER
CHARACTER EXTENSION
OPERATION
READO
TL = #
TLV = 0
READ 2
INPUT OPERATION BYTE
TEST OPERATION ?
-SIGN
+SIGN
STORE TOP LEVEL OF PUSH DOWN. TO = LAST OPERATION
>0
LEVEL (OP) -LEVEL(TL) > 0 ?
≤0
LEVEL
READ 2
SUBRT: TABLE 1
M6 < 0 (≡ NO MORE CHARACTERS)
NO
YES
RESTORE TOP OF PUSH DOWN
PDEMP


READ 2
INPUT NAME ETC.
CHR EXT TO M5 OPEN NEW M LIST
TEST TYPE ?
NAME
OPEN BRACKET
INTEGER
TEST 0
TABLE LOOK UP AND TEST TYPE ?
OTHERS
SYMBOL
MODIFIER
VALUE TO M4
TL = #
TLV = M4
TEST IF M5 (REF) IS PSEUDO ?
NO
YES
TL = MOD
TLV = M3
TEST FOR LAST CHARACTER ?
NO
YES
ERROR
FAKE
PDEMP
TEST M14 < 0 ?
M6 = -4
< 0
LEVEL
TEST M5 (REF) FOR PSEUDO ?
NO
ACE
YES PSEUDO
SBCOMP EXIT
RESTORE F4, F5, F6
READ 1


READ1
INPUT BYTE
CHR EXT. TO M5
TEST FOR CLOSE BR. ?
YES
NO
LEVEL
TO LEVEL LESS THAN INPUT LEVEL ?
NO
TABLE 1 SUBRT
REDUCE LEVEL BY 1
M LIST EMPTY ?
NO
PTT1
YES
D6
ERASE TOP M LIST
LAST CHR ?
YES
FAKE
NO
READ 1

ADDRESS COMPILATION EXIT



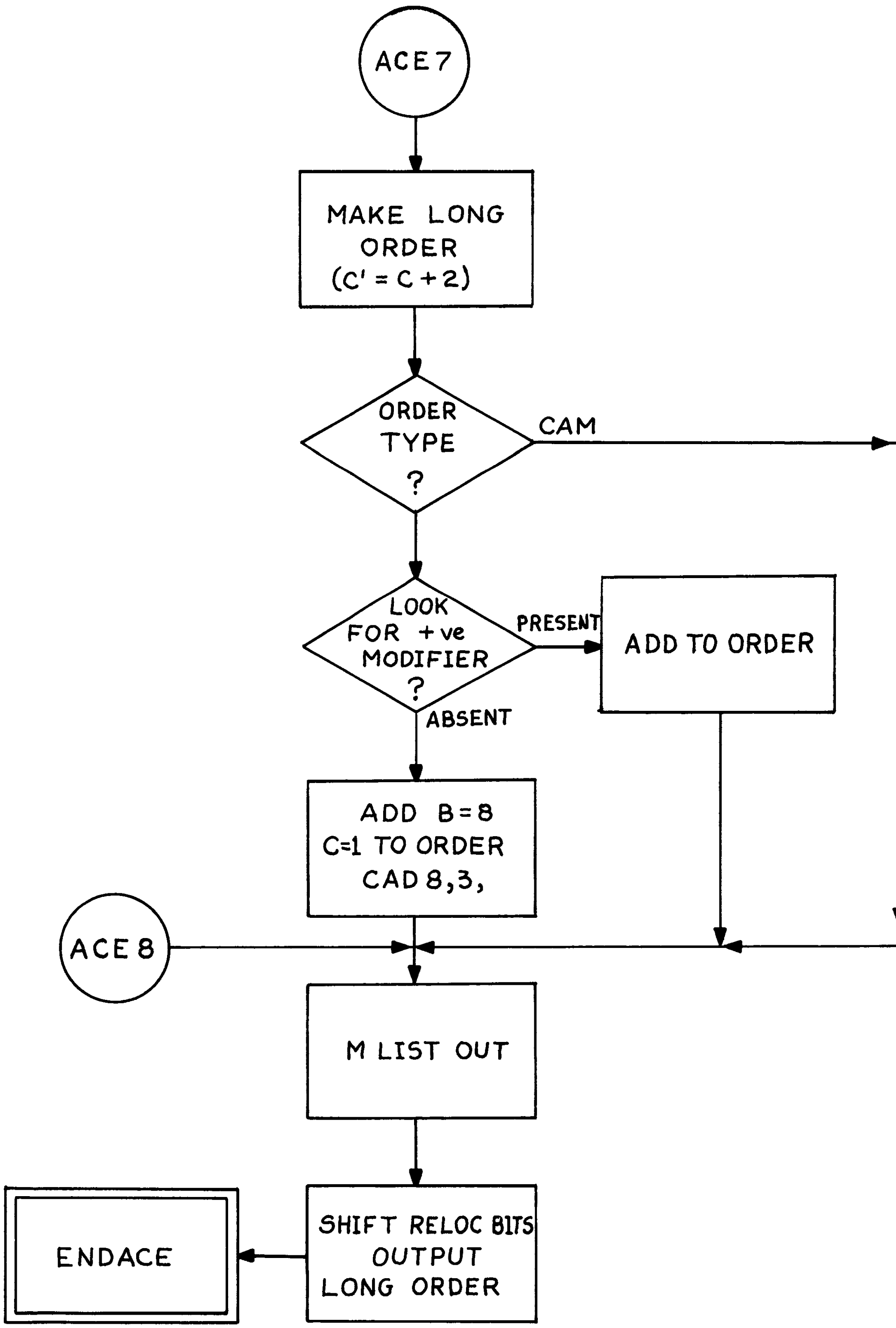
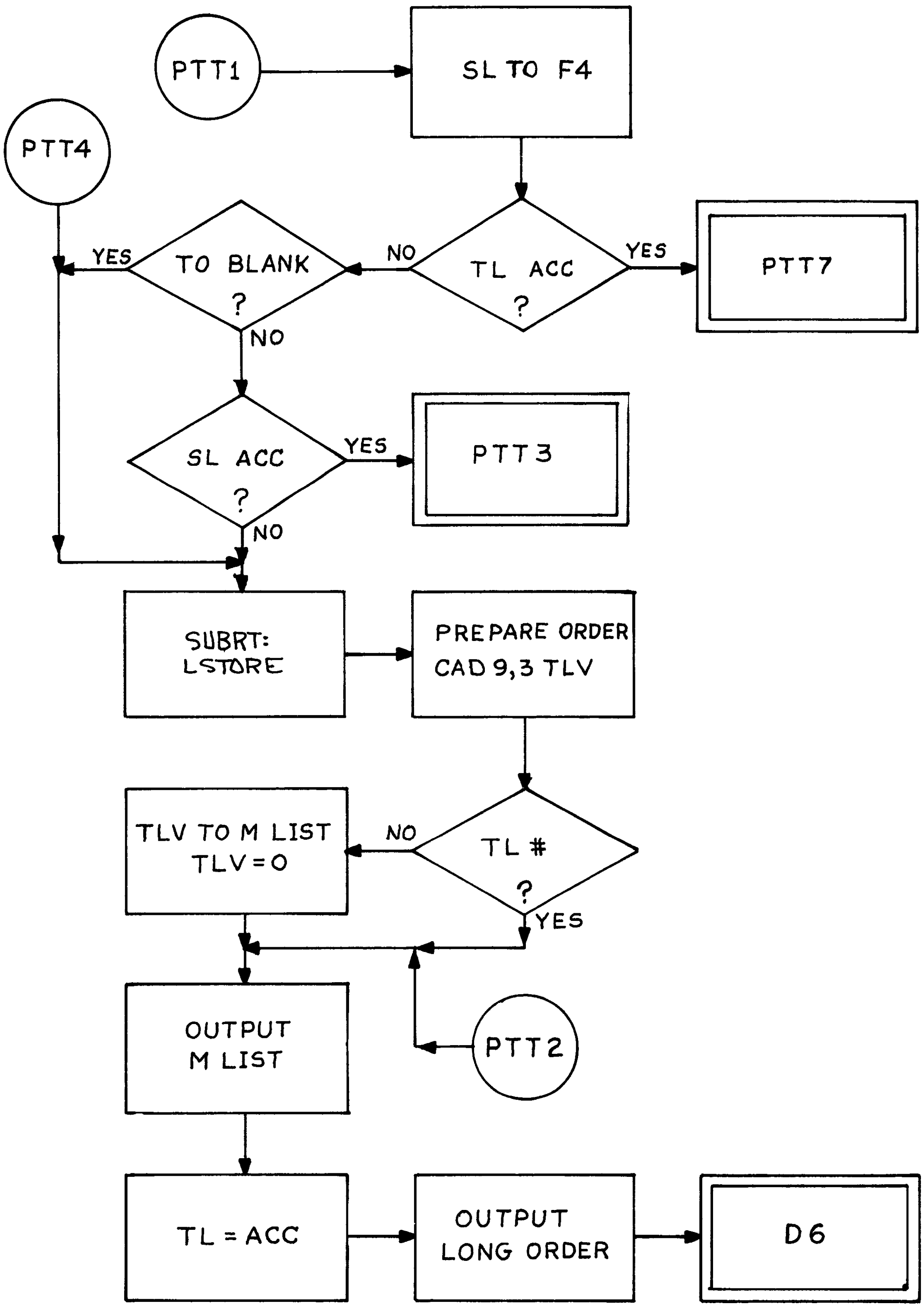

ACE7
MAKE LONG ORDER (C' = C + 2)
ORDER TYPE ?
CAM
LOOK FOR +ve MODIFIER ?
PRESENT
ADD TO ORDER
ABSENT
ADD B=8 C=1 TO ORDER CAD 8,3,
ACE8
M LIST OUT
SHIFT RELOC BITS OUTPUT LONG ORDER
ENDACE

TABLE 2



PTT1
SL TO F4
PTT4
TL ACC ?
YES
PTT7
NO
TO BLANK ?
YES
NO
SL ACC ?
YES
PTT3
NO
SUBRT: LSTORE
PREPARE ORDER CAD 9,3 TLV
TL # ?
NO
TLV TO M LIST TLV=0
YES
OUTPUT M LIST
PTT2
TL = ACC
OUTPUT LONG ORDER
D6

TABLE 2 (Cont'd)

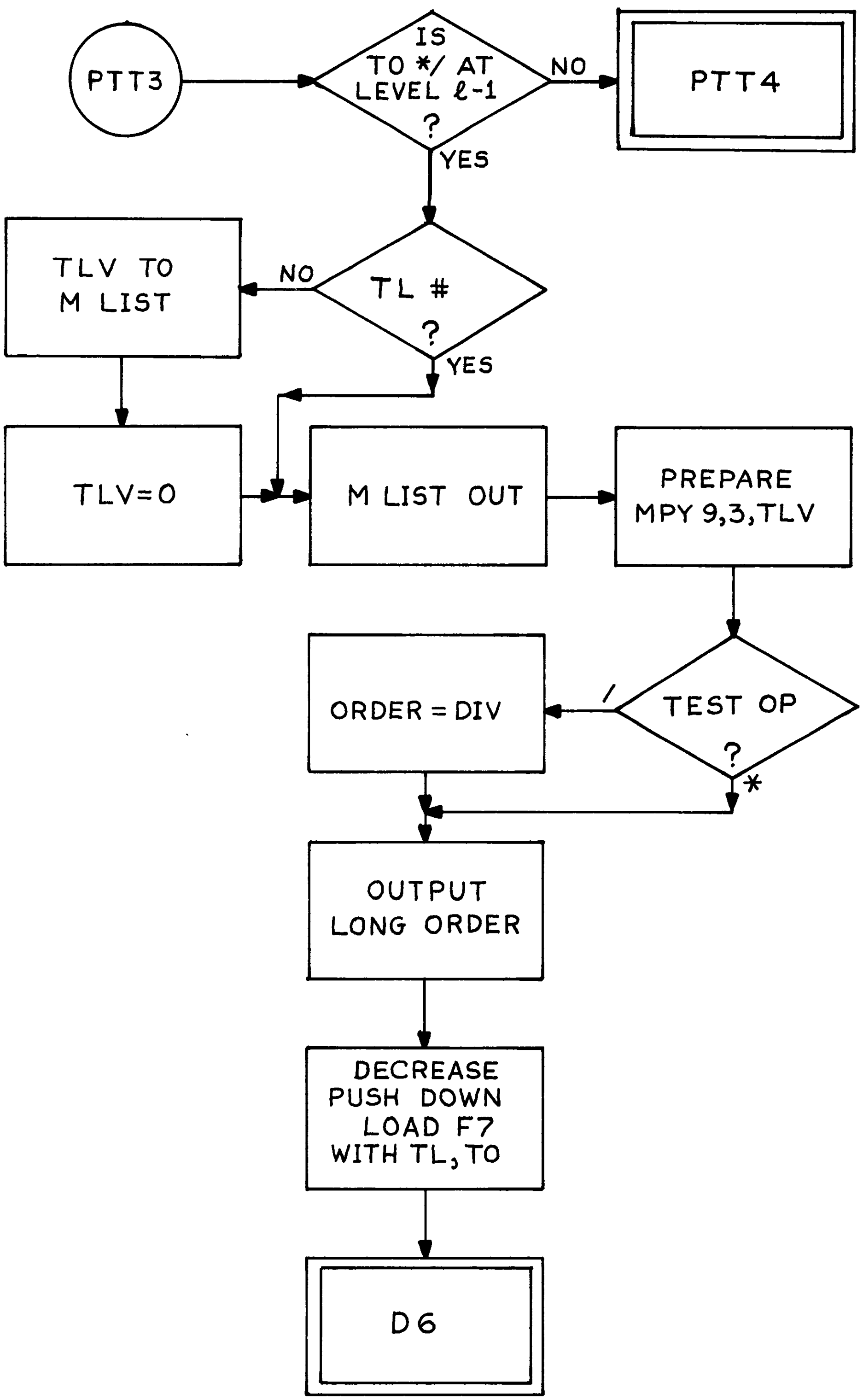


TABLE 2 (Cont'd)

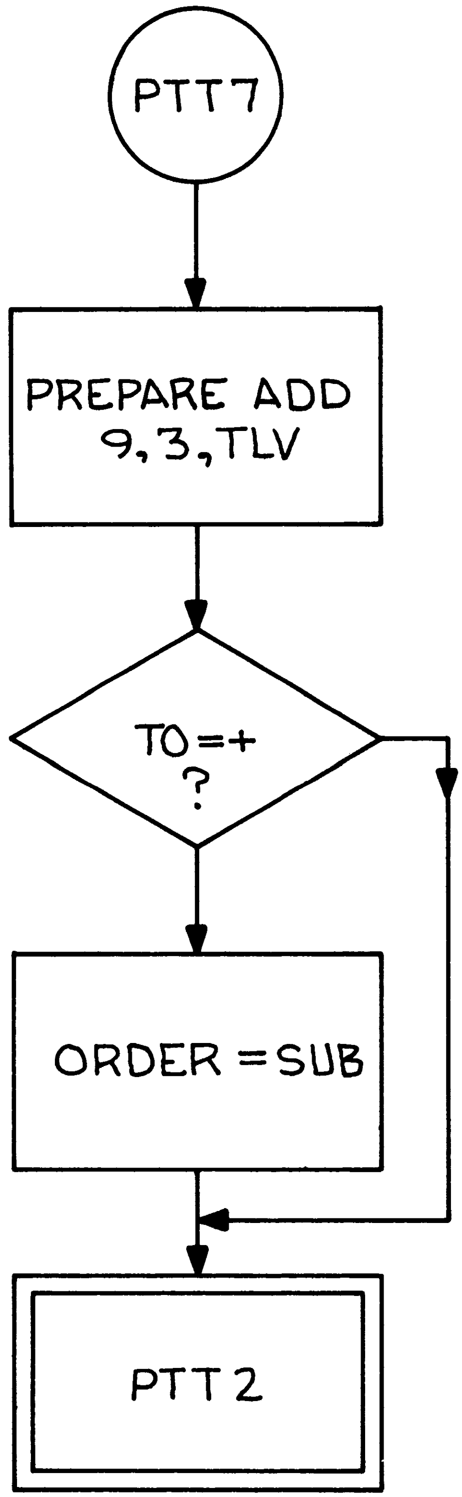
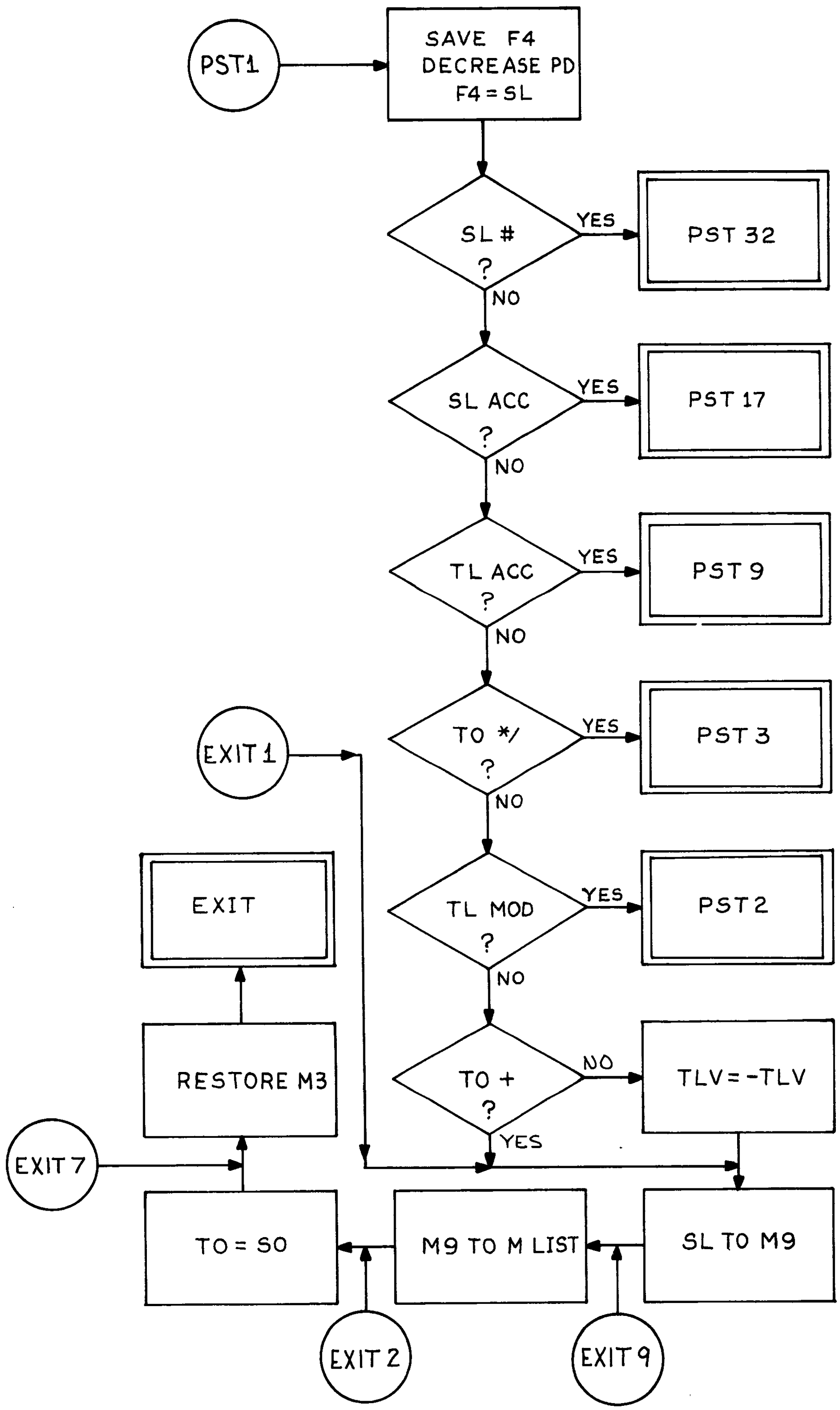
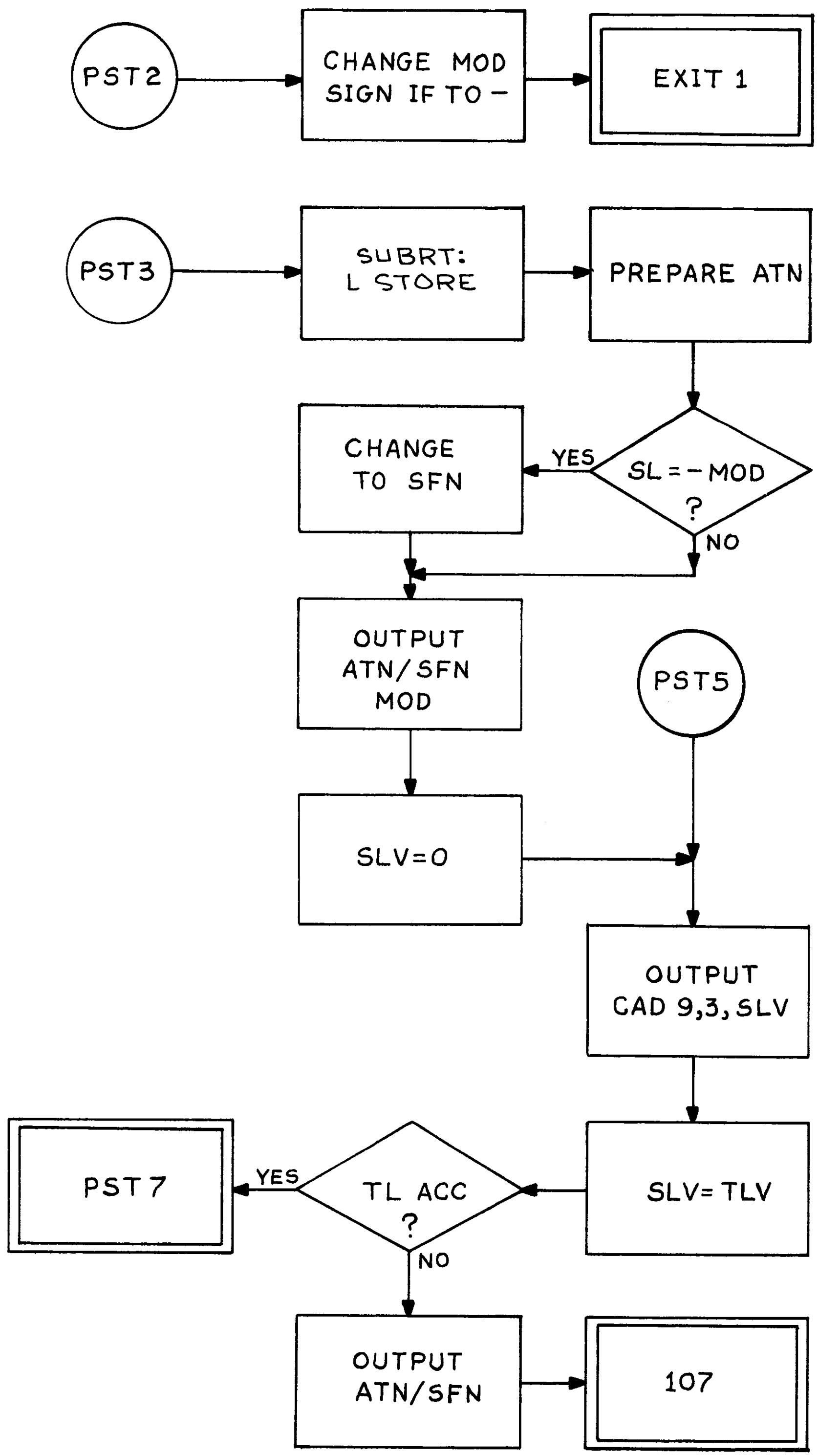
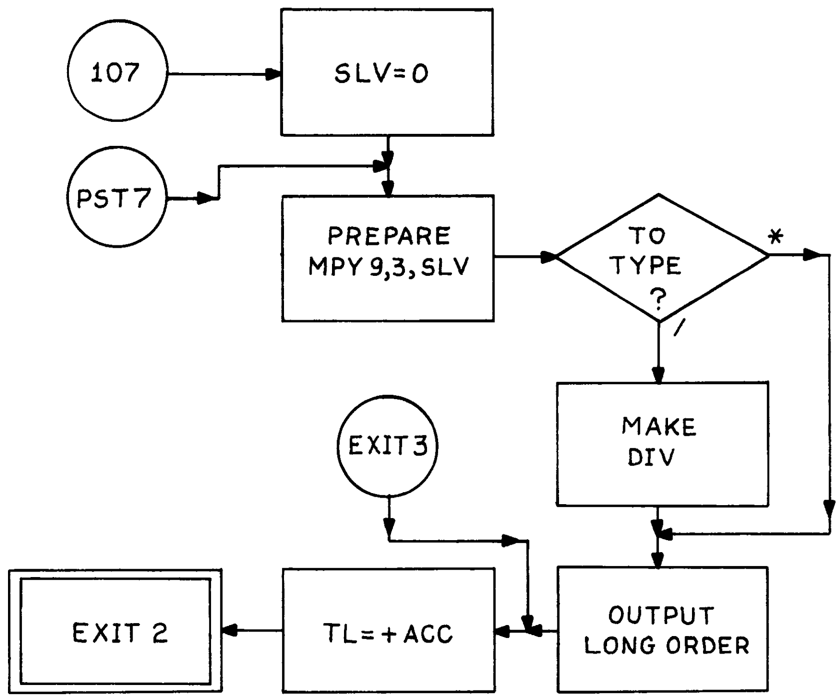
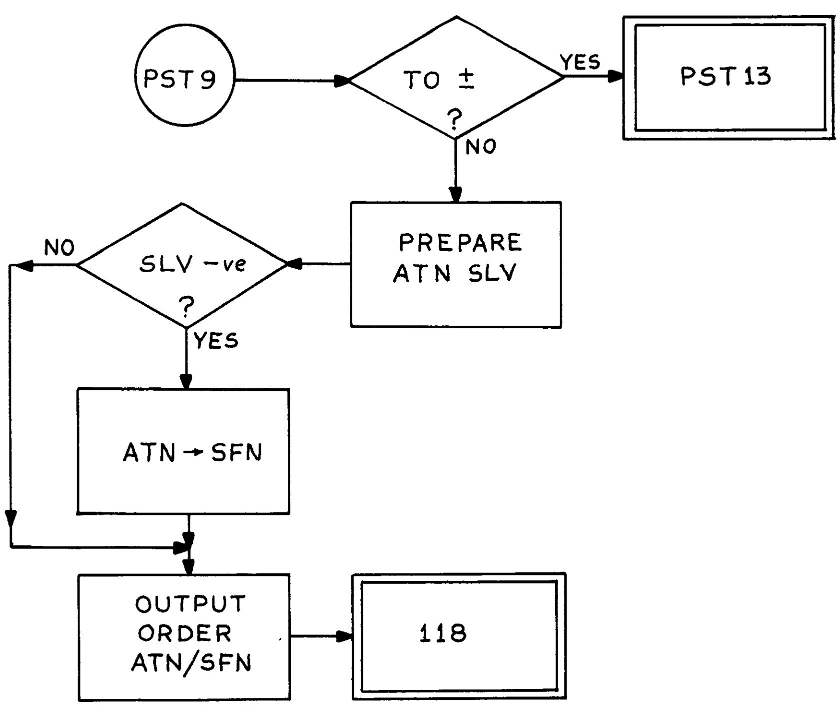


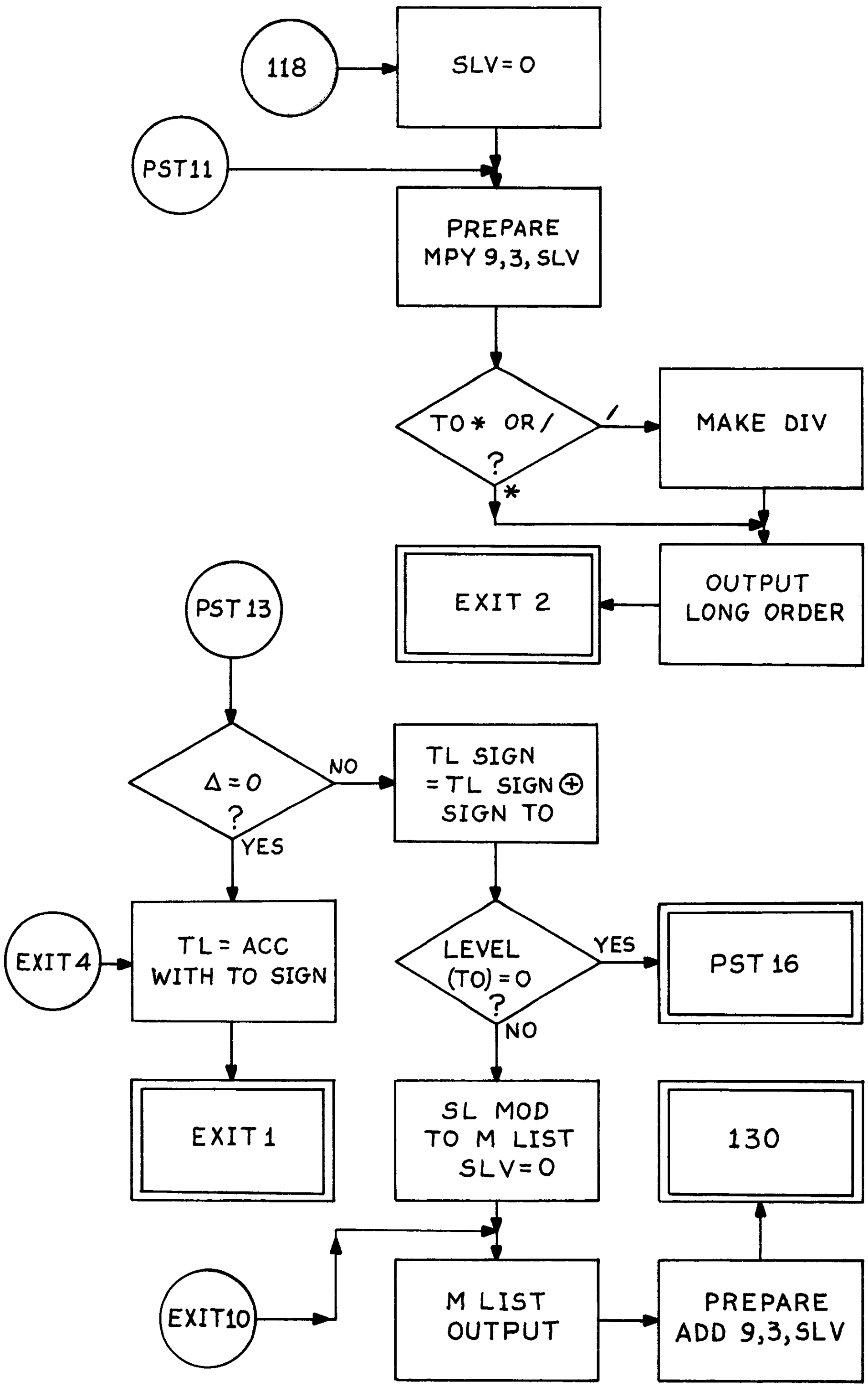
TABLE 1

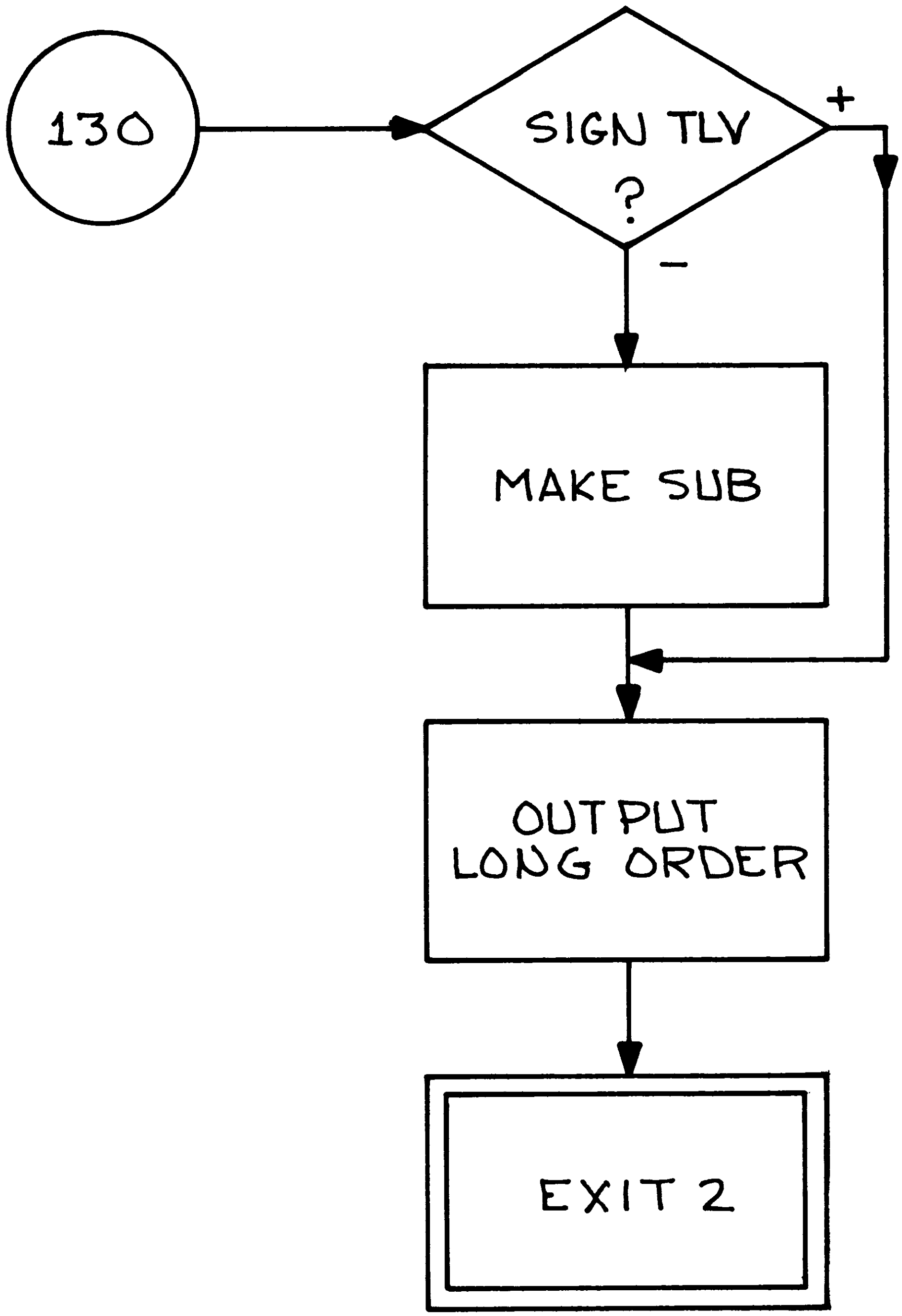

PST1
SAVE F4
DECREASE PD
F4 = SL
SL #
?
YES
PST 32
NO
SL ACC
?
YES
PST 17
NO
TL ACC
?
YES
PST 9
NO
TO */
?
YES
PST 3
NO
EXIT 1
EXIT
TL MOD
?
YES
PST 2
NO
TO +
?
NO
TLV = -TLV
YES
RESTORE M3
EXIT 7
TO = SO
M9 TO M LIST
SL TO M9
EXIT 2
EXIT 9

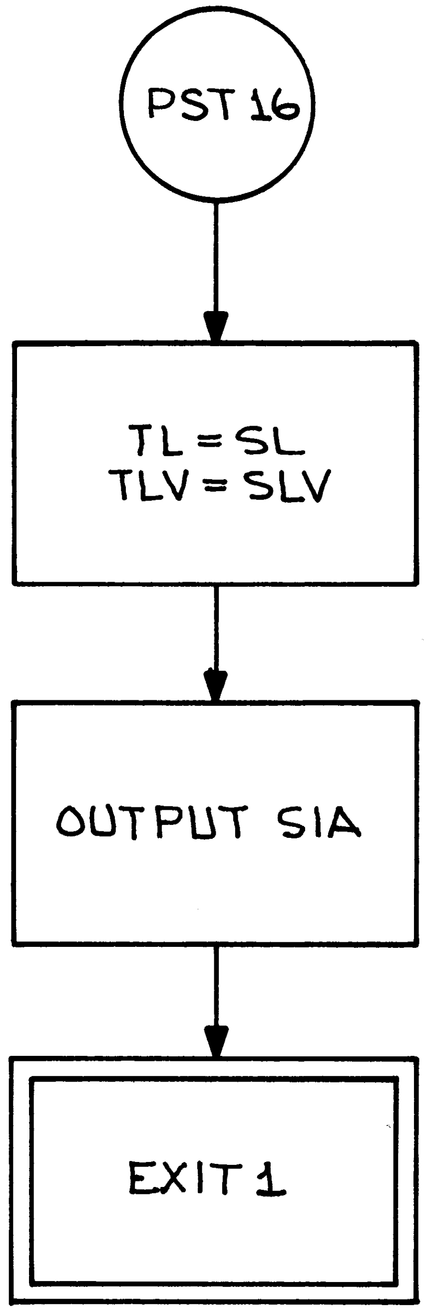

PST2
CHANGE MOD SIGN IF TO −
EXIT 1
PST3
SUBRT: L STORE
PREPARE ATN
SL = − MOD ?
YES
NO
CHANGE TO SFN
OUTPUT ATN/SFN MOD
PST5
SLV=0
OUTPUT CAD 9,3, SLV
SLV= TLV
TL ACC ?
YES
NO
PST 7
OUTPUT ATN/SFN
107

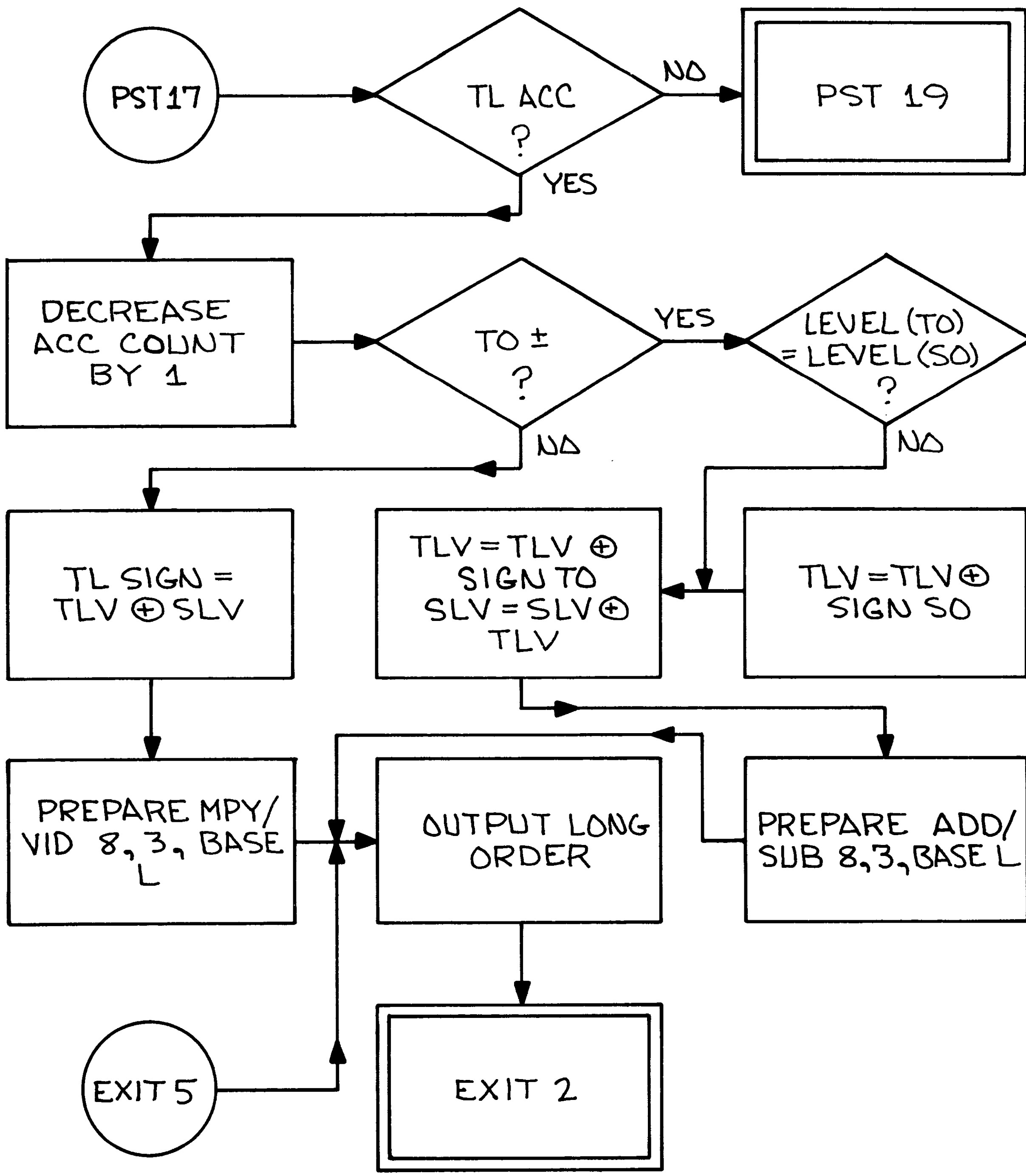

107
SLV=0
PST7
PREPARE MPY 9,3, SLV
TO TYPE ?
*
/
MAKE DIV
EXIT3
EXIT 2
TL=+ACC
OUTPUT LONG ORDER

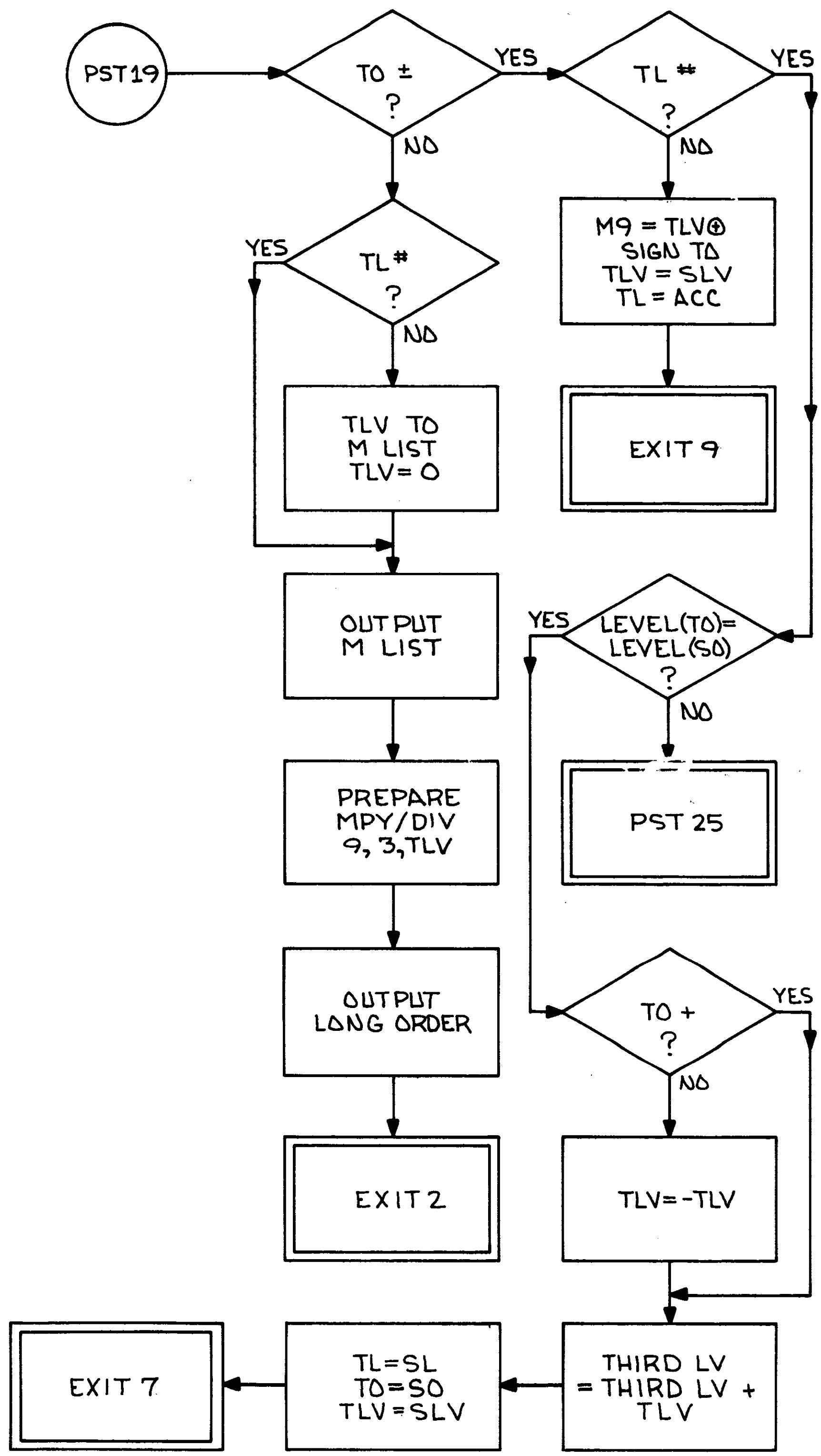

PST9
TO ± ?
YES
PST 13
NO
PREPARE ATN SLV
NO
SLV -ve ?
YES
ATN → SFN
OUTPUT ORDER ATN/SFN
118

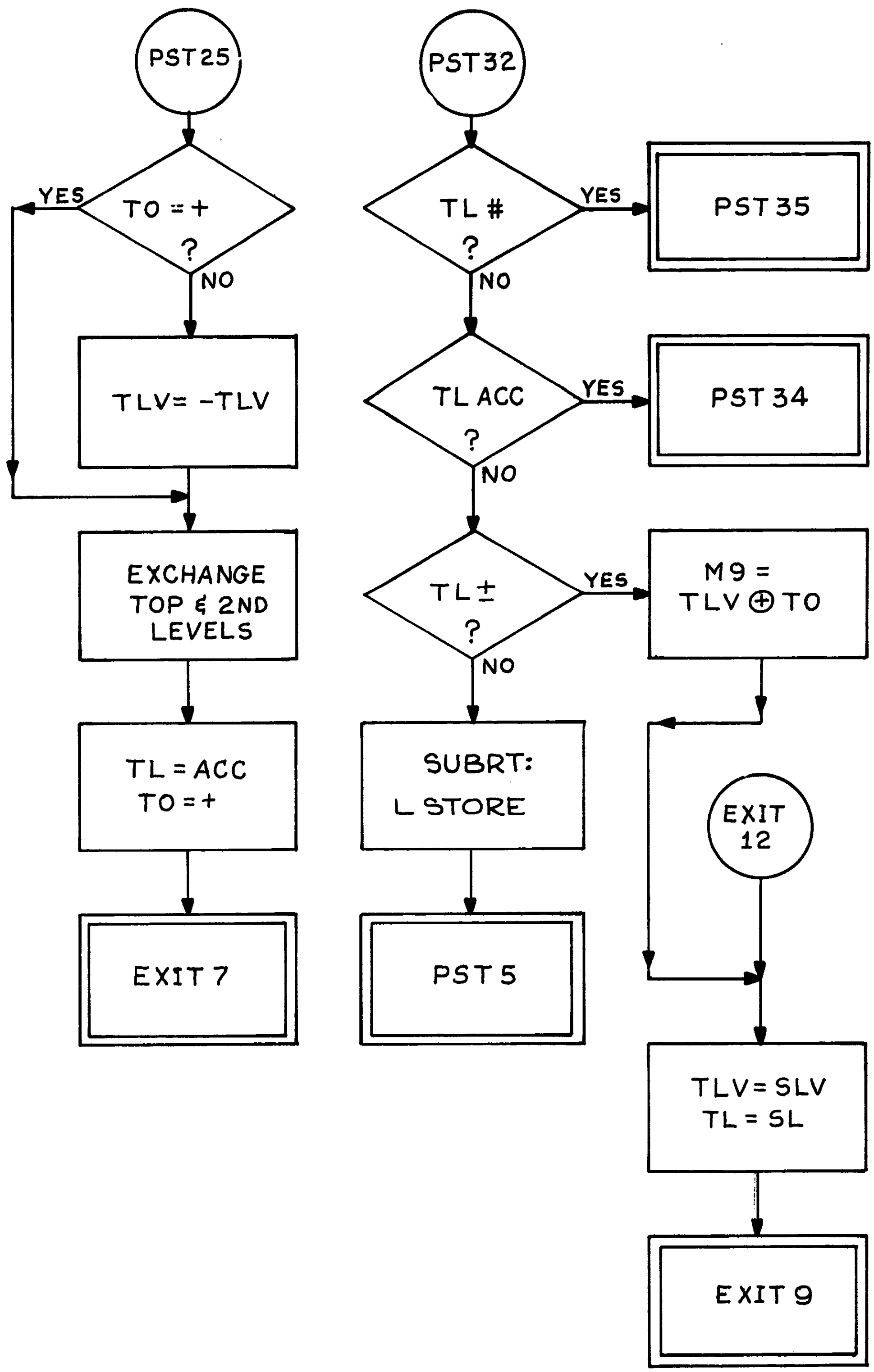

118
SLV=0
PST11
PREPARE MPY 9,3,SLV
TO * OR / ?
/
*
MAKE DIV
OUTPUT LONG ORDER
EXIT 2
PST 13
Δ=0 ?
NO
YES
TL SIGN =TL SIGN ⊕ SIGN TO
EXIT 4
TL = ACC WITH TO SIGN
LEVEL (TO)=0 ?
YES
NO
PST 16
EXIT 1
SL MOD TO M LIST SLV=0
130
EXIT10
M LIST OUTPUT
PREPARE ADD 9,3,SLV

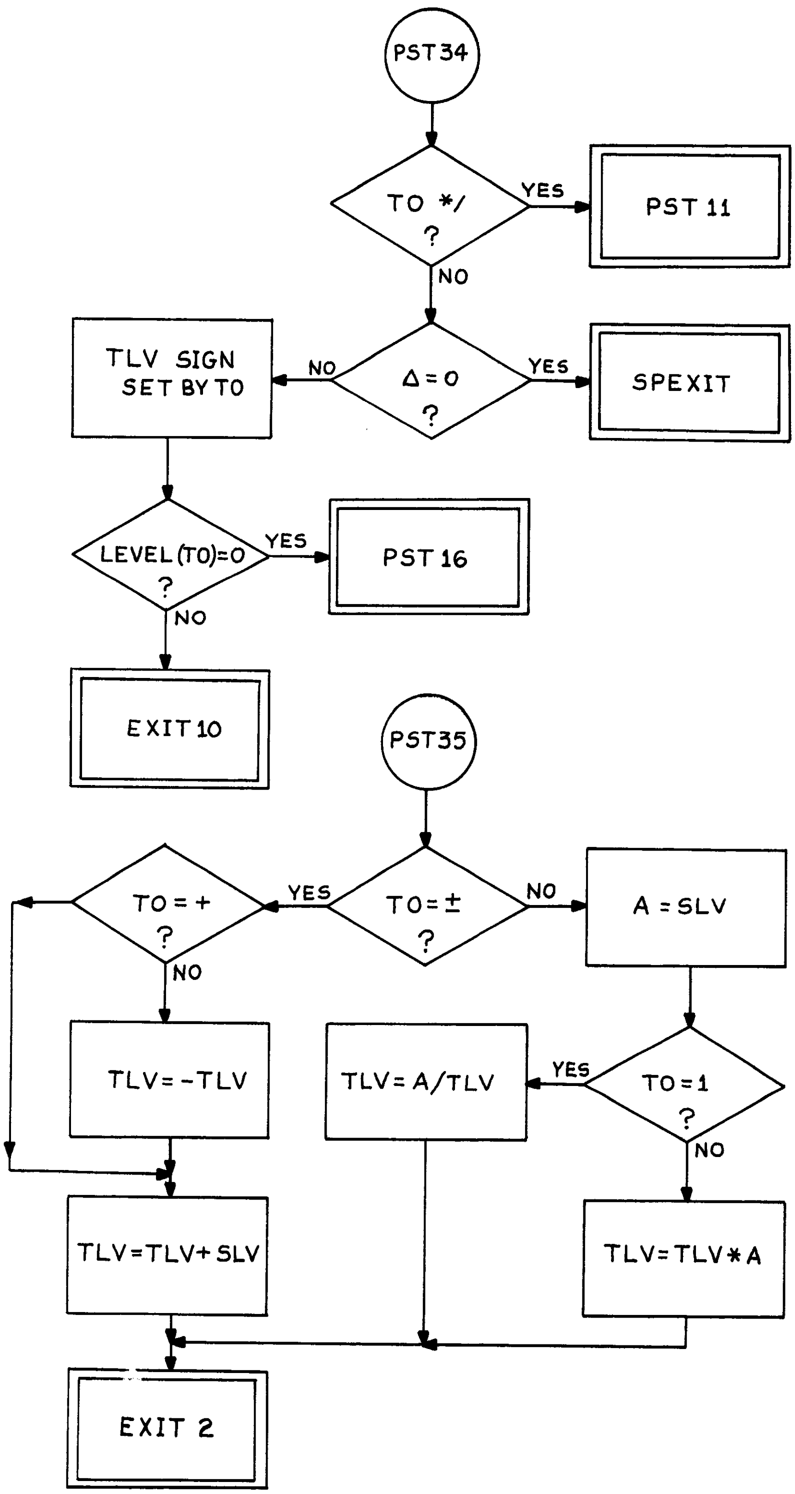

130
SIGN TLV ?
+
−
MAKE SUB
OUTPUT LONG ORDER
EXIT 2


PST 16
TL = SL
TLV = SLV
OUTPUT SIA
EXIT 1

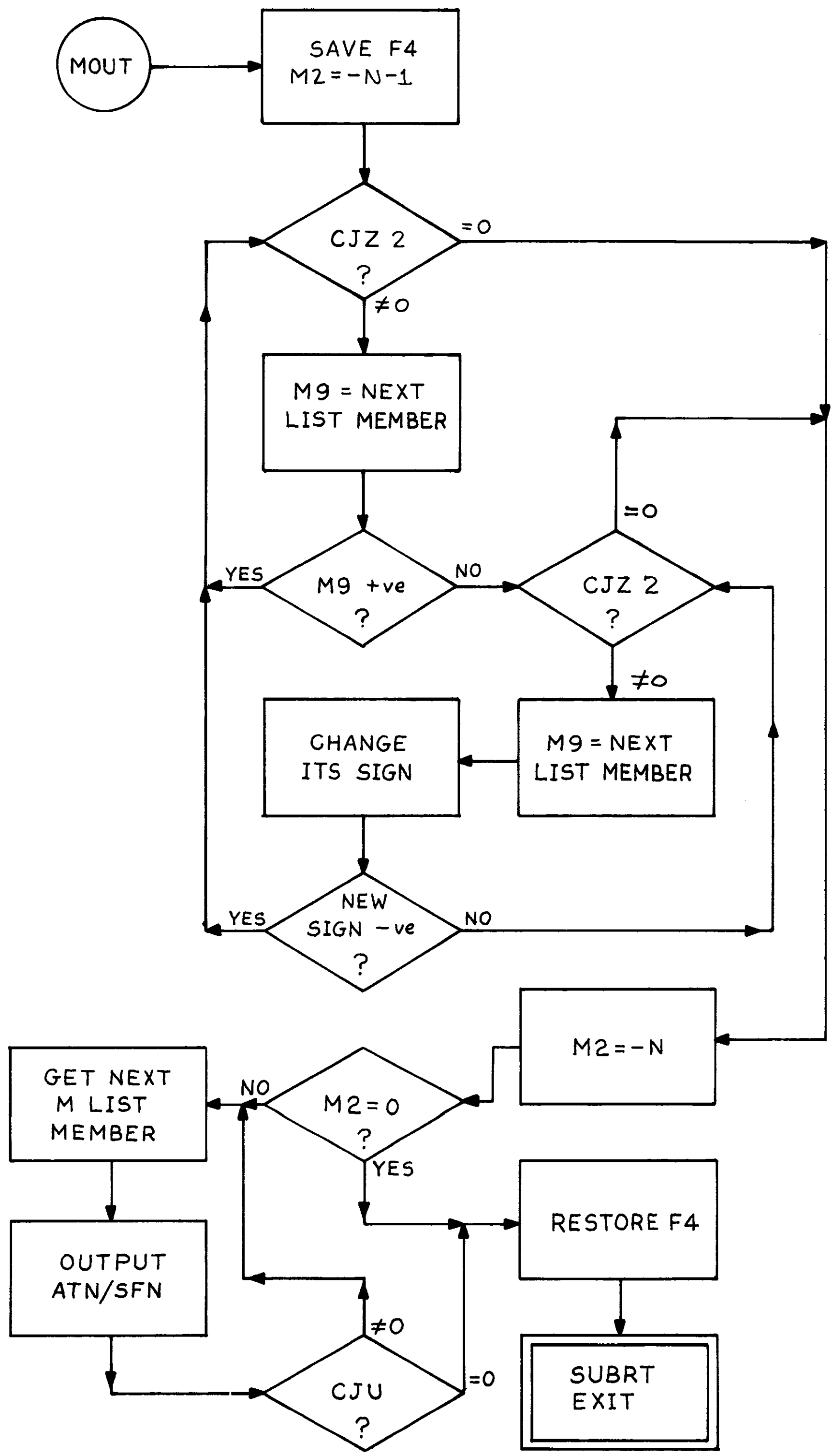

PST17
TL ACC ?
NO
PST 19
YES
DECREASE ACC COUNT BY 1
TO ± ?
YES
LEVEL (TO) = LEVEL (SO) ?
YES
NO
NO
TL SIGN = TLV ⊕ SLV
TLV = TLV ⊕ SIGN TO
SLV = SLV ⊕ TLV
TLV = TLV ⊕ SIGN SO
PREPARE MPY/VID 8, 3, BASE L
OUTPUT LONG ORDER
PREPARE ADD/SUB 8, 3, BASE L
EXIT 5
EXIT 2


PST19
TO ± ?
YES
NO
TL # ?
YES
NO
M9 = TLV⊕ SIGN TO TLV = SLV TL = ACC
EXIT 9
TL # ?
YES
NO
TLV TO M LIST TLV = 0
OUTPUT M LIST
LEVEL(TO)= LEVEL(SO) ?
YES
NO
PST 25
PREPARE MPY/DIV 9, 3,TLV
OUTPUT LONG ORDER
TO + ?
YES
NO
EXIT 2
TLV=-TLV
EXIT 7
TL=SL TO=SO TLV=SLV
THIRD LV = THIRD LV + TLV

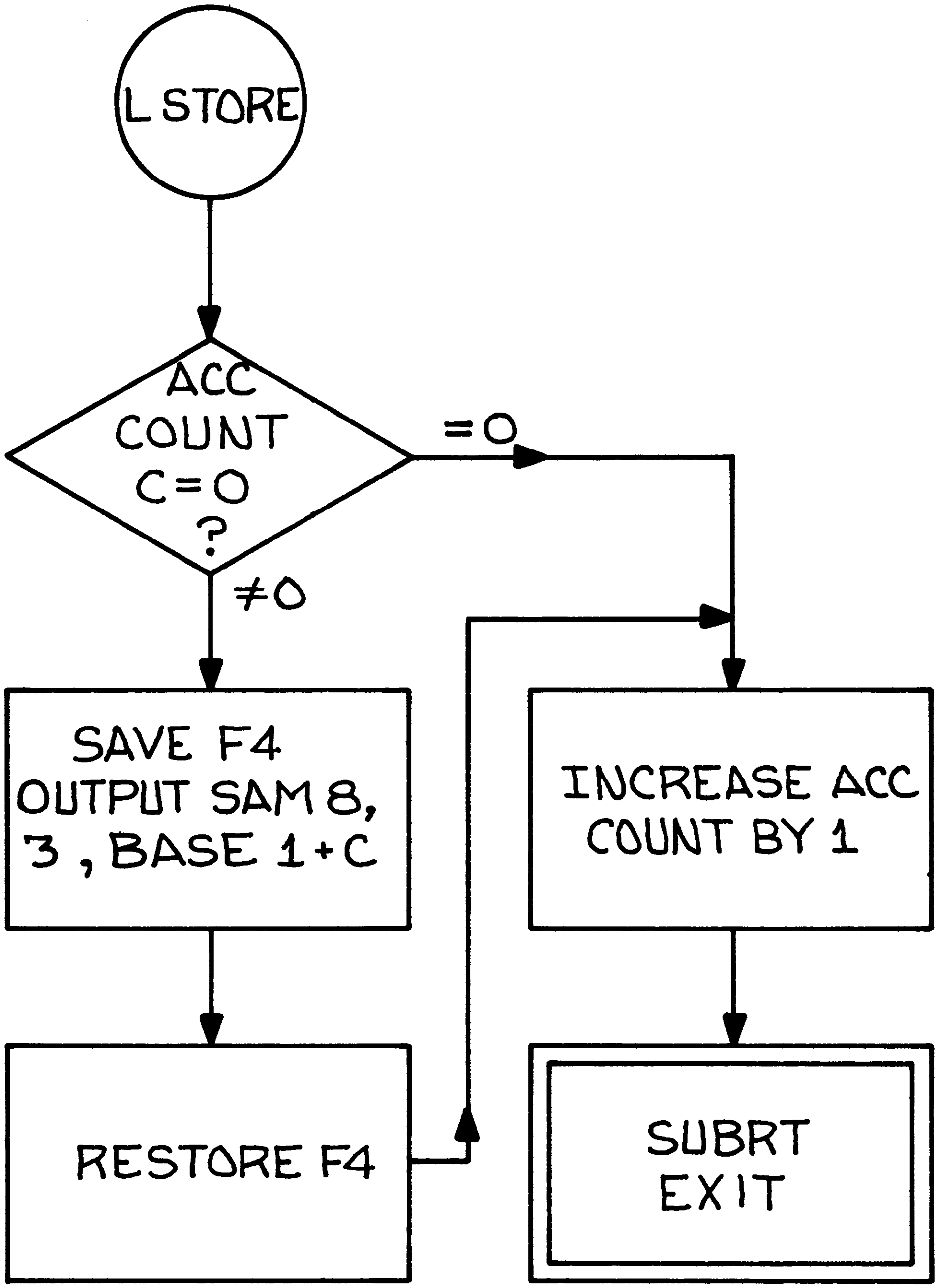

PST25
TO = +
?
YES
NO
TLV= -TLV
EXCHANGE TOP & 2ND LEVELS
TL = ACC
TO = +
EXIT 7
PST32
TL #
?
YES
NO
PST 35
TL ACC
?
YES
NO
PST 34
TL±
?
YES
NO
M9 = TLV ⊕ TO
SUBRT:
L STORE
PST 5
EXIT 12
TLV = SLV
TL = SL
EXIT 9


PST34
TO */
?
YES
PST 11
NO
Δ = 0
?
YES
SPEXIT
NO
TLV SIGN SET BY TO
LEVEL(TO)=0
?
YES
PST 16
NO
EXIT 10
PST35
TO = ±
?
YES
NO
A = SLV
TO = +
?
NO
TLV = -TLV
TO = 1
?
YES
TLV = A/TLV
NO
TLV=TLV+SLV
TLV=TLV*A
EXIT 2

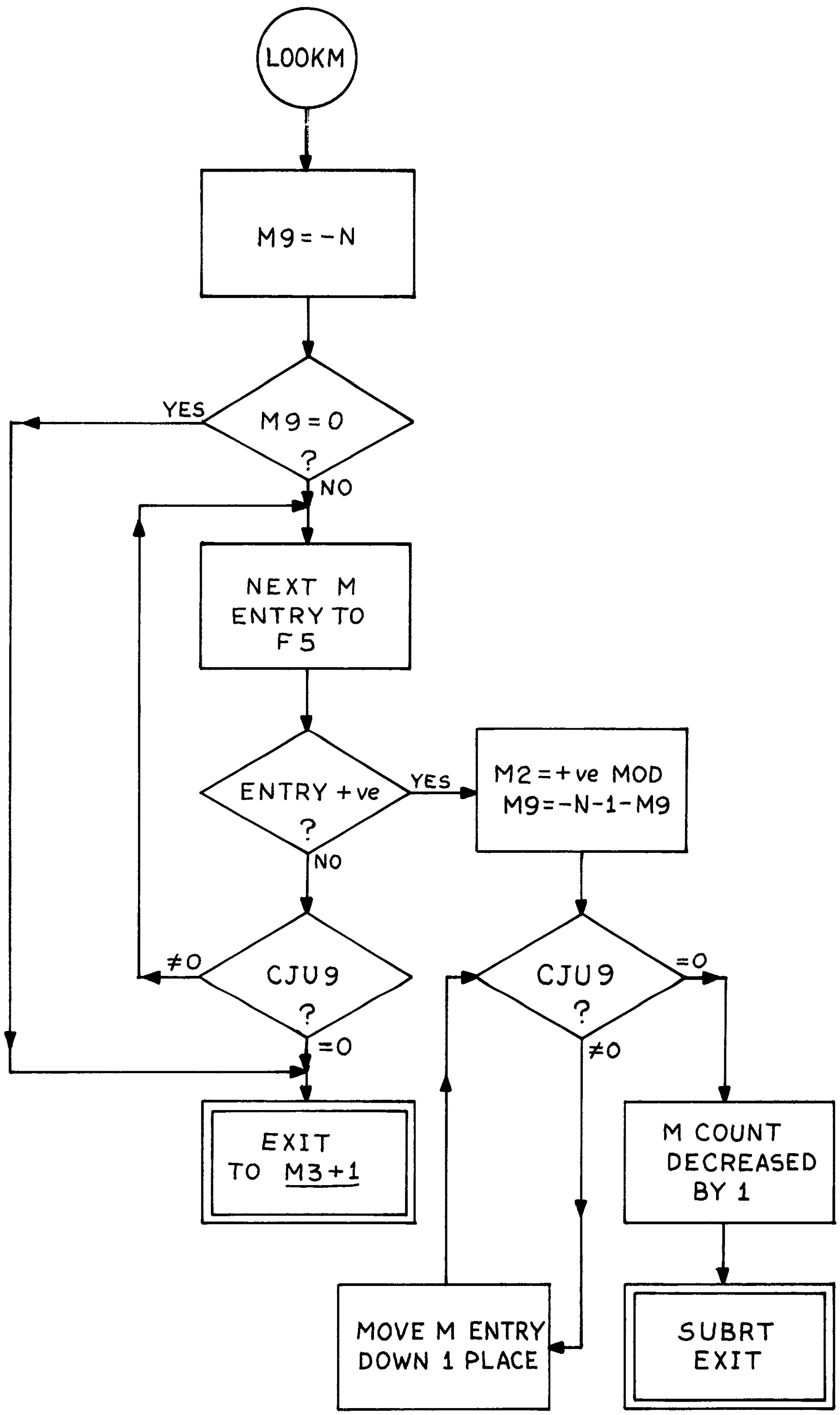
M LIST OUTPUT SUBROUTINE



LSTORE SUBROUTINE



LOOK FOR POSITIVE MODIFIER SUBROUTINE



3.3.8 Error Types of Pass III

Type	Fatal	
0	no	Symbol used in place of a label
1	no	Label used in place of a symbol
2	no	F0 illegally used
3	no	F1 illegally used
4	no	Some other Fast Register illegally used
5	yes	Modifiers used illegally
6	yes	A label or symbol used in place of tag
7	yes	Cannot be executed at computer time
8	yes	Undefined name
9	yes	Double defined name
10	no	Multiple relocation
11	yes	Undefined entry

3.3.9 Pass III Uses of Core

Octal	
00000	ERROR LIST First word is control word; third quarter is count
00400	Intermediate language buffers
01400	
02000	Pass III program
04000	Binary card buffer
04400	Name table
17000	MONITOR

```
 49012C W GEAR
       NICAP  PASS  3    JAN 1,1965                    TAS          P3
SYSTAP EQUS   7680                                                  P3
WRITE  EQUS   512                                                   P3
CHKFL  EQUS   1096                                                  P3
DRUMWD EQUS   7946                                                  P3
TUTRAN EQUS   7947                                                  P3
CHKRC  EQUS   1088                                                  P3
BCKSPF EQUS   1072                                                  P3
BCKSPR EQUS   1064                                                  P3
ERRBUF EQUS   0                                                     P3
SYSAUX EQUS   7938                                                  P3
READ   EQUS   0                                                     P3
WAIT   EQUS   256                                                   P3
LOAD   EQUS   7945                                                  P3
SYSIO  EQUS   7939                                                  P3
WTM    EQUS   1104                                                  P3
REWIND EQUS   1056                                                  P3
SYSTEM EQUS   7936                                                  P3
SYSERR EQUS   7937                                                  P3
       ORG    1024                                                  P3
       CSM    10,256                                                P3
       CAD    BLANKS                                                P3
       SAM    M10+256+BINBUF                                        P3
       CJS    10,0                                                  P3
       TRA    MPROGR                                                P3
       FIL                                                          P3
CWBLOC DECQ   0,0,0,0                                               P3
CC2    DECQ   PUDO,0,0,MLIST                                        P3
CC3    DECQ   0,0,-4,0                                              P3
WRONG  CAM    1,513                                                 P3
ERROR  LFR    7,CWPR                                                P3
       CAM    2,M13                                                 P3
       CALL   SYSERR                                                P3
```

```
OUT2    SFR     5,OUTC
        CSM     4,2             COUNT=2
        TRA     OUT3
OUT1    SFR     5,OUTC
        CSM     4,1             COUNT=1
OUT3    SFR     4,OUTC+1
        SFR     6,OUTC+2
        SFR     7,OUTC+3
        LFR     6,CWDR
        LFR     7,CWPR
OUT4    CAM     5,4+M10
        JUM     5,OUT5          INITIAL POSN
        CALL    SBOCTL          INSERT LOCATION
OUT5    CAM     5,5+M10
        CALL    SBOCTP          CODE CONVERSION
        CJU     10,OUT6         END OF WORD
        CALL    SBPR            PRINT
        CSM     10,4            RESET Q-W-C
        ADM     11,1            INCREMENT W-C
OUT6    LFR     4,OUTC+1
        CAM     0,M1
        SFR     4,OUTC+4
        LFR     4,RELOC
        SFR     4,RELOCT
        CAM     2               CLEAR RELOC BITS
        SFR     4,RELOC
        LFR     4,OUTC+4
        CJU     4,OUT4          OUT 2
        SFR     6,CWDR
        LFR     4,OUTC+1
        LFR     5,OUTC
        LFR     6,OUTC+2
        LFR     7,OUTC+3
        JLH     M3
```

```
OUTC    BSS     5
SBRD    SFR     5,SBRC
        SFR     4,SBRC+1
        LFR     5,CWPR
        JNM     4,SBRD2          NO LISTING
        JNM     6,SBRD2          MACRO
        ANM     7,4095           SWITCH TO PRINT
        ADM     5,1              INCREMENT CC
        CAM     1,M5
        CALL    DECVT
        SAM     PRBUF            DEC CC
SBRD1   ANN     6,4095
        LFR     4                NEXT ERROR
        SBM     0,M5
        JUM     0,SBRD2A         NO ERRORS ON CARD
        CAD     ASTER            INSERT *
        SAM     PRBUF+1
        ADM     6,1              INCREMENT ERROR COUNT
        TRA     SBRD1
SBRD2A  SFR     5,CWPR
        LFR     5,RDCON
        JZM     4,SBRD3+1        NO WAIT DURING TRANSFER
        CAM     5,INBUF
        CALL    SYSAUX
SBRD3   DECQ    WAIT,0,0,0
        CSM     4,10              RESET CARD COUNT
        CAM     0,PRBUF+7
        FLD
        CAD     5,1,
        SAM     0,1,             CLEAR BUFFER
        CJF     4,0
        CJU     6,SBRD4+1        NOT END OF CARD YET
        CAM     4,1              SET WAIT BIT
        CSM     6,25             CARD BUFFER COUNT
```

```
        JZM    7,SBRD5             ALREADY TAPE 6
        LFR    4,SBRD4
        CAM    3,M7+6              SET UP DRUM BLOCK ADDRESS
        SFR    4,SBRD4
        CJU    7,SBRD5             STILL DRUM
        CAM    3,1030              SET UP TAPE 6 ADDRESS
        SFR    4,SBRD4
        LFR    4,SBRD3
        CAM    3,1030              IN WAIT CALL TOO
        SFR    4,SBRD3
SBRD5   CALL   SYSAUX
SBRD4   DECQ   READ,INBUF,0,0      READ
        SFR    5,RDCON
SBRD2   LFR    5,SBRC
        LFR    4,SBRC+1
        JLH    M3
SBRC    BSS    2
ASTER   CHR    1,*
SBPR    SFR    4,SBPC
        SFR    5,SBPC+1
        LFR    5,PRBUF+2
        ORM    7,44                * BETWEEN LOCATION AND CONTENTS
        SFR    5,PRBUF+2
        LFR    5,CWPR
        JNM    4,SBPR2             NO LIST
        JNM    7,SBPR2              NO PRINT OUT
        CALL   SYSIO
        DECQ   WRITE+2,PRBUF,0,0 LIST PROGRAM
        CAD    08,3,BLANKS
        CAM    0,PRBUF
        CSM    3,17
SBPR1   SAM    0,1,
        CJU    3,SBPR1             CLEAR PRBUF
        ORM    7,4096              RESET SWITCH
```

```
        SFR     5,CWPR                                                  P3  136
SBPR2   LFR     4,SBPC                                                  P3  137
        LFR     5,SBPC+1                                                P3  138
        JLH     M3                                                      P3  139
SBPC    BSS     2                                                       P3  140
RDCON   DECQ    1,INBUF,-25,-4      --,BEFFER ADDRESS,CARD COUNT,BLOCK COUNP3  141
SBOCTL  ORB     11                                                      P3  142
SBOCTP  CAM     1,M0                                                    P3  143
        SFR     4,SBOCTC                                                P3  144
        CAM     3,SBOCT5                                                P3  145
        ANM     15,4095            SET PRINT SWITCH ON                  P3  146
        SFR     7,CWPR                                                  P3  147
        SFR     6,CWDR                                                  P3  148
        JNM     12,BINART          NO LIST                              P3  149
        CAM     10                                                      P3  150
        CSM     15,5                BINARY TO OCTAL CONVERSION          P3  151
        CRM     1,12                                                    P3  152
        ANM     1,3,1                                                   P3  153
        CAM     9                                                       P3  154
SBOCT1  JUM     9,SBOCT2                                                P3  155
        CAM     9,10                                                    P3  156
SBOCT2  CRM     10,7                                                    P3  157
        ADM     10,M9                                                   P3  158
        CJZ     15,SBOCT4                                               P3  159
        CRM     15,1                                                    P3  160
        JNM     15,SBOCT3                                               P3  161
        CAM     12,M13                                                  P3  162
        CAM     13,M10                                                  P3  163
        CAM     10                                                      P3  164
SBOCT3  CRM     15,12                                                   P3  165
        CRM     1,10                                                    P3  166
        ANN     1,7                                                     P3  167
        CAM     9                                                       P3  168
        TRA     SBOCT1                                                  P3  169
```

```
SBOCT4 CAM    14,M10
       CAM    15
       SFR    7,PRBUF+2+M5
       JUM    5,BINARY         NOT LOCATION
       LFR    7,CWPR
       CAM    1,M11
       CALL   DECVT            DECIMAL LOCATION
       LOR    PRBUF+1
       SAM    PRBUF+1
BINART JZM    5,SBOCT5         LOCATION
BINARY SFR    5,BINCD
       SFR    6,BINCD+1
       SFR    7,BINCD+2
       SFR    4,BINCD+3
       LFR    5,BINCD1
       LFR    6,BINCD2
       CAM    2,M8             WORD COUNT ON CARD
       CAM    8,M0             WORD
       CAM    12,M6+M5+18
       JZM    12,BINIT         INITIAL ENTRY FOR CARD
BINI1  LFR    7,BINSTO
       LFR    5,RELOC
       CAM    0,M7             BUFFER ADDRESS
       LFR    5,RELOCT
       CRM    6,7
       ANN    6,3
       ADM    15               RELOC BITS
       EOM    6,3
       JPM    6,BIN2           NONERASEABLE
       CAM    1,10
       CALL   SBERR
       SBM    15,3
BIN2   ANN    8,4096            SIGN BIT
       ADM    15
```

```
         CRM   15,10                                        P3  204
         CJU   9,BIN3                                       P3  205
         CSM   9,4                                          P3  206
         CRM   15,2                                         P3  207
         CJU   10,BIN30                                     P3  208
         SFR   7,M11+M0+6      STORE CONSTRUCTED WORD       P3  209
         LFR   7,BLANKS                                     P3  210
         CJU   11,BIN4                                      P3  211
         CSM   10,2                                         P3  212
         CSM   11,4                                         P3  213
         TRA   BIN3                                         P3  214
BIN4     CSM   10,4                                         P3  215
         TRA   BIN3                                         P3  216
BIN30    CAM   12,M13                                       P3  217
         CAM   13,M14                                       P3  218
         CAM   14,M15                                       P3  219
         CAM   15                                           P3  220
BIN3     SFR   7,BINSTO                                     P3  221
         LFR   5,BINCD1                                     P3  222
         LFR   7,BINSTO+1                                   P3  223
         CAM   12,M13          SHIFT 12 BITS                P3  224
         CAM   13,M14                                       P3  225
         CAM   14,M15                                       P3  226
         CAM   15,M8                                        P3  227
         SFR   6,BINCD2                                     P3  228
         CJU   5,BINEND                                     P3  229
         CSM   5,4                                          P3  230
         SFR   7,M0+M6+20                                   P3  231
         LFR   7,BLANKS                                     P3  232
         ADM   2,1              INCREMENT WORD COUNT ON CARD  P3  233
         CJU   6,BINEND                                     P3  234
         CSM   6,14                                         P3  235
         LFR   7,M0+2           COLUMNS 9-12 ON CARD        P3  236
         LFR   6,BINSTO+2                                   P3  237
```

```
        CAM     12,M2+M8
        CAM     13,M9
        CAM     2                 CLEAR WORD COUNT ON CARD
        SFR     7,M0+2
        LFR     7,BLANKS
        JPM     4,BIN5            NO PUNCHED CARDS
        LFR     6,BINAR
        LDM     11,RELOC
        CAM     9,M11
        SFR     6,BINAR
        CALL    SYSIO
BINAR   DECQ    WRITE,BINBUF,0,0  OUTPUT BINARY CARD
BIN5    LFR     6,RELOC
        ADM     11,20             INCREMENT CARD LOCATION
        CJU     7,BINEA
        ANN     4,2048             GO BIT
        CJS     10,0
        TRA     MPROGR
        CAM     3
        JZM     3,BIN5A           NO OUTPUT OF BINARY PROGRAM ONTO TAPE
        CALL    SYSAUX            BINARY TO TAPE 7
        DECQ    WRITE,BINBUF,0,1031
        CALL    SYSAUX
        DECQ    WAIT,0,0,1031
BIN5A   CSM     7,12
        CAM     11,BINBUF
        CSM     3,256
        CAD     BLANKS
        FLD
        SAM     M3+256+BINBUF
        CJF     3,0
BINEA   SFR     6,RELOC
BINEND  SFR     7,BINSTO+1
        SFR     5,BINCD1
```

```
        LFR    6,BINCD2
        CAM    8,M2
        SFR    6,BINCD2
        LFR    5,BINCD
        LFR    6,BINCD+1
        LFR    7,BINCD+2
        LFR    4,BINCD+3
        JLH    M3
BINIT   CAM    15
        CAM    12,5
        CAM    13
        CAM    14
        LFR    5,RELOC
        SFR    7,M7
        LFR    5,CWDR
        CAM    13,M7               INITIAL LOCATON
        JPM    13,BINIT1            SIGN BIT OF LOCATION
        ORM    12,16
BINIT1  ANM    12,16
        SFR    7,BINSTO+2
        TRA    BINI1
BINCD   BSS    5
RELOCT  BSS    1
RELOC   DECQ   ,,,BINBUF
BINCD2  DECQ   0,-4,-2,-4          --,GROUP OF 3, Q-WORD,WORD
BINCD1  DECQ   -1,-4,-14,-12       CARD-TAPE CONTROL,Q-WORD,WORD,CARD
BINSTO  BSS    3
SBOCT5  LFR    7,CWPR
        LFR    4,SBOCTC
        LFR    6,CWDR
        JLH    M3
        FIL
SBOCTC  BSS    3
CWPR    DECQ   0,0,1,0
```

```
CWDR    DECQ   0,0,-4,0                                      P3  306
BLANKS  DECQ   0,0,0,0                                       P3  307
SBERR   SFR    4,SBERR2                                      P3  308
        SFR    7,SBERR2+1                                    P3  309
        LFR    7,CWPR                                        P3  310
        LDM    15,2,0                                        P3  311
        CAM    0,M13           CARD CPUNT                    P3  312
        ATN    15,1,                                         P3  313
        CAM    12,-256                                       P3  314
        JNM    12,SBERR1       TOO MANY ERRORS               P3  315
        CAM    1,514                                         P3  316
        TRA    ERROR                                         P3  317
SBERR1  SFR    4,M15                                         P3  318
        SFR    7,0                                           P3  319
        LFR    4,PRBUF+1                                     P3  320
        CAM    0,2816                                        P3  321
        SFR    4,PRBUF+1                                     P3  322
        LFR    4,SBERR2                                      P3  323
        LFR    7,SBERR2+1                                    P3  324
        JLH    M3                                            P3  325
SBERR2  BSS    2                                             P3  326
DECVT   CAD    M1+4096.       OCTAL TO DECIMAL CONVERSION    P3  327
        SUB    4096.                                         P3  328
        SFR    4,GDECV1                                      P3  329
        SFR    5,GDECV1+1                                    P3  330
        ADD    10,3,2048                                     P3  331
        DIV    100.                                          P3  332
        CAM    7                                             P3  333
        CAM    4                                             P3  334
        DIV    100.                                          P3  335
        CSM    1,3                                           P3  336
        CSM    2,1                                           P3  337
GDECV2  SIA    0                                             P3  338
        SUB    M0.                                           P3  339
```

```
         JZM     7,GDECV3
         JUM     0,GDECV3
         CAM     0,10
GDECV3   CJZ     2,GDECV5
         CAM     5,M6
         CAM     6,M7
         CAM     7,M0
GDECV4   MPY     10.
         TRA     GDECV2
GDECV5   CRM     7,7
         ADM     7,M0
         CSM     2,2
         CJU     1,GDECV4
         CAD     F5
         LFR     4,GDECV1
         LFR     5,GDECV1+1
         JLH     M3
GDECV1   BSS     2
PSEUDO   CALL    INPUT
         ANN     4,7936             EXTRACT BITS
         CAM     3
         CRN     3,8
         CSM     3
         JZM     3,FIL
         CJZ     3,FLD
         CJZ     3,BESS1
         CJZ     3,BESS2
         CJZ     3,ORG
         CJZ     3,COMMN1
         CJZ     3,GOT
         CJZ     3,ERASE
         CJZ     3,ASSIGN
         CJZ     3,CALL
         CJZ     3,DECQ
```

```
        CJZ   3,IO              PSEUDO ORDER
        CJZ   3,OCTQ
        ADM   3,1
        CJZ   3,DECHR
        CJZ   3,DECHR
        CJU   3,WRONG
COMMN1  CALL  INPUT
        TRA   READRF
ERASE   CALL  INPUT
        TRA   READRF
CALL    CALL  INPUT
        LFR   4,M4
        ANN   2,3
        ATN   8,3,3980
        CAM   0
        CAM   1,M3
        LFR   5,RELOC           SET RELOC BIT
        ANN   2,384
        CAM   6
        SFR   5,RELOC
        CALL  OUT2
        CALL  SBFIL
        TRA   READRF
SBFIL   SFR   4,SBFIL1
        LFR   04,2,CWDR
        ADM   02,3,4
        CAM   00,,
        JZM   00,0,BF2
        CAM   0,2,1473            OCT CAM0,1
        CALL  OUT1
        TRA   2,SBFIL
BF2     LFR   4,SBFIL1
        JLH   03,,
SBFIL1  BSS   1
```

```
G1       CAM    0,2,1473                                       P3  408
         JSB    03,0,OUT1                                      P3  409
         FIL                                                   P3  410
FIL      LFR    06,2,CWDR                                      P3  411
         ANM    04,3,3                                         P3  412
         CSM    00,1,                                          P3  413
         ADM    10,2,4                                         P3  414
         JZM    10,0,READRF                                    P3  415
         JNM    10,,G1                                         P3  416
         SBM    10,2,4                                         P3  417
         JUM    10,,G1                                         P3  418
         JDC    00,0,READRF                                    P3  419
FD1      CAM    0,2,1473         OCT CAM0,1                    P3  420
         JSB    03,0,OUT1                                      P3  421
         FIL                                                   P3  422
FLD      LFR    06,2,CWDR                                      P3  423
         CRM    11,2,11                                        P3  424
         ANM    11,3,4                                         P3  425
         ADM    10,2,4                                         P3  426
         ANM    04,3,7                                         P3  427
         CSM    00,1,                                          P3  428
         ADM    10,,                                           P3  429
         JZM    10,0,READRF                                    P3  430
         JNM    10,0,FD1                                       P3  431
         SBM    10,2,8                                         P3  432
         JUM    10,0,FD1                                       P3  433
         JDC    00,0,READRF                                    P3  434
DECHR    JSB    03,0,SBFIL                                     P3  435
         FIL                                                   P3  436
OCTQ     ANM    4,3,248          OCT370                        P3  437
         CAM    02,,                                           P3  438
         CRM    02,3,3                                         P3  439
         CSM    2              NO OF BYTES TO BE OUTPUT        P3  440
DC1      JSB    03,0,INPUT                                     P3  441
```

```
         FIL                                                   P3  442
         ATN     04,,                                          P3  443
         CAM     00,,                                          P3  444
         CALL    OUT1              OUTPUT ONE CHARACTER        P3  445
         CJU     02,0,DC1                                      P3  446
         JDC     00,0,READRF                                   P3  447
IO       CALL    SBFIL                                         P3  448
DECQ     ANM     4,3,248             OCT370                    P3  449
         CAM     02,,                                          P3  450
         CRM     02,3,3                                        P3  451
         CSM     02,,                                          P3  452
DQ1      JSB     03,0,SBCOMP                                   P3  453
         FIL                                                   P3  454
         ATN     13,,                                          P3  455
         CAM     00,,                                          P3  456
         LFR     6,RELOC                                       P3  457
         CAM     10,M9                                         P3  458
         CAM     9                                             P3  459
         SFR     6,RELOCT                                      P3  460
         CAM     10                                            P3  461
         SFR     6,RELOC                                       P3  462
         CALL    OUT1              OUTPUT ONE CHARACTER        P3  463
         CJZ     02,0,READRF                                   P3  464
         JSB     03,0,INPUT                                    P3  465
         FIL                                                   P3  466
         ANM     5,2,8176            OCT17760                  P3  467
         ANM     04,3,15                                       P3  468
         ADM     05,,                                          P3  469
         JDC     00,0,DQ1                                      P3  470
ASSIGN   JSB     03,0,SBFIL                                    P3  471
         FIL                                                   P3  472
         ANM     4,3,248             OCT370                    P3  473
         CAM     13,,                                          P3  474
         CRM     13,3,3                                        P3  475
```

```
         CSM    13,,
         JZM    13,0,READRF
         ATN    13,,
         ATN    13,,
         CAM    15,,
ASS1     JSB    03,0,INPUT
         FIL
         CJU    13,0,ASS1
LASS     CAM    00,,
         CAM    01,,
ASS2     JSB    03,0,OUT2
         FIL
         CJU    15,0,ASS2
         TRA    READRF
BESS1    SFN    4                 BSS
BESS2    CSM    6,2               BES
         SFR    5,BESTO
         SFN    4
ORG      CSM    6,2
         SFR    4,BESSC+2
         CALL   SBFIL
         CALL   SBCOMP
         CAM    15,M6
         TRA    BESSA
         FIL
GO2      JSB    03,0,INPUT
         FIL
         ATN    04,,
         LFR    04,,
         ANM    02,3,3
         ADM    08,,
         SFR    5,BESSC+2
         LFR    07,2,CC3
         SFR    06,2,COMMON-3
```

```
        LFR    06,2,CC2                             P3  510
        CAM    06,,                                 P3  511
        CAM    07,,                                 P3  512
        ATN    11,1,                                P3  513
        SFR    05,,                                 P3  514
        CAM    3,2,GO3         NOTE                 P3  515
        SFR    4,2,COMMON-1    NOTE                 P3  516
        JDC    00,0,NAME                            P3  517
GOT     SFR    4,BESSC+2                            P3  518
        CALL   SBFIL                                P3  519
        LFR    4,BINBUF+240                         P3  520
        CAM    0,4096          SET GO BIT IN BUNBUF P3  521
        SFR    4,BINBUF+240                         P3  522
        CSM    6,1                                  P3  523
        LFR    6,CWDR                               P3  524
GO      ANM    04,3,3                               P3  525
        CAM    8                                    P3  526
        ANM    05,3,7                               P3  527
        CAM    00,2,-2                              P3  528
        JZM    00,0,GO2                             P3  529
        SFR    5,BESSC+2                            P3  530
        JSB    03,0,SBCOMP                          P3  531
        FIL                                         P3  532
GO3     CRM    8,2                                  P3  533
        CALL   SBPR                                 P3  534
        ANN    8,1                                  P3  535
        ADM    13                                   P3  536
        LFR    5,BLANKS                             P3  537
        CRN    8,4                                  P3  538
        CAM    4               Q-WORD GO ADDRESS    P3  539
        SFR    6,BESSC+1                            P3  540
        LFR    6,RELOC                              P3  541
        LFR    4,BINSTO+2                           P3  542
        ANM    0,31                                 P3  543
```

```
         ORM    0,M4+1024         Q--WORD AND SET GO BIT            P3  544
         CAM    4                                                   P3  545
         CAM    7,M13              GO ADDRESS                       P3  546
         SFR    5,M11+1                                             P3  547
         JPM    13,BESSO                                            P3  548
         ORM    0,512             CARRY FROM ADDRESS OF GO          P3  549
BESSO    SFR    4,BINSTO+2                                          P3  550
         LFR    5,BESSC+2                                           P3  551
         CAM    15,M6                                               P3  552
BESSA    SFR    5,BESSC                                             P3  553
         LFR    5,BINCD1                                            P3  554
         CAM    12,M6+14                                            P3  555
         JZM    12,BEGO           INITIAL ENTRY ON CARD             P3  556
BESSG    LFR    6,RELOC                                             P3  557
         CAM    10                 CLEAR RELOC BITS                 P3  558
         SFR    6,RELOC                                             P3  559
         LFR    6,BINCD2                                            P3  560
         CAM    5,M8                                                P3  561
         JNM    15,BESSB                                            P3  562
         CAM    3,M6+M13           AMT-WORDS LEFT ON CARD           P3  563
         JNM    13,BESSB                                            P3  564
         JNM    3,BESSE                                             P3  565
BESSB    SFN    M6+M13                                              P3  566
BESSE    CSM    7,M13                                               P3  567
BDSSF    LFR    6,BINCD2                                            P3  568
         JPM    15,BDSSF1         ALLOW CARD COUNT FOR BSS AND BES  P3  569
         CAM    8,M5-1                                              P3  570
         SFR    6,BINCD2                                            P3  571
BDSSF1   CSM    11,4                                                P3  572
         JZM    7,BESSD1                                            P3  573
         CAM    0                                                   P3  574
BESSD    CALL   BINARY            FINISH CARD                       P3  575
         CJU    11,BESSD                                            P3  576
         CJU    7,BDSSF                                             P3  577
```

```
BESSD1 CJU     15,BEXIT
BEGOT  LFR     6,BINCD1
       ADM     11,12
       JZM     11,ENDP2              LAST BINARY BLOCK ALREADY WRITTEN
       ANM     8,2048
       JZM     8,ENDP2               NO OUTPUT OF BINARY TAPE
       CALL    SYSAUX
       DECQ    WRITE,BINBUF,0,1031
ENDP2  CALL    SYSAUX
       DECQ    WAIT,0,0,1031
       LFR     07,2,ERRBUF                     F
       SFN     15,,
       CAM     14,2,1
       JPM     14,0,SWAPR3                     3
       CAM     15,2,1
SWAPR2 ATN     14,,
       CAM     13,,
       ATN     15,2,1
       CAM     12,,
       ATN     15,,
       LFR     06,,
SWAPR1 ATN     12,1,
       LFR     05,,
       SFN     08,,
       ATN     04,,
       CAM     02,,
       JPM     02,0,SWAPR4                     4
       CAD     05,3,
       ATN     12,2,-1
       SFR     06,,
       SAM     06,3,
SWAPR4 CJU     13,0,SWAPR1                     1
       ATN     15,1,
       SFR     06,,
```

```
        CJU    14,0,SWAPR2                      2                    P3  612
SWAPR3  LFR    7,BLANKS                                              P3  613
        ORM    15,1024                                               P3  614
        TRA    SYSTEM                                                P3  615
BEGO    CJU    15,BEXIT          NOT GO                              P3  616
        LFR    5,BINSTO+2                                            P3  617
        CAM    0                                                     P3  618
        CSM    11,4                                                  P3  619
BEGO1   CALL   BINARY                                                P3  620
        CJU    11,BEGO1          OUTPUT ONE WORD ON GO CARD          P3  621
        LFR    6,BINSTO+2                                            P3  622
        ANN    4,896                                                 P3  623
        ADM    8,1024             GO BIT                             P3  624
        SFR    6,BINSTO+2                                            P3  625
        SBM    15,1              RESTORE M15                         P3  626
        CAM    5                                                     P3  627
        CSM    7,13                                                  P3  628
        TRA    BDSSF                                                 P3  629
BEXIT   LFR    6,CWDR                                                P3  630
        JNM    15,BEXIT1         ORG                                 P3  631
        CAM    2,M11                                                 P3  632
        LFR    5,BESTO                                               P3  633
        JPM    6,BEXITA          BSS                                 P3  634
        ADM    11,M13                                                P3  635
BEXITA  SFR    7,BESTO                                               P3  636
        LFR    7,STARS                                               P3  637
        SFR    7,PRBUF+3                                             P3  638
        SFR    7,PRBUF+4                                             P3  639
        SFR    7,PRBUF+5                                             P3  640
        SFR    7,PRBUF+6                                             P3  641
        LFR    7,CWPR                                                P3  642
        CAM    5                 LOCATION                            P3  643
        CALL   SBOCTL                                                P3  644
        LFR    7,BESTO                                               P3  645
```

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        CAM     11,M2                                P3   646
        ATN     M11                                  P3   647
BEXIT1  CAM     11,M13                               P3   648
        SFR     6,CWDR                               P3   649
BEXIT2  LFR     5,BESSC                              P3   650
        LFR     6,BESSC+1                            P3   651
        LFR     4,BESSC+2                            P3   652
        TRA     READRF                               P3   653
BESTO   BSS     1                                    P3   654
STARS   OCTQ    5454,5454,5454,5454                  P3   655
RCARD   CALL    SBRD                                 P3   656
RREF    CALL    INPUT                                P3   657
        CAM     5,M4                                 P3   658
        JPM     5,D10               MAME CHECK       P3   659
        CALL    INPUT                                P3   660
D10     CRN     5,4                                  P3   661
        CSM     3                                    P3   662
        ORM     3,-4               17774             P3   663
        CJZ     3,ORDER                              P3   664
        CJZ     3,PSEUDO                             P3   665
        CRN     5,6                                  P3   666
        CSM     3,1                                  P3   667
        ORM     3,-16              17740             P3   668
        CJZ     3,MACBEG                             P3   669
        CJZ     3,MACEND                             P3   670
READRF  CALL    SBPR                                 P3   671
        LFR     6,RELOC                              P3   672
        CAM     9                                    P3   673
        SFR     6,RELOC                              P3   674
        TRA     RCARD                                P3   675
MACEND  LFR     7,CWPR                               P3   676
        ANM     14,4095                              P3   677
        SFR     7,CWPR                               P3   678
        TRA     READRF                               P3   679
```

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MACBEG LFR    7,CWPR                                              P3  680
       ORM    14,4096                                             P3  681
       SFR    7,CWPR                                              P3  682
       TRA    RREF                                                P3  683
ORDER  CALL   INPUT                                               P3  684
       CAM    12,M4                                               P3  685
       ANM    5,3,960           EXTRACT SUBTYPE                   P3  686
       CAM    14,,                                                P3  687
       CRM    14,2,10                                             P3  688
       SFR    07,2,COMMON+2                                       P3  689
       ANM    5,3,1024             OCT2000                        P3  690
       CAM    03,,                                                P3  691
       JZM    03,0,TSM          TAG BIT OFF                       P3  692
       ATN    04,,                                                P3  693
       LFR    04,,              NAME TABLE LOOKUP                 P3  694
       ATN    03,,                                                P3  695
       CAM    12,,              VALUE OF NAME                     P3  696
       ANM    02,3,16                                             P3  697
       CAM    09,,                                                P3  698
       JUM    09,0,UNDEFT       TAG NOT DEFINED                   P3  699
       ANM    02,3,12                                             P3  700
       CAM    09,,                                                P3  701
       JZM    09,0,LORST        SYMBOL                            P3  702
       SBM    09,2,12                                             P3  703
       JZM    09,0,LORST        LABEL                             P3  704
       ADM    09,2,4            M9=0 IF MODIFER                   P3  705
       JZM    09,0,TT1                                            P3  706
       CAM    09,2,1                                              P3  707
TT1    JSB    03,0,INPUT                                          P3  708
       FIL                                                        P3  709
       ANM    4,3,8131          ORDER BYTE                        P3  710
       ADM    12,,                                                P3  711
       SFR    07,2,COMMON+2     STORE ORDER                       P3  712
TSMTAG ANM    5,3,768           CHECK LEGAL TAG USE               P3  713
```

```
        CAM    03,,                                          P3   714
        SBM    3,2,256              OCT400                   P3   715
        JZM    03,0,TSLTAG                                   P3   716
        ANM    5,3,960              OCT1700                  P3   717
        CAM    03,,                                          P3   718
        SBM    3,2,960              OCT1700                  P3   719
        JZM    03,0,TT2                                      P3   720
        ADM    3,960                                         P3   721
        JZM    3,TT3                                         P3   722
TT4     JZM    9,TSM                                         P3   723
        CAM    1,4                                           P3   724
        CALL   SBERR                                         P3   725
        TRA    TSM                                           P3   726
TT3     ANN    4,8128                                        P3   727
        CAM    3,-4544                                       P3   728
        JUM    3,TT4                                         P3   729
        JZM    9,TT5                                         P3   730
        TRA    TSM                                           P3   731
TT5     CAM    1,3                                           P3   732
        CALL   SBERR                                         P3   733
        TRA    TSM                                           P3   734
TT2     JUM    09,0,SFRLFR                                   P3   735
        CAM    01,2,5                                        P3   736
        JSB    03,0,SBERR                                    P3   737
        FIL                                                  P3   738
CHANG3  CAM    14,2,1536            OCT3000                  P3   739
        SFR    07,2,COMMON+2                                 P3   740
        JDC    00,0,TSM                                      P3   741
TSLTAG  JZM    09,0,AMODIL                                   P3   742
        ANM    5,3,64               OCT100                   P3   743
        CAM    03,,                                          P3   744
        JZM    03,0,OUTSHO                                   P3   745
        ANM    5,3,128              OCT200                   P3   746
        CAM    03,,                                          P3   747
```

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        JZM     03,0,TAGF1                                         P3  748
SFRLFR  ANM     4,3,2048            OCT4000                        P3  749
        CAM     03,,                                               P3  750
        JZM     03,0,TAGF1                                         P3  751
        ANM     12,3,60                                            P3  752
        CAM     03,,                                               P3  753
        JUM     03,0,TAGF1                                         P3  754
        CAM     01,2,2                                             P3  755
        JSB     03,0,SBERR                                         P3  756
        FIL                                                        P3  757
TAGF1   ANM     12,3,60                                            P3  758
        CAM     03,2,-4                                            P3  759
        JUM     03,0,SM1                                           P3  760
        CAM     01,2,3                                             P3  761
        JSB     03,0,SBERR                                         P3  762
        FIL                                                        P3  763
SM1     ANM     5,3,768             OCT1400                        P3  764
        CAM     3,2,7936            OCT17400                       P3  765
        JUM     03,0,CHANG3                                        P3  766
        JDC     00,0,OUTSHO                                        P3  767
AMODIL  CAM     01,2,5                                             P3  768
        JSB     03,0,SBERR                                         P3  769
        FIL                                                        P3  770
OUTSHO  ATN     12,,                                               P3  771
        CAM     00,,                                               P3  772
        JSB     03,0,OUT1                                          P3  773
        FIL                                                        P3  774
        JDC     00,0,READRF                                        P3  775
UNDEFT  ATN     08,3,2                                             P3  776
LORST   CAM     01,2,6                                             P3  777
        JSB     03,0,SBERR                                         P3  778
        FIL                                                        P3  779
        JSB     03,0,INPUT                                         P3  780
        FIL                                                        P3  781
```

```
         ATN    04,,
         CAM    12,,
         ANM    5,3,768             OCT400
         CAM    3,2,7936            OCT17400
         JUM    03,0,CHANG3
         ATN    04,,
         CAM    00,,
         JSB    03,0,OUT1
         FIL
         JDC    00,0,READRF
         SFR    07,2,COMMON+2
TSM      ANM    5,3,768             OCT400
         CAM    03,,
         JZM    03,0,TSL
TSM1     ANN    5,8
         CAM    03,,
         JZM    03,0,ADCOMP       NOT LAST BYTE IN ADDRESS
TSM2     CALL   INPUT
         FIL
         ANM    05,3,7
         CAM    03,,
         JZM    03,0,INTEG1
         SBM    03,2,3
         ATN    04,,              FETCH NAME AS ADDRESS
         LFR    04,,
         LFR    6,RELOC
         ANN    2,384             SET RELOC BIT
         CAM    9
         SFR    6,RELOC
         ATN    03,,
         CAM    04,,
         ANM    02,3,28
         CAM    03,,
         JZM    03,0,INTEG1
```

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        CRM    03,2,2                                  P3  816
        SBM    03,2,4                                  P3  817
        JPM    03,0,EQSYM1                             P3  818
        CJZ    3,INTEG1          LABEL                 P3  819
        CJZ    03,0,MODIF1                             P3  820
        ANM    5,3,192              OCT300             P3  821
        CAM    15,,                                    P3  822
        JZM    15,0,EROR1                              P3  823
        ANM    5,3,64               OCT100             P3  824
        CAM    15,,                                    P3  825
        JZM    15,0,INSF3                              P3  826
        SBM    04,3,4                                  P3  827
        CAM    03,,                                    P3  828
        JUM    03,0,INSF3                              P3  829
        CAM    01,2,3                                  P3  830
        JSB    03,0,SBERR                              P3  831
        FIL                                            P3  832
INSF3   ANM    12,2,8128            OCT17700           P3  833
        ANM    4,3,60               OCT74              P3  834
        ATN    8,3,3                                   P3  835
        ATN    12                                      P3  836
        CAM    0                                       P3  837
        CALL   OUT1                                    P3  838
        FIL                                            P3  839
        JDC    0,0,READRF                              P3  840
EROR1   CAM    1,2,4                                   P3  841
        CALL   SBERR                                   P3  842
        FIL                                            P3  843
        ATN    12                                      P3  844
        CAM    00,,                                    P3  845
        JSB    03,0,OUT1                               P3  846
        FIL                                            P3  847
        JDC    0,0,READRF                              P3  848
EQSYM1  CAM    12                                      P3  849
```

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        JDC     0,0,D13                                    P3  850
70DIF1  ATN     8,3,1                                      P3  851
INTEG1  CAM     12,,                                       P3  852
        ATN     4                                          P3  853
D13     CAM     13                                         P3  854
        CSM     14,2,4                                     P3  855
        CAM     10                                         P3  856
        CAM     11,2,MLIST                                 P3  857
        JDC     00,0,ACE                                   P3  858
TSL     ANM     5,3,192             OCT300                 P3  859
        CAM     03,,                                       P3  860
        JUM     03,0,D14                                   P3  861
        ATN     12                                         P3  862
        CAM     00,,                                       P3  863
        ANM     12,8128                                    P3  864
        SBM     12,6080                                    P3  865
        JZM     12,SEX                                     P3  866
        ADM     12,256                                     P3  867
        JZM     12,SIA                                     P3  868
TSL1    CALL    OUT1                                       P3  869
        JDC     00,0,READRF                                P3  870
SIA     CAM     12,3                                       P3  871
SEX     CRN     0,2                                        P3  872
        CAM     3                                          P3  873
        ANN     3,3                                        P3  874
        ADM     12,8188                                    P3  875
        CJZ     12,TSL1                                    P3  876
        CAM     1,12                                       P3  877
        CALL    SBERR                                      P3  878
        TRA     TSL1                                       P3  879
D14     ANM     5,3,128             OCT200                 P3  880
        CAM     03,,                                       P3  881
        JUM     03,0,D15                                   P3  882
        ATN     12,,                                       P3  883
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        CAM     00,,                                    P3   884
        JSB     03,0,INPUT                              P3   885
        FIL                                             P3   886
        ATN     04,,                                    P3   887
        CAM     01,,                                    P3   888
        JSB     03,0,OUT2                               P3   889
        FIL                                             P3   890
        JDC     00,0,READRF                             P3   891
MODIF3  ANM     05,3,8                                  P3   892
        CAM     15,,                                    P3   893
        JZM     15,0,D20                                P3   894
        ATN     04,,                                    P3   895
        CAM     0,2,1088         OCTATN 0,0             P3   896
        JSB     03,0,OUT1                               P3   897
        FIL                                             P3   898
        ATN     12,,                                    P3   899
        CAM     00,,                                    P3   900
        CAM     01,,                                    P3   901
        JSB     03,0,OUT2                               P3   902
        FIL                                             P3   903
        JDC     00,0,READRF                             P3   904
D20     CAM     06,,                                    P3   905
        CAM     07,,                                    P3   906
        LFR     06,2,CC2                                P3   907
        LFR     07,2,CC3                                P3   908
        JDC     00,0,LATMOD                             P3   909
D15     ANM     05,3,2                                  P3   910
        CAM     03,,                                    P3   911
        JZM     03,0,ADCOMP                             P3   912
        JSB     03,0,INPUT                              P3   913
        FIL                                             P3   914
        ATN     04,,           NAME TABLE LOOKUP        P3   915
        LFR     04,,                                    P3   916
        LFR     6,RELOC                                 P3   917
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        ANN    2,384              SET RELOC BIT                  P3   918
        CAM    9                                                 P3   919
        SFR    6,RELOC                                           P3   920
        ATN    03,,                                              P3   921
        CAM    04,,                                              P3   922
        ANM    02,3,28                                           P3   923
        CAM    15,,                                              P3   924
        JZM    15,0,TCHR8                                        P3   925
        SBM    15,2,8                                            P3   926
        JZM    15,0,MODIF3                                       P3   927
        SBM    15,2,4                                            P3   928
        JZM    15,0,LABEL3                                       P3   929
        CAM    04,,                                              P3   930
        JDC    00,0,TCHR8                                        P3   931
LABEL3  ANM    5,3,64               OCT100                       P3   932
        CAM    03,,                                              P3   933
        JUM    03,0,TCHR8                                        P3   934
        ANM    02,2,3                                            P3   935
        ANM    12,3,3                                            P3   936
        ADM    02,,                                              P3   937
        ANM    12,2,8188            OCT17774                     P3   938
        ANM    02,3,3                                            P3   939
        ADM    12,,                                              P3   940
        CRM    02,2,2                                            P3   941
        ANM    02,3,1                                            P3   942
        ADM    04,,                                              P3   943
        SFR    07,2,COMMON+2                                     P3   944
TCHR8   ANM    05,3,8                                            P3   945
        CAM    03,,                                              P3   946
        JZM    03,0,D16                                          P3   947
        ATN    12,,                                              P3   948
        CAM    00,,                                              P3   949
        ATN    04,,                                              P3   950
        CAM    01,,                                              P3   951
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         LFR    6,RELOC                                  P3  952
         CAM    10,M9             SHIFT TO RELOC         P3  953
         CAM    9                 CLEAR TEMP RELOC       P3  954
         SFR    6,RELOC                                  P3  955
         JSB    03,0,OUT2                                P3  956
         FIL                                             P3  957
         JDC    00,0,READRF                              P3  958
D16      CAM    06,,                                     P3  959
         CAM    07,,                                     P3  960
         LFR    06,2,CC2                                 P3  961
         LFR    07,2,CC3                                 P3  962
         JDC    00,0,INTEG                               P3  963
SBCOMP   SFR    04,2,COMMON-1                            P3  964
         SFR    5,2,COMMON-2                             P3  965
         SFR    06,2,COMMON-3                            P3  966
ADCOMP   CAM    06,,                                     P3  967
         CAM    07,,                                     P3  968
         LFR    06,2,CC2                                 P3  969
         LFR    07,2,CC3                                 P3  970
         ATN    11,1,                                    P3  971
         SFR    05,,                                     P3  972
TESTO    ANM    05,3,15                                  P3  973
         CAM    15,2,-4                                  P3  974
         JUM    15,0,READ2                               P3  975
READO    JSB    03,0,INPUT                               P3  976
         FIL                                             P3  977
         ANM    05,2,8176                                P3  978
         ANM    4,3,15               OCT17               P3  979
         ADM    05,,                                     P3  980
         ANM    4,2,8176             OCT17760            P3  981
         CRM    04,2,4                                   P3  982
         JZM    04,0,READ2                               P3  983
         CAM    12,,                                     P3  984
         CAM    13,,                                     P3  985
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LEVEL   SFN    04,,                                   P3  986
        CSM    15,2,2                                 P3  987
        JNM    15,0,D3                                P3  988
        ADM    06,2,2                                 P3  989
D3      ANM    14,3,8190           OCT17776           P3  990
        CAM    15,,                                   P3  991
        SFN    06,,                                   P3  992
        ADM    15,,                                   P3  993
        ANM    6,2,8188            OCT17774           P3  994
        JPM    15,0,TABLE1                            P3  995
SPEX1   ATN    08,1,                                  P3  996
        SFR    07,0,                                  P3  997
        ATN    06,,                                   P3  998
        ATN    04,,                                   P3  999
        CAM    14,,                                   P3 1000
READ2   JSB    03,0,INPUT                             P3 1001
        FIL                                           P3 1002
        ANM    5,3,3               OCT3               P3 1003
        CSM    15,,                                   P3 1004
D4      JZM    15,0,INTEG                             P3 1005
        CJZ    15,0,OPENBR                            P3 1006
        CJZ    15,0,NAME                              P3 1007
        TRA    WRONG                                  P3 1008
SPEXIT  ADM    08,2,1                                 P3 1009
        JDC    00,0,SPEX1                             P3 1010
ZERINT  CAM    04,,                                   P3 1011
INTEG   CAM    12,,                                   P3 1012
        ATN    04,,                                   P3 1013
        CAM    13,,                                   P3 1014
PUTF7   ANM    05,3,15                                P3 1015
        CAM    15,2,-8                                P3 1016
        JNM    15,0,READ1                             P3 1017
FAKE    CAM    06,2,-4                                P3 1018
        CAM    04,,                                   P3 1019
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PDEMP   JPM     14,0,LEVEL                                          P3 1020
        ANM     05,3,48                                             P3 1021
        CAM     15,2,-32                                            P3 1022
        JUM     15,0,ACE                                            P3 1023
        LFR     04,2,COMMON-1                                       P3 1024
        LFR     05,2,COMMON-2                                       P3 1025
        LFR     06,2,COMMON-3                                       P3 1026
        JLH     03,,                                                P3 1027
ACE     JPM     12,0,ACE10                                          P3 1028
        CAM     0,2,5824            OCTSIA                          P3 1029
        JSB     03,0,OUT1                                           P3 1030
        FIL                                                         P3 1031
        CAM     12,2,1                                              P3 1032
ACE10   LFR     04,2,COMMON+2                                       P3 1033
        JNM     02,0,ACE4                                           P3 1034
        CRM     02,2,12                                             P3 1035
        JNM     02,0,ACE3                                           P3 1036
        SBM     2,3072                                              P3 1037
        JUM     2,ACE10A         NOT SUBTYPE 3 (LDM TYPE)           P3 1038
        ORM     0,2                                                 P3 1039
ACE10A  JZM     12,ACE8                                             P3 1040
        ATN     11,1,                                               P3 1041
        SFR     07,,                                                P3 1042
        ADM     10,2,1                                              P3 1043
        CAM     13,,                                                P3 1044
ACE8    JSB     03,0,MOUT                                           P3 1045
        FIL                                                         P3 1046
        ATN     13,,                                                P3 1047
        CAM     01,,                                                P3 1048
        LFR     6,RELOC                                             P3 1049
        CAM     10,M9            SHIFT TO RELOC                     P3 1050
        CAM     9                CLEAR TEMP RELOC                   P3 1051
        SFR     6,RELOC                                             P3 1052
        JSB     03,0,OUT2                                           P3 1053
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        FIL                                    P3 1054
        JDC     00,0,READRF                    P3 1055
ACE3    ANM     13,3,63                        P3 1056
        ADM     00,,                           P3 1057
        JSB     03,0,OUT1                      P3 1058
        FIL                                    P3 1059
        JDC     00,0,READRF                    P3 1060
ACE4    CRM     02,2,12                        P3 1061
        JZM     12,0,ACE7                      P3 1062
        ATN     11,1,                          P3 1063
        SFR     07,,                           P3 1064
        ADM     10,2,1                         P3 1065
        JNM     02,0,ACE5                      P3 1066
ACE6    JSB     03,0,MOUT                      P3 1067
        FIL                                    P3 1068
        JSB     03,0,OUT1                      P3 1069
        FIL                                    P3 1070
        JDC     00,0,READRF                    P3 1071
ACE5    JSB     03,0,LOOKM                     P3 1072
        FIL                                    P3 1073
        ATN     02,,                           P3 1074
        ADM     00,,                           P3 1075
        JDC     00,0,ACE6                      P3 1076
        CAM     13,,                           P3 1077
        ADM     0,2,35            OCT43        P3 1078
        JDC     00,0,ACE8                      P3 1079
ACE7    ADM     00,2,2                         P3 1080
        JPM     02,0,ACE8                      P3 1081
        JSB     03,0,LOOKM                     P3 1082
        FIL                                    P3 1083
        ATN     02,,                           P3 1084
        ADM     00,,                           P3 1085
        JDC     00,0,ACE8                      P3 1086
        ADM     00,2,33                        P3 1087
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         TRA    ACE8                                          P3 1088
READ1    JSB    03,0,INPUT                                    P3 1089
         FIL                                                  P3 1090
         ANM    05,2,8176                                     P3 1091
         ANM    04,3,15                                       P3 1092
         ADM    05,,                                          P3 1093
         ANM    4,2,8176           OCT17760                   P3 1094
         CRM    04,2,4                                        P3 1095
         ANM    04,3,4                                        P3 1096
         CAM    15,,                                          P3 1097
         JUM    15,0,CLOSBR                                   P3 1098
         JDC    00,0,LEVEL                                    P3 1099
NAME     ATN    04,,                                          P3 1100
         LFR    04,,                                          P3 1101
         SFR    6,BINCD                                       P3 1102
         LFR    6,RELOC                                       P3 1103
         ANN    2,384                                         P3 1104
         EOM    9               EOR RELOC                     P3 1105
         SFR    6,RELOC                                       P3 1106
         LFR    6,BINCD                                       P3 1107
         ATN    03,,                                          P3 1108
         CAM    04,,                                          P3 1109
         CRM    02,2,2                                        P3 1110
         ANM    02,3,7                                        P3 1111
         CSM    00,,                                          P3 1112
         JZM    00,0,INTEG                                    P3 1113
         CJZ    00,0,ZERINT                                   P3 1114
         CJZ    00,0,MODIF                                    P3 1115
         CJZ    00,0,INTEG                                    P3 1116
         JDC    00,0,ZERINT                                   P3 1117
MODIF    ANM    05,3,48                                       P3 1118
         CAM    15,2,-32                                      P3 1119
         JZM    15,0,ZERINT                                   P3 1120
LATMOD   ATN    04,,                                          P3 1121
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        CAM     13,,                                    P3 1122
        CAM     12,2,1                                  P3 1123
        JDC     00,0,PUTF7                              P3 1124
OPENBR  ADM     06,2,4                                  P3 1125
        ANM     04,3,15                                 P3 1126
        ADM     05,2,-1                                 P3 1127
        CAM     10,,                                    P3 1128
        ATN     11,1,                                   P3 1129
        SFR     06,,                                    P3 1130
        JDC     00,0,TESTO                              P3 1131
D5      CAM     15,2,-4                                 P3 1132
        JSB     03,0,PST1                               P3 1133
        FIL                                             P3 1134
CLOSBR  ANM     14,3,8190           OCT17776            P3 1135
        CAM     15,,                                    P3 1136
        SFN     06,,                                    P3 1137
        ADM     15,,                                    P3 1138
        JPM     15,0,D5                                 P3 1139
        SBM     06,2,4                                  P3 1140
        JZM     10,0,D6                                 P3 1141
PTT1    ATN     08,2,-1                                 P3 1142
        LFR     04,,                                    P3 1143
        JNM     12,0,PTT7                               P3 1144
        JNM     14,0,PTT4                               P3 1145
        JNM     00,0,PTT3                               P3 1146
PTT4    JSB     03,0,LSTORE                             P3 1147
        FIL                                             P3 1148
        CAM     0,2,4263            OCT CAD9,3          P3 1149
        ATN     13,,                                    P3 1150
        CAM     01,,                                    P3 1151
        CAM     13,,                                    P3 1152
        JZM     12,0,PTT2                               P3 1153
        ATN     01,,                                    P3 1154
        CAM     09,,                                    P3 1155
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         ADM    10,2,1                                              P3 1156
         ATN    11,1,                                               P3 1157
         SFR    06,,                                                P3 1158
         CAM    01,,                                                P3 1159
PTT2     JSB    03,0,MOUT                                           P3 1160
         FIL                                                        P3 1161
         CAM    12,2,4096                                           P3 1162
         JSB    03,0,OUT2                                           P3 1163
         FIL                                                        P3 1164
D6       SBM    11,2,2                                              P3 1165
         ATN    11,1,                                               P3 1166
         LDM    10,0,0                                              P3 1167
         ANM    05,3,8                                              P3 1168
         CAM    15,,                                                P3 1169
         JZM    15,0,READ1                                          P3 1170
         JDC    00,0,FAKE                                           P3 1171
PTT3     SFN    06,2,2                                              P3 1172
         ATN    14,,                                                P3 1173
         CAM    03,,                                                P3 1174
         JNM    03,0,PTT4                                           P3 1175
         JZM    12,0,PTT5                                           P3 1176
         ATN    13,,                                                P3 1177
         CAM    09,,                                                P3 1178
         ADM    10,2,1                                              P3 1179
         ATN    11,1,                                               P3 1180
         SFR    06,,                                                P3 1181
         CAM    13,,                                                P3 1182
PTT5     JSB    03,0,MOUT                                           P3 1183
         FIL                                                        P3 1184
         CAM    0,2,5159            OCTMPY9,3                       P3 1185
         ATN    13,,                                                P3 1186
         CAM    01,,                                                P3 1187
         CRM    14,2,1                                              P3 1188
         JPM    14,0,PTT6                                           P3 1189
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        ADM   0,2,64           OCT100         P3 1190
PTT6    JSB   03,0,OUT2                       P3 1191
        FIL                                   P3 1192
        SBM   08,2,1                          P3 1193
        ATN   08,,                            P3 1194
        LFR   07,,                            P3 1195
        JDC   00,0,D6                         P3 1196
PTT7    CAM   0,2,4775         OCTADD9,3      P3 1197
        CAM   01,,                            P3 1198
        JPM   13,0,PTT2                       P3 1199
        ADM   0,2,8064         OCT17600       P3 1200
        JDC   00,0,PTT2                       P3 1201
TABLE1  JSB   03,0,PST1                       P3 1202
        FIL                                   P3 1203
        JNM   06,0,PDEMP                      P3 1204
        JDC   00,0,LEVEL                      P3 1205
PST1    SFR   04,2,COMMON+1                   P3 1206
        SBM   08,2,1                          P3 1207
        ATN   08,,                            P3 1208
        LFR   04,,                            P3 1209
        CRM   14,2,2                          P3 1210
        JZM   00,0,PST32                      P3 1211
        JNM   00,0,PST17                      P3 1212
        JNM   12,0,PST9                       P3 1213
        JNM   14,0,PST3                       P3 1214
        CRM   14,2,12                         P3 1215
        JUM   12,0,PST2                       P3 1216
        JPM   14,0,EXIT1                      P3 1217
        SFN   13,,                            P3 1218
        CAM   13,,                            P3 1219
EXIT1   ATN   01,,                            P3 1220
        CAM   09,,                            P3 1221
EXIT9   ADM   10,2,1                          P3 1222
        ATN   11,1,                           P3 1223
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         SFR    06,,                                    P3 1224
EXIT2    ATN    02,,                                    P3 1225
         CAM    14,,                                    P3 1226
EXIT7    LDM    03,2,COMMON+1                           P3 1227
         JLH    03,,                                    P3 1228
PST2     ANM    14,3,4096                               P3 1229
         EOM    13,,                                    P3 1230
         JDC    00,0,EXIT1                              P3 1231
PST3     JSB    03,0,LSTORE                             P3 1232
         FIL                                            P3 1233
         ADM    1,3,1088           OCT ATN              P3 1234
         CAM    00,,                                    P3 1235
         JPM    00,0,PST4                               P3 1236
         ADM    0,2,5120           OCT12000             P3 1237
PST4     JSB    03,0,OUT1                               P3 1238
         FIL                                            P3 1239
         CAM    01,,                                    P3 1240
PST5     CAM    0,2,4263           OCT CAD9,3           P3 1241
         JSB    03,0,OUT2                               P3 1242
         FIL                                            P3 1243
         ATN    13,,                                    P3 1244
         CAM    01,,                                    P3 1245
         JZM    12,0,PST7                               P3 1246
         ADM    1,3,1088           OCT ATN              P3 1247
         CAM    00,,                                    P3 1248
         JPM    00,0,PST6                               P3 1249
         ADM    0,2,5120           OCT12000             P3 1250
PST6     JSB    03,0,OUT1                               P3 1251
         FIL                                            P3 1252
         CAM    01,,                                    P3 1253
PST7     CAM    0,2,5159           OCT MPY9,3           P3 1254
         CRM    14,2,12                                 P3 1255
         JPM    14,0,PST8                               P3 1256
         ADM    0,2,64             OCT100               P3 1257
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PST8    JSB   03,0,OUT2                          P3 1258
        FIL                                      P3 1259
EXIT3   CAM   13,,                               P3 1260
        CAM   12,2,4096                          P3 1261
        JDC   00,0,EXIT2                         P3 1262
PST9    JPM   14,0,PST13                         P3 1263
        ADM   1,3,1088         OCT ATN           P3 1264
        CAM   00,,                               P3 1265
        JPM   00,0,PST10                         P3 1266
        ADM   0,2,5120         OCT12000          P3 1267
PST10   JSB   03,0,OUT1                          P3 1268
        FIL                                      P3 1269
        CAM   01,,                               P3 1270
PST11   CRM   14,2,12                            P3 1271
        CAM   0,2,5159         OCTMPY9,3         P3 1272
        JPM   14,0,PST12                         P3 1273
        ADM   0,2,192          OCT300            P3 1274
PST12   JSB   03,0,OUT2                          P3 1275
        FIL                                      P3 1276
        JDC   00,0,EXIT2                         P3 1277
PST13   JUM   15,0,PST14                         P3 1278
EXIT4   CRM   14,2,12                            P3 1279
        ANM   14,3,4096                          P3 1280
        CAM   13,,                               P3 1281
        JDC   00,0,EXIT1                         P3 1282
PST14   ANM   14,3,2047                          P3 1283
        CAM   03,,                               P3 1284
        CRM   14,2,12                            P3 1285
        ANM   14,3,4096                          P3 1286
        EOM   13,,                               P3 1287
        JZM   03,0,PST16                         P3 1288
        ATN   01,,                               P3 1289
        CAM   09,,                               P3 1290
        ADM   10,2,1                             P3 1291
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         ATN   11,1,                                    P3 1292
         SFR   06,,                                     P3 1293
         CAM   01,,                                     P3 1294
EXIT10   JSB   03,0,MOUT                                P3 1295
         FIL                                            P3 1296
         CAM   0,2,4775          OCT ADD9,3             P3 1297
         JPM   13,0,PST15                               P3 1298
         ADM   0,2,8064          OCT17600               P3 1299
PST15    JSB   03,0,OUT2                                P3 1300
         FIL                                            P3 1301
         JDC   00,0,EXIT2                               P3 1302
PST16    ATN   00,,                                     P3 1303
         CAM   12,,                                     P3 1304
         ATN   13,,                                     P3 1305
         CAM   07,,                                     P3 1306
         ATN   01,,                                     P3 1307
         CAM   13,,                                     P3 1308
EXIT8    CAM   0,2,5824          OCT SIA                P3 1309
         JSB   03,0,OUT1                                P3 1310
         FIL                                            P3 1311
         ATN   07,,                                     P3 1312
         CAM   01,,                                     P3 1313
         CAM   07,,                                     P3 1314
         JDC   00,0,EXIT1                               P3 1315
PST17    JPM   12,0,PST19                               P3 1316
         SBM   07,2,1                                   P3 1317
         JPM   14,0,PST18                               P3 1318
         ATN   01,,                                     P3 1319
         EOM   13,,                                     P3 1320
         CAM   0,2,5155          OCT MPY8,3             P3 1321
         CRM   14,2,12                                  P3 1322
         JPM   14,0,EXIT5                               P3 1323
         ADM   0,2,192           OCT300                 P3 1324
EXIT5    CAM   1,M7                                     P3 1325
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        LFR    5,RELOC                                P3 1326
        CAM    6,4480                                 P3 1327
        SFR    5,RELOC                                P3 1328
        JSB    03,0,OUT2                              P3 1329
        FIL                                           P3 1330
        JDC    00,0,EXIT2                             P3 1331
PST18   ANM    02,3,8190                              P3 1332
        CAM    15,,                                   P3 1333
        ANM    14,3,8190                              P3 1334
        SBM    15,,                                   P3 1335
        JUM    15,0,PSTX1                             P3 1336
        ANM    02,3,1                                 P3 1337
        CAM    15,,                                   P3 1338
        CRM    15,3,1                                 P3 1339
        EOM    13,,                                   P3 1340
PSTX1   CRM    14,2,12                                P3 1341
        ANM    14,3,4096                              P3 1342
        EOM    13,,                                   P3 1343
        ATN    13,,                                   P3 1344
        EOM    01,,                                   P3 1345
        CAM    0,2,4771          OCT ADD8,3           P3 1346
        JPM    01,0,EXIT5                             P3 1347
        ADM    0,2,8064          OCT 17600            P3 1348
        JDC    00,0,EXIT5                             P3 1349
PST19   JPM    14,0,PST22                             P3 1350
        JZM    12,0,PST20                             P3 1351
        ATN    13,,                                   P3 1352
        CAM    09,,                                   P3 1353
        ADM    10,2,1                                 P3 1354
        ATN    11,1,                                  P3 1355
        SFR    06,,                                   P3 1356
        CAM    13,,                                   P3 1357
PST20   JSB    03,0,MOUT                              P3 1358
        FIL                                           P3 1359
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         CRM    14,2,12
         ATN    01,,
         CAM    09,,
         CAM    0,2,5159          OCT MPY9,3
         ATN    13,,
         CAM    01,,
         JPM    14,0,PST21
         ADM    0,2,64            OCT100
PST21    CAM    12,2,4096
         ATN    09,,
         CAM    13,,
         JSB    03,0,OUT2
         FIL
         JDC    00,0,EXIT2
PST22    JZM    12,0,PST23
         CRM    14,2,12
         ANM    14,3,4096
         EOM    13,1,
         CAM    09,,
         ATN    01,,
         CAM    13,,
         CAM    12,2,4096
         JDC    00,0,EXIT9
PST23    CRM    14,2,11
         ANM    14,3,8188
         SBM    02,,
         ANM    02,2,8190
         JUM    02,0,PST25
         ATN    08,2,-1
         LFR    04,,
         CRM    14,2,1
         JPM    14,0,PST24
         SFN    13,,
         CAM    13,,
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PST24   ATN    13,,
        ADM    01,,
        ATN    08,2,-1
        SFR    04,,
        ATN    08,,
        LFR    07,,
        JDC    00,0,EXIT7
PST25   ATN    08,,
        LFR    04,,
        CRM    14,2,1
        JPM    14,0,PST26
        SFN    13,,
        CAM    13,,
PST26   ATN    13,,
        CAM    03,,
        ATN    01,,
        CAM    13,,
        ATN    03,,
        CAM    01,,
        CAM    00,,
        CAM    12,2,4096
        CRM    14,2,12
        ANM    14,2,8190
        ATN    08,1,
        SFR    04,,
        JDC    00,0,EXIT7
PST32   JZM    12,0,PST35
        JNM    12,0,PST34
        JPM    14,0,PST33
        JSB    03,0,LSTORE
        FIL
        JDC    00,0,PST5
PST33   CRM    14,2,12
        ANM    14,3,4096
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        EOM   13,,                                    P3 1428
        ATN   13,,                                    P3 1429
        CAM   09,,                                    P3 1430
EXIT12  ATN   01,,                                    P3 1431
        CAM   13,,                                    P3 1432
        ATN   00,,                                    P3 1433
        CAM   12,,                                    P3 1434
        JDC   00,0,EXIT9                              P3 1435
PST34   JNM   14,0,PST11                              P3 1436
        CRM   14,2,11                                 P3 1437
        JZM   15,0,SPEXIT                             P3 1438
        ANM   14,3,8188                               P3 1439
        CAM   03,,                                    P3 1440
        CRM   14,2,1                                  P3 1441
        ANM   14,3,4096                               P3 1442
        EOM   13,,                                    P3 1443
        JZM   03,0,PST16                              P3 1444
        JDC   00,0,EXIT10                             P3 1445
PST35   JNM   14,0,PST37                              P3 1446
        CRM   14,2,12                                 P3 1447
        JPM   14,0,PST36                              P3 1448
        SFN   13,,                                    P3 1449
        CAM   13,,                                    P3 1450
PST36   ATN   01,,                                    P3 1451
        ADM   13,,                                    P3 1452
        JDC   00,0,EXIT2                              P3 1453
PST37   CRM   14,2,12                                 P3 1454
        ATN   01,,                                    P3 1455
        CAD   09,3,0                                  P3 1456
        JNM   14,0,PST38                              P3 1457
        ATN   13,,                                    P3 1458
        MPY   09,3,0                                  P3 1459
PST39   SIA   00,,                                    P3 1460
        ATN   00,,                                    P3 1461
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         CAM    13,,                                      P3 1462
         JDC    00,0,EXIT2                                P3 1463
PST38    ATN    13,,                                      P3 1464
         DIV    09,3,0                                    P3 1465
         JDC    00,0,PST39                                P3 1466
MOUT     SFR    04,2,COMMON+4                             P3 1467
         SFN    10,2,1                                    P3 1468
         CAM    02,,                                      P3 1469
MOUT1    CJZ    02,0,MOUT3                                P3 1470
         SBM    11,2,1                                    P3 1471
         ATN    11,,                                      P3 1472
         LDM    09,2,0                                    P3 1473
         JPM    09,0,MOUT1                                P3 1474
MOUT2    CJZ    02,0,MOUT3                                P3 1475
         SBM    11,2,1                                    P3 1476
         ATN    11,,                                      P3 1477
         LDM    09,2,0                                    P3 1478
         EOM    09,2,4096                                 P3 1479
         ATN    11,,                                      P3 1480
         SFR    06,,                                      P3 1481
         JNM    09,0,MOUT1                                P3 1482
         JDC    00,0,MOUT2                                P3 1483
MOUT3    SFN    10,,                                      P3 1484
         CAM    02,,                                      P3 1485
         JZM    02,0,MOUT5                                P3 1486
MOUT4    ATN    11,1,                                     P3 1487
         LDM    01,2,0                                    P3 1488
         ADM    1,3,1088            OCT ATN               P3 1489
         CAM    00,,                                      P3 1490
         JPM    00,0,MOUT6                                P3 1491
         ADM    0,2,5120            OCT12000              P3 1492
MOUT6    JSB    03,0,OUT1                                 P3 1493
         FIL                                              P3 1494
         CJU    02,0,MOUT4                                P3 1495
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         SFN    10,,                                     P3 1496
         ADM    11,,                                     P3 1497
         CAM    10,,                                     P3 1498
MOUT5    LFR    04,2,COMMON+4                            P3 1499
         JLH    03,,                                     P3 1500
LSTORE   JZM    07,0,LSTRE1                              P3 1501
         SFR    04,2,COMMON+4                            P3 1502
         LFR    4,RELOC                                  P3 1503
         CAM    2,4480                                   P3 1504
         SFR    4,RELOC                                  P3 1505
         CAM    0,2,5987              OCT SAM8,3         P3 1506
         CAM    1,M7                                     P3 1507
         JSB    03,0,OUT2                                P3 1508
         FIL                                             P3 1509
         LFR    04,2,COMMON+4                            P3 1510
LSTRE1   ADM    07,2,1                                   P3 1511
         JLH    03,,                                     P3 1512
LOOKM    SFN    10,,                                     P3 1513
         CAM    09,,                                     P3 1514
         JZM    09,0,MLOOK5                              P3 1515
MLOOK1   SBM    11,2,1                                   P3 1516
         ATN    11,,                                     P3 1517
         LFR    05,,                                     P3 1518
         JPM    05,0,MLOOK2                              P3 1519
         CJU    09,0,MLOOK1                              P3 1520
         ATN    10,,                                     P3 1521
         ADM    11,,                                     P3 1522
MLOOK5   JLH    03,2,1                                   P3 1523
MLOOK2   ATN    05,,                                     P3 1524
         CAM    02,,                                     P3 1525
         ATN    09,,                                     P3 1526
         SFN    10,2,1                                   P3 1527
         CAM    09,,                                     P3 1528
         JDC    00,0,MLOOK3                              P3 1529
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MLOOK4 ATN    11,2,1                                     P3 1530
       LFR    05,,                                       P3 1531
       ATN    11,1,                                      P3 1532
       SFR    05,,                                       P3 1533
MLOOK3 CJU    09,0,MLOOK4                                P3 1534
       SBM    10,2,1                                     P3 1535
       JLH    03,,                                       P3 1536
       FIL                                               P3 1537
MPROGR CALL   SYSAUX                                     P3 1538
       DECQ   READ,512,0,0                               P3 1539
       CALL   SYSIO                                      P3 1540
       DECQ   WRITE+2,BEGIN,0,0                          P3 1541
       LFR    5,BLANKS                                   P3 1542
       SFR    5,MLIST                                    P3 1543
       CALL   SYSAUX                                     P3 1544
       DECQ   READ,INBUF,0,1                             P3 1545
       LFR    4                                          P3 1546
       LFR    6,BINCD1                                   P3 1547
       CRN    2,12                                       P3 1548
       CAM    8                  PUNCH AND GO CONTROL    P3 1549
       SFR    6,BINCD1                                   P3 1550
       LFR    6,CWPR                                     P3 1551
       EON    2,4096                                     P3 1552
       CAM    8                                          P3 1553
       SFR    6,CWPR             LISTING CONTROL         P3 1554
       LFR    6,512                                      P3 1555
       LFR    5,INSTOR                                   P3 1556
       CAM    7,M11+2            3RD IL BLOCK ON DRUM    P3 1557
       SFR    5,INSTOR                                   P3 1558
       LFR    5,STG1                                     P3 1559
       CAM    7,M11              1ST IL BLOCK            P3 1560
       SFR    5,STG1                                     P3 1561
       ADM    5,256                                      P3 1562
       ADM    7,1                                        P3 1563
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         SFR    5,STG1+2           2ND IL BLOCK                            P3 1564
         CSM    5,M8                                                       P3 1565
         CSM    4,M9                                                       P3 1566
         CAM    6,M15                                                      P3 1567
         CAM    7,M13                                                      P3 1568
         SFR    5,BINBUF+1         HEADER CARD CALLS, ENTRIES, ERASEABLE ANP3 1569
         CAM    5,M14              LENGTH OF PROGRAM                       P3 1570
         CRN    14,7                                                       P3 1571
         CAM    4                                                          P3 1572
         ANM    4,32               SIGN BIT                                P3 1573
         CRM    7,6                                                        P3 1574
         ANN    7,64                                                       P3 1575
         ADM    4,2048             SIGN BIT OF COMMON LENGTH AND CODE FOR HP3 1576
         SFR    5,HD7                                                      P3 1577
         CSM    14,14              COUNT TO END OF CARD                    P3 1578
         CAM    15,513             ADDRESS IN STORAGE BLOCK OF ENTRIES ETC.P3 1579
HD4      ATN    15,1,                                                      P3 1580
         LFR    5                  TABLE ENTRY                             P3 1581
         JZM    8,HD1              NOT ENTRY                               P3 1582
         ADM    8,1                INCREASE ENTRY COUNT                    P3 1583
         LFR    4,M7                                                       P3 1584
         ANN    2,16                                                       P3 1585
         CAM    0                                                          P3 1586
         JUM    0,HD6              UNDEFINED                               P3 1587
         CAM    7,M3               WORD ADDRESS                            P3 1588
         CRM    2,1                                                        P3 1589
         ANN    2,4096                                                     P3 1590
         ADM    6                                                          P3 1591
         CRM    2,1                                                        P3 1592
         ANN    2,4096                                                     P3 1593
         ADM    5                  QUARTER WORD BITS                       P3 1594
         ADM    4,4096             ENTRY INDICATOR                         P3 1595
         TRA    HD2                                                        P3 1596
HD6      CAM    1,11                                                       P3 1597
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         CALL    SBERR                                                P3 1598
         TRA     HD2                                                  P3 1599
HD1      JZM     9,HD5            NOT CALL EITHER                     P3 1600
         SFR     5,PRBUF+7                                            P3 1601
         SFR     6,BESTO                                              P3 1602
         SFR     7,COMMON                                             P3 1603
         LFR     6,CWDR                                               P3 1604
         LFR     7,CWPR                                               P3 1605
         CAM     5                                                    P3 1606
         CALL    SBOCTL                                               P3 1607
         CALL    SBPR                                                 P3 1608
         ADM     11,1                                                 P3 1609
         SFR     6,CWDR                                               P3 1610
         LFR     6,BESTO                                              P3 1611
         LFR     7,COMMON                                             P3 1612
         LFR     5,M15-1                                              P3 1613
         ADM     9,1              INCREASE CALL COUNT                 P3 1614
HD2      CSM     1,4                                                  P3 1615
HD3      CAM     0,M4                                                 P3 1616
         CAM     4,M5                                                 P3 1617
         CAM     5,M6                                                 P3 1618
         CAM     6,M7                                                 P3 1619
         CALL    BINARY                                               P3 1620
         CJU     1,HD3                                                P3 1621
         LFR     4,BINSTO+2                                           P3 1622
         LDM     0,HD7                                                P3 1623
         LDM     1,HD7                                                P3 1624
         SFR     4,BINSTO+2       FIX UP CONTROL COLUMN OF BINARY CARD P3 1625
         CJU     14,HD4           NOT LAST ON CARD                    P3 1626
         CAM     0,3072           SUBSEQUENT HEADER CARD CONTROL      P3 1627
         SFR     4,HD7                                                P3 1628
         CSM     14,14                                                P3 1629
         TRA     HD4                                                  P3 1630
HD5      CAM     15,M14+14                                            P3 1631
```

```
         LFR     5,BLANKS                                              P3 1632
         JUM     15,HD2            NOT LAST CARD                       P3 1633
         LFR     4,HD7                                                 P3 1634
         SBM     0,3072                                                P3 1635
         JUM     0,HD2             IF NO CARD PUNCHED, GO PREPARE ONE  P3 1636
         CALL    SYSAUX                                                P3 1637
         DECQ    WRITE,BINBUF,0,0                                      P3 1638
         CALL    SYSAUX                                                P3 1639
         DECQ    WAIT,0,0,0                                            P3 1640
         CALL    SYSAUX                                                P3 1641
STG1     DECQ    READ,ILBUF1,0,0                                       P3 1642
         CALL    SYSAUX                                                P3 1643
         BSS     1                                                     P3 1644
         CAD     BLANKS                                                P3 1645
         CAM     1,PRBUF                                               P3 1646
         CSM     2,17                                                  P3 1647
INIT1    SAM     1,1,                                                  P3 1648
         CJU     2,INIT1                                               P3 1649
         TRA     RCARD                                                 P3 1650
         FIL                                                           P3 1651
INPUT    SFR     7,2,COMMON+7                                          P3 1652
         SFR     6,2,COMMON+8                                          P3 1653
         SFR     4,INPUTC                                              P3 1654
         LFR     6,INSTOR                                              P3 1655
         LFR     7,M8                                                  P3 1656
         ORB     M9                                                    P3 1657
         CAM     4,M12                                                 P3 1658
         CJU     9,,INPUT1                                             P3 1659
         CAM     9,-4                                                  P3 1660
         CJU     10,,INPUT2                                            P3 1661
         CAM     12                                                    P3 1662
         ATN     11,1,                                                 P3 1663
         CAM     15                                                    P3 1664
         CAM     13,M8-255                                             P3 1665
```

```
        SFR    7,INPUT3                                          P3 1666
        CALL   SYSAUX                                            P3 1667
INPUT3  BSS    1                                                 P3 1668
        CAM    8,2*ILBUF1+255-M13                                P3 1669
        CAM    10,-256                                           P3 1670
INPUT2  ADM    8,1                                               P3 1671
INPUT1  SFR    6,INSTOR                                          P3 1672
        LFR    6,2,COMMON+8                                      P3 1673
        LFR    7,2,COMMON+7                                      P3 1674
        LFR    4,INPUTC                                          P3 1675
        JLH    M3                                                P3 1676
        FIL                                                      P3 1677
INPUTC  BSS    1                                                 P3 1678
INSTOR  DECQ   ILBUF1,-4,-256,0                                  P3 1679
HD7     BSS    1                                                 P3 1680
I1      BSS    3                                                 P3 1681
MLIST   BSS    20                                                P3 1682
BEGIN   CHR    40,   6      NICAPS PROGRAM NOV.1                 P3 1683
PUDO    BSS    20                                                P3 1684
        BSS    3                                                 P3 1685
COMMON  BSS    13                                                P3 1686
BESSC   BSS    4                                                 P3 1687
PRBUF   BSS    17                                                P3 1688
BINBUF  EQUS   2048                                              P3 1689
INBUF   EQUS   256                                               P3 1690
ILBUF1  EQUS   512                                               P3 1691
PASS4   EQUS   896                                               P3 1692
EPASS4  EQUS   1023                                              P3 1693
        GO     768                                               P3 1694
```

3.4 NICAP Pass IV--Error and Name Table Listing

Input to Pass IV

The BCD and binary versions of the name table are left on the drum and in core by Passes I and II respectively. The error table is in core.

Output from Pass IV

A listing of the error list and the name table is made using SYSIØ. F7 is saved as a control word, where bit 2 of M15 is a one if there are no fatal errors and the program is to be executed. Exit is via SYSTEM.

Pass IV lists the errors and the name table for the assembled program. It lists the errors, three to a line, testing first the decimal card number, then the code translation and finally it notes, by include "-F" after the error type if the error is considered fatal.

It then outputs the name table, five entries per line, first listing the BCD name, then its octal address, followed by the quarter-word address, the decimal equivalent of the address, and a final mnemonic which indicates how the name is relocated (if at all). The code is as follows:

P program relocatable
C common relocatable
E erasable relocation
\- no relocation, address absolute

Since FO-F9 and MO-M15 are always defined by the assembler, these will be included in every listing.

Subroutines of Pass IV

SBOCTL

Converts the quarter word in M1 to BCD octal, link in M3, final result is in F7.

DECVT

Converts quarter word in M1 to BCD decimal equivalent. Final results in accumulator must link in MB.

These are identical to the programs in Pass III of the same name.

```
 49012C W GEAR
       NICAP  PASS  4    JAN 1,1965                  TAS              P4
       ORG    1024                                                    P4
ERLST  LFR    4,ERRBUF                                                P4
       SFR    7,ERCODE                                                P4
       JZM    3,A               NO ERRORS                             P4
       CSM    2,M3              NUMBER OF ERRORS                      P4
       CAM    12,ERRAND         ERROR BUFFER ADDRESS                  P4
       CAM    0,1                                                     P4
       CSM    13,3                                                    P4
       LFR    5,BLANKS                                                P4
       CAM    5,6                                                     P4
       SFR    5,ERRAND-1                                              P4
       CALL   SYSIO                                                   P4
       DECQ   WRITE+2,ERRAND-1,0,0                                    P4
       CAM    5                                                       P4
       SFR    5,ERRAND-1                                              P4
ERLST1 LFR    5,ERRBUF+M0       LOAD ERRORS FROM CORE                 P4
       ANN    5,512                                                   P4
       CAM    7                                                       P4
       CAM    1                                                       P4
       JUM    7,ERLST2          PASS 1 ERROR                          P4
       ADM    1,PAS1ER          PASS 1 ERRORS                         P4
       ANN    5,1024                                                  P4
       CAM    7                                                       P4
       JUM    7,ERLST2          PASS 2 ERROR                          P4
       ADM    1,PAS2ER          PASS 2 ERRORS                         P4
ERLST2 ANM    5,31              EXTRACT ERROR TYPE                    P4
       ADM    1,M5+M5+M5+M5                                           P4
       CSM    7,4                                                     P4
ERLST3 LFR    6,ERLIST+M1-4     LOAD ERROR CODE                       P4
       SFR    6,M12+M7+5        STORE IN OUTPUT BUFFER                P4
       ADM    1,1                                                     P4
       CJU    7,ERLST3                                                P4
```

```
       ANM    11,63             EXTRACT LAST CHARACTER
       EOM    11,54             FATAL ERROR
       JUM    11,ERLST9
       LFR    6,ERCODE
       ANM    11,7167
       SFR    6,ERCODE
ERLST9 CAM    1,M4
       SFR    4,ERRSTC
       CALL   DECVT
       LFR    4,ERRSTC
       SAM    M12
       ADM    12,5
       ADM    0,1
       CJZ    13,ERLST5
ERLST4 CJU    2,ERLST1
       ADM    13,3
       JZM    13,ERLST6
       SBM    13,3
       LFR    5,BLANKS          CLEARS WORD
       CSM    14,5
ERLST7 ATN    12,1,
       SFR    5
       CJU    14,ERLST7
       CSM    14,5
       CJU    13,ERLST7
       CALL   SYSIO             OUTPUT BUFFER
       DECQ   WRITE+2,ERRAND-1,0,0
ERLST6 CAM    12,ERRAND
       CSM    13,17
       LFR    5,BLANKS
ERLST8 ATN    12,1,
       SFR    5
       CJU    13,ERLST8
       TRA    A                 NAMETABLE LISTING
```

```
ERLST5 CALL    SYSIO
       DECQ    WRITE+2,ERRAND-1,0,0
       CAM     12,ERRAND
       CSM     13,3
       TRA     ERLST4
A      CAM     12,PRBUF          NAMETABLE LISTING
       CSM     0,1537            LENGTH OF NAME TABLE
       CSM     13,5
       CAM     14
       CSM     15,256
       CALL    SYSAUX            LOAD CORE WITH BCD NAMETABLE
       DECQ    READ,NMLIST,0,5
       CALL    SYSAUX
       DECQ    WAIT,0,0,0
       LFR     5,BLANKS
       CAM     5,6
       SFR     5,PRBUF-1
       CALL    SYSIO
       DECQ    WRITE+2,PRBUF-1,0,0
       CAM     5
       SFR     5,PRBUF-1
NMLST1 ATN     14,1,
       LFR     5,NMLIST          LOAD BCD MAME
       CJZ     0,END             END OF NAMETABLE
       CJZ     15,NMLST6         END OF 256WORD BLOCK
NMLST2 JZM     4,NMLST1          ENTRY IS BLANK
NMLST5 CAM     2,M7
       ANM     2,1
       JZM     2,NMLST4
NMLST7 CAM     7,M6
       CAM     6,M5
       CAM     5,M4
       LFR     6,M0+4096
       CAM     4,2816
```

```
        SFR    5,M12             STROE BCD NAME            P4  102
        ANN    10,16             EXTRACT TYPE OF NAME      P4  103
        CAM    4                                           P4  104
        JUM    4,UNDEFN                                    P4  105
        ANN    10,28             TN                        P4  106
        CAM    4                                           P4  107
        JZM    4,SYMBOL                                    P4  108
        CRM    4,2                                         P4  109
        ORM    4,8188                                      P4  110
        CJZ    4,LABEL                                     P4  111
        CRM    11,2                                        P4  112
        CAM    1,M11                                       P4  113
        CALL   DECVT                                       P4  114
        SAM    CONSTK                                      P4  115
        CAM    11                                          P4  116
        CJZ    4,RELOCR          REGISTER                  P4  117
        CJU    11,RELOCR         MODIFIER                  P4  118
LABEL   ANN    10,3              QUARTER WORD              P4  119
        CAM    4                                           P4  120
        JUM    4,LABEL1                                    P4  121
        CAM    4,10                                        P4  122
LABEL1  CRM    4,7                                         P4  123
        ADM    4,42                                        P4  124
SYMBOL  CAM    1,M11                                       P4  125
        CALL   DECVT                                       P4  126
RELOC4  SAM    CONSTK                                      P4  127
        CAM    5,M12                                       P4  128
        CAM    1,M11                                       P4  129
        CALL   SBOCTL                                      P4  130
        SFR    7,M5+1                                      P4  131
        LFR    7,SBOCTC+3                                  P4  132
        ANN    10,384                                      P4  133
        CAM    5                                           P4  134
        CRM    5,7                                         P4  135
```

```
        ORM     5,8188
        CAM     6
        CJZ     5,RELOC1
        SBM     6,1
        CJZ     5,RELOC1
        SBM     6,1
        CJZ     5,RELOC1
        SBM     6,1
RELOC1  SFR     4,NMLSTC
        SFR     7,NMLSTC+1
        LFR     4,NMLSTT+M6+3
        LFR     7,CONSTK
        CAM     1,M14
        CAM     2,M15
        CAM     0,M4
RELOC5  LFR     7,NMLSTC+1
        SFR     4,M12+2
        LFR     4,NMLSTC
NMLST3  ADM     12,3
        CJU     13,NMLST1
        CAM     2
END     CALL    SYSIO
        DECQ    WRITE+2,PRBUF-1,0,0
        CAM     12,PRBUF
        SFR     6,NMLSTC
        CSM     13,16
        LFR     6,BLAMKS
CLEAR   ATN     12,1,
        SFR     6,0
        CJU     13,CLEAR
        CAM     12,PRBUF
        CSM     13,5
        JNM     2,NMLST7
        JUM     0,NMLST1
```

```
        LFR    7,ERCODE
        TRA    SYSTEM
RELOCR  SFR    4,NMLSTC
        SFR    7,NMLSTC+1
        LFR    7,CONSTK
        LFR    4,NMLSTT+5+M11
ONEDIG  JUM    15,ONEDIT
        ADM    3,10
ONEDIT  ADM    3,M15
        TRA    RELOC5
UNDEFN  SFR    4,NMLSTC
        LFR    4,NMLSTT+4
        SFR    4,M12+2
        LFR    4,NMLSTC
        TRA    NMLST3
NMLST6  SFR    4,NMLSTC
        LFR    4,NMNMNM
        ADM    3,1
        SFR    4,NMNMNM
        CALL   SYSAUX
NMNMNM  DECQ   READ,NMLIST,0,5
        CALL   SYSAUX
        DECQ   WAIT,0,0,0
        CAM    14
        CSM    15,256
        LFR    4,NMLSTC
        TRA    NMLST2
DECVT   CAD    M1+4096.          OCTAL TO DECIMAL CONVERSION
        SUB    4096.
        SFR    4,GDECV1
        SFR    5,GDECV1+1
        ADD    10,3,2048
        DIV    100.
        CAM    7
```

```
         CAM    4                                               P4   204
         DIV    100.                                            P4   205
         CSM    1,3                                             P4   206
         CSM    2,1                                             P4   207
GDECV2   SIA    0                                               P4   208
         SUB    M0.                                             P4   209
         JZM    7,GDECV3                                        P4   210
         JUM    0,GDECV3                                        P4   211
         CAM    0,10                                            P4   212
GDECV3   CJZ    2,GDECV5                                        P4   213
         CAM    5,M6                                            P4   214
         CAM    6,M7                                            P4   215
         CAM    7,M0                                            P4   216
GDECV4   MPY    10.                                             P4   217
         TRA    GDECV2                                          P4   218
GDECV5   CRM    7,7                                             P4   219
         ADM    7,M0                                            P4   220
         CSM    2,2                                             P4   221
         CJU    1,GDECV4                                        P4   222
         CAD    F5                                              P4   223
         LFR    4,GDECV1                                        P4   224
         LFR    5,GDECV1+1                                      P4   225
         JLH    M3                                              P4   226
GDECV1   BSS    2                                               P4   227
NMLST4   LFR    6,M0+4096                                       P4   228
         ANM    10,16                                           P4   229
         JUM    10,NMLST7          UNDEFINED                    P4   230
         LFR    6,UNUSED                                        P4   231
         SFR    6,M12+2                                         P4   232
         CAM    7                                               P4   233
         CAM    9,M4                                            P4   234
         CAM    10,M5                                           P4   235
         CAM    11,M6                                           P4   236
         CAM    8,2816                                          P4   237
```

```
        SFR    6,M12                                 P4  238
        LFR    6,STARS                               P4  239
        SFR    6,M12+1                               P4  240
        ADM    12,3                                  P4  241
        CJU    13,NMLST7                             P4  242
        CSM    2,1                                   P4  243
        TRA    END                                   P4  244
SBOCTL  SFR    4,SBOCTC                              P4  245
        SFR    5,SBOCTC+1                            P4  246
        SFR    6,SBOCTC+2                            P4  247
        SFR    7,SBOCTC+3                            P4  248
        CAM    10                                    P4  249
        CSM    15,5                                  P4  250
        CRM    1,12                                  P4  251
        ANM    1,3,1                                 P4  252
        CAM    9                                     P4  253
SBOCT1  JUM    9,SBOCT2                              P4  254
        CAM    9,10                                  P4  255
SBOCT2  CRM    10,7                                  P4  256
        ADM    10,M9                                 P4  257
        CJZ    15,SBOCT4                             P4  258
        CRM    15,1                                  P4  259
        JNM    15,SBOCT3                             P4  260
        CAM    12,M13                                P4  261
        CAM    13,M10                                P4  262
        CAM    10                                    P4  263
SBOCT3  CRM    15,12                                 P4  264
        CRM    1,10                                  P4  265
        ANN    1,7                                   P4  266
        CAM    9                                     P4  267
        TRA    SBOCT1                                P4  268
SBOCT4  CAM    14,M10                                P4  269
        CAM    15                                    P4  270
        LFR    6,SBOCTC+2                            P4  271
```

```
        LFR    5,SBOCTC+1                                      P4   272
        LFR    4,SBOCTC                                        P4   273
        JLH    M3                                              P4   274
NMLSTT  BSS    1                                               P4   275
        CHR    8,      -P                                      P4   276
        CHR    8,      -C                                      P4   277
        CHR    8,      -E                                      P4   278
        CHR    8, UNDEFN                                       P4   279
        CHR    8,MODIFR                                        P4   280
        CHR    8,REGIST                                        P4   281
UNUSED  CHR    8, UNUSED                                       P4   282
ERLIST  CHR    32, ILLEGAL CHARACTER               -F          P4   283
        CHR    32, OUTSIDE NAME TOO LONG           -F          P4   284
        CHR    32, NAME TOO LONG / IN NO FIELD     -F          P4   285
        CHR    32, ILLEGAL NUMERICAL B-FIELD       -F          P4   286
        CHR    32, ILLEGAL NUMERICAL C-FIELD       -F          P4   287
        CHR    32, EVEN C-FIELD FOR CAN-TYPE                   P4   288
        CHR    32, NON-ZERO BRACKET COUNT          -F          P4   289
        CHR    32, WRONG USE OF (.)                            P4   290
        CHR    32, COMMA IN N-FIELD                            P4   291
        CHR    32, N-FIELD FOR SHORT ORDER                     P4   292
        CHR    32, ILLEGAL ADDRESS FOR FIL                     P4   293
        CHR    32, ILLEGAL FAST REGISTER USE                   P4   294
        CHR    32, ILLEGAL MNEMONIC                -F          P4   295
        CHR    32, ILLEGAL CHAR. OUTSIDE NAME                  P4   296
        CHR    32, ILLEGAL NUM IN SSR              -F          P4   297
        CHR    32, END OF CARD                                 P4   298
        CHR    32, PSEUDO TOO LONG                             P4   299
        CHR    32, EQU UNDEFINED                               P4   300
        CHR    32, ENTRY WRONG                                 P4   301
        CHR    32, NO GO CARD,CARD ADDED BY NICAP              P4   302
        CHR    32, ILLEGAL FIN                     -F          P4   303
        CHR    32, JUMP ADDRESS NOT LABEL                      P4   304
        CHR    32, LABEL IN ADDRESS FIELD                      P4   305
```

```
        CHR    32, F0 ILLEGALLY USED
        CHR    32, F1 ILLEGALLY USED
        CHR    32, ILLEGAL REGISTER USE
        CHR    32, ILLEGAL MODIFIER USE          -F
        CHR    32, LABEL OR SYMBOL FOR TAG       -F
        CHR    32, ILLEGAL ADDRESS IN PSEUDO     -F
        CHR    32, UNDEFINED NAME                -F
        CHR    32, DOUBLE DEFINED NAME           -F
        CHR    32, NON-NAME ADDRESS FOR LABEL
        CHR    32, REGISTER INSTEAD OF MODIFIER  -F
        CHR    32, MODIFIER INSTEAD OF REGISTER  -F
        CHR    32, MORE THAN 1 ADDR BYTE EQUF/M  -F
        CHR    32, INTEGER TOO LARGE IN EQUF/M   -F
        BSS    4
        CHR    32, ILLEGAL RELOCATION
        CHR    32, SYMBOL FOR LABEL
        CHR    32, LABEL FOR SYMBOL
        CHR    32, F0 ILLEGAL
        CHR    32, F1 ILLEGAL
        CHR    32, ILLEGAL FAST REGISTER USE
        CHR    32, ALL MOD ILLEGAL               -F
        CHR    32, LABEL OR SYMBOL FOR TAG       -F
        CHR    32, NOT DONE AT COMPUTER TIME     -F
        CHR    32, UNDEFINED NAME                -F
        CHR    32, DOUBLE DEFINED                -F
        CHR    32, MULTIPLE RELOCATION
        CHR    32, UNDEFINED ENTRY               -F
        CHR    32, CHECK MODIFER IN SEX OR SIA
        CHR    32, ILLEGAL USE OF BLS OR FIN     -F
SAVE    BSS    1
ERCODE  BSS    1
SBOCTC  BSS    4
NMLSTC  BSS    4
CONSTK  BSS    1
```

```
STARS  DECQ   2860,2860,2860,2860                                      P4   340
BLAMKS DECQ   0,0,0,0                                                  P4   341
BLANKS DECQ   0,0,0,0                                                  P4   342
ERRSTC BSS    1                                                        P4   343
ERRBUF EQUS   0                                                        P4   344
ERRAND EQUS   PRBUF                                                    P4   345
NMLIST EQUS   2048                                                     P4   346
NAME   EQUS   2560           BEGINNING OF NAME TABLE IN CORE           P4   347
PRBUF  EQUS   2032                                                     P4   348
DRUMWD EQUS   7946                                                     P4   349
TUTRAN EQUS   7947                                                     P4   350
SYSTAP EQUS   7680                                                     P4   351
PAS1ER EQUS   88                                                       P4   352
PAS2ER EQUS   68                                                       P4   353
CHKFL  EQUS   1096                                                     P4   354
CHKRC  EQUS   1088                                                     P4   355
BCKSPF EQUS   1072                                                     P4   356
BCKSPR EQUS   1064                                                     P4   357
SYSAUX EQUS   7938                                                     P4   358
READ   EQUS   0                                                        P4   359
WAIT   EQUS   256                                                      P4   360
WRITE  EQUS   512                                                      P4   361
LOAD   EQUS   7945                                                     P4   362
SYSIO  EQUS   7939                                                     P4   363
WTM    EQUS   1104                                                     P4   364
REWIND EQUS   1056                                                     P4   365
SYSTEM EQUS   7936                                                     P4   366
SYSERR EQUS   7937                                                     P4   367
       GO     512                                                      P4   368
```

```
 49012C W GEAR
        NICAP  SYSERR     JAN 1,1965                    TAS          SER   1
        ORG    256                                                   SER   2
L       EQUS   35                                                    SER   3
A       EQUS   49                                                    SER   4
F       EQUS   54                                                    SER   5
MM      EQUS   36                                                    SER   6
SYSTEM  EQUS   7936                                                  SER   7
DRUMWD  EQUS   7946                                                  SER   8
TUTRAN  EQUS   7947                                                  SER   9
SYSTAP  EQUS   7680                                                  SER  10
CHKFL   EQUS   1096                                                  SER  11
PRTBUF  EQUS   PRBUF                                                 SER  12
CHKRC   EQUS   1088                                                  SER  13
BCKSPF  EQUS   1072                                                  SER  14
BCKSPR  EQUS   1064                                                  SER  15
SYSAUX  EQUS   7938                                                  SER  16
READ    EQUS   0                                                     SER  17
WAIT    EQUS   256                                                   SER  18
WRITE   EQUS   512                                                   SER  19
LOAD    EQUS   7945                                                  SER  20
SYSIO   EQUS   7939                                                  SER  21
WTM     EQUS   1104                                                  SER  22
REWIND  EQUS   1056                                                  SER  23
        SFR    0,S+2                                                 SER  24
        SAM    S                                                     SER  25
        SAL    S+1                                                   SER  26
        CAD    F1                                                    SER  27
        SAM    S+3                                                   SER  28
        SFR    2,S+4                                                 SER  29
        SFR    3,S+5                                                 SER  30
        SFR    4,S+6                                                 SER  31
        SFR    5,S+7                                                 SER  32
        SFR    6,S+8                                                 SER  33
```

```
         SFR    7,S+9
BEG2     ANN    1,768
         CAM    3
         CAM    2,ERLIST-4
         JZM    3,SYSER1           PASS 1
         ADM    2,24
         ANN    1,512
         CAM    3
         JZM    3,SYSER1           PASS 2
         ADM    2,12
SYSER1   ANM    1,7
         ADM    2,M1+M1+M1+M1
         CAM    0,PRBUF
         CSM    3,4
SYSER2   ATN    2,1,
         LFR    5,
         ATN    0,1,
         SFR    5,
         CJU    3,SYSER2
         LFR    7,S+6
         CAM    1,M14
         CALL   DECVT
         SAM    M0+6
         LFR    7,CARD
         SFR    7,M0+4
         LFR    7,CARD+1
         SFR    7,M0+5
BEG1     CALL   SYSIO
         DECQ   WRITE+2,PRBUF-1,0,0
         ANM    7,63
         EOM    7,35               OCTAL L
         JUM    7,SYSER6
         LFR    7,DRUMWD
         CAM    14
```

```
        SFR     7,DRUMWD        SER  68
        LFR     4,S+6           SER  69
        CAM     1,M3            SER  70
        CALL    OCT             SER  71
        CALL    PRINT           SER  72
        CAM     8,L2            SER  73
        CALL    CHAR            SER  74
        CAM     8,A             SER  75
        CALL    CHAR            SER  76
        CAM     8,MM            SER  77
        CALL    CHAR            SER  78
        LFR     7,S             SER  79
        CALL    WORD            SER  80
        CAM     8,A             SER  81
        CALL    CHAR            SER  82
        CAM     8,L             SER  83
        CALL    CHAR            SER  84
        LFR     7,S+1           SER  85
        CALL    WORD            SER  86
        CALL    PRINT           SER  87
        CSM     0,4             SER  88
        CSM     2,2             SER  89
        CAM     4               SER  90
P3      CAM     8,L2            SER  91
        CALL    CHAR            SER  92
P1      CAM     8,F             SER  93
        CALL    CHAR            SER  94
        ATN     4,1,            SER  95
        CAM     8               SER  96
        JUM     8,P2            SER  97
        CAM     8,10            SER  98
P2      CALL    CHAR            SER  99
        LFR     7,S+M4+1        SER 100
        CALL    WORD            SER 101
```

```
        CJU     0,P1                    SER 102
        CALL    PRINT                   SER 103
        CSM     0,4                     SER 104
        CJU     2,P3                    SER 105
        CAM     9                       SER 106
        CAM     4,SW1                   SER 107
        CAM     8,L2                    SER 108
        CALL    CHAR                    SER 109
P6      CAM     5                       SER 110
        CSM     6,64                    SER 111
P5      CSM     7,4                     SER 112
P4      LFR     7,M5+4+M7               SER 113
        JUM     12,P7                   SER 114
        JUM     13,P7                   SER 115
        JUM     14,P7                   SER 116
        JUM     15,P7                   SER 117
        CJU     7,P4                    SER 118
P9      ADM     9,4                     SER 119
        ADM     5,4                     SER 120
        CJU     6,P5                    SER 121
        JLH     M4                      SER 122
        FIL                             SER 123
SW1     CALL    SYSAUX                  SER 124
        DECQ    READ,0,0,0              SER 125
        CALL    SYSAUX                  SER 126
        DECQ    WAIT,0,0,0              SER 127
        CAM     4,SW2                   SER 128
        TRA     P6                      SER 129
        FIL                             SER 130
SW2     CAM     4,SW3                   SER 131
        CAM     5,512                   SER 132
        CSM     6,768                   SER 133
        TRA     P5                      SER 134
SW3     CAM     1                       SER 135
```

```
        CAM     0,PRTBUF                               SER 136
        CSM     2,4                                    SER 137
SYSER5  ATN     1,1,                                   SER 138
        LFR     5,DRDUMP                               SER 139
        ATN     0,1,                                   SER 140
        SFR     5                                      SER 141
        CJU     2,SYSER5                               SER 142
        CALL    SYSIO                                  SER 143
        DECQ    WRITE+2,PRTBUF-1,0,0                   SER 144
        TRA     SYSTEM                                 SER 145
P7      CAM     1,M9                                   SER 146
        CALL    OCT                                    SER 147
        CSM     7,4                                    SER 148
P8      CAM     8                                      SER 149
        CALL    CHAR                                   SER 150
        CAM     8,44                                   SER 151
        CALL    CHAR                                   SER 152
        CAM     8                                      SER 153
        CALL    CHAR                                   SER 154
        LFR     7,M5+4+M7                              SER 155
        CALL    WORD                                   SER 156
        CJU     7,P8                                   SER 157
        CALL    PRINT                                  SER 158
        CAM     8                                      SER 159
        CALL    CHAR                                   SER 160
        TRA     P9                                     SER 161
L2      EQUS    33                                     SER 162
WORD    SFR     4,WD3                                  SER 163
        CSM     0,5                                    SER 164
WD1     CAM     8                                      SER 165
        CALL    CHAR                                   SER 166
        CJZ     0,WD2                                  SER 167
        CAM     1,M12                                  SER 168
        CALL    OCT                                    SER 169
```

```
         CAM    12,M13                         SER 170
         CAM    13,M14                         SER 171
         CAM    14,M15                         SER 172
         TRA    WD1                            SER 173
WD2      LFR    4,WD3                          SER 174
         JLH    M3                             SER 175
WD3      BSS    1                              SER 176
PRINT    SFR    4,PR1                          SER 177
         LFR    4,FBFWD                        SER 178
         LFR    7,FCNTS                        SER 179
         SFR    4,M13                          SER 180
         LFR    7,FZERO                        SER 181
         SFR    7,FBFWD                        SER 182
         CALL   SYSIO                          SER 183
         DECQ   WRITE+2,PRBUF,0,0              SER 184
         CAM    12                             SER 185
         CAM    13                             SER 186
         CAM    14                             SER 187
         CAM    15                             SER 188
         CSM    0,17                           SER 189
         CAM    1,PRBUF                        SER 190
         FLD                                   SER 191
         ATN    1,1,                           SER 192
         SFR    7                              SER 193
         CJF    0,0                            SER 194
         LFR    4,CHARP                        SER 195
         SFR    4,CHARC                        SER 196
         LFR    4,PR1                          SER 197
         JLH    M3                             SER 198
PR1      BSS    1                              SER 199
OCT      SFR    4,PR1                          SER 200
         CSM    0,5                            SER 201
         CRM    1,12                           SER 202
         ANN    1,1                            SER 203
```

```
         CAM    8                                                    SER 204
OCT2     JUM    8,OCT1                                               SER 205
         CAM    8,10                                                 SER 206
OCT1     CALL   CHAR                                                 SER 207
         CJZ    0,OCT3                                               SER 208
         CRM    1,10                                                 SER 209
         ANN    1,7                                                  SER 210
         CAM    8                                                    SER 211
         TRA    OCT2                                                 SER 212
OCT3     LFR    4,PR1                                                SER 213
         JLH    M3                                                   SER 214
CHAR     SFR    5,FCOM7                                              SER 215
         SFR    4,FCOM6                                              SER 216
         SFR    6,FCOM8         T CHARACTER                          SER 217
         SFR    7,FCOM9                                              SER 218
         LFR    7,FBFWD         BUFFER PEPARATION WORD               SER 219
         LFR    5,FCNTS         CONTROL WORD                         SER 220
         JLH    7,,             BRANCH ACCORDING TO QUARTER          SER 221
         FIL                    FIRST QUARTER, CHAR. TO M12          SER 222
M        ADM    12,M8           BRANCH IF RIGHT HAND PART            SER 223
         CJZ    6,FN3A          MOVE TO LEFT                         SER 224
         CRM    12,7                                                 SER 225
         TRA    FN8             SECOND QUARTER                       SER 226
         ADM    13,M8                                                SER 227
         CJZ    6,FN3A                                               SER 228
         CRM    13,7                                                 SER 229
         TRA    FN8                                                  SER 230
         ADM    14,M8           THIRD QUARTER                        SER 231
         CJZ    6,FN3A                                               SER 232
         CRM    14,7                                                 SER 233
         TRA    FN8                                                  SER 234
         ADM    15,M8           FOURTH QUARTER                       SER 235
         CJZ    6,FN6                                                SER 236
         CRM    15,7                                                 SER 237
```

```
        TRA    FN8                                                          SER 238
FN6     ATN    5,1,                 STORE BUFFER PREPARATION WORD IN BUFFER SER 239
        SFR    7                                                            SER 240
        LFR    7,FZERO              PREPARATION WORD TO BLANKS              SER 241
        CAM    7,M-2                RESET M7, QUARTER WORD CONTROL          SER 242
FN3A    CSM    6,2                  RESET LEFT/RIGHT CONTROL                SER 243
        ADM    7,2                  INCREMENTQUARTER CONTROL                SER 244
FN8     ADM    4,1                  INCREASE CHARACTER COUNT                SER 245
FN8A    SFR    7,FBFWD              STROE PREPARATION WORD                  SER 246
        SFR    5,FCNTS                                                      SER 247
        LFR    4,FCOM6                                                      SER 248
        LFR    5,FCOM7                                                      SER 249
        LFR    6,FCOM8                                                      SER 250
        LFR    7,FCOM9                                                      SER 251
        JLH    3,,                  EXIT                                    SER 252
SYSER6  LFR    7,BLANKS                                                     SER 253
        SFR    7,257                                                        SER 254
        CAM    12,2048                                                      SER 255
        SFR    7,258                                                        SER 256
        CALL   SYSAUX                                                       SER 257
        DECQ   WRITE,256,0,0                                                SER 258
        TRA    SYSTEM               U                                       SER 259
        ASSIGN FCOM7,FCOM8,FCOM9,FBFWD                                      SER 260
        ASSIGN FCOM6                                                        SER 261
FCNTS   DECQ   -133,PRBUF+2,-2,M                                            SER 262
CHARC   EQUS   FCNTS                                                        SER 263
CHARP   DECQ   -133,PRBUF,-1,M+2                                            SER 264
FZERO   BSS    1                                                            SER 265
PRBUF   CHR    32,    1SYSERR EXIT FROM                                     SER 266
        BSS    13                                                           SER 267
S       BSS    10                                                           SER 268
CARD    CHR    16, LAST CARD READ                                           SER 269
ERLIST  CHR    32, NAME TABLE FULL                                          SER 270
        CHR    32, TOO MANY EQU STATEMENTS                                  SER 271
```

```
        CHR    32, TOO MANY ERRORS PASS 1                               SER 272
        CHR    32, TOO MANY TRANSFER VECTORS                            SER 273
        CHR    32, TOO MANY ENTRIES                                     SER 274
        CHR    32, BUFFER OVERFLOW-CHECK DECQ/OCTQ                      SER 275
        CHR    32, NICAP ERR BRING DUMP TO 138 DCL                      SER 276
        CHR    32, TOO MANY NAMES OR EQU STATEMENT                      SER 277
        CHR    32, TOO MANY ERRORS PASS 2                               SER 278
        CHR    32, EQU LIST CAN NOT ALL BE DEFINED                      SER 279
        CHR    32, NICAP ERR BRING DUMP TO 138 DCL                      SER 280
        CHR    32, TOO MANY ERRORS PASS 3                               SER 281
DRDUMP  CHR    32, OPERATOR  PLEASE DUMP DRUM*****                      SER 282
BLANKS  BSS    1                                                        SER 283
DECVT   CAD    M1+4096.         OCTAL TO DECIMAL CONVERSION             SER 284
        SUB    4096.                                                    SER 285
        SFR    4,GDECV1                                                 SER 286
        SFR    5,GDECV1+1                                               SER 287
        ADD    10,3,2048                                                SER 288
        DIV    100.                                                     SER 289
        CAM    7                                                        SER 290
        CAM    4                                                        SER 291
        DIV    100.                                                     SER 292
        CSM    1,3                                                      SER 293
        CSM    2,1                                                      SER 294
GDECV2  SIA    0                                                        SER 295
        SUB    M0.                                                      SER 296
        JZM    7,GDECV3                                                 SER 297
        JUM    0,GDECV3                                                 SER 298
        CAM    0,10                                                     SER 299
GDECV3  CJZ    2,GDECV5                                                 SER 300
        CAM    5,M6                                                     SER 301
        CAM    6,M7                                                     SER 302
        CAM    7,M0                                                     SER 303
GDECV4  MPY    10.                                                      SER 304
        TRA    GDECV2                                                   SER 305
```

```
GDECV5 CRM     7,7                SER 306
       ADM     7,MO               SER 307
       CSM     2,2                SER 308
       CJU     1,GDECV4           SER 309
       CAD     F5                 SER 310
       LFR     4,GDECV1           SER 311
       LFR     5,GDECV1+1         SER 312
       JLH     M3                 SER 313
GDECV1 BSS     2                  SER 314
       GO      0                  SER 315
```

3.5 ILLIAC II--FORTRAN II

This program is a three-pass compiler, the last two passes of which are identical to the last two passes of the NICAP Assembler and are described there. The first pass will be referred to as the FORTRAN pass. Its input is the source language on card images which are read from magnetic tape or elsewhere via SYSIØ by the compiler, and its object is the intermediate language (IL) of the Assembler and the appropriate name tables for the assembler. The name tables are left in memory and the intermediate language is left on the drum at the completion of the FORTRAN pass. As with the assembler, a BCD name table is also left on the drum. In fact, the output of the FORTRAN pass is necessarily identical to the output of the first pass of the Assembler, except that during the FORTRAN pass a listing of the input FORTRAN program, together with their sequential statement numbers, is prepared. This is necessary because a listing is not normally prepared during the last pass of the Assembler on a FORTRAN program. If it is prepared, it is then a listing in machine language rather than in FORTRAN language. The reader is referred to Part 3, Section 1, for a detailed description of the output.

The FORTRAN program is split into five sections. The first four of these sections constitute the FORTRAN pass, the last section, most of which does not coexist in memory with the first four sections, prepares and digests the various tables, the common and equivalent lists, and does some modifications to the name table prior to the Assembly passes. Of the first four sections, Part I is a statement recognizer. Part 2 is the program which handles all type statements and generates appropriate intermediate language. Part 3 deals with control transfers. Part 4 deals with input/output type statements. During the execution of the first four parts of the program four major tables and one subsidiary table are constructed. Any time a new variable name or statement number is encountered in the source language an entry must be made in these tables. An entry is also made in the case of a new constant that is greater than or equal to 4096, and additional entries must be made in the case of implied DO loops in the input/output statements and in the case of transfers to the statement number which closes a DO loop. These four tables are the following:

1) Constant Table CONST

Constants are entered in this table unless they are less than or equal to 4095. If the same constant is used twice, only one entry has to be made. Constants less than 4095 can be given directly in the address of an instruction.

2) The variable table VARIAB

Variables which are not dimensioned and which are not functions are placed in this table. An indication is given in this table whether the name is fixed or floating-point, under control of a DO LOOP, etc.

3) The label table LABEL

This table contains all the statement numbers used in the program. Also, on those occasions that an internal label is needed for a transfer, an entry of the statement number zero is made. Since zero is an illegal statement number, it will never interfere with an outside label. When a transfer is made to a statement number which closes a DO loop, or several DO loops are closed on the same statement number, multiple entries must be made. Except under these conditions no two entries in any of the tables correspond to the same name or statement number.

4) The dimension-function table DIMEN

Any variable which appears in a dimension statement or is defined by an Arithmetic function statement or which is not defined but appears with a left parenthesis immediately following is entered in the dimension-function table. A bit in this table indicates whether it is assumed to be a dimensioned variable or a function name. Another bit indicates whether it is a fixed or a floating-point name. A secondary table is chained to each entry of this table. The secondary table contains additional information about the dimensioned variable or function. For example, in the case of a dimensioned variable the number of dimensions and the range of those dimensions must be specified.

In the case of a function a list of the calling parameters is kept for checking purposes. The format of the various tables is shown in Fig. 3.5.1.

Two subroutines handle all of the table manipulation work. The first, GENTAB will enter a name in the table. This does not search for a previous entry of that name. The second, GTABLE searches the table for a name. It does not enter the name if it is not found. Although the four tables are distinct, they are not allocated unique memory locations. The memory available for tables is divided into 256 word blocks. One of these blocks is assigned initially to each table. When a table is full it is chained to another 256 word block from the available storage. Table space will be exhausted when all such free blocks have been used and one of the tables requires another one. When this happens at most 768 words of memory are not being utilized. It is impossible to give in a convenient form a detailed formulation of when the tables will be exhausted.

Two other subroutines are used by virtually all pieces of the Fortran pass. They are SØUT and GERROR. The former takes the bytes of intermediate language in the CØUT buffer where they are packed one per word in the left-hand quarters and packs them four per word into a 256-word drum buffer. Whenever this buffer is full it is written on the drum for later use by the NICAP passes. GERROR takes the error code in M1 and stores it in the Error, common, equivalence list for processing immediately after the Fortran pass.

Subroutines used by all sections

GTABLE

GTABLE searches the appropriate table looking for the occurrence of the name which is held in F7. If the name is present, then its address, i.e., its internal representation, is in M2 and M0 is positive (zero), otherwise M0 is negative (4096) at exit.

The name table desired is specified by M1 at entry. M1 contains the address of a pair of words in memory which are used in the table search. The

Figure 3.5.1a. Constant Table Format

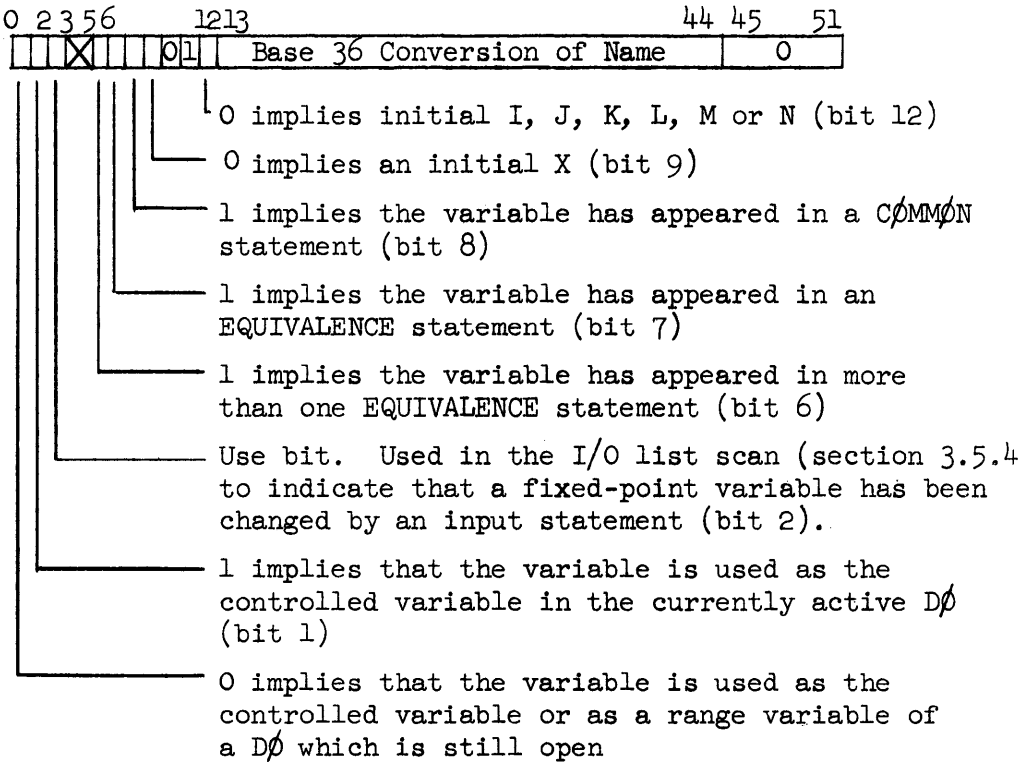


Figure 3.5.1b. Variable Table

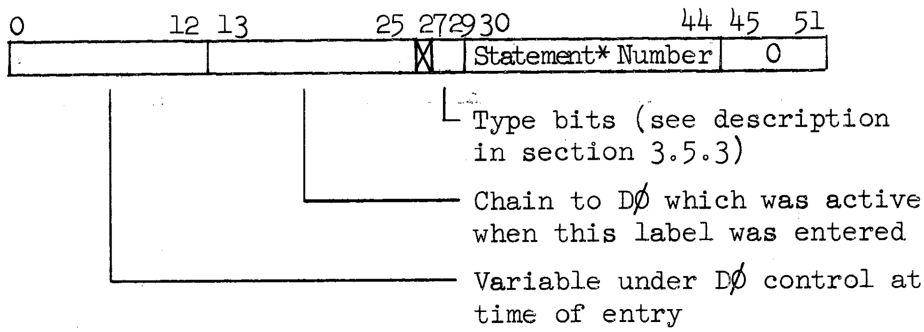


Figure 3.5.1c. Label Table

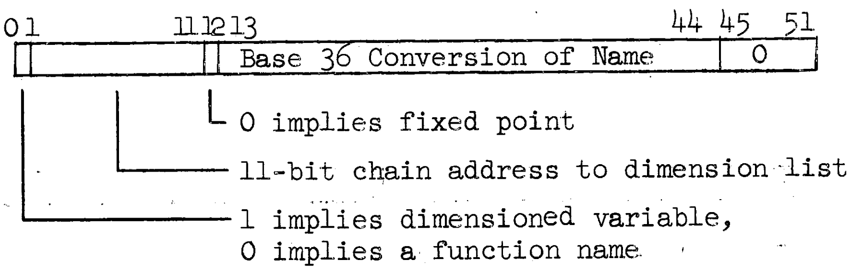


Figure 3.5.1d. DIMENSIØN Table Format

*If the statement number is 0, it is an internal name used by one of the generators. Since 0 is an illegal statement number, this cannot cause confusion.

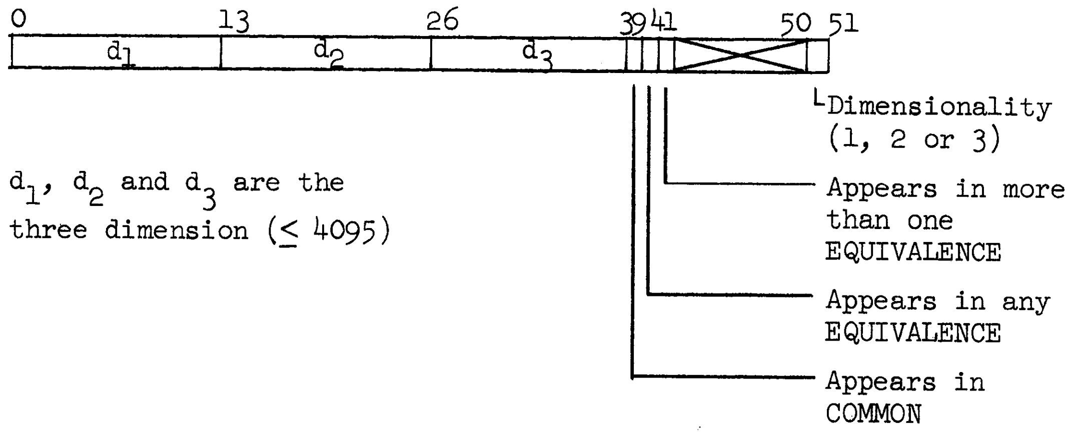


Figure 3.5.1e. Dimension List Entry for Dimensioned Variable

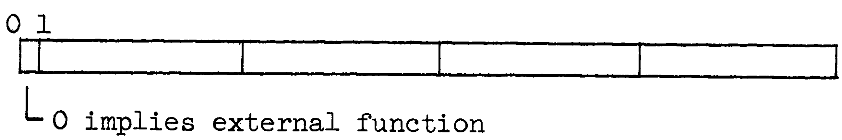
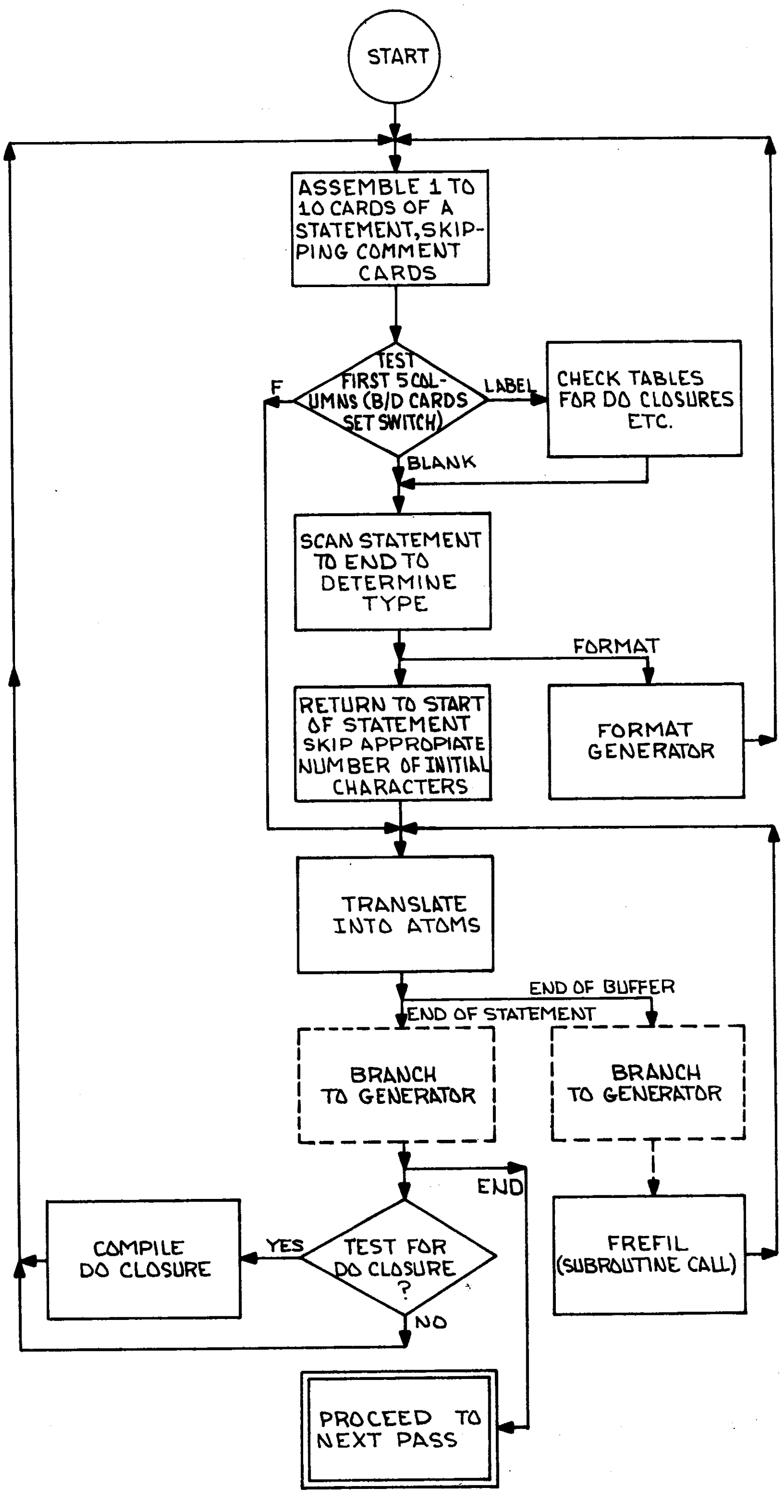


Figure 3.5.1f. Dimension List Variable for Function

SCHEMATIC FLOW OF THE FORTRAN PASS

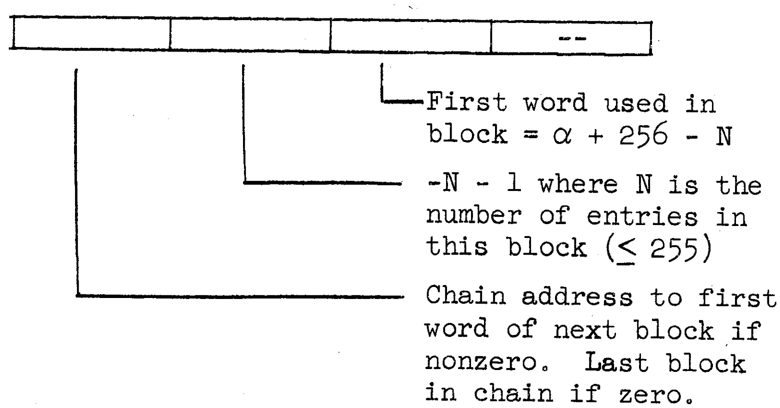


first of this pair is addressed by M1 and contains the address of the first block of the table in the first quarter. The second word of the pair contains a mask which is 1 where name bits in F7 are significant and 0 elsewhere. (Note that the exponent bits are always used in the comparison, and should therefore be 0 in all cases except for the constant table.) The masks are

DIMEN AND VARIABLE	0, 17777, 17777, 17600
LABEL	0, 0, 00777, 17600
CONSTANT	17777, 17777, 17777, 17777

The format of the blocks of storage is:

First Word of Block α



The next 255 words are used in reverse order, that is, location α + 255 receives the first entry, α + 254 the second, etc. Table searching is done with increasing addresses so that the search is in the reverse order of entry.

GENTAB

GENTAB is a companion program to GTABLE which enters the constants of F7 in the next available table position. If the current block is full, then the word GMAST is consulted. This has the format:

GMAST		--	--	--

Chain address to a free block i $\neq$ 0,
0 means end of chain

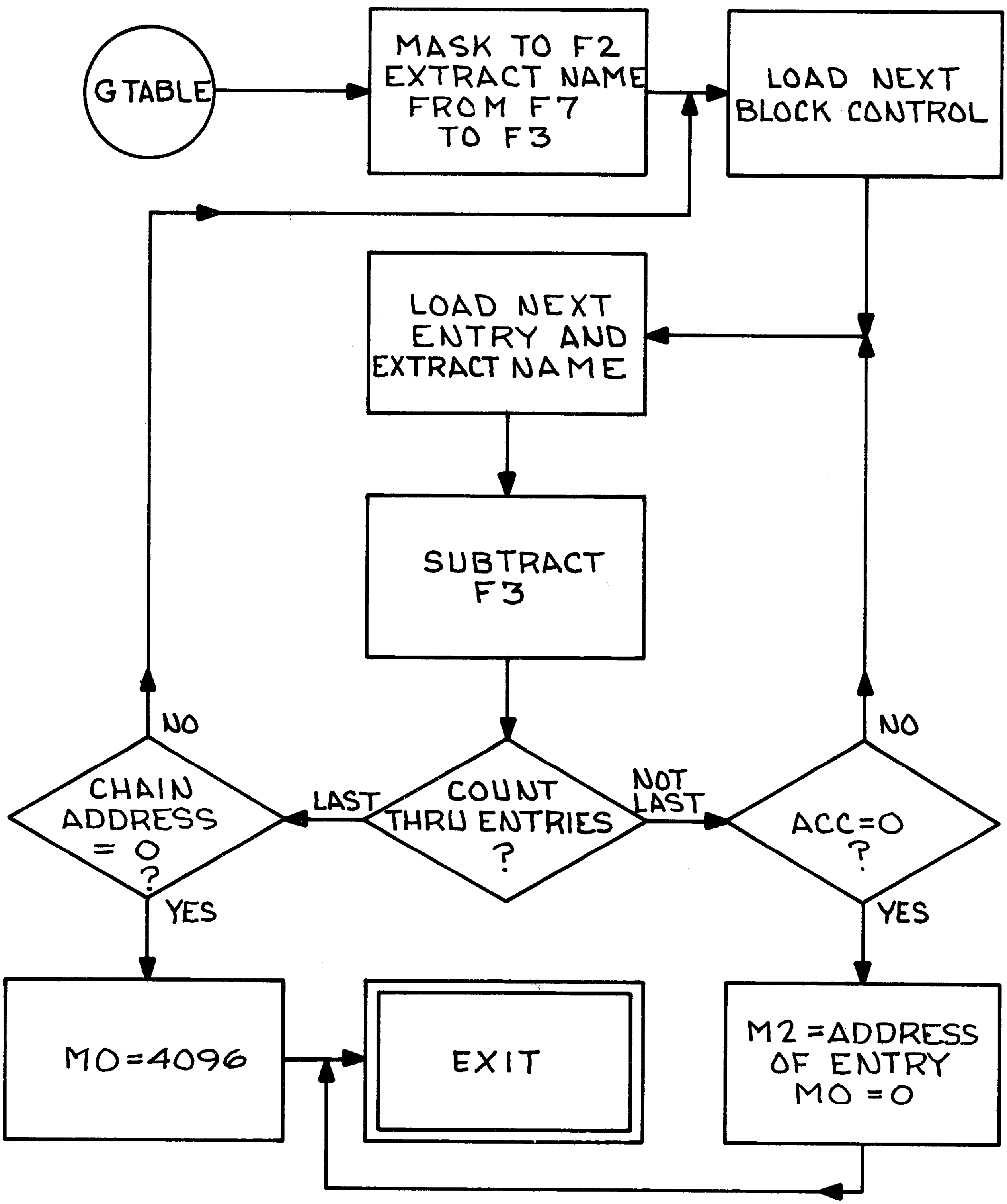
Each free block in memory is chained to the next free block. The last block contains 0 in the chain address position. If another free block is available, it is added to the beginning of the chain.

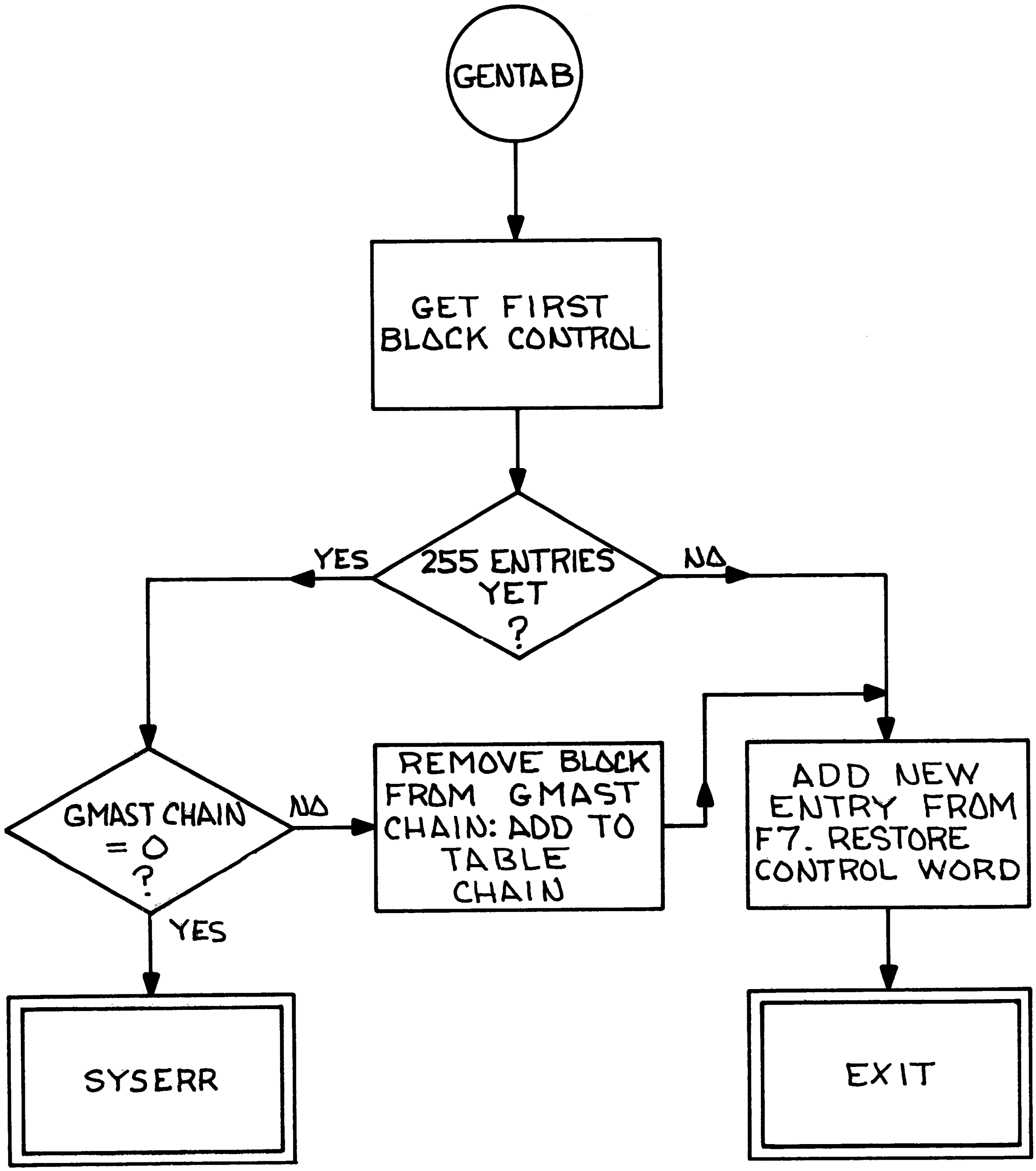
GERROR

Each entry to this program places the 13-bit number in M1 in the error table along with the current sequential statement number. These errors are listed after the Fortran Pass has been completed. Details of the program are given in section 3.5.5.

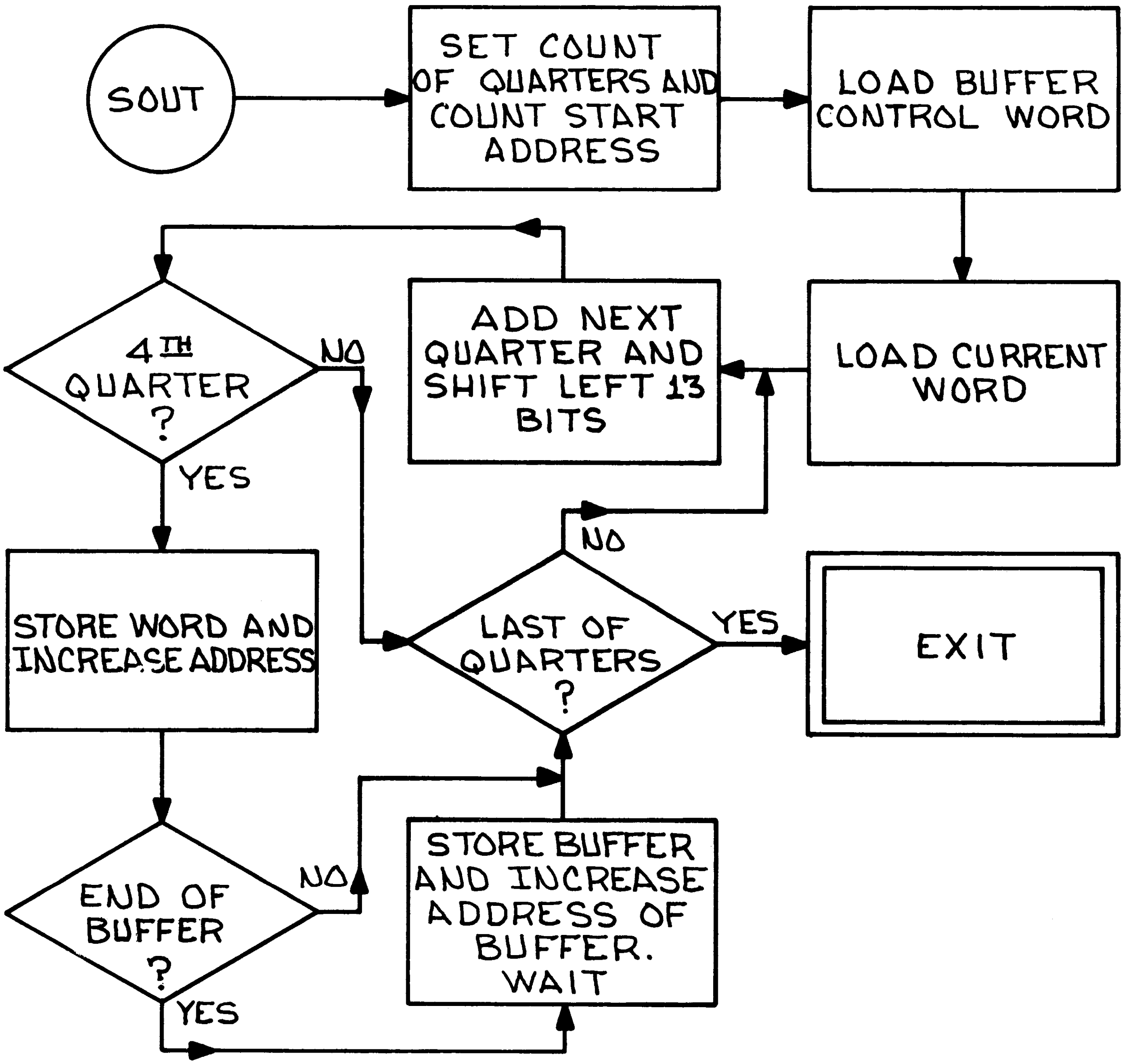
SØUT

This program takes the left-most quarter words of locations CØUT to M4-1 inclusive and packs them into a buffer which is placed on the drum each time it is full. M4 is restored to the address CØUT before exit.


GTABLE
MASK TO F2 EXTRACT NAME FROM F7 TO F3
LOAD NEXT BLOCK CONTROL
LOAD NEXT ENTRY AND EXTRACT NAME
SUBTRACT F3
COUNT THRU ENTRIES ?
LAST
NOT LAST
CHAIN ADDRESS = 0 ?
NO
YES
ACC=0 ?
NO
YES
MO=4096
EXIT
M2 =ADDRESS OF ENTRY MO =0


GENTAB
GET FIRST BLOCK CONTROL
255 ENTRIES YET ?
YES
NO
GMAST CHAIN = 0 ?
NO
YES
REMOVE BLOCK FROM GMAST CHAIN: ADD TO TABLE CHAIN
ADD NEW ENTRY FROM F7. RESTORE CONTROL WORD
SYSERR
EXIT

Date: 7/27/64
Section: 3.5
Page: 12 of 12
Revision:



3.5.1 The Statement Recognizer

The major subroutines used by the Statement Recognizer are GTABLE and GENTAB mentioned above and GREAD and GRBACK. These latter subroutines handle the source card images. GREAD reads in the next statement (occupying between one and ten cards) and lists the statement with a sequential statement number assigned by the program. In doing this it lists comment cards and skips them. They are not sequentially numbered. GREAD also examines the first five columns of a statement for Boolean, double-precision, F cards and statement numbers. B and D cards cause a switch to be set in memory for interrogation by the function generators, F cards cause an immediate exit to the statement recognizer, while statement numbers are converted into binary in the accumulator. After control is returned to the statement recognizer by GREAD following the first entry, subsequent entries to GREAD cause the characters of a statement to be given to the calling program one by one until the last, at which time an indicator is set. Further use of GREAD advances the program to the next statement whereas GRBACK will reset the GREAD subroutine so that it returns to column 6 of the first card of the current statement.

When the statement recognizer is told that there is a statement number in the first five columns, it makes an entry to section 3 of the Fortran program which deals with control transfers. This is described in section 3.5.3. The purpose of this entry is to enable the program to enter the number in the label table provided that it does not already exist there. In the case of no statement number or after return from section 3 of the program in the case of a label, the statement Recognizer scans the statement from beginning to end and determines the type of statement according to simple rules given in Table 3.5.1.1. In making this determinination it examines only sufficient information to determine that only one possibility for the statement types remains. (It may well happen that when the generator concerned with this particular statement is brought into play it will find that the statement is nonsense.)

When the Statement Recognizer has scanned to the end of the statement, it calls the program GRBACK which primes the program GREAD once again so that it is now sitting on column 6 of the first card of the statement. The Statement

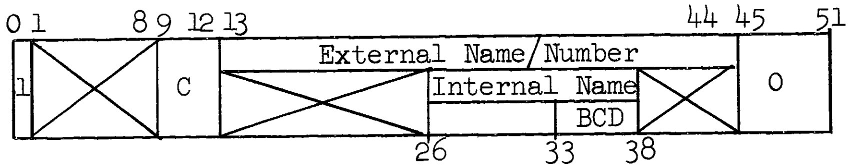
Recognizer now scans the statement for a second time, first removing a number of characters depending on the statement type. The statement is then translated into atoms. An atom is a single unit in the sense of a name, number, or operator. There is one exception. The statement FORMAT allows the generator to converse directly with the GREAD program. The Statement Recognizer removes the characters up to the (in FORMAT(and then branches to the generator.

As the Statement Recognizer translates a statement into atoms it places the atoms, one per word, in the statement buffer. The coding is shown in Table 3.5.1.1. In order to conserve memory space this statement buffer is limited to a set of words which may not be sufficient to contain the entire statement. Therefore, two additional atoms are introduced, called "End of Buffer" and "End of Statement." One and only one of these atoms will appear in the statement buffer. If the statement buffer is filled before the end of the statement is encountered the "End of Buffer" atom is inserted. Otherwise the "End of Statement" atom is inserted.

The Statement Recognizer then calls the appropriate generator. (There are 42 such generators plus one for illegal statement.) These generators must return, when they have completed the statement, by the standard subroutine return JLH M3. If, however, they encounter "End of Buffer" rather than "End of Statement" during the processing of the statement buffer atoms, they call the program FREFIL which is a part of the Statement Recognizer which continues to translate the original cards into atoms in the statement buffer.

As before, if the statement buffer is exhausted, the "End of Buffer" atom is inserted; otherwise the "End of Statement" atom is inserted. When the complete statement has been processed, the generating program will finally return to the Statement Recognizer by the standard return JHL M3.

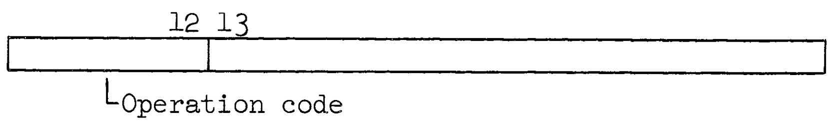
Table 3.5.1.1a. Operand Atoms in the Statement Buffer



<u>Code C</u>

000F	Internal name for a constant in the constant table. F = 0 implies fixed point.
0100	Number was fixed, was less than six digits. Appears in bits 13 to 44 as integer.
1000	BCD character in bits 33 to 38.
X01F	Name with no left parenthesis following X = 0 implies either that the first character is X if the name is longer than three characters and is followed by a (, or that that first character is I, J, K, L, M or N otherwise. F = 0 implies an initial I, J, K, L, M or N.
X11F	As X01F, but left parenthesis follows name.

Table 3.5.1.1b. Operation Atoms in the Statement Buffer



0	End of Statement
1	=
2	)
3	,
8	+
9	-
10	*
11	/
12	**
16	(
32	End of Buffer

The Initial Scan of the Statement

The statement is scanned until either the end of the statement is encountered or an = sign is encountered. During the scan a count of the number of left minus the number of right parentheses is kept. If this is 0 when an equal sign is found then the statement must fall in one of the categories:

1. Illegal Statement
2. Arithmetic Statement
14. DØ Statement
24. CALL Statement (using Hollerith parameters)

or

26. FØRMAT Statement (also using Hollerith)

The latter two cases are checked for by first comparing to see if the first four characters are CALL or the first seven FORMAT(. If the latter is true, then it is a FØRMAT statement. If the former is true, then a scan is made starting from the first (in the statement. If the sequences (dd...dH or ,dd...dH (where d is a decimal digit) appear before the first = sign, the statement is a CALL statement. Otherwise it is assumed to be an arithmetic statement.

If the first four or seven characters are not CALL or FØRMAT(respectively, then a DØ is checked for by scanning the characters beyond the first = sign. If + - * / ( ) . or EOS appears before a,, then it is not a DØ statement; otherwise it is assumed to be a DØ statement.

If there is no = sign, or if the first = sign occurs with a nonzero parenthesis count, a decision about the statement is based on some of the characters already examined and on the number of characters before the first = or EOS. The basis of the decision is given in Table 3.5.1.2 below. In this table "N3" means that there are three characters before the = or EOS; similarly for N4, N5 and N6. No such statement means that there are seven or more characters. "2 = M" means that the second character is an M. Also shown in this table is the number of characters deleted before the statement is scanned a second time in order to be broken into atoms. (During this second scan, a

Table 3.5.1.2. Statement Types

Statement Type Number	Statement	Recognition	Characters Deleted
	Illegal	Failure to satisfy other classes.	
2	Arithmetic	See above	None
3	GØ TØ	1 = G and (N5 or N6 and 2 = Ø or 5 = #)	2Ø
4	GØ TØ (#, ..., #), d	1 = G and 5 = (	2Ø
5	GØ TØ d,(#, ..., #)	1 = G and 5 = α (α means alphabetic)	2Ø
6	ASSIGN # TØ d	1 = A	1N (also two characters are removed after #)
7	IF (EXPS) #,#,#	3 = (and next seven characters not α	1F
8	SENSE LIGHT ...	2 = E	1T
9	IF (SENSE LIGHT ...	1 = I and 3 = (and 4 through 9 = SENSE L and 10 = α	1T
10	IF (SENSE SWITCH ...	1 = I and 3 = (and 4 through 9 = SENSE S and 10 = α	1H
11	IF ACCUMULATØR ØVERFLØW	1 = I and 3 = A	1W
12	IF QUØTIENT ØVERFLØW	1 = I and 3 = Q	1W
13	IF DIVIDE CHECK	1 = I and 3 = D	1K
14	DØ ...	See above	1Ø
15	CØNTINUE	1 = C and 3 = N	1E
16	PAUSE	N5 and 1 = P	1E

Table 3.5.1.2 (Cont'd): Statement Types

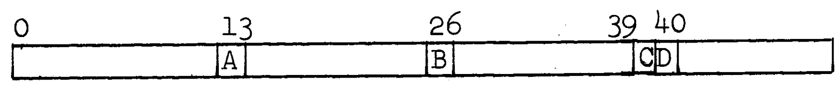
Statement Type Number	Statement	Recognition	Characters Deleted
17	PAUSE #	N6 and 2 = A and 1 ≠ C or 1 = P and 2 = A	1E
18	STØP	N4	1P
19	STØP #	N5 and 1 = S or N6 and 2 = T	1P
20	END	N3	1D
21	END(...	1 = E and 4 = (	1D
22	FUNCTIØN	1 = F and 2 = C	2N
23	SUBRØUTINE	1 = S and 2 = U	1E
24	CALL ...	N5 and 1 = C or N6 and 2 = A and 1 = C or 1 = C and 4 = L or see above	2L
25	RETURN	N6 and 2 = E	1N
26	FØRMAT ...	1 = F and 2 = Ø or see above	1(
27	READ ...	1 = R and 5 = # and 2 ≠ I or N6 and 4 = D	1D
28	READ INPUT TAPE ...	1 = R and 5 = I and 2 ≠ I	2E
28a	RIT ...	1 = R and 2 = I or N6 and 2 = I	1T
29	READ TAPE ...	1 = R and 5 = T and 2 ≠ I	2E
30	READ DRUM	1 = R and 5 = M and 2 ≠ I	1M
31	PUNCH	1 = P and 2 = U or N6 and 2 = U	1H

Table 3.5.1.2 (Cont'd): Statement Types

Statement Type Number	Statement	Recognition	Characters Deleted
32	PRINT	1 = P and 2 = R or N6 and 2 = R	1T
33	WRITE ØUTPUT TAPE ...	1 = W and 6 = Ø and 2 ≠ Ø	2E
33a	WØT	1 = W and 2 = Ø or N6 and 2 = Ø and 1 ≠ G	1T
34	WRITE TAPE	1 = W and 6 = T and 2 ≠ Ø	2E
35	WRITE DRUM	1 = W and 6 = D and 2 ≠ Ø	1M
36	END FILE	1 = E and 4 = F	2E
37	REWIND	1 = R and 5 = N and 2 ≠ I	1D
38	BACKSPACE	1 = B	1E
39	DIMENSION ...	1 = D	2N
40	FREQUENCY	1 = F and 2 = R	1Y
41	EQUIVALENCE	1 = E and 4 = I	3E
42	CØMMØN	1 = C and 3 = M	1N
43	"F CARD"	Col 1 = F	None

statement may become illegal.) The notation used in this column is of the form "2N" meaning that the scan is made to the second N before beginning the analysis.

Part of the job of checking for legal statement sequences is performed by part 1 of the program. The word PSIG is prepared by the control section, and contains information about the outside label, if any, and about preceding statements. Its format is



PSIG

If L is nonzero, this statement has a statement number, and its internal form is L. It is placed there by the routine FPLABL which is CALLed when part 1 senses a statement number.

Bit A is a one if this statement number closes a DØ loop. FPLABL turns it on, and part 1 tests it after the statement has been completed by the generator. If it is on, part 1 branches to PDOCL (do closure program).

Bit B indicates that the next executable statement must have a label. Part 1 tests this (and turns it off) only if the statement is executable. This bit is turned on by GØ TØ and IF type statements.

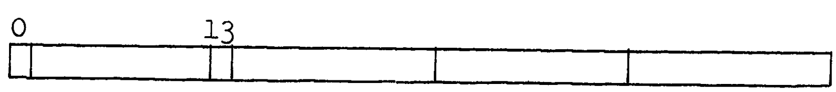
Bit C indicates that the next statement must be executable. Except in the case of FØRMAT, part 1 tests this and turns it off. It is turned on by a DØ statement.

Bit D is turned on if FPLABL finds a statement number that has been used in an input-output type statement as a format number, but has not yet been defined. Its entry type in the LABEL table is changed from type 3 to type 1 and bit D is turned on.

If D is on for anything but a format statement it is therefore illegal.

GREAD

GREAD uses a card buffer area GRCDBF to hold the next card. It also uses a 100-word buffer GRASS area to hold up to ten cards of a single statement (ten words per card). Initially bits 0 and 13 of the first word are set to 1. This state indicates that a new statement is to be processed. The first entry to GREAD recognizes these bits and causes the first card image from GRCDBF to be copied into the first available spot in the card assembly area GRASS. The next card image is read into GRCDBF and examined. If column 1 is a C, it is printed and otherwise ignored. If column 1 is not a C and column 6 is not blank or 0, it is copied into the next available spot in the GRASS buffer provided that there is still space. If there is no space left, an error is listed. If the next card does not have a C in column 1 and is blank or 0 in column 6, or if there is no next card, the statement is taken as complete, so a sign bit is set in bit 0 of the last card image in GRCDBF. Columns 1-5 of the first card of the statement are now examined for F, B or D cards and for a statement number. A statement number is converted into binary in the accumulator with 4096 in MO, B and D cards set bits in the word GRBDSW. F cards cause an immediate exit with -1 in MO.



0	0	neither B nor D card
0	1	D card
1	0	B card

GRBDSW Control Word

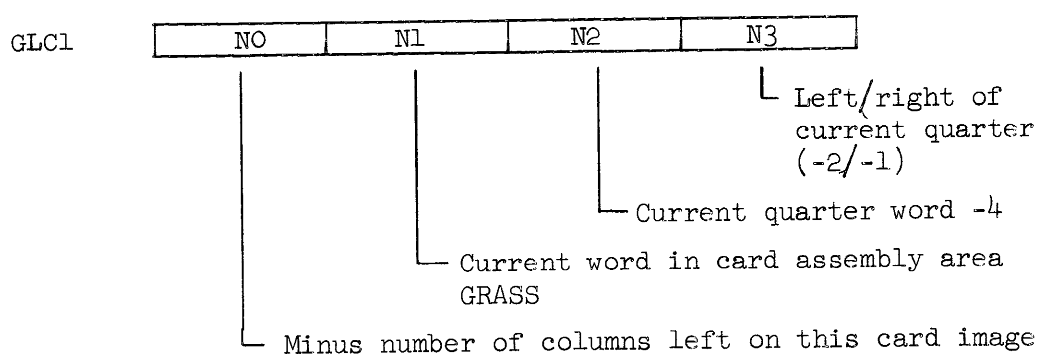
Subsequent entries to GREAD cause successive characters of the card images to be placed in MO. When the last character of a card is read, the sign bit in bit 0 of the tenth word of that card image in GRASS is tested. If it is a 1, then this is the last card, i.e., the end of the statement. A sign bit in bit 13 of the same word is now set so that on the next entry the statement processing will start over, and an exit is made with 4096 in MO as an end of statement mark.

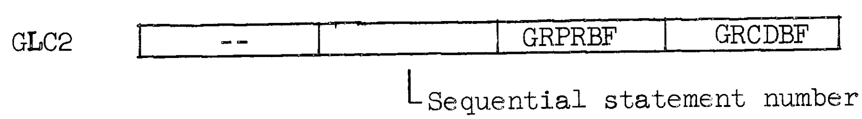
If, in this process, reading the next card causes a return due to End of File or not BCD card without $ in column 1, a sign bit is also set in bit 26 of word 10 of the last card. This causes the next request for an additional statement to print a "NO END CARD" message followed by a branch to the END statement generator.

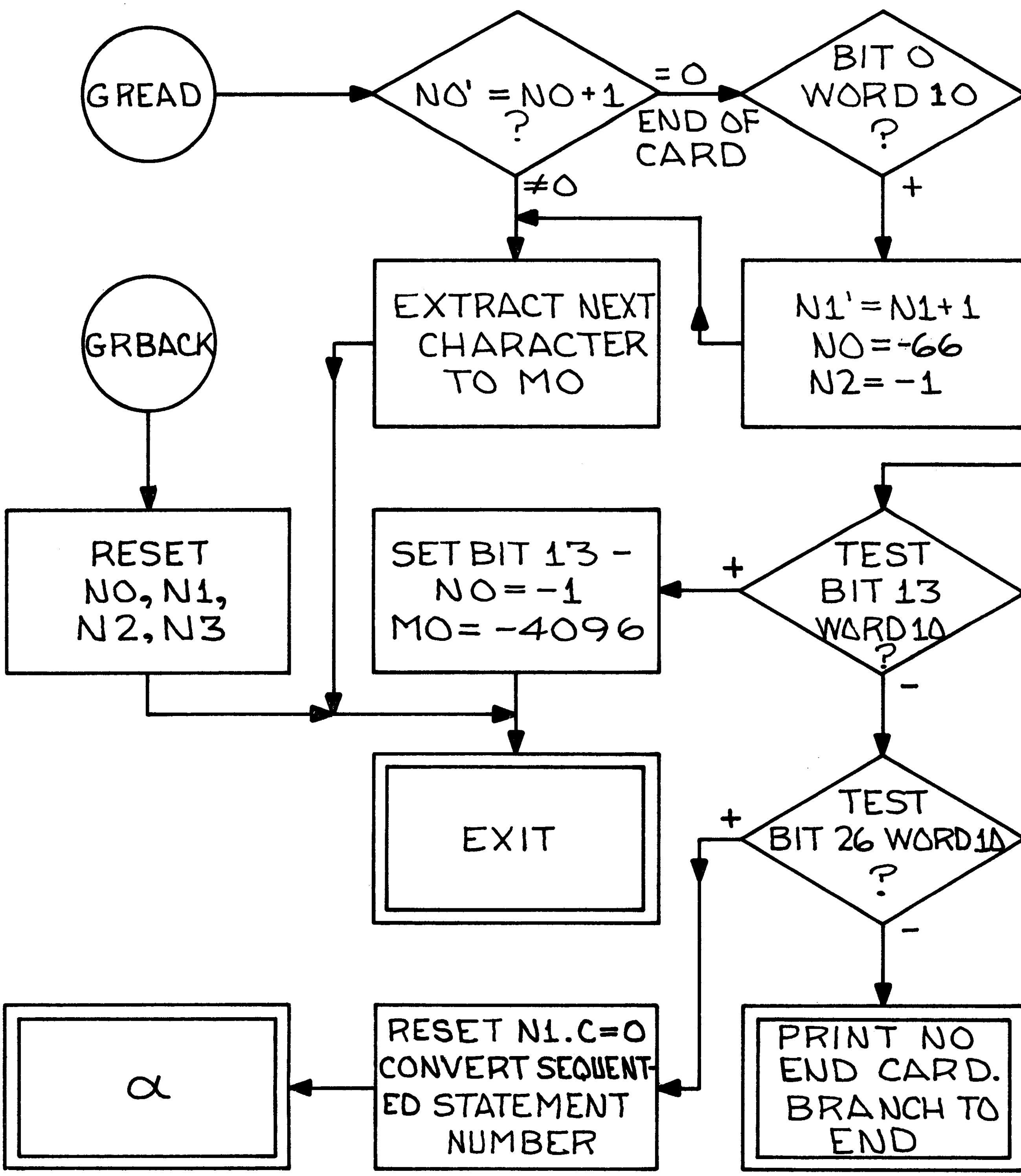
Each statement read by GREAD is listed and sequentially numbered on the right of the page.

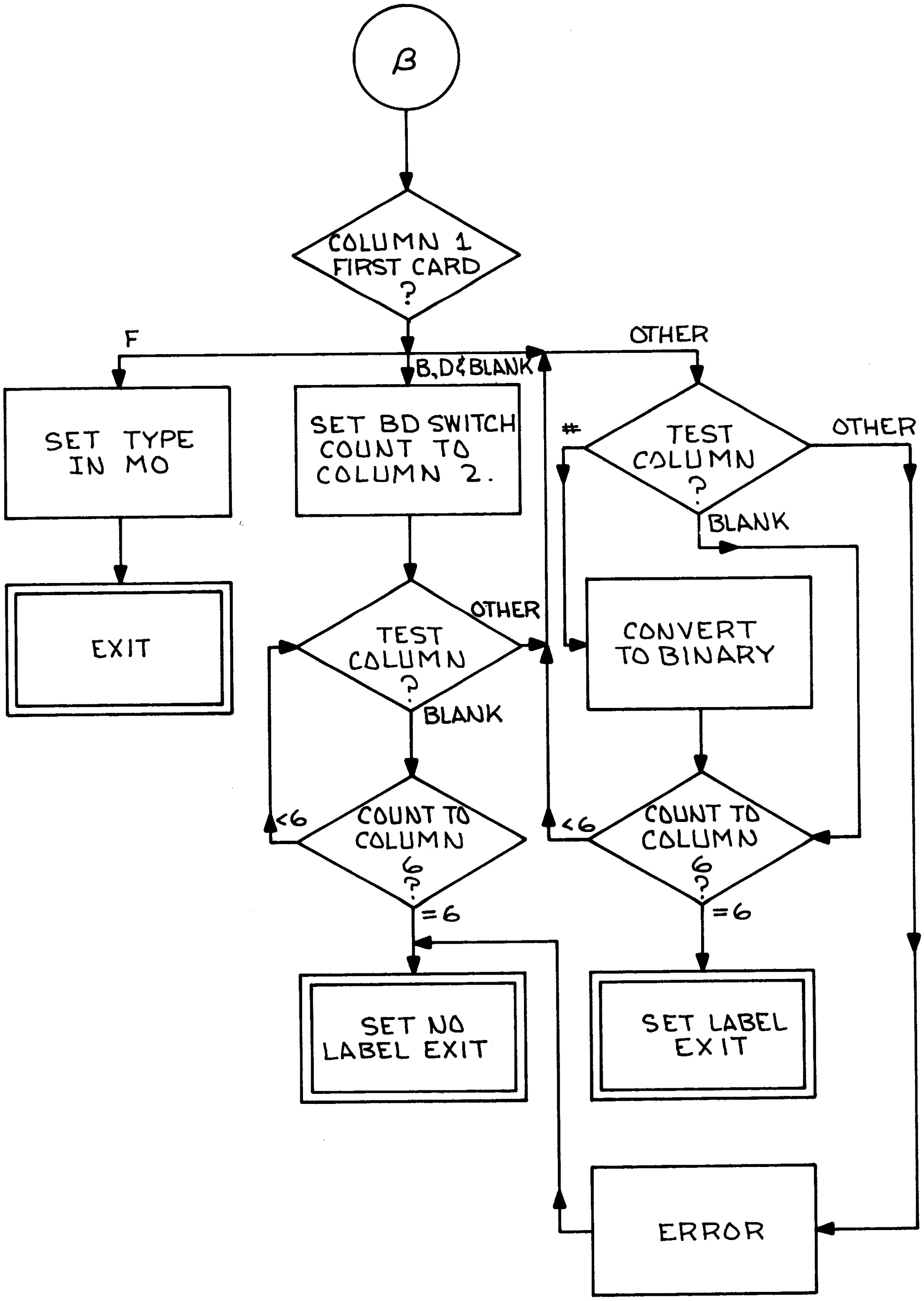
GRBACK

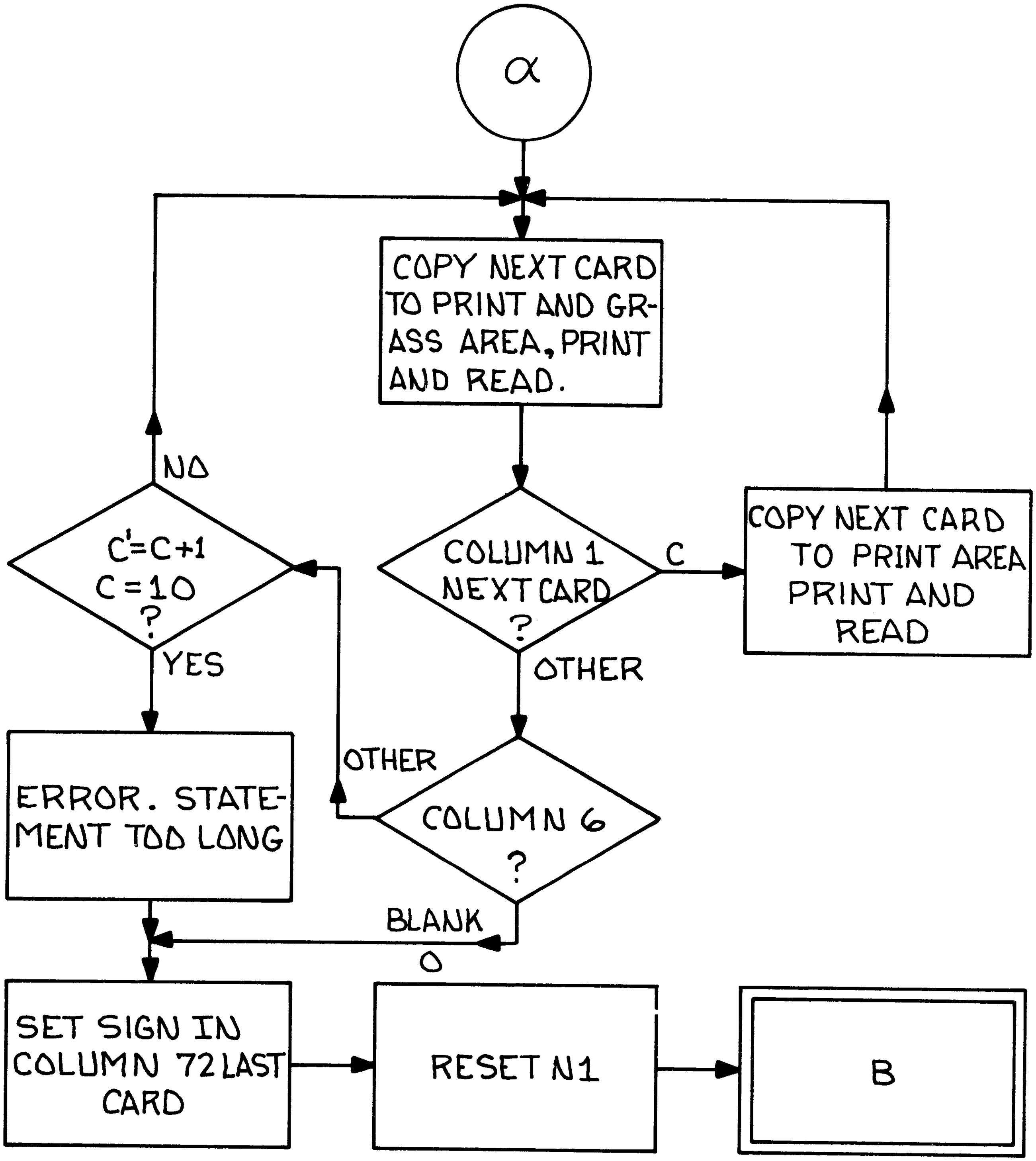
GRBACK is an additional short program that resets the counts in GREAD to the beginning of the current statement. These counts are:






GREAD
NO' = NO+1 ?
=0
END OF CARD
BIT 0 WORD 10 ?
−
≠0
+
EXTRACT NEXT CHARACTER TO MO
N1' = N1+1
NO = -66
N2 = −1
GRBACK
RESET NO, N1, N2, N3
SET BIT 13 -
NO = −1
MO = −4096
+
TEST BIT 13 WORD 10 ?
−
EXIT
+
TEST BIT 26 WORD 10 ?
−
α
RESET N1.C=0 CONVERT SEQUENTED STATEMENT NUMBER
PRINT NO END CARD. BRANCH TO END


β
COLUMN 1 FIRST CARD ?
F
B, D & BLANK
OTHER
SET TYPE IN MO
EXIT
SET BD SWITCH COUNT TO COLUMN 2.
TEST COLUMN ?
OTHER
BLANK
<6
COUNT TO COLUMN 6 ?
=6
SET NO LABEL EXIT
#
TEST COLUMN ?
OTHER
BLANK
CONVERT TO BINARY
<6
COUNT TO COLUMN 6 ?
=6
SET LABEL EXIT
ERROR



α
COPY NEXT CARD TO PRINT AND GR-ASS AREA, PRINT AND READ.
COLUMN 1 NEXT CARD ?
C
COPY NEXT CARD TO PRINT AREA PRINT AND READ
OTHER
COLUMN 6 ?
OTHER
C'=C+1 C=10 ?
NO
YES
ERROR. STATE-MENT TOO LONG
BLANK
0
SET SIGN IN COLUMN 72 LAST CARD
RESET N1
B

```
 Z7002          LIZ BROWER
$       PUNCH OBJECT
$       PRINT OBJECT
$       NICAP
        ENTRY  FREFIL,GREAD,GRBACK,GDECVT,FP1,GENTAB,GTABLE
READ    EQUS   0
BCD     EQUS   0
EE      EQUS   0
GRDTMB  EQUS   2
LEERR   EQUS   4
FT2     EQUS   0
SYSERR  EQUS   7937
GRASS   EQUS   50
COUT    EQUS   150
SYSIO   EQUS   7939
GRCDBF  EQUS   240
GRPRBF  EQUS   260
CONST   EQUS   283
PSIG    EQUS   285
        ORG    250
PCAD    DECQ   0,4095,PCAP,0
        ORG    290
GMAST   DECQ   0,0
GERROR  JLH    3,0
FPLABL  JLH    3,0
SOUT    JLH    3,0
FTY1    BSS    22
PDOCL   BSS    1
PCAP    BSS    50
FP1     CAM    FM2                 SET LABEL MARK TO ZERO
        CAM    FM2                 2.1, SET LABEL MARK TO ZERO
        LFR    2,FC17                 INITIALIZE ASSIGN SWITCH
        SFR    2,FP65
        SFR    4,FV11                 SET REFIL RETURN MARK ZERO
```

```
         JSB   FM3,GREAD        3, READ LABEL IF ANY, DETECT F CARD        0065
         FIL                                                               0066
         JPM   FM0,FP1A2        4, JUMP IF NO F CARD AND NO LABEL          0067
         CJZ   FM0,FCARD        5, JUMP TO F CARD ROUTINE                  0068
         SAM   FV1              7, SAVE LABEL IN FV1                       0070
         CSM   FM2,1            7, SET LABEL MARK = -1                     0071
         JSB   FM3,FPLABL       7, GO TO PASTA WITH LABEL IN AC, FV1       0072
         FIL                                                               0073
         ATN   1                SWITCH X1 TO 1
FP1A2    CAM   FMX1             SWITCH X1 TO 0 OR 1
         CAM   FMX5
         CAM   FMX2
         CAM   FMX3             9, SET SWITCH X3 TO ZERO                   0075
         CAM   FM4              10, ZERO IN PAREN COUNTER                  0076
         CSM   FM5,7            11, -7 IN CHAR. COUNTER                    0077
FP2      JSB   FM3,GREAD        12,                                        0078
         FIL                                                               0079
         JNM   FM0,FP11         13, EOS, GO TO SWITCH X1                   0080
         LFR   6,FM0+FT6                                                   0081
         ANN   FM8,7
         CSM   3
         JZM   3,FP2            BLANK
         CJZ   3,FP9            =
         CJZ   3,FP4            OTHER
         SBM   FM4,1
         CJZ   3,FP4            )
         ADM   FM4,2            (
FP4      JUM   FMX2,FP2         SWITCH X2                                  0094
         SER   4,FT1-FM5-1                                                 0095
         CJU   FM5,FP8          18, 19 ADD 1 TO CHAR COUNT, TEST FOR 0     0096
         CAM   FMX2,1           20, HERE IF 7 CHARS READ, PUT X2=1         0097
         LDM   0,FT1+6                                                     0098
         CAD   9,3,FM0          21                                         0099
         CSM   FM3,6            21                                         0100
```

```
FP5     LDM    0,FT1-FM3-1                                              0101
        MPY    9,3,64          21                                       0102
        ADD    9,3,FM0         21                                       0103
        CJU    FM3,FP5         21 LOOP IF NOT FINISHED                  0104
        SUB    FC5             21 COMPARE WITH CONSTANT FORMAT(         0105
        JDC    4,FP6           21 JUMP IF NOT FORMAT                    0106
        JSB    3,2,FTY1+12     FORMAT EXIT
        FIL
        TRA    GFP3+1          TAKE CARE OF PSIG
FP6     LDM    0,FT1+6                                                  0109
        CAD    9,3,FM0         21                                       0110
        CSM    FM3,3           21                                       0111
FP7     LDM    0,FT1-FM3+2                                              0112
        MPY    9,3,64          21                                       0113
        ADD    9,3,FM0         21                                       0114
        CJU    FM3,FP7         21 GO BACK IF NOT FINISHED               0115
        SUB    FC6             21 COMPARE WITH CONSTANT CALL            0116
        JDC    4,FP8           21 JUMP IF NOT CALL                      0117
        CAM    FMX6            21 HERE IF CALL                          0118
FP7A1   CAM    FMX5,1          21                                       0119
FP8     JUM    FMX3,FP2        SWITCH FX3                               0120
        CAM    FMX1,1          22                                       0121
        CAM    FMX3,1          23                                       0122
        JUM    FMX3,FP2                                                 0123
FP9     JUM    FM4,FP11A1      24, HERE ON FIRST=, TEST PAREN CT        0124
        JUM    FMX5,FP37       SWITCH FX5,                              0125
FP10    JSB    FM3,GREAD       25, BEGIN TEST FOR ARITH. OR DO STAT.    0126
        FIL                                                             0127
        JNM    FM0,FP10A2      26, JUMP FOR EOS TO TYPE 2 EXIT          0128
        LFR    6,FT6+FM0                                                0129
        JPM    FM9,FP10A1      27, JUMP IF NOT +-*/().                  0130
FP10A2  CAM    FM1,2           27, HERE IF +-*/().  SET TYPE 2 MK       0131
        JPM    FMX5,FTYP2      27 TYPE 2 FIRST EXIT                     0132
FP10A1  JPM    FM10,FP10       27 JUMP IF NOT ,                         0133
```

```
         CAM    FM1,14          27 HERE IF ,                  0134
         JNM    FM10,FTYP14     27 TYPE 14 FIRST EXIT         0135
FP11     JZM    FMX1,FP1                                      0136
FP11A1   CAM    FM3             28 SWITCH FX4                 0137
         JZM    FM5,FP12A1      7 OR MORE CHARS
         CJZ    FM5,FP33        6 CHARS
         CJZ    FM5,FP31        5 CHARS
         CAM    1,18
         CJZ    FM5,FTYP18      4 CHARS
         CAM    1,20
         CJZ    FM5,FTYP20      3 CHARS
         TRA    FTYP1           2 OR LESS
FP12A1   LDM    0,FT1+6                                       0156
         LFR    6,FT6+FMO                                     0157
         ANN    FM10,15
         CSM    3
         JZM    3,FTYP1         OTHER
         CJZ    3,FP29          G  GO TO TEST 4
         CAM    FM1,6           36 A                          0165
         CJZ    3,FTYP6         A
         CAM    FM1,38          36 B                          0167
         CJZ    3,FTYP38        B
         CJZ    3,FP27          I  GO TO TEST 6
         CJZ    3,FP25          S  GO TO TEST 7
         CJZ    3,FP23          C  GO TO TEAT 8
         CAM    FM1,39          36 D                          0175
         CJZ    3,FTYP39        D
         CJZ    3,FP21          P
         CJZ    3,FP19          E
         CJZ    3,FP17          F
         CJZ    3,FP15          R
         LDM    0,FT1+5         1=W, 2ND CHAR
         SBM    0,38            2=O
         CAM    1,33
```

```
         JZM    0,FTP33A        WOT
         LDM    0,FT1+1                              0185
         LFR    6,FT6+FM0                            0186
         ANN    FM9,3
         TRA    FP14
FP14     CAM    FM1,1           37 OTH               0190
         TRA    FTYP1           TYPE 1
         CAM    FM1,33          37 O                 0192
         TRA    FTYP33
         CAM    FM1,34          37 T                 0194
         TRA    FTYP34
         CAM    FM1,35          37, D                0196
         TRA    FTYP35
FP15     LDM    0,FT1+5         2ND CHAR
         SBM    0,57            2=I
         CAM    1,28
         JZM    0,FTP28A        RIT
         LDM    0,FT1+2         5TH CHAR
         LFR    6,FT6+FM0                            0199
         CRM    FM10,6          38                   0200
         ANN    FM10,7
         TRA    FP16
FP16     CAM    FM1,37          38, N                0204
         TRA    FTYP37
         CAM    FM1,30          38, D                0206
         TRA    FTYP30
         CAM    FM1,29          38 T                 0208
         TRA    FTYP29
         CAM    FM1,28          38 I                 0210
         TRA    FTYP28
         CAM    FM1,27          38 NUMBER            0212
         TRA    FTYP27
         TRA    FTYP1
FP17     LDM    0,FT1+5                              0216
```

```
         LFR     6,FT6+FMO                                0217
         CRM     FM10,4            39                     0218
         ANN     FM10,3
         TRA     FP18
FP18     CAM     FM1,1             39 OTH                 0222
         TRA     FTYP1
         CAM     FM1,40            39 R                   0224
         TRA     FTYP40
         CAM     FM1,22            39 U                   0226
         TRA     FTYP22
         CAM     FM1,26            39 O                   0228
         TRA     FTYP26
FP19     LDM     0,FT1+3                                  0230
         LFR     6,FT6+FMO                                0231
         CRM     FM9,2             40                     0232
         ANN     FM9,3
         TRA     FP20
FP20     CAM     FM1,21            40 (                   0236
         TRA     FTYP21
         CAM     FM1,36            40 F                   0238
         TRA     FTYP36
         CAM     FM1,41            40 I                   0240
         TRA     FTYP41
         TRA     FTYP1
FP21     LDM     0,FT1+5                                  0244
         LFR     6,FT6+FMO                                0245
         CRM     FM9,4             41                     0246
         ANN     FM9,3
         TRA     FP22
FP22     CAM     FM1,17            41 A                   0250
         TRA     FTYP17
         CAM     FM1,31            41 U                   0252
         TRA     FTYP31
         CAM     FM1,32            41 R                   0254
```

```
        TRA    FTYP32
        TRA    FTYP1
FP23    LDM    0,FT1+4                        0258
        LFR    6,FT6+FMO                      0259
        CRM    FM9,6        42                0260
        ANN    FM9,3
        TRA    FP24
FP24    CAM    FM1,1        42 OTH            0264
        TRA    FTYP1
        CAM    FM1,15       42 N              0266
        TRA    FTYP15
        CAM    FM1,24       42 L              0268
        TRA    FTYP24
        CAM    FM1,42       42 M              0270
        TRA    FTYP42
FP25    LDM    0,FT1+5                        0272
        LFR    6,FT6+FMO                      0273
        CRM    FM9,8        43                0274
        ANN    FM9,3
        TRA    FP26
FP26    CAM    FM1,8        43 E              0278
        TRA    FTYP8
        CAM    FM1,19       43 T              0280
        TRA    FTYP19
        CAM    FM1,23       43 U              0282
        TRA    FTYP23
        TRA    FTYP1
FP27    LDM    0,FT1+4                        0286
        LFR    6,FT6+FMO                      0287
        CRM    FM10,9       44                0288
        ANN    FM10,7
        TRA    FP28
FP28    CAM    FM1,7        44 (              0292
        TRA    FTYP7
```

```
         CAM     FM1,11         44 A                 0294
         TRA     FTYP11
         CAM     FM1,12         44 Q                 0296
         TRA     FTYP12
         CAM     FM1,13         44 D                 0298
         TRA     FTYP13
         TRA     FTYP1
FP29     LDM     0,FT1+2                             0302
         LFR     6,FT6+FM0                           0303
         CRM     FM9,10         45                   0304
         ANN     FM9,3
         TRA     FP30
FP30     CAM     FM1,1          45 OTH               0308
         TRA     FTYP1
         CAM     FM1,3          45 NUMBER            0310
         TRA     FTYP3
         CAM     FM1,4          45 (                 0312
         TRA     FTYP4
         CAM     FM1,5          45 ALPAA             0314
         TRA     FTYP5
FP31     LDM     0,FT1+6                             0316
         LFR     6,FT6+FM0                           0317
         CRM     FM11,3         46                   0318
         ANN     FM11,7
         TRA     FP32
FP32     CAM     FM1,1          46 OTH               0322
         TRA     FTYP1
         CAM     FM1,3          46 G                 0324
         TRA     FTYP3
         CAM     FM1,16         46 P                 0326
         TRA     FTYP16
         CAM     FM1,19         46 S                 0328
         TRA     FTYP19
         CAM     FM1,24         46 C                 0330
```

```
         TRA    FTYP24
FP33     LDM    0,FT1+5           2ND CHAR
         LFR    6,FT6+M0
         ANN    11,7
         TRA    FP34
FP34     CAM    1,1               OTHER
         TRA    FTYP1
         CAM    1,32              R
         TRA    FTYP32
         CAM    1,2               U
         TRA    FTYP3
         CAM    1,25              E
         TRA    FTYP25
         LDM    0,FT1+6           A
         TRA    FP34A
         CAM    1,19              T
         TRA    FTYP19
         LDM    0,FT1+6           O
         TRA    FP34B
         CAM    1,28              I
         TRA    1,FTP28A
FP34A    SBM    0,51              1=C
         CAM    1,24
         JZM    0,FTYP24
         CAM    1,17
         TRA    FTYP17
FP34B    SBM    0,55              1=G
         CAM    1,3
         JZM    0,FTYP3
         CAM    1,33
         TRA    FTP33A
FP37     JSB    FM3,GRBACK        52 RESET CHAR. READ TO COL. 7          0353
         FIL                      52                                     0354
FP38     JSB    FM3,GREAD         53 READ CHARACTER-SEARCH FOR (         0355
```

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         FIL                   53                                    0356
         JPM    FM0,FP39       54                                    0357
FP38A1   CAM    FM1,1          54                                    0358
         JNM    FM0,FTYP1      54 TYPE 1 FIRST EXIT                  0359
FP39     SBM    FM0,11         55 IS CHARACTER =                     0360
         JZM    FM0,FP46A2     55 JUMP IF YES TO TYPE 2 EXIT         0361
         SBM    FM0,17            55    IS CHARACTER  (              0362
         JUM    FM0,FP38          55                                 0363
FP40     JSB    FM3,GREAD      56 PRECEDING CHAR IS (                0364
         FIL                   56                                    0365
         JNM    FM0,FP38A1     JUMP TO TYPE 1 EXIT                   0366
         LFR    6,FT6+FM0      58 BEGIN TEST 16 PRIME                0367
         CRM    FM8,3          58                                    0368
         ANN    FM8,3
         CSM    3
         JZM    3,FP40         BLANK
         CJZ    3,FP44         NUMBER
FP42     JSB    FM3,GREAD      59 HERE IF OTHER                      0378
         FIL                   59                                    0379
         JPM    FM0,FP43       59                                    0380
FP42A1   CAM    FM1,1          59                                    0381
         JNM    FM0,FTYP1      59 TYPE 1 FIRST EXIT                  0382
FP43     SBM    FM0,11         60 IS CHARACTER =                     0383
         JZM    FM0,FP46A2     60 JUMP IF YES TO TYPE 2 EXIT         0384
         SBM    FM0,16         60 US CHARACTER ,                     0385
         JZM    FM0,FP40                                             0386
         JUM    FM0,FP42                                             0387
FP44     JSB    FM3,GREAD      61 HERE IF NUMBER, LOOK FOR H         0388
         FIL                   61                                    0389
         JNM    FM0,FP42A1     62 JUMP TO TYPE 1 EXIT                0390
         LFR    6,FT6+FM0      63                                    0391
         CRM    FM8,3          63                                    0392
         ANN    FM8,3
         CSM    3
```

```
         JZM     3,FP44              BLANK
         CJZ     3,FP44              NUMBER
         CJU     3,FP43              OTHER
         TRA     FMX6+FP46
FP46     CAM     FM1,24                                               0405
         JPM     FM1,FTYP24          TYPE 24 FIRST EXIT               0406
         CAM     FM1,26                                               0407
         JPM     FM1,FTYP26          TYPE 26 FIRST EXIT               0408
FP46A2   CAM     FM1,2                                                0409
         JPM     FM1,FTYP2           TYPE 2 FIRST EXIT                0410
FTYP1    CAM     1,EE+4
         CALL    GERROR
         CALL    GRBACK
FTYP1A   CALL    GREAD
         JPM     0,FTYP1A
         CAM     1                   ERROR TYPE MARK
         TRA     FP62                TAKE CARE OF PSIG
FTYP4    EQUL    FTYP3
FTYP5    EQUL    FTYP3
FTP28A   EQUL    FTYP8
FTP33A   EQUL    FTYP8
FTYP31   EQUL    FTYP10
FTYP12   EQUL    FTYP11
FTYP23   EQUL    FTYP17
FTYP28   EQUL    FTYP29
FTYP38   EQUL    FTYP17
FTYP27   EQUL    FTYP21
FTYP37   EQUL    FTYP21
FTYP39   EQUL    FTYP22
FTYP33   EQUL    FTYP29
FTYP34   EQUL    FTYP29
FTYP36   EQUL    FTYP29
FTYP35   EQUL    FTYP30
FTYP32   EQUL    FTYP8
```

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FTYP6   EQUL    FP103
FP103   LFR     2,FC16              HERE IF ASSIGN                    0825
        SFR     2,FP65                                                0826
FTYP42  ATN     18               N 45
FTYP7   EQUL    FTYP26           (
FTYP8   ATN     -37              T 23
FTYP10  ATN     34               H 70
FTYP11  ATN     -12              W 26
FTYP13  ATN     -4
FTYP14  ATN     -15              O 46
FTYP17  ATN     14               E 65
FTYP19  ATN     -13              P 47
FTYP21  ATN     24               D 64
FTYP26  ATN     -8               ( 44
FTYP30  ATN     12               M 44
FTYP40  CAM     9,24             Y  30
        TRA     FP60
FTYP15  EQUL    FTYP17
FTYP16  EQUL    FTYP17
FTYP18  EQUL    FTYP19
FTYP20  EQUL    FTYP21
FTYP25  EQUL    FTYP42
FTYP9   EQUL    FTYP8
FTYP3   ATN     1                O  46
FTYP22  ATN     2                N  45
FTYP24  ATN     -18              L  43
FTYP29  CAM     9,53             E  65
        TRA     FP59
FTYP41  CAM     9,53             E
        ATN     1
FP59    ATN     1
FP60    CSM     8,1
        CALL    GRBACK
FP61    CALL    GREAD
```

```
        JNM    0,FTYP1            EOS
        SBM    0,M9
        JUM    0,FP61
        CJU    8,FP61
        TRA    FP62
FTYP2   CALL   GRBACK
FP62    CAM    FMX10,1            64 SET SWITCH FOR NAME SUB =1             0437
        SBM    FM1,24                                                       0438
        JUM    FM1,FP62A3                                                   0439
        CAM    FMX10,0                     IF CALL SET SWITCH OF N.S.=0     0440
FP62A3  SBM    FM1,2
        JUM    FM1,FP62A4
        JSB    3,2,FTY1+12        FORMAT EXIT
        FIL
        TRA    GFP3+1             GO TO CLEAN UP PSIG
FP62A4  SBM    FM1,13
        SFR    4,FT1
        LFR    6,PSIG
        JZM    8,FP62A5
        SFR    6,COUT+1           NAME
        CAM    8,3606             LFR5,2,
        SFR    6,COUT+2
        CAM    8,4314
        SFR    6,COUT             LONG,NAME,NAME
        LFR    6,PCAD
        SFR    6,COUT+3
        JUM    8,FP62B1
        CAM    8,4112             SHORT
        SFR    6,COUT
        CAM    8,1473             CAM 0,1,
        SFR    6,COUT+2
        ATN    -1
FP62B1  CAM    4,COUT+4
        JSB    3,SOUT
```

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        FIL
        LFR     6,PSIG
FP62A5  JPM     1,FP62A7           NON EXEC
        JPM     10,FP62A6
        ANM     10,4095
        JUM     8,FP62A6
        CAM     1,EE
        CALL    GERROR
FP62A6  CAM     8
        ANM     11,4095
FP62A7  JPM     11,FP62A8
        CAM     1,EE+1
        CALL    GERROR
FP62A8  JZM     8,FP62A9
        CAM     1,EE+2
        CALL    GERROR
FP62A9  ANN     11,2048
        CAM     8
        ANM     11,2047
        JZM     8,FP62B
        CAM     8
        CAM     1,EE+3
        CALL    GERROR
FP62B   SFR     6,PSIG
        LFR     4,FT1
        LFR     6,FT2
        ADM     1,39
        JZM     1,GFP3+1           ERROR TYPE, DONT TRANSLATE
        CAM     FM11,1             65 NEXT ATOM TO BE READ IS IN 1
        CAM     FM10,0             66 NUMBER OF ATOMS IS ZERO
        CAM     FM12,0
        SFR     7,FV4
        LDM     FM5,FC8                      SET ATOM CNTR= -NUMB. OF CELLS
FP62A2  JSB     FM3,GREAD          67
```

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       FIL                          67                                          0456
FP62A1 JNM     FM0,FP69A3           68 JUMP 2F EOS                              0457
       LFR     7,FT6+FM0            68 TEST 17                                  0458
       CRM     FM12,5               68                                          0459
       ANN     FM12,7
       CSM     3
       JZM     3,FP62A2             BLANK
       CJZ     3,FP64               NUMBER OR PERIOD
       CJZ     3,FP65               ALPHA
       CJZ     3,FP66               OPERATION
       CJZ     3,FP34               OTHER
       JUM     FMX10,FP65                    H NOT HOLLERITH JUMP               0473
       JZM     FM10,FP63A1                   FIRST IN STATE BUF                 0474
       LFR     7,FT2+FM10                    GET ATOM PRECEDES H                0475
FP63A2 ANM     FM12,4103                                                        0476
       SBM     FM12,4100                                                        0477
       JZM     FM12,FP71                     JUMP TO READ HOLLERITH CHAR.       0478
       JUM     FM12,FP65                     NOT HOLLERITH GO TO NAME SUB.      0479
FP63A1 LDM     FM12,FV4                                                         0480
       JZM     FM12,FP65                     NOT CONTINUATION GO TO NAME S.     0481
       LFR     7,FV5                                                            0482
       JPM     FM10,FP63A2                                                      0483
FP64   JSB     FM3,FP87             69 JUMP TO NUMBER SUBROUTINE                0484
       FIL                          69                                          0485
       TRA     FP67
       FIL                          70                                          0487
FP65   JSB     FM3,FP77             70 JUMP TO NAME SUB., SW. FOR ASSIGN        0488
       FIL                          70                                          0489
       TRA     FP67
FP66   CRM     FM15,7               71 CONSTRUCT AND STORE OPERATOR             0491
       ANM     FM15,63              71 ATOM IN STATEMENT BUFFER                 0492
       CAM     FM12,FM15            71                                          0493
       SFR     7,FT2+FM10+1         71                                          0494
FP66A1 JSB     FM3,GREAD            72                                          0495
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        FIL
        JZM    FM0,FP66A1
        SBM    FM0,44               72A1  IS CHARACTER  * , CHK FOR ** OP
        JUM    FM0,FP66A2           72A1  IF NOT GO BACK
        SBM    FM12,10                    72A1 IS FORMER CHAR. *
        JUM    FM12,FP66A2                72A1 IF NOT GO BACK. *
        CAM    FM12,12              72A1  IF IS* PUT * IN STATE BUF
        SFR    7,FT2+FM10+1         72A1
        JSB    FM3,GREAD
        FIL
        JPM    FM10,FP67
FP66A2  ADM    FM0,44
        FIL
FP67    ADM    FM10,1             73 INCREASE ATOM COUNTERS AND TEST
FP68    CJU    FM5,FP62A1         73,74 JUMP IF NOT FULL
        CAM    FM12,0
        SFR    7,FV6
FP68A1  CAM    FM12,32            75          HERE IF FULL, LOAD BUFFER FULL
        SFR    7,FT2+FM10+1       75 MARK
        ADM    FM10,1                         INCREASE COUNTER
        SFR    4,EV2
        CAM    FM9,FM1
        ORM    FM9,4096                       MARK FOR FULL BUF BUT NO EOS
        SFR    6,FT2                          STORE FIRST WORD TO BUF
        LFR    7,FT2+FM10-1
        SFR    7,FV5                          STORE LAST WORD FROM STATE BUF
        CAM    FM12,1
        SFR    7,FV4                          STORE COUNTINUATION MARK
        SFR    5,FV10                         STORE H FIELD WIDTH COUNTER
GFP     LDM    2,FV11             FIRST ENTRY TO STATEMENT GENERATOR
        JPM    2,GFP1
        LFR    4,GFP5             RESTORE REGISTERS FOR EXIT FROM
        LFR    5,GFP5+1           FREFIL
        LFR    6,GFP5+2
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        LFR   7,GFP5+3                                    0530
        JLH   M3                                          0531
GFP1    SBM   1,1                                         0532
        CRM   1,1                                         0533
        ANN   1,31                                        0534
        LFR   5,ETY1       TRANSFER VECTOR                0535
        JPM   1,GFP2                                      0536
        CAM   4,M6         SHIFT LEFT HALF WORD           0537
        CAM   5,M7                                        0538
GFP2    SFR   5,GFP3                                      0539
        FLD
GFP3    BSS   1            BRANCH TO GENERATOR            0540
        LFR   4,PSIG                                      0541
        JPM   1,GFLPDO                                    0542
        CALL  PDOCL                                       0543
GFLPDO  LFR   4,PSIG                                      0544
        ANM   1,4095
        SFR   4,PSIG                                      0548
GFP4    TRA   FP1
GFP5    BSS   4                                           0550
FREFIL  SFR   4,GFP5       SAVE REGISTERS                 0551
        SFR   5,GFP5+1                                    0552
        SFR   6,GFP5+2                                    0553
        SFR   7,GFP5+3                                    0554
        CAM   2,-1         SET FREFIL MARK                0555
        SFR   4,FV11                                      0556
FP69A4  LFR   4,FV2        RETURN HERE AFTER EXIT DUE TO  0557
        LFR   5,FV10            RECOVER H FIELD WIDTH COUNTER  0558
        LFR   6,FT2        FULL STATEMENT BUFFER BUT NO   0559
        CAM   FM11,1       EOS .                          0560
        CAM   FM10,0                                      0561
        LDM   FM5,FC8      79                             0562
        LFR   7,FV6                                       0563
        JUM   FM12,FP72         JUMP ON H MARK            0564
```

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        JPM    FM1,FP62A1       79
        FIL                      79
FP69A3  CAM    FM12,0              69A1 HERE IF END OF STATES
        SFR    7,FT2+FM10+1      69A1 STORE EOS IN FT2
        ADM    FM10,1            L9A1 INCREASE COUNTER
FP69A7  CAM    FM9,FM1              INSERT TYPE
        SFR    6,FT2             69A2 STORE 1ST WORD OF FT2 BACK
        TRA    GFP
FP71    CRM    FM15,7                      OBTAINE THE WIDTH OF H FIELD
        CRM    FM14,7
        ANM    FM14,8128
        ADM    FM15,FM14
        CSM    FM4,FM15+1
        LFR    7,FC7
        JPM    FM1,FP73A1
FP72    JSB    FM3,GREAD
        FIL
        JPM    FM0,FP73
        JPM    FM1,FP34                    TO TYPE 1 EXIT
FP73    CAM    FM14,FM0
        CAM    FM12,4104
FP73A1  SFR    7,FT2+FM10+1                STORE H FIELD IN BUFFER
        CJU    FM4,FP74
        JSB    FM3,GREAD
        FIL
        TRA    FP67
FP74    ADM    FM10,1                      INCREASE ATOM COUNT
        CJU    FM5,FP72
        CAM    FM12,1                      BUFFER FULL DURING H READ
        SFR    7,FV6
        JPM    FM1,FP68A1
FP77    LFR    7,FT6+FM0           80
        CRM    FM12,8              80
        ANM    FM12,3              80
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        LFR    2,FC1+FM12          81,82,83  CONSTRUCT MARKS IN
        SFR    2,FT2+FM10+1        81,82,83  STATEMENT BUFFER
        CAM    FM6,0               84
        CSM    FM7,6               85    INITIATE CHAR. COUNTER
        CRM    FM15,7              86
        ANM    FM15,63             86
        CAD    9,3,FM15            86
        SIF    FF2                 86    STORE PRESENT CHAR.
        SFR    4,FV3
FP78    JSB    FM3,GREAD           87
        FIL                        87
        JZM    FM0,FP78            88    BLANK GO ON READING
        LFR    7,FT6+FM0           88    TEST 19
        CRM    FM15,7              88
        JPM    FM15,FP84           88    JUMP IF NOT ALPHA OR NUMB
        CAM    FM6,FM0             89    STORE LAST CHAR.
        ADM    FM7,1               90    SET CHAR. COUNT
        JNM    FM7,FP79            91
        JZM    FM7,FP80            91
FP78A1  CAM    FM1,1               91
        JPM    FM1,FTYP1           91    TYPE 1  EXIT
FP79    CAD    F2               92  CONSTRUCT NAME
        MPY    9,3,36              92
        ANM    FM15,63             92
        ADD    9,3,FM15            92
        SIF    FF2                 92
        JPM    FM15,FP78           92    GO ON READ NEXT CHAR.
FP80    SBM    FM0,54              93
        JZM    FM0,FP78            93    LAST CHAR. IS F
        SBM    FM1,7                     TEST FOR TYPE 9 OR 10
        JZM    FM1,FP81
        ADM    FM1,7
        JPM    FM1,FP78A1                JUMP TO TYPE 1 EXIT
FP81    CAD    F2
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        SUB    FC18                                                        0633
        JDC    5,FP82                        JUMP FOR   IF(SENSE L ...     0634
        ADD    FC18            -                                           0635
        SUB    FC19                                                        0636
        JDC    5,FP83                        JUMP FOR   IF(SENSE S...      0637
        JPM    FM1,FP78A1                    JUMP TO TYPE 1 EXIT           0638
FP82    CAM    FM1,9                                                       0639
        JSB    FM3,GRBACK                                                  0640
        FIL                                                                0641
        JPM    FM1,FTYP9       TYPE 9 FIRT EXIT
FP83    CAM    FM1,10                                                      0643
        JSB    FM3,GRBACK                                                  0644
        FIL                                                                0645
        JPM    FM1,FTYP10      TYPE 10 FIRST EXIT
FP84    SBM    FM6,54             94     CHECK FOR TERMINAL F              0647
        SFR    2,FV9
        LFR    7,FV9                                                       0656
        LDM    FM12,FT2+FM10+1    98                                       0657
        SBM    FM0,28                    CHECK FOR  (                      0658
        JUM    FM0,FP86                  GET LINK                          0659
        ORM    FM12,4                     SET MARK FOR (                   0660
        JUM    FM6,FP85           94     LAST CHAR. NOT F JUMP             0648
        JZM    FM7,FP85A       7 CHARACTER NAME IN FUNCTION O K
        ADM    FM7,3              96                                       0650
        JNM    FM7,FP85           96     NAME LESS THEN 4 CHARS.           0651
FP85A   CALL   GREAD
        TRA    2,FP86                                                      0662
FP85    ANM    12,-9           REMOVE X BIT
        ANN    12,1
        CAM    0
        EOM    0,1
        CRN    0,10
        ORM    12
        TRA    FP85A
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FP86    ADM    FM0,28                                                    0663
        ANM    FM15,8064                                                 0664
        EOM    12,8              INVERT X MARK
        SFR    7,FT2+FM10+1                PUT NAME IN STATE. BUF.       0665
        LDM    FM3,FV3                     RESTORE  LINK                 0666
        JLH    FM3                         EXIT NAME SUBROUTINE          0667
FP87    SFR    4,FV3               99      BEGIN NUMBER SUBROUTINE       0668
        CAM    FM2,0              100      INITIATE DIGIT COUNTER        0669
        CAM    FM7,0              101      INITIATE DIGIT AFTER . COUNTER 0670
        CAM    FMX9,0             102      SET DECIMAL POINT MARK        0671
        CAD    9,3,0              103                                    0672
        STC    FV7                                                       0673
        STU    FV8                                                       0674
FP87A1  LFR    7,FT6+FM0          104       TEST 20                      0675
        CRM    FM12,10            104                                    0676
        ANN    FM12,7
        CSM    3
        JZM    3,FP90            BLANK
        CJZ    3,FP89            NUMBER
        CJU    3,FP88A
        CAM    FMX9,1
        TRA    FP90              PERIOD
FP88A   CJZ    3,FP91            E
        TRA    FP98              PTHER
FP89    CAD    FV7                                                       0693
        ADD    FV8                                                       0694
        MPY    9,3,10                                                    0695
        CRM    FM15,7             105                                    0696
        ANM    FM15,63            105                                    0697
        ADD    9,3,FM15           105                                    0698
        STC    FV7                                                       0699
        STU    FV8                                                       0700
        ADM    FM2,1              106      INCREASE DIGIT COUNT          0701
        JZM    FMX9,FP90          107      NO DECIMAL POINT JUMP         0702
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        ADM    FM7,1             109  INCREASE DIGIT AFTER . COUNT    0703
FP90    JSB    FM3,GREAD         108                                  0704
        FIL                                                           0705
        JNM    FM0,FP98                                               0706
        JPM    FM0,FP87A1                                             0707
FP91    CAM    FM1,1                  EXPONENTIATION MARK             0708
FP91A1  JSB    FM3,GREAD                                              0709
        FIL                                                           0710
        JNM    FM0,FP78A1                                             0711
        LFR    7,FT6+FM0                                              0712
        CRM    FM12,10                                                0713
        ANN    FM12,7
        CSM    3
        JZM    3,FP91A1     BLANK
        CJZ    3,FP93       NUMBER
        CJZ    3,FTYP1      PERIOD
        CJZ    3,FTYP1      E
        CJZ    3,FP91A1     +
        CJU    3,FTYP1      OTHER
        CSM    FM1,1                  -                               0727
        TRA    FP91A1
FP93    CRM    FM15,7                                                 0731
        ANM    FM15,63                                                0732
        CAD    9,3,FM15                                               0733
        STC    F3                                                     0734
FP93A1  JSB    FM3,GREAD                                              0735
        FIL                                                           0736
        JNM    FM0,FP94A4                                             0737
        LFR    7,FT6+FM0                                              0738
        CRM    FM12,10                                                0739
        ANN    FM12,7
        CSM    3
        JZM    3,FP93A1     BLANK
        CJZ    3,FP94A1     NUMBER
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```
        CJZ    3,FTYP1           PERIOD
        CJZ    3,FTYP1           E
        TRA    FP94A4
        JPM    FM12,FP94A4                                              0751
FP94A1  CRM    FM15,7                                                   0756
        ANM    FM15,63                                                  0757
        CAD    F3                                                       0758
        MPY    9,3,10                                                   0759
        ADD    9,3,FM15                                                 0760
        STC    F3                                                       0761
        JSB    FM3,GREAD                                                0762
        FIL                                                             0763
FP94A4  SFR    4,FVA1                                                   0764
        CAD    F3                                                       0765
        JPM    FM1,FP94A3                                               0766
        CSB    F3                                                       0767
FP94A3  SUB    9,3,FM7                COMPUTE EXPONENT                  0768
FP94A2  SIF    FF2                    STORE EXP.                        0769
        JDC    2,FP95                 JUMP IF POSITIVE                  0770
        CSB    FF2                                                      0771
FP95    SIA    M12                    STORE ABS(EXPONENT)               0772
        CAD    9,3,1                  CONSTRUCT THE VALUE OF            0773
        CSM    FM0,5                                                    0774
FP96    CRM    FM12,1                                                   0775
        JPM    FM12,FP96A1                                              0776
        MPY    FC9+5+FM0                                                0777
FP96A1  CJU    FM0,FP96                                                 0778
        SFR    2,FV9                                                    0779
        LFR    7,FV9                                                    0780
        STR    FF2                    STORE VALUE OF EXPONENT IN F2     0781
        CAD    FV7                    GET THE ORIGINAL NUMBER IN AC     0782
        ADD    FV8                                                      0783
        JNM    FM12,FP97              JUMP IF NEGATIVE EXPONENT         0784
        MPY    FF2                    HERE IF POSITIVE EXPONENT         0785
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         JPM    FM12,FP97A2
FP97     DIV    FF2
FP97A2   STR    FF7                             STORE NUMBER IN F7
FP97A5   CAM    1,CONST                  ENTRY FOR CONSTANT SEARCH
         CALL   GTABLE
         JPM    FM0,FP97A3                      JUMP IF FOUND
         CALL   GENTAB                          ENTER CON.IN TAB.IF NOT FOUND
FP97A3   JZM    FMX9,FP97A4                     JUMP IF FIXED POINT NO.
         CAM    FM0,4097                        INSERT FLOATING POINT NO.MARK
         JUM    FMX9,FP97A1
FP97A4   CAM    FM0,4096                        INSERT FIXED POINT NO.MARK
         FIL
FP97A1   SFR    4,FT2+FM10+1                    PUT NO. IN STATE. BUF
         LDM    FM1,FV3
         LDM    FM0,FVA1
         LDM    FM3,FV3
         JLH    FM3                             RETURN
FP98     SFR    4,FVA1
         JZM    FMX9,FP99
         CSB    9,3,FM7                         GET NEG.OF NO.OF DIGITS AFTER .
         JUM    FMX9,FP94A2                     GO TO CONSTRUCT EXPONENT
FP99     SBM    FM2,6                           CHECK TOTAL NO.OF DIGITS
         JNM    FM2,FP100                       JUMP IF LESS THEN 6
         LFR    7,FV7
         JPM    FM2,FP97A5
FP100    CAD    FV7
         SIF    F4
         ANM    FM3,8064                        NO'S. WITH LESS THEN 6 DIGITS
         CAM    FM0,4100
         TRA    FP97A1
FP101    CALL   GREAD                   READ  T
         JZM    FM0,FP101
         JNM    FM0,FP34                TO TYPE 1 IF EOS
FP102    CALL   GREAD                   READ O
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         JZM     FMO,FP102                                                0820
         JNM     FMO,FP34          TO TYPE 1 IF EOS                       0821
         LFR     2,FC17                                                   0822
         SFR     2,FP65                                                   0823
         JUM     FMO,FP62A1                                               0824
FCARD    CAM     FM1,43                                                   0870
         TRA     FP62
FV1      BSS     1                                                        0872
FVA1     BSS     1                                                        0873
FV2      BSS     1                                                        0874
FV3      BSS     1                                                        0875
FV4      BSS     1                                                        0876
FV5      BSS     1                                                        0877
FV6      BSS     1                                                        0878
FV7      BSS     1                                                        0879
FV8      BSS     1                                                        0880
FV9      BSS     1                                                        0881
FV10     BSS     1                                                        0882
FV11     BSS     1                                                        0883
FV12     BSS     1                                                        0884
FT1      BSS     10                                                       0885
FF0      EQUF    0                                                        0886
FF1      EQUF    1                                                        0887
FF2      EQUF    2                                                        0888
FF3      EQUF    3                                                        0889
FF4      EQUF    4                                                        0890
FF5      EQUF    5                                                        0891
FF6      EQUF    6                                                        0892
FF7      EQUF    7                                                        0893
FM0      EQUM    0                                                        0894
FM1      EQUM    1                                                        0895
FM2      EQUM    2                                                        0896
FM3      EQUM    3                                                        0897
FMX5     EQUM    4                                                        0898
```

```
FMX6   EQUM  5                                                     0899
FM4    EQUM  6                                                     0900
FM5    EQUM  7                                                     0901
FM8    EQUM  8                                                     0902
FM9    EQUM  9                                                     0903
FM10   EQUM  10                                                    0904
FM11   EQUM  11                                                    0905
FM12   EQUM  12                                                    0906
FMX1   EQUM  13                                                    0907
FMX2   EQUM  14                                                    0908
FMX3   EQUM  15                                                    0909
FM6    EQUM  4                                                     0910
FMX9   EQUM  4                                                     0911
FM7    EQUM  5                                                     0912
FMX10  EQUM  6                                                     0913
FM15   EQUM  15                                                    0914
FM14   EQUM  14                                                    0915
FM13   EQUM  13                                                    0916
FT6    OCTQ  400,1474,4500,10000,2452,3474,4400,300                0918
       OCTQ  2452,3474,4400,500,2452,3474,4400,700        2,3
       OCTQ  2452,3474,4400,1100,2452,3474,4400,1300      4,5
       OCTQ  2452,3474,4400,1500,2452,3474,4400,1700      6,7
       OCTQ  2452,3474,4400,2100,2452,3474,4400,2300               0922
       OCTQ  2452,3474,4400,100,14571,1474,4500,200                0923
       OCTQ  14632,1474,4500,,14632,1474,4500,                     0924
       OCTQ  14632,1474,4500,,14632,1474,4500,                     0925
       OCTQ  14632,1474,4500,,14572,11474,4513,2600
       OCTQ  14532,7474,4505,7136,14532,6476,4200,7305    S,T
       OCTQ  14532,7034,4540,7502,14532,7474,4500,7700    U,V
       OCTQ  14532,7474,4514,10100,15132,7474,4500,10300           0929
       OCTQ  14532,7474,4500,10500,14532,7474,4500,10700           0930
       OCTQ  14632,1474,4500,,14572,1474,14500,600                 0931
       OCTQ  14574,15460,500,4000,14632,1474,4500,                 0932
       OCTQ  14632,1474,4500,,14632,1474,4500,                     0933
```

```
        OCTQ   12572,11474,4500,2200,14132,7474,4500,4700
        OCTQ   14132,7474,4500,5100,14132,7674,4500,5300    K,L
        OCTQ   14132,7774,4500,5500,14132,7574,4000,5700    M,N
        OCTQ   14532,7475,4560,6106,14532,7474,4510,6320    O,P
        OCTQ   14532,7474,2500,6500,14532,7454,4533,6701    Q,R
        OCTQ   14632,1474,4500,,14632,1474,4500,
        OCTQ   14572,11474,4500,2400,14632,1474,4500,
        OCTQ   14632,1474,4500,,14632,1474,4500,
        OCTQ   10572,11474,4500,2000,14532,7414,1502,2504   +,A
        OCTQ   14532,7474,4503,2700,14532,7474,4506,3140    B,C
        OCTQ   14532,7477,3107,3300,6532,6074,4511,3503     D,E
        OCTQ   14532,7464,4512,3700,14532,7474,4501,4110
        OCTQ   14662,7474,4500,4300,14132,7470,4304,4507    H,I
        OCTQ   14632,1474,4500,,4472,11474,4500,14000
        OCTQ   14573,11474,4500,400
FC1     OCTQ   10002,,,
FC2     OCTQ   10003,,,
FC3     OCTQ   10013,,,
FC4     OCTQ   0,,,
FC5     OCTQ   1551,12462,6123,7026
FC6     OCTQ   0,31,16143,10626
FC7     OCTQ   10003,,,4200
FC8     OCTQ   0,,,17720
FC9     OCTQ   05000,,,2
        OCTQ   03100,,,4
        OCTQ   04704,,,7
        OCTQ   02765,16040,,16
        OCTQ   04341,13623,07001,33
        OCTQ   0,,,
FC15    OCTQ   0,122,,
        FIL
FC16    JUM    FM12,FP101
        FIL
FC17    JSB    FM3,FP77
```

```
         FIL                                                          0968
FC18     OCTQ    0,6314,3266,3226       SENSE L                       0969
FC19     OCTQ    0,6314,3266,5026       SENSE S                       0970
E        BSS     4                                                    0971
GRBDSW   BSS     1                   BOOLEAN DOUBLE PRECISION SWITCH  0972
ZERO     BSS     1                                                    0973
         ASSIGN  GLT1,GLT2,GLT3,GLT4                                  0974
GLC1     DECQ    -1,GRASS,-4,-2        FIRST COUNT WORD, NO TO N3     0975
GLC2     DECQ    -1,-1,GRPRBF,GRCDBF
         FIL
GREOF    LFR     7,M9-1
         ORM     14,4096
         CAM     7,GRCDBF
         TRA     GRD30
GREOF2   CHR     48,    ************  END CARD MISSING ************
         CHR     48,********************************
         BSS     5
GREOF1   CALL    SYSIO
         DECQ    WRITE+2,GREOF2,0,0
         TRA     2,FTY1+9
GREAD    SFR     6,GLT2              START OF SUBROUTINE              0977
         SFR     7,GLT1                                               0978
         LFR     6,GLC1              LOAD FIRST COUNT WORD            0979
GRD4     LFR     7,M9                LOAD CARD IMAGE WORD             0980
         CJZ     8,GRD3              TEST FOR END OF CARD             0981
         ORB     10,,                EXTRACT QUARTER WORD             0982
         CAM     0,M12                                                0983
         CRM     0,6                                                  0984
         CJU     11,GRD1             TEST WHICH HALF                  0985
         CRM     0,7                                                  0986
         CAM     11,-2               RESET N 3                        0987
         CJZ     10,GRD2             INCREMENT QUARTER COUNT          0988
GRD1     ANM     0,63                EXTRACT CHARACTER                0989
GRD6     SFR     6,GLC1                                               0990
```

```
         LFR     6,GLT2                                               0991
         LFR     7,GLT1                                               0992
         JLH     3,,              EXIT                                0993
GRD2     CAM     10,-4            RESET QUARTER COUNT                 0994
         CJU     9,GRD1           AND INCREMENT WORD COUNT            0995
GRD3     JNM     12,GRD5          TEST FOR NO CONTINUE CARD           0996
         CAM     8,-67            RESET NO,N1,N2, AND N3              0997
         CAM     10,-1                                                0998
         CJU     9,GRD4           JUMP                                0999
GRD5     JNM     13,GRD7          TEST FOR PREVIOUS ENTRY AT THIS POINT 1000
         ORM     13,4096          SET PREVIOUS ENTRY SWITCH           1001
         CAM     8,-1                                                 1002
         CAM     0,4096                                               1003
         SFR     7,M9                                                 1004
         TRA     GRD6                                                 1005
GRD7     JNM     14,GREOF1
         SFR     4,GLT4
         SFR     5,GLT3                                               1007
         CAM     9,GRASS          RESET N1                            1008
         LFR     5,GLC2                                               1009
         CAM     0,-11                                                1010
         ATN     5,1,             INCREMENT RUNNING CARD COUNT        1011
         CAD     1.                                                   1012
         CALL    GDECVT           AND PRINT IN CARD                   1013
         SAM     GRPRBF+14                                            1014
GRD9     CAM     3,-10            COPY CARD TO PRINT BUFFER           1015
         FLD                                                          1016
         CAD     7,1,                                                 1017
         SAM     9,1,                                                 1018
         SAM     6,1,                                                 1019
         CJF     3,0                                                  1020
GRD28    CAM     7,GRCDBF
         CALL    SYSIO            PRINT CARDS                         1024
         DECQ    WRITE+2,GRPRBF-1,0,0
```

```
        CAM    6,GRPRBF               RESET  PRINT BUFFER                          1026
        CALL   SYSIO
        DECQ   3,GRCDBF,GREOF,GREOF
GRD8    LFR    7,M7                   LOAD COLUMNS 1 - 8 OF NEXT CARD              1027
        ANN    12,64*63               EXTRACT COLUMN U                             1028
        CAM    1,-51*64         INTO  M1                                           1029
        JZM    1,GRD27                OR C IN COL. 1                               1030
        ANM    14,63                                                               1031
        JZM    14,GRD10               COL. 6 BLANK                                 1032
        ADM    14,-10                                                              1033
        JZM    14,GRD10               OR ZERO                                      1034
        CJU    0,GRD9                 TEST FOR LESS THAN 11 CARDS                  1035
        CAM    1,EE+6                 TOO MANY CARDS
        CALL   GERROR
GRD10   LFR    7,M9-1                 SET LAST CARD IN CONTINUE SEQUENCE           1038
GRD30   ORM    12,4096                                                             1039
        SFR    7,M9-1                                                              1040
        LFR    7,GRASS                GET FIRST CARD                               1041
        ANN    12,63*64               EXTRACT COLUMN 1                             1042
        CAM    1                      PREPARE B/D SWIRCH                           1043
        CAD    0.                     PREPARE LABEL ACCUMULATION                   1044
        CAM    8,-4                   SET COLUMN COUNT FOR LOPO                    1045
        CAM    10,-4                                                               1046
        CAM    9                      B/D SWITVH                                   1047
        CAM    11,-1                                                               1048
        JZM    1,GRD13                COL1. BLANK                                  1049
        ADM    1,-52*64                                                            1050
        JZM    1,GRD12                D CARD                                       1051
        ADM    1,128                                                               1052
        JZM    1,GRD11                B CARD                                       1053
        ADM    1,-4*64                                                             1054
        JUM    1,GRD15                OTHER                                        1055
        LFR    4,GLT4                 OR F CARD, SET UP EXIT                       1056
        CAM    0,-1                                                                1057
```

```
GRD14  SFR   5,GLC2          RESTORE N4 - N7
       LFR   5,GLT3
GRD31  CAM   8,-67
       CAM   9,GRASS
       CAM   10,-1
       CAM   11,-2
       TRA   GRD6            GO TO EXIT
GRD11  CAM   9,4095          SWITVH TO B
GRD12  ADM   9,1             OR TO D
GRD13  ORB   10,,            SWITCH LAFT BLANK
       CAM   1,M12           EXTRACT CHARACTER
       CJZ   11,GRD25        HALF TEST
       CRM   1,6
GRD26  ANM   1,63            EXTRACT CHARACTER
       JUM   1,GRD16         NON BLANK CHAR.
       CJU   8,GRD13         COUNT AND TEST
GRD24  LFR   4,GLT4
       CAM   0               NO LABEL EXIT SET UP
GRD20  SFR   6,GRBDSW
       TRA   GRD14
GRD15  ADM   1,54*64
       CRM   1,6
       ADM   8,-1
GRD16  ADM   1,-11           TEST FOR NUMBER
       JPM   1,GRD23         NO
       CJU   1,GRD17         IS IT  ZERO
       ADM   1,-10           CORRECT CODE
GRD17  MPY   10.             FORM LABEL
       ADD   10+M1.
       TRA   GRD19
GRD18  ORB   10,,            EXTRACT CHAR.
       CAM   1,M12
       CJZ   11,GRD21        HALF TEST
       CRM   1,6
```

```
GRD22   ANM    1,63                                                          1092
        JUM    1,GRD16          NOT BLANK                                    1093
GRD19   CJU    8,GRD18                                                       1094
        LFR    4,GLT4                                                        1095
        CAM    0,4096           LABEL PRESENT EXIT SET UP                    1096
        TRA    GRD20                                                         1097
GRD21   CAM    11,-2                                                         1098
        CJU    10,GRD22                                                      1099
GRD23   CAM    1,EE+5           ILLEGAL CHARACTER IN COL. 1-5
        CALL   GERROR
        TRA    GRD24                                                         1102
GRD25   CAM    11,-2                                                         1103
        CJU    10,GRD26                                                      1104
GRD27   CAM    3,-10            COPY COMMENT CARD TO PRINT BUFFER AND        1105
        FLD                     GO BAK FOR NEXT CARD                         1106
        CAD    7,1,                                                          1107
        SAM    6,1,                                                          1108
        CJF    3,0                                                           1109
        LFR    7,ZERO                                                        1110
        SFR    7,GRPRBF+14                                                   1111
        TRA    GRD28                                                         1112
GRBACK  SFR    6,GLT2           GO BACK TO BEGINING OF SEQUENCE              1115
        SFR    7,GLT1                                                        1116
        LFR    6,GLC1                                                        1117
        LFR    7,M9                                                          1118
        ANM    13,4095                                                       1119
        SFR    7,M9                                                          1120
        TRA    GRD31                                                         1121
GTABLE  SFR    5,GTABT1         TABLE LOOK UP                                1122
        LFR    2,M1+1                                                        1123
        LFR    5,M1                                                          1124
        CAD    F7                                                            1125
        AND    F2                                                            1126
        SAM    F3                                                            1127
```

```
         CAM     0,M6                                        1128
GTAB2    LFR     5,M4                                        1129
         TRA     2,GTAB1                                     1130
GTAB1    TZ      GTAB3           MATCH                       1131
         CAD     6,1,                                        1132
         AND     F2                                          1133
         SUB     F3                                          1134
         CJU     5,GTAB1                                     1135
GTAB6    JUM     4,GTAB2                                     1136
         CAM     0,4096                                      1137
GTAB4    LFR     5,GTABT1                                    1138
         JLH     3,,             EXIT                        1139
GTAB3    CAM     2,M6-1
         LFR     7,M2
         CAM     0
         TRA     GTAB4                                       1143
GENTAB   SFR     5,GTABT1        TABLE ENTRY                 1144
         SFR     6,GTABT1+1                                  1145
         LFR     5,M1                                        1146
         LFR     6,M4                                        1147
         ADM     9,256                                       1148
         JZM     9,GENT2         OUT OF SPACE IN THIS BLOCK  1149
         ADM     9,-257                                      1150
         ADM     10,-1                                       1151
GENT1    SFR     6,M4                                        1152
         CAD     F7                                          1153
         SAM     M10                                         1154
         CAM     2,M10+M11       INTERNAL NAME               1155
         LFR     5,GTABT1                                    1156
         LFR     6,GTABT1+1                                  1157
         JLH     3,,             EXIT                        1158
GENT2    LFR     6,GMAST                                     1159
         CJZ     9,GENT4         NO MORE BLOCKS AVAILABLE    1160
         CAM     2,M4                                        1161
```

```
        CAM    4,M8
        SFR    5,M1                   UPDATE TABLE CONTROL
        LDM    8,M4
        SFR    6,GMAST                UPDATE TABLES MASTER
        LFR    6,M4
        CAM    8,M2
        CAM    10,M4+256
        TRA    GENT1
GENT4   CAM    1,GRDTMB
        CALL   SYSERR
GTABT1  BSS    2
START   CALL   SYSIO
        DECQ   READ,GRCDBF,0,BCD
        TRA    FP1
        FIL
GDECVT  SFR    4,GDECV1
        SFR    5,GDECV1+1
        ADD    10,3,2048
        DIV    100.
        CAM    7
        CAM    4
        DIV    100.
        CSM    1,3
        CSM    2,1
GDECV2  SIA    0
        SUB    MO.
        JZM    7,GDECV3
        JUM    0,GDECV3
        CAM    0,10
GDECV3  CJZ    2,GDECV5
        CAM    5,M6
        CAM    6,M7
        CAM    7,MO
GDECV4  MPY    10.
```

```
        TRA    GDECV2                                   1197
GDECV5  CRM    7,7                                      1198
        ADM    7,MO                                     1199
        CSM    2,2                                      1200
        CJU    1,GDECV4                                 1201
        CAD    F5                                       1202
        LFR    4,GDECV1                                 1203
        LFR    5,GDECV1+1                               1204
        JLH    M3                                       1205
GDECV1  BSS    2                                        1206
WRITE   EQUS   512                                      1207
FV13    BSS    1                                        1211
        GO     0
```

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3.5.3 Fortran Part 3. Arithmetic Section

This section handles the statements:

Arithmetic assignment statement
Arithmetic function statement
IF (Arithmetic expression)
CALL (Expression 1, ..., Expression N)
FUNCTION
SUBROUTINE
RETURN
END
F CARD

The first four of these statement utilize the arithmetic calculation section which scans an expression from left to right, compiling as it goes. The remaining statements modify tables, set up lists or use them, and compile the necessary linkage orders.

Subprogram links are always compiled as a

```
JSB 3, SUBROUTINE
FIL
DECQ   Parameter list
```

program. Depending on the nature of the parameters the items in the parameter list are addresses of variables, base addresses of arrays or addresses of transfer vectors. The return from an arithmetic function statement or from a FUNCTION subroutine is made with the result in the accumulator.

3.5.3.1 The Arithmetic Statement Scan

The scan proceeds from left to right constructing a control stack as it goes. Consecutive operations are compared according to the usual rules of precedence:

{End of Statement, Comma,), and [Indexing, Functions and (] on the left of a pair of operands}

{+ -}

{* /}

{** }

{Indexing, Functions and (on the right of a pair of operands}

If the comparison shows that the right-hand operation is the more powerful, then it is added to the top of the control stack with a PUSH; otherwise the operation at the top of the control stack is "executed," i.e., compiled. This is mechanized by coding the "input," i.e., the right-hand, operator and the "stack," i.e., the left hand, operators numerically according to Table 3.5.3.1A.

At any instant the control stack contains those operators not yet compiled in the reverse order of the left-to-right scanning order. The least significant two bits of numerical codes of the input and the top of the stack are set to 0, and then the codes are compared. The numerically larger has the higher precedence. The same rules are stated in matrix form in Table 3.5.3.1B.

Each operand is also put in control stack along with the left-most of its right-hand operators which have not yet been "executed." When the combination NAME(is sensed, both the name and either the operator "Function" or "Index" are added to the control stack accordingly as NAME has not or has been Dimensioned.

During the scan of an arithmetic function, every simple variable is compared with a sublist of dummy parameters. If it appears in this sublist, an entry is made in the control stack which indicates the matching member of the list. Such variables are not entered in the VARIAB table.

Table 3.5.3.1A. Input and Stack Codes for Operators

Operator	Input	Stack
EOS	0	--
)	1	--
,	2	--
=	--	0
IF	--	1
Arithmetic Function	--	2
CALL	--	3
(	24	8
Index	--	9
Function	--	10
+	12	12
-	13	13
*	16	16
/	17	17
**	20	20
Incompletely calculated indexed address	--	24
BEGINNING OF STATEMENT	--	-4

Table 3.5.3.1B

Stack \ Input	EOS	)	,	+ -	* /	**	(
= Arithmetic Function	E	X	X	S	S	S	S
IF	X	E	X	S	S	S	S
CALL	X	E	E	S	S	S	S
(	X	E	X	S	S	S	S
Index	X	E	E	S	S	S	S
Function	X	E	E	S	S	S	S
+ -	E	E	E	E	S	S	S
* /	E	E	E	E	E	S	S
**	E	E	E	E	E	E	S

E means "Execute."
S means "Stack" on top of control stack.
X means "Error."

When a variable is indexed, it is handled in one of three ways. If the index is fixed, then the "relocation" to be added to the location of the (1,1,1) element of the array is calculated, and the operand entry in the stack is set to Dimension. A pointer is placed in the stack which indicates the location of a word containing the name and the relocation amount. If the index contains variables (it may contain arbitrary expressions) then, after the ")" operation, the accumulator contains a number which must be added to the address, also. If this occurs on the left-hand side of an assignment statement, then the order sequence

```
SIA   MO
SAM   TEMP
```

is compiled. This has the effect of shifting the accumulator so that it is in a position to be reloaded into F6 from TEMP, at which time M8 can be added to the address of the store order to be compiled.

If the index contains variables and is on the right-hand side of an assignment statement, then the sequence

```
SIA   MO
CAD   MO+A+R
```

is compiled, where A is the name and R is the relocation.

When an arithmetic operation is "executed," the answer is typically in the accumulator. Therefore a mark (4096) is set in the operand part of the control stack to indicate this. If, when this happens, the accumulator is already in use (that is, there is another accumulator mark lower down in the control stack), it is obvious that a store into a temporary location must be performed. For example, when C * D must be "executed" in the expression

A * B + C * D,

the result A * B must be saved, viz.,

```
CAD  A
MPY  B
STR  T
CAD  C
MPY  D
ADD  T
```

To make this automatic, the following mechanism is used. A temporary storage location counter HTMP is initially set to -1. Each time that a word must be fetched into the accumulator, this count is increased by one. If it is nonzero after being incremented, an STR "T+HTMP" is compiled, where "T+HTMP" is a temporary storage address that is different for each value of HTMP. When a result is to be added (or divided, etc.) into the accumulator, as for example, after C * D has been formed above, HTMP is decreased by one, and the address "T+HTMP" is constructed once again. Thus there is a stack, at execution time, of intermediate results that have been pushed out of the accumulator.

The above section of the compilation process is handled by the subroutine HCOMP. Entry to this subroutine is made with the order bits for the desired order in MO and the operand code and additional information in M1 and M2. If the operation is a CAD or CSB and M1 indicates that the operand is in the accumulator, the operation is ignored or an STN FO is compiled respectively. However, if M1 indicates that the operand is not in the accumulator in the case of a CAD or CSB, HTMP is increased by one, and an STR is compiled if necessary. (The store compilation is handled by the subroutine HCOMPS.)

If the operation is not a CAD/CSB and the operand is marked "Accumulator," then it must be in the top of the accumulator stack. Therefore HTMP is decreased by one and the address "T+HTMP" is located.

The rules are shown in Table 3.5.3.1C.

Table 3.5.3.1C

Operand is \ Operation is	CAD/CSB	Other
Accumulator	Do nothing/STNO,3	HTMP - 1 → HTMP Compile OP T+HTMP
Not Accumulator	HTMP+1 → HTMP (Compile STR) Compile CAD/CSB	Compile OP Operand

Using this mechanism, the binary operations +, -, * and / are handled by asking HCOMP to compile a CAD of one operation followed by an ADD, SUB, MPY or DIV of the other. A test is made so that cases like A + B * C do not result in:

```
CAD  B
MPY  C
STR  T
CAD  A
ADD  T
```

If the right-hand member of a pair of operands is in the accumulator stack at the start, then it is CADded into the accumulator, and the operation is performed on the other (in which case a DIV becomes a VID). Otherwise the left-hand member is first CADded into the stack.

In the implementation, the top level of the stack remains in F6, and the input operand and its following operation are assembled into F7. Their formats are shown in Fig. 3.5.3.1 and Table 3.5.3.1D.

Q0	Q1	Q2	Q3	
Operator Code	Operand Code			

1 = Floating Point

Used as a count in function calls and indexing

Additional information about the operand

The operator is the next one that has not yet been compiled after the operand in Q1, Q2 and Q3.

Figure 3.5.3.1. Stack and Input Format

Table 3.5.3.1D. Input and Stack Codes for Operands in Q1

<table>
<tr><td>0</td><td>Empty</td></tr>
<tr><td>4096</td><td>Accumulator</td></tr>
<tr><td>1</td><td>Small number (< 4096). In Q2</td></tr>
<tr><td>2</td><td>Variable. Name in Q2</td></tr>
<tr><td>3</td><td>Dummy. (Used in arithmetic function statements only.) Q2 contains the "number" of the dummy, that is, its position in the CALL sequence, 0 being the first.</td></tr>
<tr><td>4</td><td>Dimensioned variable. Q2 contains a "list" address. In the indicated list word is
<table><tr><td>Q0</td><td>Q1</td><td>Q2</td><td>Q3</td></tr><tr><td></td><td>Number</td><td>Name of Var</td><td></td></tr></table>
The address in case 4 is the location of the NAME in quarter 2 plus the number is quarter 1.</td></tr>
</table>

During the arithmetic scan modifiers 4 through 7 contain the following information:

M4 Contains the address of next free word of CØUT buffer

M5 Contains the address of next atom from input buffer

M6 Contains 0, unless an arithmetic function statement is being compiled, in which case it contains the number of dummy variables which are in a list in store. All simple variable names must be compared against this list.

M7 Contains the address of the location in store where top of stack now in F6 will be stored at the next PUSH operation.

3.5.3.1.1 Indexed Variables

When a variable followed by a left parenthesis is read, it is looked up in the dimension table. If it is not there it is entered as a function; otherwise its type is examined. Functions are dealt with in section 3.5.3.1.2 below. If it is a dimensioned variable, it is placed in the input area and the operator "Index" is also placed in the input. A PUSH then moves the input to the top of the stack and scanning resumes. Because all operations except comma and) have higher priority then index, any expression is calculated before "Index" is obeyed. When a comma or) is read the top of the stack will contain information about the index value. If the operation just read is a comma, a SWAP at the top two levels of the stack is performed and a count (in Q3 of the top level of the stack) is incremented by one. Thus each index quantity appears in the stack below the entry "Index."

When the final) is read, further compilation of the address begins. This is done by scanning back through the entries in the stack to compile any necessary MPY's and ADD's on Accumulator or Variable entries. Entries which are fixed-point numbers are dealt with at execution time. The result is a variable name (the base address of the variabe), a relocation amount and an optional indication that the contents of the accumulator are to be added to the address. If needed, this addition is not yet compiled, rather code 24, meaning "Incomplete Dimension," is placed in the stack on top of an entry indicating the name and relocation amount.

Because code 24 is larger than any input code, it will be "executed" immediately after the next operation is read. If the next operation is = then

```
SIA   MO
SAM   "T-1"
```

is compiled; otherwise

```
SIA   MO
CAD   MO+A+R
```

is compiled where A is the base address and R is the relocation amount.

If the accumulator contents do not have to be added to the address, the variable left in the input area is of "Dimension" type, Q2 of the input (i.e., M14) contains the address of a word which contains the base address and relocation in Q2 and Q1 respectively.

Example

If the sequence ...A(3*I,2)+... is read where A has been dimensioned by A(10,5) the following will be the successive states of the control stack:

		Operand		Operation
After Reading A(	F7	0		-
	F6	DIM,0	A	Index
After Reading 3*	F7	#	3	*
	F6	DIM,0	A	Index
After PUSH	F7	0		
	F6	#	3	*
	(M7-1)	DIM,0	A	Index
After Reading I,	F7	VARIAB	I	,
	F6	#	3	*
	(M7-1)	DIM,0	A	Index
After Executing *	F7	Accumulator		,
Compiles (STR "T")	F6	DIM,0	A	Index
CAD 3.				
MPY I				
After executing Index - ,	F7	0		-
	F6	DIM,1	A	Index
	(M7-1)	Accumulator		-
After reading 2)	F7	#	2	)
	F6	DIM,1	A	Index
	(M7-1)	Accumulator		-
After executing Index	F7		0	-
where List entry is A, 9	F6	DIM LIST		Incomplete Dimension

	Operand		Operation
After reading +	F7	0	+
	F6	DIM LIST	Incomplete Dimension
After executing "Incomplete Dimension" [Compiles SIA MO / CAD MO+A+9]	F7	Accumulator	+
	F6		

3.5.3.1.2 Function Calls

Function calls are processed in a similar manner to the processing of indexing up to the point that the pair {Function,)} is executed. The only modification is that if, when {Function, comma} is executed, the input operand is "Dummy" or "Dimension," then a CAD of the input operand is compiled first. This is done because the result of the compilation will finally be a DECQ with addresses in successive quarter words in which indexing is not allowed.

When the {Function,)} pair is executed, a CALL of the function name is compiled. (Pass 2 of Fortran will take case of producing suitable transfer vectors.) If there are any parameters, a DECQ is them compiled. Quarter words are generated by scanning from the first parameters in the stack up to the top.

Because "Accumulator" entries must cause appropriate temporary locations to be generated in the DECQ, HCOMPS is first called. It generates an STR if the accumulator is in use thus making space for the result that is returned from the function via the accumulator. Then the stack is scanned to determine the number of accumulator entries in the parameter list. From this number the name of the temporary locations can be determined from the bottom up.

After the DECQ has been compiled, a FIL is compiled.

3.5.3.1.3 Exponentiation Generator

If the exponent is a fixed-point number between 2 and 10, the exponentiation operator is handed by compiling a string of MPY's; otherwise it is handled by a function CALL of EXPFL or EXPFX as the exponent is floating point or fixed point respectively.

A section of the function CALL generator is used to compile the program. This is done to save orders in the compiler. Because of it the case of a dummy variable raised to a power that involves accumulator calculation involves the compilation of an unnecessary XCH order. The case is rare and the saving in the compiler appreciable!

3.5.3.2 Arithmetic Function Statements

When Part I determines that a statement is arithmetic, Part III examines the first atom to see if it is a name followed by a left parentehsis where the name is either not in the name tables, or else is in the DIMEN table as an undefined function. If this is so, the statement is an arithmetic function definition. It is entered in the DIMEN table as a defined function and the parameter list is scanned. Names in the parameter list are counted and entered in a dummy list while M6 is incremented. When a right parenthesis has been read, the stack is initialized with type 2 as the first operator. The program

```
        TRA  T+1
        FIL
        TRA  AFUN
AFUN    SFR  4,T
        ATN  M3
        CAM  2
```

is compiled where T is a blank name entered in the name table. The purpose of the first transfer is to allow functions to appear anywhere. It transfers around the subprogram. The FIL and the second TRA are a "transfer vector" in case the program name AFUN is used as a parameter to another subprogram. SFR 4,T saves M3 should another function be called and ATN M3/CAM 2 moves M3 to M2 so that the dummy parameter following any CALL of AFUN can still be located after M3 has been changed.

During compilation of the arithmetic expression on the right, all simple variables are compared with the dummy list. If a match occurs, the variable is obtained by the sequence

```
LFR  6, M2 + N
CAD  M[8 + a]
```

where the parameter is the (4N + a)th in the list, numbering starting from 0 and $0 \leq a \leq 3$.

When the End of Statement has been processed, the orders

```
        LFR   4,T
        JLH   M3 + N + 1
T       BSS   1
```

are compiled, where N = integer part of [one-quarter of the number of parameters - 1].

3.5.3.3 The IF Statement

In the case of an IF statement, Part I, the statement recognizer, transfer initially to Part II, the control section. Part II makes a subroutine CALL on the IF generator. It compiles program to place the value of the arithmetic expression in the accumulator, and then returns to the control section for further compilation of conditional transfers.

In the Part III section, the IF is handled by initializing the stack and placing an operation "IF" (type code ≐ 1) in the stack. When a matching right parenthesis is sensed, the operand in the top of the stack is placed in the accumulator (at execution time) and a subroutine return is executed.

3.5.3.4 The CALL Statement

The first atom is read from the statement buffer. It should be either NAME or NAME(. In the former case, a CALL NAME is compiled and an immediate return to Part I is made. In the latter case the stack is initialized, then the sequence {operation CALL (type code = 3), operand NAME, operation FUNCTION (type code 10)} is added to the stack. The regular arithmetic scanning and compilation section now proceeds, producing a subroutine CALL just as for a function. When the operation pair {CALL, EOS} is sensed, exit is made to Part I.

3.5.3.5 FUNCTION and SUBROUTINE

These statements are handled almost identically. The general form of a program for either is:

	Machine Language	corresponds to	Fortran
B1	BSS 3		SUBROUTINE/FUNCTION
	Program body		Statements
	TRA B2		RETURN
	Program body		Statements
B2	LFR 4,B1		END
	Copy parameters from subprogram to CALLing program		
	LFR 5,B1 + 1		
	LFR 6,B1 + 2		
	(CAD FNNM1)		
	JLH M3		
FN NAME	SFR 4,B1		
	SFR 5,B1 + 1		
	SFR 6,B1 + 2		
	Copy parameters from CALLing program to subprogram		
	TRA B1 + 3		
	Data Storage		

where B1 and B2 are two internally-generated blank names in the VARIAB table, FNNAME is the name of the function or subroutine (in the DIMEN table) and FNNM1 is the same name in the VARIAB table. (It is used in the case of functions only. For subroutines, the order CAD FNNM1 is not compiled.)

When the SUBROUTINE or FUNCTION statement is compiled, the names B1, B2 FNNAME (and FNNM1 in the case of FUNCTION) are entered in the appropriate tables, and saved in location HEND C in quarters Q2, Q3, Q0 (and Q1) respectively. The parameter list is then read and saved (without table look-up) in a list in memory for processing by the END statement. A count of the number of parameters is placed in the last quarter of HPRMC (it may be 0) and finally B1 BSS 3 is compiled. Control is then returned to Part I. The rest of the task is described below under RETURN and END.

3.5.3.6 RETURN

RETURN causes a transfer to the address B2 found in location HENDC (see FUNCTION) to be compiled. If this address is blank, then the RETURN occurred in a main program and the statement is illegal.

3.5.3.7 END

END can cause more program to be generated than any other statement! If it occurs in a main program, a CALL SYSTEM is compiled, and an exit is made to Pass II, a clean-up of tables pass. However, if HENDC is nonblank, a subprogram is being compiled and the ordersindicated in section 3.5.3.5 must be compiled.

The job of compiling the SFR's, LFR's, etc., is straightforward and can be seen from the flow charts. The program to copy from a CALLing section to a subprogram and vice versa is generated by scanning the list of parameters one at a time.

At the start of this task, and after every four parameters if there are still parameters to deal with, the orders

```
ATN   3,1,
LFR   5
```

are compiled. This places in M4-M7 the addresses of the parameters from the CALL sequence of the CALLing program.

If the parameter is a simple variable or function, the sequence

```
CAD   PARAM
SAM   MX
```

is compiled where PARAM is the name of the parameter and X = 4, 5, 6 or 7, used in order.

If the parameter is a dimensioned variable, say of size N, the program

```
CSM   8,N
CAM   9,PARAM
FLD
CAD   9,1,
SAM   X,1,
CJF   8
```

is compiled.

On the second scan, the addresses of the CAD and the SAM are swapped in order to copy in the other direction. After the final TRA B1+3 has been compiled, exit is made to pass II.

3.5.3.8 F CARD

The F CARD must be used if a name that is not used directly as a function name in the program being compiled is to be placed in the transfer vector list. Typically this is required when a subroutine or function name is given as a parameter in another subprogram call. For example, if SQRT is the library Square Root routine, and is not used directly in a program, but a

```
CALL    ABCD(X,Y,SQRT)
```

is written, then "F SQRT" must appear in the deck.

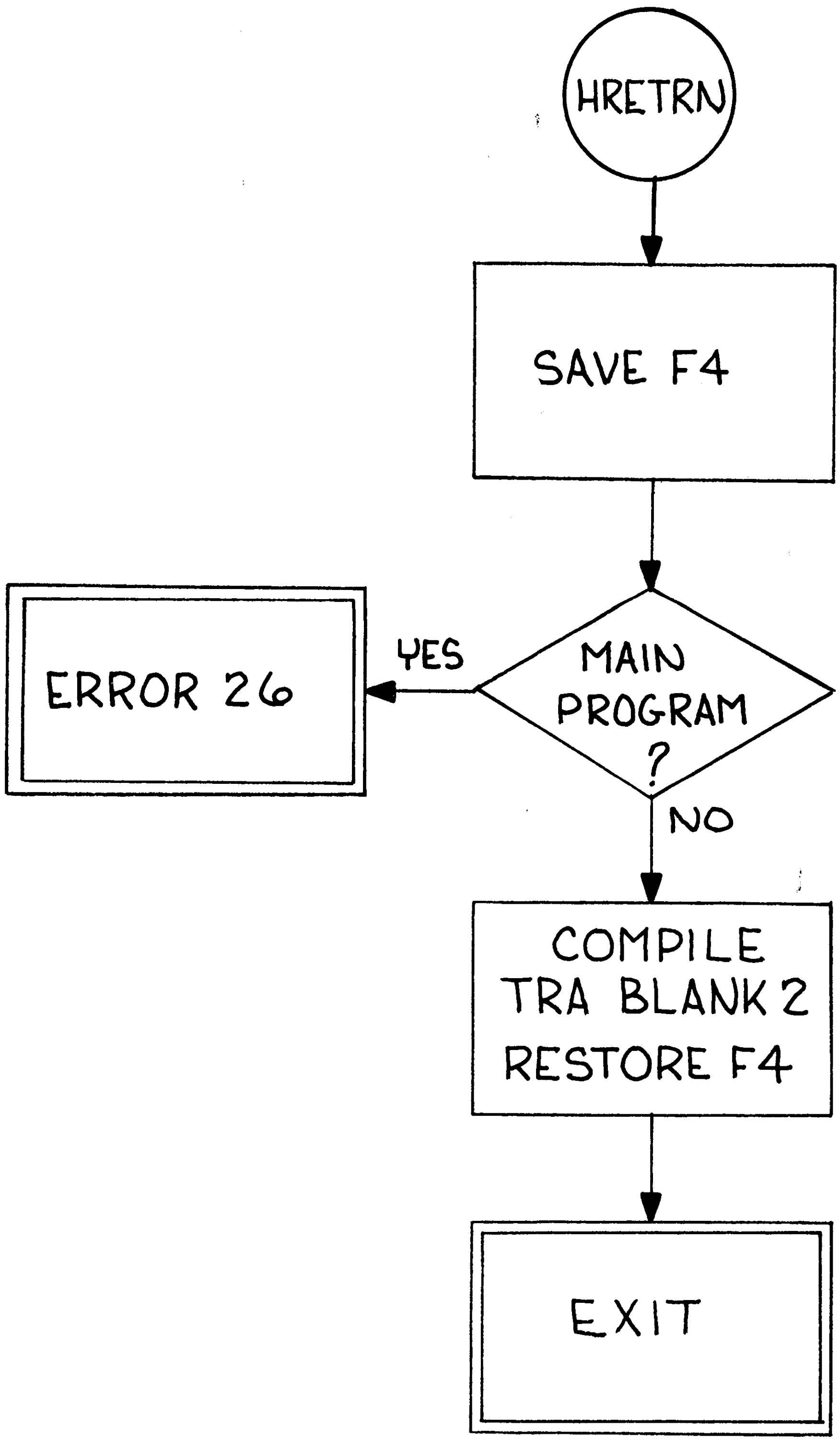
During compilation, the names on an F card are entered as undefined functions. They must appear on an F CARD before use.

3.5.3.9 Flow Charts

Flow charts are attached below giving the detailed flow of Part III.

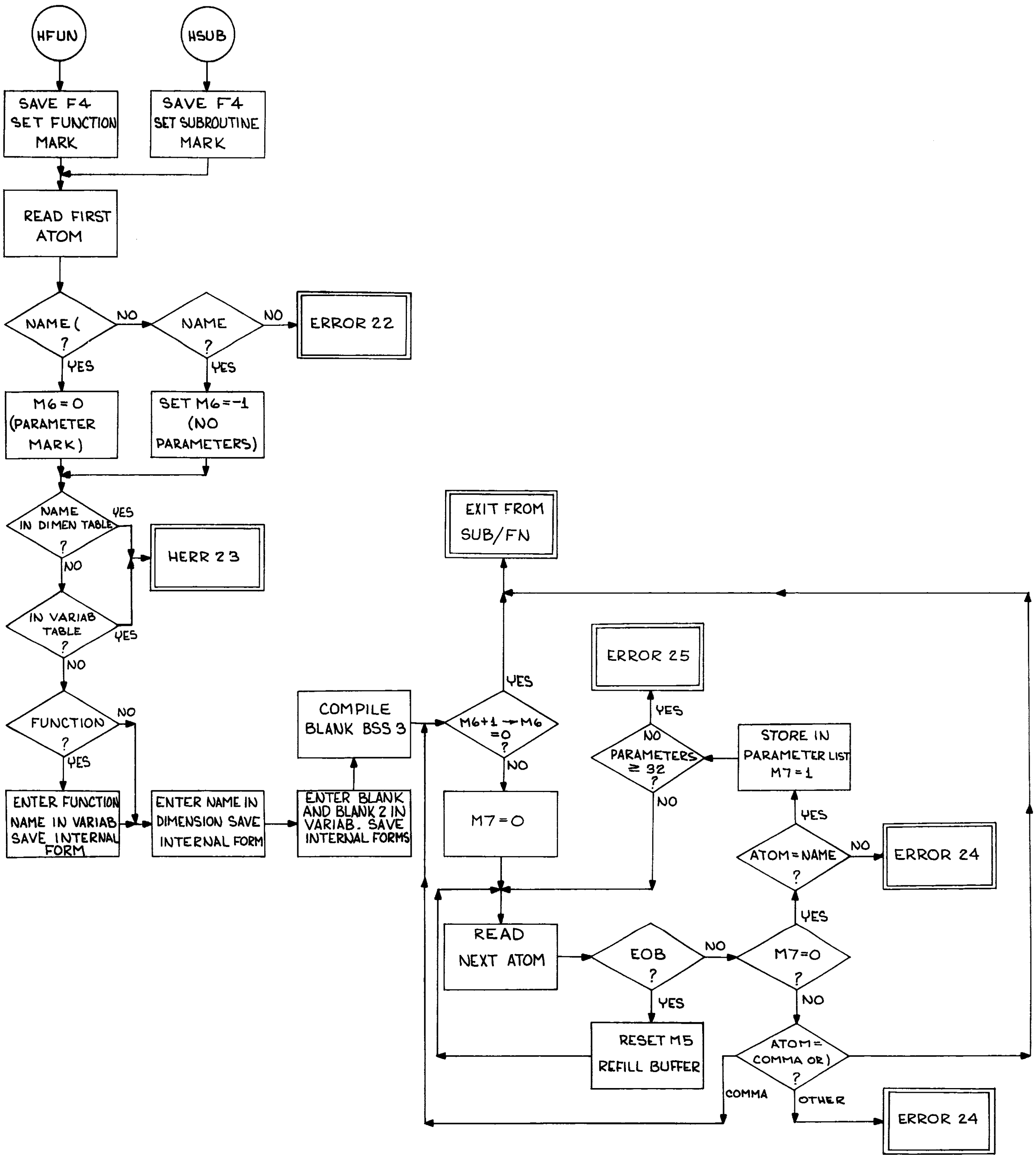
FORTRAN PART III

RETURN, SUBROUTINE AND FUNCTION STATEMENTS



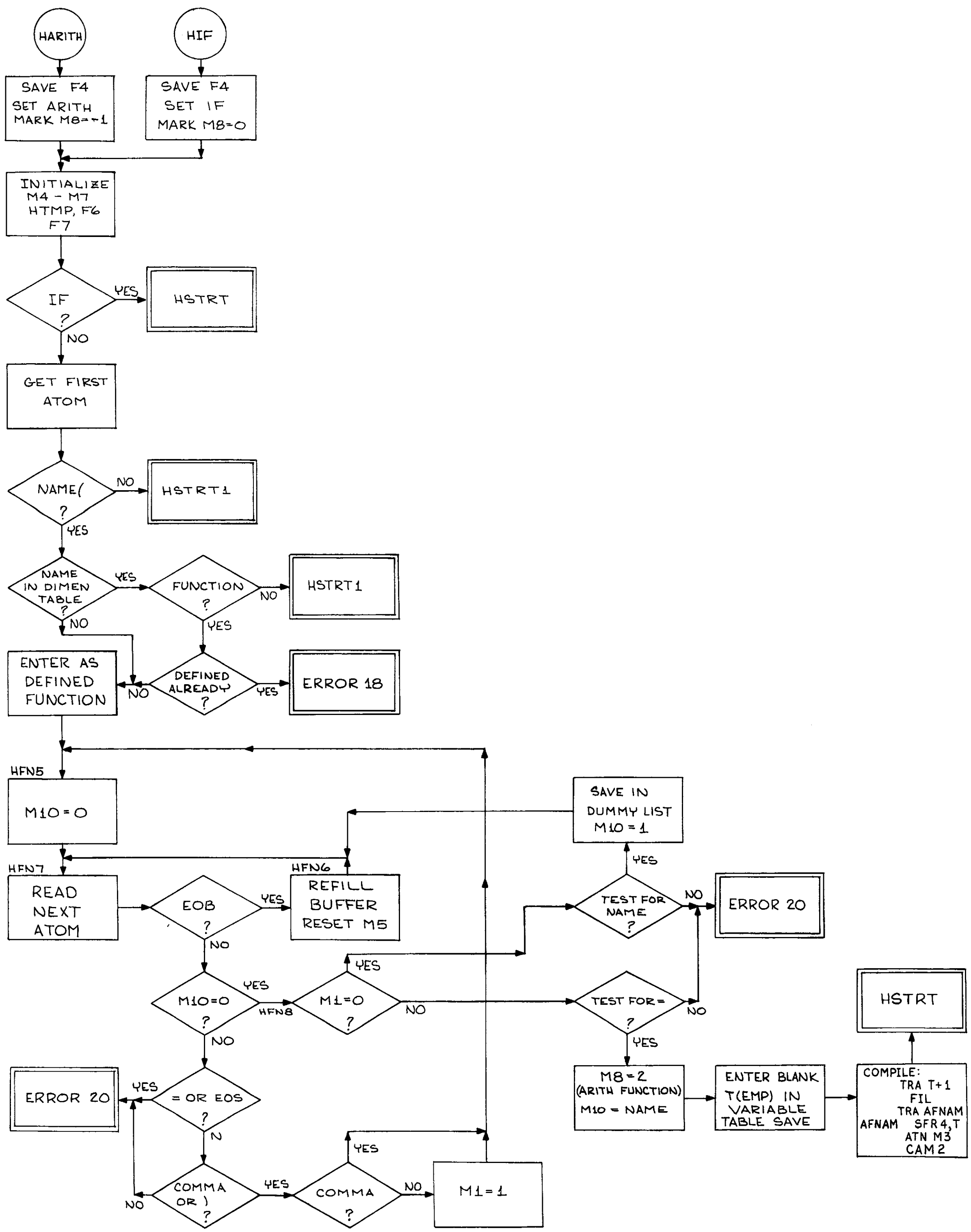
FORTRAN PART III

RETURN, SUBROUTINE AND FUNCTION STATEMENTS (Cont'd)



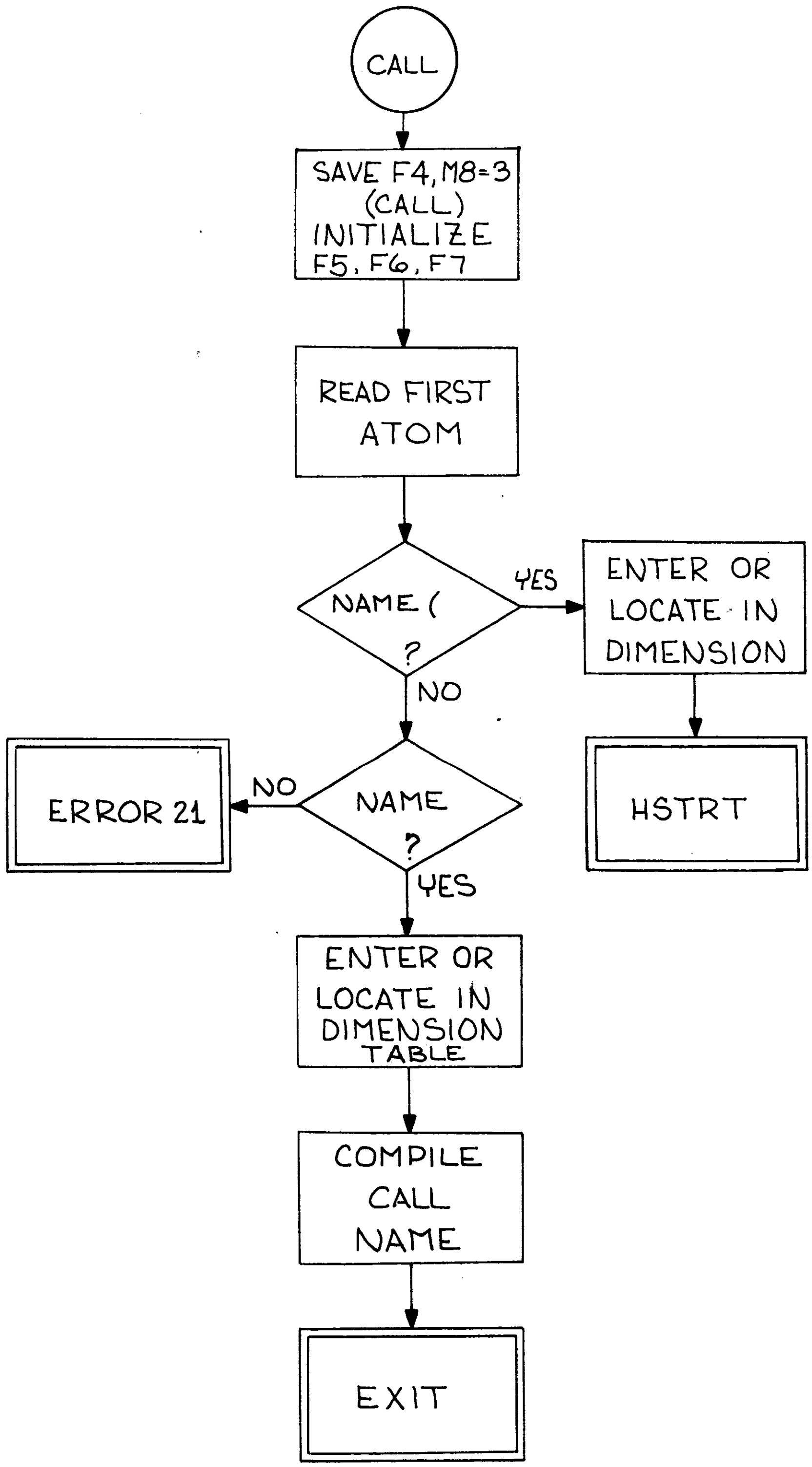
FORTRAN PART III

CALL, IF, ARITHMETIC AND ARITHMETIC FUNCTION INITIALIZATION



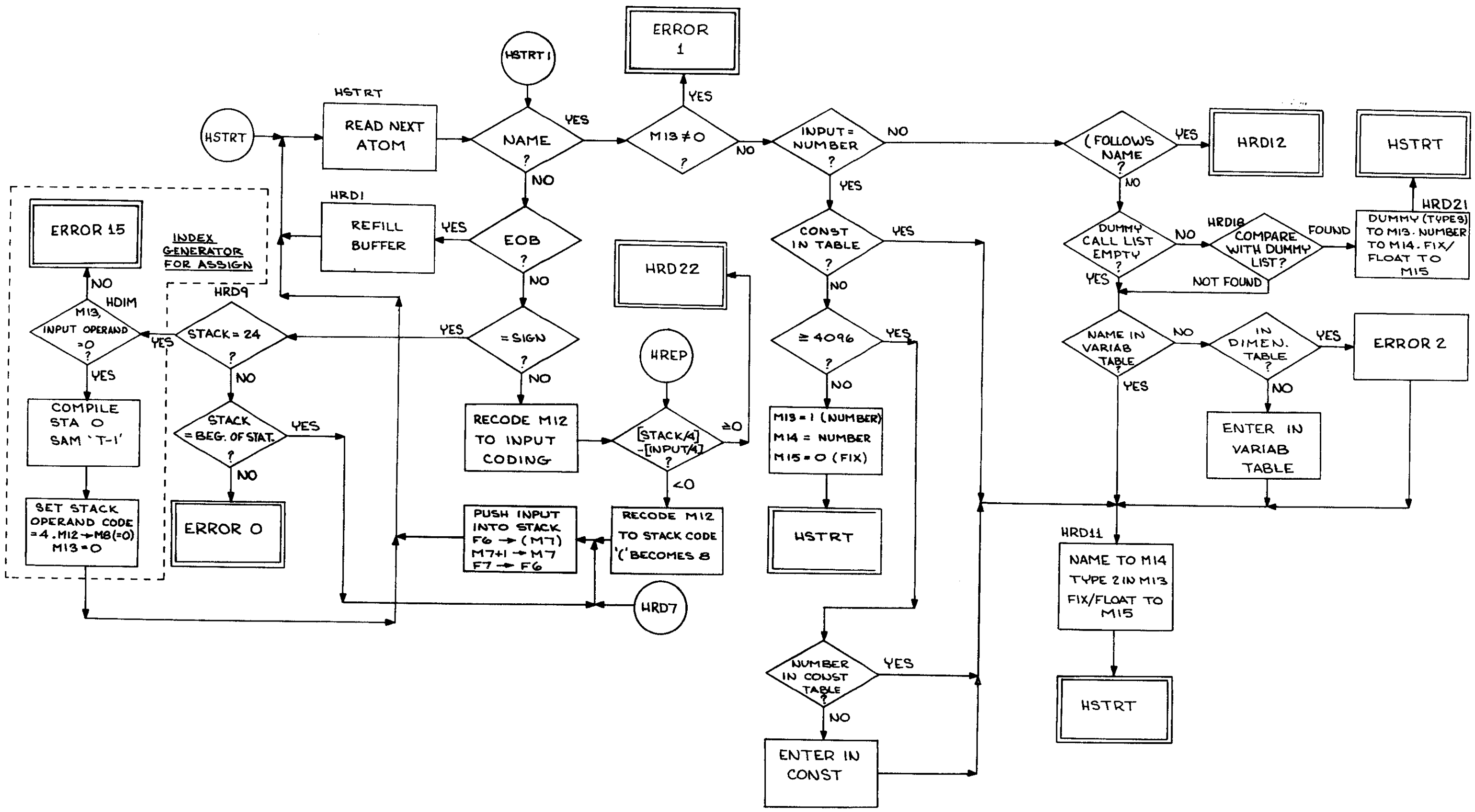
FORTRAN PART III

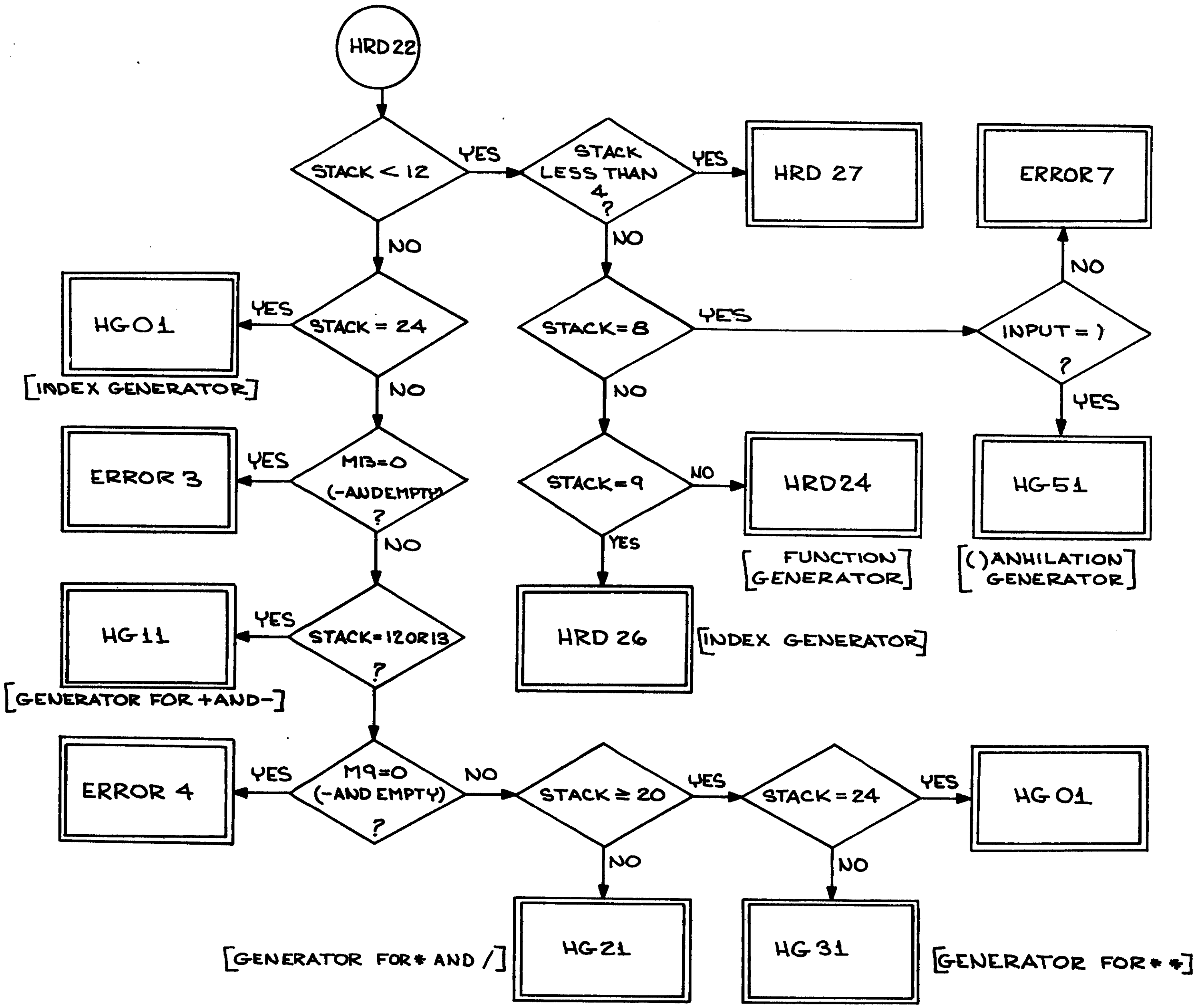
CALL, IF, ARITHMETIC AND ARITHMETIC FUNCTION INITIALIZATION (Cont'd)



FORTRAN PART III

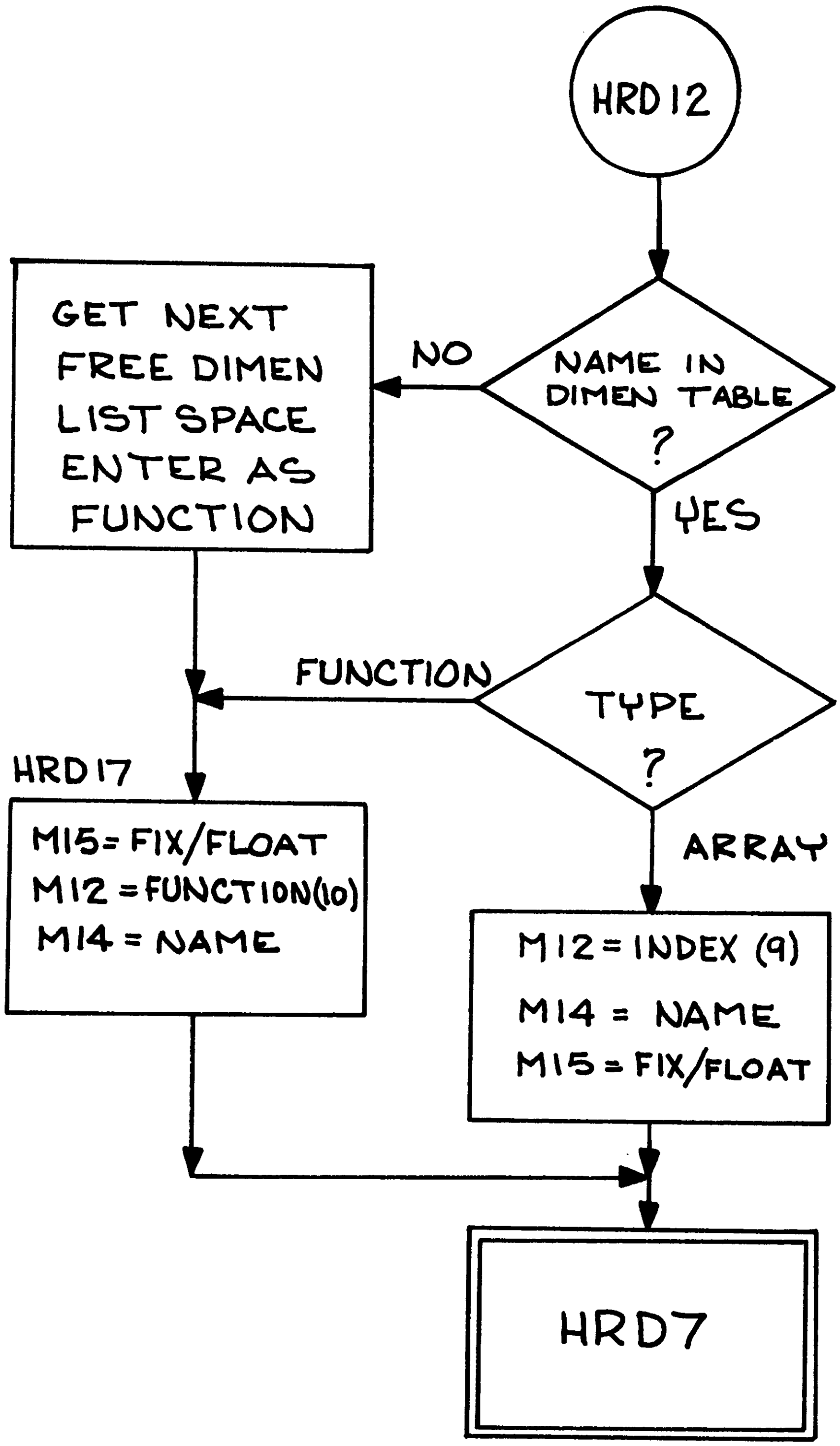
ARITHMETIC CALCULATION SECTION--STACK PREPARATION




HRD22
STACK < 12
YES
NO
STACK LESS THAN 4 ?
YES
HRD 27
NO
STACK = 24
YES
HG01
[INDEX GENERATOR]
NO
STACK=8
YES
INPUT =) ?
NO
ERROR 7
YES
HG51
[( ) ANHILATION GENERATOR]
NO
M13=0 (-AND EMPTY) ?
YES
ERROR 3
NO
STACK=9
NO
HRD24
[FUNCTION GENERATOR]
YES
HRD 26
[INDEX GENERATOR]
STACK=12 OR 13 ?
YES
HG11
[GENERATOR FOR + AND -]
M9=0 (-AND EMPTY) ?
YES
ERROR 4
NO
STACK ≥ 20
YES
STACK = 24
YES
HG 01
NO
HG21
[GENERATOR FOR * AND /]
NO
HG 31
[GENERATOR FOR * *]

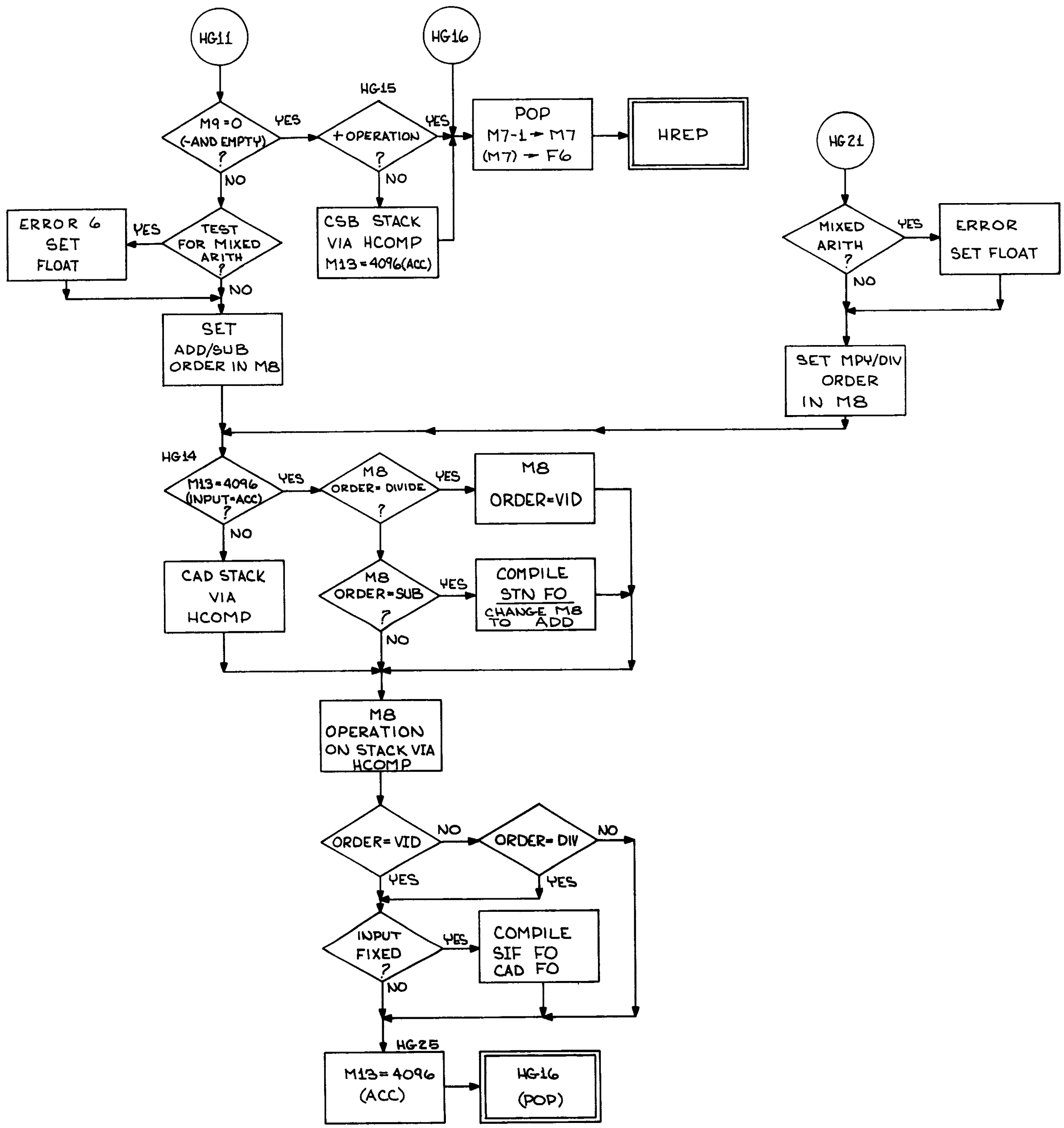
FORTRAN PART III

ARITHMETIC CALCULATION SECTION--STACK PREPARATION (Cont'd)



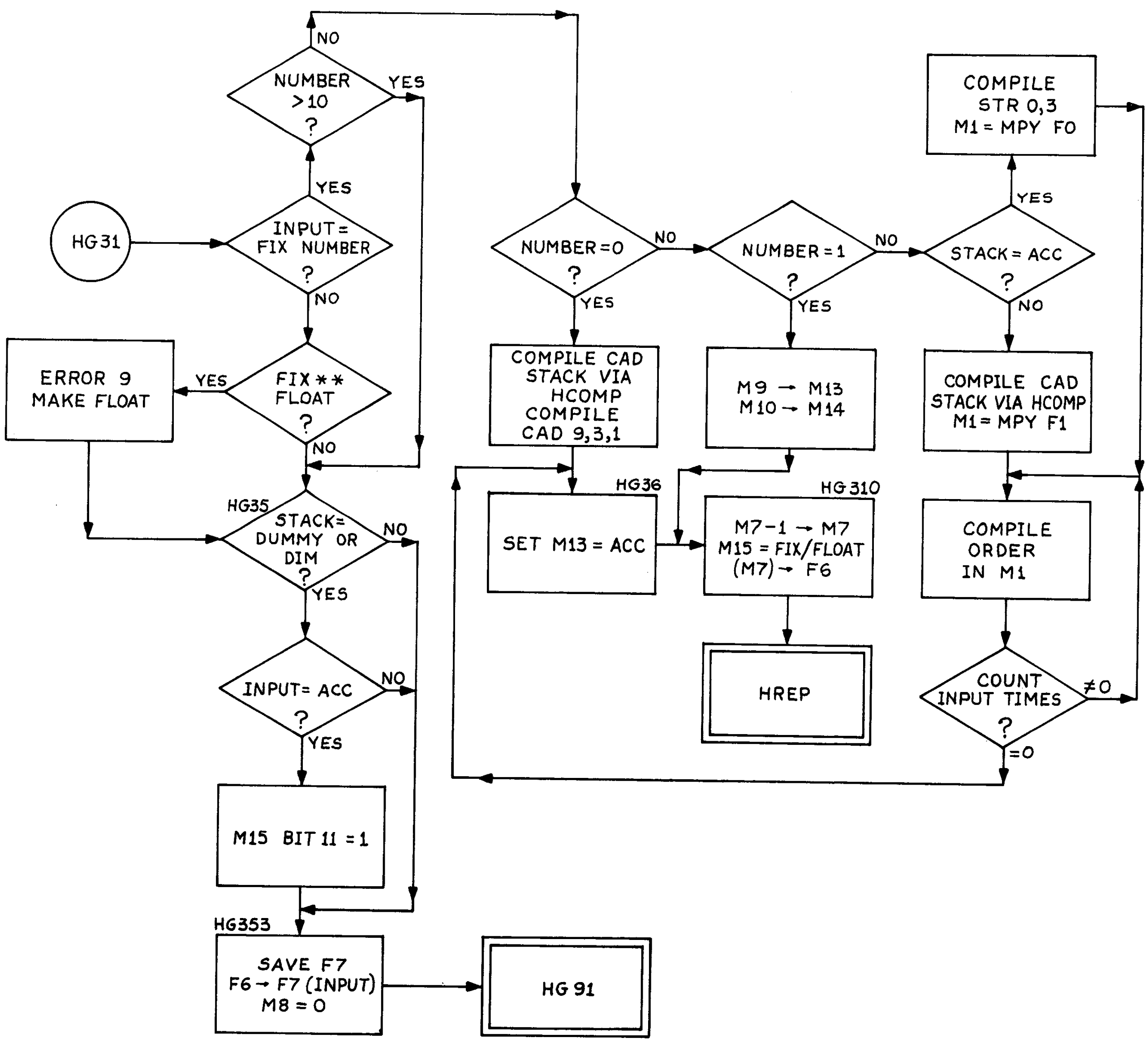
FORTRAN PART III

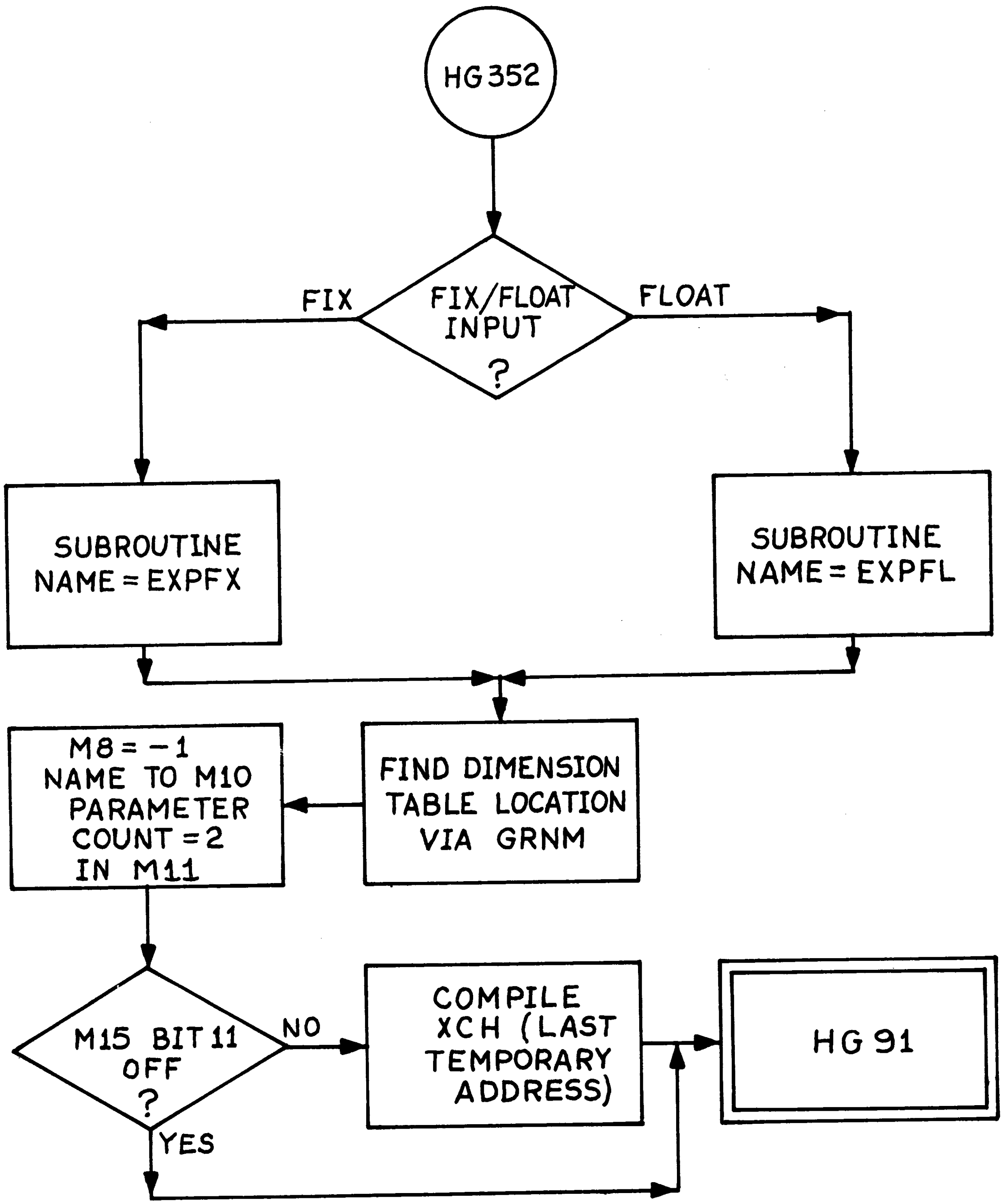
ARITHMETIC CALCULATION SECTION--GENERATIORS +, -, *, /, AND ()



FORTRAN PART III

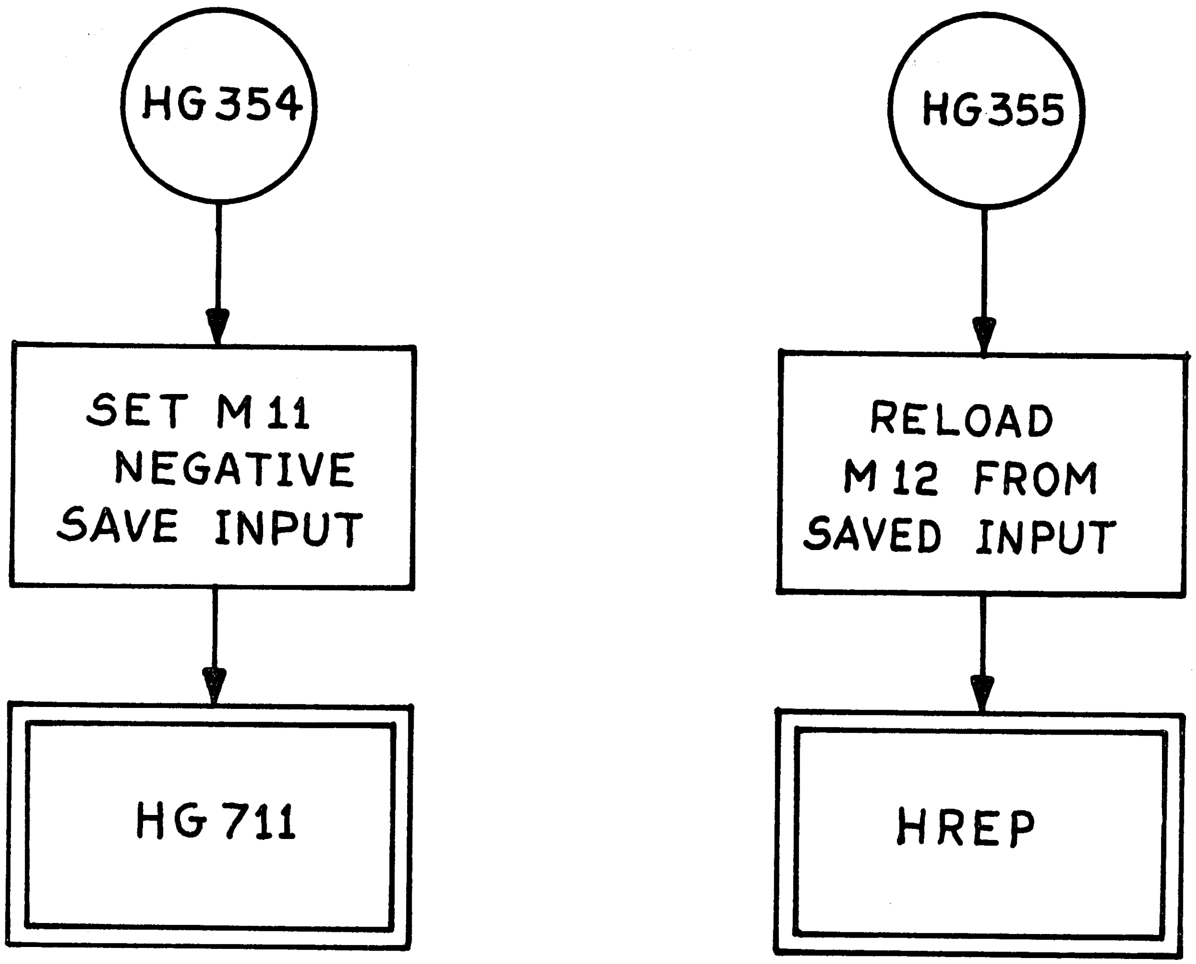
ARITHMETIC CALCULATION SECTION--GENERATOR** (Cont'd)




HG352
FIX/FLOAT INPUT ?
FIX
FLOAT
SUBROUTINE NAME = EXPFX
SUBROUTINE NAME = EXPFL
FIND DIMENSION TABLE LOCATION VIA GRNM
M8 = −1 NAME TO M10 PARAMETER COUNT = 2 IN M11
M15 BIT 11 OFF ?
NO
YES
COMPILE XCH (LAST TEMPORARY ADDRESS)
HG 91

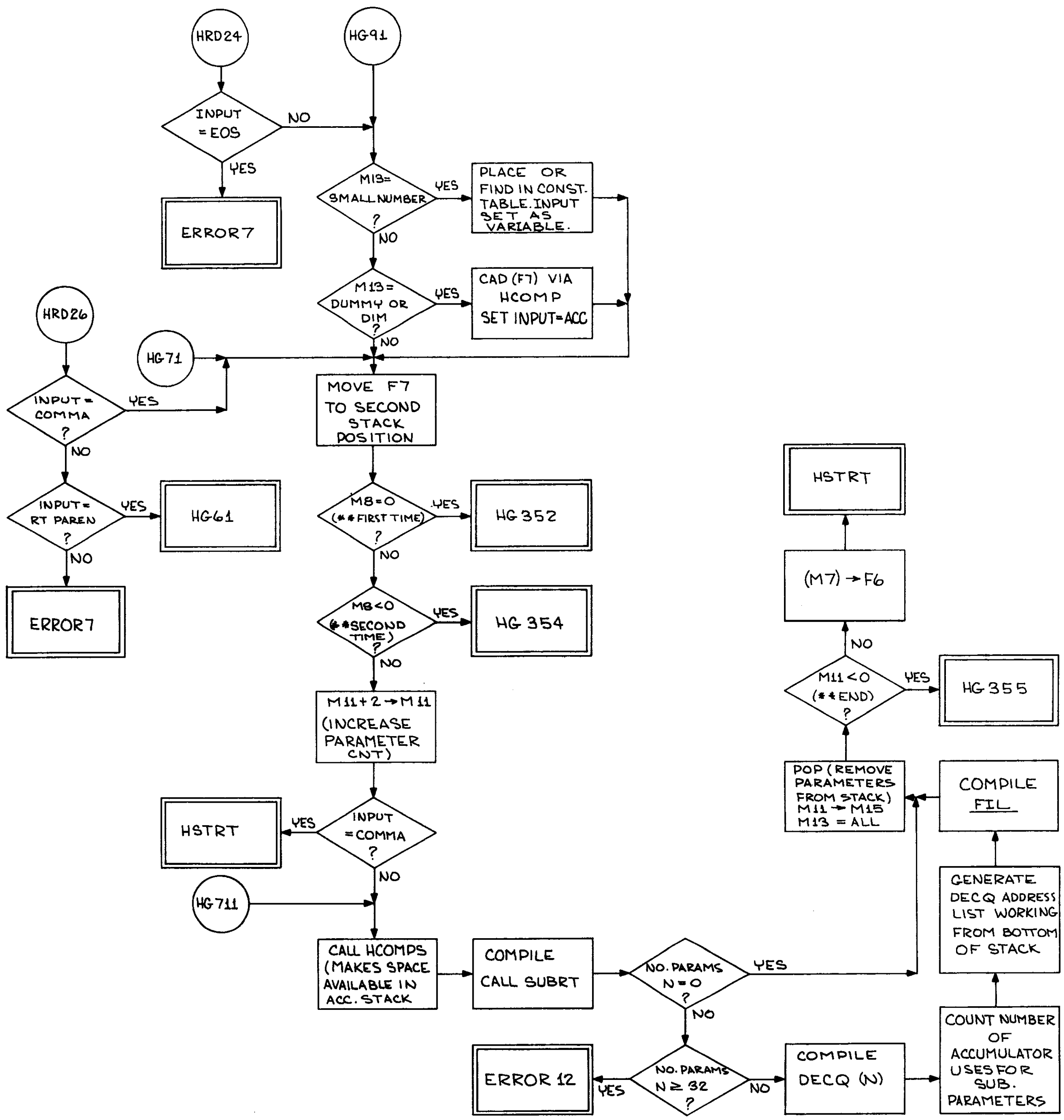
FORTRAN PART III

ARITHMETIC CALCULATION SECTION--GENERATOR**



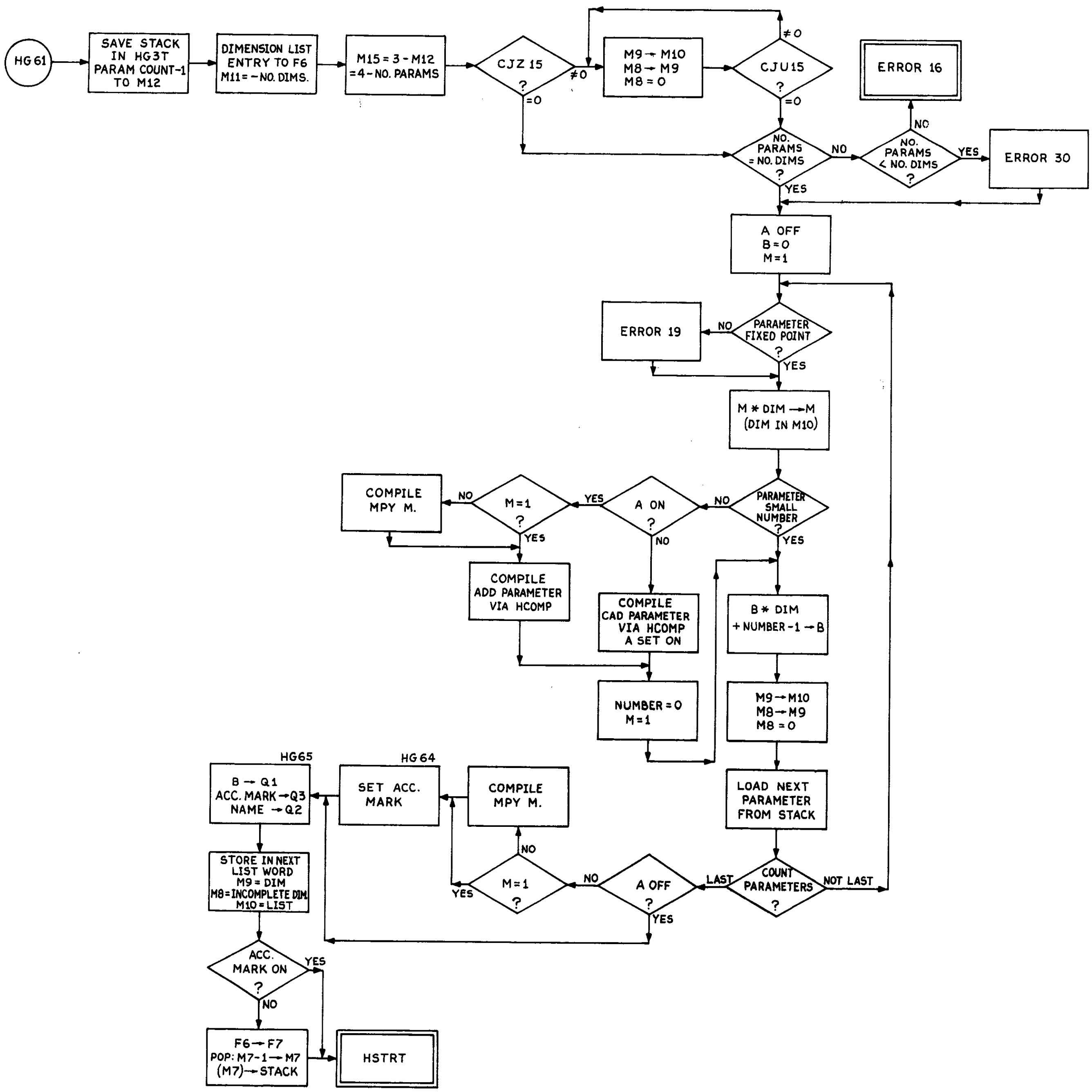
FORTRAN PART III

ARITHMETIC CALCULATION SECTION--FUNCTION/SUBROUTINE CALL GENERATOR



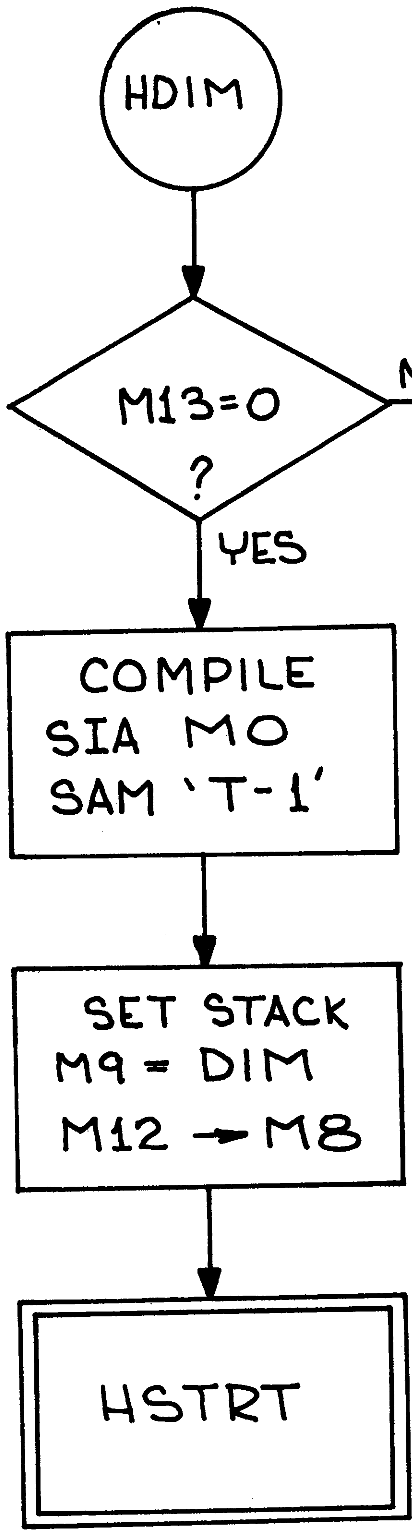
FORTRAN PART III

ARITHMETIC CALCULATION SECTION--GENERATORS FOR INDEXING



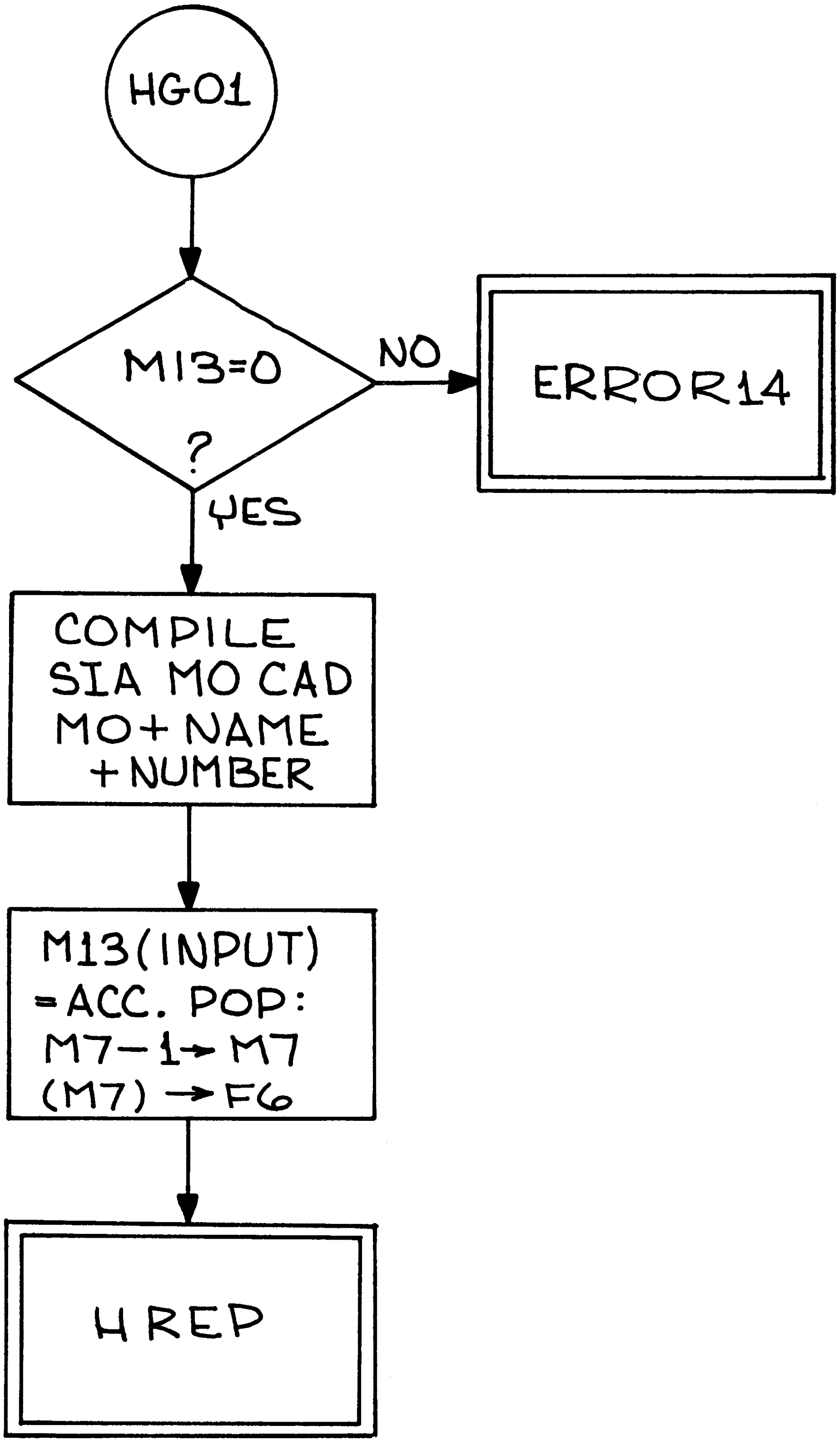
FORTRAN PART III

ARITHMETIC CALCULATION SECTION--GENERATORS FOR INDEXING (Cont'd)



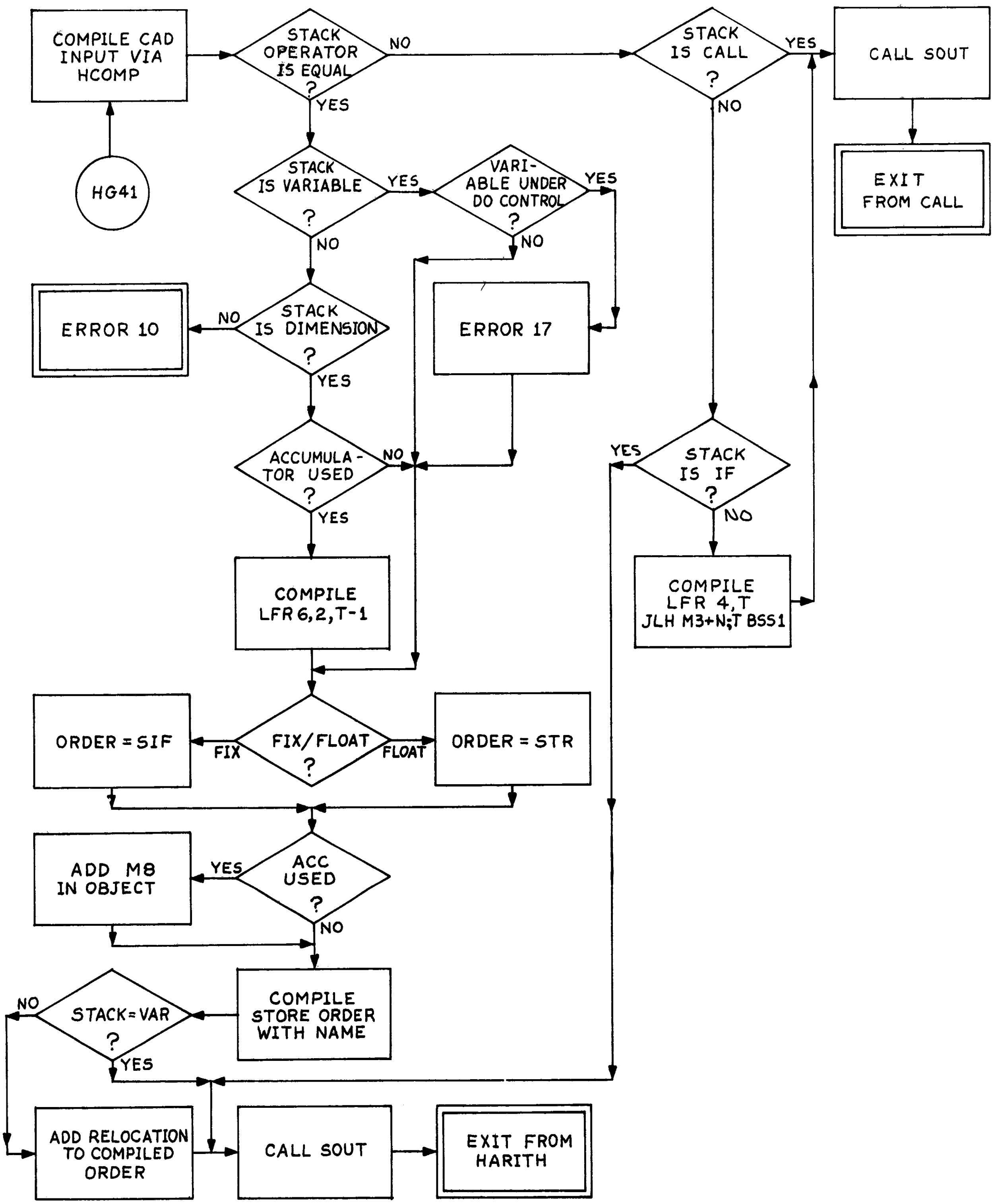
FORTRAN PART III

ARITHMETIC CALCULATION SECTION--GENERATORS FOR INDEXING (Cont'd)



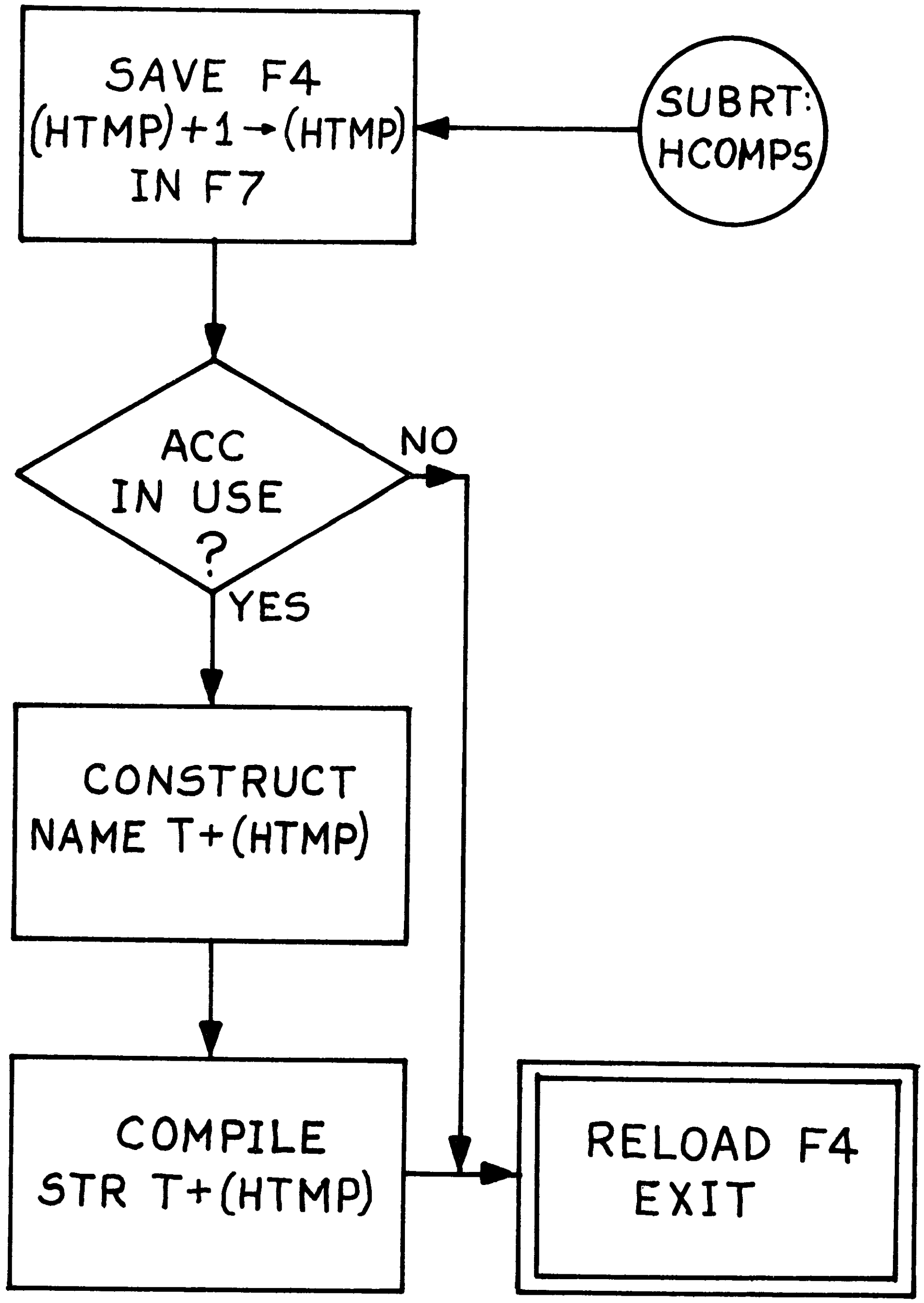
FORTRAN PART III

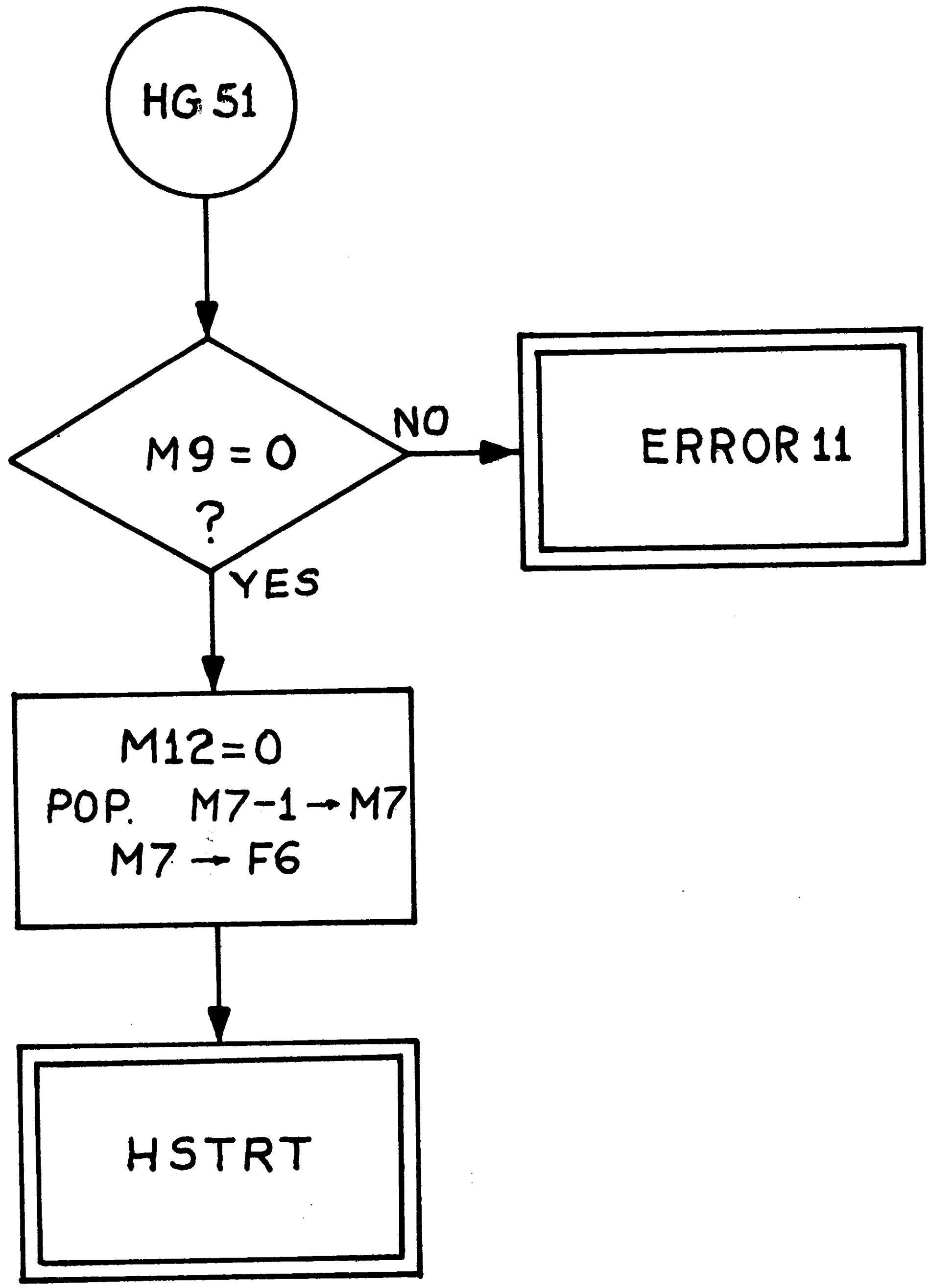
ARITHMETIC CALCULATION SECTION--GENERATORS FOR ASSIGNMENT, IF, ARITHMETIC FUNCTION AND CALL

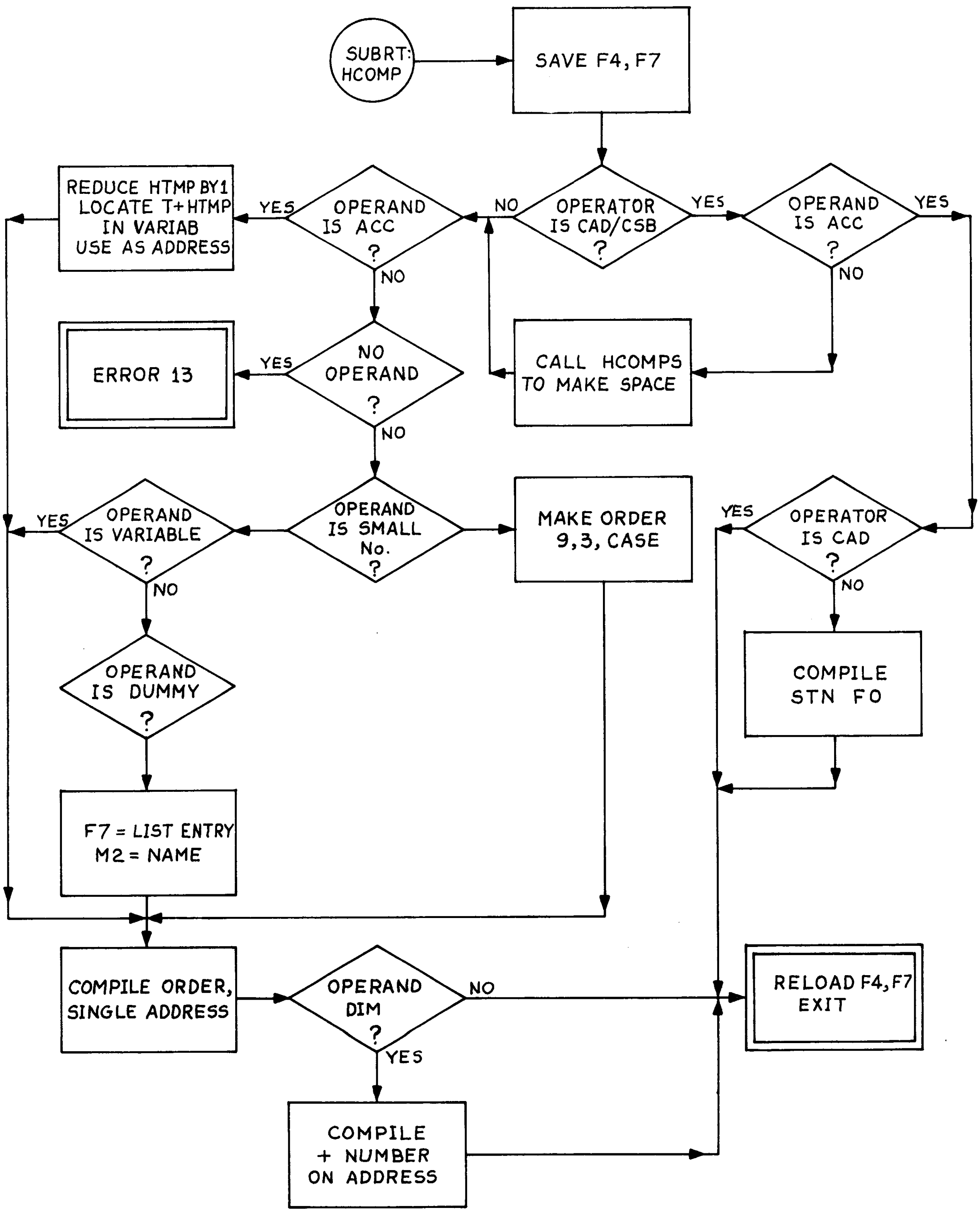


FORTRAN PART III

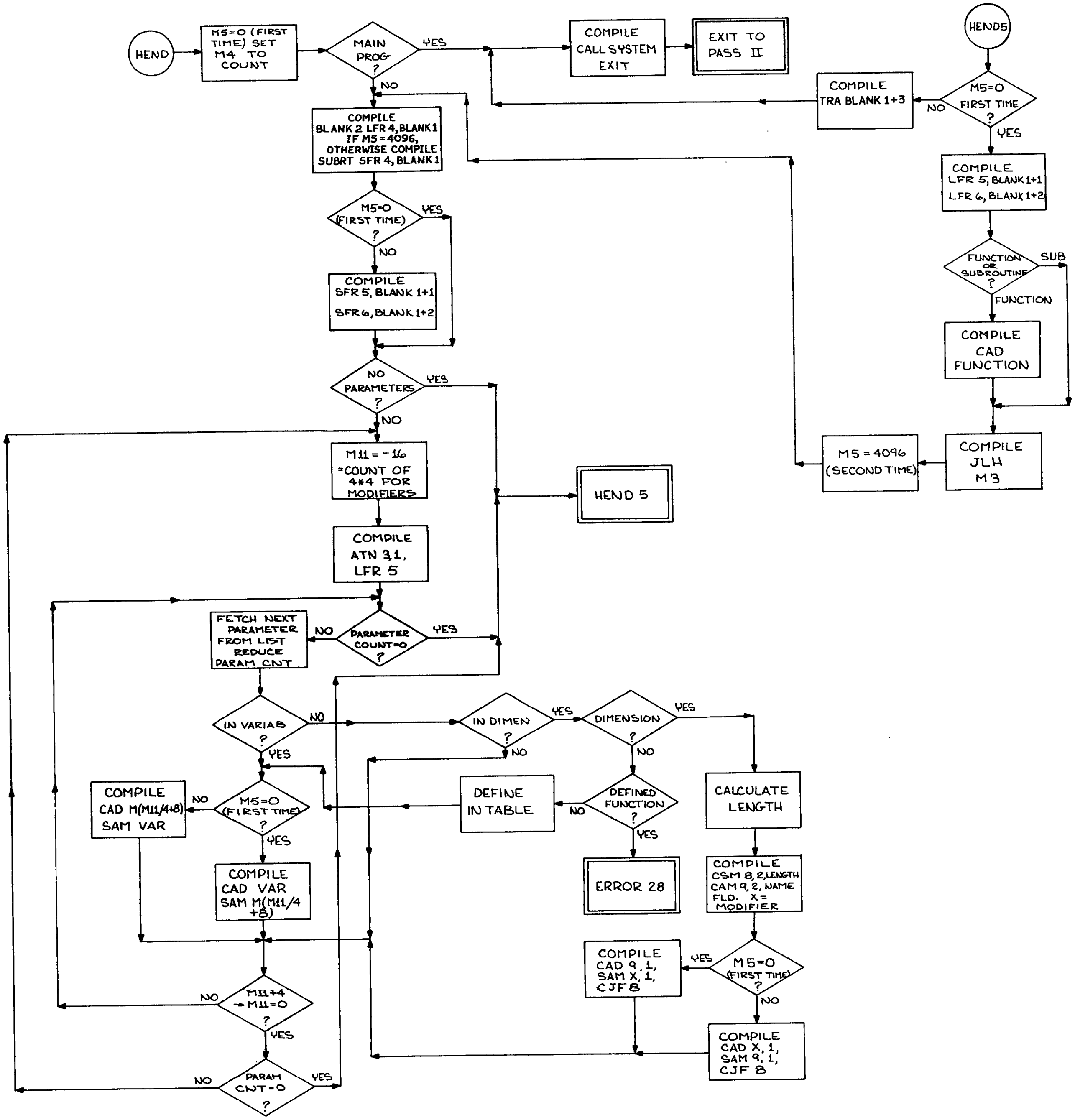
ARITHMETIC CALCULATION SECTION--SUBROUTINES



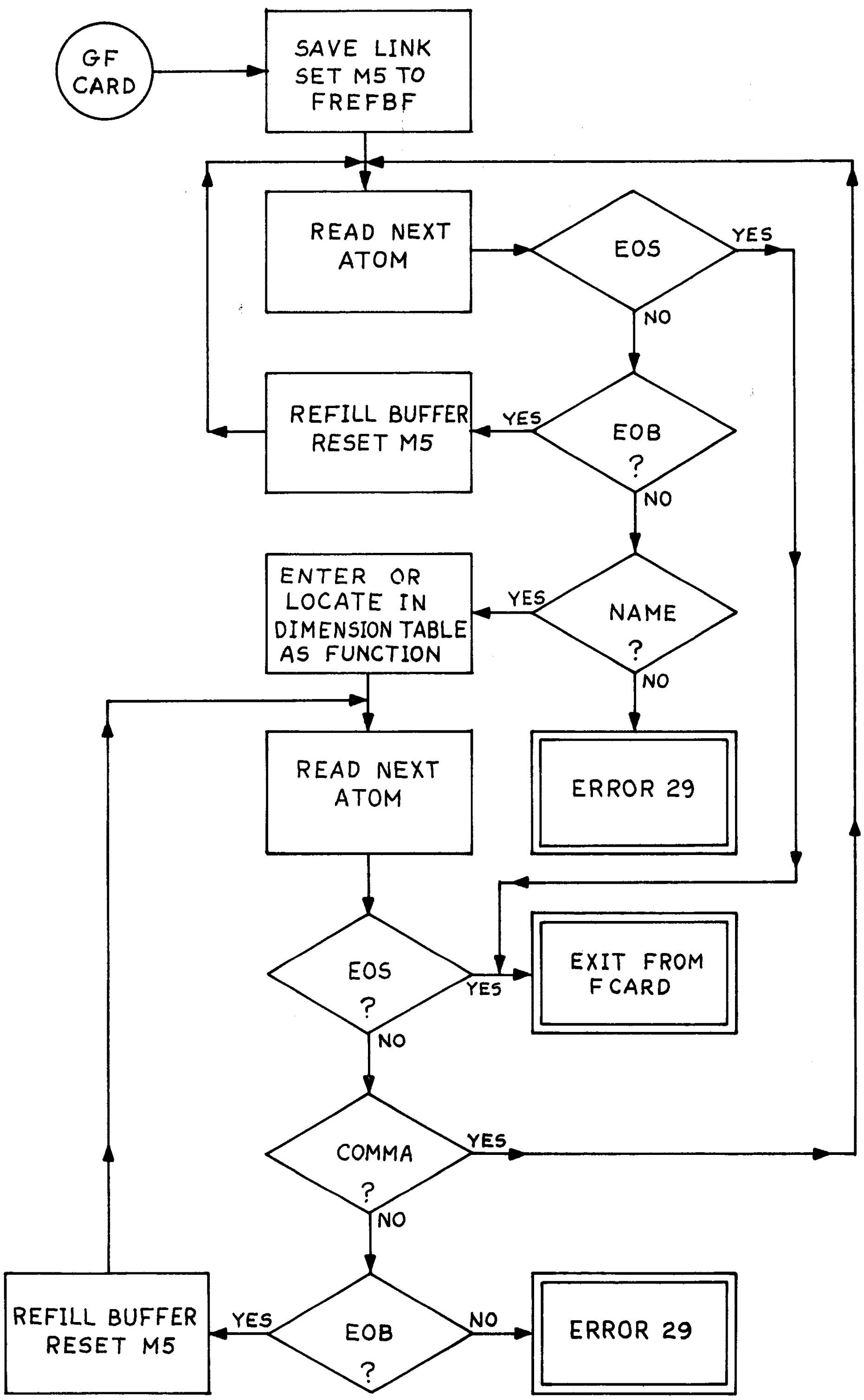

HG 51
M9 = 0
?
NO
ERROR 11
YES
M12=0
POP. M7-1→M7
M7 → F6
HSTRT


SUBRT: HCOMP
SAVE F4, F7
OPERATOR IS CAD/CSB ?
YES
NO
OPERAND IS ACC ?
YES
NO
OPERAND IS ACC ?
YES
NO
REDUCE HTMP BY1 LOCATE T+HTMP IN VARIAB USE AS ADDRESS
CALL HCOMPS TO MAKE SPACE
NO OPERAND ?
YES
NO
ERROR 13
OPERAND IS SMALL No. ?
MAKE ORDER 9,3, CASE
OPERAND IS VARIABLE ?
YES
NO
OPERAND IS DUMMY ?
F7 = LIST ENTRY M2 = NAME
OPERATOR IS CAD ?
YES
NO
COMPILE STN F0
COMPILE ORDER, SINGLE ADDRESS
OPERAND DIM ?
NO
YES
COMPILE + NUMBER ON ADDRESS
RELOAD F4, F7 EXIT

FORTRAN PART III
END STATEMENT



Date:	7/27/64
Section:	3.5.3.9
Page:	21 of 22
Revision:	


GF CARD
SAVE LINK SET M5 TO FREFBF
READ NEXT ATOM
EOS
YES
NO
REFILL BUFFER RESET M5
YES
EOB ?
NO
ENTER OR LOCATE IN DIMENSION TABLE AS FUNCTION
YES
NAME ?
NO
READ NEXT ATOM
ERROR 29
EOS ?
YES
EXIT FROM F CARD
NO
COMMA ?
YES
NO
REFILL BUFFER RESET M5
YES
EOB ?
NO
ERROR 29

```
 Z7002         LIZ BROWER
$       NICAP
$     PRINT OBJECT
$     PUNCH OBJECT
       ENTRY   HARITH,HEND,HSUB,HFUN,HIF,HRETRN,HCALL
       CALL    LEND                   XXX
       ENTRY   GFCARD
GFCARD SFR     4,HT1
GFC2   CAM     5,FREFBF
GFC6   ATN     5,1,                   NEXT ATOM
       LFR     7
       JZM     12,GFC1                END OF STATEMENT
       SBM     12,32
       JUM     12,GFC3                NOT EOB
       CALL    FREFIL
       TRA     GFC2
GFC3   ADM     12,32
       ANN     12,4102
       CAM     0,-4098
       JUM     0,HERR29               NOT NAME
       CRM     12,3
       ANM     12,1
       CALL    GRNM
GFC7   ATN     5,1,
       LFR     7
       JZM     12,GFC1                END OF STATEMENT
       CAM     0,M12-3
       JZM     0,GFC6                 COMMA
       SBM     0,29
       JUM     0,HERR29               NOT END OF BUFFER
       CAM     5,FREFBF
       CALL    FREFIL
       TRA     GFC7
GFC1   LFR     4,HT1
```

```
         JLH     M3
HEND     SFR     4,HT1                   XXXXX
         CAM     5                       FIRST TIME
HEND6    LDM     7,HPRMC
         LFR     6,HENDC
         CAM     4,COUT
         JZM     8,LEND                  MAIN PROGRAM
         CAD     4314.
         SAM     4,1,
         JNM     5,HEND2
         ORB     11
HEND2    CAM     0,M8                    BLANK2
         ATN     4,1,
         SFR     4
         JPM     5,HEND1
         ATN     -2048
HEND1    CAM     8,3602                  LFR 4,2
         ATN     4,1,
         SFR     6
         CAM     0,M10
         ATN     4,1,
         SFR     4
         JPM     5,HEND1A                FIRST TIME
         CAD     210.
         SAM     4,1,
         CAD     1558.                   SFR 5,2,
         SAM     4,1,
         CAD     M10.
         SAM     4,1,                    BLANK1
         CAD     8.                      +
         SAM     4,1,
         CAD     1.                      1
         SAM     4,1,
         CAD     210.
```

```
        SAM    4,1,
        CAD    1562.
        SAM    4,1,              SFR 6,2,
        CAD    M10.              BLANK 1
        SAM    4,1,
        CAD    8.
        SAM    4,1,              +
        CAD    2.
        SAM    4,1,              2
HEND1A  CALL   SOUT
        JZM    7,HEND5           NO PARAMETERS
        CAM    8,M7
        CAM    6                 MODIFIER USE
HEND4   CSM    11,16             DITTO
        CAD    16.
        SAM    4,1,
        CAD    1101.
        SAM    4,1,
        CAD    16.
        SAM    4,1,
        CAD    3604.             LFR 5,0,
        SAM    4,1,
HEND3   JZM    7,HEND5           NO PARAMS
        LFR    7,HPRMLS+M8-M7
        SBM    7,1
        CAM    1,VARIAB
        CALL   GTABLE
        JNM    0,HEND10          NOT IN VAR.
HEND11  JPM    5,HEND8           FIRST TIME
        CAM    0,M11+4256        CAD
        CAD    16.
        SAM    4,1,
        ATN    4,1,
        SFR    4
```

```
         CAD    218.
         SAM    4,1,
         CAD    5987.           SAM
         SAM    4,1,
         CAM    0,M2
HEND9    ATN    4,1,
         SFR    4
HEND13   CALL   SOUT
         ADM    11,4
         JUM    11,HEND3
HEND4A   JUM    7,HEND4
HEND5    JNM    5,HEND7         SECOND TIME
         CAD    210.
         SAM    4,1,
         CAD    3606.           LFR 5,2,
         SAM    4,1,
         CAD    M10.
         SAM    4,1,
         CAD    8.
         SAM    4,1,            +
         CAD    1.              1
         SAM    4,1,
         CAD    210.
         SAM    4,1,
         CAD    3610.
         SAM    4,1,            LFR 6,2,
         CAD    M10.
         SAM    4,1,
         CAD    8.
         SAM    4,1,            +
         CAD    2.
         SAM    4,1,            2
         JZM    9,HEND5A        SUBROUTINE
         CAD    218.
```

```
        SAM    4,1,
        CAD    4259.              CAD
        SAM    4,1,
        CAD    M9.                FUNCTION
        SAM    4,1,
HEND5A  CAD    16.
        SAM    4,1,
        CAD    2828.              JLH M3
        SAM    4,1,
        CALL   SOUT
        CAM    5,4096
        TRA    HEND6
HEND7   CAD    146.
        SAM    4,1,
        CAD    2948.              TRA
        SAM    4,1,
        CAM    0,M10              BLANK 1
        ATN    4,1,
        SFR    4
        CAD    8.                 +
        SAM    4,1,
        CAD    3.
        SAM    4,1,
        SFR    4
        CALL   SOUT
        CALL   LEND               XXXXXXXXXX
HEND8   CAD    218.
        SAM    4,1,
        CAD    4259.              CAD
        SAM    4,1,
        CAM    0,M2
        ATN    4,1,
        SFR    4                  NAME
        CAD    16.
```

```
       SAM    4,1,
       CAM    0,M11+5984         SAM
       TRA    HEND9
HEND10 CAM    1,DIMEN
       CALL   GTABLE
       JNM    0,HEND13           PARAMETER NOT USED
       CAM    1,M12
       CRM    12,1
       ANN    12,2047
       LFR    7,BASE
       JPM    1,HEND21           FUNCTION
       ANN    15,3
       CSM    15
       CAD    M12.
       CJZ    15,HEND12
       MPY    M13.
       CJZ    15,HEND12
       MPY    M14.
HEND12 SIA    12
       CAD    216.
       SAM    4,1,
       CAD    1378.              CSM 8,2,
       SAM    4,1,
       ATN    4,1,
       SFR    7                  NUMBER
       CAD    218.
       SAM    4,1,
       CAD    1510.              CAM 9,2,
       SAM    4,1,
       CAM    0,M2               NAME
       ATN    4,1,
       SFR    4
       CAD    32.
       SAM    4,1,
```

```
        CAD     256.                    FLD
        SAM     4,1,
        CAD     16.
        SAM     4,1,
        JPM     5,HEND14                FIRST TIME
        CAM     0,M11+4257              CAD X,1,
        ATN     4,1,
        SFR     4
        CAD     16.
        SAM     4,1,
        CAD     5989.                   SAM 9,1,
        SAM     4,1,
HEND15  CAD     16.
        SAM     4,1,
        CAD     3040.                   CJF 8
        SAM     4,1,
        TRA     HEND13
HEND21  JNM     12,HERR28               PARAMETER IS ARITH. FN.
        CAM     12,1
        CAM     15,1
        CRM     1,1
        ANN     1,2047
        SFR     7,BASE
        LFR     7,M2
        ORM     12,4096
        SFR     7,M2
        TRA     HEND11
HEND14  CAD     4261.
        SAM     4,1,                    CAD 9,1,
        CAD     16.
        SAM     4,1,
        CAM     0,M11+5985              SAM
        ATN     4,1,
        SFR     4
```

```
        TRA     HEND15
HFUN    SFR     4,HT1
        CAM     4                   FUNCTION MARK
        TRA     HSB1
HSUB    SFR     4,HT1
        CAM     4,4096              SUBROUTINE MARK
HSB1    CAM     5,FREFBF
        ATN     5,1,
        LFR     7
        ANN     12,4102
        CAM     0,-4102
        JUM     0,HSB8              NOT NAME(
        CAM     6                   PARAMETER MARK
HSB9    CAM     1,DIMEN
        CALL    GTABLE
        JPM     0,HERR23            ALREADY DEFINED
        CAM     1,VARIAB
        CALL    GTABLE
        JPM     0,HERR23            DITTO
        ANM     12,1
        ORM     12,4096
        CAM     1,VARIAB
        CALL    GENTAB
        ANM     12,4095
        ATN     M2
HSB2    CAM     9                   FUNCTION STORAGE
        CAM     1,DIMEN
        CALL    GENTAB              ENTRY NAME
        CALL    GPBASE
        CRN     0,12
        ADM     12
        SFR     7,M2
        CAM     8,M2
        CAM     12,4096             DEFINED MARK
```

```
        SFR     7,MO+BASE
        CAM     1,VARIAB
        LFR     7,BLANK
        CALL    GENTAB
        CAM     10,M2              BLANK 1
        CALL    GENTAB
        CAM     11,M2              BLANK 2
        SFR     6,HENDC
        CAM     0,4136
        SFR     4,COUT
        CAM     0,M10              BLANK 1
        SFR     4,COUT+1
        CAM     0,512              BSS
        SFR     4,COUT+2
        CAM     0,3                3
        SFR     4,COUT+3
        CAM     4,COUT+4
        CALL    SOUT
HSB5    CJZ     6,HSB6             NO PARAMETERS
        CAM     7
HSB4    ATN     5,1,
        LFR     7
        CAM     0,M12-32
        JUM     0,HSB3
        CAM     5,FREFBF
        CALL    FREFIL
        TRA     HSB4
HSB3    JZM     7,HSB7
        SBM     12,4
        JPM     12,HERR24
        ADM     12,2
        JNM     12,HERR24
        JUM     12,HSB5            COMMA
HSB6    LFR     7,HPRMC
```

```
         CAM     15,M6
         SFR     7,HPRMC
         LFR     4,HT1
         JLH     M3
HSB7     ANN     12,4102
         CAM     12,-4098
         JUM     12,HERR24
         SFR     7,HPRMLS+M6-1
         CAM     7,1
         CAM     0,M6-32
         JNM     0,HSB4
         TRA     HERR25
HSB8     ADM     0,4
         CAM     6,-1               NO PARAMETER MARK
         JZM     0,HSB9
         TRA     HERR22
HRETRN   SFR     4,HT1
         LFR     7,HENDC
         JZM     12,HERR26          MAIN PROGRAM
         CAM     0,154
         SFR     4,COUT
         CAM     0,2948             TRA
         SFR     4,COUT+1
         CAM     0,M15
         SFR     4,COUT+2
         CAM     4,COUT+3
         TRA     HCL1
HCALL    SFR     4,HT1
         CAM     8,3
         CAM     7,HGPUSH
         CAM     6
         CAM     9
         CAM     12,-1
         CAM     14,HLIST
```

```
        SFR    7,HTMP
        CAM    5,FREFBF
        CAM    4,COUT
        ATN    5,1,
        LFR    7                 FIRST BYTE
        ANN    12,4102
        CAM    0,-4102
        CAM    12
        JUM    0,HCALL1          NOT NAME(
        CALL   GRNM
        ATN    7,1,
        SFR    6
        CAM    10,M2
        CAM    9,2               VARIABLE
        CAM    8,10              SET FUNCTION
        CAM    13
        TRA    HSTRT
HCALL1  ADM    0,4
        JUM    0,HERR21          NOT NAME EITHER
        CALL   GRNM
        CAM    0,32
        ATN    4,1,
        SFR    4
        CAD    2304.             CALL
        SAM    4,1,
        CAM    0,M2
        ATN    4,1,
        SFR    4
        TRA    HCL1              EXIT IN CASE OF NO ( ) CALL
HIF     SFR    4,HT1
        CAM    8,1
        TRA    HIF1
HARITH  SFR    4,HT1
        CAM    8,-1
```

```
HIF1    CAM     4,COUT
        CAM     7,HGPUSH
        CAM     9
        CAM     6
        CAM     5,FREFBF
        CAM     12,-1
        CAM     14,HLIST
        SFR     7,HTMP
        CAM     13                  NO OP.
        JPM     8,HSTRT             IF STATEMENT
        ATN     5,1,
        LFR     7                   FIRST ENTRY
        ANN     12,4102
        CAM     0,-4102
        JZM     0,HFN1              NAME(
HFN3    CAM     13                  NO-AND
        TRA     HSTRT1
HFN1    CAM     1,DIMEN
        CALL    GTABLE
        JPM     0,HFN2
        CALL    GPBASE
        CRM     12,3
        ANM     12,1                X BIT FOR FUNCTION
        CRN     0,12
        ADM     12
        CALL    GENTAB
HFN4    CAM     12,4096             MARK FOR AF
        SFR     7,MO+BASE
        CAM     1
HFN5    CAM     10
HFN7    ATN     5,1,
        LFR     7
        SBM     12,32
        JZM     12,HFN6             EOB
```

```
         JZM     10,HFN8
         ADM     12,30
         JNM     12,HERR20         = OR EOS
         SBM     12,2
         JPM     12,HERR20         NOT COMMA
         CJZ     12,HFN5           COMMA
         CAM     1,1
         TRA     HFN5              )
HFN6     CALL    FREFIL
         CAM     5,FREFBF
         TRA     HFN7
HFN8     JUM     1,HFN9            SEEN )
         ADM     12,32
         ANN     12,4102
         CAM     12,-4098
         JUM     12,HERR20         NOT NAME
         ATN     6,1,
         SFR     7,HCLLST          SAVE DUMMY
         CAM     10,1
         TRA     HFN7
HFN9     ADM     12,31             TEST FOR =
         JUM     12,HERR20
         CAM     8,2               SET A.F.
         CAM     10,M2
         LFR     7,BLANK           T NAME
         CAM     1,VARIAB
         CALL    GENTAB
         CAM     0,M2
         SFR     4,HT2             SAVE T
         CAM     12,146
         ATN     4,1,
         SFR     7
         CAM     12,2948           'TRA'
         ATN     4,1,
```

```
SFR     7
ATN     4,1,
SFR     4               T
CAD     8.
SAM     4,1,
CAD     1.              1
SAM     4,1,
CAD     32.
SAM     4,1,
CAD     15,3,
SAM     4,1,            FIL
CAD     154.
SAM     4,1,
CAD     2948.           TRA
SAM     4,1,
CAD     M10.
SAM     4,1,
CAD     4314.
SAM     4,1,
CAM     12,M10          SUB
ATN     4,1,
SFR     7
CAD     1554.           SFR
SAM     4,1,
ATN     4,1,
SFR     4               T
CAD     16.
SAM     4,1,
CAD     1100.           ATN M3
SAM     4,1,
CAD     16.
SAM     4,1,
CAD     1480.           CAM 2
SAM     4,1,
```

```
        CALL    SOUT
        CAM     13              CLEAR NAME AREA
        TRA     HSTRT
HFN2    JNM     12,HFN3         DIMENSION
        CRN     12,1
        CAM     0
        ANM     0,2047
        LFR     7,BASE+MO
        JNM     12,HERR18       DOUBLE FUNCTION DEF
        TRA     HFN4
HRD1    CALL    FREFIL          REFIL ATOM BUFFER
        CAM     5,FREFBF
HSTRT   ATN     5,1,
        LDM     12,0            NEX ATOM
HSTRT1  JNM     12,HRD10        NAME
        SBM     12,32
        JZM     12,HRD1         END OF BUFFER
        ADM     12,16
        JZM     12,HRD2         (
        ADM     12,4
        JZM     12,HRD3         **
        ADM     12,2
        JPM     12,HRD4         * /
        ADM     12,2
        JPM     12,HRD5         +-
        ADM     12,6
        JPM     12,HRD6         , AND )
        CJZ     12,HRD9         =
        ATN     -23             EOS
HRD2    ATN     4
HRD3    ATN     4
HRD4    ATN     4
HRD5    ATN     11
HRD6    ADM     12,1            RECODE ORDER
```

```
HREP    ANN     8,-4
        CAM     0
        ANN     12,-4              COMPARE STACK  AGAINST INPUT
        SBM     0
        JPM     0,HRD22            SMALLER OR EQUAL
        CAM     0,M12-24
        JUM     0,HRD7             NOT (
        CAM     12,8
HRD7    ATN     7,1,
        SFR     6                  PUSH
        CAD     F7
        SAM     F6
        CAM     13                 CLEAR INPUT
        TRA     HSTRT
HRD9    CAM     0,M8-24
        JPM     0,HDIM             DIMENSIONED
        JPM     8,HERR             INCORRECT = SIGN
        TRA     HRD7
HRD10   JUM     13,HERR1           TWO OPERANDS
        LFR     7,M5-1
        ANN     12,2
        CAM     0
        JZM     0,HRD13            NUMBER
        ANN     12,4
        CAM     0
        JUM     0,HRD12            ( FOLLOWS NAME
        JUM     6,HRD18            CALL LIST NON EMPTY
HRD20   CAM     1,VARIAB
        CALL    GTABLE
        JPM     0,HRD11            PRESENT IN VARIAB
        CAM     1,DIMEN
        CALL    GTABLE
        JPM     0,HERR2            SIMPLE VAR IN DIMEN
        CAM     1,VARIAB
```

```
         CALL    GENTAB
HRD11    CAM     14,M2              NAME
HRD15    ANN     12,1               FIX/FLOAT BIT
         CAM     15
         CAM     13,2               VARIAB TYPE
         TRA     HSTRT
HRD12    CAM     1,DIMEN
         CALL    GTABLE
         JNM     0,HRD16            ABSENT
         JPM     12,HRD17           FUNCTION
         CAM     14,M2              NAME
         ANN     12,1               FIX / FLOAT
         CAM     15                 BASE AND FIX/FLOAT
         CAM     12,9               INDEX OP
         TRA     HRD7               PUSH
HRD13    ANN     12,4
         CAM     0
         JZM     0,HRD15            CONSTANT IN TABLE
         CAM     12
         ADM     15,22              EXPONENT
         CAD     F7
         TOR     HRD8
HRD8     SIA     0
         TOR     HRD14              TOO LARGE
         CAM     14,MO              NUMBER TO STACK
         CAM     13,1               NUMBER TYPE
         CAM     15                 FIX AND +
         TRA     HSTRT
HRD14    CAM     1,CONST            SET IN CONST TABLE
         CALL    GTABLE
         JPM     0,HRD11
         CALL    GENTAB
         TRA     HRD11              ENTER IN INPUT
HRD16    CALL    GPBASE             GET NEXT BASE ADDRESS
```

```
         CRM     12,3
         ANM     12,1                X IS FIX/FLOAT BIT
         CRN     0,12                BASE ADDRESS
         ADM     12
         CALL    GENTAB              ENTER AS FUNCTION
         SFR     7,M0+BASE
HRD17    ANN     12,1                FIX / FLOAT
         CAM     15
         CAM     12,10               FUNCTION TYPE
         CAM     14,M2
         TRA     HRD7
HRD18    CAM     2,M12               SAVE TYPE
         CAM     12
         CSM     0,M6                COUNT
HRD19    CAD     M0+M6+HCLLST
         SUB     F7
         TZ      HRD21               FOUND
         CJU     0,HRD19
         CAM     12,M2
         TRA     HRD20               NOT IN LIST
HRD21    ANN     2,1
         CAM     15                  FIX/FLOAT
         CAM     13,3                DUMMY
         CAM     14,M6+M0
         TRA     HSTRT
HRD22    CAM     0,M8-12
         CALL    SOUT
         JNM     0,HRD23             STACK LESS THAN 12
         SBM     0,12
         JZM     0,HG01              INDEX OPERATION TO CAUSE LOADING
         JZM     13,HERR3            INPUT AND EMPTY
         ADM     0,8
         JNM     0,HG11              + OR - ATOR
         JZM     9,HERR4             STACK - AND EMPTY
```

```
         SBM     0,4
         JPM     0,HG31              ** ATOR
HG21     EON     15,M11
         CAM     1
         ANM     1,1
         JUM     1,HERR5             MIXED ARITH
HG21A    ANM     8,1
         JUM     8,HG22              DIVIDE
         ATN     -64                 MULTIPLY ORDER
HG22     CAM     8,5219              DIVIDE ORDER
HG14     JNM     13,HG23             INPUT = ACC.
         CAD     F6
         SAM     F4                  CAD
         CAM     0,4259
         CALL    HCOMP
         CAD     F7
         SAM     F4
         CAM     0,M8
         TRA     HG25A
HG23     CAM     0,M8-5219
         JZM     0,HG26              STACK ATOR=/
         ADM     0,576
         JUM     0,HG24              NOT -
         CAM     0,16
         ATN     4,1,
         SFR     4
         CAM     0,5571              STN 0,3,
         ATN     4,1,
         SFR     4
         CAM     8,4771              ADD 8,3,
HG24     CAD     F6
         SAM     F4
HG25A    CALL    HCOMP
         CAM     0,M8-5347
```

```
         JZM    0,HG27          VID ORDER
         ADM    0,128
         JUM    0,HG25          NOT DIVEDE
HG27     ANN    15,1            TEST FOR FIXED
         CAM    0
         JUM    0,HG25          NOT FIXED
         CAM    8,16            SHORT REF
         ATN    4,1,
         SFR    6
         CAM    8,5699          SIF 0,3
         ATN    4,1,
         SFR    6
         CAM    8,16
         CAM    0,16
         ATN    4,1,
         SFR    6
         CAM    8,4227          CAD 0,3,
         ATN    4,1,
         SFR    6
         CALL   SOUT
HG25     CAM    13,4096         ACC TO INPUT - AND
HG16     SBM    7,1             POP
         LFR    6,M7
         TRA    HREP
HG26     CAM    8,5347          SET ORDER TO VID
         TRA    HG24
HG11     JZM    9,HG15          STACK - AND EMPTY
         EON    15,M11
         CAM    1
         ANN    1,1
         CAM    0
         JUM    0,HERR6         MIXED ARITH
HG12     ANN    8,1
         CAM    0
```

```
        JUM     0,HG13              SUB
        ATN     128                 ADD
HG13    CAM     8,4643              SUB
        TRA     HG14
HG15    ANN     8,1
        CAM     0
        JZM     0,HG16              ADD
        CAD     F7
        SAM     F4
        CAM     0,4131              CSB 8,3,
        CALL    HCOMP
        CAM     13,4096
        TRA HG16                    NOW IN ACCUMULATOR
HRD23   ADM     0,8
        JNM     0,HRD27             STACK LESS THAN 4
        SBM     0,6
        JZM     0,HRD24             FUNCTION
        CJZ     0,HRD26             INDEX
        CAM     0,M12-1             (
        JZM     0,HG51              INPUT = )
HRD25   CAM     1,HER+7             TOO MANY LEFT PAREN
        TRA     HEROR1
HRD24   CAM     0,M12-1
        JPM     0,HG91               COMMA OR )
        TRA     HRD25
HRD26   CAM     0,M12-2
        JZM     0,HG71              COMMA
        CJZ     0,HG61              )
        TRA     HRD25
HRD27   JZM     12,HG41             EOS INPUT
        SBM     12,1
        JUM     12,HERR8            NOT )
        CAM     0,M8-1
        JUM     0,HERR8             NOT  IF  STATEMENT
```

```
         TRA     HG41
HG31     SBM     0,4
         JPM     0,HG01             INDEX
         CAM     0,M13-1
         JZM     0,HG34             INPUT=FIX NUM
         NAN     15,M11
         CAM     0
         ANM     0,1
         JUM     0,HERR9            FIX ** FLOAT
HG35     CAM     0,M9-3
         JZM     0,HG353A           STACK IS DUMMY
         SBM     0,1
         JUM     0,HG353            STACK NOT DIM.
         ORM     15,4
HG353A   JPM     13,HG353           INPIT NOT ACC.
         ORM     15,2               MARK FOR SWITCH PAPAMETERS
HG353    SFR     7,HG3T+1
         CAD     F6
         SAM     F7
         CAM     8                  EXPONENTIATION MARK
         TRA     HG91
HG352    LDM     15,HG3T+1
         ANN     15,1
         CAM     0
         LFR     7,HEXPFL
         JUM     0,HG351            FLOATING POINT
         LFR     7,HEXPFX           FIXED POINT POWER SUBROUTINE
HG351    CALL    GRNM               ENTER OR FIND NAME IN TABLE
         ADM     11,4
         CAM     10,M2              NAME
         CAM     8,-1
         LFR     7,HG3T+1
         ANN     15,2
         CAM     0                  SWITCH PARAMETERS MARK
```

```
        JZM     0,HG91              OFF
        CAD     218.
        SAM     4,1,
        CAD     5475.               XCH 8,3,
        ANN     15,4
        CAM     0
        SAM     4,1,
        JZM     0,HG354A            DUMMY CASE
        ATN     1                   DIMENSION CASE
HG354A  CAD     M4-9                TEMPORARY ADDRESS RECOVERED FROM COUT BUFFER
        SAM     4,1,
        TRA     HG91
HG354   ORM     11,4096
        SFR     7,HG3T              SAVE INPUT
        TRA     HG711
HG355   LFR     6,M7
        LDM     12,HG3T
        TRA     HREP
        FIL
HEXPFL  OCTQ    0,57,15464,200
HEXPFX  OCTQ    0,57,15464,3200
HG36    CAM     13,4096             ACC
HG310   SBM     7,1
        ANN     11,1
        CAM     15                  FIX / FLOAT
        LFR     6,M7                POP
        TRA     HREP
HG34    CAM     0,M14-11
        JPM     0,HG35              GREATER THAN 10
        JZM     14,HG311            ZERO
        CSM     8,M14-1
        JZM     14,HG39             ONE
        JNM     9,HG37              STACK=ACC
        CAD     F6
```

```
        SAM    F4
        CAM    0,4259          CAD
        CALL   HCOMP           STACK
        CAM    1,5127          MPY 1,3,
HG313   CAM    0,16
        ATN    4,1,
        SFR    4
        CAM    0,M1
        ATN    4,1,
        SFR    4
        CJU    8,HG313
        TRA    HG36
HG37    CAM    0,16
        ATN    4,1,
        SFR    4
        CAM    0,5379          STR 0,3,
        ATN    4,1,
        SFR    4
        CAM    1,5123          MPY 0,3
        TRA    HG313
HG39    CAM    13,M9
        CAM    14,M10
        TRA    HG310
HG311   CAD    F6
        SAM    F4
        CAM    0,4259          CAD 8,3
        CALL   HCOMP           STACK
        CAM    0,88
        ATN    4,1,
        SFR    4
        CAM    0,4263          CAD 9,3,1
        ATN    4,1,
        SFR    4
        CAM    0,1
```

```
        ATN     4,1,
        SFR     4
        TRA     HG36
HG41    CAD     F7                      INPUT
        SAM     F4
HG42    CAM     0,4259                  CAD
        CALL    HCOMP                   CAD/CSB   INPUT
HG411   JUM     8,HG45
        CAM     0,M9-2
        JZM     0,HG43                  STACK IS VAR
        SBM     0,2
        JUM     0,HERR10                STACK NOT DIM OR VAR
        LFR     4,M10                   LIST ENTRY
        JPM     3,HG47A                 NO ACCUMULATOR
        CAM     12,218
        ATN     4,1,
        SFR     7
        CAM     12,3610                 LFR 6,2,
        ATN     4,1,
        SFR     7
        LFR     7,HTMP+1
        SBM     15,128
        CAM     1,VARIAB
        CALL    GTABLE
        CAM     0,M2
        ATN     4,1,
        SFR     4                       NAME TEMP
HG47A   LFR     7,M10
        CAM     10,M14
HG47B   ANM     11,1                    FIXED / FLOAT
        CAM     0
        JUM     11,HG47C
        CAM     0,320
HG47C   JPM     15,HG47                 NO ACCUMULATOR
```

```
         ATN     -1                    MAKE M8,2,
HG47     ADM     0,5411                STR 8,3,
HG48     CAM     12,218
         ATN     4,1,
         SFR     7
         ATN     4,1,
         SFR     4
         CAM     0,M10
         ATN     4,1,                  NAME
         SFR     4
         CAM     0,M9-2
         JZM     0,HG46                VAR
         CAM     0,210
         SFR     4,M4-3
         CAM     0,8
         ATN     4,1,
         SFR     4
         CAM     0,M13
         ATN     4,1,
         SFR     4
HG46     CALL    SOUT
         CAM     7,M5
         LFR     4,HT1
         JLH     M3
HG43     LFR     7,M10
         JPM     12,HERR17             DO CONTROL
         CAM     15
         TRA     HG47B
HG45     CAM     0,M8-3
         JZM     0,HCL1                CALL
         CJU     0,HG46                IF
         LFR     4,HT2
         CAM     8,218
         ATN     4,1,
```

```
         SFR     6
         CAM     8,3602              LFR 4,2,
         ATN     4,1,
         SFR     6
         ATN     4,1,
         SFR     4                   T
         CAD     80.
         SAM     4,1,
         CAD     2830.               JLH M3,2,
         SAM     4,1,
         ADN     6,3
         CAM     8
         CRM     8,2
         ANM     8,15
         ATN     4,1,
         SFR     6                   NUMBER OF PARAMETER WORSDS
         CAM     8,4136
         ATN     4,1,
         SFR     6
         ATN     4,1,
         SFR     4                   T
         CAM     8,512               BSS
         ATN     4,1,
         SFR     6                   BSS
         CAM     8,1
         ATN     4,1,
         SFR     6                   1
HCL1     CALL    SOUT
         LFR     4,HT1
         JLH     M3                  EXIT FROM AF
HG82     SFR     7,HG3T
         CAD     M14.
         SAM     F7                  NUMBER
         CAM     1,CONST
```

```
         CALL    GTABLE
         JPM     0,HG84          PRESENT
         CALL    GENTAB
HG84     LFR     7,HG3T
         CAM     14,M2
         CAM     13,2
         TRA     HG71
HG83     CAD     F7
         SAM     F4
         CAM     0,4259          CAD
         CALL    HCOMP           DUMMY TO TEMP STACK
         CAM     13,4096
         TRA     HG71
HG51     JUM     9,HERR11        STACK NOT EMPTY
         CAM     12
         SBM     7,1             POP
         LFR     6,M7
         TRA     HSTRT
HG91     CAM     0,M13-1
         JZM     0,HG82          SMALL NO.
         SBM     0,3
         JZM     0,HG83          DIMENSION
         CJZ     0,HG83          DUMMY
HG71     ATN     7,1,
         SFR     7
         JZM     8,HG352         EXPONENTIATION, FIRST TIME
         JNM     8,HG354         EXPONENTIATION, SECOND TIME
         ADM     11,2            INCREASE PARAM. CNT.
         CAM     13
         SBM     12,1
         JUM     12,HSTRT        COMMA
HG711    CALL    HCOMPS          MAKE ACCUMULATOR SPACE AVAILABLE FOR THE RESULT
         CAM     0,32
         ATN     4,1,
```

```
        SFR    4
        CAM    0,2304           CALL
        ATN    4,1,
        SFR    4
        CAM    0,M10
        ATN    4,1,
        SFR    4                NAME (INTERNAL)
        ANN    11,4094
        CAM    1
        CRM    1,1
        CAM    10,M1
        JZM    1,HG76           NO PARAMETERS
        CAM    0,42
        ATN    4,1,
        SFR    4
        CAM    2,M1-31
        JPM    2,HERR12         TOO MANY PARAMS.
        CRN    1,10
        CAM    0,2560           DECQ
        ATN    4,1,
        SFR    4
        CSM    0,M1
        CAM    9                NUMBER OF ACCUNMULATOR USES
HG73A2  LFR    7,M7+M0
        JPM    13,HG73A1
        SBM    9,1              ACCUMULATOR USE COUNT
HG73A1  CJU    0,HG73A2
        LFR    7,HTMP
        ADM    12,M9            FIX UP TEMPORARY ADDRESS
        SFR    7,HTMP
HG73    LFR    7,M7-M1
        CAM    0,M14
        ATN    4,1,
        SFR    4
```

```
         JPM    13,HG75                 NOT ACC
         CAM    8,M1                    SAVE M1
         LFR    4,HTMP
         CAD    MO.
         ADM    0,1
         SBE    22
         ADD    HTMP+1
         SFR    4,HTMP                  IN STORE
         STF    F7                      TEMPORARY NAME
         CAM    1,VARIAB
         CALL   GTABLE                  LOCATE
         CAM    0,M2
         SFR    4,M4-1                  RESET COUT
         CAM    1,M8                    RESTORE M1
HG75     SBM    1,1
         JZM    1,HG74                  LAST
         CAM    0,10
         ATN    4,1,
         SFR    4
         TRA    HG73
HG74     CAM    0,32
         LFR    7,HTMP
         ADM    12,M9                   DECREASE TEMPORARY STORAGE COUNT
         SFR    7,HTMP
         ATN    4,1,
         SFR    4
         CAM    0                       FIL
         ATN    4,1,
         SFR    4
HG76     SBM    7,1+M10                 POP
         ANN    11,1
         CAM    15
         CAM    13,4096
         JNM    11,HG355                EXPONENTIATION END
```

```
        LFR     6,M7
        TRA     HSTRT
HCOMP   SFR     4,HCP1
        SFR     7,HCP1+1
        ANN     0,-192
        CAM     12,-4096
        JZM     12,HCP6             ATOR IS CAD/CSB
        JNM     1,HCP10             AND IS ACC
HCP8    CSM     12,M1
        JZM     12,HERR13           NO - AND
        CJZ     12,HCP11            SMALL NUMBER
        CJZ     12,HCP2             VAR
        CJZ     12,HCP4             DUMMY
        LFR     7,M2
        CAM     2,M14
HCP2    ATN     2                   NAME
HCP3    CAM     12,216              NUMBER
        ATN     4,1,
        SFR     7
        ATN     4,1,
        SFR     4                   ORDER
        CAM     0,M2
HCP5    ATN     4,1,
        SFR     4                   ADDRESS
        SBM     1,4
        JUM     1,HCP7              NOT DIM
        CAM     0,210               CHANGE REF.
        SFR     4,M4-3
        CAM     0,8
        ATN     4,1,
        SFR     4
        CAM     0,M13               NUMBER
        ATN     4,1,
        SFR     4
```

```
HCP7    LFR    4,HCP1
        LFR    7,HCP1+1
        JLH    M3
HCP11   ADM    0,4
        TRA    HCP3
HCP4    CAM    12,32             PSEUDO
        ATN    4,1,
        SFR    7
        CAD    3108.             OCTQ 4 ...
        SAM    4,1,
        CAM    12,1096           ATN 2
        ATN    4,1,
        SFR    7
        CAM    12,3610           LFR 6,2,
        ATN    4,1,
        SFR    7
        ANN    2,-4
        CAM    12
        SBM    2,M12
        CRM    12,2
        ATN    4,1,
        SFR    7                 ADDRESS
        CRN    2,11
        ADM    0,-3              B FIELD TO ORDER
        TRA    HCP5
HCP12   ANN    0,128
        CAM    12
        JUM    12,HCP7           ATOR IS A CAD
        CAM    12,16
        ATN    4,1,
        SFR    7
        CAM    12,5571           STN
        ATN    4,1,
        SFR    7
```

```
         TRA     HCP7
HCP6     JNM     1,HCP12           -AND IS ACCUMULATOR
         CALL    HCOMPS
         TRA     HCP8
HCOMPS   SFR     4,HCP1+2
         LFR     7,HTMP
         ADM     12,1
         SFR     7,HTMP
         JZM     12,HCPS1          NOT IN USE
         CAD     M12-1.
         SBE     22
         ADD     HTMP+1
         STF     F7
         CAM     1,VARIAB
         CALL    GTABLE
         JPM     0,HCP9
         CALL    GENTAB
HCP9     CAM     0,218
         ATN     4,1,
         SFR     4
         CAM     0,5411            STR 8,3,
         ATN     4,1,
         SFR     4
         CAM     0,M2
         ATN     4,1,
         SFR     4                 TEMP
HCPS1    LFR     4,HCP1+2
         JLH     M3
HCP10    LFR     7,HTMP
         SBM     12,1
         SFR     7,HTMP
         CAD     M12.
         SBE     22
         ADD     HTMP+1            TEMP LOCATION
```

```
         STF     F7
         CAM     1,VARIAB
         CALL    GTABLE           LOCATE IN TABLE
         LDM     0,HCP1           RESET ORDER
         TRA     HCP2             ADDRESS IN M2
HCP1     BSS     3
HG01     JUM     13,HERR14        NAME AFTER )
         CAM     0,16
         ATN     4,1,
         SFR     4
         CAM     0,5824           SIA
         ATN     4,1,
         SFR     4
         CAM     0,210
         ATN     4,1,
         SFR     4
         CAM     0,4226           CAD M0,2,
         ATN     4,1,
         SFR     4
         LFR     4,M10
         CAM     0,M2
         ATN     4,1,
         SFR     4
         CAM     0,8
         ATN     4,1,
         SFR     4
         CAM     0,M1
         ATN     4,1,
         SFR     4
         CAM     13,4096          ACC
         CAM     15,M11
         SBM     7,1
         LFR     6,M7             POP
         TRA     HREP
```

```
HDIM     JUM     13,HERR15          NAME AFTER ) BEFORE =
         CAM     0,16
         ATN     4,1,
         SFR     4
         CAM     0,5824             SIA 0
         ATN     4,1,
         SFR     4
         LFR     4,HTMP
         CAM     0,-1
         SFR     4,HTMP
         LFR     7,HTMP+1
         SBM     15,128
         CAM     1,VARIAB
         CALL    GTABLE
         JPM     0,HDIM1
         CALL    GENTAB
HDIM1    CAM     0,218
         ATN     4,1,
         SFR     4
         CAM     0,5987             SAM 8,3,
         ATN     4,1,
         SFR     4
         CAM     0,M2
         ATN     4,1,
         SFR     4
         CAM     9,4                DIMENSIONAD VAR.
         CAM     8,M12
         CAM     13
         TRA     HSTRT
HG614    JPM     12,HERR16
         CAM     1,HER+30           TOO FEW INDICES
         CALL    GERROR
         TRA     HG615
HG61     SFR     6,HG3T             SAVE F6
```

```
        ANN   11,4094
        CAM   12
        CRM   12,1            NUMBER PARAMETERS - 1
        LFR   6,M10           TABLE ENTRY
        CRM   8,1
        ANN   8,2047
        LFR   6,BASE
        ANN   11,3            RANK
        CSM   11
        CAD   F7
        SAM   F4
        CSM   15,3-M12
        CJZ   15,HG613
HG612   CAM   10,M9
        CAM   9,M8
        CAM   8,1
        CJU   15,HG612
HG613   ADM   12,1+M11
        JUM   12,HG614
HG615   CAM   15              A OFF
        CAM   14              B = 0
        CAM   13,1            M = 1
HG63    CRM   3,1
        JNM   3,HERR19        NOT FIXED
HG63A   CAD   M13.
        MPY   M10.
        SIA   12
        CAM   13,M12          M' = M * DIM
        CAM   12,M1-1
        JUM   12,HG66         NOT SMALL NUMBER
HG68    CAD   M14.
        MPY   M10.
HG62    ADD   M2-1.           B=B*DIM+NO.-1
        CAM   10,M9
```

```
         CAM     9,M8
         CAM     8,1                LAST  ARRAY STEP IS ONE
         SIA     12
         CAM     14,M12
         SBM     7,1
         LFR     4,M7
         CJU     11,HG63            COUN NOT OUT
         ADM     7,1
         JZM     15,HG65            A = 0
         SBM     13,1
         JZM     13,HG64            M = 1
         CAM     0,216
         ATN     4,1,
         SFR     4
         CAM     0,5159             MPY 9,3,
         ATN     4,1,
         SFR     4
         CAM     0,M13+1            NUMBER M
         ATN     4,1,
         SFR     4
HG64     ATN     4096               ACC. MARK
HG65     CAM     3                  NO ACC.
         CAM     1,M14              NUMBER
         LFR     7,HTMP             LIST CONTROL
         LFR     6,HG3T
         CAM     9,4                DIM
         CAM     2,M10
         ATN     14,1,
         CAM     10                 LIST POINTER
         SFR     7,HTMP
         SFR     4,M10              STORE LIST ENTRY
         CAM     13
         CAM     8,24
         JNM     3,HSTRT
```

```
         CAD    F6
         SAM    F7
         SBM    7,1
         LFR    6,M7
         TRA    HSTRT
HG66     JUM    15,HG69             A NOT 0
         CAM    0
HG610    ADM    0,4259              CAD 8,3,
         CAM    15,1
         CALL   HCOMP
         CAM    2                   NO. = 0
         CAM    13,1
         TRA HG68
HG69     CAM    0,M13-1
         JZM    0,HG611
         CAM    0,216
         ATN    4,1,
         SFR    4
         CAM    0,5159              MPY 9,3,
         ATN    4,1,
         SFR    4
         CAM    0,M13
         ATN    4,1,                M.
         SFR    4
HG611    CAM    0,512
         TRA    HG610
HERR2    CAM    0,M8-10             VAR IN DIMENSION
         JUM    0,HERR2A            NOT FUNCTION
         ATN    5,1,
         LDM    12,0
         CAM    0,M12-3
         JZM    0,HERR2B            COMMA
         CJU    0,HERR2A            NOT  )
         CAM    0,-1
```

```
HERR2B CAM     14,M2
       CAM     13,2
       CAM     12,MO+2
       TRA     HG71
HERR2A CAM     1,HER+2           VAR. IN DIMENSION TABLE
       CALL    GERROR
       TRA     HRD11             CONTINUE
HERR5  CAM     1,HER+5           */MIXED ARITH
       CALL    GERROR
       ORM     15,1              SET FLOATING
       TRA     HG21A
HERR6  CAM     1,HER+6           +-MIXED ARITH
       CALL    GERROR
       ORM     15,1              SET FLOATING
       TRA HG12
HERR9  CAM     1,HER+9
       CALL    GERROR            FIX**FLOAT
       ORM     11,1              SET FLOATING
       TRA     HG35
HERR17 CAM     1,HER+17          VARIABLE ASSIGNED,UNDERDO
       CALL    GERROR
       TRA     HG47B
HERR29 CAM     1,HER+29
       CALL    GERROR
       TRA     GFC7
HERR19 CAM     1,HER+19
       CALL    GERROR
       TRA     HG63A             FLOATING SUBSCRIPT
HERR28 CAM     1,HER+28
       CALL    GERROR
       CALL    LEND
HERR26 ATN     1                 RETURN IN MAIN PROGRAM
HERR25 ATN     1                 MORE THAN 31 LIST ENTRIES
HERR24 ATN     1                 NOT , OR ) IN CALL LIST
```

```
HERR23 ATN    1                  DOUBLE DEF. OF SUB NAME
HERR22 ATN    1                  INCORRECT NAME IN FN./SUB.
HERR21 ATN    1                  INCORRECT CALL
HERR20 ATN    2
HERR18 ATN    2                  DOUBLE FUNCTION DEF
HERR16 ATN    1                  DIMENS DONT MATCH
HERR15 ATN    1                  NAME AFTER) BEFORE =
HERR14 ATN    1                  NAME AFTER )
HERR13 ATN    1                  NO AND IN HCOMP
HERR12 ATN    1                  TOO MANY PARAMS IN FN.
HERR11 ATN    1                  STACK NOT EMPTY AT (N)
HERR10 ATN    2                  STACK NOT DIM. OR VAR. AT =
HERR8  ATN    4                  TOO MANY ) OR (
HERR4  ATN    1                  UNARY * / **
HERR3  ATN    2                  INPUT =AND EMPTY
HERR1  ATN    1                  ADJACENT OPERANDS
HERR   CAM    1,HER              INCORRECT =
HEROR1 CALL   GERROR
HROR1  LFR    4,FREFBF-1
       JPM    1,HROR2
       CALL   FREFIL
       TRA    HROR1
HROR2  LFR    4,HT1
       JLH    M3
BLANK  BSS    1
HT2    BSS    1
HTMP   BSS    1                  NUMBER TEMP, MAX
       OCTQ   0,2154,16004,0     9T0000 CONVERSION
HT1    BSS    1                  F4 SAVE FOR ARITH
HG3T   BSS    2
HGLOG  OCTQ   1,1,4625,0         ELOG CONVERSION
HGEXP  OCTQ   1,0,456,7200       EXP CONVERSION
HPRMLS BSS    31
HCLLST BSS    20
```

```
HGPUSH BSS     30
HLIST  BSS     40
HENDC  EQUS    289
HPRMC  EQUS    314
HER    EQUS    37
DIMEN  EQUS    277
VARIAB EQUS    279
LABEL  EQUS    281
CONST  EQUS    283
BASE   EQUS    4096
COUT   EQUS    150
FREFBF EQUS    1
       GO      0
```

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Date:	7/27/64
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3.5.4 Input, Output and Auxiliary Storage Statements in FORTRAN

This section deals with the statements:

```
FORMAT (...)
READ #, I/O list
WRITE #, I/O list
PUNCH #, I/O list
READ INPUT TAPE n, #, I/O list
WRITE OUTPUT TAPE n, #, I/O list
READ TAPE n, I/O list
WRITE TAPE n, I/O list
REWIND n
END FILE n
BACKSPACE n
READ DRUM n, I/O list
WRITE DRUM n, I/O list
```

3.5.4.1 General Description

3.5.4.1.1 FØRMAT

On entry to the FØRMAT program, PSIG is checked. This word has the format

0	13		26		39	
L	A	12	B	12	C	12

If L is 0, the format statement has no label; therefore an error is recorded, and the statement is skipped. If L is nonzero, bit C is checked. If it is one, an error is recorded and the statement is skipped. If the label L is already in the label table, it is tested. Types 0 and 1 are accepted, and made into type 1 (format label); otherwise an error is listed and the statement is skipped. If the label is not in the table, it is entered as type 1.

If translation of the statement can proceed, a program of the form

```
       TRA    L + n
L      CHR    8n, format *
```

is assembled. The value of n is chosen to be the smallest integer at least as large as one-eight of the number of characters in the format statement. If this is larger than seven, the CHR is actually broken into several CHR's, each with a maximum of 56 characters. The format statement differs from all other statements in that it uses GREAD directly rather than receiving data via the statement buffer.

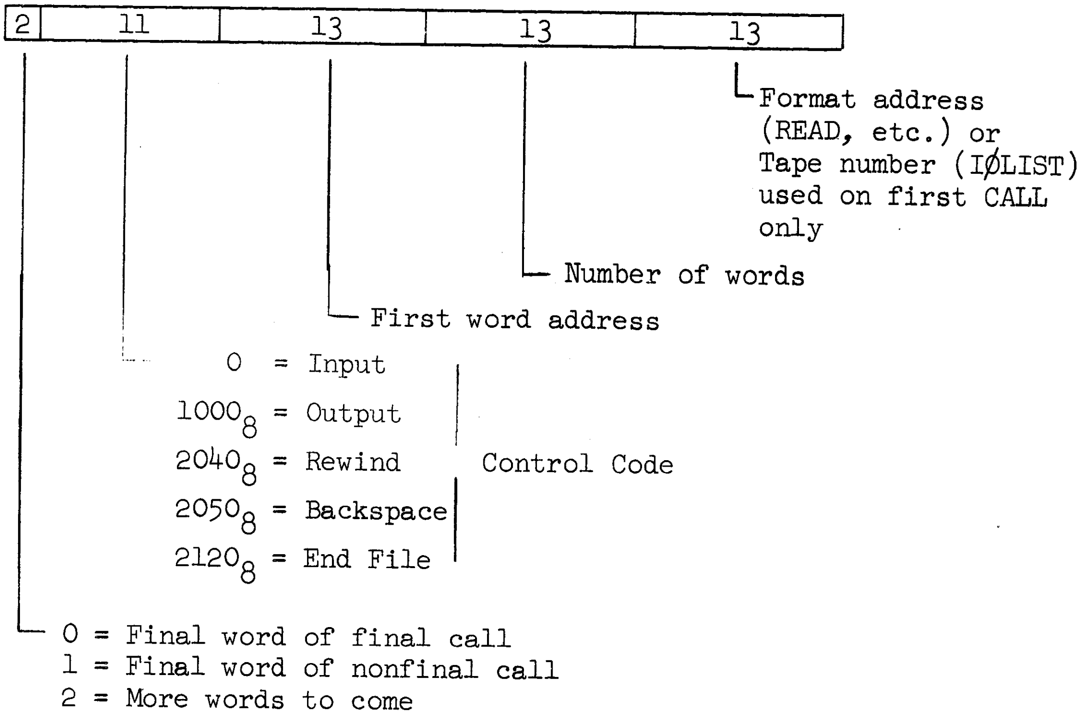
3.5.4.1.2 Execution Subroutines for I/O

Input-Output and Auxiliary storage are handled at execution time by the PRINT/READ/PUNCH and the IØLIST programs. These use SYSIØ and SYSAUX respectively for communication with tapes.

The PRINT/READ/PUNCH program is identical to that used in assembly language. It performs the necessary conversions of data. Output is converted and written on the system output tape of SYSIØ and input is read from the system input tape by SYSIØ and converted. The conversion is done according to a format string of characters. At execution time the I/O list is prepared and given to the I/O conversion program along with a format statement. The format determines the nature of the records read or written; they must, of course, be compatible with the device being used (80 columns for cards, 133 for printer).

The IØLIST program plays the part of the I/O conversion program in the case of statements like "READ TAPE n, I/O list." An I/O list is prepared in a manner identical to that used in "PRINT 7, I/O list" and given to the IØLIST program. This takes the items off the tape and puts them in the appropriate memory cells (READ) or moves the items from the cells to tape (WRITE). Since these must be contiguous in memory at the time of tape motion, a 256-word buffer is used. Because the I/O list can contain more than 256 words, one Read or Write Tape statement can cause several records to be read or written. The set of data words moved in one such statement will be referred to as a block. It is written on the tape with a maximum of 255 words per records in the format shown in Fig. 3.5.4.1.3.

The execution subroutines are used by CALLing them with M1 containing an address of an I/O list. Programs compiled by FORTRAN will limit this list to a maximum of ten words. Larger lists are handled by CALLing the subroutines several times. The format of the list is described in detail in Chapters 5 and 8 of the ILLIAC II Manual in the description of READ and IØLIST. Briefly, it has the form



The top two bits are used to determine the length of the list and the number of CALLS required except in control operations, when they are not used. For example, if the 150 words in location A1 to A1 + 9, A2 to A2 + 9, ..., A15 to A15 + 9 are to be read from tape 7 by READ TAPE 7, A1, A2, ..., A15 a FORTRAN compiled program would execute the following program (assuming that A1, A2, ..., A15 have been dimensioned to be ten element vectors):

```
CAM   11, 7
CAM   1, LIST
CAM   8, 4096
CAM   9, A1
CAM   10, 10
SFR   6, LIST
CAM   9, A2
SFR   6, LIST + 1
  .
  .
  .
CAM   9, A10
EØM   8, 6144
SFR   6, LIST + 9
CALL  IØLIST
CAM   8, 4096
CAM   9, A11
SFR   6, LIST
  .
  .
  .
CAM   9, A15
EØM   8, 4096
SFR   6, LIST + 5
CALL  IØLIST
```

LIST is a block of ten words in memory.

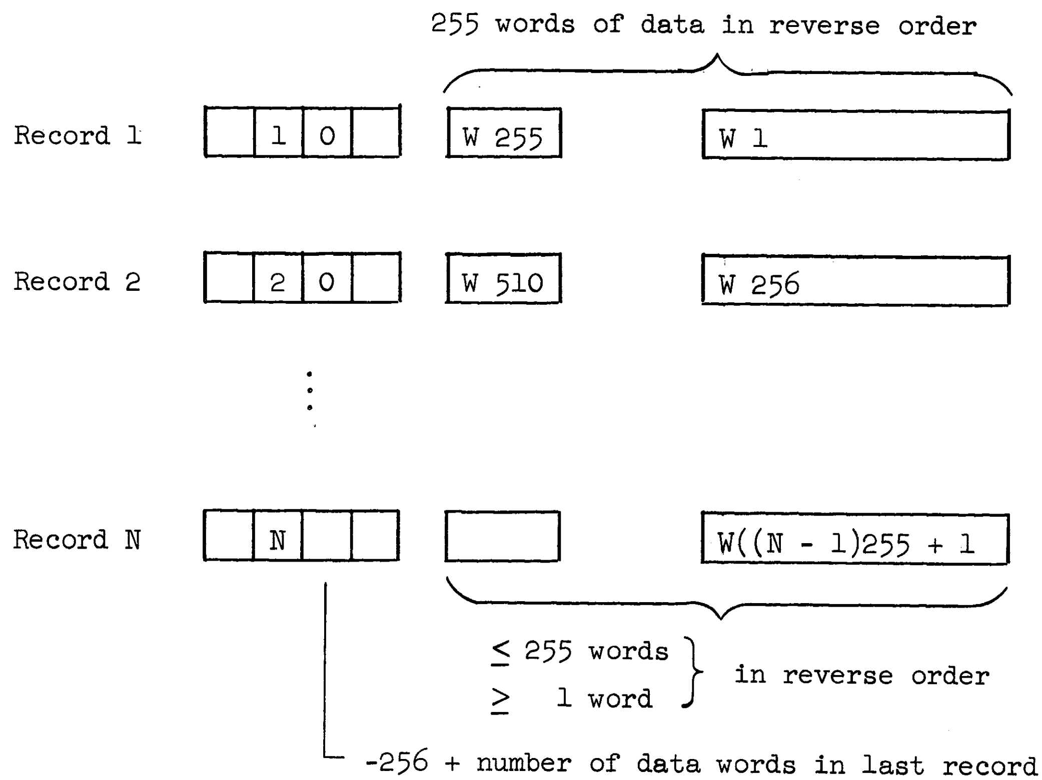


Figure 3.5.4.1.3. Format of FORTRAN Block on Tape

3.5.4.1.3 Compilation of First LIST Word

The data move operations involve an I/O list which is independent of the particular operation involved. Recompilation of the list is discussed below. First we examine the differences between the operations prior to the start of the list compile.

The cases are handled as follows:

READ DRUM WRITE DRUM	
READ n PRINT n PUNCH n	Where n is a number $\leq$ 32,767 and $\geq$ 1. An internal name FRM (n) is found for the format statement number n and CAM 11, FRM (n) is compiled. The program to be called is READ, WRITE or PUNCH respectively.
READ INPUT TAPE x, n	is treated exactly as "READ n."
WRITE OUTPUT TAPE x, n,	If x is an odd number, it is treated as "PUNCH n,,"; if x is an even number or a fixed-point variable name, it is treated as "PRINT n,".
READ TAPE x,	If x is a number, CAM 11, x is compiled. If x is a fixed-point name, CAD x SIA 8 ATN M8 CAM 11 is compiled. The program to be called is IØLIST.
WRITE TAPE x,	is similar to READ TAPE x,

REWIND TAPE x
END FILE x
BACKSPACE x
} Also start identically to READ TAPE x,

All statements next cause a CAM 1, LIST to be compiled. The three control statements them compile as

```
CAM   8, control code
SFR   6, LIST
CALL  IØLIST
```

3.5.4.1.4 Handling of the I/O List

As the I/O list is scanned, orders are compiled which will construct the execution list in LIST, LIST + 1, etc. M1 will be set to contain LIST by the code CAM 1, LIST, and M11 will be set to contain either the unit number or format number by the compiled code described above.

Each time that a new execution list is started, a CAM 8, 4096 or CAM 8, 4096 + 512, for read or write respectively, is compiled. As each element of the I/O list is scanned, a CAM 9 "address" is compiled for that element. If this is the first element of the statement or if it involves a number of words different from the last one examined, a CAM 10, N (where N is the number of words) is compiled. If this is the last member of the I/O list statement, an EØM 8, 4096 and an SFR 6, LIST + # are compiled, followed by a CALL IØLIST. If the available space for LIST (ten words) is now exhausted, or if one of the conditions described below occurs, an EØM 8, 6144 is compiled instead of the EØM 8, 4096. This sets the "nonfinal call" bit on in LIST so that the block may be continued by another CALL. Otherwise an SFR 6, LIST + # is compiled and the scan continues.

Example

If A has been dimensioned as A(7,3,5) and V and W are simple variables, "A(5,3,2), V, A, W" will compile as

```
CAM   9, A + 39
CAM   10, 1
SFR   6, LIST
CAM   9, V
SFR   6, LIST + 1
CAM   9, A
CAM   10, 105
SFR   6, LIST + 2
CAM   9, W
CAM   10, 1
SFR   6, LIST + 3
```

If a dimensioned variable uses variables in its indexing then the accumulator is used to calculate the address in the following manner. The address is expanded so that it is in the form

$$V + C_1 * N_1 + C_2 * N_2 + C_3 + N_3 + C$$

where C_1, C_2, C_3 and C are numeric constants, N_1, N_2 and N_3 are the fixed-point names that appear in the indices and V is the base address of the variable. Orders are compiled which will construct

$$C_1 * N_1 + C_2 * N_2 + C_3 * N_3$$

in the accumulator, using FO as temporary storage. Then

```
SIA    0
ATN    MO
CAM    9, V + C
```

is compiled.

3.5.4.1.5 Partial CALLs of the Execution Subroutines READ, etc.

As mentioned above, when the execution list reaches ten items, a CALL (partial, i.e., not final) is made in order to give the information in the list to the execution subroutine. This must also happen in the circumstances below.

a) If an input statement includes in its list a simple fixed-point variable, say I, followed by an indexed variable which uses I in its indexing, e.g., ... I, A(I,7,3), ..., I must be stored in memory before the address of A(I,7,3) can be calculated. After the CAM 9, I has been compiled, a partial call, that is, EØM 8, 6144/SFR 6, LIST + #/CALL subroutine, is compiled before the variable A is taken care of. To detect this case, a flag, bit 2 of the variable table word for I, is set at compile time when it is found in an input statement. This flag is cleared when a CALL is compiled.

b) Another time that a partial call must be compiled is when an implied DØ loop is found. When a "(" that does not follow a variable name is found, a partial CALL is compiled unless no variables have been seen since the last partial CALL. Thus RBAD 7,I((J,A(J), (..., will cause a partial CALL to be compiled at the first and third "(" but not at the second. When the end of the DØ loop is indicated by the occurrence of "simple fixed-point variable =" a further partial CALL must be compiled.

3.5.4.1.6 Handling of DØ Indexing in I/O Statement

The indexing is done in memory in floating point. When a "(" is found, two internal labels, L_1 and L_2 are assigned and placed on top of a push-down stack.

```
        TRA   L2
  L1     .
         .
         .
```

is then compiled after a partial CALL (if necessary). (L1 is a label for the next machine order.)

When an "I =" is found (I is any fixed-point variable) a scan is made to find either L, M, N) or L, M) where L, M and N are fixed-point names or numbers of not more than five digits. Anything else is illegal. Then the following code is compiled after a partial CALL

```
        CAD   I
        ADD   N (1 if N is not specified)
        STR   I
        SUB   M
        TZN   L1
        TRA   2, L2 + 1
  L2    CAD   L
        STR   I
        TRA   L1
```

The addresses L1 and L2 are removed from the top of the push-down stack so that such loops may be nested. The DØ push down is limited to three levels, only in order to be compatible with the 7094 FØRTRAN. When the end of the statement is reached, a final CALL is compiled, that is, EØM 8, 4096/SFR 6, LIST + 1#/CALL execution subroutine. If at this time the execution list should happen to be empty because of a previous partial CALL, then a CAM 10 is first compiled.

Example

```
DIMENSIØN   A(10,10,20)
READ 7,(K,J,(A(J,I,L),I=1,K),L=1,20)
```

will compile as

```
        CAM    11, FRM(7)
        CAM    1, LIST
        TRA    L20
L10     CAM    8, 4096
        CAM    9, K
        CAM    10, 1
        SFR    6, LIST
        CAM    9, J
        EØM    8, 6144    partial CALL
        SFR    6, LIST + 1
        CALL   READ
        TRA    L21
L11     CAM    8, 4096   (This resets M8 after each partial CALL.)
        CAD    L
        MPY    100.
        STR    FO
        CAD    I
        MPY    10.
        ADD    FO
        ADD    J
        SIA    0
        ATN    MO
        CAM    9, A - 111   (A is the address of A(1,1,1).)
        EØM    8, 6144    Partial CALL
        SFR    6, LIST
        CALL   READ
        CAD    I
        ADD    1.
```

```
        STR   I
        SUB   K
        TZN   L11
        TRA   2, L21 + 1
L21     CAD   1.
        STR   I
        TRA   L11
        CAD   L
        ADD   1
        STR   L
        SUB   20.
        TZN   L10
        TRA   2, L20 + 1
L20     CAD   1.
        STR   L
        TRA   L10
        CAM   8, 4096
        CAM   10
        EØM   8, 4096    Final CALL
        SFR   6, LIST
        CALL  READ
```

3.5.4.1.7 Errors

If, during the scan of a statement, an illegal combination of characters is met, an error is listed. In order to search for as many errors as possible, the scan is continued whenever possible. In order to do this, one of the following actions is taken.

A1 Skip to the next comma, then start the scan.

A2 Skip to the next), then skip to a comma, then start the scan.

A3 Skip to the end of the statement and return to the statement recognizer.

A4 List an error but continue the compilation.

If the scan is restarted, it is always at the beginning of the I/O list program. The various errors that are recognized and their subsequent actions are:

Error No.	Reason	Action
I1	Comma missing between I/O list items	A1
I2	A number of function appears in the I/O list	A1
I3	Too few indices in a dimensioned variable	A1
I4	An operator which was not "(" follows a comma	A1
I5	) comes too soon in DØ description, e.g., ... I = 1	A1
I6	First item after READ, etc., is not a number	A1
I7	Tape unit address is not # or fixed name	A1
I8	Format label is not type 0 or 1 (double defined)	A1
L9	Variable followed by (has not been dimensioned	A2
I10	Address construction in a dimensioned variable is not valid	A2
I11	Address of dimensioned variable too large	A2
I12	DØ control parameters are incorrect	A2
I13	Left and right parentheses don't match (can be caused by other errors)	A3

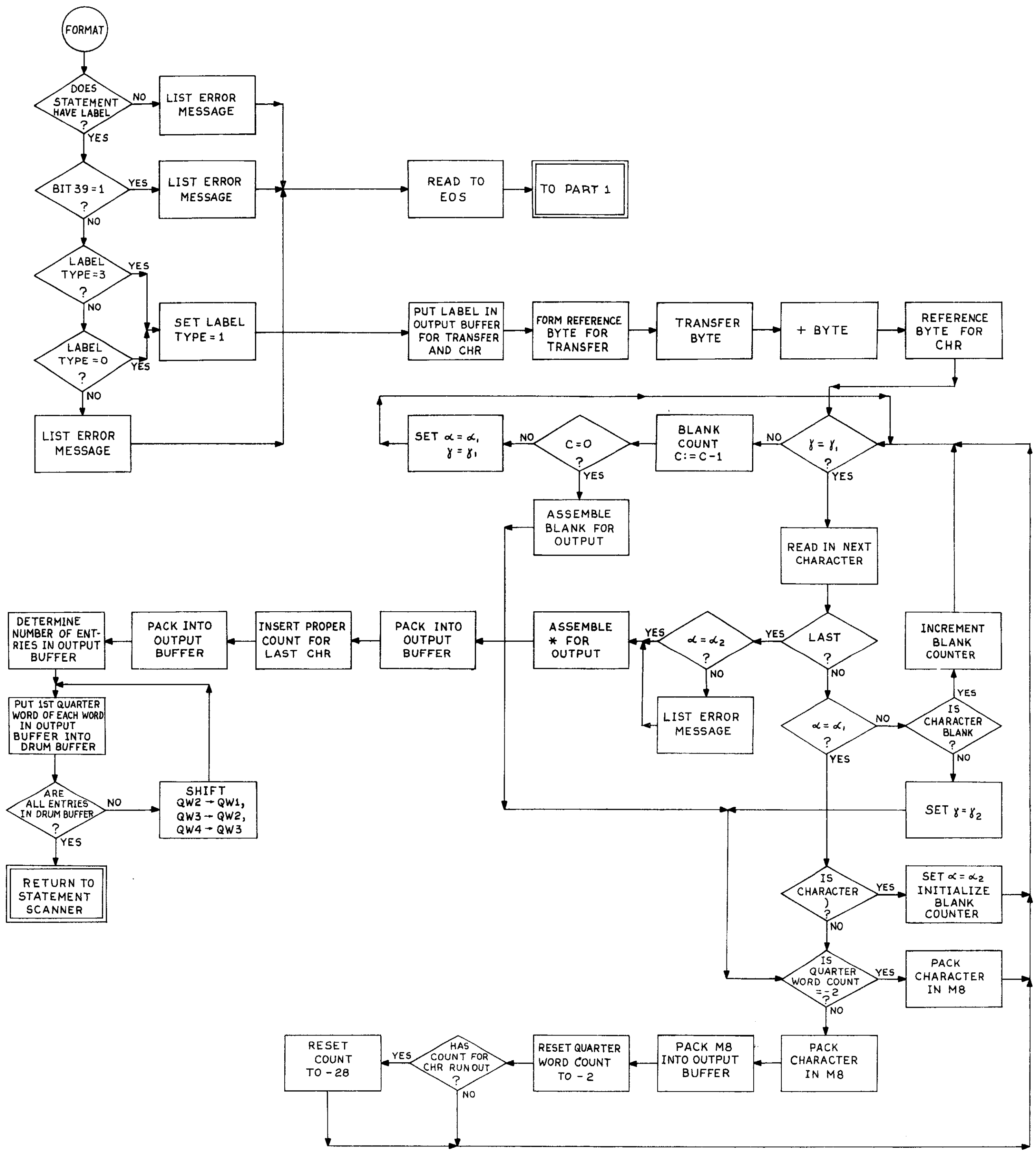
Error No.	Reason	Action
I14	End of statement occurs when not expected.	A3
I15	Variable in read is under external DØ control.	A4
I16	Implied DØ loop variable has been read or is under external DØ control.	A4
I17	Too many nested implied DØ loops.	A3
I18	Tape unit address is not # or fixed name in RIT or WØT	A3

3.5.4.2 Logical Organization of the I/O Section

3.5.4.2.1 Format Flow Description

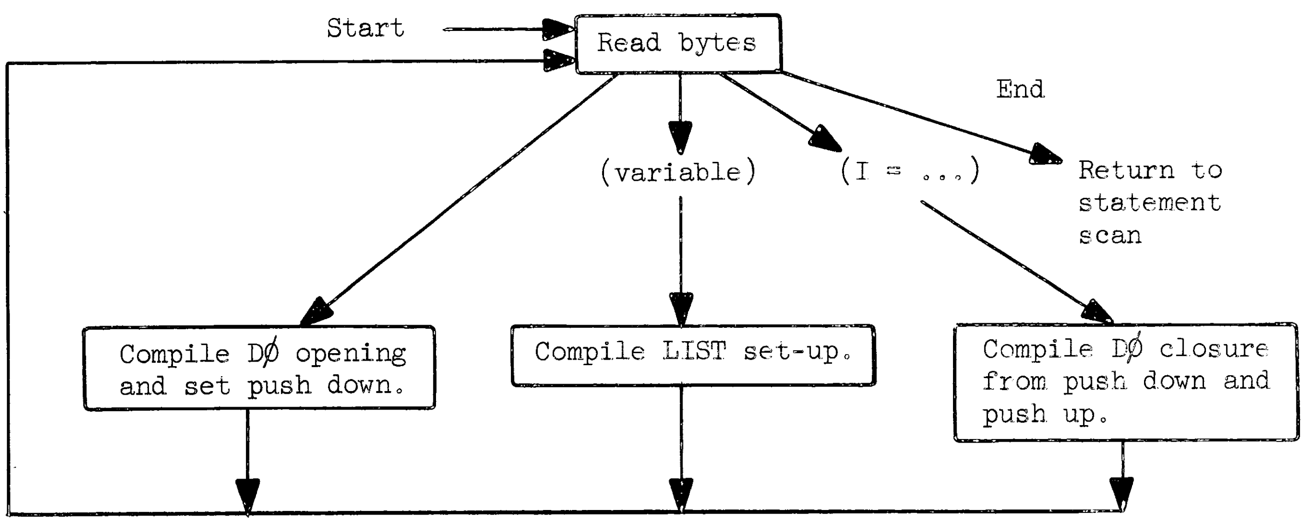
Because a TRA order is compiled around the format string to be loaded into memory, the complete statement must be scanned to determine its length before the compilation of the first order can proceed. When the end of the statement is sensed, the last nonblank character is checked. If it was a right parenthesis, it is replaced by an asterisk and following blanks are deleted. If it was not a right parenthesis, an error is listed and an asterisk is added, then trailing blanks are eliminated. This process is programmed by using two switches, α and γ. α is set to α_2 if the last nonblank character encountered in the scan is a right parenthesis. When this is set, a count, C, of the number of blank characters is set to zero and incremented for each blank character read. α is reset to α_1 when a nonblank character other than a right parenthesis is read. If, when such a character is read, α is α_2, a right parenthesis and the blanks indicated by the blank counter C are output into a CHR statement. When the end of the statement is reached, α should be α_2. γ controls the generation of the CHR's. It is set to γ_2 when the blanks are being output.

A maximum of 56 characters (28 quarter words) are packed into each CHR due to a restriction imposed by NICAP.


FORMAT
DOES STATEMENT HAVE LABEL ?
NO
YES
LIST ERROR MESSAGE
BIT 39 = 1 ?
YES
NO
LIST ERROR MESSAGE
READ TO EOS
TO PART 1
LABEL TYPE = 3 ?
YES
NO
SET LABEL TYPE = 1
LABEL TYPE = 0 ?
YES
NO
LIST ERROR MESSAGE
PUT LABEL IN OUTPUT BUFFER FOR TRANSFER AND CHR
FORM REFERENCE BYTE FOR TRANSFER
TRANSFER BYTE
+ BYTE
REFERENCE BYTE FOR CHR
SET α = α₁, γ = γ₁
C = 0 ?
BLANK COUNT C := C − 1
γ = γ₁ ?
ASSEMBLE BLANK FOR OUTPUT
READ IN NEXT CHARACTER
DETERMINE NUMBER OF ENTRIES IN OUTPUT BUFFER
PACK INTO OUTPUT BUFFER
INSERT PROPER COUNT FOR LAST CHR
PACK INTO OUTPUT BUFFER
ASSEMBLE * FOR OUTPUT
α = α₂ ?
LAST ?
INCREMENT BLANK COUNTER
LIST ERROR MESSAGE
α = α₁ ?
IS CHARACTER BLANK ?
PUT 1ST QUARTER WORD OF EACH WORD IN OUTPUT BUFFER INTO DRUM BUFFER
ARE ALL ENTRIES IN DRUM BUFFER ?
SHIFT QW2 → QW1, QW3 → QW2, QW4 → QW3
SET γ = γ₂
RETURN TO STATEMENT SCANNER
IS CHARACTER) ?
SET α = α₂ INITIALIZE BLANK COUNTER
IS QUARTER WORD COUNT = −2 ?
PACK CHARACTER IN M8
RESET COUNT TO −28
HAS COUNT FOR CHR RUN OUT ?
RESET QUARTER WORD COUNT TO −2
PACK M8 INTO OUTPUT BUFFER
PACK CHARACTER IN M8

3.5.4.2.2 I/O List Scan

The first atoms of the statement are scanned according to the statement type as shown in the flow charts. Control statement (BACKSPACE, REWIND, END FILE) then compile a call of the SRØLST and terminate. The other statements proceed into the I/O list scan. The basic form of this scan is:



The subroutines described in Section 5.4.2.3 control the compilation of outside labels, compilation of CALL's at the right time and making sure that M10 has the correct value at execution time.

When a variable is indexed, the actual address must be calculated. This is shown in the address calculation flow chart. The address is calculated by scanning from left to right and constructing a list of up to three levels containing the variables used in the indexing and their multipliers. The base address is also constructed. The most general construction

$$A(C_{11} * I_1 + C_{12}, C_{21} * I_2 + C_{22}, C_{31} * I_3 + C_{32})$$

where A is dimensioned as A(L,M,N), results in the base address

$$A + C_{12} - 1 + L * (C_{22} - 1) + L * M * (C_{32} - 1)$$

and the index variables

$$C_{11} * I$$

$$L * C_{21} * I_2$$

and

$$L * M * C_{31} * I_3$$

An opening parenthesis causes a push down to be constructed with the format

Label 1	Label 2		

Up to three levels of the push down are allowed. When the DØ loop is closed the labels are selected from the push down for use.

Index Register and Control Word Usage

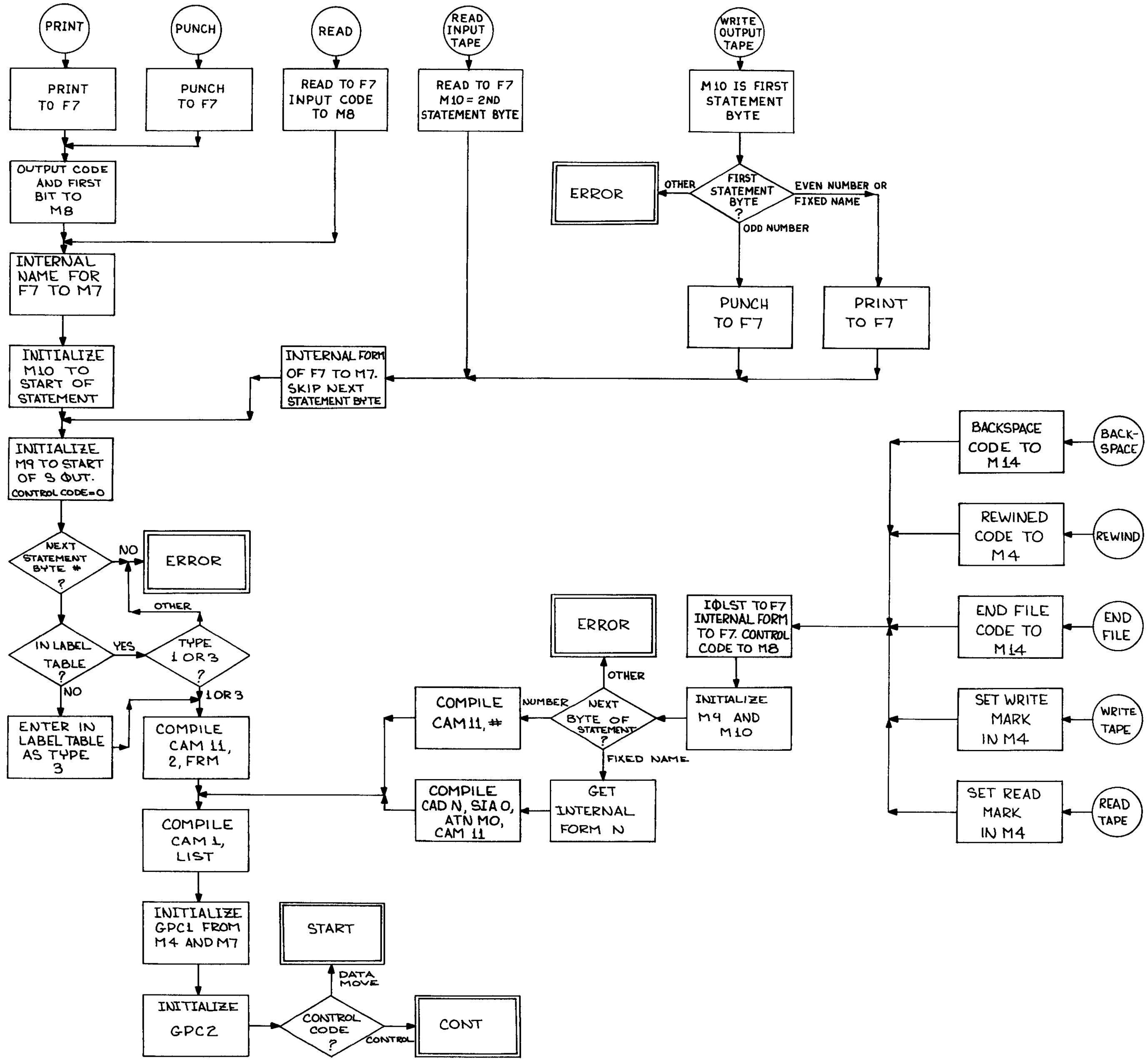
M8 bit 0 is set to a 0 initially. It is set to 1 each time that an outside label is to be constructed by GPD on the next order.

M8 bit 1 is 0 or 1 accordingly as the label to be put in the next order by GPD is from label 1 or label 2 of the push down.

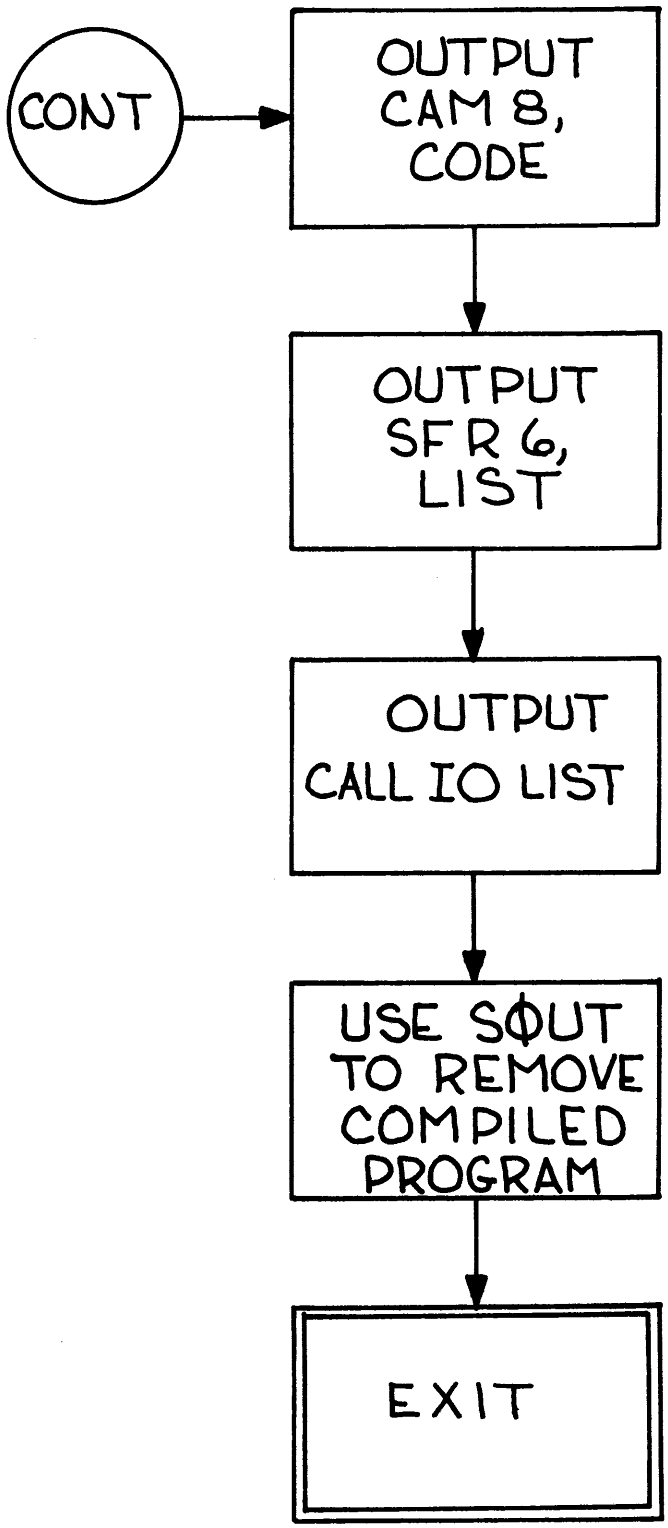
M8 bit 2 A 1 implies that a CALL is to be compiled on the next use of GPA.

M8	bit 3	is a 0 or 1 accordingly as the CALL is to be final or partial CALL.
M8	bit 4	is a 1 after the first order has been compiled in the I/O scan.
M9		is the address of the CØUT buffer into which the next output byte is to be placed.
M10		is the address of the next word of the statement buffer.
M11		is a count of the length of the object list being compiled.
GPC1	Quarter 0	contains the code which is put into M8 at execution time.
GPC1	Quarter 1	contains the length of the block last put in MO.
GPC1	Quarter 2	Bit 0 is a 0 if a CAM 8, code is to be compiled on the next entry to GPA.
GPC1	Quarter 3	contains the internal form of the subroutine name to be used in a CALL.
GPC2	Quarter 0	is a pointer to LIST 1, the list of fixed-point names changed in an input statement.
GPC2	Quarter 2	is the push down pointer.

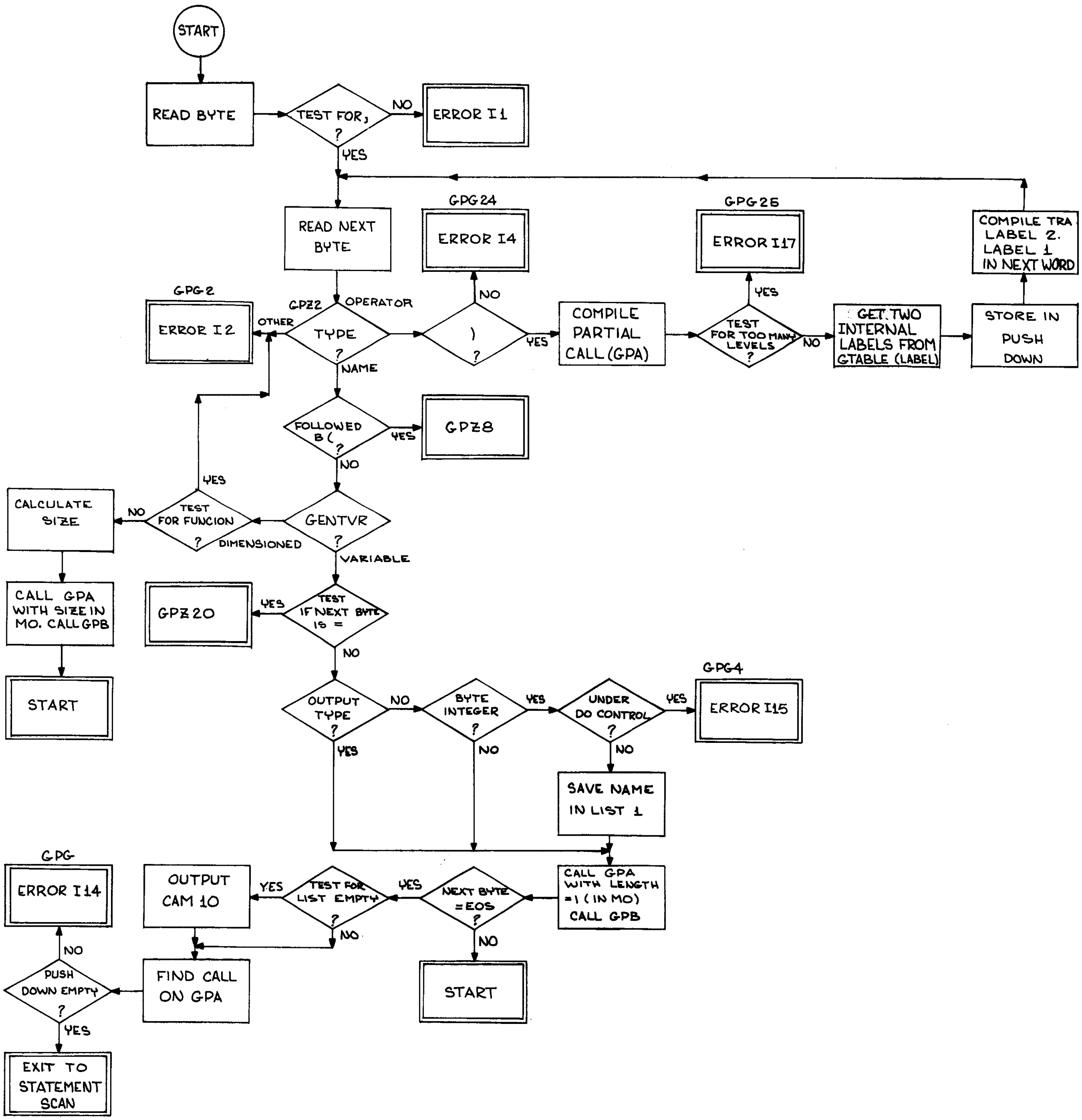
COMPILATION OF EXECUTION SUBROUTINE NAME AND FORMAT OR UNIT NUMBER



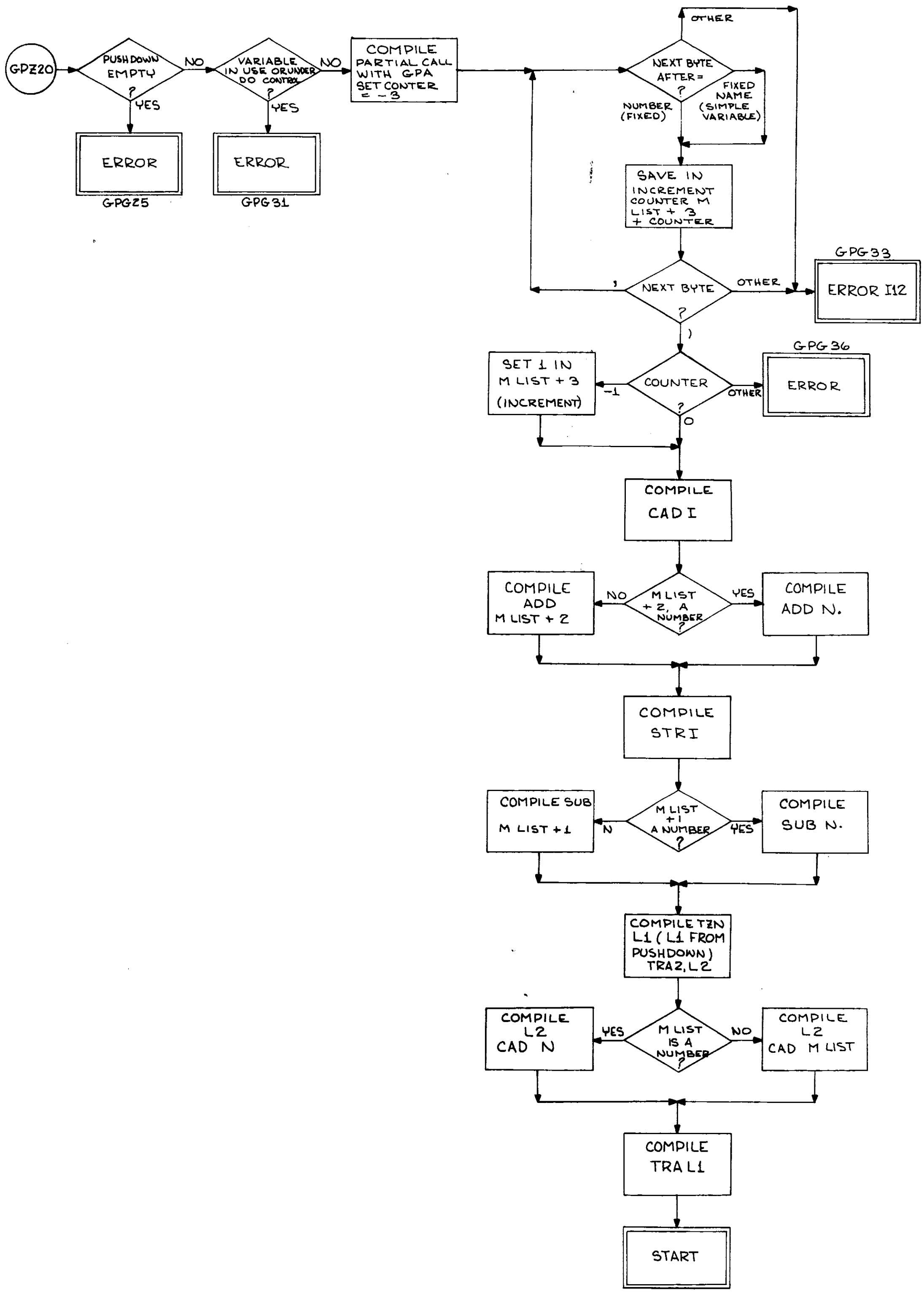
COMPILE CONTROL ENTRIES



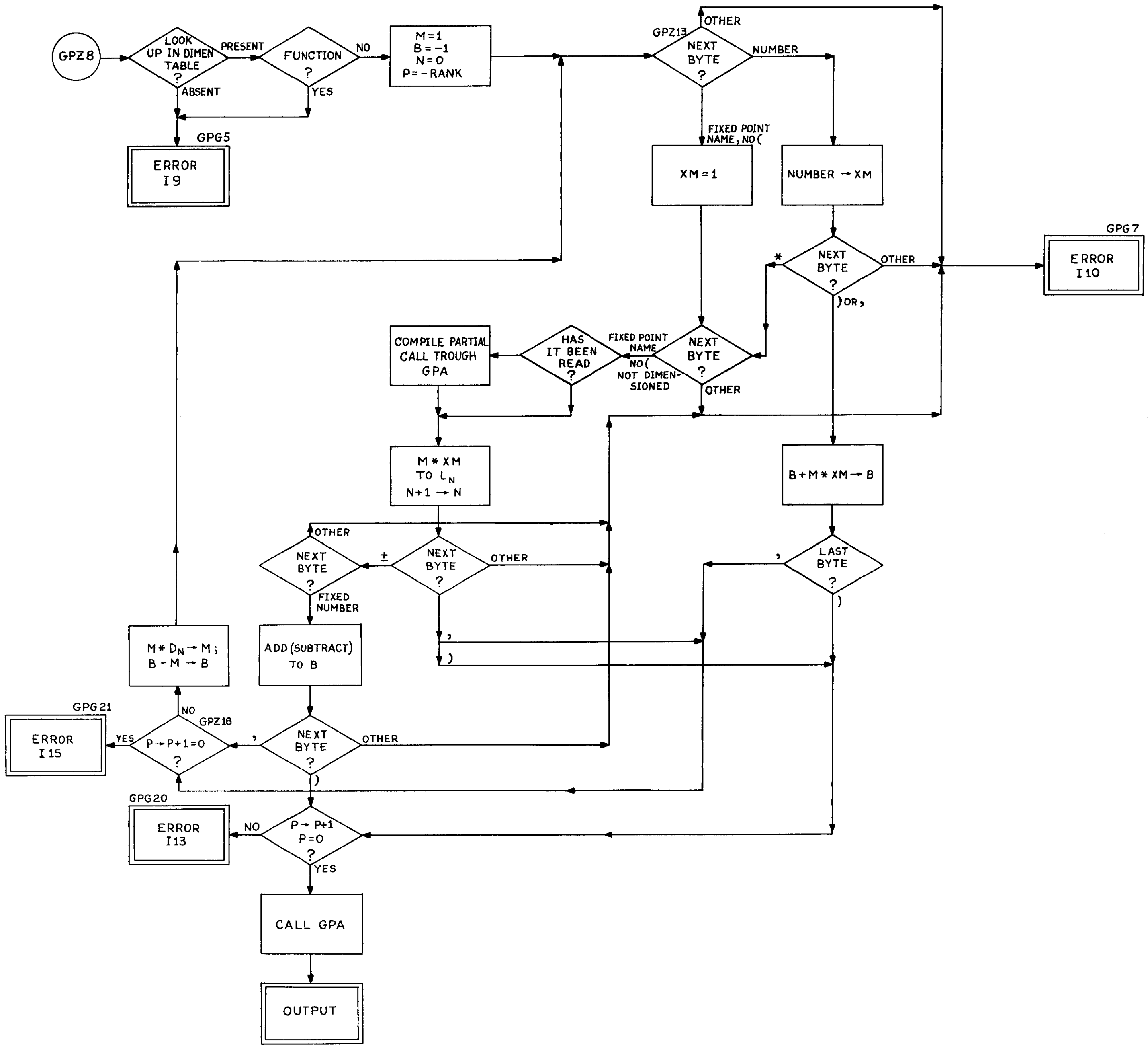
I/O LIST SCAN


START
READ BYTE
TEST FOR, ?
NO
YES
ERROR I1
READ NEXT BYTE
GPG24
ERROR I4
GPG25
ERROR I17
COMPILE TRA LABEL 2. LABEL 1 IN NEXT WORD
GPG2
ERROR I2
OTHER
GPZ2
TYPE ?
OPERATOR
NAME
) ?
NO
YES
COMPILE PARTIAL CALL (GPA)
TEST FOR TOO MANY LEVELS ?
YES
NO
GET TWO INTERNAL LABELS FROM GTABLE (LABEL)
STORE IN PUSH DOWN
FOLLOWED B(?
YES
GPZ8
NO
CALCULATE SIZE
NO
TEST FOR FUNCION ?
YES
GENTVR ?
DIMENSIONED
VARIABLE
CALL GPA WITH SIZE IN MO. CALL GPB
START
GPZ20
YES
TEST IF NEXT BYTE IS =
NO
OUTPUT TYPE ?
NO
BYTE INTEGER ?
YES
UNDER DO CONTROL ?
YES
GPG4
ERROR I15
YES
NO
NO
SAVE NAME IN LIST 1
GPG
ERROR I14
OUTPUT CAM 10
YES
TEST FOR LIST EMPTY ?
YES
NEXT BYTE =EOS ?
CALL GPA WITH LENGTH =1 (IN MO) CALL GPB
NO
NO
NO
PUSH DOWN EMPTY ?
FIND CALL ON GPA
START
YES
EXIT TO STATEMENT SCAN

COMPILE END OF DO LOOP



GPZ8--CALCULATE AND COMPILE ADDRESS



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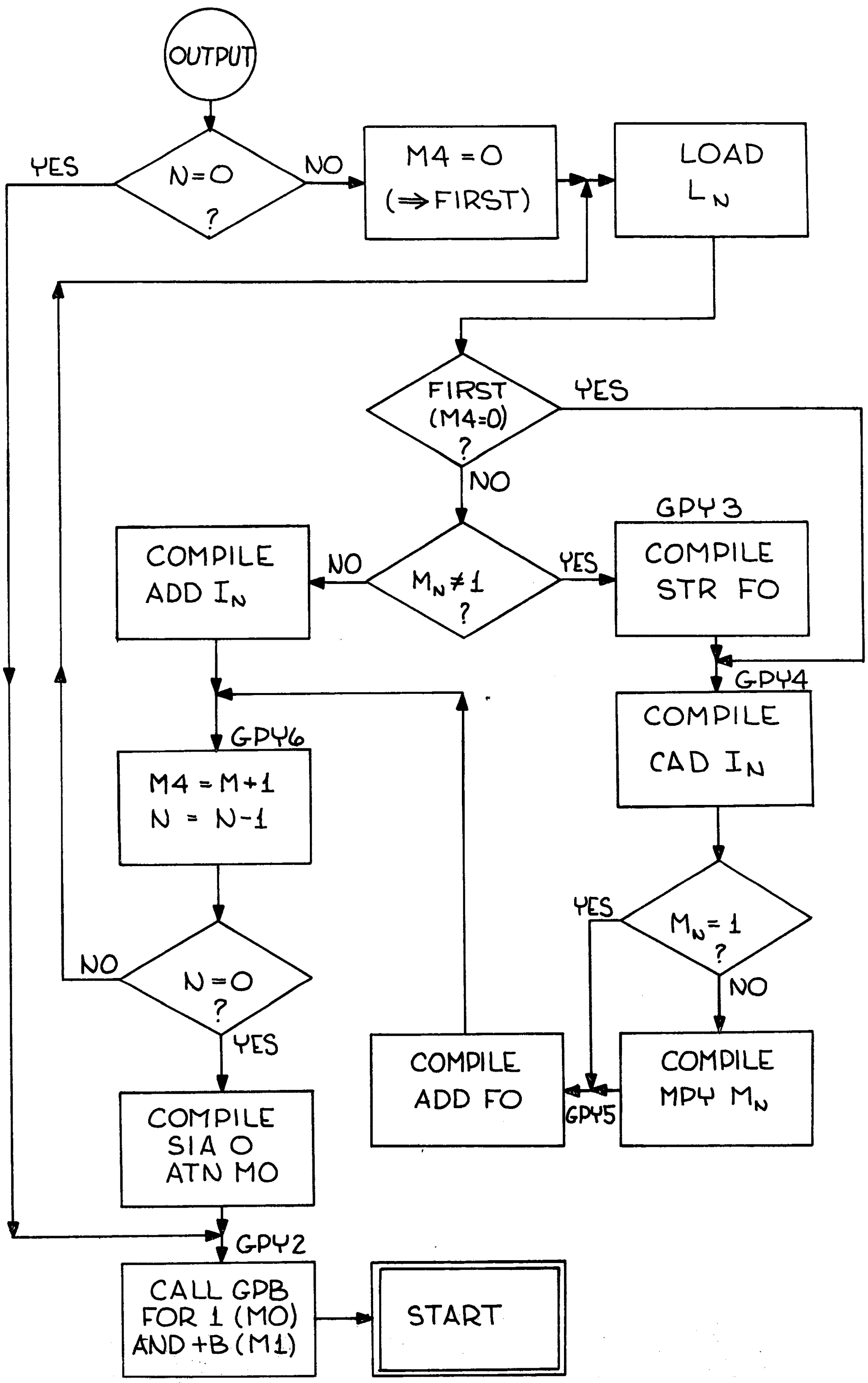
Revision:	

OUTPUT RESULT (OF ADDRESS CALCULATION)



3.5.4.2.3 The Use of Subroutines in the I/O Section

In addition to the subroutines GREAD, GTABLE, GENTAB, FREBIL, SOUT, and GERROR described elsewhere, the I/O section makes use of the subroutines:

GRPD

GPRD gets the next byte from the buffer, taking care of EØB and EØS.

GPD

GPD, and subsidiaries, generate an appropriate IL reference byte, taking care of an outside name if required.

GENTVR

GENTVR has two exits, the first to (M3) if the name in F7 is in the dimension table, the second, to (2,M3) if the name is in the variable table, or if it is in neither, in which case it is put in the variable table.

GPBASE

GPBASE supplies the next available address in the dimension list.

GPA

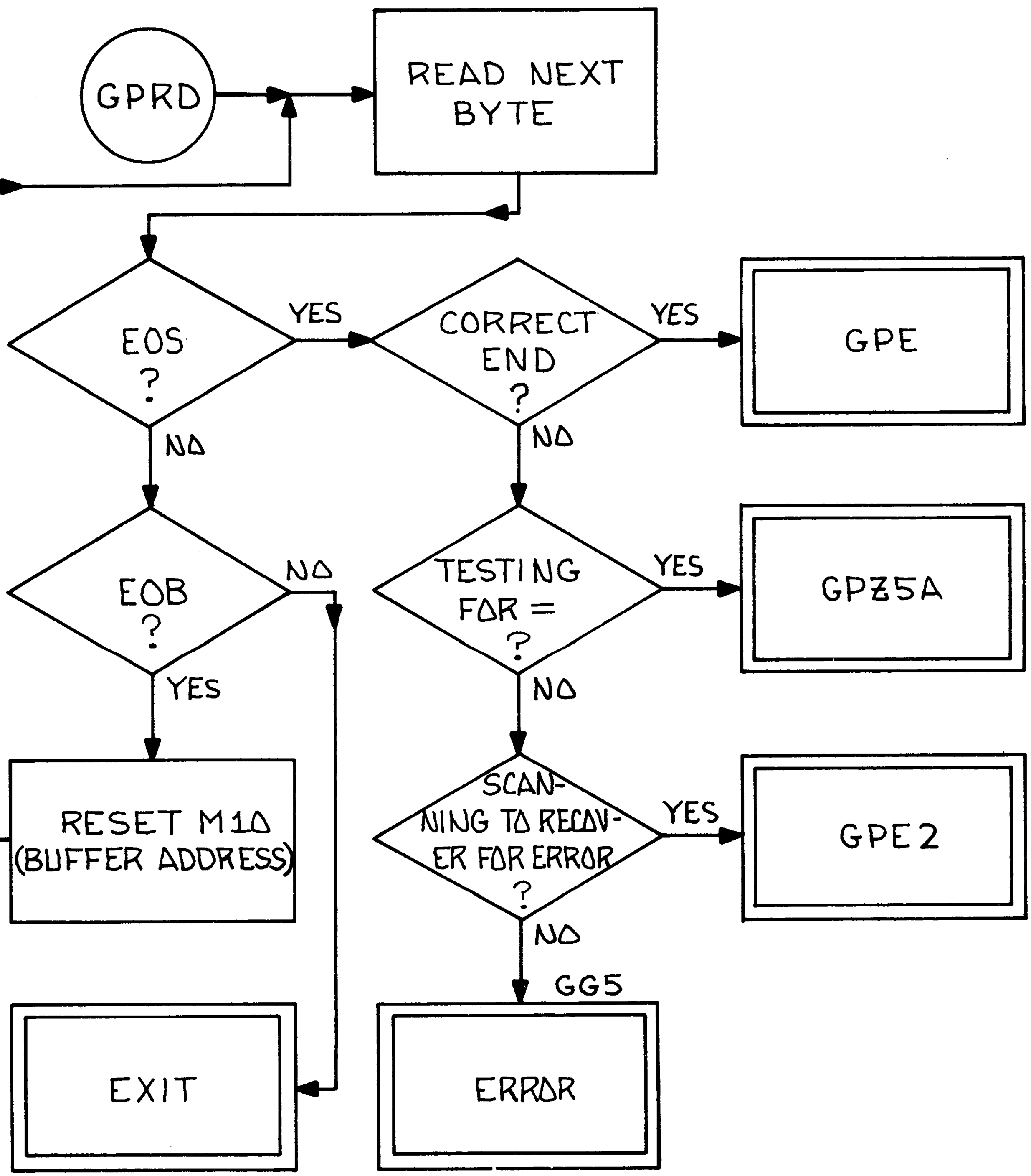
GPA compiles a CAM 8, code if this is the first use following the compile of a CALL and an SFR 6, list + n otherwise. n is incremented, and if it becomes 10, a partial CALL is compiled and it is reset to 0. According to control bits in M8, it can also be forced to compile a partial or a final CALL sequence.

When a CALL SEQUENCE is compiled, the LIST1, which contains those fixed-point variables which have been changed by a read since the last CALL, is cleared.

GPB

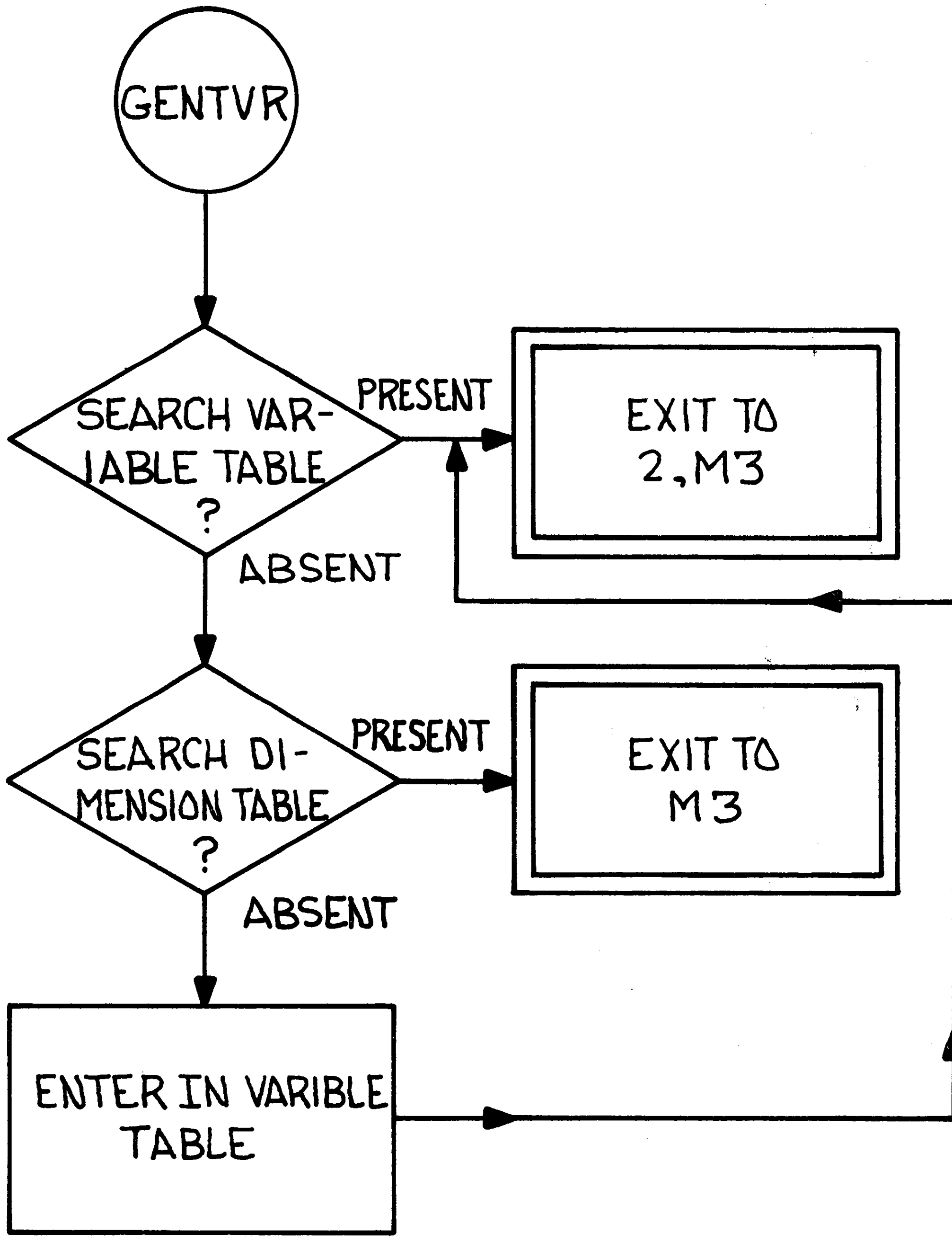
GPB compiles a CAM 9, "name" if M1 = 0 and a CAM 9, name + (M1) if M1 $\neq$ 0. It then compiles a CAM 10, (M0) if M0 is different from the current contents of M10 at execution time or if this is not known.

SUBROUTINE GPRD (READS BYTE AND TESTS FOR EOS)

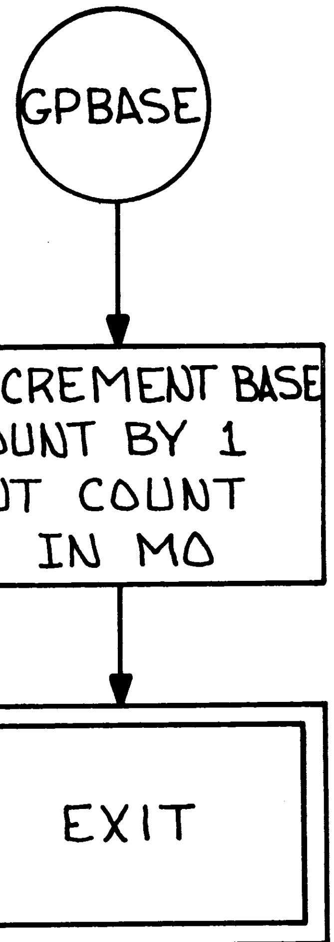


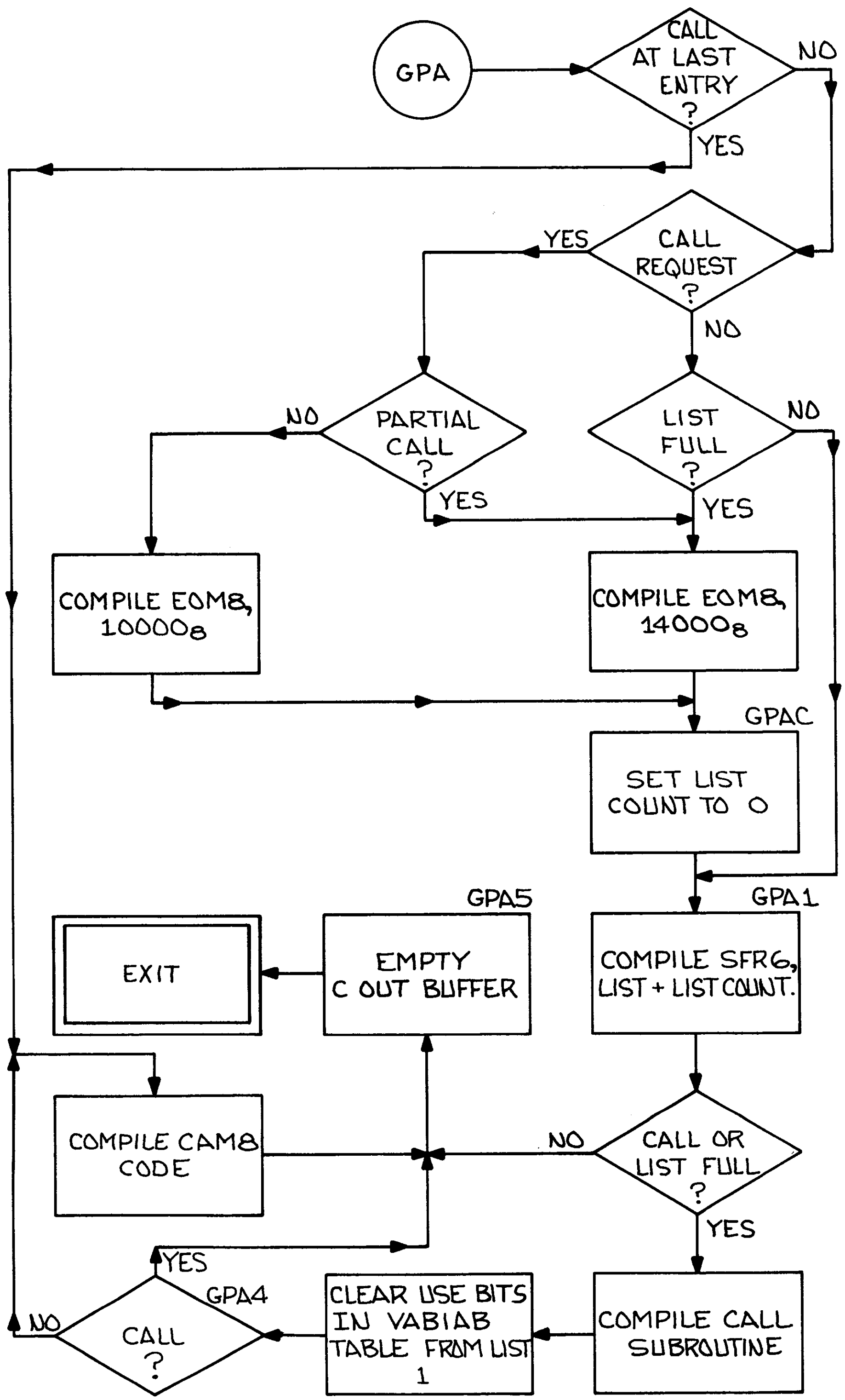
Note: The various cases tested when End of Statement is sensed correspond to a legal case (GPE), the "look-ahead" for an = after an integer name which is also legal, and the result of a previous error (GPE2) which should not cause further error messages.

SUBROUTINE GENTVR

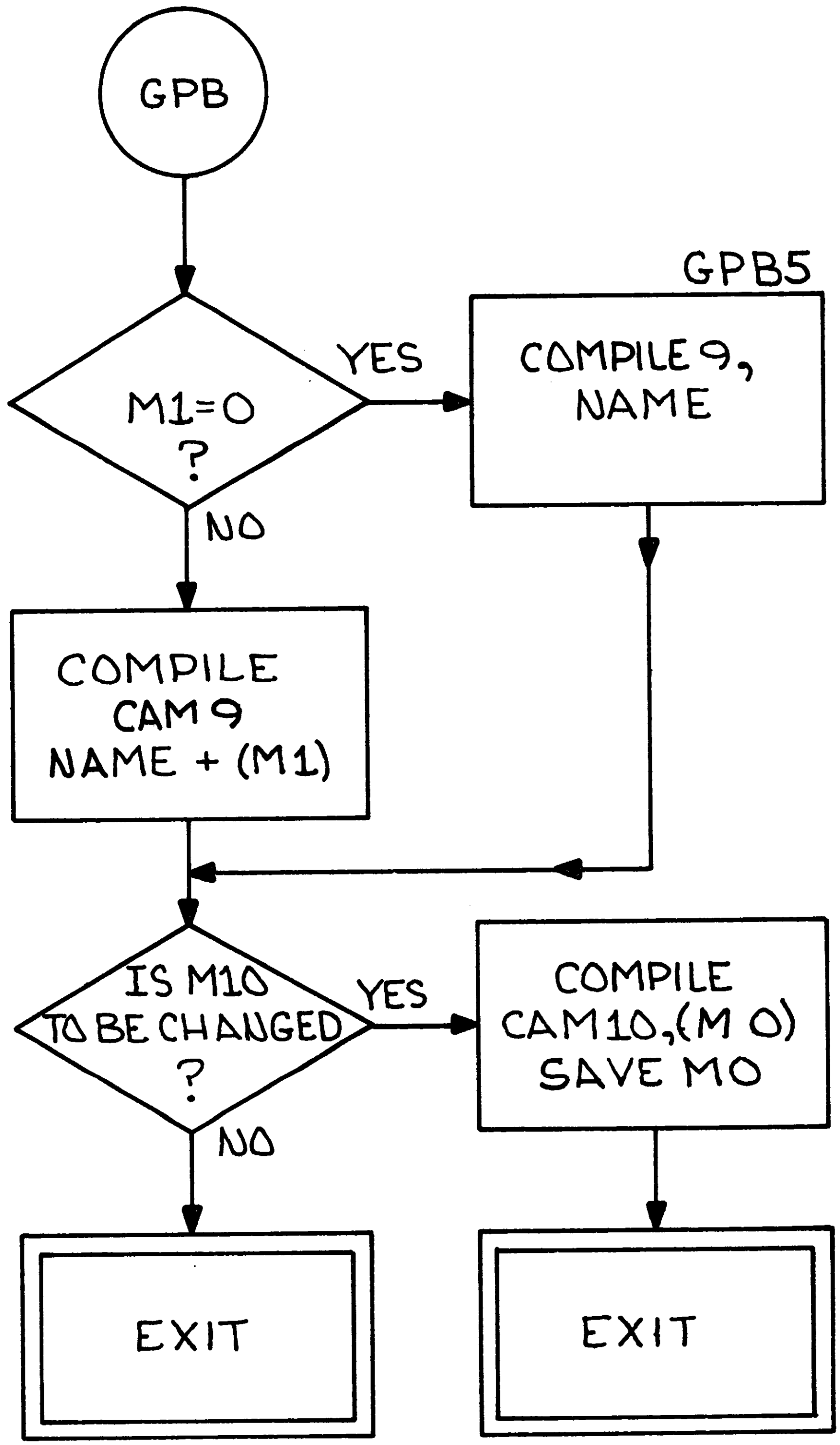


SUBROUTINE GPBASE (GETS NEXT PLACE IN DIMENSION LIST)




GPA
CALL AT LAST ENTRY ?
NO
YES
CALL REQUEST ?
YES
NO
PARTIAL CALL ?
NO
YES
LIST FULL ?
NO
YES
COMPILE EOM8, 10000$_8$
COMPILE EOM8, 14000$_8$
GPAC
SET LIST COUNT TO 0
GPA5
GPA1
EXIT
EMPTY C OUT BUFFER
COMPILE SFR6, LIST + LIST COUNT.
COMPILE CAM8 CODE
NO
CALL OR LIST FULL ?
YES
YES
GPA4
NO
CALL ?
CLEAR USE BITS IN VABIAB TABLE FROM LIST 1
COMPILE CALL SUBROUTINE

SUBROUTINE GPB (COMPILED I/O LIST SET-UP)



```
 49012C W GEAR
$       PRINT OBJECT
$       PUNCH OBJECT
$       NICAP
$       DUMP
        ENTRY  GRNM
        ENTRY  GENTVR
        ENTRY  GREDE,GRIT,GRTP,GPUN,GPRI,GWOT,GWTP,GEOF,GREW,GBCK
COUT    EQUS   150
DIMEN   EQUS   277
VARIAB  EQUS   279
LABEL   EQUS   281
CONST   EQUS   283
BASE    EQUS   4096
PSIG    EQUS   285
FREFBF  EQUS   1
GRTP2   CALL   GPD                LONG ORDER, MADE UP
        CAM    12,1518            CAM 11,2,
        ATN    9,1,
        SFR    7
        CAM    12                 CLEAR CODE BITS
        CAD    F7                 NUMBER TO D.C.
        CAE    22
        SIA    12                 INTEGER
        TRA    GPRI2
GPE     LFR    5,GPC1
        JNM    6,GPE1             NOT FIRST
        CALL   GPA
        CALL   GPD8               SHORT ORDER REFERENCE
        CAM    12,1512            CAM 10,0
        ATN    9,1,
        SFR    7
GPE1    ORM    8,1536
        CALL   GPA                FINAL CALL
```

```
         LFR    5,GPC2
         SBM    6,GPPSDN
         JUM    6,GPG              PUSH DOWN NOT EMPTY
GPE2     LFR    4,GRTP1
         JLH    M3
GPRI1A   ANN    14,3584
         CAM    0,-1536
         JZM    0,GPRI1
         ADM    0,1024
         JUM    0,GG6              NOT TYPE 1 OR 3
         TRA    GPRI1
GPRI     LFR    7,SPRINT
         TRA    2,GPUN
GPUN     LFR    7,SPUNCH
         CAM    8,256
         TRA    GRED1
GREDE    LFR    7,SREAD
         CAM    8
GRED1    SFR    4,GRTP1
         CALL   GRNM
         CAM    7,M2
         CAM    10,FREFBF
GPRI3    CAM    9,COUT
         CAM    4
         CALL   GPRD
         ANN    12,4103
         CAM    0,-4100
         JUM    0,GG3              NOT FORMAT NO.
         CAM    1,LABEL
         CALL   GTABLE
         JPM    0,GPRI1A           PRESENT
         ADM    14,1536
         CALL   GENTAB             ENTER TYPE3
GPRI1    CALL   GPD7               REF - LONG, NAME FOLLOWS
```

```
        CAM    12,1518          CAM 11,2,
        ATN    9,1,
        SFR    7
        CAM    12,M2
        TRA    GPRI2
GRIT    CAM    10,FREFBF+1
        CAM    8
        SFR    4,GRTP1
        LFR    7,SREAD
GRIT1   CALL   GRNM
        ADM    10,1
        CAM    7,M2
        TRA    GPRI3
GWOT    CAM    10,FREFBF
        CAM    8,256
        SFR    4,GRTP1
        CALL   GPRD
        ANN    12,4103
        CAM    0,-4100
        JZM    0,GWOT1          NUMBER
        ADM    0,2
        JUM    0,GG4            ERROR, NOT CORRECT UNIT
GWOT2   LFR    7,SPRINT
        TRA    GRIT1
GWOT1   CRM    15,8
        JPM    15,GWOT2         EVEN NUMBER
        LFR    7,SPUNCH
        TRA    GRIT1
GENTVR  SFR    4,GENVR1
        CAM    1,VARIAB
        CALL   GTABLE
        JPM    0,GENVR2
        CAM    1,DIMEN
        CALL   GTABLE
```

```
         JPM    0,GENVR3
         CAM    1,VARIAB
         CALL   GENTAB
GENVR2   LDM    3,GENVR1
         TRA    2,M3
GENVR3   LDM    3,GENVR1
         JLH    M3
GENVR1   BSS    1
GRNM     SFR    4,GRNM1
         CAM    1,DIMEN
         CALL   GTABLE
         JPM    0,GRNM2          PRESENT
         CALL   GENTAB
         CALL   GPBASE           GET LIST ADDRESS
         CRN    0,12
         ADM    12               ADD TO FIX/FLOAT BIT
         SFR    7,M2             FUNCTION TYPE
         CAM    12
         SFR    7,M0+BASE        STORE IN DIMENSION LIST
GRNM2    LDM    3,GRNM1
         JLH    M3
GRNM1    BSS    1
GWTP     ATN    512              WRITE MARK
GRTP     CAM    4
         ANN    4,512
         CAM    8
         CRM    8,1
         SFR    4,GRTP1
         LFR    7,SIOL           IOLIST NAME
         CALL   GRNM             GET INTERVAL FORM
         CAM    10,FREFBF        SET INPUT START
         CAM    9,COUT
         CAM    7,M2
         CALL   GPRD             UNIT NUMBER
```

```
         ANN     12,4103
         CAM     0,-4100
         JZM     0,GRTP2            NUMBER
         ADM     0,2
         JUM     0,GG1              ERROR, NOT FIXED NAME
         CALL    GENTVR             ENTER AS VAR
         TRA     GG1                DIMENSIONED IN ERROR
         CALL    GPD7               LONG ORDER REF
         CAM     12,4259            CAD 8,3
         ATN     9,1,
         SFR     7
         CAM     12,M2
         ATN     9,1,
         SFR     7
         CALL    GPD9               OCTQ REF
         CAM     12,3096            OCTQ ,3 QUARTERS
         ATN     9,1,
         SFR     7
         CAM     12,5856            SIA 8
         ATN     9,1,
         SFR     7
         CAM     12,1120            ATN M8
         ATN     9,1,
         SFR     7
         CAM     12,1516            CAM 11
GPRI2    ATN     9,1,
         SFR     7
         CAM     6
         CAM     5,4096
         SFR     5,GPC1
         CAM     11
         CALL    GPD7
         CAM     12,1478            CAM 1,2,
         ATN     9,1,
```

```
        SFR     7
        CAM     1,DIMEN
        LFR     7,LISTEN
        CALL    GTABLE
        JPM     O,LISTE1
        CALL    GENTAB
        CALL    GPBASE
        CRN     O,12
        CAM     12,4096
        SFR     7,M2
        CAM     12,10
        CAM     15,1
        SFR     7,MO+BASE
        LFR     7,GPLIST
        CAM     12,M2
        SFR     7,GPLIST
LISTE1  CAM     12,M2
        ATN     9,1,
        SFR     7
        CAM     12,GPLST1
        CAM     14,GPPSDN
        SFR     7,GPC2
        ANN     4,1024
        CAM     O
        JUM     O,GCON              CONTROL OPERATIOKN
GPZ1    CALL    GPRD
GPZ1A   EON     12,3
        CAM     3
        JUM     3,GPG1              ERROR JUMP  COMMA ABSENT
GPZ2    CALL    GPRD
GPZ2A   CRN     12,2
        CAM     3
        JPM     12,GPH              JUMP IF OPERATOR
        JPM     3,GPG2              INITIAL NUMBER
```

```
        CRM     3,1
        JNM     3,GPZ8              JUMP IF ( FOLLOWS
        CALL    GENTVR
        TRA     GPZ4                DIMENSION
GPZ5    CAD     F7
        SAM     F5
        CALL    GPRD
GPZ5A   CAM     0,M12-1
        JZM     0,GPZ20             JUMP IF EQUAL SIGN
        ANN     8,256
        CAM     0
        JUM     0,GPZ6              OUTPUT
        ANN     4,1
        CAM     0
        JUM     0,GPZ6              NOT INTEGER
        JPM     4,GPG4              UNDER DO CONTROL
GPG4A   ORM     4,1024
        SFR     5,M2
        LFR     5,GPC2
        ATN     4,1,                LIST1 POINTER
        SFR     4                   NAME TO LIST1
        SFR     5,GPC2
GPZ6    CAM     0,1
        CAM     1
        SFR     7,GPTM              SAVE NEXT BYTE
        CALL    GPA
        CALL    GPB
        LFR     7,GPTM              GET NEXT BYTE
        JUM     12,GPZ1A            NOT EOS
        TRA     GPE                 CORRECT END OF LIST
GPZ8    CAM     1,DIMEN
        CALL    GTABLE
        JNM     0,GPG5              NOT IN TABLE
        JPM     12,GPG5             FUNCTION
```

```
GPZ8A   SFR    4,GPT3           SAVE NAME
        CAD    1.
        STR    GPTM             M=1
        STN    GPTB             B=-1
        CRM    12,1
        ANN    12,2047
        LFR    5,BASE
        ANN    7,3
        CSM    7                MINUS DIMENSIONALITY
        CAM    6                N=0
GPZ13   CALL   GPRD             NEXT STATEMENT BUFFER BYTE
        JPM    12,GPG7          NOT OPERAND
        ANN    12,7
        CAM    0,-2
        JZM    0,GPZ14          NAME, FIXED PT , NO (
        ADM    0,-2
        JUM    0,GPG7           NOT NUMBER
GPZ13A  CAM    12
        ADM    15,22            SET EXPONENT
        SFR    7,GPTXM          XM=NO.
GPZ13B  CALL   GPRD             NSBB
        JNM    12,GPG7          NOT OPERATOR
        CAM    0,M12-4
        JNM    0,GPZ16          COMMA OR ) OR ERROR
        ADM    0,-6
        JUM    0,GPG7           NOT  *
GPZ13C  CALL   GPRD             NEXT STATEMENT BUFFER BYTE
        ANN    12,4096+7
        CAM    0,4094
        JUM    0,GPG7           NOT NAME
GPZ15   CALL   GENTVR
        TRA    GPG7             DIMENSIONED
GPZ9    ANM    12,1024
        JZM    12,GPZ10         NOT CHANGED
```

```
GPZ9A   SFR     5,GPT4
        ORM     8,512
        CALL    GPA                  PARTIAL CALL
        LFR     5,GPT4
GPZ10   TOR     2,GPZ10
        CAD     GPTXM
        MPY     GPTM
        SIA     0
        TOR     GPG13
GPZ10B  ATN     6,1,
        SFR     4,GPIMLS
GPZ10C  CALL    GPRD
        JNM     12,GPG7              NOT OPERATOR
        CAM     0,M12-4
        JNM     0,GPZ19              COMMA,    )  OR ERROR
        ADM     0,-5
        JZM     0,GPZ11              MINUS
        CJU     0,GPG7               NOT PLUS OR MINUS
GPZ10D  CAM     0,1                  PLUS INDICATOR
GPZ11   CALL    GPRD                 NEXT STATEMENT BUFFER BYTE
        ANN     12,4100
        CAM     1,-4100
        JNM     1,GPG7               NOT NUMBER
        CAM     12
GPZ11A  ADM     15,22                EXPONENT
        CAD     F7
        MPY     GPTM
        JUM     0,GPZ12              POSITIVE
        STN     F0
GPZ12   ASC     GPTB
GPZ12A  CALL    GPRD                 NSBB
        JNM     12,GPG7              NOT OPERATOR
        CAM     0,M12-4
        JPM     0,GPG7               NOT COMMA )  OR  =
```

```
        CJZ     0,GPZ18              COMMA
        CJU 0,GPG7                   NOT )   OR  ,
GPZ17   CJU     7,GPG20              DIMENSIONS DONT MATCH
GPZ17A  CALL    GPA
        JZM     6,GPY2
        CAM     4
GPY1    LFR     4,M6+GPIMLS-1        M,I
        JZM     4,GPY4               FIRST
        CAM     1,M0-1
        JUM     1,GPY3               M NOT 1
        CALL    GPD7
        CAM     12,4771              ADD 8,3
        ATN     9,1,
        SFR     7
        CAM     12,M2                I
        ATN     9,1,
        SFR     7
GPY6    SBM     6,1
        CAM     4,1
        JUM     6,GPY1
        CALL    GPD8
        CAM     12,5824              SIA
        ATN     9,1,
        SFR     7
        CALL    GPD8
        CAM     12,1088              ATN M0
        ATN     9,1,
        SFR     7
GPY2    CAD     GPTB
        LFR     4,GPT3
        SIA     0
        CAM     1,M0
        CAM     0,1
        CALL    GPB
```

```
        TRA     GPZ1
GPY3    CALL    GPD8
        CAM     12,5379             STR FO
        ATN     9,1,
        SFR     7
GPY4    CALL    GPD7
        CAM     12,4259             CAD 8,3,
        ATN     9,1,
        SFR     7
        CAM     12,M2               I
        ATN     9,1,
        SFR     7
        CAM     1,MO-1
        JZM     1,GPY5
        CALL    GPD
        CAM     12,5159             MPY 9,3,
        ATN     9,1,
        SFR     7
        CAM     12,MO
        ATN     9,1,
        SFR     7
GPY5    JZM     4,GPY6
        CALL    GPD8
        CAM     12,4739             ADD FO
        ATN     9,1,
        SFR     7
        TRA     GPY6
GPZ14   CAD     1.
        STR     GPTXM               XM=1
        TRA     GPZ15
GPZ16   CAD     GPTXM
        MPY     GPTM
        ASC     GPTB                B=B+XM
        CJZ     0,GPZ18             COMMA
```

```
        CJU 0,GPG7              NOT   )
        TRA     GPZ17
GPZ18   CJZ     7,GPG21         DIMENSIONS DONT MATCH
GPZ18A  CAD     GPTM
        MPY     M4.
        STR     GPTM
        SUB     GPTB
        STN     GPTB
        CAM     4,M5
        TRA     GPZ13
GPZ19   CJZ     0,GPZ18         COMMA
        CJU     0,GPG20         DIMENSIONS DONT MATCH
        TRA     GPZ17
GPZ20   CAD     F5
        SAM     F7              NAME BACK TO F7
        LFR     5,GPC2
        SBM     6,GPPSDN
        JZM     6,GPG25         PUSHDOWN ALREADY EMPTY
        CAM     6,M2            INRERNAL NAME
        ANN     12,7175
        CAM     0,-4098
        JUM     0,GPG31         ACTIVE VARIABLE-IN USE OR DO
GPZ20A  ORM     8,512
        CALL    GPA
        CSM     4,3             COUNTER
GPZ21   CALL    GPRD
        ANN     12,4103
        CAM     0,-4100         FIXED PT. NUMBER
        JZM     0,GPZ22A
        ADM     0,2
        JUM     0,GPG33         NOT FIXED PT. NAME OR NUMBER
        CALL    GENTVR
        TRA     GPG33           DIMENSION
GPZ21A  CAM     14,M2
```

```
        TRA    GPZ22
GPZ221  CAM    1,CONST
        CALL   GTABLE
        JPM    0,GPZ222          PRESENT ALREADY
        CALL   GENTAB
GPZ222  CAM    12,4098           NAME MARK
        TRA    GPZ21A
GPZ22A  TOR    2,GPZ22A
        CAM    12
        ADM    15,22
        CAD    F7
        SIA    0
        TOR    GPZ221            TEST FOR TOO LARGER FOR IMMEDIATE ADDRES
        CAM    14,M0
GPZ22   ATN    4,1,
        SFR    7,GPIMLS+3
        CALL   GPRD
        EOM    12,3
        JZM    12,GPZ21          COMMA
        EOM    12,1
        JUM    12,GPG33          NOT PARENTHESIS
GPZ22B  JZM    4,GPZ23           J,M,K)
        CJU    4,GPG36           NOT J,M)
GPZ22C  LFR    7,GPONE
        SFR    7,GPIMLS+2
GPZ23   CALL   GPD7
        CAM    12,4259           CAD 8,3,
        ATN    9,1,
        SFR    7
        CAM    12,M6             I
        ATN    9,1,
        SFR    7
        LFR    7,GPIMLS+2        S
        JZM    12,GPZ25          S IS A NUMBER
```

```
        CALL   GPD7
        CAM    12,4771          ADD 8,3,
GPZ24   ATN    9,1,
        SFR    7
        CAM    12,M14           S
        ATN    9,1,
        SFR    7
        CALL   GPD7
        CAM    12,5411          STR 8,3,
        ATN    9,1,
        SFR    7
        CAM    12,M6            I
        ATN    9,1,
        SFR    7
        LFR    7,GPIMLS+1
        JZM    12,GPZ26         T IS A NUMBER
        CALL   GPD7
        CAM    12,4643          SUB 8,3,
GPZ28   ATN    9,1,
        SFR    7
        CAM    12,M14
        ATN    9,1,
        SFR    7
        CALL   GPD5
        CAM    12,2972          TZN
        ATN    9,1,
        SFR    7
        LFR    7,GPC2
        LFR    7,M14-1
        ATN    9,1,
        SFR    7
        CALL   GPD4
        CAM    12,2950          TRA2,
        ATN    9,1,
```

```
        SFR     7
        CAM     12,M13          ADDRESS2
        ATN     9,1,
        SFR     7
        CAM     12,8            +
        ATN     9,1,
        SFR     7
        CAM     12,1
        ATN     9,1,
        SFR     7
        ORM     8,6144          SET UP FOR ADDRESS 2
        LFR     7,GPIMLS
        JZM     12,GPZ27        Z IS A NUMBER
        CALL    GPD7
        CAM     12,4259         CAD 8,3,
GPZ29   ATN     9,1,
        SFR     7
        CAM     12,M14          Z
        ATN     9,1,
        SFR     7
        CALL    GPD7
        CAM     12,5411         STR 8,3,
        ATN     9,1,
        SFR     7
        CAM     12,M6           I
        ATN     9,1,
        SFR     7
GPG1B   CALL    GPD5            TRANSFER ORDER WITH NAME
        CAM     12,2948         TRA
        ATN     9,1,
        SFR     7
        LFR     7,GPC2
        SBM     14,1
        SFR     7,GPC2
```

```
         LFR     7,M14                 ADDRESS1
         ATN     9,1,
         SFR     7
         TRA     GPZ1
GPG1     EOM     3,1
         JUM     3,GPG1A               NOT ) EITHER
         ORM     8,512                 SPECIAL CASE TO HANDLE PARENTHESES THAT
         CALL    GPA                   THAT DON'T IMPLY A DO LOOP
         LFR     7,GPC2
         LFR     7,M14-1
         CALL    GPD5
         CAM     12,2950               TRA
         ATN     9,1,
         SFR     7
         CAM     12,M13
         ATN     9,1,
         SFR     7                     ADDRESS
         ORM     8,6144                ADDRESS 2 SET
         TRA     GPG1B                 COMPILE TRA ADDRESS 1
GPZ25    CALL    GPD
         CAM     12,4775               ADD 9,3,
         TRA     GPZ24
GPZ26    CALL    GPD                   LONG ORDER REFERENCE
         CAM     12,4647
         TRA     GPZ28
GPZ27    CALL    GPD
         CAM     12,4263               CAD 9,3,
         TRA     GPZ29
GPH      CRM     3,3
         JPM     3,GPG24               NOT LEFT PARENTHESIS
         ORM     8,512
         CALL    GPA                   PARTIAL CALL COMPILE
         CALL    GPD5
         LFR     5,GPC2
```

```
         SFN     6,1,
         CSM     0,GPPSDN+3
         JPM     0,GPG25             TOO MANY PUSH DOWN LEVELS
GPHA     SFR     5,GPC2
         LFR     7,GPZERO
         CAM     1,LABEL             SFR
         CALL    GENTAB
         CAM     4,M2
         LFR     7,GPZERO
         CALL    GENTAB
         CAM     5,M2
         SFR     5,M6-1              STORE PUSH DOWN ADDRESSES
         CAM     12,2948             TRA
         ATN     9,1,
         SFR     7
         CAM     12,M5               ADDRESS    2
         ATN     9,1,
         SFR     7
         ORM     8,4096              OUTSIDE NAM NEXT
         TRA     GPZ2
GPB      SFR     4,GPT1
         SFR     5,GPT5
         JZM     1,GPB5              NUMBER IS ZERO
         CALL    GPD6
GPB1     CAM     12,1510             CAM 9,2
         ATN     9,1,
         SFR     7
         CAM     12,M2
         ATN     9,1,                NAME
         SFR     7
         JZM     1,GPB2
         CAM     12,8                +
         ATN     9,1,
         SFR     7
```

```
        CAM     12,M1
        ATN     9,1,                NUMBER
        SFR     7
GPB2    LFR     5,GPC1
        JNM     5,GPB3
        SBM     5,MO
        JZM     5,GPB4
GPB3    CALL    GPD
        CAM     12,1514             CAM 10,2
        ATN     9,1,
        SFR     7
        ATN     9,1,
        SFR     4
GPB4    CAM     5,MO
        SFR     5,GPC1
        LFR     5,GPT5
        LFR     4,GPT1
        JLH     M3
GPB5    CALL    GPD7
        TRA     GPB1
GPA     SFR     5,GPT5
        LFR     5,GPC1
        SFR     4,GPT1
        JPM     6,GPA4              FIRST
        CAM     0,M11-GPENLS
        ANN     8,512
        CAM     13
        JZM     13,GPA7
        CAM     0
GPA7    JNM     0,GPA1
        CALL    GPD                 LONG ORDER REFERENCE
        CAM     12,3490             EOM 8,2
        ATN     9,1,
        SFR     7
```

```
        ANN     8,1024
        CAM     13
        JUM     13,GPA6
        ATN     2048
GPA6    CAM     12,4096
        ATN     9,1,
        SFR     7
GPA1    CALL    GPD6
        CAM     12,1562             SFR 6,2
        ATN     9,1,
        SFR     7
        LDM     12,GPLIST
        ATN     9,1,
        SFR     7
        CAM     12,8                + LAST NUMBER
        ATN     9,1,
        SFR     7
        ATN     11,1,               UST ADDRESS
        CAM     12
        ATN     9,1,
        SFR     7
        JNM     0,GPA5              LIST NOT FULL
        CALL    GPD9                PSEUDO REFERENCE BYTE
        CAM     12,2304             CALL
        ATN     9,1,
        SFR     7
        CAM     12,M7               SUBROUTINE NAME FROM C1
        ATN     9,1,
        SFR     7
        LFR     5,GPC2
        CAM     11
        CAM     0,GPLST1-M4
        JZM     0,GPA3
GPA2    SBM     4,1
```

```
         LDM    2,M4                NAME
         LFR    7,M2                TABLE ENTRY
         ANM    12,-1025            REMOVE USED BIT
         SFR    7,M2
         CJU    0,GPA2
         SFR    5,GPC2
GPA3     LFR    5,GPC1
GPA4     ANN    8,512
         CAM    13
         ANM    6,4095
         JUM    13,GPA8
         ORM    6,4096
         CALL   GPD
         CAM    12,1506             CAM 8,2,
         ATN    9,1,
         SFR    7
         CAM    12,4096+M4         CODE
         ATN    9,1,
         SFR    7
GPA8     SFR    5,GPC1
GPA5     CAM    4,M9
         CAM    9,COUT
         CALL   SOUT
         LFR    4,GPT1
         LFR    5,GPT5
         ANM    8,6655
         JLH    M3
         ASSIGN GPT1,GPT2
GPT5     BSS    1
GPLST1   BSS    10
GPLIST   OCTQ   12345,0,0,0
         BSS    1                   ALLOCATED FOR GPPSDN
GPPSDN   BSS    3
GPC1     DECQ   3,-1,0,4095
```

```
GPC2    DECQ   GPLST1,0,GPPSDN,0
GPONE   DECQ   0,0,1,0
GPENLS  EQUS   9
GPLST   EQUS   0
GPD4    CAM    12,146                 TRA A+--
        TRA    GPD1
GPD5    CAM    12,154                 TRA A
        TRA    GPD1
GPD6    CAM    12,210                 LONG ORDER  N,2,A+--
        TRA    GPD1
GPD7    CAM    12,218                 LONG ORDER N,2,A
        TRA    GPD1
GPD8    CAM    12,16                  SHORT ORDER
        TRA    GPD1
GPD9    CAM    12,32
        TRA    GPD1
GPD     CAM    12,80                  LONG ORDER
GPD1    ANN    8,4096
        ADM    12
        ATN    9,1,
        SFR    7
        JPM    8,GPD3
        CRM    8,12
        SFR    5,GPT2
        LFR    5,GPC2
        LFR    5,M6-1                 PUSHDOWN
        JPM    8,GPD2                 ADDRESS 1
        CAM    4,M5
GPD2    ATN    9,1,
        SFR    5
        LFR    5,GPT2
        CRM    8,1
        ANM    8,2047
GPD3    JLH    M3
```

```
GEOF    ATN    40
GBCK    ATN    8
GREW    CAM    4,1056            OCT 2040
        TRA    1,GRTP
GCON    CALL   GPD               LONG
        CAM    12,1506           CAM 8,2,
        ATN    9,1,
        SFR    7
        CAM    12,M4             CADE
        ATN    9,1,
        SFR    7
        CALL   GPD7
        CAM    12,1562           SFR 6,2,
        ATN    9,1,
        SFR    7
        LDM    12,GPLIST         IOLIST ADDRESS
        ATN    9,1,
        SFR    7
        CALL   GPD9
        CAM    12,2304
        ATN    9,1,
        SFR    7
        CAM    12,M7             ADDRESS OF IOLIST PROGRAM
        ATN    9,1,
        SFR    7
        CAM    4,M9
        CALL   SOUT
        TRA    GPG40             END OF CONTROL OPERATION COMPILE
        FIL
SIOL    OCTQ   0,4152,13711,13200
SPRINT  OCTQ   0,122,10500,16200
SPUNCH  OCTQ   0,122,15052,14200
SREAD   OCTQ   0,2,7004,5200
GPZ4    JPM    12,GPG2           ERROR JUMP - FUNCTION
```

```
         CRM     12,1
         ANN     12,2047
         LFR     7,BASE
         ANN     15,3
         CSM     15                 MINUS DIMENSIONALITY
         CAD     M12.
         CJZ     15,GPZ3
         MPY     M13.
         CJZ     15,GPZ3
         MPY     M14.
GPZ3     SIA     0
GPZ7     CAM     1
         CALL    GPA                CAM 8  OR  SFR  ETC
         CALL    GPB                CAM9 / CAM10
         TRA     GPZ1
GG5      ATN     1
GPG      CAM     1,E3
         CALL    GERROR
         TRA     GPE2
GPG4     CAM     1,E40
         CALL    GERROR
         TRA     GPG4A
GPG31    CAM     1,E41
         CALL    GERROR
         TRA     GPZ20A
GG4      ATN     1
GPG25    CAM     1,E5
         CALL    GERROR
GPG40    LFR     7,FREFBF-1
         JPM     13,GPE2
         CALL    FREFIL
         TRA     GPG40
GG3      ANN     12,4102
         CAM     0,-4098
```

```
         JUM     0,GG3A               NOT VARAIBLE WITHOUT (
         CALL    GENTVR
         TRA     GPRI1
         TRA     GPRI1
GG6      ATN     1
GG1      ATN     1
GG3A     ATN     1                    FORMAT NOT NUMBER OR VARIABLE
GPG36    ATN     1
GPG24    ATN     1
GPG20    ATN     1
GPG2     ATN     1
GPG1A    CAM     1,E1                 MISSING COMMA
         CALL    GERROR
GPE1A    CAM     0,3
         CALL    GPRD
GPE1B    SBM     12,M0
         JUM     12,2,GPE1A
         SBM     0,3
         JUM     0,GPE1A
         TRA     GPZ2                 RETURN TO SCANNING  LANGEAGU
GPG21    ATN     1
GPG33    ATN     1
GPG13    ATN     1
GPG7     ATN     1
GPG5     CAM     1,E2
         CALL    GERROR
         CAM     0,2
         TRA     2,GPE1A
GPZERO   BSS     1                    LABEL TYPE 0
GPIMLS   BSS     3
         ASSIGN  GPT3,GPT4,GPTXM,GPTM,GPTB
GPRD     ATN     10,1,
         LFR     7                    NEXT STATEMENT ATOM
         JZM     12,GPRD5
```

```
GPRD3   EOM     12,32
        JZM     12,GPRD1            END OF BUFFER
        EOM     12,32
        JLH     M3
GPRD1   CAM     10,FREFBF
        SFR     4,GPRD2
        CALL    FREFIL              NEXT BUFFER LOAD
        LFR     4,GPRD2
        TRA     GPRD
GPRD5   SBM     3,GPZ1A
        JZM     3,GPE               CORRECT TERMINATION OF  LIST
        SBM     3,GPZ5A-GPZ1A
        JZM     3,GPZ5A
        SBM     3,GPE1B-GPZ5A
        JZM     3,GPE2
        SBM     3,GPZ2A-GPE1B       HANGING COMMA CASE
        JZM     3,GPE
        TRA     GG5
GPRD2   BSS     1
READ    EQUS    3972
GRTP1   BSS     1
        FIL
LISTEN  OCTQ    0,0,0,13400
E6      EQUS    26
E3      EQUS    20
E40     EQUS    22
E41     EQUS    23
E5      EQUS    24
E1      EQUS    7
E2      EQUS    15
        GO      0
```

5. UPDATING AND SYSTEM MODIFICATION PROGRAMS

This chapter describes the programs not directly employed by the user, but used to prepare system program packages on various memory devices. Typical of these are the update programs used to change and copy the system tape and the library tape.

CHAPTER 5. UPDATING AND SYSTEM MODIFICATION PROGRAMS

TABLE OF CONTENTS

5.3 The Library Tape Update Program

This program makes it possible to add, replace or delete a program on the system library tape and to adjust the table of contents accordingly.

Logical tape number 1 is the system library tape. It consists of one or more records of the table of contents followed by the programs in relocatable binary card images packed 12 per record of 256 words. Each program occupies an integral number of records, so that the last record of each program may contain fewer than 12 card images.

Each program is characterized by its major name, zero or more minor names, zero or more names of required subroutines and the number of records it occupies on tape. The major and minor names are those BCD names by which the program can be CALLed. The major name is the first such name. There is no other difference to the user between these names. A few programs are designated in the table of contents as monitor programs, that is, they are in high core at execution time and do not, therefore, appear on the library tape except for an entry in the table of contents. Instead, the table of contents indicates the core address of the program start (assumed to be at quarter-word zero).

The table of contents has the following format for each program:

Monitor Programs

0		0		1		Core Address

$\underbrace{\hspace{6cm}}_{\text{BCD Name}}$

Other Programs

Major Names

0		0		0		-Number Records

$\underbrace{\hspace{6cm}}_{\text{BCD Name}}$

Minor Names

0		1		0		1

BCD Name

Required Subroutines

1		0		0		0

BCD Name

Programs appear in the table of contents in the order that they appear in the subsequent records. Monitor programs may appear anywhere in the table. Within each program the major names, minor names and required subroutines are entered in that order. Immediately after the last entry in the table of contents, the word

1		1				

is stored as an end marker. It also appears in the last word of the last block of the table if this is different from the above. This word enables the load program to sense the end of the table.

To aid in tape copying, the last record on the tape is followed by two End of File marks. The order on the tape is important because it will determine the load time. During the loading of a program, the table of contents is scanned for undefined programs. A list of these (that are on the library tape) is prepared in the order in which they appear on the tape.

They are then added to the program in that order. The copy time will therefore be shorter if all of the programs are near the beginning of the tape.

Use

The programs are accepted from relocatable binary cards preceded by a control card. The format of the control cards is

	Column 9	Blank
	Column 10	A --Add a program
		D --Delete a program
		E --End of update
		R --Replace a program
	Column 11	Blank--
	Column 12	Blank--Ordinary program
		M --Monitor program to be added or replaced (blank if delete job)
	Columns 17-24	--The number of the program on tape to be deleted or replaced, or the number of the program to be added. (Numbering starts from 0.)
Blank unless monitor program	Columns 25-30	--BCD name of monitor program
Blank unless monitor program	Columns 33-40	--Core address of monitor program
	Columns 41-80	--Arbitrary title that is reproduced at the top of the table listing

If this is a delete or monitor job, then no binary cards are needed.

As the job is processed the table of contents is listed with the format of

Columns 1-24	--Number of program on tape, major name, - number of records or monitor address
Columns 25-72	--Up to six minor names per line on as many lines as necessary
Columns 73-96	--Up to six required subroutine names per line on as many lines as necessary

Each change will produce a new table. When the job has been completed, the new versions of the library tape are on logical units 7 and 8. The tape from unit 7 should be used as the new master copy since it has been reread once for checking purposes.

The End control card causes a rewind of tapes 7 and 8 and a transfer to SYSTEM.

Method

Heavy reliance is place on two subroutines, ULØUT and ULIN. These take care of the table of contents of the new and the old versions respectively. Each time ULIN is called, the next entry in the table of the old version is placed in F7. A record is read whenever necessary. Consequently when the last entry has been read, the tape is spaced to the first block of relocatable binary program. ULØUT takes the table entry in F7 and adds it to the table of the new version. Each time that a record (256 words) is full, ULØUT writes on the new tape (logical unit 7), ULØUT also prints the new table, testing the control bits in M12 and M13 to find out the type of name (major, minor or required). When the final entry is sensed (control bits 11), ULØUT puts the last record on tape 7. Thus the new tape is also ready to receive the new version of the binary program.

The copy of the binary part of the tape is achieved by preparing four counts. They are

1) The number of blocks before the change. Stored in UBLCNT + 1.

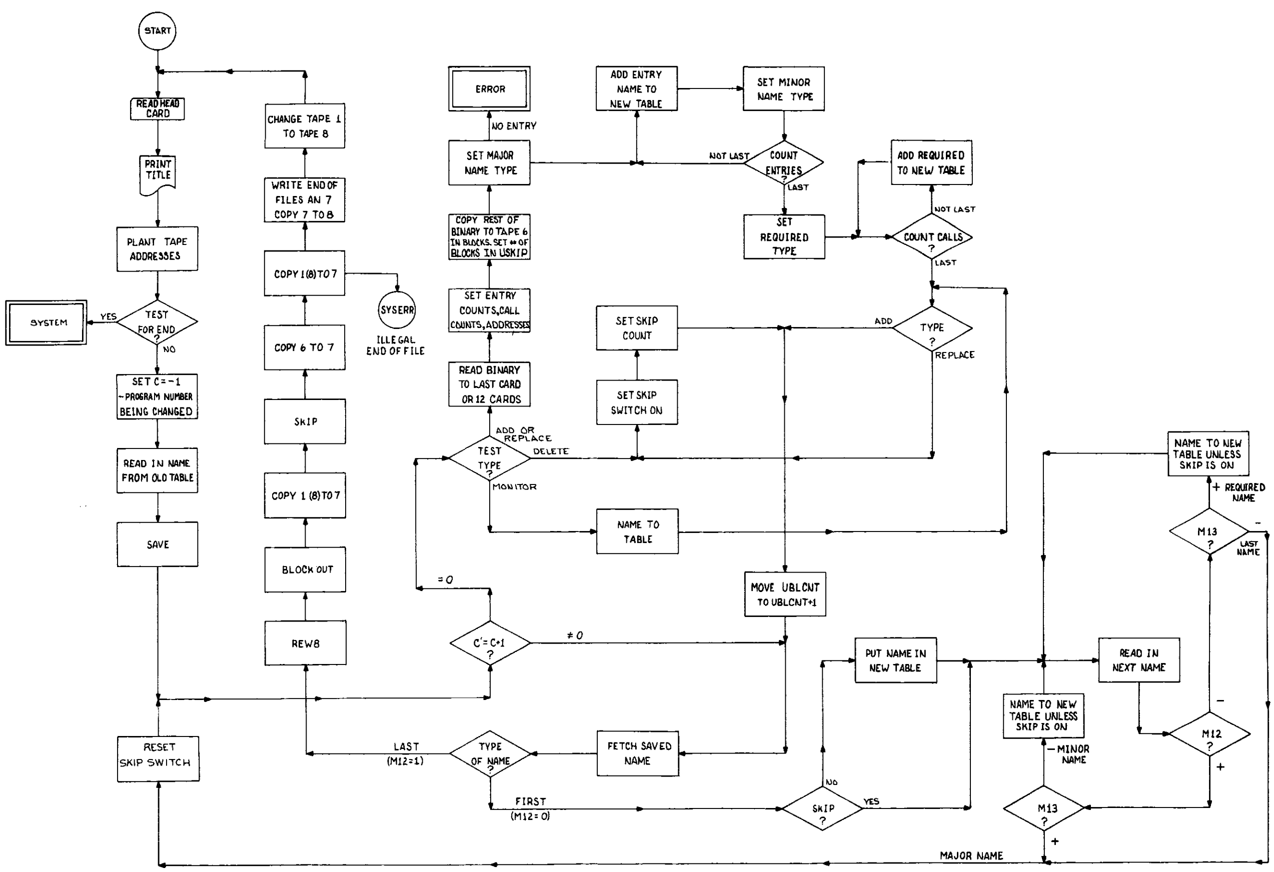
2) The number of blocks to be skipped on the old tape (0 if an addition). Stored in USKIP.

3) The number of blocks of the addition or replacements to be copied from tape 6 (0 if a deletion). Stored in ULCNT.

4) The number of blocks to be copied after the change. Stored in UBLCNT.

The copy is done from tape 1 on the first change, and tape 8 subsequently, to tape 7, getting the new program of tape 6 where it has previously been loaded. When this has been completed, tape 1 or 8 is checked to see if an End of File mark is next on the tape. An exit to SYSERR is made if not, or if an earlier END OF FILE was sensed. Finally tape 7 is copied to tape 8 to prepare a second copy and to check tape 7 for parity errors a second time.

Another card is now read, either to begin another job or to cause an exit to SYSTEM in the case of an End card.



```
 49012C W GEAR
$       PRINT OBJECT
$       NICAP
$       PUNCH OBJECT
        ENTRY  SYSERR,SYSTEM,SYSIO,SYSAUX
SYSTEM  EQUS   7936
SYSERR  EQUS   7937
SYSAUX  EQUS   7938
SYSIO   EQUS   7939
        ORG    256
ULBOUT  BSS    512
ULOUTB  BSS    256
ULINB   BSS    1024
        CALL   SYSTEM
START   CAM    1,UTITL1           READ TITLE
        CALL   READ
        LFR    7,TUTRAN+1
        ANM    15,4095
        SFR    7,TUTRAN+1
TUTRAN  EQUS   7947
        LFR    7,ULIN1+1
        CAM    12,ULINB
        CSM    13,1
        SFR    7,ULIN1+1
        CAM    1,UTITL2           PRINT TITLE
        CALL   PRINT
        LFR    7,UL13
        CAM    13,ULBOUT
        SFR    7,UL13
        LFR    6,ULC1             SET UP TAPE ADDRESSES
        LFR    7,ULIN3
        CAM    15,M8
        SFR    7,ULIN3
        CAM    13,ULOUTB
```

```
         SFR    7,UL4
         CAM    12,WAIT
         SFR    7,ULIN3+2
         SFR    7,UL4+2
         CAM    12,CHKRC
         SFR    7,UL7
         CAM    12,WRITE
         CAM    15,M9
         SFR    7,ULOUT3
         SFR    7,UL5
         CAM    12,WAIT
         SFR    7,ULOUT3+2
         SFR    7,UL5+2
         CAD    15,3,
         STR    UBLCNT
         STR    USKIP
         STR    ULCNT
         CALL   SYSAUX
         DECQ   REWIND,0,0,1025
         CALL   SYSAUX
         DECQ   REWIND,0,0,1030
         CALL   SYSAUX
         DECQ   REWIND,0,0,1031
         CALL   SYSAUX
         DECQ   REWIND,0,0,1032
         LFR    7,TYPE
         SBM    12,53
         JZM    12,SYSTEM          END
         CALL   ULIN
         SFR    7,ULSV
         CAD    1.
         ASC    UPRG               PREPARE PROGRAM COUNT
         TRA    UL31
UL28     LFR    7,TYPE
```

```
         SBM     12,52               D
         JZM     12,UL24             DELETE
         SBM     13,36               M
         JZM     13,UL25             MONITOR PROGRAM
         CAM     11                  COUNT
         CAM     9,ULBOUT
UL14     CSM     10,12
UL11     LFR     7,UL10
         CAM     13,M9
         SFR     7,UL10
         CALL    SYSIO
UL10     DECQ    RD,0,0,0            READ
         LDM     8,M9+2
         ANM     8,3072
         SBM     8,1024
         JZM     8,UL12              GO CARD
         ADM     9,20
         CJU     10,UL11             GET ANOTHER CARD
UL15     CALL    SYSAUX
UL13     DECQ    WRITE,ULBOUT,0,1030
         LFR     7,UL13
         CAM     13,ULBOUT+256
         SFR     7,UL13
         CALL    SYSAUX
         DECQ    WAIT,0,0,1030
         CAM     9,ULBOUT+256
         ADM     11,1                COUNT BLOCKS
         JUM     8,UL14              NOT GO BLOCK
         LFR     5,ULBOUT+1          CONTROL
         CSB     M11.
         STR     ULCNT
         CAM     8,ULBOUT+6          WORD
         JZM     5,ULERR             NO ENTRIES
UL21     CSM     9,14
```

```
UL18    ATN     8,1,
        LFR     7
        CSM     15,M11
        JUM     11,UL16
        ORM     13,4096
UL16    CAM     11
        JUM     5,UL17          NOT CALL
        ORM     12,4096
        ANM     13,4095
UL17    CALL    ULOUT
        JZM     5,UL19
        SBM     5,1
        JUM     5,UL20
UL19    JZM     4,UL22          LAST CALL
        SBM     4,1
UL20    CJU     9,UL18
        ADM     8,6
        TRA     UL21
UL22    LFR     7,TYPE
        CAM     8               NO SKIP
        SBM     12,49           A
        CAD     15,3,
        JZM     12,UL23         ADD
UL24    LFR     7,ULSV
        CAM     8,1
        JNM     14,UL23
        CAD     M15.
UL23    STR     USKIP
        CAD     UBLCNT
        STR     UBLCNT+1        BEFORE COUNT
        CAD     15,3,
        STR     UBLCNT
UL29    LFR     7,ULSV
        JNM     12,UL01         LAST
```

```
         JUM    8,UL26
         JNM    14,UL27
         CAD    M15.
         ASC    UBLCNT
UL27     JUM    8,UL26             SKIP PROGRAM
         CALL   ULOUT
UL26     CALL   ULIN
         SFR    7,ULSV
         JNM    12,UL30
         JNM    13,UL27
UL31     CAM    8
         CSB    1.
         ADD    UPRG
         STR    UPRG
         TZ     UL28
         TRA    UL29
UL30     JPM    13,UL27
         TRA    UL31
UL12     ANM    9,-256
         CAM    12,4096
         SFR    7,M9+240           SET GO BIT
         TRA    UL15
UL25     LFR    7,ULMON
         CAD    ULMON+1
         SIA    4
         CAM    15,M4
         ORM    14,4096
         CALL   ULOUT
         TRA    UL22
UL01     CALL   SYSAUX
         DECQ   REWIND,0,0,1030
         CAM    12,4096
         CAM    13,4096
         CALL   ULOUT
```

```
        CSM     1,2
        CSM     2,2
UL2     CAD     UBLCNT+1
        TZ      UL3
        ADD     1.
        STR     UBLCNT+1
        CALL    SYSAUX
UL4     DECQ    RD,ULOUTB,ULEOF,1025
        CALL    SYSAUX
        DECQ    WAIT,0,0,1025
        CALL    SYSAUX
UL5     DECQ    WRITE,ULOUTB,0,1031
        CALL    SYSAUX
        DECQ    WAIT,0,0,1031
        TRA     UL2
UL3     CJZ     2,UL6
        LFR     7,UL4
        CAD     ULCNT
        CAM     15,1030             TAPE 6
UL9     SFR     7,UL4
        CAM     12,WAIT
        SFR     7,UL4+2
        STR     UBLCNT+1
        TRA     UL2
UL6     CSM     2,1
        CJZ     1,UL110
UL8     CAD     USKIP
        TZ      UL100
        ADD     1.
        STR     USKIP
        CALL    SYSAUX
UL7     DECQ    CHKRC,0,ULEOF,1025
        TRA     UL8
        FIL
```

```
ULEOF   CALL    SYSERR
UL100   CAD     UBLCNT
        LFR     7,UL4
        LFR     6,ULC1
        CAM     15,M8
        TRA     UL9
UL110   LFR     6,UL5
        CAM     8,WTM
        SFR     6,UL111
        LFR     6,UL4
        CAM     10,UL112
        SFR     6,UL113
        CAM     8,WAIT
        SFR     6,UL114
        CSM     8,2
        CALL    SYSAUX
UL113   BSS     1
        CALL    SYSAUX
UL114   BSS     1
        CALL    SYSERR
        FIL
UL112   CALL    SYSAUX
UL111   BSS     1
        CJU     8,UL112               WRITE TWO TAPW MARKS
        CALL    SYSAUX
        DECQ    REWIND,0,0,1032
        CALL    SYSAUX
        DECQ    REWIND,0,0,1031
COPY78  CALL    SYSAUX
        DECQ    READ,ULOUTB,EOF7,1031
        CALL    SYSAUX
        DECQ    WAIT,0,0,1031
        CALL    SYSAUX
        DECQ    WRITE,ULOUTB,0,1032
```

```
        CALL   SYSAUX
        DECQ   WAIT,0,0,1032
        TRA    COPY78
        FIL
EOF7    CSM    8,2
        CALL   SYSAUX
        DECQ   WTM,0,0,1032
        CJU    8,2,EOF7
        LFR    7,ULC1
        CAM    12,1032
        SFR    7,ULC1
        TRA    START
ULOUT   SFR    4,ULOUT1
        SFR    5,ULOUT1+1
        LFR    5,ULOUT1+3
        ATN    4,1,
        SFR    7
        SFR    7,ULOUTB+255        STR IN CASE LAST ENTRY
        SFR    7,ULOUT1+4
        JPM    12,ULOUT2
        JNM    13,ULOUT5
ULOUT2  CJU    5,ULOUT4
ULOUT5  CAM    4,ULOUTB
        CSM    5,256
        CALL   SYSAUX
ULOUT3  DECQ   WRITE,ULOUTB,0,1031
        CALL   SYSAUX
        DECQ   WAIT,ULOUTB,0,1031
ULOUT4  JPM    12,ULOUT9
        JPM    13,ULOT13
ULOUT6  CAM    1,ULOTD
        JUM    7,ULOT17
        JZM    6,ULOT15            NO PRINT TO FINISH
ULOT17  CALL   PRINT
```

```
         CAM     6
         CAM     7
ULOT15   JNM     12,ULOUT7
ULOT10   CAM     1,ULOST                 FIRST ENTRY
         CALL    PRINT
         CAM     6,1                     SET PRINT TO FINISH SWITCH
         CAD     1,
         ASC     ULOUT1+2                COUNT
ULOUT8   CAM     2
ULOT12   SFR     5,ULOUT1+3
         LFR     4,ULOUT1
         LFR     5,ULOUT1+1
         JLH     M3
ULOUT7   CAM     3
         CAD     15,3,
         STR     ULOUT1+2                COUNT TO ZERO
         TRA     ULOUT8
ULOUT9   JNM     13,ULOT11
         TRA     ULOUT6
ULOT11   CAM     1,ULCL
         CALL    PRINT
         CAM     6,1
         TRA     ULOT12
ULOT13   JZM     6,ULOT14                NO PRINT TO FINISH
         CAM     1,ULOTD
         CAM     6
         CALL    PRINT
ULOT14   CAM     1,ULCL
         CALL    PRINT
         CAM     7,1
         TRA     ULOT12
ULOUT1   BSS     3
         DECQ    ULOUT8,-256,0,0
         BSS     1
```

```
ULOTD   DECQ    0,0,0,0
ULOST   DECQ    4096,ULOUT1+2,1,ULOST+3
        DECQ    4096,ULOUT1+4,1,0
        DECQ    2048+3,ULOUT1+4,1,0
        CHR     48,F10,2X,A6,D6,6(S2,A6)/(S24,6(S2,A6))*
ULCL    DECQ    2048,ULOUT1+4,1,ULCL+1
        CHR     32,(1H ,72(1H-),6(S2,A6))*
ULIN    SFR     4,ULIN1
        LFR     4,ULIN1+1
        CJU     1,ULIN2
        CSM     1,256
        CAM     0,ULINB
        CALL    SYSAUX
ULIN3   DECQ    RD,ULINB,0,1025
        CALL    SYSAUX
        DECQ    WAIT,0,0,1025
ULIN2   ATN     0,1,
        LFR     7
        SFR     4,ULIN1+1
        LFR     4,ULIN1
        JLH     M3
ULIN1   BSS     1
        DECQ    0,-1,0,0
        FIL
UTITL1  DECQ    4096,TYPE,1,ULIF
        DECQ    4096,UPRG,1,0
        DECQ    4096,ULMON,2,0
        DECQ    0,TITLE,5,0
ULIF    CHR     24,S8,A8,F8,A8,F8,5A8*
UTITL2  DECQ    0,TITLE,5,UL2F
UL2F    CHR     16,1H1,S20,5A8//*
TITLE   BSS     5
        ASSIGN  TYPE,UPRG,USKIP,ULSV,ULCNT
ULMON   BSS     2
```

```
UBLCNT BSS     2
ULC1   DECQ    1025,1031,0,0
ULERR  HLT
CHKFL  EQUS    1096
CHKRC  EQUS    1088
BCKSPF EQUS    1072
BCKSPR EQUS    1064
WAIT   EQUS    256
RD     EQUS    0
WRITE  EQUS    512
WTM    EQUS    1104
REWIND EQUS    1056
       GO      START
```