TECHNICAL DOCUMENTATION

for

UNICODE

Automatic Programming System for Univac Scientific 1103A and 1105

Volume III

April , 1961

PX 1790

Remington Rand Univac®
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EQUATION GENERATION

Equation Generation No. 1

The coding for an equation is generated in three stages numbered 1, 2 and 3. Number 1 produces a sorted list of symbols, No. 2 eliminates some redundant calculations, and No. 3 produces the coding.

The idea of No. 1 is to add parentheses to the equation (which has been "strung out" one call word per computer word by the equation translator) and number call words by use of the parentheses in the expression. The numbered call words are then sorted and generator No. 2 takes over.

Thus there are three passes made by No. 1: processing (adding parentheses), numbering symbols, and sorting. An explanation of each of these follows a description of the lists.

The six lists made up or used by this routine are as follows:

1) Translation List (WL)

This is the input to the routine and is produced by the equation translator. It contains one call word per computer word, the call words being in the v addresses, except that an open parenthesis is a 1 in the u address and a closed parenthesis is a 2 in the u address. See the equation translation description for a more detailed explanation.

2) Processed List (PR)

The WL list is examined one call word at a time and parentheses are added where needed to produce this list.

3) Numbered List (WL (same region as Translation List))

The Processed List entries are picked up one at a time, starting with the last symbol in the list, numbered, and then transferred to the Numbered List, with the exception of open and closed parentheses which are used to alter the Numbers of Symbols (NS) List and are not sent to the Numbered List. (See descriptions of numbering and Numbers of Symbols List.)

4) Sorted List (PR (same region as Processed List))

This is the list produced by sorting the Numbered List so that larger numbers are at the beginning of the list. It is the output of the routine.

5) Parentheses List (PL)

This is a two-word-per-item list which contains a code for the type of open parenthesis in the operation portion of the first word and the level bit in one of the remaining 30 bits. The second word contains the Processed List address of the parenthesis in the u address of the word. This list contains only items for open parentheses.

Op	u	v
0 X	(level bit)	
0 0	(P)	

X = type of parenthesis

X = 0 - "not special"
X = 1 - level
X = 2 - term
X = 3 - Library
X = 4 - POW

P = address of parenthesis in PR list.

6) Numbers of Symbols List (NS)

This list is used when producing the Numbered List. In the Processed List every parenthesis will have a count in the v address to indicate how many parentheses are at this point. For example the following words might appear in the Processed List (not consecutively):

Op	u	v	
0 0	0 0 0 0 1	0 0 0 0 6	Six open parentheses
0 0	0 0 0 0 2	0 0 0 0 4	Four closed parentheses

For every closed parenthesis encountered in the Processed List, numbers are added to the NS List. The number of numbers added is equal to the count in the v address of the closed-parenthesis word. Open parentheses are handled similarly except that numbers are deleted from the NS List. The numbers in the NS List are in the u addresses of the words. For example, at one time the NS List may look as follows:

	Op	u	v
NS	0	1	0
NS 1	0	2	0
NS 2	0	3	0
NS 3	0	4	0
NS 4	0	10	0
NS 5	0	11	0
NS 6	0	16	0
NS 7	0	24	0

The last number in the list (24 in this one) is always the number added to a symbol call word to make up the numbered symbol for the Numbered List. (The length of list NS varies, of course.) The last number in the list is always the largest still in the list but there may have been larger numbers previously. Parentheses are never put in the Numbered List; they are merely used to alter the NS List. Suppose we now encounter an open parenthesis with a count of 5. Five is subtracted from the last address (NS7) and the last address now becomes NS2 and the number to assign symbols is 3. Later we encounter a closed parenthesis with a count of 7. Numbers are added to the list starting with 25 since we have already used 1 to 24. Since we must add 7 numbers the list becomes:

	Op	u	v
NS	0	1	0
1	0	2	0
2	0	3	0
3	0	25	0
4	0	26	0
5	0	27	0
6	0	30	0
7	0	31	0
10	0	32	0
NS11	0	33	0

and the next symbol (if not a parenthesis) will be numbered 33.

The explanation of the three passes follows:

Processing:

A level bit is kept up to date at all times. It starts at the rightmost bit position and is shifted left by one every time an open parenthesis or open absolute-value sign is encountered, and right by one for every closed paren-

thesis or absolute-value sign. One may write up to 29 open parentheses and/or absolute-value signs before he must close some. That is, he may write symbols on the 29th level but not on higher levels.

There are five types of open parentheses added to the Processed List. These are the level, term, library, POW, and anticipation (for want of a better name). A level and a term parenthesis are added to the Processed List every time an open parenthesis, open absolute-value sign or comma is encountered in the Translation List. A level parenthesis is put in the Processed List before the first symbol is picked up from the Translation List and, when the equals sign is encountered, level and term parentheses are also added. A term parenthesis is added at the beginning of each term, i.e., after a binary + or - sign.

A library (LIB) parenthesis is added before each Library Routine symbol unless there is already an unclosed library parenthesis (on the same level) in the list.

When POW is encountered, the last open parenthesis is changed to a POW parenthesis in the Parenthesis List (PL).

The anticipation parenthesis is added in the following places:

1) After every multiplication, division or unary minus sign in anticipation of the next operation being POW. (If is isn't POW, the anticipation parenthesis will not alter the interpretation.)

2) Before and after a library call word when there is already a library parenthesis on this level. This is to handle the case:

```
( LIB ( LIB ( X )) )
↑     A     A
Library
```

where all of the parentheses have been added, i.e., none were originally written in the expression. This puts the rightmost Library Routine on the highest level.

3) After a library call word so the operands will be assigned larger numbers than the library call word.

4) Before every unary minus to associate the unary minus with the operand which follows.

The preceding discussion deals with open parentheses. When closing parentheses, a closed parenthesis with a count of zero is added to the Processed List and open parentheses in the Parentheses List are examined one at a time starting with the last parenthesis item in the list. Parentheses are closed by adding one to the count of both the closed and open parentheses in the Processed List. If the parenthesis just closed is not of the type sought, it is deleted from the Parentheses List by subtracting 2 from its address in the Parentheses List. This puts the next parenthesis "on deck" and the process continues until the type of parenthesis sought is closed. After this the parenthesis is left "on deck" or deleted from the Parenthesis List depending on circumstances.

Following is a summary of what is done upon encountering each of the symbols of an equation in the Translation List ("level" means the level due to parentheses or absolute value signs written in the UNICODE Program.)

Subscripted Variable - Anticipation parenthesis to Processed and Parentheses lists. Variable call word to Processed List.

Library Routine - 1) Previous library parenthesis on same level, still in Parenthesis List: Anticipation parenthesis to lists. Library call word to Processed List. Anticipation parenthesis to lists.

2) No previous library parenthesis on same level, still in Parentheses List: Library parenthesis to lists. Library call word to Processed List. Anticipation parenthesis to list.

P O W - 1) Previous POW parenthesis on same level, still in Parenthesis List: Close parentheses to POW parenthesis (leave POW parenthesis "on deck"). POW to Processed List.

2) Previous library parenthesis on same level, still in Parenthesis List: Close to library parenthesis and change it to a POW parenthesis in the Parenthesis List (leave POW parenthesis "on deck"). POW to Processed List.

		3) No previous library or POW parenthesis. Close to last open parenthesis and change it to a POW parenthesis. POW to Processed List.
Special powers (Square, Square Root, etc.)	-	Same as POW then: Close to POW parenthesis (leave "on deck").
Open parenthesis and Open absolute value sign	-	Increase level. Level and term parentheses to lists. (Note that no open absolute value sign is put in Processed List.)
Closed Parenthesis	-	Close to level parenthesis and delete it from Parenthesis List. Decrease level.
Closed Absolute Value Sign	-	Close to level. Absolute value sign to Processed List. Close to level and delete from Parenthesis List. Decrease level.
+ or - sign	-	Close to level. + or - to Processed List. Term parenthesis to lists.
Unary plus	-	Ignore.
Unary minus	-	Anticipation parenthesis to lists. Unary minus to Processed List. Anticipation parenthesis to lists.
Comma	-	Close to level parenthesis. Add level and term parenthesisto lists. (Note no comma is sent to Processed List.)
Equals sign	-	Close to level parenthesis. Add level and term parentheses to lists. (Note no equals sign is sent to Processed List.)
* or / sign	-	Close to term parenthesis. * or / to Processed List. Anticipation parenthesis to lists.
Space period	-	Close to level parenthesis. Space period to Processed List. Jump to numbering routine.

In addition, indicator bits are kept for each term of the expression so ambiguous sequences can be recognized and a warning printed on the typewriter.

Then, if the programmer is not sure of the interpretation of UNICODE he can rewrite the sentence and put parentheses in the expression so he will be sure to get the correct interpretation. The following ambiguous terms are recog - nized (the interpretation of UNICODE is on the right):

```
A POW B POW C = (A POW B) POW C
A/B/C = (A/B) / C
LIB A POW B = (LIB A) POW B
LIB A*B = (LIB A) * B
LIB A/B = (LIB A) / B
```

Compilation continues after the warning is printed.

Numbering:

Call words are numbered by use of the last number in the Numbers of Symbols List (NS). The numbers in this list are in the u addresses, one number per word. Two things must be known to use this list:

1. The address of the last number in the list.
2. The largest number put in the list so far. (The last number in the list is the largest in the list but not necessarily the largest number which has been in the list for this equation.)

Once a number has been in the list and has been taken out, it will not appear in the list again. The first number put in the list is 1.

Call words and parentheses are picked up from the Processed List starting with the last call word (space period). Call words other than parentheses are numbered with the last number in the NS List; then the numbered call word is sent to the Numbered List.

When a closed parenthesis is encountered, numbers are added to the NS List, the number of numbers added being equal to the count associated with the closed parenthesis. Numbers which are added are equal to the largest number which is or has been in the list plus 1. The address of the last number in the list is increased by one for each number added to the list, of course.

When an open parenthesis is encountered, the count is subtracted from the address of the last number in the list, hence essentially deleting numbers from the list.

The space period is numbered zero.

Sorting:

The Numbered List is sorted, largest first, to produce the Sorted List which is the output of equation generator No. 1.

For example, consider the following equation as input to the routine.

F (I,J) = - X POW Y + (SIN | u - v |) * WΔ.

The Processed List would be as follows (numbers above parentheses are counts and letters below are types, where L = level, T = term, A = anticipation, B = library, P = POW.):

```
11  11 2  11 22 211 2 1       4   2 111    1 31 2 1 2   141   1 3
((F ((I)  ((J)) (((-(X) POW  Y ) + ( (((SIN ( ((u)-(v) | ))) * (w)Δ.
LA  LT    LT    LTA A           T LTB    A LT   T          A
                  P
```

Numbering the symbols:

Δ. is numbered zero and sent to Numbered List.

Symbol	NS List	Numbered List	
		Number	Symbol
Δ.		0	Δ.
)	1,2,3		
W		3	W
(	1,2		
*		2	*
)	1,2,4		
)	1,2,4,5,6,7,8		
)	1,2,4,5,6,7,8,9		
|		9	|
)	1,2,4,5,6,7,8,9,10,11		
V		11	V
(	1,2,4,5,6,7,8,9,10		
-		10	-
)	1,2,4,5,6,7,8,9,10,12,13		
U		13	U
(	1,2,4,5,6,7,8,9,10,12		
(	1,2,4,5,6,7,8		
(	1,2,4,5,6,7		
SIN		7	SIN
(	1,2,4,5,6		
(	1,2,4,5		
(	1,2,4		
(	1		
+		1	+
)	1,14,15,16,17		
Y		17	Y
POW		17	POW
)	1,14,15,16,17,18		

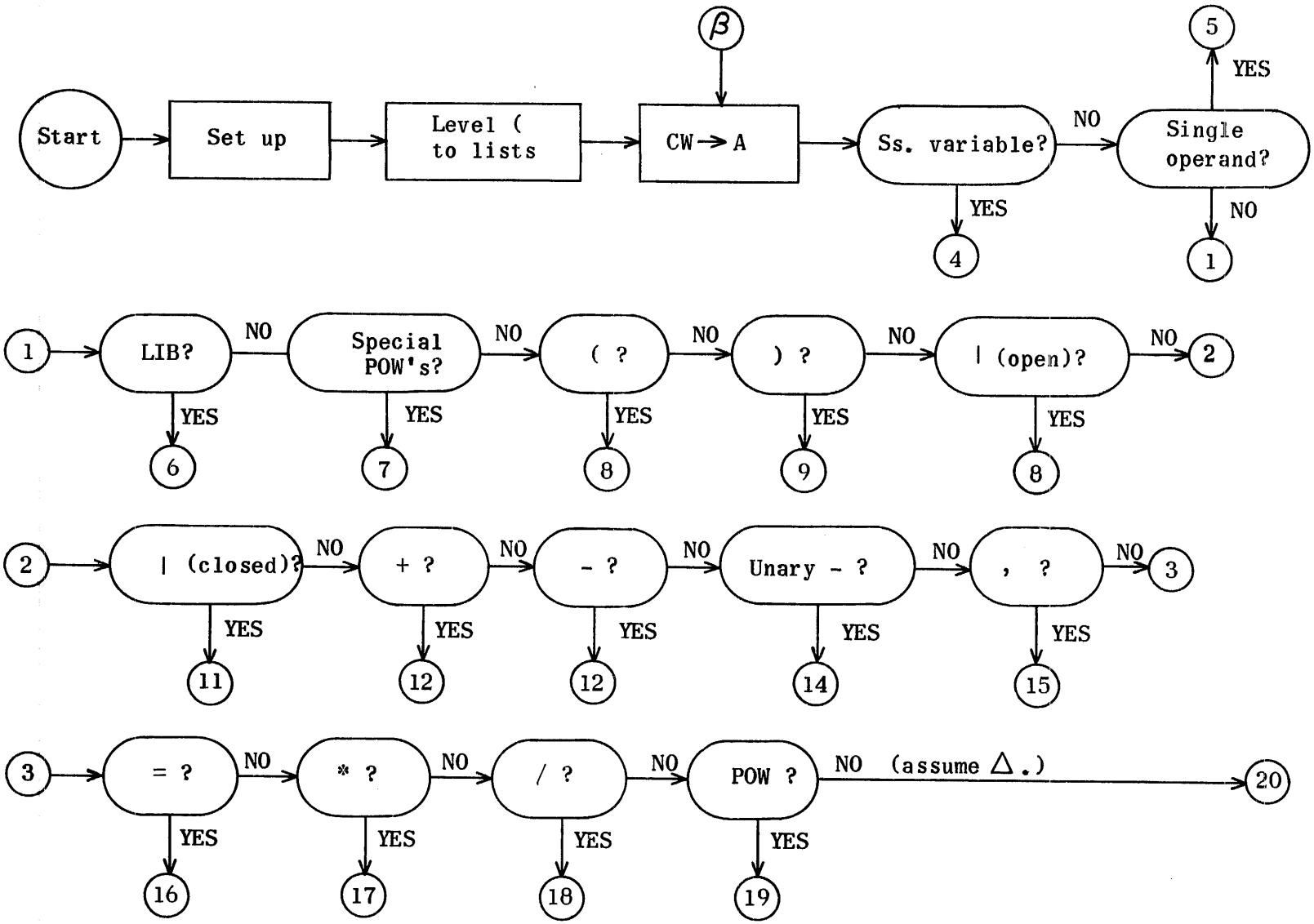
Symbol	NS List	Numbered List	
		Number	Symbol
X		18	X
$(^{2}$	1,14,15,16		
-		16	-
$(^{'}$	1,14,15		
$(^{'}$	1,14		
$(^{2}$	list empty		
$)^{2}$	19,20		
$)^{2}$	19,20,21,22		
J		22	J
$(^{'}$	19,20,21		
$(^{'}$	19,20		
$)^{2}$	19,20,23,24		
I		24	I
$(^{'}$	19,20,23		
$(^{'}$	19,20		
F		20	F
$(^{'}$	19		
$(^{'}$	list empty		

Note: Numbers over parentheses denote count of parentheses occurring at this point.

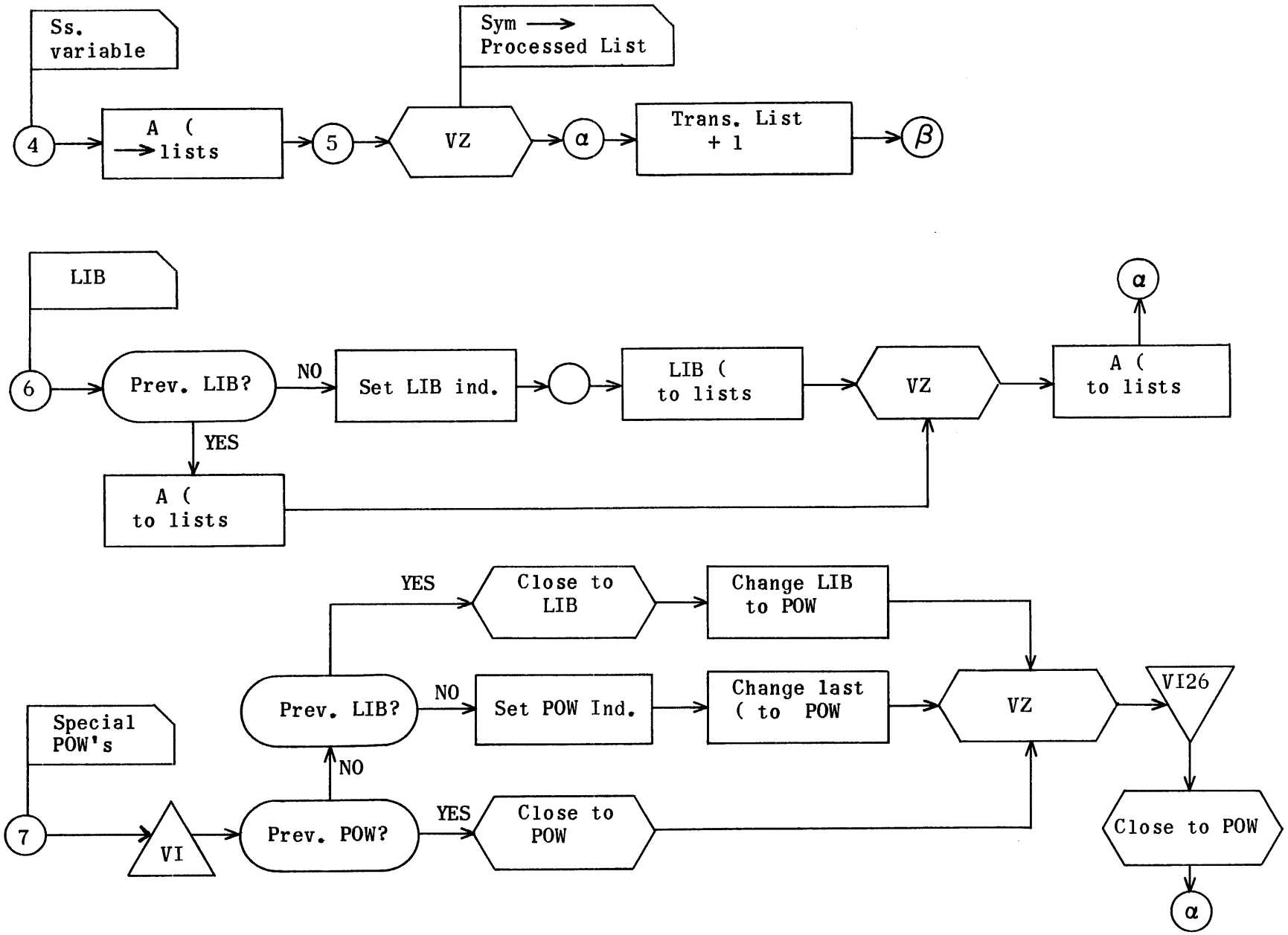
Sorted List:

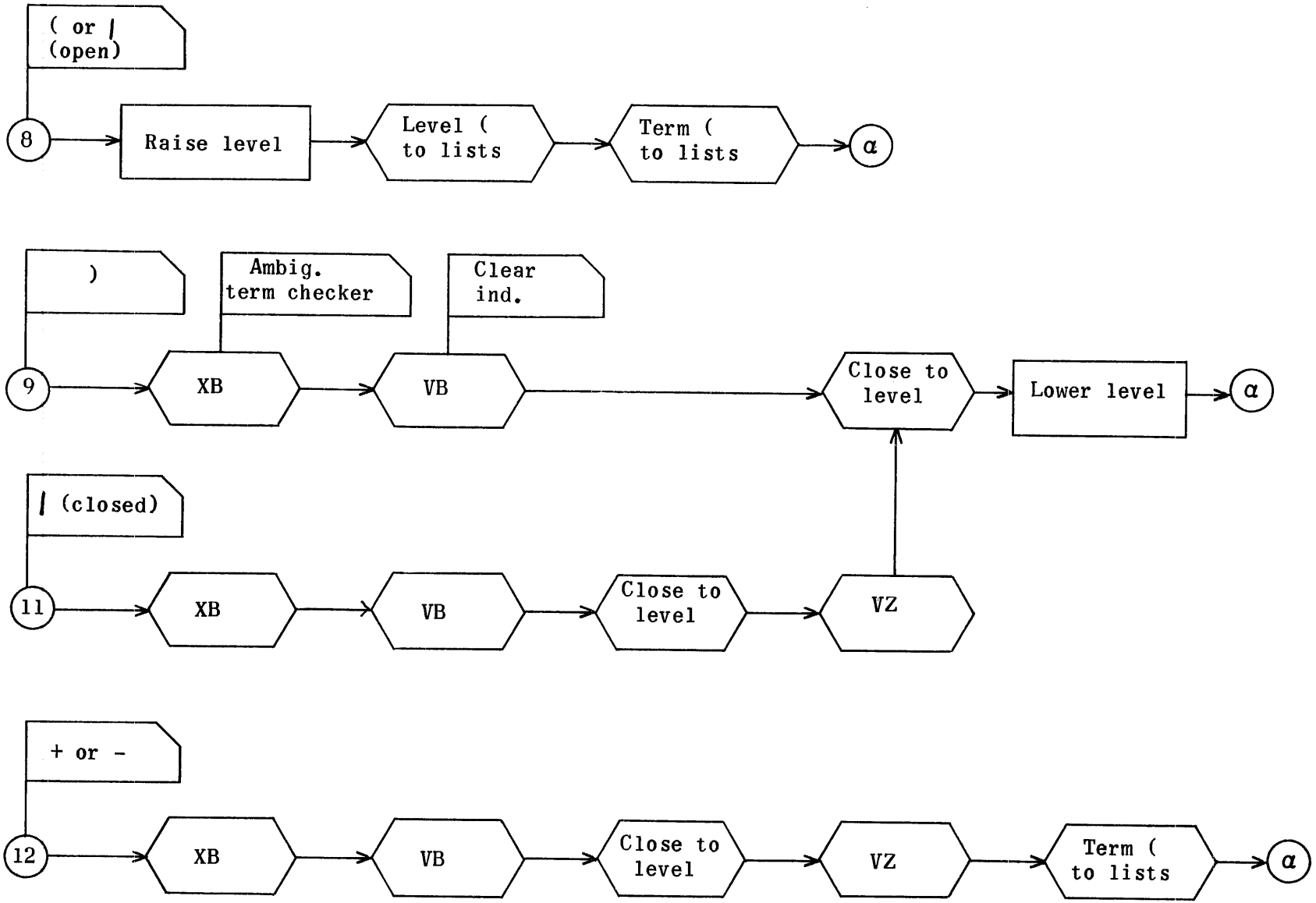
I
J
F
X
Y, POW — both numbered 17 but operands always have larger call words than operations.
\- — Unary
U
V
\- — Binary
|
SIN
W
*
+
Δ.

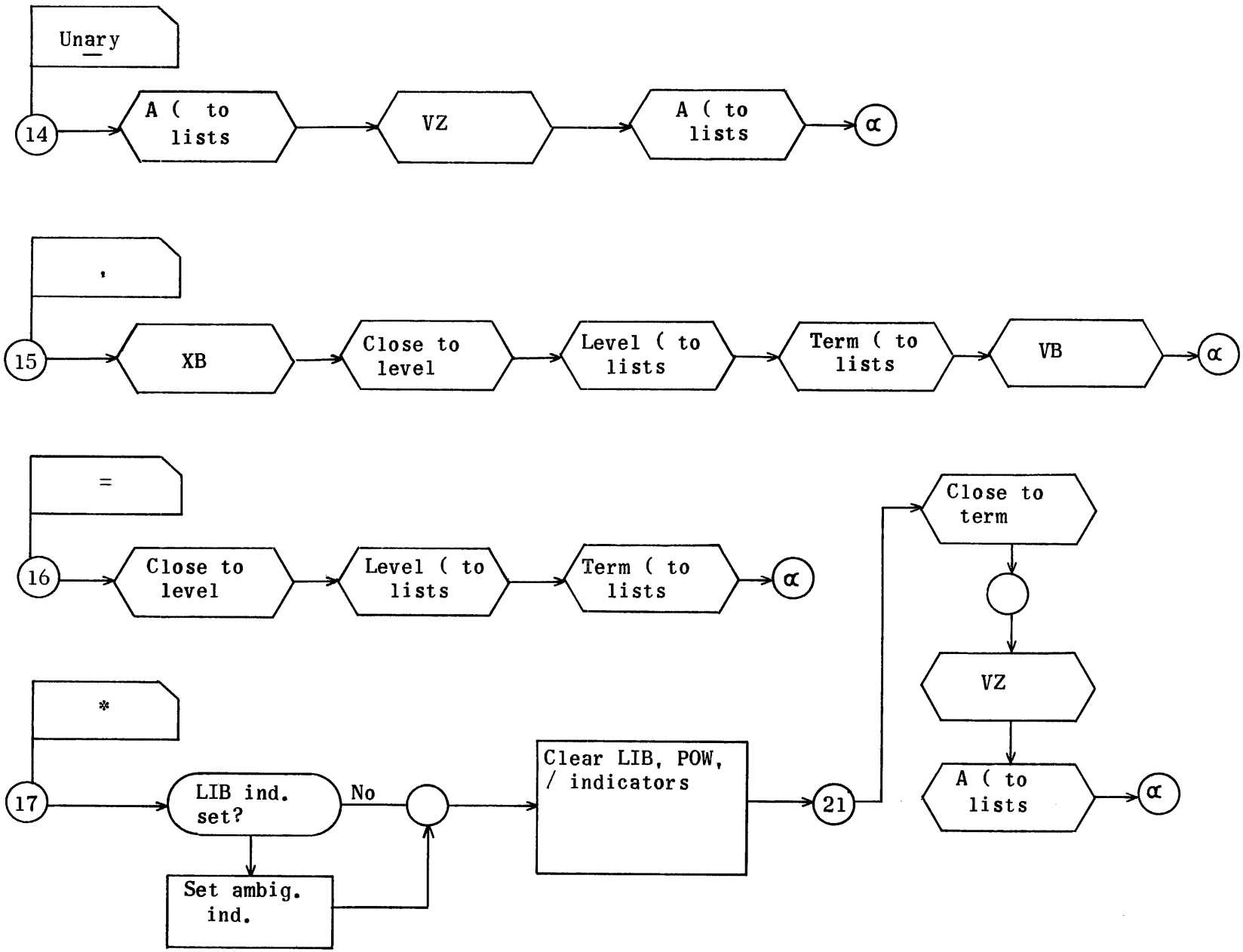
Equation Generation No. 1

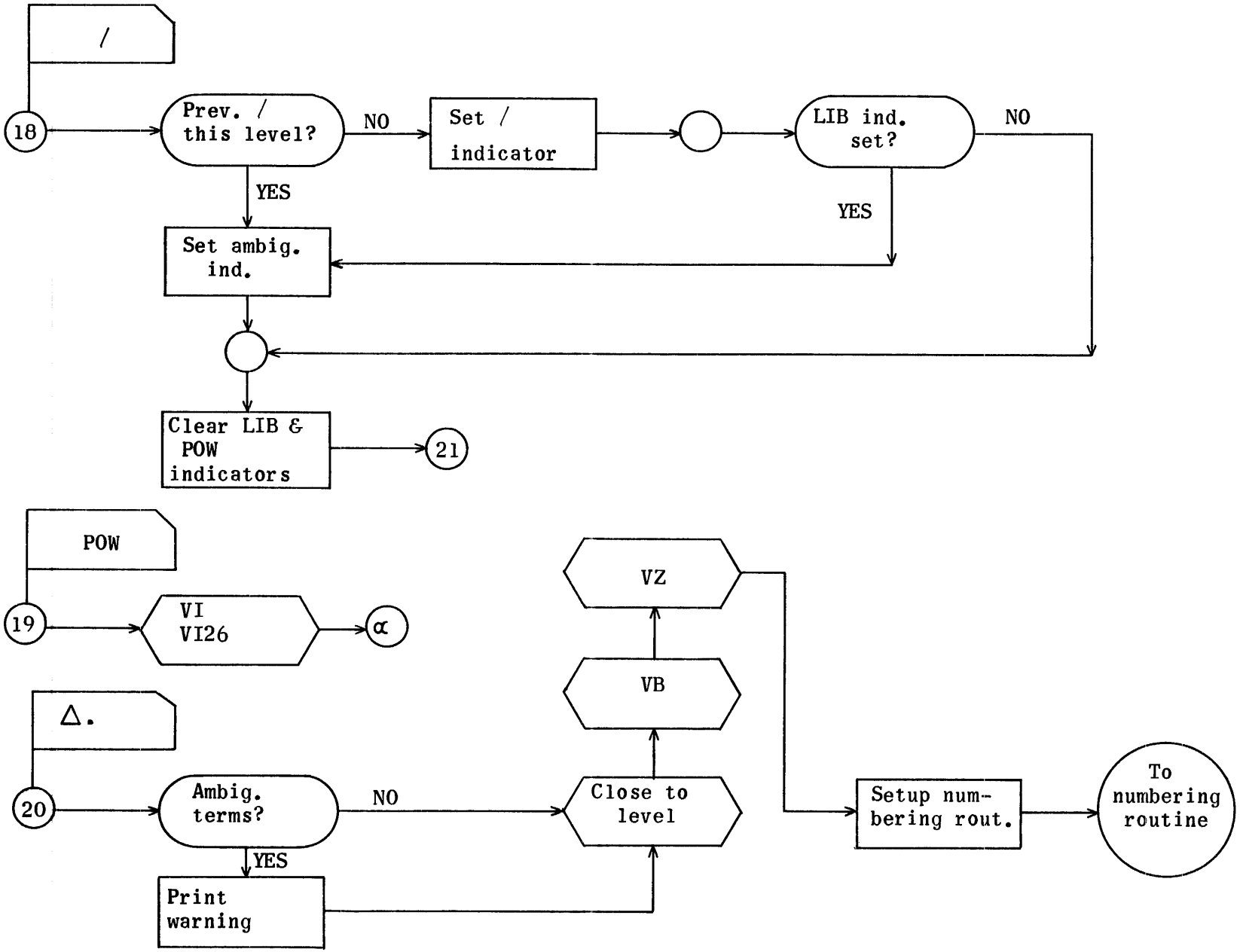


A = Anticipation

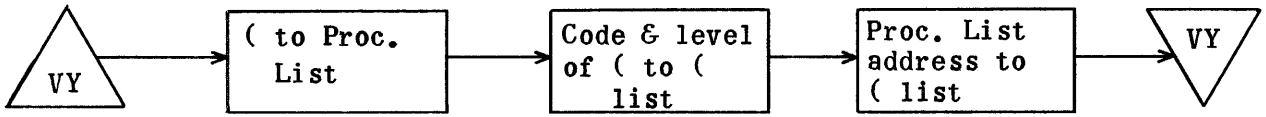

Ss.
variable
Sym →
Processed List
4
A (
→lists
5
VZ
α
Trans. List
+ 1
β
LIB
6
Prev. LIB?
NO
Set LIB ind.
LIB (
to lists
VZ
A (
to lists
α
YES
A (
to lists
YES
Close to
LIB
Change LIB
to POW
Prev. LIB?
NO
Set POW Ind.
Change last
(to POW
VZ
VI26
Special
POW's
NO
7
VI
Prev. POW?
YES
Close to
POW
Close to POW
α


(or |
(open)
8
Raise level
Level (
to lists
Term (
to lists
α
)
Ambig.
term checker
Clear
ind.
9
XB
VB
Close to
level
Lower level
α
| (closed)
11
XB
VB
Close to
level
VZ
+ or -
12
XB
VB
Close to
level
VZ
Term (
to lists
α

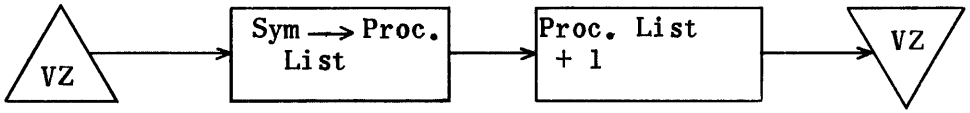

Unary
14
A (to lists
VZ
A (to lists
α
'
15
XB
Close to level
Level (to lists
Term (to lists
VB
α
=
16
Close to level
Level (to lists
Term (to lists
α
*
17
LIB ind. set?
No
Set ambig. ind.
Clear LIB, POW, / indicators
21
Close to term
VZ
A (to lists
α


/
18
Prev. / this level?
NO
Set / indicator
LIB ind. set?
NO
YES
YES
Set ambig. ind.
Clear LIB & POW indicators
21
POW
19
VI
VI26
α
VZ
VB
Δ.
20
Ambig. terms?
NO
YES
Print warning
Close to level
Setup num-bering rout.
To numbering routine

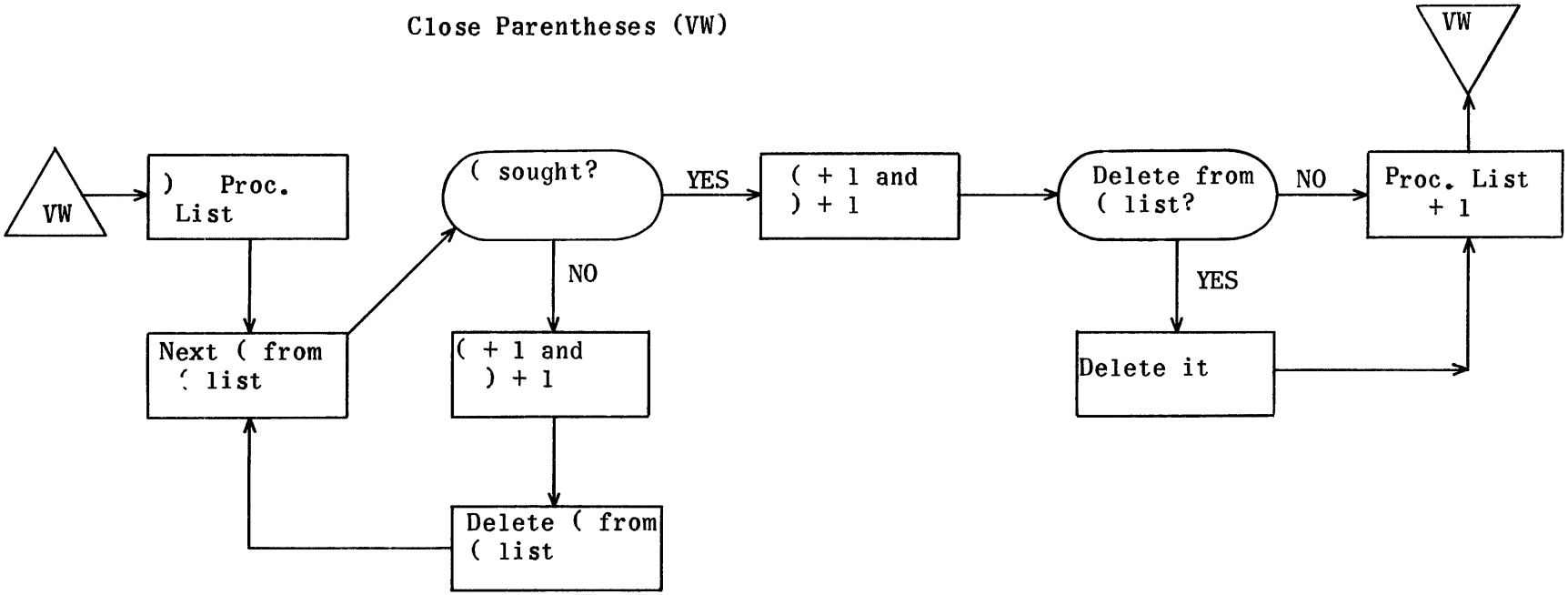
Open Parenthesis to Lists (VY)



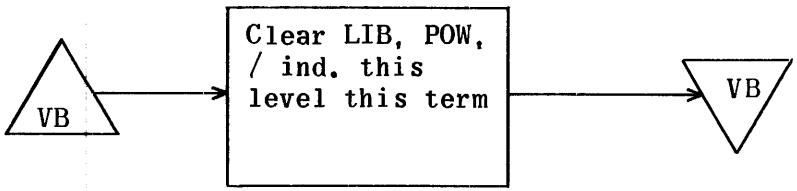
Symbol to Processed List (VZ)



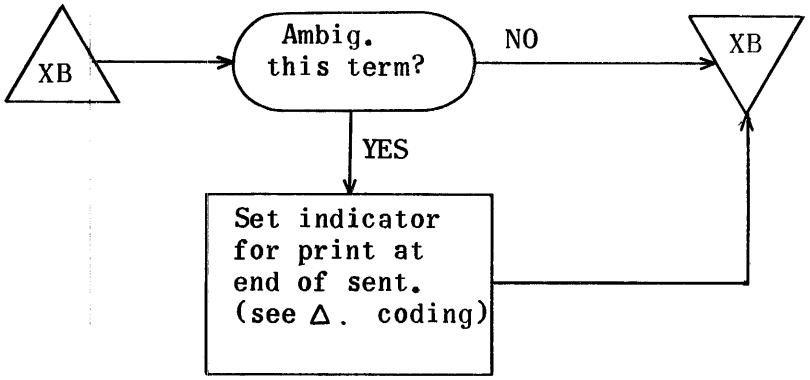
Close Parentheses (VW)



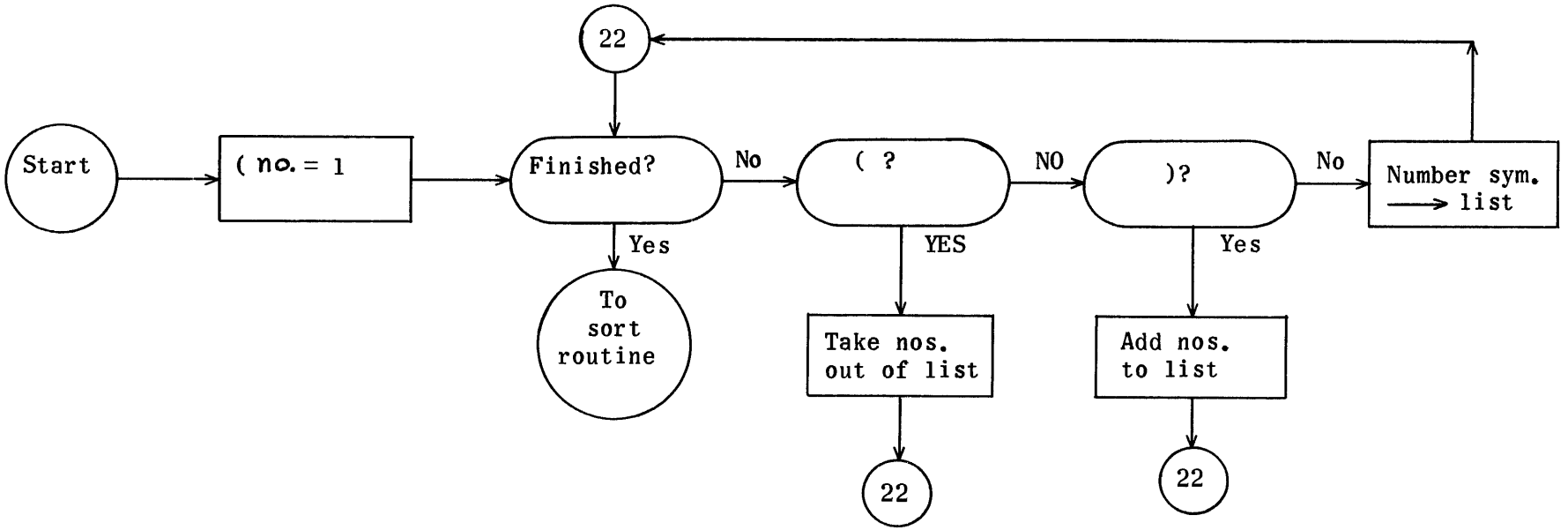
Clear Indicators (VB)



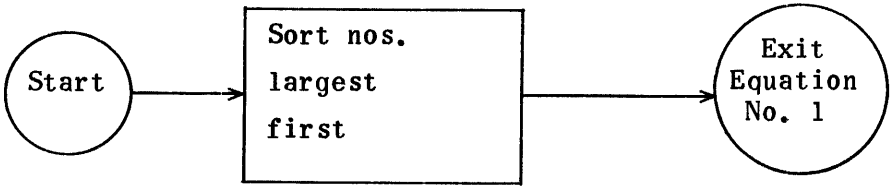
Check for Ambiguity (XB)



NUMBERING ROUTINE



Sort Routine



Equation Generator No. 1 Regions and Coding

Region	Address	Name or Symbol Handled
VD	2512	Setup
VB	2523	Clear Indicators
VC	2532	Constants
VE	2616	Switch
VF	2654	Subscripted Variable
VH	2660	Library Routine
VI	2674	Special POWS
VJ	2752	Open Parenthesis and Open absolute
VK	2760	Closed Parenthesis
VL	2770	Closed Absolute Value
VM	3003	+ or -
VN	3013	Unary -
VO	3020	Comma
VP	3033	=
VQ	3044	*
VR	3062	/
VS	3075	POW
VT	3077	Δ .
VU	3114	Numbering Routine
VW	3147	Close Parentheses
VX	3172	(+1 and) +1
VY	3202	Add Parenthesis to List
VZ	3220	Symbol to Processed List
XA	3226	Trans. List +1
XB	3230	Check for Ambiguity
XC	3236	Constants
SR	3244	Sort Routine
VA	3324	Variable
PR	3351	Processed List
NS	4351	Numbers of Symbols List
PL	5351	Parentheses List
WL	2242	Translation List
NT	2774	Close to level and Sym → Processed List

Setup Equation Generation

```
     IA   VD
 0   MJ   0       (30000)   Exit
 1   RP   13025   VD3       }
 2   TP   VC      VA        }  Clear variables
 3   TP   VC4     VA        Level bit
 4   RP   30004   VD6       }
 5   TP   VC60    VA6       }  Set list addresses
 6   TP   VC44    VY2       }
 7   RJ   VY      VY1       }  Add level (  to lists
10   MJ   0       VE        → (β)
     CA   VD11
```

```
(α)
     IA   XA
 0   RA   VA6     VC1       Sym/wd list +1
 1   MJ   0       VE        → (β)
     CA   XA2
```

(β)

	IA	VE		
0	TU	VA6	VE1	Symbol → Q
1	TP	(30000)	Q	
2	QT	VC13	A	
3	EJ	VC13	VF	Ss. var. 77,76,75, → VF
4	EJ	VC14	VF2	Single operand → VF2
5	EJ	VC15	VH	LIB → VH
6	EJ	VC17	VI	POW'S → VI
7	QT	VC7	A	(→ VJ
10	EJ	VC42	VJ	
11	EJ	VC43	VK	) → VK
12	TP	Q	A	CW → A
13	EJ	VC21	VJ	| (open) → VJ
14	EJ	VC22	VL	(closed) → VL
15	EJ	VC40	VL	
16	EJ	VC23	VM	+ → VM
17	EJ	VC24	VM	
20	EJ	VC25	VM	- → VM
21	EJ	VC26	VM	
22	EJ	VC27	VN	Unary - → VN
23	EJ	VC30	VN	
24	EJ	VC31	VO	, → VO
25	EJ	VC32	VP	= → VP
26	EJ	VC33	VQ	* → VQ
27	EJ	VC34	VQ	
30	EJ	VC35	VR	/ → VR
31	EJ	VC36	VR	
32	EJ	VC37	VS	POW → VS
33	EJ	VC56	VS	
34	MJ	0	VT	Assume Δ.
	CA	VE35		

Subscripted Variable

```
     IA   VF
0    TP   VC    VY2 }
1    RJ   VY    VY1 }      0 (→ lists
2    RJ   VZ    VZ1        Subscripted variable to Processed List
3    MJ   0     XA         → α
     CA   VF4
```

Library Routine

```
     IA   VH
0    TP   VA    Q   }
1    QT   VA3   A   }      LIB? → VH12
2    ZJ   VH12  VH3 }      No ↓
3    QS   VC55  VA3        Set LIB
4    TP   VC46  VY2 }
(40) 5    RJ   VY    VY1 }      LIB (→ lists
6    RJ   VZ    VZ1        LIB →  Pro. List
7    TP   VC    VY2 }
10   RJ   VY    VY1 }      0 (→ lists
11   MJ   0     XA         → (α)
12   TP   VC    VY2        0 (→ lists
13   MJ   0     VH5        → (40)
     CA   VH14
```

```
     IA   VI
 0   TP   VA       Q
 1   QT   VA4      A        POW this level?   VI51
 2   ZJ   VI51     VI3      No↓
 3   QS   VC55     VA4      Set POW
 4   QT   VA3      A        LIB? → VI34
 5   ZJ   VI34     VI6      No↓
 6   TP   VA11     A
 7   ST   VC1      A
10   TU   A        VI11     Add 1 to count of last open
11   TU   (30000)  VI12
12   RA   (30000)  VC4
13   TV   VA7      VI14     ) (count of one) → Pro. List
14   TP   VC5      (30000)
15   RA   VA7      VC1      Increase add. of Pro. List
16   TV   VA11     VI20
17   TP   VC47     A        POW (→ ( list
20   AT   VA       (30000)
21   RA   VA11     VC1       ( list +1
22   TV   VA11     VI23     Add. of POW (→ ( list
23   TU   VI12     (30000)
24   RA   VA11     VC1       ( list + 1
25   RJ   VZ       VZ1      Sq. sqrt. etc.→ Pro. List
26   RJ   VI26     VI27     Exit
27   TP   VC       VW2
30   SP   VC47     0
31   AT   VA       VW3      Close to POW (no clear)
32   RJ   VW       VW1
33   MJ   0        XA       → (α)
34   TP   VC20     VW2      LIB
35   TP   VC46     A
36   AT   VA       VW3      Close to LIB (clear)
37   RJ   VW       VW1
40   TV   VA11     VI42
41   TP   VC47     A        Change LIB to POW
42   AT   VA       (30000)
43   RA   VA11     VC2      ( List +2
44   TN   VA       Q
45   QT   VA3      VA3      Clear LIB
46   TP   VA       Q
47   QS   VC55     VA2      Set print term
50   MJ   0        VI25     → 26
51   TP   VC       VW2
52   TP   VC47     A
53   AT   VA       VW3      Close to POW
54   RJ   VW       VW1
55   MJ   0        VI46     → 27
     CA   VI56
```

Open Parenthesis (and Open Absolute |

```
    IA  VJ
0   LQ  VA    1          Raise level
1   TP  VC44  VY2
2   RJ  VY    VY1        Add level and term ( 's
3   TP  VC45  VY2
4   RJ  VY    VY1
5   MJ  0     XA         → (α)
    CA  VJ6
```

Closed)

```
    IA  VK
0   RJ  XB    XB1        Print term checker
1   RJ  VB    VB1        Clear ind.
2   TP  VC20  VW2
3   TP  VC44  A          Close to level (clear) plus lower level
4   AT  VA    VW3
5   RJ  VW    VW1
6   LQ  VA    43         Lower level
7   MJ  0     XA         → (α)
    CA  VK10
```

Closed Absolute Value |

```
     IA   VL
0    RJ   XB     XB1        → Amb. term check
1    RJ   VB     VB1        Clear ind.
2    RJ   NT     NT1        Sym → Pro. List
3    MJ   0      VK2        Close to level (clear)
     CA   VL4
```

```
     IA   NT
0    MJ    0     30000      Exit
1    TP   VC     VW2  )
2    TP   VC44   A    }
3    AT   VA     VW3  }     Close to level (no clear)
4    RJ   VW     VW1  )
5    RJ   VZ     VZ1        Sym → Processed List
6    MJ   0      NT         Exit
     CA   NT7
```

+ or -

```
     IA   VM
0    RJ   XB     XB1        → Ambiguous term checker
1    RJ   VB     VB1        Clear
2    RJ   NT     NT1        Close to level (no clear) sym → Pro.
3    TP   VC45   VY2  )
4    RJ   VY     VY1  }     Term (→ list
5    MJ   0      XA         → (α)
     CA   VM6
```

Unary Minus

```
     IA   VN
0    TP   VC    VY2  }
1    RJ   VY    VY1  }      0 (→ lists
2    RJ   VZ    VZ1           - →Pro. List
3    RJ   VY    VY1           0 (→ lists
4    MJ   0     XA            → (α)
     CA   VN5
```

Comma

```
     IA   V0
0    RJ   XB    XB1           Amb. term checker
1    TP   VC20  VW2  ⎫
2    TP   VC44  A    ⎬        Close to level (clear)
3    AT   VA    VW3  ⎪
4    RJ   VW    VW1  ⎭
5    TP   VC44  VY2  ⎫
6    RJ   VY    VY1  ⎬        Add level & term ('s
7    TP   VC45  VY2  ⎪
10   RJ   VY    VY1  ⎭
11   RJ   VB    VB1           Clear
12   MJ   0     XA            → (α)
     CA   V013
```

Equals (=)

```
     IA   VP
 0   TP   VC20   VW2 ┐
 1   TP   VC44   A   │
 2   AT   VA     VW3 │   Close to level (clear)
 3   RJ   VW     VW1 ┘
 4   TP   VC44   VY2 ┐
 5   RJ   VY     VY1 │
 6   TP   VC45   VY2 │   Add level & term ('s
 7   RJ   VY     VY1 ┘
10   MJ   0      XA      → (α)
     CA   VP11
```

Floating and Fixed *

```
     IA   VQ
 0   TP   VA     Q   ┐
 1   QT   VA3    A   │   LIB ↓ no → (30)
 2   ZJ   VQ3    VQ4 ┘
 3   QS   VC55   VA2     Set print term
(30) 4   TN   VA     Q   ┐
 5   RJ   VB     VB3 ┘   Clear LIB, POW, /
(19) 6   TP   VC     VW2 ┐
 7   TP   VC45   A   │
10   AT   VA     VW3 │   Close to term (no clear)
11   RJ   VW     VW1 ┘
(36) 12  RJ   VZ     VZ1     * → Pro. List
13   TP   VC     VY2 ┐
14   RJ   VY     VY1 ┘   0 (→ lists
15   MJ   0      XA      → (α)
     CA   VQ16
```

Floating and Fixed /

```
      IA   VR
 0    TP   VA     Q
 1    QT   VA5    A
 2    ZJ   VR6    VR3      /→ VR6    no↓
 3    QS   VC55   VA5      Set /
 4    QT   VA3    A
 5    ZJ   VR6    VR7      LIB↓  no → (33)
(32)
 6    QS   VC55   VA2      Set print term
(33)
 7    TN   VA     Q
10    QT   VA3    VA3      Clear LIB & POW
11    QT   VA4    VA4
12    MJ   0      VQ6      → (19)
      CA   VR13
```

POW

```
      IA   VS
 0    RJ   VI26   VI       → POW sect.
 1    MJ   0      XA       → (α)
      CA   VS2
```

Space Period Δ .

```
     IA   VT
 0   TP   VA16   Q      }
 1   QJ   VT2    VT5    }   Print term ↓ no → VT5
 2   RJ   WA     WA2    }
 3   TP   XC     UP3    }   Print WARNING,ΔΔ AMBIGUOUS TERMS.
 4   RJ   UP2    UP     }
 5   TP   VC20   VW2    }
 6   TP   VC44   A      }
 7   AT   VA     VW3    }   Close to level (clear)
10   RJ   VW     VW1    }
11   RJ   VB     VB1         Clear
12   RJ   VZ     VZ1         Δ . → Pro. List
13   TP   VC60   VA6         Set address of no. list
14   MJ   0      VU          →  numbering routine
     CA   VT15
```

Print

```
     IA   XC
 0   40   XC1    5
 1   71   24545  03450       W A R N I N
 2   32   21010  12447       G , Δ Δ A M
 3   25   34326  75167       B I G U 0 U
 4   65   01663  05447       S Δ T E R M
 5   17   65432  27777       ( S ) . 77 77
     CA   XC6
```

Numbering Routine

```
     IA   VU
 0   TP   VC6       VA14      Set ( no. =1
 1   RS   VA7       VC1  }
 2   TJ   VC61      SR   }    Finished numbering → SR  No ↓
 3   TU   A         VU4  }
 4   TP   (30000)   Q    }    Sym → Q
 5   QT   VC7       A
 6   EJ   VC42      VU16      (→ VU16
 7   EJ   VC43      VU23      )→ VU23
10   TU   VA10      VU11 }
11   TP   (30000)   A    }    No.→ A
12   TV   VA6       VU13 }
13   AT   Q         (30000)}  No. sym → list
14   RA   VA6       VC1       Address +1
15   MJ   0         VU1
16   QT   VC12      Q         Count → Q
17   SP   Q         17   }
20   AT    Q        VA15 }
21   RS   VA10      VA15 }    Take nos. off list
22   MJ   0         VU1
23   QT   VC12      A         Count → A
24   ST   VC4       VA15      Set index
25   RA   VA10      VC1  }
26   TV   VA10      VU27 }    Add nos. to list
27   TP   VA14      (30000)}
30   RA   VA14      VC6       Increase highest no.
31   IJ   VA15      VU25
32   MJ   0         VU1
     CA   VU33
```

```
     IA   SR
 0   SP   VA6      0          }
 1   ST   VC60     VA21       }   No. to be sorted → VA21
 2   TP   VC7      Q          }
 3   QS   VA21     SR4        }   Set n of repeat
 4   RP   30000    SR6        }
 5   TN   WL24     WL24       }   List negative
 6   TP   VC60     VA6            Address of no. list = WL24
 7   SP   VC61     0          |
10   SA   VA21     0          }   Address of Sorted List → VA7
11   ST   VC1      VA7        |
12   TV   A        SR13       }
13   TP   WL24     (30000)    }   1st sym → Sorted List
14   RA   VA6      VC1            No. List +1
15   TU   A        SR23       |
16   TU   A        SR51       }   # of nos. in Sorted List → VA22
17   ST   VC60     VA22       |
20   TP   VC7      Q          }
21   QS   VA22     SR24       }   Set n of repeat
22   TU   VA7      SR25           Set address of Sorted List
23   TP   (30000)  A              # → A
24   RP   20000    SR35       }
25   TJ   (30000)  SR26       }   largest # yet → SR35  No ↓
26   TU   SR24     VA24           j  n → VA24
27   LQ   Q        17         |
30   SP   VA24     0          }   r - 1 → VA12
31   SS   Q        0          }
32   ST   VC3      VA12       |
33   AT   VC52     SR43           Set repeat to move back nos.
34   MJ   0        SR40
35   TP   VC7      Q          }
36   QS   SR24     SR43       }   Set to move back all nos.
37   QS   SR24     VA12           r -1 = all nos.
40   SP   VC54     0               TP    0     0
41   SA   VA7      0               TP   SL+   SL+
42   ST   VC4      SR44            TP   SL+  (SL+) -1
43   RP   30000    SR45       }
44   TP   (30000)  (30000)    }   Move nos. back
45   LQ   VA12     25             r - 1 → V address
46   SP   SR44     0          |
47   SA   Q        0          }
50   TV   A        SR51       }   TP no. L+  (SL+) + r - 1
51   TP   (30000)  (30000)    |
52   RS   VA7      VC1            Sorted list address -1
53   TJ   VC50     SR55           Done → SR55   no ↓
54   MJ   0        SR14           →  SR14
55   TU   SR4      SR56           Set n of repeat
```

```
56   RP  0        VD  }    Exit
57   TN  PR       WL4 }    Change to positive
     CA  SR60
```

Add Parenthesis to Lists

```
     IA   VY
 0   MJ   0       (30000)      Exit
 1   MJ   0       VY3          Start
 2   0    0       0            Type of ( to add  (no level)
 3   TV   VA7     VY4          (→ Processed List
 4   TP   VC42    (30000)
 5   TV   VA11    VY7          Code word→ ( list (count zero)
 6   TP   VY2     A
 7   AT   VA      (30000)
10   RA   VA11    VC1          Address→ ( list
11   TV   VA11    VY12
12   TU   VA7     (30000)
13   RA   VA7     VC1          Pro. List +1
14   RA   VA11    VC1          ( list + 1
15   MJ   0       VY           Exit
     CA   VY16
```

Sym → Processed List

```
     IA   VZ
 0   MJ   0       (30000)  Exit
 1   TU   VA6     VZ3
 2   TV   VA7     VZ3      Sym→ Pro. List
 3   TP   (30000) (30000)
 4   RA   VA7     VC1      Pro. List +1
 5   MJ   0       VZ       Exit
     CA   VZ6
```

Close Parentheses

```
    IA  VW
 0  MJ  0        (30000)  Exit
 1  MJ  0        VW4      Start
 2  0   0        0        - Take off list, + leave on
 3  0   0        0        Code of ( and level
 4  TV  VA7      VW5      )→ Pro. List (count zero)
 5  TP  VC43     (30000)
 6  TU  VA11     VW10
 7  RS  VW10     VC57     Code of (→ A
10  TP  (30000)  A
11  EJ  VW3      VW15     =→VW15     no↓
12  RJ  VX       VX1      ( +1 and ) + 1
13  RS  VA11     VC2      Take  ( off list
14  MJ  0        VW6      Return
15  RJ  VX       VX1      ( +1 and ) + 1
16  TP  VW2      Q        Delete from list↓  no→ VW21
17  QJ  VW20     VW21
20  RS  VA11     VC2      Clear ( from list
21  RA  VA7      VC1      Add. of Pro. List +1
22  MJ  0        VW       Exit
    CA  VW23
```

(+1 and) +1

```
    IA  VX
 0  MJ  0        (30000)  Exit
 1  TU  VW10     VX3
 2  RA  VX3      VC3      Increase count on open
 3  TU  (30000)  VX4
 4  RA  (30000)  VC4
 5  TU  VA7      VX6
 6  RA  (30000)  VC4      Increase count on closed
 7  MJ  0        VX       Exit
    CA  VX10
```

Clear Indicators

```
     IA   VB
0    MJ   0      (30000)      Exit
1    TN   VA     Q
2    QT   VA2    VA2          P.T.
3    QT   VA3    VA3          LIB
4    QT   VA4    VA4          POW          } clear
5    QT   VA5    VA5          DIVIDE
6    MJ   0      VB           Exit
     CA   VB7
```

Check for Ambiguity

```
     IA   XB
0    MJ   0      (30000)      Exit
1    TP   VA     Q
2    QT   VA2    A            Ambiguity ↓ no → exit
3    ZJ   XB4    XB
4    TP   VC20   VA16         Set indicator
5    MJ   0      XB           Exit
     CA   XB6
```

Constants

	IA	VC		
0	0	0	0	Zero
1	0	1	1	One
2	0	2	2	Two
3	0	1	0	One in u
4	0	0	1	One in v
5	0	2	1	) count of 1
6	0	1	0	(numbering bit
7	0	07777	0	Sort
10	0	0	0	NP routine
11	0	0	07777	
12	0	0	77777	
13	0	0	70000	Sub. var.
14	0	0	60000	Single operand
15	0	0	50000	LIB
16	0	0	40000	Pseudo Op.
17	0	0	10000	POW'S
20	40	0	0	Close off bit indicator
21	0	0	10	| (open)
22	0	0	12	| (closed) floating
23	0	0	20	Fl. +
24	0	0	21	Fx. +
25	0	0	30	Fl. -
26	0	0	31	Fx. -
27	0	0	32	Fl. Unary -
30	0	0	33	Fx. Unary -
31	0	0	40	,
32	0	0	50	=
33	0	0	60	Fl. *
34	0	0	61	Fx. *
35	0	0	70	Fl. /
36	0	0	71	Fx. /
37	0	0	100	POW
40	0	0	13	| (closed) fixed
41	0	0	120	Δ .
42	0	1	0	(
43	0	2	0	)
44	1	0	0	Level
45	2	0	0	Term
46	3	0	0	LIB
47	4	0	0	POW
50	0	PR1	PR1	Sort
51	0	PR1000	PR1000	Limit of Processed List
52	RP	30000	SR45	Sort routine
53	0	0	2	NP3 and NP32
54	TP	0	0	Sort
55	77	77777	77777	

56	0	0	101	POW (int.)
57	0	2	0	2 in u
60	0	WL24	WL24	Sym/wd and No. Lists
61	0	PR	PR	Processed and Sorted Lists
62	0	NS	NS	Number of Symbol List
63	0	PL	PL	Parenthesis List
	CA	VC64		

Variables (VA) - Explanation of Temporaries

VA 0	0	0	1		Level bit
1	(	)			Combination List size
2					Print Term this level
3					LIB this level
4					POW this level
5					Divide this level
6	(	)	(	)	Address in Sym/Wd List and Numbered List
7	(	)	(	)	Address in Processed List and Sorted List
10	(	)	(	)	Address of Symbol Number
11	(	)	(	)	Available address in (list
12	(	)			r - 1 in sort
13	(	)			j n in print
14					Highest number of ('s
15					Index
16					Temp 1- ambiguous term bit
17	(	)			Temp 2
20	(	)			Temp 3- add. to start pr. of Pro. List
21	(	)	(	)	n of repeat to set Pro. List
22	(	)	(	)	# of nos. in Sorted List
23	0	0	(0)		Unused
24	(	)			j n in sort.

EQUATION GENERATION NO. 2

EQUATION REDUNDANCY CHECK AND EQUATION GENERATION PHASE

The purpose of the Equation Redundancy check and Equation Generation Phase is two-fold:

1) The elimination of redundant calculations within the same equation;

2) The generation of a relatively coded routine for each equation.

The inputs to this phase are the Sorted List, the Dimension List, and the Pseudo Operation List. The symbols for a given equation are obtained in order from the Sorted List and each operator, together with its operand (s), is put in the form of a pseudo instruction to facilitate the check for redundant calculations. These pseudo instructions are entered in what is called the Expanded List, unless an identical pseudo instruction has been previously entered. In the case of an identical previous entry, the current pseudo instruction represents a redundant calculation and provision is made to utilize the result of the prior calculation. Through the special formats for the pseudo instructions, many redundant calculations will be eliminated. For example:

1) Identical Symbol Strings.
   eg., X = sin (A+B+C-D/E) + (A+B+C-D/E) Pow 2
   The quantity (A+B+C-D/E) will be calculated only once.

2) Simple Transpositions.
   eg., X = A*B-sin(B*A)
   The quantity A*B will be recognized as equivalent to the quantity B*A and would not be recomputed.

3) Transpositions within Expressions where some reordering is caused by the hierarchy of operators.
   eg., X = (A+B*C)/E - tan((C*B+A)/E)
   The quantities (A+B*C)/E and (C*B+A)/E will be recognized as equivalent and only one computation will be made.

A unique partial result symbol for each calculation is entered in the Expanded List following each pseudo instruction. This partial result symbol identifies the result of a given calculation as an operand for a succeeding calculation. When a partial result from a calculation is used as an operand for

the next calculation, register storage (A or Q) may be utilized; hence, each pseudo instruction is checked to determine if the last assigned partial result appears as one of its operands. In this way, effective utilization of register storage is realized; thereby minimizing the need for temporary storage.

The Expanded List, together with lists of supplemental information, serves as input for the generation of the relatively coded equation routine. Each pseudo instruction is obtained in order from the Expanded List and decoded. The series of relatively coded machine instructions necessary to perform the required computation and store the partial result is then generated. After all pseudo instructions have been processed, the fixed constants and relative constants are transferred to the generated routine package. At this time also, the Op File describing this generated routine is prepared. The equation routine and Op File are then transcribed on magnetic tape for use as input to succeeding phases of the compiler.

As an example, consider the equation:

$$X = A+B*C - \sin(C*B)$$

In the Sorted List this equation would appear as:

X

B
C
*
A
+
C
B
*
sin
-
Δ.

Following the elimination of redundant calculations, the equation appears in pseudo instruction form in the Expanded List as:

*	B	C
		PR 1
+	PR 1	A
		PR 2
sin	0	PR 1
		PR 3
-	PR 2	PR 3
		PR 4
Δ.	PR 4	X

Note 1: (PR__) represents unique partial result symbols.

Note 2: The computation of the quantity (C*B) is recognized as a redundant calculation and the result of the prior calculation (PR 1) is used as the argument for the "sin" operator.

The Expanded List is processed to form the following generated equation routine:

EXIT	MJ	0	[ ]	
ENTRY	FM	B	C	B*C → Q
	TP	Q	TEMP 1	B*C → TEMP 1
	FA	Q	A	B*C+A → Q
	TP	Q	TEMP 2	B*C+A → TEMP 2
	TP	TEMP 1	SIN	B*C → SIN + 3
	10	0	3	
	RJ	SIN	SIN	SIN(B*C) → Q
	10	2	0	
	TN	Q	Q	-SIN(B*C) → Q
	FA	Q	TEMP 2	[-SIN(B*C)] + [B*C+A] → Q
	TP	Q	X	A + B*C-SIN(B*C) → X

Consider another equation which appears in the Sorted List as:

8	X
6	B
5	C
4	D
4	POW
3	*
2	A
2	+
1	Δ.

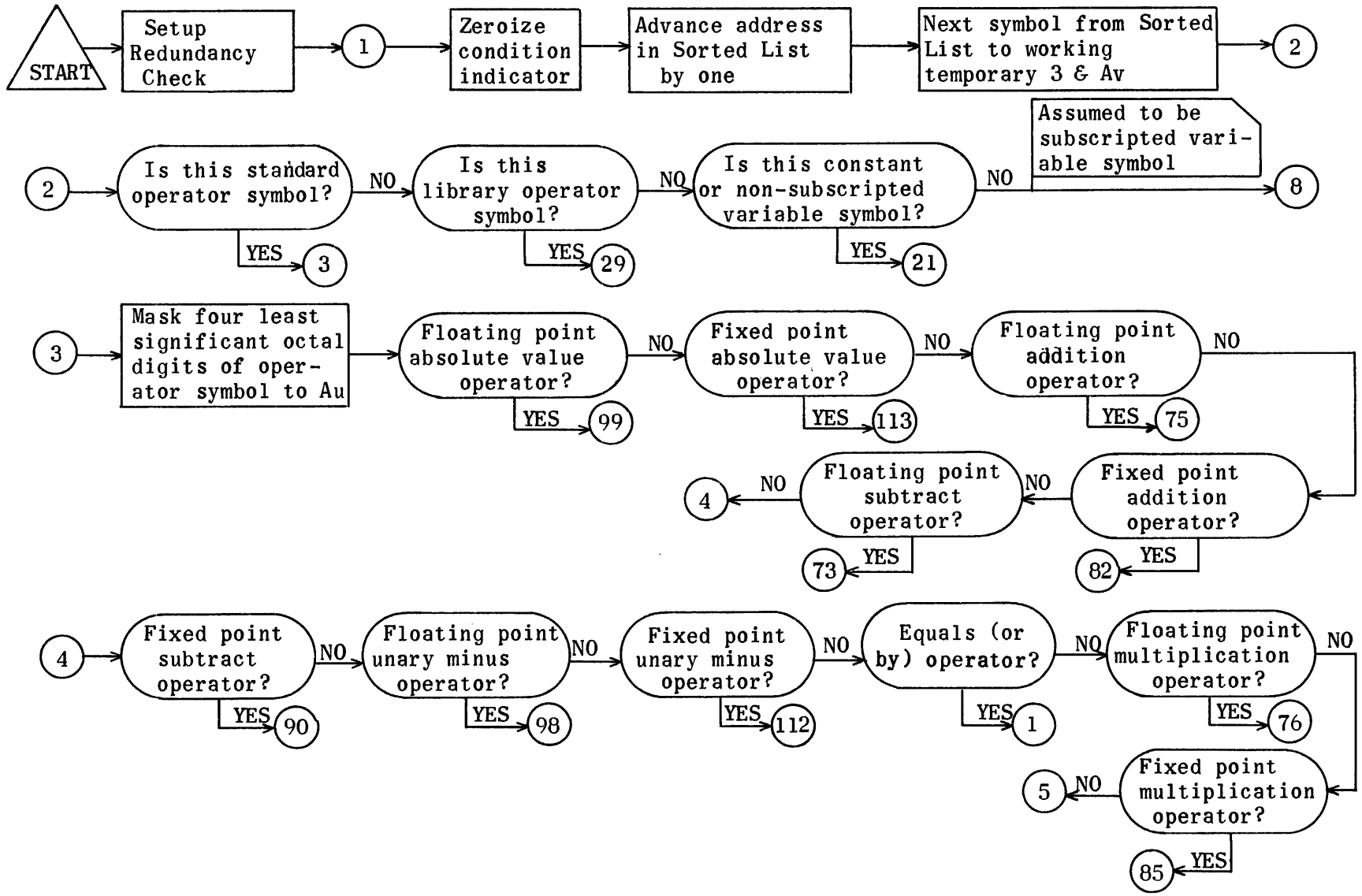
Following the elimination of redundancies (none in the example), the equation appears in the Expanded List as:

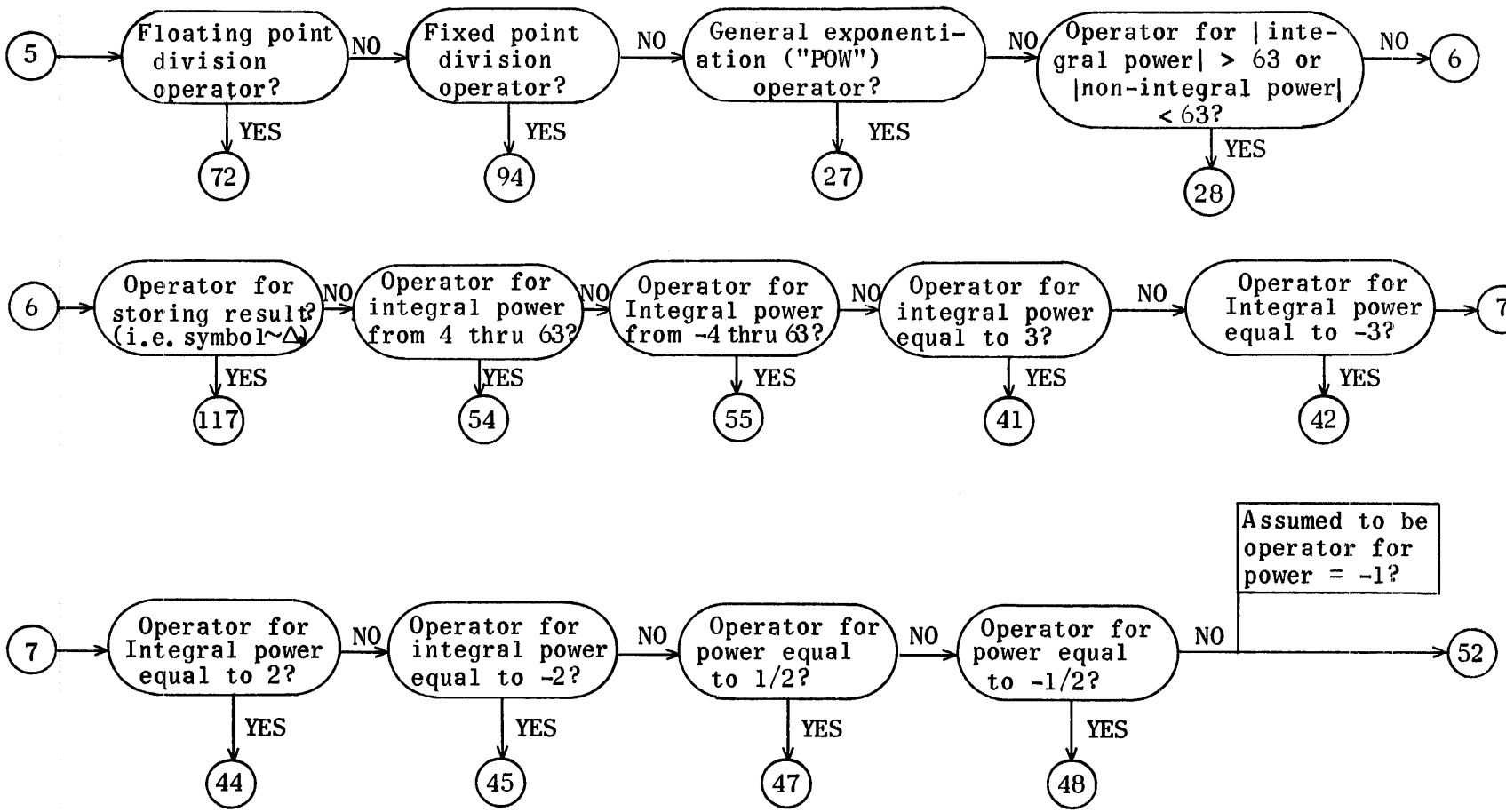
POW	C	D	
		PR 1	
*	PR 1	B	
		PR 2	
+	PR 2	A	
		PR 3	
Δ.	PR 3	X	

Finally, the generated equation routine would be:

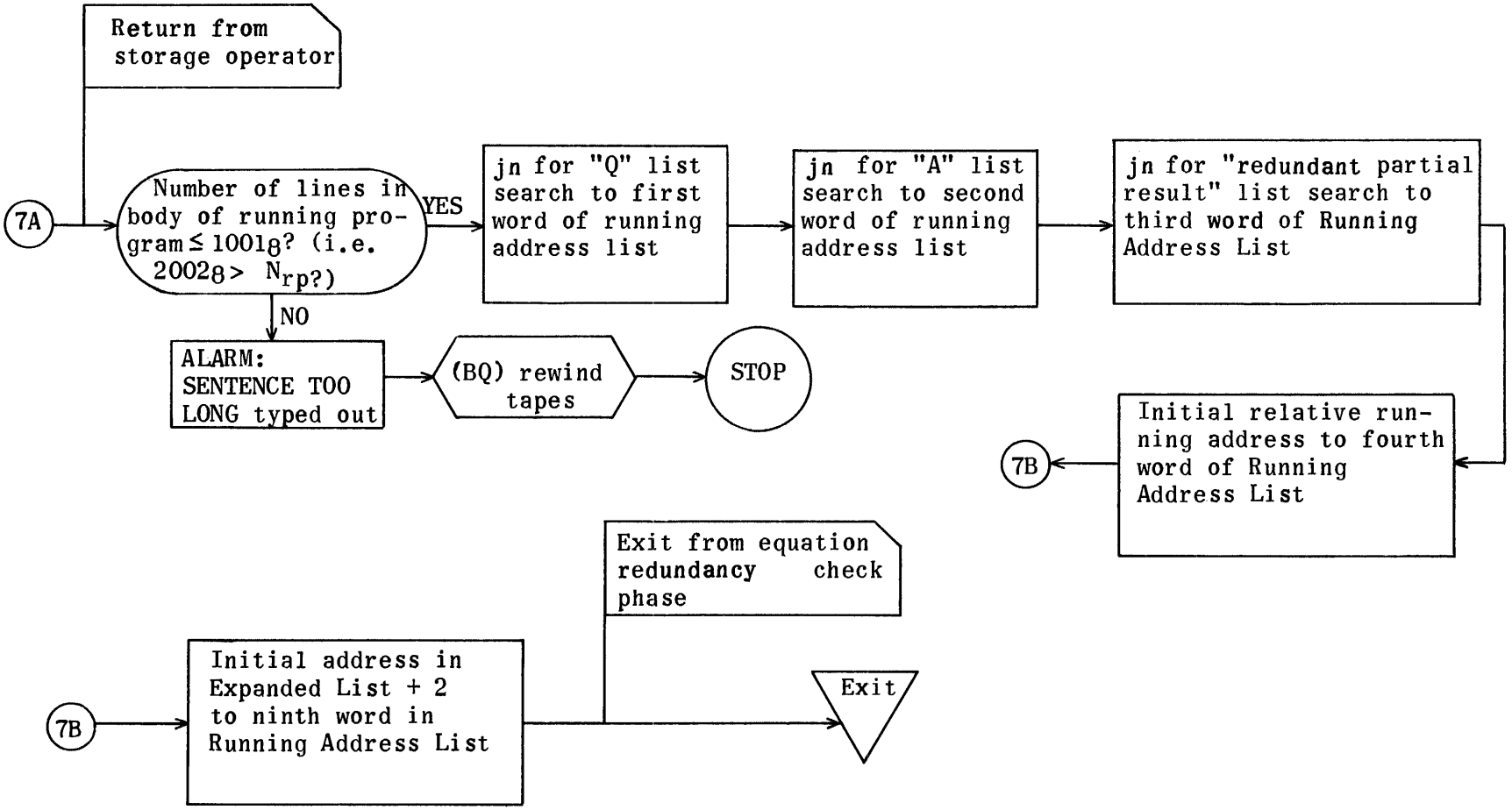
EXIT	MJ	0	[ ]
ENTRY	TP	C	POW
	10	0	3
	TP	D	POW
	10	0	4
	RJ	POW	POW
	10	2	0
	FM	Q	B
	FA	Q	A
	TP	Q	X
	MJ	0	EXIT

Equation Redundancy Check (Symbol Search)

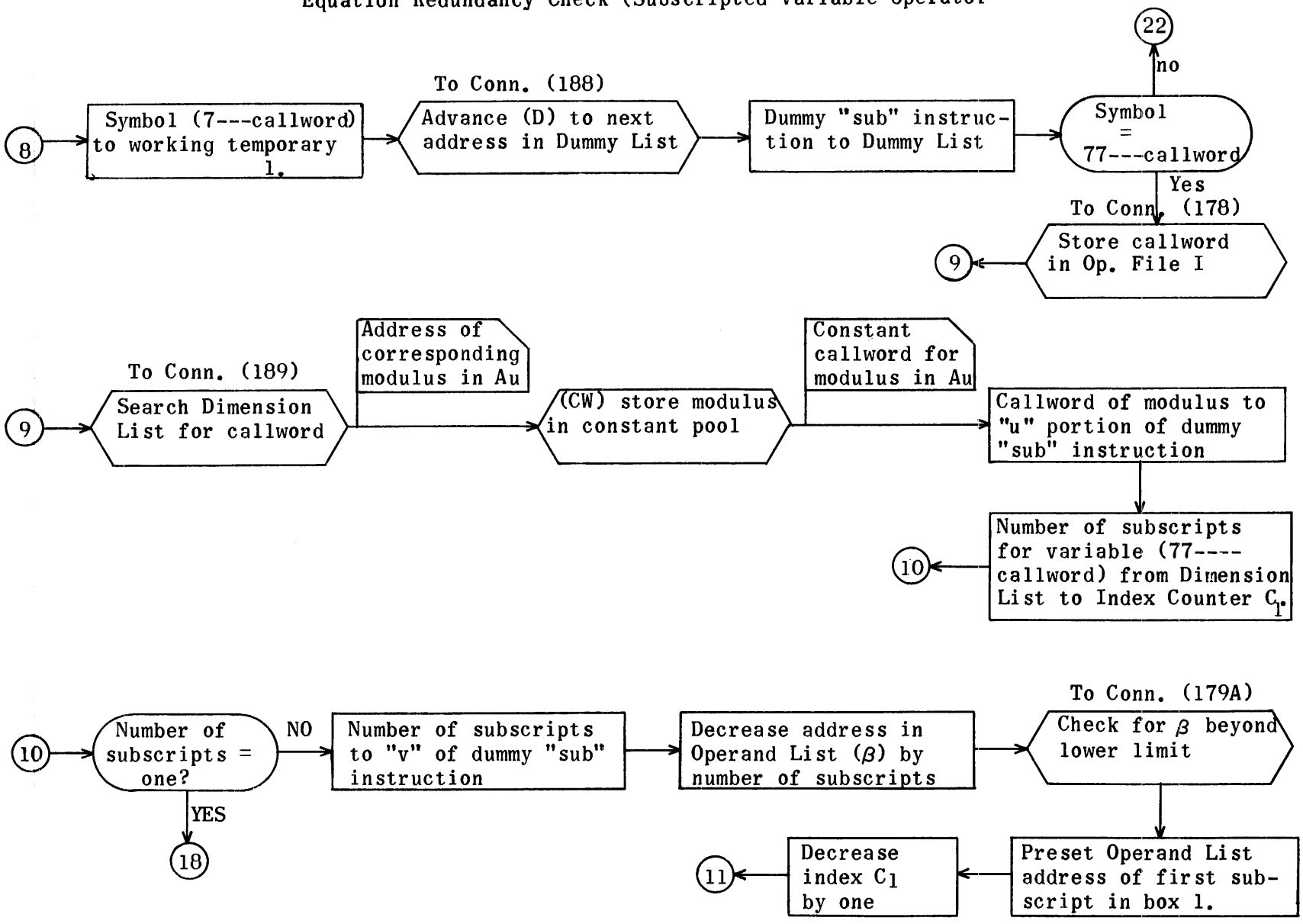


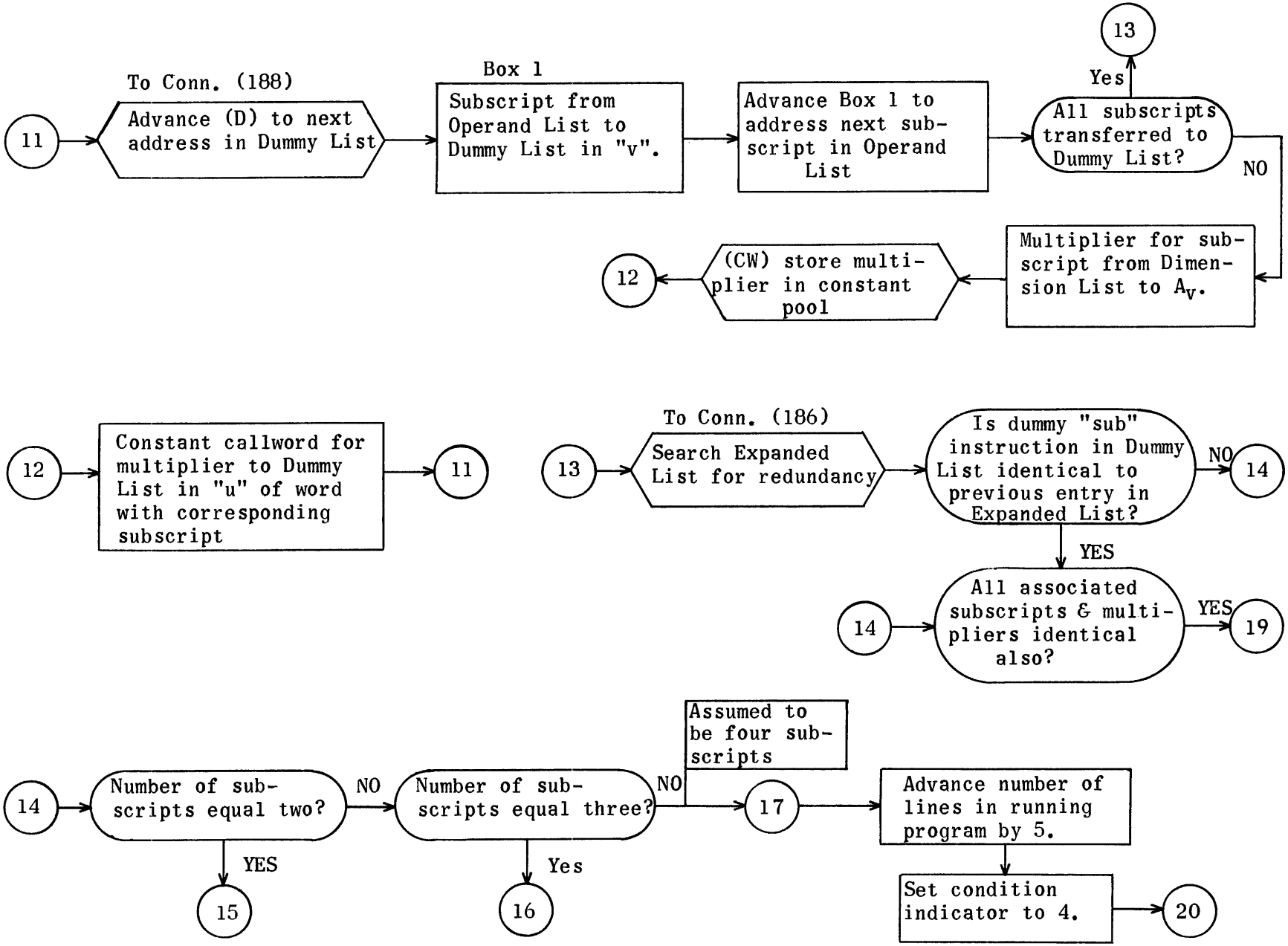

5
Floating point division operator?
NO
Fixed point division operator?
NO
General exponentiation ("POW") operator?
NO
Operator for |integral power| > 63 or |non-integral power| < 63?
NO
6
YES
72
YES
94
YES
27
YES
28
6
Operator for storing result? (i.e. symbol~Δ)
NO
Operator for integral power from 4 thru 63?
NO
Operator for Integral power from -4 thru 63?
NO
Operator for integral power equal to 3?
NO
Operator for Integral power equal to -3?
7
YES
117
YES
54
YES
55
YES
41
YES
42
7
Operator for Integral power equal to 2?
NO
Operator for integral power equal to -2?
NO
Operator for power equal to 1/2?
NO
Operator for power equal to -1/2?
NO
Assumed to be operator for power = -1?
52
YES
44
YES
45
YES
47
YES
48

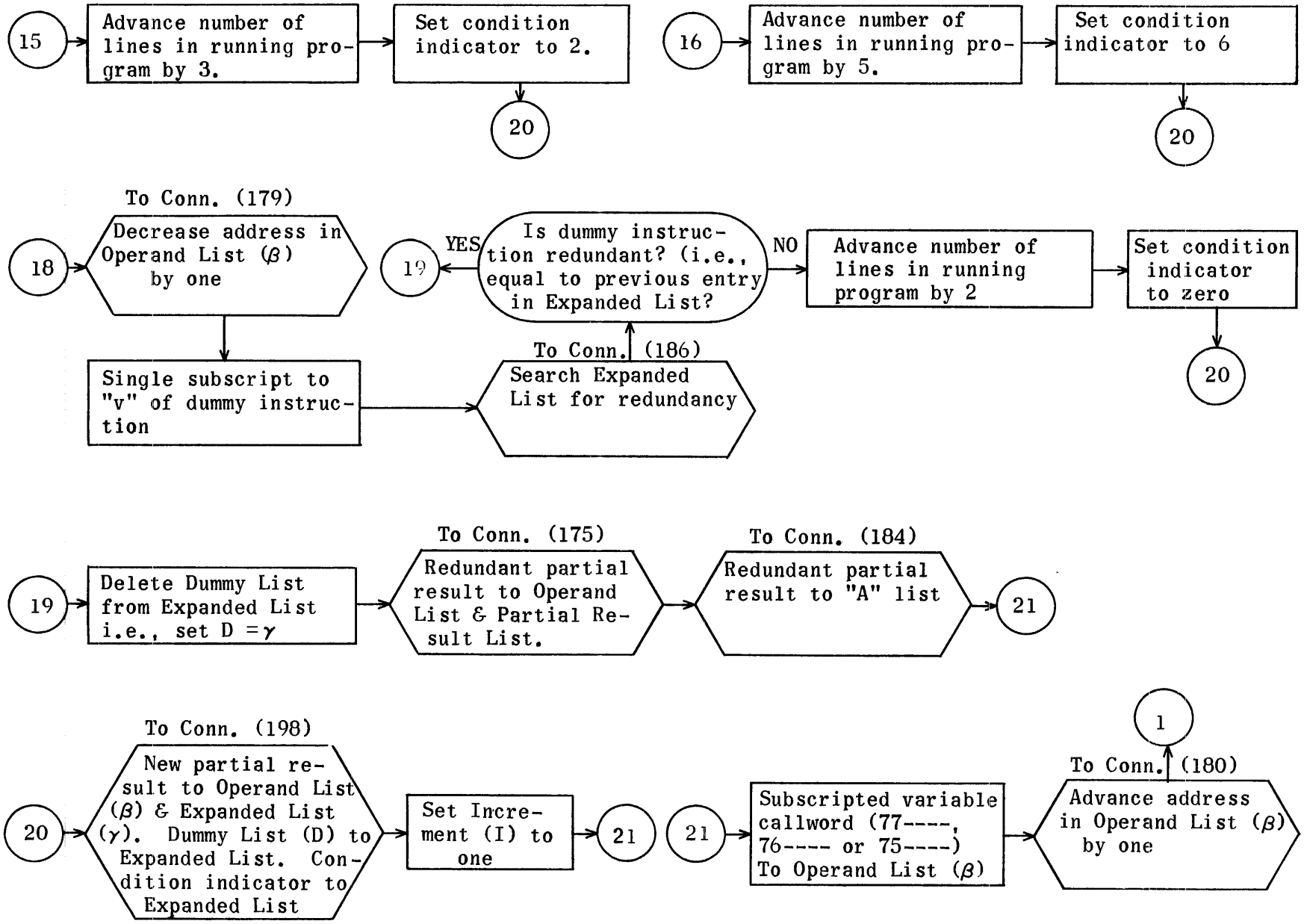
END EQUATION REDUNDANCY CHECK

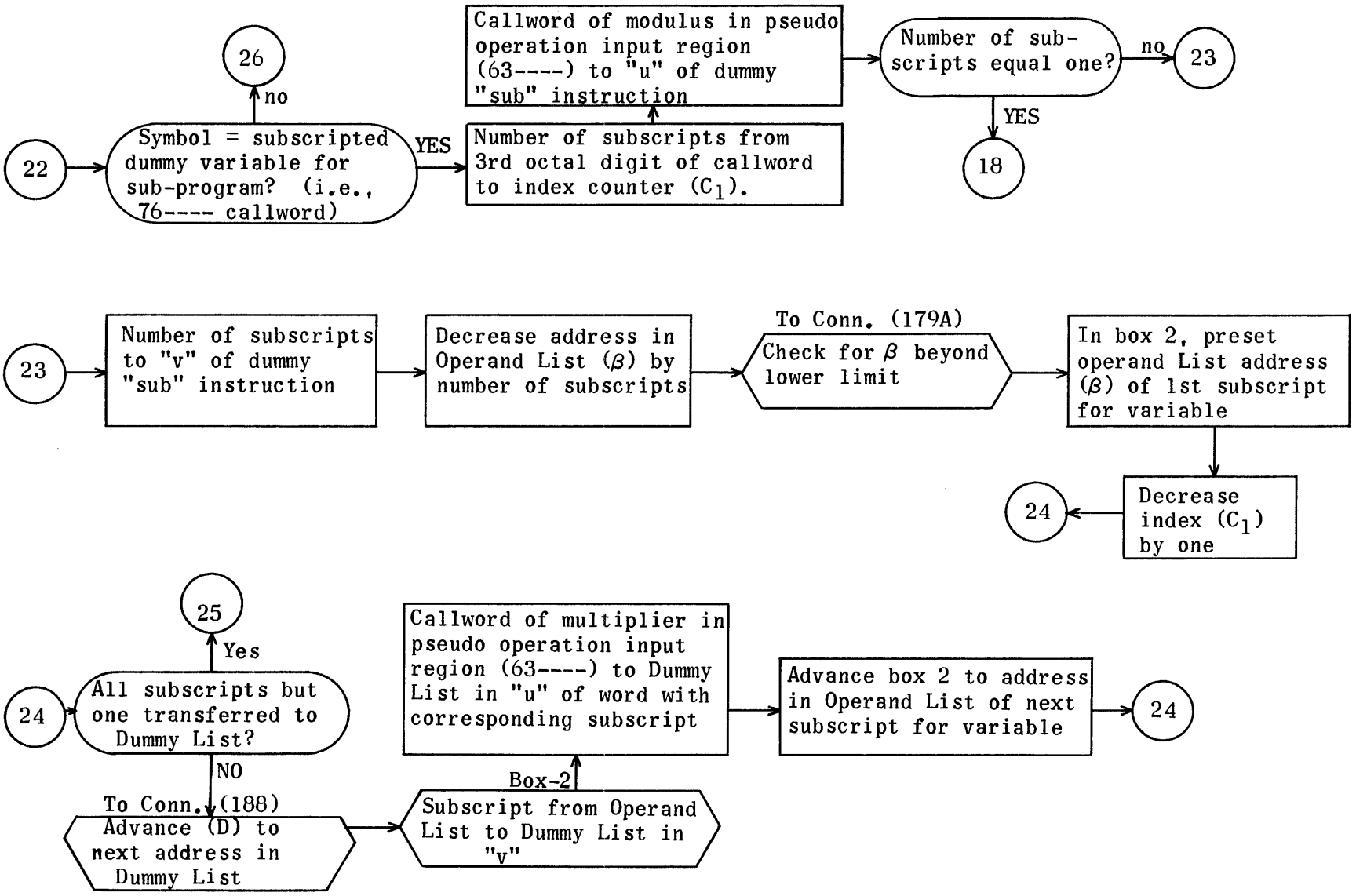


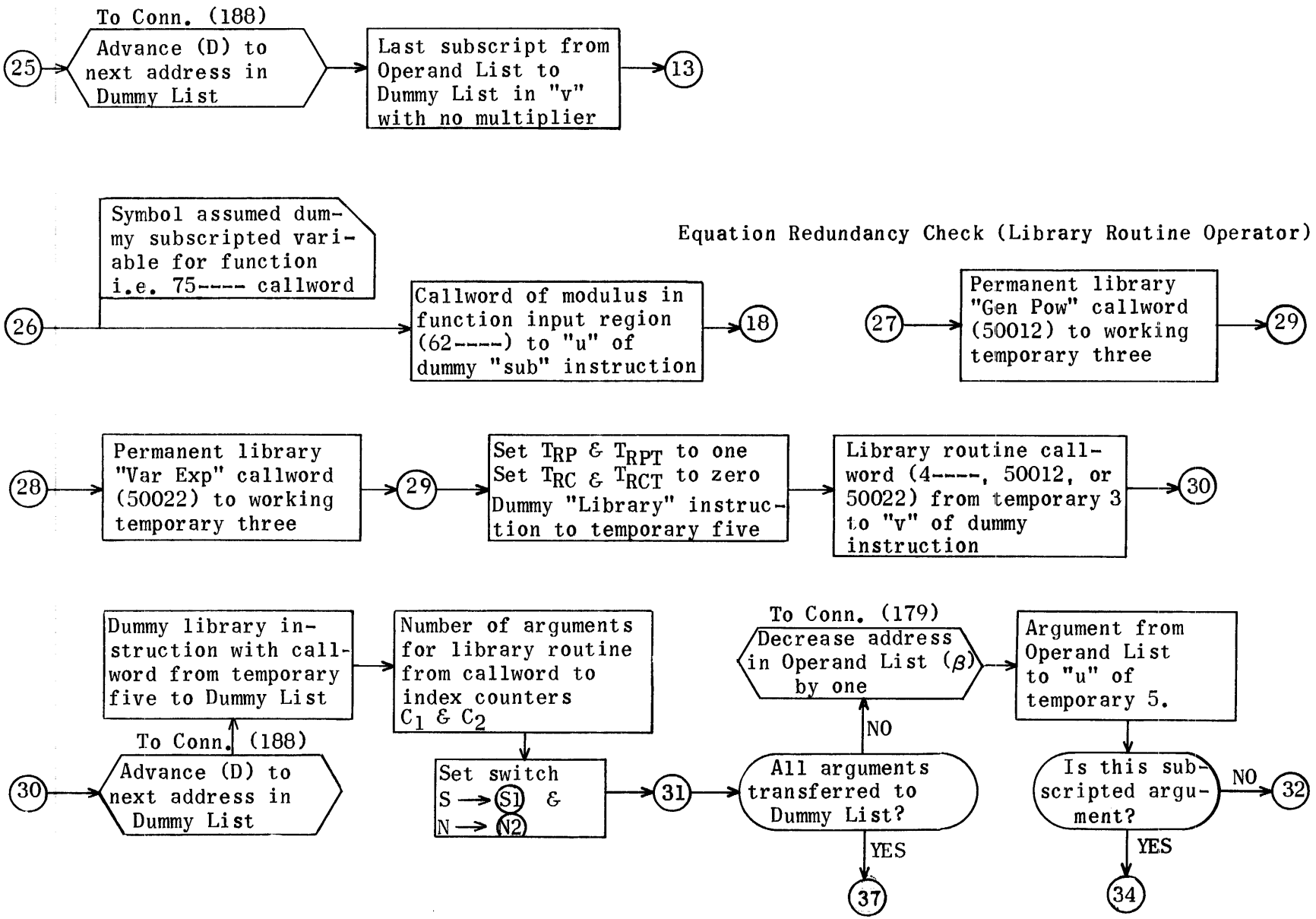
Equation Redundancy Check (Subscripted Variable Operator

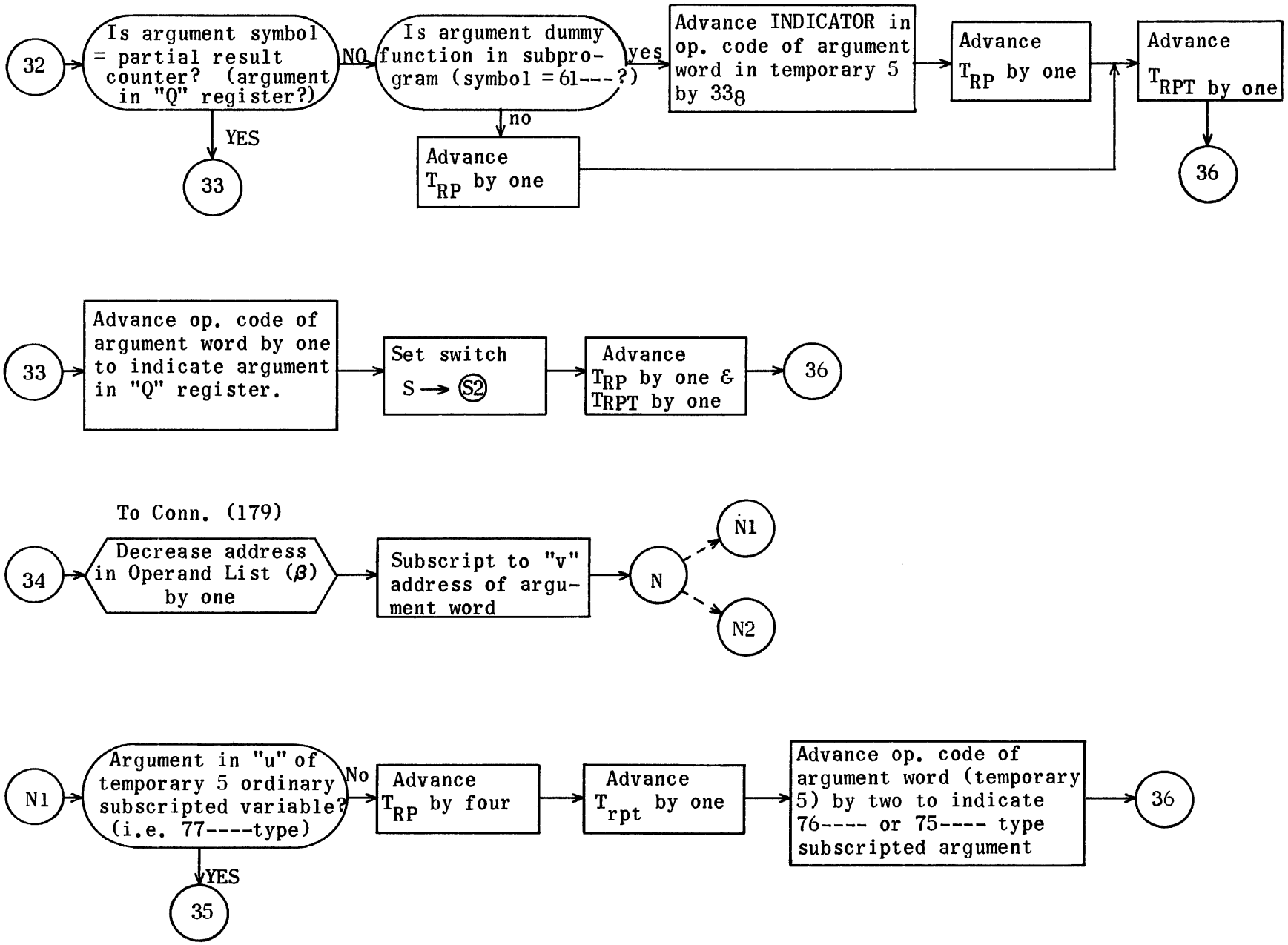



11
To Conn. (188)
Advance (D) to next address in Dummy List
Box 1
Subscript from Operand List to Dummy List in "v".
Advance Box 1 to address next subscript in Operand List
13
Yes
All subscripts transferred to Dummy List?
NO
Multiplier for subscript from Dimension List to A_v.
12
(CW) store multiplier in constant pool
12
Constant callword for multiplier to Dummy List in "u" of word with corresponding subscript
11
13
To Conn. (186)
Search Expanded List for redundancy
Is dummy "sub" instruction in Dummy List identical to previous entry in Expanded List?
NO
14
YES
14
All associated subscripts & multipliers identical also?
YES
19
14
Number of subscripts equal two?
NO
Number of subscripts equal three?
NO
Assumed to be four subscripts
17
Advance number of lines in running program by 5.
YES
15
Yes
16
Set condition indicator to 4.
20

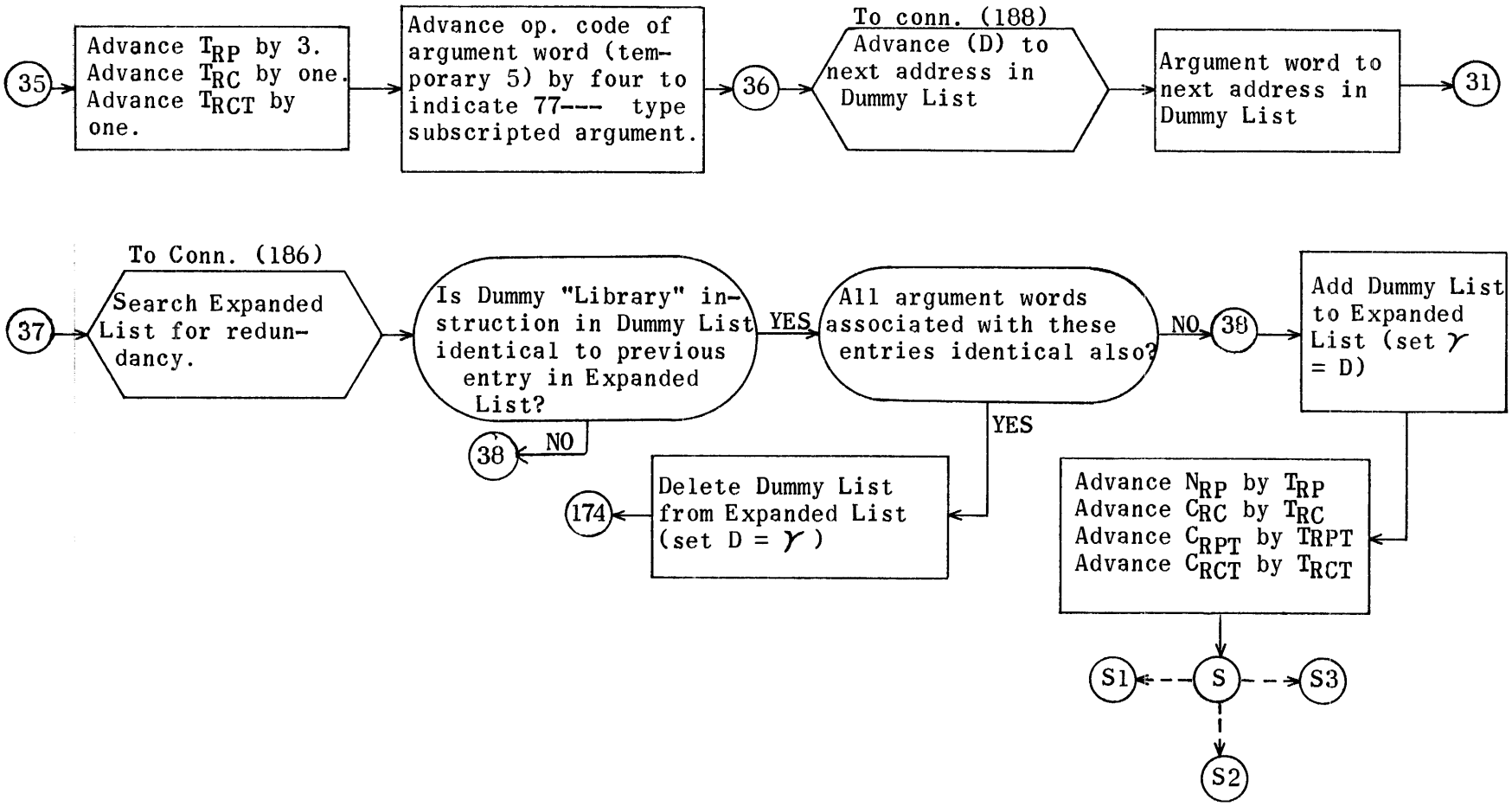

15
Advance number of lines in running program by 3.
Set condition indicator to 2.
20
16
Advance number of lines in running program by 5.
Set condition indicator to 6
20
To Conn. (179)
18
Decrease address in Operand List (β) by one
Single subscript to "v" of dummy instruction
19
YES
Is dummy instruction redundant? (i.e., equal to previous entry in Expanded List?
NO
Advance number of lines in running program by 2
Set condition indicator to zero
20
To Conn. (186)
Search Expanded List for redundancy
19
Delete Dummy List from Expanded List i.e., set D = γ
To Conn. (175)
Redundant partial result to Operand List & Partial Result List.
To Conn. (184)
Redundant partial result to "A" list
21
To Conn. (198)
20
New partial result to Operand List (β) & Expanded List (γ). Dummy List (D) to Expanded List. Condition indicator to Expanded List
Set Increment (I) to one
21
21
Subscripted variable callword (77----, 76---- or 75----) To Operand List (β)
1
To Conn. (180)
Advance address in Operand List (β) by one

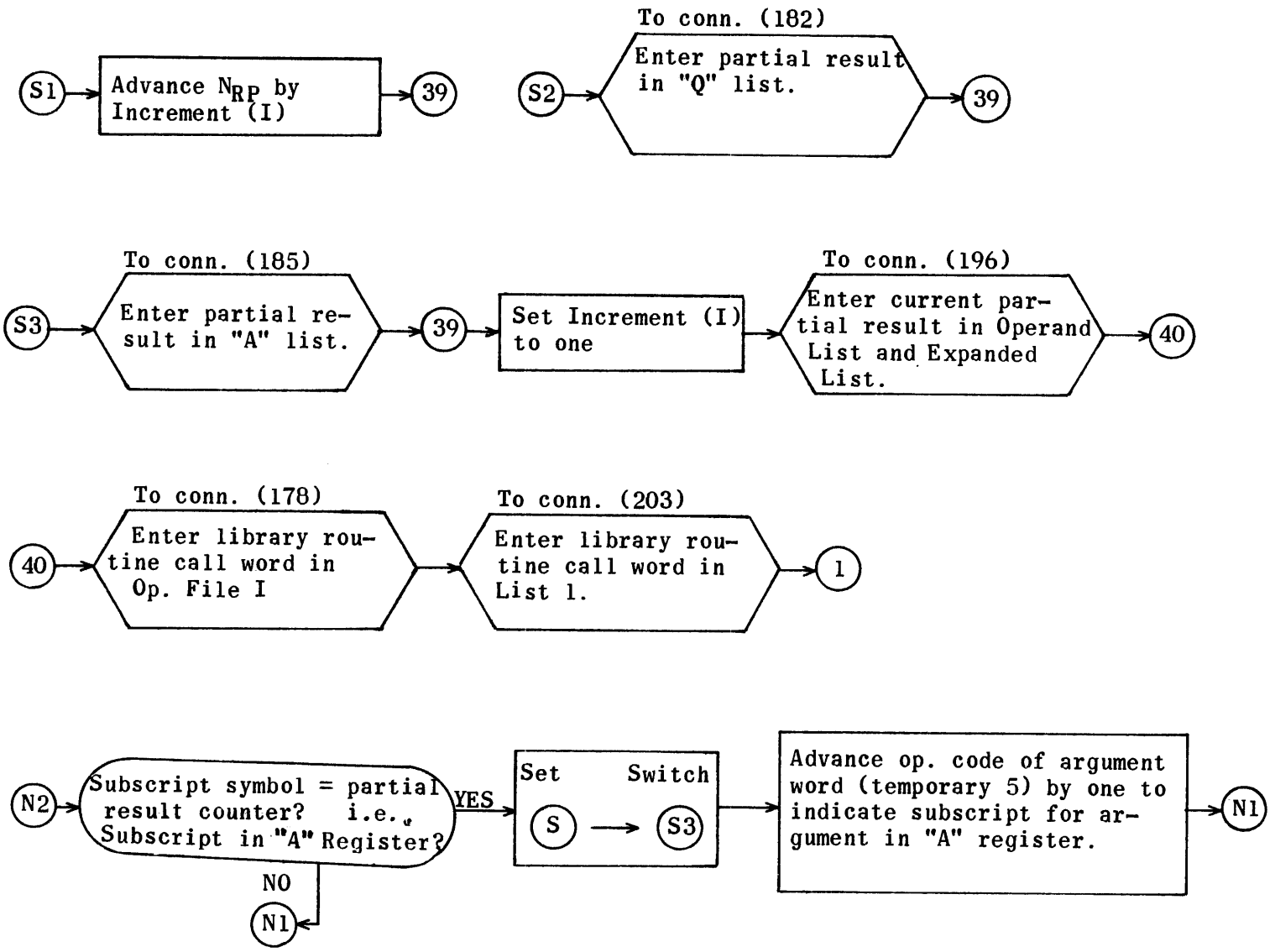

22
Symbol = subscripted dummy variable for sub-program? (i.e., 76---- callword)
no
26
YES
Number of subscripts from 3rd octal digit of callword to index counter (C_1).
Callword of modulus in pseudo operation input region (63----) to "u" of dummy "sub" instruction
Number of sub-scripts equal one?
no
23
YES
18
23
Number of subscripts to "v" of dummy "sub" instruction
Decrease address in Operand List (β) by number of subscripts
To Conn. (179A)
Check for β beyond lower limit
In box 2, preset operand List address (β) of 1st subscript for variable
Decrease index (C_1) by one
24
24
All subscripts but one transferred to Dummy List?
Yes
25
NO
To Conn. (188)
Advance (D) to next address in Dummy List
Box-2
Subscript from Operand List to Dummy List in "v"
Callword of multiplier in pseudo operation input region (63----) to Dummy List in "u" of word with corresponding subscript
Advance box 2 to address in Operand List of next subscript for variable
24


To Conn. (188)
25
Advance (D) to next address in Dummy List
Last subscript from Operand List to Dummy List in "v" with no multiplier
13
Symbol assumed dummy subscripted variable for function i.e. 75---- callword
26
Callword of modulus in function input region (62----) to "u" of dummy "sub" instruction
18
Equation Redundancy Check (Library Routine Operator)
27
Permanent library "Gen Pow" callword (50012) to working temporary three
29
28
Permanent library "Var Exp" callword (50022) to working temporary three
29
Set T_{RP} & T_{RPT} to one
Set T_{RC} & T_{RCT} to zero
Dummy "Library" instruction to temporary five
Library routine callword (4----, 50012, or 50022) from temporary 3 to "v" of dummy instruction
30
Dummy library instruction with callword from temporary five to Dummy List
Number of arguments for library routine from callword to index counters C_1 & C_2
To Conn. (179)
Decrease address in Operand List (β) by one
Argument from Operand List to "u" of temporary 5.
To Conn. (188)
30
Advance (D) to next address in Dummy List
Set switch
S → S1 &
N → N2
31
NO
All arguments transferred to Dummy List?
Is this subscripted argument?
NO
32
YES
37
YES
34

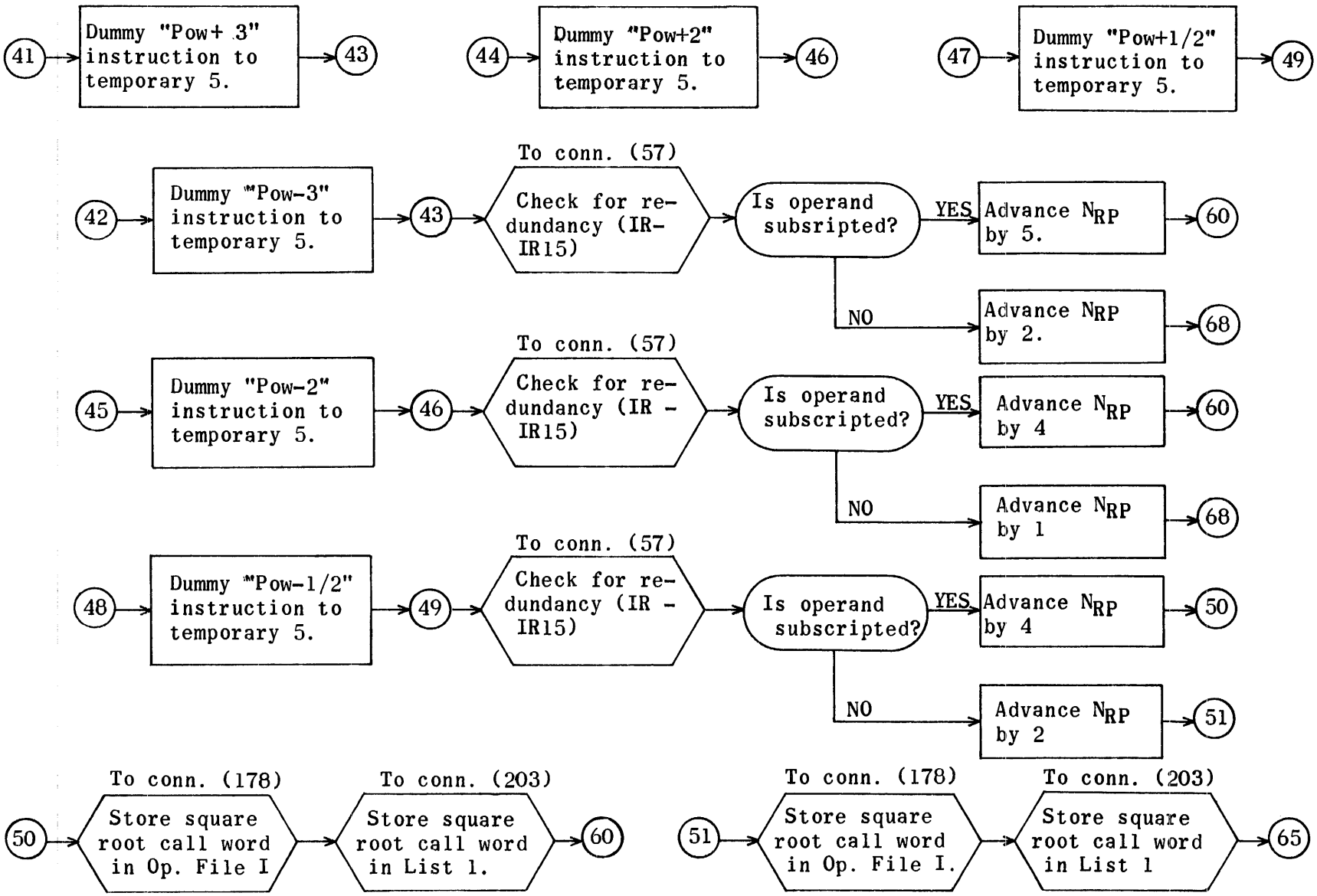

32
Is argument symbol = partial result counter? (argument in "Q" register?)
NO
Is argument dummy function in subprogram (symbol = 61---?)
yes
Advance INDICATOR in op. code of argument word in temporary 5 by 33₈
Advance T_{RP} by one
Advance T_{RPT} by one
36
YES
33
no
Advance T_{RP} by one
33
Advance op. code of argument word by one to indicate argument in "Q" register.
Set switch S → S2
Advance T_{RP} by one & T_{RPT} by one
36
To Conn. (179)
34
Decrease address in Operand List (β) by one
Subscript to "v" address of argument word
N
N1
N2
N1
Argument in "u" of temporary 5 ordinary subscripted variable? (i.e. 77----type)
No
Advance T_{RP} by four
Advance T_{rpt} by one
Advance op. code of argument word (temporary 5) by two to indicate 76---- or 75---- type subscripted argument
36
YES
35

Equation Redundancy Check (Library Routine Operator)

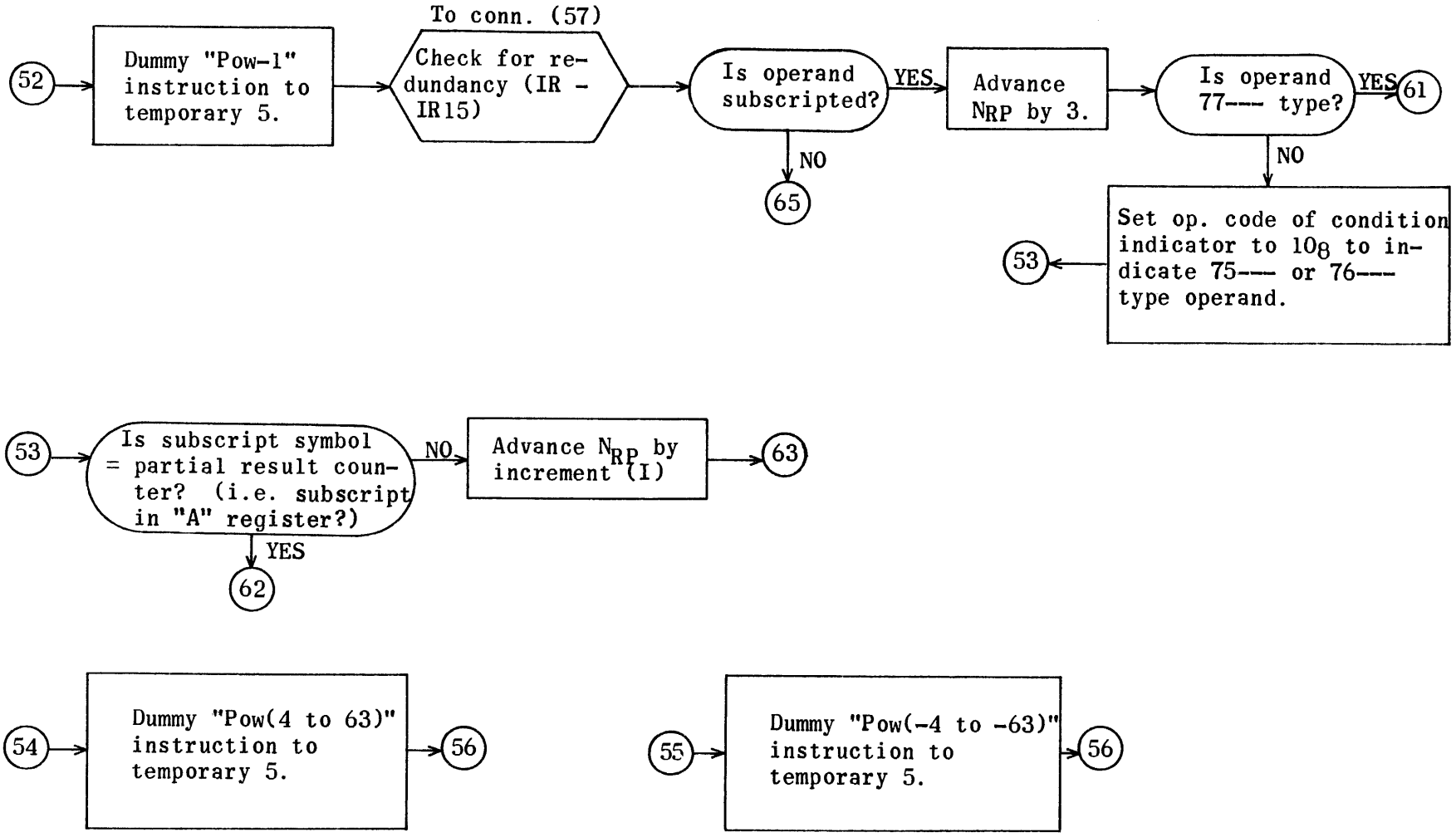


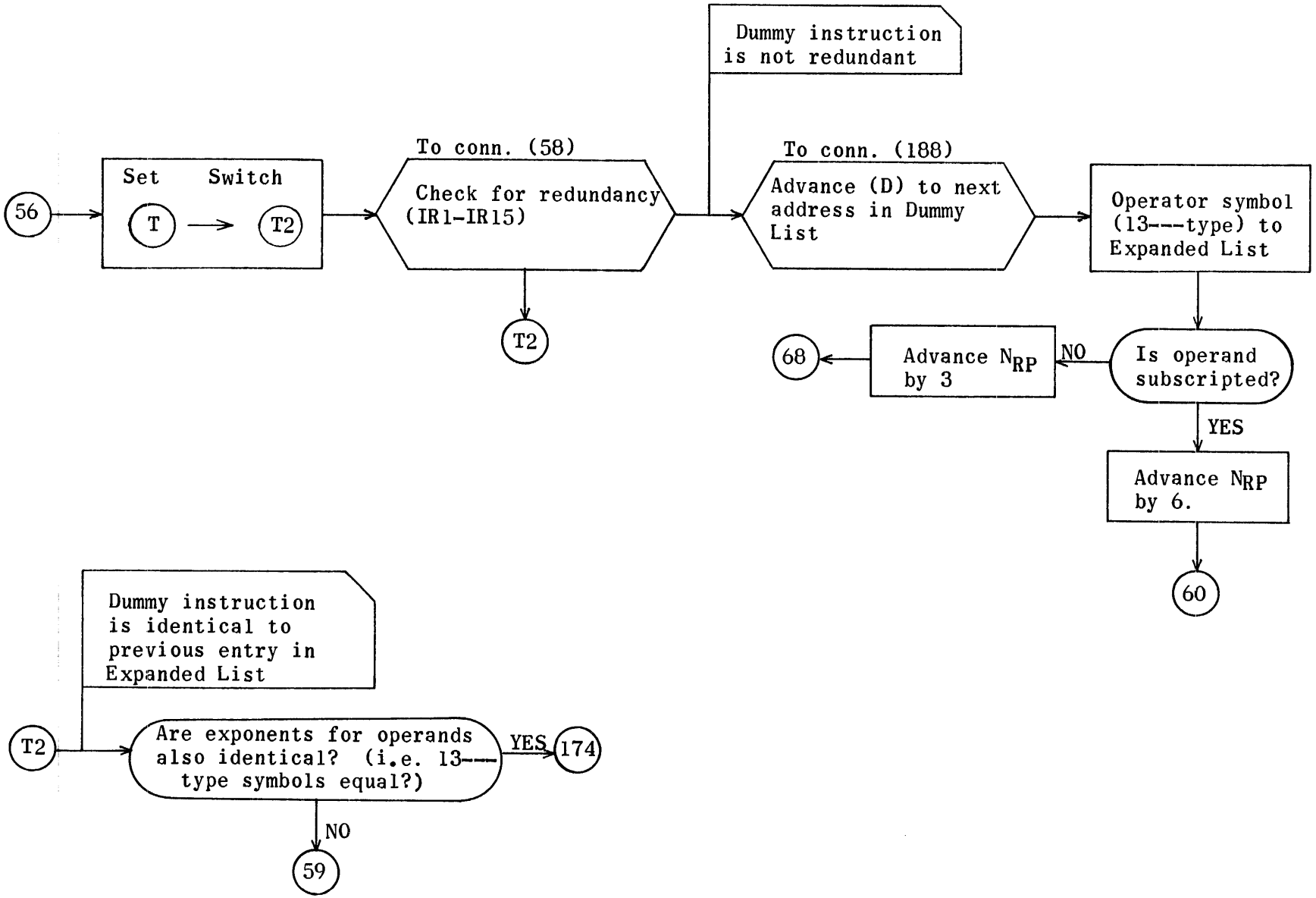

S1
Advance N_{RP} by Increment (I)
39
To conn. (182)
S2
Enter partial result in "Q" list.
39
S3
To conn. (185)
Enter partial result in "A" list.
39
Set Increment (I) to one
To conn. (196)
Enter current partial result in Operand List and Expanded List.
40
40
To conn. (178)
Enter library routine call word in Op. File I
To conn. (203)
Enter library routine call word in List 1.
1
N2
Subscript symbol = partial result counter? i.e., Subscript in "A" Register?
YES
Set
Switch
S
S3
Advance op. code of argument word (temporary 5) by one to indicate subscript for argument in "A" register.
N1
NO
N1

Equation Redundancy Check (Power Operators)

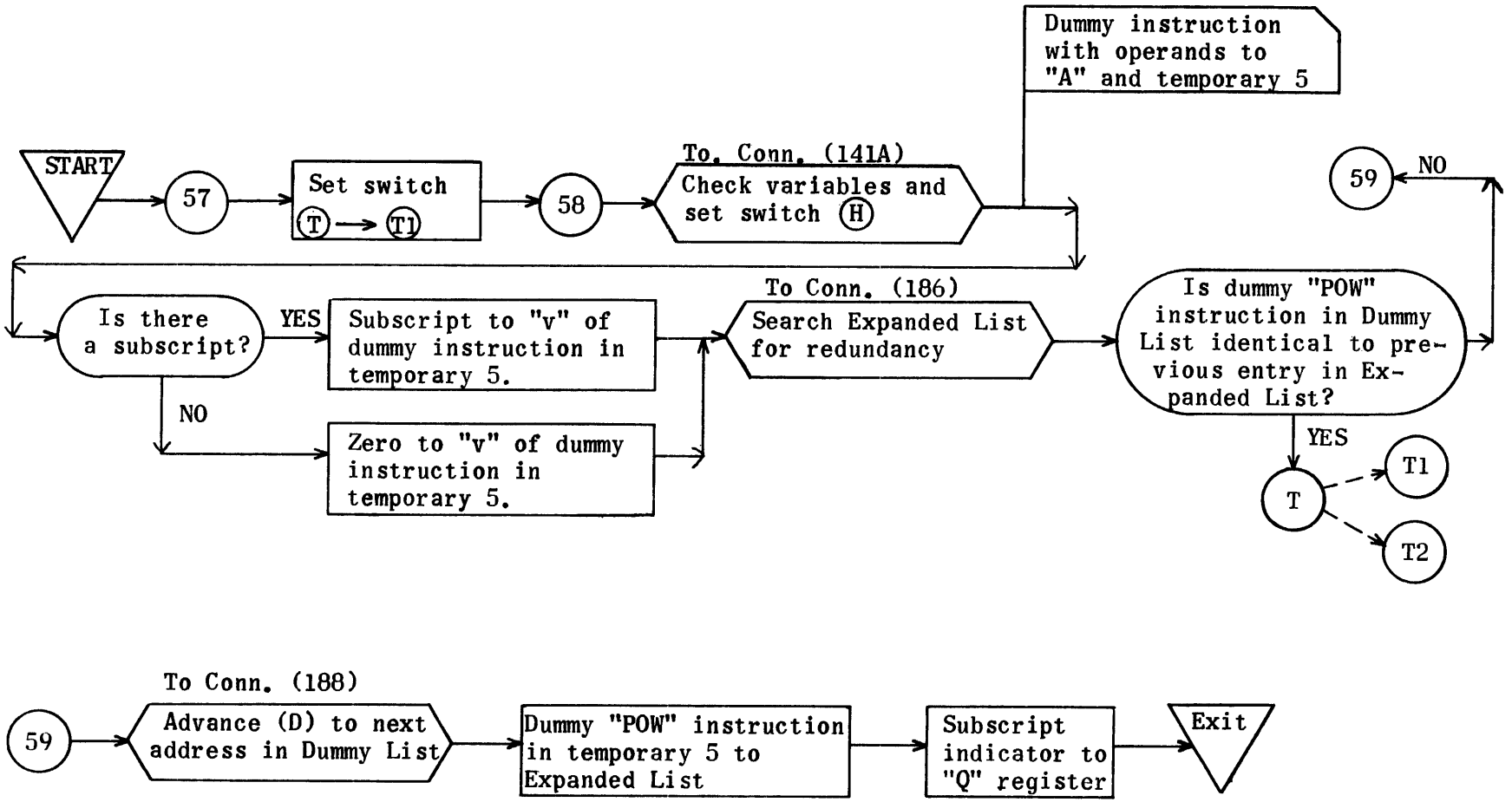


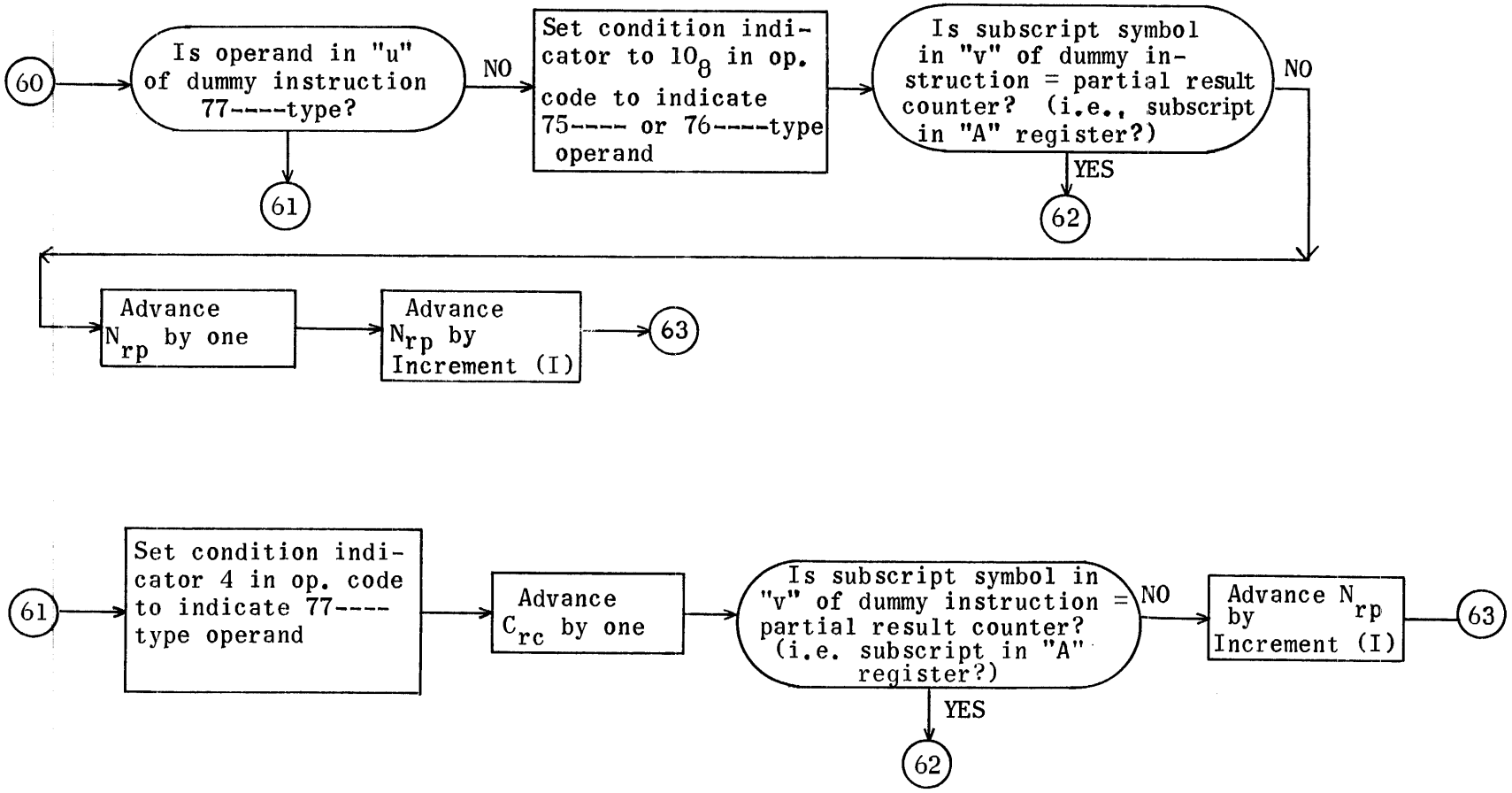
Equation Redundancy Check (Integral Power Operator)

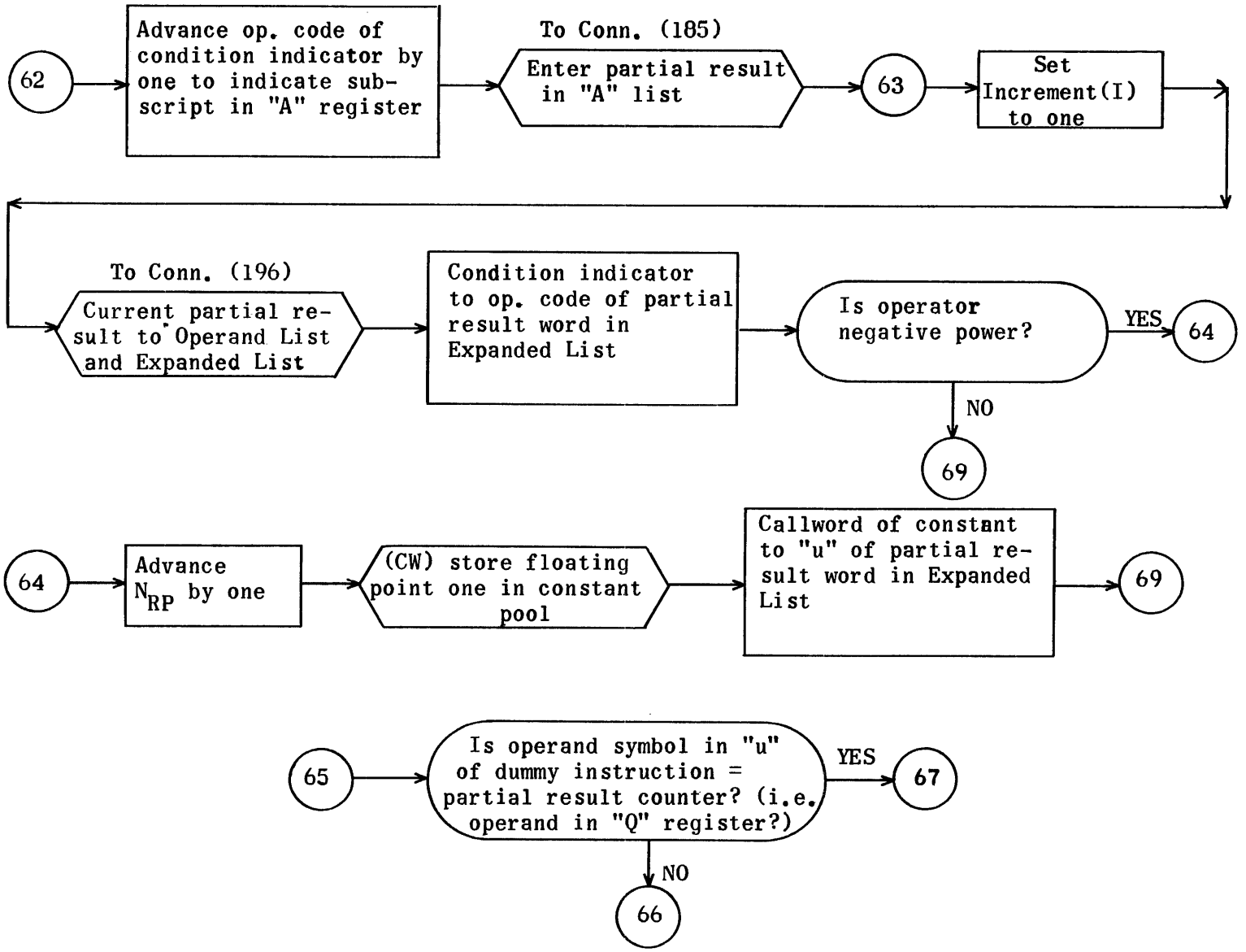


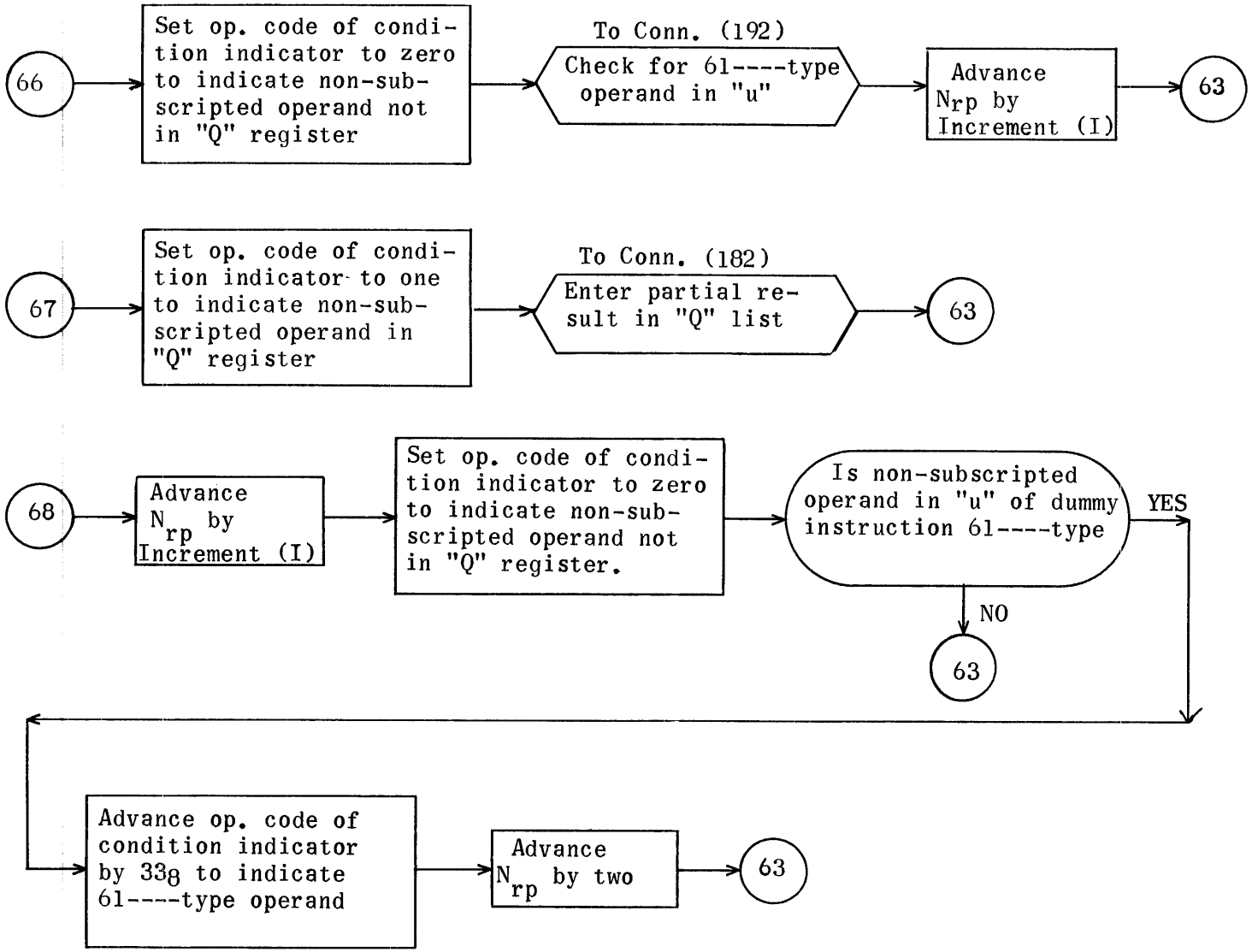

56
Set Switch
T
T2
To conn. (58)
Check for redundancy (IR1-IR15)
T2
Dummy instruction is not redundant
To conn. (188)
Advance (D) to next address in Dummy List
Operator symbol (13---type) to Expanded List
Is operand subscripted?
NO
Advance N_{RP} by 3
68
YES
Advance N_{RP} by 6.
60
Dummy instruction is identical to previous entry in Expanded List
T2
Are exponents for operands also identical? (i.e. 13--- type symbols equal?)
YES
174
NO
59

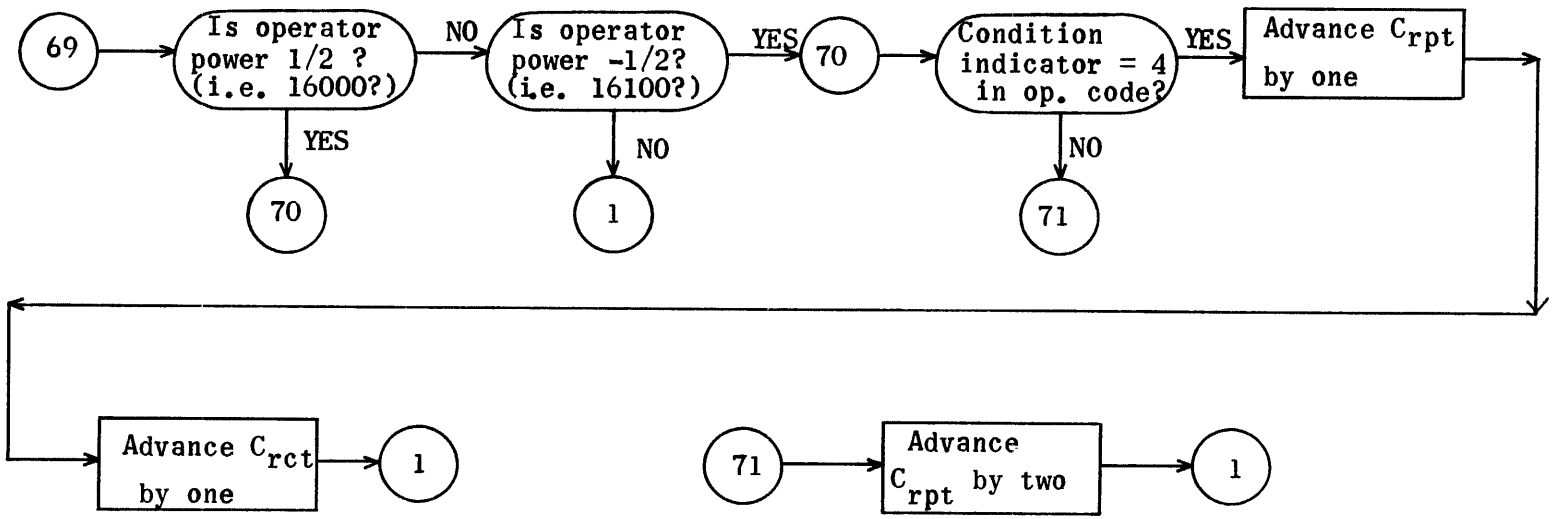
Equation Redundancy Check (Integral Power Operator)
Subroutine To Check for Redundancy of Integral Power Operator



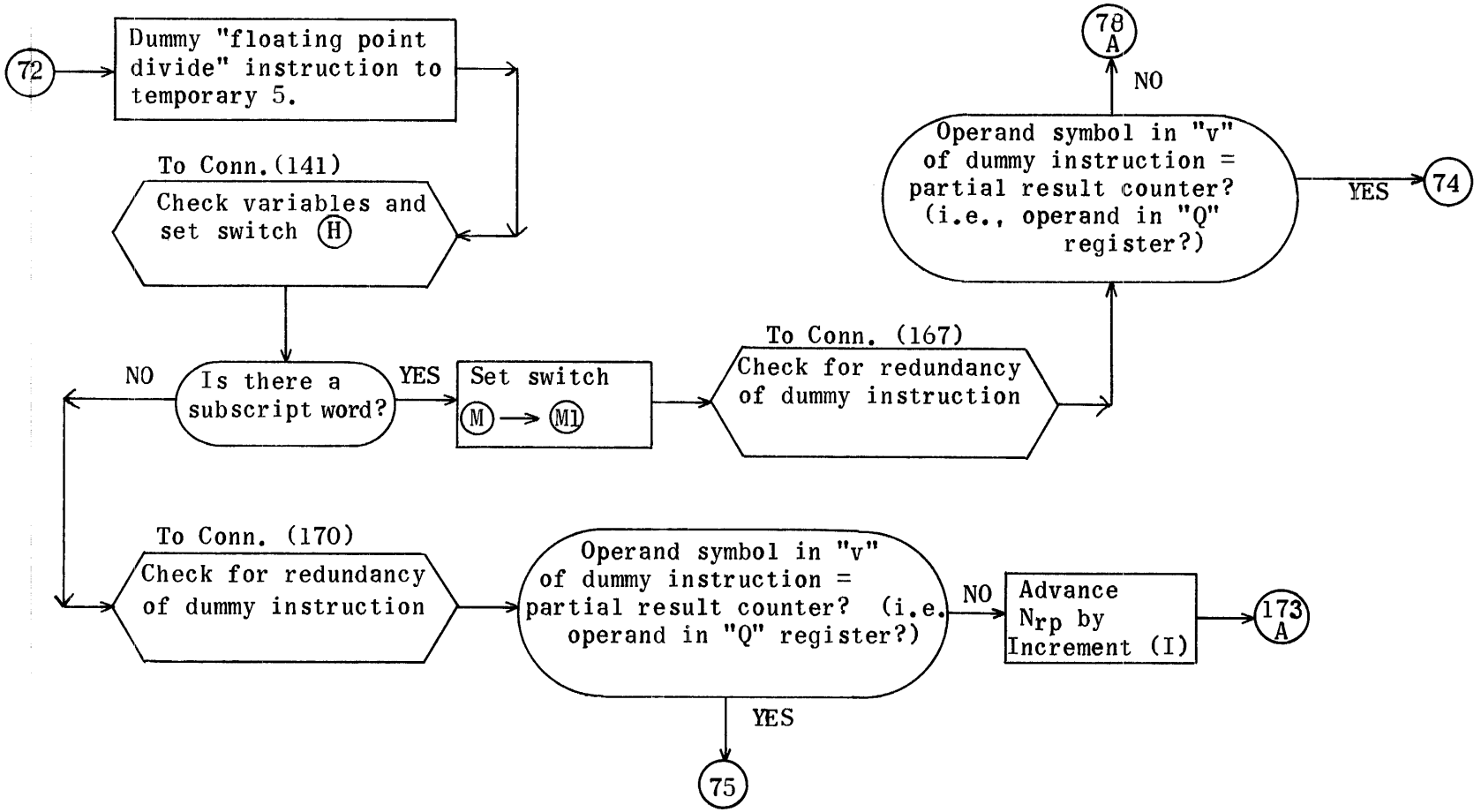

60
Is operand in "u" of dummy instruction 77----type?
NO
Set condition indicator to 10_8 in op. code to indicate 75---- or 76----type operand
Is subscript symbol in "v" of dummy instruction = partial result counter? (i.e., subscript in "A" register?)
NO
YES
61
62
Advance N_{rp} by one
Advance N_{rp} by Increment (I)
63
61
Set condition indicator 4 in op. code to indicate 77---- type operand
Advance C_{rc} by one
Is subscript symbol in "v" of dummy instruction = partial result counter? (i.e. subscript in "A" register?)
NO
Advance N_{rp} by Increment (I)
63
YES
62

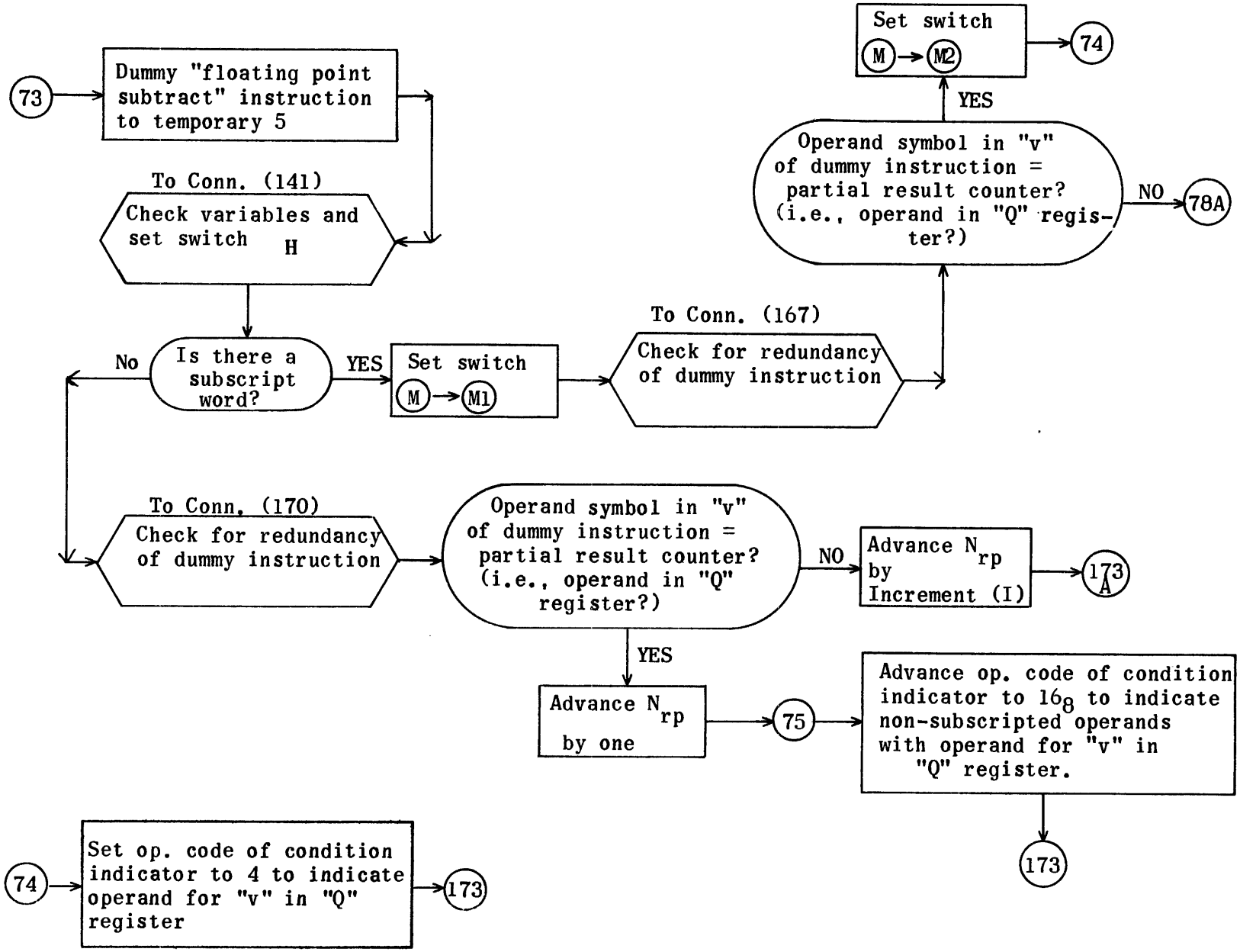

62
Advance op. code of condition indicator by one to indicate subscript in "A" register
To Conn. (185)
Enter partial result in "A" list
63
Set Increment(I) to one
To Conn. (196)
Current partial result to Operand List and Expanded List
Condition indicator to op. code of partial result word in Expanded List
Is operator negative power?
YES
64
NO
69
64
Advance N_{RP} by one
(CW) store floating point one in constant pool
Callword of constant to "u" of partial result word in Expanded List
69
65
Is operand symbol in "u" of dummy instruction = partial result counter? (i.e. operand in "Q" register?)
YES
67
NO
66

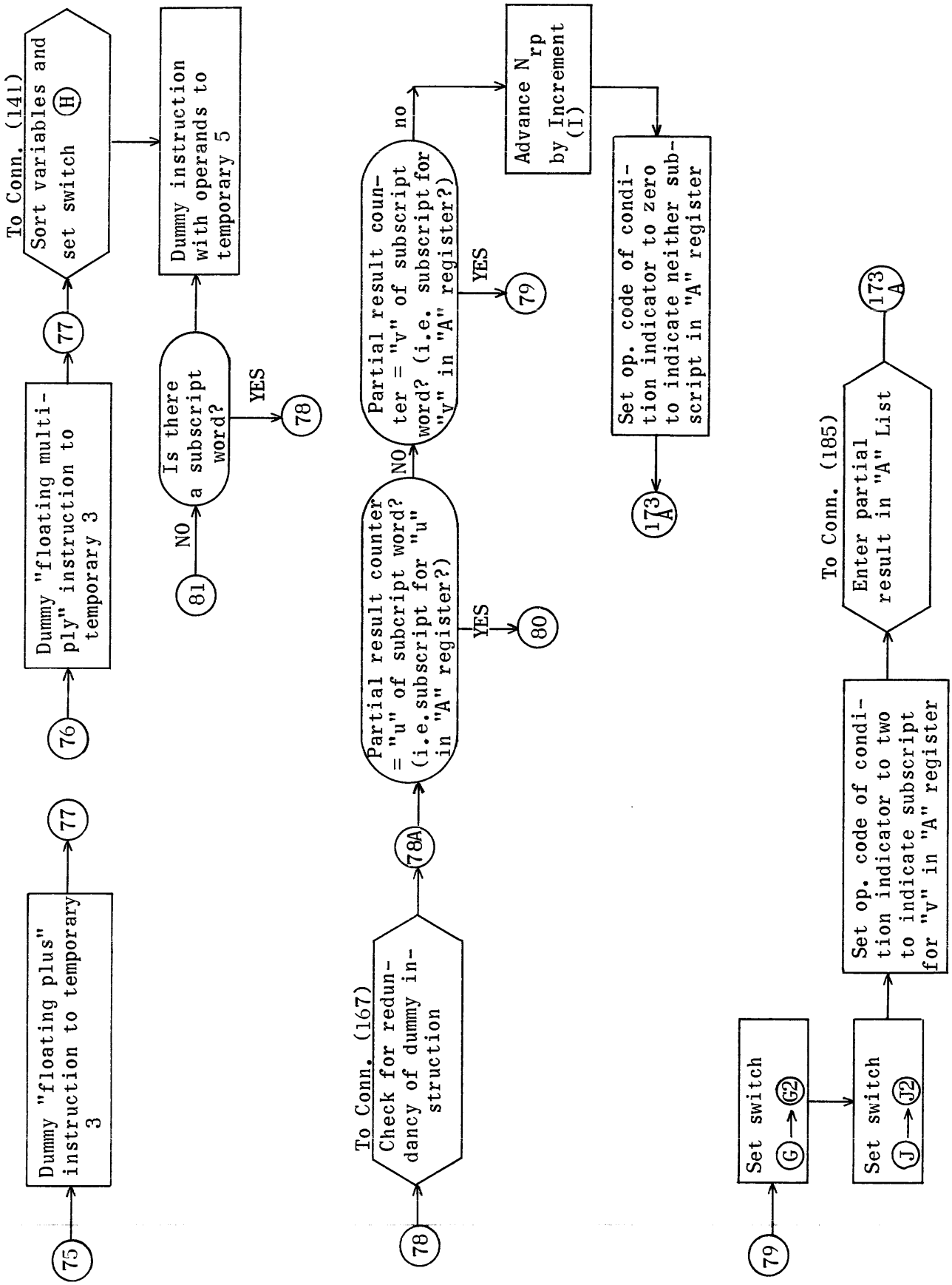

66
Set op. code of condition indicator to zero to indicate non-subscripted operand not in "Q" register
To Conn. (192)
Check for 61----type operand in "u"
Advance Nrp by Increment (I)
63
67
Set op. code of condition indicator to one to indicate non-subscripted operand in "Q" register
To Conn. (182)
Enter partial result in "Q" list
63
68
Advance Nrp by Increment (I)
Set op. code of condition indicator to zero to indicate non-subscripted operand not in "Q" register.
Is non-subscripted operand in "u" of dummy instruction 61----type
YES
NO
63
Advance op. code of condition indicator by 33₈ to indicate 61----type operand
Advance Nrp by two
63

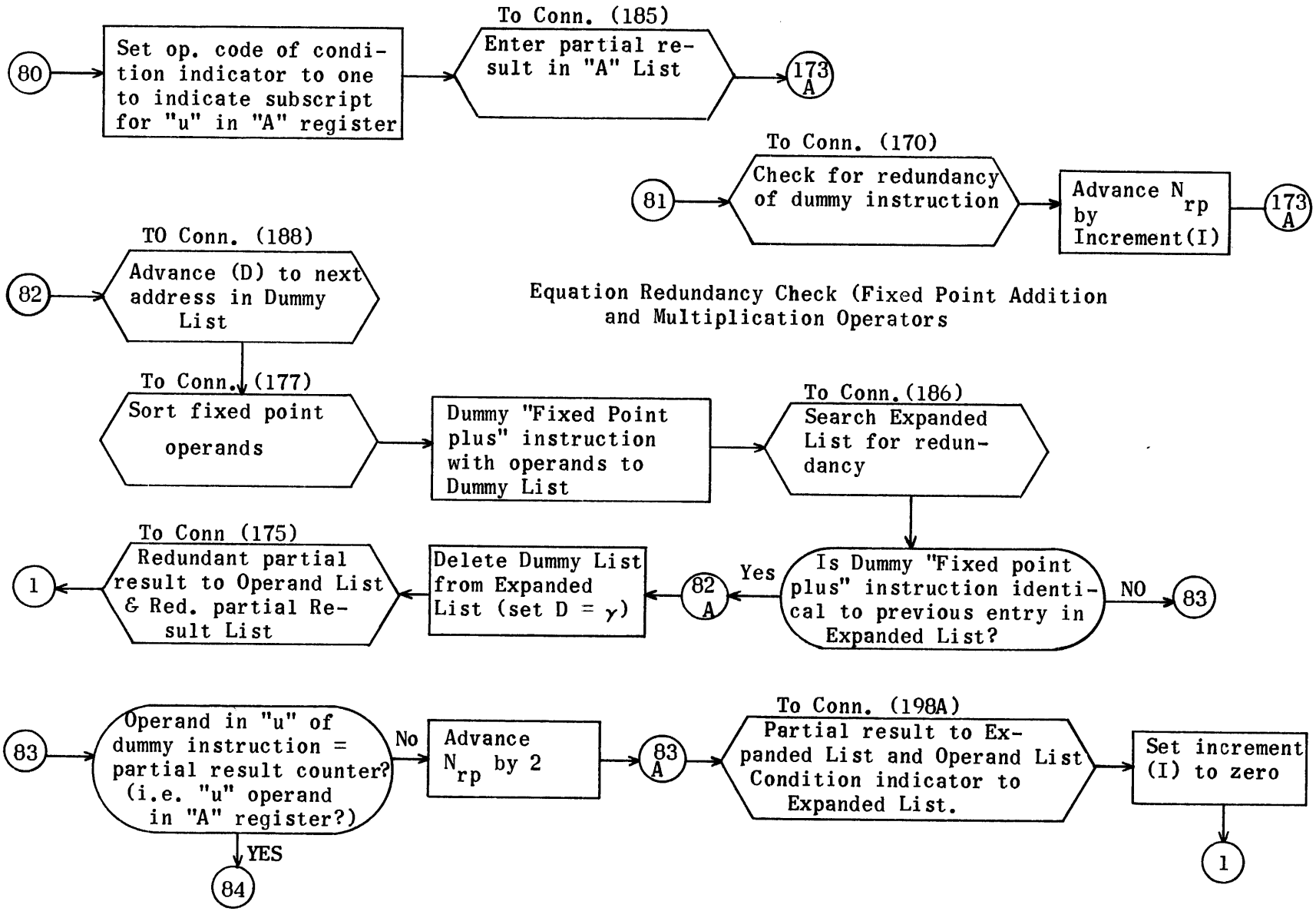

69
Is operator power 1/2 ? (i.e. 16000?)
NO
Is operator power -1/2? (i.e. 16100?)
YES
70
Condition indicator = 4 in op. code?
YES
Advance C_{rpt} by one
YES
70
NO
1
NO
71
Advance C_{rct} by one
1
71
Advance C_{rpt} by two
1

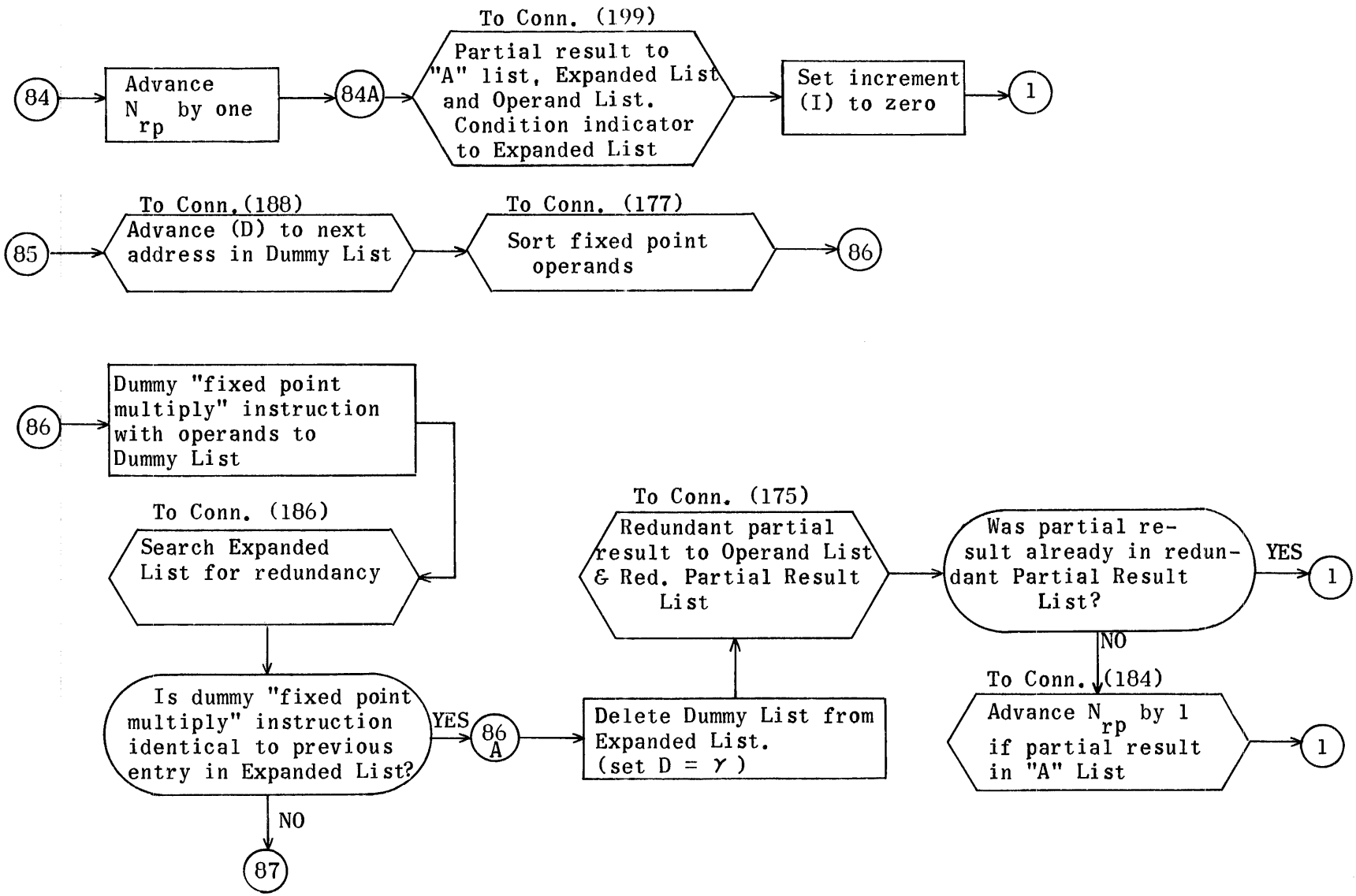
Equation Redundancy Check (Floating Point Divide and Subtract Operators)

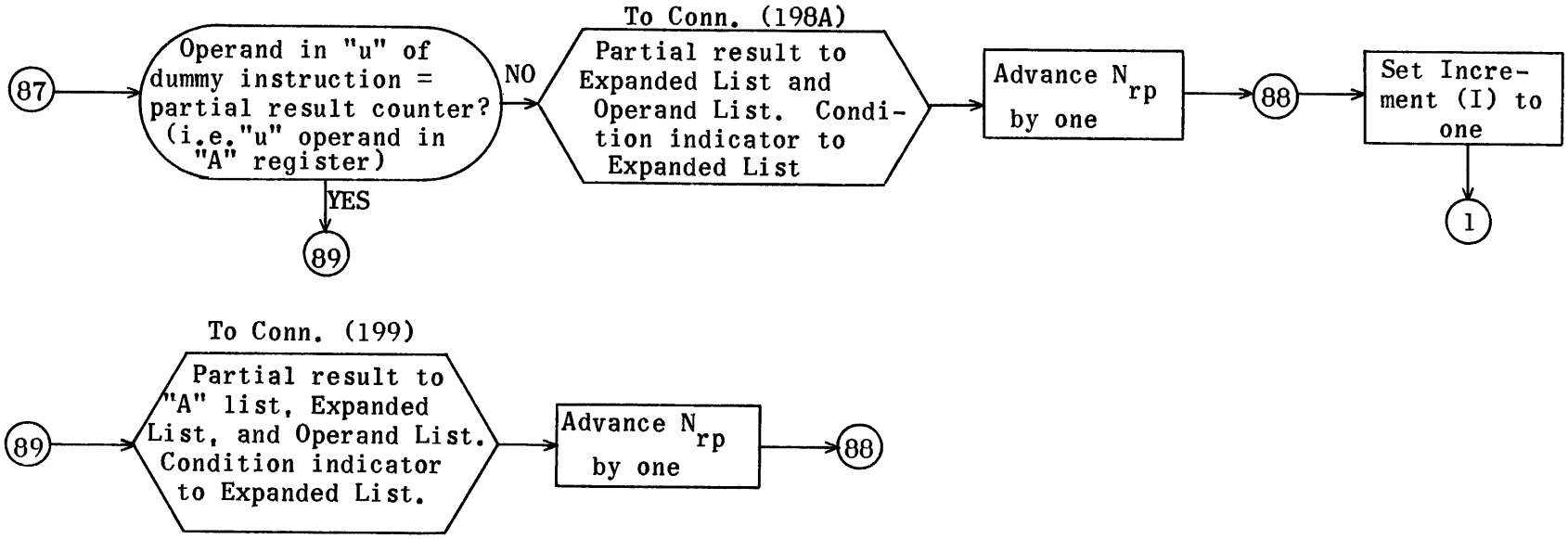



73
Dummy "floating point subtract" instruction to temporary 5
To Conn. (141)
Check variables and set switch H
No
Is there a subscript word?
YES
Set switch M → M1
To Conn. (167)
Check for redundancy of dummy instruction
Operand symbol in "v" of dummy instruction = partial result counter? (i.e., operand in "Q" register?)
YES
Set switch M → M2
74
NO
78A
To Conn. (170)
Check for redundancy of dummy instruction
Operand symbol in "v" of dummy instruction = partial result counter? (i.e., operand in "Q" register?)
NO
Advance N_{rp} by Increment (I)
173 A
YES
Advance N_{rp} by one
75
Advance op. code of condition indicator to 16_8 to indicate non-subscripted operands with operand for "v" in "Q" register.
173
74
Set op. code of condition indicator to 4 to indicate operand for "v" in "Q" register
173

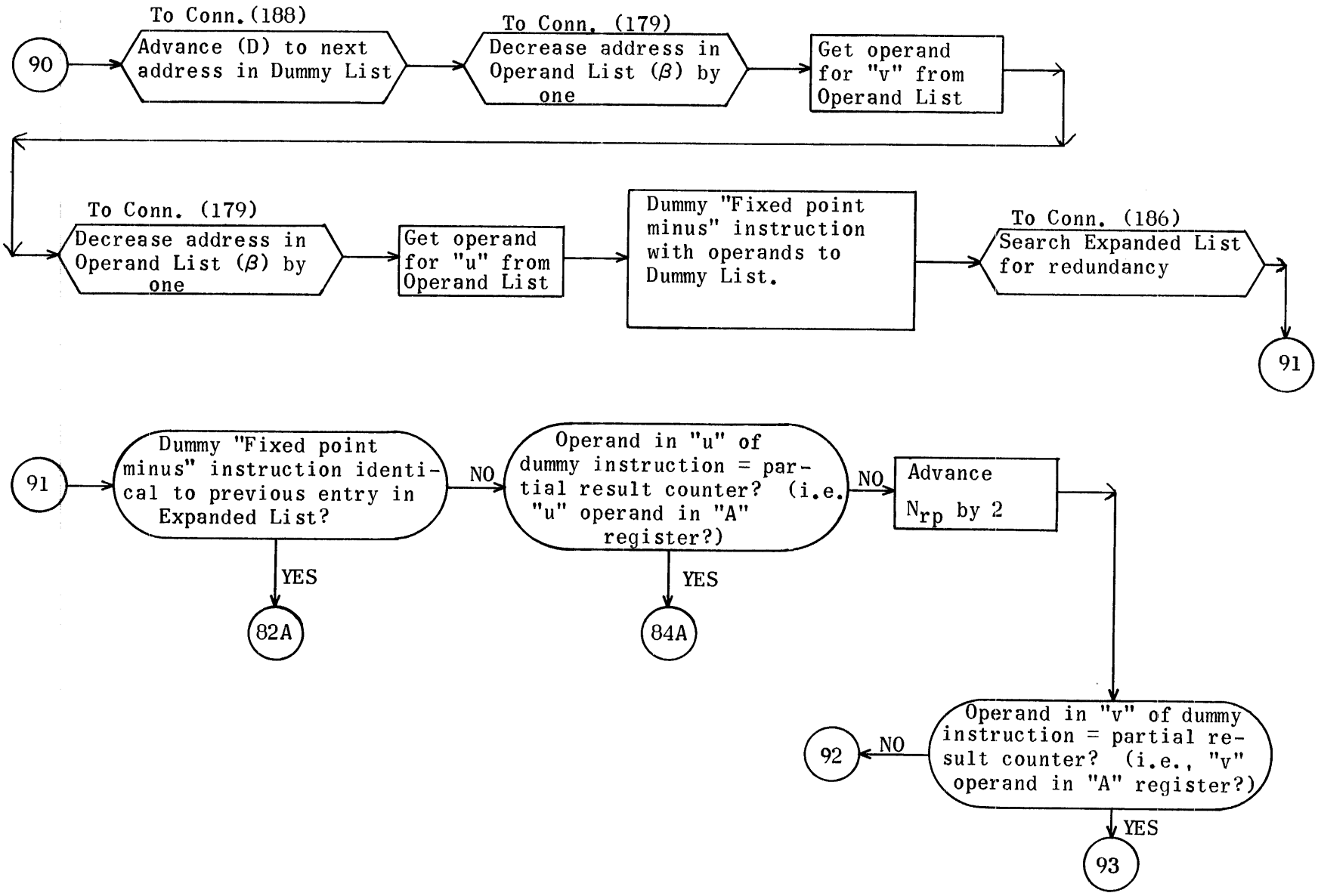

To Conn. (141)
Sort variables and set switch (H)
Dummy instruction with operands to temporary 5
Is there a subscript word?
YES
NO
Dummy "floating multiply" instruction to temporary 3
Dummy "floating plus" instruction to temporary 3
To Conn. (167)
Check for redundancy of dummy instruction
Partial result counter = "u" of subcript word? (i.e.subscript for "u" in "A" register?)
YES
NO
Partial result counter = "v" of subscript word? (i.e. subscript for "v" in "A" register?)
YES
no
Advance N_{rp} by Increment (I)
Set op. code of condition indicator to zero to indicate neither subscript in "A" register
To Conn. (185)
Enter partial result in "A" List
Set op. code of condition indicator to two to indicate subscript for "v" in "A" register
Set switch G → G2
Set switch J → J2
75
76
77
78
78A
79
80
81
173 A

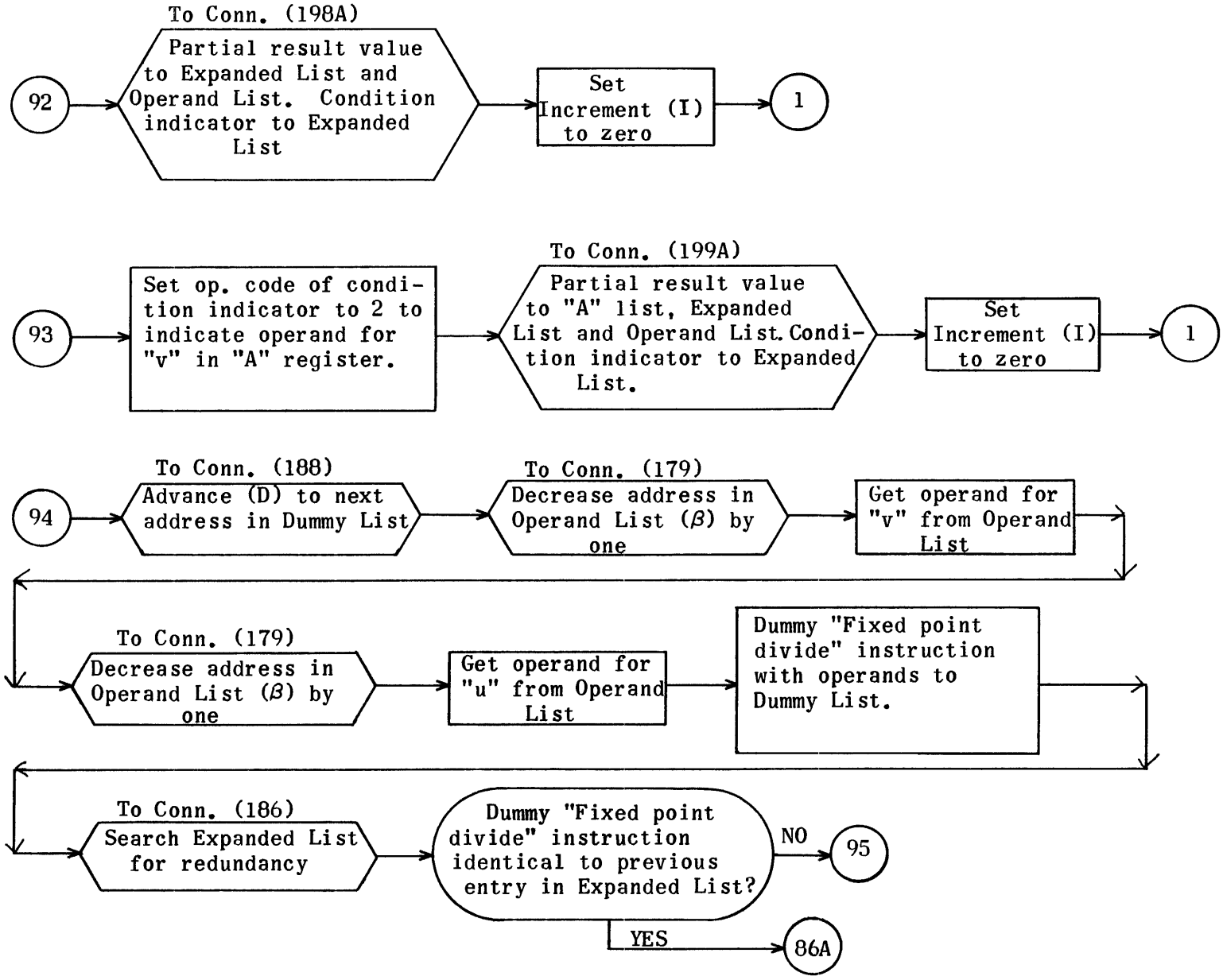

80
Set op. code of condition indicator to one to indicate subscript for "u" in "A" register
To Conn. (185)
Enter partial result in "A" List
173 A
81
To Conn. (170)
Check for redundancy of dummy instruction
Advance N rp by Increment(I)
173 A
TO Conn. (188)
82
Advance (D) to next address in Dummy List
Equation Redundancy Check (Fixed Point Addition and Multiplication Operators
To Conn. (177)
Sort fixed point operands
Dummy "Fixed Point plus" instruction with operands to Dummy List
To Conn. (186)
Search Expanded List for redundancy
To Conn (175)
1
Redundant partial result to Operand List & Red. partial Result List
Delete Dummy List from Expanded List (set D = γ)
82 A
Yes
Is Dummy "Fixed point plus" instruction identical to previous entry in Expanded List?
NO
83
83
Operand in "u" of dummy instruction = partial result counter? (i.e. "u" operand in "A" register?)
No
Advance N rp by 2
83 A
To Conn. (198A)
Partial result to Expanded List and Operand List Condition indicator to Expanded List.
Set increment (I) to zero
1
YES
84

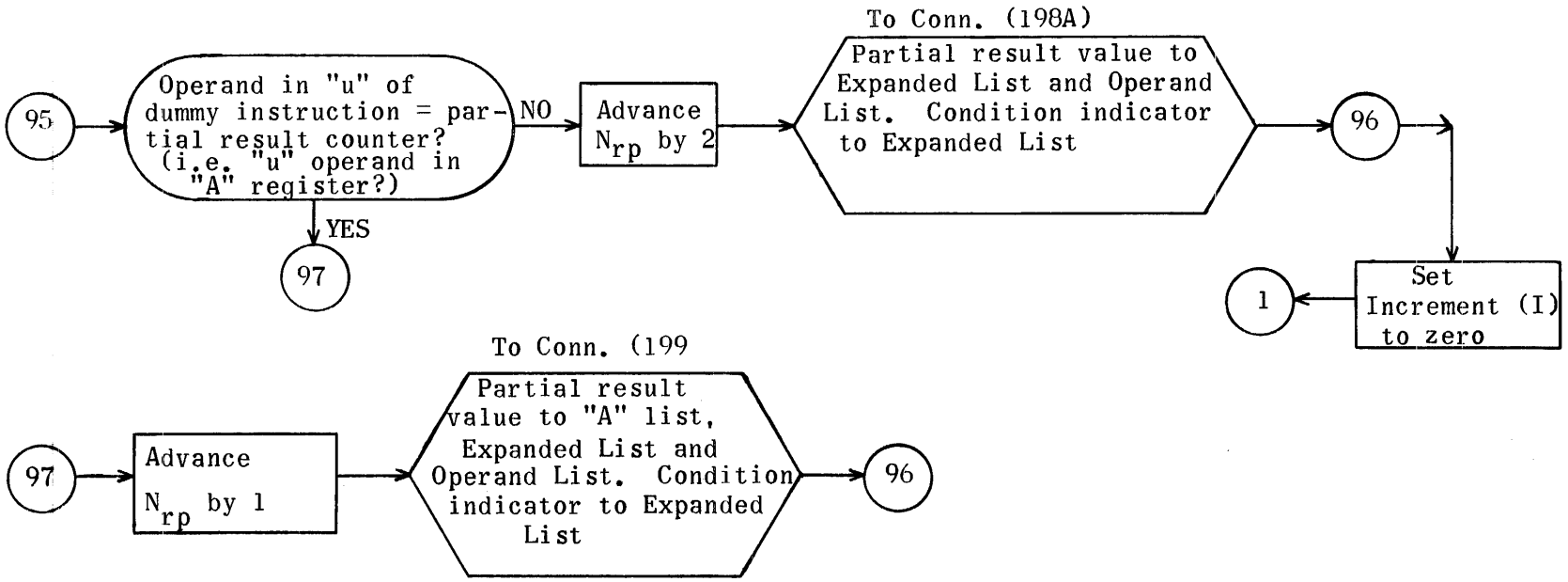

84
Advance N rp by one
84A
To Conn. (199)
Partial result to "A" list, Expanded List and Operand List. Condition indicator to Expanded List
Set increment (I) to zero
1
85
To Conn. (188)
Advance (D) to next address in Dummy List
To Conn. (177)
Sort fixed point operands
86
86
Dummy "fixed point multiply" instruction with operands to Dummy List
To Conn. (186)
Search Expanded List for redundancy
Is dummy "fixed point multiply" instruction identical to previous entry in Expanded List?
YES
86 A
NO
87
To Conn. (175)
Redundant partial result to Operand List & Red. Partial Result List
Delete Dummy List from Expanded List. (set D = γ)
Was partial result already in redundant Partial Result List?
YES
1
NO
To Conn. (184)
Advance N rp by 1 if partial result in "A" List
1

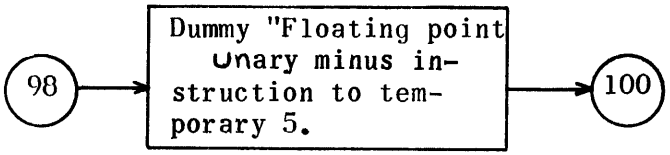

87
Operand in "u" of dummy instruction = partial result counter? (i.e."u" operand in "A" register)
NO
To Conn. (198A)
Partial result to Expanded List and Operand List. Condition indicator to Expanded List
Advance N_{rp} by one
88
Set Increment (I) to one
1
YES
89
To Conn. (199)
89
Partial result to "A" list, Expanded List, and Operand List. Condition indicator to Expanded List.
Advance N_{rp} by one
88

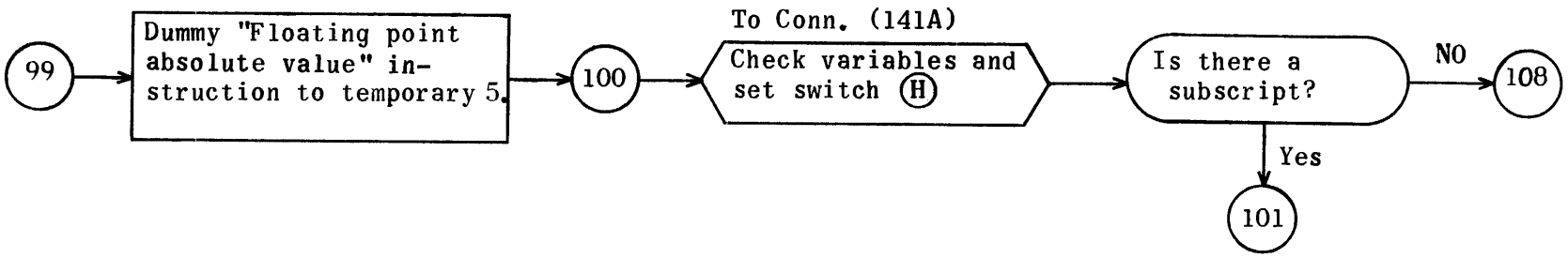
Equation Redundancy Check (Fixed Point Subtraction and Division Operators)

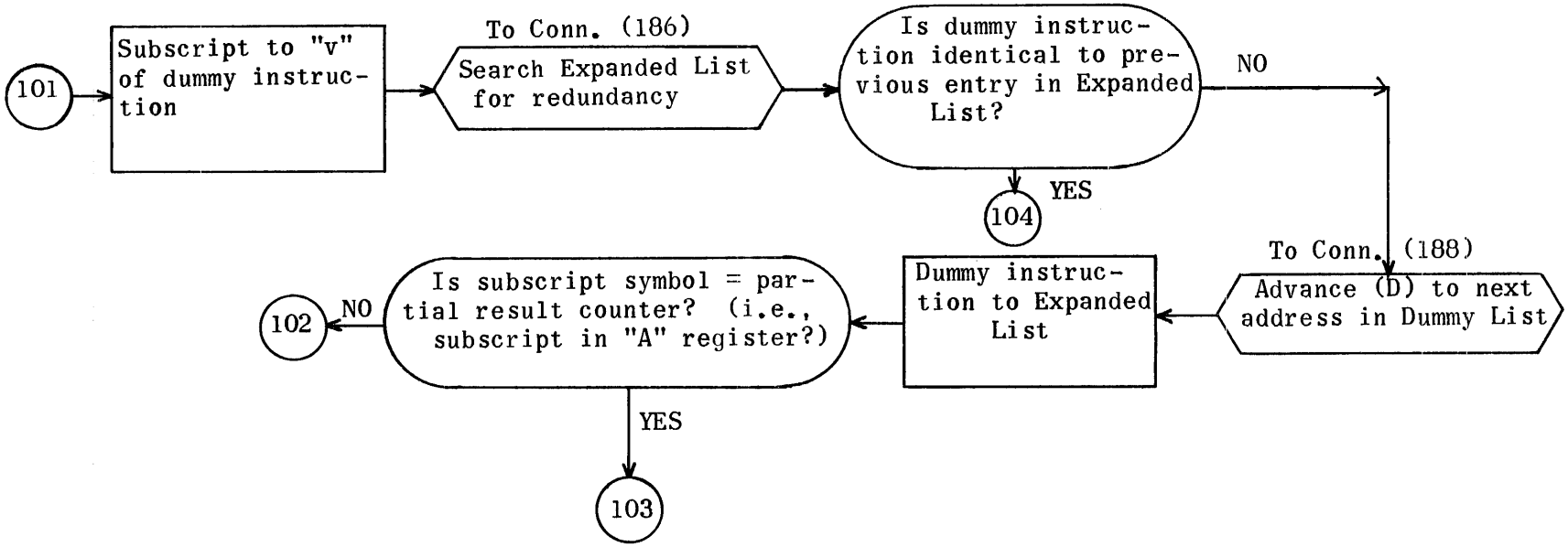


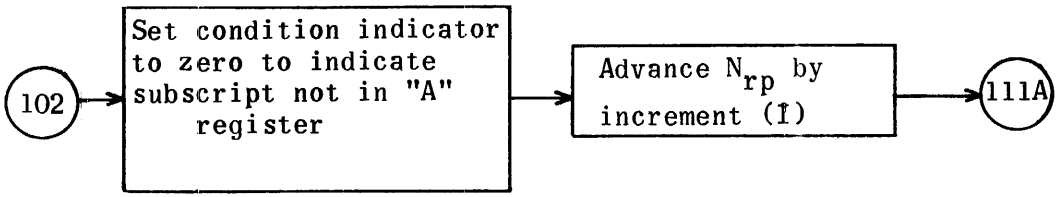

92
To Conn. (198A)
Partial result value to Expanded List and Operand List. Condition indicator to Expanded List
Set Increment (I) to zero
1
93
Set op. code of condition indicator to 2 to indicate operand for "v" in "A" register.
To Conn. (199A)
Partial result value to "A" list, Expanded List and Operand List. Condition indicator to Expanded List.
Set Increment (I) to zero
1
94
To Conn. (188)
Advance (D) to next address in Dummy List
To Conn. (179)
Decrease address in Operand List (β) by one
Get operand for "v" from Operand List
To Conn. (179)
Decrease address in Operand List (β) by one
Get operand for "u" from Operand List
Dummy "Fixed point divide" instruction with operands to Dummy List.
To Conn. (186)
Search Expanded List for redundancy
Dummy "Fixed point divide" instruction identical to previous entry in Expanded List?
NO
95
YES
86A

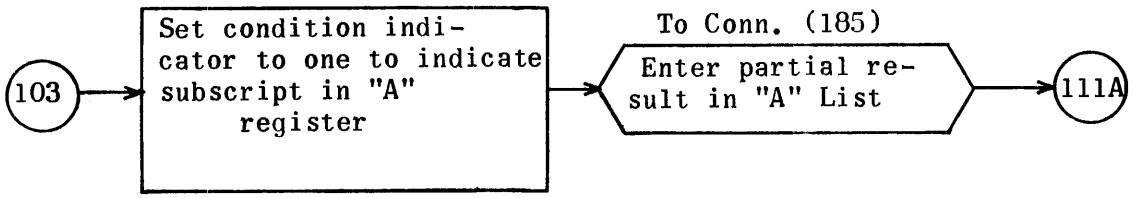

95
Operand in "u" of dummy instruction = partial result counter? (i.e. "u" operand in "A" register?)
NO
Advance N_{rp} by 2
To Conn. (198A)
Partial result value to Expanded List and Operand List. Condition indicator to Expanded List
96
YES
97
Set Increment (I) to zero
1
To Conn. (199
97
Advance N_{rp} by 1
Partial result value to "A" list, Expanded List and Operand List. Condition indicator to Expanded List
96

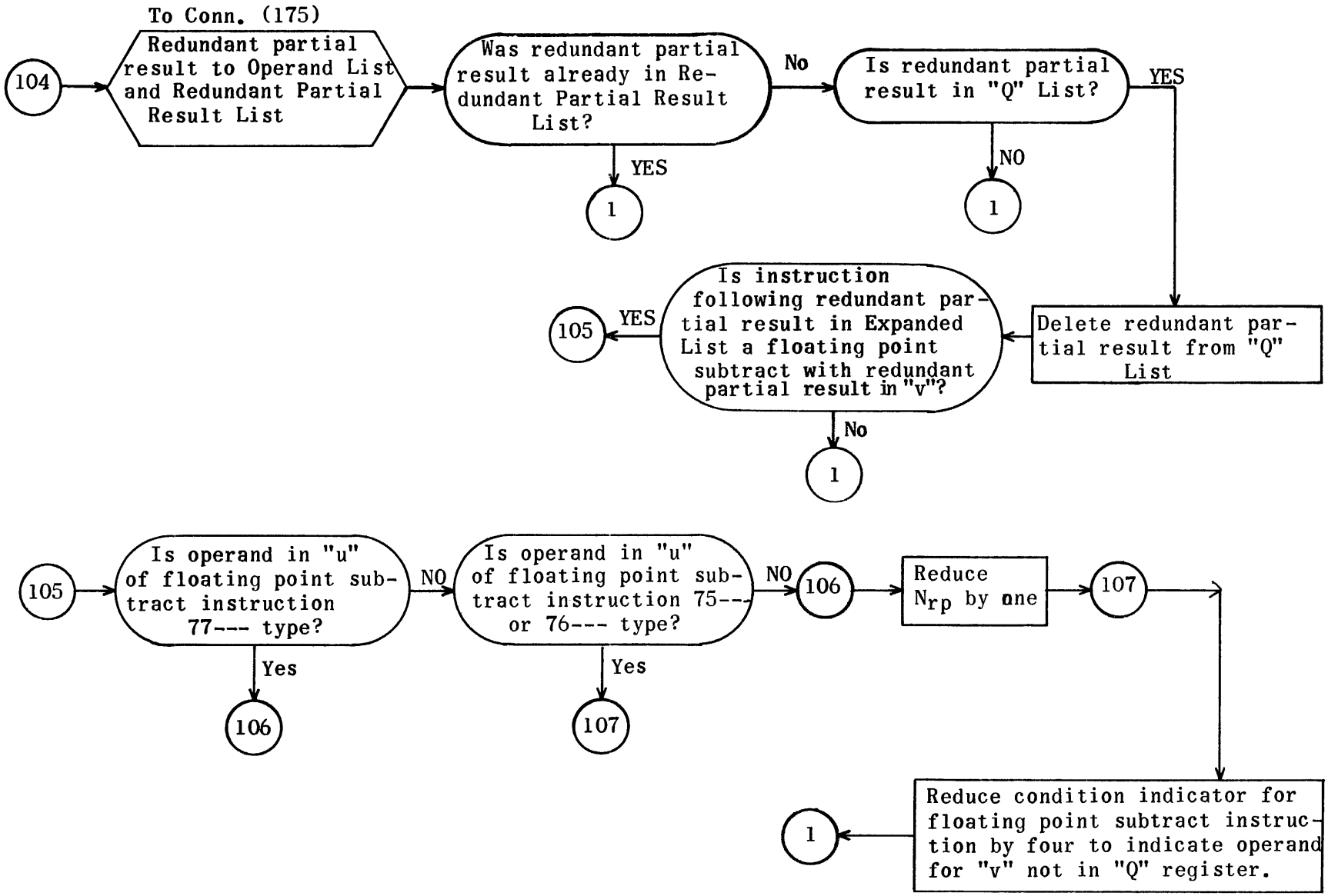

98
Dummy "Floating point Unary minus instruction to temporary 5.
100

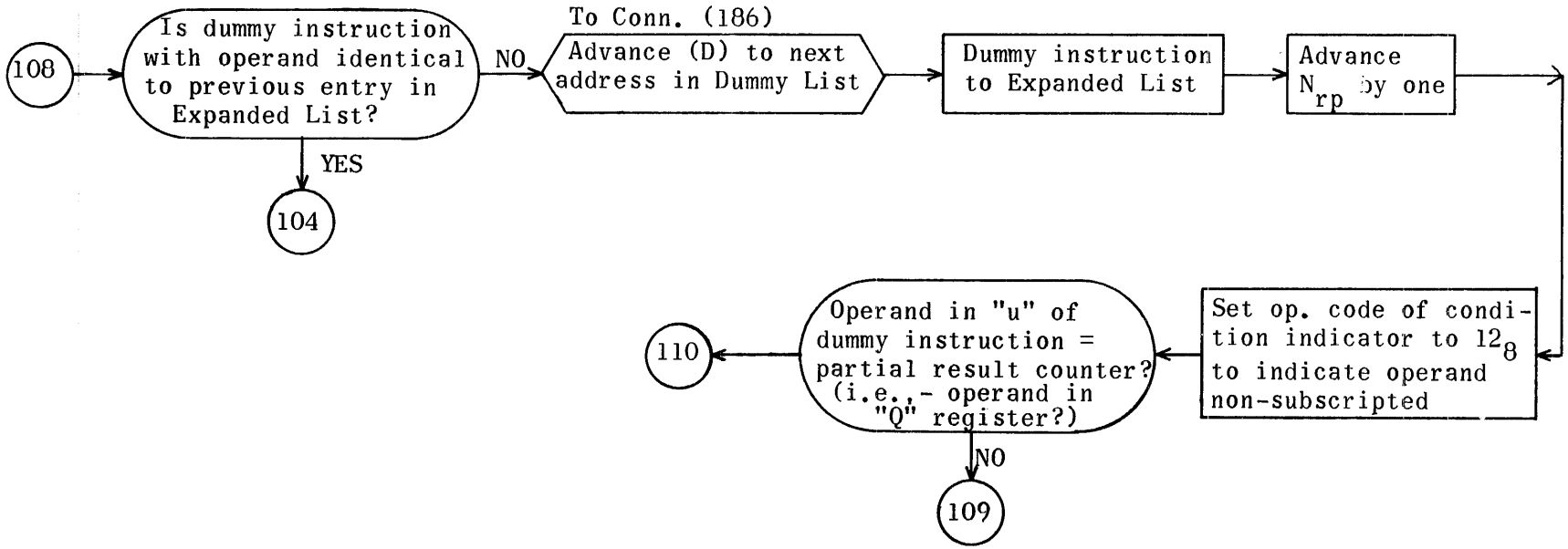

99
Dummy "Floating point absolute value" instruction to temporary 5.
100
To Conn. (141A)
Check variables and set switch (H)
Is there a subscript?
NO
108
Yes
101

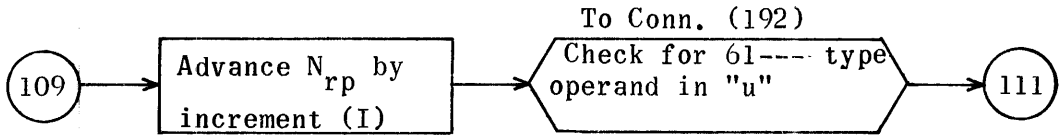

101
Subscript to "v" of dummy instruction
To Conn. (186)
Search Expanded List for redundancy
Is dummy instruction identical to previous entry in Expanded List?
NO
YES
104
To Conn. (188)
Advance (D) to next address in Dummy List
Dummy instruction to Expanded List
Is subscript symbol = partial result counter? (i.e., subscript in "A" register?)
NO
102
YES
103

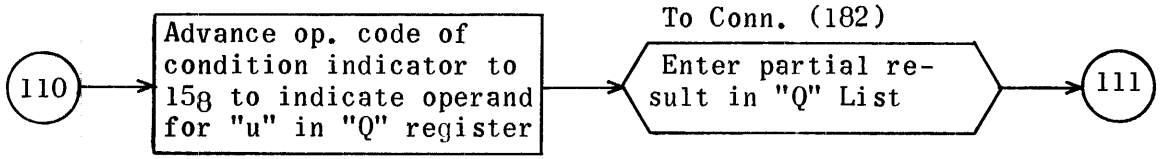

102
Set condition indicator to zero to indicate subscript not in "A" register
Advance N_{rp} by increment (I)
111A

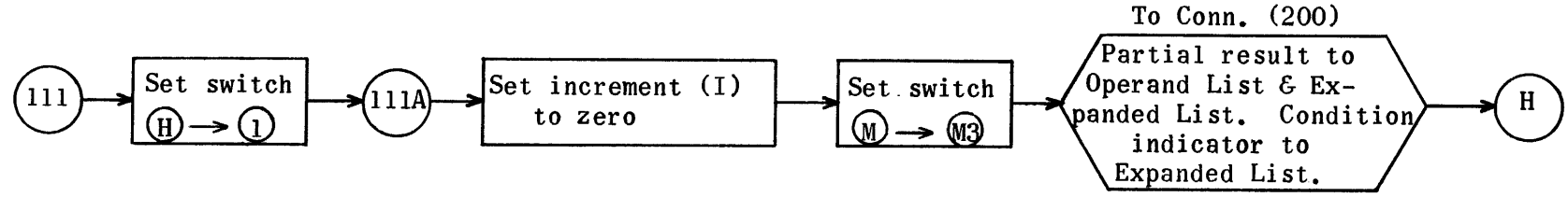

103
Set condition indicator to one to indicate subscript in "A" register
To Conn. (185)
Enter partial result in "A" List
111A


To Conn. (175)
104
Redundant partial result to Operand List and Redundant Partial Result List
Was redundant partial result already in Redundant Partial Result List?
No
Is redundant partial result in "Q" List?
YES
YES
1
NO
1
Delete redundant partial result from "Q" List
Is instruction following redundant partial result in Expanded List a floating point subtract with redundant partial result in "v"?
YES
105
No
1
105
Is operand in "u" of floating point subtract instruction 77--- type?
NO
Is operand in "u" of floating point subtract instruction 75--- or 76--- type?
NO
106
Reduce N_{rp} by one
107
Yes
106
Yes
107
1
Reduce condition indicator for floating point subtract instruction by four to indicate operand for "v" not in "Q" register.

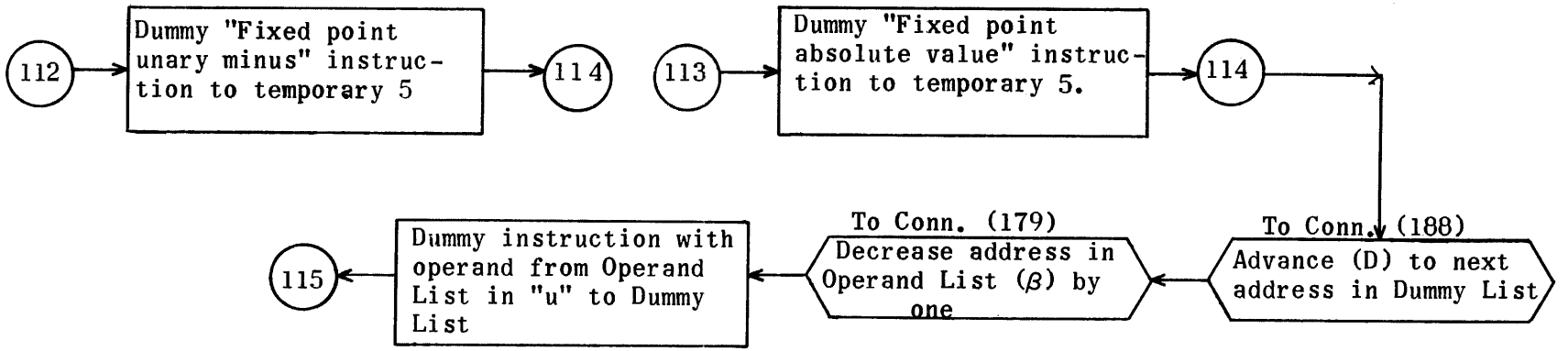

108
Is dummy instruction with operand identical to previous entry in Expanded List?
NO
To Conn. (186)
Advance (D) to next address in Dummy List
Dummy instruction to Expanded List
Advance N_{rp} by one
YES
104
110
Operand in "u" of dummy instruction = partial result counter? (i.e., - operand in "Q" register?)
Set op. code of condition indicator to 12_8 to indicate operand non-subscripted
NO
109

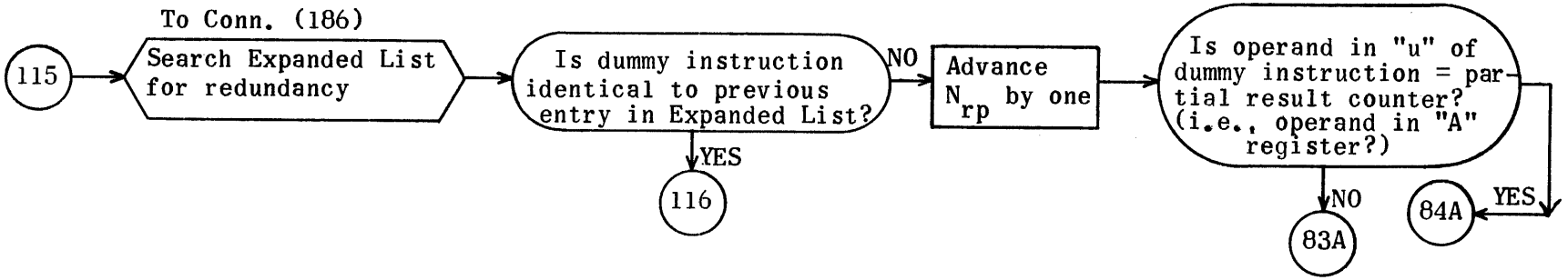

109
Advance N_{rp} by increment (I)
To Conn. (192)
Check for 61--- type operand in "u"
111

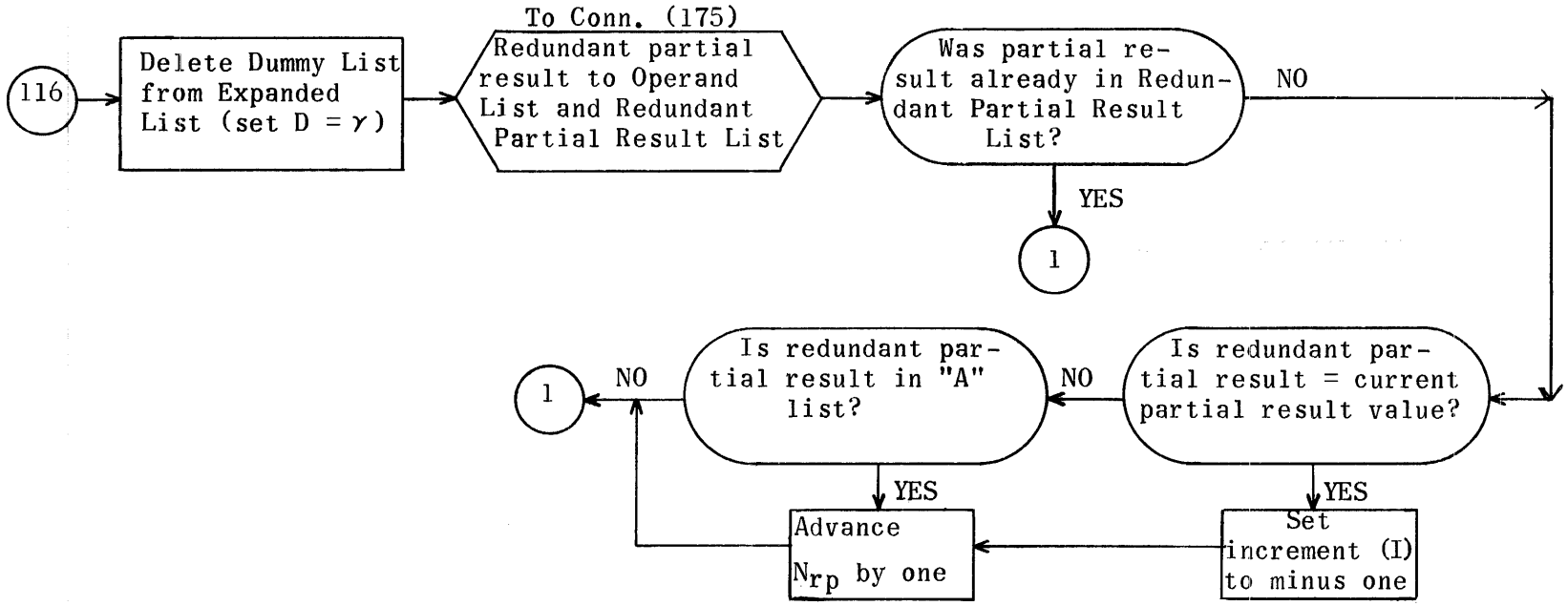

110
Advance op. code of condition indicator to 15_8 to indicate operand for "u" in "Q" register
To Conn. (182)
Enter partial result in "Q" List
111



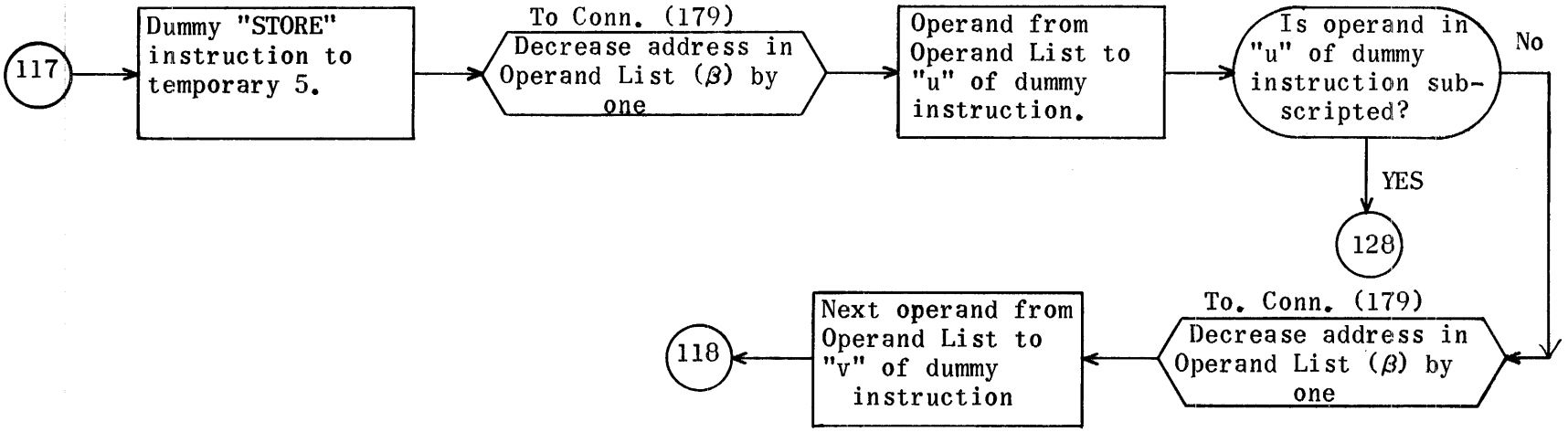
Equation Redundancy Check (Fixed Point Unary Minus and Absolute Value Operators)

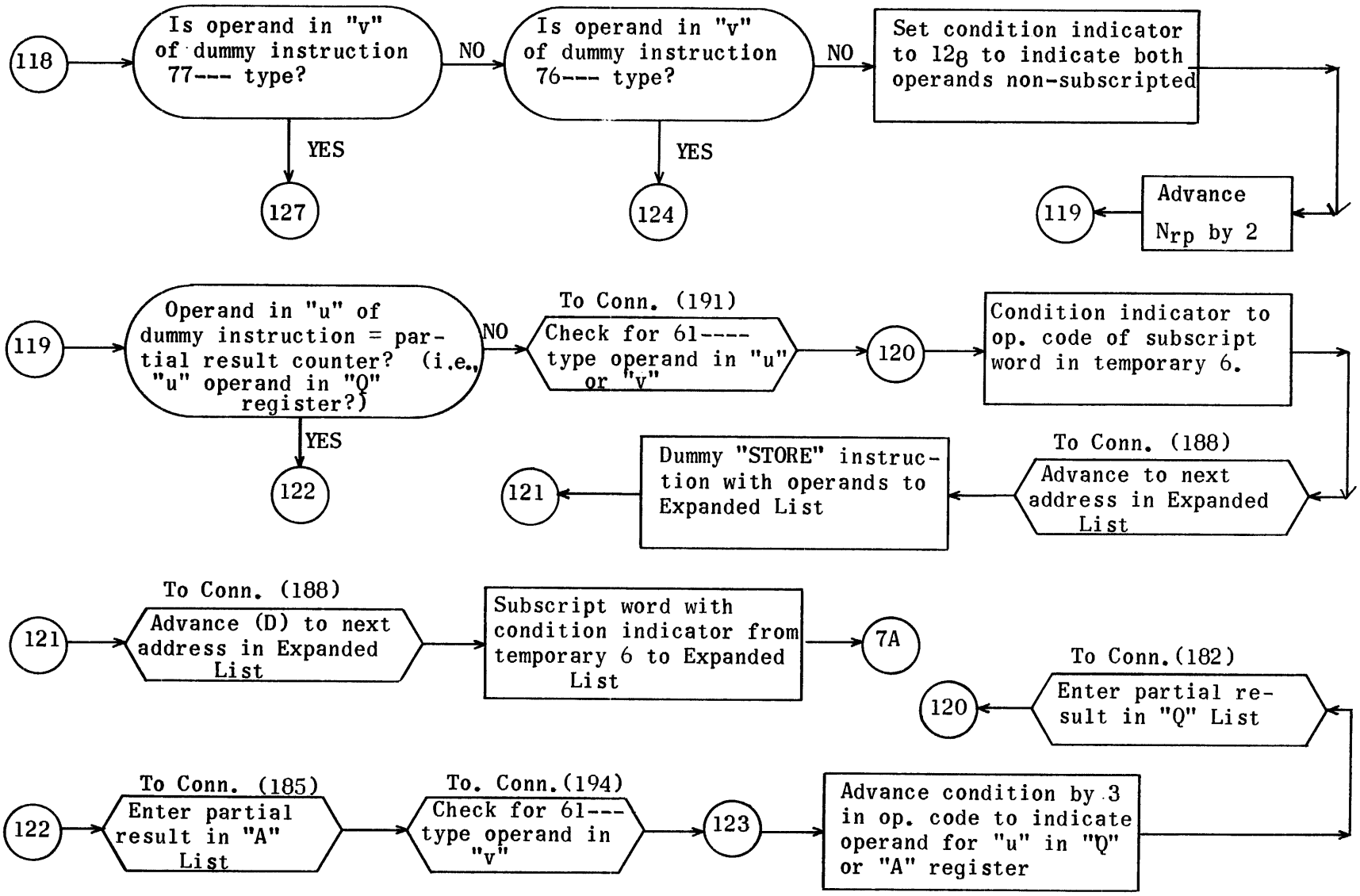




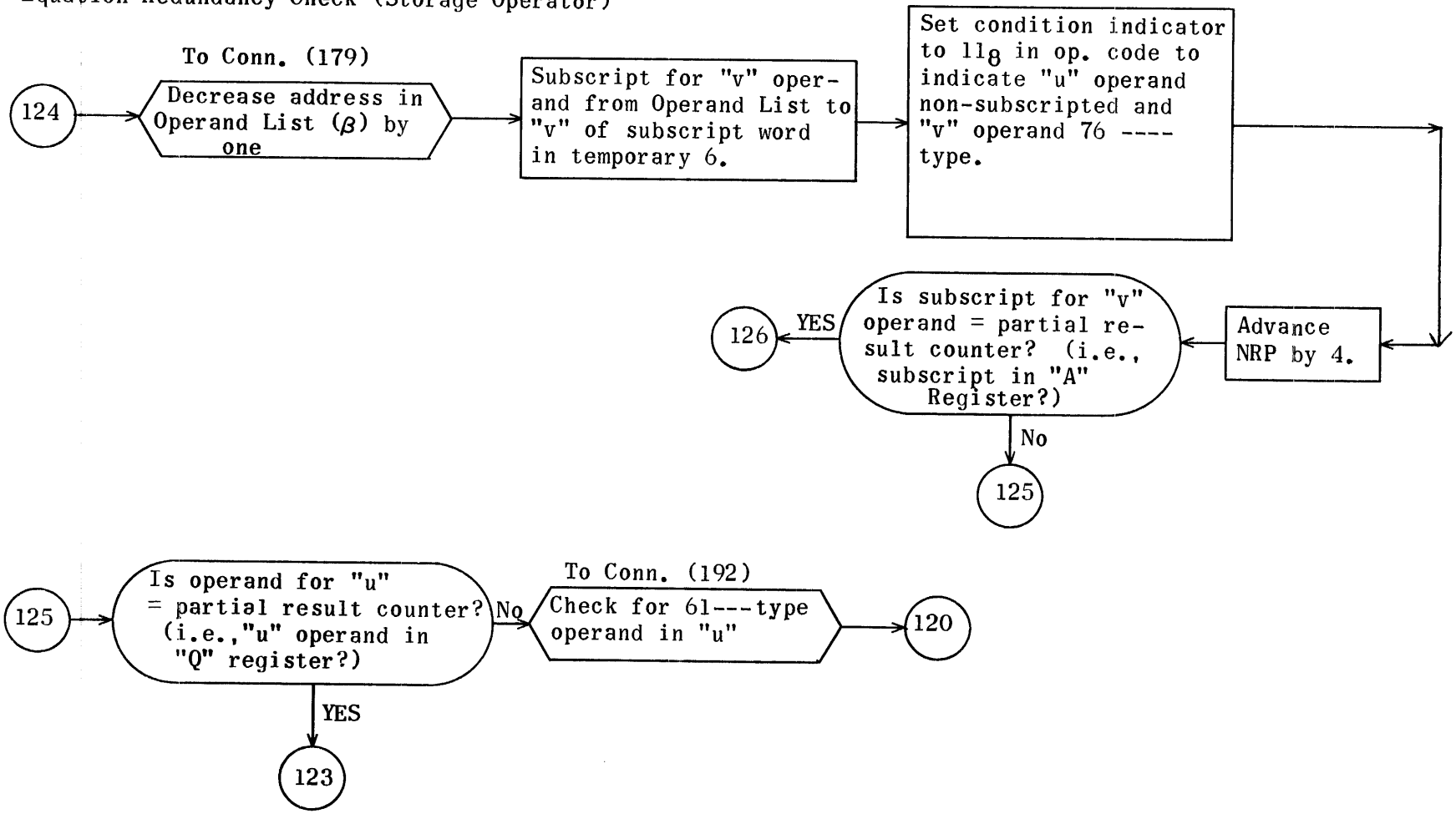


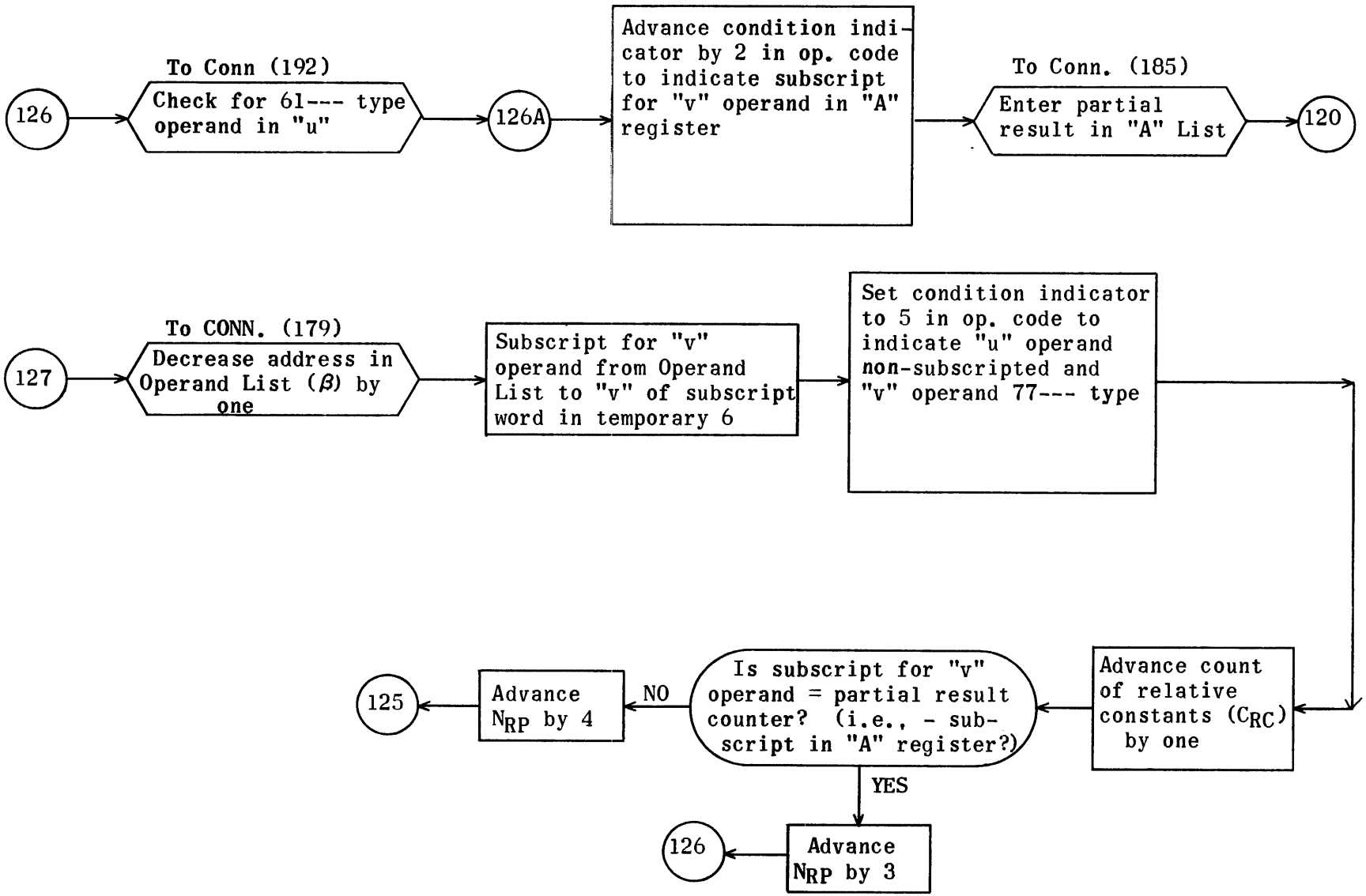
Equation Redundancy Check (Storage Operator)

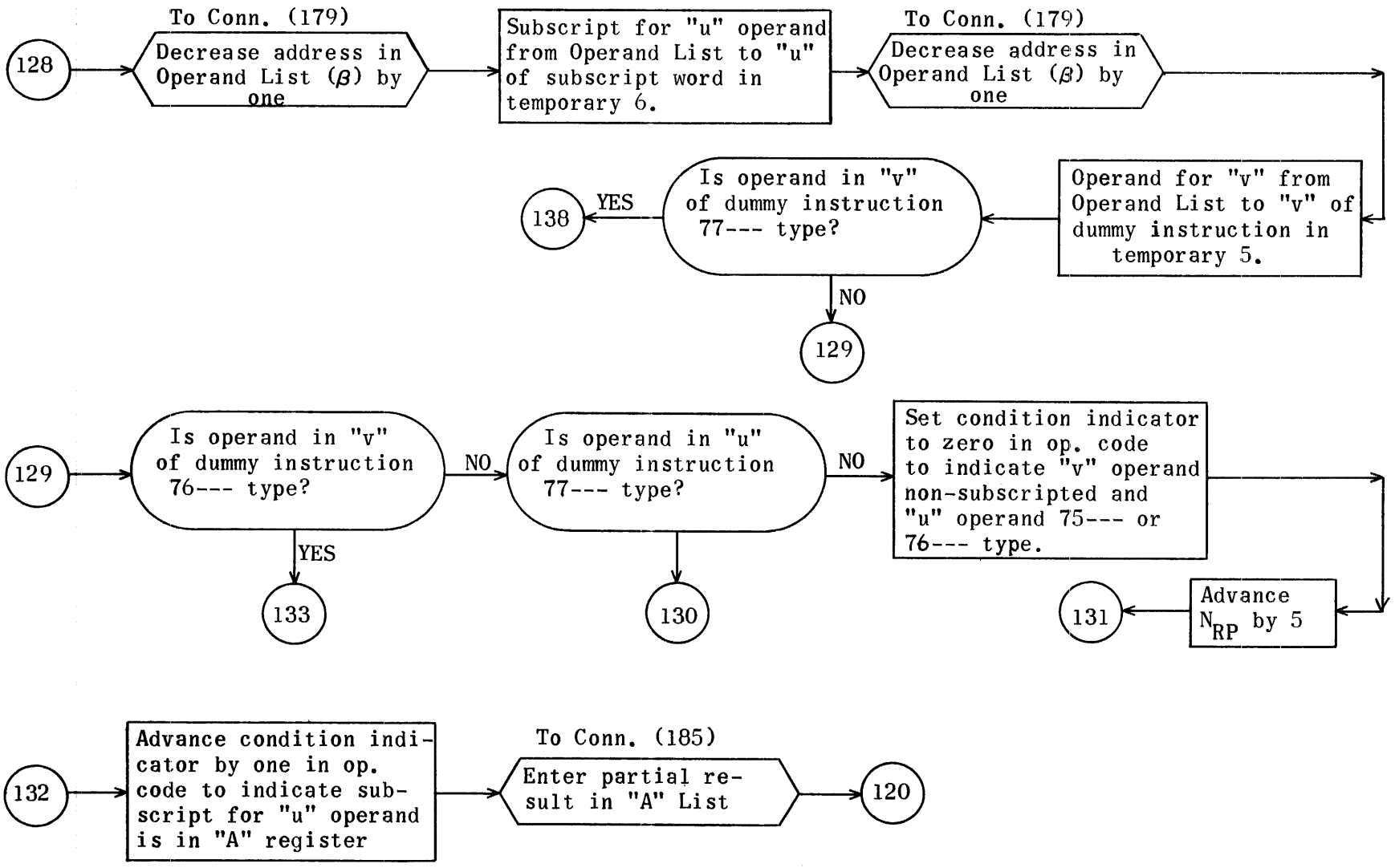


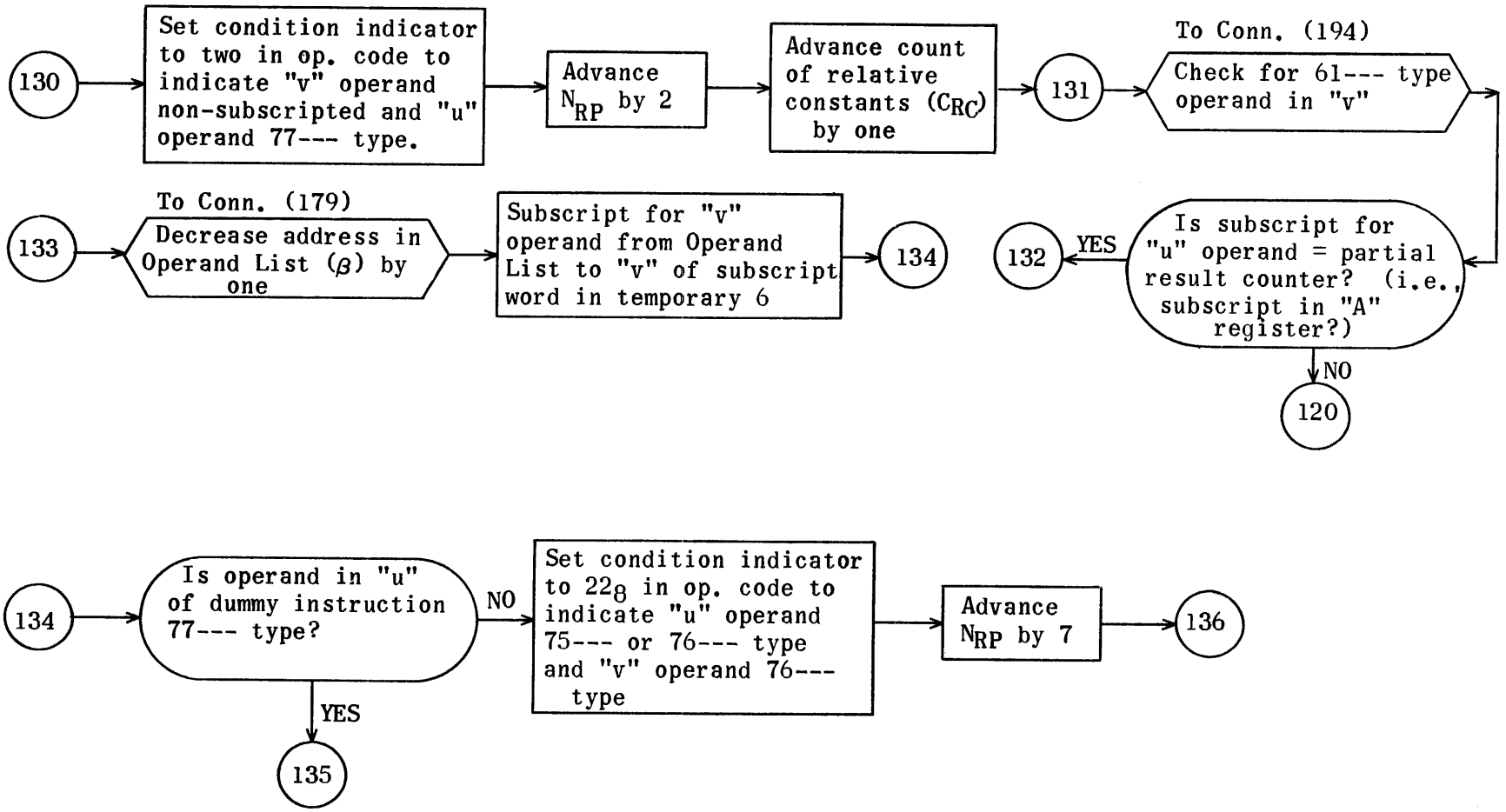

118
Is operand in "v" of dummy instruction 77--- type?
NO
Is operand in "v" of dummy instruction 76--- type?
NO
Set condition indicator to 12₈ to indicate both operands non-subscripted
YES
127
YES
124
119
Advance N_{rp} by 2
119
Operand in "u" of dummy instruction = partial result counter? (i.e., "u" operand in "Q" register?)
NO
To Conn. (191)
Check for 61---- type operand in "u" or "v"
120
Condition indicator to op. code of subscript word in temporary 6.
YES
122
121
Dummy "STORE" instruction with operands to Expanded List
To Conn. (188)
Advance to next address in Expanded List
121
To Conn. (188)
Advance (D) to next address in Expanded List
Subscript word with condition indicator from temporary 6 to Expanded List
7A
120
To Conn.(182)
Enter partial result in "Q" List
122
To Conn. (185)
Enter partial result in "A" List
To. Conn.(194)
Check for 61--- type operand in "v"
123
Advance condition by 3 in op. code to indicate operand for "u" in "Q" or "A" register

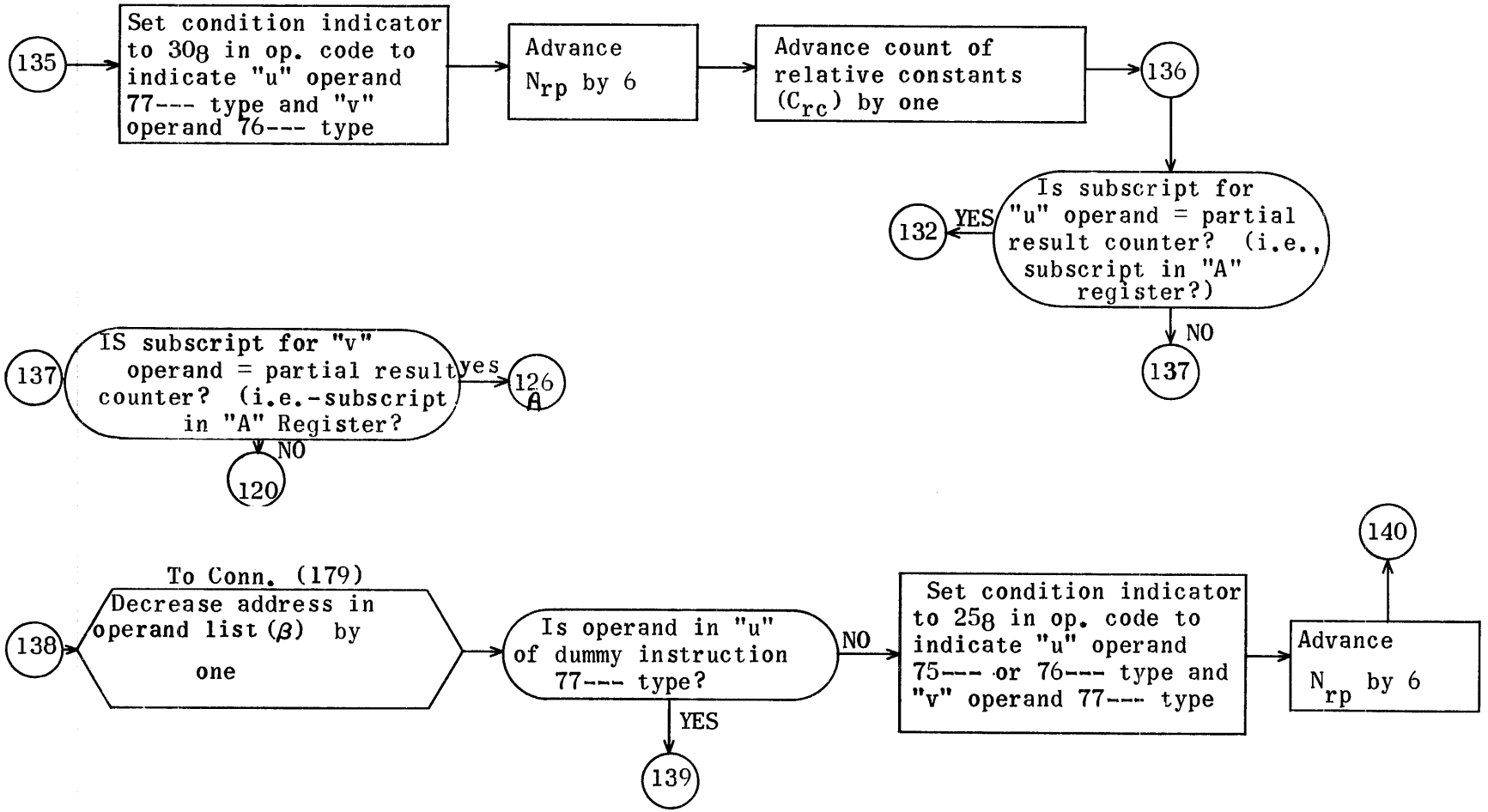
Equation Redundancy Check (Storage Operator)



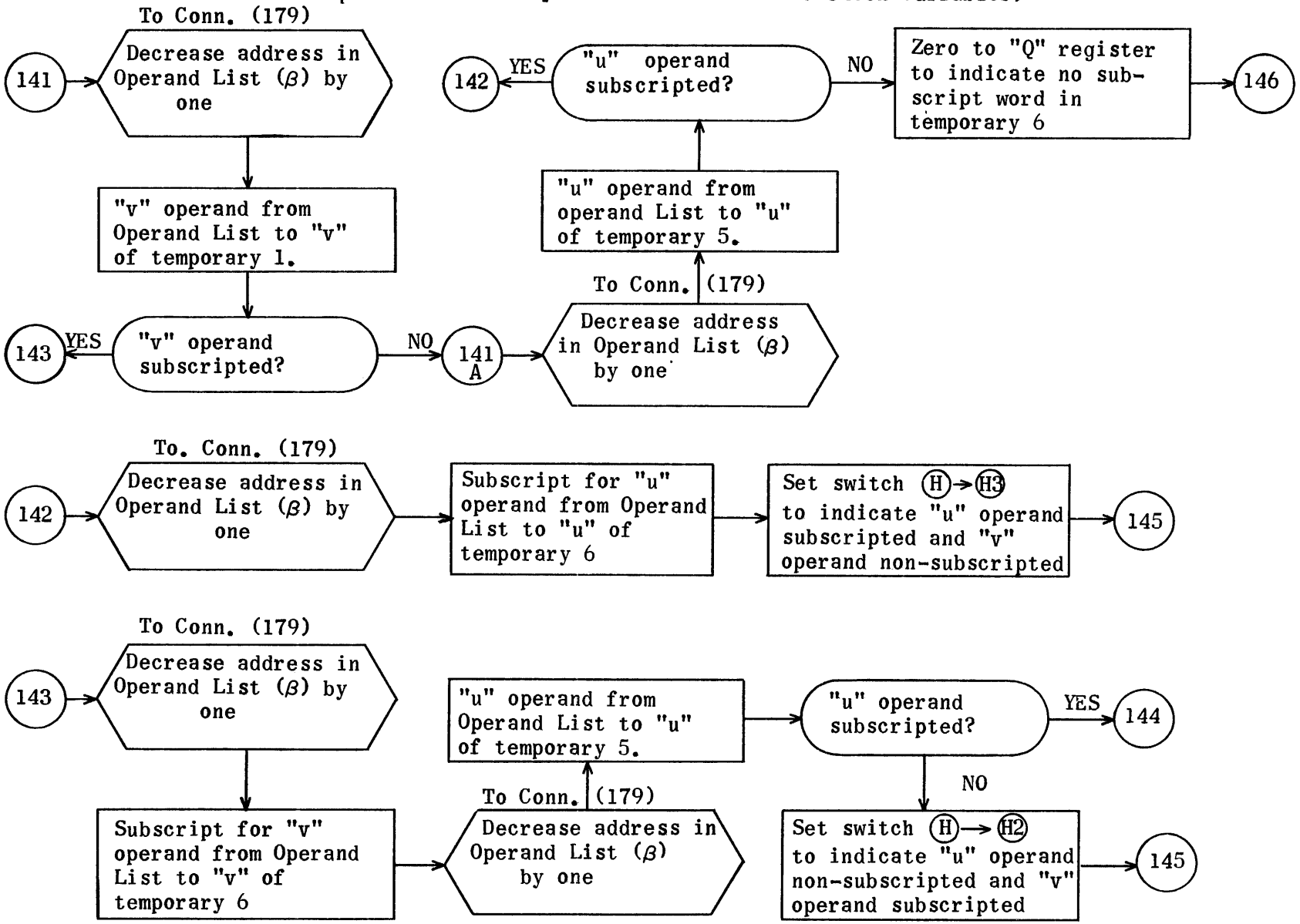

126
To Conn (192)
Check for 61--- type operand in "u"
126A
Advance condition indicator by 2 in op. code to indicate subscript for "v" operand in "A" register
To Conn. (185)
Enter partial result in "A" List
120
127
To CONN. (179)
Decrease address in Operand List (β) by one
Subscript for "v" operand from Operand List to "v" of subscript word in temporary 6
Set condition indicator to 5 in op. code to indicate "u" operand non-subscripted and "v" operand 77--- type
Advance count of relative constants (C_{RC}) by one
Is subscript for "v" operand = partial result counter? (i.e., - subscript in "A" register?)
NO
Advance N_{RP} by 4
125
YES
Advance N_{RP} by 3
126

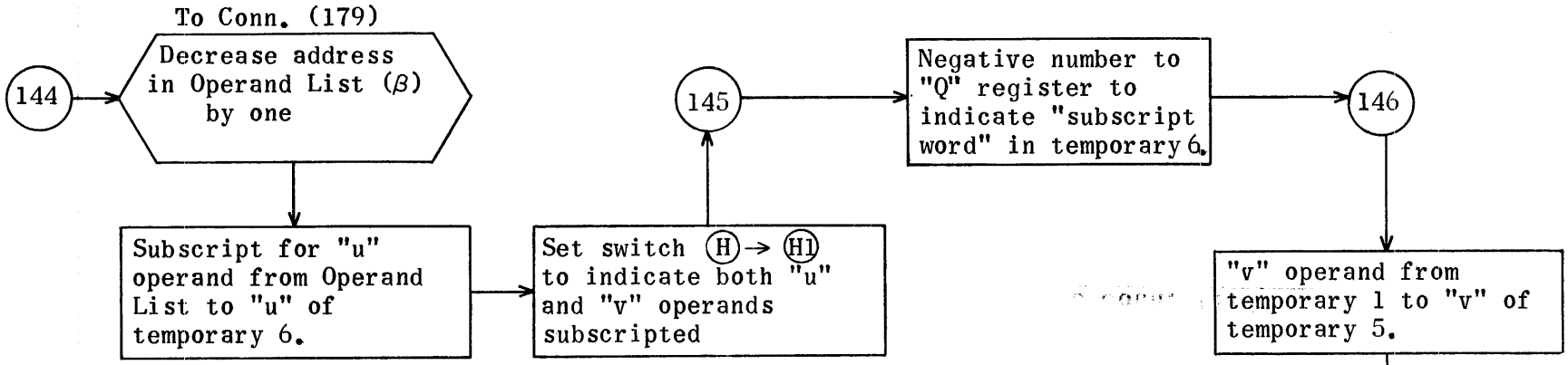

128
To Conn. (179)
Decrease address in Operand List (β) by one
Subscript for "u" operand from Operand List to "u" of subscript word in temporary 6.
To Conn. (179)
Decrease address in Operand List (β) by one
Operand for "v" from Operand List to "v" of dummy instruction in temporary 5.
Is operand in "v" of dummy instruction 77--- type?
YES
138
NO
129
129
Is operand in "v" of dummy instruction 76--- type?
NO
Is operand in "u" of dummy instruction 77--- type?
NO
Set condition indicator to zero in op. code to indicate "v" operand non-subscripted and "u" operand 75--- or 76--- type.
YES
133
130
131
Advance N_{RP} by 5
132
Advance condition indicator by one in op. code to indicate subscript for "u" operand is in "A" register
To Conn. (185)
Enter partial result in "A" List
120


130
Set condition indicator to two in op. code to indicate "v" operand non-subscripted and "u" operand 77--- type.
Advance N_{RP} by 2
Advance count of relative constants (C_{RC}) by one
131
To Conn. (194)
Check for 61--- type operand in "v"
Is subscript for "u" operand = partial result counter? (i.e., subscript in "A" register?)
YES
132
NO
120
133
To Conn. (179)
Decrease address in Operand List (β) by one
Subscript for "v" operand from Operand List to "v" of subscript word in temporary 6
134
134
Is operand in "u" of dummy instruction 77--- type?
NO
Set condition indicator to 22_8 in op. code to indicate "u" operand 75--- or 76--- type and "v" operand 76--- type
Advance N_{RP} by 7
136
YES
135

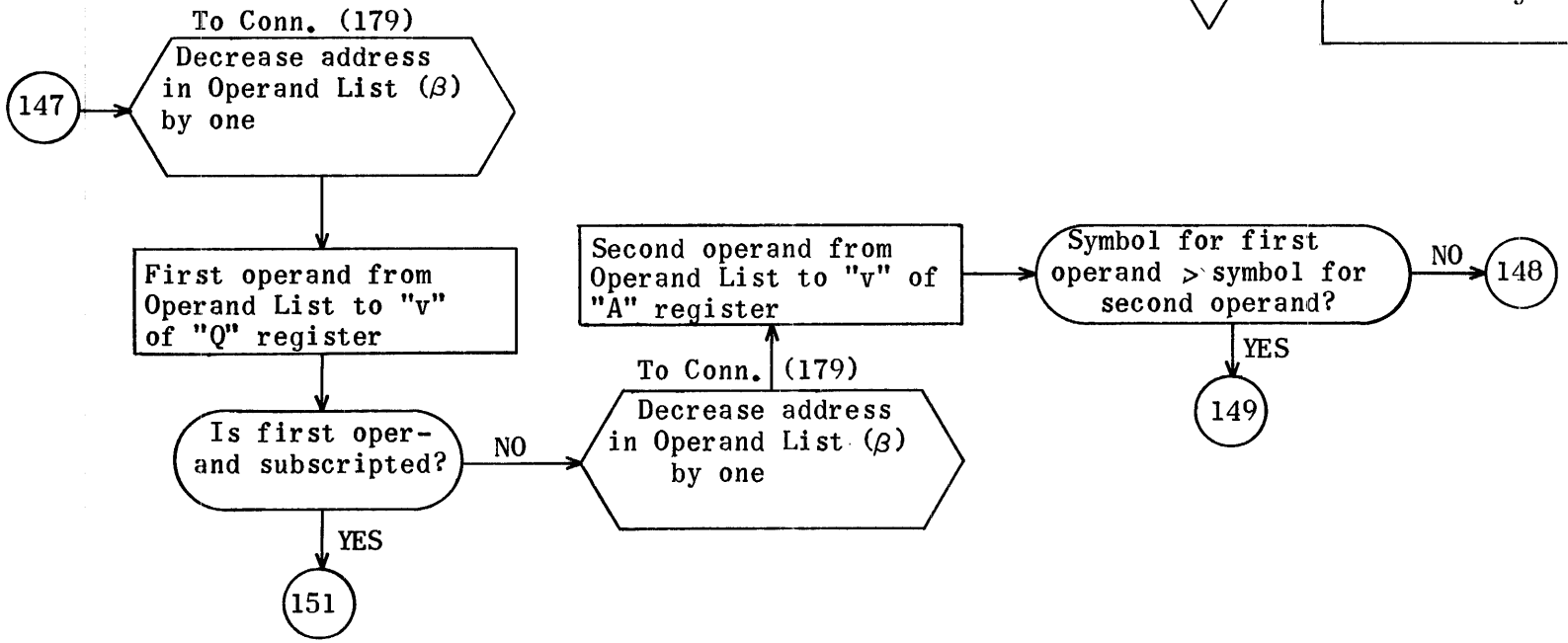

135
Set condition indicator to 30₈ in op. code to indicate "u" operand 77--- type and "v" operand 76--- type
Advance N_{rp} by 6
Advance count of relative constants (C_{rc}) by one
136
Is subscript for "u" operand = partial result counter? (i.e., subscript in "A" register?)
YES
132
NO
137
IS subscript for "v" operand = partial result counter? (i.e.-subscript in "A" Register?
yes
126
A
NO
120
To Conn. (179)
138
Decrease address in operand list (β) by one
Is operand in "u" of dummy instruction 77--- type?
NO
YES
139
Set condition indicator to 25₈ in op. code to indicate "u" operand 75--- or 76--- type and "v" operand 77--- type
Advance N_{rp} by 6
140
139
Set condition indicator to 17₈ in op. code to indicate "u" operand 77--- type and "v" operand 77--- type.
Advance N_{rp} by 5
140
Advance count of relative constants (C_{rc}) by one
136

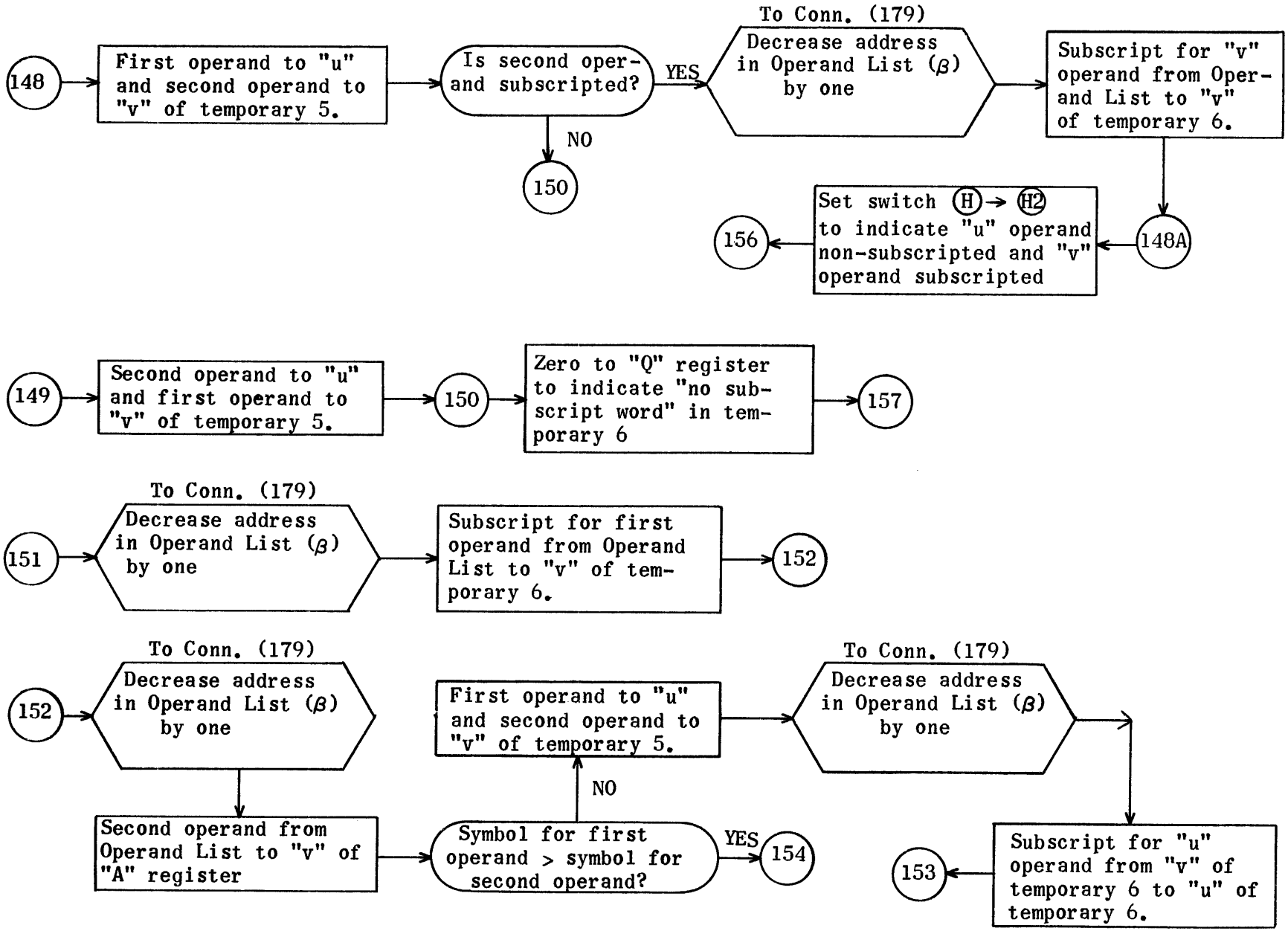
Equation Redundancy Check (Subroutine to Check Variables)

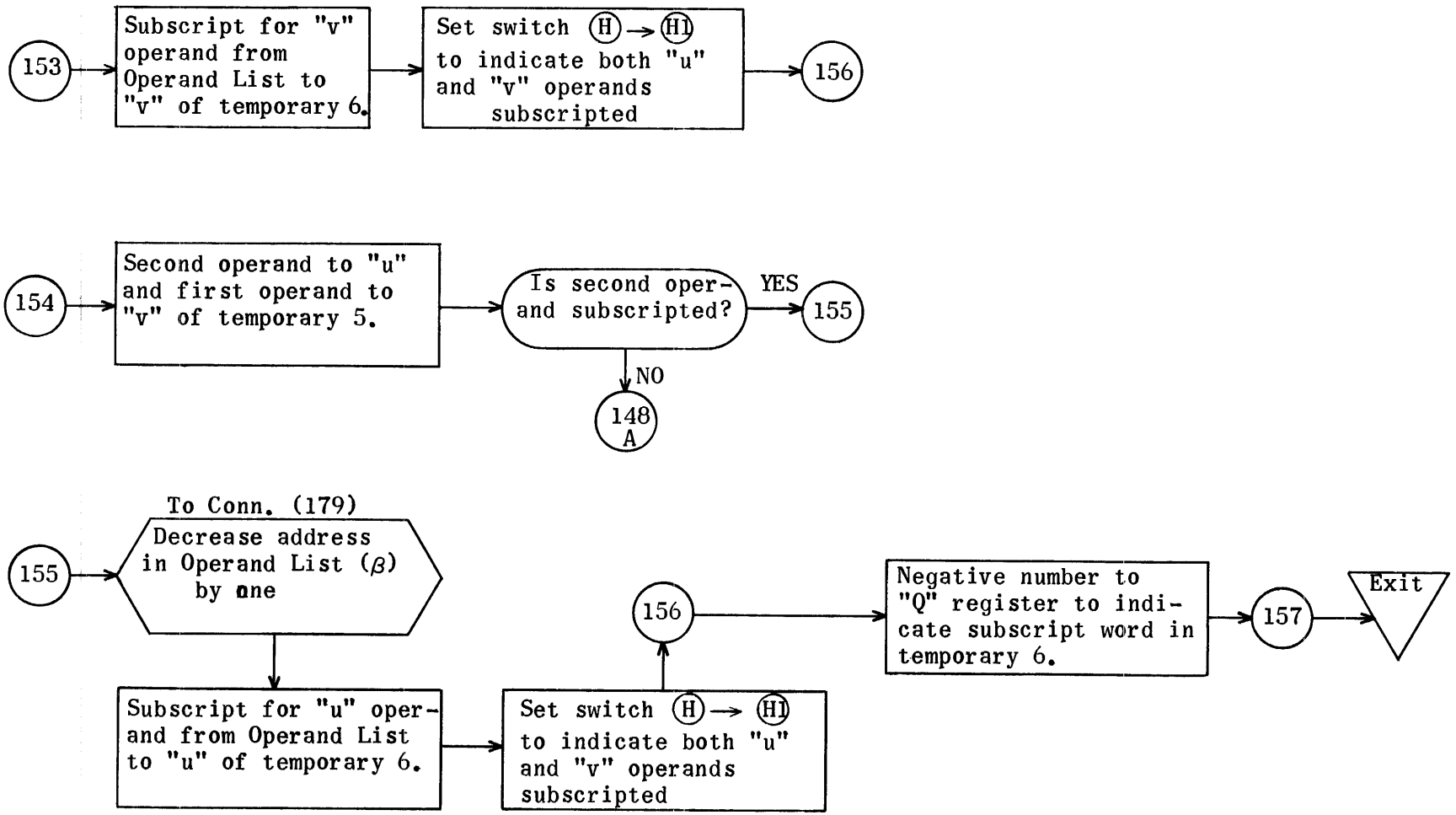




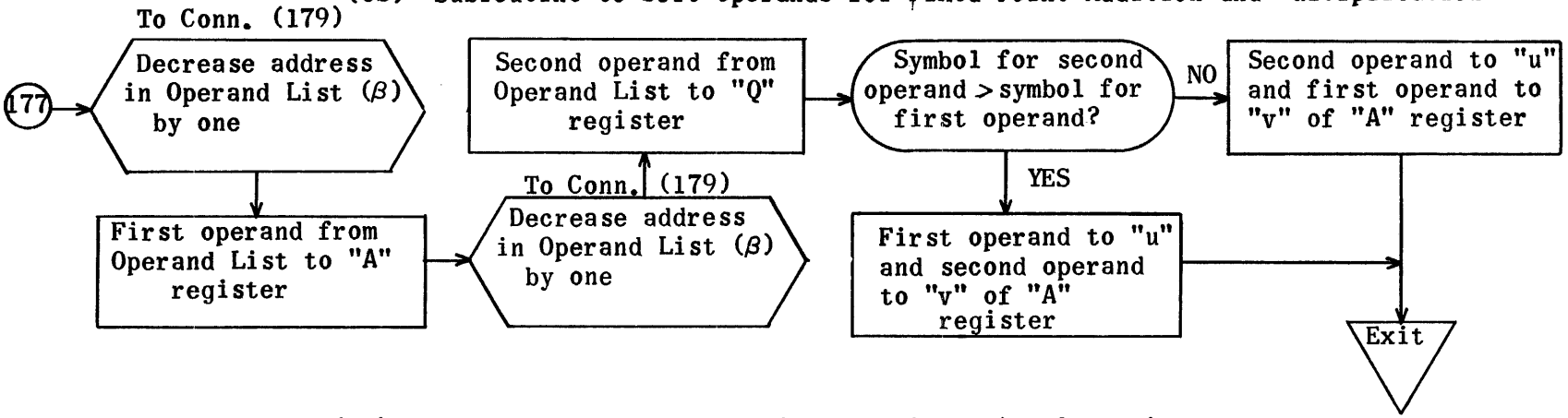
(VS) Subroutine To Sort Operands for Floating Point Addition or Multiplication



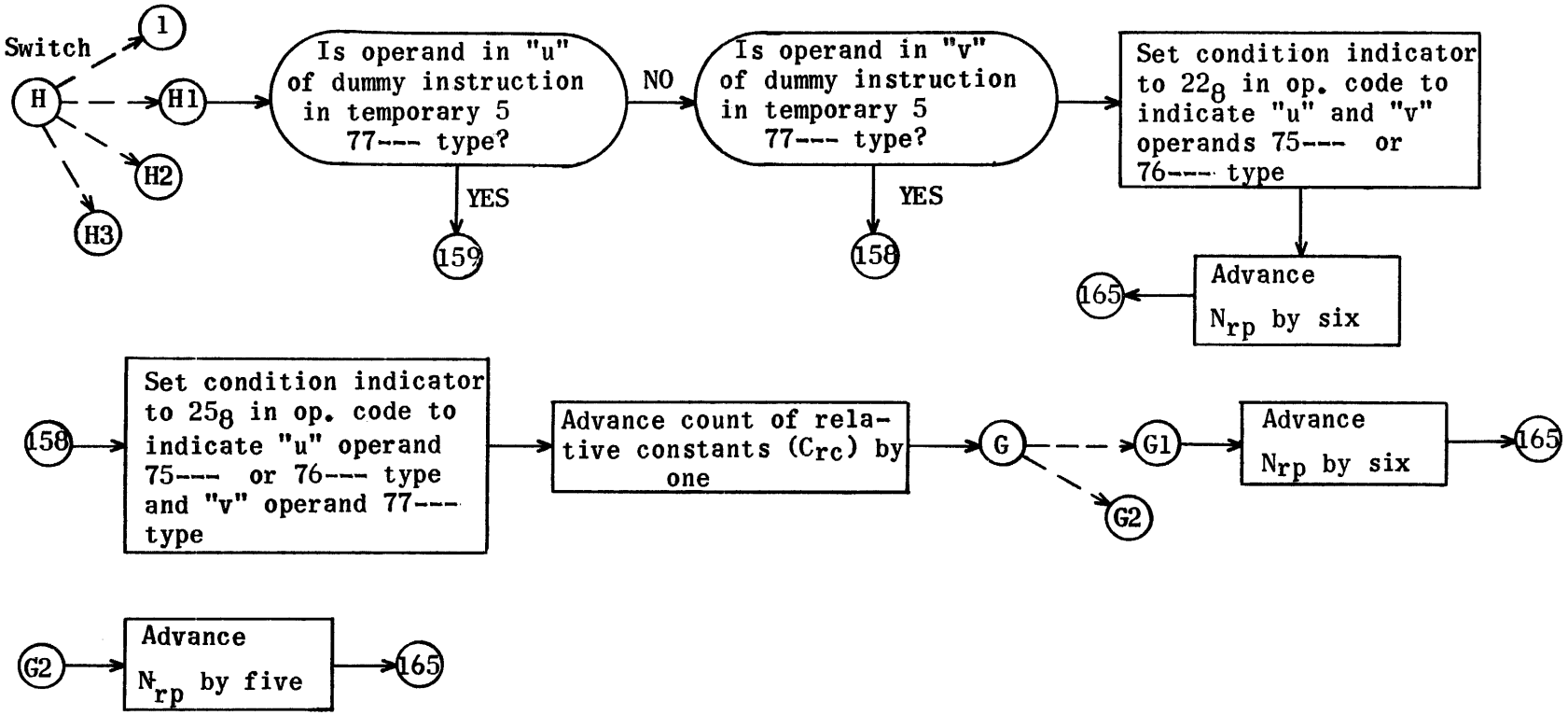

148
First operand to "u" and second operand to "v" of temporary 5.
Is second operand subscripted?
YES
NO
To Conn. (179)
Decrease address in Operand List (β) by one
Subscript for "v" operand from Operand List to "v" of temporary 6.
150
Set switch (H) → (H2) to indicate "u" operand non-subscripted and "v" operand subscripted
156
148A
149
Second operand to "u" and first operand to "v" of temporary 5.
150
Zero to "Q" register to indicate "no subscript word" in temporary 6
157
151
To Conn. (179)
Decrease address in Operand List (β) by one
Subscript for first operand from Operand List to "v" of temporary 6.
152
152
To Conn. (179)
Decrease address in Operand List (β) by one
Second operand from Operand List to "v" of "A" register
Symbol for first operand > symbol for second operand?
NO
YES
154
First operand to "u" and second operand to "v" of temporary 5.
To Conn. (179)
Decrease address in Operand List (β) by one
153
Subscript for "u" operand from "v" of temporary 6 to "u" of temporary 6.

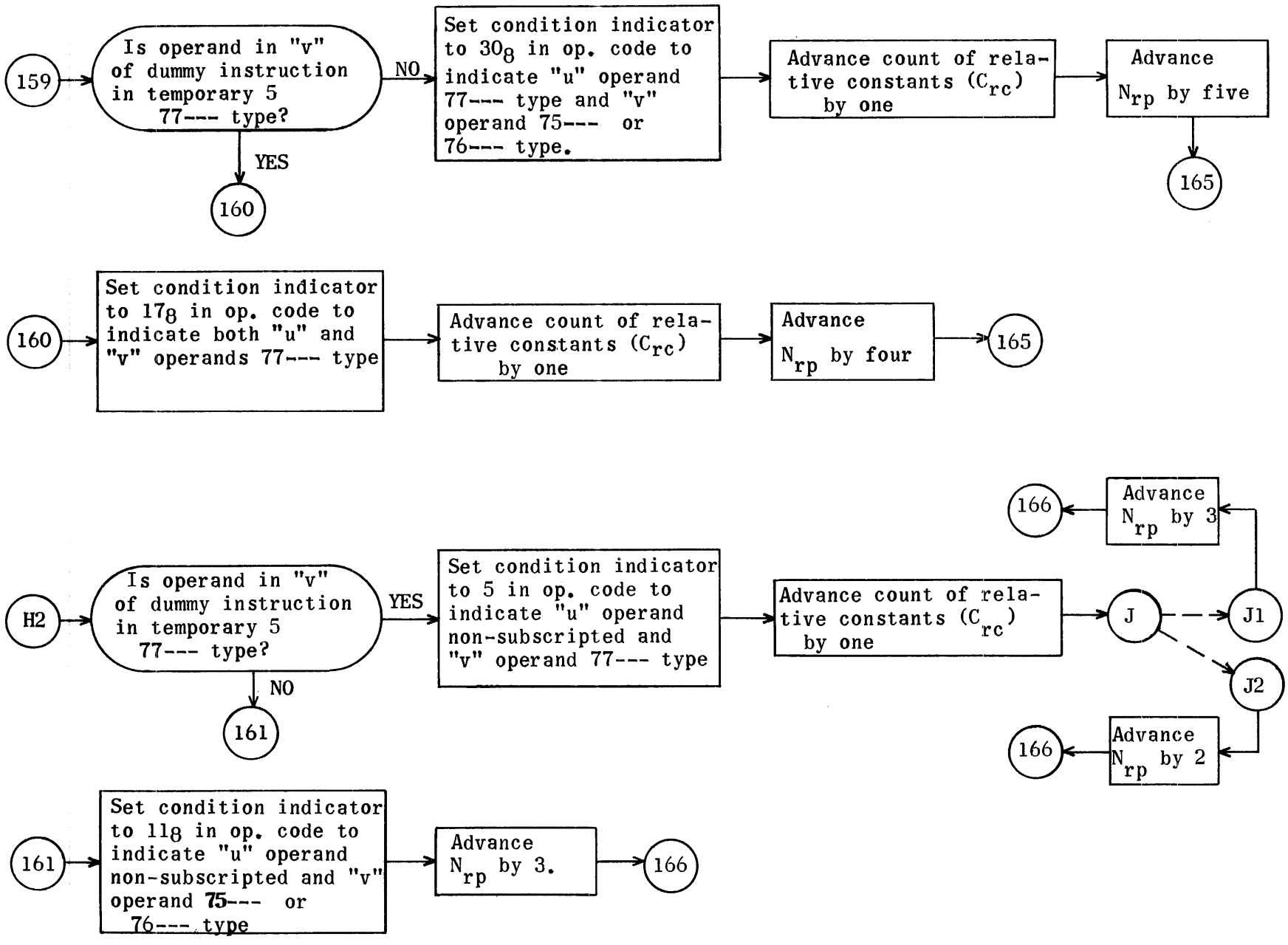

153
Subscript for "v" operand from Operand List to "v" of temporary 6.
Set switch (H) → (H1) to indicate both "u" and "v" operands subscripted
156
154
Second operand to "u" and first operand to "v" of temporary 5.
Is second operand subscripted?
YES
155
NO
148 A
To Conn. (179)
155
Decrease address in Operand List (β) by one
Subscript for "u" operand from Operand List to "u" of temporary 6.
Set switch (H) → (H1) to indicate both "u" and "v" operands subscripted
156
Negative number to "Q" register to indicate subscript word in temporary 6.
157
Exit

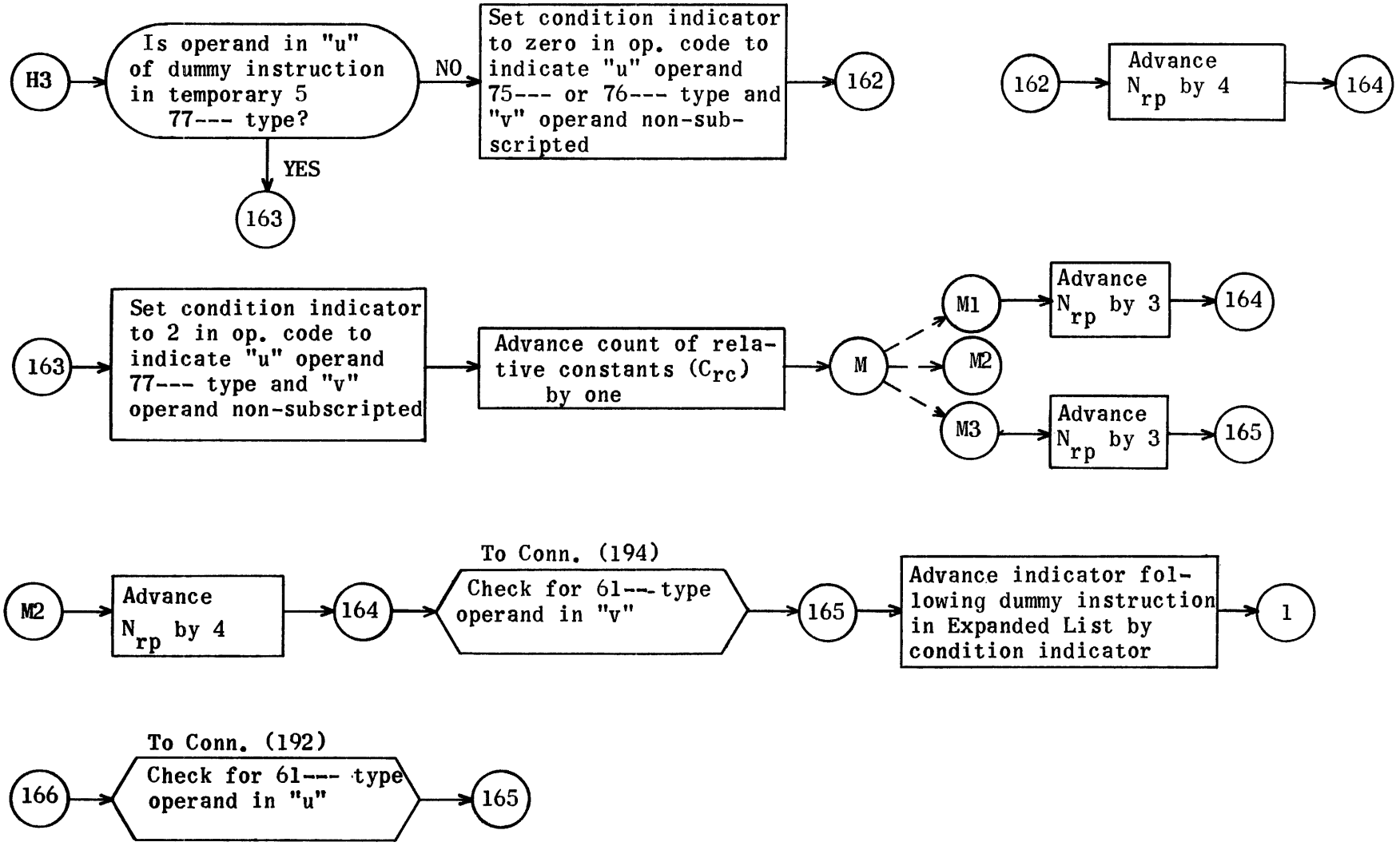
(OS) Subroutine to Sort Operands for Fixed Point Addition and Multiplication



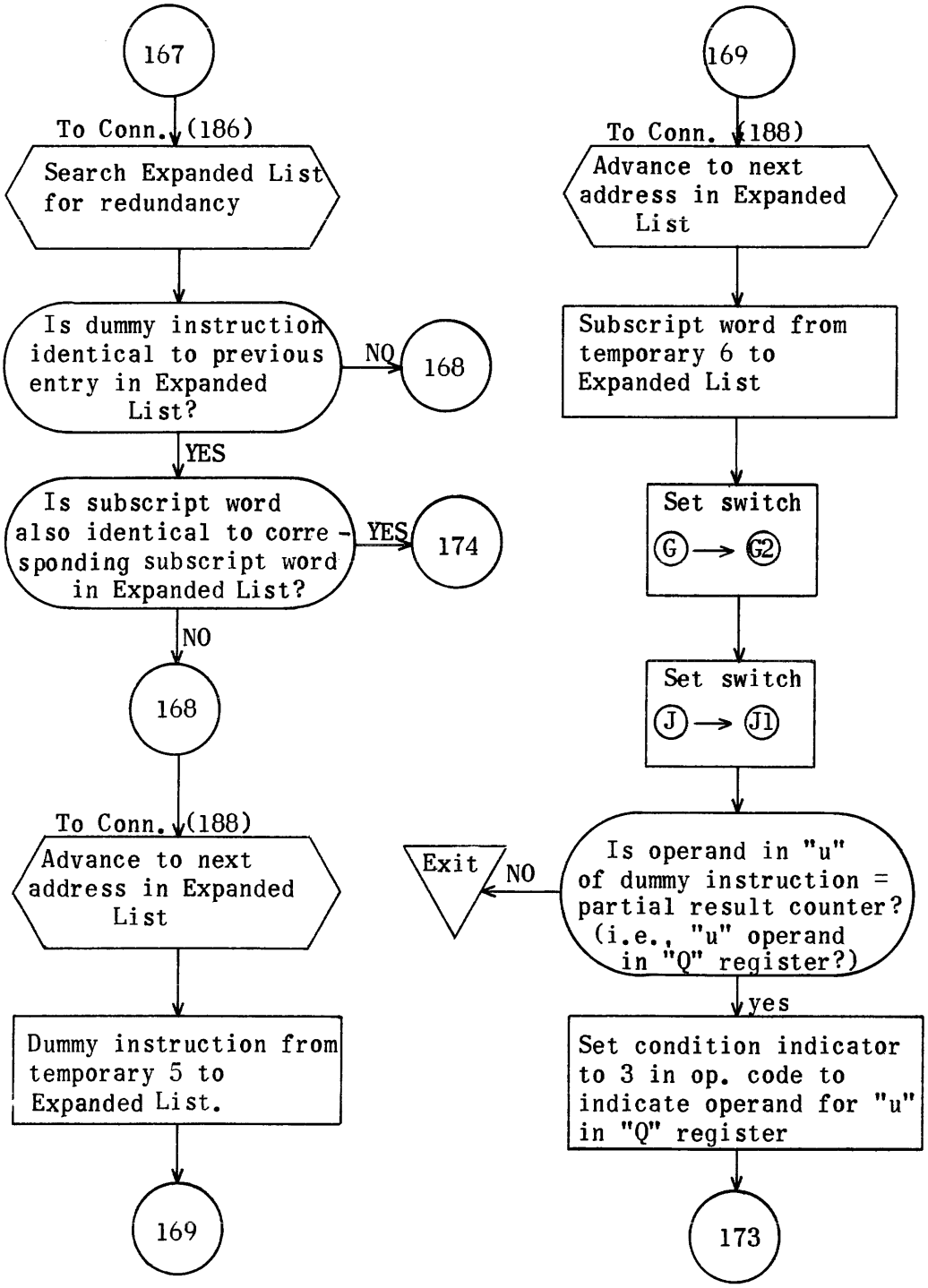
(PN) Set Condition Indicator for Floating Point Operations

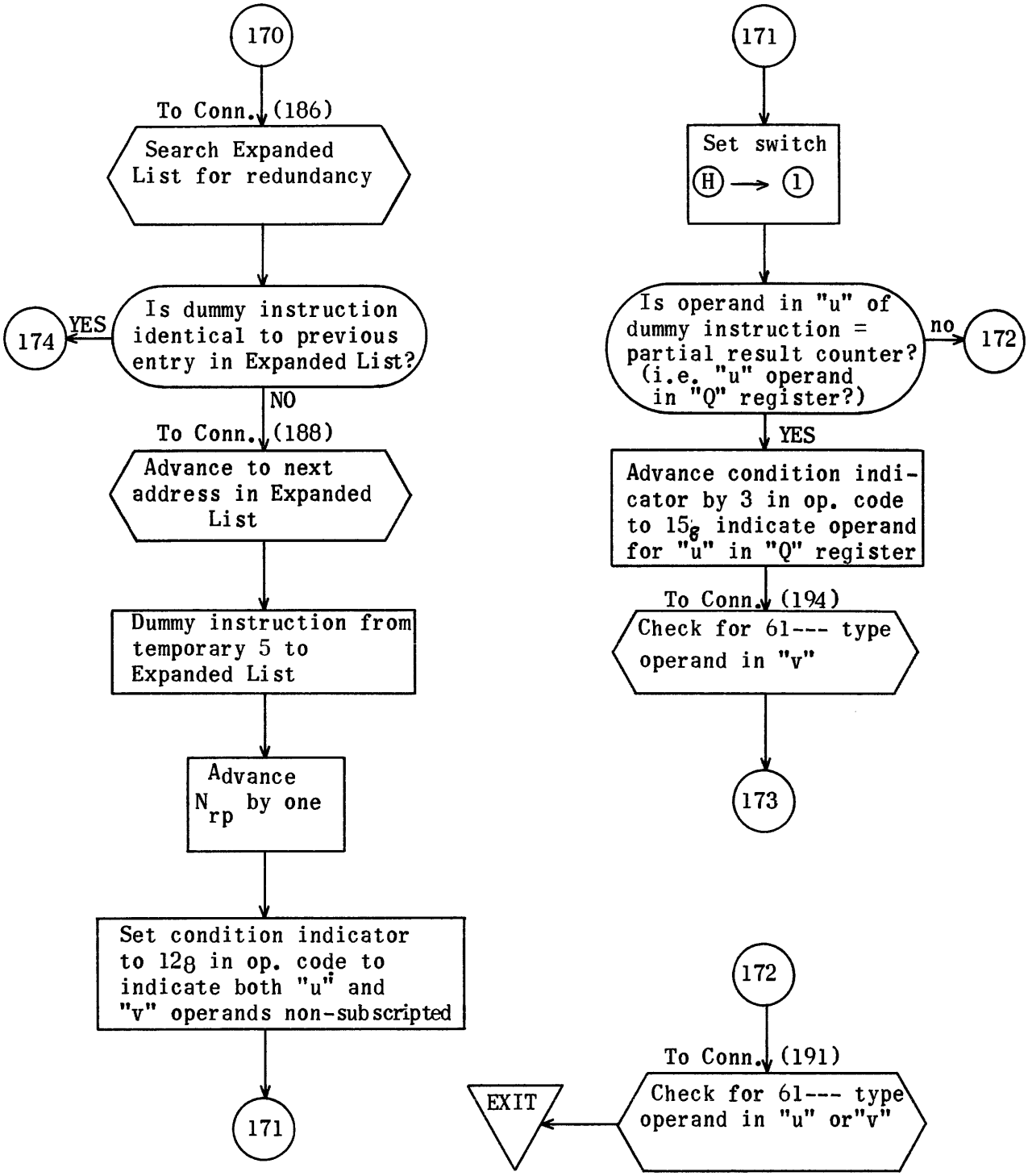


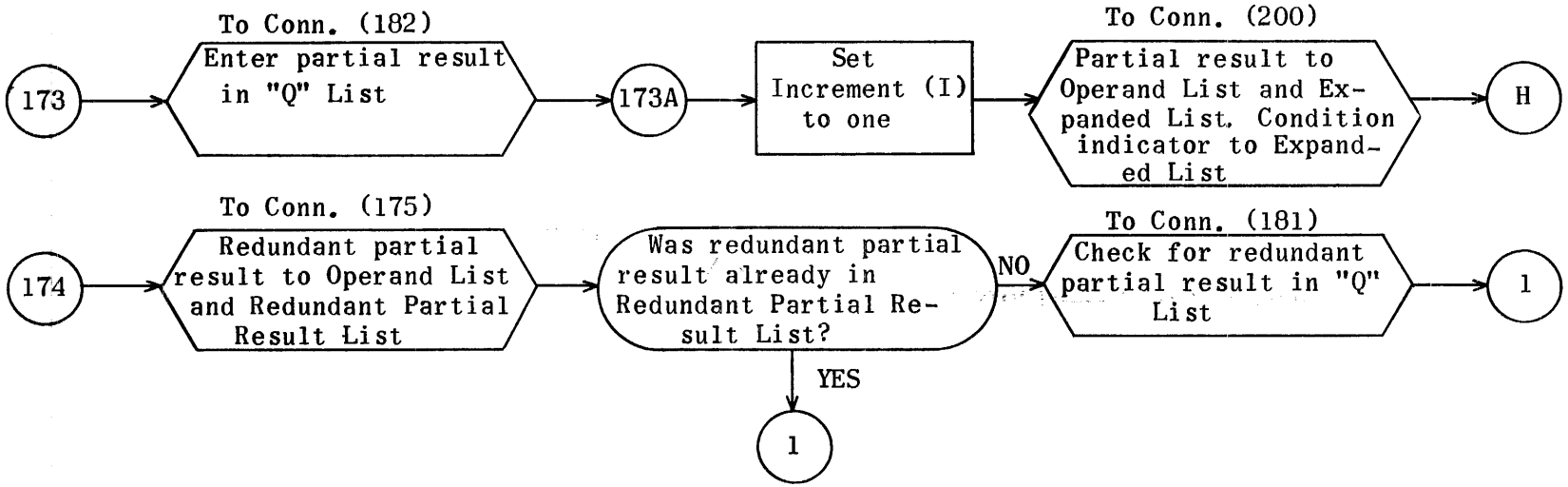

159
Is operand in "v" of dummy instruction in temporary 5 77--- type?
NO
YES
160
Set condition indicator to 30_8 in op. code to indicate "u" operand 77--- type and "v" operand 75--- or 76--- type.
Advance count of relative constants (C_{rc}) by one
Advance N_{rp} by five
165
160
Set condition indicator to 17_8 in op. code to indicate both "u" and "v" operands 77--- type
Advance count of relative constants (C_{rc}) by one
Advance N_{rp} by four
165
H2
Is operand in "v" of dummy instruction in temporary 5 77--- type?
YES
NO
161
Set condition indicator to 5 in op. code to indicate "u" operand non-subscripted and "v" operand 77--- type
Advance count of relative constants (C_{rc}) by one
J
J1
J2
166
Advance N_{rp} by 3
166
Advance N_{rp} by 2
161
Set condition indicator to 11_8 in op. code to indicate "u" operand non-subscripted and "v" operand 75--- or 76--- type
Advance N_{rp} by 3.
166


H3
Is operand in "u" of dummy instruction in temporary 5 77--- type?
NO
Set condition indicator to zero in op. code to indicate "u" operand 75--- or 76--- type and "v" operand non-subscripted
162
YES
163
162
Advance N_{rp} by 4
164
163
Set condition indicator to 2 in op. code to indicate "u" operand 77--- type and "v" operand non-subscripted
Advance count of relative constants (C_{rc}) by one
M
M1
Advance N_{rp} by 3
164
M2
M3
Advance N_{rp} by 3
165
M2
Advance N_{rp} by 4
164
To Conn. (194)
Check for 61--- type operand in "v"
165
Advance indicator following dummy instruction in Expanded List by condition indicator
1
To Conn. (192)
166
Check for 61--- type operand in "u"
165

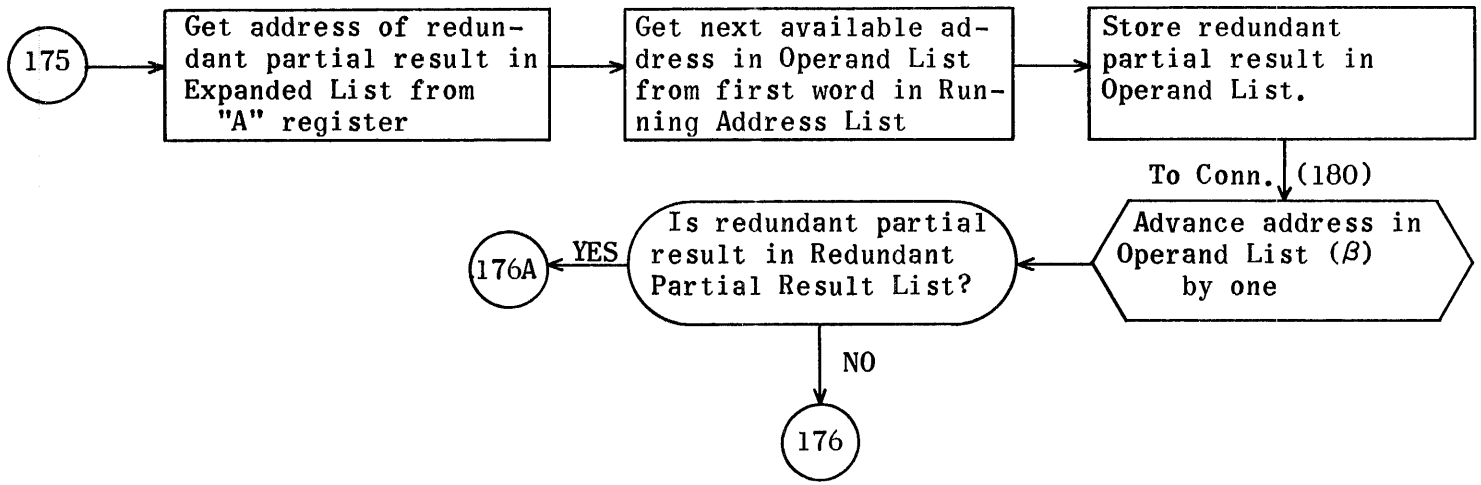
(RR) Subroutine To Check for Redundant Floating Point Binary Operation

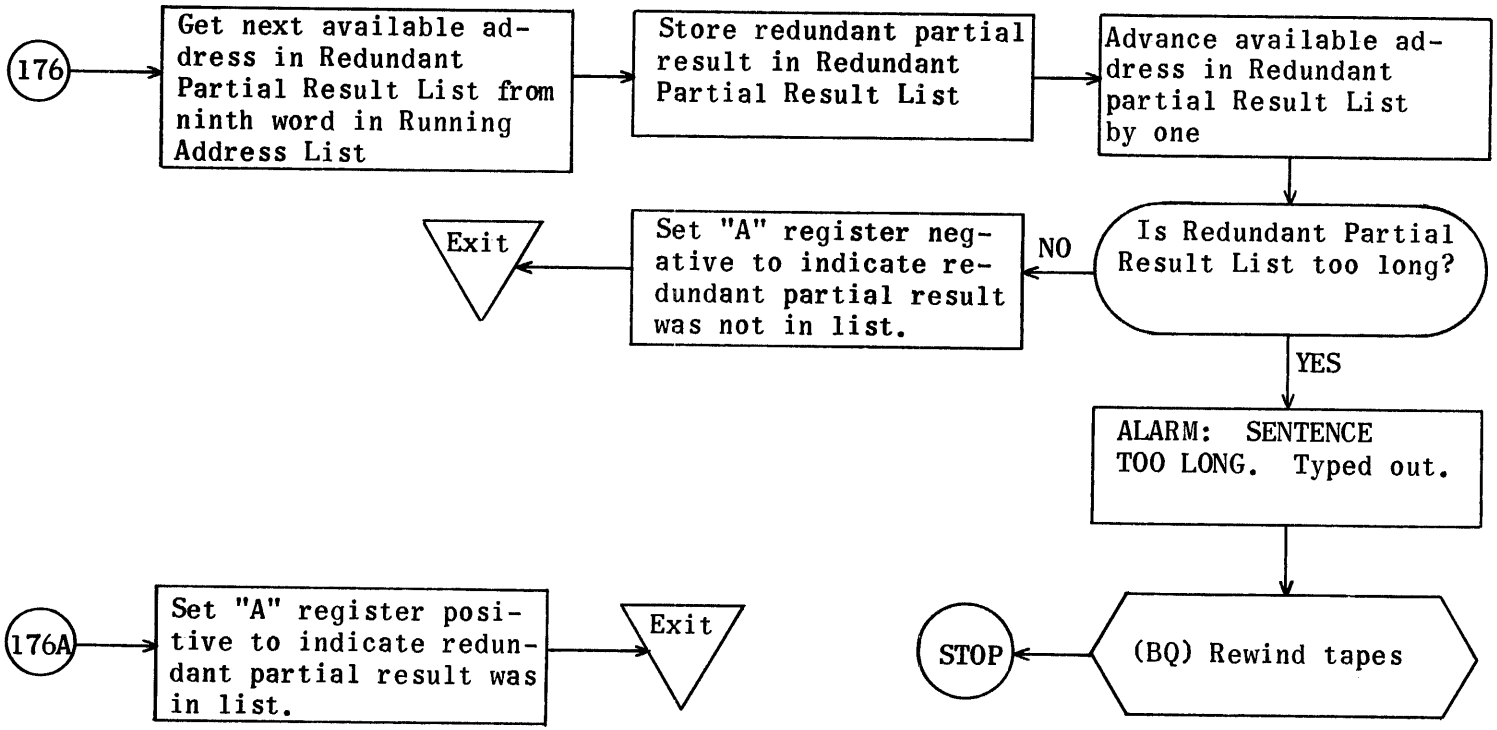



170
To Conn. (186)
Search Expanded List for redundancy
Is dummy instruction identical to previous entry in Expanded List?
YES
174
NO
To Conn. (188)
Advance to next address in Expanded List
Dummy instruction from temporary 5 to Expanded List
Advance N_{rp} by one
Set condition indicator to 12_8 in op. code to indicate both "u" and "v" operands non-subscripted
171
171
Set switch (H) → (1)
Is operand in "u" of dummy instruction = partial result counter? (i.e. "u" operand in "Q" register?)
no
172
YES
Advance condition indicator by 3 in op. code to 15_8 indicate operand for "u" in "Q" register
To Conn. (194)
Check for 61--- type operand in "v"
173
172
To Conn. (191)
Check for 61--- type operand in "u" or"v"
EXIT

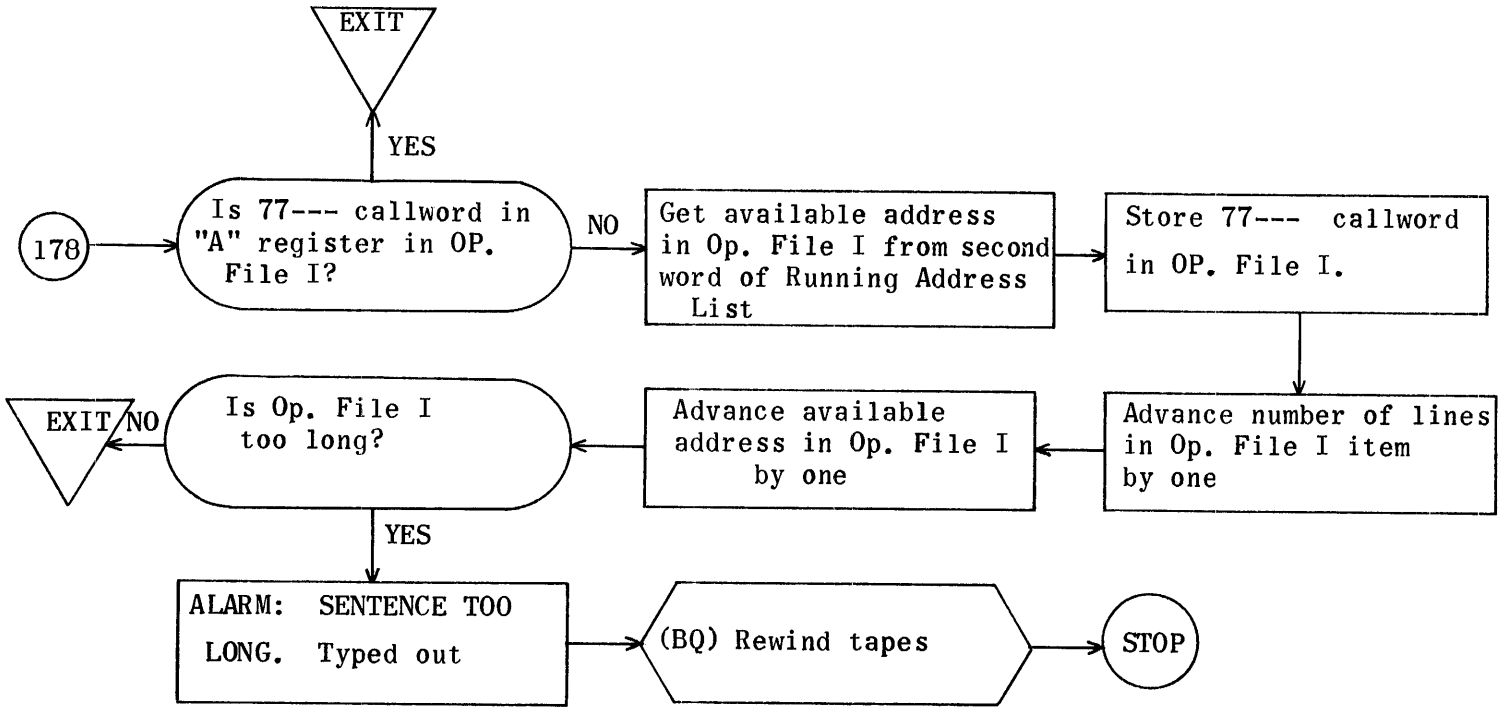


(RS) Subroutine to Store Redundant Partial Result in Operand List and Redundant Partial Result List.

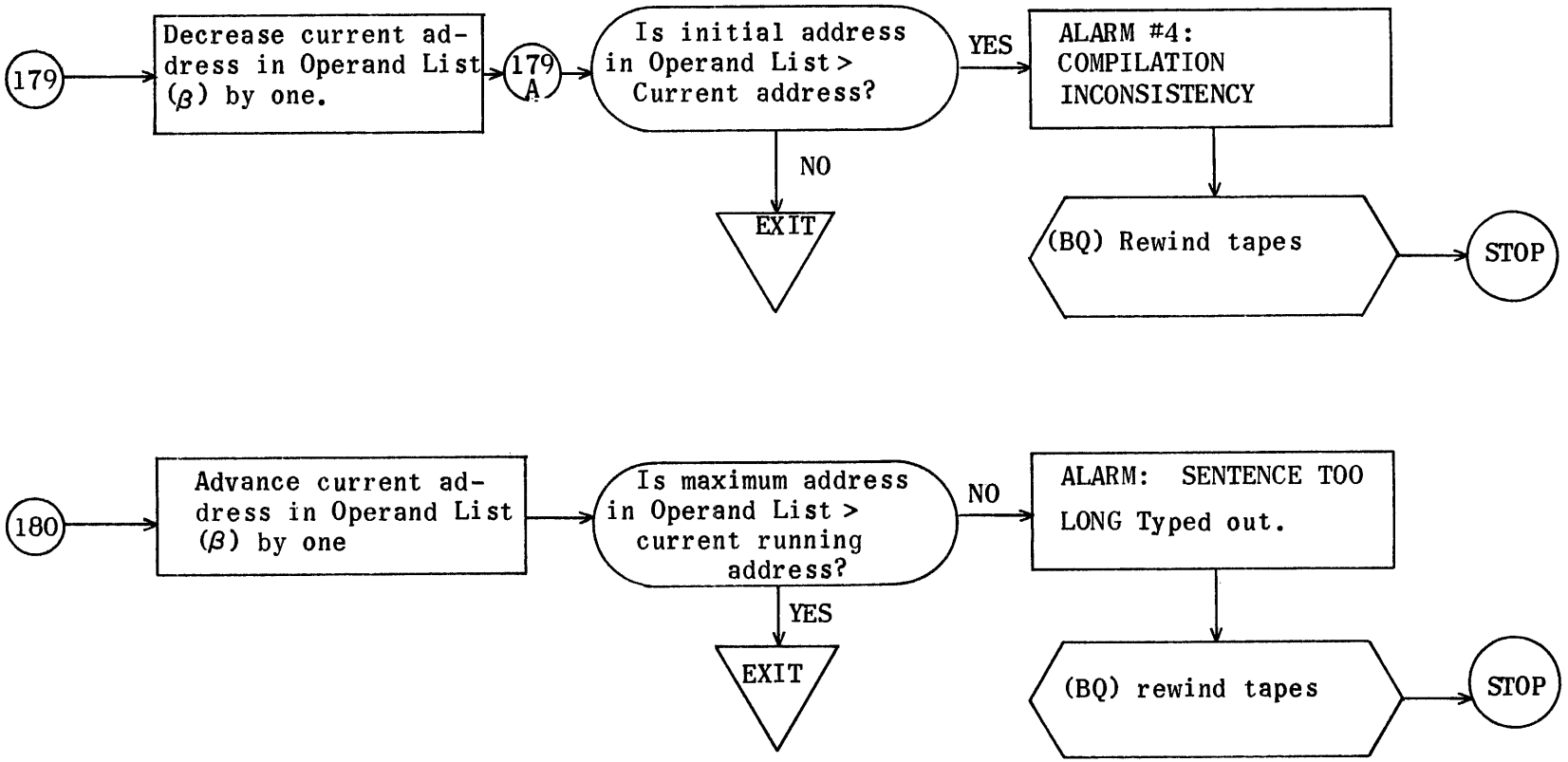



176
Get next available address in Redundant Partial Result List from ninth word in Running Address List
Store redundant partial result in Redundant Partial Result List
Advance available address in Redundant partial Result List by one
Is Redundant Partial Result List too long?
NO
Set "A" register negative to indicate redundant partial result was not in list.
Exit
YES
ALARM: SENTENCE TOO LONG. Typed out.
(BQ) Rewind tapes
STOP
176A
Set "A" register positive to indicate redundant partial result was in list.
Exit

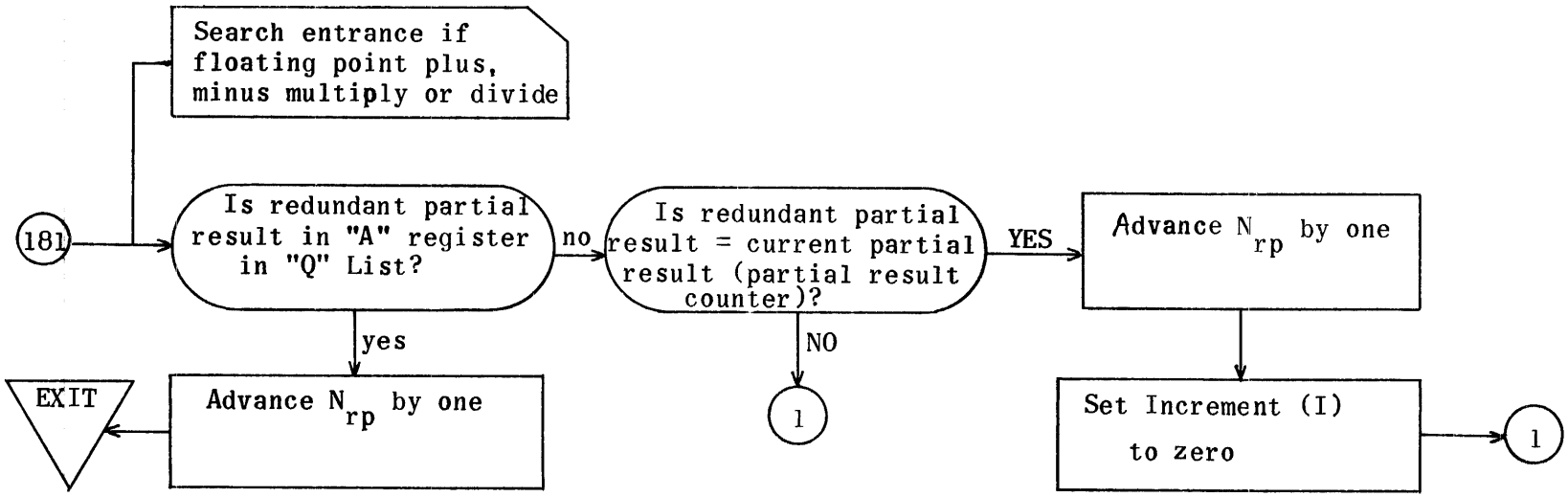
(FS) Subroutine To Store Callword in Op. File 1 Item
Input-Callword in " " of "A" Register

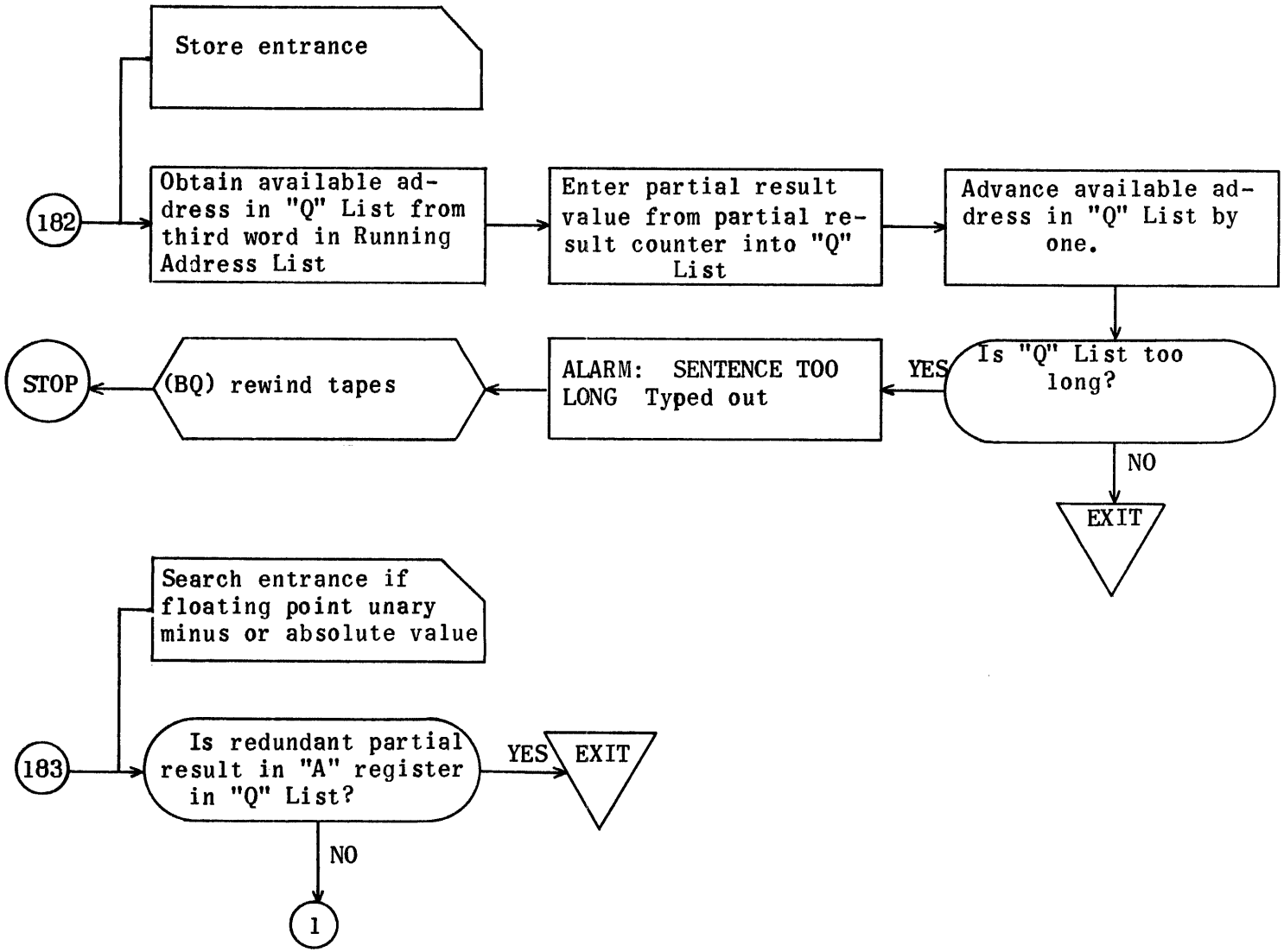


(BR) Subroutine to Advance or Decrease Available Address in Operand List (Beta Routine)



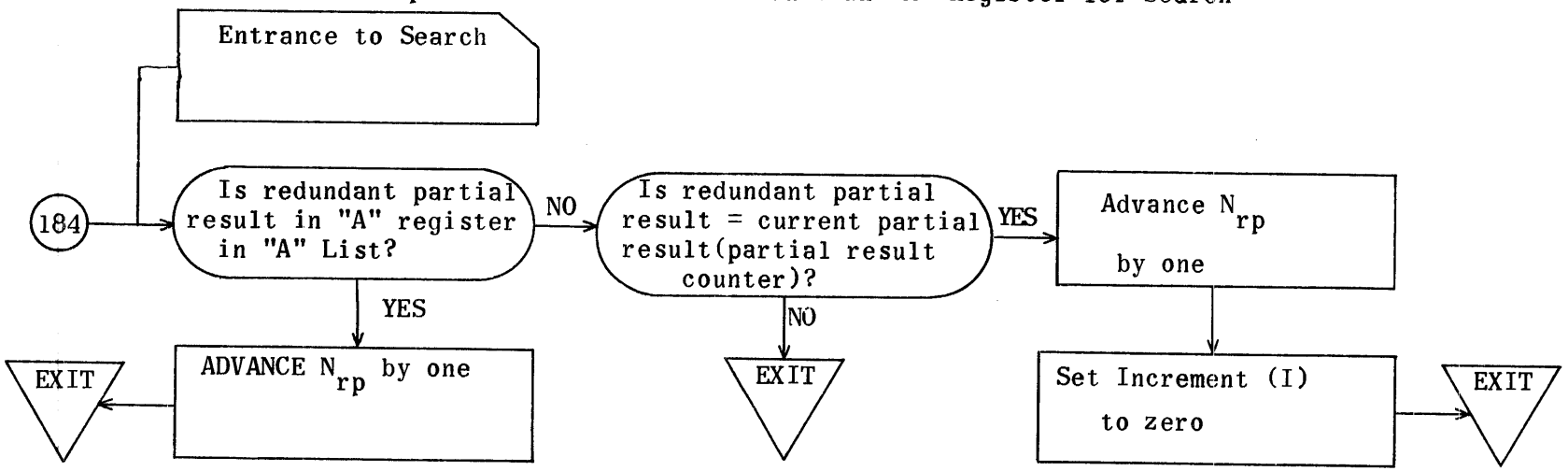
(LQ) Subroutine To Search for or Store Partial Result Symbol in "Q" List
Input—Redundant Partial Result in "A" Register for Search

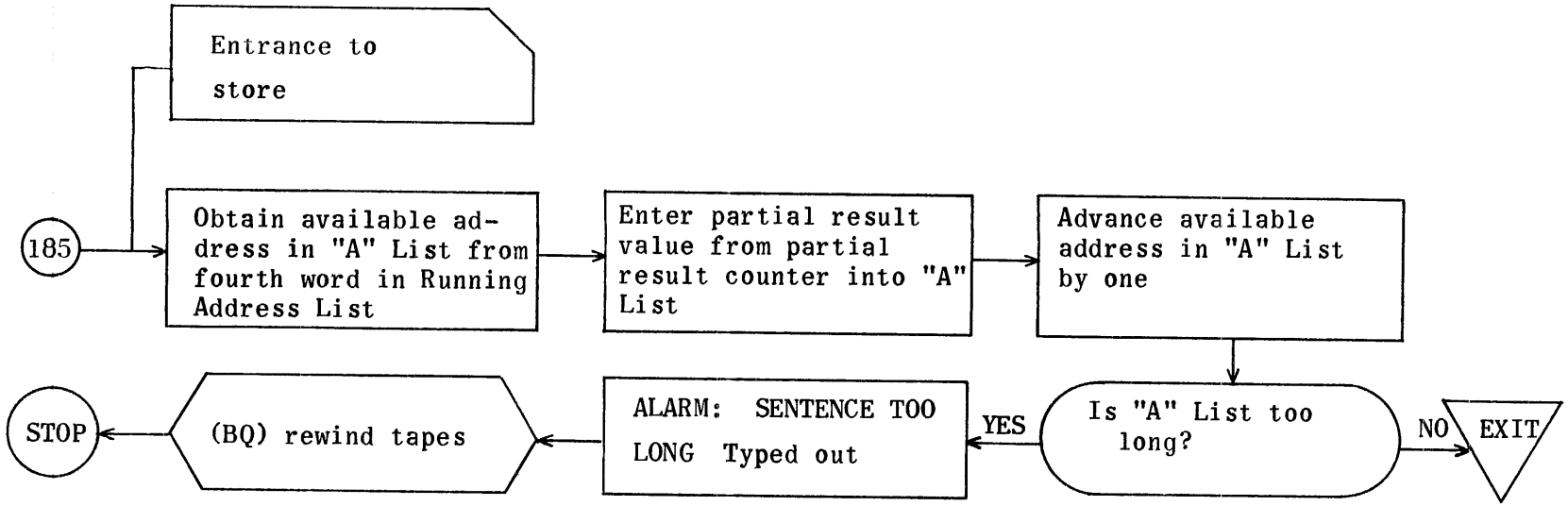



Store entrance
182
Obtain available address in "Q" List from third word in Running Address List
Enter partial result value from partial result counter into "Q" List
Advance available address in "Q" List by one.
Is "Q" List too long?
YES
ALARM: SENTENCE TOO LONG Typed out
(BQ) rewind tapes
STOP
NO
EXIT
Search entrance if floating point unary minus or absolute value
183
Is redundant partial result in "A" register in "Q" List?
YES
EXIT
NO
1

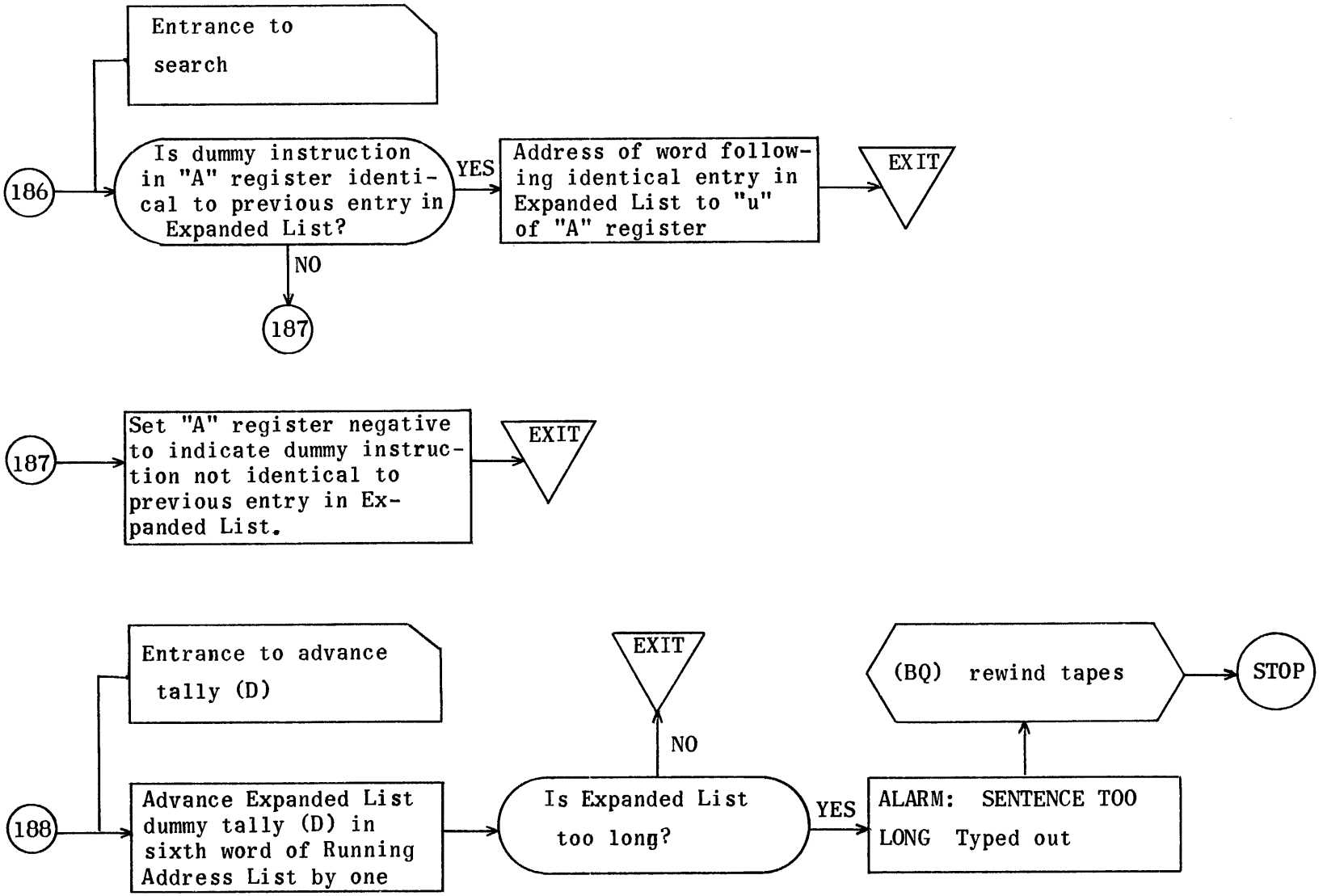
(LA) Subroutine To Search for or Store Partial Result Symbol in "A" List

Input—Redundant Partial Result in "A" Register for Search

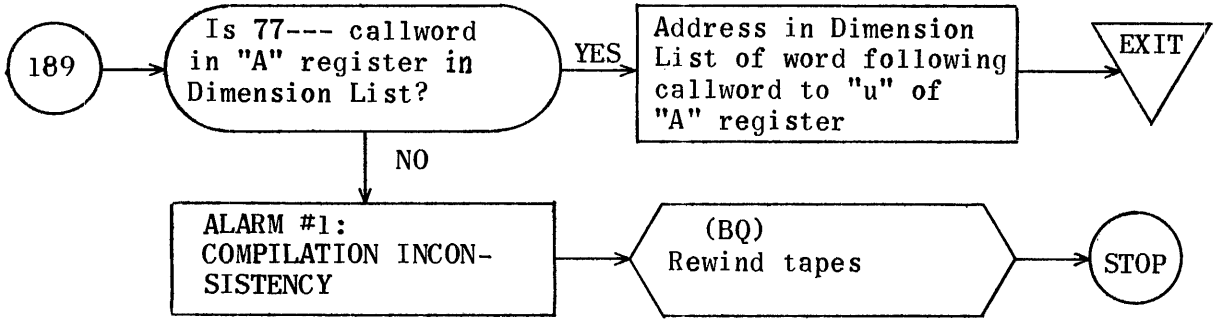




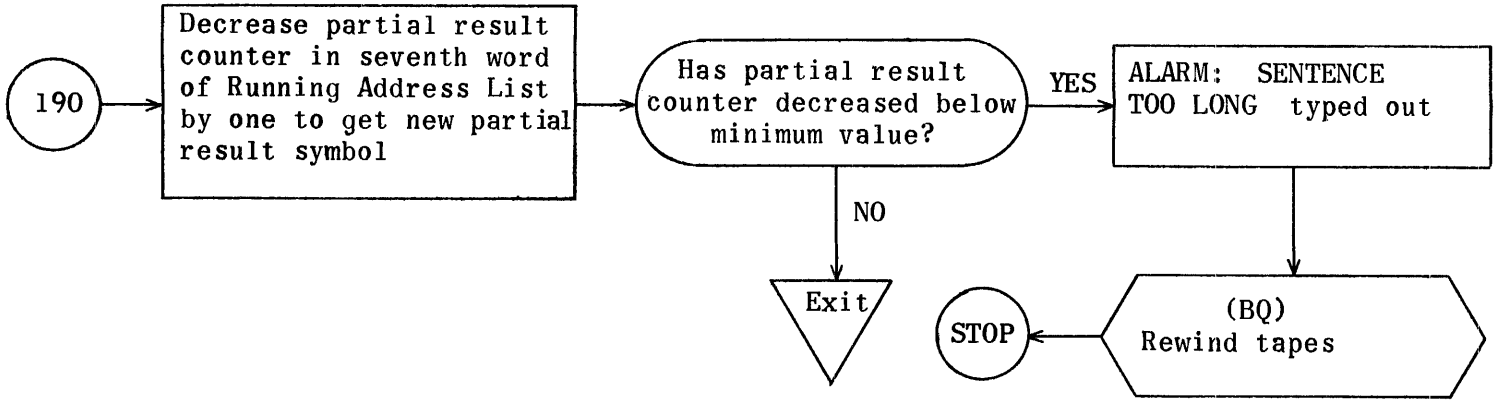
(ES) Subroutine To Search for Dummy Instruction or Advance Dummy Tally in Expanded List
Input—Dummy Instruction in "A" Register



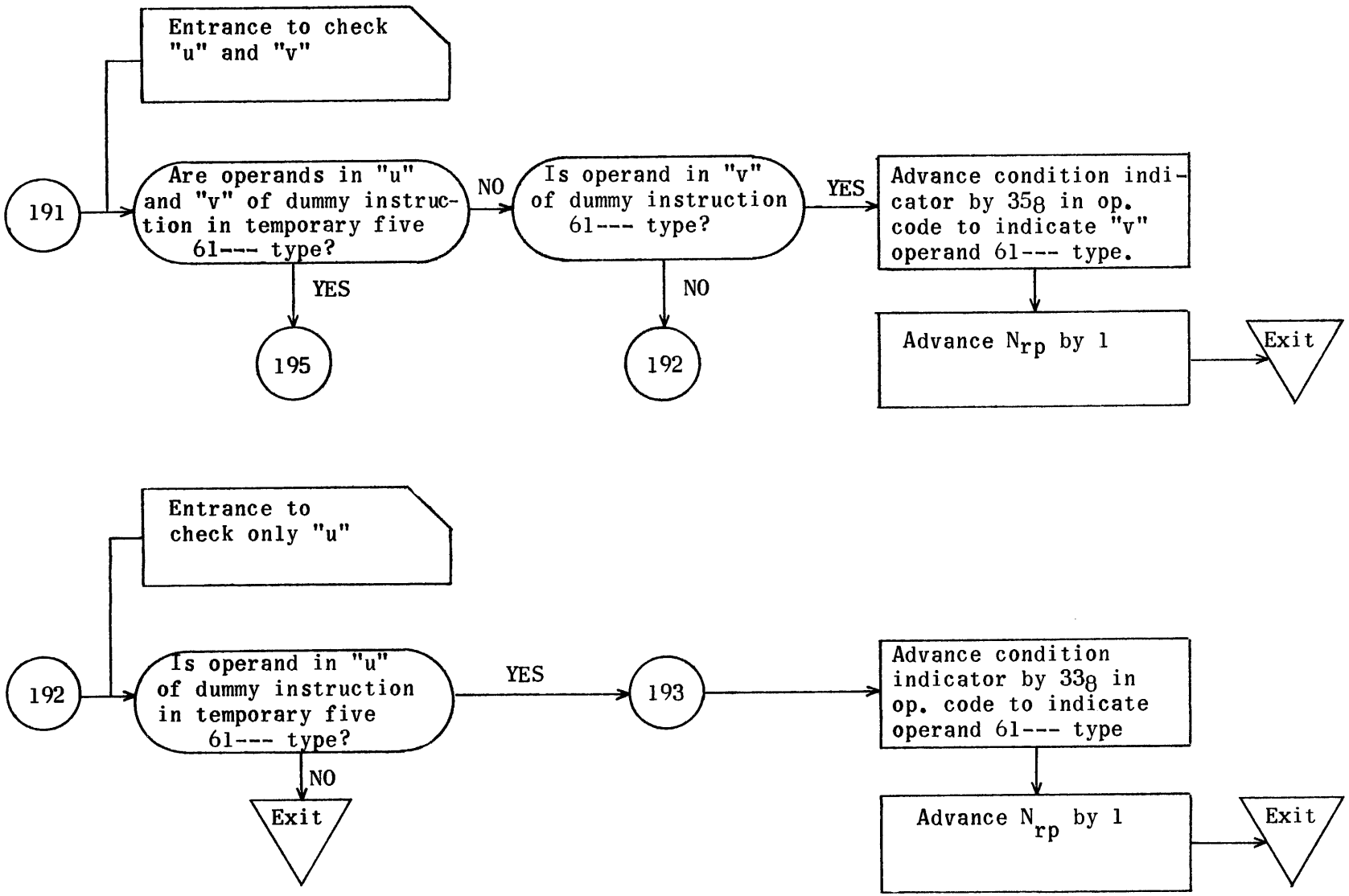
(DS) Subroutine to Search Dimension List
(Input-Callword in "A" Register)

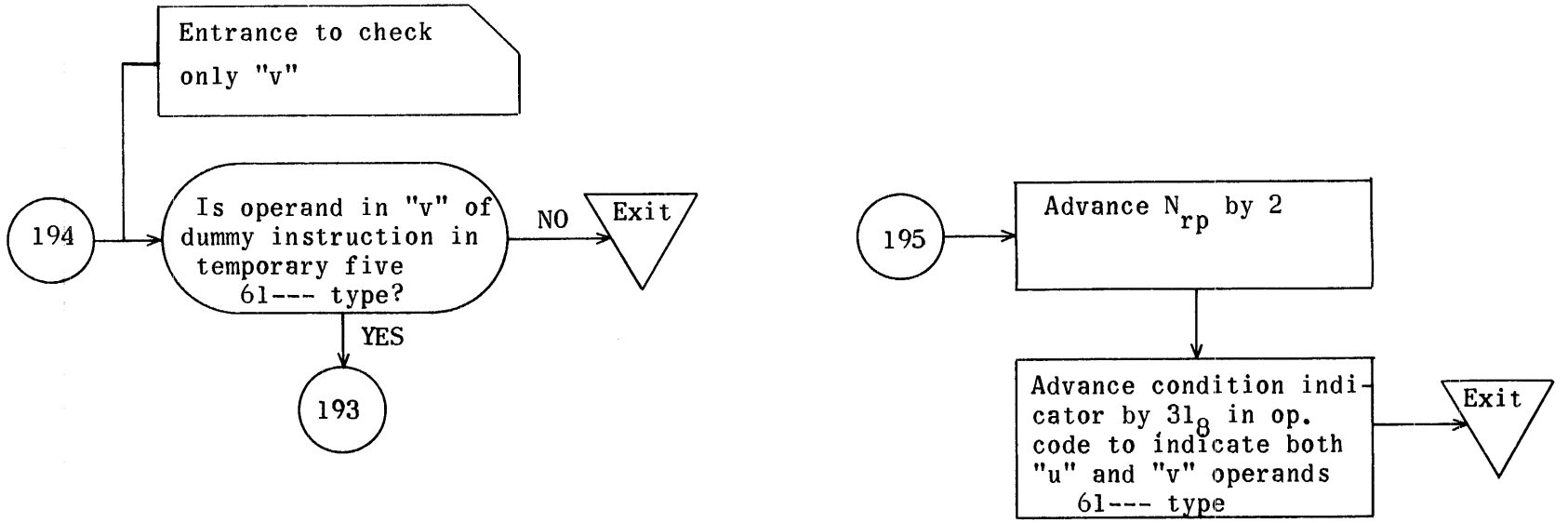


(PR) Subroutine to Decrease and Check Partial Result Counter

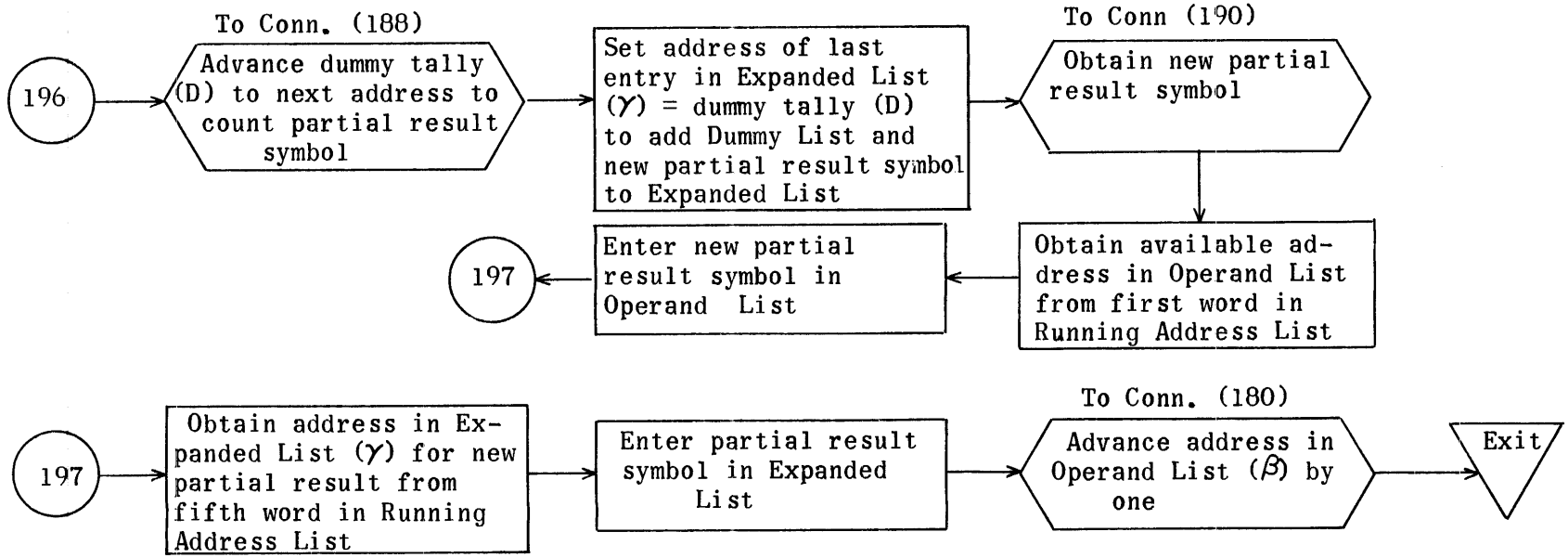


(EK) Subroutine to Check for 61--- Type Operands in Dummy Instruction

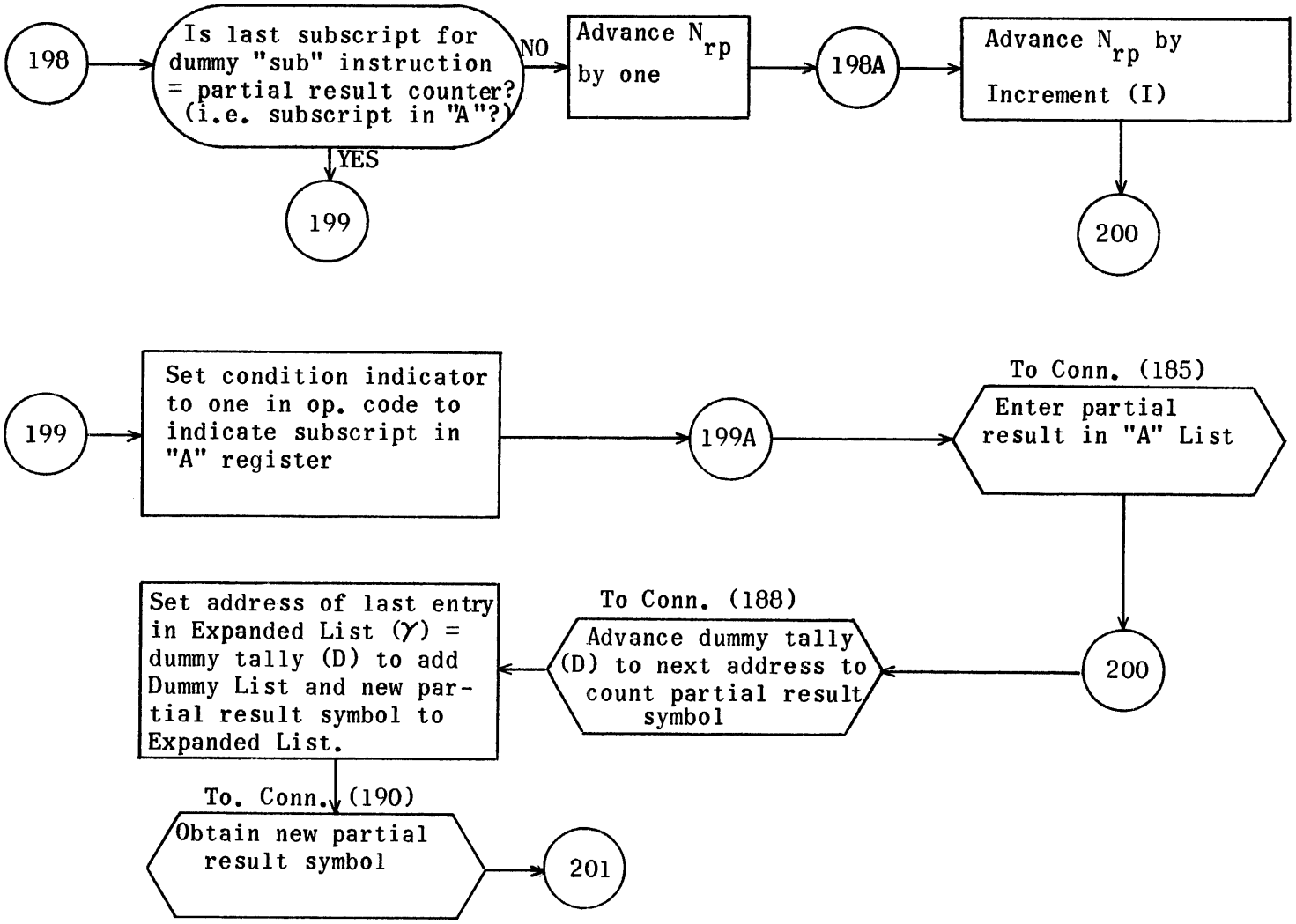


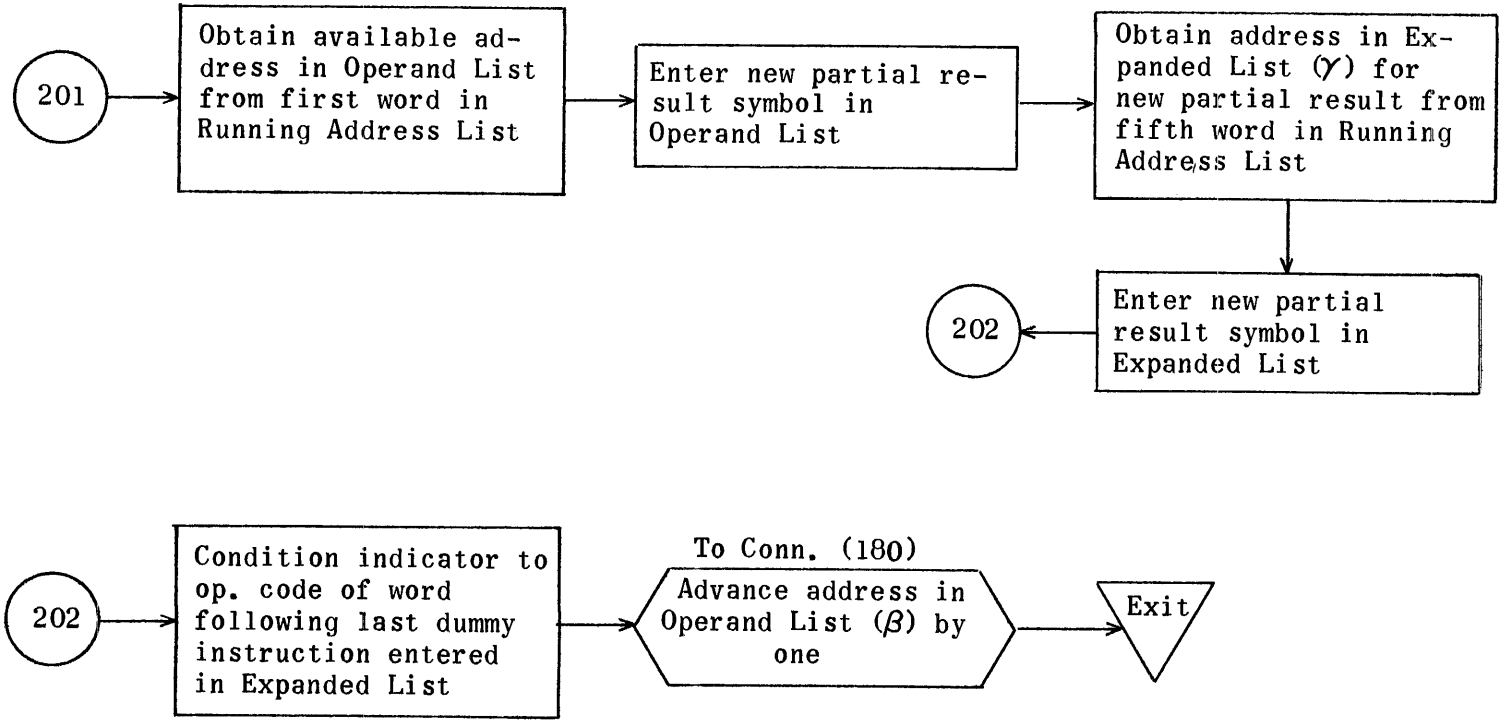


(PP) Subroutine to enter Current Partial Result Symbol in Expanded List and Operand List

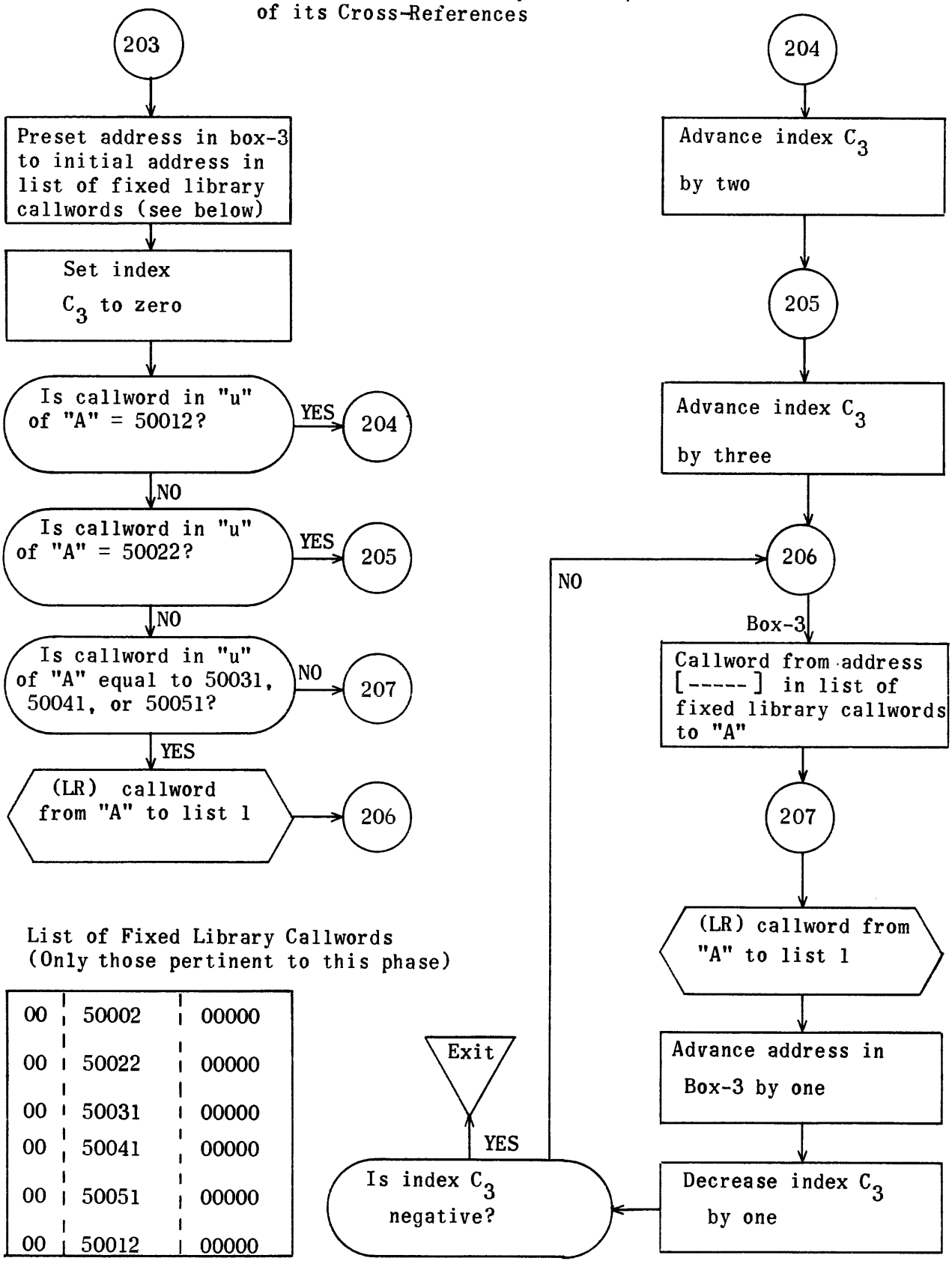


Subroutine to Store Partial Result Symbol for "Sub" Operation in Expanded List and Operand List




201
Obtain available address in Operand List from first word in Running Address List
Enter new partial result symbol in Operand List
Obtain address in Expanded List (γ) for new partial result from fifth word in Running Address List
202
Enter new partial result symbol in Expanded List
202
Condition indicator to op. code of word following last dummy instruction entered in Expanded List
To Conn. (180)
Advance address in Operand List (β) by one
Exit

(LS) Subroutine to Store in List 1, Callword of Library Routine and, if Fixed Library Routine, Callwords of its Cross-References



List of Fixed Library Callwords
(Only those pertinent to this phase)

00	50002	00000
00	50022	00000
00	50031	00000
00	50041	00000
00	50051	00000
00	50012	00000

Equation No. 2 (Redundancy Check) Coding

Regional Assignments for Equation Redundancy Check Phase

		Region and Address	Name or Description
General Subroutines (not part of this phase) ↓	RE	UP421	Uniprint Routine
	RE	EP537	Alarm Routine
	RE	BQ632	Rewind Tapes Routine
	RE	WA653	Type Alarm Heading
	RE	CW1211	Constant Callword Routine
	RE	LR1465	Build List 1 Routine
Input from Translation	RE	SL2242	Sorted List
Program	RE	BB2512	Setup Redundancy Check Phase (Start)
	RE	SS2544	Check Symbol from Sorted List
	RE	ER2614	End Redundancy Check Phase
	RE	SO2633	Subscript Operator (77___type callword)
	RE	SP2715	Subscript Operator (continued)
	RE	SQ2757	Subscript Operator (continued)
	RE	ST3010	Subscript Operator (76__or 75__type callword)
	RE	LJ3064	Library Operator
	RE	LK3111	Library Operator (continued)
	RE	LL3133	Library Operator (continued)
	RE	LM3161	Library Operator (continued)
	RE	LN3210	Library Operator (continued)
	RE	IP3236	Power Operators (3),(-3),(2),(-2),(½),(-½)
	RE	IQ3300	Power Operators (-1),(4to63),(-4 to -63)
	RE	IR3335	Power Operators (continued)
	RE	IS3375	Power Operators (continued)
	RE	FD3454	Floating Point Divide and Subtract Operators
	RE	FP3513	Floating Point Plus and Multiply Operators
	RE	PO3544	Fixed Point Plus Operator
	RE	MO3570	Fixed Point Multiply Operator
	RE	NO3617	Fixed Point Subtract Operator
	RE	DO3651	Fixed Point Divide Operator
	RE	FN3700	Floating Point Unary Minus and Absolute Value Operators
	RE	NF4014	Fixed Point Unary Minus and Absolute Value Operators
	RE	NE4041	Fixed Point Unary Minus and Abs. Val. (continued)
	RE	EE4051	Storage Operator (space-period)

	RE	EF4110	Storage Operator (continued)
	RE	EG4152	Storage Operator (continued)
	RE	EH4206	Storage Operator (continued)
Subroutines	RE	VC4246	Subroutine to Check Variables
	RE	VS4317	Subroutine to Sort Operands for Floating Plus or Multiply
	RE	PN4404	Set Condition Indicator for Floating Point Operations
	RE	RR4502	Subroutine to Check for Redundant Floating Point Binary Operation
	RE	RS4562	Subroutine to Store Redundant Partial Result Symbol in Operand List and Redundant Partial Result List
	RE	OS4610	Subroutine to Sort Operands for Fixed Plus or Multiply
	RE	FS4624	Subroutine to Store Callword in Op. File 1
	RE	BR4642	Subroutine to Advance or Decrease Address β in Operand List (Beta Routine)
	RE	LQ4654	Subroutine to Search for or Store Partial Result Symbol in "Q" List
	RE	LA4703	Subroutine to Search for or Store Partial Result Symbol in "A" List
	RE	ES4726	Subroutine to Search for Dummy Instruction or Advance Dummy Tally in Expanded List
	RE	DS4746	Subroutine to Search Dimension List
	RE	PR4755	Subroutine to Decrease and Check Partial Result Counter
	RE	EK4764	Subroutine to Check for 61___Type Operands in Dummy Instruction
	RE	PP5012	Subroutine to Enter Current Partial Result Symbol in Expanded List and Operand List
	RE	SR5023	Subroutine to Store Partial Result Symbol for Subscript Operation in Expanded List and Operand List
Constants	RE	FC5051	Fixed Constants
	RE	RC5174	Relative Constants
	RE	TO5227	Alarm Text
	RE	IA5233	Initial Addresses of Lists
	RE	LV5245	Limiting Addresses for Lists etc.
Subroutine	RE	LS5257	Subroutine to Store in List 1, Callword of Library Routine and If Fixed Library Routine, Callwords of Cross-References

Temporaries	RE RE	WT5306 CT5315	Working Temporaries Counters
Lists	RE RE RE RE RE RE RE	RA5550 XQ5561 XA5761 RL6161 EL6261 FL7161 BL7361	Running (current) Addresses in Lists "Q" List "A" List Redundant Partial Result List Expanded List Op. File 1 Item Operand List
Permanent List	RE	DL40102	Dimension List

Equation Redundancy Check Phase

		IA	BB		
					Setup Redundancy Check Phase
	0	MJ	0	[30000]	Exit-Redundancy Phase
Start	1	TP	IA	RA	Preset Running Add. in Operand List
	2	TP	IA1	RA1	Preset Running Add. in Op. File 1 item
	3	TP	IA2	RA2	Preset Running Add. in "Q" List
	4	TP	IA3	RA3	Preset Running Add. in "A" List
	5	TP	IA4	RA4	Preset Running Add. in Expanded List
	6	TP	IA4	RA5	Preset Dummy Tally for Expanded List
	7	TP	IA5	RA6	Preset Partial Result counter
	10	TP	IA6	RA7	Preset Running Tally #lines in Running prog. +1000
	11	TP	IA7	RA10	Preset Running Add. in Red. P.R. List
	12	TU	IA10	SS3	Preset Running Add. in Sorted List→ Initial Add.
	13	TP	SL1	EL1	Line Number to 2nd Word of Expanded List
	14	SP	SL3	17	Callword to "u" of A
	15	TP	A	EL	Callword to "u" of 1st word in Exp. List
	16	AT	FC23	FL	Callword to 1st line Op. File 1 item
	17	TP	FC	FL1	Zeroize 2nd line Op. File 1 Item
	20	TU	6	DS1	jn from f_6 to "u" of RP to search Dim. List
	21	TP	FC	CT7	Preset increment (I) to Zero
	22	TP	FC	CT	Preset Crc to Zero
	23	TP	FC	CT1	Preset Crpt to Zero
	24	TP	FC	CT2	Preset Crct to Zero
	25	TP	FC	WT	Zeroize Temp 0
	26	TP	FC	WT1	Zeroize Temp 1
	27	TP	FC	CT11	Zeroize index Counter (C_1)
	30	TP	FC	CT12	Zeroize index Counter (C_2)
	31	MJ	0	SS	
		CA	BB32		

		IA	SS		Check Symbol from Sorted List
(1)	0	TP	FC	CT10	Zeroize condition Indicator
	1	TP	FC32	Q	Mask for "v" to "Q"
	2	RA	SS3	FC2	Adv. add. in Sorted List → Add. next symbol
	3	QT	[30000]	A	Symbol from Sorted List → "v" of "A"
	4	TP	A	WT3	Symbol → "v" of WT3
(2)	5	TJ	FC112	SS11	50000 > Symbol? (Is this operation Symbol?)
	6	TJ	FC43	LJ3	61000 > Symbol? (Is this Library Symbol?)
	7	TJ	FC61	SQ14	75000 > Symbol? (Is this Non-sub Var. or Const. Sym?)
	10	MJ	0	SO	Subscripted Variable Symbol (77___ , 76___, or 75___)
(3)	11	LQ	A	17	Symbol → "u" of Q
	12	QT	FC114	A	Mask rightmost 4 octal digits to "u" of A
	13	AT	FC113	A	Form [MJ | 0[symbol] | 00000]
	14	RP	30031	SS47	Search List for Operation Symbol
	15	TJ	SS16	SS16	Jump according to symbol
	16	MJ	12	FN2	Floating Point Absolute Value
	17	MJ	13	NF2	Fixed Point Absolute Value
	20	MJ	20	FP	Floating Point Plus
	21	MJ	21	PO	Fixed Point Plus
	22	MJ	30	FD7	Floating Point Subtract
(4)	23	MJ	31	NO	Fixed Point Subtract
	24	MJ	32	FN	Floating Point Unary Minus
	25	MJ	33	NF	Fixed Point Unary Minus
	26	MJ	50	SS	=
	27	MJ	52	SS	By
	30	MJ	60	FP2	Floating Point Multiply
	31	MJ	61	MO	Fixed Point Multiply
(5)	32	MJ	70	FD	Floating Point Divide
	33	MJ	71	DO	Fixed Point Divide
	34	MJ	100	LJ	General "POWER"
	35	MJ	101	LJ2	|POW| > 63 or |Non-integral POW| < 63 (superscript cases only)
(6)	36	MJ	120	EE	Storage Operater (space-period)
	37	MJ	3077	IQ14	Integral Power (4 to 63)
	40	MJ	3177	IQ16	Integral Power (-4 to -63)
	41	MJ	4000	IP	Integral Power (3)
	42	MJ	4100	IP2	Integral Power (-3)
(7)	43	MJ	5000	IP11	Integral Power (2)
	44	MJ	5100	IP13	Integral Power (-2)
	45	MJ	6000	IP22	Power (½)
	46	MJ	6100	IP24	Power (-½)
	47	MJ	7100	IQ	Integral Power (-1)
		CA	SS50		

```
                IA  ER                      End Redundancy Phase
(7A)      0     TP  RA7       A       Initial Relative constant Running Add-
                                        ress to "A"
          1     TJ  LV7       ER6     Number Lines in object program body ≤
                                        1001₈?
          2     RJ  WA        WA1     No; Type sentence Number
          3     TP  TO        UP3     Codeword to Alarm Print
          4     RJ  UP2       UP      Alarm; SENTENCE____TOO LONG.
          5     MJ  0         BQ6     Rewind Tapes and Stop
          6     RS  RA2       IA2     #Entries "Q" List to "u" and "v" of "A"
          7     AT  FC110     RA      jn for "Q" List Search to Generation In-
                                        put
         10     RS  RA3       IA3     #Entries "A" List to "u" and "v" of "A"
         11     AT  FC110     RA1     jn for "A" List Search to Generation In-
                                        put
         12     RS  RA10      IA7     #Redundancy Temps to "u" and "v" of "A"
         13     AT  FC110     RA2     jn for Redundant Partial Result Search
                                        to Gen. Inp.
         14     TP  FC107     RA3     Initial Relative Running Address to Gen.
                                        Input
(7B)     15     TP  IA11      RA10    Initial Address in Expanded List +2 to
                                        Generation Input
         16     MJ  0         BB
                CA  ER17
```

		IA	SO		Subscript Operator (77___ callword)
(8)	0	TP	A	WT1	7____ symbol to "v" of working Temp #1
	1	RJ	ES	ES12	Advance "D" to available dummy inst. address
	2	TV	A	WT4	Address of dummy inst. to "v" of Temp 4
	3	TV	A	S04	Address for dummy inst. to "v" of NI
	4	TP	RC1	[30000]	Dummy "sub" instruction to Dummy List (D)
	5	TP	WT3	A	7____ type symbol to "A"
	6	TJ	FC53	ST	Symbol 77___ ? (i.e. 77000> A)
	7	RJ	FS	FS1	Yes, store symbol in Op. File 1.
(9)	10	TP	WT3	A	77___type symbol to "A"
	11	RJ	DS	DS1	Search Dimension List for symbol (Address of next word in "u" of A)
	12	TU	A	S013	Address of modulus to "u" of next inst.
	13	TU	[30000]	WT	Modulus to "u" of Temp 0
	14	SP	WT	71	Modulus to "v" of A_R
	15	RJ	CW	CW1	Store modulus in constant pool (callword in "u" of A)
	16	TV	S04	S017	Address of Dummy inst. in Dummy List (D) to "v" of NI
	17	TU	A	[30000]	Callword of Modulus to "u" of Dummy instruction
	20	TU	S013	S021	Address of # S.S. to "u" of NI
	21	TV	[30000]	CT11	# of subscripts to index counter C_i
(10)	22	TP	FC1	A	1 in "v" to "A"
	23	EJ	CT11	SQ	# Subscripts = one?
	24	TV	S04	S025	Address of dummy instruction to "v" of NI
	25	TV	CT11	[30000]	# Subscripts to "v" of dummy instruction
	26	SP	CT11	17	#Subscripts to "u" of "A"
	27	AT	CT11	Q	#Subscripts to "u" and "v" of Q
	30	RS	RA	Q	Decrease add. in Operand List (β) by #S.S. in "u" and "v"
	31	RJ	BR	BR2	Has β decreased beyond lower limit.
	32	TU	A	S040	Address of first s.s. to "u" of TP
	33	TV	RC31	S042	Preset switch for multiplier in "v"
	34	TU	S013	S046	Preset address of multiplier
	35	RS	CT11	FC1	Decrease index counter by 1 in "v"
(11)	36	RJ	ES	ES12	Advance D to next address in Dummy List
	37	TV	A	S040	Address for subscript in Dummy List to "v" of NI
	40	TP	[30000]	[30000]	Subscript from Operand List to Dummy List in "v"
	41	RA	S040	FC2	Advance address to next s.s. in Operand List
	42	IJ	CT11	[30000]	All subscripts transferred to Dummy List?
	43	MJ	0	SP	Yes

```
44   TV  RC32      S042     Preset switch for multiplier in "u"
45   RA  S046      FC2      Advance "u" of NI by one (Add. of Mult.)
46   TV  [30000]   WT1      Multiplier to "v" of working Temp.
47   TP  WT1       A        Multiplier to "v" of A
50   RJ  CW        CW1      Store multiplier in constant pool (call-
                            word in "u" of A)
(12) 51  TV  S040      S052     Address of subscript in Dummy List to
                                "v" of NI
52   TU  A         [30000]  Multiplier to Dummy List with Corres.
                            Subscript
53   MJ  0         S036
54   TU  S046      S055     Address of Multiplier in Dim. List to
                            "u" of NI
55   TU  [30000]   WT       Multiplier to "u" of Working Temp.
56   SP  WT        25       Multiplier to "v" of Al
57   LT  0         A        Multiplier to "v" of Ar
60   TV  RC31      S042     Preset switch for multiplier in "v"
61   MJ  0         S050
     CA  S062
```

		IA	SP		Subscript Operator (continued)
(13)	0	SP	S04	17	Address of Dummy Inst. to "u" of A
	1	TU	A	SP2	Address of Dummy Inst. to "u" of NI
	2	TP	[30000]	A	Dummy inst to A
	3	TV	A	CT11	#Subscripts to index counter C_1
	4	TV	A	CT12	#Subscripts to index counter C_2
	5	RJ	ES	ES1	Search Expanded List for Redundancy
	6	SJ	SP22	SP7	Is dummy inst. redundant? yes to SP7
	7	TP	FC35	Q	Mask for "u" and "v" to "Q"
	10	SS	FC2	0	Add. of prev. entry in Exp. List to "u" of A
	11	TU	A	SP20	Add. of prev. entry in Expanded List to "u" of QT
	12	TU	SP2	SP21	Add. of Dummy inst. to "u" of EJ
	13	IJ	CT11	SP16	All subscripts compared for redundancy?
	14	RA	SP20	FC2	Yes
	15	MJ	0	SQ20	
	16	RA	SP20	FC2	Adv. "u" of QT → Add. of next s.s. in Exp. List
	17	RA	SP21	FC2	Adv. "u" of EJ → Add. of next s.s. in Dummy List
	20	QT	[30000]	A	Subscript from Expanded List → A
	21	EJ	[30000]	SP13	S.S. in Dummy List = S.S. in Expanded List?
(14)	22	TP	CT12	A	#Subscripts → A
	23	EJ	FC23	SP26	#Subscripts = 2?
	24	EJ	FC57	SP31	#Subscripts = 3?
	25	MJ	0	SP34	Assume four subscripts
(15)	26	RA	RA7	FC24	Adv. Nrp by 3
	27	TP	FC6	CT10	Set Cond. Ind. → 2(2 subs w/s.s. not in A)
	30	MJ	0	SP36	
(16)	31	RA	RA7	FC25	Adv. Nrp by 4
	32	TP	FC10	CT10	Set Cond. Ind. → 4(3subs. w/s.s. not in A)
	33	MJ	0	SP36	
(17)	34	RA	RA7	FC26	Adv. Nrp by 5
	35	TP	FC70	CT10	Set cond. Ind. → 6(4 subs. w/s.s. not in A)
	36	SP	RA5	17	Add. of last entry in Exp. List → "u" of A
	37	TU	A	SR	Address of Last Subscript → "u" of TV
	40	MJ	0	SQ12	
		CA	SP41		

		IA	SQ		Subscript Operator (continued)
(18)	0	RJ	BR	BR1	Decrease address in Operand List (β) by 1 in "u" and "v"
	1	TU	RA	SQ3	Address of last operand in Oper. List → "u" of TV
	2	TV	S04	SQ3	Address of Dummy instruction → "v" of NI
	3	TV	[30000]	[30000]	Subscript → "v" of dummy instruction
	4	SP	S04	17	Address of Dummy inst. → "u" of A
	5	TU	A	SQ6	Address of Dummy inst. → "u" of NI
	6	TP	[30000]	A	Dummy instruction → A
	7	RJ	ES	ES1	Search Expanded List for redundancy
	10	SJ	SQ26	SQ20	Is dummy inst. = prev. entry in Expanded List?
(20)	11	TU	SQ6	SR	Address of dummy inst. → "u" of TV
	12	RJ	SR25	SR	P.R. Value → Oper. List and Exp. List; Cond. Ind. → Exp. List
	13	TP	FC3	CT7	Set increment (I) → one in "u" and "v"
(21)	14	TV	RA	SQ15	Available address in Operand List (β) → "v" of NI
	15	TP	WT3	[30000]	Operand Symbol → Operand List
	16	RJ	BR	BR4	Advance address in Operand List (β) by 1 in "u" and "v"
	17	MJ	0	SS	Return to pick up next symbol in Sorted List
(19)	20	TP	RA4	RA5	Set D = γ (delete Dummy List from Expanded List)
	21	RJ	RS	RS1	Redundant P.R. → Operand List and Red. P.R. List
	22	SJ	SQ23	SQ24	Was P.R. previously entered in Redundant P.R. List?
	23	TP	WT1	A	No, Redundant Partial Result to A
	24	RJ	LA	LA1	Redundant P.R. in "A" List? (If yes, Advance Nrp by one)
	25	MJ	0	SQ14	
	26	RA	RA7	FC4	Advance Nrp by 2
	27	TP	FC	CT10	Set Cond. Ind → zero (1 subs. w/s.s. not in A)
	30	MJ	0	SQ11	
		CA	SQ31		

		IA	ST		Subscript Operator (76___ or 75___ CW)
(22)	0	TJ	FC60	ST45	Symbol 76___ ? (i.e. 76000 > A)
	1	TP	FC73	Q	Mask for 3rd octal digit of "v" → Q
	2	QT	WT3	CT11	#s.s. → 3rd octal digit of "v" of Counter C_1
	3	LQ	CT11	36	#s.s. → "v" of index counter C_1
	4	TP	FC74	Q	Mask for rightmost 2 octal digits of "v" → Q
	5	QT	WT3	A	Mask Rel. Location in Ps. Op. Input from 76___ callword
	6	AT	LV11	WT2	Add callword of pseudo op. input region (63000)
	7	SA	CT11	17	Callword of Modulus Location → "u" of A
	10	TV	S04	ST11	Preset address of Dummy Instruction in Dummy List (D)
	11	TU	A	[30000]	Callword of Modulus Location → "u" of Dummy Inst.
	12	TP	FC1	A	1 in "v" → A
	13	EJ	CT11	SQ	#s.s. = 1? yes to SQ
(23)	14	TV	S04	ST15	Add of Dummy Inst. → "v" of NI
	15	TV	CT11	[30000]	#s.s. → "v" of Dummy Inst.
	16	SP	CT11	17	#s.s. → "u" of A
	17	AT	CT11	Q	#s.s. → "u" and "v" of Q
	20	RS	RA	Q	Decrease address in Operand List (β) by #s.s. in "u" and "v"
	21	RJ	BR	BR2	Has β decreased beyond Lower Limit
	22	TU	A	ST32	Address of first s.s.
	23	RS	CT11	FC1	Reduce "v" of index counter (#s.s.) by one
(24)	24	SP	WT2	17	Callword of Location of Subs. Variable to "u" of A
	25	TU	A	WT	Callword to working temp.
	26	IJ	CT11	ST30	All subscripts but one transferred to Dummy List
	27	MJ	0	ST40	Yes
	30	RJ	ES	ES12	Advance D → next address in Dummy List
	31	TV	A	ST32	Address for subscript in Dummy List → "v" of NI
	32	TP	[30000]	[30000]	Subscript to Dummy List in "v"
	33	RA	WT	FC2	Adv. "u" of working temp by one → Add. of next mult.
	34	TV	ST32	ST35	
	35	TU	WT	[30000]	Callword of Multiplier Location to Dummy List
	36	RA	ST32	FC2	Adv. "u" address of TP → next s.s. in Operand List
	37	MJ	0	ST26	
(25)	40	RJ	ES	ES12	Advance D → next address in Dummy List

	41	TV	A	ST43	Address for s.s. in Dummy List → "v" of TP
	42	TU	ST32	ST43	Address of s.s. in Oper. List → "u" of TP
	43	TP	[30000]	[30000]	Last s.s. → Dummy List (no multiplier)
	44	MJ	0	SP	
(26)	45	TP	FC74	Q	Mask for rightmost 2 octal digits of "v" → Q
	46	QT	A	A	Location index in Dummy region from 75100 Cw → Av
	47	AT	LV10	WT2	Add callword for function input region (62000)
	50	SA	FC1	17	Callword of Modulus Location → "u" of A
	51	TV	S04	ST52	Preset Address of dummy "sub" inst. in Dummy List (D)
	52	TU	A	[30000]	Callword of Modulus → "u" of dummy inst.
	53	MJ	0	SQ	
		CA	ST54		

					Library Operator
		IA	LJ		
(27)	0	TP	FC64	WT3	"Gen. Pow." callword (50012) → "v" of symbol Temp.
	1	MJ	0	LJ3	
(28)	2	TP	FC67	WT3	"Var. Exp." CW (50022) → "v" of symbol temp.
(29)	3	TP	FC3	CT3	Set Trp → one (count transfer of control) in "u" and "v"
	4	TP	FC	CT4	Set Trc → Zero
	5	TP	FC3	CT5	Set Trpt → one (count 10 line for transfer of cont.)
	6	TP	FC	CT6	Set Trct → Zero
	7	TP	RC4	WT5	Dummy inst → working temp.
	10	TU	FC	WT5	Zero → "u" of dummy inst.
	11	TV	WT3	WT5	Lib CW → "v" of dummy inst.
(30)	12	RJ	ES	ES12	Adv. "D" to available dummy inst address
	13	TV	A	WT4	Add of dummy inst. → "v" working temp.
	14	TV	A	LJ15	Add. of dummy inst. → "v" of TP
	15	TP	WT5	[30000]	Dummy inst. w/callword → Dummy List
	16	TP	FC30	Q	Mask for rightmost octal digit of "v" → Q
	17	QT	WT3	CT11	#Arguments → index counter C_1
	20	TP	CT11	CT12	#Arguments → index counter C_2
	21	TV	RC15	LL6	Set switch N to N2
	22	TV	RC13	LM24	Set switch S to S1
(31)	23	IJ	CT12	LK	All arguments transferred → Dummy List
	24	MJ	0	LM	
		CA	LJ25		

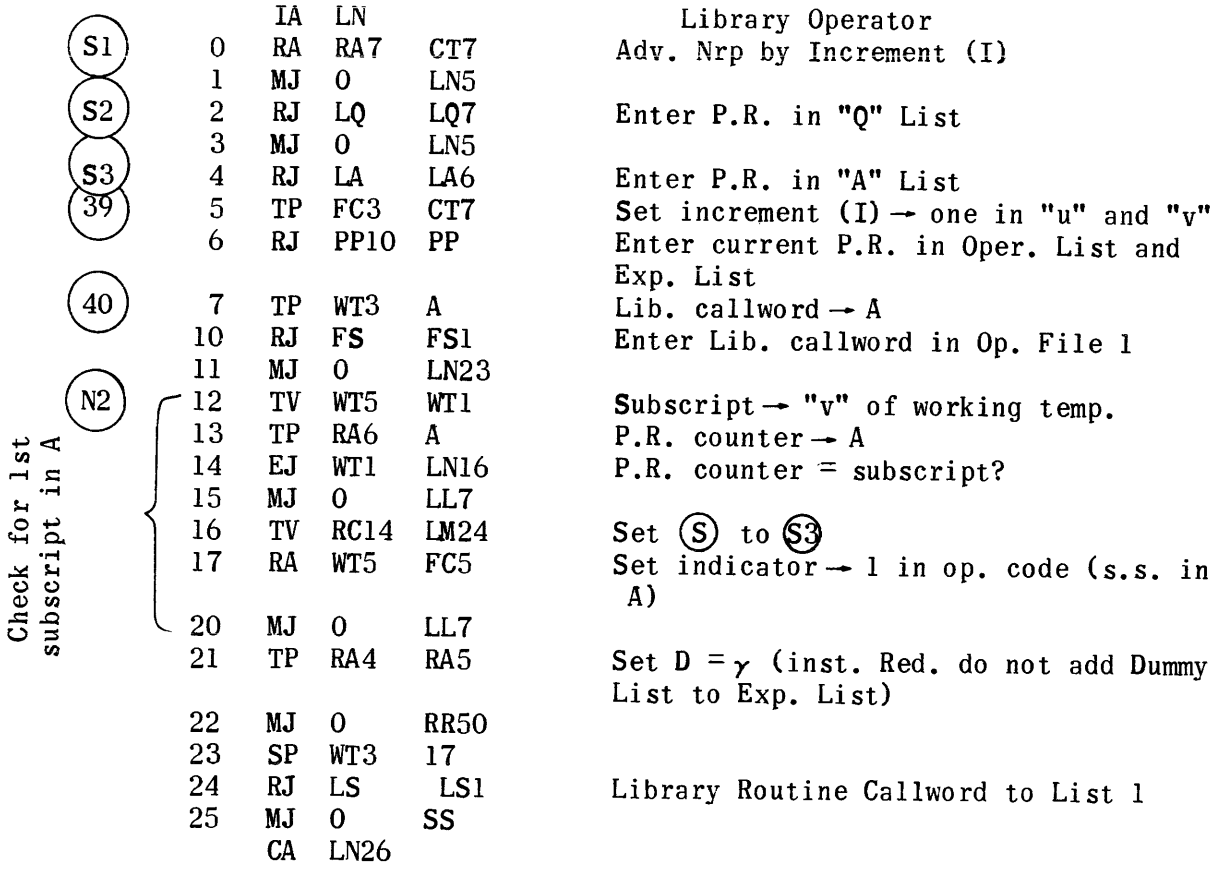
Library Operator (continued)

	IA	LK		
0	RJ	BR	BR1	Decrease Add. in Oper. List by 1 in "u" and "v"
1	TU	RA	LK2	
2	SP	[30000]	17	Arg. → "u" of A
3	TP	A	WT5	Arg. → "u" of temp. 5
4	TP	FC54	A	74777 → "u" of A
5	TJ	WT5	LL3	Is arg. subscripted? No to LK6
6	SP	RA6	17	P.R. counter → "u" of A
7	TU	WT5	WT	Operand → "u" of working temp.
10	EJ	WT	LL	Operand = P.R. counter? (oper in Q)
11	TP	FC103	Q	No
12	QT	WT5	A	
13	EJ	FC101	LK17	Operand 61___Type?
14	RA	CT3	FC3	No-adv. Trp by one in "u" and "v"
15	RA	CT5	FC3	Adv. Trpt by one in "u" and "v"
16	MJ	0	LL22	
17	RA	WT5	FC115	Adv. indicator by 33_8 in op. code
20	RA	CT3	FC4	Adv. Trp by two in "u" and "v"
21	MJ	0	LK15	
	CA	LK22		

(32)

		IA	LL		Library Operator
(33)	0	RA	WT5	FC5	Set indicator to 1 in op. code (oper in Q)
	1	TV	RC12	LM24	Set switch (S) to (S2)
	2	MJ	0	LK14	
(34)	3	RJ	BR	BR1	Dec. add. in Oper. List by 1 in "u" and "v"
	4	TU	RA	LL5	
	5	TV	[30000]	WT5	Subscript → "v" of Arg. word
	6	RJ	LL6	[30000]	Switch (N)
(N1)	7	TP	FC56	A	76777 → "u" of A
	10	TU	WT5	WT	Oper. → "u" of working temp.
	11	TJ	WT	LL16	Operand 77___ type?
	12	RA	CT3	FC25	Adv. Trp by 4 in "u" and "v"
	13	RA	CT5	FC3	Adv. Trpt by 1 in "u" and "v"
	14	RA	WT5	FC6	Adv. ind. by 2 in op. code (75___or 76___ type arg.)
	15	MJ	0	LL22	
(35)	16	RA	CT3	FC24	Adv. Trp by 3
	17	RA	CT4	FC3	Adv. Trc by 1
	20	RA	CT6	FC3	Adv. Trct by 1
	21	RA	WT5	FC10	Adv. indicator by 4 in op. code (77___ type arg.)
(36)	22	RJ	ES	ES12	Adv. "D" to avail. Dummy inst. Add.
	23	TV	RA5	LL24	Add. for Arg. word in Dummy List → "v" of NI
	24	TP	WT5	[30000]	Arg. word → Dummy List
	25	MJ	0	LJ23	
		CA	LL26		

		IA	LM		Library Operator
(37)	0	SP	WT4	17	Add. of Dummy inst. to "u" of A
	1	TU	A	LM2	Add. of Dummy Inst. to "u" of NI
	2	TP	[30000]	A	Dummy inst. to A
	3	RJ	ES	ES1	Search Exp. List for Redundancy
	4	SJ	LM17	LM5	Is dummy inst. redundant? yes to LM5
	5	TU	A	LM12	Preset address in Expanded List of first argument
	6	TU	LM2	LM15	Preset address of dummy library instruction
	7	TP	FC35	Q	Mask for "u" and "v" to Q
	10	IJ	CT11	LM12	All arguments compared for redundancy?
	11	MJ	0	LM25	
	12	QT	[30000]	WT2	Argument from Expanded List to temp. 2
	13	RA	LM12	FC2	Advance to next argument in Expanded List
	14	RA	LM15	FC2	Advance to next argument in Dummy List
	15	QT	[30000]	A	Argument from Dummy List to A
	16	EJ	WT2	LM10	Arg. in Dummy List = Arg. in Expanded List
(38)	17	TP	RA5	RA4	Set γ = D (add Dummy List to Expanded List)
	20	RA	RA7	CT3	Adv. Nrp by Trp
	21	RA	CT	CT4	Adv. Crc by Trc
	22	RA	CT1	CT5	Adv. Crpt by Trpt
	23	RA	CT2	CT6	Adv. Crct by Trct
	24	MJ	0	[30000]	Switch (S)
	25	TP	LM12	A	Address of redundant partial result to "u" of A
	26	MJ	0	LN21	
		CA	LM27		


Check for 1st subscript in A
S1
S2
S3
39
40
N2
IA LN
0 RA RA7 CT7
1 MJ 0 LN5
2 RJ LQ LQ7
3 MJ 0 LN5
4 RJ LA LA6
5 TP FC3 CT7
6 RJ PP10 PP
7 TP WT3 A
10 RJ FS FS1
11 MJ 0 LN23
12 TV WT5 WT1
13 TP RA6 A
14 EJ WT1 LN16
15 MJ 0 LL7
16 TV RC14 LM24
17 RA WT5 FC5
20 MJ 0 LL7
21 TP RA4 RA5
22 MJ 0 RR50
23 SP WT3 17
24 RJ LS LS1
25 MJ 0 SS
CA LN26
Library Operator
Adv. Nrp by Increment (I)
Enter P.R. in "Q" List
Enter P.R. in "A" List
Set increment (I) → one in "u" and "v"
Enter current P.R. in Oper. List and Exp. List
Lib. callword → A
Enter Lib. callword in Op. File 1
Subscript → "v" of working temp.
P.R. counter → A
P.R. counter = subscript?
Set S to S3
Set indicator → 1 in op. code (s.s. in A)
Set D = γ (inst. Red. do not add Dummy List to Exp. List)
Library Routine Callword to List 1

Power Operators
(3), (-3), (2), (-2), (½), (-½)

```
      IA   IP
41  0 TP   RC11  WT5     Entrance-POW (3)
    1 MJ   0     IP3
42  2 TP   RC12  WT5     Entrance-POW (-3)
43  3 RJ   IR15  IR      Check for redundancy
    4 QJ   IP5   IP7     Is operand subscripted?
    5 RA   RA7   FC26    Advance Nrp by 5 in "u" and "v"
    6 MJ   0     IR16
    7 RA   RA7   FC4     Advance Nrp by 2 in "u" and "v"
   10 MJ   0     IS33
44 11 TP   RC7   WT5     Entrance-POW (2)
   12 MJ   0     IP14
45 13 TP   RC10  WT5     Entrance-POW (-2)
46 14 RJ   IR15  IR      Check for redundancy
   15 QJ   IP16  IP20    Is operand subscripted?
   16 RA   RA7   FC25    Advance Nrp by 4 in "u" and "v"
   17 MJ   0     IR16
   20 RA   RA7   FC3     Advance Nrp by one in "u" and "v"
   21 MJ   0     IS33
47 22 TP   RC13  WT5     Entrance-POW (½)
   23 MJ   0     IP25
48 24 TP   RC14  WT5     Entrance-POW (-½)
49 25 RJ   IR15  IR      Check for redundancy
   26 QJ   IP27  IP32    Is operand subscripted?
   27 RA   RA7   FC25    Advance Nrp by 4 in "u" and "v"
50 30 RJ   IP41  IP35    Square root callword to Op. File 1 and
                         List 1
   31 MJ   0     IR16
   32 RA   RA7   FC4     Advance Nrp by 2
51 33 RJ   IP41  IP35    Square root callword to Op. File 1 and
                         List 1
   34 MJ   0     IS21
   35 TP   FC66  A       Square root callword to "A"
   36 RJ   FS    FS1     Store square root callword in Op. File 1
   37 TP   LS25  A       Square root callword to "A"
   40 RJ   LS    LS1     Store square root callword in List 1
   41 MJ   0     [30000 ]
      CA   IP42
```

		IA	IQ		Power Operators (-1),(4to63),(-4 to -63)
(52)	0	TP	RC17	WT5	Entrance-POW (-1) inst. to temp. 5
	1	RJ	IR15	IR	Check for redundancy
	2	QJ	IQ3	IS21	Is operand subscripted?
	3	RA	RA7	FC4	Advance Nrp by 3 in "u" and "v"
	4	TU	WT5	WT	Operand to working temp.
	5	TP	FC56	A	76777→ "u" of A
	6	TJ	WT	IR27	Is operand 77___type?
(53)	7	TP	FC12	CT10	10→ op. code of cond. ind.
	10	TV	WT5	WT1	
	11	TP	RA6	A	P.R. ocunter→ A
	12	EJ	WT1	IS	Operand = P.R. counter? (subscript in "A"?)
	13	MJ	0	IR33	No
(54)	14	TP	RC15	WT5	Entrance-POW (4 to 63)
(55)	15	MJ	0	IQ17	
(56)	16	TP	RC16	WT5	Entrance-POW (-4 to -63)
	17	TV	RC17	IR10	Set switch (T) to (T2)
	20	RJ	IR15	IR1	Check for redundancy
	21	RJ	ES	ES12	Advance dummy tally D by one
	22	TV	RA5	IQ23	Available address in Exp. List → "v" of TP
	23	TP	WT3	[30000]	13___symbol in "v"→ Exp. List
	24	QJ	IQ25	IQ27	Is operand subscripted?
	25	RA	RA7	FC27	Advance Nrp by 6 in "u" and "v"
	26	MJ	0	IR16	
	27	RA	RA7	FC24	Advance Nrp by 3 in "u" and "v"
	30	MJ	0	IS33	
(T2)	31	TU	A	IQ32	Address of 13___symbol (POW word) in Exp. List→ "u" of TP
	32	TP	[30000]	A	13___symbol (POW word) from Exp. List→A
	33	EJ	WT3	RR50	Is 13___symbol (POWword) also redundant?
	34	MJ	0	IR11	
		CA	IQ35		

		IA	IR		Power Operators (continued)
57	0	TV	RC16	IR10	Set switch (T) to (T1)
58	1	RJ	VC50	VC5	Check variables and set switch (H)
	2	TP	Q	WT2	s.s. "yes or no" indicator → working temp.
	3	QJ	IR4	IR36	Is there a subscript?
	4	TU	RA	IR5	Address of s.s. → "v" of NI
	5	TV	[30000]	WT5	s.s. → "v" of dummy inst.
	6	TP	WT5	A	Dummy instruction to "A"
	7	RJ	ES	ES1	Search Exp. List for instruction
	10	SJ	IR11	[30000]	Is instruction redundant? (switch T)
59	11	RJ	ES	ES12	Advance dummy tally by one
	12	TV	RA5	IR13	Available address in Expanded List → "v" of TP
	13	TP	WT5	[30000]	Instruction to Expanded List
	14	TP	WT2	Q	s.s. "yes or no" indicator → Q
	15	MJ	0	[30000]	Exit
60	16	TU	WT5	WT	"u" of dummy inst. → working temp.
	17	TP	FC56	A	76777 → "u" of A
	20	TJ	WT	IR27	Is operand 77___type 75___
	21	TP	FC12	CT10	Set cond. ind. → 10 (operand 74___type)
	22	TV	WT5	WT1	Subscript to working temp.
	23	TP	RA6	A	P.R. counter → A
	24	EJ	WT1	IS	P.R. counter = subscript? (is subscript in A)
	25	RA	RA7	FC3	Advance Nrp by one in "u" and "v"
	26	MJ	0	IR34	
61	27	TP	FC10	CT10	Set cond. ind. → 4 (operand 77___type)
	30	RA	CT	FC3	Advance Crc (count of rel. const.) by one in "u" and "v"
	31	TV	WT5	WT1	Subscript to "v" of working temp.
	32	TP	RA6	A	P.R. counter → A
	33	EJ	WT1	IS	Subscript = P.R. counter (is subscript in A)
	34	RA	RA7	CT7	Advance Nrp by increment (I)
	35	MJ	0	IS2	
	36	TV	FC	WT5	Zero → "v" of dummy inst.
	37	MJ	0	IR6	
		CA	IR40		

Redundancy check

Operand subscripted

		IA	IS		Power Operators (continued)
(62)	0	RA	CT10	FC5	Adv. op. code of cond. ind. by one (s.s. in A)
	1	RJ	LA	LA6	Enter P.R. value in "A" List
(63)	2	TP	FC3	CT7	Set increment (I) → one
	3	RJ	PP10	PP	New P.R. value → Exp. List and Oper. List
	4	TV	RA4	IS6	Address of P.R. value in Exp. List → "v" of QT
	5	TP	FC36	Q	
	6	QS	CT10	[30000]	Indicator → op. code of P.R. word
	7	TP	FC73	Q	Mask for 3rd octal digit of "v" → Q
	10	QT	WT3	A	3rd octal digit → A
	11	ZJ	IS13	IS12	3rd octal digit = 1 (is this neg. power)
	12	MJ	0	IS44	
(64)	13	RA	RA7	FC3	Advance Nrp by one in "u" and "v"
	14	TP	FC65	A	Floating point one → A
	15	RJ	CW	CW1	Store floating pt. "one" in constant pool
	16	TV	IS6	IS17	Address of P.R. word → "v" of NI
	17	TU	A	[30000]	Callword of fixed const. → "u" of P.R. word
	20	MJ	0	IS44	
(65)	21	TU	WT5	WT	Operand → working temp.
	22	SP	RA6	17	P.R. counter → "u" of A
	23	EJ	WT	IS30	Operand = P.R. counter? (operand in "Q")
(66)	24	TP	FC	CT10	No, set op. code of cond. ind. → Zero
	25	RJ	EK25	EK6	To 61___routine ("u" ent.)
	26	RA	RA7	CT7	Advance Nrp by increment (I)
	27	MJ	0	IS2	
(67)	30	TP	FC5	CT10	Set op. code of cond. ind. → one
	31	RJ	LQ	LQ7	Enter P.R. value in Q list
	32	MJ	0	IS2	
(68)	33	RA	RA7	CT7	Advance Nrp by increment (I)
	34	TP	FC	CT10	Set op. code of cond. ind. → zero
	35	TP	FC103	Q	Mask for first two octal digits of "u" → Q
	36	QT	WT5	A	First two octal digits of "u" of D → A
	37	EJ	FC101	IS41	Operand = 61___type?
	40	MJ	0	IS2	
	41	RA	CT10	FC115	Adv. cond. ind. by 33_8 in op. code. (oper in "u" 61___)
	42	RA	RA7	FC4	Adv. Nrp by 2 in "u" and "v"
	43	MJ	0	IS2	
(69)	44	TP	WT3	A	Operation symbol to "A"
	45	EJ	FC117	IS50	Symbol = 16000 (POW ½)?
	46	EJ	FC120	IS50	Symbol = 16100 (POW -½)?
	47	MJ	0	SS	
(70)	50	TP	CT10	A	Condition indicator to A
	51	EJ	FC10	IS54	Cond. ind = 4?

no subscript 16__ or 17__

No subscript 13__, 14__, or 15

(71)

```
52   RA   CT1      FC4      No - advance Crpt by 2 in "u" and "v"
53   MJ   0        SS
54   RA   CT1      FC3      Advance Crpt by 1 in "u" and "v"
55   RA   CT2      FC3      Advance Crct by 1 in "u" and "v"
56   MJ   0        SS
     CA   IS57
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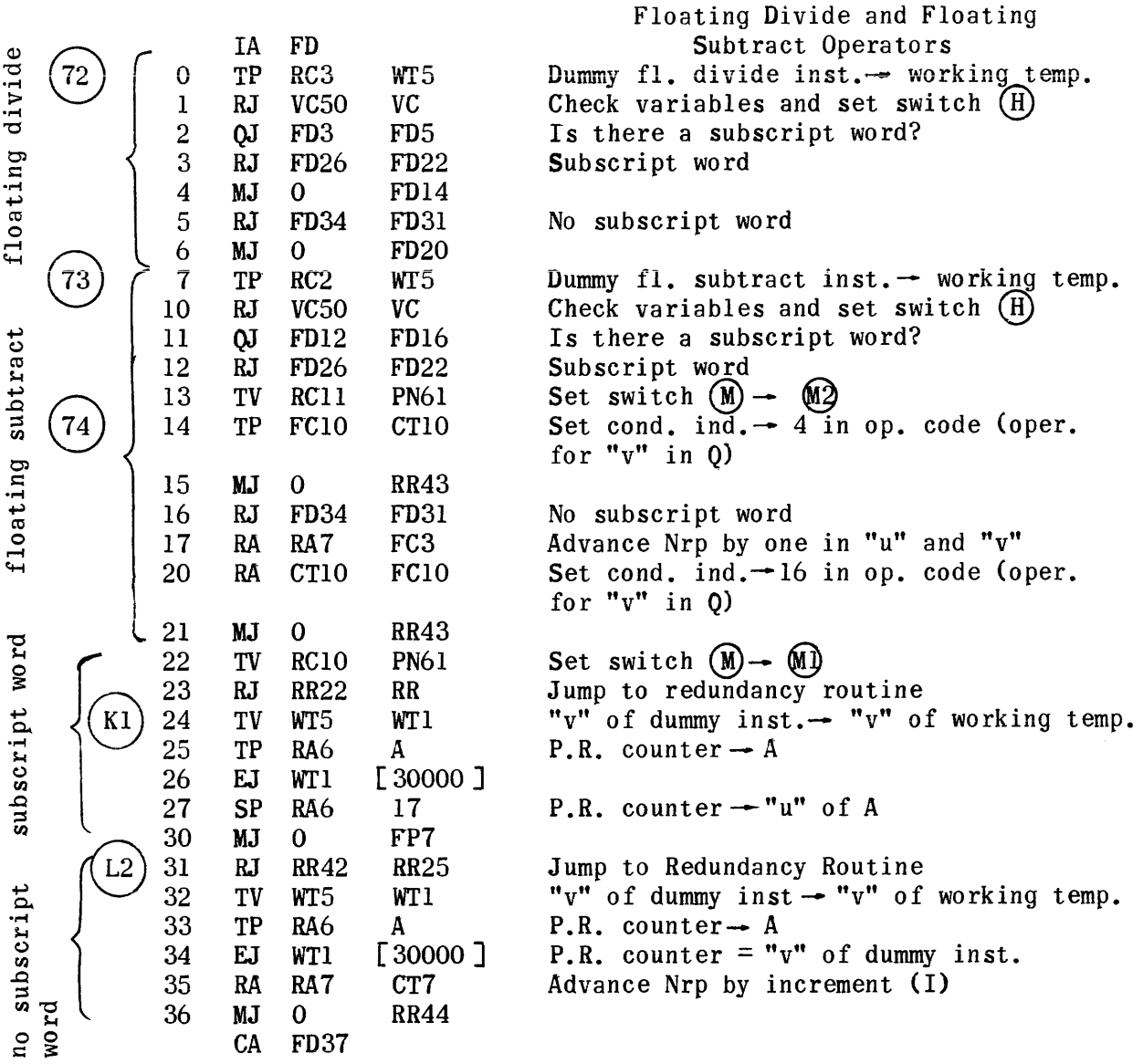
Floating Divide and Floating Subtract Operators
floating divide
floating subtract
subscript word
no subscript word
72
73
74
K1
L2
IA FD
0 TP RC3 WT5 Dummy fl. divide inst.→ working temp.
1 RJ VC50 VC Check variables and set switch (H)
2 QJ FD3 FD5 Is there a subscript word?
3 RJ FD26 FD22 Subscript word
4 MJ 0 FD14
5 RJ FD34 FD31 No subscript word
6 MJ 0 FD20
7 TP RC2 WT5 Dummy fl. subtract inst.→ working temp.
10 RJ VC50 VC Check variables and set switch (H)
11 QJ FD12 FD16 Is there a subscript word?
12 RJ FD26 FD22 Subscript word
13 TV RC11 PN61 Set switch (M) → (M2)
14 TP FC10 CT10 Set cond. ind.→ 4 in op. code (oper. for "v" in Q)
15 MJ 0 RR43
16 RJ FD34 FD31 No subscript word
17 RA RA7 FC3 Advance Nrp by one in "u" and "v"
20 RA CT10 FC10 Set cond. ind.→16 in op. code (oper. for "v" in Q)
21 MJ 0 RR43
22 TV RC10 PN61 Set switch (M)→ (M1)
23 RJ RR22 RR Jump to redundancy routine
24 TV WT5 WT1 "v" of dummy inst.→ "v" of working temp.
25 TP RA6 A P.R. counter → A
26 EJ WT1 [30000]
27 SP RA6 17 P.R. counter → "u" of A
30 MJ 0 FP7
31 RJ RR42 RR25 Jump to Redundancy Routine
32 TV WT5 WT1 "v" of dummy inst → "v" of working temp.
33 TP RA6 A P.R. counter→ A
34 EJ WT1 [30000] P.R. counter = "v" of dummy inst.
35 RA RA7 CT7 Advance Nrp by increment (I)
36 MJ 0 RR44
CA FD37

Floating Plus and Floating Multiply Operators

		IA	FP		
(75)	0	TP	RC21	WT3	Dummy fl. plus w/zero in "u" and "v"→ working temp.
	1	MJ	0	FP3	
(76)	2	TP	RC22	WT3	Dummy fl. mult. w/zero in "u" and "v"→ working temp.
(77)	3	RJ	VS64	VS	Sort operands and set switch (H)
	4	RA	WT5	WT3	Dummy floating [plus / multiply] with operands → "A" and temp.
(78)	5	QJ	FP6	FP26	Is there a subscript word? yes to FP6
	6	RJ	RR22	RR	Is operation redundant? no to FP7
(78A)	7	TU	WT6	WT	"u" of s.s. word→ working temp.
	10	EJ	WT	FP23	Is P.R. counter = "u" of s.s. word (s.s. for "u" in A)
	11	TP	RA6	A	P.R. counter→ "v" of A
	12	TV	WT6	WT1	"v" of s.s. word→ working temp.
	13	EJ	WT1	FP17	P.R. counter = "v" of s.s. word (s.s. for "v" in A)
	14	RA	RA7	CT7	Advance Nrp by increment (I)
	15	TP	FC	CT10	Set cond. ind.→ Zero (neither s.s. in A)
	16	MJ	0	RR44	
(79)	17	TV	RC3	PN14	Set switch (G)→ (G2)
	20	TV	RC5	PN44	Set switch (J)→ (J2)
	21	TP	FC6	CT10	Set cond. ind.→ 2 in op. code (s.s. for "v" in A)
	22	MJ	0	FP24	
(80)	23	TP	FC5	CT10	Set cond. ind.→ 1 in op. code (s.s. for "u" in A)
	24	RJ	LA	LA6	Enter P.R. in "A" list
	25	MJ	0	RR44	
(81)	26	RJ	RR42	RR25	Is operation redundant? no to FP27
	27	RA	RA7	CT7	Advance Nrp by increment (I)
	30	MJ	0	RR44	
		CA	FP31		

		IA	PO		Fixed Point Plus Operator
(82)	0	RJ	ES	ES12	Advance "D" to available dummy inst. address
	1	TV	A	PO4	Available dummy inst. address → "v" of AT
	2	TV	A	WT4	Address of dummy inst. → "v" of temp.
	3	RJ	OS13	OS	Sorted operands → "u" and "v" of A
	4	AT	RC23	[30000]	Dummy "fixed plus" inst. w/operands → Dummy List
	5	TU	A	WT	Operand in "u" of dummy inst. → working temp.
	6	RJ	ES	ES1	Search Expanded List for redundancy
	7	SJ	PO10	PO21	"u" if inst. not redundant - "v" if inst. is redundant
(83)	10	SP	RA6	17	Partial result counter → "u" of A
	11	EJ	WT	PO16	Is P.R. counter = "u" of dummy inst. (operand in A?)
	12	RA	RA7	FC4	No, advance #lines in running prog (Nrp) by 2 in "v"
(83A)	13	RJ	SR25	SR4	P.R. value → Exp. List and Oper. List; cond. ind. → Expanded List
	14	TP	FC	CT7	Set increment (I) → zero
	15	MJ	0	SS	
(84)	16	RA	RA7	FC3	Advance #lines in running prog (Nrp) by 1 in "u" and "v"
(84A)	17	RJ	SR25	SR7	P.R. value → "A" List, Exp. List and Oper. List; cond. ind. → Exp. List
	20	MJ	0	PO14	
(82A)	21	TP	RA4	RA5	Set D = γ (delete Dummy List from Expanded List)
	22	RJ	RS	RS1	Redundant P.R. value → Expanded List and Red. P.R. List
	23	MJ	0	SS	
		CA	PO24		

		IA	MO		Fixed Point Multiply Operator
(85)	0	RJ	ES	ES12	Advance "D" to available dummy inst. address
	1	TV	A	MO4	Available dummy inst. address → "v" of AT
	2	TV	A	WT4	Address of dummy inst → "v" of temp.
	3	RJ	OS13	OS	Sorted operands → "u" and "v" of A
(86)	4	AT	RC25	[30000]	Dummy "fixed mult" inst w/operands → Dummy List
	5	TU	A	WT	Operand in "u" of dummy inst → working temp.
	6	RJ	ES	ES1	Search Expanded List for redundancy
	7	SJ	MO10	MO21	"u" if not redundant; "v" if redundant
(87)	10	SP	RA6	17	Partial result counter → "u" of A
	11	EJ	WT	MO16	Is P.R. counter = "u" of dummy inst.? (operand in A)
	12	RJ	SR25	SR4	No, P.R. symbol → Exp. List and Oper. List; cond. ind. → Exp. List
	13	RA	RA7	FC3	Advance #lines in running prog. (Nrp) by 1 in "v"
(88)	14	TP	FC3	CT7	Set increment (I) → one in "u" and "v"
	15	MJ	0	SS	
(89)	16	RA	RA7	FC3	Advance #lines in running prog (Nrp) by 1 in "u" and "v"
	17	RJ	SR25	SR7	P.R. value → "A" list, Exp. List and Oper. List; cond. ind → Exp. List
	20	MJ	0	MO14	
(86A)	21	TP	RA4	RA5	Set D = γ (delete Dummy List from Expanded List)
	22	RJ	RS	RS1	Redundant P.R. → Expanded List and Red. P.R. List
	23	SJ	MO24	MO26	Was P.R. previously entered in Redundant P.R. List?
	24	TP	WT1	A	
	25	RJ	LA	LA1	Redundant P.R. in "A" List (if yes, advance Nrp by 1)
	26	MJ	0	SS	
		CA	MO27		

		IA	NO		Fixed Point Subtract Operator
(90)	0	RJ	ES	ES12	Advance "D" to available dummy inst. address
	1	TV	A	NO12	Dummy inst. address → "v" of AT
	2	TV	A	WT4	Dummy inst. address → "v" of working temp
	3	RJ	BR	BR1	Decrease address in Oper. List (β) by 1 in "u" and "v"
	4	TU	RA	NO5	Address of first operand → "u" of NI
	5	TP	[30000]	WT5	First operand → "v" of working temp.
	6	RJ	BR	BR1	Decrease add. in Oper. List (β) by 1 in "u" and "v"
	7	TU	RA	NO10	Address of second operand → "u" of NI
	10	SP	[30000]	17	Second operand → "u" of A
	11	SA	WT5	0	Operand → "u" and "v" of A
	12	AT	RC24	[30000]	Dummy "fixed minus" inst. w/operands → Dummy List
	13	TU	A	WT	Operand in "u" of dummy inst. → working temp.
	14	TV	A	WT1	Operand in "v" of dummy inst. → working temp.
	15	RJ	ES	ES1	Search Expanded List for redundancy
(91)	16	SJ	NO17	PO21	"u" if inst. not redundant - "v" if inst. redundant
	17	SP	RA6	17	Partial result counter → "u" of A
	20	EJ	WT	PO17	Is P.R. counter = "u" of dummy inst. (operand in A)
	21	RA	RA7	FC4	Advance #lines in running prog (Nrp) by 2 in "u" and "v"
	22	TP	RA6	A	Partial result counter → "v" of A
	23	EJ	WT1	NO26	Operand for "v" in A
(92)	24	RJ	SR25	SR4	P.R. value → Exp. List and Oper. List; cond, ind → Exp. List
	25	MJ	0	NO30	
(93)	26	TP	FC6	CT10	Set condition indicator → two (operand for "v" in A)
	27	RJ	SR25	SR10	P.R. value → "A" list, Exp. List and Oper. List; cond. ind. → Exp. List
	30	TP	FC	CT7	Set increment (I) → Zero
	31	MJ	0	SS	
		CA	NO32		

		IA	DO		Divide Operator
(94)	0	RJ	ES	ES12	Advance "D" to available dummy inst. address
	1	TV	A	DO12	Dummy inst. address → "v" of AT
	2	TV	A	WT4	Dummy inst. address → "v" of working temp.
	3	RJ	BR	BR1	Decrease add. in Oper. List (β) by 1 in "u" and "v"
	4	TU	RA	DO5	Address of first operand → "u" of NI
	5	TP	[30000]	WT5	First operand → "v" of dummy inst. (divisor)
	6	RJ	BR	BR1	Decrease add. in Oper. List (β) by 1 in "u" and "v"
	7	TU	RA	DO10	Address of second operand → "u" of NI
	10	SP	[30000]	17	Second operand → "u" of A (dividend)
	11	SA	WT5	0	Operand → "u" and "v" of A
	12	AT	RC26	[30000]	Dummy "fixed divide" inst. w/operands → Dummy List
	13	TU	A	WT	Operand in "u" of dummy inst → working temp.
	14	RJ	ES	ES1	Search Expanded List for redundancy
	15	SJ	DO16	MO21	"u" if inst. not redundant - "v" if inst. redundant
	16	SP	RA6	17	Partial result counter → "u" of A
(95)	17	EJ	WT	DO24	Is P.R. counter = "u" of dummy inst. (operand in A?)
	20	RA	RA7	FC4	Advance #lines in running prog (Nrp) by 2 in "u" and "v"
	21	RJ	SR25	SR4	P.R. value → Exp. List and Oper. List; cond. ind → Exp. List
(96)	22	TP	FC	CT7	Set increment (I) → Zero
	23	MJ	0	SS	
(97)	24	RA	RA7	FC3	Advance #lines in running prog (Nrp) by 1 in "u" and "v"
	25	RJ	SR25	SR7	P.R. value → "A" list, Exp. List and Oper List; cond. ind. → Exp. List
	26	MJ	0	DO22	
		CA	DO27		

Floating Point Unary Minus and Absolute Value

		IA	FN		
(98)	0	TP	RC5	WT5	Dummy floating Unary minus→ temp 5
	1	MJ	0	FN3	
(99)	2	TP	RC6	WT5	Dummy floating absolute value→ temp 5
(100)	3	RJ	VC50	VC5	Check variable and set switch (H)
	4	QJ	FN5	FN60	Is there a subscript? no, take "v"
	5	TU	RA	FN6	Yes
(101)	6	TV	[30000]	WT5	Subscript→ "v" of dummy instruction
	7	TP	WT5	A	Dummy instruction to "A"
	10	RJ	ES	ES1	Search Exp. List for instruction
	11	SJ	FN12	FN26	Is instruction redundant? yes to FN26
	12	RJ	ES	ES12	Advance dummy tally by one.
	13	TV	RA5	FN14	Available address in Exp. List→ "v" of TP
	14	TP	WT5	[30000]	Inst. at D→ Expanded List
	15	TV	WT5	WT1	s.s.→ "v" of working temp.
	16	TP	RA6	A	P.R. counter→ A
	17	EJ	WT1	FN23	Is P.R. counter = subscript? (s.s. for "u" in "A"?)
(102)	20	TP	FC	CT10	Set cond. ind.→ Zero (neither s.s. in "A")
	21	RA	RA7	CT7	Advance Nrp by increment (I)
	22	MJ	0	FN102	
(103)	23	TP	FC5	CT10	Set cond. ind.→ one (s.s. for "u" in A)
	24	RJ	LA	LA6	Enter P.R. value in "A" List
	25	MJ	0	FN102	
(104)	26	RJ	RS	RS1	Redundant P.R. value→ Oper. List and Red. P.R. List
	27	SJ	FN30	SS	Was redundant P.R. in Red. P.R. List?
	30	TP	WT1	A	Redundant P.R.→ A
	31	RJ	LQ	LQ17	Is redundant P.R. in "Q" List (yes→ NI; no→ SS)
	32	SN	Q	17	-jn+r→ "u" of A
	33	SA	RA2	0	+r→ "u" of A
	34	SS	FC2	0	(r-1)→ "u" of A
	35	SA	LQ21	25	IQ+r-1→ "v" of A_L (address of P.R. in "Q" List)
	36	LT	0	A	IQ+r-1→ "v" of A_R
	37	TV	A	FN40	Address of redundant P.R. in "Q" List→ "v" of NI
	40	TP	FC	[30000]	Delete redundant P.R. from "Q" List
	41	TU	RS2	FN43	Add. of redundant P.R. in Exp. List→ "u" of TP
	42	RA	FN43	FC2	Adv. to address after redundant P.R. in Exp. List
	43	TP	[30000]	Q	Mask for op. code and "v"→ Q
	44	QT	FC37	WT2	Op. code and "v" of word following Red. P.R.→ working temp.

	45	TP	WT2	A	Op. code and "v" of word following red. P.R.→ A
	46	TP	RC2	WT2	Dummy FS→ working temp.
	47	TV	WT1	WT2	Redundant P.R.→ "v" of dummy FS in working temp.
	50	EJ	WT2	FN52	Is inst. following red. P.R. in Exp. List = FS with red. P.R. in "v"?
	51	MJ	0	SS	
(105)	52	TU	Q	WT	"u" of inst. following red. P.R.→ "u" of working temp.
	53	TP	FC56	A	76777→ "u" of A
	54	TJ	WT	FN107	"u" of FS inst. 77___ type? no to FN55
	55	TP	FC54	A	73777→ "u" of A
	56	TJ	WT	FN110	"u" of FS inst. 75___ or 76___type?
	57	MJ	0	FN107	
(108)	60	TV	FC	WT5	Zero to "v" of dummy instruction
	61	TP	WT5	A	Dummy instruction→ A
	62	RJ	ES	ES1	Search Exp. List for instruction
	63	SJ	FN64	FN26	Is instruction redundant? yes, take "v"
	64	RJ	ES	ES12	Advance dummy tally by one
	65	TV	RA5	FN66	Available address in Expanded List→ "v" of TP
	66	TP	WT5	[30000]	Instruction→ Expanded List
	67	RA	RA7	FC3	Advance Nrp by one
	70	TP	FC13	CT10	Set cond. ind.→ 12 in op. code (neither "u" nor "v" subs)
	71	SP	RA6	17	P.R. counter→ "u" of A
	72	TU	WT5	WT	"u" of dummy inst.→ "u" of working temp.
	73	EJ	WT	FN77	P.R. counter = "u" of dummy inst.?
(109)	74	RA	RA7	CT7	Advance Nrp by increment (I)
	75	RJ	EK25	EK6	To 61___ routine "u" ent.
	76	MJ	0	FN101	
(110)	77	RA	CT10	FC7	Set cond. ind.→ 15 in op. code
	100	RJ	LQ	LQ7	Enter partial result symbol in "Q" List
(111)	101	TV	RC7	PN	Set switch (H) to (1)
(111A)	102	TV	RA5	WT4	Address of dummy inst.→ "v" of working temp.
	103	TP	FC	CT7	Set increment (I)→ Zero
	104	TV	RC20	PN61	Set switch (M) to (M3)
	105	RJ	SR25	SR11	P.R. value→ Oper. List (β) and Exp. List (γ); cond. ind→ Exp. List
	106	MJ	0	PN	
(106)	107	RS	RA7	FC3	Reduce Nrp by one
(107)	110	TU	FN43	FN112	
	111	RA	FN112	FC2	
	112	RS	[30000]	FC10	Change ind for "FS"→ operand for "v" not in Q
	113	MJ	0	SS	
		CA	FN114		

Fixed Point Unary Minus and
Absolute Value Operators

		IA	NF		
(112)	0	TP	RC27	WT5	Dummy fixed pt. unary minus inst. to temp
	1	MJ	0	NF3	
(113)	2	TP	RC30	WT5	Dummy fixed pt. abs. value inst. to temp
(114)	3	RJ	ES	ES12	Adv. "D" to available dummy inst. address
	4	TV	A	NF12	Preset address in Exp. List for dummy inst.
	5	TV	A	WT4	Store address for dummy inst. in temp
	6	RJ	BR	BR1	Decrease address in Operand List (β) by 1
	7	TU	RA	NF10	Preset address of next operand
	10	TP	[30000]	Q	Obtain next operand from Operand List
	11	SP	Q	17	
	12	AT	WT5	[30000]	Dummy instruction with operands to Dummy List
	13	TP	Q	WT1	
(115)	14	RJ	ES	ES1	Search Expanded List for redundancy
	15	SJ	NF16	NF22	"u" if not redundant, "v" if redundant
	16	RA	RA7	FC3	Advance Nrp by 1
	17	TP	WT1	A	Operand to "A"
	20	EJ	RA6	P017	P.R. counter = operand? (operand in "A"?)
	21	MJ	0	P013	No
(116)	22	TP	RA4	RA5	Delete Dummy List from Expanded List (set $D = \gamma$)
	23	RJ	RS	RS1	Was redundant P.R. in redundant P.R. List
	24	SJ	NE	SS	"u" if no, "v" if yes
		CA	NF25		

Fixed Point Unary Minus and
Absolute Value Operators

	IA	NE		
0	TP	WT1	A	Redundant partial result to A
1	EJ	RA6	NE5	Redundant P.R. = P.R. counter (current P.R.)?
2	TU	RA3	NE3	
3	RP	[30000]	SS	Search "A" List
4	EJ	XA	NE6	Is redundant P.R. in "A" List?
5	TP	FC122	CT7	Set increment (I) to minus one
6	RA	RA7	FC3	Advance Nrp by one
7	MJ	0	SS	
	CA	NE10		

		IA	EE		Storage Operator (space-period)
(117)	0	TP	RC20	WT5	Dummy store inst. to working temp 5
	1	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	2	TU	RA	EE3	Preset address of operand
	3	SP	[30000]	17	Operand to "u" of A
	4	TU	A	WT5	Operand to "u" of working temp 5
	5	TU	A	WT	Operand to "u" of working temp
	6	TP	FC54	A	74777 to "u" of A
	7	TJ	WT	EG	Operand > 74777? (operand subscripted?)
	10	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	11	TU	RA	EE12	Address of 2nd operand → "u" of NI
	12	TV	[30000]	WT5	Operand → "u" of working temp 5
	13	TV	WT5	WT1	Operand → "v" of working temp 1
	14	TP	FC52	A	76777 → "v" of A
(118)	15	TJ	WT1	EF26	Operand in "v"> 76777? (i.e. 77___ type)
	16	TP	FC76	A	74777 → "v" of A
	17	TJ	WT1	EF5	Operand in "v"> 74777? (i.e. 75___ type)
	20	TP	FC13	CT10	Set cond. ind.→ (12) in op. code - ("u" and "v" non-subs)
	21	RA	RA7	FC4	Advance Nrp by 2 in "u" and "v"
(119)	22	TU	WT5	WT	Operand for "u" to temp
	23	SP	RA6	17	P.R. counter → "u" of A
	24	EJ	WT	EF	P.R. counter = operand? (i.e. oper. for "u" in "Q"?)
	25	RJ	EK25	EK	No, to 61___ routine ("u" and "v" ent.)
(120)	26	TP	FC36	Q	Mask for op. code → Q
	27	QS	CT10	WT6	Condition indicator to op. code temp 6
	30	RJ	ES	ES12	Advance D by 1 → next available add. in Exp. List
	31	TV	A	EE32	Next available add. in Exp. List → "v" of NI
	32	TP	WT5	[30000]	Dummy storage instruction → Expanded List
(121)	33	RJ	ES	ES12	Advance D by 1 → next available add. in Exp. List
	34	TV	A	EE35	Next available address in Exp. List → "v" of NI
	35	TP	WT6	[30000]	Indicator and s.s. word → Expanded List
	36	MJ	0	ER	Exit-to end redundancy phase
		CA	EE37		

		IA	EF		Storage Operator (continued)
(122)	0	RJ	LA	LA6	Store P.R. value in "A" list
	1	RJ	EK25	EK14	To 61___routine ("v" ent.)
(123)	2	RA	CT10	FC7	Adv. cond. ind. by 3 (oper. for "u" in Q)
	3	RJ	LQ	LQ7	Store P.R. value in "Q" List
	4	MJ	0	EE26	
(124)	5	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	6	TU	RA	EF7	Address of s.s. for "v"→ "u" of NI
	7	TV	[30000]	WT6	s.s. at β →"v" of temp 6
	10	TP	FC62	CT10	Set cond. ind.→ (11) in op. code ("u" non-subs and "v" 75___)
	11	RA	RA7	FC25	Advance Nrp by 4 in "u" and "v"
	12	TV	WT6	WT1	Subscript for "v" operand to temp 1
	13	TP	RA6	A	P.R. value → "v" of A
	14	EJ	WT1	EF22	P.R. counter = subscript? (s.s. for "v" in "A"?)
(125)	15	TU	WT5	WT	"u" operand to temp 0
	16	SP	RA6	17	P.R. value→ "u" of A
	17	EJ	WT	EF2	"u" operand = P.R. counter? (oper. for "u" in "Q"?)
	20	RJ	EK25	EK6	To 61___routine ("u" ent.)
	21	MJ	0	EE26	
(126)	22	RJ	EK25	EK6	To 61___routine ("u" ent.)
(126A)	23	RA	CT10	FC6	Adv. cond. ind. by 2 in op. code
	24	RJ	LA	LA6	Store P.R. value in "A" list
	25	MJ	0	EE26	
(127)	26	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	27	TU	RA	EF30	Address of s.s. for "v"→ "u" of NI
	30	TV	[30000]	WT6	s.s. at β →"v" of temp 6
	31	TP	FC11	CT10	Set cond. ind. → (5) ("u" non-subs and "v" 77___)
	32	RA	CT	FC3	Advance #rel. const. (Crc) by 1 in "u" and "v"
	33	TV	WT6	WT1	Subscript for "v" operand to temp 1
	34	TP	RA6	A	P.R. value → "v" of A
	35	EJ	WT1	EF40	Subscript = P.R. counter? (s.s. for "v" in "A"?)
	36	RA	RA7	FC25	Advance Nrp by 4 in "u" and "v"
	37	MJ	0	EF15	
	40	RA	RA7	FC24	Advance Nrp by 3 in "u" and "v"
	41	MJ	0	EF22	
		CA	EF42		

					Storage Operator (continued)
		IA	EG		
(128)	0	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	1	TU	RA	EG2	Address of s.s. → "u" of NI
	2	SP	[30000]	17	s.s. → "u" of A
	3	TP	A	WT6	s.s. → "u" of temp 6
	4	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	5	TU	RA	EG6	Add. of oper. for "v" → "u" of NI
	6	TV	[30000]	WT5	Operand → "v" of temp 5
	7	TV	WT5	WT1	"v" operand to "v" of working temp 1
	10	TP	FC52	A	76777 → "v" of A
	11	TJ	WT1	EH23	Operand for "v" > 76777? (i.e. 77___type)
(129)	12	TP	FC76	A	74777 → "v" of A
	13	TJ	WT1	EH	"v" operand > 74777? (i.e. 76___type)
	14	TU	WT5	WT	"u" operand to temp 0
	15	TP	FC56	A	76777 → "u" of A
	16	TJ	WT	EG22	"u" operand > 76777? (i.e. 77___type)
	17	TP	FC	CT10	Zero to cond. ind. ("u" 75___or 76___and "v" non-subs)
	20	RA	RA7	FC26	Adv. Nrp by 5 in "u" and "v"
	21	MJ	0	EG25	
(130)	22	TP	FC6	CT10	Set cond. Ind. → (2) in op. code ("u" 77___ and "v" non-subs.)
	23	RA	RA7	FC25	Adv. Nrp by 4 in "u" and "v"
	24	RA	CT	FC3	Adv. Crc by 1
(131)	25	RJ	EK25	EK14	To 61___routine ("v" ent.)
	26	TU	WT6	WT	Subscript for "u" operand to temp 0
	27	SP	RA6	17	P.R. counter → A
	30	EJ	WT	EG32	Subscript = P.R. counter? (s.s. for "u" in "A"?)
	31	MJ	0	EE26	
(132)	32	RA	CT10	FC5	Adv. cond. ind by 1 in op. code (s.s. for "u" in A)
	33	MJ	0	EF24	
		CA	EG34		

					Storage Operator (continued)
		IA	EH		
(133)	0	RJ	BR	BR1	Decrease β by 1 in "u" and"v"
	1	TU	RA	EH2	Address of s.s.→ "u" of NI
	2	TV	[30000]	WT6	s.s.→ "v" of temp 6
(134)	3	TU	WT5	WT	"u" operand to "u" of temp 0
	4	TP	FC56	A	76777→"u" of A
	5	TJ	WT	EH11	"u" operand > 76777? (i.e. 77___type)
	6	TP	FC16	CT10	Set cond. ind. to 22 ("u" 75___or 76___ and "v" 75___)
	7	RA	RA7	FC121	Adv. Nrp by 7 in "u" and "v"
	10	MJ	0	EH14	
(135)	11	TP	FC20	CT10	Set cond. ind.→ (30) in op. code ("u" 77___ and "v" 75___)
	12	RA	RA7	FC27	Adv. Nrp by 6 in "u" and "v"
	13	RA	CT	FC3	Adv. Crc by 1 in "u" and "v"
(136)	14	TU	WT6	WT	Subscript for "u" to working temp
	15	SP	RA6	17	P.R. counter→"u" of A
	16	EJ	WT	EG32	Subscript = P.R. counter? (s.s. for "u" in "A"?)
(137)	17	TV	WT6	WT1	Subscript for "v" to working temp
	20	TP	RA6	A	P.R. counter→"v" of A
	21	EJ	WT1	EF23	Subscript = P.R. counter? (s.s. for "v" in "A"?)
	22	MJ	0	EE26	
(138)	23	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	24	TU	RA	EH25	Add. of s.s.→ "u" of NI
	25	TV	[30000]	WT6	Subscript to "v" of temp 6
	26	TU	WT5	WT	"u" operand to working temp
	27	TP	FC56	A	76777→"u" of A
	30	TJ	WT	EH34	"u" operand > 76777? (i.e. 77___type)
	31	TP	FC17	CT10	Set cond. ind. to 25 ("u" 75___or 76___ and "v" 77___)
	32	RA	RA7	FC27	Adv. Nrp by 6 in "u" and "v"
	33	MJ	0	EH36	
(139)	34	TP	FC14	CT10	Set cond. ind.→ (17) in op. code ("u" and "v" 77___)
	35	RA	RA7	FC26	Adv. Nrp by 5 in "u" and "v"
(140)	36	RA	CT	FC1	Adv. Crc by 1 in "u" and "v"
	37	MJ	0	EH14	
		CA	EH40		

```
                IA  VC                          Subroutine to Check Variables
(141)      0    RJ  BR      BR1       Decrease β by 1 in "u" and "v"
           1    TU  RA      VC3       Address of 1st operand→ "u" of TV
           2    TP  FC76    A         74777→ "v" of A
           3    TV  [30000] WT1       Operand→ "v" of working temp
           4    TJ  WT1     VC24      1st operand > 74777? (i.e. subscripted?)
(141A)     5    RJ  BR      BR1       Decrease β by 1 in "u" and "v"
           6    TU  RA      VC7       Address of second operand→ "u" of NI
           7    SP  [30000] 17        2nd operand → "u" of A
          10    TU  A       WT        2nd operand → "u" of working temp
          11    TU  A       WT5       2nd operand → "u" of temp 5
          12    TP  FC54    A         74777 → "u" of A
          13    TJ  WT      VC16      2nd operand > 74777? (i.e. subscripted?)
          14    TP  FC      Q         (Q35 = 0) no subscript word
          15    MJ  0       VC46
(142)     16    RJ  BR      BR1       Decrease β by 1 in "u" and "v"
          17    TU  RA      VC20      Address of s.s. for oper. in "u"→ "u"
                                       of NI
          20    SP  [30000] 17        s.s. for oper. in "u"→ "u" of A
          21    TP  A       WT6       s.s. → "u" of temp. 6
          22    TV  RC6     PN        Set switch (H) to (H3), "u" subs and "v"
                                       non-subs
          23    MJ  0       VC45
(143)     24    RJ  BR      BR1       Decrease β by 1 in "u" and "v"
          25    TU  RA      VC26      Address of s.s. for oper. in "v"→ "u"
                                       of NI
          26    TP  [30000] WT6       s.s. → "v" of temp 6
          27    RJ  BR      BR1       Decrease β by 1 in "u" and "v"
          30    TU  RA      VC31      Address of 2nd operand → "u" of NI
          31    SP  [30000] 17        2nd operand → "u" of A
          32    TU  A       WT        2nd operand → "u" of working temp
          33    TU  A       WT5       2nd operand → "u" of temp 5
          34    TP  FC54    A         74777 → "u" of A
          35    TJ  WT      VC40      2nd operand > 74777?
          36    TV  RC      PN        Set switch (H) to (H2), "u" non-subs and
                                       "v" subs
          37    MJ  0       VC45
(144)     40    RJ  BR      BR1       Decrease β by 1 in "u" and "v"
          41    TU  RA      VC42      Address of s.s. for oper. in "u"→ "u"
                                       of NI
          42    SP  [30000] 17        s.s. for oper. in "u"→ "u" of A
          43    TU  A       WT6       s.s. → "u" of temp 6
          44    TV  RC1     PN        Set switch (H) to (H1), "u" non-subs and
                                       "v" subs
(145)     45    TP  FC36    Q         (Q35 = 1) subscript word
(146)     46    TV  WT1     WT5       Operand→ "v" of dummy inst.
          47    TP  WT5     A         Dummy inst. w/operands → A
          50    MJ  0       [30000]   Exit
                CA  VC51
```

Subroutine to Sort Operands
for Floating Plus or Multiply

		IA	VS		
(147)	0	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	1	TU	RA	VS2	Address of 1st operand → "u" of NI
	2	TP	[30000]	Q	First operand → Q
	3	TP	FC76	A	74777 → "v" of A
	4	TJ	Q	VS31	First operand > 74777? (i.e. subscripted)
	5	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	6	TU	RA	VS7	Address of 2nd operand → "u" of NI
	7	TP	[30000]	A	Second operand → A
	10	TJ	Q	VS25	First operand > second operand?
(148)	11	LQ	Q	17	First operand → "u" of Q
	12	AT	Q	WT5	Operands → "u" and "v" of temp 5
	13	TV	WT5	WT1	Second operand → "v" of working temp
	14	TP	FC76	A	74777 → A
	15	TJ	WT1	VS20	Second operand > 74777? (i.e. subscripted)
(150)	16	TP	FC	Q	(Q_{35} = 0) no subscript word
	17	MJ	0	VS64	
	20	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	21	TU	RA	VS22	Address of s.s. for oper. in "v" → "u" of NI
	22	TP	[30000]	WT6	s.s. for oper. in "v" → "v" of temp 6
(148A)	23	TV	RC	PN	Set (H) to (H2) "u" non-subs and "v" subscripted
	24	MJ	0	VS63	
(149)	25	TV	A	WT1	Second operand → "v" of working temp
	26	LA	A	17	Second operand → "u" of A
	27	AT	Q	WT5	Operands → "u" and "v" of temp 5
	30	MJ	0	VS16	
(151)	31	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	32	TU	RA	VS33	Address of s.s. for first oper. → "u" of NI
	33	TP	[30000]	WT6	s.s. → "v" of temp 6
(152)	34	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	35	TU	RA	VS36	Address of second operand → "u" of NI
	36	TP	[30000]	A	Second operand → A
	37	TJ	Q	VS50	First operand > second operand?
	40	LQ	Q	17	First operand → "u" of Q
	41	AT	Q	WT5	Operands → "u" and "v" of temp 5
	42	RJ	BR	BR1	Decrease β by 1 in "u" and "v"
	43	TU	RA	VS45	Address of second s.s. → "u" of TV
	44	LA	WT6	17	First s.s. → "u" of temp 6
(153)	45	TV	[30000]	WT6	Second s.s. → "v" of temp 6
	46	TV	RC1	PN	Set (H) to (H1) "u" and "v" subscripted
	47	MJ	0	VS63	
(154)	50	TV	A	WT1	Second oper. → "v" of working temp
	51	LA	A	17	Second operand → "u" of A
	52	AT	Q	WT5	Operands → "u" and "v" of temp 5
	53	TP	FC76	A	74777 → "v" of A

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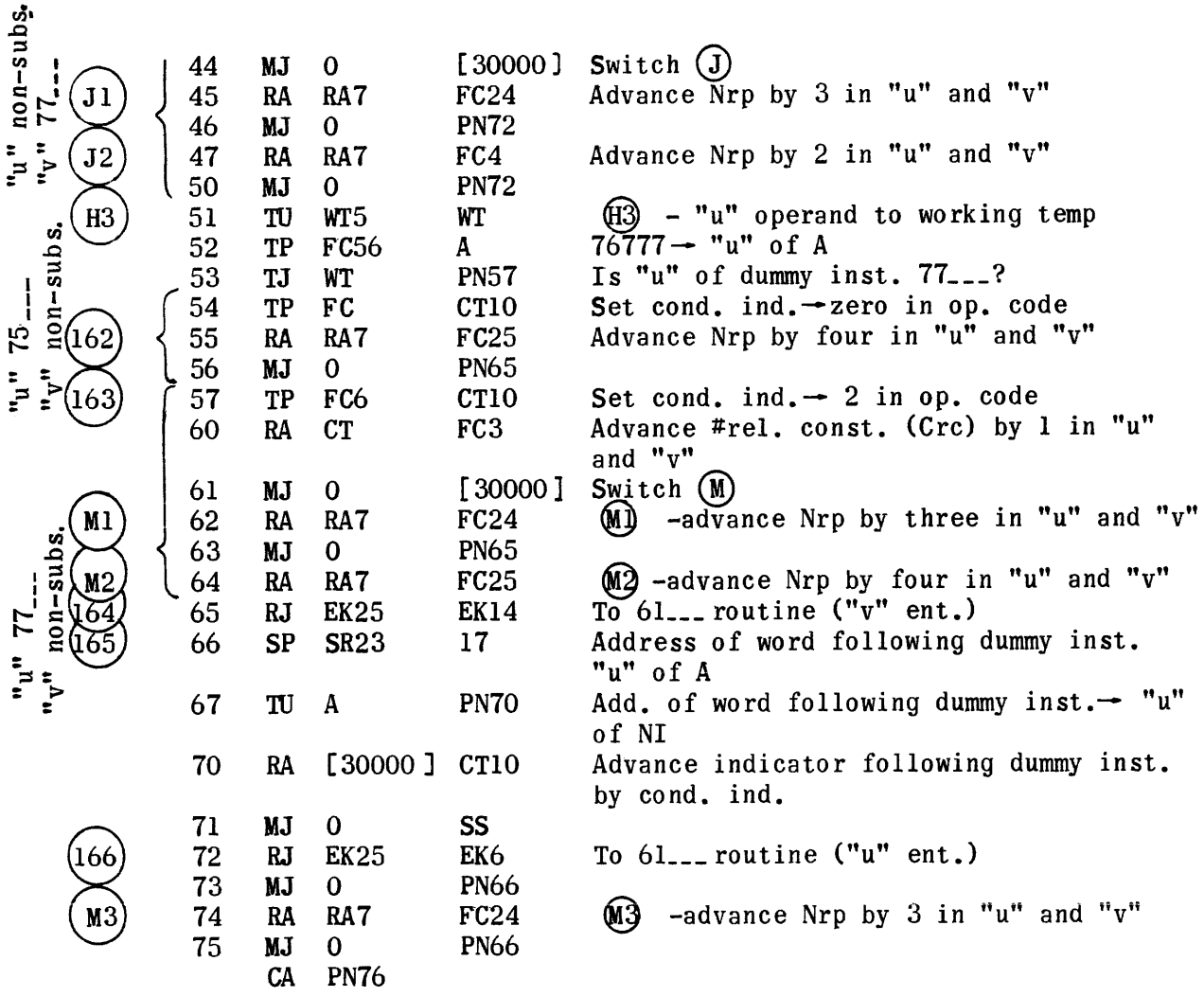
        54   TJ   WT1        VS56      Oper. in "u" (2nd oper.) > 74777? (i.e.
                                       subscripted)
        55   MJ   0          VS23
(155)   56   RJ   BR         BR1       Decrease β by 1 in "u" and "v"
        57   TU   RA         VS60      Address of s.s. for oper. in "u" → "u"
                                       of NI
        60   SP   [30000]    17        s.s. for 2nd oper. → "u" of A
        61   TU   A          WT6       s.s. for 2nd oper. → "u" of temp 6
        62   TV   RC1        PN        Set (H) to (H1) "u" and "v" subscripted
(156)   63   TP   FC36       Q         (Q35 = 1) subscript word
(157)   64   MJ   0          [Exit]
             CA   VS65
```

Set Condition Indicator for Floating Point Operations

		IA	PN		
	0	MJ	0	[30000]	Switch (H)
(H1)	1	TU	WT5	WT	
	2	TP	FC56	A	76777 → "u" of A
	3	TJ	WT	PN21	Is "u" of dummy inst. 77___ ? yes; take "v"
	4	TV	WT5	WT1	No
	5	TP	FC52	A	76777 → "v" of A
"u" 75___ "v" 75___	6	TJ	WT1	PN12	Is "v" of dummy inst. 77___? yes; take "v"
	7	TP	FC16	CT10	No; set condition indicator to 22 in op. code
	10	RA	RA7	FC27	Advance Nrp by six in "u" and "v"
	11	MJ	0	PN66	
(158)	12	TP	FC17	CT10	Set cond. ind.→ 25 in op. code
	13	RA	CT	FC3	Advance #rel. const (Crc) by 1 in "u" and "v"
	14	MJ	0	[30000]	Switch (G)
(G1)	15	RA	RA7	FC27	(G1) - advance Nrp by six in "u" and "v"
	16	MJ	0	PN66	
"u" 75___ "v" 77___ (G2)	17	RA	RA7	FC26	(G2) - advance Nrp by five in "u" and "v"
	20	MJ	0	PN66	
(159)	21	TV	WT5	WT1	Oper. in "v" of dummy inst.→ working temp
	22	TP	FC52	A	76777 → "v" of A
	23	TJ	WT1	PN30	Is "v" of dummy inst 77___ ? yes; take "v"
	24	TP	FC20	CT10	Set cond. ind.→ 30 in op. code
"u" 77___ "v" 75___	25	RA	CT	FC3	Advance #rel. const. (Crc) by 1 in "u" and "v"
	26	RA	RA7	FC26	Advance Nrp by six in "u" and "v"
	27	MJ	0	PN66	
(160)	30	TP	FC14	CT10	Set cond. ind.→ 17 in op. code
"u" 77___ "v" 77___	31	RA	CT	FC3	Advance #rel. const. (Crc) by 1 in "u" and "v"
	32	RA	RA7	FC25	Advance Nrp by four in "u" and "v"
	33	MJ	0	PN66	
(H2)	34	TV	WT5	WT1	(H2) - oper. in "v" of dummy inst. to temp 1
	35	TP	FC52	A	76777 → "v" of A
	36	TJ	WT1	PN42	Is "v" of dummy inst. 77___? yes; take "v"
(161)	37	TP	FC62	CT10	No; set condition indicator to 11 in op. code
"u" non-subs. 75___ "v"	40	RA	RA7	FC24	Advance Nrp by three in "u" and "v"
	41	MJ	0	PN72	
	42	TP	FC11	CT10	Set cond. ind.→ 5 in op. code
	43	RA	CT	FC3	Advance #rel. const. (Crc) by 1 in "u" and "v"



	44	MJ	0	[30000]	Switch (J)
J1	45	RA	RA7	FC24	Advance Nrp by 3 in "u" and "v"
	46	MJ	0	PN72	
J2	47	RA	RA7	FC4	Advance Nrp by 2 in "u" and "v"
	50	MJ	0	PN72	
H3	51	TU	WT5	WT	(H3) - "u" operand to working temp
	52	TP	FC56	A	76777→ "u" of A
	53	TJ	WT	PN57	Is "u" of dummy inst. 77___?
	54	TP	FC	CT10	Set cond. ind.→zero in op. code
162	55	RA	RA7	FC25	Advance Nrp by four in "u" and "v"
	56	MJ	0	PN65	
163	57	TP	FC6	CT10	Set cond. ind.→ 2 in op. code
	60	RA	CT	FC3	Advance #rel. const. (Crc) by 1 in "u" and "v"
	61	MJ	0	[30000]	Switch (M)
M1	62	RA	RA7	FC24	(M1) -advance Nrp by three in "u" and "v"
	63	MJ	0	PN65	
M2	64	RA	RA7	FC25	(M2) -advance Nrp by four in "u" and "v"
164	65	RJ	EK25	EK14	To 61___ routine ("v" ent.)
165	66	SP	SR23	17	Address of word following dummy inst. "u" of A
	67	TU	A	PN70	Add. of word following dummy inst.→ "u" of NI
	70	RA	[30000]	CT10	Advance indicator following dummy inst. by cond. ind.
	71	MJ	0	SS	
166	72	RJ	EK25	EK6	To 61___ routine ("u" ent.)
	73	MJ	0	PN66	
M3	74	RA	RA7	FC24	(M3) -advance Nrp by 3 in "u" and "v"
	75	MJ	0	PN66	
		CA	PN76		

Subroutine to Check for Redundant Floating Point Operation

		IA	RR		
(167)	0	RJ	ES	ES1	Search Expanded List for Dummy inst.
	1	SJ	RR6	RR2	Is instruction redundant? No; to RR6
	2	TU	A	RR4	Address of s.s. word in Expanded List →"u" of QT
	3	TP	FC35	Q	
	4	QT	[30000]	A	Subscript word from Expanded List → A
	5	EJ	WT6	RR47	Is subscript word in temp 6 redundant? Yes; to RR47
(168)	6	RJ	ES	ES12	No, advance dummy tally by one
	7	TV	A	RR10	Available address in Exp. List → "v" of NI
	10	TP	WT5	[30000]	Dummy instruction to Expanded List
(169)	11	RJ	ES	ES12	Advance dummy tally by one
	12	TV	A	RR13	Available address in Exp. List → "v" of NI
	13	TP	WT6	[30000]	Subscript word to Expanded List
	14	TV	RR10	WT4	Address of dummy instruction to "v" of temp
	15	TV	RC3	PN14	Set switch (G) to (G2)
	16	TV	RC4	PN44	Set switch (J) to (J1)
	17	SP	RA6	17	P.R. counter → "u" of A
	20	TU	WT5	WT	"u" of dummy inst. → working temp.
	21	EJ	WT	RR23	Is P.R. counter = "u" operand? (oper. for "u" in Q)
	22	MJ	0	[30000]	Exit - subscript word
	23	TP	FC7	CT10	Set cond. ind. → 3 in op. code (oper. for "u" in Q)
	24	MJ	0	RR43	
(170)	25	RJ	ES	ES1	Search Expanded List for dummy instruction
	26	SJ	RR27	RR50	Is instruction redundant? yes; to RR50
	27	RJ	ES	ES12	No, advance dummy tally by one
	30	TV	RA5	RR32	Available address in Exp. List → "v" of TP
	31	TV	RA5	WT4	Address of dummy inst. → "v" of temp.
	32	TP	WT5	[30000]	Dummy instruction to Expanded List
	33	RA	RA7	FC3	Advance Nrp by one in "u" and "v"
	34	TP	FC13	CT10	Set cond. ind. → 12 in op. code (neither "u" nor "v" subs)
(171)	35	SP	RA6	17	P.R. counter → "u" of A
	36	TU	WT5	WT	"u" of dummy inst. to working temp
	37	TV	RC7	PN	Set switch (H) → (1)
	40	EJ	WT	RR55	P.R. counter = "u" operand? (oper. for "u" in "Q")
(172)	41	RJ	EK25	EK	To 61___ routine ("u" and "v" ent.)
(173)	42	MJ	0	[30000]	Exit - no subscript word
(173A)	43	RJ	LQ	LQ7	Enter P.R. value in Q List
	44	TP	FC3	CT7	Set increment (I) → one in "u" and "v"

operand for "u" in Q

redundant instruction

(174)

45	RJ	SR25	SR11	P.R. value → Oper. List (β) and Exp. List γ ; cond. ind. → Exp. List
46	MJ	0	PN	Go to (H) (prediction routine)
47	RA	RR4	FC2	Address of redundant P.R. value → "u" of A
50	RJ	RS	RS1	Redundant P.R. value → Oper. List and Red. P.R. List
51	SJ	RR52	SS	Was redundant P.R. in List?
52	TP	WT1	A	Redundant P.R. → A
53	RJ	LQ	LQ1	Was redundant P.R. in Q List?
54	MJ	0	SS	
55	RA	CT10	FC7	Adv. cond. ind. by 3 in op. code (oper. for "u" in Q-set ind → (15))
56	RJ	EK25	EK14	To 61___ routine ("v" ent.)
57	MJ	0	RR43	
	CA	RR60		

Subroutine to Store Redundant Partial Result

		IA	RS		
	0	MJ	0	[30000]	Exit
(175)	1	TU	A	RS2	Address of redundant P.R. value → "u" of NI
	2	TV	[30000]	WT1	Redundant P.R.→ "v" of working temp
	3	TV	RA	RS4	Available address in Operand List → "v" of NI
	4	TP	WT1	[30000]	Redundant P.R. value → Operand List (β)
	5	RJ	BR	BR4	Advance address in Operand List (β) by 1 in "u" and "v"
	6	TP	WT1	A	Redundant P.R.→ A
	7	TU	RA10	RS10	Length of redundant P.R. List → jn of repeat
	10	RP	[30000]	RS12	Search Redundant P.R. List
	11	EJ	RL	RS24	Is P.R. in "A" in Redundant P.R.List?
(176)	12	TV	RA10	RS13	No; available address in Redundant P.R. List → "v" of NI
	13	TP	A	[30000]	Redundant P.R.→ redundant P.R. List
	14	RA	RA10	FC3	Advance available add. and jn for Red. P.R. List by one
	15	TJ	LV1	RS22	Redundant P.R. List too long?
	16	RJ	WA	WA1	Sent.# → print out
	17	TP	TO	UP3	Codeword → alarm print
	20	RJ	UP2	UP	Alarm-Red. P.R. List too long [type: SENTENCE TOO LONG.]
	21	MJ	0	BQ6	Rewind tapes
	22	TP	FC36	A	Set (A) → Red. P.R. was not in list (A-)
	23	MJ	0	RS	
(176A)	24	TP	FC	A	Set (A) → Red. P.R. was in list (A+)
	25	MJ	0	RS	
		CA	RS26		

Subroutine to Sort Operands for Fixed Plus or Multiply

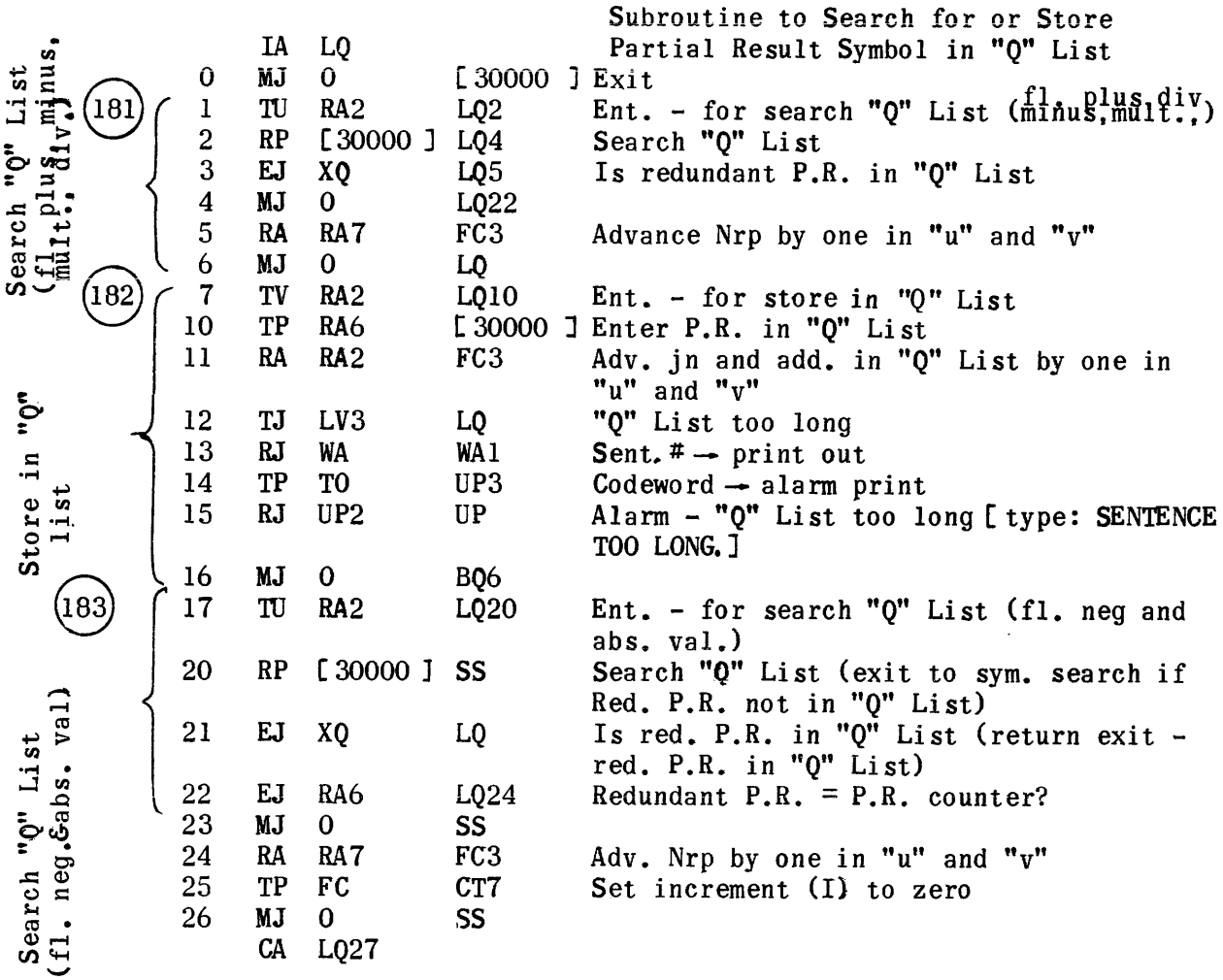
		IA	OS		
(177)	0	RJ	BR	BR1	Decrease address in Operand List (β) by 1 in "u" and "v"
	1	TU	RA	OS4	Address of first operand → TP
	2	RJ	BR	BR1	Decrease address in Operand List (β) by 1 in "u" and "v"
	3	TU	RA	OS5	Address of second operand → TP
	4	TP	[30000]	A	First operand → A
	5	TP	[30000]	Q	Second operand → Q
	6	TJ	Q	OS11	Operand at Q > operand at A
	7	LQ	Q	17	Shift operand in Q → "u" of Q
	10	MJ	0	OS12	
	11	LA	A	17	Shift operand in A → "u" of A
	12	SA	Q	0	Operands → "u" and "v" of A
	13	MJ	0	[30000]	
		CA	OS14		

Subroutine to Store Callword in Op. File 1

		IA	FS		
(178)	0	MJ	0	[30000]	Exit
	1	SP	A	17	Callword → "u" of A
	2	TU	RA1	FS3	Length Op. File 1 → jn of repeat
	3	RP	[30000]	FS5	Search Op. File 1 for callword
	4	EJ	FL2	FS	Callword in Op. File 1? no to FS5
	5	TV	RA1	FS6	Available address in Op. File 1 → "v" of NI
	6	TP	A	[30000]	Store callword in Op. File 1
	7	RA	FL	FC1	Adv. #lines this Op. File 1 item by one
	10	RA	RA1	FC3	Adv. available add. and jn for Op. File 1 by one
	11	TJ	LV2	FS	Op. File 1 too long?
	12	RJ	WA	WA1	Sent.# → print out
	13	TP	TO	UP3	Codeword → alarm print
	14	RJ	UP2	UP	Alarm-Op. File 1 too long [type: SENTENCE TOO LONG.]
	15	MJ	0	BQ6	Rewind tapes
		CA	FS16		

Subroutine to Advance or Decrease Available Address in Operand List (Beta Routine)

		IA	BR		
(179)	0	MJ	0	[30000]	Exit
Decrease β	1	RS	RA	FC3	Decrease address in Operand List (β) by 1 in "u" and "v"
(179A)	2	TJ	IA	EP4	Init. add. Oper. List > current add.? Yes → alarm #4
	3	MJ	0	BR	No; to exit
(180)	4	RA	RA	FC3	Adv. address in Oper. List (β) by 1 in "u" and "v"
	5	TJ	LV	BR	Max. address in Oper. List > current address?
Advance β	6	RJ	WA	WA1	Yes; type sentence number
	7	TP	TO	UP3	Code word → alarm print
	10	RJ	UP2	UP	Alarm-too many operands [type: SENTENCE TOO LONG.]
	11	MJ	0	BQ6	Rewind tapes and stop
		CA	BR12		




```
                                        Subroutine to Search for or Store
                                        Partial Result Symbol in "Q" List
     IA  LQ
0    MJ  0          [30000 ]  Exit
1    TU  RA2        LQ2       Ent. - for search "Q" List (fl. plus div
2    RP  [30000 ]   LQ4       Search "Q" List                minus,mult.,)
3    EJ  XQ         LQ5       Is redundant P.R. in "Q" List
4    MJ  0          LQ22
5    RA  RA7        FC3       Advance Nrp by one in "u" and "v"
6    MJ  0          LQ
7    TV  RA2        LQ10      Ent. - for store in "Q" List
10   TP  RA6        [30000 ]  Enter P.R. in "Q" List
11   RA  RA2        FC3       Adv. jn and add. in "Q" List by one in
                              "u" and "v"
12   TJ  LV3        LQ        "Q" List too long
13   RJ  WA         WA1       Sent. # → print out
14   TP  TO         UP3       Codeword → alarm print
15   RJ  UP2        UP        Alarm - "Q" List too long [type: SENTENCE
                              TOO LONG.]
16   MJ  0          BQ6
17   TU  RA2        LQ20      Ent. - for search "Q" List (fl. neg and
                              abs. val.)
20   RP  [30000 ]   SS        Search "Q" List (exit to sym. search if
                              Red. P.R. not in "Q" List)
21   EJ  XQ         LQ        Is red. P.R. in "Q" List (return exit -
                              red. P.R. in "Q" List)
22   EJ  RA6        LQ24      Redundant P.R. = P.R. counter?
23   MJ  0          SS
24   RA  RA7        FC3       Adv. Nrp by one in "u" and "v"
25   TP  FC         CT7       Set increment (I) to zero
26   MJ  0          SS
     CA  LQ27
```

search "A" list

Store in "A" list

(184)

(185)

```
                                        Subroutine to Search for or Store
      IA   LA                           Partial Result Symbol in "A" List
 0    MJ   0          [30000]  Exit
 1    TU   RA3        LA2      Ent.-for search "A" List
 2    RP   [30000]    LA16     Search "A" List
 3    EJ   XA         LA4      Is redundant P.R. in "A" List?
 4    RA   RA7        FC3      Advance Nrp by one in "u" and "v"
 5    MJ   0          LA
 6    TV   RA3        LA7      Ent.-for store in "A" List
 7    TP   RA6        [30000]  Enter P.R. in "A" List
10    RA   RA3        FC3      Adv. jn and add. in "A" List by one in
                                "u" and "v"
11    TJ   LV4        LA       "A" List too long?
12    RJ   WA         WA1      Sent.# - print out
13    TP   TO         UP3      Codeword → alarm print
14    RJ   UP2        UP       Alarm-"A" List too long [type: SENTENCE
                                TOO LONG.]
15    MJ   0          BQ6      Rewind tapes and stop
16    EJ   RA6        LA20     Redundant P.R. = P.R. counter?
17    MJ   0          LA       No
20    RA   RA7        FC3      Adv. Nrp by 1 in "u" and "v"
21    TP   FC         CT7      Set increment (I) to Zero
22    MJ   0          LA
      CA   LA23
```

*Note: Sent. callword from sorted list → first word in Exp. List
Sent. number from sorted list → second word in Exp. List

Search Exp. List

Advance dummy tally (D)

		IA	ES		Input-dummy inst. in A Subroutine to Search for Dummy Instruction or Advance Dummy Tally in Exp. List
	0	MJ	0	[30000]	Exit
(186)	1	TU	RA4	ES2	jn for repeat → NI
	2	RP	[30000]	ES10	Search Expanded List
	3	EJ	EL2	ES4	Dummy inst = prev. entry in Exp. List? yes; to ES4
	4	SN	Q	17	-jn+r → "u" of A
	5	SA	ES2	0	+r → "u" of A
	6	SA	ES3	0	EL+r → "u" of A
	7	MJ	0	ES	
(187)	10	TP	FC36	A	Equality not met indicator → A (i.e. A_{71} = 1)
	11	MJ	0	ES	
(188)	12	RA	RA5	FC3	Adv. dummy tally for Exp. List by 1 in "u" and "v"
	13	TJ	LV5	ES	Expanded List too long? no; to exit
	14	RJ	WA	WA1	Yes; type sentence number
	15	TP	TO	UP3	Codeword → alarm print
	16	RJ	UP2	UP	Alarm-Exp. List too long [type: SENTENCE TOO LONG.]
	17	MJ	0	BQ6	Rewind tapes and stop
		CA	ES20		

		IA	DS		Dimension List Search
	0	MJ	0	[30000]	Exit
(189)	1	RP	[30000]	EP1	Search Dimension List (preset from f_6)
	2	EJ	DL	DS3	Callword in Dimension List? Alarm #1 if no.
	3	SN	Q	17	Yes; -jn+r → "u" of A
	4	SA	DS1	0	+r → "u" of A
	5	SA	DS2	0	DL+r → "u" of A
	6	MJ	0	DS	
		CA	DS7		

Subroutine to Decrease and Check Partial Result Counter

		IA	PR		
(190)	0	RS	RA6	FC1	Decrease partial result counter to new P.R. symbol
	1	TJ	LV6	PR3	Has P.R. counter reached minimum value? "v" if yes
	2	MJ	0	[30000]	No; to exit
	3	RJ	WA	WA1	Yes; type sentence number
	4	TP	TO	UP3	Codeword → alarm print
	5	RJ	UP2	UP	Alarm-P.R. counter below minimum [type: SENTENCE TOO LONG]
	6	MJ	0	BQ6	
		CA	PR7		

Subroutine to Check for 61___ Type Operands in Dummy Instruction

		IA	EK		
(191)	0	TP	FC77	Q	Mask → Q
	1	QT	WT5	A	First two octal digits of "u" and "v" operands to "A"
	2	EJ	FC100	EK23	"u" and "v" operands = 61___type? yes; take "v"
	3	TP	FC104	Q	Mask for first two octal digits of "v" → Q
	4	QT	WT5	A	First 2 octal digits of "v" operand to "A"
	5	EJ	FC102	EK20	"v" operand = 61___type? yes; take "v"
(192)	6	TP	FC103	Q	Mask for first two octal digits of "u" to "Q"
	7	QT	WT5	A	
	10	EJ	FC101	EK12	"u" operand = 61___type? yes; take "v"
	11	MJ	0	EK25	To exit
(193)	12	RA	CT10	FC115	Adv. cond ind. by 33 in op. code
	13	MJ	0	EK21	
(194)	14	TP	FC104	Q	Mask for first two octal digits of "v" to "Q"
	15	QT	WT5	A	First 2 octal digits of "v" operand to "A"
	16	EJ	FC102	EK12	"v" operand = 61___type? yes; take "v"
	17	MJ	0	EK25	To exit
	20	RA	CT10	FC105	Adv. cond. ind. by 35 in op. code
	21	RA	RA7	FC3	Adv. Nrp by 1 in "u" and "v"
	22	MJ	0	EK25	To exit
(195)	23	RA	RA7	FC4	Adv. Nrp by 2 in "u" and "v"
	24	RA	CT10	FC106	Adv. cond. ind. by 31 in op. code
	25	MJ	0	[30000]	Exit
		CA	EK26		

Subroutine
to Enter Current Partial Result Symbol
in Expanded List and Operand List

		IA	PP		
(196)	0	RJ	ES	ES12	Advance dummy tally (D) by 1 in "u" and "v"
	1	TP	RA5	RA4	Set γ = D (advance γ to add Dummy List to Exp. List)
	2	RJ	PR2	PR	Decrease P.R. counter → new partial result (P.R. in A)
	3	TV	RA	PP4	Available address in Operand List (β) → "v" of NI
	4	TP	A	[30000]	P.R. value → Operand List
(197)	5	TV	RA4	PP6	Next address in Exp. List → "v" of NI
	6	TP	A	[30000]	P.R. value → Expanded List
	7	RJ	BR	BR4	Adv. add. in Operand List (β) by 1 in "u" and "v"
	10	MJ	0	[30000]	
		CA	PP11		

Subroutine to Store
Partial Result Symbol for Subscript Operation in Expanded List and Operand List

		IA	SR		
(198)	0	TV	[30000]	WT1	Last subscript → "v" of WT1
	1	TP	WT1	A	Last subscript → "v" of A
	2	EJ	RA6	SR7	P.R. counter = last subscript (i.e. subscript in A)
	3	RA	RA7	FC3	No, advance Nrp by one
(198A)	4	RA	RA7	CT7	Advance Nrp by increment (I)
	5	MJ	0	SR11	
	6	0	[30000]	[30000]	Vacant
(199)	7	RA	CT10	FC5	Set condition indicator → one (s.s. in A)
(199A)	10	RJ	LA	LA6	Enter P.R. value in "A" list
(200)	11	RJ	ES	ES12	Advance dummy tally (D) by 1 in "u" and "v" to count P.R.
	12	TP	RA5	RA4	Set γ = D (advance γ to add Dummy List to Exp. List)
(201)	13	RJ	PR2	PR	Decrease P.R. counter → new partial result (P.R. in A)
	14	TV	RA	SR15	Available address in Operand List (β) to "v" of NI
	15	TP	A	[30000]	P.R. value → Operand List
	16	TV	RA4	SR17	Next address in Expanded List → "v" of NI
	17	TP	A	[30000]	P.R. value → Expanded List
(202)	20	TV	WT4	SR23	Dummy inst. address → "v" of QT
	21	RA	SR23	FC1	Advance add. of QS → word following dummy inst.
	22	TP	FC36	Q	Mask for op. code → Q
	23	QS	CT10	[30000]	Condition indicator → op. code of word following dummy inst.
	24	RJ	BR	BR4	Advance address in Operand List (β) by 1 in "u" and "v"
	25	MJ	0	[30000]	
		CA	SR26		

	IA	FC		Fixed Constants
0	0	0	0	
1	0	0	1	
2	0	1	0	
3	0	1	1	
4	0	2	2	
5	1	0	0	Subscript for "u" in A
6	2	0	0	Subscript for "v" in A
7	3	0	0	Operand for "u" in Q
10	4	0	0	Operand for "v" in Q
11	5	0	0	
12	10	0	0	
13	12	0	0	
14	17	0	0	
15	20	0	0	
16	22	0	0	
17	25	0	0	
20	30	0	0	
21	40	0	0	
22	70	0	0	
23	0	0	2	
24	0	3	3	
25	0	4	4	
26	0	5	5	
27	0	6	6	
30	0	0	7	
31	0	0	10	
32	0	0	77777	
33	0	77777	0	
34	0	07777	0	
35	0	77777	77777	
36	77	0	0	
37	77	0	77777	

	IA	FC40	
40	77	77777	0
41	07	77777	77777
42	07	77000	0
43	0	0	61000
44	0	0	62000
45	0	0	64000
46	0	0	70000
47	0	0	73000
50	0	0	73777
51	0	0	74000
52	0	0	76777
53	0	0	77000
54	0	74777	0
55	0	74000	0
56	0	76777	0

57	0	0	3	
60	0	0	76000	
61	0	0	75000	
62	11	0	0	
63	0	0	7	
64	0	0	50012	General power library routine callword
65	20	14000	0	Floating point-one
66	0	0	50051	Square root library routine callword
67	0	0	50022	Int. x^y where $\|y\| > 29$
70	6	0	0	
71	0	0	31000	
72	0	31000	0	
73	0	0	700	
74	0	0	77	
75	37	40000	0	
76	0	0	74777	
77	0	77000	77000	

	IA	FC100	
100	0	61000	61000
101	0	61000	0
102	0	0	61000
103	0	77000	0
104	0	0	77000
105	35	0	0
106	31	0	0
107	0	01000	01000
110	0	20000	20000
111	0	0	4
112	0	0	50000
113	MJ	0	0
114	77	07777	77777
115	33	0	0
116	0	777	777
117	0	0	16000
120	0	0	16100
121	0	7	7
122	77	77777	77776
	CA	FC123	

	IA	RC		Op. Codes Contain Operation Symbols for Expanded List; Relative Constants in "v"	
0	0	0	PN34		to set Ⓗ → H2
1	37	0	PN1	Subscript operator	to set Ⓗ → H1
2	52	0	PN15	Floating subtract	to set Ⓖ → G1
3	54	0	PN17	Floating divide	to set Ⓖ → G2
4	61	0	PN45	Library operator	to set Ⓙ → J1
5	62	0	PN47	Floating unary minus	to set Ⓙ → J2
6	64	0	PN51	Floating absolute value	to set Ⓗ → H3
7	66	0	SS	POW +2	to set Ⓗ → 1
10	67	0	PN62	POW -2	to set Ⓜ → M1
11	70	0	PN64	POW +3	to set Ⓜ → M2
12	71	0	LN2	POW -3	to set Ⓢ → S2
13	72	0	LN	POW ½	to set Ⓢ → S1
14	73	0	LN4	POW -½	to set Ⓢ → S3
15	74	0	LN12	POW (4 to 63)	to set Ⓝ → N2
16	75	0	RR50	POW (-4 to -63)	to set Ⓣ → T1
17	76	0	IQ31	POW -1	to set Ⓣ → T2
20	77	0	PN74	Storage operator	to set Ⓜ → M3
21	41	0	0	Floating plus	
22	53	0	0	Floating multiply	
23	55	0	0	Fixed plus	
24	56	0	0	Fixed subtract	
25	57	0	0	Fixed multiply	
26	60	0	0	Fixed divide	
27	63	0	0	Fixed unary minus	
30	65	0	0	Fixed absolute value	
31	0	0	S044		
32	0	0	S054		
	CA	RC33			

	IA	T0		Alarm Text
0	40	T01	3	
1	65	30506	63050	S E N T E N
2	26	30016	65151	C E Δ T 0 0
3	01	46515	03222	Δ L O N G .
	CA	T04		

		IA	IA		Initial Addresses
To preset RA	0	0	BL	BL	β initial (initial add. Operand List)
To preset RA1	1	0	20000	FL2	Op. File 1 item (jn to search in "u" - init. cross ref. item in "v")
To preset RA2	2	0	20000	XQ	"Q" list (jn to search in "u" - init. add. "Q" List in "v")
To preset RA3	3	0	20000	XA	"A" list (jn to search in "u" - init. add. "A" List in "v")
To preset RA4 & RA5	4	0	20000	EL1	Exp. list (jn to search in "u" - init. avail. add. -1 in "v")
To preset RA6	5	0	0	31000	Initial P.R. value in "v" +1
To preset RA7	6	0	01001	01001	Init. #lines in running prog +1000 in "u" and "v" (counts MJ exit)
To preset RA8	7	0	20000	RL	Red. P.R. List (jn to search in "u" - init. add. in Red. P.R. List in "v")
To preset SS3	10	0	SL3	0	α initial (initial address in Sorted List)
	11	0	EL2	0	Init. add. in Exp. List +2
		CA	IA12		

	IA	LV		Limiting Addresses for Lists, etc.
0	0	BL177	BL177	Max. address in Oper. List in "u" and "v" (max. β)
1	0	20077	RL77	Max. jn in "u" and max. address in "v" for redundant P.R. List
2	0	20175	FL177	Max. jn in "u" and max. address in "v" for Op. File 1 item
3	0	20177	XQ177	Max jn in "u" and max. address in "v" for "Q" List
4	0	20177	XA177	Max. jn in "u" and max. address in "v" for "A" List
5	0	20675	EL677	Max. jn in "u" and max. address in "v" for Expanded List
6	0	0	30000	Minimum P.R. value in "v"
7	0	02002	02002	Max. #lines object prog. body (incl. jump to exit) +1001
10	0	0	62000	Dummy callword for function input region
11	0	0	63000	Dummy callword for pseudo operation input region
	CA	LV12		

```
                                    Subroutine to Store in List 1, Callword
                                    of Library Routine and if Fixed Library
      IA   LS                       Routine, Callwords of its Cross-references
 0    MJ    0       [30000 ]
203   1    TU   LS26    LS13
      2    TP    FC      CT13      Zero → index C3
      3    EJ   LS25    LS11       Callword = 50012? yes; to LS11
      4    EJ   LS21    LS12       Callword = 50022? yes; to LS12
      5    RP  20003    LS14       Callword = 50031, 50041, or 50051?
      6    EJ   LS22     LS7       Yes; to LS7
      7    RJ   LR      LR1        50031, 50041, or 50051 callword to List 1
     10    MJ    0      LS13       50002 callword to list 1
204  11    RA   CT13     FC23      Advance index by 2 in "v"
205  12    RA   CT13     FC57      Advance index by 3 in "v"
206  13    TP  [30000]     A       Callword → A
207  14    RJ   LR      LR1        Callword to list 1
     15    RA  LS13     FC2        Advance by 1 in "u" to address of next
                                    callword
     16    IJ   CT13    LS13       More callwords to store in list 1? yes;
                                    to LS13
     17    MJ    0      LS         No; to exit
     20     0  50002      0
     21     0  50022      0
     22     0  50031      0
     23     0  50041      0
     24     0  50051      0
     25     0  50012      0
     26     0  LS20       0
           CA  LS27
```

Explanation of working Temporaries (WT)

```
WT0    0   [30000 ]    0       Temp 0 - op. code and "v" always Zero
  1    0      0     [30000 ]   Temp 1 - op. code and "u" always Zero
  2  [—       —        —]      Temp 2
  3  [—       —        —]      Symbol temp | Floating point inst.
  4  [—       —        —]      Dummy inst. address | Register indicator
  5  [—       —        —]      Dummy instruction
  6  [—       —        —]      Subscript word following dummy instruc-
                                tion
```

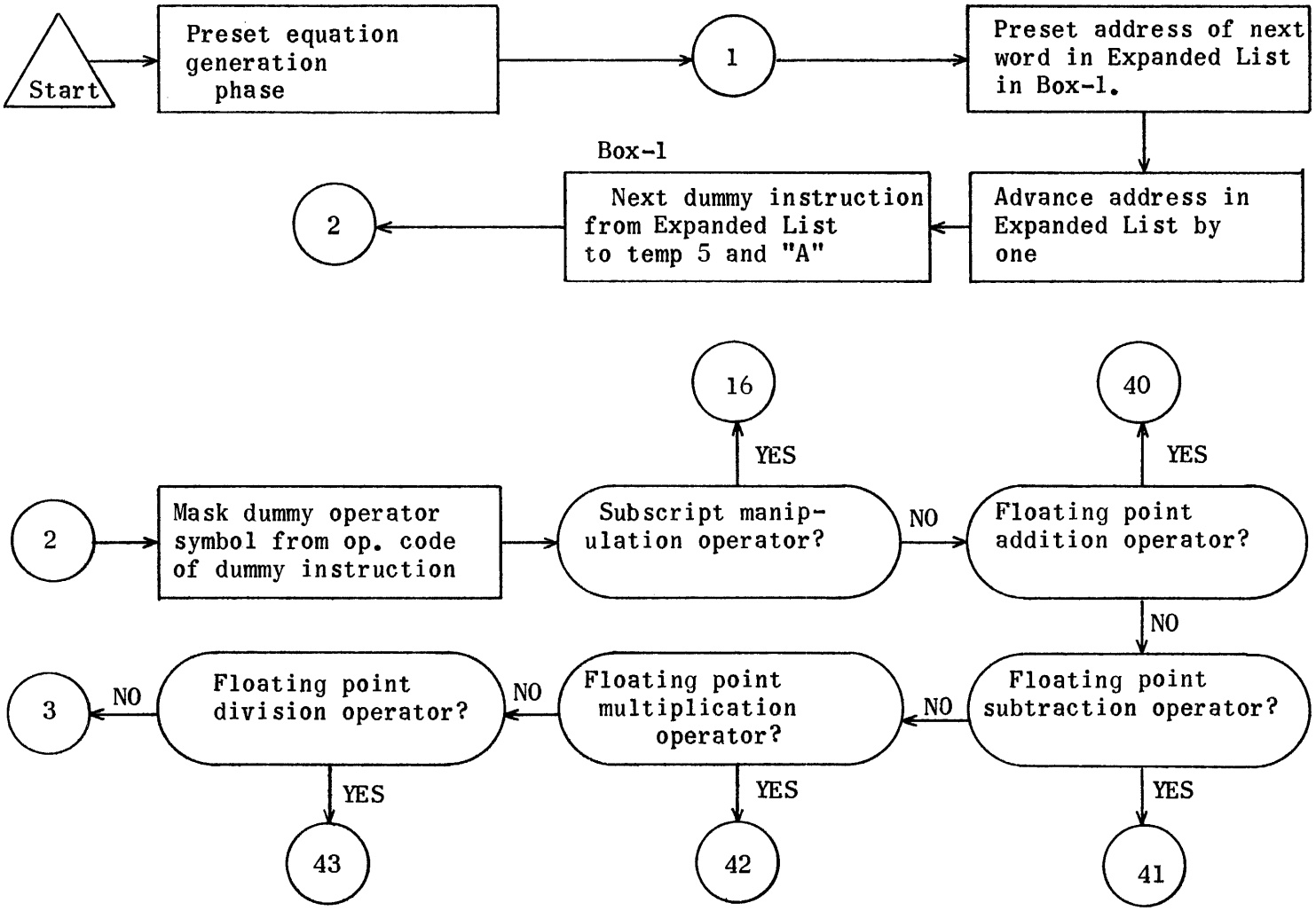
Explanation of Counters (CT)

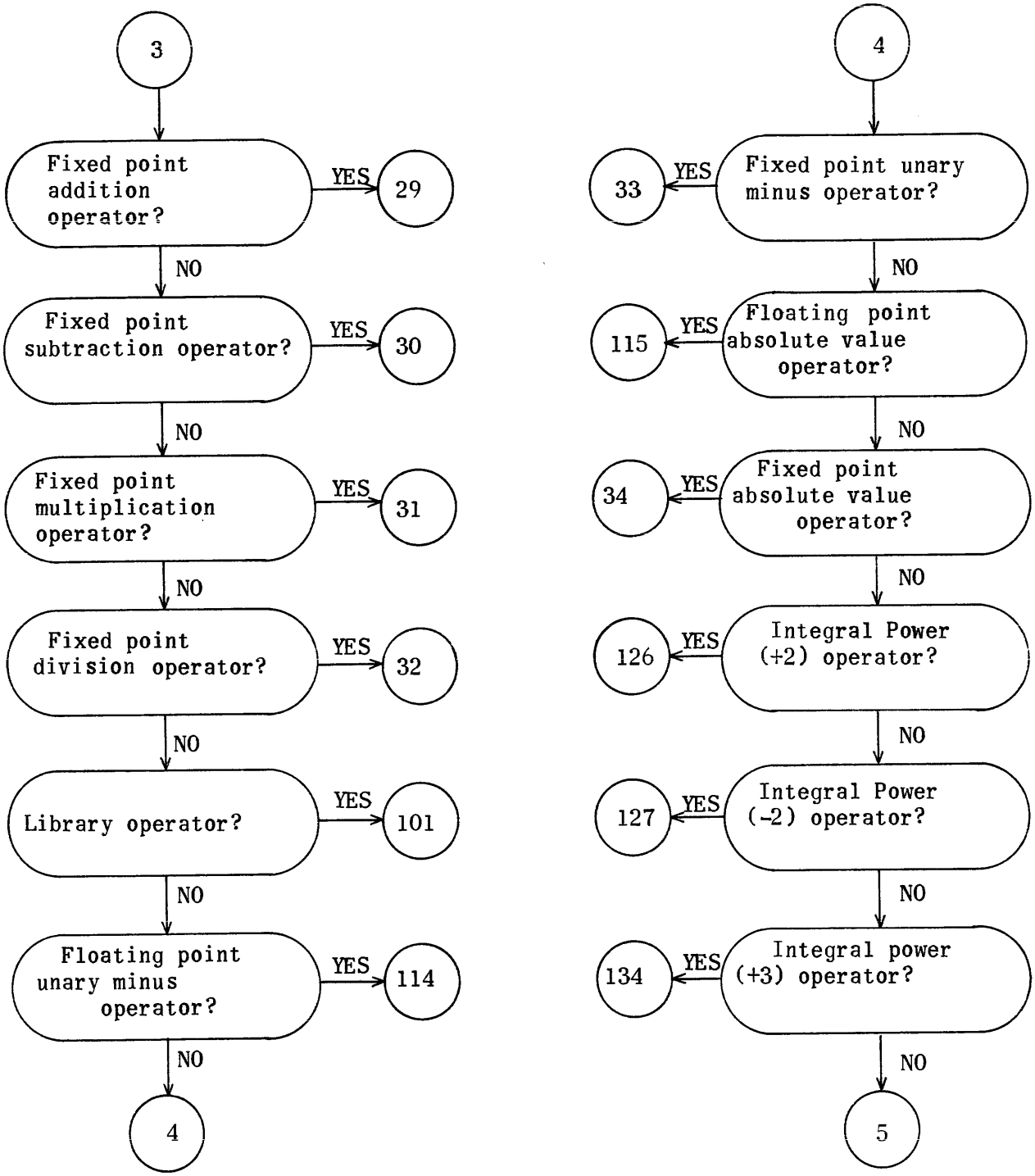
CT0	0	[—]	[—]	Crc-no. relative constants
1	0	[—]	[—]	Crpt-no. ten lines in running prog. body
2	0	[—]	[—]	Crct-no. ten lines in relative constant region
3	0	[—]	[—]	Trp-subtally of no. lines in running prog.
4	0	[—]	[—]	Trc-subtally of no. relative constants
5	0	[—]	[—]	Trpt-subtally of no. ten lines in running prog. body
6	0	[—]	[—]	Trct-subtally of no. ten lines in rel. const. region
7	0	[—]	[—]	Increment (I)
10	[—	—	—]	Condition indicator
11	0	0	[—]	Index counter (C_1)
12	0	0	[—]	Index counter (C_2)
13	0	0	[—]	Index counter (C_3)

			List of	running (current) Addresses in Lists (RA)
RA0	[—	—	—]	β (available open address in Operand List in "u" and "v")
1	[—	—	—]	Op. File 1 tally (jn in "u"-available address in "v")
2	[—	—	—]	"Q" List tally (jn in "u"-available address in "v")
3	[—	—	—]	"A" List tally (jn in "u"-available address in "v").
4	[—	—	—]	γ -Expanded List tally (jn in "u"-last used address in "v")
5	[—	—	—]	Dummy tally (D) for Expanded List (same format as γ)
6	[—	—	—]	Partial result (P.R.) counter (current P.R. in "v")
7	[—	—	—]	Tally of number of lines in running program +1000
10	[—	—	—]	Redundant P.R. List tally (jn in "u" - available address in "v")

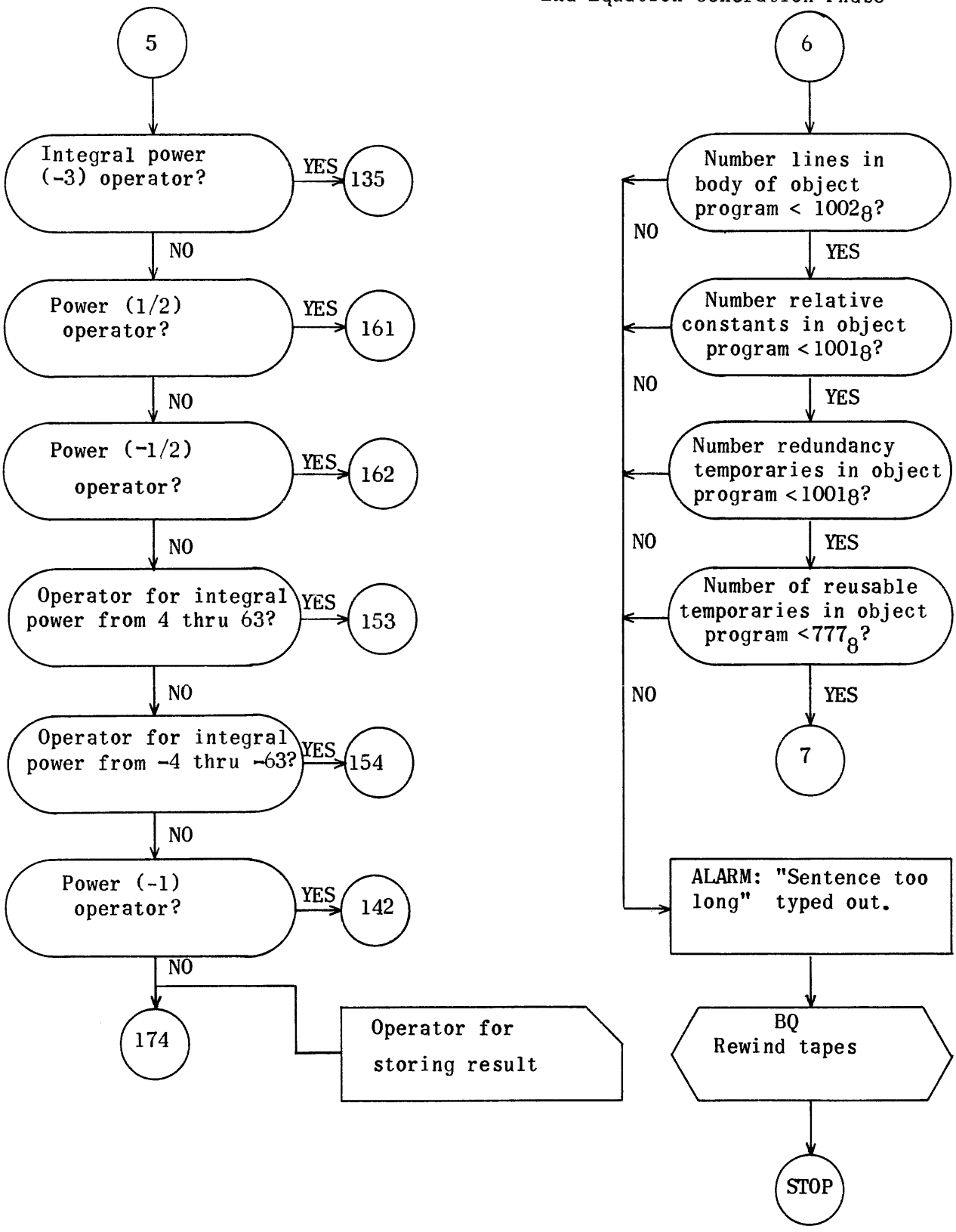
Equation Generation No. 3 Flow Charts

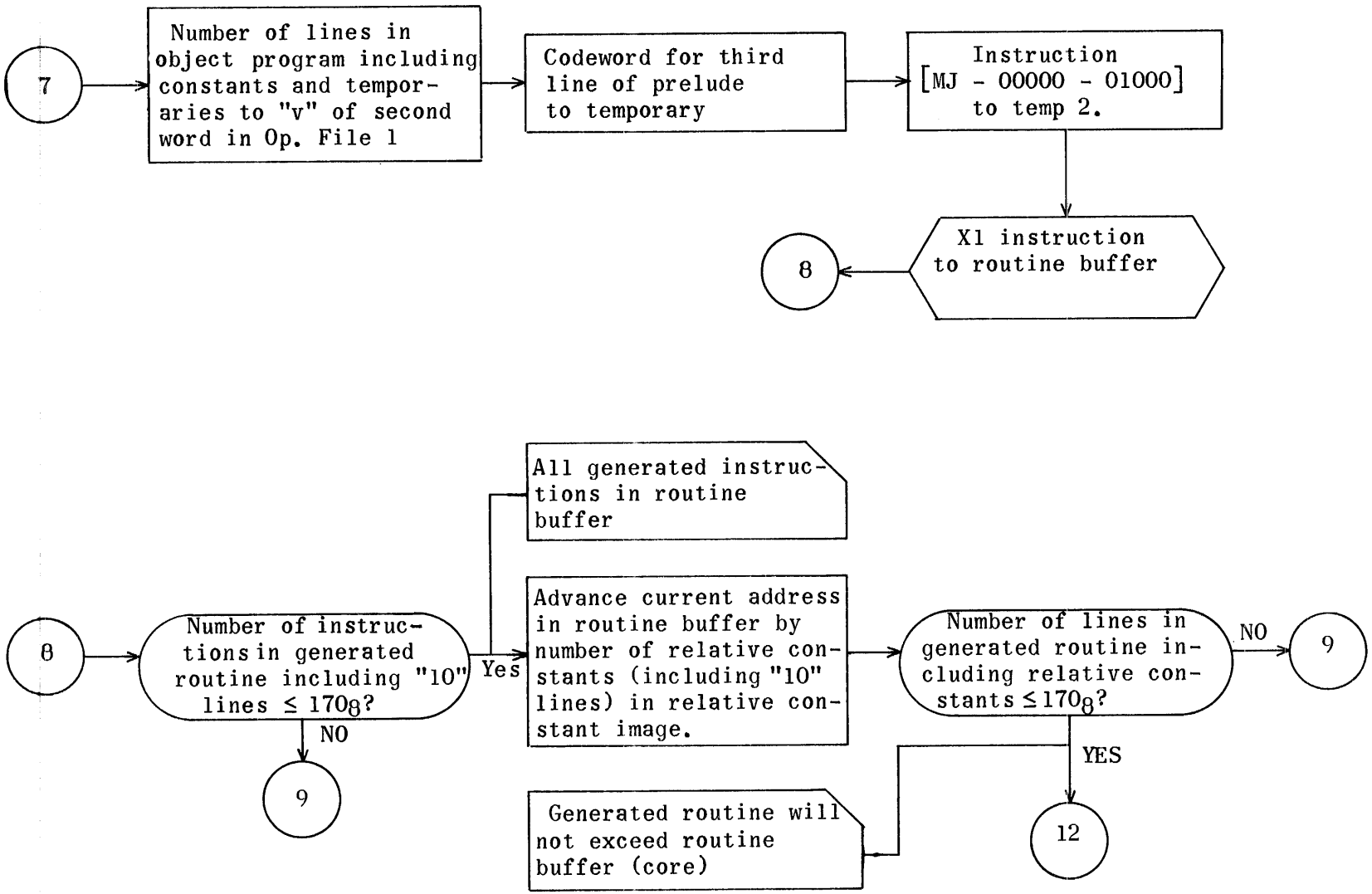
Equation Generation Phase

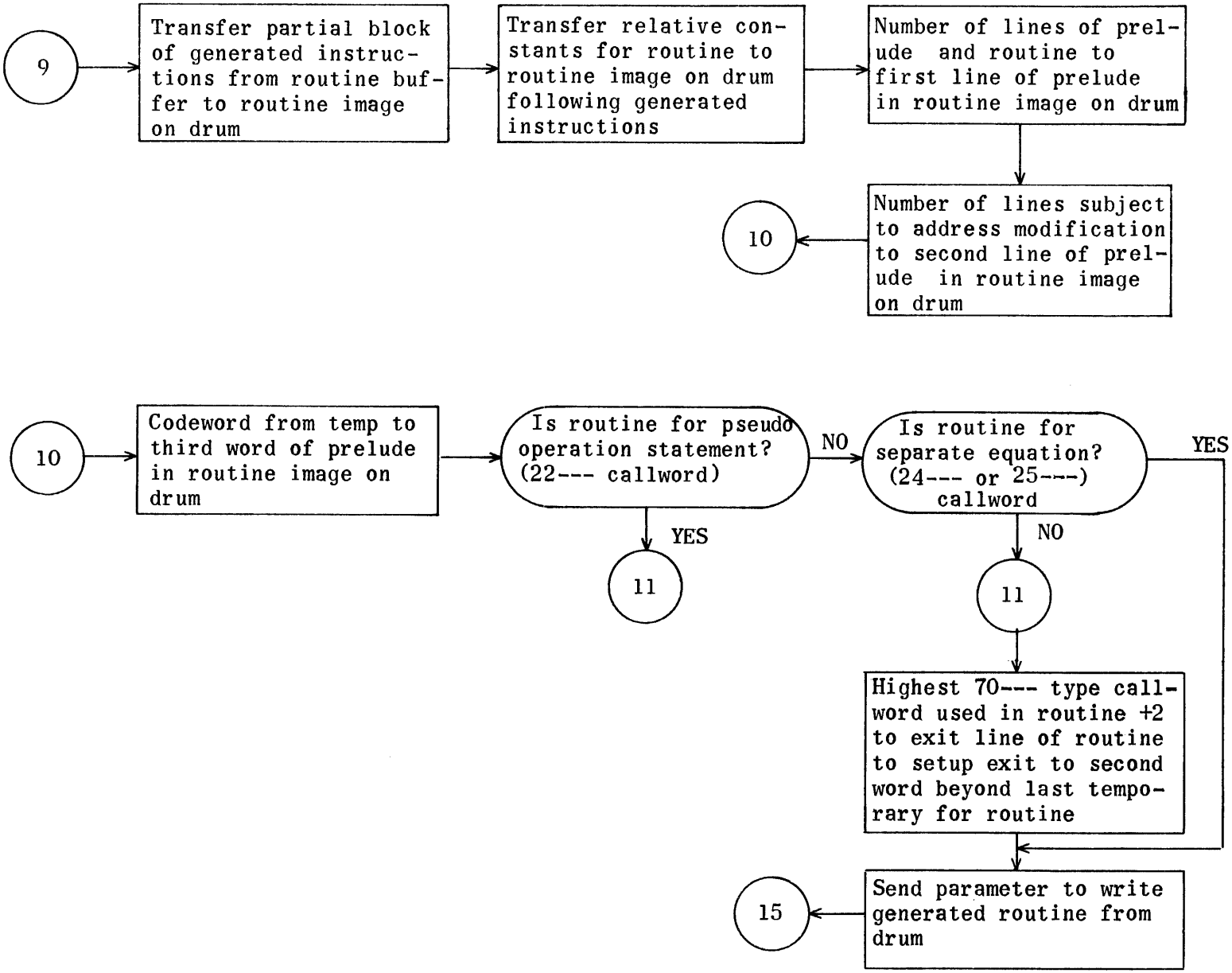


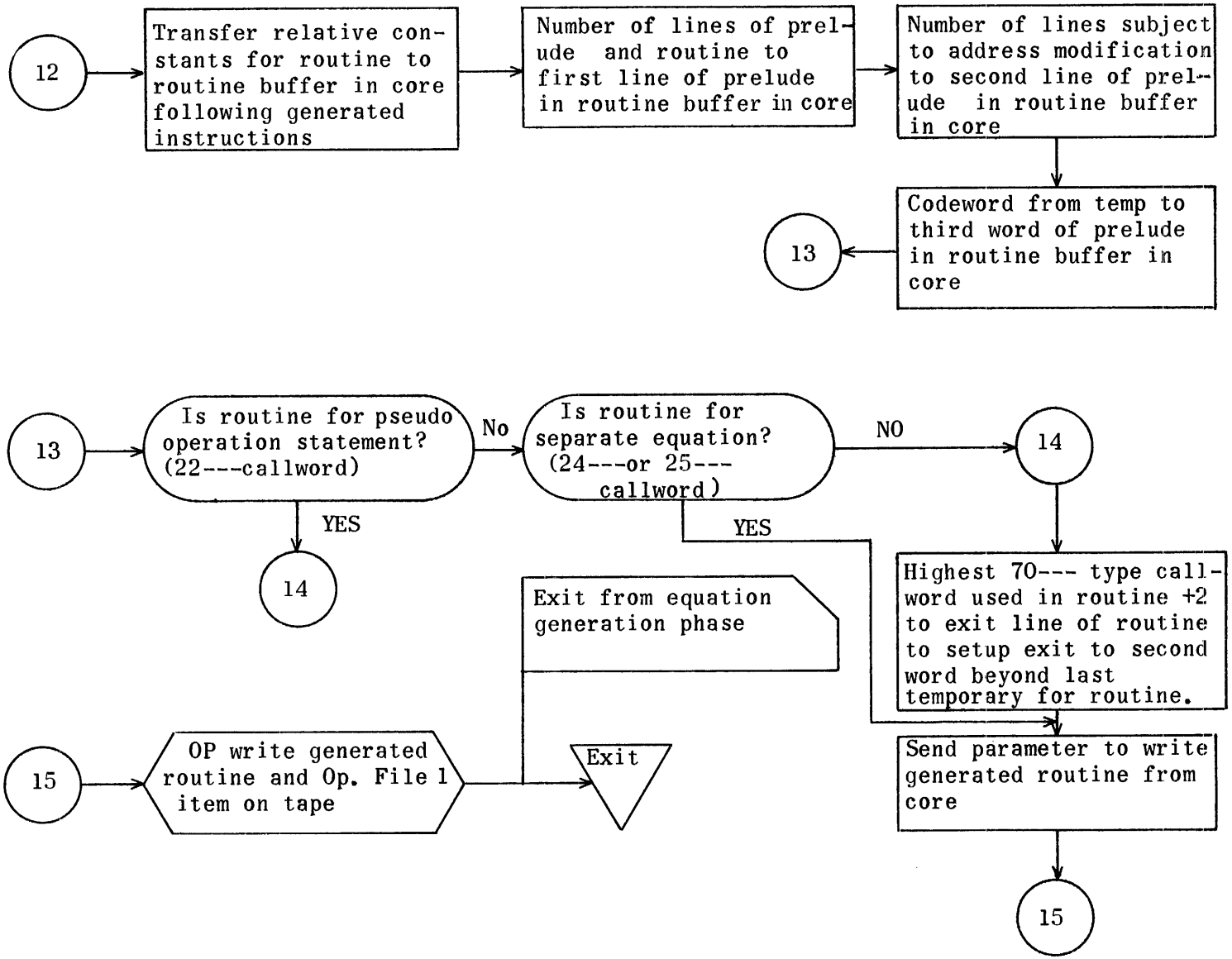

3
Fixed point addition operator?
YES
29
NO
Fixed point subtraction operator?
YES
30
NO
Fixed point multiplication operator?
YES
31
NO
Fixed point division operator?
YES
32
NO
Library operator?
YES
101
NO
Floating point unary minus operator?
YES
114
NO
4
4
Fixed point unary minus operator?
YES
33
NO
Floating point absolute value operator?
YES
115
NO
Fixed point absolute value operator?
YES
34
NO
Integral Power (+2) operator?
YES
126
NO
Integral Power (-2) operator?
YES
127
NO
Integral power (+3) operator?
YES
134
NO
5

End Equation Generation Phase

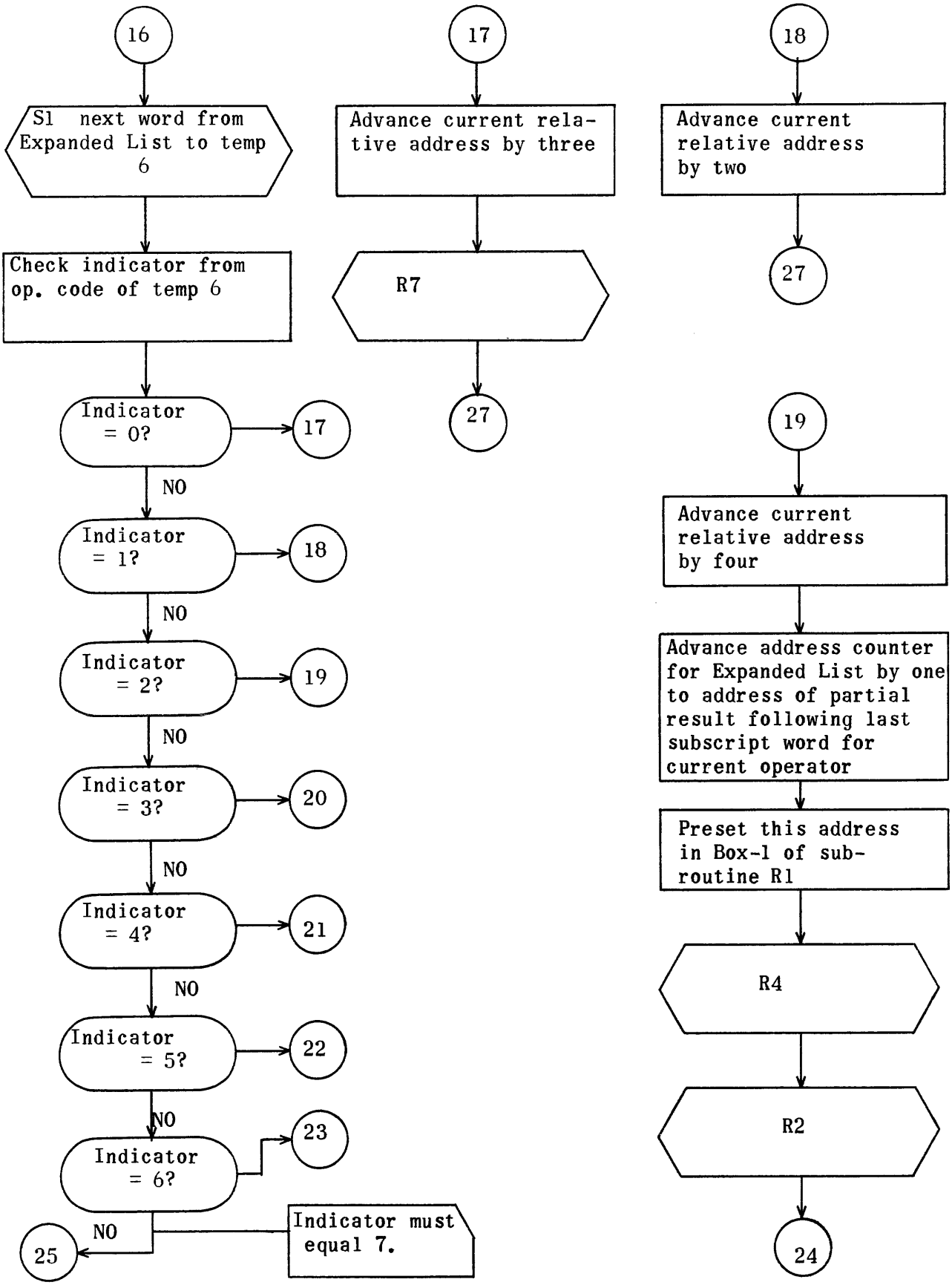


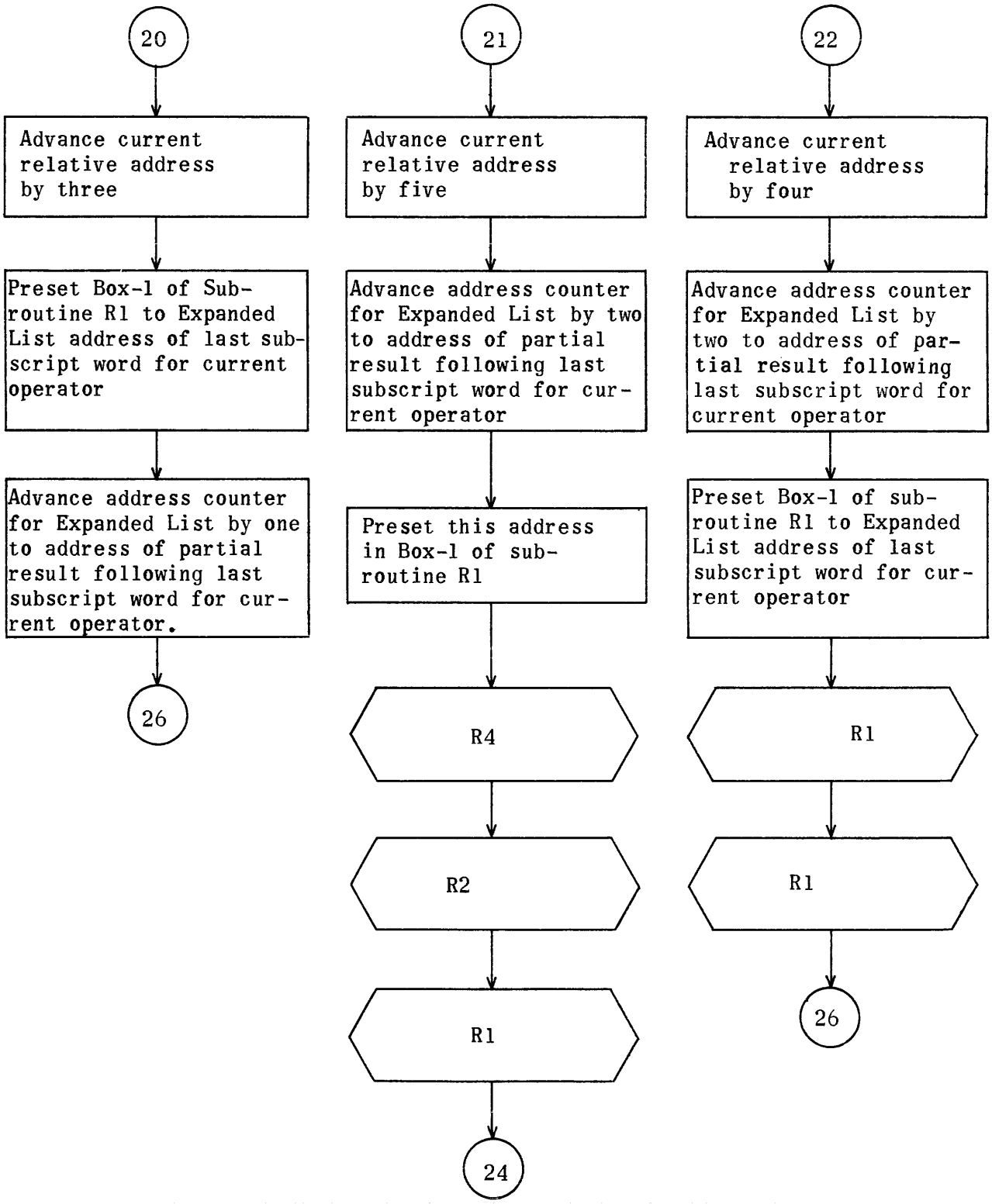

7
Number of lines in object program including constants and temporaries to "v" of second word in Op. File 1
Codeword for third line of prelude to temporary
Instruction [MJ - 00000 - 01000] to temp 2.
X1 instruction to routine buffer
8
8
Number of instructions in generated routine including "10" lines ≤ 170₈?
Yes
NO
9
All generated instructions in routine buffer
Advance current address in routine buffer by number of relative constants (including "10" lines) in relative constant image.
Number of lines in generated routine including relative constants ≤ 170₈?
NO
9
YES
12
Generated routine will not exceed routine buffer (core)

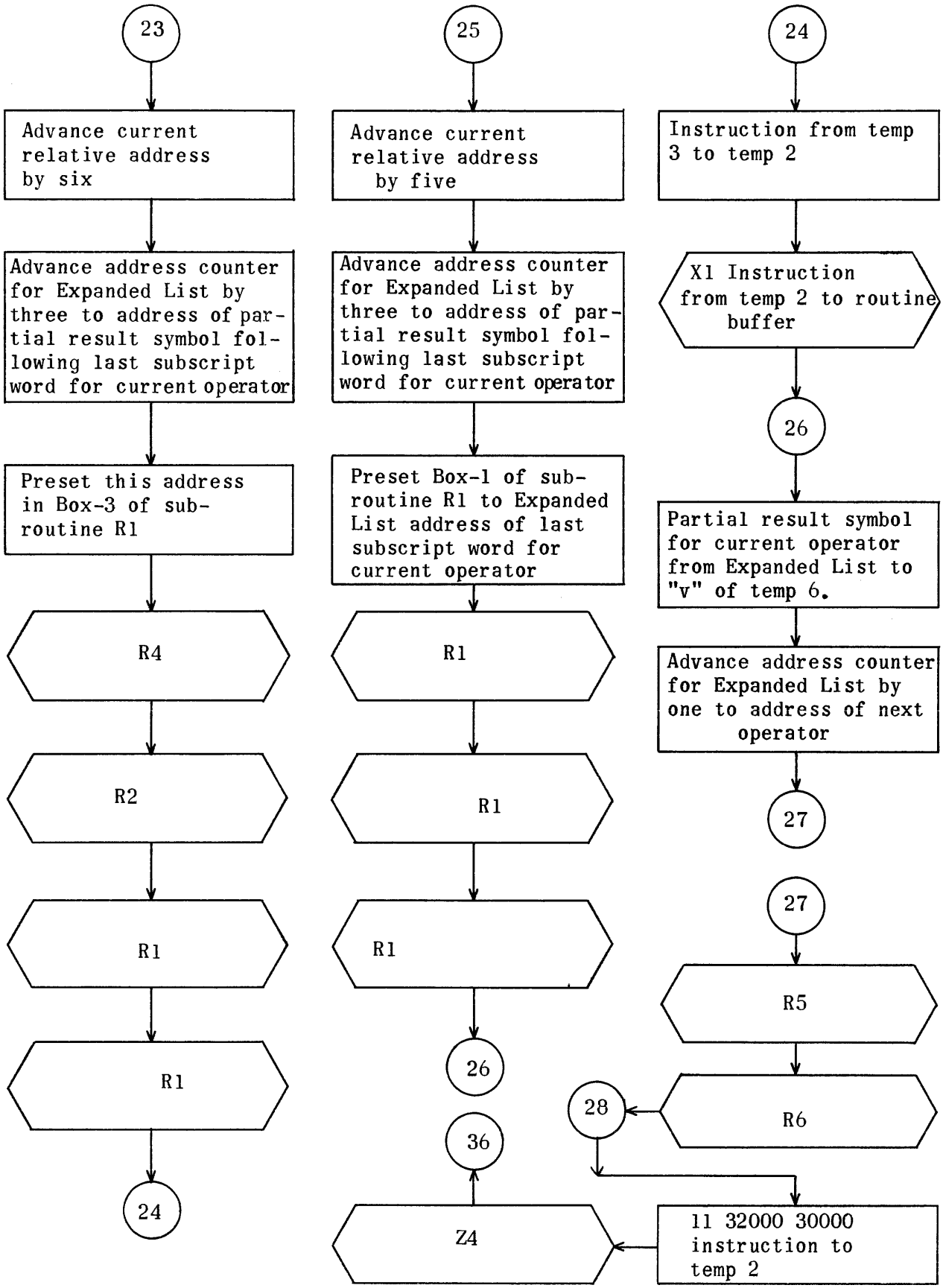

9
Transfer partial block of generated instructions from routine buffer to routine image on drum
Transfer relative constants for routine to routine image on drum following generated instructions
Number of lines of prelude and routine to first line of prelude in routine image on drum
Number of lines subject to address modification to second line of prelude in routine image on drum
10
10
Codeword from temp to third word of prelude in routine image on drum
Is routine for pseudo operation statement? (22--- callword)
NO
Is routine for separate equation? (24--- or 25---) callword
YES
YES
11
NO
11
Highest 70--- type callword used in routine +2 to exit line of routine to setup exit to second word beyond last temporary for routine
15
Send parameter to write generated routine from drum


12
Transfer relative constants for routine to routine buffer in core following generated instructions
Number of lines of prelude and routine to first line of prelude in routine buffer in core
Number of lines subject to address modification to second line of prelude in routine buffer in core
Codeword from temp to third word of prelude in routine buffer in core
13
13
Is routine for pseudo operation statement? (22---callword)
No
Is routine for separate equation? (24---or 25--- callword)
NO
14
YES
YES
14
Exit from equation generation phase
Highest 70--- type callword used in routine +2 to exit line of routine to setup exit to second word beyond last temporary for routine.
15
OP write generated routine and Op. File 1 item on tape
Exit
Send parameter to write generated routine from core
15

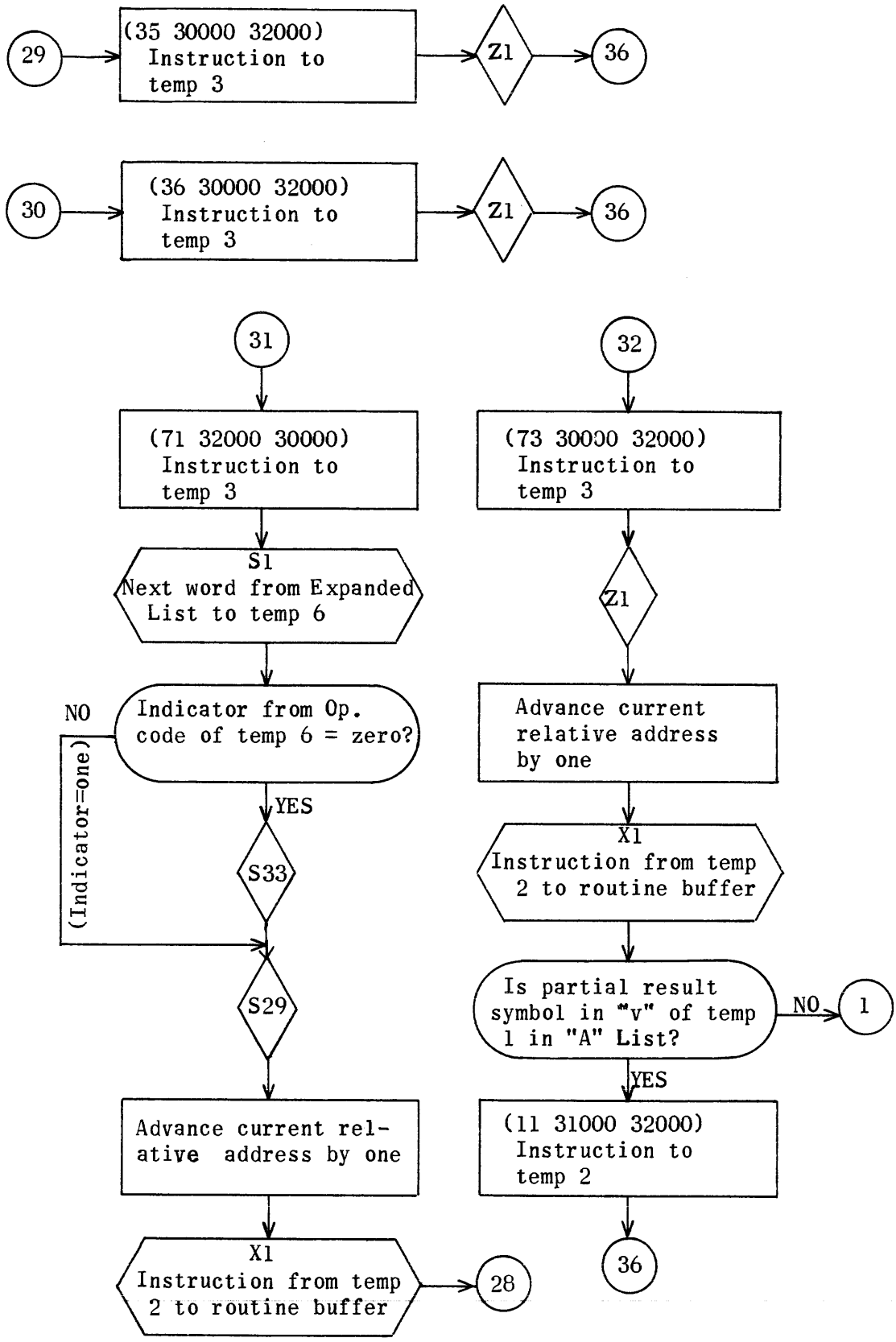
Equation Generation Phase (Subscript Manipulation Operator)

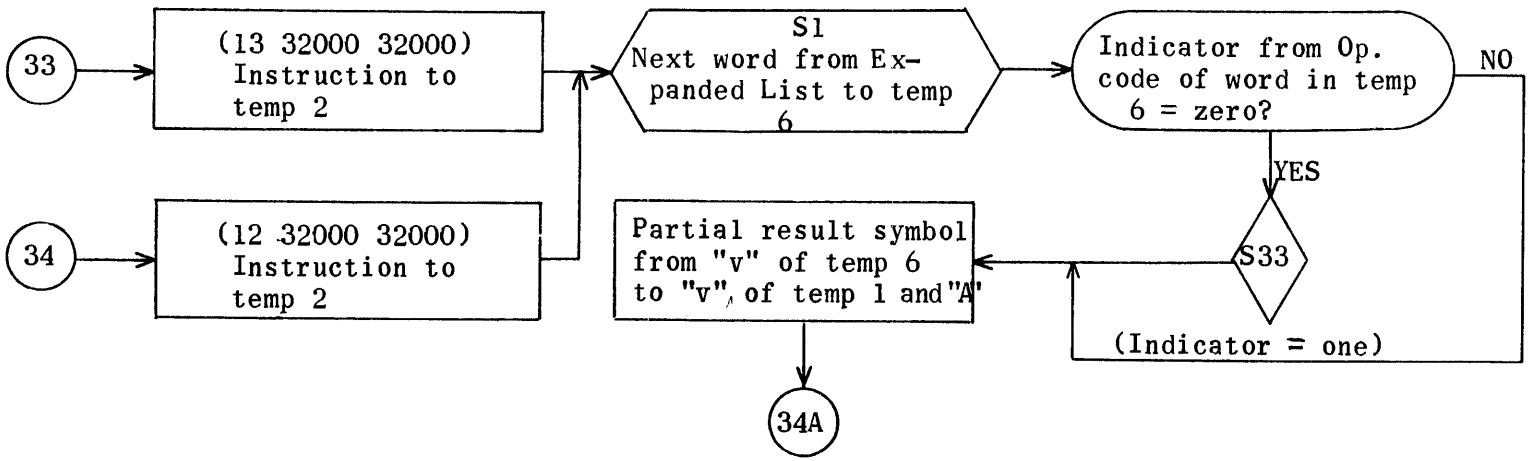


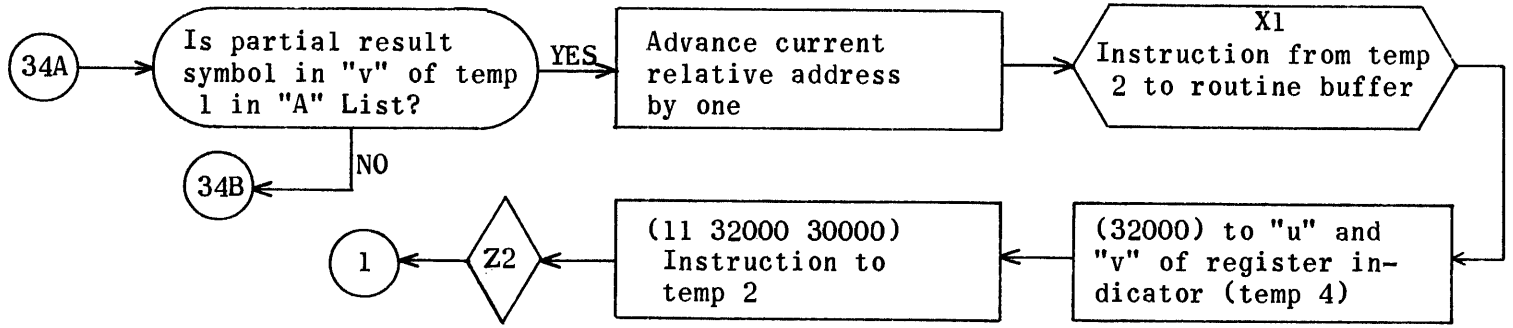

20
Advance current relative address by three
Preset Box-1 of Sub-routine R1 to Expanded List address of last sub-script word for current operator
Advance address counter for Expanded List by one to address of partial result following last subscript word for cur-rent operator.
26
21
Advance current relative address by five
Advance address counter for Expanded List by two to address of partial result following last subscript word for cur-rent operator
Preset this address in Box-1 of sub-routine R1
R4
R2
R1
24
22
Advance current relative address by four
Advance address counter for Expanded List by two to address of par-tial result following last subscript word for current operator
Preset Box-1 of sub-routine R1 to Expanded List address of last subscript word for cur-rent operator
R1
R1
26


23
Advance current relative address by six
Advance address counter for Expanded List by three to address of partial result symbol following last subscript word for current operator
Preset this address in Box-3 of subroutine R1
R4
R2
R1
R1
24
25
Advance current relative address by five
Advance address counter for Expanded List by three to address of partial result symbol following last subscript word for current operator
Preset Box-1 of subroutine R1 to Expanded List address of last subscript word for current operator
R1
R1
R1
26
36
Z4
24
Instruction from temp 3 to temp 2
X1 Instruction from temp 2 to routine buffer
26
Partial result symbol for current operator from Expanded List to "v" of temp 6.
Advance address counter for Expanded List by one to address of next operator
27
27
R5
28
R6
11 32000 30000 instruction to temp 2

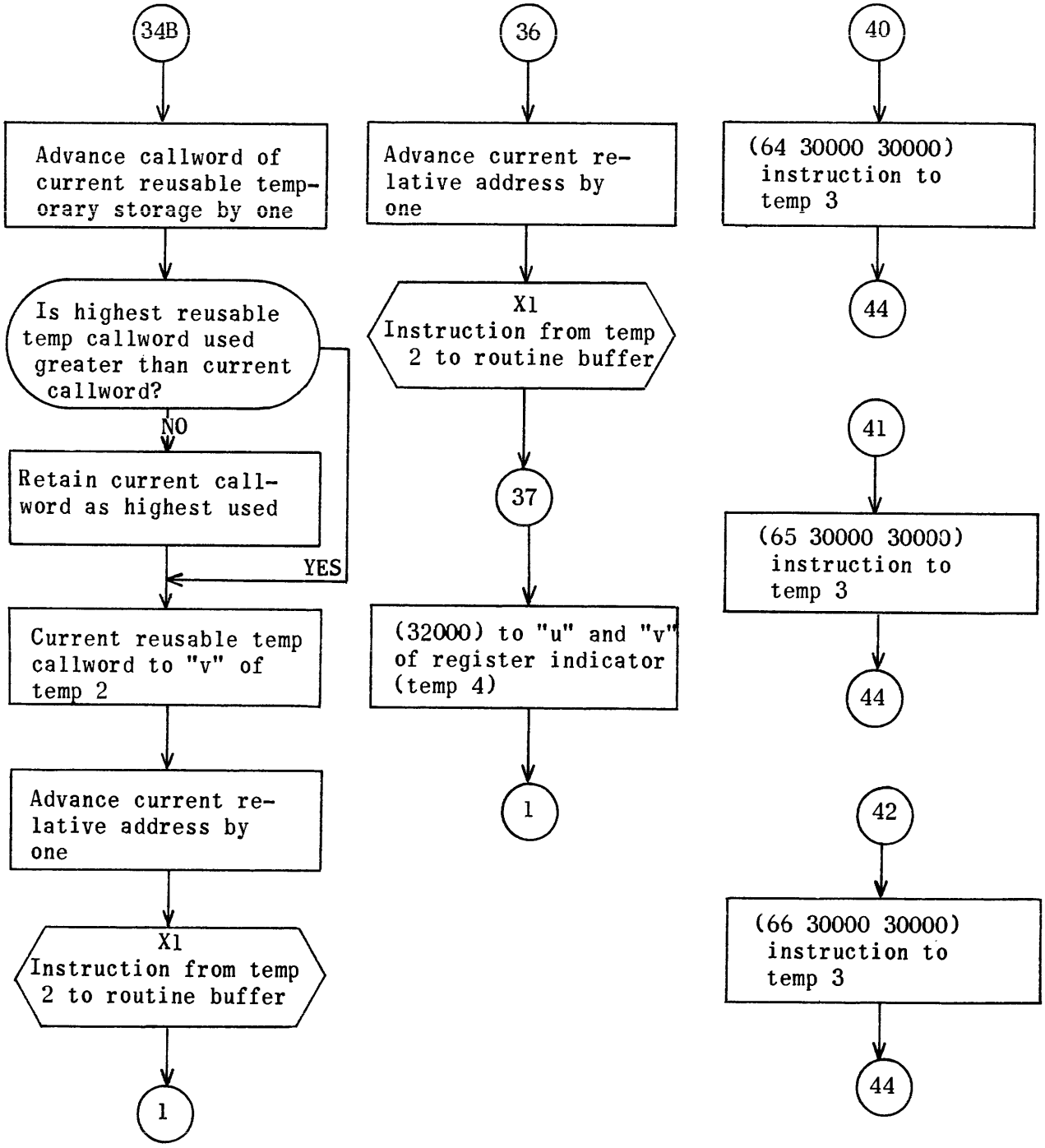
Equation Generation Phase (Fixed Point Operators)

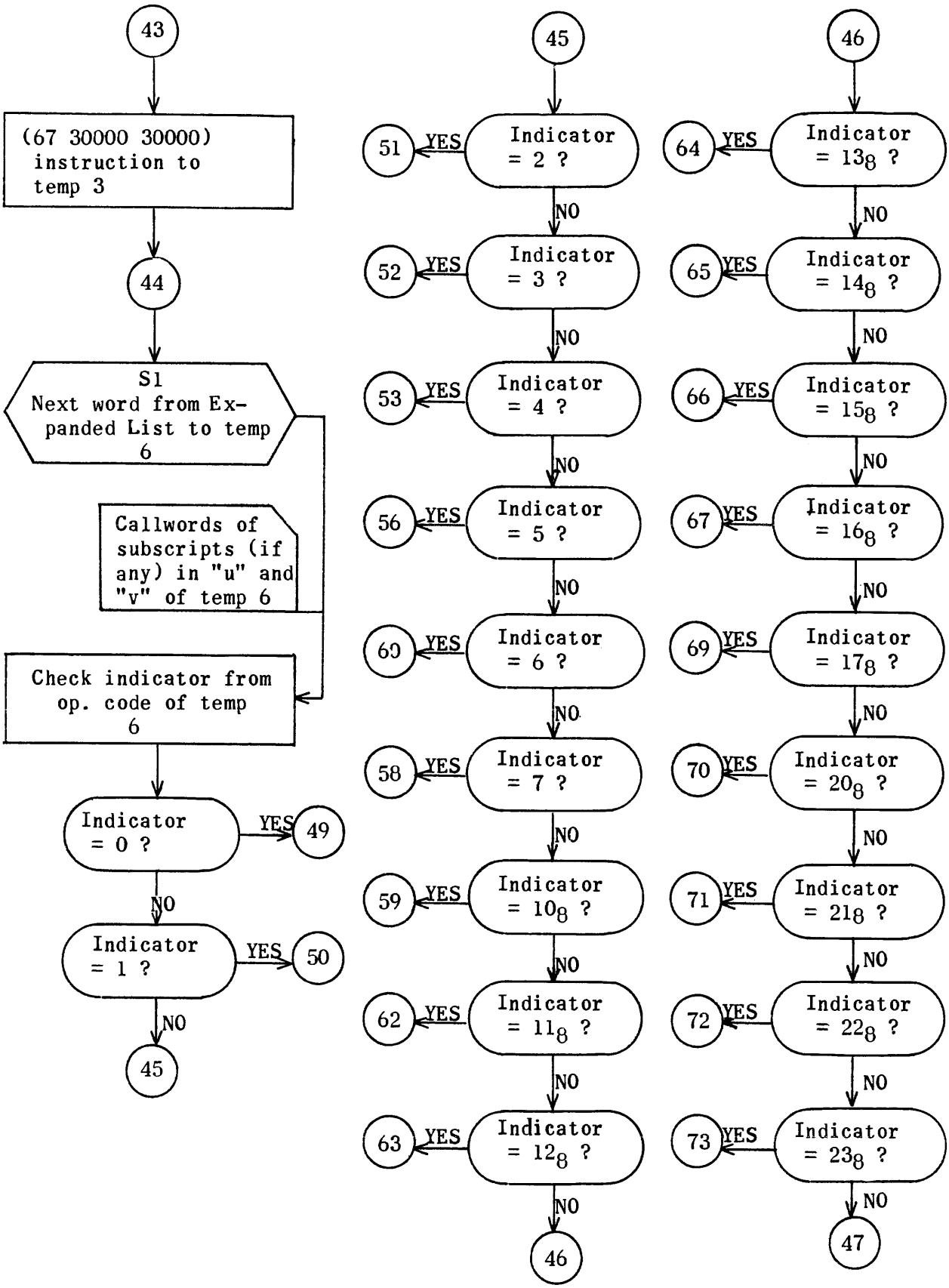


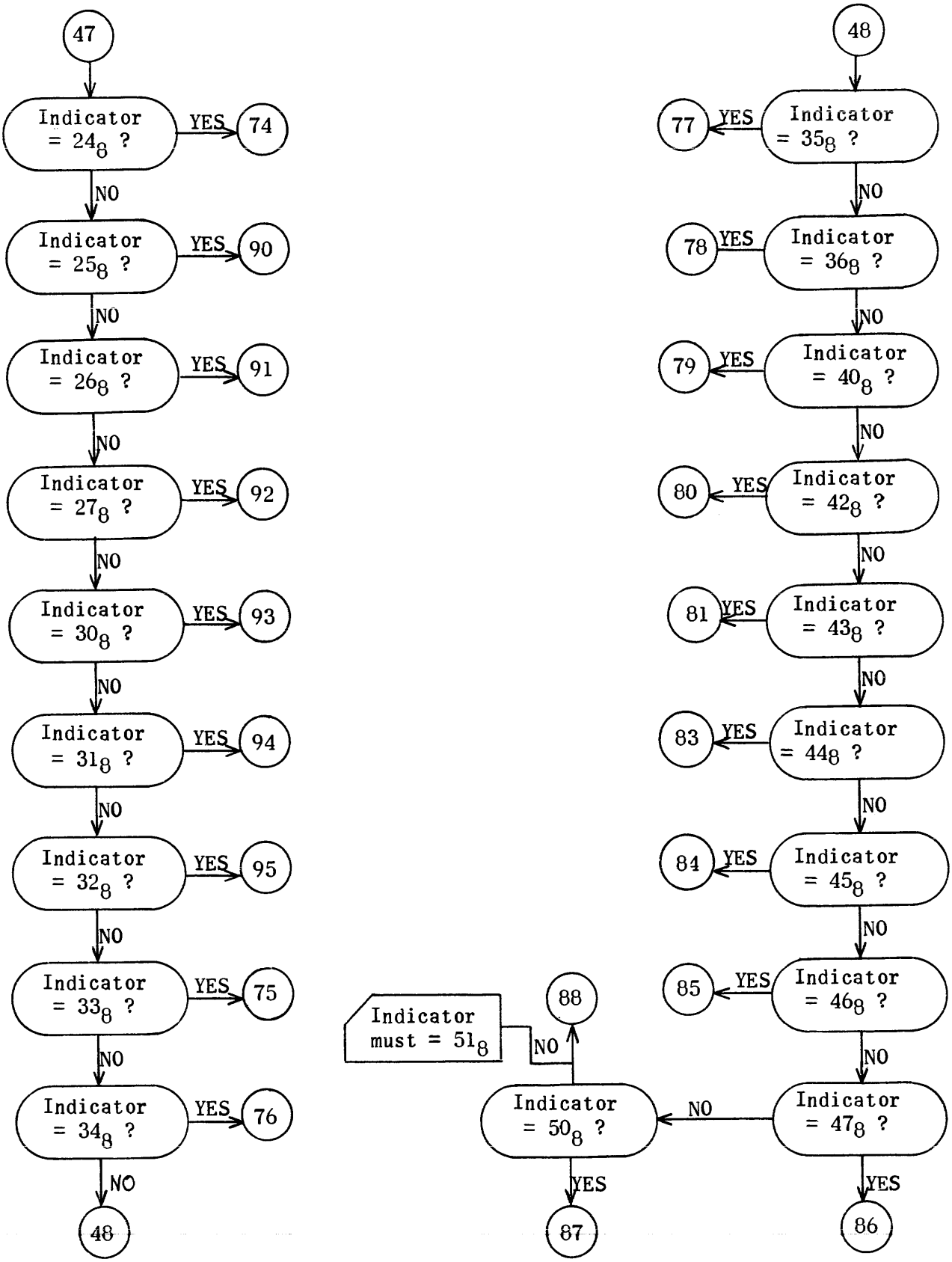

33
(13 32000 32000)
Instruction to
temp 2
34
(12 32000 32000)
Instruction to
temp 2
S1
Next word from Ex-
panded List to temp
6
Indicator from Op.
code of word in temp
6 = zero?
NO
YES
S33
(Indicator = one)
Partial result symbol
from "v" of temp 6
to "v" of temp 1 and "A"
34A

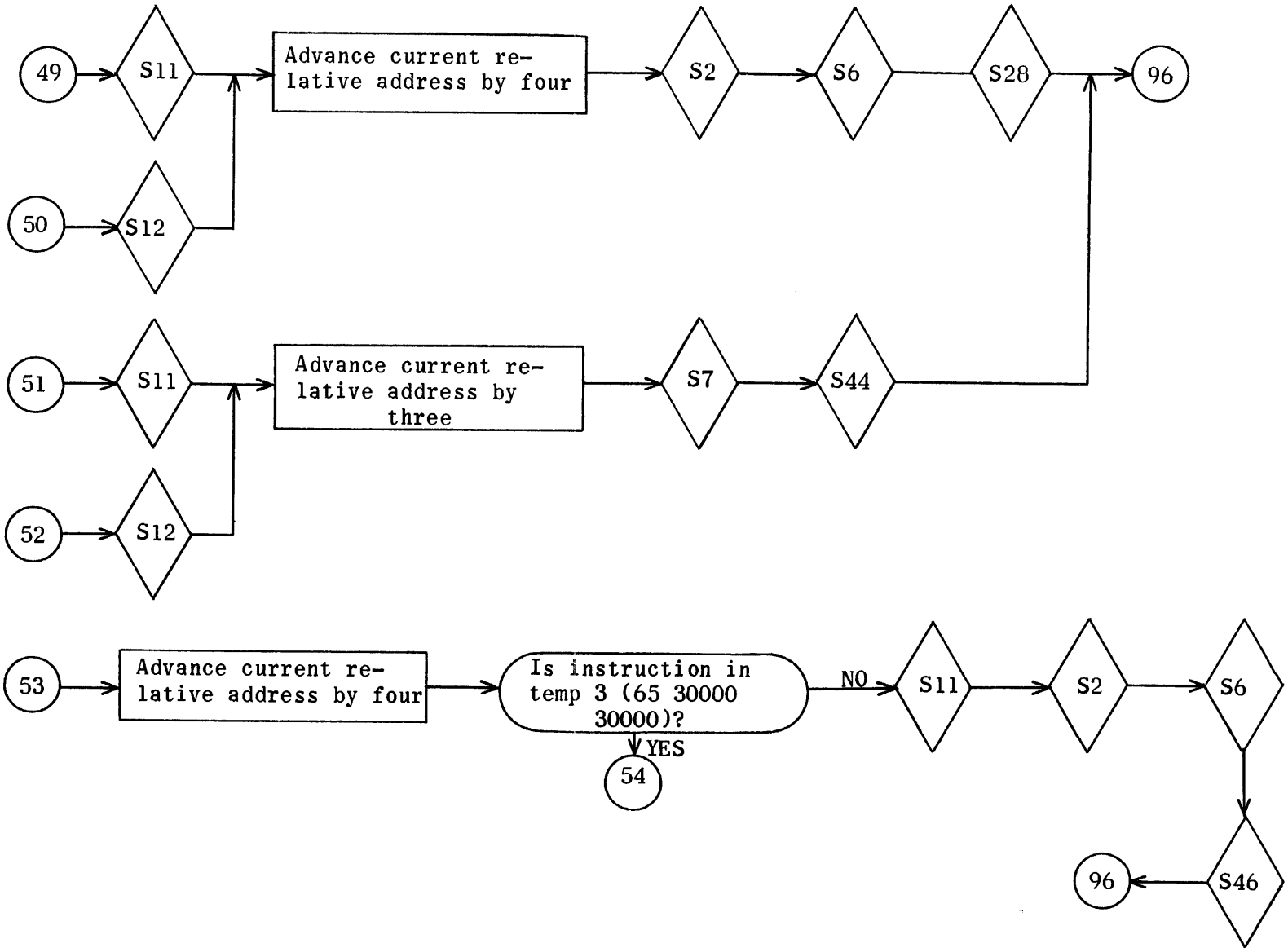

34A
Is partial result
symbol in "v" of temp
1 in "A" List?
YES
NO
34B
Advance current
relative address
by one
X1
Instruction from temp
2 to routine buffer
(32000) to "u" and
"v" of register in-
dicator (temp 4)
(11 32000 30000)
Instruction to
temp 2
Z2
1

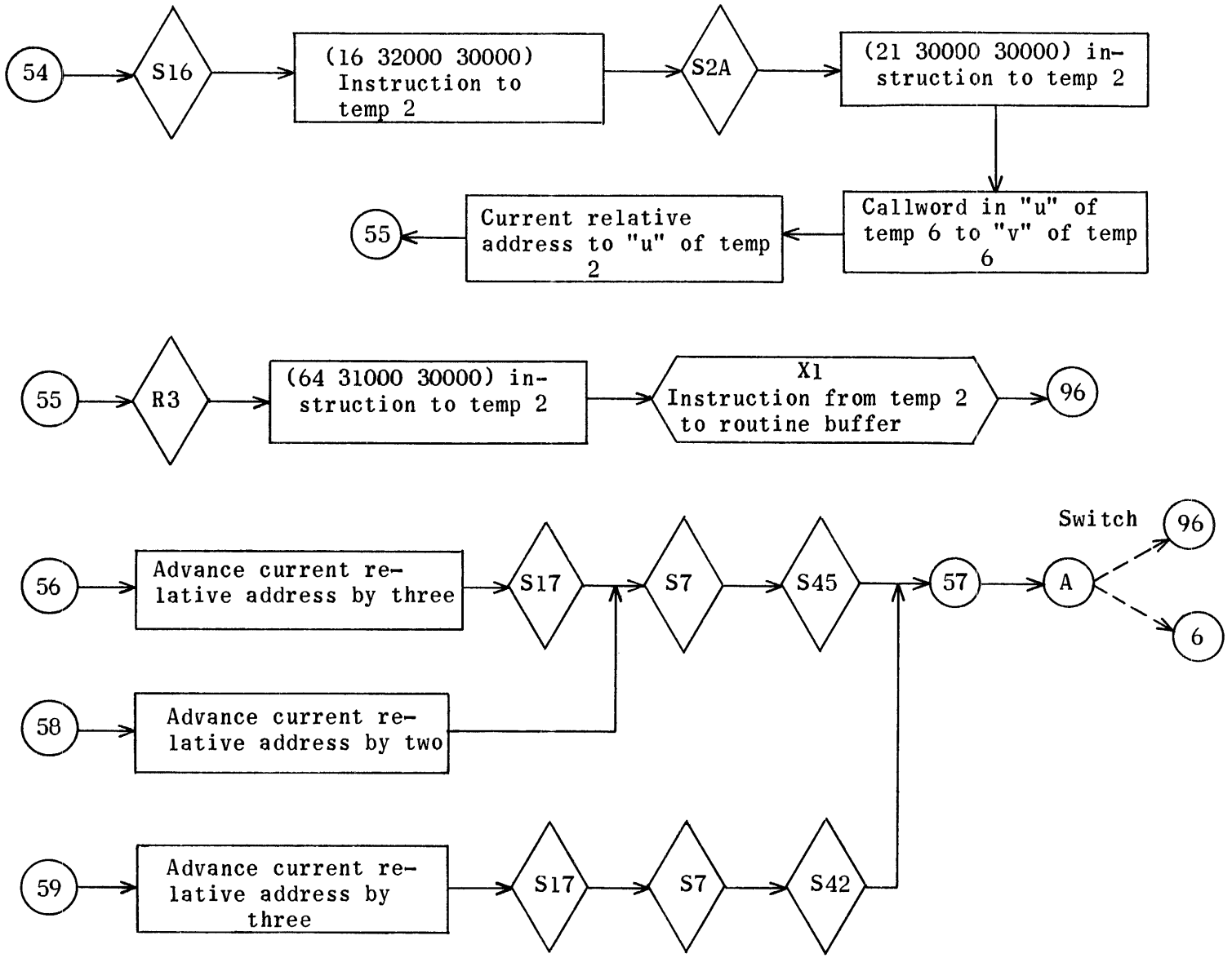
Equation Generation Phase (Fixed Point Operators and Floating Point Binary Operators)

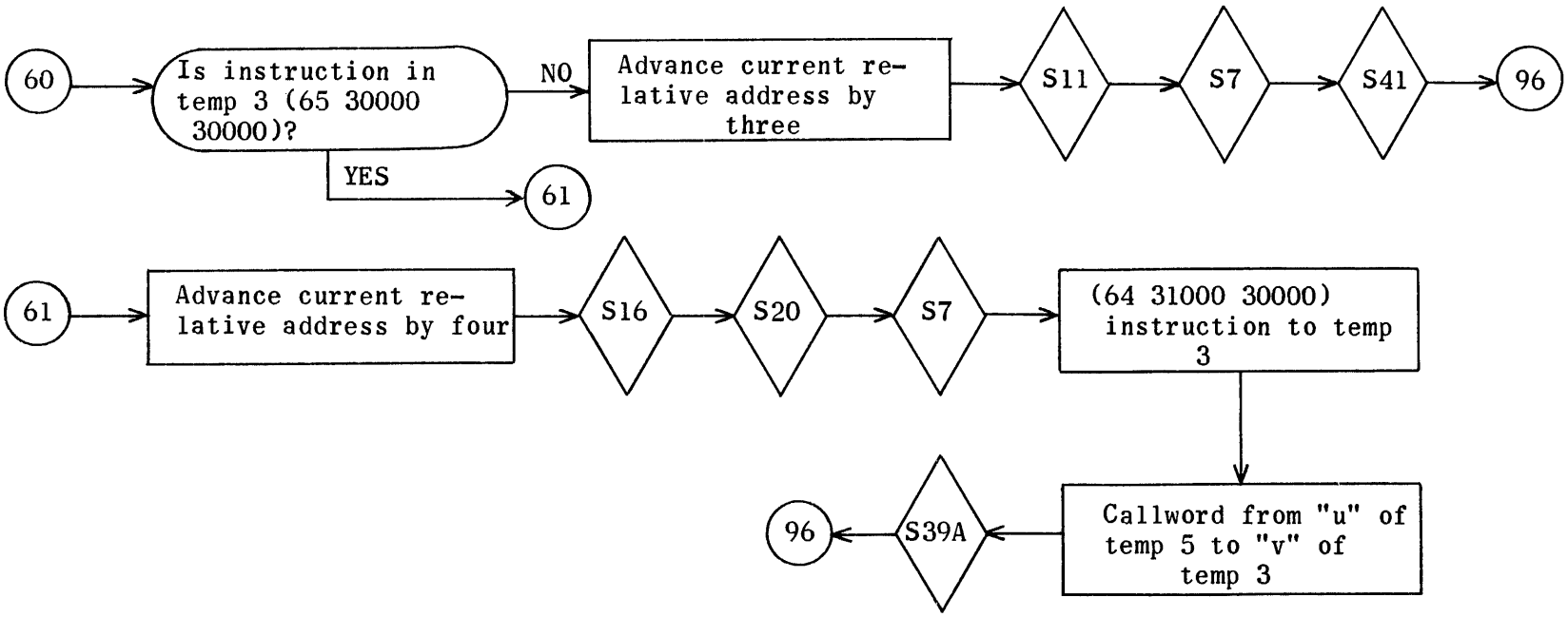


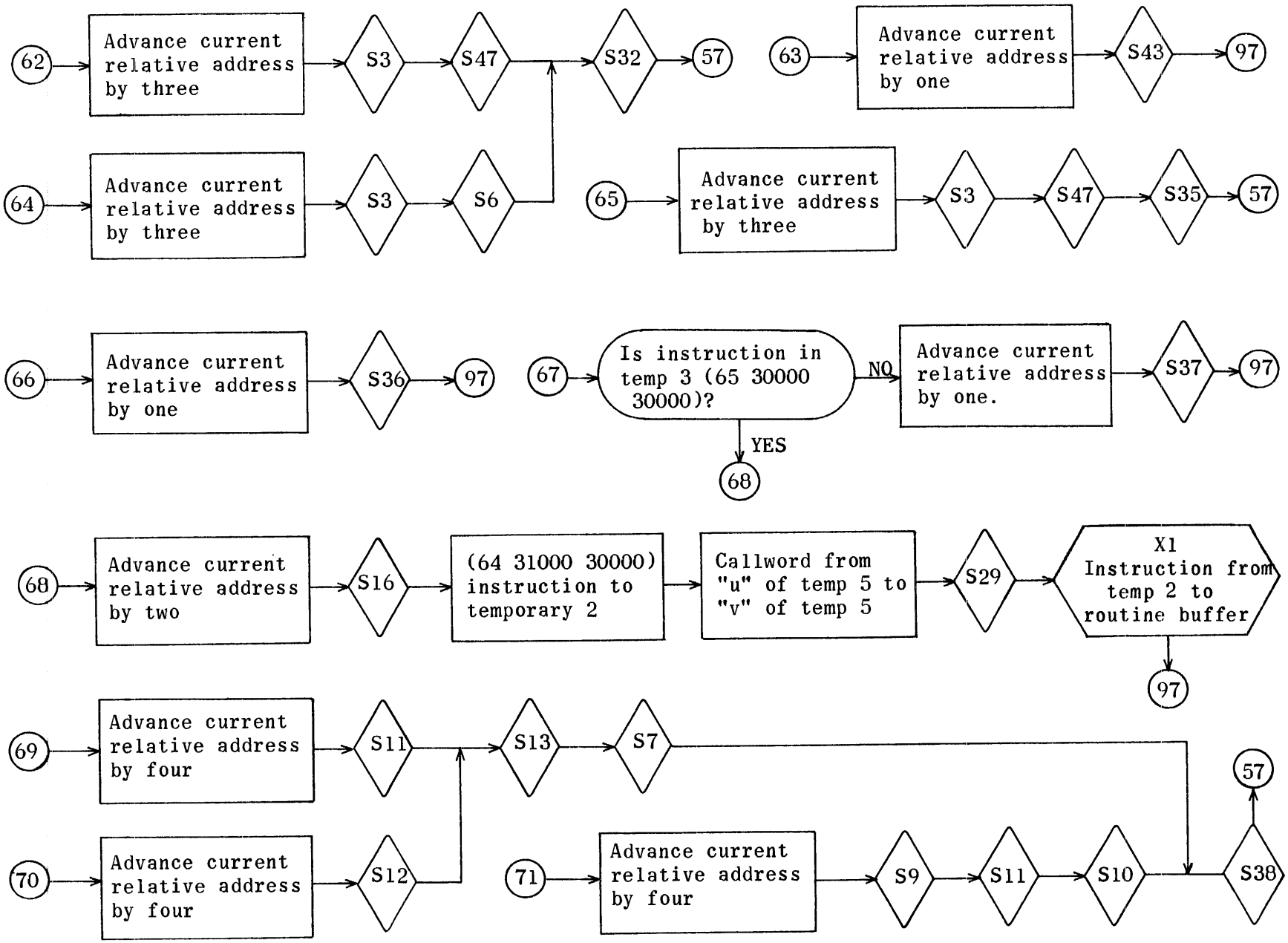

43
(67 30000 30000) instruction to temp 3
44
S1 Next word from Expanded List to temp 6
Callwords of subscripts (if any) in "u" and "v" of temp 6
Check indicator from op. code of temp 6
Indicator = 0 ?
YES
49
NO
Indicator = 1 ?
YES
50
NO
45
45
51
YES
Indicator = 2 ?
NO
52
YES
Indicator = 3 ?
NO
53
YES
Indicator = 4 ?
NO
56
YES
Indicator = 5 ?
NO
60
YES
Indicator = 6 ?
NO
58
YES
Indicator = 7 ?
NO
59
YES
Indicator = 10_8 ?
NO
62
YES
Indicator = 11_8 ?
NO
63
YES
Indicator = 12_8 ?
NO
46
46
64
YES
Indicator = 13_8 ?
NO
65
YES
Indicator = 14_8 ?
NO
66
YES
Indicator = 15_8 ?
NO
67
YES
Indicator = 16_8 ?
NO
69
YES
Indicator = 17_8 ?
NO
70
YES
Indicator = 20_8 ?
NO
71
YES
Indicator = 21_8 ?
NO
72
YES
Indicator = 22_8 ?
NO
73
YES
Indicator = 23_8 ?
NO
47

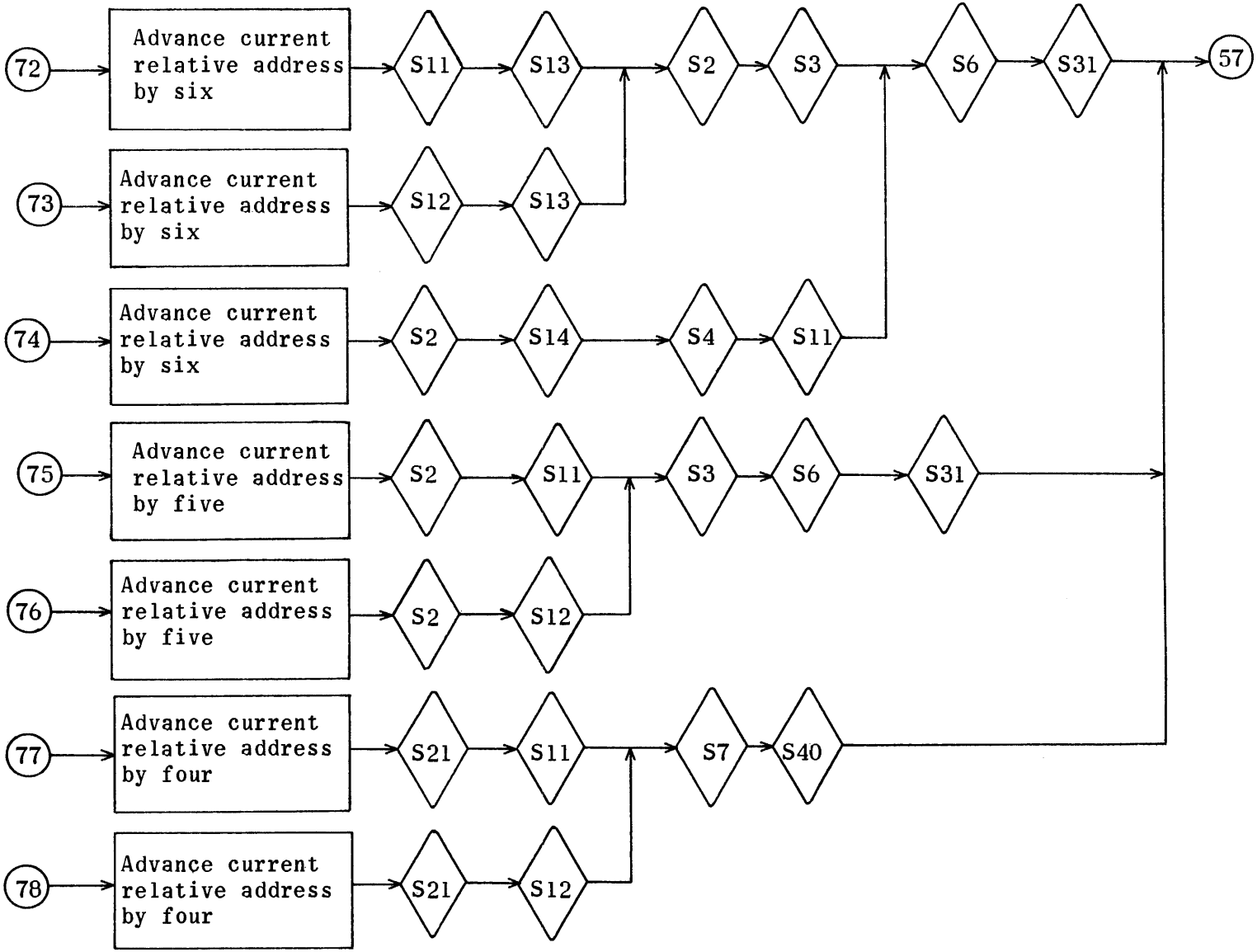

47
Indicator = 24_8 ?
YES
74
NO
Indicator = 25_8 ?
YES
90
NO
Indicator = 26_8 ?
YES
91
NO
Indicator = 27_8 ?
YES
92
NO
Indicator = 30_8 ?
YES
93
NO
Indicator = 31_8 ?
YES
94
NO
Indicator = 32_8 ?
YES
95
NO
Indicator = 33_8 ?
YES
75
NO
Indicator = 34_8 ?
YES
76
NO
48
48
77
YES
Indicator = 35_8 ?
NO
78
YES
Indicator = 36_8 ?
NO
79
YES
Indicator = 40_8 ?
NO
80
YES
Indicator = 42_8 ?
NO
81
YES
Indicator = 43_8 ?
NO
83
YES
Indicator = 44_8 ?
NO
84
YES
Indicator = 45_8 ?
NO
85
YES
Indicator = 46_8 ?
NO
Indicator = 47_8 ?
YES
86
NO
Indicator = 50_8 ?
YES
87
88
Indicator must = 51_8
NO

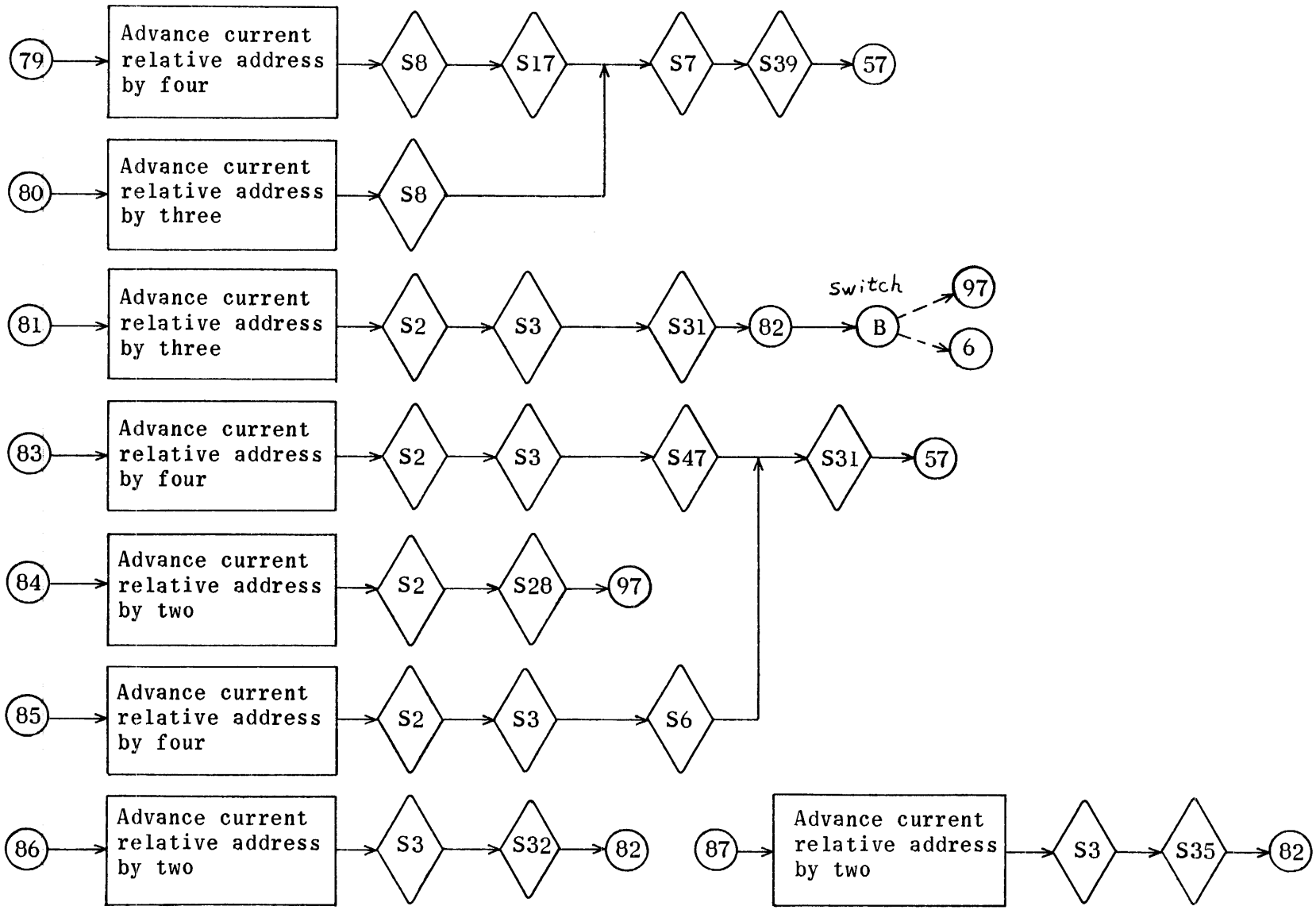

49
S11
Advance current relative address by four
S2
S6
S28
96
50
S12
51
S11
Advance current relative address by three
S7
S44
52
S12
53
Advance current relative address by four
Is instruction in temp 3 (65 30000 30000)?
NO
S11
S2
S6
YES
54
96
S46

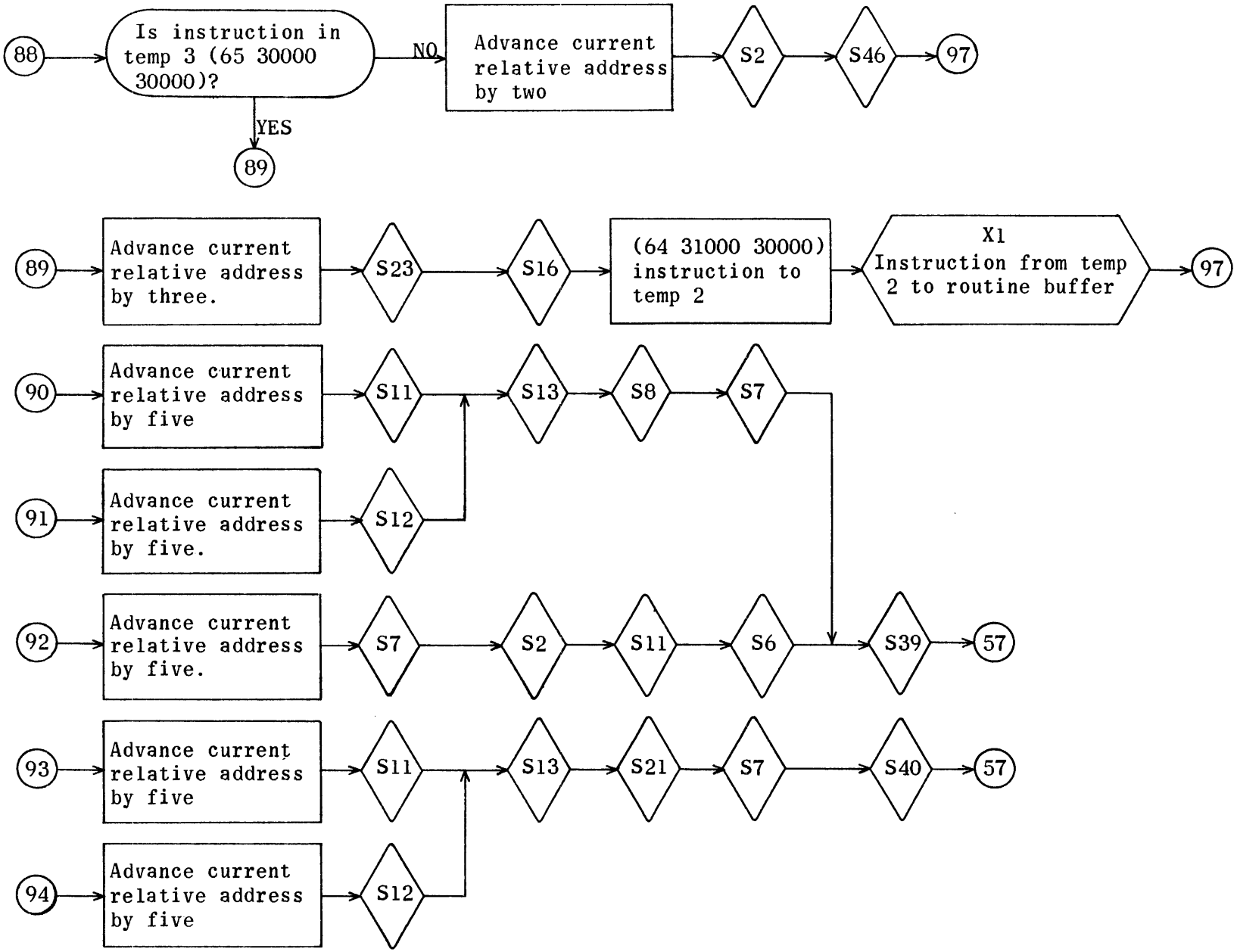

54
S16
(16 32000 30000) Instruction to temp 2
S2A
(21 30000 30000) instruction to temp 2
Callword in "u" of temp 6 to "v" of temp 6
Current relative address to "u" of temp 2
55
55
R3
(64 31000 30000) instruction to temp 2
X1 Instruction from temp 2 to routine buffer
96
56
Advance current relative address by three
S17
S7
S45
57
A
Switch
96
6
58
Advance current relative address by two
59
Advance current relative address by three
S17
S7
S42

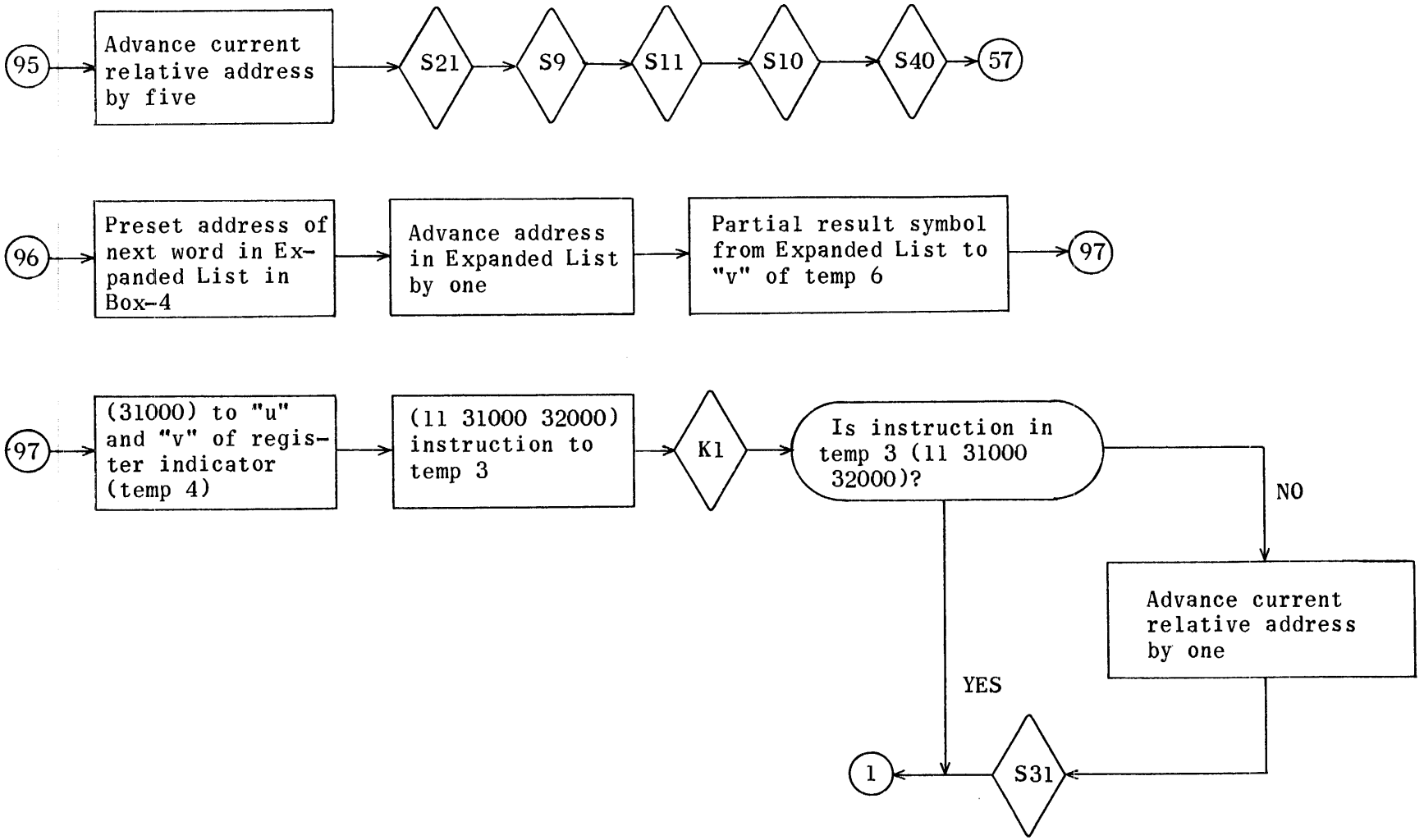

60
Is instruction in temp 3 (65 30000 30000)?
NO
Advance current relative address by three
S11
S7
S41
96
YES
61
61
Advance current relative address by four
S16
S20
S7
(64 31000 30000) instruction to temp 3
Callword from "u" of temp 5 to "v" of temp 3
S39A
96


62
Advance current relative address by three
S3
S47
S32
57
63
Advance current relative address by one
S43
97
64
Advance current relative address by three
S3
S6
65
Advance current relative address by three
S3
S47
S35
57
66
Advance current relative address by one
S36
97
67
Is instruction in temp 3 (65 30000 30000)?
NO
Advance current relative address by one.
S37
97
YES
68
68
Advance current relative address by two
S16
(64 31000 30000) instruction to temporary 2
Callword from "u" of temp 5 to "v" of temp 5
S29
X1 Instruction from temp 2 to routine buffer
97
69
Advance current relative address by four
S11
S13
S7
57
70
Advance current relative address by four
S12
71
Advance current relative address by four
S9
S11
S10
S38

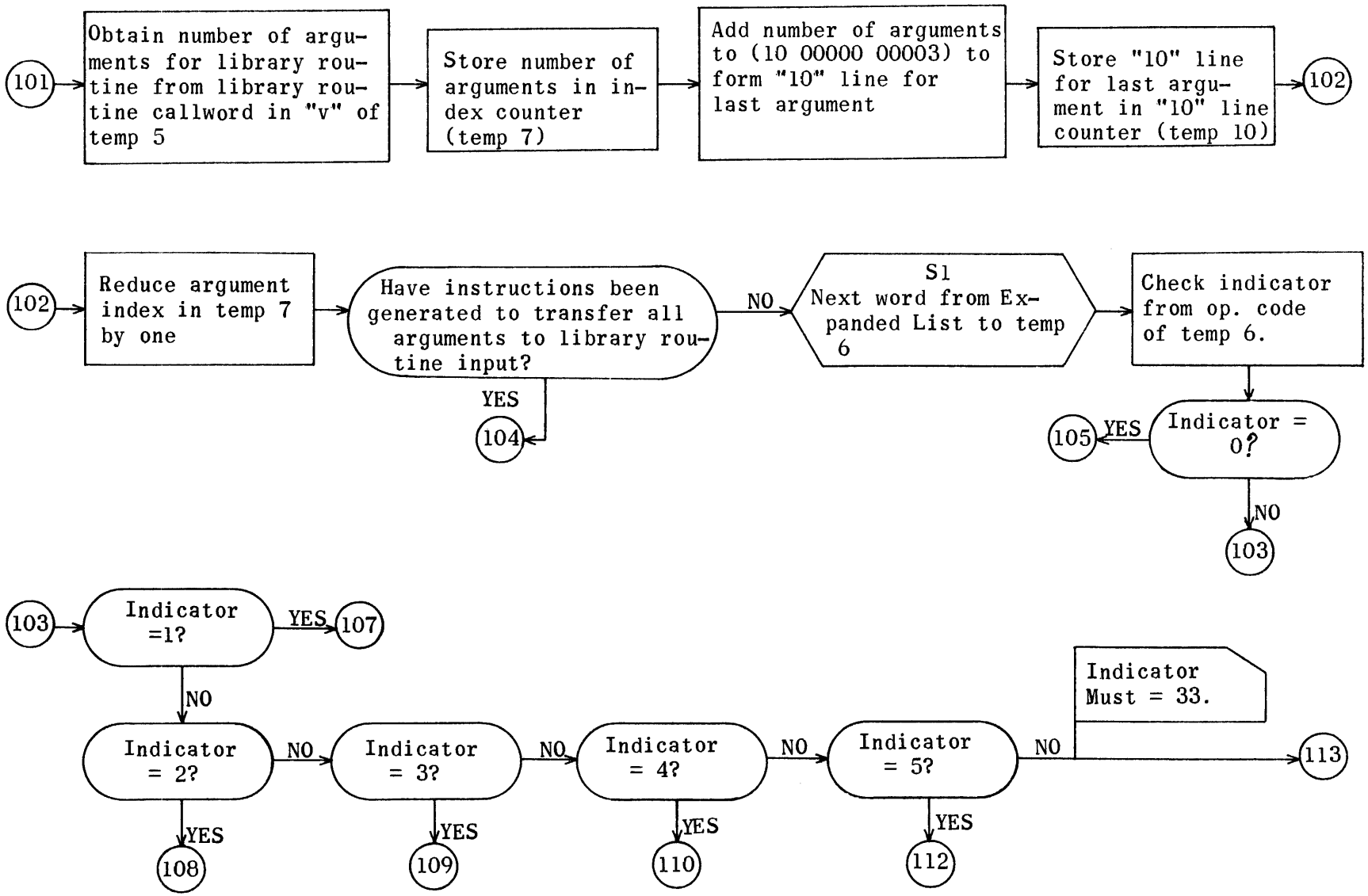

72
Advance current relative address by six
S11
S13
S2
S3
S6
S31
57
73
Advance current relative address by six
S12
S13
74
Advance current relative address by six
S2
S14
S4
S11
75
Advance current relative address by five
S2
S11
S3
S6
S31
76
Advance current relative address by five
S2
S12
77
Advance current relative address by four
S21
S11
S7
S40
78
Advance current relative address by four
S21
S12

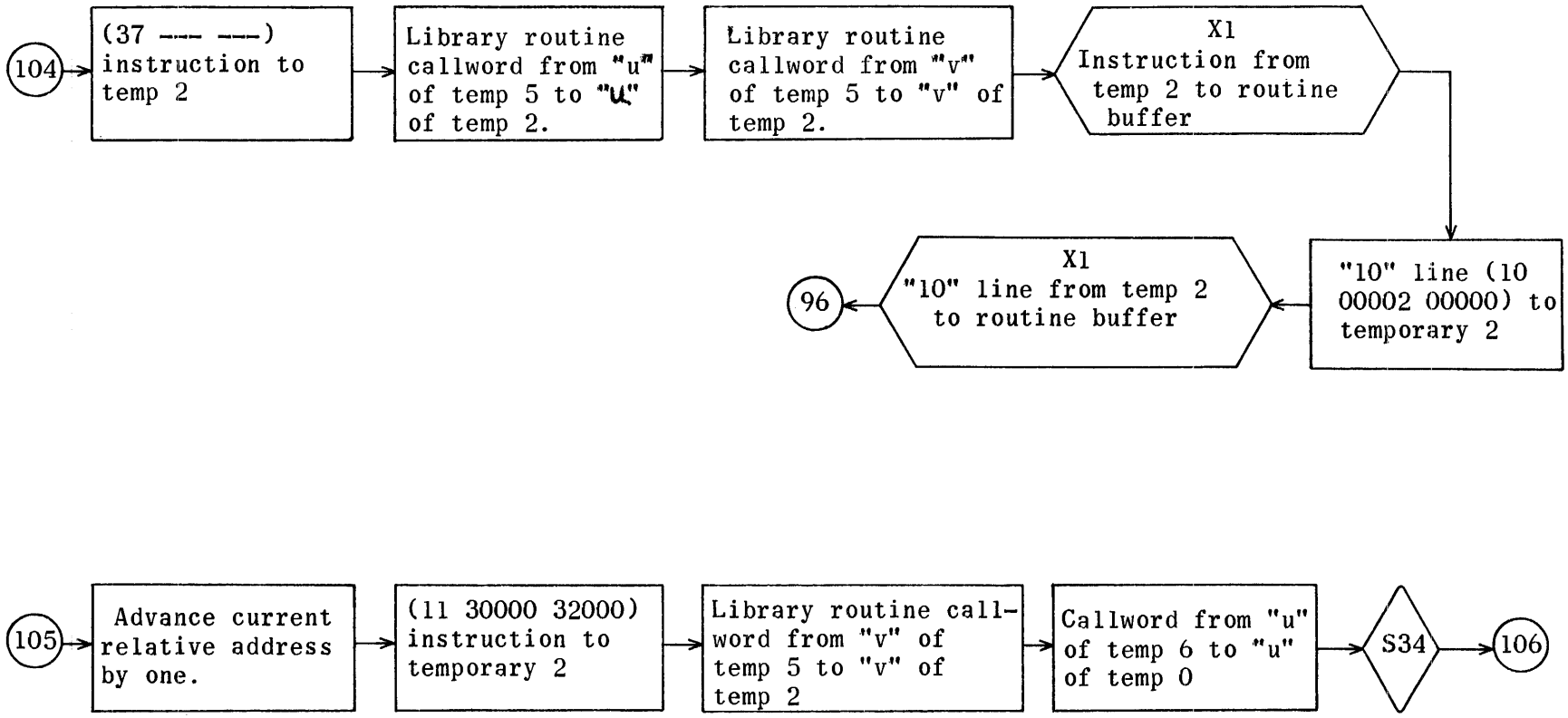

79
Advance current relative address by four
S8
S17
S7
S39
57
80
Advance current relative address by three
S8
81
Advance current relative address by three
S2
S3
S31
82
switch
B
97
6
83
Advance current relative address by four
S2
S3
S47
S31
57
84
Advance current relative address by two
S2
S28
97
85
Advance current relative address by four
S2
S3
S6
86
Advance current relative address by two
S3
S32
82
87
Advance current relative address by two
S3
S35
82

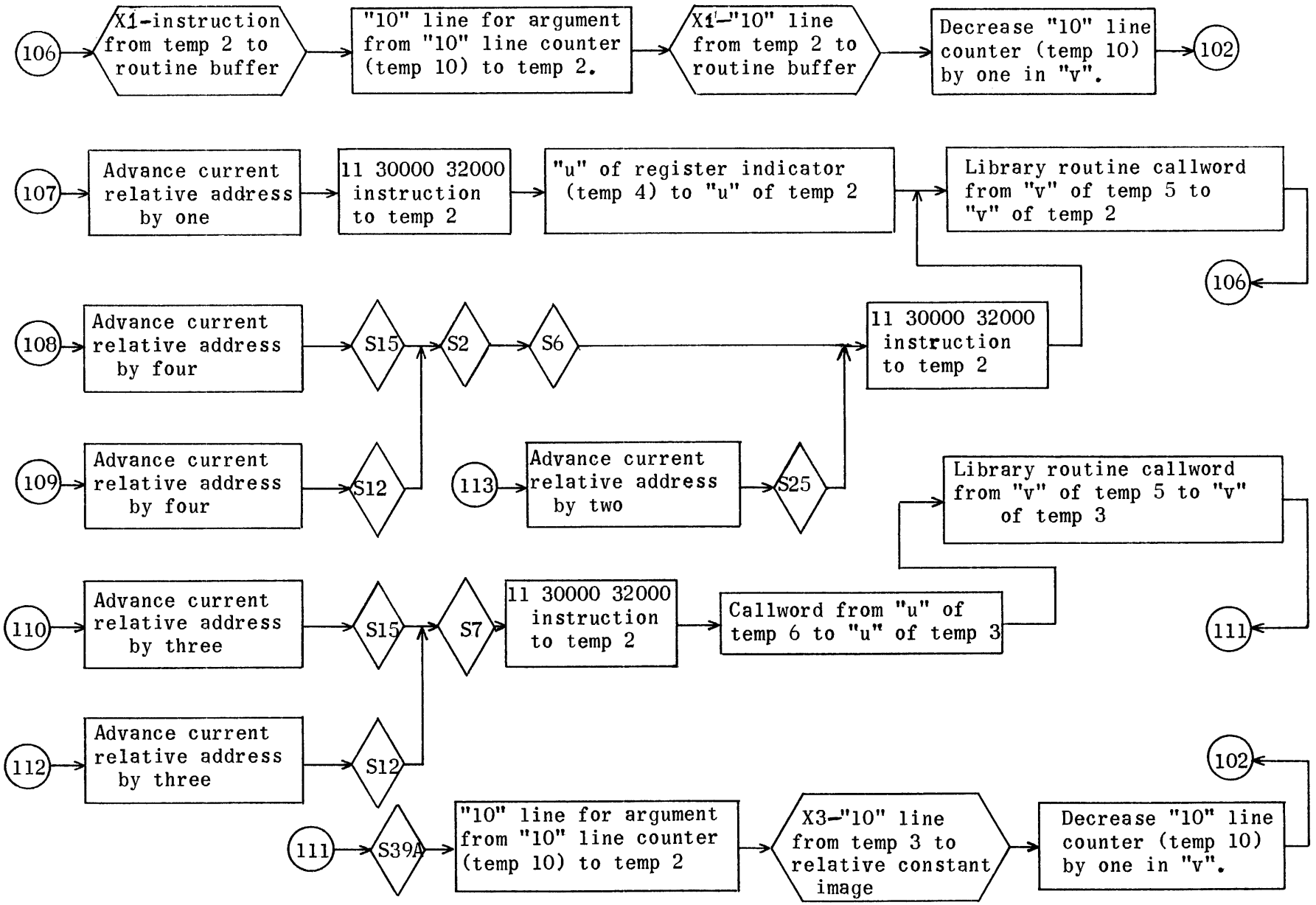

88
Is instruction in temp 3 (65 30000 30000)?
NO
Advance current relative address by two
S2
S46
97
YES
89
89
Advance current relative address by three.
S23
S16
(64 31000 30000) instruction to temp 2
X1
Instruction from temp 2 to routine buffer
97
90
Advance current relative address by five
S11
S13
S8
S7
91
Advance current relative address by five.
S12
92
Advance current relative address by five.
S7
S2
S11
S6
S39
57
93
Advance current relative address by five
S11
S13
S21
S7
S40
57
94
Advance current relative address by five
S12


95
Advance current relative address by five
S21
S9
S11
S10
S40
57
96
Preset address of next word in Expanded List in Box-4
Advance address in Expanded List by one
Partial result symbol from Expanded List to "v" of temp 6
97
97
(31000) to "u" and "v" of register indicator (temp 4)
(11 31000 32000) instruction to temp 3
K1
Is instruction in temp 3 (11 31000 32000)?
NO
Advance current relative address by one
YES
1
S31

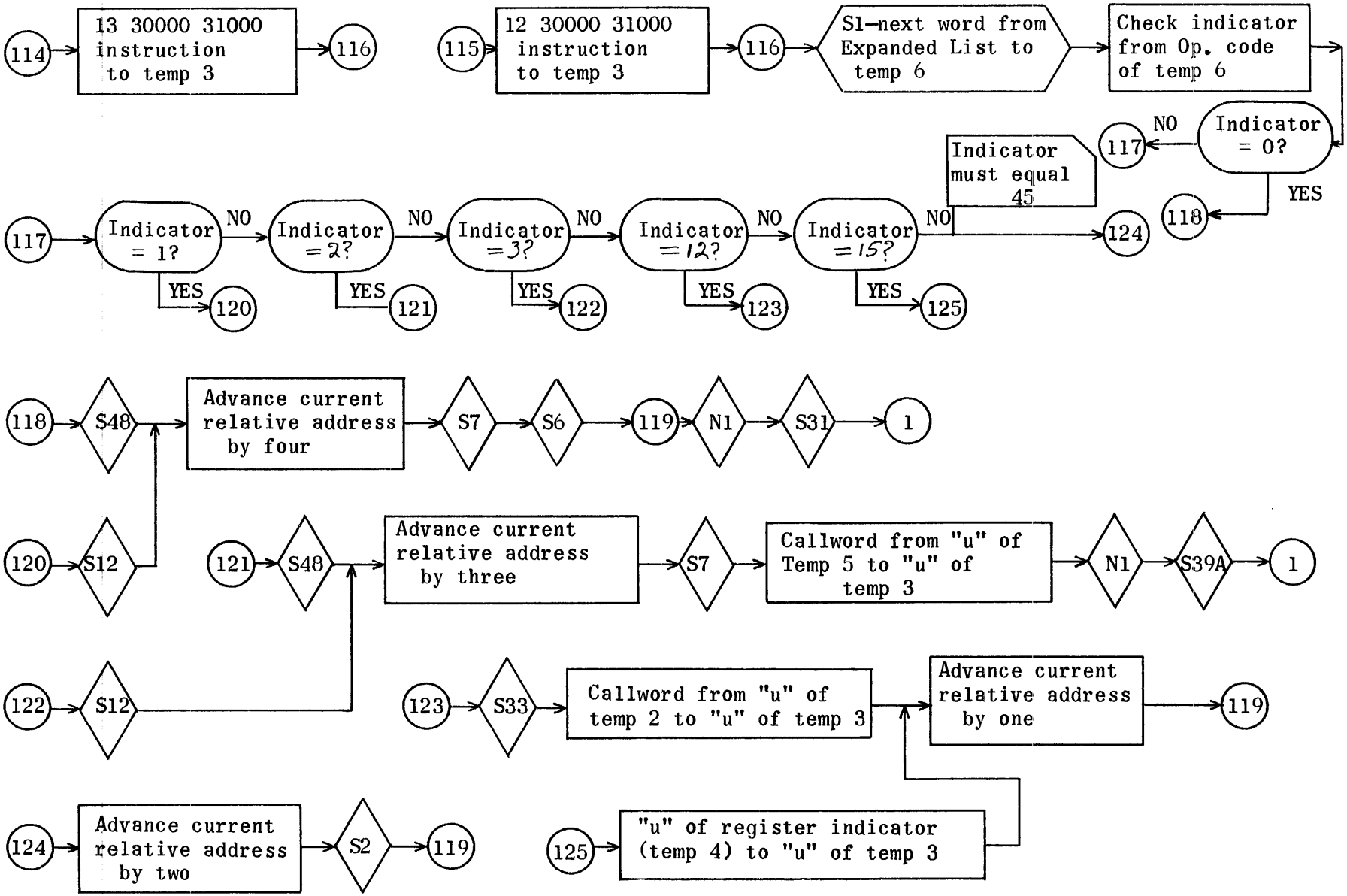
Equation Generation Phase (Library Routine Operator)



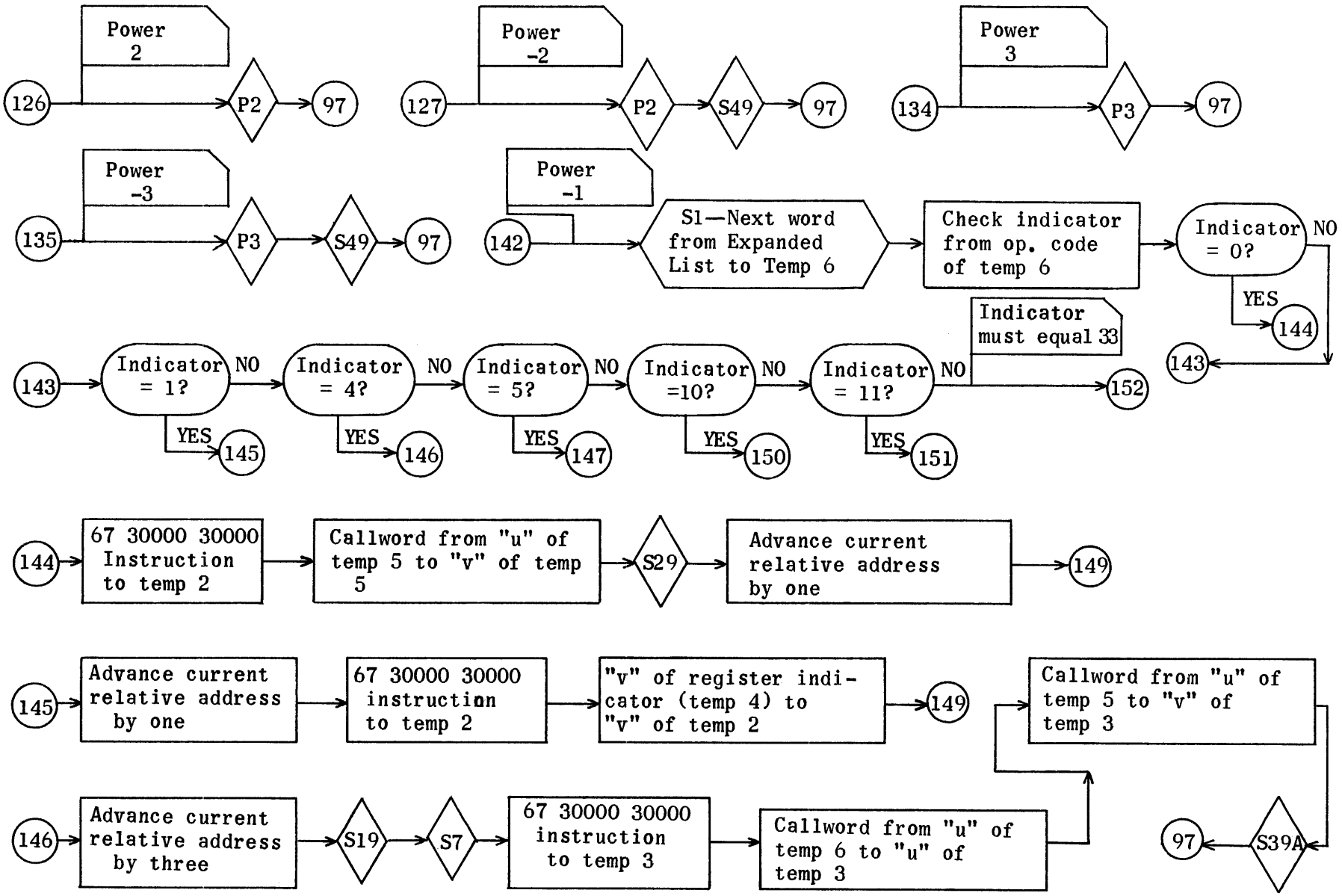

104
(37 --- ---) instruction to temp 2
Library routine callword from "u" of temp 5 to "u" of temp 2.
Library routine callword from "v" of temp 5 to "v" of temp 2.
X1 Instruction from temp 2 to routine buffer
"10" line (10 00002 00000) to temporary 2
X1 "10" line from temp 2 to routine buffer
96
105
Advance current relative address by one.
(11 30000 32000) instruction to temporary 2
Library routine callword from "v" of temp 5 to "v" of temp 2
Callword from "u" of temp 6 to "u" of temp 0
S34
106

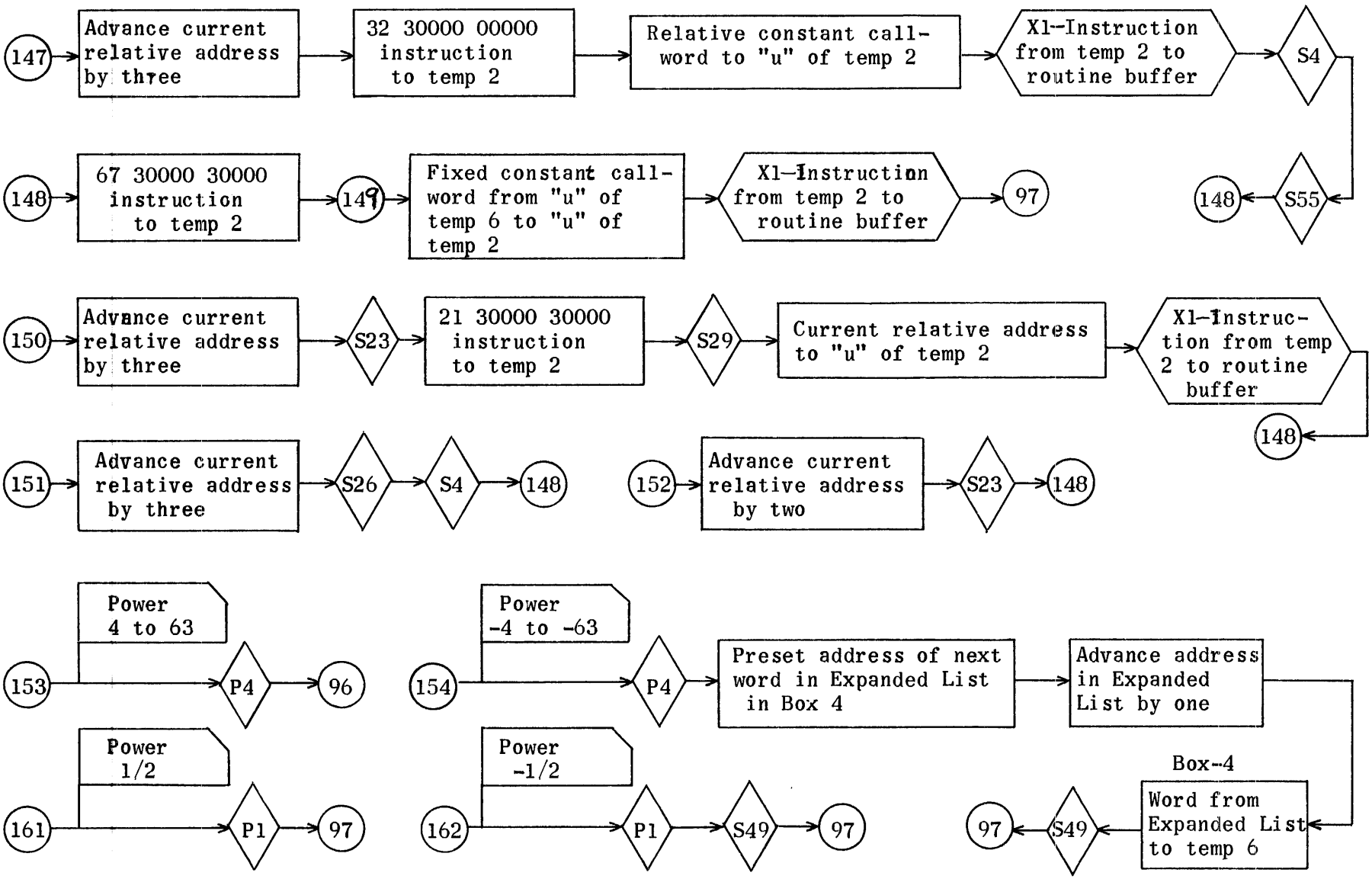

106
X1-instruction from temp 2 to routine buffer
"10" line for argument from "10" line counter (temp 10) to temp 2.
X1'-"10" line from temp 2 to routine buffer
Decrease "10" line counter (temp 10) by one in "v".
102
107
Advance current relative address by one
11 30000 32000 instruction to temp 2
"u" of register indicator (temp 4) to "u" of temp 2
Library routine callword from "v" of temp 5 to "v" of temp 2
106
108
Advance current relative address by four
S15
S2
S6
11 30000 32000 instruction to temp 2
109
Advance current relative address by four
S12
113
Advance current relative address by two
S25
Library routine callword from "v" of temp 5 to "v" of temp 3
110
Advance current relative address by three
S15
S7
11 30000 32000 instruction to temp 2
Callword from "u" of temp 6 to "u" of temp 3
111
112
Advance current relative address by three
S12
102
111
S39A
"10" line for argument from "10" line counter (temp 10) to temp 2
X3-"10" line from temp 3 to relative constant image
Decrease "10" line counter (temp 10) by one in "v".

Equation Generation Phase (Floating Point Unary Minus and Absolute Value Operators)

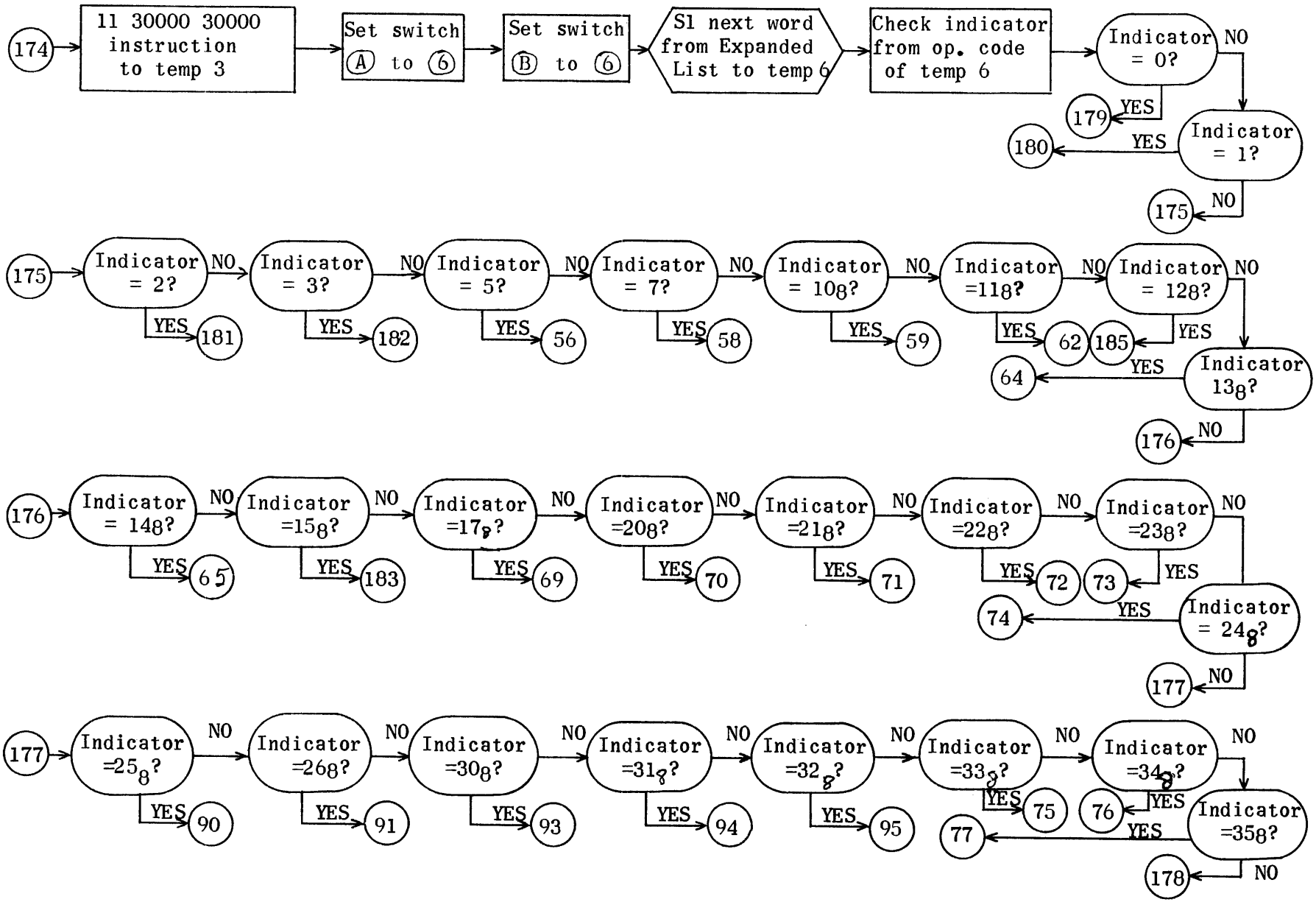


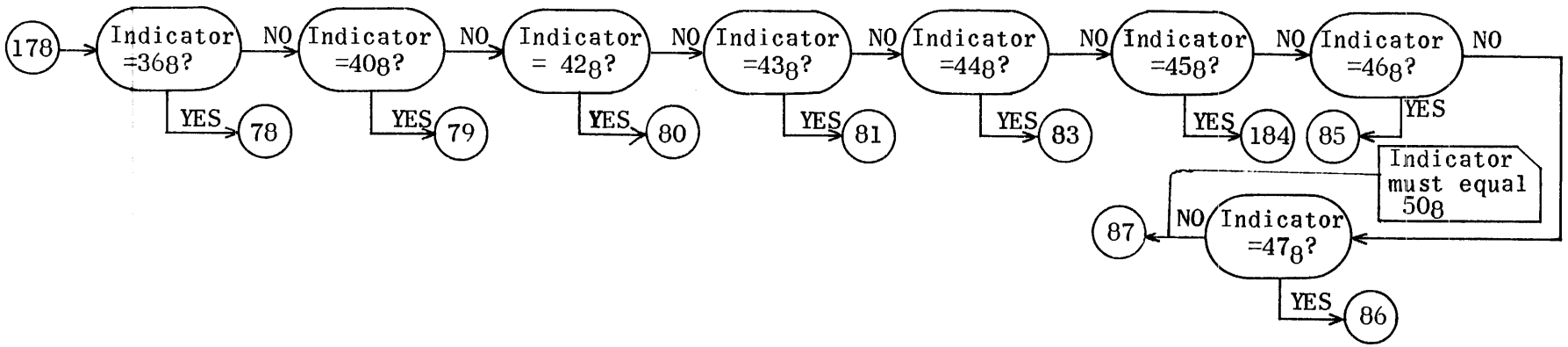
Equation Generation Phase (Integral Power Operators)

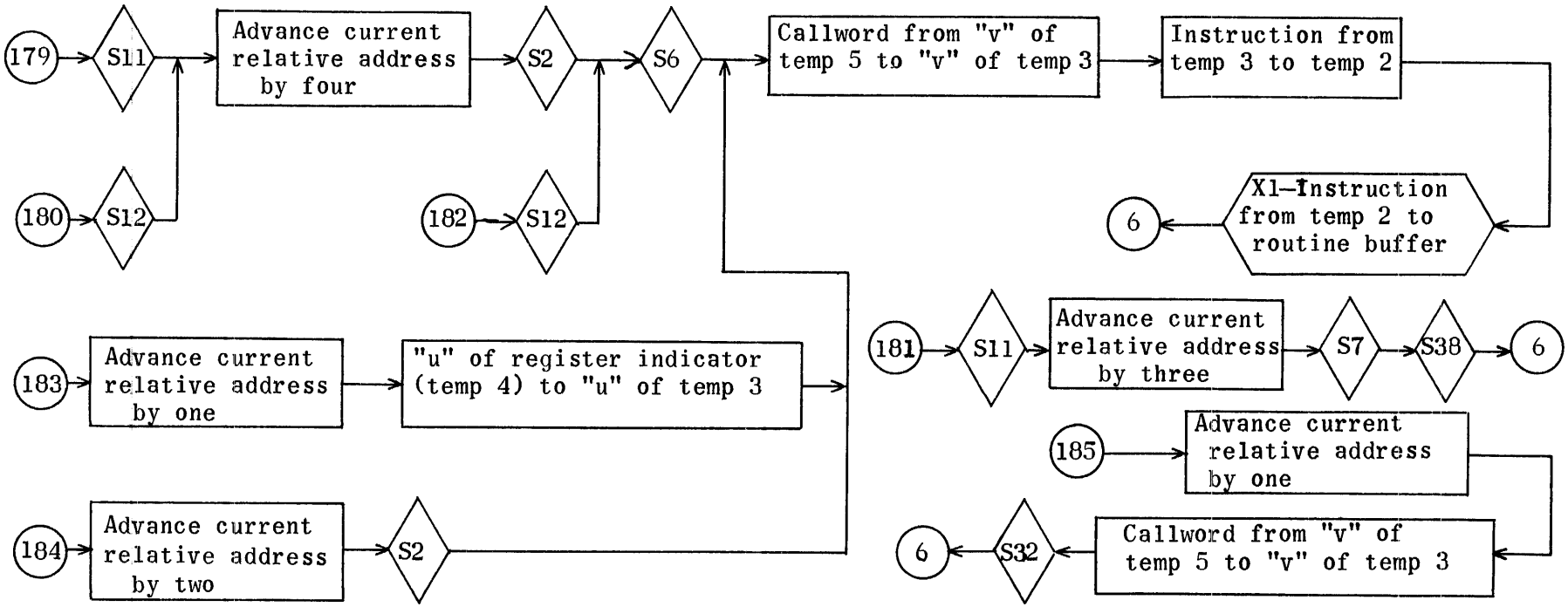



147
Advance current relative address by three
32 30000 00000 instruction to temp 2
Relative constant call-word to "u" of temp 2
Xl--Instruction from temp 2 to routine buffer
S4
148
67 30000 30000 instruction to temp 2
149
Fixed constant call-word from "u" of temp 6 to "u" of temp 2
Xl--Instruction from temp 2 to routine buffer
97
148
S55
150
Advance current relative address by three
S23
21 30000 30000 instruction to temp 2
S29
Current relative address to "u" of temp 2
Xl--Instruction from temp 2 to routine buffer
148
151
Advance current relative address by three
S26
S4
148
152
Advance current relative address by two
S23
148
Power 4 to 63
153
P4
96
Power 1/2
161
P1
97
Power -4 to -63
154
P4
Preset address of next word in Expanded List in Box 4
Advance address in Expanded List by one
Power -1/2
162
P1
S49
97
Box-4
Word from Expanded List to temp 6
97
S49

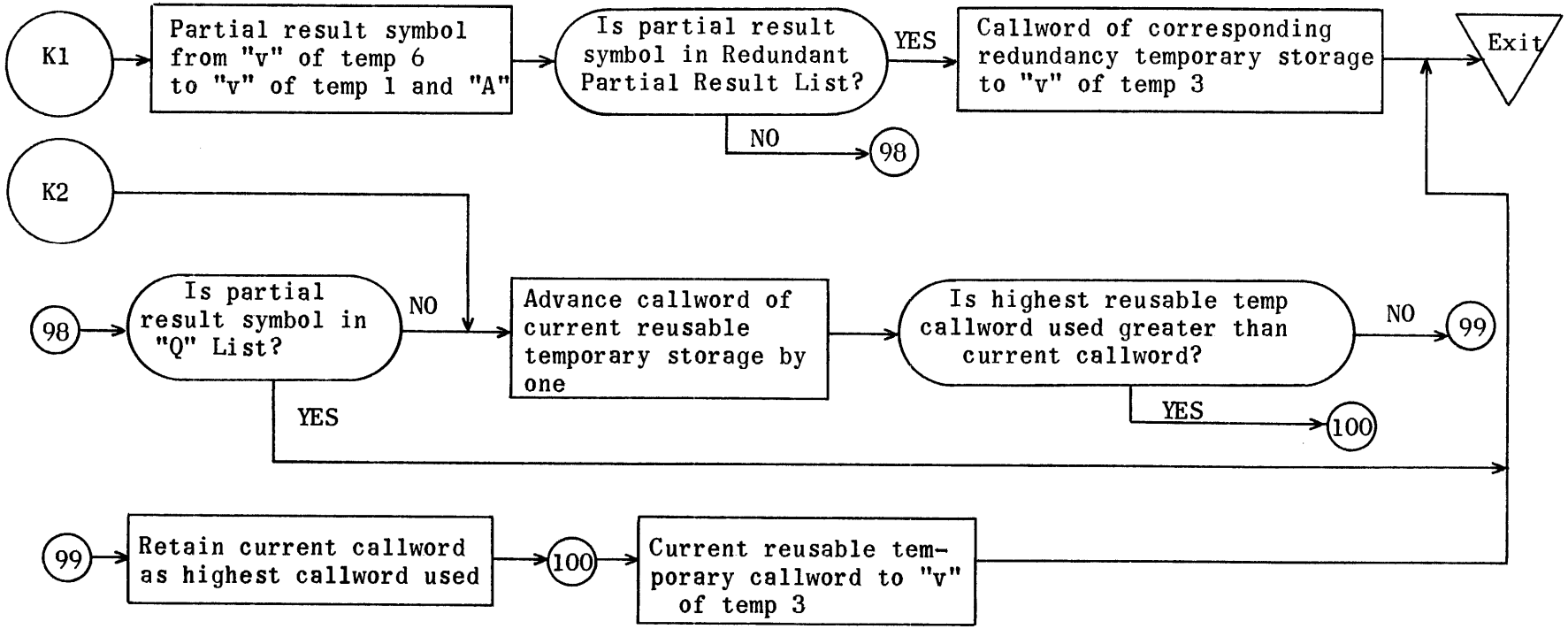
Equation Generation Phase (Operator to Store Result)



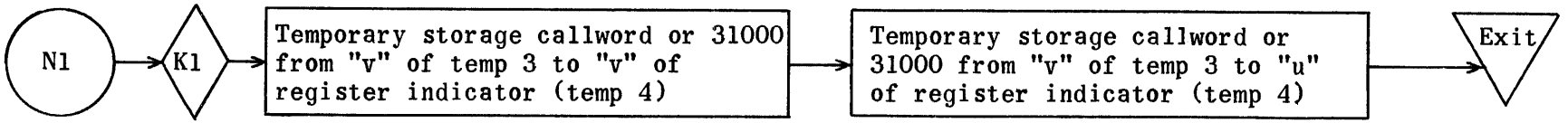

178
Indicator =36₈?
NO
Indicator =40₈?
NO
Indicator = 42₈?
NO
Indicator =43₈?
NO
Indicator =44₈?
NO
Indicator =45₈?
NO
Indicator =46₈?
NO
YES
78
YES
79
YES
80
YES
81
YES
83
YES
184
85
YES
Indicator must equal 50₈
87
NO
Indicator =47₈?
YES
86


179
S11
Advance current relative address by four
S2
S6
Callword from "v" of temp 5 to "v" of temp 3
Instruction from temp 3 to temp 2
180
S12
182
S12
6
X1—Instruction from temp 2 to routine buffer
183
Advance current relative address by one
"u" of register indicator (temp 4) to "u" of temp 3
181
S11
Advance current relative address by three
S7
S38
6
185
Advance current relative address by one
184
Advance current relative address by two
S2
6
S32
Callword from "v" of temp 5 to "v" of temp 3

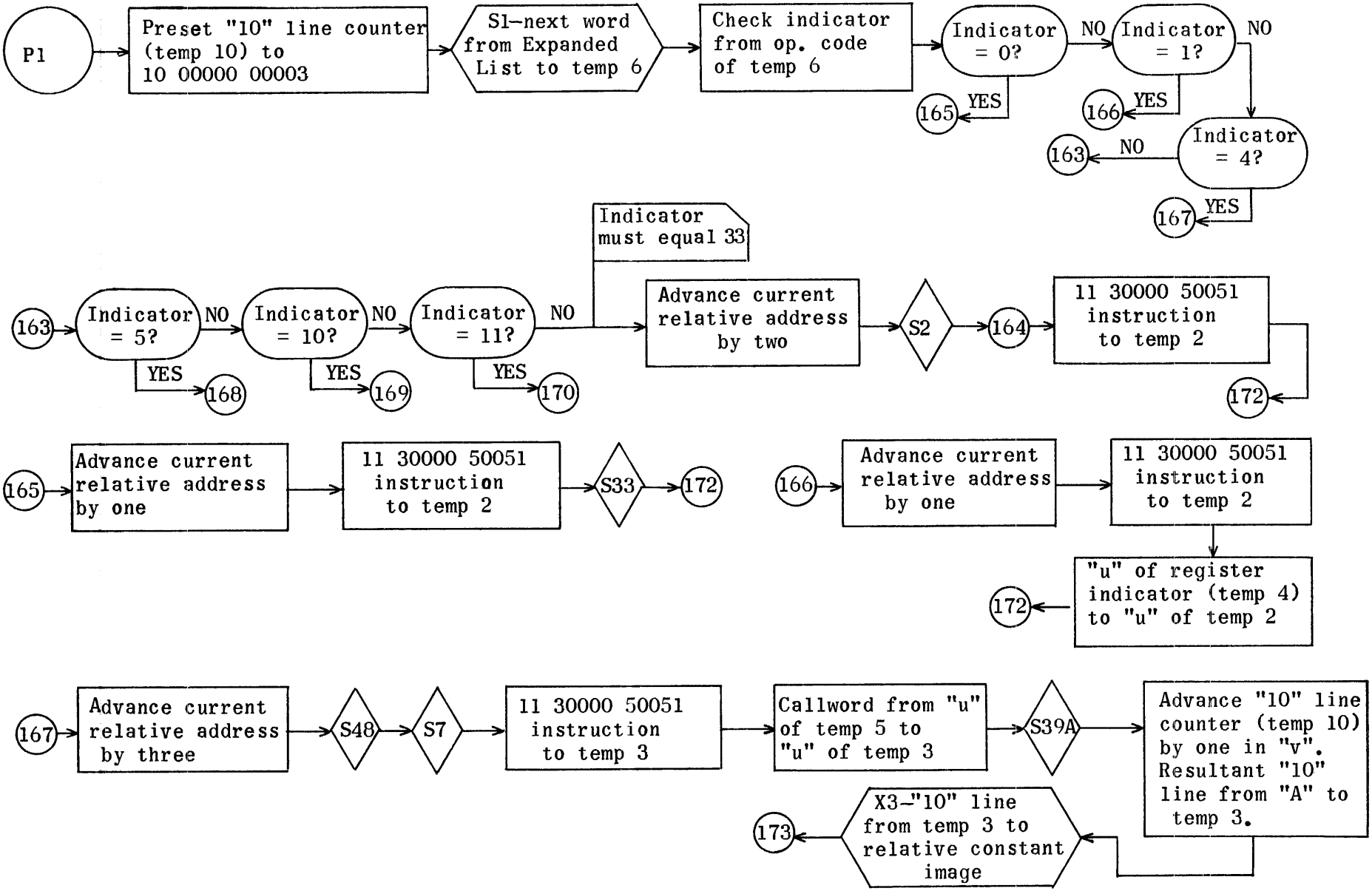
Equation Generation Subroutine for Floating Point Operators

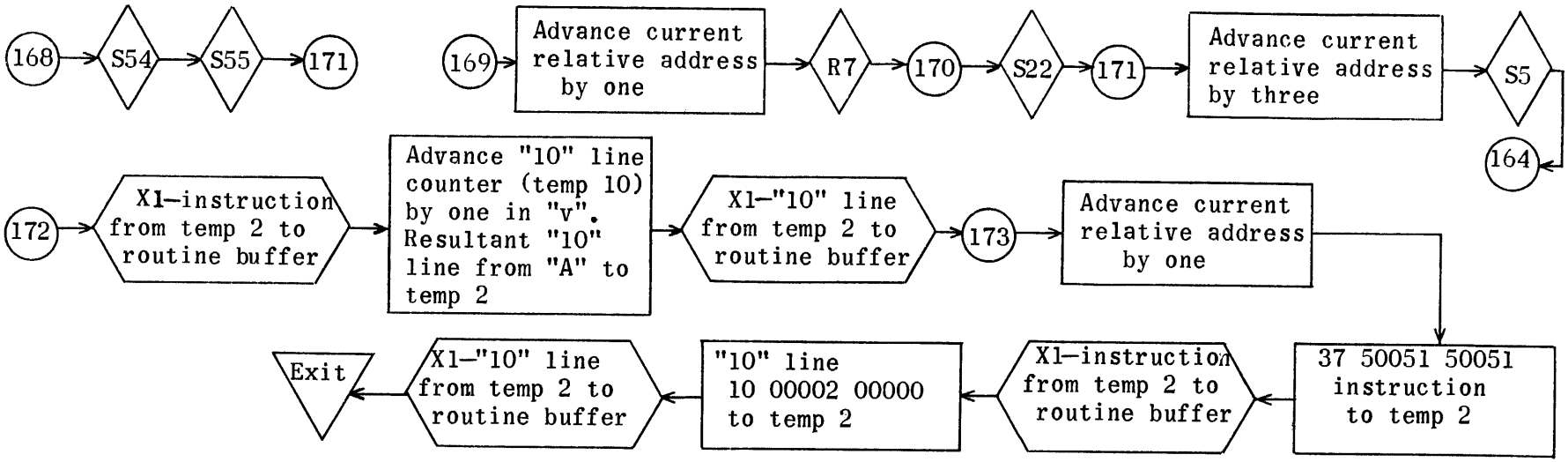


Equation Generation Subroutine for Floating Point Unary Minus and Absolute Value Operators

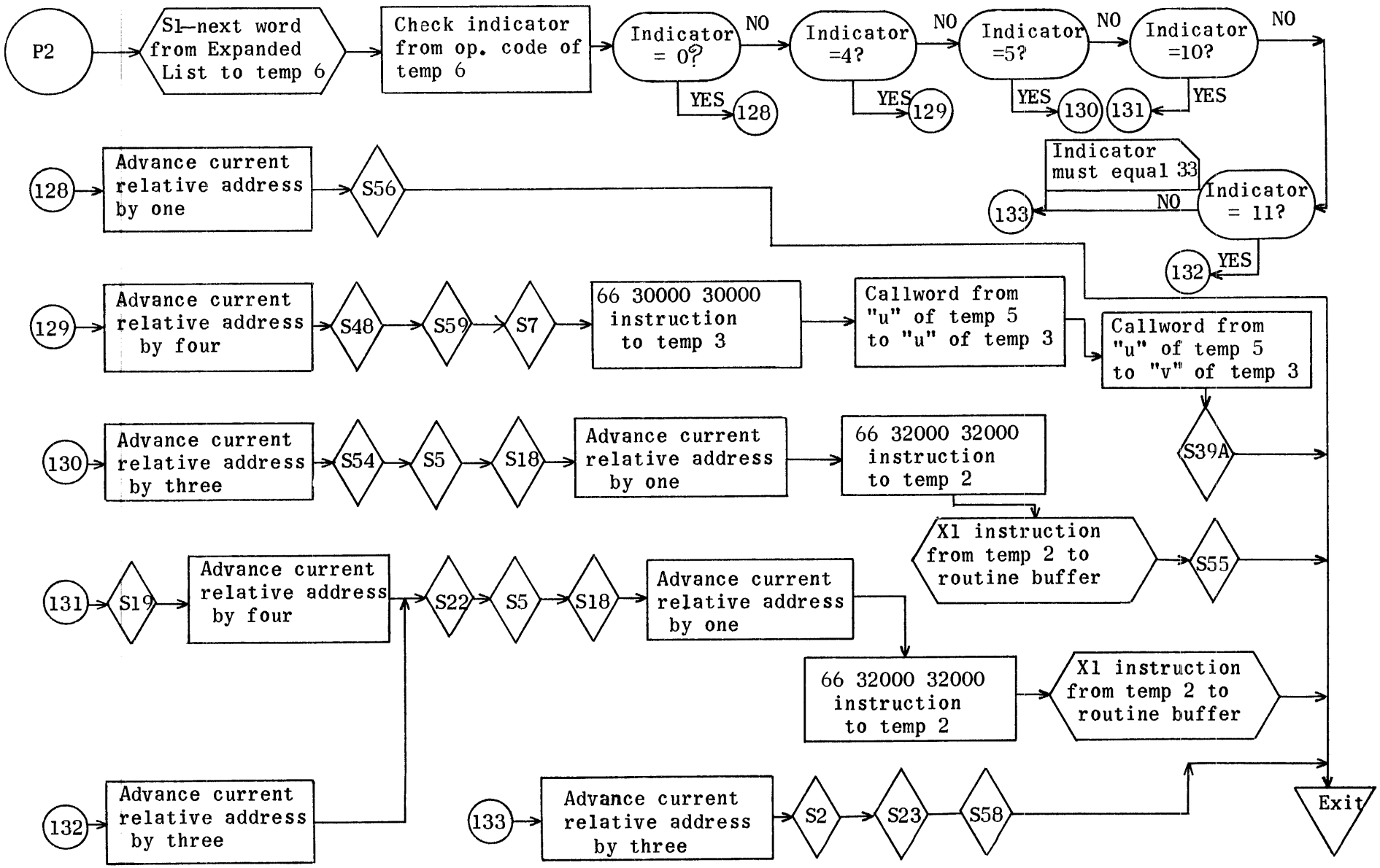


Equation Generation Subroutine for Power (1/2) and (-1/2)

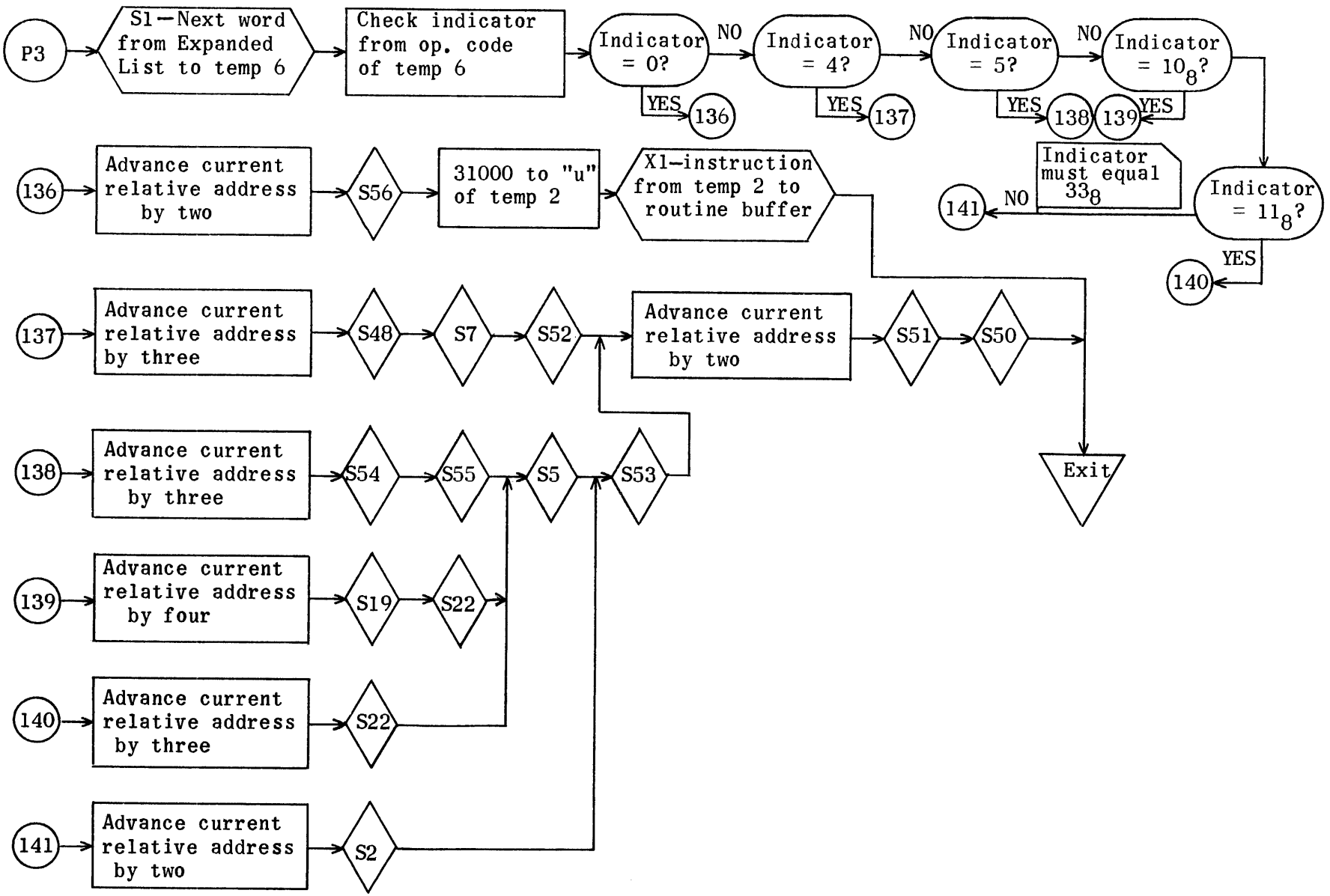



168
S54
S55
171
169
Advance current relative address by one
R7
170
S22
171
Advance current relative address by three
S5
164
172
X1—instruction from temp 2 to routine buffer
Advance "10" line counter (temp 10) by one in "v". Resultant "10" line from "A" to temp 2
X1—"10" line from temp 2 to routine buffer
173
Advance current relative address by one
37 50051 50051 instruction to temp 2
X1—instruction from temp 2 to routine buffer
"10" line 10 00002 00000 to temp 2
X1—"10" line from temp 2 to routine buffer
Exit

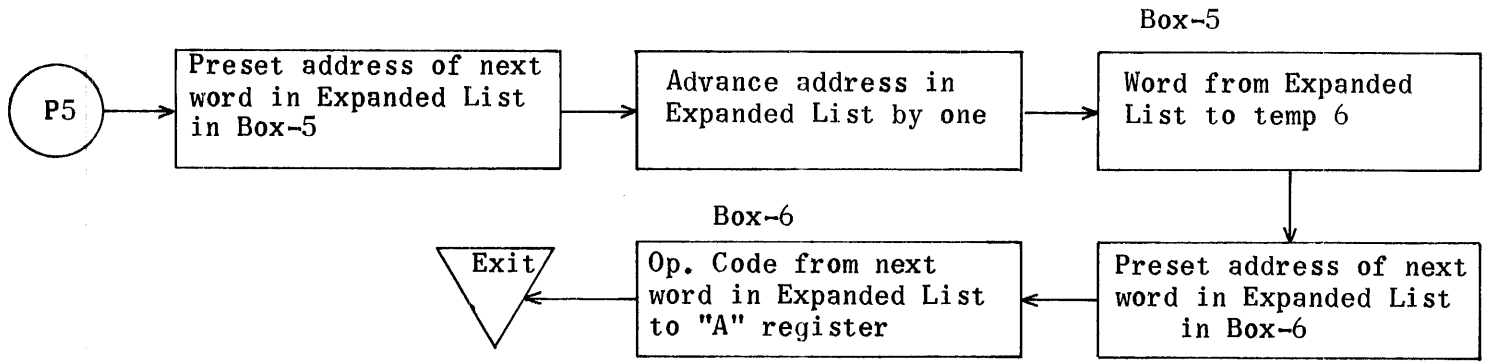
Equation Generation Subroutine for Power (2) and (-2)

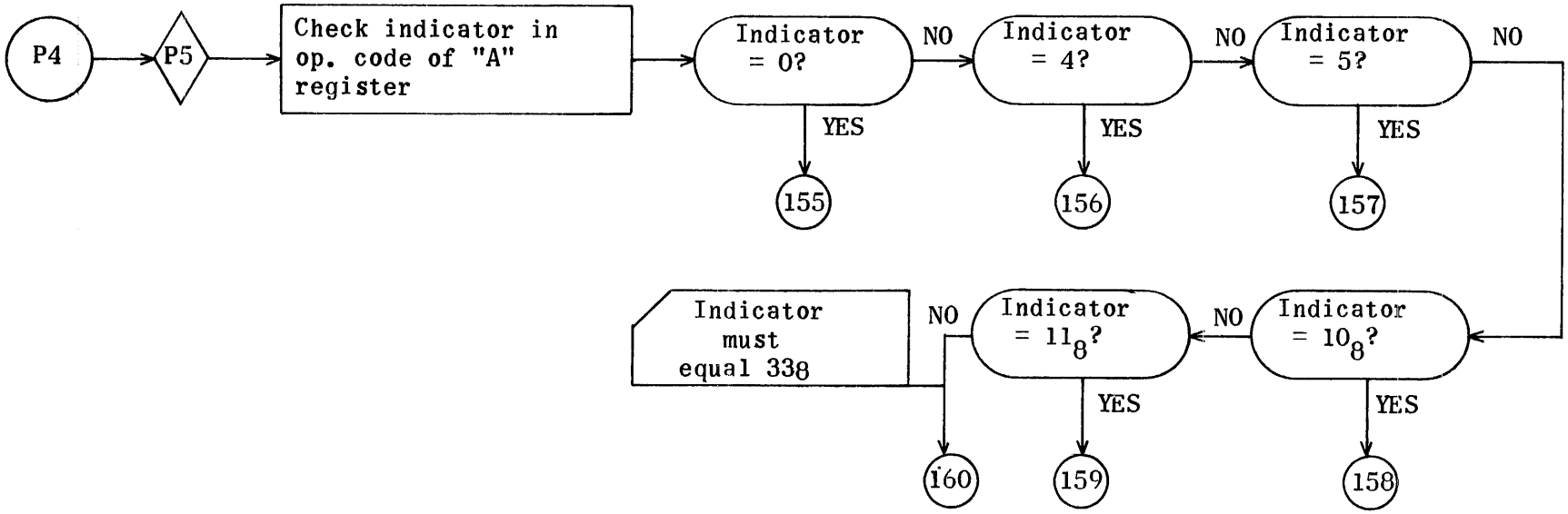


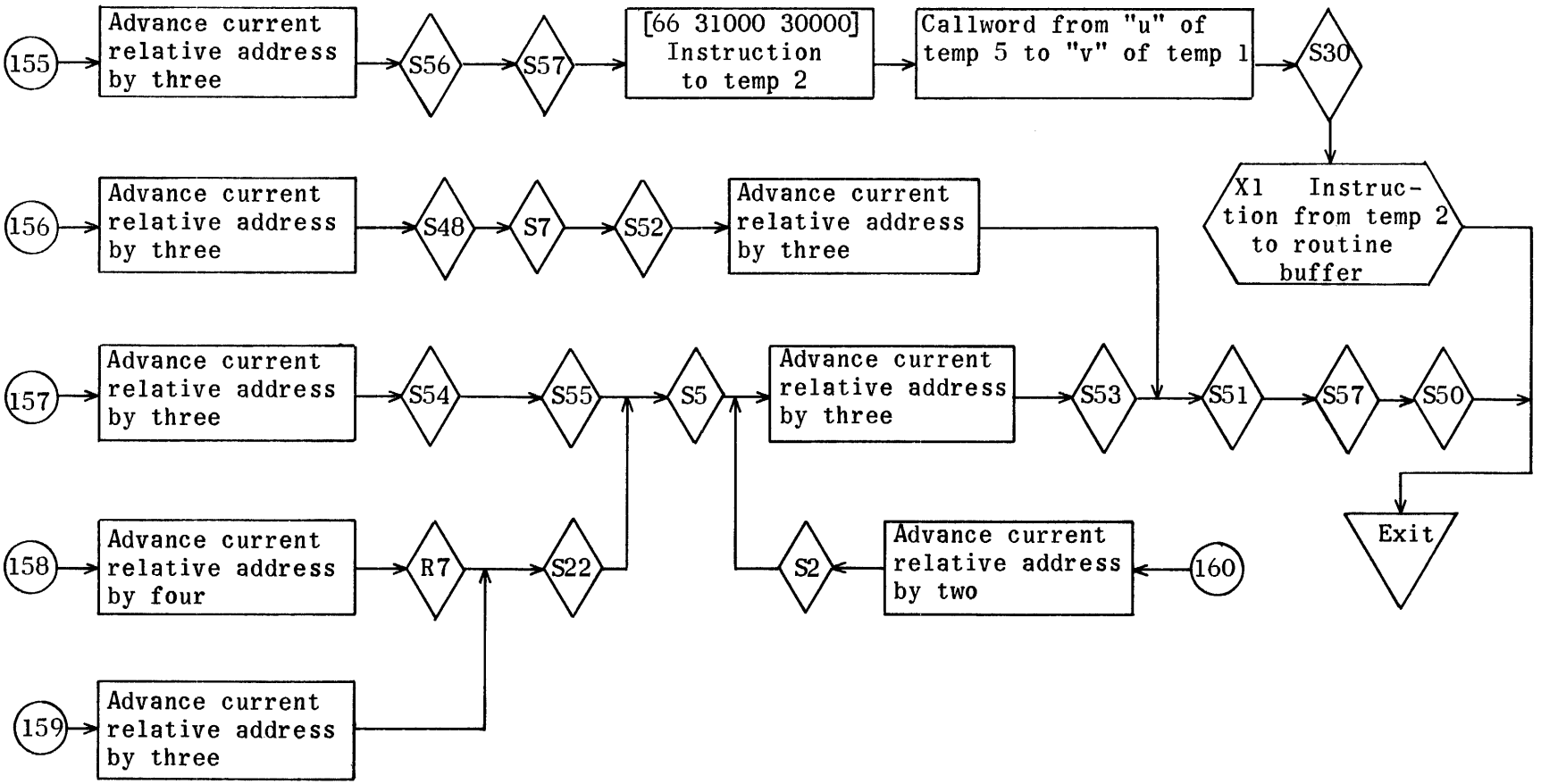
Equation Generation Subroutine for Power (3) and (-3)



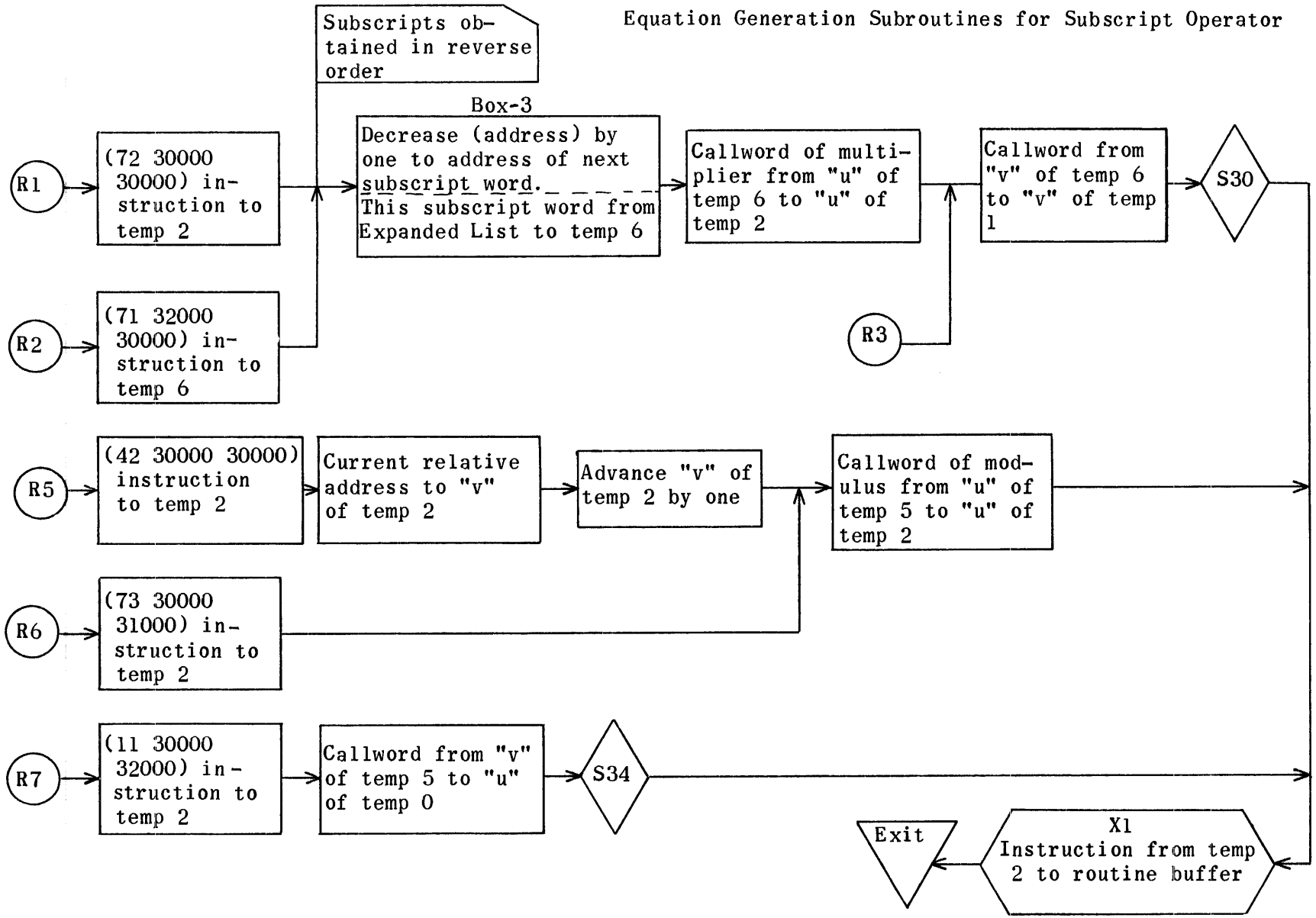
Equation Generation Subroutines for Power (4 to 63) and (-4 to -63)

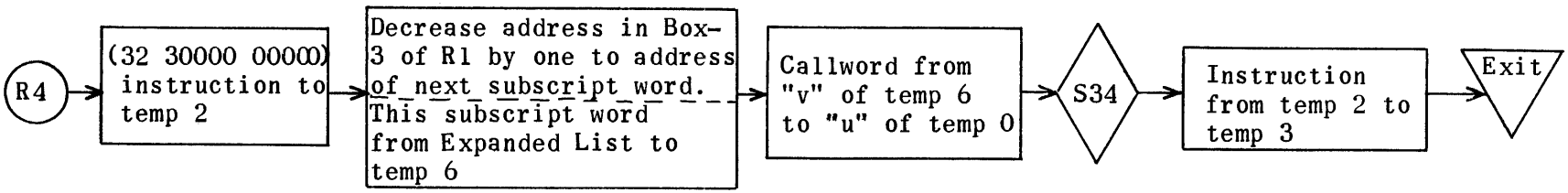




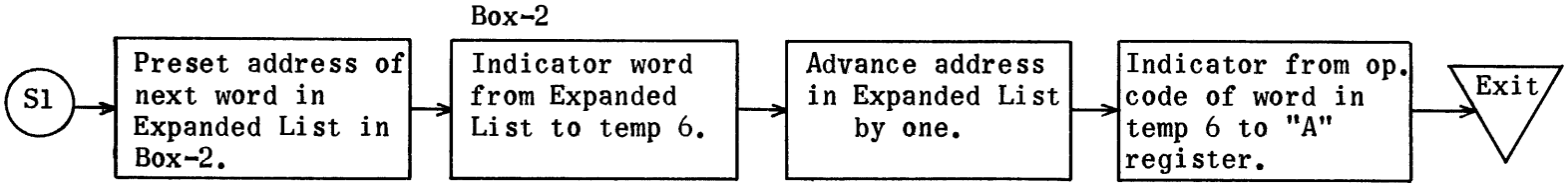

155
Advance current relative address by three
S56
S57
[66 31000 30000] Instruction to temp 2
Callword from "u" of temp 5 to "v" of temp 1
S30
156
Advance current relative address by three
S48
S7
S52
Advance current relative address by three
X1 Instruction from temp 2 to routine buffer
157
Advance current relative address by three
S54
S55
S5
Advance current relative address by three
S53
S51
S57
S50
Exit
158
Advance current relative address by four
R7
S22
S2
Advance current relative address by two
160
159
Advance current relative address by three

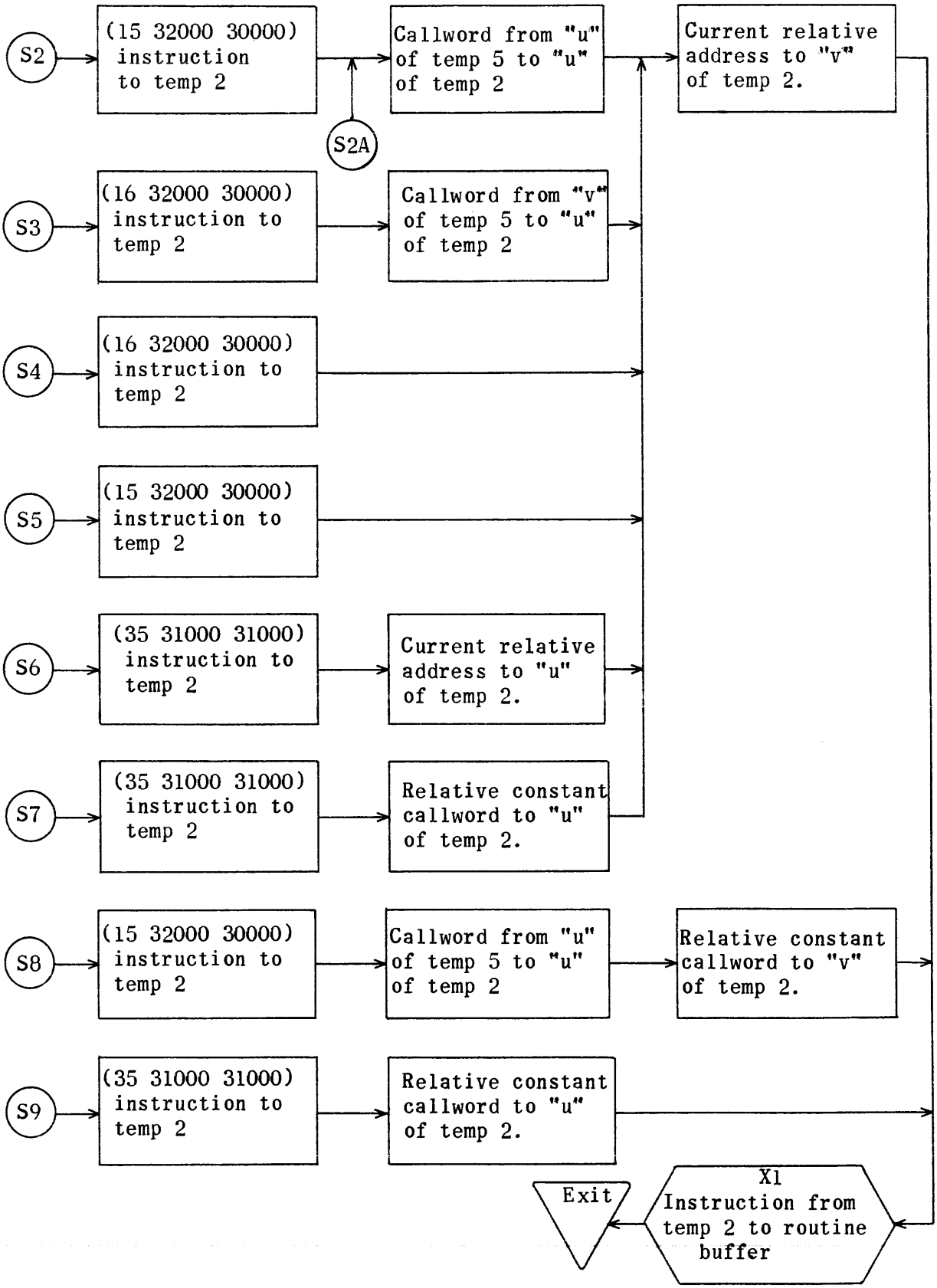
Equation Generation Subroutines for Subscript Operator

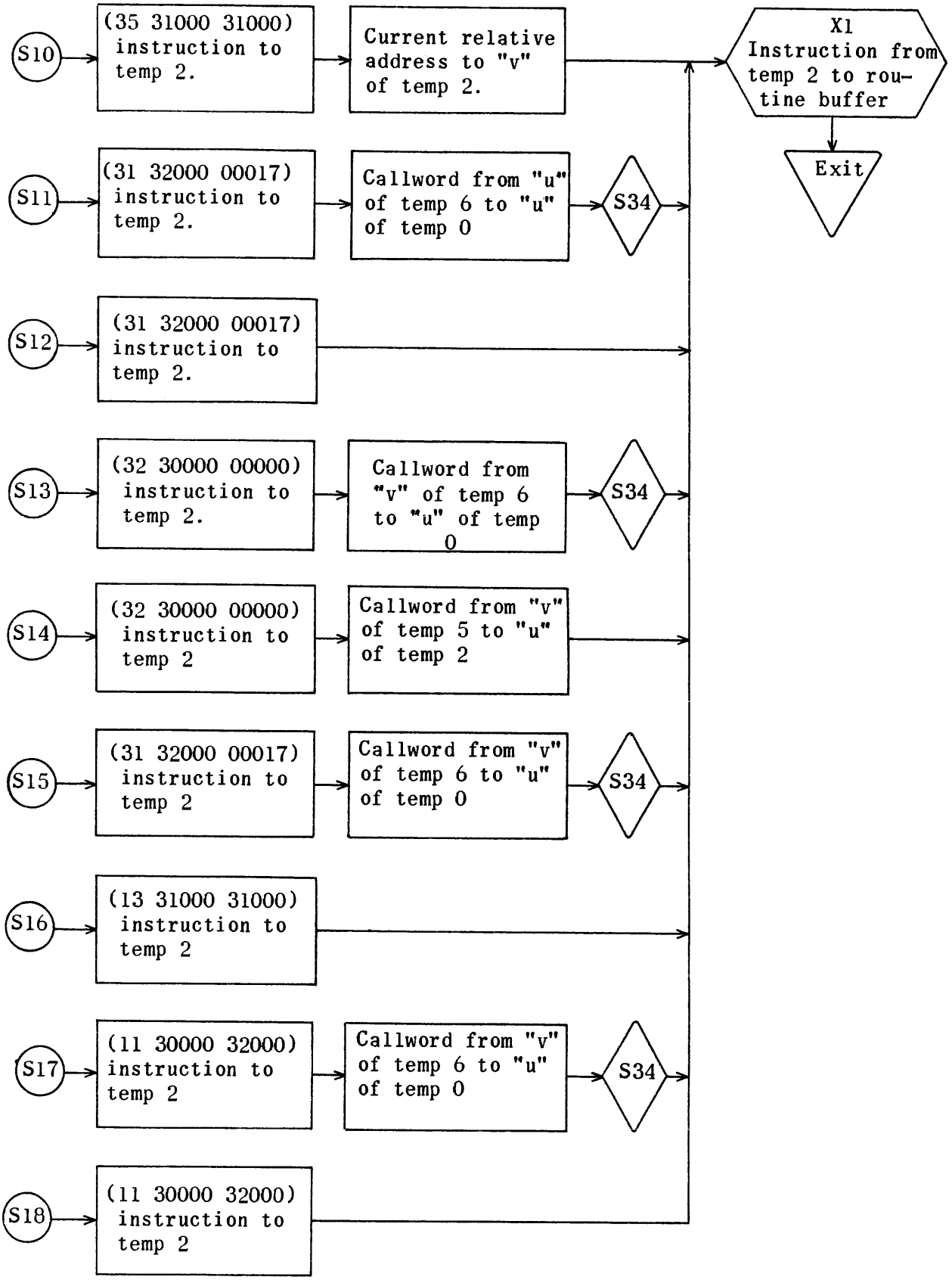


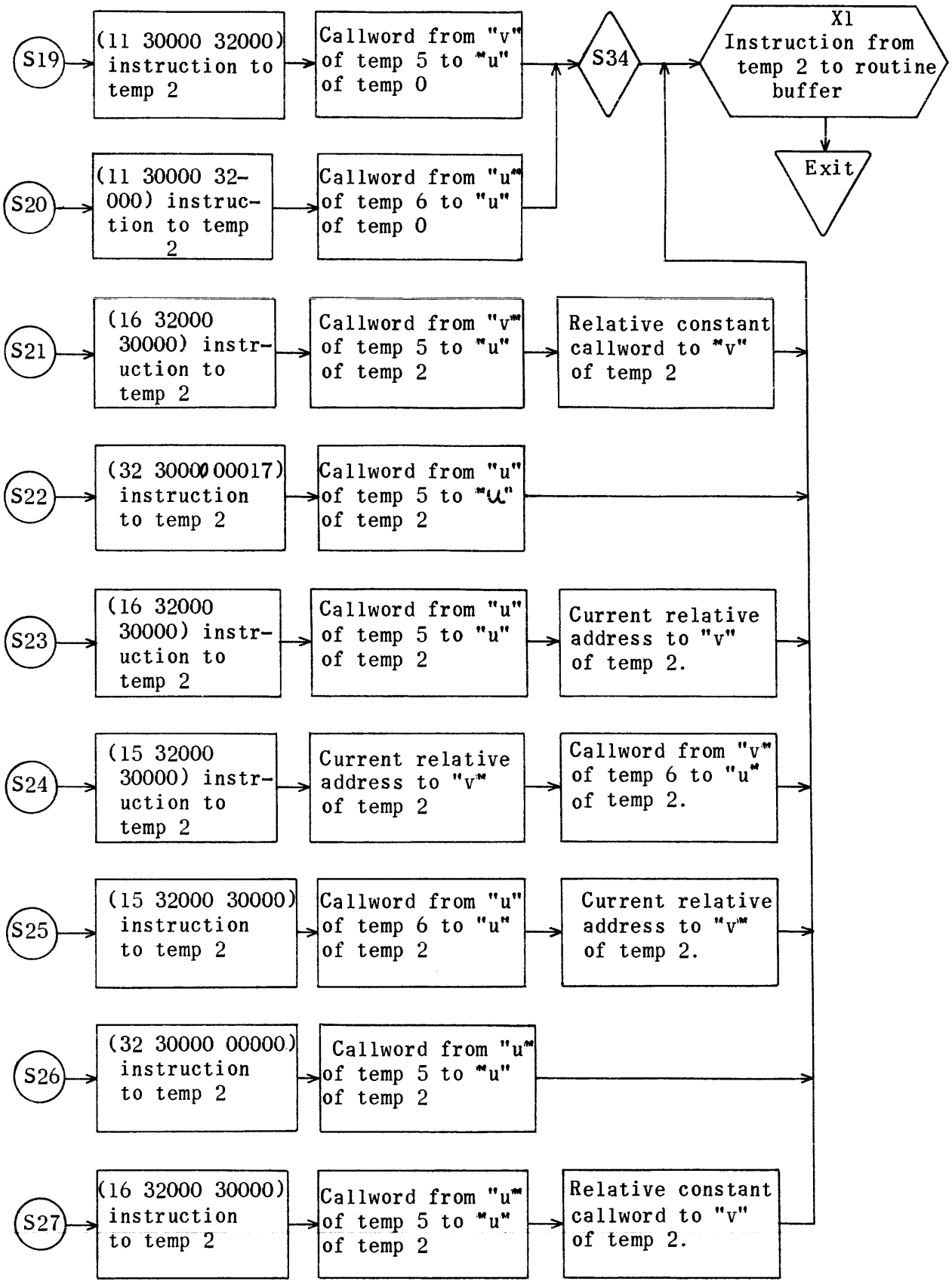


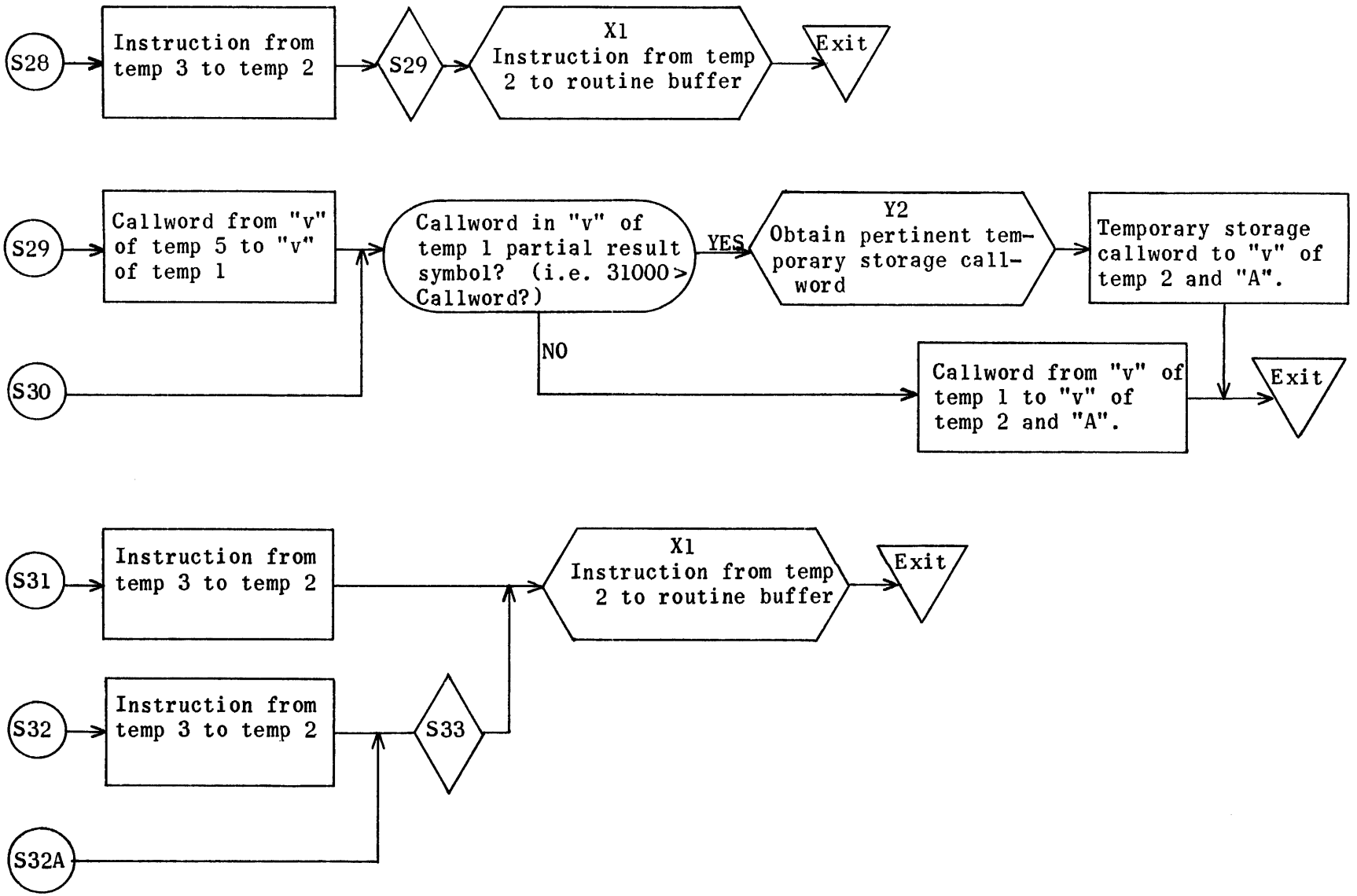
Equation Generation Subroutines

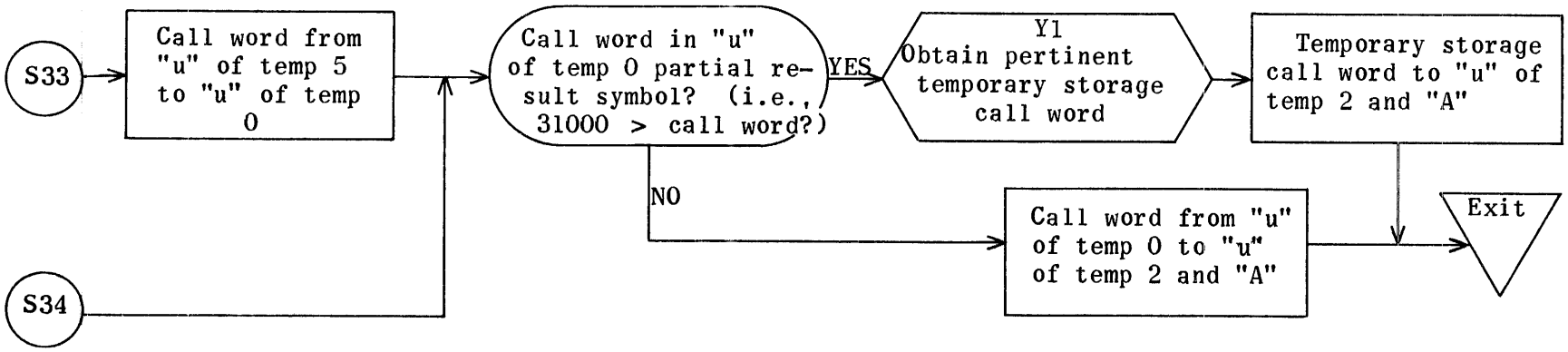



S2
(15 32000 30000) instruction to temp 2
S2A
Callword from "u" of temp 5 to "u" of temp 2
Current relative address to "v" of temp 2.
S3
(16 32000 30000) instruction to temp 2
Callword from "v" of temp 5 to "u" of temp 2
S4
(16 32000 30000) instruction to temp 2
S5
(15 32000 30000) instruction to temp 2
S6
(35 31000 31000) instruction to temp 2
Current relative address to "u" of temp 2.
S7
(35 31000 31000) instruction to temp 2
Relative constant callword to "u" of temp 2.
S8
(15 32000 30000) instruction to temp 2
Callword from "u" of temp 5 to "u" of temp 2
Relative constant callword to "v" of temp 2.
S9
(35 31000 31000) instruction to temp 2
Relative constant callword to "u" of temp 2.
Exit
X1
Instruction from temp 2 to routine buffer

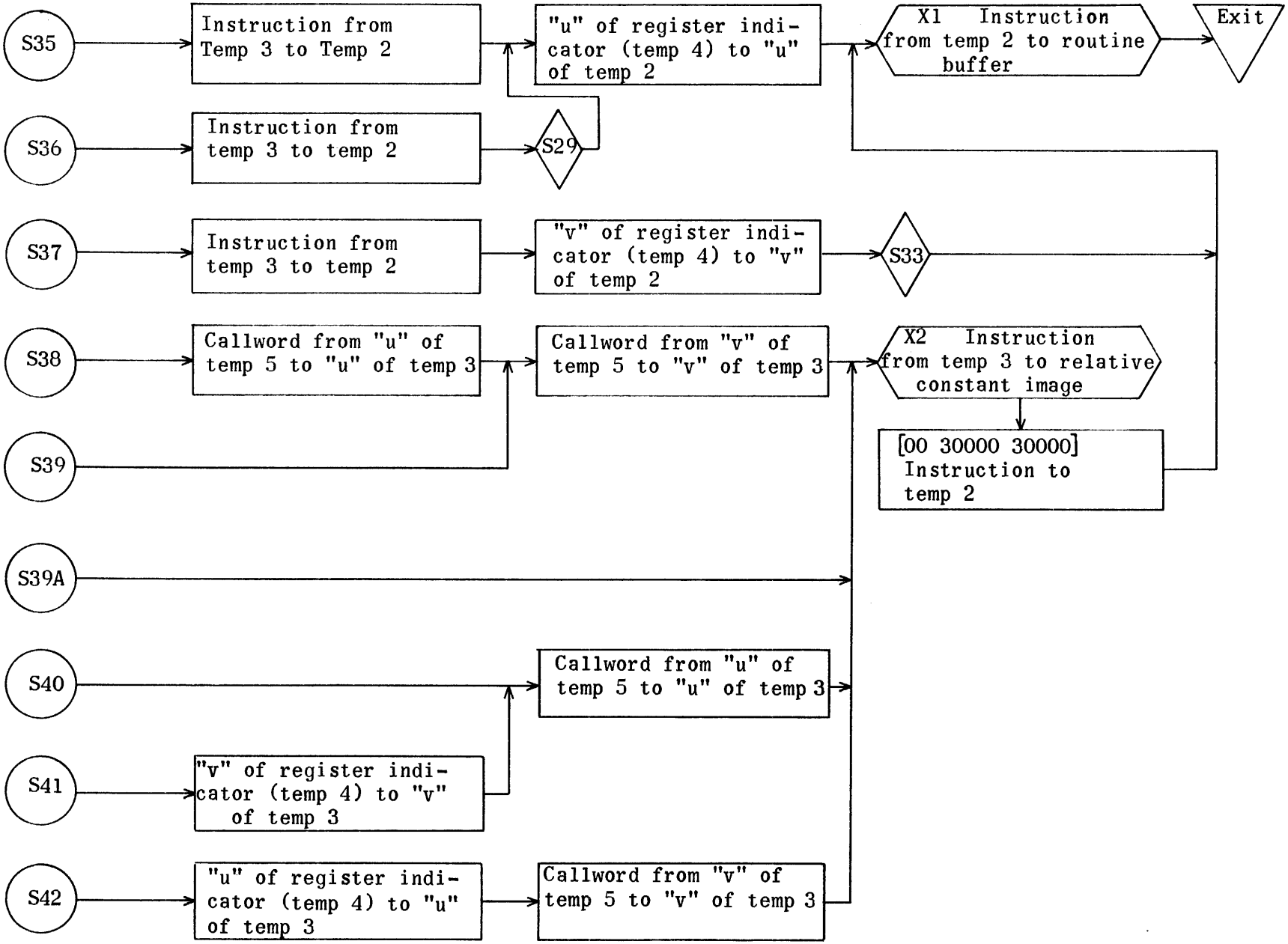

S10
(35 31000 31000) instruction to temp 2.
Current relative address to "v" of temp 2.
X1 Instruction from temp 2 to routine buffer
Exit
S11
(31 32000 00017) instruction to temp 2.
Callword from "u" of temp 6 to "u" of temp 0
S34
S12
(31 32000 00017) instruction to temp 2.
S13
(32 30000 00000) instruction to temp 2.
Callword from "v" of temp 6 to "u" of temp 0
S34
S14
(32 30000 00000) instruction to temp 2
Callword from "v" of temp 5 to "u" of temp 2
S15
(31 32000 00017) instruction to temp 2
Callword from "v" of temp 6 to "u" of temp 0
S34
S16
(13 31000 31000) instruction to temp 2
S17
(11 30000 32000) instruction to temp 2
Callword from "v" of temp 6 to "u" of temp 0
S34
S18
(11 30000 32000) instruction to temp 2

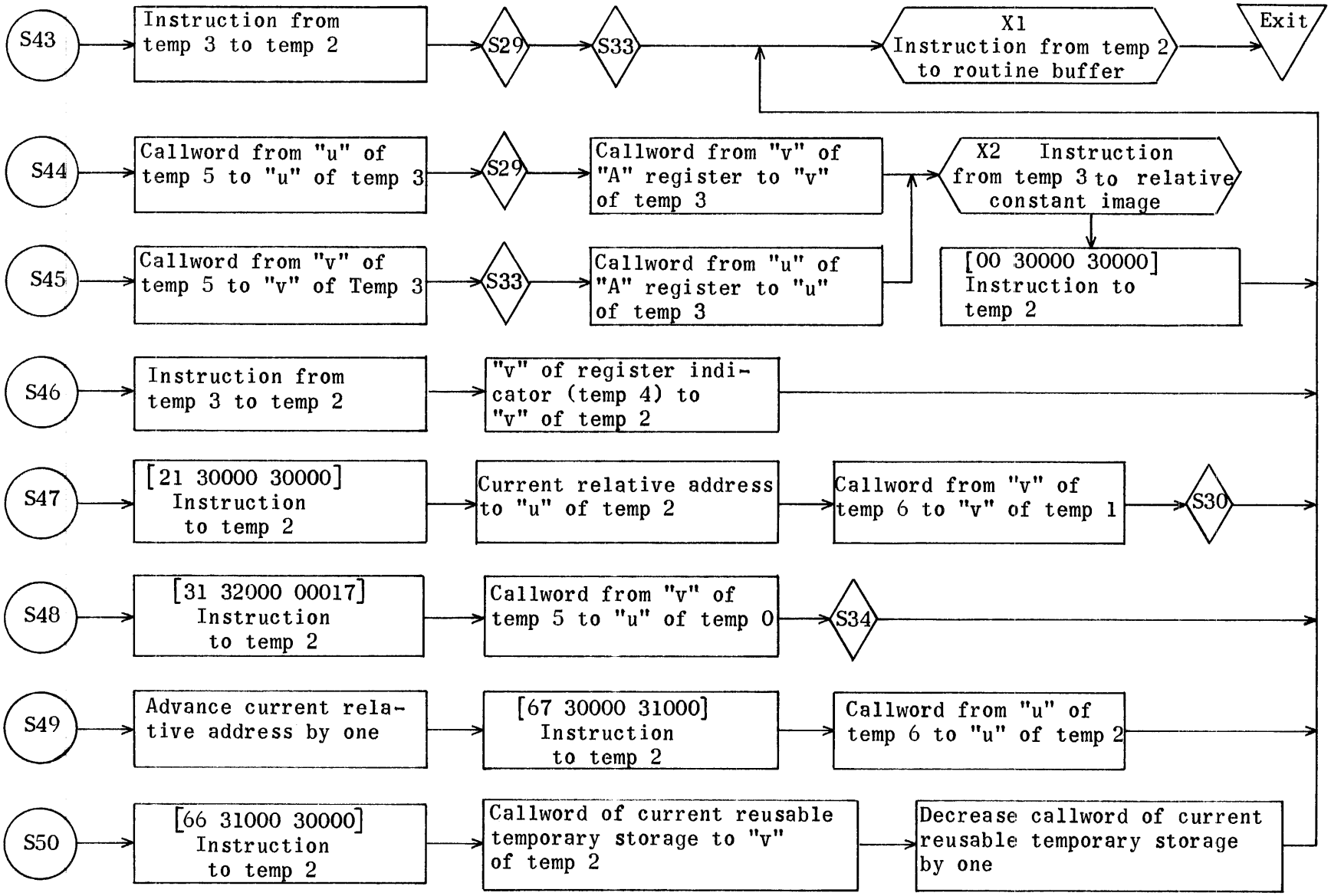

S19
(11 30000 32000) instruction to temp 2
Callword from "v" of temp 5 to "u" of temp 0
S34
X1
Instruction from temp 2 to routine buffer
Exit
S20
(11 30000 32-000) instruction to temp 2
Callword from "u" of temp 6 to "u" of temp 0
S21
(16 32000 30000) instruction to temp 2
Callword from "v" of temp 5 to "u" of temp 2
Relative constant callword to "v" of temp 2
S22
(32 30000 00017) instruction to temp 2
Callword from "u" of temp 5 to "u" of temp 2
S23
(16 32000 30000) instruction to temp 2
Callword from "u" of temp 5 to "u" of temp 2
Current relative address to "v" of temp 2.
S24
(15 32000 30000) instruction to temp 2
Current relative address to "v" of temp 2
Callword from "v" of temp 6 to "u" of temp 2.
S25
(15 32000 30000) instruction to temp 2
Callword from "u" of temp 6 to "u" of temp 2
Current relative address to "v" of temp 2.
S26
(32 30000 00000) instruction to temp 2
Callword from "u" of temp 5 to "u" of temp 2
S27
(16 32000 30000) instruction to temp 2
Callword from "u" of temp 5 to "u" of temp 2
Relative constant callword to "v" of temp 2.

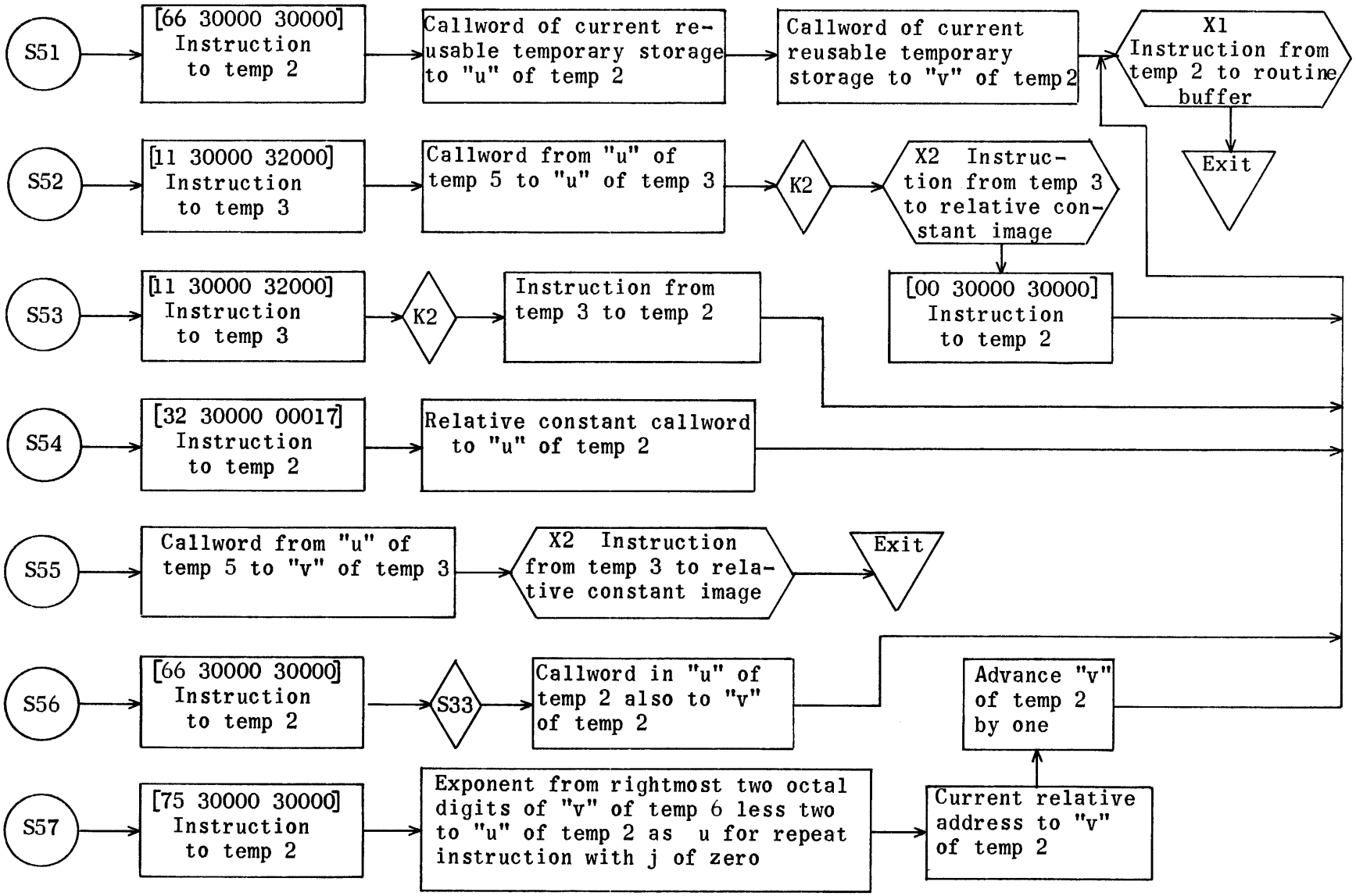

S28
Instruction from temp 3 to temp 2
S29
X1
Instruction from temp 2 to routine buffer
Exit
S29
Callword from "v" of temp 5 to "v" of temp 1
Callword in "v" of temp 1 partial result symbol? (i.e. 31000> Callword?)
YES
Y2
Obtain pertinent temporary storage callword
Temporary storage callword to "v" of temp 2 and "A".
NO
S30
Callword from "v" of temp 1 to "v" of temp 2 and "A".
Exit
S31
Instruction from temp 3 to temp 2
X1
Instruction from temp 2 to routine buffer
Exit
S32
Instruction from temp 3 to temp 2
S33
S32A

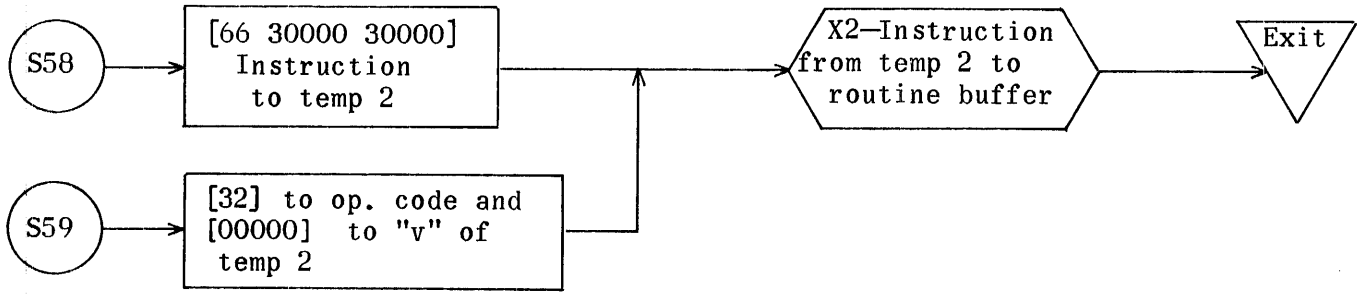

S33
Call word from "u" of temp 5 to "u" of temp 0
Call word in "u" of temp 0 partial result symbol? (i.e., 31000 > call word?)
YES
Y1
Obtain pertinent temporary storage call word
Temporary storage call word to "u" of temp 2 and "A"
NO
Call word from "u" of temp 0 to "u" of temp 2 and "A"
Exit
S34

Equation Generation Subroutines

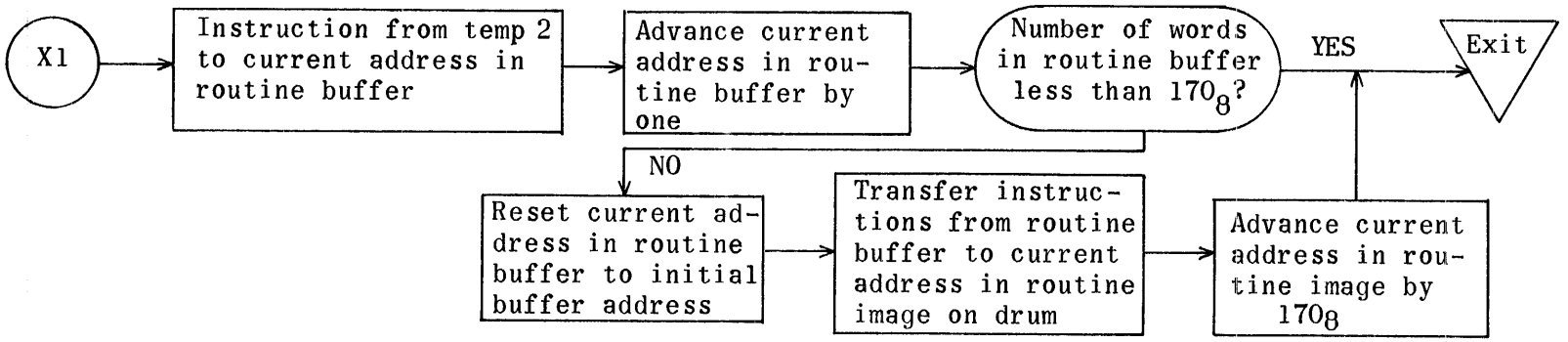



S43
Instruction from temp 3 to temp 2
S29
S33
X1
Instruction from temp 2 to routine buffer
Exit
S44
Callword from "u" of temp 5 to "u" of temp 3
S29
Callword from "v" of "A" register to "v" of temp 3
X2 Instruction from temp 3 to relative constant image
S45
Callword from "v" of temp 5 to "v" of Temp 3
S33
Callword from "u" of "A" register to "u" of temp 3
[00 30000 30000] Instruction to temp 2
S46
Instruction from temp 3 to temp 2
"v" of register indicator (temp 4) to "v" of temp 2
S47
[21 30000 30000] Instruction to temp 2
Current relative address to "u" of temp 2
Callword from "v" of temp 6 to "v" of temp 1
S30
S48
[31 32000 00017] Instruction to temp 2
Callword from "v" of temp 5 to "u" of temp 0
S34
S49
Advance current relative address by one
[67 30000 31000] Instruction to temp 2
Callword from "u" of temp 6 to "u" of temp 2
S50
[66 31000 30000] Instruction to temp 2
Callword of current reusable temporary storage to "v" of temp 2
Decrease callword of current reusable temporary storage by one

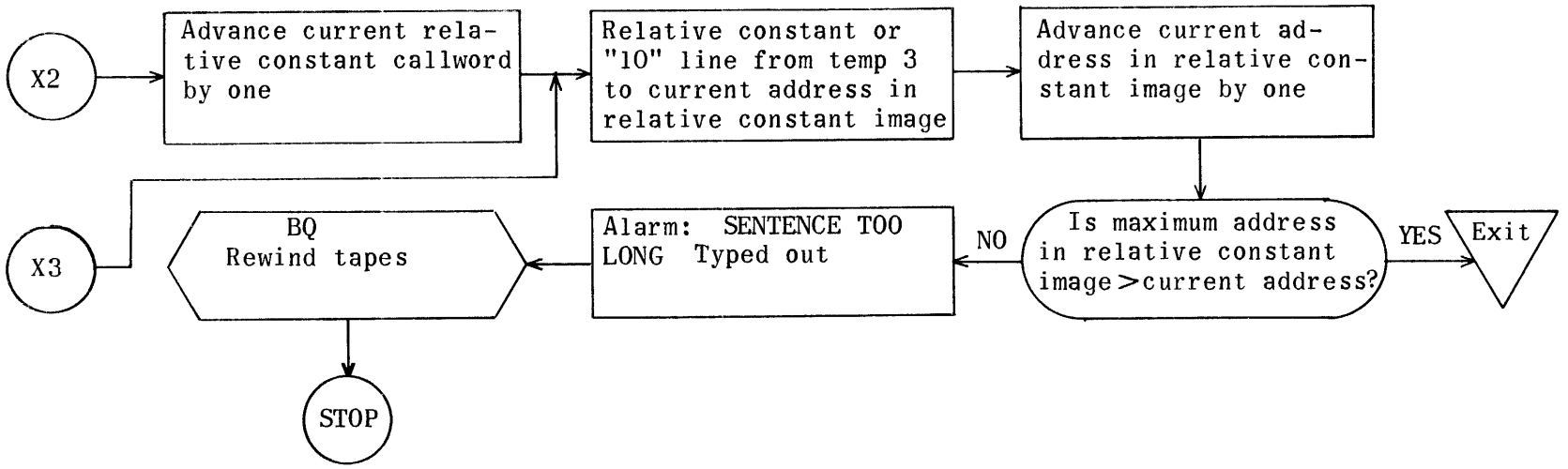

S51
[66 30000 30000] Instruction to temp 2
Callword of current reusable temporary storage to "u" of temp 2
Callword of current reusable temporary storage to "v" of temp 2
X1 Instruction from temp 2 to routine buffer
Exit
S52
[11 30000 32000] Instruction to temp 3
Callword from "u" of temp 5 to "u" of temp 3
K2
X2 Instruction from temp 3 to relative constant image
S53
[11 30000 32000] Instruction to temp 3
K2
Instruction from temp 3 to temp 2
[00 30000 30000] Instruction to temp 2
S54
[32 30000 00017] Instruction to temp 2
Relative constant callword to "u" of temp 2
S55
Callword from "u" of temp 5 to "v" of temp 3
X2 Instruction from temp 3 to relative constant image
Exit
S56
[66 30000 30000] Instruction to temp 2
S33
Callword in "u" of temp 2 also to "v" of temp 2
Advance "v" of temp 2 by one
S57
[75 30000 30000] Instruction to temp 2
Exponent from rightmost two octal digits of "v" of temp 6 less two to "u" of temp 2 as u for repeat instruction with j of zero
Current relative address to "v" of temp 2



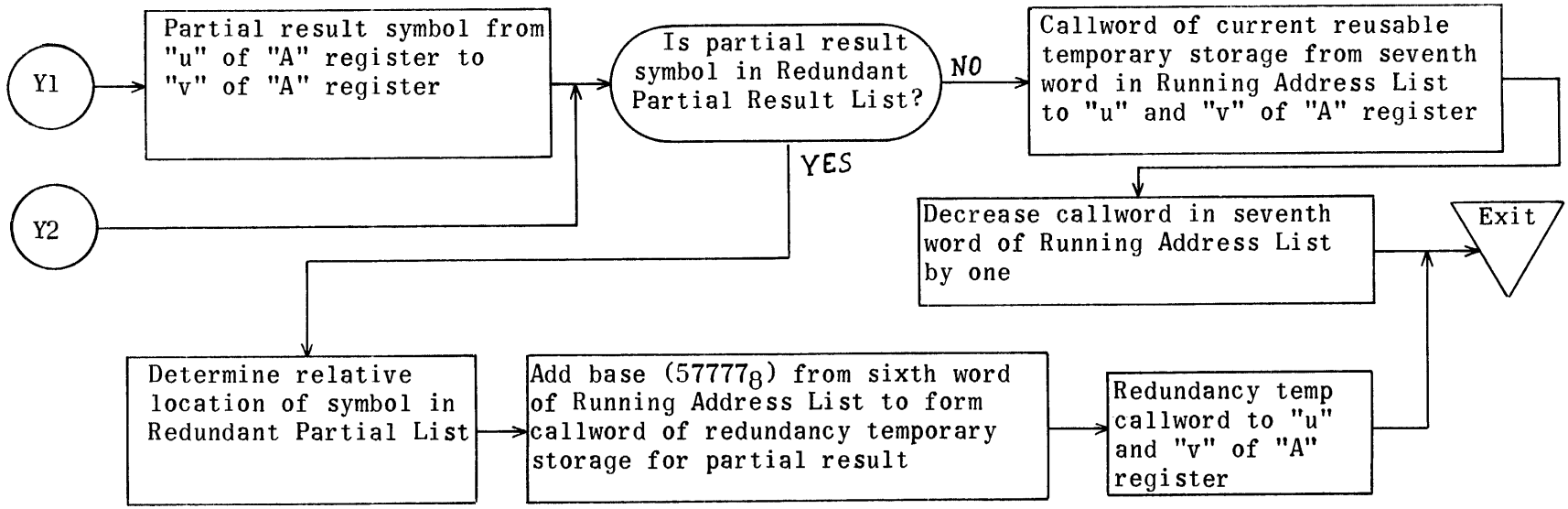
Equation Generation Subroutine to Store Instruction in Routine Buffer



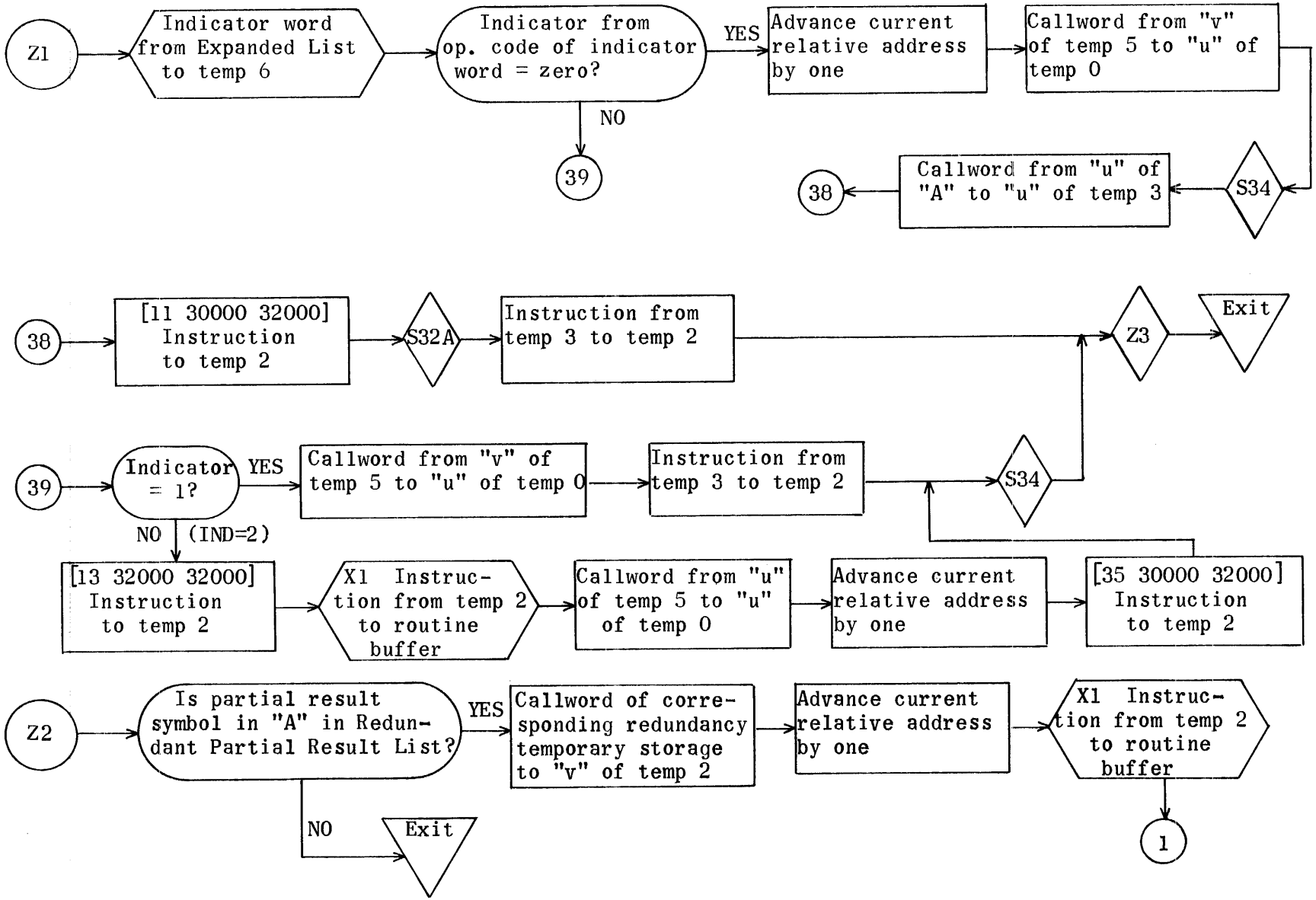
Equation Generation Subroutine to Store Relative Constant in Relative Constant Image

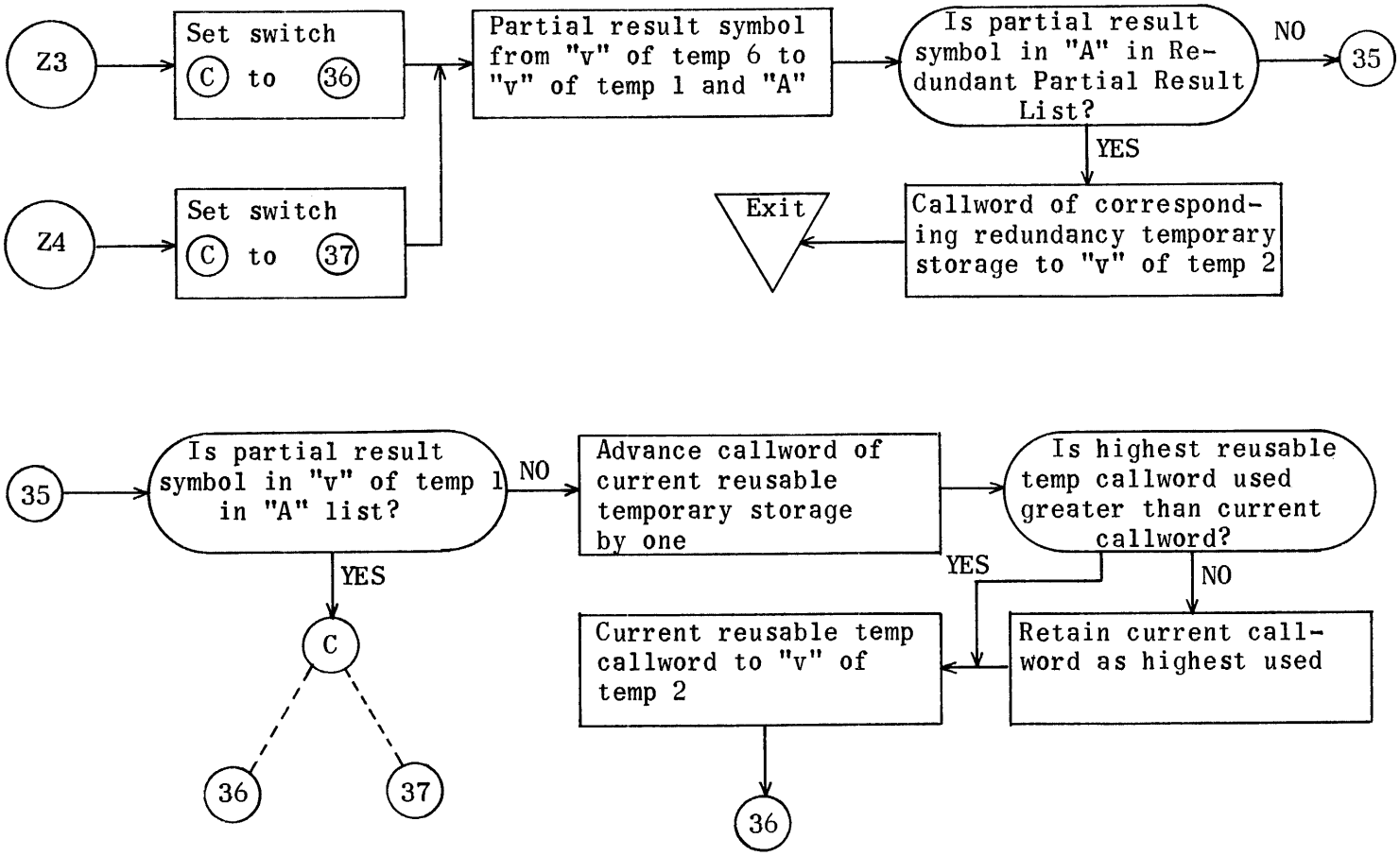


Equation Generation Subroutine to Obtain Pertinent Temporary Storage Callword (TR)



Equation Generation Subroutines for Fixed Point Operators




Z3
Set switch C to 36
Partial result symbol from "v" of temp 6 to "v" of temp 1 and "A"
Is partial result symbol in "A" in Redundant Partial Result List?
NO
35
YES
Z4
Set switch C to 37
Exit
Callword of corresponding redundancy temporary storage to "v" of temp 2
35
Is partial result symbol in "v" of temp 1 in "A" list?
NO
Advance callword of current reusable temporary storage by one
Is highest reusable temp callword used greater than current callword?
YES
NO
YES
C
Current reusable temp callword to "v" of temp 2
Retain current callword as highest used
36
37
36

REGIONS FOR EQUATION GENERATION NO. 3

RE UP421	Uniprint	
RE EP537 RE BQ632	Machine Error Routine	
RE WA653	Routine to Print Error Heading	
RE OP1047	Op. Control Routine	
RE CW1211	Constant Callword Routine	
RE BG2512		
RE GE2542		
RE EG2603		
RE GY2730		
RE GZ3030		
RE NZ3120		
RE ZZ3150		
RE GF3176		
RE GG3262		
RE GH3357		
RE GI3457		
RE GJ3564		
RE GK3624		
RE GL3661		
RE GM3713		
RE GN3764		
RE GP4043		
RE GQ4131		
RE GR4210		
RE GW4277		
RE GX4376		
RE GA4472		
RE GB4545		
RE GS4600		
RE GT4716		
RE GU5014		
RE GV5073		
RE SI5133		
RE TR5154		
RE GC5171		
RE TI5245		
RE TO5316		
RE LG5322		
RE TT5324	Temporary Storage	
RE RB5360	"Generated Routine" Buffer (170_8 words)	
RE RA5550	Relative Address List	Inputs from equation Redundancy check
RE XQ5561	"Q" List	
RE XA5761	"A" List	
RE RL6161	Redundant Partial Result List	
RE EL6261	Expanded List	
RE FL7161	Op. File 1 Item for Generated Routine	
RE CI7361	"Generated Relative Constants" Image	

REGIONS FOR EQUATION GENERATION NO. 3 (continued)

RE DL40102	Dimension List
RE RI65000	"Generated Routine" Image (used when Routine exceeds routine buffer, RB)
RE II5245	Dummy Instructions

Equation Generation No. 3

	IA	BG		Begin Generation
0	MJ	0	[30000]	Exit from phase
1	TP	GC50	RA4	Preset initial relative constant callword (10000_8)
2	TP	GC51	RA5	Preset initial redundancy temp callword less 1
3	TP	GC52	RA6	Preset initial reusable temp callword less 1
4	TP	GC52	RA7	Set highest temp CW = initial reus. temp CW less 1
5	TP	EL	RB	EQ. CW & # lines subj. add. mod.→ 1st line of prelude
6	TP	GC17	RB3	#inputs = Zero → 4th line of prelude
7	TP	GC17	RB4	#outputs = Zero → 5th line of prelude
10	TP	EL1	RB5	Sentence number→ 6th line of prelude
11	TP	II50	R36	Exit line → 1st line of Generated routine
12	TP	GC20	SI1	Preset add. in routine buffer for 2nd line Gen. routine
13	TP	GC27	SI6	Preset initial address in routine image
14	TP	GC30	SI12	Preset initial address in relative constant image
15	TV	GC21	GG45	Preset switch (A)
16	TP	GC17	TT	Zeroize temp 0
17	TP	GC17	TT1	Zeroize temp 1
20	TV	GC41	GI42	Preset switch (B)
21	TU	RA2	ZZ5	Preset repeat to search Redundant Partial Result List
22	TU	RA1	ZZ14	Preset repeat to search "A" List
23	TU	RA1	GZ24	Preset repeat to search "A" List
24	TU	RA2	TR2	Preset repeat to search Redundant Partial Result List
25	TU	RA1	NZ	Preset repeat to search "A" List
26	TU	RA2	NZ21	Preset repeat to search Redundant Partial Result List
27	MJ	0	GE	
	CA	BG30		

```
                IA    GE                    Generator Symbol Search
(1)     0       TU    RA10      GE2         Preset address of next word in Expanded
                                              List
        1       RA    RA10      GC6         Advance address in Expanded List by one
        2       SP    [30000]   0           Dummy instruction from Expanded List
                                              ⟶A
        3       TP    A         TT5         Dummy instruction to temp 5
(2)     4       LT    6         Q           Get operator symbol from Op.code of
                                              dummy instruction
        5       SP    Q         17          Operator symbol to "u" of A
        6       AT    II16      A           Form [MJ | symbol | 0] ⟶ A
        7       RP    30027     GE40        Search list for operator symbol
       10       TJ    GE11      GE11        Jump according to symbol
       11       MJ    37        GY          Symbol for subscript manipulation
       12       MJ    41        GF          Symbol for floating plus
       13       MJ    52        GF2         Symbol for floating subtract
       14       MJ    53        GF4         Symbol for floating multiply
       15       MJ    54        GF6         Symbol for floating divide
(3)    16       MJ    55        GZ          Symbol for fixed plus
       17       MJ    56        GZ3         Symbol for fixed subtract
       20       MJ    57        GZ5         Symbol for fixed multiply
       21       MJ    60        GZ16        Symbol for fixed divide
       22       MJ    61        GL          Symbol for library operator
       23       MJ    62        GN          Symbol for floating unary minus (neg)
(4)    24       MJ    63        GZ26        Symbol for fixed unary minus (neg)
       25       MJ    64        GN2         Symbol for floating Abs. value
       26       MJ    65        GZ30        Symbol for fixed Abs. value
       27       MJ    66        GP          Symbol for POW + 2
       30       MJ    67        GP2         Symbol for POW - 2
       31       MJ    70        GQ          Symbol for POW + 3
(5)    32       MJ    71        GQ2         Symbol for POW - 3
       33       MJ    72        GX          Symbol for POW  1/2
       34       MJ    73        GX2         Symbol for POW - 1/2
       35       MJ    74        GW          Symbol for POW (4 to 63)
       36       MJ    75        GW2         Symbol for POW (-4 to -63)
       37       MJ    76        GR          Symbol for POW -1
                CA    GE40
```

```
          IA   GE40
     40   MJ   77      GA        Symbol for storage operator
          CA   GE41


          IA   EG                End Generation of Equation
(6)  0    RS   RA3     GC53      Number lines in object program body to
                                 A
     1    TJ   LG1     EG6       Is number of lines in object prog. body
                                 more than 1001 8?
     2    RJ   WA      WA1       Yes; Type:  SENTENCE___(EQUATION)
     3    TP   TO      UP3       Parameter for alarm text to type routine
     4    RJ   UP2     UP        Type:  SENTENCE TOO LONG.
     5    MJ   0       BQ6       Rewind tapes and stop
     6    RS   RA4     GC50      Number of relative constants for object
                                 program to A
     7    TJ   GC44    EG11      Is number of relative constants more
                                 than 1000 8?
    10    MJ   0       EG2       Yes, jump to type alarm
    11    RS   RA2     GC45      Number of redundancy temps for object
                                 program to A.
    12    TJ   GC44    EG14      Is number of redundancy temps more
                                 than 1000 8?
    13    MJ   0       EG2       Yes, jump to type alarm
    14    TP   RA7     A
    15    ST   GC52    RA6       Number of reusable temps for object
                                 program to A
    16    TJ   GC23    EG20      Is number of reusable temps more than
                                 776 8?
    17    MJ   0       EG2       Yes, jump to type alarm
(7) 20    SA   RA2     0         Number reusable temps + number redundancy
                                 temps
    21    SA   RA4     0         Add number of relative constants
    22    SA   RA3     0         Add number of lines in object program
                                 body
    23    TV   A       FL1       Number lines in object prog. including
                                 temps to Op. File 1
    24    SP   RA4     6         Form codeword containing number of
    25    TV   A       RA6       redundancy temps, number of reusable
    26    TU   RA2     TT        temps and number of relative constants
    27    SP   TT      11        for third line of prelude for
    30    SA   RA6     3         routine.
    31    TP   A       RA5       Store codeword temporarily
    32    TP   II47    TT2       [MJ   0   1000] to temp 2 (jump to
                                 exit)
    33    RJ   SI      SI1       Store inst. in temp 2 in routine image
(8) 34    TP   SI6     A
    35    EJ   GC27    EG41      Number of instructions in generated
                                 routine ≤ 170 8?
    36    TP   SI12    A         No
    37    ST   GC30    TT3       Number of relative constants in relative
          CA   EG40              constant image to A
```

```
      IA    EG40
40    MJ    0       EG45
41    TP    SI12    A
42    ST    GC30    TT3      Number of relative constants in
                               relative constant image to A
43    SA    SI1     0
44    TJ    GC42    EG101    Number lines in Gen. routine including
                               rel. const. ≤ 170(8)?
(9)
45    TP    SI1     A        No
46    ST    GC24    TT4
47    SA    GC31    17
50    TU    A       EG52
51    TV    SI6     EG53
52    RP    [30000] EG54  }  Generated Instructions from routine
                            }  buffer
53    TP    RB      [30000]}  to current address in routine image
                               on drum
54    TP    TT3     A
55    SA    GC31    17
56    TU    A       EG62
57    TV    TT4     TT1
60    TV    SI6     EG63
61    RA    EG63    TT1
62    RP    [30000] EG64  }  Relative constants from relative
63    TP    CI      [30000]}  constant image to routine image on drum
64    TV    EG63    EG53     following generated instructions
65    RA    TT3     EG53
66    SS    GC27    0
67    TV    A       RI       Number lines in prelude & routine to
                               1st line of prelude
(10)
70    ST    GC40    RI1      Number lines subject to address
                               modification to 2nd line of prelude
71    TP    RA5     RI2      Codeword to third line of prelude
                               for routine
72    TP    EL      A        Sentence callword from first word in
                               Expanded List to A
73    TJ    GC46    EG75     Is callword for equation in pseudo
                               operation? (22---)
74    TJ    GC15    EG77     No, is callword for separate equation?
                               (24--- or 25---)
(11)
75    RA    RA7     GC2      No, advance highest reusable temp
                               callword by two
76    TV    A       RI6      Callword to "v" of exit line for
                               Generated Routine
77    TP    GC16    OP1      Send parameter to write Generated Routine
                               from drum
      CA    EG100
```

		IA	EG100		
	100	MJ	0	EG123	
(12)	101	TP	TT3	A	Number of relative constants in rel. const. image to A
	102	SA	GC31	17	
	103	TU	A	EG105	
	104	TV	SI1	EG106	
	105	RP	[30000]	EG107	Relative constants from relative constant image to routine buffer in core following generated instructions
	106	TP	CI	[30000]	
	107	TV	EG106	SI1	
	110	RA	TT3	SI1	
	111	SS	GC24	0	
	112	TV	A	RB	Number lines in prelude and routine to 1st line of prelude
	113	ST	GC40	RB1	Number lines subject to address modification to 2nd line of prelude
	114	TP	RA5	RB2	Codeword to third line of prelude
(13)	115	TP	EL	A	Sentence callword from first word in Expanded List to A
	116	TJ	GC46	EG120	Is callword for equation in Pseudo operation? (22---)
	117	TJ	GC15	EG122	No, is callword for separate equation? (24--- or 25---)
(14)	120	RA	RA7	GC2	No, advance highest reusable temp callword by two
	121	TV	A	RB6	Callword to "v" of exit line for Generated Routine
	122	TP	GC43	OP1	Send parameter to write Generated Routine from core
(15)	123	RJ	OP	OP2	Write generated routine and Op. File 1 item on tape
	124	MJ	0	BG	Jump to exit from phase
		CA	EG125		

		IA	GY		Generate Subscript Instructions
(16) "Sub" Operator	0	RJ	GS5	GS	Next word from Expanded List to temp 6
	1	LQ	A	25	Indicator from Op. code of word to "u" of A
	2	AT	II16	A	MJ | INDICATOR | 00000 → A
	3	RP	30007	GY14	Search list for indicator
	4	TJ	GY5	GY5	Jump according to indicator
	5	MJ	0	GY15	Ind = 0
	6	MJ	1	GY20	Ind = 1
	7	MJ	2	GY22	Ind = 2
	10	MJ	3	GY30	Ind = 3
	11	MJ	4	GY34	Ind = 4
	12	MJ	5	GY42	Ind = 5
	13	MJ	6	GY47	Ind = 6
	14	MJ	7	GY61	Ind = 7
(17) Ind = 0	15	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	16	RJ	GS12	GV31	To R7
	17	MJ	0	GY73	
(18) Ind = 1	20	RA	RA3	GC2	Adv. current rel. address by 2 in "u" and "v"
	21	MJ	0	GY73	
(19) Ind = 2	22	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	23	RA	RA10	GC6	Adv. add. in Exp. List by 1 → Add. of P.R. value
	24	TU	A	GV2	Add. of word following last subs. in Exp. List → "u" of TP
	25	RJ	GV21	GV11	To R4
	26	RJ	GS12	GV7	To R2
	27	MJ	0	GY56	
(20) Ind = 3	30	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	31	TU	RA10	GV2	Add. of last S.S. in Exp. List → "u" of TP
	32	RA	RA10	GC6	Adv. Add. in Exp. List by 1 → add. of P.R. value
	33	MJ	0	GY67	
(21) Ind = 4	34	RA	RA3	GC4	Adv. current rel. address by 5 in "u" and "v"
	35	RA	RA10	GC36	Adv. Add. in Exp. List by 2 → Add. of P.R. value
	36	TU	A	GV2	Add. of word following last S.S. in Exp. List → "u" of TP
	37	RJ	GV21	GV11	To R4
		CA	GY40		

		IA	GY40		Generate Subscript Ins. (cont.)
	40	RJ	GS12	GV7	To R2
	41	MJ	0	GY55	
(22) Ind = 5	42	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	43	RA	RA10	GC36	Adv. add. in Exp. List by 2 → Add. of P.R. value
	44	SS	GC6	0	Dec. "u" of A by one → Add. last subs. in Exp. List.
	45	TU	A	GV2	Add. of last S.S. in Exp. List → "u" of TP
	46	MJ	0	GY66	
(23) Ind = 6	47	RA	RA3	GC5	Adv. current rel. address by 6 in "u" and "v"
	50	RA	RA10	GC37	Adv. add. in Exp. List by 3 → Add. of P.R. value
	51	TU	A	GV2	Add. of word following last S.S. in Exp. List → "u" of TP
	52	RJ	GV21	GV11	To R4
	53	RJ	GS12	GV7	To R2
	54	RJ	GS12	GV	To R1
	55	RJ	GS12	GV	To R1
(24)	56	TP	TT3	TT2	Generated [SA — 0] inst → temp 2
	57	RJ	SI	SI1	Store inst. in temp 2 in routine image
	60	MJ	0	GY70	
(25) Ind = 7	61	RA	RA3	GC4	Adv. current rel. add. by 5 in "u" and "v"
	62	RA	RA10	GC37	Adv. add. in Exp. List by 3 → add. of P.R. value
	63	SS	GC6	0	Dec. "u" of A by one → add. of last S.S. in Exp. list
	64	TU	A	GV2	Add. of last S.S. in Exp. List → "u" of TP
	65	RJ	GS12	GV	To R1
	66	RJ	GS12	GV	To R1
	67	RJ	GS12	GV	To R1
(26)	70	TU	RA10	GY71	Add of P.R. value in Exp. List → "u" of NI
	71	TP	[30000]	TT6	P.R. value → "v" of temp 6
	72	RA	RA10	GC6	Adv. add. in Exp. List by 1 in "u"
(27)	73	RJ	GS12	GV22	To R5
	74	RJ	GS12	GV27	To R6
(28)	75	TP	II42	TT2	[TP A 30000] → Temp 2
	76	RJ	ZZ13	ZZ2	
	77	MJ	0	ZZ22	
		CA	GY100		

		IA	GZ		Generate Fixed Point Inst.
(29) Fixed	0	TP	II12	TT3	[At 30000 A] → Temp 3
add.	1	RJ	GZ53	GZ40	To Z1
	2	MJ	0	ZZ22	
(30) Fixed	3	TP	II13	TT3	[ST 30000 A] → Temp 3
subt.	4	MJ	0	GZ1	
(31) Fixed	5	RJ	GS5	GS	Next word from Expanded List to temp 6
mult.	6	TP	II24	TT2	[MP A 30000] → temp 2
	7	ZJ	GZ12	GZ10	Check indicator from op. code of word in temp 6
	10	RJ	GT27	GT21	Indicator = 0 (to S33)
	11	MJ	0	GZ12	
	12	RJ	GT13	GT5	Indicator = 1 (to S29)
	13	RA	RA3	GC3	Adv. current relative address by one
	14	RJ	SI	SI1	Store inst. in temp 2 in routine image
	15	MJ	0	GY75	
(32)	16	TP	II37	TT3	[DV 30000 A] → temp 3
Fixed	17	RJ	GZ53	GZ40	To Z1
div.	20	RA	RA3	GC3	Adv. current rel. address by 1 in "u" and "v"
	21	RJ	SI	SI1	Store inst. in temp 2 in routine image
	22	TP	II41	TT2	[TP Q A] → temp 2
	23	TP	TT1	A	Partial result symbol → "A" register
	24	RP	[30000]	GE	Is partial result symbol in "A" List?
	25	EJ	XA	ZZ22	Yes → ZZ22; No → GE
(33)	26	TP	II31	TT2	[TN A A] → temp 2
Fixed	27	MJ	0	GZ31	
Unary	30	TP	II44	TT2	[TM A A] → temp 2
minus	31	RJ	GS5	GS	Next word from Expanded List to temp 6
Fixed	32	ZJ	GZ34	GZ33	Check Indicator from op. code of word in temp 6
abs. val.	33	RJ	GT27	GT21	Indicator = 0. (to S33)
	34	TV	TT6	TT1	Ind. = 1; P.R. symbol → "v" of temp 1
	35	TP	TT1	A	P.R. → "v" of A
	36	MJ	0	NZ	
		CA	GZ37		

		IA	GZ40		
(Z1)	40	RJ	GS5	GS	Next word from Expanded List to temp 6
	41	ZJ	GZ54	GZ42	Check indicator in op. code of word (to GZ42 if ind = 0)
Ind = 0	42	RA	RA3	GC3	Adv. current relative address by one
	43	SP	TT5	17	
	44	TU	A	TT	Operand symbol from "v" of temp 5 to "u" of temp 0
	45	RJ	GT27	GT22	To S34
	46	TU	A	TT3	Operand or temp callword to "u" of temp 3
(38)	47	TP	II1	TT2	[TP 30000 A] → to temp 2
	50	RJ	GS12	GT17	To S32A
	51	TP	TT3	TT2	Instruction from temp 3 to temp 2
	52	RJ	ZZ13	ZZ	
	53	MJ	0	[30000]	
(39)	54	TJ	GC14	GZ64	To GZ64 if indicator = 1
Ind = 2	55	TP	II31	TT2	Ind = 2; [TN A A] to temp 2
	56	RJ	SI	SI1	Store instruction in temp 2 in routine image
	57	TU	TT5	TT	Operand symbol from "u" of temp 5 to "u" of temp 0
	60	RA	RA3	GC3	Advance current relative address by one
	61	TP	II12	TT2	[AT 30000 A] → temp 2
	62	RJ	GT27	GT22	To S34
	63	MJ	0	GZ52	
Ind = 1	64	SP	TT5	17	Ind = 1
	65	TU	A	TT	Operand symbol from "v" of temp 5 to "u" of temp 0
	66	TP	TT3	TT2	Instruction from temp 3 to temp 2
	67	MJ	0	GZ62	
		CA	GZ70		

		IA	NZ		
(34A)	0	RP	[30000]	NZ11	Is partial result symbol in "A" List?
	1	EJ	XA	NZ2	Yes → NZ2; no → NZ11
	2	RA	RA3	GC3	Advance current relative address by one
	3	RJ	SI	SI1	Store instruction in temp 2 in routine image
	4	TP	II31	TT4	Set register indicator to "A" in "u" and "v"
	5	TP	II42	TT2	[TP A 30000] → temp 2
	6	TP	TT1	A	Partial result symbol → "v" of A
	7	RJ	NZ21	NZ21	To Z2 (search Redundant P.R. List for P.R.)
	10	MJ	0	GE	Exit - P.R. in "A" List and not in Redundant P.R. List
(34B)	11	RJ	NZ21	NZ21	To Z2 (search Red. P.R. List when P.R. not in "A" List)
	12	RA	RA6	GC3	Advance current reusable temp callword by one
	13	TJ	RA7	NZ15	Is highest temp callword used > current callword?
	14	TP	A	RA7	No; retain current temp callword as highest used
	15	TV	A	TT2	Reusable temp callword → "v" of temp 2
	16	RA	RA3	GC3	Advance current relative address by one
	17	RJ	SI	SI1	Store instruction in temp 2 in routine image
	20	MJ	0	GE	
(Z2)	21	RP	[30000]	[30000]	Is partial result symbol in Redundant P.R. List?
	22	EJ	RL	NZ23	Yes → NZ23; No → repeat exit
	23	TP	RA2	A	jn → "u" & "v" of A
	24	SS	Q	0	jn - (jn - r) → "v" of A
	25	SA	RA5	0	Base redundancy temp callword + r → "v" of A
	26	TV	A	TT2	Redundancy temp callword to "v" of temp 2
	27	MJ	0	NZ16	
		CA	NZ30		

		IA	ZZ		
(Z3)	0	TV	GZ25	ZZ15	
	1	MJ	0	ZZ3	
(Z4)	2	TV	GC22	ZZ15	
	3	TV	TT6	TT1	Partial result symbol to "v" of temp 1
	4	TP	TT1	A	P.R. symbol → "v" of A
	5	RP	[30000]	ZZ14	Is P.R. in Redundant P.R. List?
	6	EJ	RL	ZZ7	Yes to ZZ7 ; no to ZZ14
	7	TP	RA2	A	jn → "u" and "v" of A
	10	SS	Q	0	jn - (jn - r) → "v" of A
	11	SA	RA5	0	Base redundancy temp. callword + r → "v" of A
	12	TV	A	TT2	Redundancy temp. callword → "v" of temp 2
	13	MJ	0	[30000]	Exit
(35)	14	RP	[30000]	ZZ16	Is partial result symbol in "A" List?
	15	EJ	XA	[30000]	No to ZZ16
	16	RA	RA6	GC3	Adv. current reusable temp callword by one
	17	TJ	RA7	ZZ21	Is highest temp used > current temp?
	20	TP	A	RA7	No, retain current temp callword as highest used
	21	TV	A	TT2	Current temp. callword → "v" of temp 2
(36)	22	RA	RA3	GC3	Advance current relative address by one
	23	RJ	SI	SI1	Store inst. in temp. 2 in routine image
(37)	24	TP	II31	TT4	Set register indicator to "A" in "u" and "v"
	25	MJ	0	GE	
		CA	ZZ26		

		IA	GF		Generate Floating Point Inst.
(40) Fl.	0	TP	II20	TT3	[FA 30000 30000] → temp 3
plus	1	MJ	0	GF7	
(41) Fl.	2	TP	II21	TT3	[FS 30000 30000] → temp 3
subt.	3	MJ	0	GF7	
(42) Fl.	4	TP	II22	TT3	[FM 30000 30000] → temp 3
mult.	5	MJ	0	GF7	
(43) Fl.	6	TP	II23	TT3	[FD 30000 30000] → temp 3
divide	7	RJ	GS5	GS	Next word from Expanded List to temp 6
(44)	10	LQ	A	25	Indicator from op. code of word to "u" of A
	11	AT	II16	A	[MJ | INDICATOR | 00000] → A
	12	RP	30047	GF63	Search list for indicator
	13	TJ	GF14	GF14	Jump according to indicator
	14	MJ	0	GG	Ind. = 0
	15	MJ	1	GG6	Ind. = 1
(45)	16	MJ	2	GG10	Ind. = 2
	17	MJ	3	GG15	Ind. = 3
	20	MJ	4	GG17	Ind. = 4
	21	MJ	5	GG41	Ind. = 5
	22	MJ	6	GG55	Ind. = 6
	23	MJ	7	GG46	Ind. = 7
	24	MJ	10	GG50	Ind. = 10
	25	MJ	11	GH	Ind. = 11
	26	MJ	12	GH5	Ind. = 12
(46)	27	MJ	13	GH10	Ind. = 13
	30	MJ	14	GH14	Ind. = 14
	31	MJ	15	GH21	Ind. = 15
	32	MJ	16	GH24	Ind. = 16
	33	MJ	17	GH40	Ind. = 17
	34	MJ	20	GH45	Ind. = 20
	35	MJ	21	GH50	Ind. = 21
	36	MJ	22	GH56	Ind. = 22
	37	MJ	23	GH66	Ind. = 23
		CA	GF40		

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                IA      GF40
(47)    40      MJ      24      GH72        Ind.= 24
        41      MJ      25      GJ          Ind.= 25
        42      MJ      26      GJ6         Ind.= 26
        43      MJ      27      GJ11        Ind.= 27
        44      MJ      30      GJ20        Ind.= 30
        45      MJ      31      GJ27        Ind.= 31
        46      MJ      32      GJ32        Ind.= 32
        47      MJ      33      GI          Ind.= 33
        50      MJ      34      GI7         Ind.= 34
(48)    51      MJ      35      GI13        Ind.= 35
        52      MJ      36      GI21        Ind.= 36
        53      MJ      40      GI25        Ind.= 40
        54      MJ      42      GI33        Ind.= 42
        55      MJ      43      GI36        Ind.= 43
        56      MJ      44      GI43        Ind.= 44
        57      MJ      45      GI50        Ind.= 45
        60      MJ      46      GI54        Ind.= 46
        61      MJ      47      GI61        Ind.= 47
        62      MJ      50      GI65        Ind.= 50
        63      MJ      51      GI71        Ind.= 51
                CA      GF64
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		IA	GG		Generate Floating Point (cont.)
(49) Ind	0	RJ	GS12	GS42	To S11
= 0	1	RA	RA3	GC	Adv. current rel. add. by 4 in "u" and "v"
	2	RJ	GS12	GS6	To S2
	3	RJ	GS12	GS27	To S6
	4	RJ	GS12	GT2	To S28
	5	MJ	0	GK	
(50) Ind	6	RJ	GS12	GS45	To S12
= 1	7	MJ	0	GG1	
(51) Ind	10	RJ	GS12	GS42	To S11
= 2	11	RA	RA3	GC1	Adv. current rel. add. by 3 in "u" and "v"
	12	RJ	GS12	GS32	To S7
	13	RJ	GS12	GT60	To S44
	14	MJ	0	GK	
(52) Ind	15	RJ	GS12	GS45	To S12
= 3	16	MJ	0	GG11	
(53) Ind	17	RA	RA3	GC	Adv. current rel. add. by 4 in "u" and "v"
= 4					
	20	TP	II21	A	[FS 30000 30000] → A
	21	EJ	TT3	GG27	Is floating subtract inst. in temp 3?
	22	RJ	GS12	GS42	No; to S11
	23	RJ	GS12	GS6	To S2
	24	RJ	GS12	GS27	To S6
	25	RJ	GS12	GT70	To S46
	26	MJ	0	GK	
(54)	27	RJ	GS12	GS60	To S16
	30	TP	II5	TT2	[TV A 30000] → temp 2
	31	RJ	GS12	GS7	To S2A
	32	TP	II6	TT2	[RA 30000 30000] → temp 2
	33	LQ	TT6	25	
	34	TU	RA3	TT2	Current relative address to "u" of temp 2
(55)	35	RJ	GS12	GV4	To R3
	36	TP	II40	TT2	[FA Q 30000] → temp 2
	37	RJ	SI	SI1	Store inst. in temp 2 in routine image
		CA	GG40		

```
                IA      GG40
        40      MJ      0       GK
(56) Ind 41     RA      RA3     GC1     Adv. current rel. address by 3 in
= 5                                     "u" and "v"
        42      RJ      GS12    GS62    To S17
        43      RJ      GS12    GS32    To S7
        44      RJ      GS12    GT64    To S45
(57)    45      MJ      0       [30000] Switch(A)
(58) Ind 46     RA      RA3     GC2     Adv. current rel. address by 2 in
= 7                                     "u" and "v"
        47      MJ      0       GG43
(59) Ind 50     RA      RA3     GC1     Adv. current rel. address by 3 in "u"
= 10                                    and "v"
        51      RJ      GS12    GS62    To S17
        52      RJ      GS12    GS32    To S7
        53      RJ      GS12    GT52    To S42
        54      MJ      0       GG45    To switch(A)
(60) Ind 55     TP      II21    A       [FS  30000  30000] → A
= 6     56      EJ      TT3     GG64    Is floating subt. inst. in temp 3?
        57      RA      RA3     GC1     No, advance current relative address
                                        by three
        60      RJ      GS12    GS42    To S11
        61      RJ      GS12    GS32    To S7
        62      RJ      GS12    GT50    To S41
        63      MJ      0       GK
(61)    64      RA      RA3     GC      Adv. current rel. address by 4 in "u"
                                        and "v"
        65      RJ      GS12    GS60    To S16
        66      RJ      GS12    GS70    To S20
        67      RJ      GS12    GS32    To S7
        70      TP      II40    TT3     [FA  Q  30000] → temp 3
        71      LQ      TT5     25
        72      TV      Q       TT3     Operand symbol from "u" of temp 5 to
                                        "v" of temp 3
        73      RJ      GS12    GT43    To S39A
        74      MJ      0       GK
                CA      GG75
```

		IA	GH		Generate Floating Point (cont.)
(62) Ind = 11	0	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	1	RJ	GS12	GS13	To S3
	2	RJ	GS12	GT73	To S47
	3	RJ	GS12	GT16	To S32
	4	MJ	0	GG45	To switch (A)
(63) Ind = 12	5	RA	RA3	GC3	Adv. current rel. address by 1 in "u" and "v"
	6	RJ	GS12	GT54	To S43
	7	MJ	0	GK3	
(64) Ind = 13	10	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	11	RJ	GS12	GS13	To S3
	12	RJ	GS12	GS27	To S6
	13	MJ	0	GH3	
(65) Ind = 14	14	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	15	RJ	GS12	GS13	To S3
	16	RJ	GS12	GT73	To S47
	17	RJ	GS12	GT30	To S35
	20	MJ	0	GG45	To switch (A)
(66) Ind = 15	21	RA	RA3	GC3	Adv. current rel. address by 1 in "u" and "v"
	22	RJ	GS12	GT33	To S36
	23	MJ	0	GK3	
(67) Ind = 16	24	TP	II21	A	[FS 30000 30000] → A
	25	EJ	TT3	GH31	Is floating subt. inst. in temp 3?
	26	RA	RA3	GC3	No, advance current relative address by one
	27	RJ	GS12	GT36	To S37
	30	MJ	0	GK3	
(68)	31	RA	RA3	GC2	Adv. current rel. address by 2 in "u" and "v"
	32	RJ	GS12	GS60	To S16
	33	TP	II40	TT2	[FA Q 30000] → temp 2
	34	LQ	TT5	25	Operand symbol from "u" of temp 5 to "v" of temp 5
	35	RJ	GT13	GT5	To S29
	36	RJ	SI	SI1	Store inst in temp 2 in routine image
	37	MJ	0	GK3	
		CA	GH40		

		IA	GH40		Generate Floating Point (cont.)
(69) Ind = 17	40	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	41	RJ	GS12	GS42	To S11
	42	RJ	GS12	GS47	To S13
	43	RJ	GS12	GS32	To S7
	44	MJ	0	GH54	
(70) Ind = 20	45	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	46	RJ	GS12	GS45	To S12
	47	MJ	0	GH42	
(71) Ind = 21	50	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	51	RJ	GS12	GS35	To S9
	52	RJ	GS12	GS42	To S11
	53	RJ	GS12	GS40	To S10
	54	RJ	GS12	GT41	To S38
	55	MJ	0	GG45	To switch (A)
(72) Ind = 22	56	RA	RA3	GC5	Adv. current rel. address by 6 in "u" and "v"
	57	RJ	GS12	GS42	To S11
	60	RJ	GS12	GS47	To S13
	61	RJ	GS12	GS6	To S2
	62	RJ	GS12	GS13	To S3
	63	RJ	GS12	GS27	To S6
	64	RJ	GS12	GT14	To S31
	65	MJ	0	GG45	To switch (A)
(73) Ind = 23	66	RA	RA3	GC5	Adv. current rel. address by 6 in "u" and "v"
	67	RJ	GS12	GS45	To S12
	70	RJ	GS12	GS47	To S13
	71	MJ	0	GH61	
(74) Ind = 24	72	RA	RA3	GC5	Adv. current rel. address by 6 in "u" and "v"
	73	RJ	GS12	GS6	To S2
	74	RJ	GS12	GS53	To S14
	75	RJ	GS12	GS17	To S4
	76	RJ	GS12	GS42	To S11
	77	MJ	0	GH63	
		CA	GH100		

```
                    IA      GI                  Generate Floating Pt. (Function 61--- type)
(75) Ind    0       RA      RA3     GC4             Adv. current rel. add. by 5 in "u"
= 33                                                and "v"
            1       RJ      GS12    GS6             To S2
            2       RJ      GS12    GS42            To S11
            3       RJ      GS12    GS13            To S3
            4       RJ      GS12    GS27            To S6
            5       RJ      GS12    GT14            To S31
            6       MJ      0       GG45            To switch (A)
(76) Ind    7       RA      RA3     GC4             Adv. current rel. add. by 5 in "u"
= 34                                                and "v"
           10       RJ      GS12    GS6             To S2
           11       RJ      GS12    GS45            To S12
           12       MJ      0       GI3
(77) Ind   13       RA      RA3     GC              Adv. current rel. add. by 4 in "u"
= 35                                                and "v"
           14       RJ      GS12    GS72            To S21
           15       RJ      GS12    GS42            To S11
           16       RJ      GS12    GS32            To S7
           17       RJ      GS12    GT46            To S40
           20       MJ      0       GG45            To switch (A)
(78) Ind   21       RA      RA3     GC              Adv. current rel. add. by 4 in "u"
= 36                                                and "v"
           22       RJ      GS12    GS72            To S21
           23       RJ      GS12    GS45            To S12
           24       MJ      0       GI16
(79) Ind   25       RA      RA3     GC              Adv. current rel. add. 4 in "u" and "v"
= 40       26       RJ      GS12    GS23            To S8
           27       RJ      GS12    GS62            To S17
           30       RJ      GS12    GS32            To S7
           31       RJ      GS12    GT42            To S39
           32       MJ      0       GG45            To switch (A)
(80) Ind   33       RA      RA3     GC1             Adv. current rel. add. by 3 in "u"
= 42                                                and "v"
           34       RJ      GS12    GS23            To S8
           35       MJ      0       GI30
(81) Ind   36       RA      RA3     GC1             Adv. current rel. add. by 3 in "u"
= 43                                                and "v"
           37       RJ      GS12    GS6             To S2
           CA       GI40
```

```
                IA      GI40                Gen. Fl. Pt. (Function 61--- Type) (cont.)
          40    RJ      GS12    GS13        To S3
          41    RJ      GS12    GT14        To S31
(82)      42    MJ      0       [30000]     Switch(B)
(83) Ind  43    RA      RA3     GC          Adv. current rel. add. by 4 in "u"
= 44                                        and "v"
          44    RJ      GS12    GS6         To S2
          45    RJ      GS12    GS13        To S3
          46    RJ      GS12    GT73        To S47
          47    MJ      0       GH64
(84) Ind  50    RA      RA3     GC2         Adv. current rel. add.by 2 in "u" & "v"
= 45      51    RJ      GS12    GS6         To S2
          52    RJ      GS12    GT2         To S28
          53    MJ      0       GK3
(85) Ind  54    RA      RA3     GC          Adv. current rel. add. by 4 in "u"
= 46                                        and "v"
          55    RJ      GS12    GS6         To S2
          56    RJ      GS12    GS13        To S3
          57    RJ      GS12    GS27        To S6
          60    MJ      0       GH64
(86) Ind  61    RA      RA3     GC2         Adv. current rel. add. by 2 in "u"
= 47                                        and "v"
          62    RJ      GS12    GS13        To S3
          63    RJ      GS12    GT16        To S35
          64    MJ      0       GI42        To switch(B)
(87) Ind  65    RA      RA3     GC2         Adv. current rel. add. by 2 in "u"
= 50                                        and "v"
          66    RJ      GS12    GS13        To S2
          67    RJ      GS12    GT30        To S19
          70    MJ      0       GI42        To switch(B)
(88) Ind  71    TP      II21    A           [FS  30000  30000] → A
= 51      72    EJ      TT3     GI77        Is floating subtract inst. in temp 3?
          73    RA      RA3     GC2         No, advance current relative address
                                            by two
          74    RJ      GS12    GS6         To S2
          75    RJ      GS12    GT70        To S46
          76    MJ      0       GK3
(89)      77    RA      RA3     GC1         Adv. current rel. add. by 3 in "u"
                                            and "v"
                CA      GI100

                IA      GI100
         100    RJ      GS12    GS101         To S23
         101    RJ      GS12    GS60          To S16
         102    TP      II40    TT2           [FA  Q  30000] → temp 2
         103    RJ      SI      SI1           Store instruction in temp 2 in
                                              routine image
         104    MJ      0       GK3
                CA      GI105
```

```
                    IA      GJ                      Generate Floating Point (cont.)
(90) Ind    0       RA      RA3     GC4             Adv. current rel. address by 5 in "u"
= 25                                                and "v"
            1       RJ      GS12    GS42            To S11
            2       RJ      GS12    GS47            To S13
            3       RJ      GS12    GS23            To S8
            4       RJ      GS12    GS32            To S7
            5       MJ      0       GJ16
(91) Ind    6       RA      RA3     GC4             Adv. current rel. address by 5 in "u"
= 26                                                and "v"
            7       RJ      GS12    GS45            To S12
            10      MJ      0       GJ2
(92) Ind    11      RA      RA3     GC4             Adv. current rel. address by 5 in "u"
= 27                                                and "v"
            12      RJ      GS12    GS32            To S7
            13      RJ      GS12    GS6             To S2
            14      RJ      GS12    GS42            To S11
            15      RJ      GS12    GS27            To S6
            16      RJ      GS12    GT42            To S39
            17      MJ      0       GG45            To switch (A)
(93) Ind    20      RA      RA3     GC4             Adv. current rel. address by 5 in "u"
= 30                                                and "v"
            21      RJ      GS12    GS42            To S11
            22      RJ      GS12    GS47            To S13
            23      RJ      GS12    GS72            To S21
            24      RJ      GS12    GS32            To S7
            25      RJ      GS12    GT46            To S40
            26      MJ      0       GG45            To Switch (A)
(94) Ind    27      RA      RA3     GC4             Adv. current rel. address by 5 in "u"
= 31                                                and "v"
            30      RJ      GS12    GS45            To S12
            31      MJ      0       GJ22
(95) Ind    32      RA      RA3     GC4             Adv. current rel. address by 5 in "u"
= 32                                                and "v"
            33      RJ      GS12    GS72            To S21
            34      RJ      GS12    GS35            To S9
            35      RJ      GS12    GS42            To S11
            36      RJ      GS12    GS40            To S10
            37      MJ      0       GJ25
                    CA      GJ40
```

		IA	GK		Generate Floating Point (cont.)
(96)	0	TU	RA10	GK2	Address of next word in Expanded List → "u" of TV
	1	RA	RA10	GC6	Advance address in Expanded List by 1 in "u"
	2	TV	[30000]	TT6	Partial result symbol from Expanded List to "v" of temp 6
(97)	3	TP	II33	TT4	Set register indicator to "Q" in "u" and "v"
	4	TP	II41	TT3	[TP Q A] → temp 3
	5	RJ	GK34	GK13	To K1
	6	TP	TT3	A	Inst. in temp 3 → A
	7	EJ	II41	GK12	Is inst. in temp 3 = [TP Q A] ?
	10	RA	RA3	GC3	No; advance current relative address by one
	11	RJ	GS12	GT14	To S31 (store instruction in temp 3 in routine image)
	12	MJ	0	GE	
(K1)	13	TV	TT6	TT1	Partial result symbol from "v" of temp 6 to "v" of temp 1
	14	TU	RA2	GK16	Preset repeat to search Redundant P.R. List
	15	TP	TT1	A	Partial result symbol to "v" of A
	16	RP	[30000]	GK25	Is partial result symbol in Redundant P.R. List?
	17	EJ	RL	GK20	Yes, to GK20; no, to GK25
	20	TP	RA2	A	jn to "u" and "v" of A
	21	SS	Q	0	jn - (jn - r) to "v" of A
	22	SA	RA5	0	Base redundancy temp callword + r to "v" of A
	23	TV	A	TT3	Redundancy temp callword to "v" of temp 3
	24	MJ	0	GK34	
(98)	25	TU	RA	GK26	Preset repeat to search "Q" List
	26	RP	[30000]	GK30	Is partial result symbol in "Q" List?
	27	EJ	XQ	GK34	Yes, to GK34; no, to GK30
	30	RA	RA6	GC3	Advance current reusable temp callword by one
	31	TJ	RA7	GK33	Is highest temp callword used > current callword?
(99)	32	TP	A	RA7	No, retain current temp callword as highest used
(100)	33	TV	A	TT3	Reusable temp callword to "v" of temp 3
	34	MJ	0	[30000]	Exit
		CA	GK35		

		IA	GL		Generate Library Routine Reference
(101) Lib. Op.	0	TP	GC7	Q	Mask for rightmost octal digit of "v" → Q
	1	QT	TT5	TT7	Number of arguments for library routine to temp 7
	2	TP	GC32	A	[10 0 3] → A
	3	AT	TT7	TT10	Set 10 line counter → 10 line for last argument
(102)	4	IJ	TT7	GL16	Have all arguments been generated?
(104)	5	RA	RA3	GC3	Yes, advance current relative address by one
	6	TP	II14	TT2	[RJ ___ ___] → temp 2
	7	SP	TT5	17	Library routine callword from "v" of temp 5 to "u" of A
	10	TU	A	TT2	Library callword to "u" of RJ in temp 2
	11	TV	TT5	TT2	Library callword to "v" of RJ in temp 2
	12	RJ	SI	SI1	Store inst. in temp 2 in routine image
	13	TP	II43	TT2	[10 00002 00000] to temp 2
	14	RJ	SI	SI1	Store "10" line in temp 2 in routine image
	15	MJ	0	GK	
	16	RJ	GS5	GS	Next word from Expanded List to temp 6
	17	LQ	A	25	Indicator from op. code of word to "u" of A
	20	AT	II16	A	MJ | indicator | 00000 to "A" register
	21	RP	30006	GL31	Search list for indicator
	22	TJ	GL23	GL23	Jump according to indicator
	23	MJ	0	GM	Ind.= 0
(103)	24	MJ	1	GM12	Ind.= 1
	25	MJ	2	GM17	Ind.= 2
	26	MJ	3	GM25	Ind.= 3
	27	MJ	4	GM30	Ind.= 4
	30	MJ	5	GM43	Ind.= 5
	31	MJ	33	GM46	Ind.= 33
		CA	GL32		

		IA	GM		Generate Library Routine Ref. (cont.)
(105) Ind = 0	0	RA	RA3	GC3	Adv. current rel. add. by 1 in "u" and "v"
	1	TP	II1	TT2	[TP 30000 A] → temp 2
	2	TV	TT5	TT2	Library routine callword to "v" of TP inst. in temp 2
	3	TU	TT6	TT	Argument callword from "u" of temp 6 to "u" of temp 1
	4	RJ	GT27	GT22	To S34
(106)	5	RJ	SI	SI1	Store inst. in temp 2 in routine image
	6	TP	TT10	TT2	"10" line for argument to temp 2
	7	RJ	SI	SI1	Store "10 line" in temp 2 in routine image
	10	RS	TT10	GC11	Decrease "10" line counter by one
	11	MJ	0	GL4	
(107) Ind = 1	12	RA	RA3	GC3	Adv. current rel. add. by 1 in "u" and "v"
	13	TP	II1	TT2	[TP 30000 A] → temp 2
	14	TU	TT4	TT2	"u" of register indicator to "u" of TP inst. in temp 2
	15	TV	TT5	TT2	Library routine callword to "v" of TP inst. in temp 2
	16	MJ	0	GM5	
(108) Ind = 2	17	RA	RA3	GC	Adv. current rel. add. by 4 in "u" and "v"
	20	RJ	GS12	GS56	To S15
	21	RJ	GS12	GS106	To S2
	22	RJ	GS12	GS27	To S6
	23	TP	II1	TT2	[TP 30000 A] → temp 2
	24	MJ	0	GM15	
(109) Ind = 3	25	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	26	RJ	GS12	GS45	To S12
	27	MJ	0	GM21	
(110) Ind = 4	30	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	31	RJ	GS12	GS56	To S15
	32	RJ	GS12	GS32	To S7
	33	TP	II1	TT3	[TP 30000 A] → temp 3
	34	TU	TT6	TT3	Argument callword to "u" of TP inst. in temp 3
	35	TV	TT5	TT3	Library routine callword to "v" of TP inst. in temp 3
(111)	36	RJ	GS12	GT43	To S39A (inst. in temp 3 to relative constant image)
	37	TP	TT10	TT3	"10" line for argument to temp 3
		CA	GM40		

```
                IA      GM40
        40      RJ      SI      SI12        "10" line in temp 3 to relative
                                            constant image
        41      RS      TT10    GC11        Decrease "10" line counter by one
        42      MJ      0       GL4
(112) Ind 43    RA      RA3     GC1         Adv. current rel. add. by 3 in "u"
= 5                                         and "v"
        44      RJ      GS12    GS45        To S12
        45      MJ      0       GM32
(113) Ind 46    RA      RA3     GC2         Adv. current rel. add. by 2 in "u"
= 33                                        and "v"
        47      RJ      GS12    GS106       To S25
        50      MJ      0       GM23
                CA      GM51
```

		IA	GN		Generate Floating Neg. and Abs. Value
(114) Fl.	0	TP	II3	TT3	[TN 30000 Q] → temp 3
Unary	1	MJ	0	GN3	
minus	2	TP	II2	TT3	[TM 30000 Q] → temp 3
(115) Fl.	3	RJ	GS5	GS	Next word from Expanded List to temp 6
Abs. Value	4	LQ	A	25	Indicator from op. code of word to "u" of A
(116)	5	AT	II16	A	Form [MJ | indicator | 00000] in A
	6	RP	30006	GN16	Search list for indicator
	7	TJ	GN10	GN10	Jump according to indicator
	10	MJ	0	GN17	Ind. = 0
(117)	11	MJ	1	GN26	Ind. = 1
	12	MJ	2	GN30	Ind. = 2
	13	MJ	3	GN37	Ind. = 3
	14	MJ	12	GN41	Ind. = 12
	15	MJ	15	GN45	Ind. = 15
	16	MJ	45	GN47	Ind. = 45
(118) Ind	17	RJ	GS12	GV36	To S48
= 0	20	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	21	RJ	GS12	GS6	To S7
	22	RJ	GS12	GS27	To S6
(119)	23	RJ	GN56	GN52	To NI
	24	RJ	GS12	GT14	To S31 (store instruction in temp 3 in routine image)
	25	MJ	0	GE	
(120) Ind	26	RJ	GS12	GS45	To S12
= 1	27	MJ	0	GN20	
(121) Ind	30	RJ	GS12	GS36	To S48
= 2	31	RA	RA3	GC1	Adv. current rel. address by 3 in "u" and "v"
	32	RJ	GS12	GS32	To S7
	33	TU	TT5	TT3	Operand callword from "u" of temp 5 to "u" of temp 3
	34	RJ	GN56	GN52	To (N1)
	35	RJ	GS12	GT43	To S39A (inst. from temp 3 to relative constant image)
	36	MJ	0	GE	
(122) Ind	37	RJ	GS12	GS45	To S12
= 3		CA	GN40		

```
                IA    GN40
          40    MJ    0       GN31
(123) Ind 41    RJ    GT27    GT21
= 12      42    TU    TT2     TT3
          43    RA    RA3     GC3
          44    MJ    0       GN23
Ind =     45    TU    TT4     TT3
15
          46    MJ    0       GN43
Ind =     47    RA    RA3     GC2
45        50    RJ    GS12    GS6
          51    MJ    0       GN23
(N1)      52    RJ    GK34    GK13
          53    TV    TT3     TT4
          54    SP    TT3     17
          55    TU    A       TT4
          56    MJ    0       30000
                CA    GN57
```

Gen. Fl. Neg. and Abs. Val. (cont.)

To S33

Operand or temp callword to "u" of temp 3

Advance current relative address by one

"u" of register indicator to "u" of temp 3

Advance current relative address by two

To S2

To K1

Set "v" of register indicator

Set "u" of register indicator

		IA	GP		Generate Int. Power Inst.
(126) POW 2	0	RJ	GP65	GP5	To P2
	1	MJ	0	GK3	
(127) POW -2	2	RJ	GP65	GP5	To P2
	3	RJ	GS12	GU	To S49
	4	MJ	0	GK3	
(P2)	5	RJ	GS5	GS	Next word from Expanded List to temp 6
	6	LQ	A	25	Indicator from op. code of word to "u" of A
	7	AT	II16	A	Form [MJ | indicator | 00000] in "A"
	10	RP	30005	GP17	Search list for indicator
	11	TJ	GP12	GP12	Jump according to indicator
	12	MJ	0	GP20	Ind. = 0
	13	MJ	4	GP23	Ind. = 4
	14	MJ	5	GP35	Ind. = 5
	15	MJ	10	GP46	Ind. = 10
	16	MJ	11	GP57	Ind. = 11
	17	MJ	33	GP61	Ind. = 33
(128) Ind = 0	20	RA	RA3	GC3	Adv. current rel. address by 1 in "u" and "v"
	21	RJ	GS12	GU34	To S56
	22	MJ	0	GP65	
(129) Ind = 4	23	RA	RA3	GC	Adv. current rel. address by 4 in "u" and "v"
	24	RJ	GS12	GV36	To S48
	25	RJ	GS12	GU54	To S59
	26	RJ	GS12	GS32	To S7
	27	TP	II22	TT3	[FM 30000 30000] → temp 3
	30	TU	TT5	TT3	Operand callword to "u" of FM inst. in temp 3
	31	LQ	TT5	25	
	32	TV	Q	TT3	Same callword to "v" of FM inst. in temp 3
	33	RJ	GS12	GT43	To S39A (inst. from temp 3 to relative constant image)
	34	MJ	0	GP65	
(130) Ind = 5	35	RA	RA3	GC1	Advance current rel. address by 3 in "u" and "v"
	36	RJ	GS12	GU24	To S54
	37	RJ	GS12	GS21	To S5
		CA	GP40		

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                IA      GP40                Generate Int. Power Inst. (cont.)
        40      RJ      GS12    GS64        To S18
        41      RA      RA3     GC3         Adv. current rel. address by 1 in "u"
                                            and "v"
        42      TP      II34    TT2         [FM   A  A] to temp 2
        43      RJ      SI      SI1         Store inst. in temp 2 in routine image
        44      RJ      GU33    GU27        To S55
        45      MJ      0       GP65
(131) Ind 46    RJ      GS12    GS66        To S19
= 10    47      RA      RA3     GC          Adv. current rel. address by 4 in "u"
                                            and "v"
        50      RJ      GS12    GS76        To S22
        51      RJ      GS12    GS21        To S5
        52      RJ      GS12    GS64        To S18
        53      RA      RA3     GC3         Adv. current rel. address by 1 in "u"
                                            and "v"
        54      TP      II34    TT2         [FM   A  A] to temp 2
        55      RJ      SI      SI1         Store instruction in temp 2 in routine
                                            image
        56      MJ      0       GP65
(132) Ind 57    RA      RA3     GC1         Adv. current rel. address by 3 in "u"
= 11                                        and "v"
        60      MJ      0       GP50
(133) Ind 61    RA      RA3     GC1         Adv. current rel. address by 3 in "u"
= 33                                        and "v"
        62      RJ      GS12    GS6         To S2
        63      RJ      GS12    GS101       To S23
        64      RJ      GS12    GU52        To S58
        65      MJ      0       [30000]     Exit
                CA      GP66
```

```
                    IA      GQ                      Generate Int. Power Inst. (cont.)
(134) POW   0       RJ      GQ54        GQ5         To P3
3           1       MJ      0           GK3
(135) POW   2       RJ      GQ54        GQ5         To P3
-3          3       RJ      GS12        GU          To S49
            4       MJ      0           GK3
(P3)        5       RJ      GS5         GS          Next word from Expanded List to temp 6
            6       LQ      A           25          Indicator from op. code of word to "u"
                                                    of A
            7       AT      II16        A           Form | MJ | indicator | 00000 | in "A"
           10       RP      30005       GQ17        Search list for indicator
           11       TJ      GQ12        GQ12        Jump according to indicator
           12       MJ      0           GQ20        Ind.= 0
           13       MJ      4           GQ25        Ind.= 4
           14       MJ      5           GQ34        Ind.= 5
           15       MJ      10          GQ42        Ind.= 10
           16       MJ      11          GQ46        Ind.= 11
           17       MJ      33          GQ51        Ind.= 33
(136) Ind  20       RA      RA3         GC2         Adv. current rel. address by 2 in "u"
= 0                                                 and "v"
           21       RJ      GS12        GU34        To S56
           22       TU      II33        TT2         "Q" address to "u" of instruction in
                                                    temp 2
           23       RJ      SI          SI1         Store instruction in temp 2 in routine
                                                    image
           24       MJ      0           GQ54
(137) Ind  25       RA      RA3         GC1         Adv. current rel. address by 3 in "u"
= 4                                                 and "v"
           26       RJ      GS12        GV36        To S48
           27       RJ      GS12        GS32        To S7
           30       RJ      GS12        GU14        To S52
           31       RA      RA3         GC2         Advance current rel. address by 2 in
                                                    "u" and "v"
           32       RJ      GS12        GU10        To S51
           33       MJ      0           GQ55
(138) Ind  34       RA      RA3         GC1         Adv. current rel. address by 3 in "u"
= 5                                                 and "v"
           35       RJ      GS12        GU24        To S54
           36       RJ      GU33        GU27        To S55
           37       RJ      GS12        GS21        To S5
                    CA      GQ40
```

```
                IA      GQ40                    Generate Int. Power Inst. (cont.)
          40    RJ      GS12    GU20            To S53
          41    MJ      0       GQ31
Ind =     42    RA      RA3     GC              Adv. current rel. address by 4 in "u"
10                                              and "v"
          43    RJ      GS12    GS66            To S19
          44    RJ      GS12    GS76            To S22
          45    MJ      0       GQ37
Ind =     46    RA      RA3     GC1             Adv. current rel. address by 3 in "u"
11                                              and "v"
          47    RJ      GS12    GS76            To S22
          50    MJ      0       GQ37
Ind =     51    RA      RA3     GC2             Adv. current rel. address by 2 in "u"
33                                              and "v"
          52    RJ      GS12    GS6             To S2
          53    MJ      0       GQ40
          54    MJ      0       [30000]         Exit
          55    RJ      GS12    GU4             To S50
          56    MJ      0       GQ54
                CA      GQ57
```

		IA	GR		Generate Int. Power Inst. (cont.)
(142) POW	0	RJ	GS5	GS	Next word from Expanded List to temp 6
-1	1	LQ	A	25	Indicator from op. code of word to "u" of A
	2	AT	II16	A	From [MJ | indicator | 00000] to "A"
	3	RP	30006	GR13	Search list for indicator
	4	TJ	GR5	GR5	Jump according to indicator
	5	MJ	0	GR14	Ind.= 0
(143)	6	MJ	1	GR21	Ind.= 1
	7	MJ	4	GR25	Ind.= 4
	10	MJ	5	GR36	Ind.= 5
	11	MJ	10	GR50	Ind.= 10
	12	MJ	11	GR53	Ind.= 11
	13	MJ	33	GR57	Ind.= 33
(144) Ind	14	TP	II23	TT2	[FD 30000 30000] → temp 2
= 0	15	LQ	TT5	25	Operand callword from "u" of temp 5 to "v" of temp 5
	16	RJ	GT13	GT5	To S29
	17	RA	RA3	GC3	Advance current relative address by one
	20	MJ	0	GR45	
(145) Ind	21	RA	RA3	GC3	Advance current relative address by one
= 1	22	TP	II23	TT2	[FD 30000 30000] → temp 2
	23	TV	TT4	TT2	"v" of register indicator → "v" of temp 2
	24	MJ	0	GR45	
(146) Ind	25	RA	RA3	GC1	Advance current relative address by three
= 4	26	RJ	GS12	GS66	To S19
	27	RJ	GS12	GS32	To S7
	30	TP	II23	TT3	[FD 30000 30000] → temp 3
	31	TU	TT6	TT3	Constant callword for floating point one to "u" of temp 3
	32	LQ	TT5	25	
	33	TV	Q	TT3	Operand callword to "v" of FD inst. in temp 3
	34	RJ	GS12	GT43	To S39A (inst. from temp 3 to relative constant image)
	35	MJ	0	GK3	
(147) Ind	36	RA	RA3	GC1	Advance current relative address by three
= 5	37	TP	II32	TT2	[SA 30000 0] → temp 2
		CA	GR40		

```
                IA      GR40                    Gen. Int. Power  Inst. (cont.)
        40      TU      RA4     TT2             Relative constant callword to "u" of
                                                temp 2
        41      RJ      SI      SI1             Store inst. in temp 2 in routine image
        42      RJ      GS12    GS17            To S4
        43      RJ      GU33    GU27            To S55
(148)   44      TP      II23    TT2             [FD  30000  30000] --> temp 2
(149)   45      TU      TT6     TT2             Constant callword for floating point
                                                one to "u" of temp 2
        46      RJ      SI      SI1             Store inst. in temp 2 in routine image
        47      MJ      0       GK3
(150) Ind 50    RA      RA3     GC1             Adv. current rel. add. by 3 in "u"
=10                                             and "v"
        51      RJ      GS12    GS101           To S23
        52      MJ      0       GR62
(151) Ind 53    RA      RA3     GC1             Adv. current rel. add. by 3 in "u"
=11                                             and "v"
        54      RJ      GS12    GS114           To S26
        55      RJ      GS12    GS17            To S4
        56      MJ      0       GR44
(152) Ind 57    RA      RA3     GC2             Adv. current rel. address by 2 in "u"
=33                                             and "v"
        60      RJ      GS12    GS101           To S23
        61      MJ      0       GR44
        62      TP      II6     TT2             [RA  30000  30000] to temp 2
        63      RJ      GT13    GT5             To S29
        64      TU      RA3     TT2             Current relative address to "u" of
                                                temp 2
        65      RJ      SI      SI1             Store instruction in temp 2 in
                                                routine image
        66      MJ      0       GR44
                CA      GR67
```

		IA	GW		Generate Int. Power Inst. (cont.)
(153) POW (4 to 63)	0	RJ	GW64	GW10	To P4
	1	MJ	0	GK	
(154) POW (=4 to -63)	2	RJ	GW64	GW10	To P4
	3	TU	RA10	GW5	Address of next word in Expanded List → "u" of TP
	4	RA	RA10	GC6	Advance address in Expanded List by 1 in "u"
	5	TP	[30000]	TT6	Next word in Expanded List to temp 6
	6	RJ	GS12	GU	To S49
	7	MJ	0	GK3	
(P4)	10	RJ	GW73	GW65	Next word from Expanded List to temp 6
	11	LQ	A	25	Indicator from op. code of next word to "u" of A
	12	AT	II16	A	Form [MJ | indicator | 00000] in "A"
	13	RP	30005	GW22	Search list for indicator
	14	TJ	GW15	GW15	Jump according to indicator
	15	MJ	0	GW23	Ind. = 0
	16	MJ	4	GW34	Ind. = 4
	17	MJ	5	GW46	Ind. = 5
	20	MJ	10	GW53	Ind. = 10
	21	MJ	11	GW57	Ind. = 11
	22	MJ	33	GW61	Ind. = 33
(155) Ind =0	23	RA	RA3	GC1	Adv. current rel. address by 3
	24	RJ	GS12	GU34	To S56
	25	RJ	GS12	GU42	To S57
	26	TP	II35	TT2	[FM Q 30000] → temp 2
	27	LQ	TT5	25	
	30	TV	Q	TT1	Operand callword from "u" of temp 5 to "v" of temp 1
	31	RJ	GT13	GT6	To S30
	32	RJ	SI	SI1	Store inst. in temp 2 in routine image
	33	MJ	0	GW64	
(156) Ind =4	34	RA	RA3	GC1	Advance current relative address by three
	35	RJ	GS12	GV36	To S48
	36	RJ	GS12	GS32	To S7
	37	MJ	0	GW74	
		CA	GW40		

```
                IA      GW40                    Generate Int. Power Inst. (cont.)
          40    RA      RA3     GC1             Adv. current rel. address by 3 in "u"
                                                and "v"
          41    RJ      GS12    GU20            To S53
          42    RJ      GS12    GU10            To S51
          43    RJ      GS12    GU42            To S57
          44    RJ      GS12    GU4             To S50
          45    MJ      0       GW64
(157) Ind 46    RA      RA3     GC1             Adv. current address by 3 in "u" and "v"
= 5       47    RJ      GS12    GU24            To S54
          50    RJ      GU33    GU27            To S55
          51    RJ      GS12    GS21            To S5
          52    MJ      0       GW40
(158) Ind 53    RA      RA3     GC              Adv. current rel. add. by 4 in "u"
= 10                                            and "v"
          54    RJ      GS12    GV31            To R7
          55    RJ      GS12    GS76            To S22
          56    MJ      0       GW51
(159) Ind 57    RA      RA3     GC1             Adv. current rel. address by 3 in "u"
= 11                                            and "v"
          60    MJ      0       GW55
(160) Ind 61    RA      RA3     GC2             Adv. current rel. address by 2 in "u"
= 33                                            and "v"
          62    RJ      GS12    GS6             To S2
          63    MJ      0       GW40
          64    MJ      0       [30000]         Exit
(P5)      65    TU      RA10    GW67            Preset address of next word in Expanded
                                                List
          66    RA      RA10    GC6             Advance address in Expanded List by one
          67    TP      [30000] TT6             Next word in Expanded List to temp 6
          70    TU      RA10    GW72            Preset address of next word in Expanded
                                                List
          71    TP      GC10    Q
          72    QT      [30000] A               Indicator from op. code of this word to
                                                op. code of A
          73    MJ      0       [30000]
          74    RJ      GS12    GU14            To S52
          75    RA      RA3     GC1             Advance current relative address by
                                                three
          76    MJ      0       GW42
                CA      GW77
```

```
                    IA    GX                    Generate Int. Power Inst. (cont.)
(161) POW    0      RJ    GX67    GX5           To P1
1/2          1      MJ    0       GK3
(162) POW    2      RJ    GX67    GX5           To P1
-1/2         3      RJ    GS12    GU            To S49
             4      MJ    0       GK3
(P1)         5      TP    GC32    TT10          Preset "10" line counter to
                                                 [10   00000  00003]
             6      RJ    GS5     GS            Next word from Expanded List to temp 6
             7      LQ    A       25            Indicator from op. code of this word to
                                                 "u" of A
            10      AT    II16    A             Form [MJ | indicator | 00000] in A
            11      RP    30006   GX21          Search list for indicator
            12      TJ    GX13    GX13          Jump according to indicator
            13      MJ    0       GX22          Ind.= 0
            14      MJ    1       GX26          Ind.= 1
            15      MJ    4       GX32          Ind.= 4
(163)       16      MJ    5       GX44          Ind.= 5
            17      MJ    10      GX46          Ind.= 10
            20      MJ    11      GX47          Ind.= 11
            21      MJ    33      GX53          Ind.= 33
(165) Ind   22      RA    RA3     GC3           Adv. current rel. address by 1 in "u"
= 0                                             and "v"
            23      TP    II30    TT2           [TP   30000  50051] → temp 2
            24      RJ    GT27    GT21          To S33
            25      MJ    0       GX56
(166) Ind   26      RA    RA3     GC3           Advance current relative address by one
= 1         27      TP    II30    TT2           [TP   30000  50051] → temp 2
            30      TU    TT4     TT2           "u" of register indicator to "u" of
                                                 temp 2
            31      MJ    0       GX56
(167) Ind   32      RA    RA3     GC1           Adv. current rel. add. by 3 in "u"
= 4                                             and "v"
            33      RJ    GS12    GV36          To S48
            34      RJ    GS12    GS32          To S7
            35      TP    II30    TT3           [TP   30000  50051] → temp 3
            36      TU    TT5     TT3           Operand callword from
                                                 "u" of temp 5 to "u" of temp 3
            37      RJ    GS12    GT43          To S39A (Inst. from temp 3 to relative
                                                 constant image)
                    CA    GX40
```

```
                IA      GX40                    Gen. Int. Power (cont.)
        40      RA      TT10    GC11            Advance "10" line counter by one
        41      TP      A       TT3             "10" line in "A" to temp 3
        42      RJ      SI      SI12            "10" line in temps 3 to relative
                                                constant image
        43      MJ      0       GX62
(168) Ind 44    RJ      GS12    GU24            To S54
=5      45      MJ      0       GX72
(169) Ind 46    RJ      GS12    GX70
=10     47      RJ      GS12    GS76            To S22
(170) Ind 50    RA      RA3     GC1             Advance current relative address by
=11                                             three
(171)   51      RJ      GS12    GS21            To S5
        52      MJ      0       GX55
Ind =   53      RA      RA3     GC2             Advance current relative address by
33                                              two
        54      RJ      GS12    GS6             To S2
(164)   55      TP      II30    TT2             [TP   30000  50051]  to temp 2
(172)   56      RJ      SI      SI1             Store inst. in temp 2 in routine image
        57      RA      TT10    GC11            Advance "10" line counter by one in "v"
        60      TP      A       TT2             "10" line in A to temp 2
        61      RJ      SI      SI1             Store inst. in temp 2 in routine image
(173)   62      RA      RA3     GC3             Advance current relative address by one
        63      TP      II14    TT2             [RJ   50051  50051] to temp 2
        64      RJ      SI      SI1             Store inst. in temp 2 in routine image
        65      TP      II43    TT2             [10  00002  00000]to temp 2
        66      RJ      SI      SI1             Store "10" line in temp 2 in routine
                                                image
        67      MJ      0       [30000]         Exit
        70      RA      RA3     GC3             Advance current relative address by one
        71      MJ      0       GV31            To R7
        72      RJ      GU33    GU27            To S55
        73      MJ      0       GX50
                CA      GX74
```

		IA	GA		
					Generate Store (by or =) Instruction
(174)	0	TP	II46	TT3	[TP 30000 30000] instruction to temp 3
	1	TV	GC33	GG45	Set switch (A)
	2	TV	GC33	GI42	Set switch (B)
	3	RJ	GS5	GS	Next word from Expanded List to temp 6
	4	LQ	A	25	Indicator from op. code of this word to "u" of A
	5	AT	II16	A	Form [MJ | indicator | 00000] in A
	6	RP	30042	GA52	Search list for indicator
	7	TJ	GA10	GA10	Jump according to indicator
	10	MJ	0	GB	Ind. = 0
	11	MJ	1	GB10	Ind. = 1
(175)	12	MJ	2	GB12	Ind. = 2
	13	MJ	3	GB17	Ind. = 3
	14	MJ	5	GG41	Ind. = 5
	15	MJ	7	GG46	Ind. = 7
	16	MJ	10	GG50	Ind. = 10
	17	MJ	11	GH	Ind. = 11
	20	MJ	12	GB27	Ind. = 12
	21	MJ	13	GH10	Ind. = 13
(176)	22	MJ	14	GH14	Ind. = 14
	23	MJ	15	GB21	Ind. = 15
	24	MJ	17	GH40	Ind. = 17
	25	MJ	20	GH45	Ind. = 20
	26	MJ	21	GH50	Ind. = 21
	27	MJ	22	GH56	Ind. = 22
	30	MJ	23	GH66	Ind. = 23
	31	MJ	24	GH72	Ind. = 24
(177)	32	MJ	25	GJ	Ind. = 25
	33	MJ	26	GJ6	Ind. = 26
	34	MJ	30	GJ20	Ind. = 30
	35	MJ	31	GJ27	Ind. = 31
	36	MJ	32	GJ32	Ind. = 32
	37	MJ	33	GI	Ind. = 33
		CA	GA40		

	IA	GA40		Gen. Store Inst. (cont.)
40	MJ	34	GI7	Ind. = 34
41	MJ	35	GI13	Ind. = 35
(178) 42	MJ	36	GI21	Ind. = 36
43	MJ	40	GI25	Ind. = 40
44	MJ	42	GI33	Ind. = 42
45	MJ	43	GI36	Ind. = 43
46	MJ	44	GI43	Ind. = 44
47	MJ	45	GB24	Ind. = 45
50	MJ	46	GI54	Ind. = 46
51	MJ	47	GI61	Ind. = 47
52	MJ	50	GI65	Ind. = 50
	CA	GA53		

		IA	GB		Gen. Store Inst. (cont.)
(179) Ind	0	RJ	GS12	GS42	To S11
=0	1	RA	RA3	GC	Advance current relative address by four
	2	RJ	GS12	GS6	To S2
	3	RJ	GS12	GS27	To S6
	4	TV	TT5	TT3	Callword of variable defined by equation to "v" of temp 3
	5	TP	TT3	TT2	Generated inst. to store result to temp 2
	6	RJ	SI	SI1	Store inst. in temp 2 in routine image
	7	MJ	0	EG	
(180) Ind	10	RJ	GS12	GS45	To S12
=1	11	MJ	0	GB1	
(181) Ind	12	RJ	GS12	GS42	To S11
=2	13	RA	RA3	GC1	Advance current relative address by three
	14	RJ	GS12	GS32	To S7
	15	RJ	GS12	GT41	To S38
	16	MJ	0	EG	
(182) Ind	17	RJ	GS12	GS45	To S12
=3	20	MJ	0	GB13	
(183) Ind	21	RA	RA3	GC3	Advance current relative address by one
=15	22	TU	TT4	TT3	"A" or "Q" address from register indicator to "u" of temp 3
	23	MJ	0	GB4	
(184) Ind	24	RA	RA3	GC2	Advance current relative address by two
=45	25	RJ	GS12	GS6	To S2
	26	MJ	0	GB4	
(185) Ind	27	RA	RA3	GC3	Advance current relative address by one
=12	30	TV	TT5	TT3	
	31	RJ	GS12	GT16	To S32
	32	MJ	0	EG	
		CA	GB33		

		IA	GS		Equation Generation Subroutines
(S1)	0	TU	RA10	GS2	Address of next word in Expanded List to "u" of TP
	1	RA	RA10	GC6	Advance address in Expanded List by 1 in "u"
	2	TP	[30000]	TT6	Next word in Expanded List to temp 6
	3	TP	GC10	Q	Mask for op. code to Q
	4	QT	TT6	A	Indicator from op. code of temp 6 to op. code of A
	5	MJ	0	[30000]	Exit
(S2)	6	TP	II4	TT2	[TU A 30000] → temp 2
	7	TU	TT5	TT2	Callword from "u" of temp 5 to "u" of temp 2
	10	TV	RA3	TT2	Current relative address to "v" of temp 2
	11	RJ	SI	SI1	Store instruction in temp 2 in routine image
	12	MJ	0	[30000]	Common exit
(S3)	13	TP	II5	TT2	[TV A 30000] → temp 2
	14	SP	TT5	17	
	15	TU	A	TT2	Callword from "v" of temp 5 to "u" of temp 2
	16	MJ	0	GS10	
(S4)	17	TP	II5	TT2	[TV A 30000] → temp 2
	20	MJ	0	GS10	
(S5)	21	TP	II4	TT2	[TU A 30000] → temp 2
	22	MJ	0	GS10	
(S8)	23	TP	II4	TT2	[TU A 30000] → temp 2
	24	TU	TT5	TT2	Callword from "u" of temp 5 to "u" of temp 2
	25	TV	RA4	TT2	Relative constant callword to "v" of temp 2
	26	MJ	0	GS11	
(S6)	27	TP	II33	TT2	[AT Q Q] → temp 2
	30	TU	RA3	TT2	Current relative address to "u" of temp 2
	31	MJ	0	GS10	
(S7)	32	TP	II33	TT2	[AT Q Q] → temp 2
	33	TU	RA4	TT2	Relative constant callword to "u" of temp 2
	34	MJ	0	GS10	
(S9)	35	TP	II33	TT2	[AT Q Q] → temp 2
	36	TU	RA4	TT2	Relative constant callword to "u" of temp 2
	37	MJ	0	GS11	
		CA	GS40		

```
                IA      GS40
(S10)   40      TP      II33    TT2     [AT  Q  Q] → temp 2
        41      MJ      0       GS10
(S11)   42      TP      II7     TT2     [SP  A  17] → temp 2
        43      TU      TT6     TT      Callword from "u" of temp 6 to "u"
                                        of temp 0
        44      MJ      0       GV34
(S12)   45      TP      II7     TT2     [SP  A  17] → temp 2
        46      MJ      0       GS11
(S13)   47      TP      II32    TT2     [SA  30000  0] → temp 2
        50      SP      TT6     17      Callword from "v" of temp 6 to "u" of A
        51      TU      A       TT      "u" of A  to "u" of temp 2
        52      MJ      0       GV34
(S14)   53      TP      II32    TT2     [SA  30000  0] → temp 2
        54      SP      TT5     17      Callword from "v" of temp 5 to "u" of A
        55      MJ      0       GS112
(S15)   56      TP      II7     TT2     [SP  A  17] → temp 2
        57      MJ      0       GS50
(S16)   60      TP      II45    TT2     [TN  Q  Q] → temp 2
        61      MJ      0       GS11
(S17)   62      TP      II1     TT2     [TP  30000  A] → temp 2
        63      MJ      0       GS50
(S18)   64      TP      II1     TT2     [TP  30000  A] → temp 2
        65      MJ      0       GS11
(S19)   66      TP      II1     TT2     [TP  30000  A] → temp 2
        67      MJ      0       GV32
(S20)   70      TP      II1     TT2     [TP  30000  A] → temp 2
        71      MJ      0       GS43
(S21)   72      TP      II5     TT2     [TV  A  30000] → temp 2
        73      SP      TT5     17      Callword from "v" of temp 5 to "u" of A
        74      TU      A       TT2     "u" of A to "u" of temp 2
        75      MJ      0       GS25
(S22)   76      TP      II10    TT2     [SA  30000  17] → temp 2
        77      TU      TT5     TT2     Callword from "u" of temp 5 to "u"
                                        of temp 2
                CA      GS100
```

```
          IA    GS100
     100  MJ    0       GS11
(S23)101  TP    II5     TT2     [TV  A  30000] → temp 2
     102  MJ    0       GS7
(S24)103  TP    II4     TT2     [TU  A  30000] → temp 2
     104  TV    RA3     TT2     Current relative address to "v" of
                                temp 2
     105  MJ    0       GS111
(S25)106  TP    II4     TT2     [TU  A  30000] → temp 2
     107  TU    TT6     TT2     Callword from "u" of temp 6 to "u" of
                                temp 2
     110  MJ    0       GS10
     111  SP    TT6     17      Callword from "v" of temp 6 to "u" of A
     112  TU    A       TT2     "u" of A to "u" of temp 2
     113  MJ    0       GS11
(S26)114  TP    II32    TT2     [SA  30000  0] → temp 2
     115  MJ    0       GS77
          CA    GS116
```

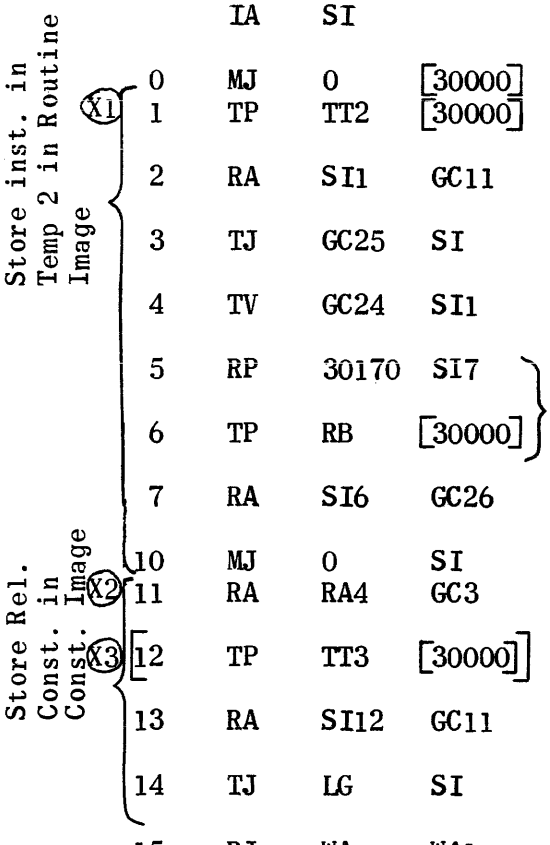
		IA	GT		Generator Subroutines (cont.)
S24	0	TP	II5	TT2	[TV A 30000] → temp 2
	1	MJ	0	GS24	
S28	2	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
	3	RJ	GT13	GT5	To S29
	4	MJ	0	GS11	
S29	5	TV	TT5	TT1	Callword from "v" of temp 5 to "v" of temp 1
S30	6	TP	TT1	A	Callword from "v" of temp 1 to "v" of A
	7	TJ	GC34	GT11	Is callword partial result symbol? (i.e.,30---)
	10	MJ	0	GT12	No
	11	RJ	TR	TR2	Yes; pertinent temporary storage callword to "v" of A
	12	TV	A	TT2	Operand or temp callword to "v" of temp 2
	13	MJ	0	[30000]	Exit
S31	14	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
	15	MJ	0	GS11	
S32	16	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
S32A	17	RJ	GT27	GT21	
	20	MJ	0	GS11	
S33	21	TU	TT5	TT	Callword from "u" of temp 5 to "u" of temp 0
S34	22	TP	TT	A	Callword from "u" of temp 0 to "u" of A
	23	TJ	GC35	GT25	Is callword partial result symbol? (i.e.,30---)
	24	MJ	0	GT26	No
	25	RJ	TR	TR1	Yes, pertinent temporary storage callword to "u" of A
	26	TU	A	TT2	Operand or temp callword to "u" of temp 2
	27	MJ	0	[30000]	Exit
S35	30	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
	31	TU	TT4	TT2	"u" of register indicator to "u" of temp 2
	32	MJ	0	GS11	
S36	33	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
	34	RJ	GT13	GT5	
	35	MJ	0	GT31	
S37	36	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
	37	TV	TT4	TT2	"v" of register indicator to "v" of temp 2
		CA	GT40		

		IA	GT40		
	40	MJ	0	GT17	
S38	41	TU	TT5	TT3	Callword from "u" of temp 5 to "u" of temp 3
S39	42	TV	TT5	TT3	Callword from "v" of temp 5 to "v" of temp 3
S39A	43	RJ	SI	SI11	Inst. in temp 3 to relative constant image
	44	TP	II	TT2	[00 30000 30000] → temp 2
	45	MJ	0	GS11	
S40	46	TU	TT5	TT3	Callword from "u" of temp 5 to "u" of temp 3
	47	MJ	0	GT43	
S41	50	TV	TT4	TT3	"v" of register indicator to "v" of temp 3
	51	MJ	0	GT46	
S42	52	TU	TT4	TT3	"u" of register indicator to "u" of temp 3
	53	MJ	0	GT42	
S43	54	TP	TT3	TT2	[F 30000 30000] from temp 3 → temp 2
	55	RJ	GT13	GT5	To S29
	56	RJ	GT27	GT21	To S33
	57	MJ	0	GS11	
S44	60	TU	TT5	TT3	Callword from "u" of temp 5 to "u" of temp 3
	61	RJ	GT13	GT5	To S29
	62	TV	A	TT3	Callword of variable, constant or temp to "v" of temp 3
	63	MJ	0	GT43	
S45	64	TV	TT5	TT3	Callword from "v" of temp 5 to "v" of temp 3
	65	RJ	GT27	GT21	To S33
	66	TU	A	TT3	Callword of variable, constant or temp to "u" of temp 3
	67	MJ	0	GT43	
S46	70	TP	TT3	TT2	[F_ 30000 30000] from temp 3 → temp 2
	71	TV	TT4	TT2	"v" of register indicator to "v" of temp 2
	72	MJ	0	GS11	
S47	73	TP	II6	TT2	[RA 30000 30000] → temp 2
	74	TU	RA3	TT2	Current relative address to "u" of temp 2
	75	MJ	0	GV4	
		CA	GT76		

```
                IA      GU
(S49)    0      RA      RA3     GC3     Generator Subroutine (Int. Power)
                                        Advance current rel. address by 1 in
                                        "u" and "v"
         1      TP      II36    TT2     [FD  30000  Q] → temp 2
         2      TU      TT6     TT2     Callword from "u" of temp 6 to "u" of
                                        temp 2
         3      MJ      0       GS11
(S50)    4      TP      II35    TT2     [FM  Q  30000] → temp 2
         5      TV      RA6     TT2     Current reusable temp callword to "v"
                                        of temp 2
         6      RS      RA6     GC3     Decrease current reusable temp callword
                                        by one
         7      MJ      0       GS11
(S51)    10     TP      II22    TT2     [FM  30000  30000] → temp 2
         11     TU      RA6     TT2     Current reusable temp callword to "u"
                                        of temp 2
         12     TV      RA6     TT2     Current reusable temp callword to "v"
                                        of temp 2
         13     MJ      0       GS11
(S52)    14     TP      II1     TT3     [TP 30000  A] → temp 3
         15     TU      TT5     TT3     Callword from "u" of temp 5 to "u" of
                                        temp 3
         16     RJ      GK34    GK30    Callword of available reusable temp to
                                        "v" of temp 3
         17     MJ      0       GT43
(S53)    20     TP      II1     TT3     [TP  30000  A] → temp 3
         21     RJ      GK34    GK30    Callword of available reusable temp to
                                        "v" of temp 3
         22     TP      TT3     TT2     Instruction from temp 3 to temp 2
         23     MJ      0       GS11
(S54)    24     TP      II10    TT2     [SA  30000  17] → temp 2
         25     TU      RA4     TT2     Relative constant callword to "u" of
                                        temp 2
         26     MJ      0       GS11
(S55)    27     TU      TT5     TT      Callword from "u" of temp 5 to "u" of
                                        temp 0
         30     SP      TT      25
         31     LT      0       TT3     Callword from "u" of temp 0 to "v" of
                                        temp 3
         32     RJ      SI      SI11    Inst. in temp 3 to relative constant
                                        image
         33     MJ      0       [30000] Exit
(S56)    34     TP      II22    TT2     [FM  30000  30000] → temp 2
         35     RJ      GT27    GT21    To S33
         36     SP      TT2     25
         37     LT      0       A
                CA      GU40
```

		IA	GU40		
	40	TV	A	TT2	Callword from "u" of temp 2 to "v" of temp 2
	41	MJ	0	GS11	
S57	42	TP	II27	TT2	[RP 30000 30000] → temp 2
	43	TP	GC12	Q	Mask for rightmost "two" octal digits of "v" → Q
	44	QT	TT6	A	Exponent from temp 6 to "v" of A
	45	SS	GC13	17	Exponent less two to "u" of A
	46	TU	A	TT2	jn to "u" of repeat instruction in temp 2
	47	TV	RA3	TT2	Current relative address to "v" of RP inst. in temp 2
	50	RA	TT2	GC11	Advance "v" of RP inst. in temp 2 by one
	51	MJ	0	GS11	
S58	52	TP	II22	TT2	[FM 30000 30000] → temp 2
	53	MJ	0	GS11	To (3)
S59	54	TP	GC47	Q	Mask for op. code and "v" to Q
	55	QS	II32	TT2	[32 __ 00000] to op. code and "v" of temp 2
	56	MJ	0	GS11	
		CA	GU57		

```
                IA    GV                  Generator Subroutines (Subscript Operator)
(R1)    0       TP    II25      TT2       [MA  30000  30000] → temp 2
        1       RS    GV2       GC6       Decrease "u" of next instruction by one
        2       TP    [30000]   TT6       Next subscript word from Expanded List
                                            to temp 6
        3       TU    TT6       TT2       Callword of multiplier from "v" of temp
                                            6 to "v" of temp 2
(R3)    4       TV    TT6       TT1       Callword of subscript from "v" of temp
                                            6 to "v" of temp 1
        5       RJ    GT13      GT6       To S30
        6       MJ    0         GS11
(R2)    7       TP    II24      TT2       [MP 30000  30000] → temp 2
        10      MJ    0         GV1
(R4)    11      TP    II32      TT2       [SA  30000    0] → temp 2
        12      RS    GV2       GC6       Decrease by one in "u"
        13      TU    A         GV14      Preset address of next subscript word in
                                            Expanded List
        14      TP    [30000]   TT6       Next subscript word from Expanded List
                                            to temp 6
        15      SP    TT6       17
        16      TU    A         TT        Callword of subscript from "v" of temp
                                            6 to "u" of temp 0
        17      RJ    GT27      GT22      To S34
        20      TP    TT2       TT3       Generated Instruction to temp 3
        21      MJ    0         [30000]
(R5)    22      TP    II15      TT2       [TJ  30000  30000] → temp 2
        23      TV    RA3       TT2       Current relative address to "v" of
                                            temp 2
        24      RA    TT2       GC11      Advance "v" of temp 2
        25      TU    TT5       TT2       Callword from "u" of temp 5 to "u" of
                                            temp 2
        26      MJ    0         GS11
(R6)    27      TP    II26      TT2       [DV  30000  Q] → temp 2
        30      MJ    0         GV25
(R7)    31      TP    II1       TT2       [TP  30000  A] → temp 2
        32      SP    TT5       17        Callword from "v" of temp 5 to "u" of A
        33      TU    A         TT        Callword from "u" of A to "u" of
                                            temp 0
        34      RJ    GT27      GT22      To S34
        35      MJ    0         GS11
(S48)   36      TP    II7       TT2       [SP  A  17] → temp 2
        37      MJ    0         GV32
                CA    GV40
```



	IA	SI		Store inst. in Routine Image or Relative Constant Image
0	MJ	0	[30000]	Exit
1	TP	TT2	[30000]	Inst.in temp 2 to current address in Routine Buffer
2	RA	SI1	GC11	Advance current address in routine buffer by one
3	TJ	GC25	SI	Are there 170$_8$ words in routine buffer? Exit if no.
4	TV	GC24	SI1	Yes; reset current address in routine buffer to initial address
5	RP	30170	SI7	Transfer 170$_8$ generated Inst. from routine buffer to current address in routine image on drum
6	TP	RB	[30000]	
7	RA	SI6	GC26	Advance current address in routine image by 170$_8$
10	MJ	0	SI	To Exit
11	RA	RA4	GC3	Advance current relative constant callword by one
12	TP	TT3	[30000]	Relative constant (or "10" line) in temp 3 to relative constant image
13	RA	SI12	GC11	Advance current address in relative constant image by one
14	TJ	LG	SI	Are there more than 77$_8$ relative constants? Exit if no.
15	RJ	WA	WA1	Yes, type SENTENCE___ (equation)
16	TP	T0	UP3	Parameter for alarm text to type routine
17	RJ	UP2	UP	Type: SENTENCE TOO LONG.
20	MJ	0	BQ6	Rewind tapes and stop
	CA	SI21		

```
          IA    TR                    Obtain Redundancy or Reusable Temp
                                      Callword for Partial Result
     0    MJ    0       [30000]       Exit
(Y1) 1    LT    25      A             Partial result symbol to "v" of A
(Y2) 2    RP    [30000] TR12          Is partial result symbol in Redundant
                                      Partial Result List?
     3    EJ    RL      TR4           Yes; to TR4. No; to TR12
     4    SP    Q       17            jn - r→"u" of A
     5    AT    Q       Q             jn - r→"u" & "v" of Q
     6    TP    RA2     A             jn → "u" & "v" of A
     7    SS    Q       0             +r → "u" & "v" of A
    10    SA    RA5     0             Callword of redundancy temp for partial
                                      result to "u" and "v" of A
    11    MJ    0       TR            To exit
    12    RS    RA6     GC3           Decrease current reusable temp callword
                                      by one
    13    SA    GC3     0             Callword of reusable temp for partial
                                      result to "u" and "v" of A
    14    MJ    0       TR            To exit
          CA    TR15
```

	IA	GC		Generator Constants (Fixed)
0	0	4	4	
1	0	3	3	
2	0	2	2	
3	0	1	1	
4	0	5	5	
5	0	6	6	
6	0	1	0	
7	0	0	7	
10	77	0	0	
11	0	0	1	
12	0	0	77	
13	0	0	2	
14	02	0	0	
15	0	26000	0	
16	0	RI	FL	Parameter to write generated routine from drum to tape
17	0	0	0	
20	0	0	RB7	
21	0	0	GK	To set switch (A)
22	0	0	ZZ24	
23	0	00777	00777	
24	TP	TT2	RB	Initial address in routine buffer in "v"
25	TP	TT2	RB170	
26	0	0	170	
27	TP	RB	RI	Initial address in routine image on drum in "v"
30	TP	TT3	CI	Initial address in relative constant image in "v"
31	0	0	30000	
32	10	0	3	
33	0	0	EG	To set switch (A) and (B)
34	0	0	31000	
35	0	31000	0	
36	0	2	0	
37	0	3	0	
	CA	GC40		

	IA	GC40		
40	0	0	6	
41	0	0	GK3	To switch (B)
42	TP	TT2	RB171	
43	0	RB	FL	Parameter to write generated routine from core to tape
44	0	1000	1000	
45	0	20000	20000	
46	0	23000	0	
47	77	0	77777	
50	0	10000	10000	Initial relative constant callword
51	0	57777	57777	Initial redundancy temp callword less 1
52	0	67777	67777	Initial reusable temp callword less 1
53	0	776	776	
	CA	GC54		

	IA	II		Dummy Instructions
0	00	30000	30000	
1	11	30000	A	
2	12	30000	Q	
3	13	30000	Q	
4	15	A	30000	
5	16	A	30000	
6	21	30000	30000	
7	31	A	17	
10	32	30000	17	
11	34	30000	30000	
12	35	30000	A	
13	36	30000	A	
14	37	50051	50051	Callword of "Square Root" Library Routine (SQRT) in "u" and "v"
15	42	30000	30000	
16	45	0	0	
17	56	0	30000	
20	64	30000	30000	
21	65	30000	30000	
22	66	30000	30000	
23	67	30000	30000	
24	71	A	30000	
25	72	30000	30000	
26	73	30000	Q	
27	75	30000	30000	
30	11	30000	50051	Callword of "Square Root" Library Routine (SQRT) in "v"
31	13	A	A	
32	32	30000	0	
33	35	Q	Q	
34	66	A	A	
35	66	Q	30000	
36	67	30000	Q	
37	73	30000	A	
	CA	II40		
	IA	II40		
40	64	Q	30000	
41	11	Q	A	
42	11	A	30000	
43	10	2	0	
44	12	A	A	
45	13	Q	Q	
46	11	30000	30000	
47	45	0	01000	
50	45	0	30000	
	CA	II51		

	IA	TO		Alarm Text
0	40	T01	3	Parameter for alarm text
1	65	30506	63050	S E N T E N
2	26	30016	65151	C E Δ T 0 0
3	01	46515	03222	Δ L 0 N G .
	CA	T04		

	IA	LG		Limiting Values
0	TP	TT3	CI100	Maximum address in relative constant image + 1
1	0	1002	1002	Maximum number of lines in object program body (including jump to exit) + 1
	CA	LG2		

Explanation of Relative (Running) Address List

RA0	—	—	—	jn for "Q" List search in "u"
1	—	—	—	jn for "A" List search in "u"
2	—	—	—	jn for Redundant Partial Result List
3	—	—	—	Current relative object program address in "u" and "v"
4	—	—	—	Current relative constant callword in "u" and "v"
5	—	—	—	Initial redundancy temp callword less 1 in "u" and "v"
6	—	—	—	Current reusable temporary storage callword in "u" and "v"
7	—	—	—	Highest reusable temporary storage callword in "u" and "v"
10	—	—	—	Initial address in Expanded List + 2 in "u"

Explanation of Working Temporaries (TT)

TT0	0	[30000]	0	Temp 0 - op. code and "v" always zero
1	0	0	[30000]	Temp 1 - op. code and "u" always zero
2	0	0	0	Temp 2 - usually generated instruction to be stored
3	0	0	0	Temp 3 - usually relative constant to be stored
4	0	0	0	Temp 4 - register indicator
5	0	0	0	Temp 5 - operator word from Expanded List
6	0	0	0	Temp 6 - indicator word from Expanded List
7	0	0	0	Temp 7 - index counter
10	0	0	0	Temp 10 - "10" line counter

V. ALLOCATION PHASE

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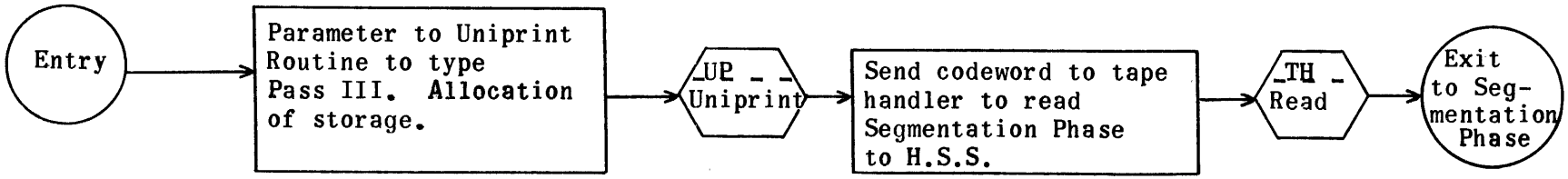
1. Segmentor

a. Segmentation Setup

This Setup Routine for Segmentation prints out the information that the Allocation Phase (including the Segmentor, the Allocator, and the Initialization Generator) is about to begin.

The routine reads the nine blocks of Segmentation from the UNICODE Master Tape and then jumps into the phase.



Flow Chart for Set-Up Segmentation

Segmentation Set-Up Regions

```
      RE      ZS7230          Loading address for segmentation setup
      RE      ZZ7230          Operating address of segmentation setup
      RE      SA674           Loading and operating address of
                                segmentation phase
      RE      SL1100          11 = number of blocks for segmentation
                                phase
      RE      TH21
      RE      UP421
```

Set-Up for Segmentor

```
          IA      ZS
ZZ0       TP      ZZ6     UP3  }   Print:  Pass III.  ALLOCATION OF
                                      STORAGE.
1         RJ      UP2     UP   }
2         TP      ZZ5     TH3  }   Read Segmentation Phase to H.S.S.
3         RJ      TH2     TH   }
4         MJ      0       SA       Enter Segmentation Phase.
5         50      SL1     SA       Tape handler code word (Read).
6         0       ZZ7     7        Code word for UP
7         01      01010   10101    Δ Δ Δ Δ Δ Δ
10        52      24656   50134    P A S S Δ I
11        34      34220   10101    I I . Δ Δ Δ
12        01      24464   65126    Δ A L L 0 C
13        24      66345   15001    A T I 0 N Δ
14        51      31016   56651    0 F Δ S T 0
15        54      24323   02201    R A G E . Δ
          CA      ZS16
```

b. Segmentation

Phase I.

Phase I prepares two directories using Op File I of the generated routines on Uniservo 5 and Op File I of the library routines on Uniservo 2. First, all items of Op File I on the generated routine tape are read into H.S.S. and then transferred to the MD. Directory I is constructed by making an entry for each item placed on the MD. The first word of this entry contains the call word for this item in the u position; the second contains the locating MD address for this item in the y position.

When Op File I of the generated routine tape has been completely read into H.S.S., List 1 (a listing of all library routines required for the problem prepared during translation) is read into H.S.S. (List 1 is stored following Op File I of the generated routine tape.) Next Op File I of the library tape is read from tape and checked for the occurrence of the items of List 1. When an item of List 1 is found in the library Op File I, the Op File for this item is placed on the MD and an entry is made in Directory 1.

Directory 2 consists of only two words. The first word holds the MD address of the first statement Op File; the second contains information relating to the MD address of the last statement Op File. This two word directory is prepared concurrently with Directory 1.

Phase II.

Phase II uses Directories 1 and 2 to divide the problem into efficient running segments producing Op File IIa and IIb on tape for each segment.

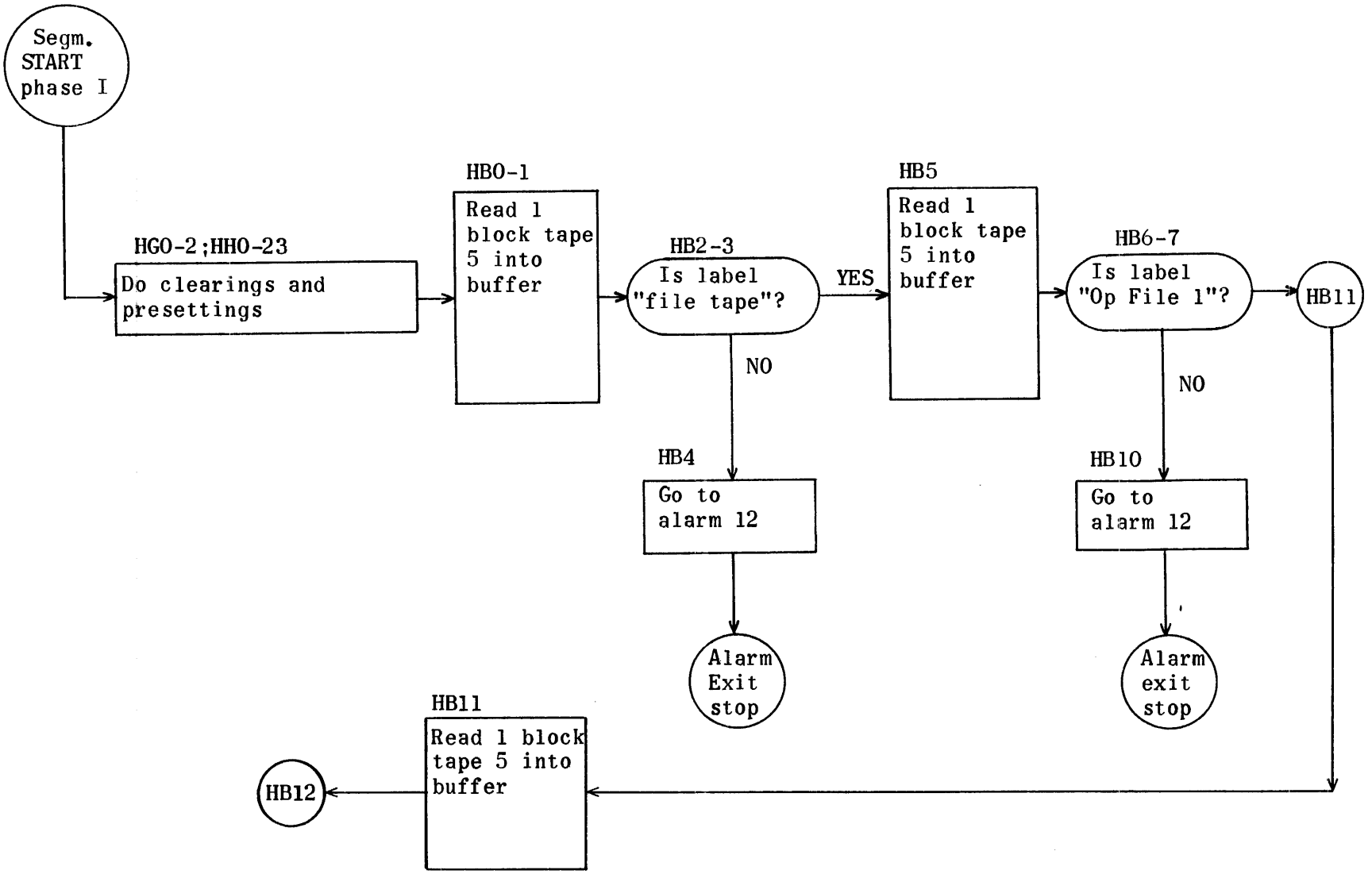
Using the first word of Directory 2 (location of Op File I for the first statement) as the initial point, Op File I for each statement is processed in sequence. A sub-tally of the total number of lines of coding required for each current statement and its necessary cross references is maintained. This in turn updates a master tally for the segment which contains the accumulated total number of lines needed for all statements and their required cross reference routines. After processing each complete statement, the master tally is checked to determine if it is within the prescribed limits (4096m-N; where N is the length of the Control Section and m the number of core banks available). If it has exceeded the set limits, the sub-tally is subtracted from the master tally and this becomes the length of the segment. If a single statement and its necessary cross references exceeds (4096m-N) the routine gives an alarm. The last statement processed which exceeds the set limit becomes the first entry in the following segment.

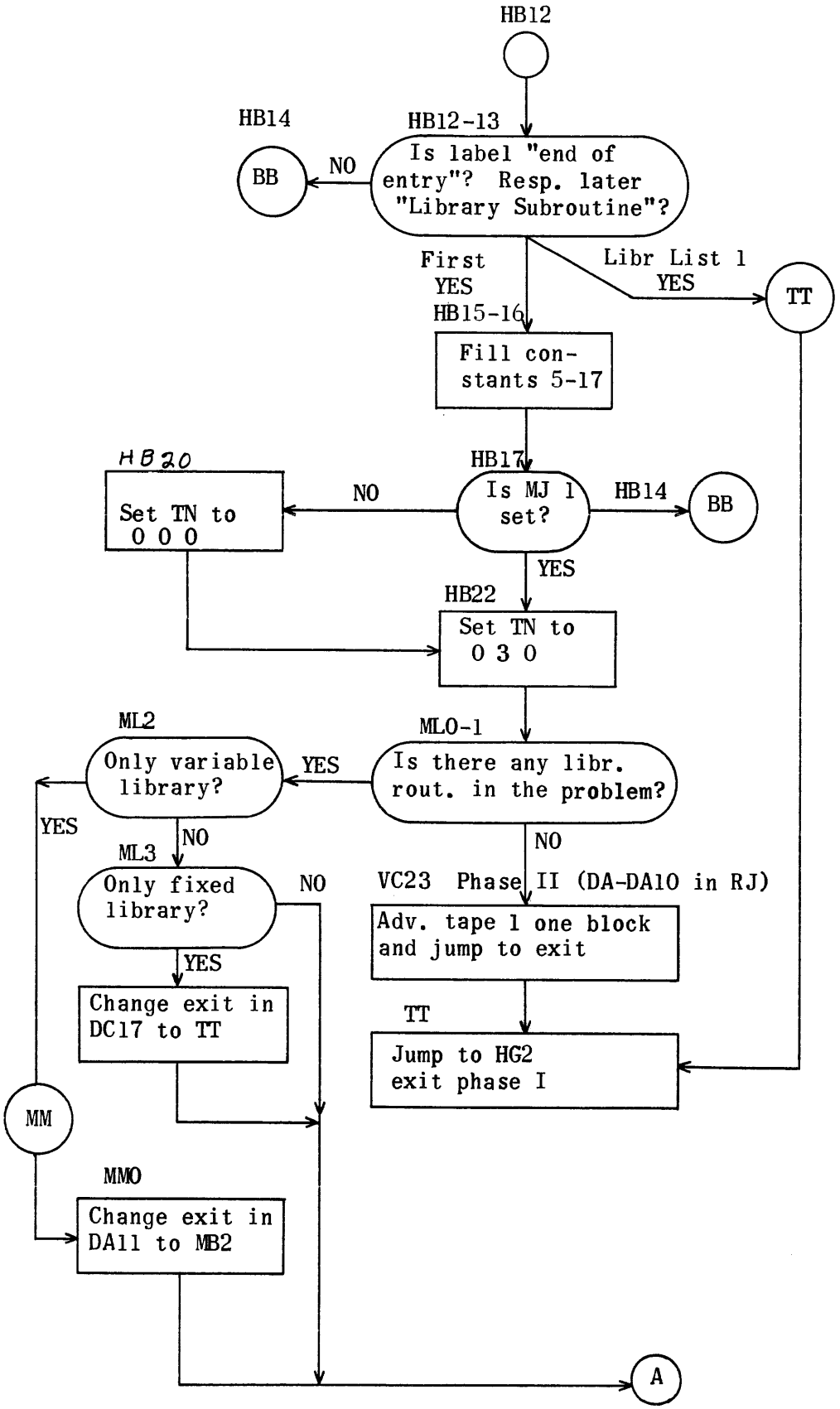
Vary loops are treated differently in order to avoid unnecessary jumping between segments. All statements within the range of a Vary are counted together in the sub-tally as one large statement, including other Vary statements that might be nested within the first loop. If the master tally then exceeds (4096m-N), the routines check whether the sub-tally exceeds (4096m-N). If not, the routine ends a segment right before the Vary statement, starting the next segment with a Vary loop. If the Vary loop in itself exceeds (4096m-N), the segmentation goes backward within the sentences of the Vary loop until the limit (4096m-N) is reached again. If there is no Vary

within the Vary, it forms a segment right there. If there are other Vary sentences nested within the large Vary loop, it goes further back beyond the next Vary statement and forms the segment so that the new segment would start with a Vary Statement.

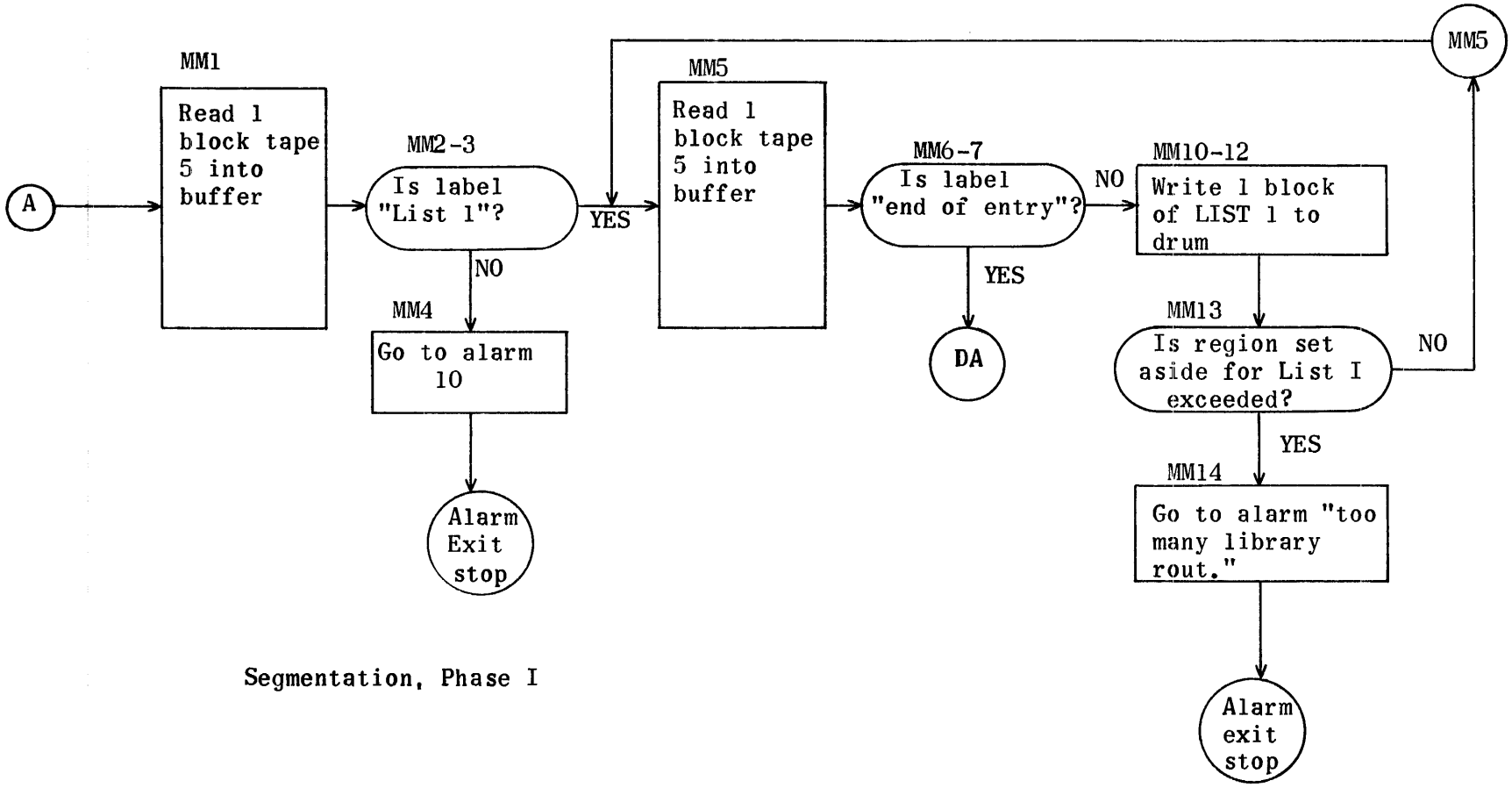
Processing continues entering each item in turn into Op File IIa using the length (4096m-N) as a limit for each segment. Whenever cross references to other statements (open jumps) are recognized, these call words are entered into Op File IIb. Thus, Op File IIb is a listing of jump cross reference call words for each segment. When sufficient statements for one segment have been processed and their call words entered into Op File IIa and IIb (as needed), these files are written on tape ready for use by the allocator. The process is repeated, building Op File IIa and IIb for each segment using the second word of Directory 2 to indicate when the last statement in Op File I has been processed.

Segmentation, Phase I

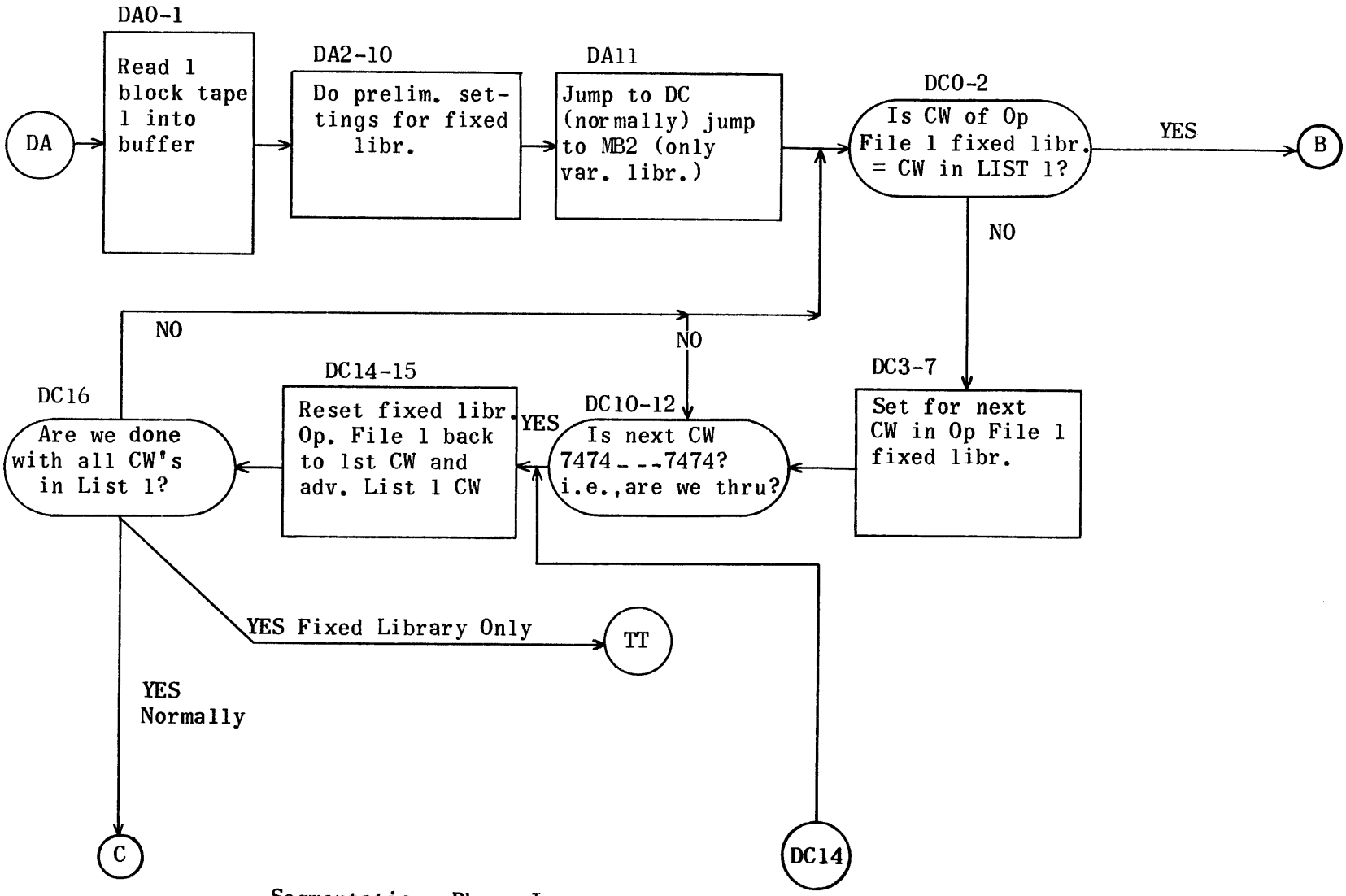




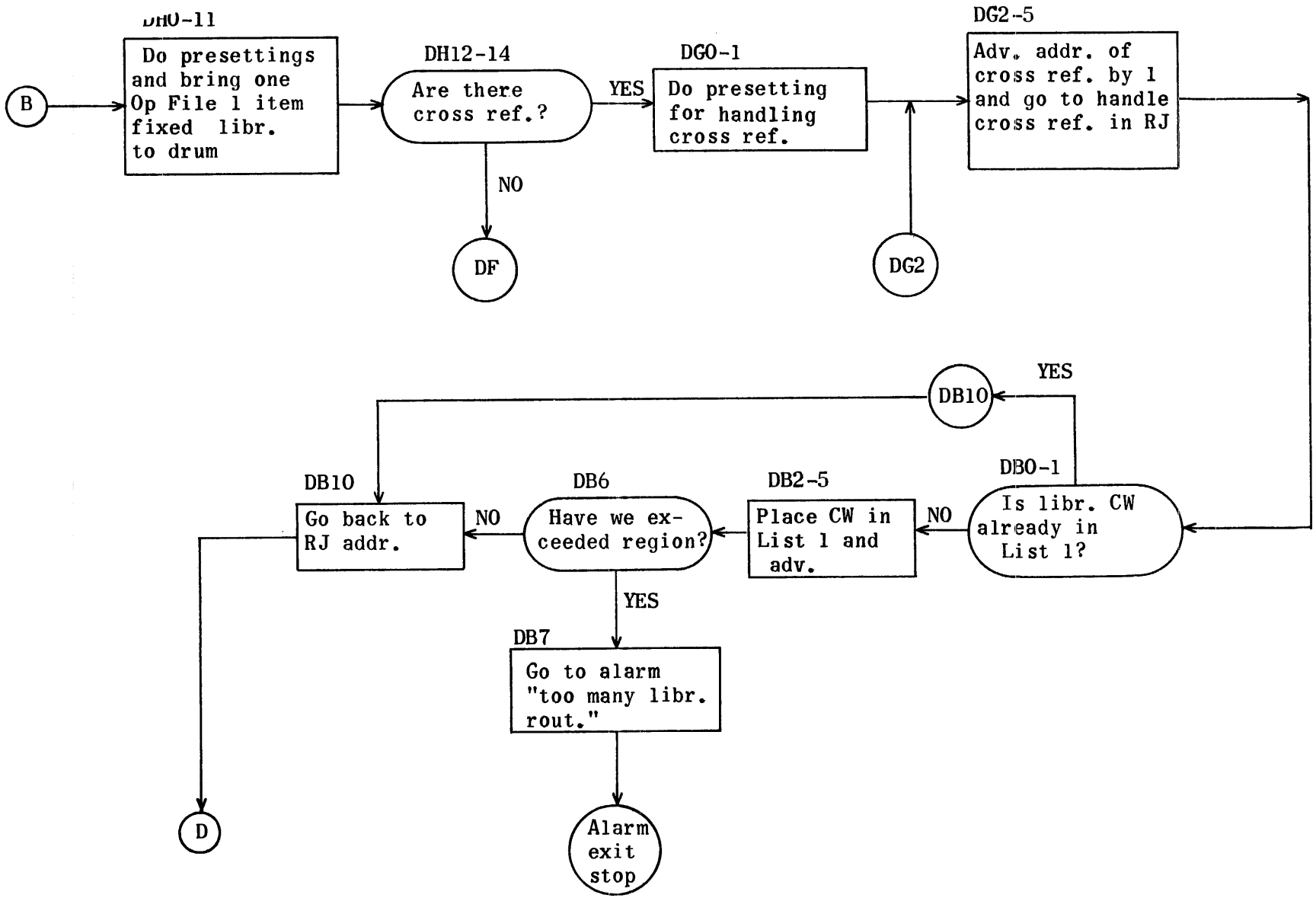
Segmentation, Phase I

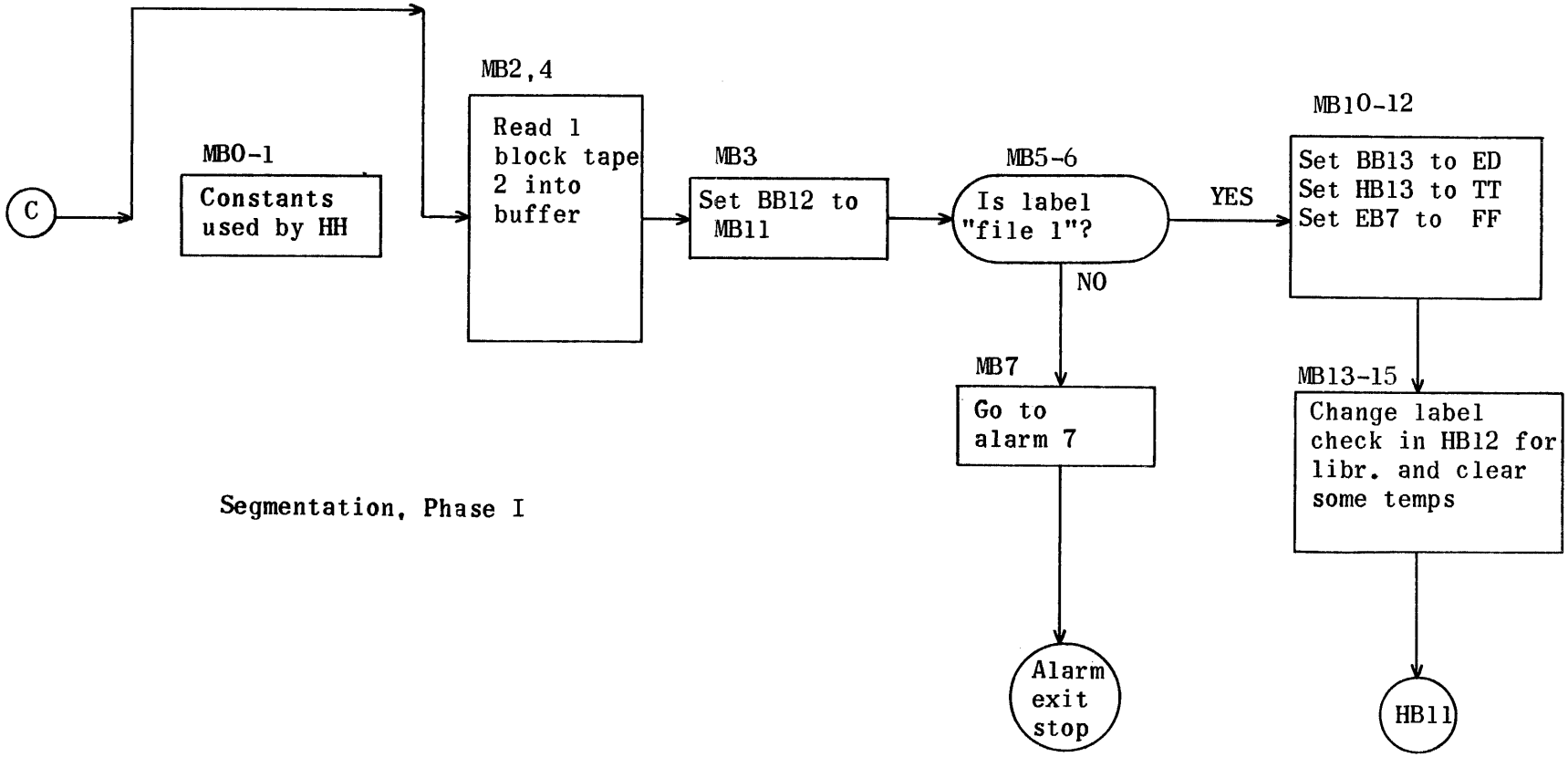


Segmentation, Phase I

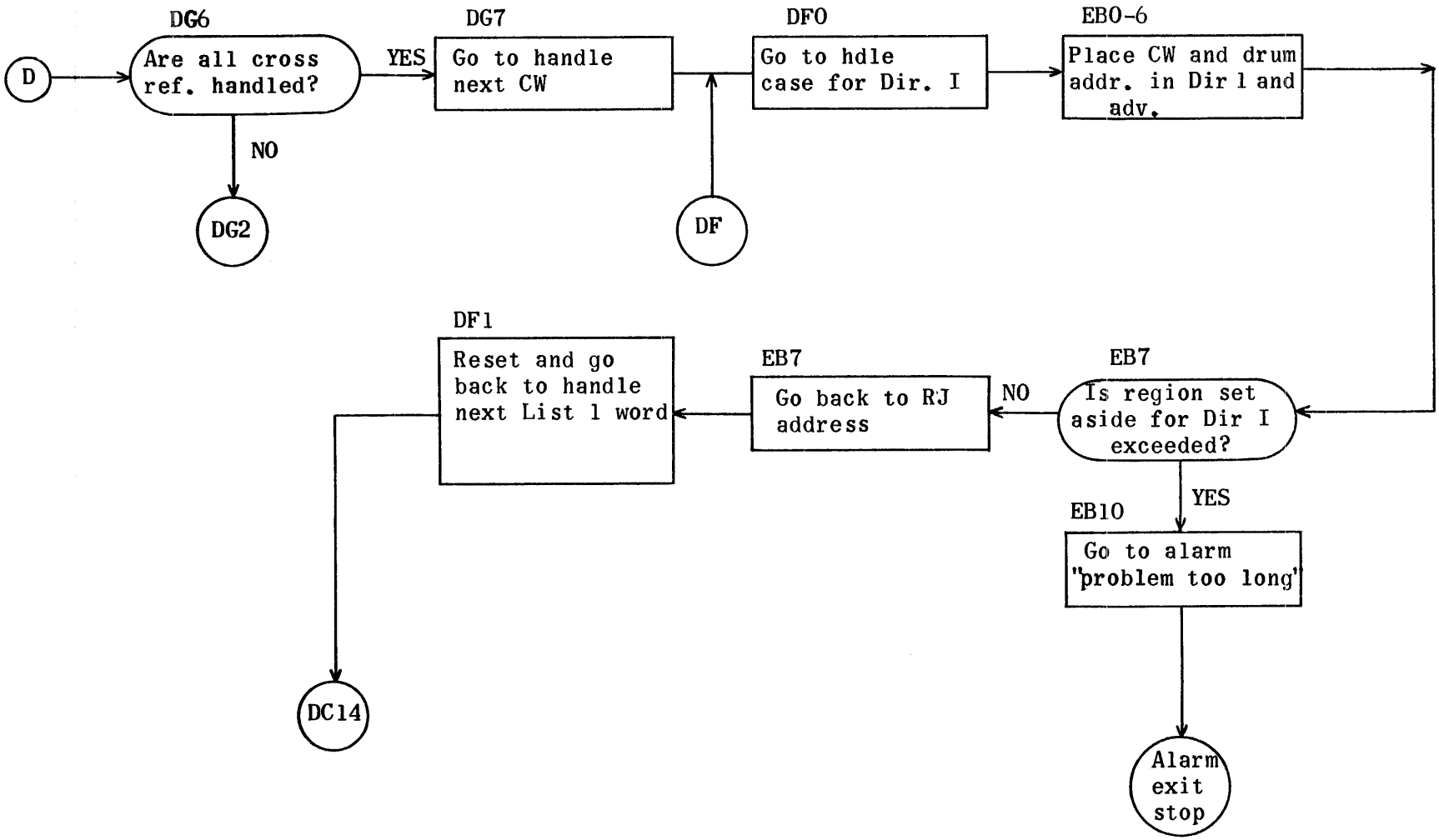


Segmentation, Phase I

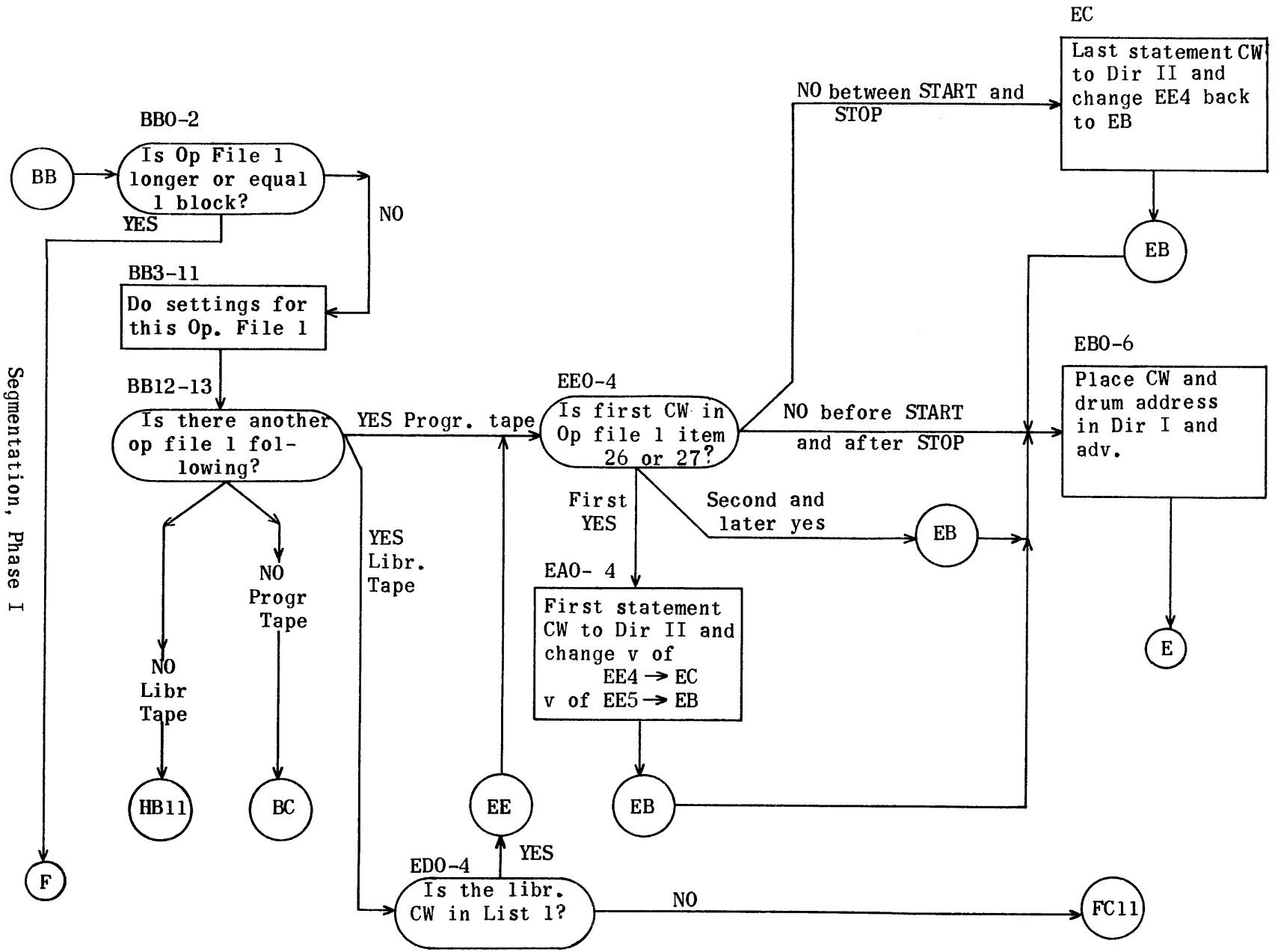

DH0-11
Do presettings and bring one Op File 1 item fixed libr. to drum
B
DH12-14
Are there cross ref.?
YES
NO
DF
DG0-1
Do presetting for handling cross ref.
DG2
DG2-5
Adv. addr. of cross ref. by 1 and go to handle cross ref. in RJ
DB10
YES
DB0-1
Is libr. CW already in List 1?
NO
DB2-5
Place CW in List 1 and adv.
NO
DB6
Have we exceeded region?
NO
DB10
Go back to RJ addr.
D
YES
DB7
Go to alarm "too many libr. rout."
Alarm exit stop

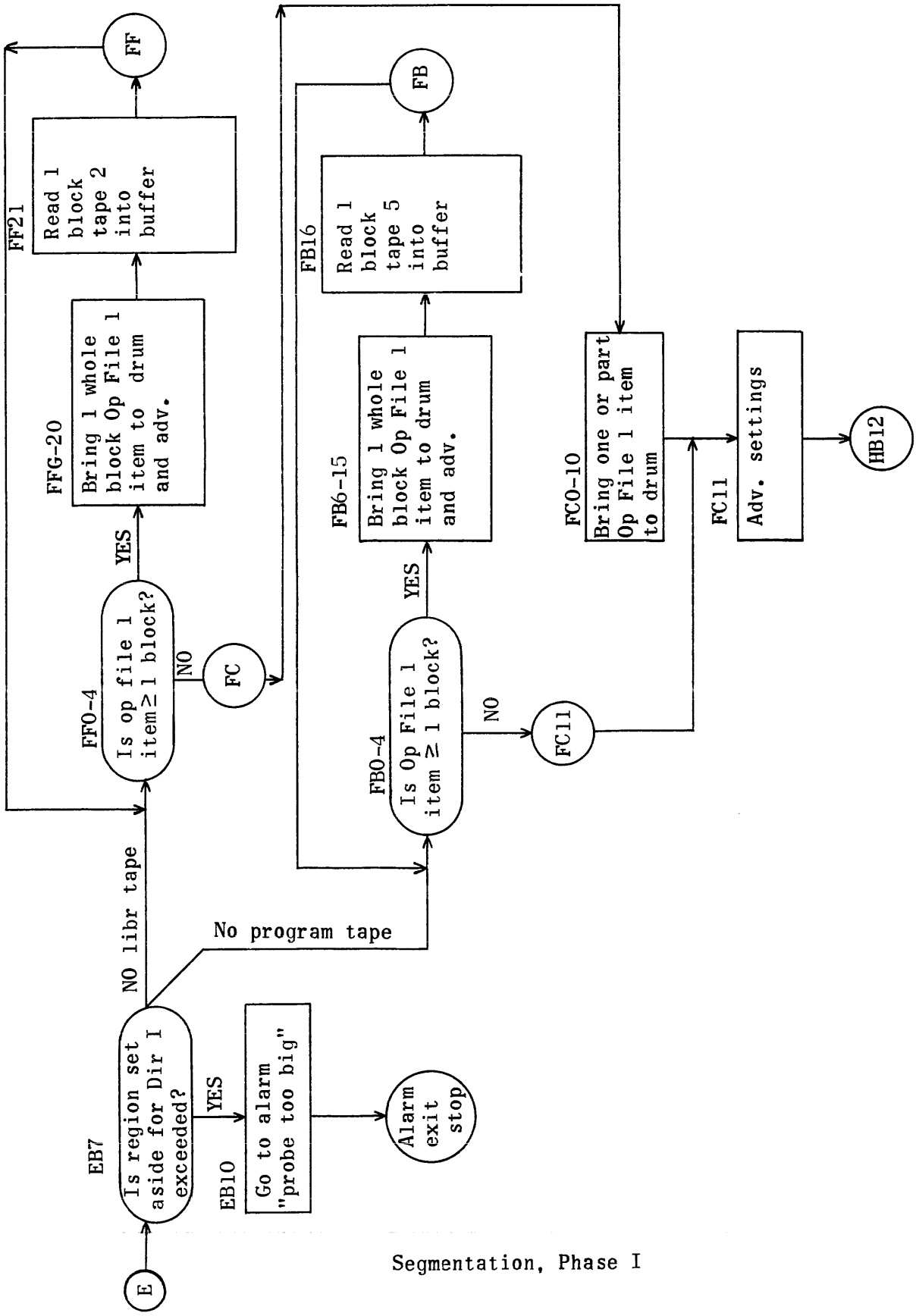


Segmentation, Phase I

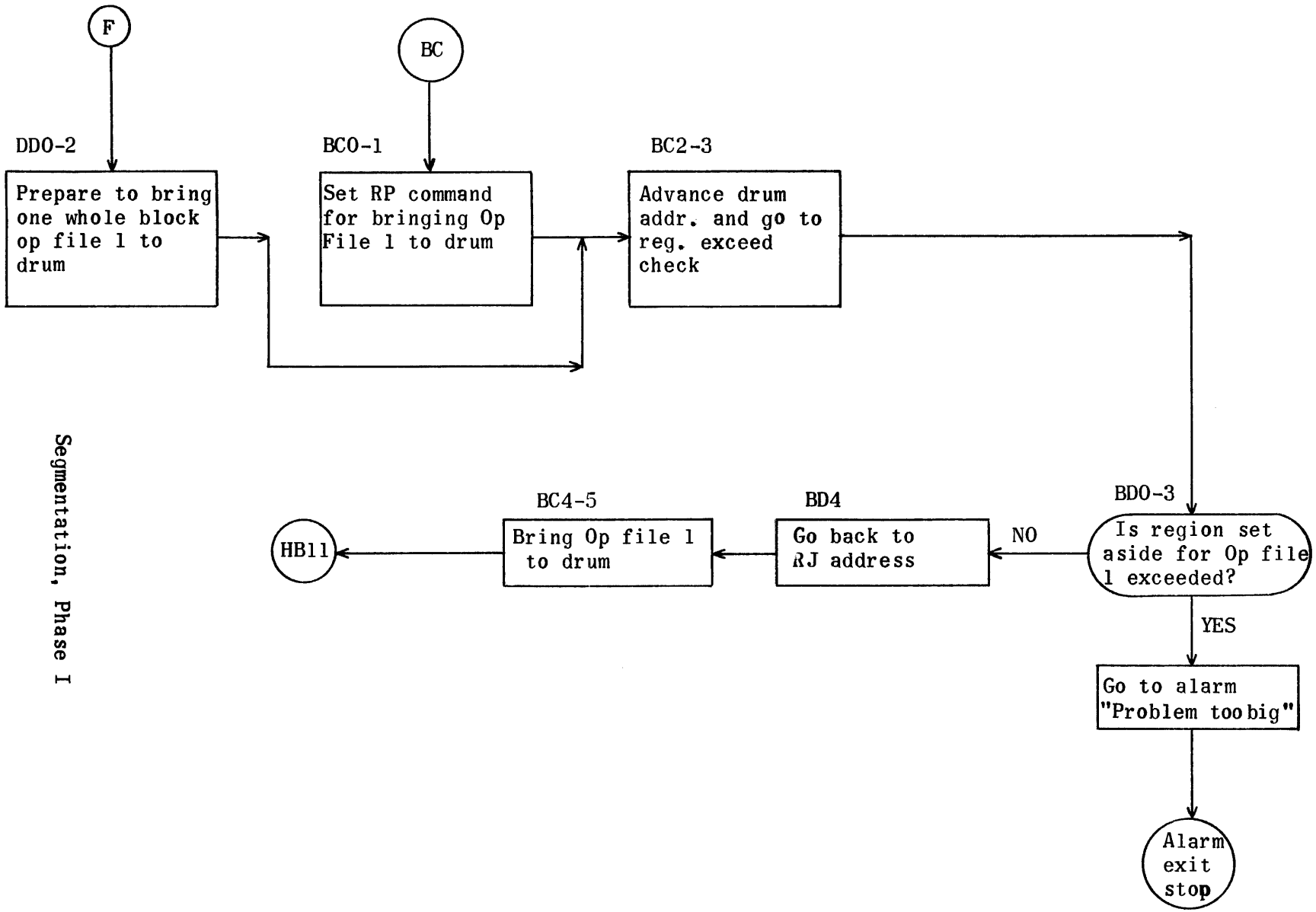


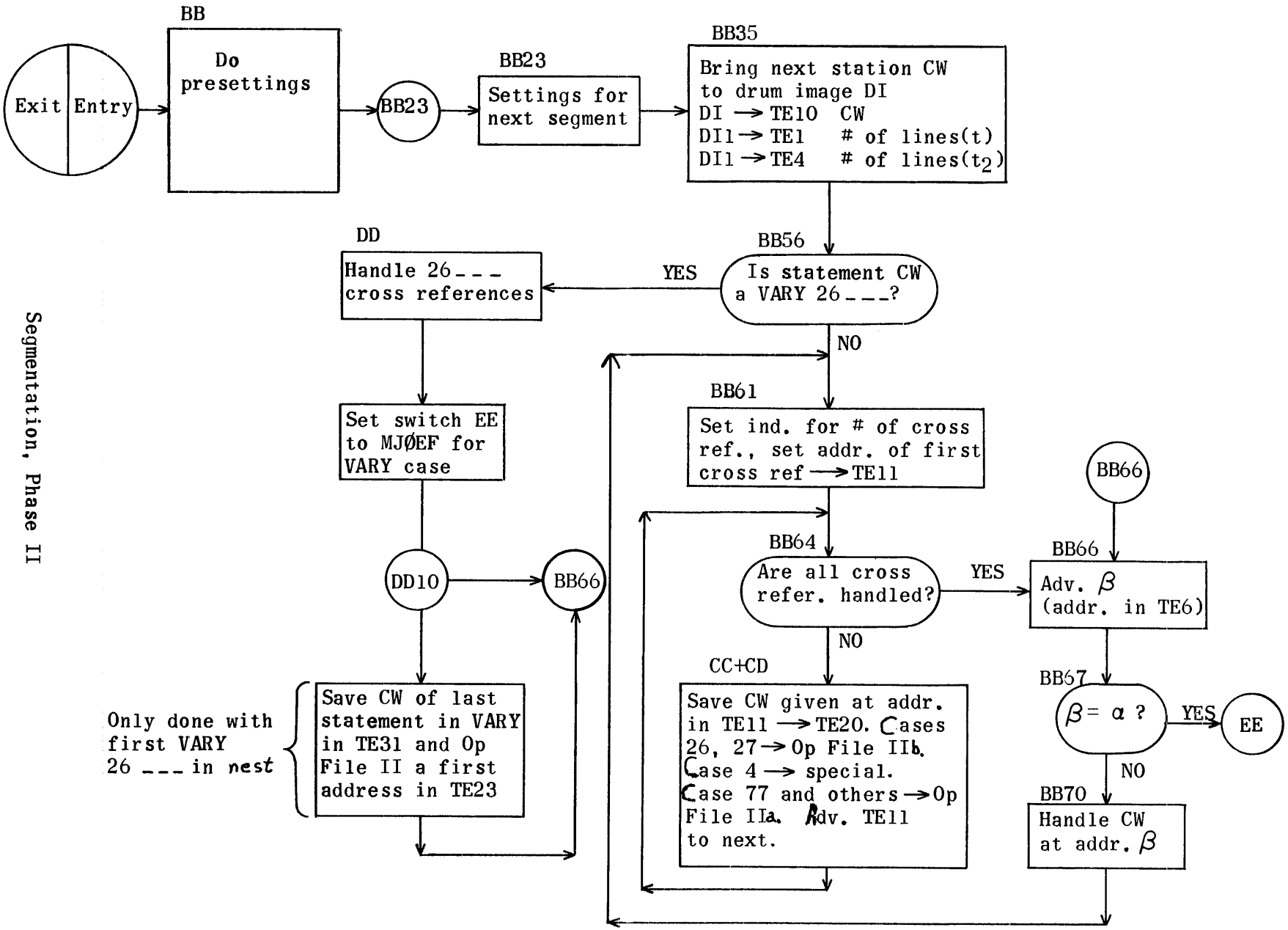
Segmentation, Phase I

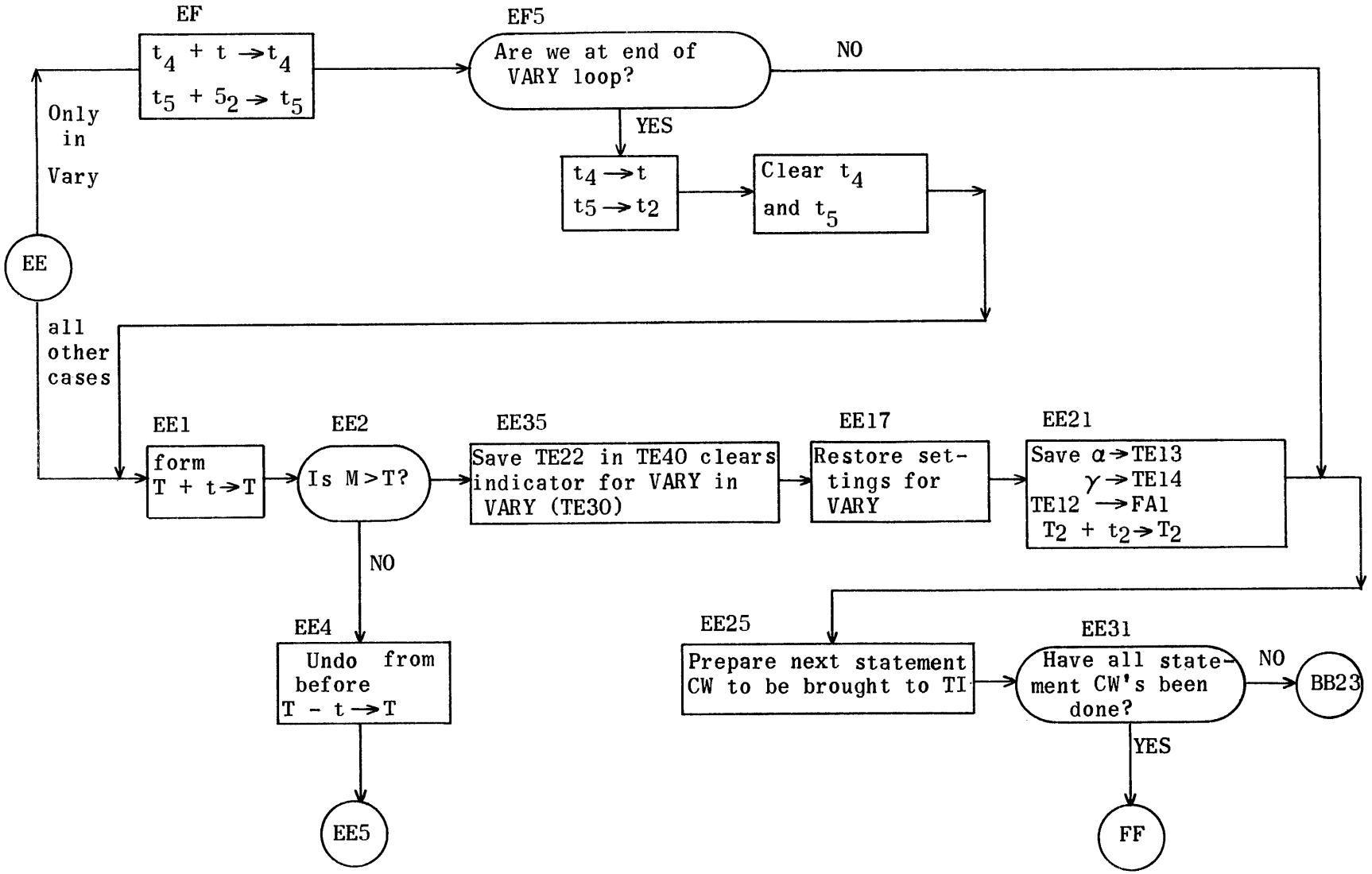

BB
BBO-2
Is Op File 1 longer or equal 1 block?
YES
NO
BB3-11
Do settings for this Op. File 1
BB12-13
Is there another op file 1 following?
YES Progr. tape
YES Libr. Tape
NO Progr Tape
NO Libr Tape
HB11
BC
F
EEO-4
Is first CW in Op file 1 item 26 or 27?
NO between START and STOP
NO before START and after STOP
EC
Last statement CW to Dir II and change EE4 back to EB
EB
EBO-6
Place CW and drum address in Dir I and adv.
E
First YES
Second and later yes
EB
EAO- 4
First statement CW to Dir II and change v of EE4 → EC
v of EE5 → EB
EB
EE
EDO-4
Is the libr. CW in List 1?
YES
NO
FC11

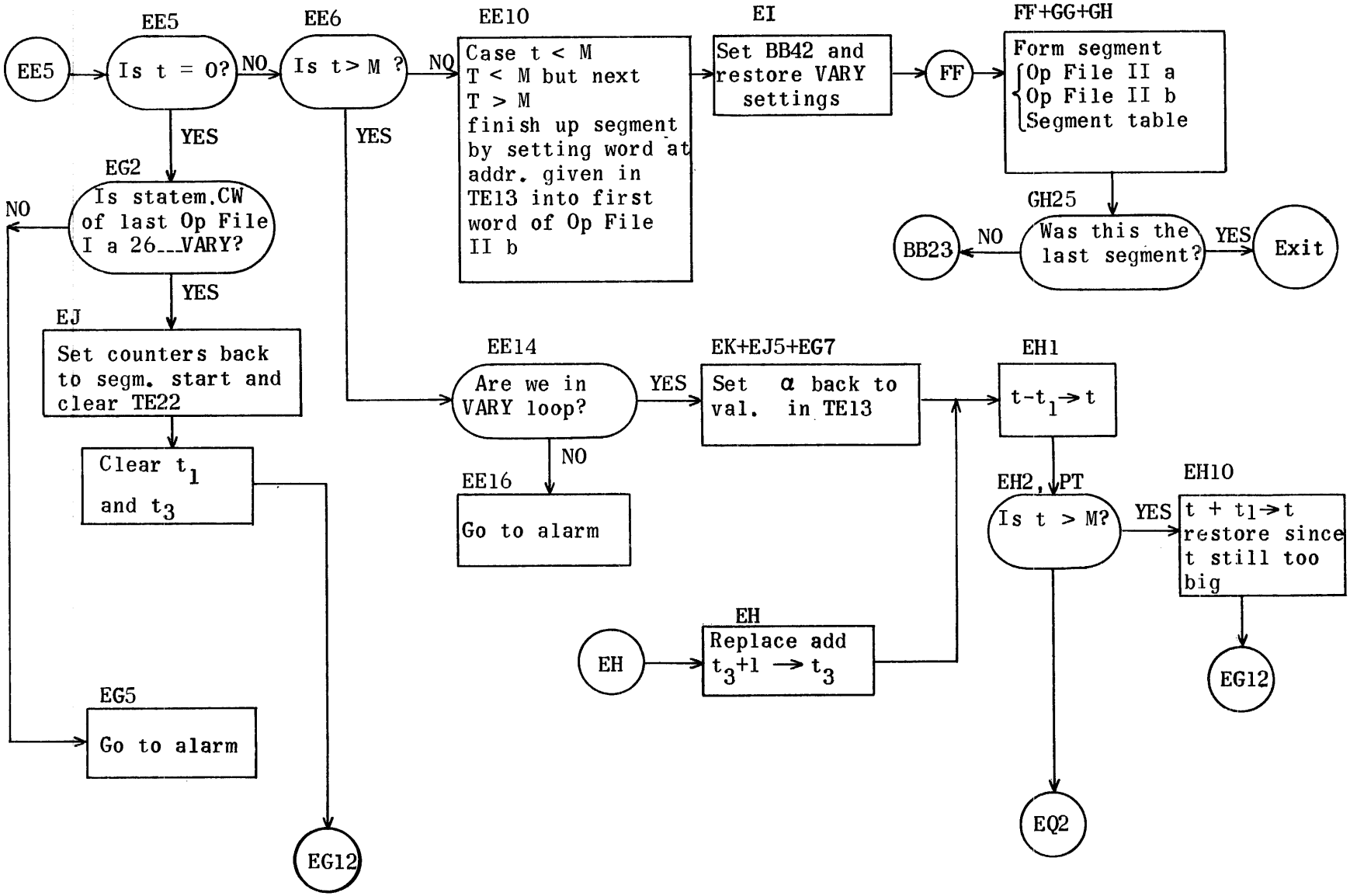


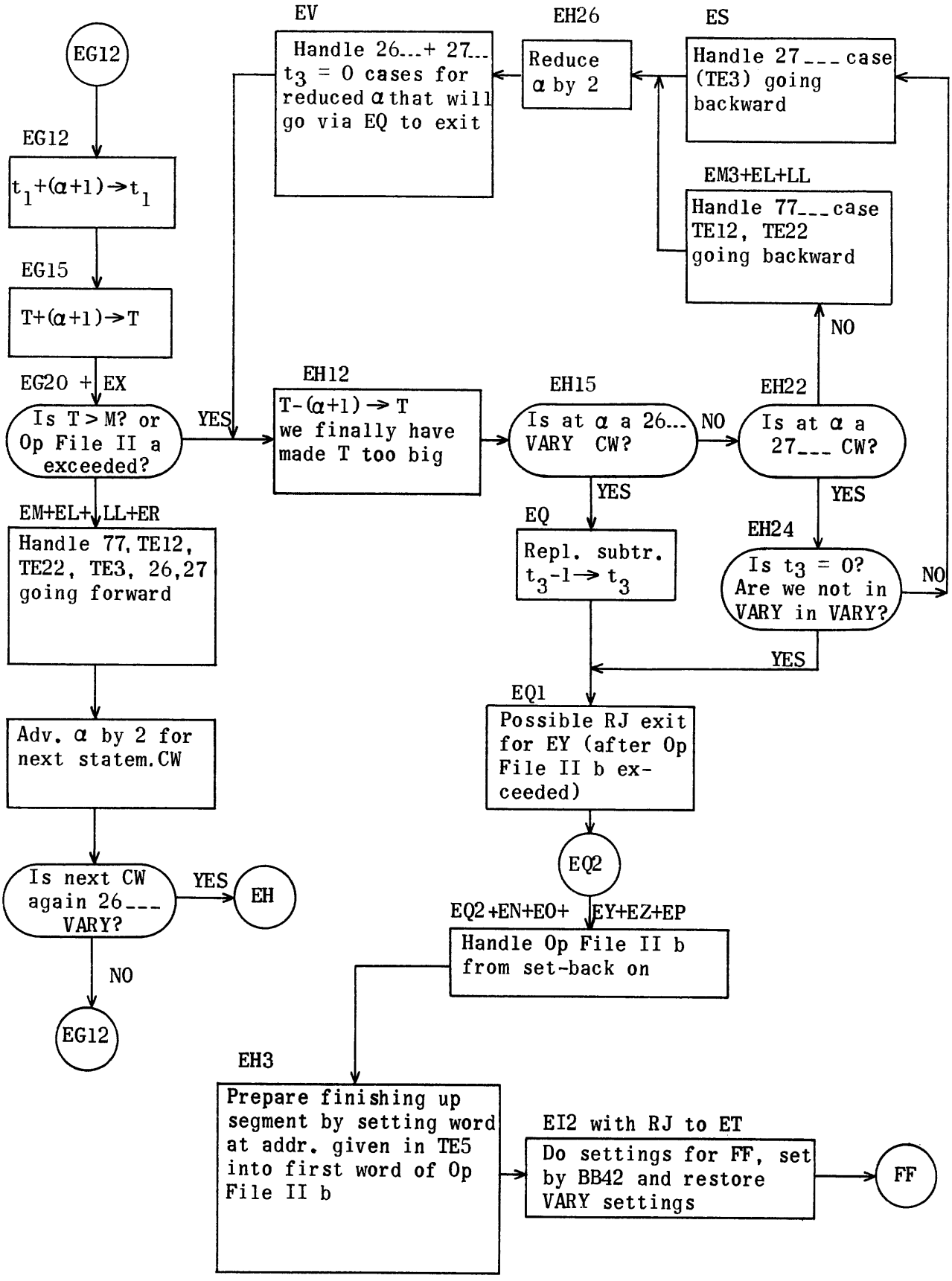
Segmentation, Phase I


F
BC
DDO-2
Prepare to bring one whole block op file 1 to drum
BCO-1
Set RP command for bringing Op File 1 to drum
BC2-3
Advance drum addr. and go to reg. exceed check
BDO-3
Is region set aside for Op file 1 exceeded?
NO
BD4
Go back to RJ address
BC4-5
Bring Op file 1 to drum
HB11
YES
Go to alarm "Problem too big"
Alarm exit stop


BB
Exit
Entry
Do presettings
BB23
BB23
Settings for next segment
BB35
Bring next station CW to drum image DI
DI → TE10 CW
DI1 → TE1 # of lines(t)
DI1 → TE4 # of lines(t2)
BB56
Is statement CW a VARY 26___?
YES
DD
Handle 26___ cross references
NO
BB61
Set ind. for # of cross ref., set addr. of first cross ref → TE11
Set switch EE to MJØEF for VARY case
BB66
BB64
Are all cross refer. handled?
YES
BB66
Adv. β (addr. in TE6)
DD10
BB66
NO
CC+CD
Save CW given at addr. in TE11 → TE20. Cases 26, 27 → Op File IIb. Case 4 → special. Case 77 and others → Op File IIa. Adv. TE11 to next.
BB67
β = α ?
YES
EE
NO
BB70
Handle CW at addr. β
Only done with first VARY 26 ___ in nest
Save CW of last statement in VARY in TE31 and Op File II a first address in TE23


EF
$t_4 + t \rightarrow t_4$
$t_5 + 5_2 \rightarrow t_5$
EF5
Are we at end of VARY loop?
NO
YES
$t_4 \rightarrow t$
$t5 \rightarrow t2$
Clear t_4 and t_5
Only in Vary
EE
all other cases
EE1
form T + t→T
EE2
Is M>T?
EE35
Save TE22 in TE40 clears indicator for VARY in VARY (TE30)
EE17
Restore settings for VARY
EE21
Save α→TE13
γ→TE14
TE12 →FA1
$T_2 + t_2 \rightarrow T_2$
NO
EE4
Undo from before
T - t→T
EE5
EE25
Prepare next statement CW to be brought to TI
EE31
Have all statement CW's been done?
NO
BB23
YES
FF


EE5
Is t = 0?
NO
EE6
Is t > M ?
NO
EE10
Case t < M
T < M but next
T > M
finish up segment
by setting word at
addr. given in
TE13 into first
word of Op File
II b
EI
Set BB42 and
restore VARY
settings
FF
FF+GG+GH
Form segment
Op File II a
Op File II b
Segment table
GH25
Was this the
last segment?
YES
Exit
NO
BB23
YES
EG2
Is statem.CW
of last Op File
I a 26__VARY?
NO
YES
EJ
Set counters back
to segm. start and
clear TE22
Clear t_1
and t_3
EG5
Go to alarm
EG12
EE14
Are we in
VARY loop?
YES
NO
EE16
Go to alarm
EK+EJ5+EG7
Set α back to
val. in TE13
EH
EH
Replace add
$t_3+1 \rightarrow t_3$
EH1
$t-t_1 \rightarrow t$
EH2, PT
Is t > M?
YES
EH10
t + $t_1 \rightarrow$ t
restore since
t still too
big
EG12
EQ2



Segmentation, Phase II

Segmentation Regions Phase I

```
RE ZA77000
RE BQ632
RE BR537
RE ST653                    Segment Table
RE GK1000
RE TN20
RE UP421
RE TH21                     Tape Handler
RE TI3274                   Tape Image
RE DI3464                   Drum Image
RE SD4156                   Directory II
RE FD40101                  Directory I
RE FA4260                   Op File IIa
RE FP7660                   Op File IIb
RE OP45215                  Op File I
RE LI4160                   List I
RE VV2764                   Temporaries Phase I
RE TE1300                   Temporaries Phase II

RE PP1373
RE HG674
RE HH677
RE HB723
RE ML747
RE BB756
RE BC772
RE DD1000
RE BD1003
RE DA1012
RE DB1024
RE DC1035
RE DF1055
RE DG1060
RE DH1070
RE EE1105
RE EA1113
RE EB1120
RE EC1131
RE ED1135
RE FF1145
RE FB1170
RE FC1210
RE MM1223
RE TT1241
RE MB1242
RE CC1260
RE WM1347
RE FT1352
RE HT1360
RE VC2472
RE BE76777
RE EF45213
RE DE5161
RE LF3274
```

Entrance Phase I

```
        IA HG
0       MJ 0 HH                 Jump to start
1       MJ 0 BQ6                Alarm exit
2       MJ 0 PP                 Jump to Phase II
        CA HG3


        IA HH                   Come from HG
0       RP 15014 HH2  }
1       TP CC23 VV    }         Clear core from 2764-7777
2       RP 17777 HH4  }
3       TP CC23 40101 }
4       RA HH3 MB1    }         Clear drum from 40101-76277
5       IJ MB HH2     }
6       RP 11702 HH10 }
7       TP CC23 70076 }
10      TP CC25 VV              Set K = 0p
11      TP CC25 VV1             Set b = 0p
12      TV CC31 EB    }
13      TV CC32 EB1   }         Set addresses of first directory
14      TV CC33 MM11            Set address of List 1
15      TV CC36 HB23            (A)→(A1)
16      TV CC37 BB13            (B)→(B1)
17      TV CC40 EE5             (C)→(C1)
20      TV CC41 EE4             (D)→(C2)
21      TV CC42 EB7             (E)→(E1)
```

```
22      TV CC51 BB12                Enable boxes 3 and 4
23      MJ 0 HB
        CA HH24

        IA HB                       Come from HH23
0       TP CC TH3
1       RJ TH2 TH                   Read 1 block Uniservo 5
2       TP TI24 A
3       EJ CC11 HB5                 Identification of Δ FILE (Δ TAPE Δ)
4       MJ 0 BR12                   Alarm
(1) 5   RJ TH2 TH                   Come from HB3 or MB14, read next
                                    block
6       TP TI1 A
7       EJ CC4 HB11                 Identification of (ΔΔΔOPΔ)FILEΔ1
10      MJ 0 BR12                   Alarm
(2) 11  RJ TH2 TH                   Read next block
(3) 12  TP TI1 A
13      EJ CC6 HB15                 Identification of (END Δ OF) Δ ENTRY
                                      resp. after change ident. of SUBRTN
                                      v changed by MB11 to TT, u changed
                                      by MB13
14      MJ 0 BB                     Not finished yet, go to (5)
15      RP 30013 HB17
16      TP TI2 5                    Fill constants 5-17 inclusive
17      MJ 10000 HB22
20      TP CC23 TN
21      MJ 0 HB23                   Do setting for 5 or 7 tapes depend-
                                      ing MJ1 test
22      TP CC57 TN                  TN = 0 0 0  (5 tapes)
                                    TN = 0 3 0  (7 tapes)
(A) 23  MJ 0 30000                  Set by HH15 to ML, after all Op Files
                                      1 read in → (A) switch
        CA HB24
```

```
                IA BB                    Come from HB14
(5)     0       TP CC24 A
        1       TJ VV2 DD                Is Op File I longer than 1 block?
        2       EJ VV2 DD                          equal?
        3       TP VV2 VV3                         Smaller?
        4       SP VV3 17                Store j (length of Op File 1 item
                                           within block) in v of VV3 and u
                                           of VV5
        5       TP A VV5
        6       AT CC47 VV4              TI 0 + j → VV4 in u
        7       TU VV4 BB10              Set NI
        10      TP 30000 A               Place first "CW + # of addresses" of
                                           next Op File item → VV6
        11      TP A VV6                 Is there another Op File I following?
        12      EJ CC12 30000            Set by HH22 to BC0, later by MB3 to
                                           HB11.    No.
(B)     13      MJ 0 30000               Set by HH16 to EE0 later by MB10 to
                                           ED0.  Yes.

                CA BB14
```

```
                IA BC                       Come from BB12
(6)     0       TP CC15 Q                   Mask 0 07777 0
        1       QS VV5 BC4                  Set RP command for bringing Op File
        2       TV VV1 BC5                    to drum.
        3       RJ BD4 BD                   Advance and check whether it exceeds
                                              region.
        4       RP 30000 HB11               Set by BC1 or DD1
        5       TP TI 30000                 Set by BC2
                CA BC6

                IA BD                       Come from BC3
        0       RA VV1 VV3                  Advance
        1       QT BC4 Q                    CC15 mask is already in Q
        2       SP BC5 17                   Does Op File I exceed region?
        3       SA Q 71
        4       TJ CC55 30000               Set by RJ in BC3 to BC4
        5       TU FT WM                    Go to alarm (region exceeded)
        6       MJ 0 WM
                CA BD7
```

```
     IA DA                    Come from MM7, fixed libr. prelim.
                                settings
0    TP CC61 TH3 }
                 }  Read 1 block of Tape 1 into buffer
1    RJ TH2 TH   }
2    TP CC15 Q   }
                 }  Set RP for comparison with List 1
3    QS 5 DB     }
4    QT 5 A      }
                 }
5    LA A 71     }  Set right addr. for first addition
                 }    to List 1 and index List 1
6    TP A VV14   }
7    RA DB2 VV14              Set addr. for next item --> List 1
10   RS VV14 CC62             Set index for # of addresses in
                                List 1
11   MJ 0 DC
     CA DA12


     IA DB                    Come from DG5 with RJ. Fixed libr.
0    RP 20000 DB2 }           Set by DA3  Already in List 1?
                  }
1    EJ LI1 DB10  }           Yes, do nothing.
2    TP A LI                  Set by DA7 No., place CW in List 1.
3    RA DB CC53               Adv. u in RP command.
4    RA VV14 CC62             Adv. index for List 1 elements.
5    RA DB2 CC62              Adv. addr. in List 1 for next CW.
6    TJ CC60 DB10 }           Have we exceeded region?
                  }
7    MJ 0 MM14    }           Alarm (too many libr. rout. refer-
                                enced)
10   MJ 0 30000
     CA DB11
```

```
     IA DC                    Come from DA11.
0    TN CC14 Q                Mask 77 77777 0 to Q.
1    QT TI A                  CW of Op File 1 fixed libr. --> u
                                of A.
2    EJ LI DH                 Equal CW in List 1? Yes, go to
                                further handl.
3    TP CC14 Q                No
4    TU DC1 DC5
5    QT 30000 A               Set next addr. for comparison.
6    LA A 17
7    AT DC1 DC1
10   TU DC1 DC11
11   TP 30000 A               Is next word "74 74747 47474"?
12   EJ CC12 DC14
13   MJ 0 DC                  No, go back in loop.
14   RA DC2 CC53              Yes, do settings for next CW in
                                List 1.
15   TU CC33 DC1              Reset DC1 to first CW in Op File 1.
16   IJ VV14 DC               Are we thru with List 1? No, go
                                back in loop.
17   MJ 0 MB2                 Yes, go to rout. for handl. normal
                                libr. Tape, or changed by ML5 to
                                TT, skip normal libr. Tape.
     CA DC20
```

```
     IA DD                    Come from BB1 or BB2
0    RS VV2 CC24              Form words in Op File 1 minus 170
1    TU CC36 BC4              Set RP command BC4
2    MJ 0 BC2
     CA DD3


     IA DF                    Come from DH14 or DG7, fixed libr.
0    RJ EB7 EB                Place CW and drum addr. -> Direct 1
                                and adv. counters.
1    TP CC14 Q                Restore mask in Q.
2    MJ 0 DC14                Back to handl. next List 1 word.
     CA DF3


     IA DG                    Come from DH13, fixed libr.
0    TU DC1 DG4               Set addr. of Op File CW in DG4
                                (after equality).
1    RA DG4 CC53              Adv. by 1.
2    RA DG4 CC53              Adv. by 1.
3    TP CC13 Q                Put cross reference -> A.
4    QT 30000 A
5    RJ DB10 DB               Go to handl. cross reference.
6    IJ VV15 DG2              Are all cross ref. handled?
                                No, back in loop.
7    MJ 0 DF                  Yes, go to handl. CW.
     CA DG10
```

```
        IA DH
0       TU DC1 DH11          Set RP command.
1       TU DC1 DH3           Set addr. DH3.
2       TP CC14 Q            Mask
3       TP 30000 VV6         Save CW + # of lines in Op File
                               item in VV6.
4       QT VV6 VV15          Save # of lines in Op File item in
                               VV15.
5       TV VV1 DH11          Place next drum addr. for Op File
                               item in v of DH11
6       SP VV15 17           Set addr. DH7
7       AT CC63 DH10
10      0 0 0                Place Op File item --> drum.
11      TP 30000 30000
12      RA VV1 VV15          Adv. drum addr.
13      RS VV15 CC64         Subtr. 3 from # of lines to get in-
                               dex for cross ref.
14      SJ DF DG             Ind. neg; skip hdl. cross ref.,
                               pos. go to hdl. cross ref.

        CA DH15


        IA EA                Come from EE5
(C1)
0       SP VV 17             K --> 1st word Direct. II
                             drum addr. of first statem.
1       TU A SD              CW in Op File I --> u of SD
2       TV CC41 EE5          (C) -> (C2)
3       TV CC45 EE4          (D) -> (D2)
4       MJ 0 EB              --> (C2)

        CA EA5
```

```
                IA EB                    Come from EA4 or EE4 or EE5
(C2)    0       TU VV6 30000             Set by HH12 to [FD1] CW ⟶ FD1
        1       TV VV 30000              Set by HH13 to [FD2]  K ⟶ FD2
        2       RA FD CC22               Adv. counter in FD by 2 in u
        3       TV VV6 VV2               v of j'th  word ⟶temp 1
        4       RA VV VV2                K + temp 1 ⟶ K.  Updates drum addr.
                                           next item.
        5       RP 20002 EB7 }           Adv. addr. in Dir. I for next CW.
        6       RA EB CC21   }
(7)     7       TJ CC56 30000 }          Set by HH21 to FB, later by MB12 to
                                           FF, in between used by DF5 in RJ.
       10       MJ 0 BD5     }           Is Directory 1 too long on drum?
                                           Jump to alarm:  THE PROBLEM IS TOO
                CA EB11                    LONG.

                IA EC                    Come from EE4
(D2)    0       SP VV 17 }
                         }               K ⟶ 2nd word Directory II
        1       TU A SD1 }
        2       TV CC41 EE4              (D)→(C2) set in order to skip this
                                                  region later
        3       MJ 0 EB                  →(C2)
                CA EC4
```

```
                IA ED                          Come from BB13
(B2)    0       TP CC15 A  }
        1       QS 5 ED4   }                   Fill u of RP
        2       TU VV6 VV7 }
        3       TP VV7 A   }                   CW → A
        4       RP 20000 ED6 }
        5       EJ LI EE     }                 Is CW in List 1?
        6       TV VV6 VV2                     v of j'th word → temp 1
        7       MJ 0 FC11
                                               → (10)
                CA ED10

                IA EE                          Come from BB13
(B1)    0       TP CC16 Q  }
        1       QT VV6 A   }                   Is first CW in Op File item 26--- Or
        2       EJ CC17 EE5 }                    27---?
        3       EJ CC20 EE5 }
(D)     4       MJ 0 30000                     Set by HH20 to EB, later by EA3 to
                                                 EC and by EC2 to EB
(C)     5       MJ 0 30000                     Set by HH20 to EA, later by EA4 to
                                                 EB
                CA EE6
```

```
                IA FB                       Come from EB7
(E1)    0       TP VV2 A
                                            Temp 1 + j --> VV10
        1       AT VV3 VV10
        2       TP CC24 A
                                            Temp 1 + j ≥ 120 --> FB6
        3       TJ VV10 FB6
        4       EJ VV10 FB6
        5       MJ 0 FC11                   No --> (10)
        6       TV VV1 FB10                 Case when file exceeds block
                                              TI --> drum
        7       RP 30170 FB11
        10      TP TI 30000
        11      RA VV1 CC24                 G + 120 --> G
        12      TP VV2 A
                                            Temp 1 - (120-j) --> temp 1
        13      AT VV3 A
        14      ST CC24 VV2
        15      TP CC23 VV3                 j = 0
        16      RJ TH2 TH                   Bring next block to core
        17      MJ 0 FB                     --> (E1)
                CA FB20
```

```
                IA FC                          Come from FF5
(9)       0     SP VV2 17
          1     TP A VV13                      RP    3 (temp 1)
          2     TP CC15 Q                      TP    TI + j     [drum addr.]
          3     QS VV13 FC6
          4     TV VV1 FC7
          5     TU VV4 FC7
          6     RP 30000 FC10                  Bring Op File I item to drum
          7     TP 30000 30000
         10     RA VV1 VV2
(10)      11    RA VV2 VV3                     Come from FC10 or FB5 or ED7
         12     MJ 0 HB12                      → (3)
                CA FC13
```

```
                IA FF                       Come from EB7
(E2)    0       TP VV2 A
        1       AT VV3 VV10                 Temp 1 + j ⟶ VV10
        2       TP CC24 A
        3       TJ VV10 FF6                 Temp 1 + j ≥ 120 ⟶ FF6
        4       EJ VV10 FF6
        5       MJ 0 FC                     No ⟶ (9)
        6       TP CC50 A                   Case file exceeds block
        7       ST VV5 VV11
       10       TP CC15 Q
       11       QS VV11 FF14                Library Op File ⟶ drum
       12       TU VV4 FF15
       13       TV VV1 FF15
       14       RP 30000 FF16
       15       TP 30000 30000
       16       RA VV1 VV11                 G + (120-j) ⟶ G
       17       RS VV2 VV11                 Temp 1 - (120-j) ⟶ temp 1
       20       TP CC23 VV3                 j = 0
       21       RJ TH2 TH
       22       MJ 0 FF                     ⟶ (E2)
                CA FF23
```

```
        IA MB                       Come from DC16 after List 1 is
                                      read to drum
    0   0 0 2                   }
                                    Gets changed constants used by HH
    1   0 0 7777                }    for presetting used by HH4
(7) 2   TP CC26 TH3             }
    3   TV BC4 BB12             }   Read 1 block of Tape II and disable
                                      boxes 3 and 4
    4   RJ TH2 TH               }
    5   TP TI1 A                    Put second word → A
    6   EJ CC4 MB10                 Is it "FILE Δ 1"?
    7   MJ 0 BR7                    No; alarm.
   10   TV CC44 BB13                (B) → (B2)
   11   TV CC43 HB13                (A) → (A2)
   12   TV CC46 EB7                 (E) → (E2)
   13   RA HB13 CC22                Change test for "end of entry" "to"
                                      "libr. subrout"
   14   RP 10002 HB11           }   → (1)
   15   TP  CC23 VV2            }   Clear VV2 words in block
                                      and VV3 words in Op File 1 item j
        CA  MB16
```

```
        IA ML                       Come from HB23
    0   TP 5 A                  }
                                    Case no library rout at all skip
    1   EJ VC10 VC23            }   handling libraries but jump to adv.
                                    tape 1 by 1 block VC23 is patch in
                                    constant pool FC23 of Phase II
    2   SJ ML3 MM                   Only variable library
    3   TJ CC26 ML5                 Only fixed library
    4   MJ 0 MM1                    Both libraries
    5   TV CC43 DC17            }   Only fixed library
    6   MJ 0 MM1                }
        CA ML7
```

```
                IA MM                   Come from HB23

          0     TV CC66 DA11            Entry for only variable library,
                                        change exit
(A1)      1     RJ TH2 TH               Read next block on Tape 5
          2     TP TI A
                                        Is first word List 1?
          3     EJ CC7 MM5
          4     MJ 0 BR12               Jump to alarm: LIST 1 LABEL IN-
                                        CORRECT.
(4)       5     RJ TH2 TH               Read next block of Tape 5
          6     TP TI1 A                Is it END OF ENTRY?
          7     EJ CC6 DA               Exit to DA handl. of fixed libr.
         10     RP 30170 MM12
         11     TP TI 30000             Set by HH14 to LI.  Read whole
                                        List 1 to LI on drum
         12     RA MM11 CC24
         13     TJ CC65 MM5             Does it exceed region?
         14     TU HT WM
                                        Go to alarm:  TOO MANY LIBR. ROUT.
         15     MJ 0 WM                 REFERENCED.
                CA MM16

                IA TT                   Come from ML1 (with no List 1) rsp
                                        HB13 with List 1
(A2)            MJ 0 HG2                Exit out of Phase I, go to Phase II
                CA TT1
```

Alarm Routine

```
      IA WM
0     TP 30000 UP3
1     RJ UP2 UP
2     MJ 0 HG1
      CA WM3
      IA FT
0     0 FT1 0
1     0 FT2 4
2     66 33300 15254
3     51 25463 04701
4     34 65016 65151
5     01 46515 03222
      CA FT6
      IA HT
0     0 HT1 0
1     0 HT2 11
2     66 51510 14724
3     50 73014 63425
4     54 24547 30154
5     51 67663 45030
6     65 01543 03130
7     54 30502 63027
10    01 34500 16633
11    30 01525 45125
12    46 30472 27777
      CA HT13
```

Alarm, the problem is too long.

Alarm, too many library routines referenced in the problem.

Constants

	IA CC
0	50 00105 TI
1	01 01323 05001
2	01 66245 23001
3	01 01015 15201
4	31 34463 00104
5	30 50270 15131
6	01 30506 65473
7	46 34656 60104
10	65 67255 46650
11	01 31344 63001
12	74 74747 47474
13	0 77777 0
14	0 0 77777
15	0 7777 0
16	0 77000 0
17	0 27000 0
20	0 26000 0
21	0 0 2
22	0 2 0
23	0 0 0
24	0 0 170
25	0 0 0P
26	50 00102 TI
27	10 5 0

```
30      10 2 0
31      0 0 FD1
32      0 0 FD2
33      0 TI LI
34      0 0 6
35      0 0 7
36      0 30170 ML
37      0 0 EE
40      0 0 EA
41      0 0 EB
42      0 0 FB
43      0 0 TT
44      0 0 ED
45      0 0 EC
46      0 0 FF
47      0 TI 0
50      0 170 0
51      0 0 BC
52      0 0 77
53      0 1 0
54      0 0 5
55      TP TI BE
56      TV VV EF
57      0 3 0
60      TP A DE
61      50 101 TI
```

```
62      0 0 1
63      RP 30000 DH12
64      0 0 3
65      TP TI DE
66      0 0 MB2
        CA CC67
```

Temporaries VV 2764 Segment. Phase I

VV0		( )	K drum address of beginning of item
1		( )	G drum address next TI item on drum
2		( )	Temp 1 # of word handled already within this block
3		( )	j (in v) length of Op File to be handled next
4	( )		TI 0 + j (in u) addr. in tape image where next Op File starts
5	( )		j (in u)
6	( )	( )	Current word
7	( )		Call word (in u)
10			Temp 1 + j
11			120 - j
12			Temp 2 = 0 (temp 1) 0
13			Temp period
14			Ind. List 1 and working space
15			Ind. for cross ref. in Op File 1 item of fixed libr. and working space

RE VV2764	Temporaries Phase I
RE MB1242	
RE CF2627	
RE LM2641	
RE FA4260	Op File IIa
RE ZA77000	
RE BQ632	
RE BR537	
RE ST653	Segment table
RE GK1000	
RE TN20	
RE UP421	
RE TH21	Tape Handler
RE TI3274	Tape Image
RE DI3464	Drum Image
RE SD4156	Directory II
RE FD 40101	Directory I
RE FP 7660	Op File IIb
RE OP45215	Op File I
RE LI4160	List I
RE TE1300	Temporaries Phase II

RE BB1373

RE CC1520

RE CD1536

RE CE1567

RE PT1600

RE DD1602

RE EE1617

RE EF1657

RE EG1672

RE EH1724

RE EI1754

RE EJ1766

RE EK2001

RE EL2004

RE EM2017

RE EN2031

RE EO2064

RE EP2067

RE EQ2106

RE ER2117

RE ES2124

RE ET2131

RE EV2135

RE EW2150

RE EX2153

RE EY2156

RE EZ2163

RE LL2165

RE FF2173

RE FG2266

RE GG2273

RE GH2325

RE GI2360

RE GJ2404

RE GL2407

RE HH2414

RE RC2464

RE FC2472

RE WN2567

RE BU2572

RE EU2606

RE FU2614

RE FB7660

RE DA1012

RE TT1241

RE WSO

RE SO10000

RE SM7660

RE SN10000

```
      IA BB                    Come from HG2 Phase I
0     MJ 0 BB3                 Jump to start
1     MJ 0 BQ6                 Alarm exit
2     MJ 0 ZA10                Normal exit
3     TP FC12 Q
4     QT 10 TE26               10000
                               20000 - (00010)v --> 00010v
5     TP FC63 A                30000
6     ST TE26 A
7     TV A 10
10    MJ 0 BB14
11    QT 7 TE26
12    EJ FC7 BB123             Is (7)v zero?  Yes, clear 7
13    MJ 0 BB20
14    QT 10 A
15    SS 7 17                  File 7u
16    TU A 7
17    MJ 0 GI                  Go to form segm. length for this
                               probl.
20    TU FD BB73               Set RP command
21    RA BB73 FC10
22    TU SD BB42               Set MD address of first statement
(1)
23    RP 10005 BB25
24    TP FC7 TE22              Clear temporaries
25    RP 10021 BB27
26    TP FC7 TE
27    TP FC17 TE5              Set α and β to same fixed Op File IIa
                               addr.
30    TP FC17 TE6
```

31	TP FC20 TE7	Set γ to fixed Op File IIb addr.
32	TP FC7 FP	Clear first word of Op File IIb area
33	RP 13400 BB35	Clear Op File IIa area
34	TP FC7 FA	
35	TU BB42 BB37	Come from BB34 or EE34
36	TP FC45 A	Set u of repeat command BB41
37	SA 30000 17	
40	TU A BB41	
41	RP 30000 BB43	Transfer next statement Op File item to drum
42	TP 30000 DI	
43	TP DI TE10	Record 1st word of statement Op File in Temp 1
44	TV DI1 TE1	# of lines in this statement rout. $\longrightarrow t$ and t_2
45	TV DI1 TE4	
46	TV TE5 BB47	α address to NI
47	TU TE10 30000	Statement call word $\longrightarrow$ Op File IIa
50	TV TE5 BB52	α address to BB52
51	RA BB52 FC5	$\alpha + 1$
52	TV DI1 30000	# of lines in routine $\longrightarrow \alpha + 1$
53	RJ CE1 CE	Advance α and K by 2 and check exceeded region
54	RA TE2 FC13	
55	MJ 0 BB56	Free but needed
56	TP FC3 Q	Is CW 26---?
57	QT TE10 A	
60	EJ FC46 DD	

(4)	61	TV DI TE15	Come from BB60 or BB120
	62	RS TE15 FC6	Set index for # of cross ref. (one higher since ind. jump in beginning
	63	TV FC47 TE11	Set addr. of first cross ref → TE11
	64	IJ TE15 CC	Are all cross references handled?
	65	MJ 0 BB66	Free but needed
(6)	66	RA TE6 FC6	Adv β by 2
	67	EJ TE5 EE	$\beta = \alpha$? yes, go to switch
	70	SP A 17	Do handl. of β's
	71	TU A BB72	Next CW to be processed for $\beta \rightarrow$ A
	72	SP 30000 0	Set by BB71
	73	RP 30000 BB75	Set by BB20, 21
	74	EJ FD1 BB77	Search Directory I for call word at addr. β
	75	MJ 0 BR5	Go to alarm 5 (Directory incorrect)
	76	02 0 0	
	77	SN Q 17	-j-n+r in u (-j-n+r)+(j+n) = r
	100	SA BB73 0	
	101	SA BB74 0	Set u of BB103 r + FD1
	102	TU A BB103	
	103	SP 30000 17	Set by BB102
	104	TU A BB112	Set this Directory I addr. into u of BB112
	105	TU BB112 BB107	
	106	TP FC45 A	30000 in v of A
	107	SA 30000 17	Set u address of BB112 Set by BB105
	110	TU A BB111	
	111	RP 30000 BB113	Set by BB110 transfer cross ref. Op File I item
	112	TP 30000 DI	Set by BB104 from MD to drum image

```
113     RA TE1 DI1                  Add # of lines in this routine to t
114     TV TE6 BB116
115     RA BB116 FC5                Enter # of lines in this routine in
116     TP DI1 30000                the address following the CW in Op
                                    File IIa
117     SP DI 0                     Is 77000 > CW?  If no, then 77___
120     TJ FC3 BB61                 → (4) go to set index for handl.
                                    cross ref.
121     RF CF11 CF                  Go to handle 77___case
122     MJ 0 BB66                   → (6) (has no cross ref., therefore
                                    no index needed)
123     TP FC7 7                    Come from BB13
124     MJ 0 BB20                   Setting of 00007 in case no single
                                    valued variables
        CA BB125
```

```
      IA CC                        Come from BB64
0     SP TE11 17
1     TU A CC2                     Put CW at addr. given by TE11 in NI
2     TP 30000 TE20                Save found CW in TE20
3     TP FC3 Q                     Mask
4     QT TE20 A
5     EJ FC53 CC14                 27---?
6     EJ FC46 CC14                 26---?
7     TP FC54 Q                    4----?
10    QT TE20 A
11    EJ FC55 HH
12    RJ CD13 CD                   None of the three cases for Op
                                   File IIa
13    MJ 0 BB64                    26--- or 27---
14    RJ CD30 CD14                 Case for Op File IIb
15    MJ 0 BB64
      CA CC16
```

```
      IA CD                Come from CC12 or . . .
0     TU TE2 CD3           Set n in u of RP command CD3
1     RA CD3 FC10
2     SP TE20 0            Check whether CW already in
                           Op File IIa
3     RP 30000 CD5
4     EJ FA2 CD11
5     TV TE5 CD6           Set v of NI
6     TP A 30000           Place CW in Op File IIa
7     RJ CE1 CE            Adv. by 2 in v and check over-
                           flow and take care of 77 case
10    RA TE2 FC13          Adv. by 2 in u
11    RJ CD11 CD12         Exit possible for Vary
                           (DD region)
12    RA TE11 FC5          Adv. to next cross ref. address
13    MJ 0 30000           Exit for RJ
14    SP TE7 0             Come from E01 or EP5 or . . .
15    SS FC20 17           Next addr. in Op File IIb
                           Subtract first addr. and
                           shift to u
16    TU A CD21            Set n in u of RP command CD21
17    RA CD21 FC10         Check whether CW already in
                           Op File IIb
20    SP TE20 0
21    RP 30000 CD23
22    EJ FP1 CD26
23    TV TE7 CD24          Set v of NI
24    TP A 30000           Place CW in Op File IIb and adv.
25    RJ CE5 CE4
```

Op File IIa

Op File IIb

26	RJ CD26 CD27	Exit possible for Vary	Op File IIb
27	RA TE11 FC5	Adv. to next cross ref. address	
30	MJ 0 30000	Exit of RJ	
	CA CD31		

```
      IA CE                    Come from CF or CF2
0     RA TE5 FC6
                                                      Op F IIa
                                                      FA = 4260
1     TJ FC64 30000            Adv. next addr. for Op File
                               IIa by 2 and check whether
                                                      FC64 = SM
                                                           = 7660
2     MJ 0 EW                  region exceeded
                                                      space for
                                                      3400

3     0 0 0                    Free
                                                      Op F IIb
                                                      FP = 7660
4     RA TE7 FC5               Come from CD25
                                                      FC65 = SN
                                                           = 10000
5     TJ FC65 30000            Adv. next addr. for Op
                               File IIb by 1 and check
                               whether region exceeded
                                                      space for
                                                      120
6     MJ 0 EW

7     0 0 0                    Free

      CA CE10
```

```
      IA      PT              (patch)
0     TJ      TE1     EH10    Come from EH3
1     MJ      0       EQ2
      CA      PT2
```

```
      IA CF                          Come from BB121
0     RA TE12 DI1                    Adv. TE12
1     SP MB1 1                       Is # of elements  > 17776?
2     TJ DI1 CF6
3     SP MB1 0                       Is # of elements  > 7777?
4     TJ DI1 CF7
5     MJ 0 CF10
6     RA TE22 FC5                    Adv. TE22
7     RA TE22 FC5
10    RA TE22 FC5
11    MJ 0 30000                     Exit used only in RJ, by BB121
      CA CF12
```

```
      IA DD                          Come from BB57 after detected
                                     26---CW
0     TP FC12 Q
                                     Mask out # of lines
1     QT TE10 A
2     EJ FC57 DD5                    Is it 4 ?  Or 5 ? Go NI
3     TP DI4 TE20
                                     Store (after check) library rout.
4     RJ CD11 CD                     in Op File IIa
5     TP DI3 TE20
                                     Store (after check) last (jump out)
6     RJ CD26 CD14                   CW in Op File IIb
7     TV FC61 EE                     Set switch
10    RJ DD10 DD12                   Chance for jumping once in Vary
                                     start (orig. set to jump, reset
                                     by EF14)
11    MJ 0 BB66                      Exit to (6)
12    TP DI2 TE31                    Save CW of last statem in Vary loop
                                     Save addr. in Op F IIa of first statem
                                       CW in Vary loop
13    TV BB47 TE23                   Done once in Vary loop
14    MJ 0 DD11
      CA DD15
```

```
        IA EE                       Come from BB67

0       MJ 0 EE1                    Switch for Vary set by DD7 to EF
                                    (Vary), restored by EE30

1       RA TE TE1                   Come from EE or EF11 form T + t ⟶T

2       SP TE 0                     is M > T?
3       TJ TE21 EE35

4       RS TE TE1                   T - t ⟶T

5       ZJ EE6 EG2                  Is T = 0 ? (i.e. are we at beginning
                                    of segment?)
6       TP TE21 A                   Is t > M ?
7       TJ TE1 EE14

10      SP TE13 17                  Case t < M and next T would be > M
                                    TE13 was filled when bef. at EE3
                                    we had gone to EE17
11      TU A EE12                   Record latest statem. CW into first
                                    word Op File IIb (for IP command)
12      TP 30000 FB

13      MJ 0 EI                     Go and make segment with settings
                                    before

14      TP FC61 A                   Come from EE7 are we in Vary loop?
15      EJ EE EK                    Yes; go to handl. Vary case
16      MJ 0 EG5                    No; go to alarm (statem. too big)

17      TV FC62 EE                  Come from EE3, case M > T
                                    Restore switch to Non-Vary case
20      TV FC50 DD10                Reset RJ to beginning position for
                                      Vary loop

21      TP TE5 TE13                 Save values of this case, for the case
22      TP TE7 TE14                 we overshoot with next statem.
23      TP TE12 FA1                 TE12 = Temp 3 ⟶ second word in
                                    Op File IIa
24      RA TE3 TE4                  T2 + t2 ⟶ T2
```

α ⟶Temp 4 = TE13
γ ⟶Temp 5 = TE14

```
25      TP FC12 Q
26      QT TE10 A
27      SP A 17
30      AT BB42 BB42
31      TP FC11 Q
32      QT A A
33      EJ SD1 FF
34      MJ 0 BB35
35      TP FC7 TE30
36      TP TE22 TE40
37      MJ 0 EE17
        CA EE40
```

Come from EF6
Case we are not yet at end of Vary loop or segm. length,
Mask 0 0 77777 → Q

Adv. u portion of transfer command by # words in Op File item

Set u in BB42

Have all statem. CW's been processed? i.e., entered in Op File IIa? Detects end of needed information

No, go back to handle next CW

Patch, clear TE30 and save TE22 in TE40

```
     IA EF                                  Case we are inside Vary loop
                                            Come from EE0 after having been in DD
0    RA TE24 TE1                            t4 + t = t4
1    RA TE25 TE4                            t5 + t2 = t5
2    TP FC11 Q                              Mask 0 77777 0 → Q
3    QT TE31 TE26
4    QT TE10 A                              Are we at end of Vary loop?
5    EJ TE26 EF7                            Yes
6    MJ 0 EE25                              No (skip saving α and γ since in Vary
                                            only first import.)
7    TP TE24 TE1                            t4 → t
10   TP TE25 TE4                            t5 → t2
11   RP 10002 EE1                           Clear t4 and t5
12   TP FC7 TE24
     CA EF13
```

```
        IA EG                   Case T > M, yet we are at the be-
                                ginning of segment (implies t > M)
0       RJ EG EG1               Come from EO1. RJ exit for EP15
1       MJ 0 EN31               Patch to EO. Exit after region
                                check when region not exceeded
2       TP FC3 Q                Come from EE5 or EW2
3       QT FA2 A                Is CW at beginning of Op File IIa a
4       EJ FC46 EJ              26---?
5       TU BU WN                Go to alarm (segm. too big)
6       MJ 0 WN
7       TP FC7 TE27             Clear t1 and t3
10      TP FC7 TE30
11      RJ EG11 EG12            Inserted for jump out of EK
12      TV TE5 EG14             Come from EG11 or EH11 or EG27
13      RA EG14 FC5             t1 + (α + 1) → t2
14      RA TE27 30000
15      TV EG14 EG16            T + ( α + 1) → T
16      RA TE 30000
17      TP TE21 A               Is T > M?
20      TJ TE EH12              → (37)
21      MJ 0 EX                 Adv. α by 2 taken out here, see EG30
                                now
22      LA A 17
23      TU A EG25
24      TP FC3 Q                Is CW at α a 26---?
25      QT 30000 A
26      EJ FC46 EH
27      MJ 0 EG12
```

```
30      RA TE5 FC6  }           Patch, come from EM7 adv. α by 2
31      MJ 0 EG22   }           (Patch for replaced instruct. EG21)
        CA EG32
```

	IA EH	Come from EE15 or EG26. Case $t > M$ and we are not at beg. of segm.
0	RA TE30 FC5	Set $t_3 = 1$. Index for Vary within Vary
1	RS TE1 TE27	Come from EK2 or EH $t - t_1 = t$
2	TP TE21 A	Is $t > M$?
3	TJ TE1 EH10	
4	SP TE5 17	Case $t < M$
5	TU A EH6	Record statem. CW into first CW of Op File IIb (for IP command.)
6	TP 30000 FP	
7	MJ 0 EI2	Go to D, exit to write on tape
10	RA TE1 TE27	$t + t_1 = t$ restore t since it is still too big and we have to make beginning segment bigger
11	MJ 0 EG12	Go to (34)
12	TV TE5 EH14	Come from EG20 or EH27
13	RA EH14 FC5	$T - (\alpha + 1) \rightarrow T$. We finally made first part too big and have to go back to last statement and form segm. resp. back to last Vary within Vary
14	RS TE 30000	
15	SP TE5 17	
16	TU A EH20	
17	TP FC3 Q	CW at α = 26---?
20	QT 30000 A	
21	EJ FC46 EQ	Vary beginning, OK, go and form segment
22	EJ FC53 EH24	CW at α = 27---? Statem. CW, go to check whether Vary inside Vary

```
23      MJ 0 EM3                    Other CW (for inst. libr. rout.)
                                    go farther back and try again
24      TP TE30 A
25      ZJ ES EQ1                   Is t3 = 0?      ≠0 Vary in Vary
                                                      = 0 not so
26      RS TE5 FC6                  Reduce α by 2
27      MJ 0 EV                     Jump to try with reduced length
                                    after hdl. 26, 27 case that go out
        CA EH30

        IA EI                       Come from EE13 or EW1
0       RJ ET3 GI13                 Set addr. BB42
1       MJ 0 EI6                    Jump to restoring Vary settings
2       TP TE5 TE13                 Come from EH7; save α
3       RJ ET3 ET                   Set addr BB42
4       TP TE12 FA1                 Save 77 count
5       TP TE7 TE14                 Save γ
6       TP FC7 TE30
7       TV FC62 EE                  Restore Vary settings
10      TV FC50 DD10
11      MJ 0 FF                     Jump to write segment on tape
        CA EI12
```

```
        IA EJ                       Come from EG4 resetting to Vary in
                                    beginning of segm.
0       TP FC17 TE5
1       TP TE7 TE32                 Save TE7= γ in TE32 and set counters
                                    back to segment start
2       TP FC20 TE7
3       TP FC7 TE12
4       MJ 0 EJ11                   Jump to clearing TE22, t1, t3 and
                                    exit
5       TP TE13 TE5                 Come from EK
6       TP TE7 TE32                 Save TE7 = γ in TE32 and set counters
                                    back to Vary start
7       TP TE14 TE7
10      TP FA1 TE12
11      TP FC7 TE22                 Clear TE22
12      MJ 0 EG7                    Jump to clearing t1 and t3 and to
                                    exit from RJ
        CA EJ13
        IA EK                       Come from EE15 resetting to Vary not
                                    in beginning of segment.
0       RJ EG11 EJ5                 Do resetting of counters
1       TP TE40 TE22                Reset TE22
2       MJ 0 EH1
        CA EK3
```

```
        IA EL                       Come from LL1 or LL3
0       TP FC3 Q
1       SP TE5 17                   Is CW at hand a 77---?
2       TU A EL3
3       QT 30000 A
4       EJ FC3 EL6
5       MJ 0 30000                  Not 77---, skip changing TE12 and
                                    TE22 (set to ER or to EL12)
                                              by EM      by EM3
6       0 0 0                       Adv. resp. reduce TE22
7       TV TE5 EL11                 Adv. resp. reduce TE12 by # of
                                    instructions
10      RA EL11 FC5
11      0 0 0                       Used !!!
12      0 0 0                       Jump back to rout.
        CA EL13
```

```
      IA EM                          Come from EX1
0     TV FC74 EL5                    Set "ER" in v of EL5
1     RP 30002 LL                    Entrance for going forward
2     TP EM6 EL11
3     TV ER2 EL5                     Come from EH23
                                     Set "EL12" in v of EL5
4     RP 30002 LL2                   Entrance for going backward
5     TP EM10 EL11
6     RA TE12 30000                  Const. for EL11, EL12 in forward case
7     MJ 0 EG30
10    RS TE12 30000                  Const. for EL11, EL12 in backward
                                     case
11    MJ 0 EH26
      CA EM12
      IA LL
0     TP LL4 EL6                     Come from EM1
1     MJ 0 EL                        Forward
2     TP LL5 EL6                     Come from EM4
3     MJ 0 EL                        Backward
4     RJ LM14 LM                     Const. for forward
5     RJ LM20 LM15                   Const. for backward
      CA LL6
```

```
     IA LM                    Come from EL6
0    TP FC5 A                 Entrance for forward
1    SA TE5 17
2    TU A LM3                 Is # of inst. > 17776?
3    TP 30000 TE34
4    SP MB1 1
5    TJ TE34 LM11
6    SP MB1 0                 Is # of inst. > 7777?
7    TJ TE34 LM12
10   MJ 0 LM13                Adv. resp. reduce TE22
11   RA TE22 FC5
12   RA TE22 FC5
13   RA TE22 FC5
14   MJ 0 30000               Exit, used in RJ from EL6 for
                              forward case
15   RP 20003 LM17            Entrance for backward
16   RA LM11 BB76             Change RA to RS in LM11-13
17   RJ LM14 LM               Handle TE22 for 77 ... when going
                              backward
20   RP 20003 30000           Exit, used in RJ from EL6 for
21   RS LM11 BB76             backward case
     CA LM22
```

```
        IA EN                          Come from EQ10
0       TP TE16 A                      Are we finished with all CW's in
                                       Op File IIa?
1       EJ TE5 EH4                     Exit
2       SP TE16 17
3       TU A EN5
4       TP BB73 EN6                    Search Dir. I for CW given at
                                       new α
5       SP 30000 0                     Set by EN3
6       0 0 0                          Set by EN4.  RP ... BB75 exit to
                                       alarm
7       EJ FD1 EN10
10      SN Q 17
11      SA EN6 0                       Set u addr. in EN14
12      SA EN7 0
13      TU A EN14
14      SP 30000 17                    Set by EN13
15      RJ EN15 EN16                   Set u of  EN24.  RJ for use in
                                       addr. ET1
16      TU A EN24
17      TU EN24 EN21
20      TP FC45 A                      Set u of EN23
21      SA 30000 17                    Set by EN17
22      TU A EN23
23      RP 30000 EN25                  Set by EN22
                                       Transfer Op File I item to drum image
24      TP 30000 DI                    Set by EN16
```

```
25      TP FC3 Q
26      QT DI A          Is CW 26---?
27      EJ FC46 EO       Go to handle IIb 26---
30      EJ FC53 EP       Is CW 27---?  Go to handle IIb 27---
31      RA TE16 FC6      Come from EN30 or EG1 or EP2.
                         Adv. new α addr. by 2
32      MJ 0 EN          Go back in loop
        CA EN33
        IA EO            Come from EN27    CW 26---
0       RA TE7 FC5       Adv. Op File IIb address
1       TJ FC65 EG       Did we exceed region?  No, go via
                         patch EG-EG1 to EN31
2       MJ 0 EY          Yes; jump to make segment
        CA EO3
```

```
        IA EP                          Come from EN30    CW27---
0       TP FC12 Q                      Mask out # of lines
1       QT DI A
2       ST FC6 TE17                    Set index for # of cross ref.
                                       (1 too high, pre-done)
3       TU DD12 EP6                    Preset EP6 to DI2
4       IJ TE17 EP6                    Are all done?
5       MJ 0 EN31                      Yes
6       TP 30000 TE20                  (Starts with DI2)
7       TP FC3 Q                       Mask out CW code
10      QT TE20 A
11      EJ FC46 EP15                   CW = 26---?
12      EJ FC53 EP15                   CW = 27---?
13      RA EP6 FC51                    Adv. addr of cross ref.
14      MJ 0 EP4                       Go to handle next cross ref.
15      RJ EG E0                       Put CW in Op File IIb resp. adv.,
16      MJ 0 EP13                      Op File IIb addr. (since the CW is
                                       already in from the first try)
        CA EP17
```

```
      IA EQ                    Come from EH21
0     RS TE30 FC5              Subtract indicator for Vary in
                               Vary by 1
1     RJ EQ1 EQ2               Inserted for RJ use by EY
2     TP FC20 A                Has anything been in Op File
                               IIb before we went back?
3     EJ TE32 EH4              No, skip the part EQ (TE32 set by EJ1
                               or EJ6)
4     TJ TE7 EQ7               Is γ > FC20? (0  0  FP1)
5     TP FC17 TE16             Case T was = 0
6     MJ 0 EQ10                                    } Set new α in either
                                                   } case to starting
7     TP TE13 TE16             Case T was ≠ 0      } addr.
10    MJ 0 EN                  Go to handle case Op File IIb
      CA EQ11

      IA ER                    Come from EL5.  Handle TE3 for going
                               forward
0     EJ FC46 ER3              Is CW 26---?
1     EJ FC53 ER3              Is CW 27---?
2     MJ 0 EL12                Skip changing TE3 = T2 (v used as
                               constant also; by EM3)
3     TU FC74 EL11             Change in EL11 the TE12 ⟶ TE3
4     MJ 0 EL7                 Jump to change TE3 (but not TE22!)
      CA ER5

      IA ES                    Come from EH25
0     TV TE5 ES2
1     RA ES2 FC5
2     RS TE3 30000             Handle TE3 for going backward
3     RJ ES3 ES4               Inserted for use in RJ by EV
4     MJ 0 EH26
      CA ES5
```

```
     IA ET                    Come from EI3 or GI14
0    SP TE13 17
1    RJ EN15 EN3              Set addr. BB42
2    TU A BB42
3    MJ 0 30000
     CA ET4
     IA EV                    Come from  EH27
0    SP TE5 17
1    TU A EV3                 CW at α = 26---?
2    TP FC3 Q
3    QT 30000 A
4    EJ FC46 EV11
5    EJ FC53 EV7              CW at  α  = 27---?
6    MJ 0 EH12                Exit after handling either case
7    TP TE30 A                Is TE30 = 0?
10   ZJ EV6 EV11
11   RJ ES3 ES                Reduce TE3 for going backward
12   MJ 0 EV6
     CA EV13
     IA EW                    Come from CE2 or CE6 (Op File IIa
                              or b exceeded)
0    TP FC7 A                 Is T = 0?
1    TJ TE EE10               No; make segment (with restor. BB42
                              from TE13)
2    MJ 0 EG2                 Yes; start normal Vary way for T = 0
     CA EW3
```

```
      IA EX                    Come from EG21
0     TP TE5 A                 Is Op File IIa exceeded?
1     TJ FC64 EM               No
2     MJ 0 EH12                Yes; go backward where segm. can be
                               made
      CA EX3
      IA EY                    Come from E02 (after Op File IIb
                               region exceeded)
0     RS TE5 FC6               Reduce α by 2
1     RJ EQ1 EH12              Go back to next possible break off
                               point
2     TP TE5 A                 Is α farther back than TE16?
3     TJ TE16 EZ               Yes; break off
4     MJ 0 EY1                 No; go back in loop
      CA EY5
      IA EZ                    Come from EY3
0     TP FC20 TE7              Do setting for final Op File IIb
                               (after it was exceeded) and jump
                               to handling Op File IIb
1     MJ 0 EQ5
      CA EZ2
```

```
        IA FF                                   Come from EE33 or
0       RJ GJ2 GJ                               Jump first to set TE41, later set by
                                                FF1 to MJ 0 FF12
1       TP RC1 FF                               Set switch in FF to MJ 0  FF12
2       RP 10024 FF4                            Set Z's in beginning of first block
3       TP FC35 TI
4       TP FC27 TI24                            Set FILE Δ Δ TWO Δ Δ Δ
5       TP FC30 TI25            Done once       done
                                                once
6       RP 10142 FF10                           Fill up with Z's
7       TP FC35 TI26
10      RJ FG2 FG                               Set tape hdl. code for right tape
                                                (3 or 6)
11      RJ TH2 TH                               Write first block
12      TP FC31 TI                              Set "TWO Δ AΔSEGMT" in first 2 words
13      TP FC32 TI1                             of tape
14      SP TE13 0
15      ST FC17 TI2                             Set length of Op File IIa for this
                                                segm. in 3rd word of tape
16      TP FA1 TI3                              Set # of 77---lines in 4th word of
                                                tape
17      SP TE 0                                 # of lines in statements + Routines
20      SS FA1 0                                + 2 to 5th word of tape
21      AT FC6 TI4
22      SP TE41 0                               Address for IP command (N + T2 + 1)
23      AT TE3 TI5
24      RP 10162 FF71                           Fill first block up with Z's
25      TP FC35 TI6
26      RJ TH2 TH                               Write first block on tape 3
```

```
27    SP TI2 0
30    DV FC21 TE16      Set index how many more
31    TP A TE17         Remainder saved for # of words
                        left over
32    TP RC2 FF70
33    TU FC26 FF37      Set beginning addr. FA2 (Op File IIa)
                        in FF37
34    IJ TE16 FF36      Are all complete blocks written?
35    MJ 0 FF43         Yes; go to handle last fractional
                        block
36    RP 30170 FF40     Come from FF34
37    TP 30000 TI       [FA2] in beginning set by FF33
40    RJ TH2 TH         Write next block
41    RA FF37 FC22      Adv. addr.  Op File II
42    MJ 0 FF34         Go back in loop for next block
43    SP TE17 0         Come from FF35 after all whole blocks
                        written.
44    ZJ FF45 FF63      Are there words for partial block?
45    SP A 17
46    AT RC4 FF50
47    TU FF37 FF51      Set last words in partial block
50    RP 30000 FF52
51    TP 30000 TI
52    SP TE17 17
53    SS FC22 0
54    SN A 0            Fill rest of block with Z's
55    AT RC5 FF57
56    RA FF60 TE17
57    RP 30000 FF61
60    TP FC35 TI
```

```
61      RS FF60 TE17                    Restore last instr.

62      RJ TH2 TH                       Write last data block

63      TP FC36 TI                      Place end of entry
64      TP FC37 TI1

65      RP 10166 FF67                   Fill up with Z's
66      TP FC35 TI2

67      RJ TH2 TH                       Write last block

70      0 0 0                           Set by FF32 to MJ 0 GG or by GG14
                                        to MJ 0 GG16

71      TP TI4 TE37                     Patch
72      MJ 0 FF26                       Save first TI4 for forming segment
                                        table
        CA FF73
        IA FG                           Set code word for tape 3 resp. 6
                                        with TN ≠ 0

0       SP FC40 0                       Set code for:
1       AT TN TH3                       WRITE 1 BLOCK OF TAPE
2       MJ 0 30000
3       SP FC41 0                       Set code for:  (only used in RJ)
4       MJ 0 FG1                        REWIND TAPE
        CA FG5
```

```
     IA GG                    Come from switch FF70
0    TP FC33 TI
1    TP FC34 TI1              Put TWO Δ B Δ SEGMT Δ in TI and TI1
2    SP TE14 0
3    SS FC20 0                Put # of entries in TI2
4    AT FC5 TI2
5    RP 10165 GG7
6    TP FC35 TI3              Fill rest of first block with Z's
7    RJ TH2 TH                Write one block
10   SP TI2 0
11   DV FC21 TE16             Set counter for # of blocks
12   TP A TE17                Save remainder for addr. to fill
                              with Z's
13   TU FC4 FF37              Restore first addr. of Op File IIb
                              in transfer command
14   TP RC3 FF70              Set switch E to E2 (MJ 0 GG16)
15   MJ 0 FF34                Jump to write rest of blocks
16   TP FC11 Q                Come from switch FF70. Mask 0 77777
                              0 → Q
17   QT BB42 A                Have all statem. CW's been processed?
20   EJ SD1 GI22              Yes; go to handle segm. table for
                              last segm. and finish up at GG22
21   MJ 0 GH                  Go back to beginning for next segm.
                              after having handled segm. table
22   TP FC35 TI
23   TP FC35 TI1              Write sentinel block
24   RJ TH2 TH
```

```
25      RJ TH2 TH                   Write second sentinel block
26      RJ FG2 FG3
27      RJ TH2 TH                   Rewind tape for Op File III
30      TP FC42 TH3                 Transfer parameter to read in
                                    Phase III
31      MJ 0 BB2                    Go to:  EXIT OUT OF SEGMENTATION
        CA GG32
```

```
     IA GH                  Come from GG21.  Form segment table
0    RJ GH GI15             Jump (only once) to set ST and do
                            presettings
1    SP TE22
2    AT TE37 A              (A + 2x # of 77 CW's in Op File IIa) / 170
3    DV FC21 TE34           or (A + B) / 170
4    ZJ GH5 GH6             Is there remainder?
5    RA TE34 FC5            Add 1 for remainder of (A + B) / 170
6    RA TE34 FC5            Add 1 for sentinel block
                            } Must be done separate because of ZJ before!
7    SP TE22 1
10   DV FC21 TE26           (2 x # of 77 CW's in Op File IIa) / 170
11   ZJ GH12 GH13           or B/170
12   RA TE26 FC5            Add 1 for remainder of B/170
13   RA TE34 TE26           Add both terms = # of blocks → TE34
14   TP TE33 Q              Mask (event. shifted) → Q
15   SP TE34 33             Mask the # of blocks into segm. table
16   QS A ST2
17   RA GH16 FC5            Adv. last instr. by 1 in v
20   IJ TE35 GH32           Go to Exit (handl. next segm)
                            Ind 17₈ down?
21   TP FC73 TE35           Res. ind.
22   TV GI21 GH16           Set GH16 to ST1 in v
23   LQ TE33 33             Shift mask
24   RS GH15 FC72           Reduce shift count by 11
25   IJ TE36 GH32           Go to Exit      Ind 3₈ down?
26   TP GH32 A              Was this last segm.?
27   EJ FC71 GH32           Yes → GH32
```

30	TU EU WN	No } alarm MORE THAN 63 SEGMENTS
31	MJ 0 WN	
32	MJ 0 BB23	Gets changed with last segm. in RJ to MJ 0 GI23
	CA GH33	

```
     IA GI                    Come from BB17 (only once)
0    TP 12 A                  Indicator for READ, LIST, BOTH in
                              u ⟶A
1    EJ FC7 GI5               Zero?
2    EJ FC51 GI10             One? only LIST
3    EJ FC13 GI11             Two? only READ
4    SP FC 0                  Three assumed
5    AT FC67 ST               Add space for Tape Hdl + Contr + 1 +
                                Term buffer ⟶ST
6    TV A 12                  Set v part of 12
7    MJ 0 GL                  After ST set, do preliminary settings
10   RS GI11 FC51             Case only LIST
11   SP FC2 0                 Case only READ
12   MJ 0 GI5
13   TP TE40 TE22             Come from EI set # of 77 CW's for
                              forming segm.
14   MJ 0 ET                  Go to setting BB42 (RJ exit of ET3
                              is already set to EI1)
15   TP FC70 TE33             Come from GH (only once) put mask
                              in TE33
16   TP FC73 TE35             Set ind. for first time 17 (20 rows)
17   TP FC25 TE36             Set ind. 3 (4 words per row)
20   RP 10020 GH1             Clear rest of segm. table and jump
21   TP FC7 ST1               to GH1
22   RJ GH32 GH               Come from GG20
23   MJ 0 GG22                Case we have last segment
     CA GI24
```

```
      IA GJ                    Come from FF
0     TP ST A
1     AT FC5 TE41              Set once for whole program N in
                               TE41 to FN + 1 for FN + 1 + T2
                               (later formed)
2     MJ 0 30000               Used only once in RJ from FF
      CA GJ3
      IA GL                    Come from GI7
0     SP 7 25
1     LT 0 A
2     ST ST TE21               Set TE21 segment length
3     RS TE21 FC6
4     MJ 0 BB11
      CA GL5
```

```
        IA HH                       Come from CC11    Case CW 4---
0       TU TE2 HH3
1       RA HH3 FC10
2       SP TE20 0                   Is this 4--- CW already in Op File
                                     IIa?
3       RP 30000 HH7                No
4       EJ FA2 HH5                  Yes
5       RA TE11 FC5                 Adv. to next cross ref.
6       MJ 0 BB64                   See whether all handled?
7       TU BB73 HH10
10      RP 30000 HH12               Search
11      EJ FD1 HH14                 Found
12      TU FU WN                    Not found
13      MJ 0 WN                     Go to alarm
14      SN Q 17                     Found, put
15      SA HH10 0                    drum address
16      SA HH11 0                    (where CW placed
17      TU A HH20                    in Op File IIa)
20      TP 30000 TE26                -->TE26
21      TV TE5 HH22
22      TP TE20 30000               Place CW in Op File IIa
23      RJ CE1 CE                   Adv. by 2 in v and check exceeded
                                     region
24      RA TE2 FC13                 Adv. by 2 in u
```

search 4--- in Directory I and store drum address (Op FileI) in TE26(v)

```
25    TP FC12 Q                    v mask ⟶ Q
26    LA TE26 A17                  Addr ⟶ u of A
27    TU A HH30                    v of word in
30    QT 30000 A                   Directory I ⟶ A
31    AT TE26 TE26                 Addr. for next
                                   CW ⟶ TE26
32    LA A 17
33    TU A HH34                    Next CW ⟶ u of TE20
34    TU 30000 TE20
35    TP FC3 Q                     Mask 0 77000 0 ⟶ Q
36    QT TE20 A                    Is CW 23---?
37    EJ FC56 HH5
40    TP FC54 Q                    Mask 0 70000 0 ⟶ Q
41    QT TE20 A                    Is CW4 - ?
42    EJ FC55 HH5
43    TU TE2 HH46                  None of them
44    RA HH46 FC10
45    SP TE20 0
46    RP 30000 HH21
47    EJ FA2 HH25
      CA HH50
```

Adv. to next wanted Op File I address and put addr. in v of TE26 Put CW in u of TE20

Is next CW 23--- or 4---? Yes, exit this part

Is CW already in Op File IIa ?

```
        IA RC                                   Constants for switches
0       MJ 0 FF1
1       MJ 0 FF12
2       MJ 0 GG
3       MJ 0 GG16
4       RP 30000 FF52
5       RP 10000 FF60
        CA RC6
        IA WN                                   Alarm routine
0       TP 30000 UP3
1       RJ UP2 UP
2       MJ 0 BB1
        CA WN3
        IA BU
0       0 BU1 0                                 Alarm:  ONE STATEMENT WITH ALL
                                                REFERENCES IS TOO LARGE FOR SEGMENT.
1       0 BU2 12
2       51      50300   16566       O N E Δ S T
3       24      66304   73050       A T E M E N
4       66      01713   46633       T Δ W I T H
5       01      24464   60154       Δ A L L Δ R
6       30      31305   43050       E F E R E N
7       26      30650   13465       C E S Δ I S
10      01      66515   10146       Δ T 0 0 Δ L
11      24      54323   00131       A R G E Δ F
12      51      54016   53032       0 R Δ S E G
13      47      30506   62277       M E N T .
        CA      BU14
```

```
      IA EU                                  Alarm:  MORE THAN 63 SEGMENTS.
0     0 EU1 0
1     0 EU2 4
2     47    51543    00166
3     33    24500    11106
4     01    65303    24730
5     50    66652    27777
      CA    EU6
      IA    FU
0     0 FU1 0                                Alarm:  PSEUDO OPERATION IS
                                                     REFERENCED BUT DOES NOT APPEAR.
1     0 FU2 11
2     52    65306    72751
3     01    51523    05424
4     66    34515    00134
5     65    01543    03130
6     54    30502    63027
7     01    25676    60127
10    51    30650    15051
11    66    01245    25230
12    24    54227    77777
      CA    FU13
```

	IA FC	Constants
0	0 0 344	$5 + 103_{10} + 120_{10}$ for both
1	0 0 175	$5 + 120_{10}$ for list alone
2	0 0 151	$2 + 103_{10}$ for read alone
3	0 77000 0	
4	0 FP 0	
5	0 0 1	
6	0 0 2	
7	0 0 0	
10	0 20000 0	
11	0 77777 0	
12	0 0 77777	
13	0 2 0	
14	0 0 DI	
15	0 0 DI1	
16	0 FD1 0	
17	0 0 FA2	
20	0 0 FP1	
21	0 0 170	
22	0 170 0	
23	RJ DA11 DA	Used for patch of Phase I, ML1
24	MJ 0 TT	
25	0 0 3	
26	0 FA2 0	
27	31 34463 00101	
30	66 71510 10101	

```
31      66 71510 12401
32      65 30324 76601
33      66 71510 12501
34      65 30324 76601
35      74 74747 47474
36      30 50270 15131
37      01 30506 65473
40      71 00103 TI
41      10 3 0
42      50 1 1100
43      0 0 22
44      0 0 24
45      0 0 30000
46      0 26000 0
47      0 0 DI2
50      0 0 DD12
51      0 1 0
52      0 0 BB46
53      0 27000 0
54      0 70000 0
55      0 40000 0
56      0 23000 0
57      0 0 4
60      0 0 TE31
61      MJ 0 EF
62      0 0 EE1
```

```
63      0 0 SO
64      0 0 SM
65      0 0 SN
66      0 0 5
67      0 0 GK
70      77 70000 00000
71      MJ 0 GI23
72      0 0 11
73      0 0 17
74      0 TE3 ER
        CA FC75
```

Temporaries TE

			Segment Phase II
TE0		T	# of addresses (generated rout.) in segm. for 22, 24, 25, 26, 27, 40, 50, 77
1		t	# of addresses per sentence; set with TV in BB31
2	K		# of entries in Op File IIa
3		T_2	# of addr. for 26, 27 only; adv. in EE24 $T_2 + t_2 \rightarrow T_2$
4		t_2	# of addr. per sentence; set with TV together with TE1
5		α	Present statem. CW addr. of Op File IIa
6		β	Next statem. CW addr. of Op File IIa
7		γ	Next statem. CW addr. of Op File IIb
10	[ ]	TEMP 1	Statem. CW(u) + # of words in item (v) set with TP
11		TEMP 2	Addr. of cross ref. CW; set by ...
12		TEMP 3	# of 77--- data words in this segm.; adv. by 1 with RA
13		TEMP 4	Op File IIa addr. for this statem. CW
14		TEMP 5	Op File IIb addr. for last cross ref. of previous statem. CW
15		INDEX 1	Index for # of cross ref; set with TV
16		INDEX 2	# of full blocks to be written and used by EN, EQ for storage
17		R	# words in partial block
20	[ ]	WS	Holds CW to be placed, whose addr. is in TE11
21		[ ]	Segm. length for problem; fixed for whole problem

22	[ ]		Counter for # of 77 CW's (CW's, not addresses)
23	[ ]		Op File IIa address of first statem. CW in Vary loop
24	t_4		
25	t_5		
26	[ ]		Storage space used by EF3, BB10, HH, GH
27	t_1		# of instructions for 1 sentence at a time
30	t_3		Index that we are in Vary within Vary
31	[ ]		CW of last statem. in Vary loop for comparison
32	[ ]		Storage for γ in EG and EH part
33	[ ]		77 70000 00000 mask shifted for segm. table
34	[ ]		Quotient for GI and GH for segm. table
35	[ ]		Index for 17_8 for segm. table
36	[ ]		Index for 3 for segm. table
37	[ ]		Storage for TI4 of first block for segm. table
40	[ ]		Storage for reset TE22
41	[ ]		Storage for N + 1

2. ALLOCATOR

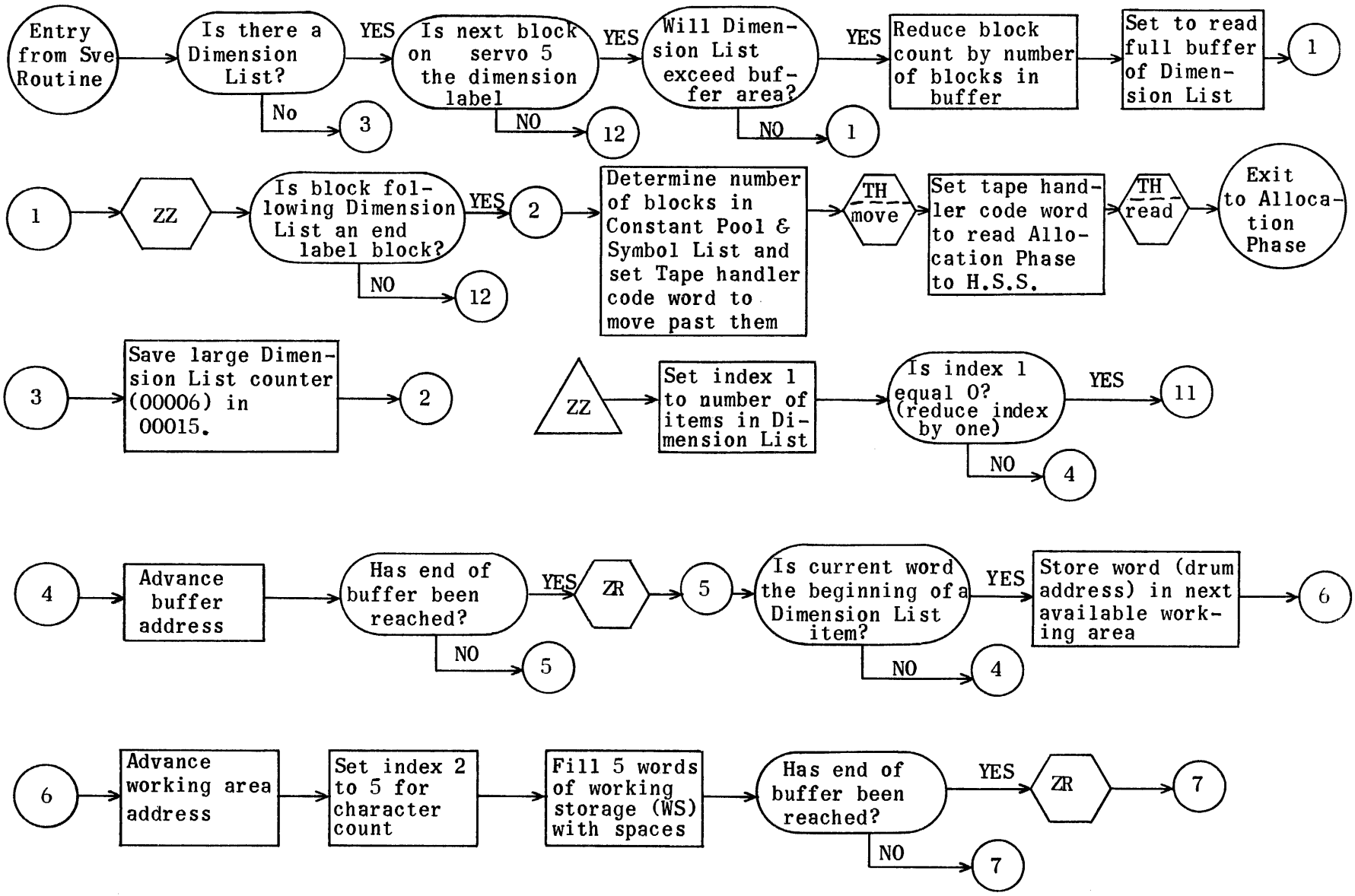
2. Allocator

a. ALLOCATION Setup

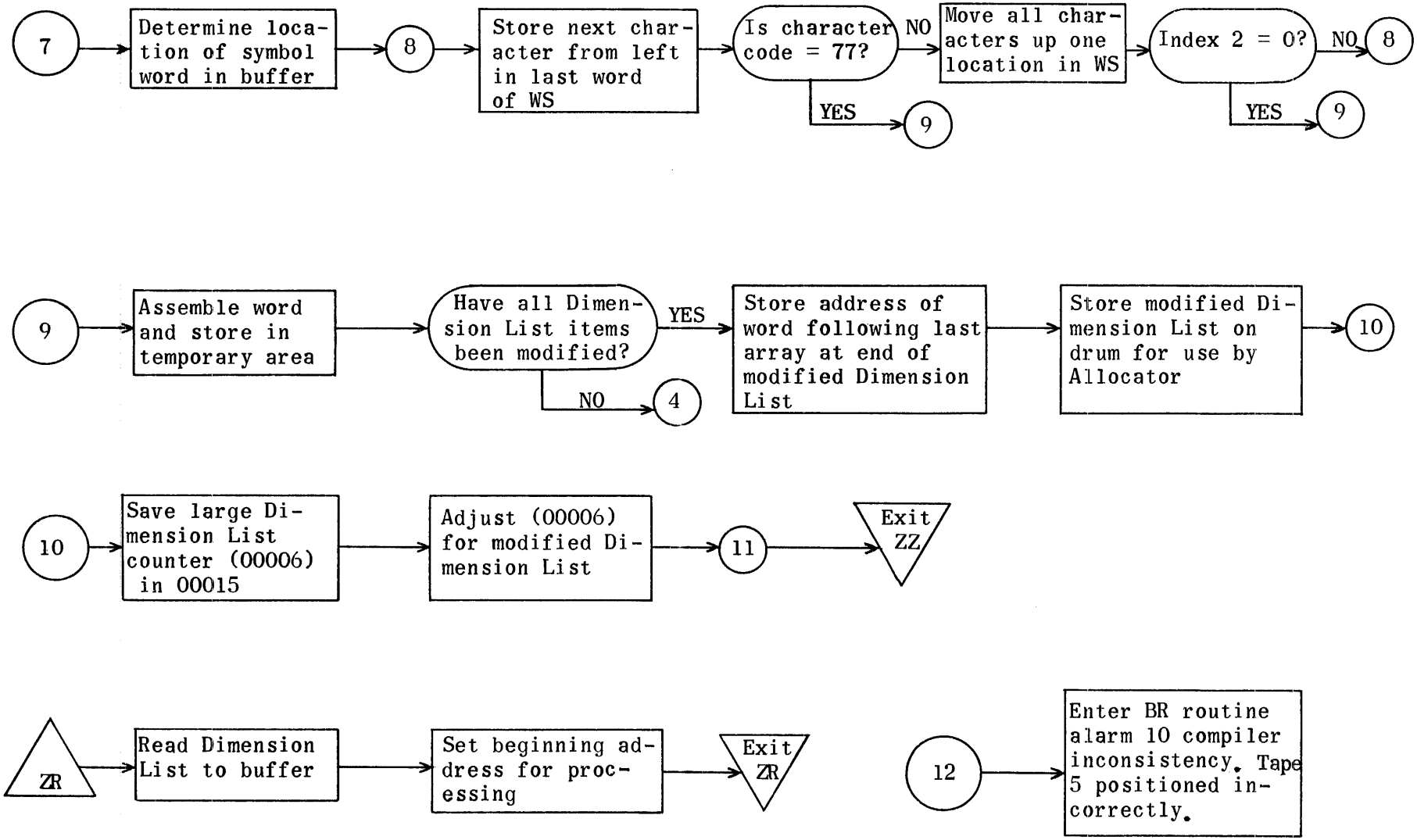
The setup routine for the Allocator reads the Dimension List from magnetic tape and modifies it so that each array is represented by two words instead of the variable (up to six) word items of the original list. The modified Dimension List is then stored on the drum for use by the Allocator. The Dimension List is modified at this time because the Allocator and later the Processor make extensive use of drum storage. Between these phases, the Initialization Generator must have more Dimension information than is available in the modified Dimension List so the original Dimension List is read again from tape and stored on drum preceding the operation of that phase.

After modifying the Dimension List, the setup routine adjusts the Dimension List counter (at location 00006) to reflect the length of the modified list. The counter for the original list is saved at location 00015. The tape on Uniservo 5 is then moved forward past the Constant Pool and Symbol List so that it is positioned properly for the Allocator to write Op File III, Preface, and Termination.

The seven blocks of the Allocator are then read from the UNICODE Master Tape and control is transferred into the Phase.



Allocation Set-Up Flow Chart



Allocation Set-Up (cont.)

Region for Allocation Setup

RE	DC22	Buffer load (in blocks)
RE	TH21	Tape handler
RE	DD40101	Modified Dimension List
RE	BR537	Compiler Inconsistency Routine
RE	ZI7230	
RE	ZZ7270	
RE	ZR7354	
RE	ZX7362	
RE	ZT7403	(1) Temporary (holds number of blocks of Dimension List)
RE	WS674	Working area
RE	ZY2705	Buffer area (= WS 2011)
RE	LC674	Storage and execution address of Allocator
RE	MA700	7 = # blocks Allocation phase?
RE	LA7064	LA = last word of buffer area.

Allocation Setup

```
                IA      ZI
          0     TP      ZX      Q
          1     QT      14      A       Is there a Dimension List?
          2     ZJ      ZI3     ZI24
          3     LT      11      A       # blocks Dimension List →temp.
          4     ST      ZX1     ZT
          5     TP      ZX2     TH3
          6     RJ      TH2     TH      Read one block and check label for
                                        DIMENS.
          7     TP      ZY      A
         10     EJ      ZX3     ZI12
         11     MJ      0       BR12    Tape #5 positioned incorrectly.
         12     SP      ZT      0       Will Dimension List exceed buffer
                                        area?
         13     TJ      ZX4     ZI16
         14     RS      ZT      ZX4     Reduce block count by buffer length.
         15     TU      ZI13    ZR      Set to read full buffer of Dimension
                                        List.
(1)      16     RJ      ZZ63    ZZ      To build modified Dimension List.
         17     TP      ZX2     TH3
         20     RJ      TH2     TH
         21     TP      ZY      A       Read one block and check label for
                                        E N D Δ O F
         22     EJ      ZX17    ZI25
         23     MJ      0       BR12    Tape #5 positioned incorrectly
(3)      24     TP      6       15      Large Dimension List counter →15.
(2)      25     SP      14      0       # blocks in Constant Pool
         26     LT      3       A
```

```
27      LQ      14      Q17
30      QA      ZX13    A
31      SP      A       25
32      AT      ZX15    TH3
33      RJ      TH2     TH
34      TP      ZX16    TH3
35      RJ      TH2     TH
36      MJ      0       LC
        CA      ZI37
```

Add # blocks in Symbol List

Move Uniservo #5 forward past Constant Pool and Symbol List.

Read Allocation Phase to H.S.S.

Jump to Allocation Phase.

		IA	ZZ		
	0	TV	6	ZZ3	Set index to # items in Dimension List
	1	IJ	ZZ3	ZZ6	Reduce index by one
	2	MJ	0	ZZ63	To exit
	3	0	0	0	Index
(4)	4	RA	ZZ10	ZX11	Advance address within buffer.
	5	TJ	ZX12	ZZ7	Still in buffer?
	6	RJ	ZR5	ZR	No; so go to read in next block
(5)	7	TP	ZX6	Q	Bit 29 mask →Q
	10	QT	30000	A	Bit 29 of word → A
	11	ZJ	ZZ12	ZZ4	If = 0, recycle
	12	TU	ZZ10	ZZ13	If not = 0, store first word (drum address)
	13	TP	(30000)	(WS10)	
(6)	14	RA	ZZ13	ZX7	Advance to next word
	15	TV	ZZ13	ZZ40	
	16	RA	ZZ13	ZX7	Set address of 1st word for next variable
	17	TP	ZX10	WS	Set index for character count.
	20	RP	10005	ZZ22	Fill with XS3 spaces
	21	TP	ZX7	WS2	
	22	RA	ZZ10	ZX11	Text for end of buffer area
	23	TJ	ZX12	ZZ25	
	24	RJ	ZR5	ZR	Read in 2nd buffer load
(7)	25	TU	ZZ10	ZZ26	Set to address of symbol word
(8)	26	LQ	30000	6	
	27	QT	ZX13	WS7	One digit →WS7

```
30    EJ    ZX13     ZZ34      If = 77, go to assemble digits
31    RP    30006    ZZ33      If ≠ 77, move digits up one word in
32    TP    WS2      WS1       the image.
33    IJ    WS       ZZ26      6 digits?
(9)
34    SP    WS1      6
35    RP    20004    ZZ37
36    SA    WS2      6         Assemble digits in A_R
37    SA    WS6      0
40    TP    A        30000     Store assembled word.
41    LJ    ZZ3      ZZ4       Recycle to get all arrays
42    TV    ZZ13     ZZ53
43    RS    ZZ40     ZX7
44    TV    A        ZZ52
45    TP    ZZ2      ZZ25      Set addresses to calculate and
46    RJ    ZZ25     ZZ22      store final word
47    RJ    ZZ25     ZZ22
50    TU    ZZ10     ZZ51
51    TU    30000    ZZ3
52    RA    ZZ3      30000     Form and store final word.
53    TP    A        30000
54    RP    32001    ZZ56      Store modified Dimension List.
55    TP    WS10     DD
56    TP    6        15        Save counter for large dimension list.
57    TP    ZX14     Q
60    SP    6        20        Adjust (00006) for modified
61    SA    ZX11     0         Dimension List.
```

```
      62    QS    A       6
(11)  63    MJ    0       30000
      CA    ZZ64
            IA    ZR
      0     SP    [ZT]    25      }
      1     AT    ZX5     TH3     }   Read Dimension List to buffer
      2     RJ    TH2     TH      }
      3     TU    ZX20    ZZ10        Set beginning address for processing
      4     TU    ZI12    ZR
      5     MJ    0       30000
            CA    ZR6
```

```
        IA      ZX
 0      07      70000   0
 1      0       0       2
 2      50      105     ZY
 3      27      34473   05065       D  I  M  E  N  S
 4      0       0       DC
 5      50      5       ZY          Read Parameter (except # blocks.)
 6      0       40000   0
 7      0       0       1
10      0       0       5
11      0       1       0
12      QT      LA1     A           LA = last word of buffer area
13      0       0       77
14      0       7777    0
15      30      5       0
16      50      MA1     LC
17      30      50270   15131       E  N  D  Δ  O  F
20      0       ZY      0
        CA      ZX21
```

b. ALLOCATION PHASE

The Allocation Phase serves two purposes:

1) Builds Op File III for each segment and writes on tape.

Op File III (2 word items)

	Op	u	v	
1.		Call word		
2.		# lines in routine	H.S.S. running location	
		or		
1.		Call word		
2.	14	Segment # from | Segment # jumped to	H.S.S. running location in another segment	If the end point of one-way jump is in another segment
		or		
1.		Call word		
2.		# of data	H.S.S. running location	If call word is of the form 77xxx which refers to a group of data, e.g., x_1, x_2, ... x_{10}.

2) Generates the necessary instructions to manipulate data between segments during the running program. These instructions are called:

a) The Preface, which transfers 77xxx type data to their storage locations in H.S.S.

b) The Termination, which transfers updated 77xxx type data to their designated locations on MD.

The Preface and Termination instructions operate in H.S.S. during the interlude between 2 segments. After generation of these instructions for each segment, the Preface and Termination are written on magnetic tape.

Input: The Allocator receives as input (from Segmentation):

1) Op File IIa - call words of routines and data in segment.

2) Op File IIb - call words of end points of all one way jumps within the segment.

These files are on Uniservo tape by segment.

3) Dimension List with MD storage addresses for 77xxx data.

Output: The output of Allocation consists of:

1) Op File III by segments on tape.

2) Preface and Termination for each segment on drum.

Procedure: Read Op Files IIa and IIb into H.S.S. one segment at a time. Then compare each call word in Op File IIb against the entire Op File IIa for this segment to determine if the end of the jumps (which are actually the words in IIb) appear in the same segment. If equality is not met, the call word from IIb is entered in IIa, thus increasing the length of Op File IIa. Each new entry into IIa at this time is accompanied with the flag 14 in the operation position of the next word. Thus, each new entry in IIa is an entry of 2 words. Each time an entry is made in Op File IIa the call word from IIb is also placed in another list, called Directory 4, which will be used only during this phase. Each entry in Directory 4 is also a 2 word entry, consisting of call word in the first word and the segment number in the second word. An item in Directory 4 at this time looks like this:

	Op	u			v
1st word	00	Call word			00000
2nd word	00	0	Segment number	00	00000

The above procedure is followed until all the call words in Op File IIb have been checked against Op File IIa for one segment.

Each call word in Op File IIa is then checked to determine the type of routine or data to which it refers.

The determination of the type of routines used in the segment, along with the number of lines in the running routine (available in Op File IIa), enables us at this time to assign actual operating addresses according to the High Speed Storage layout:

	CONTROL SECTION (fixed length all problems; includes Tape Handler)
	BUFFER AREAS for Input-Output Instructions (as required)
S	STATEMENTS
R	SUBROUTINES 1) Library Routines 2) Pseudo Operations 3) Defining Equations
D	DATA AREA 1 Multiple valued (77---type)
	DATA AREA 2 Single-valued variables (fixed length for all segments)
	CONSTANT POOL (fixed length for all segments)

Control being of fixed length and buffer area requirements for this problem being known, we can locate S exactly. During Segmentation, a separate tally of statement lengths permits determination of R exactly. D is determined by the accumulated tally of total statement and subroutine lengths plus two. (The plus two accounts for the locations required by the Processor to provide continuity between sequential segments.) With these starting points

S, R, and D, assignment of memory locations in a forward direction can be made according to the category determined by the call word.

The number of lines of data, or the number of lines in the routine, is also used to fill in the u portion of the items in Op File IIa. At this time, Op File IIa is beginning to resemble the new Op File III which is actually an expanded and modified Op File IIa.

After completion of the foregoing process for each segment, that segment's Op File III (Formerly Op File IIa) is written on the drum, and Directory 3 is constructed, containing one word for each segment, in the following format:

Op	u	v
00	MD location of 1st word of Op File III	# of words in Op File III for this segment

Thus, the first word in Directory 3 refers to the first segment, the second word, the second segment, etc.

When Op File III for the last segment has been written on the drum, Op File III is in its final form for all items except those referring to jumps to other segments. But Directory 4 is actually a combined listing of these call words for all segments. So, we use the items of Directory 4 to search against Op File III (by segment) and fill in Directory 4 with number of the segment in which the call word is found, and the operating address of the routine during execution. This continues until all the entries in Directory 4 have been processed. A complete Directory 4 item is of the form:

	Op	u			v
1st word	00	Call word			00000
2nd word	14	0	Segment from	Segment to	H.S.S. running address in segment to

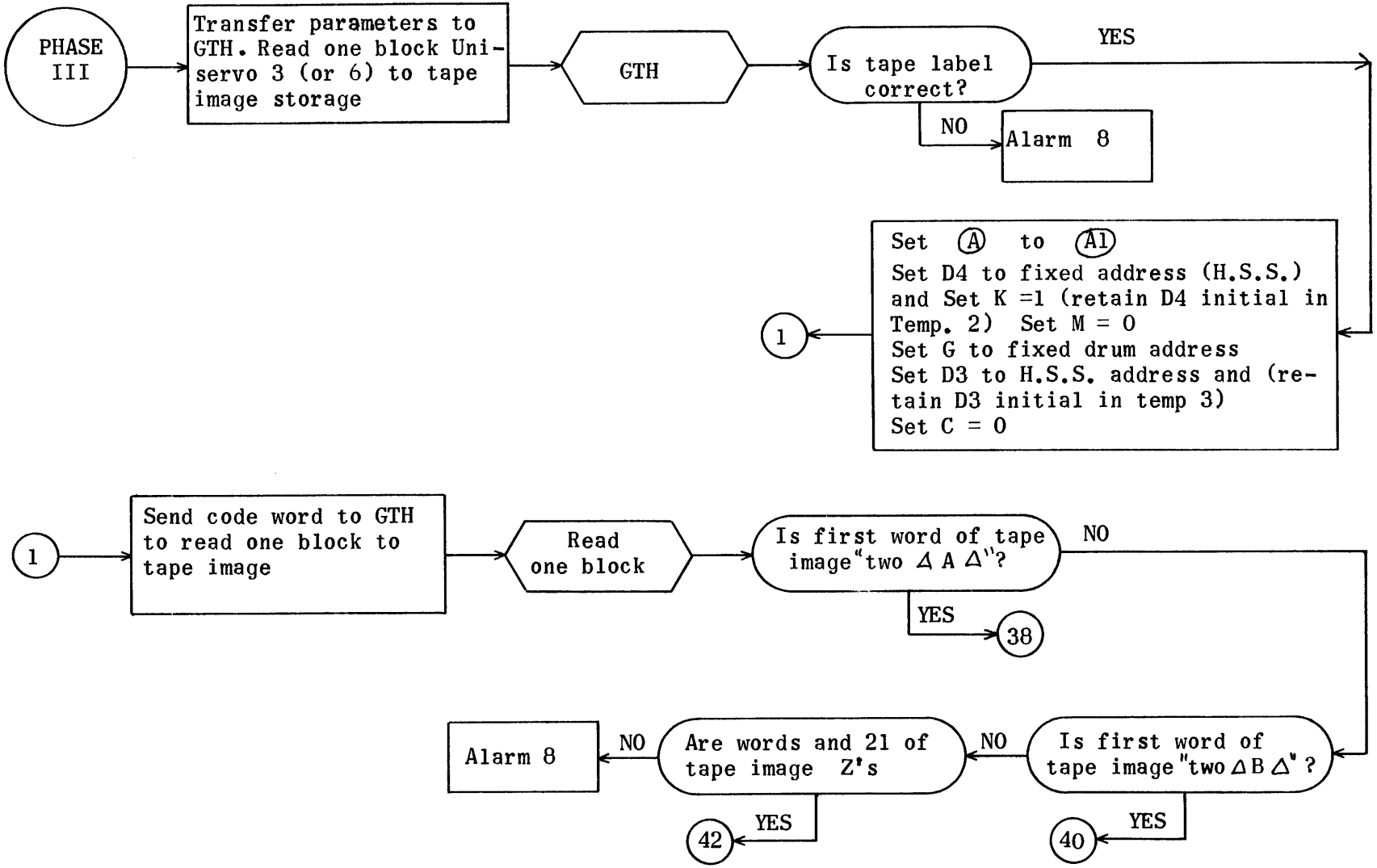
The second word of the above item in Directory 4 is filled into Op File III (one segment at a time) in its appropriate place to complete Op File III. While each segment is in H.S.S. at this time, the instructions for data manipulation are generated and stored on the drum.

The instructions for data manipulation are prepared from Op File III. Each multiple word data group has been assigned an area on MD and the starting address of the area for each variable is available in the Dimension List. Using Op File III and Dimension List information for each 77xxx type call word, the Repeated TP's are generated. When this listing is complete, the w's of Repeat orders are determined and recorded. (Reverse direction for Preface; forward for Termination.) The w's for the Preface are fixed H.S.S. operating locations (not relative) since they are generated at a point during compilation when the exact starting address of Data Area 1 (77 - - - type) is known. Since the length of the Preface is known when Termination w's are written, they too are assigned fixed addresses in the 120-word buffer area within the Control Section.

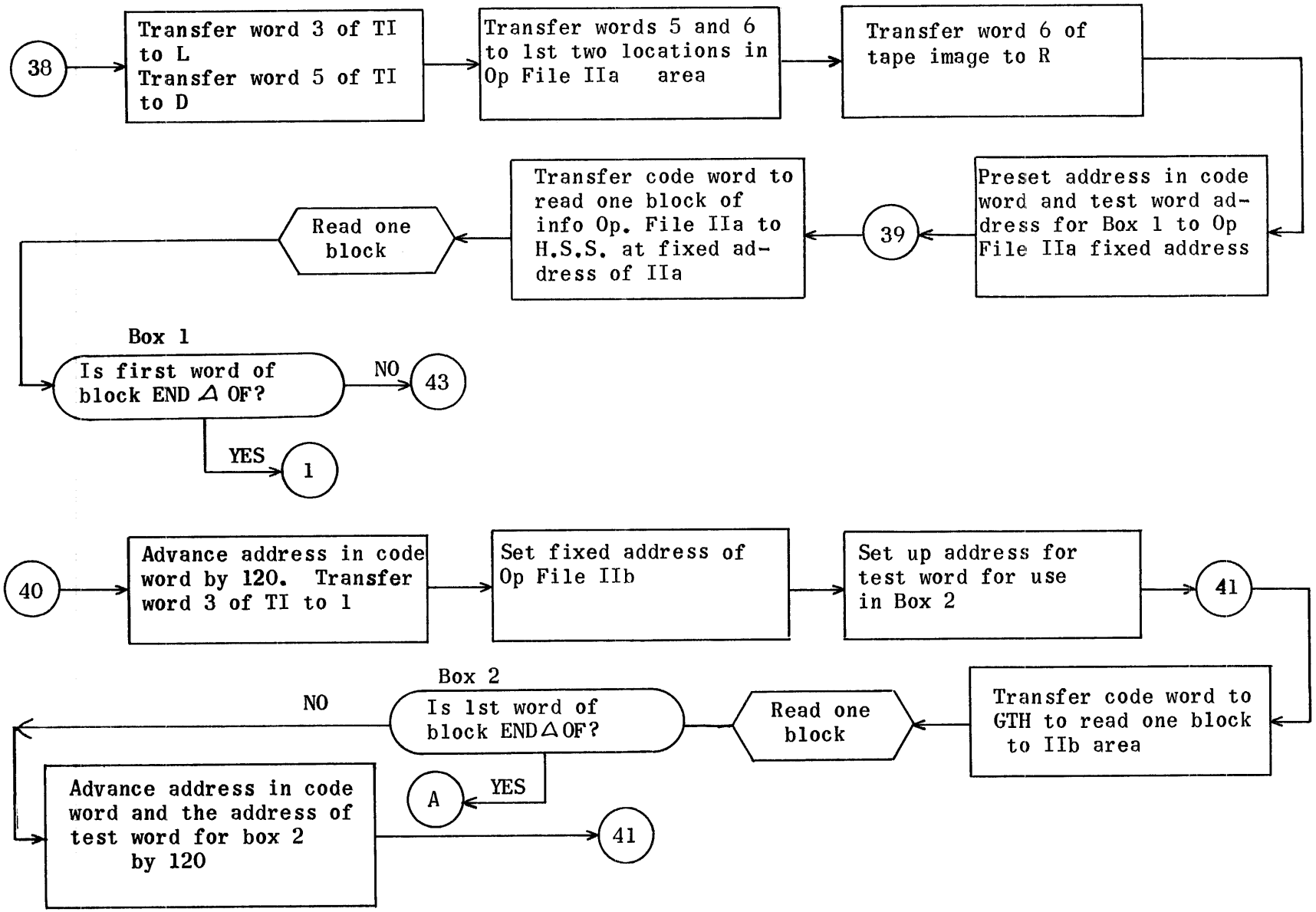
The completed Op File III and the Preface and Termination for each segment are stored on magnetic tape and will be used during the Processing Phase.

This phase is complete when Op File III, Preface, and Termination for all segments of the problem have been written on tape.

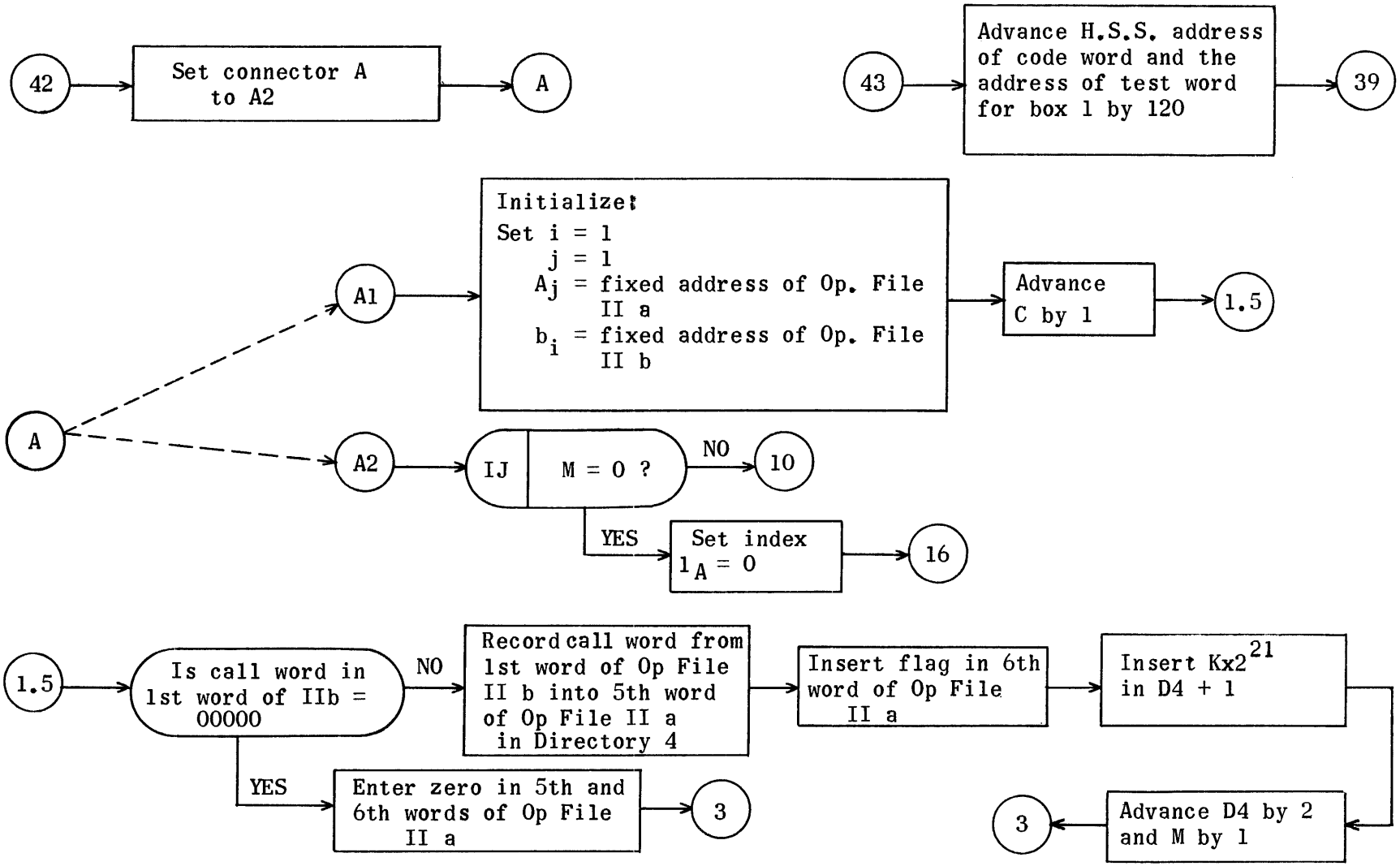
Allocation Phase Flow Chart



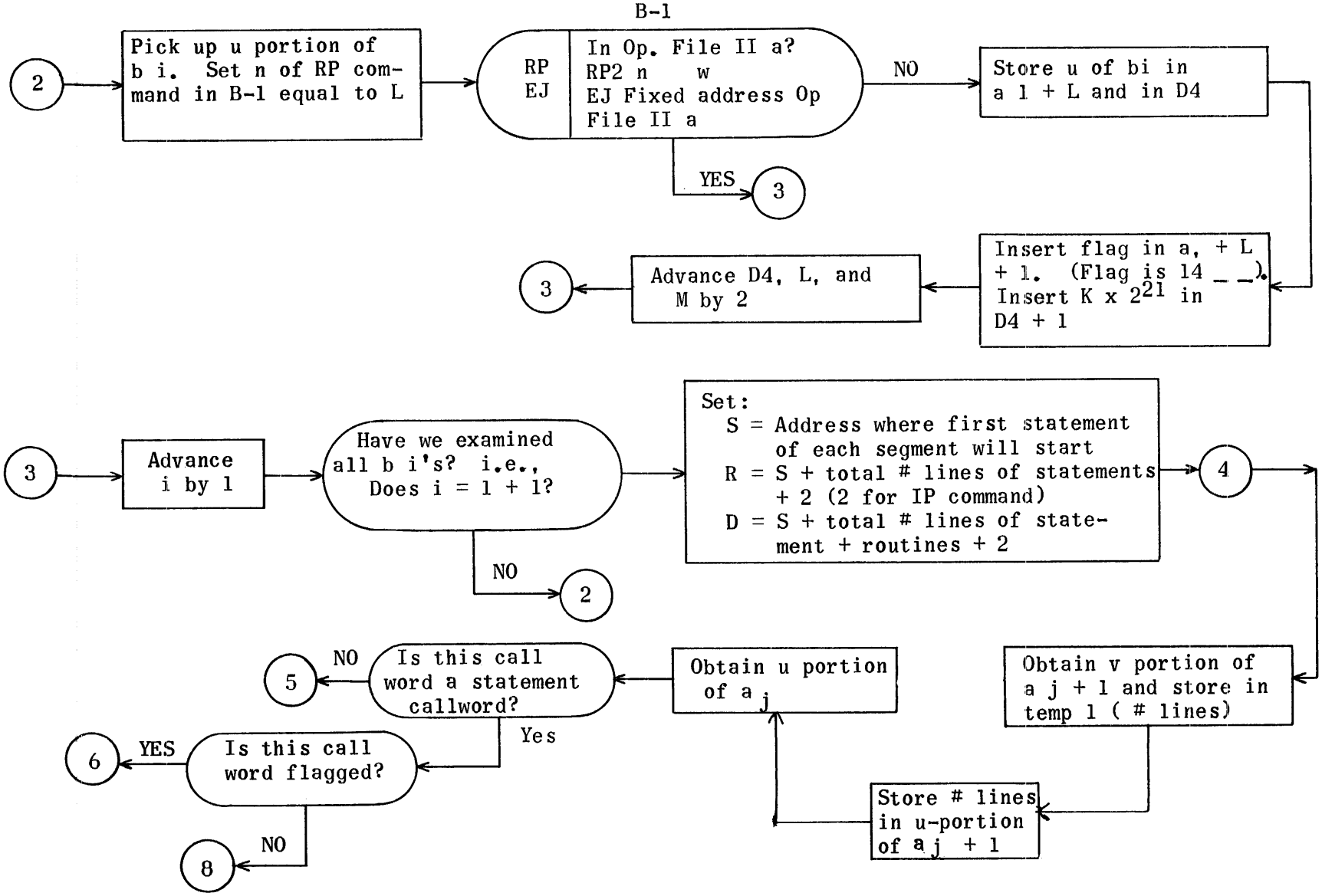
Allocation Phase Flow Chart (cont.)



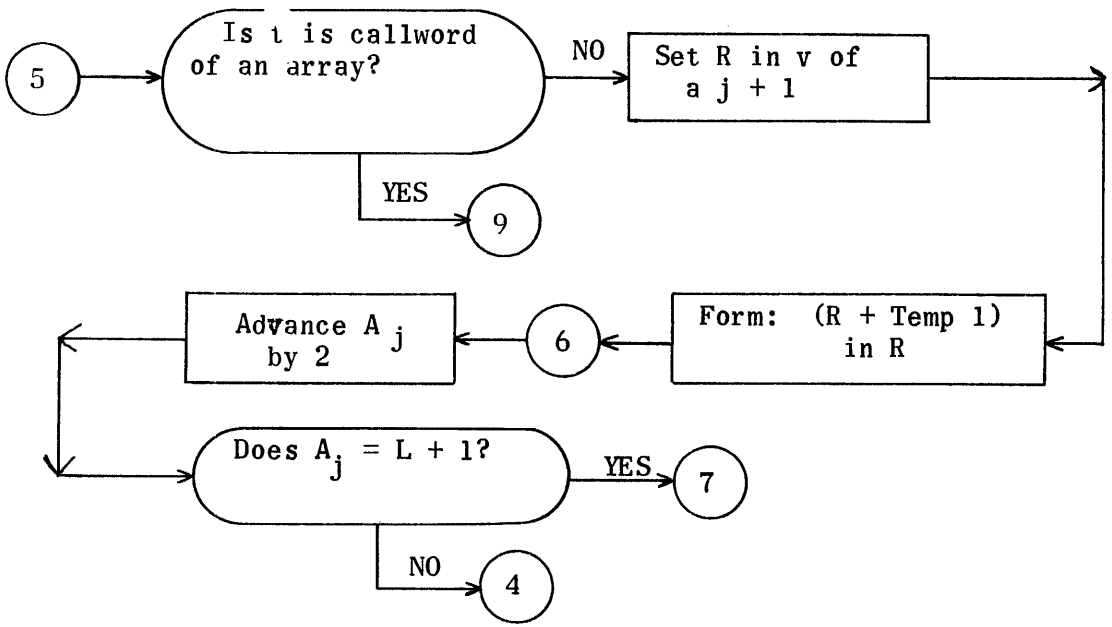
Allocation Phase Flow Chart (cont.)



Allocation Phase Flow Chart (Cont.)



Allocation Flow Chart (cont.)

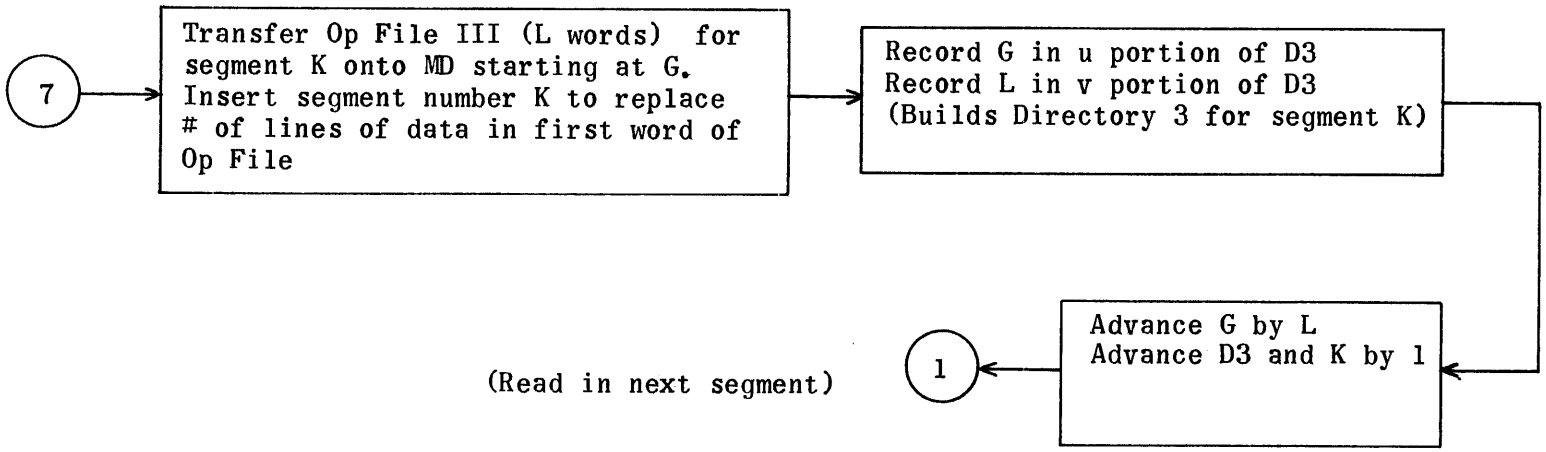


NOTE

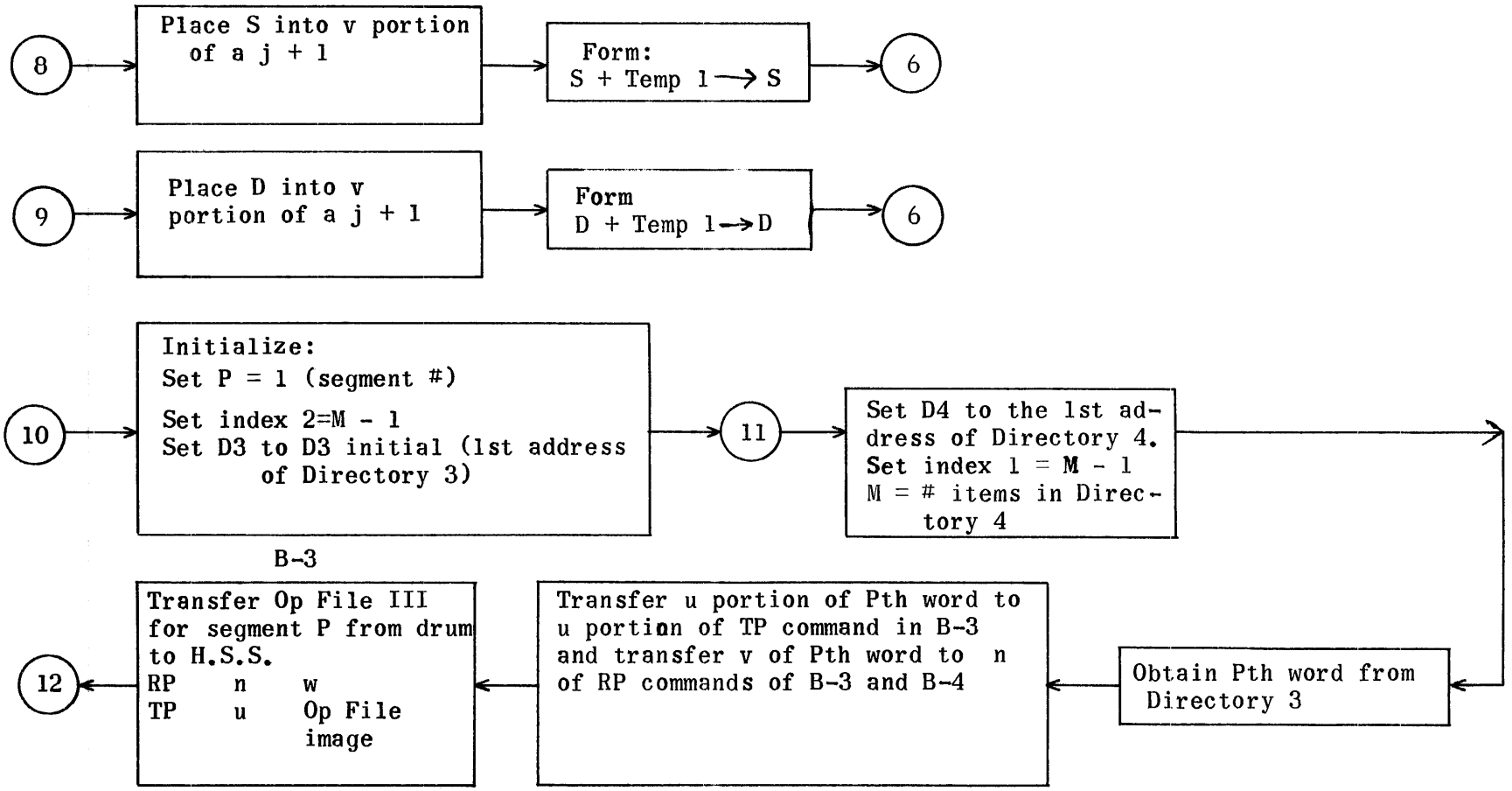
Call words changed from:

	to
70___	27___
71___	24___
	25___
72___	4____
73___	5____
74___	22___
75___	26___
76___	66___
	65___
	64___
77___	77___

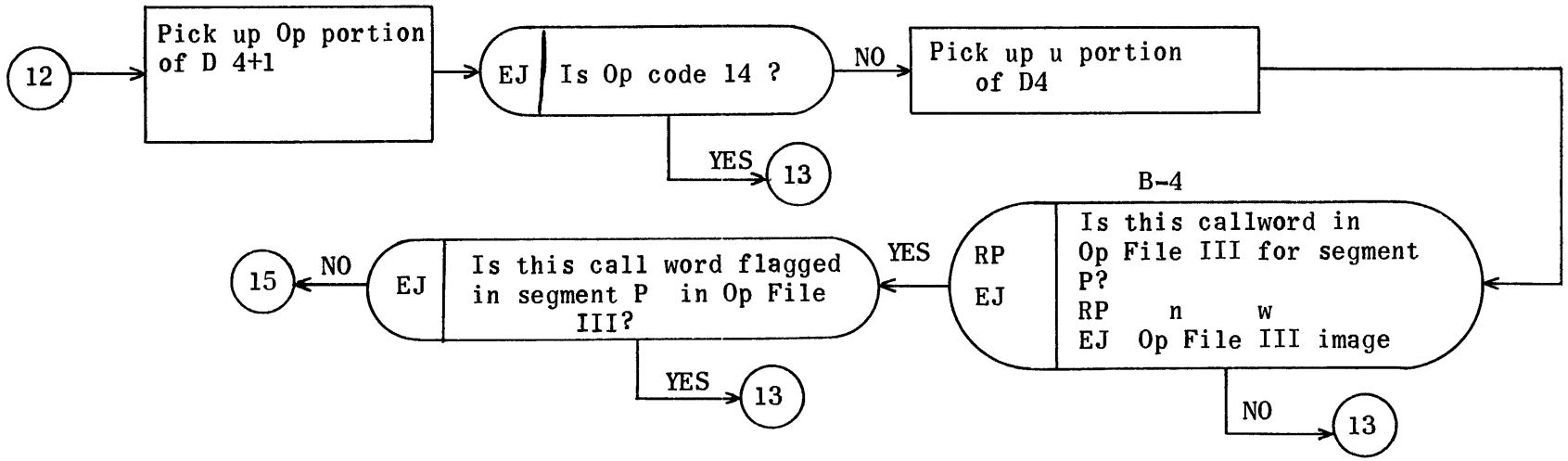
B-2

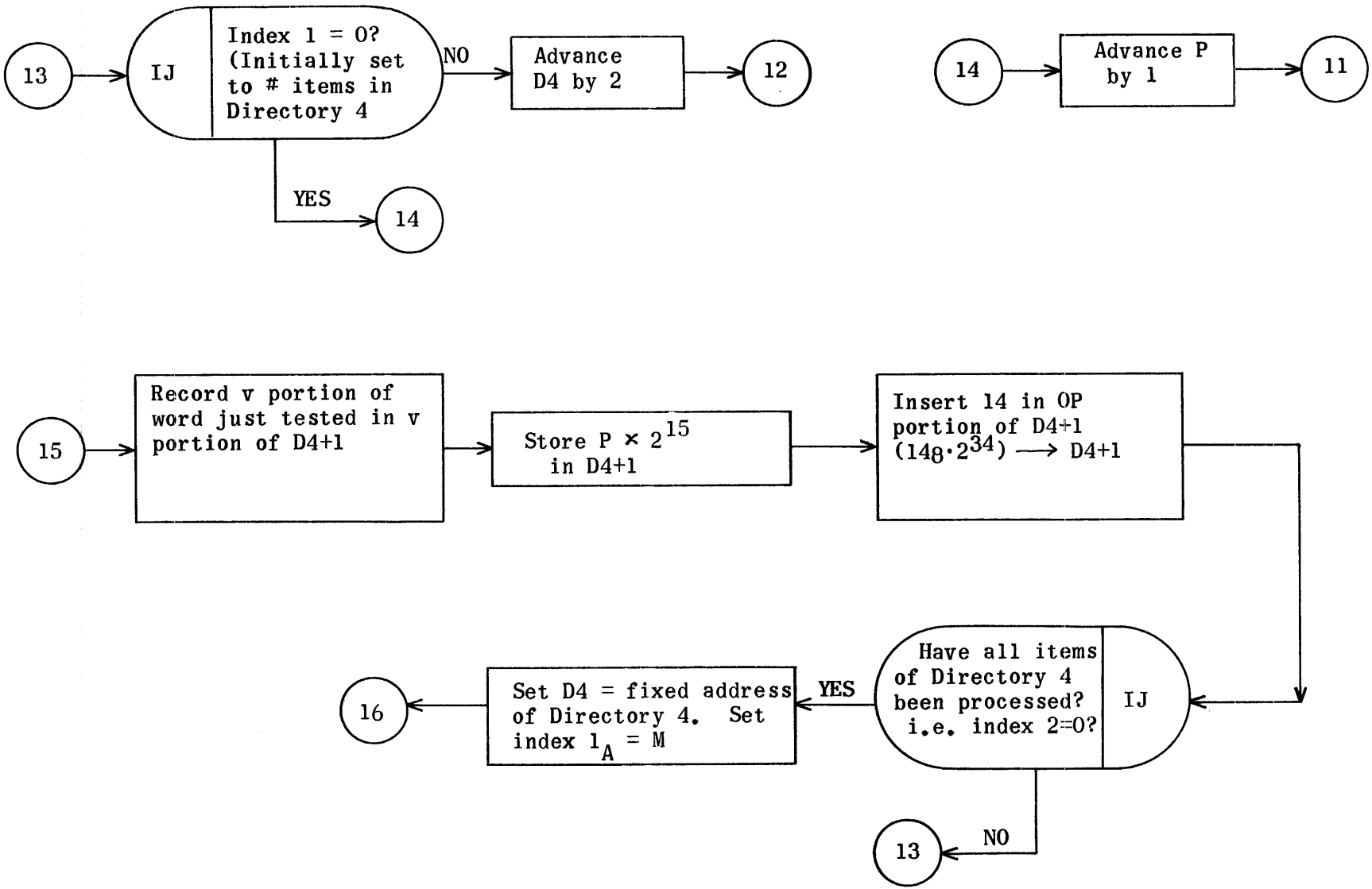


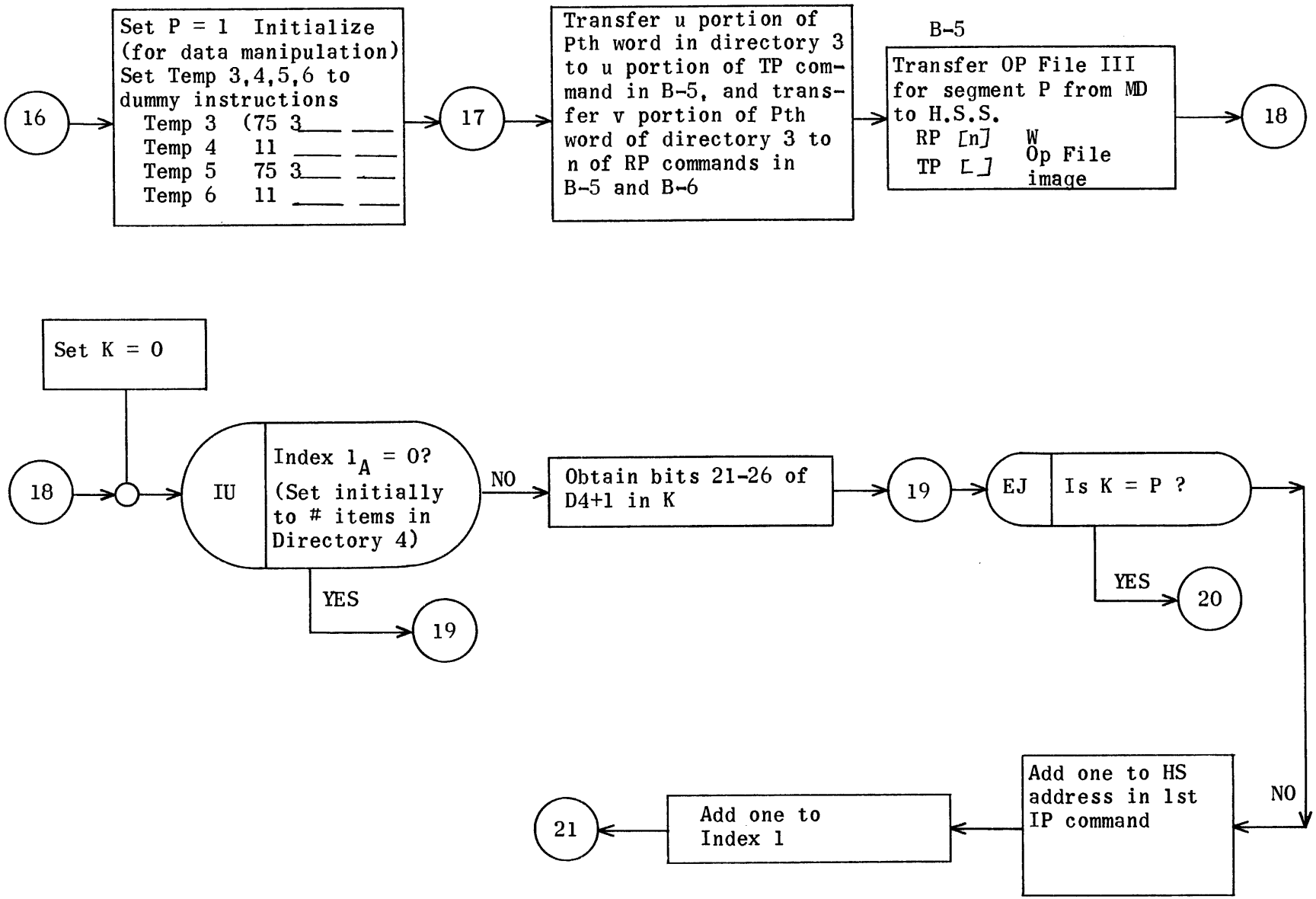
Allocation Flow Chart (Cont.)

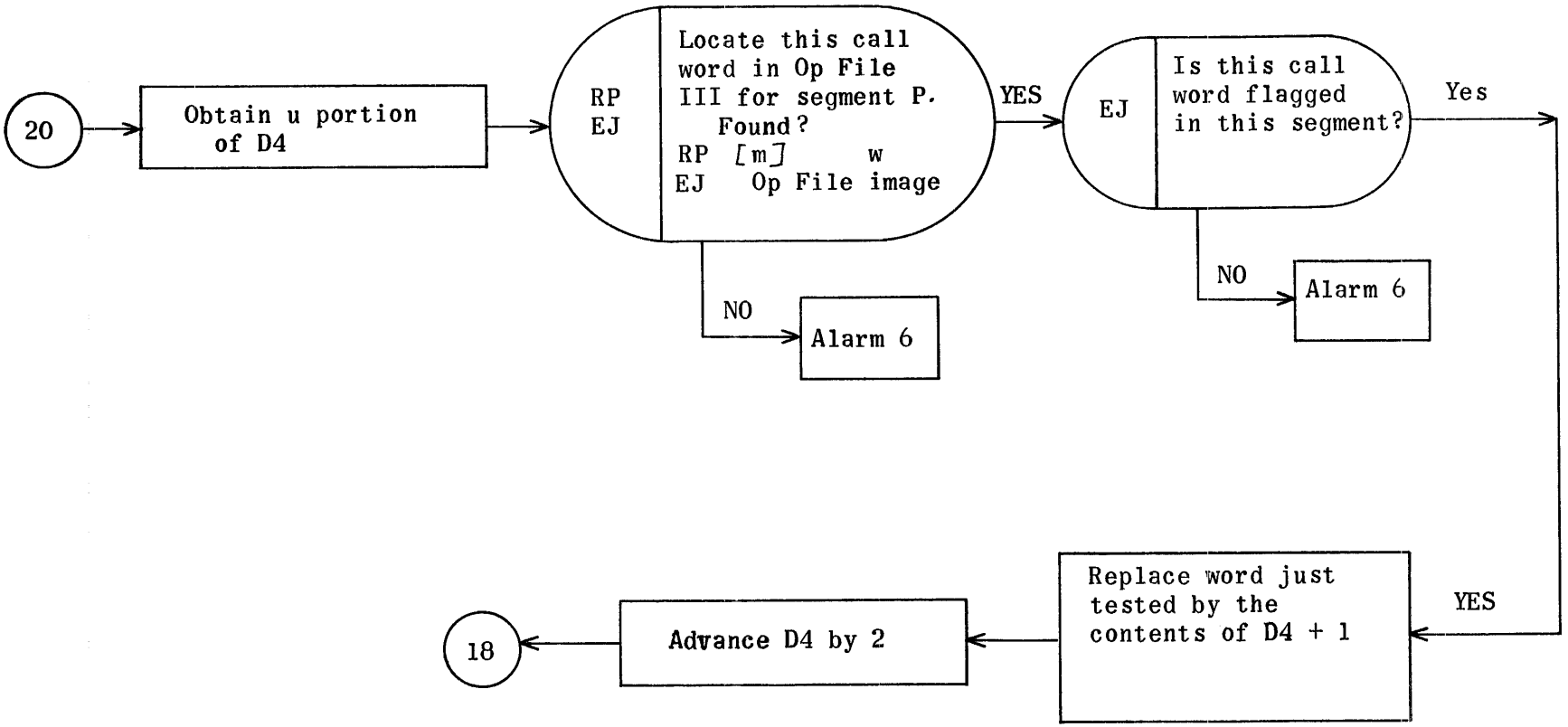


Allocation Flow Chart (Cont.)

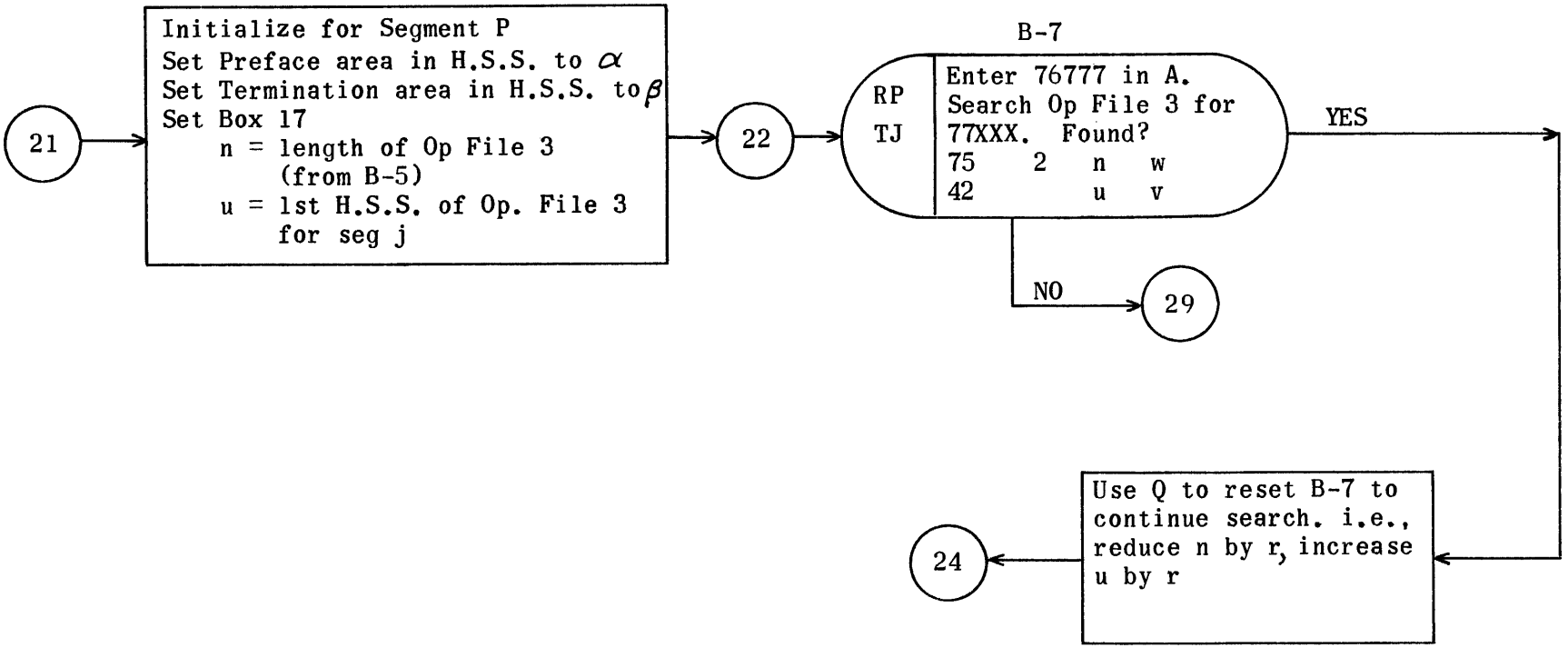



13
IJ
Index 1 = 0?
(Initially set
to # items in
Directory 4
NO
Advance
D4 by 2
12
YES
14
14
Advance P
by 1
11
15
Record v portion of
word just tested in v
portion of D4+1
Store P × 2^15
in D4+1
Insert 14 in OP
portion of D4+1
(14_8 · 2^34) ⟶ D4+1
Have all items
of Directory 4
been processed?
i.e. index 2=0?
IJ
YES
Set D4 = fixed address
of Directory 4. Set
index 1_A = M
16
NO
13

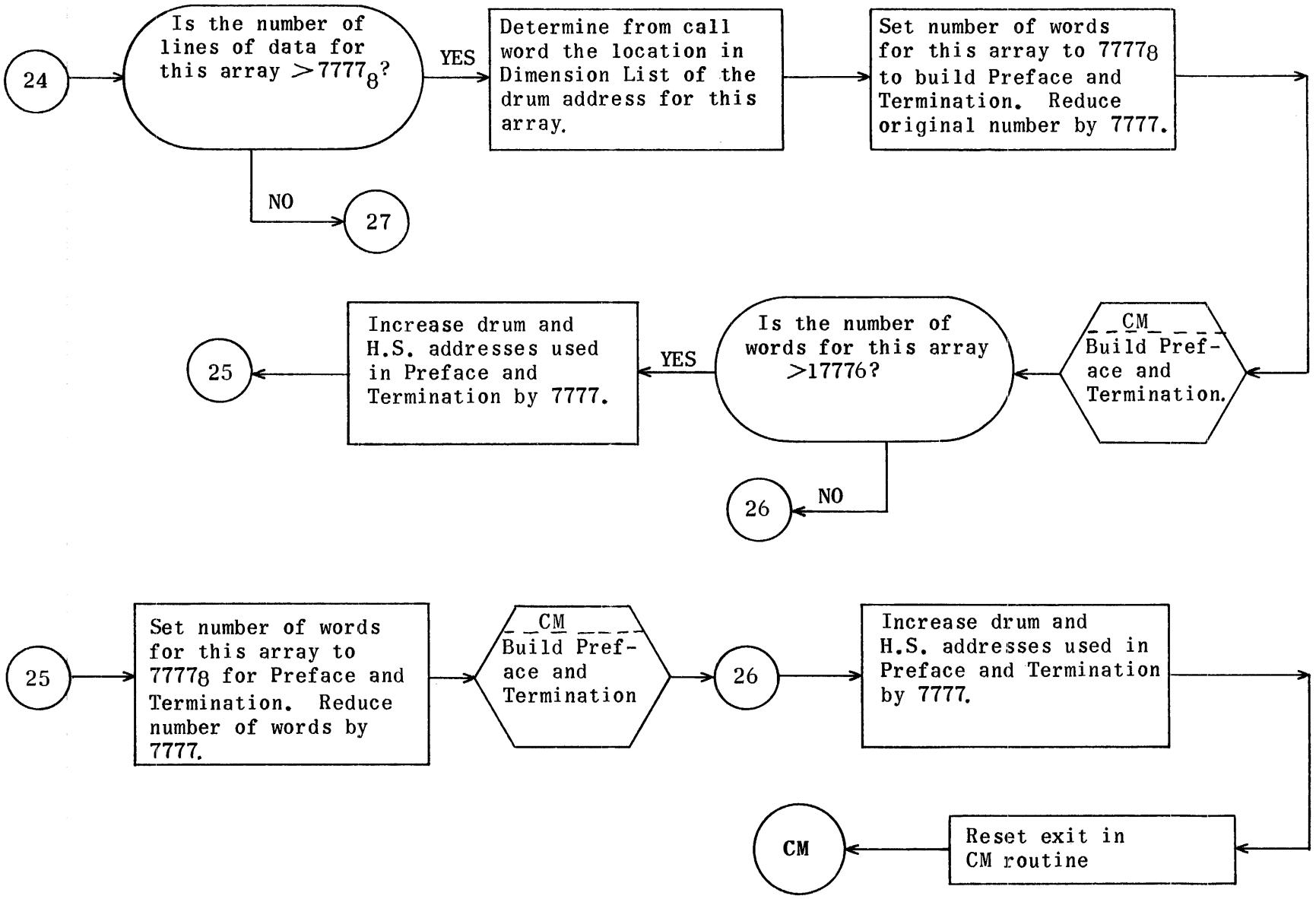

16
Set P = 1 Initialize
(for data manipulation)
Set Temp 3,4,5,6 to
dummy instructions
Temp 3 (75 3___ ___
Temp 4 11 ___ ___
Temp 5 75 3___ ___
Temp 6 11 ___ ___
17
Transfer u portion of
Pth word in directory 3
to u portion of TP com-
mand in B-5, and trans-
fer v portion of Pth
word of directory 3 to
n of RP commands in
B-5 and B-6
B-5
Transfer OP File III
for segment P from MD
to H.S.S.
RP [n] W
TP [ ] Op File
image
18
Set K = 0
18
IU
Index 1A = 0?
(Set initially
to # items in
Directory 4)
NO
Obtain bits 21-26 of
D4+1 in K
19
EJ
Is K = P ?
YES
20
YES
19
NO
Add one to HS
address in 1st
IP command
Add one to
Index 1
21

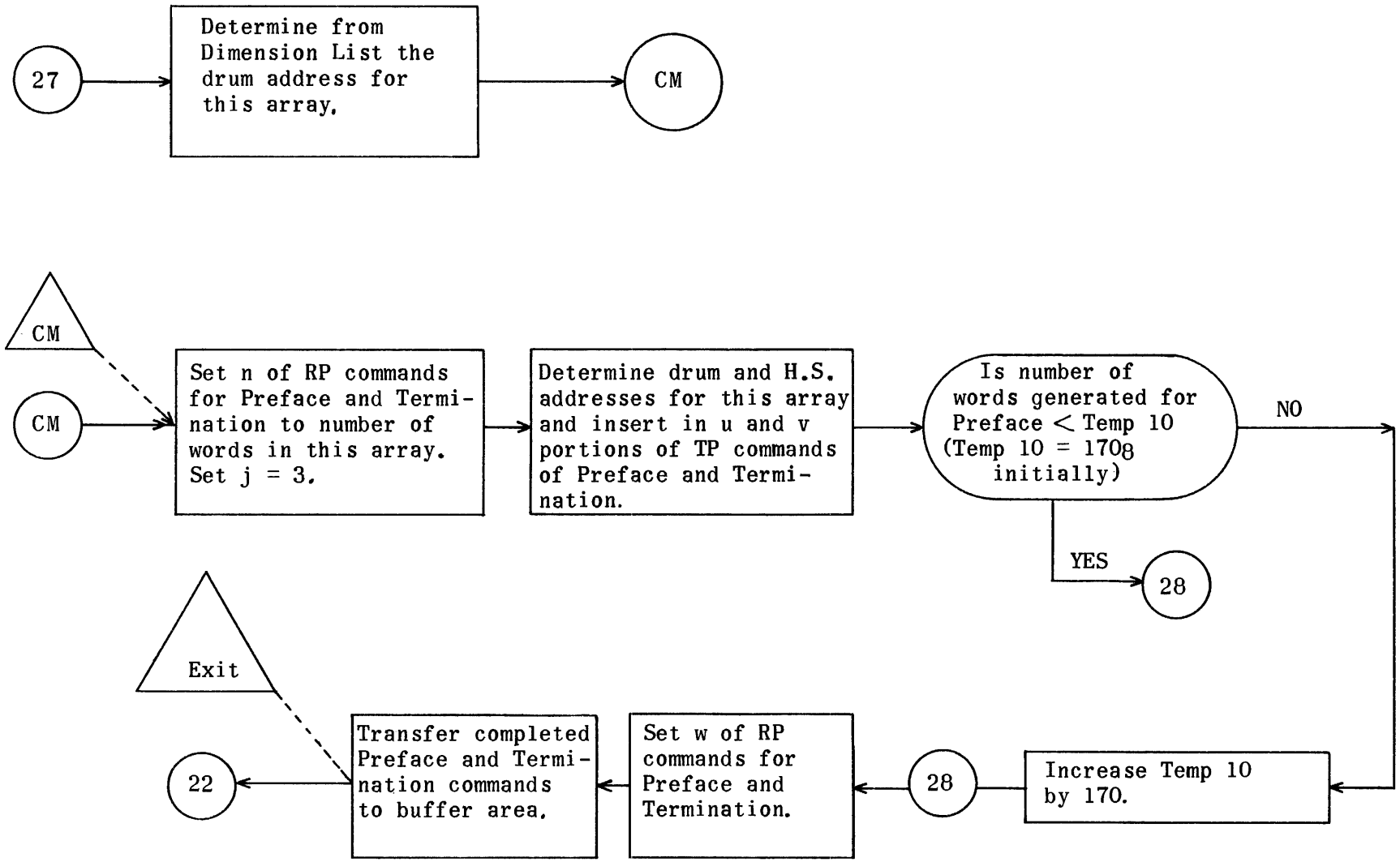

20
Obtain u portion of D4
RP
EJ
Locate this call word in Op File III for segment P.
Found?
RP [m] w
EJ Op File image
YES
NO
Alarm 6
EJ
Is this call word flagged in this segment?
Yes
NO
Alarm 6
Replace word just tested by the contents of D4 + 1
YES
Advance D4 by 2
18

Allocation Flow Chart (cont.)

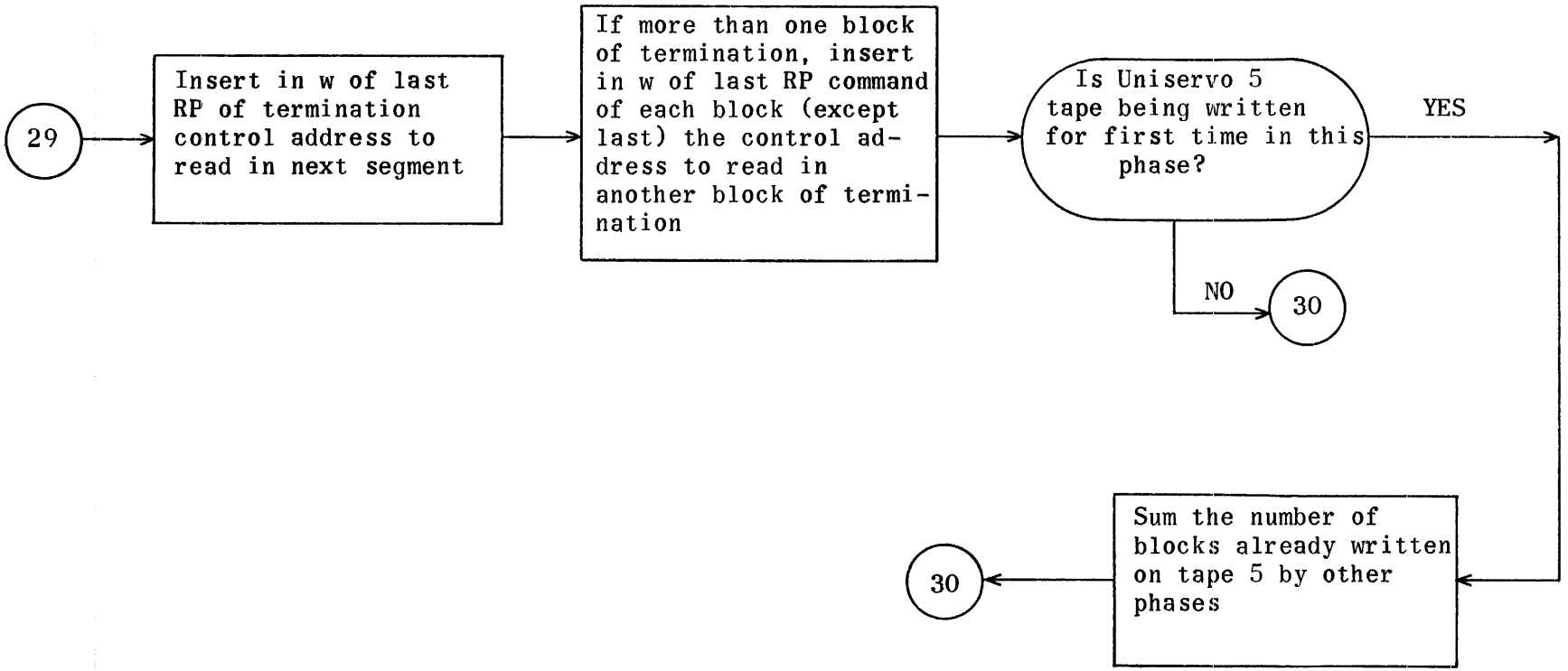


Allocation Flow Chart (Cont.)

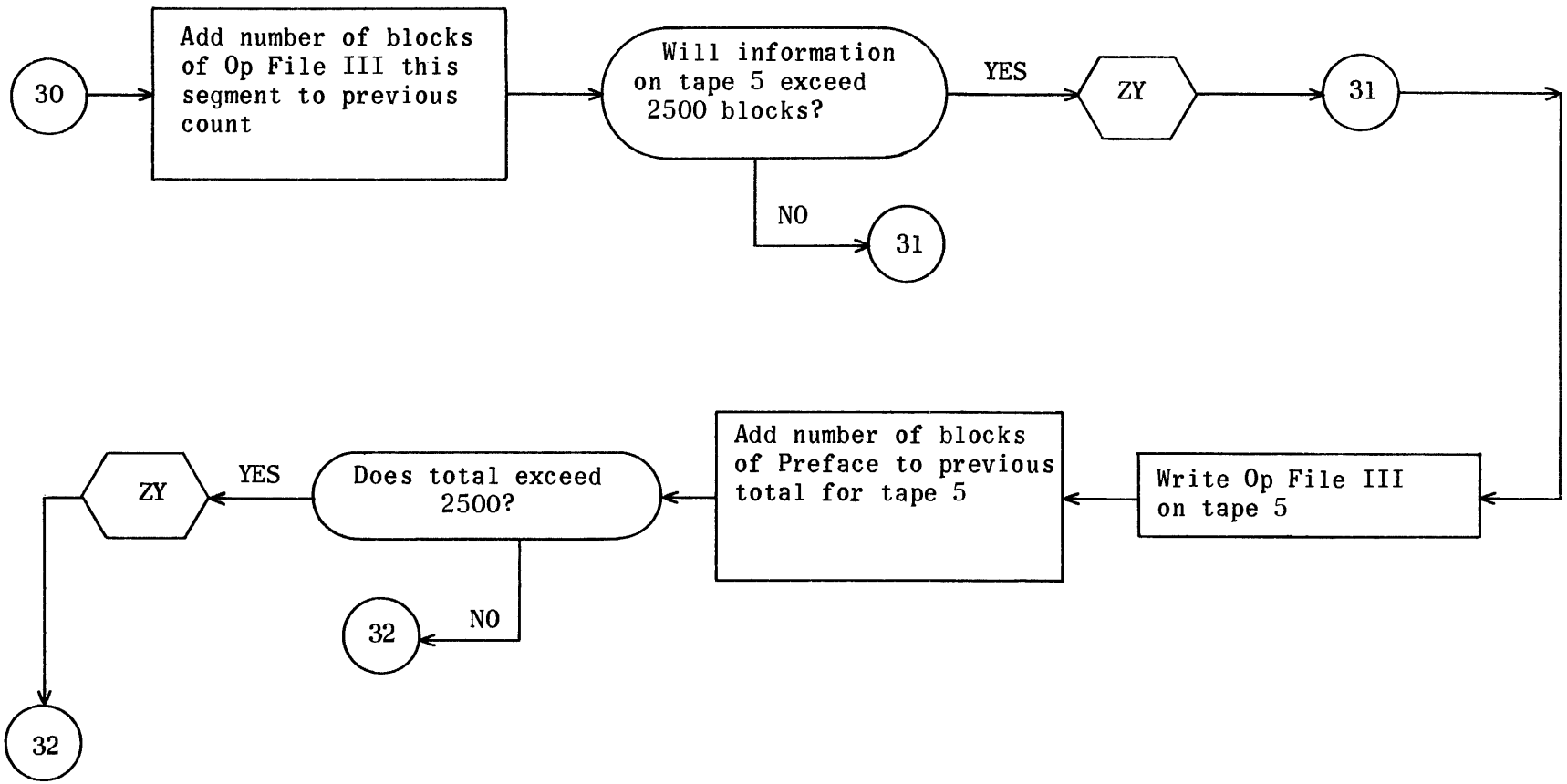



27
Determine from Dimension List the drum address for this array.
CM
CM
CM
Set n of RP commands for Preface and Termination to number of words in this array. Set j = 3.
Determine drum and H.S. addresses for this array and insert in u and v portions of TP commands of Preface and Termination.
Is number of words generated for Preface < Temp 10 (Temp 10 = 1708 initially)
NO
YES
28
Increase Temp 10 by 170.
28
Set w of RP commands for Preface and Termination.
Transfer completed Preface and Termination commands to buffer area.
Exit
22

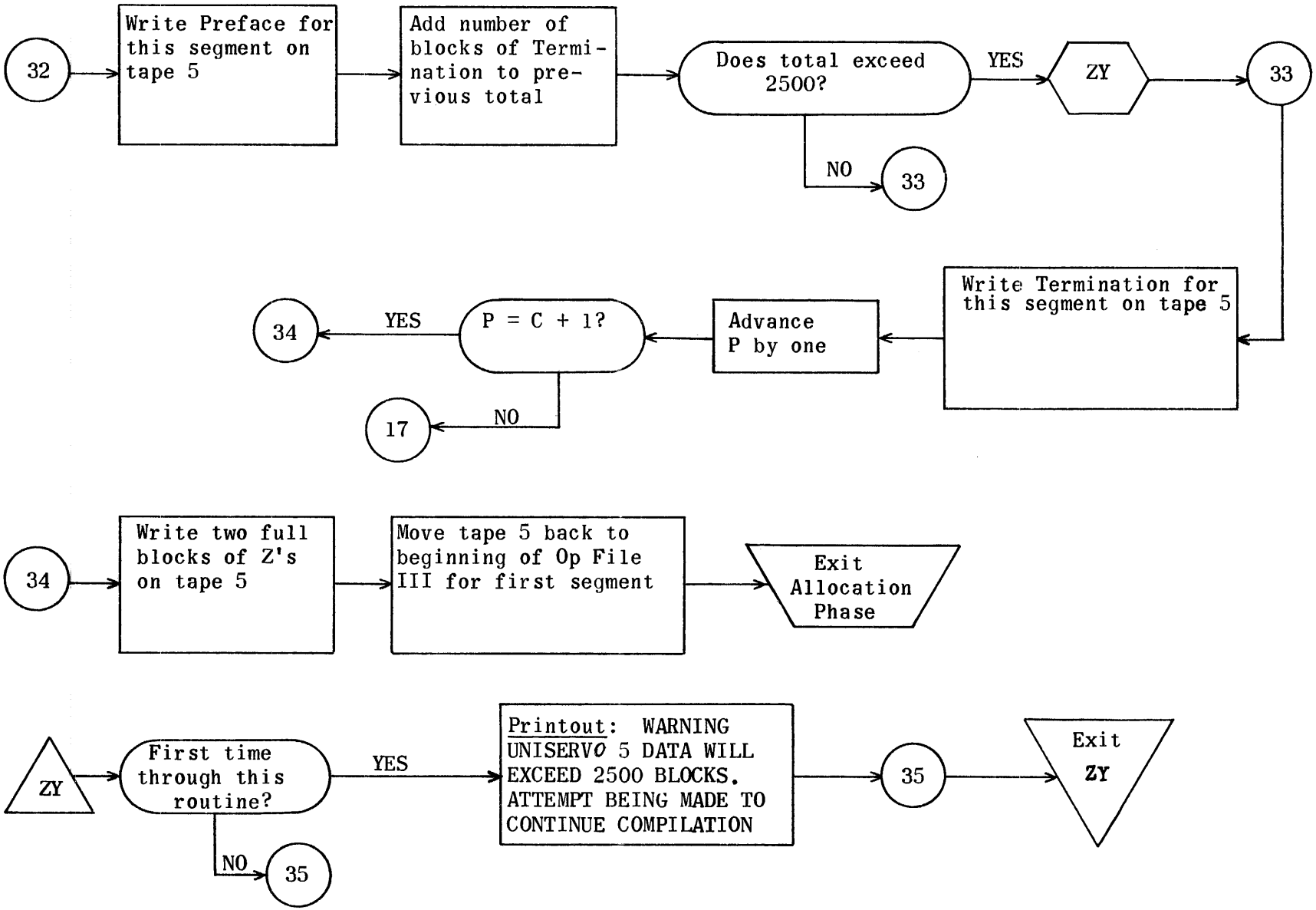
Allocation Flow Charts (Cont.)



Allocation Flow Chart (Cont.)



Allocation Flow Charts (Cont)



Allocation Regions

RE	GT21	Subroutines
RE	UP421	
RE	BR537	
RE	BQ632	
RE	CA674	
RE	CB763	
RE	CC1020	
RE	CD1056	
RE	CE1120	
RE	CF1175	
RE	CG1237	
RE	CH1266	
RE	CI1321	
RE	CJ1355	
RE	CK1407	Begin Data manipulation
RE	CL1435	Stores information for Preface and Term.
RE	CM1450	Build Preface and Term. in buffer areas
RE	CN1505	
RE	CP1522	Sets up "W" of RP-TP for exit of Term.
RE	BK1545	Preparation for writing onto tape
RE	CQ1557	Write Op File III onto tape
RE	CR1645	Write Preface, this segment onto tape
RE	CS1707	Write Termination this seg. onto tape
RE	CT1742	Exit region
RE	ZZ1760	Storage and constants
RE	ZY2144	Error Printout
RE	ZW2174	Warning Printout
RE	CO2213	Patch correction regions $(27)_8$ loc.
RE	FA3142	H.S.S. Address Op. F. 2A-6
RE	ZA3142	
RE	ZB2545	Fixed address of Directory 3
RE	ZC42102	Fixed drum address of Op File III
RE	ZD2644	Fixed address of Directory 4
RE	LD2242	Limit of drum $(77000)_8$
RE	TL2243	Limit of tape $(4704)_8$
RE	TI2355	Tape Image
RE	CU6	For assigning loc. for CT13 & CT16
RE	ZF7000	Fixed address for building Preface
RE	ZG7400	Fixed address for building Term.
RE	ZX76000	H.S.S. dump of TI for checkout
RE	BS76017	Region for generating M.S.'s in checkout
RE	ZE7230	Fixed address of LOC 2B
RE	CX2255	Patch correction allowing data arrays > 7777
RE	CZ2323	

Allocation

		IA	CA		
	0	MJ	0	CO	Read in Tape label (1st Bk)
	1	RJ	GT2	GT	i.e., 'FILEΔΔTWOΔΔΔ'
	2	TP	TI24	A	
	3	EJ	ZZ43	CA5	
	4	MJ	0	BR10	Test for proper label
	5	TP	TI25	A	of Tape #3 (1st Bk)
	6	EJ	ZZ44	CA10	
	7	MJ	0	BR10	
	10	TP	ZZ	CA66	Set connector A to A1
	11	TP	ZZ25	ZZ103	Segment #1→K
	12	TP	ZZ31	ZZ107	0→M (word count Directory 4)
	13	TP	ZZ31	ZZ62	0→Temp 1 (# lines rtne. for current C/W)
	14	TP	ZZ16	ZZ106	MDAF3→G (fixed drum address Op File III)
	15	TP	ZZ17	ZZ72	Set Dir. 4 & Dir. 3 to
	16	TP	ZZ20	ZZ71	fixed address
	17	TP	ZZ31	ZZ105	0→C (C_u = count of segments)
(1)	20	TP	ZZ52	GT3	Read in next block
	21	RJ	GT2	GT	into TI
	22	TP	TI	A	First word→A
	23	EJ	ZZ45	CA32	Test for 'TWOΔAΔ'→CONN 38
	24	EJ	ZZ46	CA51	Test for 'TWOΔBΔ'→CONN 40
	25	EJ	ZZ51	CA27	Test for 'ZZZZZZ'
	26	MJ	0	BR10	
	27	TP	TI24	A	21st word to A
	30	EJ	ZZ51	CA65	Test for 'ZZZZZZ'→CONN 42
	31	MJ	0	BR10	
(38)	32	TP	TI2	ZZ110	Length this segment IIa→L
	33	TP	TI4	ZZ113	Start to build D for this segment
	34	TP	TI4	ZA2	5th & 6th words saved
	35	TP	TI5	ZA3	for Op File III
	36	TP	TI5	ZZ112	→R = next address to assign to rtnes.
	37	TV	ZZ21	ZZ102	Set up LOC2A address in code word for GTH
	40	SP	ZZ21	17	Set up "test word" address
	41	TU	A	CA44	
(39)	42	TP	ZZ102	GT3	Read in next block into IIa area
	43	RJ	GT2	GT	
	44	TP	[30000]	A	Test first word for ENDΔOF
	45	EJ	ZZ47	CA20	(CA20 = (1))
(43)	46	RA	ZZ102	ZZ30	GENCOD + 120→GENCOD
	47	RA	CA44	ZZ27	Test word address + 120→Test word address
	50	MJ	0	CA42	Jump to read next block (CONN 39)
(40)	51	RA	ZZ102	ZZ30	GENCOD + 120→GENCOD
	52	TP	TI2	ZZ111	Length IIb this segment→1
	53	TV	ZZ22	ZZ102	TV LOC2B GENCOD

	54	SP	ZZ22	17	Set up address for test of
	55	TU	A	CA60	ENDΔ OF for Op File IIb
(41)	56	TP	ZZ102	GT3	
	57	RJ	GT2	GT	Read 1 block into IIb area
	60	TP	30000	A	Test word for ENDΔ OF
	61	EJ	ZZ47	CA66	$\longrightarrow$CONN A
	62	RA	ZZ102	ZZ30	GENCOD + 120$\longrightarrow$GENCOD
	63	RA	CA60	ZZ27	Test word address + 120$\longrightarrow$Test word address
	64	MJ	0	CA56	Jump to read next block
(42)	65	TP	ZZ1	CA66	
(A)	66	[30	0	0]	Either MJ CONN A1 or CONN A2
		CA	CA67		
		IA	CB		
(A1)	0	TP	ZZ21	ZZ76	Set up AJ & BI this segment
	1	TP	ZZ22	ZZ77	LOC2A$\longrightarrow$AJ; LOC2B$\longrightarrow$ BI
	2	SP	ZZ77	0	
	3	AT	ZZ111	ZZ101	Form test address to indicate
	4	MJ	0	CB5	end of Op File IIb list
	5	RA	ZZ105	ZZ25	C + 1$\longrightarrow$C (seg. counter)
(1.5)	6	SP	ZZ22	17	LOC2B$\longrightarrow A_u$
	7	TU	A	CB17	
	10	TU	A	CB33	Set commands with first address of Op File IIb
	11	TU	A	CB12	
	12	SP	[30000]	0	Is first word of Op File IIb = 0 ?
	13	ZJ	CB17	CB14	
	14	TP	A	ZA4	Zeroize 5th and 6th words of Op File IIa
	15	TP	A	ZA5	
	16	MJ	0	CC33	Jump to (3)
	17	TP	[30000]	ZA4	Record first call word of Op File IIb into 5th word of Op File IIa
	20	MJ	0	CB27	and first word of Directory 4
	21	TP	ZZ41	ZA5	Flag$\longrightarrow$next word of Op File IIa
	22	SP	ZZ103	6	Insert segment # in second
	23	TP	A	30000	word of Directory 4
	24	RA	ZZ72	ZZ32	Dir. 4 + 2$\longrightarrow$Dir. 4 (next loc.)
	25	RA	ZZ107	ZZ26	M + 1$\longrightarrow$M (count of items in Directory 4)
	26	MJ	0	CC33	Jump to (3)
	27	SP	ZZ72	0	Dir. 4$\longrightarrow$V
	30	TV	A	CB33	
	31	SA	ZZ26	0	
	32	TV	A	CB23	
	33	TP	30000	30000	
	34	MJ	0	CB21	
		CA	CB35		

		IA	CC		
②	0	SP	ZZ110	17	Set n of RP to L; j = 2.
	1	SA	ZZ135	0	
	2	TU	A	CC6	
	3	SP	ZZ77	17	Pick up "u" portion of BI in A
	4	TU	A	CC5	
	5	SP	[30000]	0	
	6	RP	[30000]	CC10	Test Op File IIa for CW from Op File IIb
	7	EJ	ZA4	CC33	
	10	TP	A	ZZ115	Hold A_R in WS1
	11	SP	ZZ21	0	LOC2A → A; A + L → A — Setup CC15
	12	SA	ZZ110	0	
	13	TV	A	CC15	
	14	TV	ZZ72	CC16	
	15	TP	ZZ115	[30000]	WS1 → i.e. store CW in BI at Op F. 2A + L and in Directory 4
	16	TP	ZZ115	[30000]	
	17	SP	CC15	0	Setup CC22
	20	SA	ZZ26	0	
	21	TV	A	CC22	
	22	TP	ZZ41	[30000]	Insert flag at Op.F. 2A + L + 1
	23	SP	CC16	0	Set up CC27
	24	SA	ZZ26	0	
	25	TV	A	CC27	
	26	SP	ZZ103	6	
	27	TP	A	[30000]	Insert K x 2^{21} (seg. #) in Directory 4
	30	RA	ZZ72	ZZ32	Dir. 4 + 2 → Dir. 4 (next loc. available)
	31	RA	ZZ110	ZZ32	L + 2 → L (length + 2)
	32	RA	ZZ107	ZZ26	M + 1 → M (count of items in Directory 4)
③	33	RA	ZZ77	ZZ26	BI + 1 → BI (address next Op File IIb item)
	34	EJ	ZZ101	CD	Test for completion of BI test
	35	MJ	0	CC	Jump to CONN 2
		CA	CC36		
		IA	CD		
	0	RA	ZZ112	ZZ26	Set R to address following IP command
	1	TP	ZZ2	Q	Set up mask V
	2	QT	12	ZZ114	Mask 'Ⓢ' from location $(12)_8$
	3	RA	ZZ113	ZZ114	D + S → D
	4	SP	ZZ76	0	Form test address to indicate end of expanded IIa list
	5	AT	ZZ110	ZZ100	
④	6	SP	ZZ76	17	CW address → A_u
	7	TU	A	CD16	
	10	SA	ZZ25	0	1 in u
	11	TU	A	ZZ115	(CW address) + 1 → $(WS1)_u$
	12	TU	A	CD15	
	13	LT	25	A	Shift (CW address) + 1 to A_v

	14	TV	A	CD20	
	15	TV	[30000]	ZZ62	# lines in rtne in Temp 1
	16	SP	[30000]	0	CW→A_u
	17	LQ	ZZ62	17	Shift ^{u}# lines to u position
	20	TU	ZZ62	[30000]	# lines→u of second word of item
	21	LT	14	A	
	22	EJ	ZZ124	CD25	Test "26" CW
	23	EJ	ZZ125	CD25	Test "27" CW
	24	MJ	0	CE	Jump to (5)
	25	SP	ZZ115	0	
	26	TU	A	CD27	
	27	SP	[30000]	0	
	30	TP	ZZ5	Q	Test for flag "14"
	31	QT	A	A	
	32	EJ	ZZ41	CE16	Jump→6
(8)	33	SP	ZZ115	0	(CW address) + 1→A_u
	34	LT	25	A	(CW address) + 1→A_v
	35	TV	A	CD36	
	36	TV	ZZ114	[30000]	Send S to v portion of 2nd word of item
	37	LQ	ZZ62	25	
	40	RA	ZZ114	ZZ62	
	41	MJ	0	CE16	Jump to (6)
		CA	CD42		
		IA	CE		
(5)	0	EJ	ZZ126	CF	Test 77 type CW→(9)
	1	MJ	0	CE10	Assume 25, 24, 22, 5, or 4
	2	0	0	170	
	3	0	0	0	
	4	0	0	0	
	5	0	0	0	
	6	0	0	0	
	7	0	0	0	
	10	SP	ZZ115	0	(CW address) + 1 → A_u
	11	LT	25	A	(CW address) + 1 → A_v
	12	TV	A	CE13	
	13	TV	ZZ112	[30000]	R→v portion
	14	LQ	ZZ62	25	# lines shifted in Temp 1
	15	RA	ZZ112	ZZ62	R + # lines→R
(6)	16	RA	ZZ76	ZZ32	Address of CW address + 2
	17	EJ	ZZ100	CE21	Jump to (7) when end of Op File IIa reached.
	20	MJ	0	CD6	Jump (4)
(7)	21	TP	ZZ103	FA	Seg. #→Op File III
	22	RA	ZZ110	ZZ32	L + 2→L
	23	SA	ZZ35	0	A = L; A + 4→A
	24	SA	ZZ106	0	Add G (next open M.D. address for Op File III
	25	TJ	LD	CE27	Test limit of drum
	26	MJ	0	ZW1	→Error print & jump to BQ6 (rewind tape, etc.)
	27	SP	ZZ110	17	L→A_u

	30	TP	A	ZA1	$A_u \rightarrow$ # words Op File III
	31	SA	ZZ34	0	Add 4 in u
	32	SA	ZZ37	0	Add 3 in j
	33	TU	A	CE35	
	34	TV	ZZ106	CE36	
	35	RP	[30000]	CE37	Transfer L + 4 words of
	36	TP	FA	[30000]	Op File III to MD at G
	37	TV	ZZ71	CE42	
	40	TV	ZZ71	CE44	
	41	SP	ZZ106	17	$G \rightarrow A_u$
	42	TU	A	[30000]	$A_u \rightarrow$ Directory 3
	43	MJ	0	CE52	# lines in Op File III $\rightarrow A_V$
	44	TV	A	[30000]	$A_V \rightarrow$ Directory 3
	45	RA	ZZ71	ZZ26	
	46	RA	ZZ103	ZZ25	
	47	RA	ZZ106	ZZ110	
	50	AT	ZZ35	ZZ106	
	51	MJ	0	CA20	Jump to (1); read in next seg.
	52	SP	FA1	0	
	53	LT	25	A	
	54	MJ	0	CE44	
		CA	CE55		
		IA	CF		
(9)	0	SP	ZZ115	0	(CW address) + 1 $\rightarrow A_u$
	1	LT	25	A	(CW address) + 1 $\rightarrow A_V$
	2	TV	A	CF3	D $\rightarrow$ (CW address) + 1
	3	TV	ZZ113	[30000]	
	4	LQ	ZZ62	25	# lines + D $\rightarrow$ D
	5	RA	ZZ113	ZZ62	
	6	MJ	0	CE16	Jump to (6)
(A2)	7	SP	ZZ107	0	M $\rightarrow$ A
	10	ZJ	CF13	CF11	
	11	TP	ZZ31	ZZ120	0 $\rightarrow$ Index 1
	12	MJ	0	CH24	Jump to (16)
(10)→	13	TP	ZZ25	ZZ104	$1_u \rightarrow P_u$
	14	ST	ZZ26	ZZ121	M - 1 $\rightarrow$ Index 2
(11)→	15	TP	ZZ17	ZZ72	Set Dir. 4 to fixed address
	16	SP	ZZ107	0	
	17	ST	ZZ26	ZZ120	M - 1 $\rightarrow$ Index 1
	20	SP	ZZ20	17	Item address of Directory 3 $\rightarrow A_u$
	21	SA	ZZ104	0	Add P
	22	SS	ZZ25	0	Subtract 1_u Transfer u-portion
	23	TU	A	CF25	of p^{th} word in Directory 3
	24	TU	A	CF26	to transfer command
	25	TU	[30000]	CF34	and
	26	SP	[30000]	17	Transfer v-portion of p^{th} word
	27	MJ	0	CF35	in Directory 3 to n of RP command
	30	SA	ZZ34	0	+ 4 in u
	31	SA	ZZ37	0	+ 3 in j
	32	TU	A	CF33	

	33	RP	[30000]	CG	Transfer Op File III for
	34	TP	[30000]	FA	this seg. from M.D. to H.S.S.
	35	TU	A	CG12	Set up j n at CG12
	36	RA	CG12	ZZ36	
	37	TU	CF26	CF40	Set up j n at CF33
	40	SP	30000	17	
	41	MJ	0	CF30	
		CA	CF42		
		IA	CG		
(12)	0	TP	ZZ5	Q	Mask Op→Q
	1	SP	ZZ72	17	Dir. 4→A_u
	2	TU	A	CG11	
	3	SA	ZZ25	0	Dir. 4 + 1→A — Pick up Op portion of word given by address at Dir. 4 + 1
	4	TU	A	CG5	
	5	SP	[30000]	0	
	6	QT	A	A	
	7	EJ	ZZ41	CH	Test Op portion for '14' flag
	10	MJ	0	CG11	Set j of RP to 2
	11	SP	30000	0	Obtain CW given by address in Dir. 4
	12	RP	30000	CH	Test this segment Op File III
	13	EJ	ZA4	CG14	for this CW
	14	SP	CG12	0	jn→A_u
	15	LQ	Q	17	jn - r→Q_u
	16	SS	Q	0	jn - (jn - r) = + r→A_u
	17	SA	ZZ7	0	Add fixed address of Op File III
	20	TU	A	CG23	
	21	TU	A	CH10	
	22	TP	ZZ5	Q	
	23	SP	[30000]	0	Test for flagged CW in segment P
	24	QT	A	A	
	25	EJ	ZZ41	CH	Jump to (13)
	26	MJ	0	CH5	Jump to (15)
		CA	CG27		
		IA	CH		
(13)	0	IJ	ZZ120	CH3	Test that all Directory 4 checked against this segment
(14)	1	RA	ZZ104	ZZ25	P + 1_u→P
	2	MJ	0	CF15	Jump to→(11)
	3	RA	ZZ72	ZZ32	Dir. 4 + 2→Dir. 4
	4	MJ	0	CG	Jump to→(12)
(15)	5	SP	ZZ72	0	
	6	SA	ZZ26	0	Set v-portion CH_{10} to address
	7	TV	A	CH10	given by Dir. 4 + 1
	10	TV	[30000]	[30000]	Record running address for this CW at Dir. 4 + 1
	11	TV	CH10	CH13	
	12	TP	ZZ3	Q	Mask→Q
	13	QS	ZZ104	[30000]	Record P x 2^{15} in Dir. 4 (segment to)
	14	TV	CH13	CH16	
	15	TP	ZZ5	Q	Mask Op — Insert "14" in Op of address given by address at Dir. 4 + 1
	16	QS	ZZ41	[30000]	

	17	IJ	ZZ121	CH	Test index 2 that all items Directory 4 processed
	20	MJ	0	CH21	
	21	TP	ZZ17	ZZ72	Set Dir. 4 to fixed address
	22	TP	ZZ107	ZZ161	Set Index 1_A to M
	23	MJ	0	CH24	
(16)	24	TP	ZZ25	ZZ104	$1_u \rightarrow P$, set to 1
	25	TP	ZZ10	ZZ63	
	26	TP	ZZ133	ZZ64'	
	27	TP	ZZ134	ZZ65	Set Temps 1, 3, 4, 5 & 6 to Dummy instructions
	30	TP	ZZ133	ZZ66	
	31	TP	ZZ134	ZZ67	
	32	MJ	0	CI	Jump to→ (17)
		CA	CH33		
		IA	CI		
(17)	0	SP	ZZ20	17	LOCD3 $\rightarrow A_u$
	1	SA	ZZ104	0	A + P $\rightarrow$ A ; Transfer u-portion
	2	SS	ZZ25	0	of P^{th} word of Directory 3 to
	3	TU	A	CI5	the u-portion of the transfer
	4	TU	A	CI6	command in CI16 and set n
	5	TU	[30000]	CI16	of the RP commands at CI15
	6	SP	[30000]	17	A_u = # words in Op File III this seg.
	7	TU	A	CK7	Set # words for 77--- data search
	10	TU	A	ZZ117	Save # words in working Temp
	11	TU	A	CJ5	
	12	SA	ZZ34	0	+ 4
	13	SA	ZZ37	0	+ j = 3
	14	TU	A	CI15	
	15	RP	[30000]	CI32	Build Op File III image
	16	TP	[30000]	FA	
(18)	17	TP	ZZ31	ZZ103	0 $\rightarrow$ K
	20	IJ	ZZ161	CI22	Index 1_A set initially to M
	21	MJ	0	CJ	Jump to CONN 19
	22	SP	ZZ72	17	Dir. 4 $\rightarrow A_u$
	23	TU	A	CJ4	Set address of Directory 4 item
	24	SA	ZZ25	0	plus one
	25	TU	A	CI30	Set address of word 2 of Directory 4 item
	26	TU	A	CJ24	
	27	TP	ZZ4	Q	Mask 'segment from' number into K (26-21)
	30	QT	[30000]	ZZ103	
	31	MJ	0	CJ	Jump to (19)
	32	RA	CJ5	ZZ36	+ j = 2
	33	MJ	0	CI17	
		CA	CI34		

```
                IA    CJ
(19)      0     SP    ZZ104    6        P→A
          1     EJ    ZZ103    CJ3      If P = K, go to (20)  (00P00 = 00K00)
          2     MJ    0        CJ27
(20)      3     TP    C022     ZZ162    Reset value to 171 for region CM
          4     SP    [30000]  0        Jump call word to A
          5     RP    [30000]  CJ7      Locate this call word in Op File III
          6     EJ    ZA4      CJ10     for segment P
          7     MJ    0        BR6      Alarm 6
         10     SP    CJ5      0        jn→(A_R)_u
         11     LQ    Q        17       jn - r→Q_u
         12     SS    Q        0        r→(A_R)_u
         13     SA    ZZ7      0        Finds address of 2nd word Op File III
                                         item
         14     TU    A        CJ16
         15     TP    ZZ5      Q        Test if CW flagged in this segment.
         16     SP    [30000]  0
         17     QT    A        A
         20     EJ    ZZ41     CJ22
         21     MJ    0        BR6      Alarm 6
         22     LQ    CJ16     Q25
         23     TV    Q        CJ24     Replace Op File III word by second
                                         word of Directory 4 item.
         24     TP    [30000]  30000
         25     RA    ZZ72     ZZ32     Dir. 4 + 2→Dir. 4
         26     MJ    0        CI17     Jump to (18)
         27     RA    FA5      ZZ26     Add 1 to H.S.S. of first "IP"
         30     RA    ZZ161    ZZ26     Add 1 to index l_A
         31     MJ    0        CK       Jump to (21)
                CA    CJ32

                IA    CK
(21)      0     TP    ZZ11     ZZ74     Initialize Alpha and Beta
          1     TP    ZZ12     ZZ75     (next address in Preface or Term.)
          2     RA    CK7      ZZ36
          3     SP    FA2      0
          4     AT    12       ZZ113    Set "D" for Preface area
          5     TP    A        ZZ141    and Temp D = # words = (S+R+2)+L ( )_R
(22)      6     SP    ZZ153    0        76777→A_u
          7     RP    [30000]  CK24     →                          search for
         10     TJ    [FA4]    CK11                                data CW
         11     SN    Q        17       - jn + r→A_u
         12     SA    CK7      0        + jn                       calculate #
         13     TU    A        ZZ115    r→WS_1                     repeats
         14     RS    CK7      ZZ115    Set to continue search
         15     RA    CK10     ZZ115
         16     TU    A        CL
         17     TU    A        CK22
         20     RS    CK22     ZZ25     Test if above TJ command
         21     SP    ZZ41     0        reacted on a "14" in the Op code
         22     TJ    30000    CK6
         23     MJ    0        CL
```

(29)	24	TU	ZZ7	CK10	Reset (TJ FA4 CK11) on exit
	25	MJ	0	CP	
		CA	CK26		

Stores Information Necessary In Building Termination and Preface

```
                IA    CL
(24)    0       SP    [30000]   0          2nd word of 77--- data item→A
        1       MJ    0         CX2
(27)    2       TV    A         ZZ137      H.S.S. address →Temp B_v
        3       RS    CL        ZZ25
        4       TU    CL        CL5
        5       SP    [30000]   0          CW→A_u
        6       TP    ZZ6       Q          L(00777)_u→Q
        7       QT    A         A          Mask and multiply by 2
       10       LA    A         1
       11       AT    ZZ143     ZZ140      MD address of array→Temp C_u
       12       MJ    0         CM
                CA    CL13

                IA    CM
        0       TU    ZZ136     ZZ64       Set up RP command for Preface
        1       RA    ZZ64      ZZ37
        2       TU    ZZ64      ZZ66       Set up RP command for Term.
        3       TV    ZZ137     ZZ65       Set data H.S.S. address for Preface
        4       SP    ZZ140     0
        5       TU    A         CM6        Set up address of array on MD
        6       TU    [30000]   ZZ65
        7       TU    A         CM10
       10       SP    [30000]   0          Set up address of array on MD
       11       LT    25        A          for Term.
       12       TV    A         ZZ67
       13       SP    ZZ137     17         Set data H.S.S. address for Term.
       14       TU    A         ZZ67
       15       SP    ZZ74      0          Calculate # words in Preface
       16       SS    ZZ11      0
       17       TJ    ZZ162     CM23       Test # words < 170
       20       RA    ZZ162     ZZ146      Increment by 170
       21       MJ    0         CM22
       22       TP    C021      ZZ147
(28)   23       RJ    CM23      CM31       1 shot switch
       24       TV    ZZ113     ZZ64
       25       RA    ZZ113     ZZ32       D + 2→D          } W
       26       RA    ZZ147     ZZ32                        } of
       27       TV    ZZ147     ZZ66       TE + 2→TE        } RP
       30       MJ    0         CN
       31       SP    ZZ37      0
       32       LT    25        A          Send (30000)_v to first Preface
                                           RP_w command
       33       TV    A         ZZ64
       34       MJ    0         CM26
                CA    CM35
```

```
     IA    CN
0    TV    ZZ74   CN6
1    RA    ZZ74   ZZ26
2    TV    ZZ74   CN7      } Set up transfer commands (i.e., fill
                             in v-addresses)
3    TV    ZZ75   CN10
4    RA    ZZ75   ZZ26
5    TV    ZZ75   CN11
6    TP    ZZ64   [30000]  }
7    TP    ZZ65   [30000]  } Transfer RP - TP setup
10   TP    ZZ66   [30000]  } to proper location in buffer
11   TP    ZZ67   [30000]  } area
12   RA    ZZ74   ZZ26     } Update available locations
13   RA    ZZ75   ZZ26     } in buffer area
14   MJ    0      CK6      Jump to continue searching list
     CA    CN15
```

Setup "W" of RP - Commands for Exit of Termination

```
      IA    CP
 0    TV    ZZ152   CM23          Reset 1 shot switch
 1    RS    ZZ75    ZZ32  )
 2    TV    ZZ75    CP3   }      Insert "CT16" in W of last
 3    TV    ZZ151   [30000] )    RP command in Termination
 4    SP    ZZ74    0             ALPHA ──→A  )  # of entries in Pref-
                                                }  ace area ──→A
 5    ST    ZZ11    A                         )
 6    TJ    CE2     BK            Test A ≤ 170.
 7    DV    ZZ146   ZZ120            i.e.A > 170 indicates more than
10    MJ    0       CP11             one block needed.  Dividing
11    ZJ    CP13    CP12             # of entries by (170)8 gives
12    RS    ZZ120   ZZ26             # of blocks needed.  A = 0
13    SP    ZZ12    0                indicates an integral
14    SA    ZZ163   0                number of blocks needed.
15    TV    A       CP20             A = # of blocks needed -1
16    IJ    ZZ120   CP20             if Q ≠ 0 or # blocks if Q = 0.
17    MJ    0       BK               Set index 1 to A and let
20    TV    ZZ150   [30000]          the index control the number
21    RA    CP20    ZZ146            of times (CT13)  is inserted
22    MJ    0       CP16
      CA    CP23
```

Preparation for Writing Onto Tape

```
      IA    BK
 0    RJ    BK      BK2
 1    MJ    0       CQ
 2    TP    14      Q     )
 3    QT    ZZ2     ZZ157 }      Sum number of blocks already written
 4    LQ    Q       17    }
 5    QT    BK11    A     }
 6    AT    ZZ157   ZZ157 )
 7    TP    ZZ157   ZZ160        Save # blocks already written
10    MJ    0       CQ
11    0     0       77
      CA    BK12
```

Write Op File III Onto Tape #5

		IA	CQ		
	0	RP	10170	CQ2	Fill TI with Z's
	1	TP	ZZ51	TI	
(30)	2	RA	ZZ157	ZZ26	Test for exceeding tape length
	3	TJ	TL	CQ5	
	4	RJ	ZY	ZY1	
(31)	5	TP	ZZ154	TI	F I L E Δ 3
	6	TP	ZZ155	TI1	S E G Δ Δ Δ
	7	RP	30004	CQ11	Read first 4 words
	10	TP	ZA	TI2	of Op File III image → Tape image
	11	SP	ZZ74	0	(ALPHA-LOCPRE) = # words
	12	SS	ZZ11	17	
	13	TP	A	TI6	Calculate # words in Preface
	14	LT	25	ZZ142	→ save in $(TEMPE)_V$
	15	TP	ZZ53	GT3	Write first block on tape
	16	RJ	GT2	GT	
	17	LQ	ZZ117	25	
	20	TP	ZZ2	Q	Calculate # words in Op File III
	21	QT	ZZ117	A	this seg.
	22	DV	ZZ30	ZZ121	Record # full blocks required into Index 2
	23	LT	10017	ZZ112	Shift remainder → R_u
	24	TU	ZZ7	CQ33	LOC Op File (3)
	25	IJ	ZZ121	CQ27	Have all full blocks been written?
	26	MJ	0	CQ37	→Jump →(34)
	27	RA	ZZ157	ZZ26	
	30	TJ	TL	CQ32	Test for exceeding tape length
	31	RJ	ZY	ZY1	
	32	RP	30170	CQ34	Transfer 120 words from File III
	33	TP	[30000]	TI	image into TI
	34	RJ	GT2	GT	Write 1 full block on tape
	35	RA	CQ33	ZZ27	Advance Op File III image address
	36	MJ	0	CQ25	→Jump →(33)
	37	MJ	0	CQ62	
	40	TJ	TL	CQ42	Test for exceeding length
	41	RJ	ZY	ZY1	of tape
	42	RP	10170	CQ44	Fill TI with Z's
	43	TP	ZZ51	TI	
	44	TU	ZZ112	CQ47	Set N of RP command
	45	RA	CQ47	ZZ37	3 in j
	46	TU	CQ33	CQ50	Set "u" of transfer command
	47	RP	[30000]	CQ51	Transfer partial block to TI
	50	TP	[30000]	TI	
	51	RJ	GT2	GT	Write partial block
	52	RA	ZZ157	ZZ26	
	53	TJ	TL	CQ55	Test exceeding length of tape
	54	RJ	ZY	ZY1	
	55	RP	10170	CQ57	Fill with Z's
	56	TP	ZZ51	TI	

```
57      TP      ZZ47    TI          E N D   O F
60      RJ      GT2     GT
61      MJ      0       CR
62      TP      ZZ112   A       }   Handles special case where
63      ZJ      CQ64    CQ52    }   0 mod  170 words are written.
64      RA      ZZ157   ZZ26
65      MJ      0       CQ40
        CA      CQ66
```

Write Preface for This Seg. Onto Tape #5

```
        IA      CR
 0      RP      10170   CR2     }   Fill TI with Z's
 1      TP      ZZ51    TI      }
 2      SP      ZZ142   0           # words in Preface → A_u
 3      ZJ      CR36    CT      }   # full blocks
 4      TP      Q       ZZ122   }   → Index 1 ; TEMPT
 5      LT      10017   ZZ112       # words in partial block
 6      SP      ZZ11    17      }   Set up u of transfer command
 7      TU      A       CR16    }
10      IJ      ZZ120   CR12        Have all full blocks been written?
11      MJ      0       CR40
12      RA      ZZ157   ZZ26    }
13      TJ      TL      CR15    }   Test for exceeding length
14      RJ      ZY      ZY1     }   of tape
15      RP      30170   CR17    }   Transfer 1 full block
16      TP      [30000] TI      }   into TI
17      RJ      GT2     GT          Write 1 full block onto tape #5
20      RA      CR16    ZZ27        Advance u-address by (120)_10
21      MJ      0       CR10
22      RA      ZZ157   ZZ26    }
23      TJ      TL      CR25    }   Test exceeding block length
24      RJ      ZY      ZY1     }
25      RP      10170   CR27    }   Fill TI with Z's
26      TP      ZZ51    TI      }
27      TU      ZZ112   CR32    }   Set up RP command to
30      RA      CR32    ZZ37    }   # of words in partial block
31      TU      CR16    CR33        Set up TP command
32      RP      [30000] CR34    }   Read partial block into TI
33      TP      [30000] TI      }
34      RJ      GT2     GT          Write 1 block onto tape #5
35      MJ      0       CS
36      DV      ZZ30    ZZ120
37      MJ      0       CR4
40      TP      ZZ112   A
41      ZJ      CR22    CS
        CA      CR42
```

Write Termination For This Seg. Onto Tape #5

```
        IA    CS
 0      TP    ZZ122    ZZ120      Set up Index 1 = # full blocks to
                                   be written
 1      SP    ZZ12     17         Set up "u" of TP command
 2      TU    A        CS11
 3      IJ    ZZ120    CS5
 4      MJ    0        CS31       Jump to write partial block
 5      RA    ZZ157    ZZ26
 6      TJ    TL       CS10       Test for exceeding length of tape
 7      RJ    ZY       ZY1
(33)10  RP    30170    CS12       Read 1 block into TI
11      TP    [30000]  TI
12      RJ    GT2      GT         Write 1 block onto tape #5
13      RA    CS11     ZZ27       Increase address of TP command
14      MJ    0        CS3
15      RA    ZZ157    ZZ26
16      TJ    TL       CS20       Test for exceeding length of
17      RJ    ZY       ZY1        block
20      RP    10170    CS22       Fill TI with Z's
21      TP    ZZ51     TI
22      TU    ZZ112    CS25
23      RA    CS25     ZZ37       Setup RP - TP commands
24      TU    CS11     CS26
25      RP    [30000]  CS27       Read partial block into TI
26      TP    [30000]  TI
27      RJ    GT2      GT         Write 1 block
30      MJ    0        CT
31      TP    ZZ112    A          Test for 0 mod  170 entries
32      ZJ    CS15     CT
        CA    CS33


        IA    CT
 0      RA    ZZ104    ZZ25       Advance P by 1
 1      SP    ZZ105    0          C + 1 ⟶ A
 2      SA    ZZ25     0
 3      EJ    ZZ104    C06        Then ⟶ CT5
 4      MJ    0        C04        Then jump to (17)
 5      SP    ZZ157    0
 6      SS    ZZ160    25
 7      TP    A        CT14
10      RA    CT15     CT14
11      TP    CT15     GT3
12      RJ    GT2      GT
13      MJ    0        77010      Exit allocation phase
14      0     0        0          Parameter for repositioning tape
15      40    5        0
        CA    CT16
```

```
         IA    CO
 0       RA    ZZ52    20
 1       RA    ZZ102   20      Add TN to code word
 2       TP    ZZ52    GT3     for tape handler
 3       MJ    0       CA1
 4       TP    C021    ZZ147   Reset initialization value
 5       MJ    0       CI      for termination, then → (17)
(34) 6   RA    ZZ157   ZZ26
 7       TJ    TL      C011
10       RJ    ZY      ZY1
11       RP    10170   C013
12       TP    ZZ51    TI      Write double block of Z's
13       RJ    GT2     GT
14       TV    C020    C011
15       MJ    0       C06
16       RJ    GT2     GT
17       MJ    0       CT5
20       0     0       C016
21       0     0       610
22       0     0       171     Mask for counting blocks written
                               on tape
         CA    C023

         IA    ZW
 0       MJ    0       BQ6
 1       TP    ZW16    UP3
 2       RJ    UP2     UP
 3       MJ    0       ZW
 4       52    54512   54630   P R O B L E
 5       47    01665   15101   M Δ T O O Δ
 6       46    51503   22201   L O N G . Δ
 7       01    27546   74701   Δ D R U M Δ
10       65    66515   42432   S T O R A G
11       30    01307   22630   E Δ E X C E
12       30    27302   70125   E D E D Δ B
13       73    01244   64651   Y Δ A L L O
14       26    24663   45150   C A T I O N
15       01    31344   63022   Δ F I L E .
16       0     ZW4     12
         CA    ZW17
```

Print Error Warning of Exceeding Length of Tape

```
        TA    ZY
    0   MJ    0       [30000]
    1   RJ    ZY1     ZY3          One shot switch
(35) 2  MJ    0       ZY
    3   TP    ZY27    UP3
    4   RJ    UP2     UP
    5   MJ    0       ZY
    6   71    24545   03450        W A R N I N
    7   32    22010   16750        G . Δ Δ U N
   10   34    65305   47051        I S E R V O
   11   01    10012   72466        Δ 5 Δ D A T
   12   24    01713   44646        A Δ W I L L
   13   01    30722   63030        Δ E X C E E
   14   27    01051   00303        D Δ 2 5 0 0
   15   01    25465   12645        Δ B L O C K
   16   65    22010   12466        S . Δ Δ A T
   17   66    30475   26601        T E M P T Δ
   20   25    30345   03201        B E I N G Δ
   21   47    24273   00166        M A D E Δ T
   22   51    01010   10101        0 Δ Δ Δ Δ Δ
   23   01    01265   15066        Δ Δ C O N T
   24   34    50673   00126        I N U E Δ C
   25   51    47523   44624        O M P I L A
   26   66    34515   02277        T I O N . 77
   27   0     ZY6     21
        CA    ZY30
```

```
      IA    CX
 0    TU    A     ZZ136
 1    MJ    0     CL2
 2    TJ    CZ    CX
 3    TP    A     CZ6
 4    RS    CL    ZZ25
 5    TU    CL    CX6
 6    SP    30000 0
 7    TP    ZZ6   Q
10    QT    A     A
11    LA    A     1
12    AT    ZZ143 ZZ140
13    TV    CZ6   ZZ137
14    TU    CZ3   ZZ136
15    RJ    CN14  CM
16    RS    CZ6   CZ3
17    TJ    CZ    CX27
20    TJ    CZ2   CX22
21    MJ    0     CX22
(25) 22    TU    CZ3   ZZ136
23    RA    ZZ137 CZ4
24    RJ    CX35  CX36
25    RJ    CN14  CM
26    RS    CZ6   CZ3
(26) 27    TU    CZ6   ZZ136
30    LQ    CZ6   25
31    RA    ZZ137 CZ4
32    RJ    CX35  CX36
33    TP    CX45  CN14
34    MJ    0     CM
35    MJ    0     30000
36    TU    ZZ140 CX37
37    TU    30000 CX44
40    RA    CX44  CZ3
41    TU    CX43  ZZ140
42    MJ    0     CX35
43    0     CX44  0
44    0     0     0
45    MJ    0     CK6
      CA    CX46
```

Exit to main program

Test # lines > 7777
Save information

Compute address which
contains address where S.S.
data is stored on drum

Core address of beginning of array
words set to 7777
Build Preface and Term.
Reduce number of words by 7777
1 core < # lines ≤ 2 cores
2 core < # lines ≤ 3 cores

Update MD address
Process Preface and Term.

Update H.S.S. address

Update MD address
Reset Exit in main program

Routine for updating MD address

	IA	CZ		
0	0	10000	0	
1	0	17777	0	
2	0	27776	0	
3	0	7777	0	
4	0	0	7777	
5	0	17776	0	
6	0	0	0	Temp
	CA	CZ7		

		IA	ZZ				
	0	MJ	0	CB	MJ	0	CONN A1
	1	MJ	0	CF7	MJ	0	CONN A2
	2	0	0	77777			
	3	00	00077	0	Jump "to" mask		
	4	0	7700	0	Jump "from" mask		
	5	77	0	0			
	6	0	00777	0			
	7	0	ZA4	0	Fixed address of start of Op File III		
LOC77	10	0	0	0	Fixed drum address for starting 77 data		
LOCPRE	11	0	0	ZF	Fixed address for Preface		
LOCTER	12	0	0	ZG	Fixed address for Termination		
LOCD5	13	0	0	0			
LOCFCA	14	0	0	0			
LOCBA	15	0	0	0			
DLOCF3	16	0	0	ZC	Fixed drum address for Op File III		
LOCD4	17	0	0	ZD	Fixed address of Directory 4		
LOCD3	20	0	0	ZB	Fixed address of Directory 3		
LOC2A	21	0	0	ZA6	Fixed address Op File IIa (H.S.S.)		
LOC2B	22	0	0	ZE	Fixed address (by segment) Op File IIb		
LOCCSA	23	0	0	0			
LOCCTA	24	0	0	0			
	25	0	1	0			
	26	0	0	1			
	27	0	170	0			
	30	0	0	170			
ZERO	31	0	0	0			
	32	0	0	2			
	33	0	2	0			
	34	0	4	0			
	35	0	0	4			
	36	0	20000	0			
	37	0	30000	0			
CONST	40	0	0	0			
FLAG	41	14	0	0			
DATA	42	0	0	0			
	43	31	34463	00101	F I L E Δ Δ		
	44	66	71510	10101	T W 0 Δ Δ Δ		
	45	66	71510	12401	T W 0 Δ A Δ		
	46	66	71510	12501	T W 0 Δ B Δ		
	47	30	50270	15131	E N D Δ 0 F		
	50	01	30506	65473			
	51	74	74747	47474	Z Z Z Z Z Z		
	52	50	00103	TI	GT code word to read Op File IIa		
	53	71	00105	TI			
	54	0	0	0			
	55	0	0	0			
	56	0	0	0			
N	57	0	0	[30000]	Length of control (also initial address of S)		
MINUS	60	0	0	0			

ENDBUF	61	0	0	0	
TEMP1	62	0	0	0	
2	63	0	0	0	
3	64	0	0	0	
4	65	0	0	0	
5	66	0	0	0	
6	67	0	0	0	
7	70	0	0	0	
	71	0	0	0	Dir. 3 - next open address of Directory 3
	72	0	0	0	Dir. 4 - next open address of Directory 4
	73	0	0	0	Not used
ALPHA	74	0	0	0	Next open address in Preface
BETA	75	0	0	0	Next open address in Termination
AJ	76	0	0	0	Address next Op File IIa item.
BI	77	0	0	0	Address next Op File IIb item.
AJTEST	100	0	0	0	
BITEST	101	0	0	0	
GENCOD	102	50	00103	[30000]	
K	103	0	0	0	
P	104	0	0	0	
C	105	0	0	0	
G	106	0	0	0	
M	107	0	0	0	Count of Directory 4 items
L	110	0	0	0	
1	111	0	0	0	
R	112	0	0	0	Next address to assign to routines
D	113	0	0	0	Next address to assign data
S	114	0	0	0	
WS1	115	0	0	0	
WS2	116	0	0	0	
WS3	117	0	0	0	
INDEX1	120	0	0	0	
INDEX2	121	0	0	0	
TEMPT	122	0	0	0	
	123	0	0	3	
	124	0	0	26	
	125	0	0	27	
	126	0	0	77	
	127	0	0	25	
	130	0	0	24	
	131	0	0	22	
	132	0	0	5	
	133	75	0	0	
	134	11	0	0	
	135	0	20002	0	
TEMPA	136	0	0	0	
TEMPB	137	0	0	0	

TEMPC	140	0	0	0	
TEMPD	141	0	0	0	
TEMPE	142	0	0	0	
	143	0	40101	0	
	144	0	0	165	
	145	0	0	167	
	146	0	0	170	
TE	147	0	0	610	
CT13	150	0	0	CU13	
CT16	151	0	0	CU16	
	152	0	0	CM31	For resetting 1 shot switch
	153	0	76777	0	
	154	31	34463	00106	F I L E Δ 3
	155	01	01653	03201	Δ Δ S E G Δ
	156	0	0	TL	
TEMPBKCTR1	157	0	0	0	
TEMPBKCTR	160	0	0	0	# blocks already written
INDEX1A	161	0	0	0	
	162	0	0	170	
	163	0	0	166	
		CA	ZZ164		

3. INITIALIZATION GENERATOR

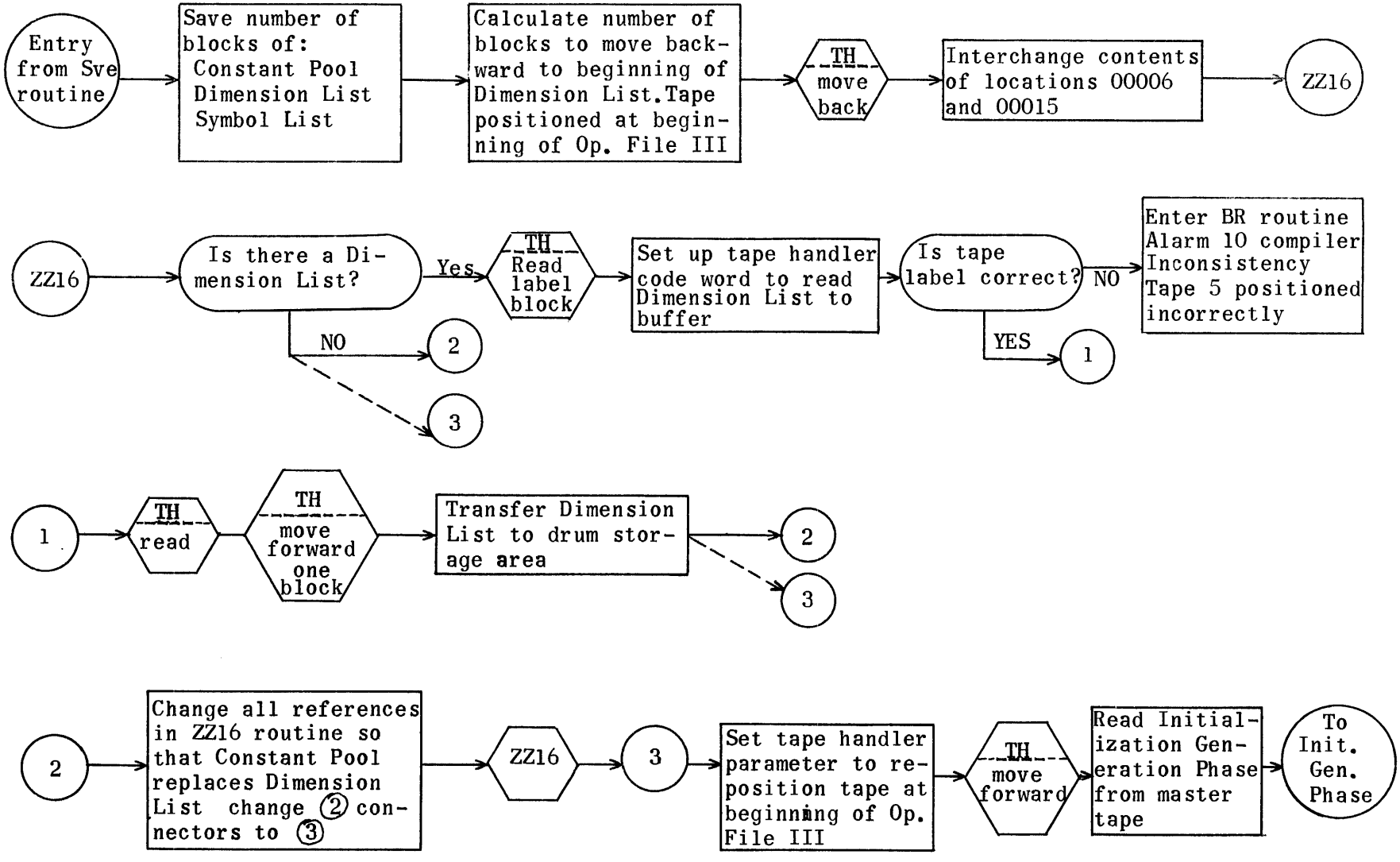
3. Initialization Generator

Initialization Generation Setup

The Setup Routine for Initialization Generation reads the original Dimension List and the Constant Pool from magnetic tape and stores them on the drum. These lists do not overlay the modified Dimension List that was built by the Allocator Setup Routine since it will be used by the Processing Phase later.

The counters at locations 00006 and 00015 are interchanged so that 00006 becomes the Dimension List counter for this phase.

After reading the Dimension List and Constant Pool the tape is repositioned to the beginning of Op File III. The 14 blocks of the Initialization Generation Phase are then read from the UNICODE master tape and control is transferred to it.



Initialization Generation Set-Up Flow Chart

Regions for Initialization Generation Setup

RE	ZZ7230	(37)
RE	ZW7267	(15)
RE	ZX7304	(14)
RE	ZT7320	(3)
RE	TH21	Tape handler
RE	BR537	Compiler Inconsistency Routine
RE	DL42102	(6000) Dimension List
RE	CL50102	(1000) Constant Pool
RE	ZY700	Buffer
RE	IG2000	Loading and entry address for IG
RE	IL1600	168 = # blocks of Initialization Generation phase

Initialization Generation Setup Routine

```
      IA    ZZ
 0    SP    14      0
 1    LT    3       ZT          Save # blocks of Constant Pool
 2    SP    A       0
 3    LT    6       ZT1         Save # blocks of Dimension List
 4    SP    A       0
 5    LT    6       ZT2         Save # blocks of Symbol List
 6    SP    ZT      0
 7    SA    ZT1     0
10    SA    ZT2     25          Calculate and move # blocks backward
11    AT    ZX7     TH3         to beginning of Dimension List
12    RJ    TH2     TH          (if any)
13    TP    15      Q
14    TP    6       15          Interchange contents of 6 and 15
15    TP    Q       6
16    SP   [ZT1 ]   0           Is there a Dimension list
17    ZJ    ZZ20   [ZW ]        (Constant Pool)?
20    TP    ZX2     TH3         Read label block to H.S.S.
21    RJ    TH2     TH
22    SP   [ZT1 ]   0
23    SS    ZX      25          Set up code word to read Dimension
24    AT    ZX3     TH3         List  (Constant Pool)
25    TP    ZY      A           Check label
26    EJ   [ZX10]   ZZ30
27    MJ    0       BR12
30    RJ    TH2     TH          Read Dimension List (Constant Pool)
                                to H.S.S.
31    TP    ZX4     TH3         Move past end label
32    RJ    TH2     TH
33    TU   [6 ]     ZZ35        Set up transfer
34    RA    ZZ35    ZX1
35    RP    30000  [ZW ]        Transfer Dimension List (Constant
36    TP    ZY     [DL ]        Pool) to storage area
      CA    ZZ37
```

```
                IA      ZW
(2)     0       TU      ZZ6     ZZ16
        1       TU      ZZ6     ZZ22
        2       TV      ZX12    ZZ17    Set for reading Constant Pool
        3       TU      ZX12    ZZ26
        4       TU      ZX13    ZZ33
        5       TV      ZX13    ZZ36
        6       RJ      ZZ35    ZZ16    Go to read Constant Pool and transfer
(3)     7       SP      ZT2     25      Move forward past Symbol List
        10      AT      ZX5     TH3
        11      RJ      TH2     TH
        12      TP      ZX6     TH3     Read  Initialization Generation
        13      RJ      TH2     TH      to H.S.S.
        14      MJ      0       IG      Jump into Phase
                CA      ZW15

                IA      ZX
        0       0       0       2
        1       0       10000   0
        2       50      105     ZY      Read one block of Uniservo 5
        3       50      5       ZY      General Read for Uniservo 5
        4       30      105     0       Move one block forward
        5       30      5       0       General move forward
        6       50      IL1     IG      IL = (# of blocks of Initialization
                                        Generation)✗100
        7       40      5       0       General move backward - tape 5
        10      27      34473   05065   D I M E N S
        11      26      51506   56624   C O N S T A
        12      0       ZX11    ZW7
        13      0       10      CL
                CA      ZX14
```

Initialization

It is convenient to divide this write-up into two sections. The first describes the initialization phase proper, and the second explains the actual generation. The distinction between the two should be kept in mind at all times.

Running Initialization

There are two classes of operation that may be considered; (1) functions always performed, and (2) functions whose operation depends upon the circumstances of the particular object program compiled. We may tabulate these two classes as follows:

Functions always performed	Functions sometimes performed
1) Rewind program tape 2) Clear 1 core bank to zero 3) Load GTH coding 4) Load Control coding 5) Load Constant Pool ↓ and finally, transfer control to Control coding, to pull in Segment 1	1) Read in and translate "DATA INDEX" from either paper or magnetic tape. 2) Determine which data tapes are required by the program, and check that these are mounted in Uniservos. 3) Load values for a certain class of subscripted variables to their appropriate drum area.

All coding, constants, etc., necessary for all parts of Initialization are written on the Object program tape preceding Segment 1 of the generated coding. See Page 1617, Layout of Object Program Tape.

The coding is entered to H.S.S., and control transferred there at appropriate points, by means of the Object Program Loader Routine, which is part of the UNICODE Service Library (Sect. II, 1, c, (2).) The loader performs items 1 and 2 in the list above of "functions always performed". From this point onward, the loader merely loads data, and transfers control to such data as indicated. In other words, computer operations are entirely guided by what is present on Object Program Magnetic Tape #1.

In all problems, the first operation at this point is to load the Generalized Tape Handler into the operating locations it will occupy throughout running of the Object Program. After this, the procedure will vary, depending on the program under consideration. We may discuss the case where all possibilities are included, for the sake of completeness, and reference to the diagram on page 1617 should make clear which portions are variable.

From this point initialization may be divided into three sections. The first two are optional; the third invariant.

Section 1.

This coding is required in one form or another, if, in the compiled program, there are any input subscripted variables. These are defined as subscripted variables either referenced by Read sentences, or appearing only on the right-hand side of equations. This coding causes a "DATA INDEX" to be read in, either from paper tape, or from magnetic tape on Uniservo 2, translates it to the form required by the running program, and then performs certain checking operations.

Because Read sentences specify only variables to be read in, and not the Uniservo on which they are to be found, as in the original UNICODE program, the DATA INDEX is necessary to supply this information. It informs the

computer of the tape on which a given variable is written, its position relative to other data, and its identifying tape label. This permits data to be referenced in the program by one symbol, and labelled on tape by a different name.

After the index has been set up, the next operation scans the index, checking that all variables required by input operations at various stages of running are present. While this is being done, a list is built of the Uniservo numbers containing the data required, and the next operation in sequence rewinds all these servos, and checks that they do, in fact, hold data tapes. Note that checking does <u>not</u> go so far as to check the <u>contents</u> of these data tapes. This would be excessively time-consuming, and if a tape is found at a later stage which does <u>not</u> contain data that the index says it should, the machine will stop, and a correct tape may then be substituted.

A further operation of this section is to build a list of all input variables (see previous definition) <u>not</u> specifically referenced by Read sentences. This list, called List B, is for use by Section 2 of Initialization. Its format is shown on page 1618.

When all these operations are satisfactorily completed, control is returned to the loader, which pulls in more tape from Uniservo 1, and acts according to the data thereon. This will probably be Section 2 of initialization, described below.

<u>Section 2.</u>

This section is needed whenever the "automatic data read-in" facility is utilized. It accepts as input LIST B, produced by the preceding section of Initialization, which contains the XS3 representations of the variables required, the number of values of each required (the modulus), and the drum addresses pertaining. The conditions under which subscripted variables are "automatically" read in are:

1) The variable should appear only on the right-hand side of equations.

2) The variable is not referenced by any Read sentence.

The number of values specified by the relevant Dimension statement are read in. If there are less than this on tape, the computer will indicate this and stop. On continuing, the remaining values are filled in with zeros.

The basic reading is performed by a subroutine essentially identical to the Read library subroutine. The annotated coding and flow charts for this subroutine begin on page 106 of this manual, and should be consulted for further information.

At the conclusion of operations, control is returned to the UNICODE Loader to pull in more tape and perform the remaining functions of Initialization.

Section 3.

This includes all the remaining operations of Initialization, which are always performed, whatever the nature of the program compiled. They are a series of loading operations, followed by a transfer to an IP command which causes UNICODE Control to take over and initiate the running of Segment 1.

The material loaded is listed below in the order of loading.

1) UNICODE Control

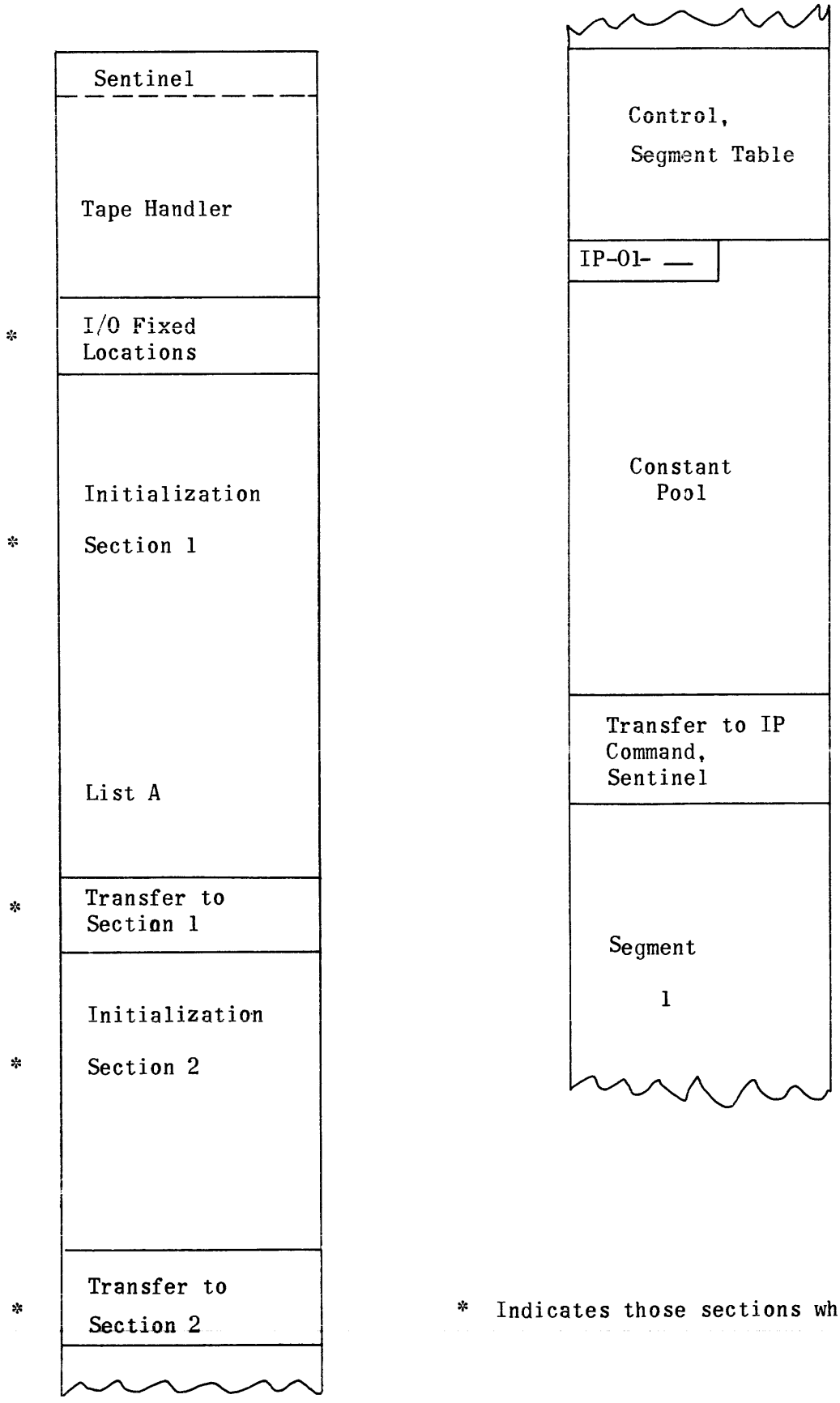
2) Segment table

3) IP order

4) Constant Pool

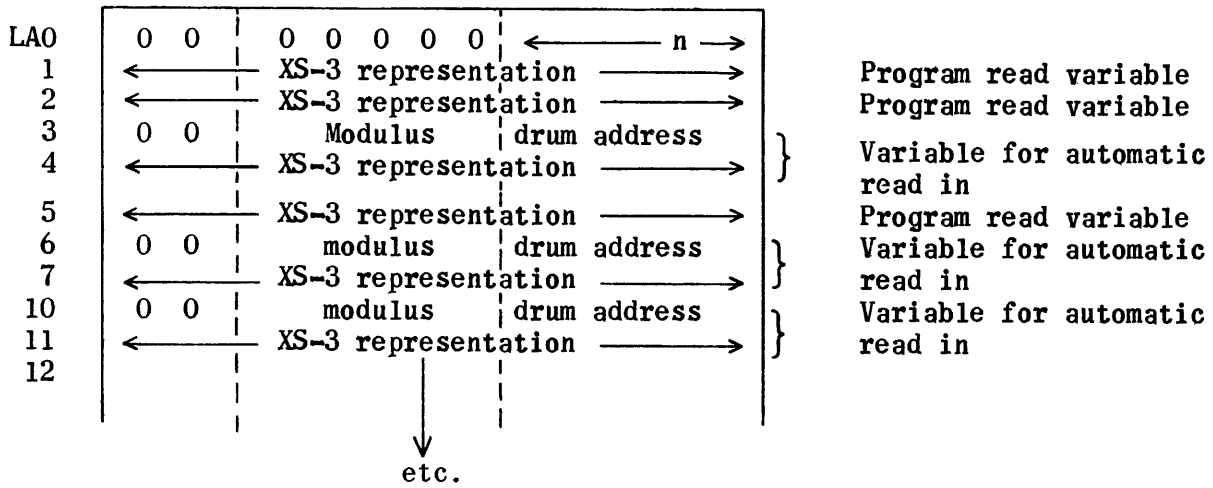
Initialization Generation.

The generation of Initialization takes place after the Allocation phase. The generation itself is relatively simple. First, the leading sentinels and the GTH are written on tape. Then some tests are made on the contents of the Dimension List to determine which, if any, variables are input variables. Depending on the results, values for the I/O fixed locations and such variable coding as may be necessary are written on tape, together with LIST A. Finally, Control is written, followed by the table of Segment lengths and the Constant Pool. The Constant Pool is preceded by an IP order, designed, when operative, to pull in Segment 1 and start running.



* Indicates those sections which may be absent

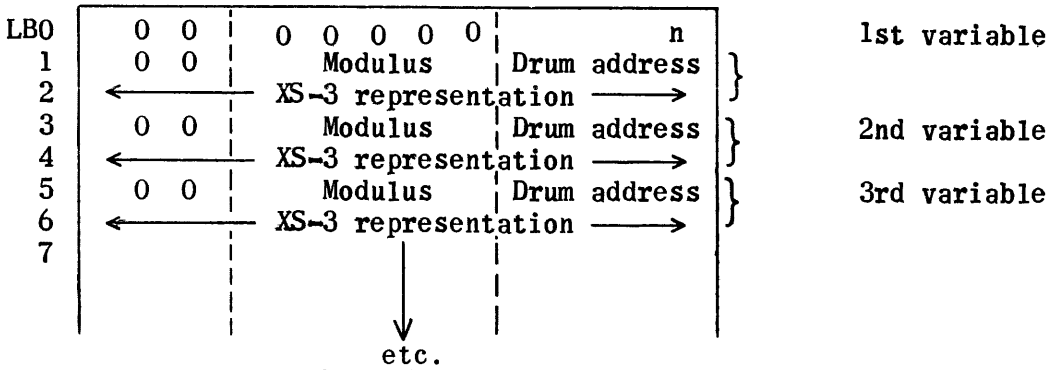
Layout of Object Program Tape



n = number of items in list.
(e.g., above case through LA11, n = 6)

List A format (built by Initialization Generation)

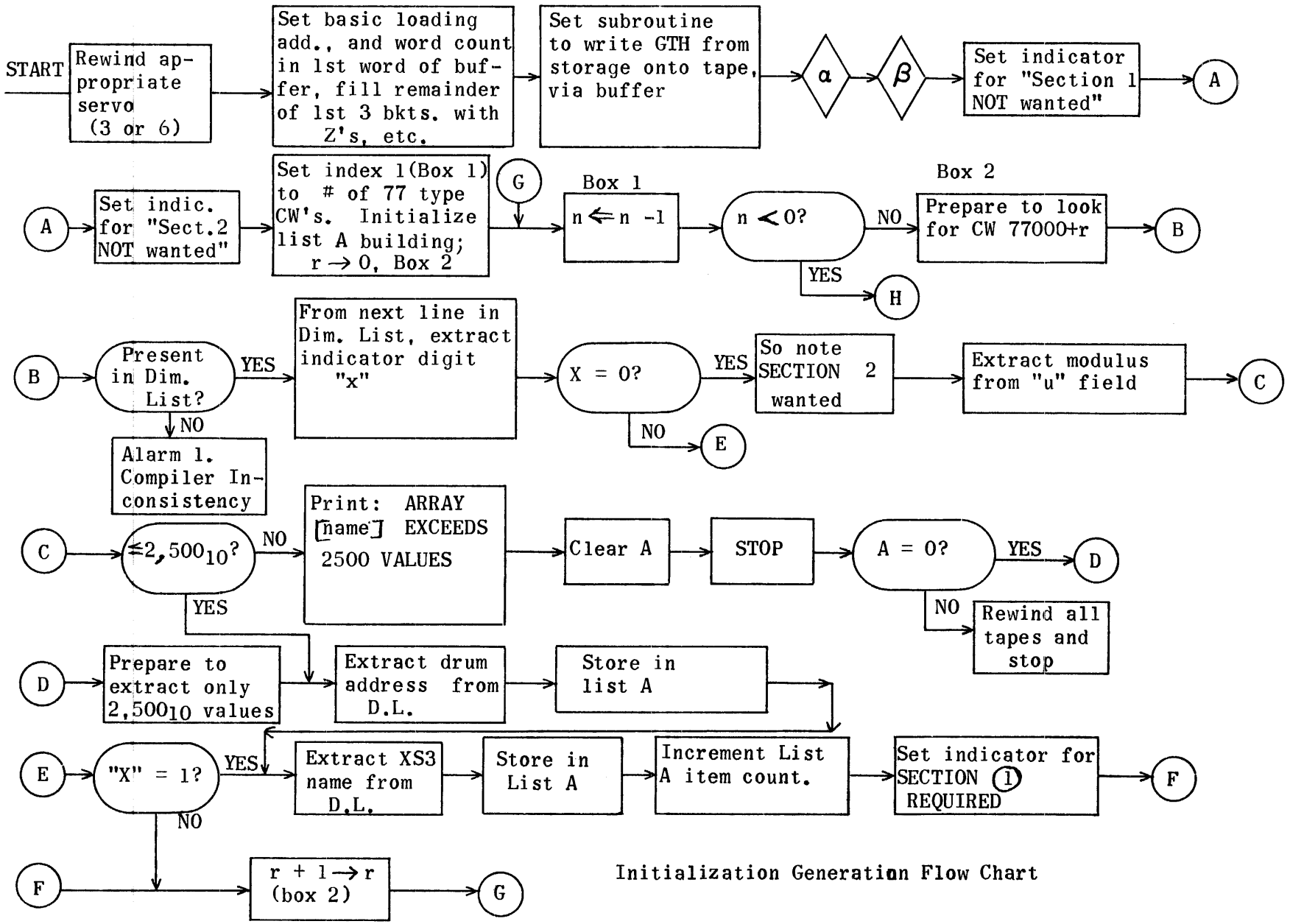
This list is derived from the Dimension List and includes all subscripted variables that are to be read in for a program.



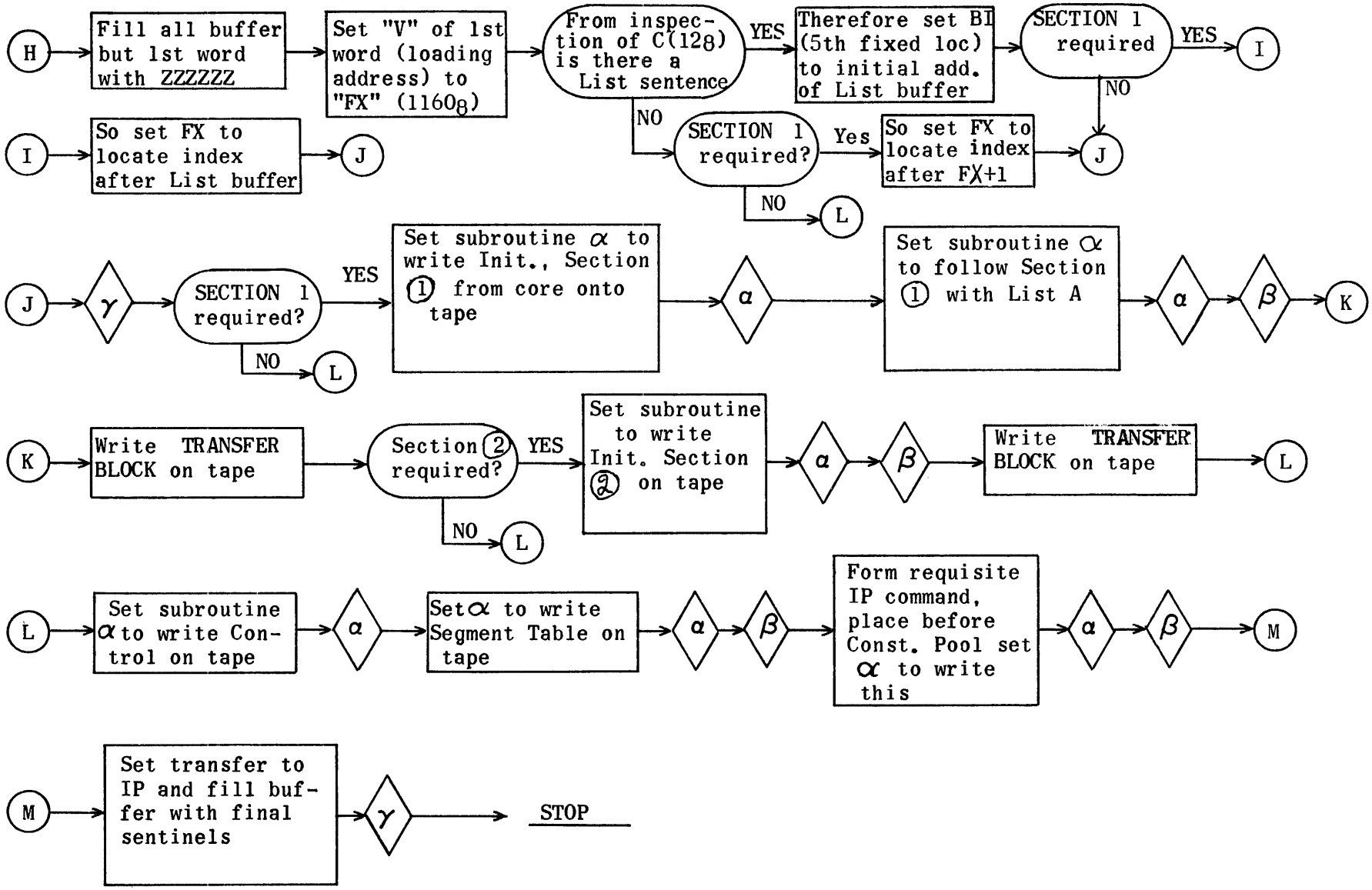
n = number of items in list
(e.g., above case through LB6, n = 3)

List B format (built by Initialization, Section 1)

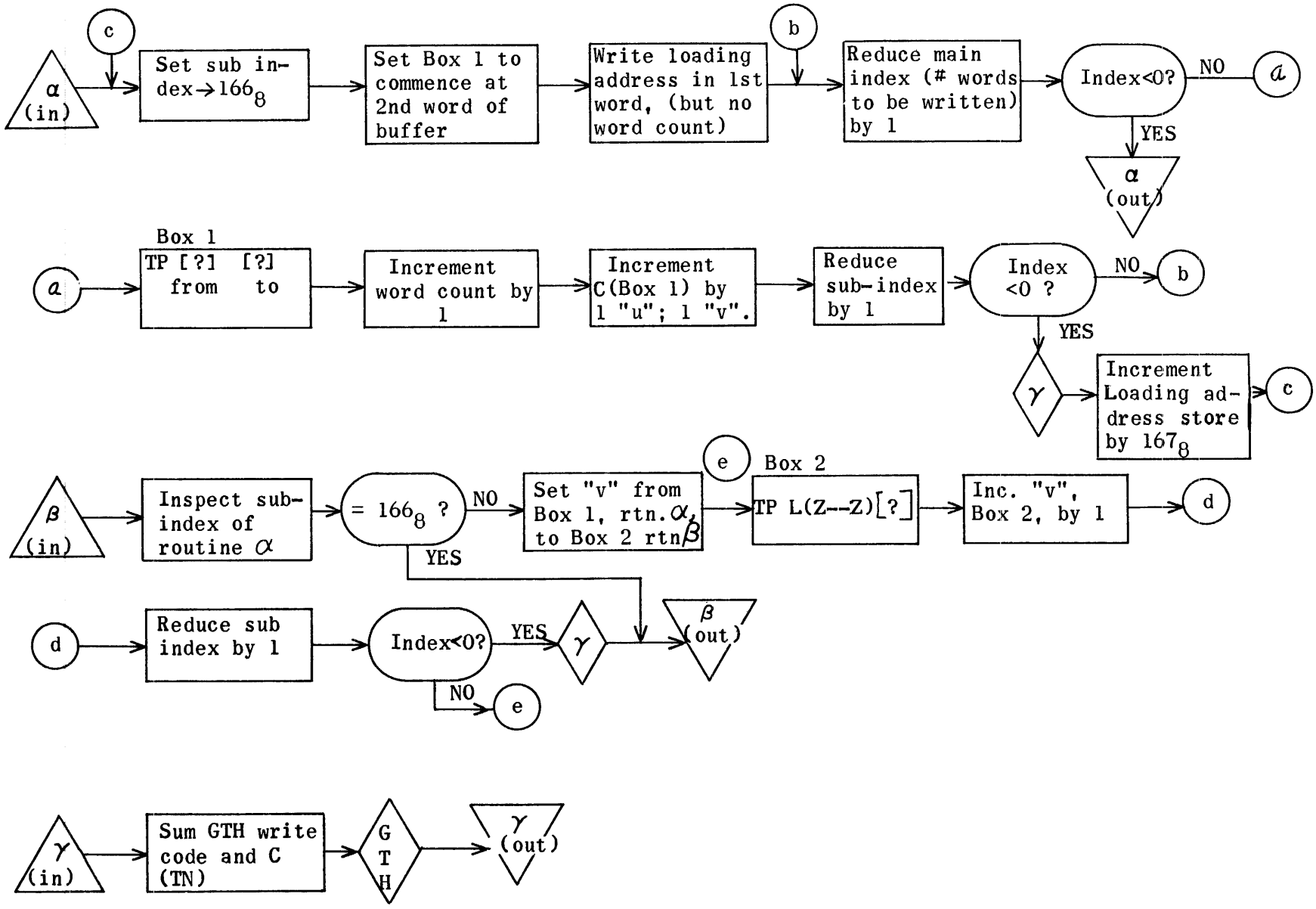
This list is derived from List A and includes all variables to be automatically read.



Initialization Generation Flow Chart



Initialization Generation Flow Chart (Cont.)



Initialization Generation Flow Chart (Cont.)

Regions for Initialization Generation

RE GI2000	Loading address
RE IG2000	Coding for Initialization Generation
RE IA2354	Stored coding for Section 1 of Initialization
RE ID3460	Stored coding for Section 2 of Initialization
RE ON4274	Stored coding for Control Section
RE TG4461	Stored coding for Tape Handler
RE WB5300	Output buffer
RE FL5470	List A
RE DL42102	Dimension List
RE CL50102	Constant Pool
RE ST653	Segment Table
RE TN20	Indicator word for number of Uniservos
RE GH21	Tape handler for compilation
RE UP421	Uniprint Routine
RE BR537 RE RB640	Compiler Inconsistency Routine
RE HD115	HD + 73 = operating address of Object Program Tape Handler
RE LG400	Length of Tape Handler
RE FX1000	Fixed I/O locations
RE LI1104	Length of Section 1
RE IN2000	Initial operating address of Section 1
RE LN614	Length of Section 2
RE DD1750	Initial operating address of Section 2
RE LC165	Length of Control Section
RE LT21	Length of Segment Table
RE ZA77000	Service Routine

```
                IA GI
IG      0       TP IG304        A       }
        1       RJ IG250        IG246   }   Rewind appropriate servo (3 or 6)
        2       TP IG327        WB          Set 1st word (loading address + W.C.
                                              for 3 bkts.)
        3       RP 10023        IG5     }
        4       TP IG251        WB1     }   Fill in rest of 1st bkt. with Z---Z
        5       RP 30004        IG7     }
        6       TP IG252        WB24    }   UNICODE Δ OBJECT Δ PROGRAM Δ
        7       RP 10044        IG11    }
       10       TP IG251        WB30    }   Fill in 2nd and 3rd bkts. with Z---Z
       11       TP IG330        IG230       Set index to length of (stored) GTH
       12       TP IG331        IG232       Set "Load Add. Temp" store (no word
                                              count)
       13       TU IG332        IG221       Initialize to start of (stored) GTH
       14       TP IG265        IG231       Set block index to 73(8)
       15       TV IG307        IG221       Initialize to WB74
       16       RJ IG220        IG217       Go write GTH
       17       RJ IG242        IG233       Conclude any unfinished block
       20       TP IG302        IG353       Set indicator for "no index" (large
                                              +ve no.)
       21       TV IG126        IG145       Assume no "Automatic Read"
       22       TP IG273        WB          First CW is 77000
       23       TP IG262        WB1     }
       24       TV 6            WB1     }   Set index to # of 77--- type CW's
       25       TV IG310        IG107       Initialize List A building to start
                                              at FL1
       26       TP IG262        FL          Zeroize List A item counter
       27       TP IG263        IG112       1 → List A line counter
       30       TU 6            IG34        Set up RP
       31       IJ WB1          IG33
       32       MJ 0            IG113       Exit to next section
       33       TP WB           A           CW for extraction → A
       34       RP[0]           BR1         Alarm if not present
       35       EJ DL           IG36
       36       SN Q            17
       37       SA IG34         0
                CA GI40

                IA GI40
IG      40       SA IG35        0
        41       TU A           IG42
        42       TP[30000]      Q           "X" and mod. line → Q
        43       QT IG303       A           Inspect all "X"
        44       ZJ IG70        IG45        Auto-read required?
        45       TV IG311       IG145       Yes.  So note (→ IG146)
        46       QT IG301       WB2         Extract modulus from u-field
        47       TJ IG300       IG62        Test with 2,501(10)
       [50       TU IG42        IG52        Too large an array.
        51       RS IG52        IG275   }
        52       TP[30000]      IG314   }   Go back 2 lines for XS3 rep.
```

```
        53   TP IG312     UP3  }
        54   RJ UP2       UP   }   Print-out.
        55   SP IG262     0        Clear A
        56   MS 0         IG57     Alarm stop
        57   ZJ RB        IG60
        60   TP IG310     Q        Place 2,500(10) in Q "u"
        61   MJ 0         IG46     and back.
        62   TU IG42      IG64 }
        63   RS IG64      IG276}   Go back 3 lines for drum address
        64   LQ[30000]    Q25
        65   TV Q         WB2      Complete line for List A
        66   RJ IG111     IG106    Store it (not incrementing item count)
        67   MJ 0         IG72
        70   QT IG302     A        "X" ≠ 0, so inspect "read-bit"
        71   ZJ IG72      IG77     If no prog. "read-out"?
        72   RS IG42      IG275    Prog. read. relates, so note the
                                     XS3 name
        73   TU A         IG74     (Go back 2 lines for XS3 name)
        74   TP[30000]    WB2
        75   RJ IG111     IG101    Store in List A (Incrementing item
                                     count)
        76   TP IG262     IG353    Note index wanted (zeroize indicator
                                     register)
        77   RA WB        IG263    Prepare for next CW
             CA GI100

             IA GI100
IG     100   MJ 0         IG31     And then back.
       101   RA FL        IG263    Increment item count
       102   TJ IG264     IG106    Test with 51(10)
       103   TP IG321     UP3
       104   RJ UP2       UP
       105   MJ 0         RB       To rewind tapes and stop.
       106   RA IG112     IG263    Increment line counter.
       107   TP WB2       [30000]
       110   RA IG107     IG263    Inc. storing order
       111   MJ 0         [30000]  Exit
       112   [0 30000     30000]   Line counter
       113   RP 10167     IG115}
       114   TP IG251     WB1  }   Fill block with Z----Z
       115   TP IG333     WB       Set loading address (FX), but no
                                     word count
       116   TP 12        Q
       117   QT IG274     A    }
       120   ZJ IG121     IG126}   Is there a List order?
       121   TP IG334     WB5      Yes, set BI
       122   TU IG307     WB       And set word count ⟶ 5
       123   IJ IG353     IG131    Index wanted?
       124   TP IG335     WB1      Yes, set FX
       125   MJ 0         IG131
       126   IJ IG353     IG155    No List order, but index wanted?
       127   TP IG336     WB1      Yes, set FX
```

List A building

```
        130   TU IG274    WB          And set word count ⟶ 1
        131   RJ IG250    IG245       Now write block
        132   IJ IG353    IG155       Index wanted?
        133   TP IG337    IG230       Yes, set in length of Init. ①
        134   TP IG340    IG232       Set "Loading Add. Temp" store.
                                        (no word count)
        135   TU IG341    IG221       Initialize to where Init. ① stored.
        136   RJ IG220    IG214       Go write tape
        137   TP IG112    IG230       Now, add List A.  Set index
              CA GI140
              IA GI140
IG      140   TU IG101    IG221       Pick it up from FL
        141   RJ IG220    IG217       Go write tape
        142   RJ IG242    IG233       Conclude any unfinished block
        143   TP IG340    WB          Set "transfer" word
        144   RJ IG250    IG243         And fill in rest of block
        145   MJ 0        [30000]     Automatic read wanted?
                                      (if not IG155)
        146   TP IG342    IG230       Yes.  Set index to length of Init. ②
        147   TP IG343    IG232       Set "Loading Add. Temp" store
        150   TU IG344    IG221       Initialize to where Init. ② is
                                        stored.
        151   RJ IG220    IG214       Go write
        152   RJ IG242    IG233       Conclude any unfinished block
        153   TP IG343    WB          Set "transfer" word
        154   RJ IG250    IG243       And fill in rest of block
        155   TP IG345    IG230       Set index to length of Control
                                        (Excluding Seg. Tab)
        156   TP IG346    IG232       Set "Loading Add. Temp" store
        157   TU IG347    IG221       Initialize to where Control is stored.
        160   RJ IG220    IG214       Go write
        161   TP IG350    IG230       Set index for length of segment table
        162   TU IG351    IG221       Initialize to where ST is stored.
        163   RJ IG220    IG217       Go write ST
        164   RJ IG242    IG233       Conclude any unfinished block.
        165   TP 10       Q           Using v mask, note initial address of CP
        166   QT IG272    A
        167   ST IG263    WB          Subtract 1 to leave room for IP
        170   TP A        IG232       Set "Loading Address Temp" store
        171   TP A        IG353       Save it for "transfer" word
        172   TU IG274    WB          Set W.C. ⟶ 1 (as at least IP)
        173   LQ 10       Q25         With partial v mask, set index to
        174   QT IG271    IG230         length of CP
        175   TU IG352    IG221       Initialize to where CP stored.
        176   TP IG306    WB1         Basic IP
        177   TV 12       WB1
              CA GI200
              IA GI200
IG      200   RA WB1      IG263       Increment by 1 to complete IP
        201   TP IG266    IG231       Set block index to 165
        202   TV IG65     IG221       Initialize to WB2
```

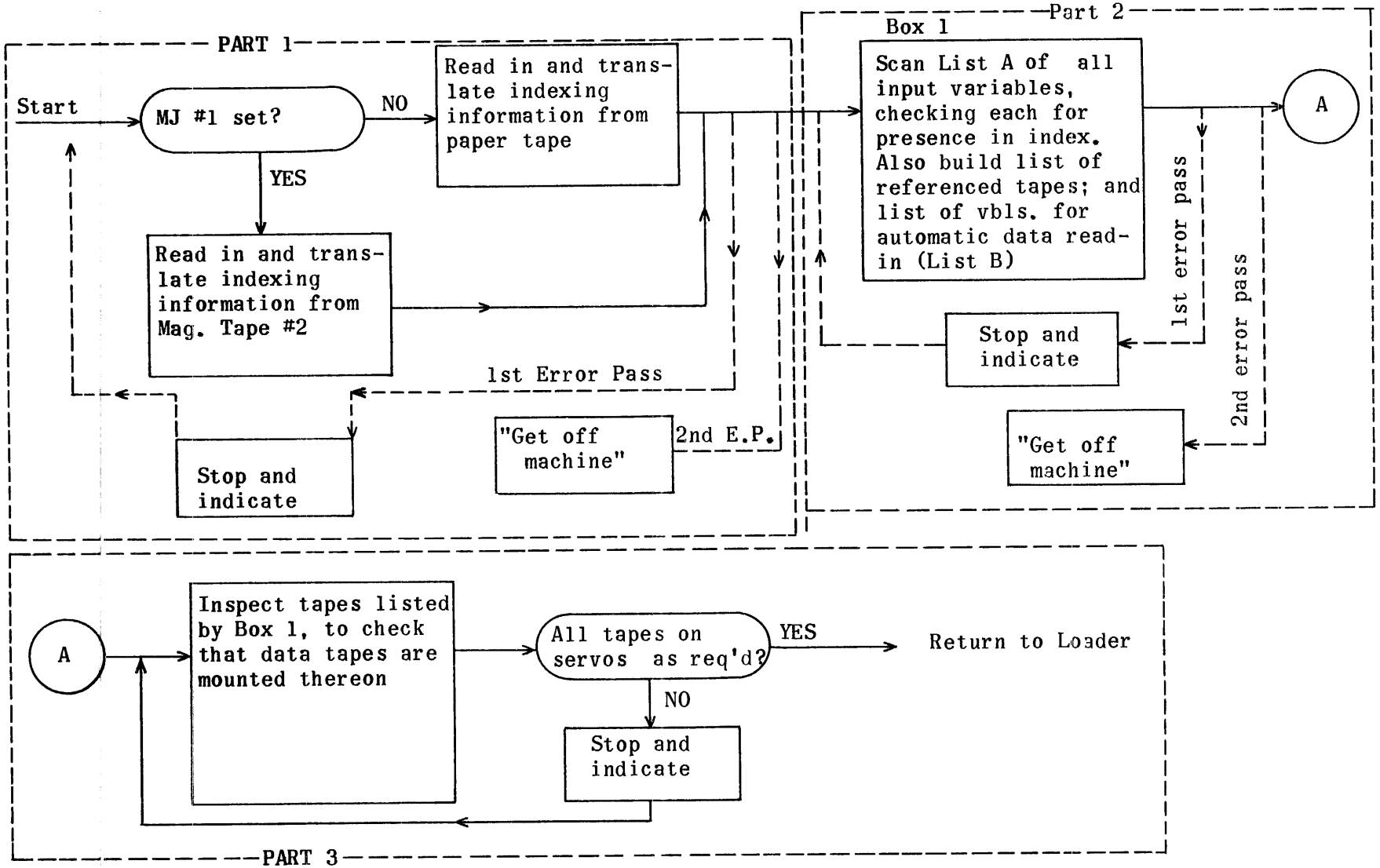
```
        203   RJ IG220      IG217        Go write
        204   RJ IG242      IG233        Conclude any unfinished block
        205   TP IG353      WB           Set "transfer"
        206   RP 30004      IG210 }      END Δ OF Δ INIT
        207   TP IG256      WB1   }
        210   RP 10163      IG212 }      Fill with Z----Z
        211   TP IG251      WB5   }
        212   RJ IG250      IG245        Go write
        213   MJ 0          ZA10         End.  Back to Service Routine.
Write   214   TP IG267      IG231        Set index ⟶ 166
(1)     215   TV IG4        IG221        Initialize to WB1
        216   TP IG232      WB           Write 1st word ( [W.C.]   1.a.)
        217   IJ IG230      IG221        Jump on main index
        220   MJ 0          [30000]      Exit
        221   TP [30000]    [30000]
        222   RA WB         IG274        Count 1 word.
        223   RA IG221      IG277
        224   IJ IG231      IG217        Jump back on block index.
        225   RJ IG250      IG245        Block full-go write it.
        226   RA IG232      IG270        Increment "Ld. Add. Temp." by 167 (V)
        227   MJ 0          IG214
        230   [0  0         0    ]       Main index
        231   [0  0         0    ]       Block index
Write   232   [0  0         0    ]       "Loading address temp" store.
(2)     233   SP IG231      0    }       If block index = 166₈, no
        234   EJ IG267      IG242}       partial block to finish
        235   TV IG221      IG236
        236   TP IG251      [30000]}     Fill with Z----Z
        237   RA IG236      IG263 }
              CA GI240

              IA GI240
IG      240   IJ IG231      IG236
        241   RJ IG250      IG245        Go write
        242   MJ 0          [30000]      Exit
Write   243   RP 10167      IG245}       Fill with Z---Z
(3)     244   TP IG251      WB1  }
        245   TP IG305      A    }
        246   AT TN         GH3  }       Go write on tape
        247   RJ GH2        GH   }
        250   MJ 0          [30000]      Exit
        251   74 74747      47474        Z Z Z Z Z Z  (XS3)
        252   67 50342      65127        U  N  I  C  0  D  }
        253   30 01512      54430        E  Δ  0  B  J  E  }  (XS3)
        254   26 66015      25451        C  T  Δ  P  R  0  }
        255   32 54244      72201        G  R  A  M  .  Δ  }
        256   30 50270      15131        E  N  D  Δ  0  F  }
        257   01 34503      46634        Δ  I  N  I  T  I  }  (XS3)
        260   24 46346      52466        A  L  I  Z  A  T  }
        261   34 51500      10101        I  0  N  Δ  Δ  Δ  }
        262   0  0          0
        263   0  0          1
        264   0  0          63           51₁₀
```

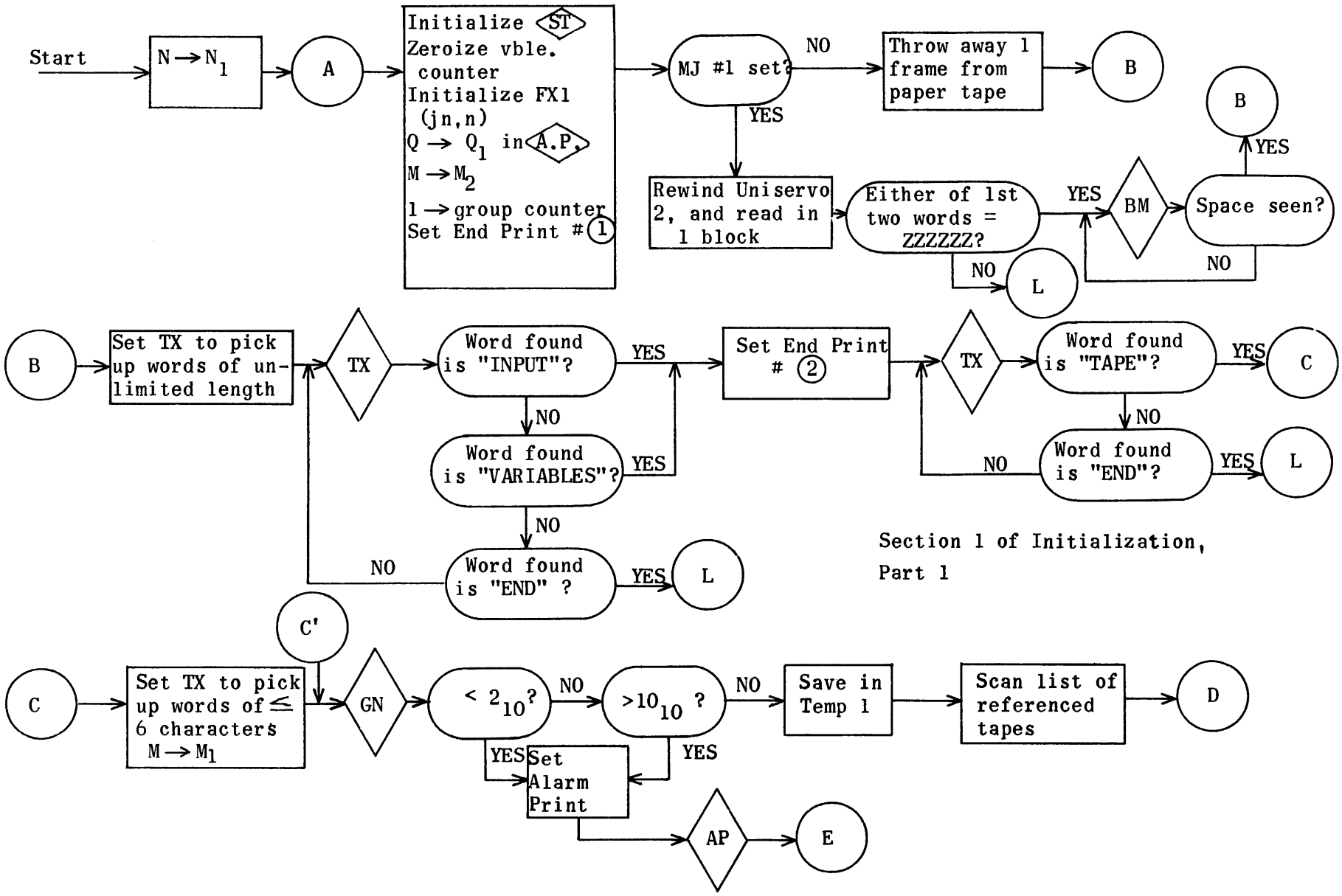
```
        265     0  0          73
        266     0  0          165
        267     0  0          166
        270     0  0          167
        271     0  0          07777
        272     0  0          77777
        273     0  0          77000
        274     0  1          0
        275     0  2          0
        276     0  3          0
        277     0  1          1
                CA GI300

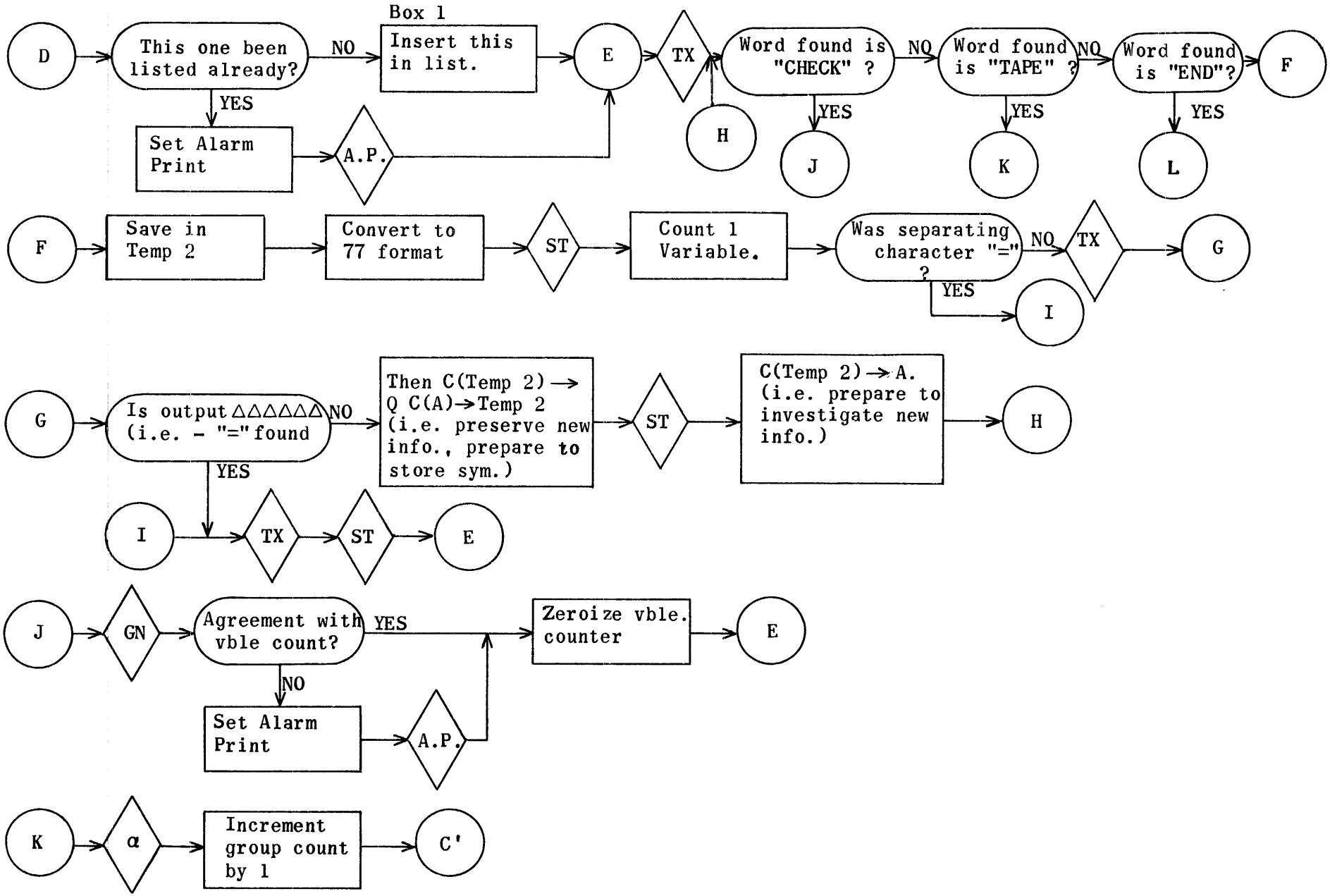
                IA GI300
IG      300     0  4705       0          2501(10)
        301     0  77777      0
        302     01 0          0          Read bit mask
        303     07 0          0          "X" mask
        304     10 3          0          Rewind Uniservo 3 code.
        305     71 00103      WB         Write Uniservo 3 code
        306     IP 00001      0          Basic IP
        307     0  5          WB74
        310     0  4704       FL1
        311     0  0          IG146
        312     0  IG313      6          1st print-out parameter.
        313     24 54542      47301      A R R A Y Δ
        314     [77 77777     77777]     [Name]
        315     01 30722      63030      Δ E X C E E
        316     27 65010      51003      D S Δ 2 5 0
        317     03 01702      44667      0 Δ V A L U
        320     30 65227      77777      E S .
        321     0  IG322      5
        322     66 51510      14724      T 0 0 Δ M A
        323     50 73013      45052      N Y Δ I N P
        324     67 66012      45454      U T Δ A R R
        325     24 73652      20154      A Y S . Δ R
        326     30 71543      46630      E W R I T E
        327     0  73         HD         HD + 73 = 1st operating address
                                        of GTH.  (= GT)
        330     0  0          LG         Length of GTH
        331     0  0          HD
        332     0  TG         0          1st address of stored GTH.
        333     0  0          FX
        334     0  0          FX5        BI setting
        335     0  FX175      FX175      FX Setting for index if List
                                        buffer present
        336     0  FX2        FX2        FX Setting for index if no list
                                        buffer present
        337     0  0          LI         length of Section (1) , initialization
                CA GI340
                IA GI340
IG      340     0  0          IN         Initial running address of Section (1)
        341     0  IA         0          Stored here
```

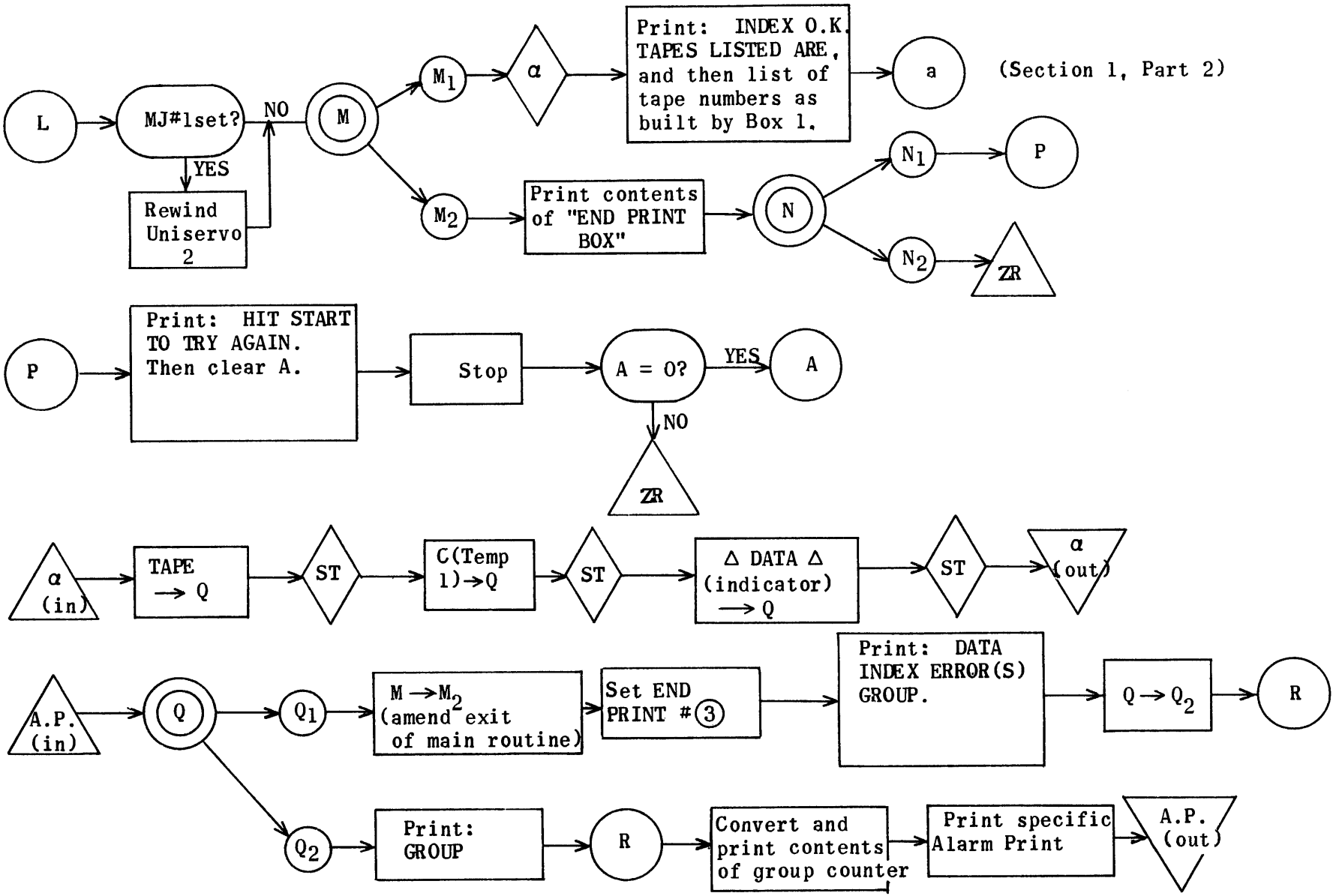
```
342     0  0          LN          Length of section ② of Init.
343     0  0          DD          Initial running address of Section ②
344     0  ID         0           Stored here
345     0  0          LC          Length of Control (excluding Seg.
                                  Table)
346     0  0          1           Initial running address
347     0  ON         0           Stored here
350     0  0          LT          Length of Segment Table
351     0  ST         0           Stored (formed) here
352     0  CL         0           Const. Pool stored here
353   [0   30000      30000]      Indicator
        CA GI354
```

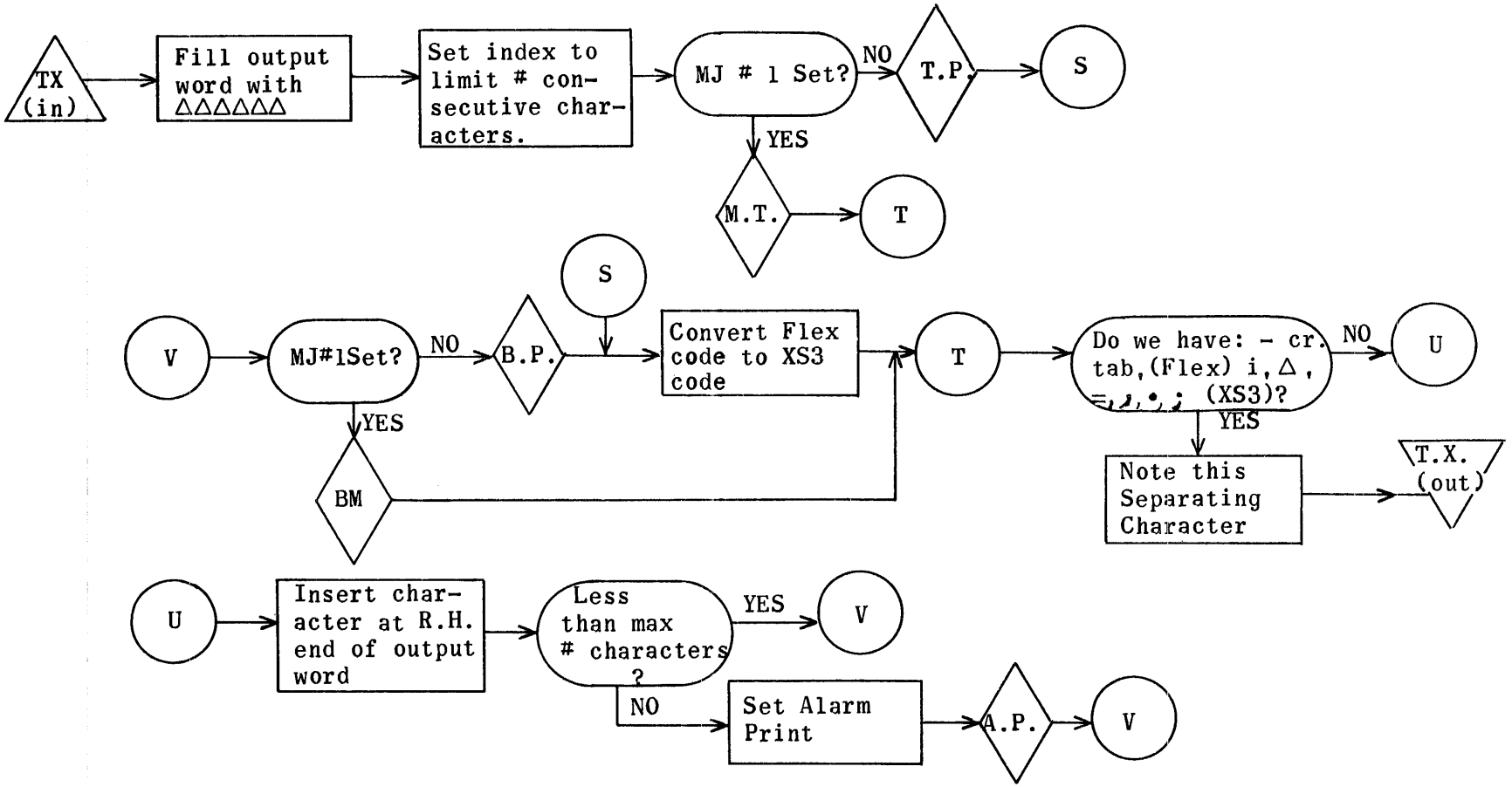


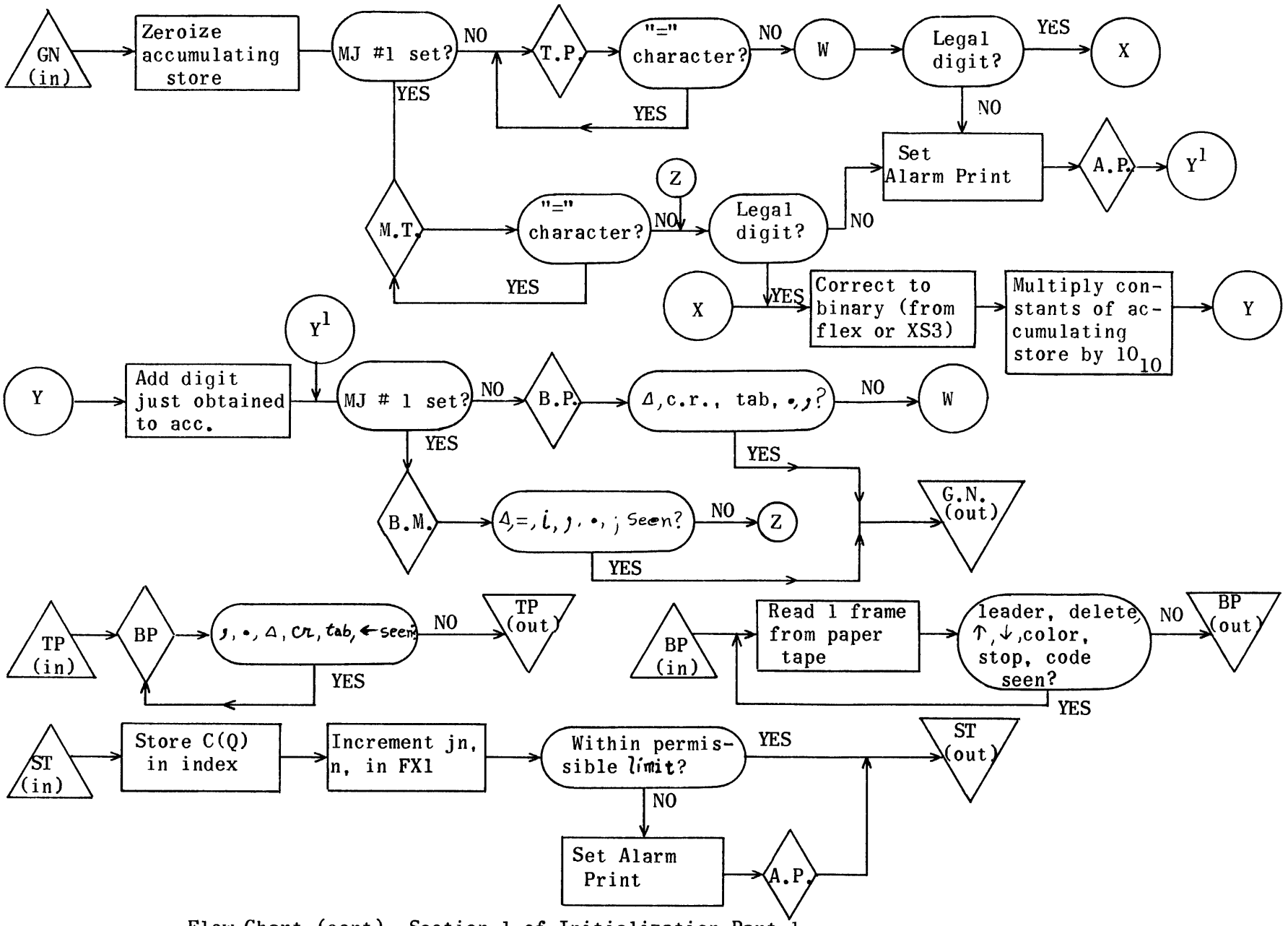
Flow Chart, General Layout of Section 1 of Initialization


Start
N → N1
A
Initialize ST
Zeroize vble. counter
Initialize FX1 (jn,n)
Q → Q1 in A.P.
M → M2
1 → group counter
Set End Print # 1
MJ #1 set?
NO
Throw away 1 frame from paper tape
B
YES
Rewind Uniservo 2, and read in 1 block
Either of 1st two words = ZZZZZZ?
YES
BM
Space seen?
YES
NO
NO
L
B
Set TX to pick up words of unlimited length
TX
Word found is "INPUT"?
YES
NO
Word found is "VARIABLES"?
YES
NO
Word found is "END" ?
YES
NO
L
Set End Print # 2
TX
Word found is "TAPE"?
YES
C
NO
Word found is "END"?
YES
NO
L
Section 1 of Initialization, Part 1
C'
C
Set TX to pick up words of ≤ 6 characters
M → M1
GN
< 2 10 ?
NO
> 10 10 ?
NO
Save in Temp 1
Scan list of referenced tapes
D
YES
Set Alarm Print
YES
AP
E

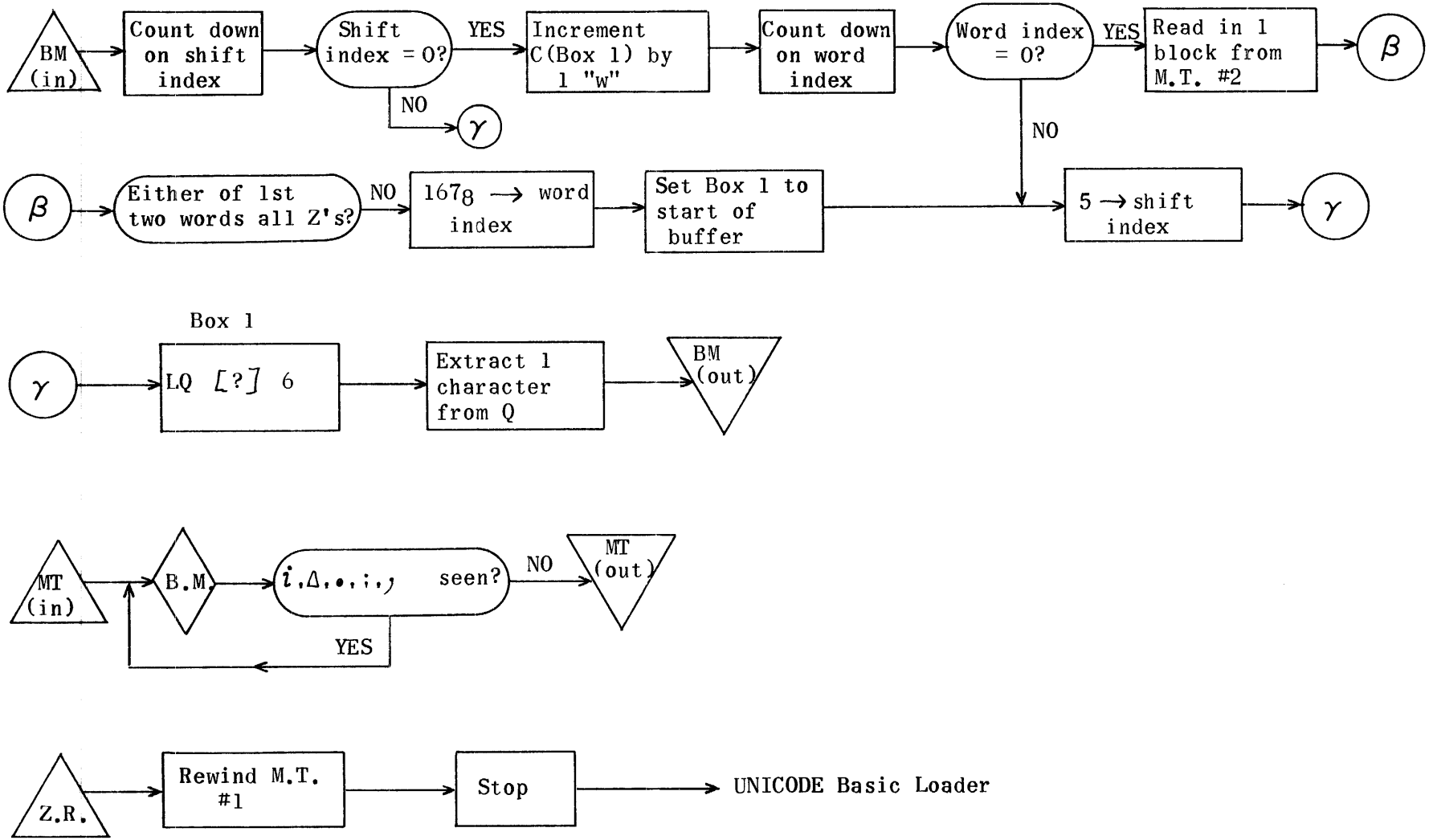

D
This one been listed already?
NO
Box 1
Insert this in list.
E
TX
H
Word found is "CHECK" ?
NO
Word found is "TAPE" ?
NO
Word found is "END"?
F
YES
J
YES
K
YES
L
YES
Set Alarm Print
A.P.
F
Save in Temp 2
Convert to 77 format
ST
Count 1 Variable.
Was separating character "=" ?
NO
TX
G
YES
I
G
Is output ΔΔΔΔΔΔ (i.e. - "=" found
NO
Then C(Temp 2) → Q C(A) → Temp 2 (i.e. preserve new info., prepare to store sym.)
ST
C(Temp 2) → A. (i.e. prepare to investigate new info.)
H
YES
I
TX
ST
E
J
GN
Agreement with vble count?
YES
Zeroize vble. counter
E
NO
Set Alarm Print
A.P.
K
α
Increment group count by 1
C'


L
MJ#1set?
NO
YES
Rewind Uniservo 2
M
M1
M2
α
Print: INDEX O.K. TAPES LISTED ARE, and then list of tape numbers as built by Box 1.
a
(Section 1, Part 2)
Print contents of "END PRINT BOX"
N
N1
N2
P
ZR
P
Print: HIT START TO TRY AGAIN. Then clear A.
Stop
A = 0?
YES
A
NO
ZR
α (in)
TAPE → Q
ST
C(Temp 1)→Q
ST
Δ DATA Δ (indicator) → Q
ST
α (out)
A.P. (in)
Q
Q1
M → M2 (amend exit of main routine)
Set END PRINT #3
Print: DATA INDEX ERROR(S) GROUP.
Q → Q2
R
Q2
Print: GROUP
R
Convert and print contents of group counter
Print specific Alarm Print
A.P. (out)


TX (in)
Fill output word with ΔΔΔΔΔΔ
Set index to limit # consecutive characters.
MJ # 1 Set?
NO
T.P.
S
YES
M.T.
T
S
V
MJ#1Set?
NO
B.P.
Convert Flex code to XS3 code
T
Do we have: - cr. tab,(Flex) i,Δ, =,,,•,; (XS3)?
NO
U
YES
BM
Note this Separating Character
T.X. (out)
U
Insert character at R.H. end of output word
Less than max # characters ?
YES
V
NO
Set Alarm Print
A.P.
V

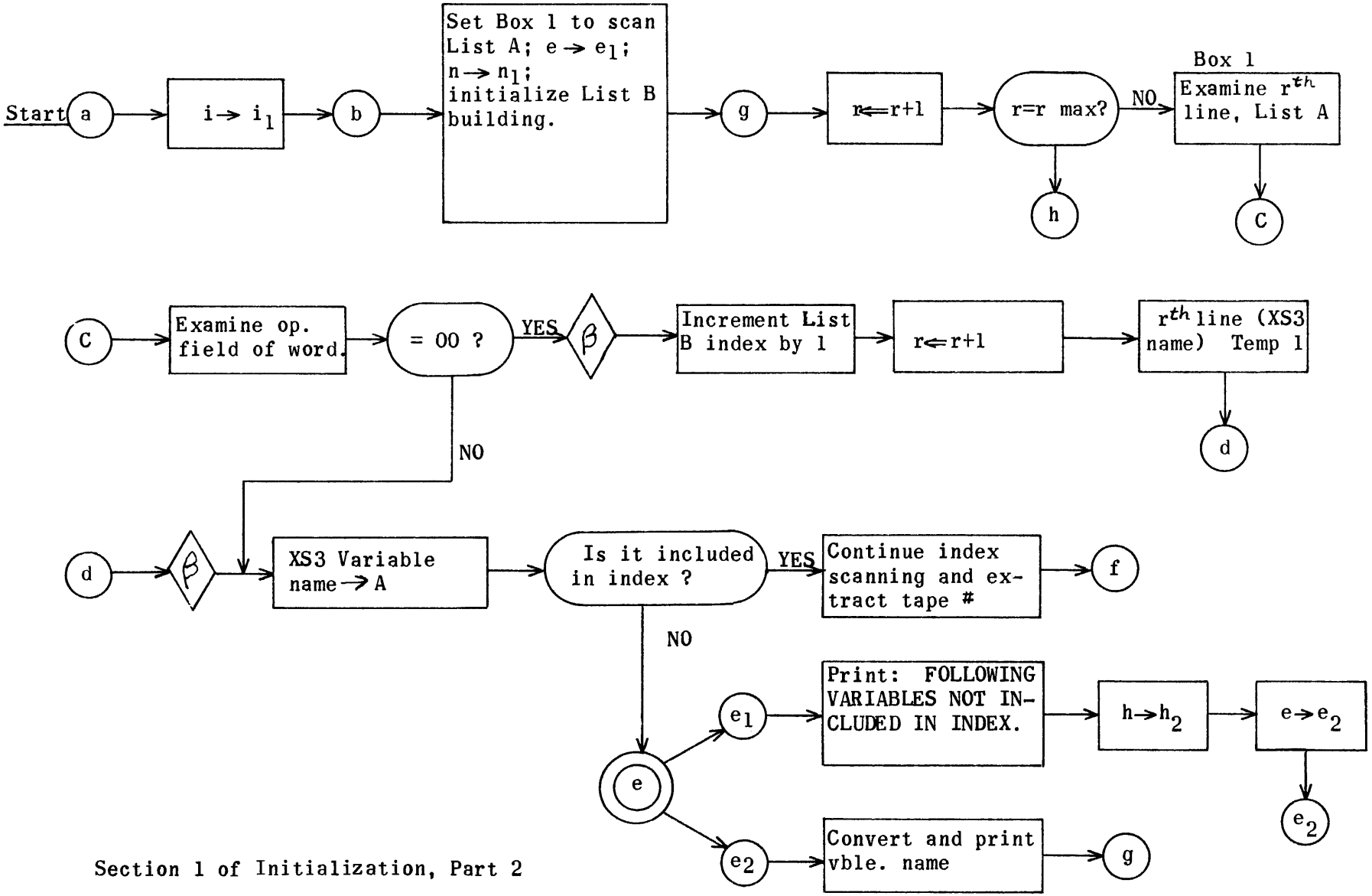


Flow Chart (cont) Section 1 of Initialization Part 1

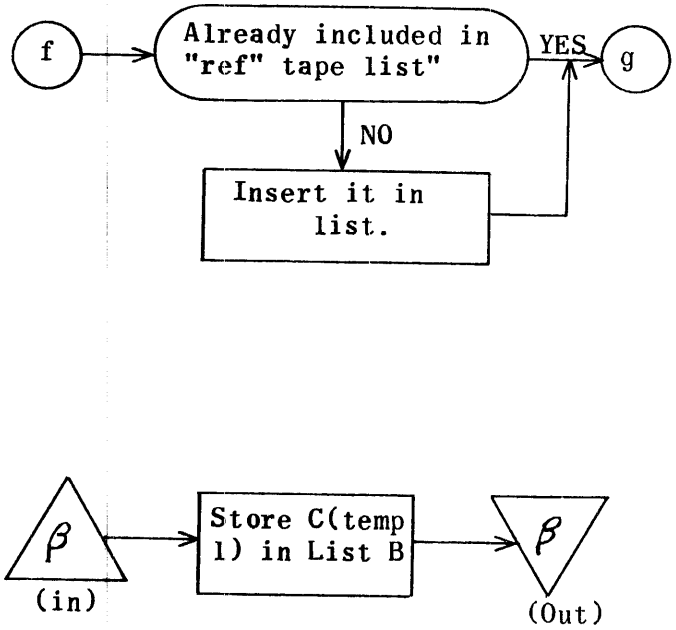


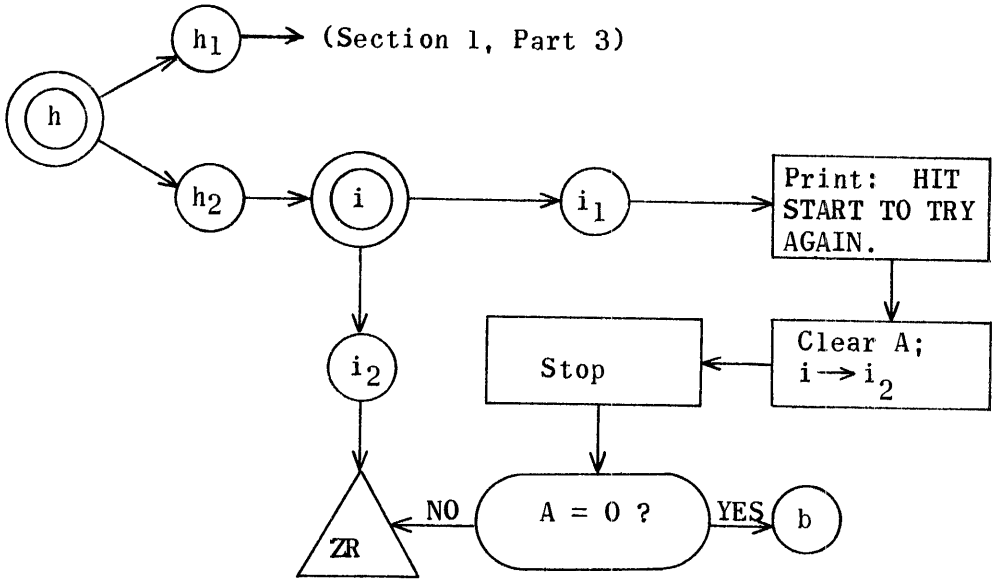
Flow Chart (cont.)

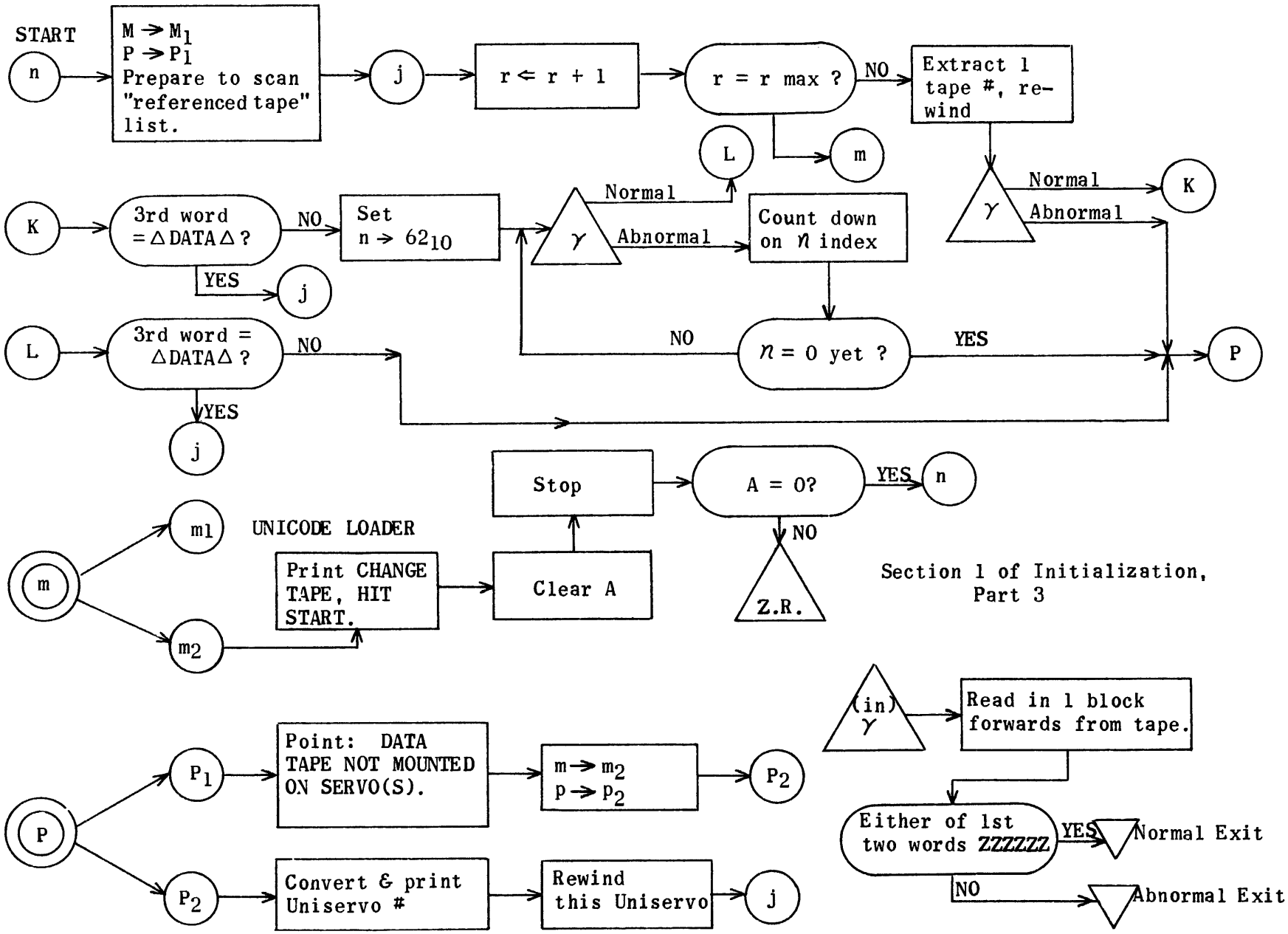
Section 1 of initialization, Part 1



Section 1 of Initialization, Part 2


f
Already included in "ref" tape list"
YES
g
NO
Insert it in list.
β
(in)
Store C(temp 1) in List B
β
(Out)


h1
(Section 1, Part 3)
h
h2
i
i1
Print: HIT START TO TRY AGAIN.
Clear A; i → i2
Stop
i2
ZR
NO
A = 0 ?
YES
b


START
n
M → M1
P → P1
Prepare to scan "referenced tape" list.
j
r ⇐ r + 1
r = r max ?
NO
m
L
Extract 1 tape #, rewind
Normal
Abnormal
K
γ
K
3rd word =ΔDATAΔ ?
NO
Set n → 62₁₀
Normal
Abnormal
Count down on n index
YES
j
L
3rd word = ΔDATAΔ ?
NO
YES
j
NO
n = 0 yet ?
YES
P
Stop
A = 0?
YES
n
NO
Z.R.
m
m1
m2
UNICODE LOADER
Print CHANGE TAPE, HIT START.
Clear A
Section 1 of Initialization, Part 3
(in) γ
Read in 1 block forwards from tape.
Either of 1st two words ZZZZZZ
YES
Normal Exit
NO
Abnormal Exit
P
P1
P2
Point: DATA TAPE NOT MOUNTED ON SERVO(S).
m → m2
p → p2
P2
Convert & print Uniservo #
Rewind this Uniservo
j

Section 1 of Initialization

```
                RE IA2354                   Loading Address
                RE IN2000                   (27)
                RE MR2027                   (171)
                RE TX2220                   (37)
                RE GN2257                   (34)
                RE BP2313                   (5)
                RE TP2320                   (3)
                RE ST2323                   (14)
                RE BM2337                   (24)        Operating address of
                RE MT2363                   (3)           program
                RE DP2366                   (14)      (Total length = 1104_8 words)
                RE YW2402                   (12)
                RE XW2414                   (113)
                RE YH2527                   (5)
                RE XH2534                   (51)
                RE CN2605                   (102)
                RE CL2707                   (40)
                RE LP2747                   (132)
                RE ZR3101                   (3)
                RE LA3104                               List A
                RE LB7475                               List B
                RE TL660                    (12)  Temporaries in Termination
                                                  Buffer
                RE TM700                    (5)
                RE TB1                      Buffer
                RE GT210                    Tape Handler during Object Program
                RE FX1000                   Fixed I/O locations.

                RE PR77250                  Flex print Routine
                RE DA77300                  Object Program Loader
                RE LD1500                   Running address of Loader.
                IA IA
IN        0     TV CN2        MR132         N ---> N_1 (Enable 2nd pass)
          1     TV FX         ST1     }
          2     TP CN4        ST12    }     Initialize ST
          3     TP CL         ST13          Zeroize vble. counter
          4     TP CN10       FX1           Start FX1 with [0  20000  0]
          5     TV CN40       MR152         Q ---> Q_1
          6     TV CN41       MR107         M ---> M_2
          7     TP CN4        TM3           1 Group counter
         10     TP CN10       TL            Initialize Tape List Index
         11     TP LP4        MR150         Set EP (1)
         12     MJ 10000      IN16          P  or  M?
         13     EF 0          BP4     }
         14     ER 0          A       }     P - Throw away 1 frame
         15     MJ 0          MR1           ---> Main Routine
         16     EF 0          CN100         Mag. tape.  Rewind #2
         17     TP CN77       GT3     }
         20     RJ GT2        GT      }     Read 1 block forward
         21     TP CN61       A             Z----Z---> A
```

```
        22    EJ TB       IN25  }
        23    EJ TB1      IN25  }     Check for Sentinel
        24    MJ 0        MR104       NO - go to End Routine
        25    RJ BM       BM11        Initialize BM
        26    EJ CN4      MR1         If space, carry on
              CA IA27                 (= MR)

              IA IA27
MR      0     MJ 0        BM1
        1     TP CN54     TX2         ∞ ⟶ TX index
        2     RJ TX       TX3          Get 1 word
        3     EJ CN63     MR7         INPUT?
        4     EJ CN65     MR7         (VARIABLES?)
        5     EJ CN67     MR104       END?
        6     MJ 0        TX3
        7     TP LP11     MR150       Set EP (2)
       10     RJ TX       TX3         Get next word.
       11     EJ CN71     MR14        TAPE?
       12     EJ CN67     MR104       END?
       13     MJ 0        TX3         No.
       14     TV CN43     MR107       TAPE seen.  M ⟶ M1
       15     TP CN70     TX2         6 ⟶ TX index
       16     RJ GN       GN1
       17     TJ CL4      MR21        Should not be < 2 (i.e. - don't
                                        jump if good)
       20     TJ CN60     MR24        Should not be ≥ 11 (i.e. - do jump
                                        if good)
       21     TP LP53     MR151 }     Alarm (illegal tape #)
       22     RJ MR170    MR152 }
       23     MJ 0        MR37
       24     TP A        TM          Preserve in Temp. 1
       25     TU TL       MR26        Set up RP
       26     RP[0]       MR33  }     Search tape list to see if already
       27     EJ TL1      MR30  }       referenced (if so - error)
       30     TP LP60     MR151 }
       31     RJ MR170    MR152 }     Alarm (Duplicate tape #)
       32     MJ 0        MR37
       33     TV TL       MR35
       34     RA MR35     CN101       (by L(TL1) v)
       35     TP TM       [30000]
       36     RA TL       CN47        by lu, lv
       37     RJ TX       TX3         Find 1 word
              CA IA67

              IA IA67
MR      40    EJ CN73     MR73        = CHECK?
       41     EJ CN71     MR101       = TAPE?
       42     EJ CN67     MR104       = END?
       43     TP A        TM1         No - preserve in case needed as
                                        synomyn
       44     TP A        TM2         Now count to 77 format.  Send to
                                        working store.
       45     TP CN53     Q           Op field mask ⟶ Q
```

```
        46    QT TM2      A        Inspect 1st two digits
        47    EJ CN54     MR52     = 01?
        50    TP TM2      Q        No, result to Q, all finished
        51    MJ 0        MR55
        52    QS CN53     TM2      Yes, replace by 77
        53    LQ TM2      6          and shift left
        54    MJ 0        MR45
        55    RJ ST11     ST       Now Q holds 77 format.  Store
                                     (counting 1 vble)
        56    SP TX1      0        Separating symbol ⟶ A
        57    EJ CL21     MR67     = ?
        60    RJ TX       TX3      No, get more information
        61    EJ CN55     MR67     Is output Δ _____ Δ ?
        62    TP TM1      Q        No, so = was not seen.  Prepare to
                                     store previous,meanwhile preserving
                                     new information
        63    TP A        TM1
        64    RJ ST11     ST1      Store old name
        65    TP TM1      A        Now go investigate new information
        66    MJ 0        MR40
        67    RJ TX       TX3      = seen.  Obtain synomyn
        70    TP A        Q          and store it
        71    RJ ST11     ST1
        72    MJ 0        MR37     Then back to look for more.
        73    RJ GN       GN1      Obtain check #
        74    EJ ST13     MR77     Correct?
        75    TP LP64     MR151    No.
        76    RJ MR170    MR152      Alarm
        77    TP CL       ST13     Zeroize check counter
              CA IA127
              IA IA127
MR    100     MJ 0        MR37
TAPE  101     RJ MR147    MR141    Act appropriately
      102     RA TM3      CN4      Up group count by 1
      103     MJ 0        MR16       and back for tape #
END   104     MJ 10000    MR106    P. or M.?
      105     MJ 0        MR107    P - jump.
      106     EF 0        CN100    M - rewind # 2
      107     MJ 0        [30000]
(Z)   110     RJ MR147    MR141    Act appropriately
      111     TP LP40     PR3      INDEX OK. TAPES LISTED ARE ↓
Z1    112     RJ PR2      PR
(good)113     TP CL       TM2      Zeroize index
      114     TV TL       TM2      Set it up.
      115     TU MR27     MR120    Initialize
      116     IJ TM2      MR120    Jump on index
      117     MJ 0        MR124    All through-out
      120     TP [30000]  A        1 tape # to A
      121     RJ DP13     DP       Print it
      122     RA MR120    CN50     Increment by 1 "u"
      123     MJ 0        MR116    Back for more
      124     PR 0        CL7      Period
```

```
        125    PR 0          CL11          Carriage return
        126    PR 0          CL11          Carriage return
        127    MJ 0          YW            Exit (Normal)
(Z2)    130    TP MR150      PR3    }      EP Box
        131    RJ PR2        PR     }
(bad)   132    RJ MR132      [30000]       (Initially MR 134)
        133    MJ 0          ZR            Exit (Get off machine)
        134    TP LP32       PR3    }
        135    RJ PR2        PR     }      HIT START TO TRY AGAIN, ETC.
        136    SP CL         0             Clear A
        137    MS 0          MR140         Stop
               CA IA167
               IA IA167
MR      140    ZJ ZR         IN1           (Non zero - get off machine exit)
        141    TP CN75       Q             Δ TAPE Δ ⟶ Q
        142    RJ ST11       ST1           ⟶ index
        143    TP TM         Q             Tape # ⟶ Q
        144    RJ ST11       ST1           ⟶ index
        145    TP CL35       Q      }
        146    RJ ST11       ST1    }      leave room (cleared) for indicator
        147    MJ 0          [30000]
Error   150   [0  30000      30000]        EP parameter.
Rtne.   151   [0  30000      30000]        REP parameter.
(M)     152    MJ 0          [30000]       Entry. Initially MR 153
        153    TV CN41       MR107         M ⟶ M2
        154    TP LP16       MR150         Set EP (3)
        155    TP LP46       PR3           Prepare for Print-out
        156    RJ MR152      MR160         Q ⟶ Q2
(M2)    157    TP LP47       PR3
        160    RJ PR2        PR            Go print
        161    SP TM3        0             Group count ⟶ A
        162    PR 0          CL3           Shift down
        163    RJ DP13       DP            Print group count.
        164    PR 0          CL10          Space
        165    PR 0          CL2           Shift up
        166    TP MR151      PR     }      Specific diagnosis
        167    RJ PR2        PR     }
        170    MJ 0          [30000]       Exit
               CA IA220
               IA IA220
TX        0    MJ 0          [30000]       Exit.
          1   [0  30000      30000]        Output line (for cut-off symbol)
          2   [0  30000      30000]        Input line (value for index setting)
          3    TP CN55       TX36          Entry.  Fill word with Δ ---- Δ
          4    TP TX2        TM2           Set index
          5    MJ 10000      TX10          P or M?
          6    RJ TP1        TP            P.  Find start
          7    MJ 0          TX14          Go translate
         10    RJ MT1        MT            M.  Find start
         11    MJ 0          TX21
         12    MJ 10000      TX20          P or M?
         13    RJ BP2        BP            P - Find next frame.
         14    SA CN         17     }
         15    TU A          TX16   }      Translate
         16    TP[30000]     A      }
         17    MJ 0          TX21
```

```
          20    RJ BM          BM1          M - Find next character
          21    RP 20006       TX23  }      Exit { FLEX Δ cr tab. , =
          22    EJ CL14        TX33  }           { XS3  i Δ = ,. ;
          23    LQ TX36        6
          24    TP CL1         Q            Mask ⟶ Q
          25    QS A           TX36         Insert new character
          26    IJ TM2         TX12
          27    TP LP70        MR151 }      Alarm
          30    RJ MR170       MR152 }
          31    TP CN54        TM2          Reset index to large value
          32    MJ 0           TX12
          33    TP A           TX1
          34    TP TX36        A            Output to A
          35    MJ 0           TX
          36    [0  30000      30000]       Word assembly space
                CA IA257

                IA IA257
GN        0     MJ 0           [30000]      Exit
          1     TP CL          GN33         Zeroize working store
          2     MJ 10000       GN7          P or M?
          3     RJ TP1         TP           P.  Get 1st character
          4     EJ CN22        TP           Throw away =
          5     RP 20012       GN30         Check down digit list
          6     EJ CL22        GN14
          7     RJ MT1         MT           Mag. Tape - Find 1st character.
          10    EJ CL21        MT           Throw away =
          11    TJ CN56        GN13         Should be < 15₈
          12    MJ 0           GN30
          13    ST CN37        Q            Subtract 3 ⟶ Q
          14    SP GN33        2     }      Multiply previous by 10
          15    SA GN33        1     }
          16    QA CL33        GN33         Add in new figure
          17    MJ 10000       GN23         P or M?
          20    RJ BP2         BP           P - get next ch.
          21    RP 20005       GN5   }      Exit if Δ cr tab . ,   FLEX
          22    EJ CL6         GN26  }
          23    RJ BM          BM1          M.  Get next ch.
          24    RP 20006       GN11  }      Exit if Δ = i , . ;   XS3
          25    EJ CL14        GN26  }
          26    SP GN33        0            Result ⟶ A
          27    MJ 0           GN             and out.
          30    TP LP74        MR151 }      Alarm
          31    RJ MR170       MR152 }
          32    MJ 0           GN17
          33    [0  30000      30000]       Erasable
                CA IA313

                IA IA313
BP        0     EF 0           BP4   }
          1     ER 0           A     }
```

```
        2     RP 20006   [30000]    Basic paper tape read.
        3     EJ CL       BP
        4     10 3        0
              CA IA320

              IA IA320
TP      0     RJ BP2      BP         Throw away routine.  (After this,
        1     RP 20006   [30000]     we have a significant code)
        2     EJ CL6      BP
              CA IA323

              IA IA323
ST      0     RA ST13     CN4        Count 1 vble.
        1     TP Q       [30000]     Build index
        2     RA ST1      ST12       Inc. st. order
        3     RA FX1      CN47
        4     TJ CN76     ST11
        5     TP LP77     MR151      Alarm.
        6     RJ MR170    MR152      Alarm.
        7     TP CL       ST12
       10     TP CN10     FX1
       11     MJ 0       [30000]
       12     0 [30000    30000]     Increment
       13     0 [30000    30000]     Vble. count.
              CA IA337

              IA IA337
BM      0     MJ 0       [30000]     Exit
        1     IJ BM22     BM14       Entry.  Jump on shift index
        2     RA BM14     CN50
        3     IJ BM23     BM13       Jump on word index
        4     TP CN77     GT3        Read 1 block forward
        5     RJ GT2      GT         Read 1 block forward
        6     TP CN61     A          Z-------Z --> A
        7     EJ TB       BM17       If Sentinel seen., alarm.
       10     EJ TB1      BM17       If Sentinel seen., alarm.
       11     TP CN57     BM23       Word index --> 167
       12     TU BM7      BM14
       13     TP CN74     BM22       Shift index --> 5
       14     LQ [30000]. 6          Extract 1 character
       15     QT CL1      A          Extract 1 character
       16     MJ 0        BM         And out
       17     TP LP24     MR151      Alarm
       20     RJ MR170    MR152      Alarm
       21     MJ 0        MR104
       22     [0  30000   30000]     Shift index
       23     [0  30000   30000]     Word index
              CA IA363

              IA IA363
MT      0     RJ BM       BM1        Mag. Tape throw away.
```

```
          1     RP 20005   [30000] }        (Discard i Δ , . ;)
          2     EJ CL14     BM1    }
                CA IA366

                IA IA366
DP        0     DV CN72     Q               Quantity given in A.  Divide by 10
          1     TP A        TM4             Save remainder
          2     TN Q        A      }
          3     ZJ DP4      DP6    }        Tens figure zero?
          4     AT CL34     DP5             No, form print order
          5    [0  30000    30000]
          6     TP CL34     A               Dummy print again
          7     ST TM4      DP10              form print order for units
         10    [0  30000    30000]
         11     PR 0        CL10   }
         12     PR 0        CL10   }        Then 2 spaces
         13     MJ 0       [30000]          Exit
                CA IA402
```

Initialization for XW

```
                IA IA402
YW        0     TV XW106    XW74            Enable restart after 1st error pass
          1     TU FX       XW16   }
          2     TU FX1      XW15   }        Set up index-scanning
          3     TV XW107    XW53            Initialize error print-out section
          4     TP CN10     TL              Set Tape List index to 0  20000  0
          5     TV XW110    XW1             Set normal exit (YH)
          6     TU XW106    XW2             Scan List A from LA1  }
          7     TP LA       TM1             Set index             } LA
         10     TV XW111    XW50            Build List B from LB1
         11     TP CL       LB                and set index
                CA IA414
```

First Run-Through Data List, and Preliminary Checking.

```
                IA IA414
XW      0       IJ TM1      XW2          Jump on List A index
        1       MJ 0        [30000]      Exit when all completed
        2       TP[30000]   A            Examine one item.
        3       TP A        TM           Save it in temp
        4       TP CN53     Q            Op field mask ⟶ Q
        5       QT A        A            and examine Op. field
        6       ZJ XW14     XW7
        7       RJ XW52     XW47         Zero, . . a "mod. Ed.a" line -
                                         build List B
       10       RA XW2      CN50         So
       11       TU A        XW12         extract
       12       TP[30000]   TM           next line (XS3 name)
       13       RJ XW52     XW50           and store it as well, in List B
       14       TP TM       A            Now, name to A
       15       RP[0 ]      XW53  }      Scan index. (Alarm, if not present)
       16       EJ[30000]   XW17  }
       17       SN Q        17
       20       SA XW15     0
       21       SA XW16     0
       22       TU A        XW27         Set up EJ for continued search
       23       LQ Q        17
       24       TU Q        XW26         Set up RP
       25       TP CN75     A            [Δ TAPE Δ to A
       26       RP[0 ]      XW103 }      Continue to scan index, searching for
       27       EJ[30000]   XW30  }        tape #
       30       SN Q        17
       31       SA XW26     0
       32       SA XW27     0
       33       TU A        XW34
       34       SP[30000]   0            Tape # ⟶ A
       35       TP A        TM             and save it
       36       TU TL       XW37
       37       RP[0 ]      XW41
                CA IA454

                IA IA454
XW      40       EJ TL1      XW45         Scan referenced tape list
        41       TV TL       XW43         Not yet present - so insert it
        42       RA XW43     CN101
        43       TP TM       [30000]
        44       RA TL       CN47         Increment index
        45       RA XW2      CN50         Prepare to scan further down list
        46       MJ 0        XW
        47       RA LB       CN4
        50       TP TM       [30000]
        51       RA XW50     CN4
        52       MJ 0        [30000]
```

```
          53    MJ 0        [30000]      Initially XW54.  Error Routine.
          54    TP LP110    PR3     }    Print:  FOLLOWING VARIABLES NOT
          55    RJ PR2      PR      }    INCLUDED IN INDEX.
          56    TV XW112    XW1          Amend exit from main routine
                                         (to XW 73)
          57    RJ XW53     XW60
          60    TP CN74     TM2          2nd and subsequent errors here.
                                         5 ⟶ index
          61    LQ TM       6            Shift one character over
          62    QT CL1      A            Extract it
          63    RP 20074    XW71    }
          64    EJ CN1      XW65    }
          65    SN Q        17      }    Compute and print Flex-code
          66    SA XW63     71      }
          67    PR 0        A       }
          70    IJ TM2      XW61
          71    PR 0        CL11         Carriage return, when fully printed
          72    MJ 0        XW45
          73    PR 0        CL11         Extra CR
          74    RJ XW74     [30000]      Error END.  Initially XW76
          75    MJ 0        ZR           2nd time - get off machine
          76    TP LP32     PR3     }    1st time:  HIT START TO TRY AGAIN
          77    RJ PR2      PR      }
                CA IA514

                IA IA514
XW        100   SP CL       0            Clear A
          101   MS 0        XW102        Stop
          102   ZJ ZR       YW1          If A ≠ 0, get off machine; otherwise,
                                           try again
          103   TP LP131    PR3     }
          104   RJ PR32     PR      }    Print:  MACHINE ERROR
          105   MJ 0        ZR      }    G-O-M
          106   0  LA1      XW76    }
          107   0  0        XW54    }
          110   0  0        YH      }    Constants.
          111   0  0        LB1     }
          112   0  0        XW73    }
                CA IA527
```

Initialization for XH

```
                IA IA527
YH        0     TP CL       TM3     }
          1     TV TL       TM3     }    Set index
          2     TV XH46     XH1          Set normal exit:  BACK TO LOADER
          3     TU XW40     XH2          Start list at TLI
          4     TV XH47     XH17         Initialize error procedures
                CA IA534
```

```
                IA IA534
XH      0       IJ TM3      XH2         Count down on index
        1       MJ 0        [30000]     Exit
        2       TP[30000]   TM          Extract 1 tape #
        3       SP TM       14      }
        4       AT CL36     TM1     }   Rewind this tape.
        5       EF 0        A       }
        6       RJ XH40     XH31        Go read in 1 block forward
        7       MJ 0        XH17        Alarm return - no lead Sentinels
       10       TP CL35     A           Δ DATA ⟶A
       11       EJ TB2      XH27        Tape so labelled?
       12       TP CL21     TM2         No, prepare to read more.  Set scan
                                        index
       13       RJ XH40     XH31
       14       IJ TM2      XH31        No Sentinel seen
       15       TP CL35     A           Δ DATA Δ⟶A
       16       EJ TB2      XH27        Tape so labelled?
       17       MJ 0        [30000]     No, alarm. (initially XH20)
       20       TP LP117    PR3     }   Print:  DATA TAPE NOT MOUNTED
       21       RJ PR2      PR      }   ON SERVOS Δ
       22       TV XH50     XH1         Amend exit from main routine.(to XH41)
       23       RJ XH17     XH24        Disconnect this path
       24       SP TM       0           Tape #⟶A
       25       RJ DP13     DP          Convert and print it
       26       EF 0        TM1         Rewind tape
       27       RA XH2      CN50        Pick next one
       30       MJ 0        XH
       31       SP TM       17      }
       32       AT CL37     GT3     }   Read 1 block forward
       33       RJ GT2      GT      }
       34       TP CN61     A           Z-------Z to A
       35       RP 20002    XH40        If ZZ___Z seen, go to exit +1.
       36       EJ TB       XH37        If not, normal exit.
       37       RA XH40     CN4
                CA IA574

                IA IA574
XH      40       MJ 0       [30000]
        41       TP LP125    PR3         Error exit.
        42       RJ PR2      PR          Print:  CHANGE TAPE, HIT START.
        43       SP CL       0           Clear A
        44       MS 0        XH45        Stop
        45       ZJ ZR       YH          Hit Start to continue
        46       0  0        LD1
        47       0  0        XH20
        50       0  0        XH41
                 CA IA605
```

		IA	IA605		
CN	0	0	0	CN	
	1	0	0	66	T
	2	0	0	MR134	
	3	0	0	51	0
	4	0	0	01	Δ
	5	0	0	33	H
	6	0	0	50	N
	7	0	0	47	M
	10	0	20000	0	
	11	0	0	46	L
	12	0	0	54	R
	13	0	0	32	G
	14	0	0	34	I
	15	0	0	52	P
	16	0	0	26	C
	17	0	0	70	V
	20	0	0	30	E
	21	0	0	74	Z
	22	0	0	27	D
	23	0	0	25	B
	24	0	0	65	S
	25	0	0	73	Y
	26	0	0	31	F
	27	0	0	72	X
	30	0	0	24	A
	31	0	0	71	W
	32	0	0	44	J
	33	0	0	14	9
	34	0	0	67	U
	35	0	0	53	Q
	36	0	0	45	K
	37	0	0	03	0
		CA	IA645		
		IA	IA645		
CN	40	0	0	MR153	
	41	0	0	MR130	
	42	0	0	22	.
	43	0	0	MR110	
	44	0	0	76	=
	45	0	0	01	cr => Δ
	46	0	0	21	,
	47	0	1	1	
	50	0	1	0	
	51	0	0	01	tab => Δ
	52	0	0	04	1
	53	77	0	0	
	54	01	0	0	

```
 55      01 01010    10101
 56      0  0        15
 57      0  0        167
 60      0  0        13          8
 61      74 74747    47474       Z-----Z
 62      0  0        10          5
 63      01 34505    26766       Δ INPUT
 64      0  0        07          4
 65      34 24254    63065       IABLES
 66      0  0        11          6
 67      01 01013    05027       ΔΔΔEND
 70      0  0        06
 71      01 01662    45230         ΔΔTAPE
 72      0  0        12          7
 73      01 26333    02645       Δ CHECK
 74      0  0        05          2
 75      01 66245    23001       ΔTAPE Δ
 76      0  20150    150         Limit for index
 77      50 102      TB          GTH code for read 1 blk. forward(#2)
100      02 00200    20000       Rewind Uniservo 2
101      0  0        TL1         Constant
         CA IA707
```

		IA IA707			
CL	0	0 0	0	Leader	
	1	0 0	77	Delete	
	2	0 0	47	↑ →	basic throw aways
	3	0 0	57	↓	
	4	0 0	02	Color	
	5	0 0	43	Stop	Flex
	6	0 0	46	'	
	7	0 0	42	.	
	10	0 0	04	△	Cut off's
	11	0 0	45	Cr	
	12	0 0	51	Tab	
	13	0 0	61	Backspace	
	14	0 0	01	△	
	15	0 0	21	'	
	16	0 0	22	.	XS3 codes.
	17	0 0	23	;	
	20	0 0	0	i	
	21	0 0	76	=	
	22	0 0	33	9	
	23	0 0	60	8	
	24	0 0	72	7	
	25	0 0	66	6	
	26	0 0	62	5	
	27	0 0	64	4	Flex-codes
	30	0 0	70	3	
	31	0 0	74	2	
	32	0 0	52	1	
	33	0 0	37	0	
	34	PR 0	CL33	Dummy print	
	35	01 27246	62401	△ DATA △	
	36	02 00200	0	General rewind code	
	37	50 00100	TB	General read code	
		CA IA747			
		IA IA747			
LP	0	45 47140	62220	Cr ↑ I N D E	
	1	27 04140	61603	X △ I N C O	
	2	07 15122	00520	M P R E H E	EP ①
	3	06 24142	31120	N S I B L E	
	4	0 LP	4		
	5	45 47060	30422	Cr ↑ N O △ D	
	6	30 01300	40130	A T A △ T A	EP ②
	7	15 20042	41520	P E △ S P E	
	10	16 14261	42022	C I F I E D	
	11	0 LP5	4		
	12	45 01052	01220	Cr T H E R E	
	13	26 03122	00434	F O R E △ U	
	14	06 30161	62015	N A C C E P	EP ③
	15	~~01 30231~~	~~12000~~	T A B L E -	
	16	0 LP12	4		
	17	45 47200	62204	Cr ↑ E N D △)	

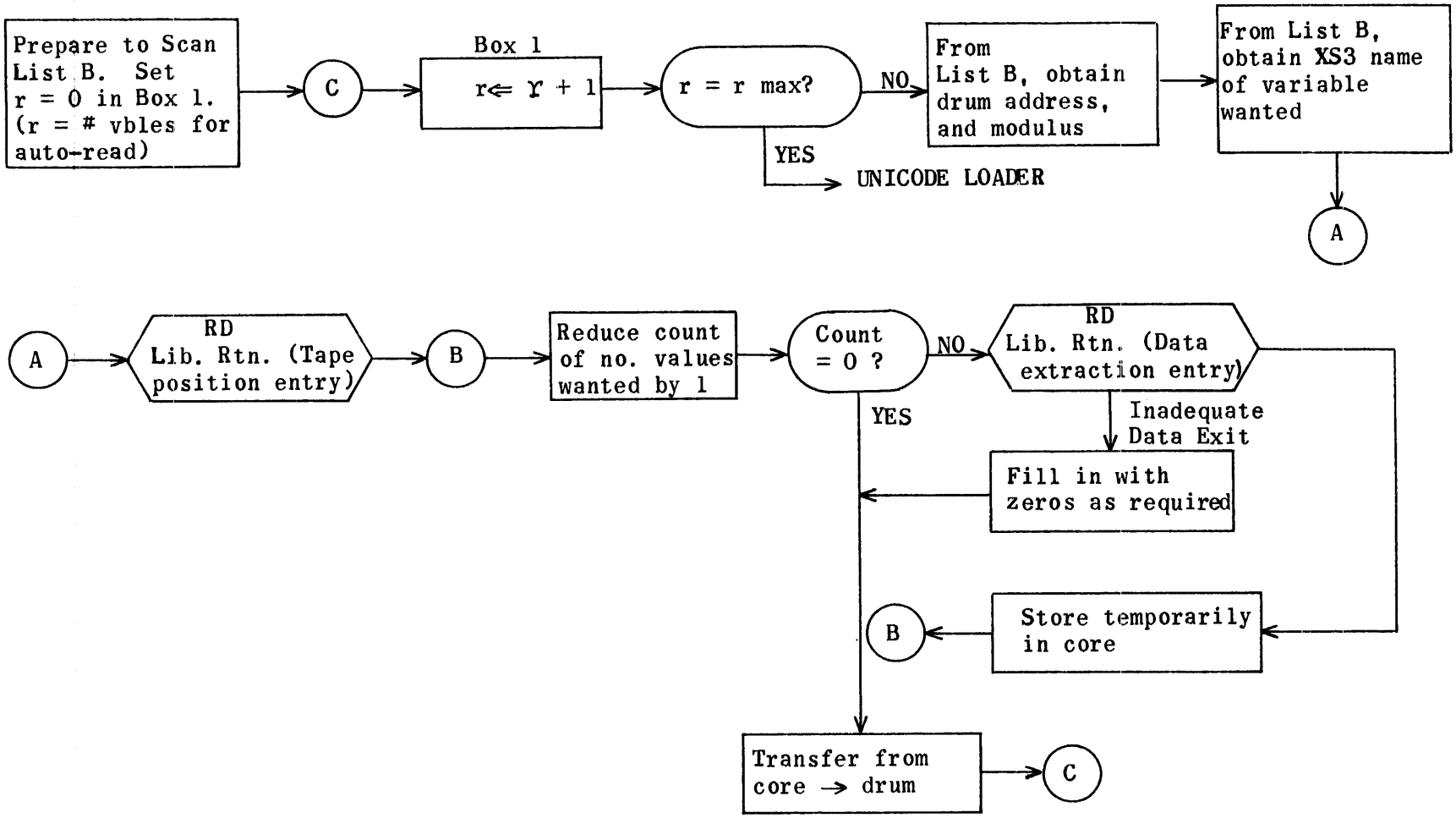
20	06	03010	43112	N O T △ W R	BM Special alarm
21	14	01012	00604	I T T E N △	
22	03	06040	13015	O N △ T A P	
23	20	45450	00000	E Cr Cr	
24	0	LP17	5		
25	04	04040	40514	△ △ △ △ H I	
26	01	04240	13012	T △ S T A R	
27	01	04010	30401	T △ T O △ T	
30	12	25043	01330	R Y △ A G A	
31	14	06454	50000	I N Cr Cr ——	
32	0	LP25	5		
33	45	47140	62220	Cr ↑ I N D E	
34	27	04033	60404	X △ O K △ △	
35	01	30152	02404	T A P E S △	
36	11	14240	12022	L I S T E D	
37	04	30122	00457	△ A R E △ ↓	
	CA	IA1007			

```
                IA   IA1007
LP      40      0    LP33       5
        41      45   47223      00130     Cr ↑ D A T A
        42      04   14062      22027     △ I N D E X
        43      04   20121      20312     △ E R R O R      } Error print-out headings
        44      24   45454      50000     S Cr Cr Cr - -
        45      13   12033      41504     G R O U P △
        46      0    LP41       5
        47      0    LP45       1
        50      14   11112      01330     I L L E G A
        51      11   04013      01520     L △ T A P E
        52      04   06034      54500     △ N O Cr Cr -      (1)
        53      0    LP50       3
        54      22   34151      11416     D U P L I C
        55      30   01200      40130     A T E △ T A        (2)
        56      15   20040      60345     P E △ N O Cr
        57      45   0          0         Cr
        60      0    LP54       4
        61      16   05201      63604     C H E C K △
        62      14   06160      31212     I N C O R R        (3)
        63      20   16014      54500     E C T Cr Cr -
        64      0    LP61       3
        65      31   03122      20401     W O R D △ T
        66      03   03041      10306     O O △ L O N        (4)
        67      13   45450      0         Cr Cr Cr -
        70      0    LP65       3
        71      14   11112      01330     I L L E G A
        72      11   04221      41314     L △ D I G I
        73      01   45450      0         T Cr Cr
        74      0    LP71       3
        75      03   17201      22611     O V E R F L
        76      03   31454      50000     O W Cr Cr -
        77      0    LP75       2
                CA   IA1047
```

```
                IA   IA1047
LP      100     45   47260     31111      Cr ↑ F O L L
        101     03   31140     61304      O W I N G △
        102     17   30121     43023      V A R I A B
        103     11   20240     40603      L E S △ N O
        104     01   04140     61611      T △ I N C L      } Box 2
        105     34   22202     20414      U D E D △ I      } errors
        106     06   04140     62220      N △ I N D E
        107     27   45450     0          X Cr Cr
        110     0    LP100     10
        111     45   47223     00130      Cr ↑ D A T A
        112     04   01301     52004      △ T A P E △
        113     06   03010     40703      N O T △ M O
        114     34   06012     02204      U N T E D △
        115     03   06042     42012      O N △ S E R
        116     17   03240     40457      V O S △ △ ↓
        117     0    LP111     6
        120     45   45471     60530      Cr Cr ↑ C H A
        121     06   13200     40130      N G E △ T A
        122     15   20040     40405      P E △ △ △ H
        123     14   01042     40130      I T △ S T A
        124     12   01454     50000      R T Cr Cr
        125     0    LP120     5
        126     45   47073     01605      Cr ↑ M A C H
        127     14   06200     42012      I N E △ E R
        130     12   03124     54500      R O R Cr Cr -
        131     0    LP126     3
                CA   IA1101

                IA   IA1101
ZR      0       EF   0         ZR2        Rewind tape # 1
        1       MS   0         DA         Back to basic loader
        2       02   00200     10000
                CA   IA1104
```

Section 2 of Initialization



Regional Definitions for Section 2 of Initialization.

```
RE  ID3460      Loading address
RE  DD1750      (46)  ┐
RE  IN2016      (12)  │
RE  DR2030      (67)  │
RE  BM2117      (30)  │   Operating addresses of
RE  ST2147      (15)  │   program
RE  PS2164      (65)  │   (total length = 614₈
RE  SC2251      (10)  │    words)
RE  MF2261      (7)   │
RE  TB2270      (12)  │
RE  EP2302      (17)  │
RE  GG2321      (170) │
RE  CF2511      (53)  ┘

RE  BF1         Buffer
RE  GT210       Tape Handler during Object Program
RE  FX1000      Fixed I/O locations

RE  TN660       (1)   ┐
RE  XX661       (5)   │   Temporaries in Termination
RE  CC666       (27)  ┘   Buffer

RE  IL2571      2500₁₀ words of intermediate storage
RE  LB7475      List B

RE  PR77250     Flex print routine
RE  LD1500      Operating address of Object Program
                Loader
```

Automatic Data Read-in— Section 2 of Initialization

```
                IA ID
DD      0       TP LB          DD44          Set up List B index
        1       TU DD35        DD5    }
        2       TU DD36        DD13   }      Initialize reading of List B
        3       IJ DD44        DD5           Count down on List index
        4       MJ 0           LD1           All through - Exit - BACK TO LOADER
        5       TP [30000]     Q             1st of line pair (mod, da) --> Q
        6       TV Q           DD31          Set drum address
        7       QT DD37        DD45          Extract modulus
       10       AT DD40        DD30            and form drum loading RP
       11       LQ DD45        25            Shift to "v" to form index
       12       TV DD35        DD21          Initialize
       13       TP [30000]     IN1           Name of variable wanted?
       14       RJ IN          IN2           Position tape
       15       MJ 0           DD13          EOD exit - should never come up
       16       IJ DD45        DD20          OK - no count down on quantity req'd
       17       MJ 0           DD30

       20       RJ IN          IN3           Obtain 1 word
       21       TP Q           [30000]       Store temporarily in core
       22       RA DD21        DD42
       23       MJ 0           DD16
       24       TV DD21        DD25          Here on inadequate data - fill
                                               with zero
       25       TP DD41        [30000]
       26       RA DD25        DD42
       27       IJ DD45        DD25
       30       [0  30000      30000]  }
       31       TP IL          [30000] }     OK - transfer to drum
       32       RA DD5         DD43
       33       RA DD13        DD43
       34       MJ 0           DD3           Back for more
       35       0  LB1         IL
       36       0  LB2         0
       37       0  07777       0
                CA ID40
```

```
                IA    ID40

DD      40      RP    30000     DD32
        41      0     0         0
        42      0     0         1
        43      0     2         0
        44      [0    30000     30000]      Erasable.  List B index
        45      [0    30000     30000]      Erasable.  Quantity index
                CA    ID46
```

The Read Permanent Library Subroutine is inserted from ID46 through ID350. Annotated coding for this subroutine can be found in Section II, 2, b, of this manual.

From ID351 on, the Excess-Three Decimal to Floating Point routine is inserted. This routine is flow charted and explained in Section III, 3, a, under Translation Subroutines.

Control Section for Object Program

During the execution of the Object Program the Control section is entered through F_2 as a result of an Interpret (IP) command. The IP command is used in the Object Program to provide the required information for suitable transfer of control from one segment to another. The form of the IP command is:

14 OFFTT XXXXX

Where FF is the number of the segment containing the IP command,

TT is the number of the segment to which control is to be transferred, and

XXXXX is the address in segment TT receiving control.

Although there is no actual segment numbered 0, an IP command with FF = 0 and TT = 1 is built by Initialization Generation to provide the starting point for Segment 1. Thus, when MS2 is set, which provides a computer stop at the end of a segment, a stop will also occur at the end of the imaginary Segment 0 and preceding the read-in of Segment 1. There is, of course, no Termination coding for the imaginary Segment 0.

When control is entered it performs the following tasks:

1) Reads in and executes Termination (if any) for Segment FF.
2) Moves Object Program tape to Segment TT.
3) Reads Segment TT and its Preface (if any) to H.S.S.
4) Executes Preface (if any) for Segment TT.
5) Transfers control into Segment TT at XXXXX given in IP command.

The Move Tape subroutine is dependent on the Segment Table, built by the Segmentation Phase, to determine the correct block count in moving the Object Program tape from Segment FF to Segment TT. The Segment Table is always 17_{10} words in length, as follows:

TBO	0 0 0	0 0 0	0 X X	X X X
1	B (0)	B(16)	B(32)	B(48)
2	B (1)	B(17)	B(33)	B(49)
3	B (2)	B(18)	B(34)	B(50)
4	B (3)	B(19)	B(35)	B(51)
5	B (4)	B(20)	B(36)	B(52)
6	B (5)	B(21)	B(37)	B(53)
7	B (6)	B(22)	B(38)	B(54)
10	B (7)	B(23)	B(39)	B(55)
11	B (8)	B(24)	B(40)	B(56)
12	B (9)	B(25)	B(41)	B(57)
13	B(10)	B(26)	B(42)	B(58)
14	B(11)	B(27)	B(43)	B(59)
15	B(12)	B(28)	B(44)	B(60)
16	B(13)	B(29)	B(45)	B(61)
17	B(14)	B(30)	B(46)	B(62)
20	B(15)	B(31)	B(47)	B(63)

XXXXX = address to which all segments of the problem are read from tape.

B(K) denotes the total number of blocks on the Object Program tape required by Segment K. This includes the Label block, the Segment, the Preface, and the Termination blocks.

B(0) = 0

B(K) = 0 if K> the total number of segments in the problem.

The following conditions are assumed for FF and TT

$$0 \leq FF \leq 63_{10}$$
$$1 \leq TT \leq 63_{10}$$
$$FF \neq TT$$

To move the tape from Segment FF to Segment TT, two cases must be considered.

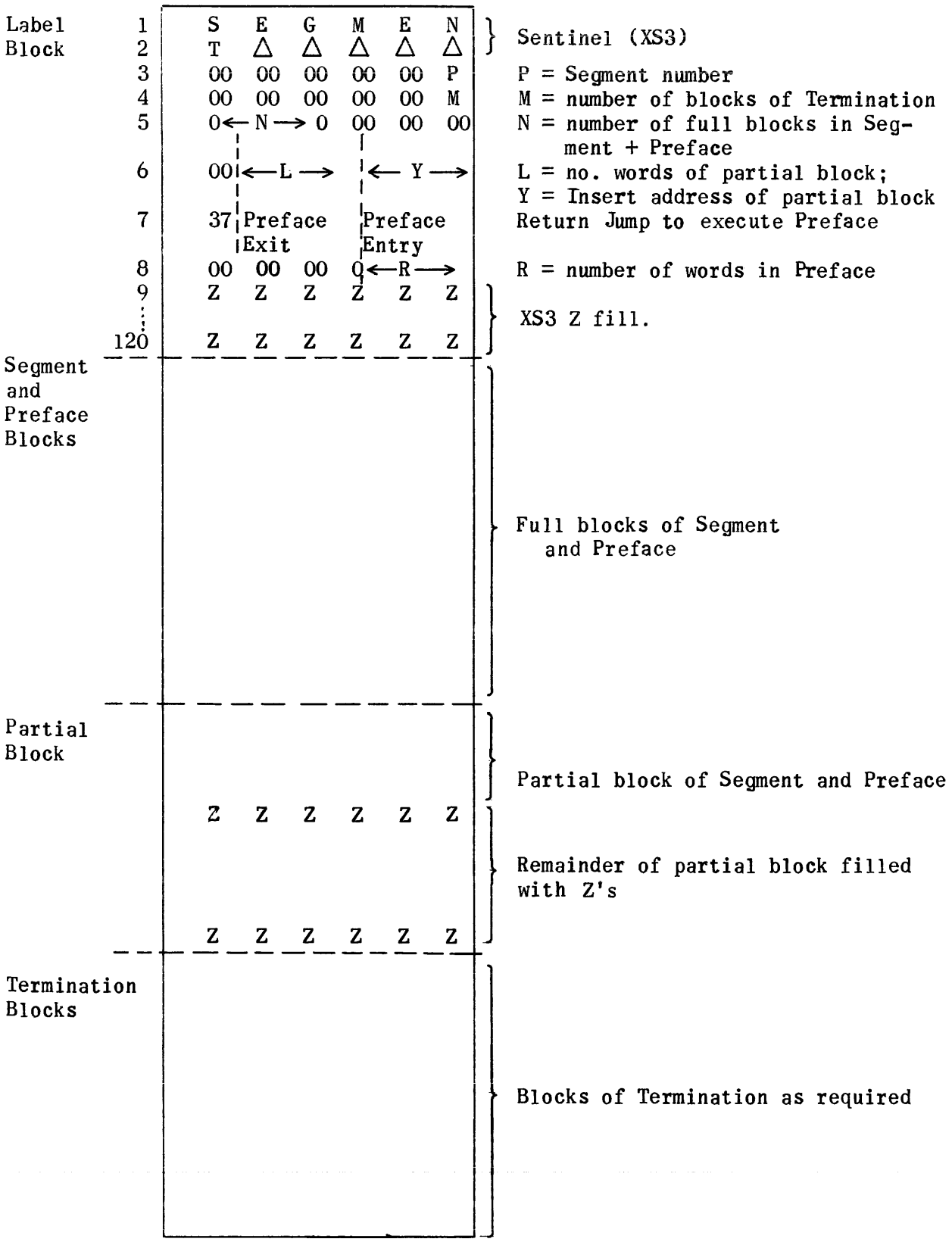
Case 1 : FF < TT
Case 2 : FF > TT

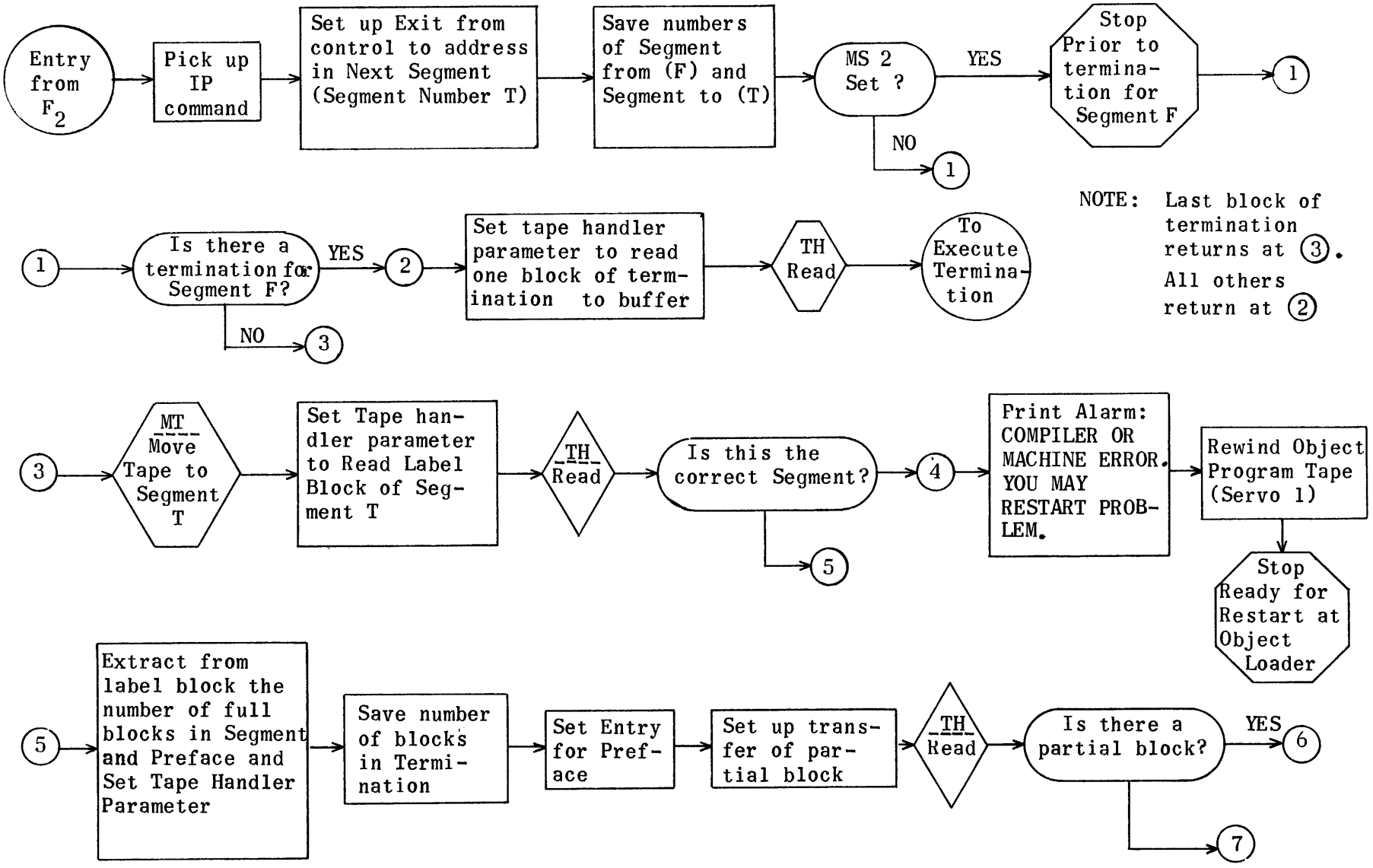
At the time the tape is to be moved from Segment FF to Segment TT, it is positioned exactly at the end of Segment FF. Hence the number of blocks the tape is to be moved to position it at the beginning of Segment TT is:

Case 1 : B(FF + 1) + B(FF + 2) + . . . + B(TT - 1)
Case 2 : B(TT) + B(TT + 1) + ... + B(FF)

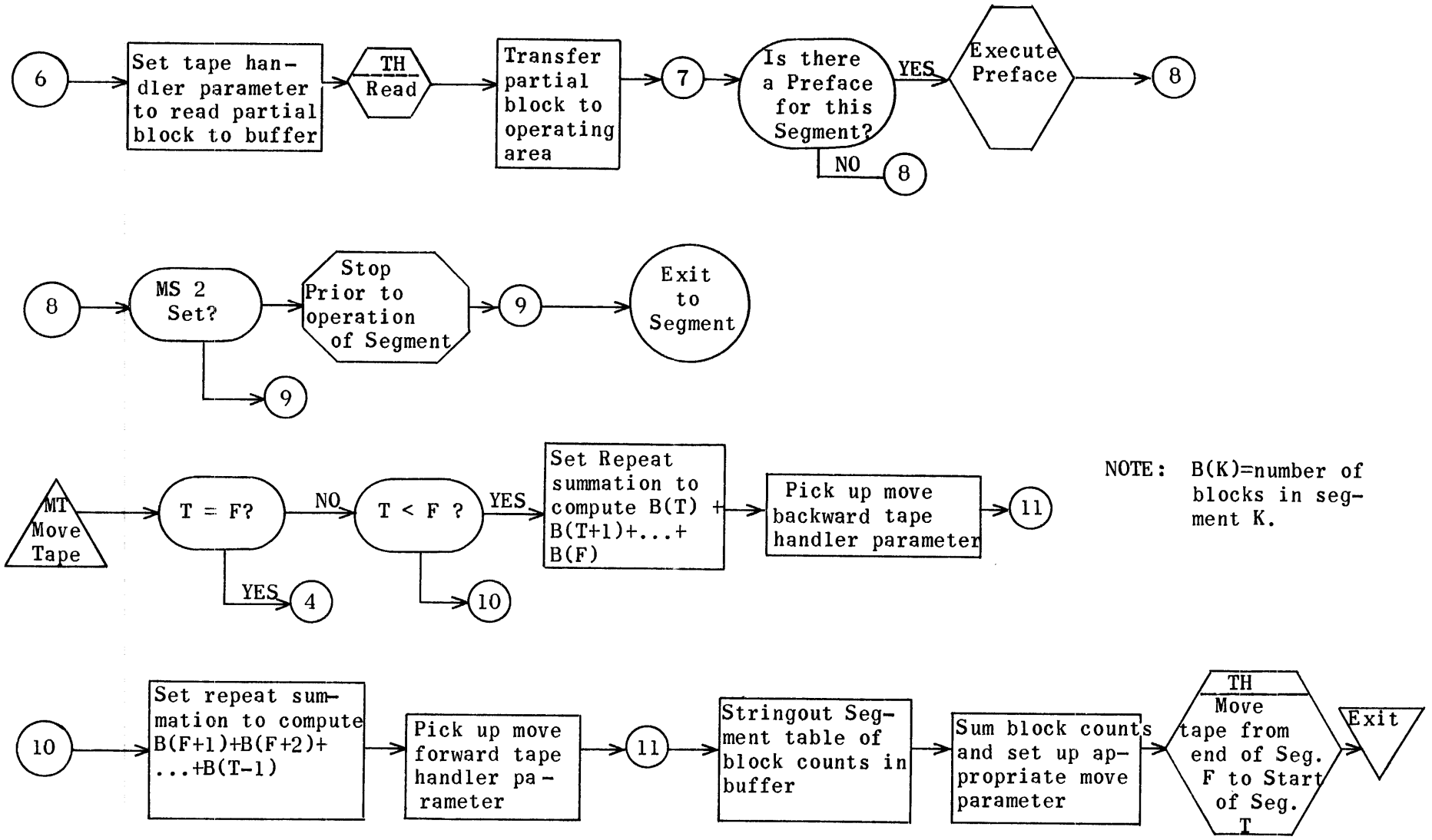
The tape is moved forward for Case 1, backward for Case 2.

Segment Layout on Object Program Tape





Control Section for Object Program



NOTE: B(K)=number of blocks in segment K.

Control Section for Object Program (Cont.)

Regions for UNICODE Control

RE	ON4274	Loading address during Initialization Generation
RE	CT5	Operating address during Object Program
RE	MT77	Move tape routine
RE	KK142	
RE	KT161	
RE	TB166	Segment table
RE	GT210	Tape handler
RE	BU610	Termination buffer
RE	DA77300	Object Program Loader
RE	PR77250	Flex print routine

		IA	ON		Segment from = F Segment to = T
		MJ	0	CT	F_2 : Jump to control
		0	30000	30000	
		0	30000	30000	
		0	30000	30000	
	CT0	TP	0	A	
	1	SS	KK0	17	Set up address of IP command
	2	TU	A	CT3	
	3	TP	30000	Q	IP command → Q
	4	TV	Q	CT52	Set up exit from Control to segment T
	5	QT	KK13	A	$F \cdot 2^{21} \rightarrow A$
	6	LT	17	KT1	F → KT1
	7	QT	KK14	A	$T \cdot 2^{15} \rightarrow A$
	10	LT	25	KT2	T → KT2
	11	MS	20000	CT12	Selective stop at end of segment
①	12	TP	KT0	A	Is there a Termination for segment F?
	13	ZJ	CT14	CT17	
②	14	TP	KK15	GT3	Yes, so read block of Termination to buffer and execute. Returns at CT14 or CT17
	15	RJ	GT2	GT0	
	16	MJ	0	BU0	
③	17	RJ	MT0	MT1	Move tape to segment T
	20	TP	KK15	GT3	Read label block of segment T
	21	RJ	GT2	GT0	
	22	TP	BU2	A	Is this segment T?
	23	EJ	KT2	CT25	
	24	MJ	0	CT53	No, so go to print alarm
⑤	25	TP	BU4	A	Extract information from label
	26	AT	KK3	GT3	Set up parameter to read full blocks of segment and Preface
	27	TV	TB0	GT3	
	30	TP	BU3	KT0	Set KT0 to number of blocks in Termination
	31	TP	BU6	CT50	Set entry for Preface
	32	TP	KK12	KT3	Set up partial block word count
	33	TU	BU5	KT3	
	34	TP	KK16	A	
	35	AT	KT3	CT44	Set up transfer of partial block
	36	TV	BU5	CT45	
	37	RJ	GT2	GT0	Read full blocks of segment and Preface
	40	TP	KT3	A	Is there a partial block?
	41	ZJ	CT42	CT46	
⑥	42	TP	KK15	GT3	Yes, so read it to buffer
	43	RJ	GT2	GT0	
	44	RP	30000	CT46	Transfer partial block to operating location
	45	TP	BU0	30000	

```
⑦   46   TP   KT0    A      }   Is there a Preface for segment T
    47   ZJ   CT50   CT51    }
    50   RJ   30000  30000      Execute Preface
⑧   51   MS   10000  CT52       Selective stop before operation of
                                segment
⑨   52   MJ   0      30000      Execute segment T
④   53   TP   CT60   PR3     }  Print alarm
    54   RJ   PR2    PR0     }
    55   EF   0      CT57       Rewind Object Program tape
                                (Uniservo 1)
    56   MS   0      DA0        Stop
    57   02   200    10000
    60   0    CT61   11         Parameter
    61   45   47160  30715      Cr ↑ C O M P
    62   14   11201  20403      I L E R △ 0
    63   12   04073  01605      R △ M A C H
    64   14   06200  42012      I N E △ E R
    65   12   03124  52503      R 0 R Cr Y 0
    66   34   04073  02504      U △ M A Y △
    67   12   20240  13012      R E S T A R
    70   01   04151  20323      T △ P R 0 B
    71   11   20074  55700      L E M Cr ↓

MT0  MJ   0      30000      Exit
 1   TP   KT2    A          Entry
 2   ST   KT1    A          T - F → A
 3   ZJ   MT4    CT53       If T = F, go to print alarm
 4   SJ   MT5    MT13       Is T > F?
 5   TN   A      A          No, so F - T → A
 6   SA   KK0    17         (F - T + 1) · 2^15 → A
 7   AT   KK4    MT35       Set up repeat summation on Segment
                            table
10   SP   KT2    17         T · 2^15 → A
11   TP   KK2    KT4        Pick up move back dummy
12   MJ   0      MT20
⑩   13   SS   KK0    17     T > F, so form (T - F - 1) · 2^15
                            in A
14   AT   KK4    MT35       Set up repeat summation
15   TP   KT1    A          F → A
16   SA   KK0    17         (F + 1) · 2^15 → A
17   TP   KK1    KT4        Pick up move forward dummy
⑪   20   AT   KK5    MT36   Set to pick up first term
21   RP   30020  MT23    }  Segment table → buffer
22   TP   TB1    BU100   }
23   TP   KK7    KT3        Set index
24   TP   KK10   MT31
25   RP   20020  MT27    }  Position columns
26   LQ   BU100  11      }
27   TP   KK6    Q       }
```

String out the block counts of the Seg-

```
 30      RP   30020     MT32 ]          Mask out columns          | ment Table
 31      QT   BU100     BU0                                       | to simpli-
 32      RA   MT31      KK11                                      | fy the
 33      IJ   KT3       MT25            4 columns strung out?     ] summation
 34      TP   KK12      A
 35      RP   20000     MT37 }          Add block counts to determine the
 36      SA   BU0       0    }          number of blocks to move tape
 37      LA   A         25
 40      AT   KT4       GT3  }          Add sum of blocks to parameter and
 41      RJ   GT2       GT0  }          move tape to segment T
 42      MJ   0         MT0             To exit.

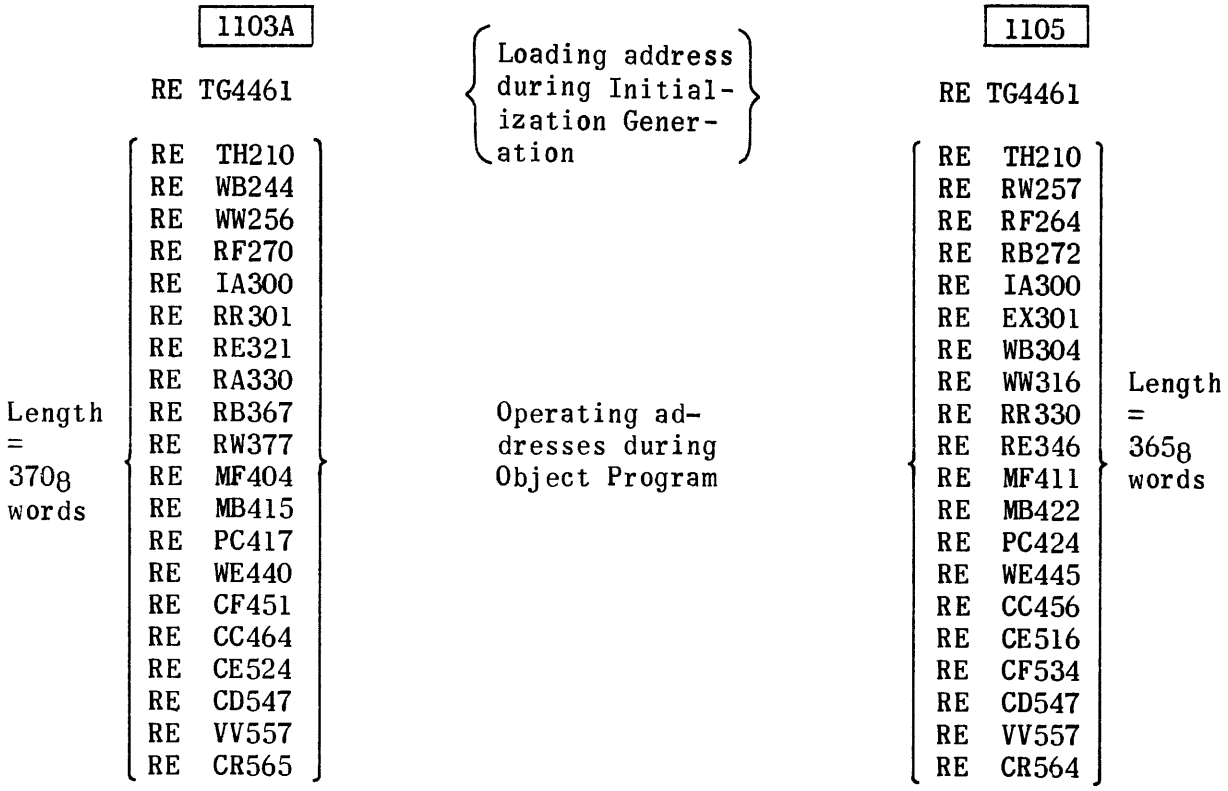
KK0      0   0         1
  1     30   1         0               Move forward dummy
  2     40   1         0               Move backward dummy
  3     50   1         30000           Read forward dummy
  4     RP   20000     MT37 }          Repeat summation dummies
  5     SA   BU0       0    }
  6      0   0         777             Segment table column mask
  7      0   0         3
 10     QT   BU100     BU0
 11      0   0         20
 12      0   0         0
 13      0   7700      0               Segment "from" mask
 14      0   77        0               Segment "to" mask
 15     50   101       BU0             Parameter to read one block to
                                          buffer
 16     RP   30000     CT46            Partial block repeat dummy.

KT0      0   0         0               Number of blocks of termination
                                          (= 0 for F = 0)
  1      0   0         0               F = segment number "from"
  2      0   0         0               T = segment number "to"
  3      0   0         0
  4      0   0         0
         CA   ON165
```

Object Program Tape Handlers

Since the 1103A and 1105 Tape Handlers which are put on the Object Program Tape by Initialization Generation are the same as those used in the Translation Phase, only their regional assignments are shown here. Flow charting, coding, and an explanation of them may be found in Section III, 3, a— Translation Subroutines.

Object Program Tape Handler Regions



VI. PROCESSING PHASE

VI PROCESSING PHASE

The Processor uses as input the Op File III for each segment together with the library and generated subroutines with their preludes. From this input the Processor assembles the required subroutines for each segment. As each subroutine is processed, the relatively coded addresses are changed to the proper machine coded operating addresses. Cross reference call words are replaced by the necessary machine coding to accomplish the cross reference, depending on whether the reference is "within a segment" or "from one segment to another". When all the routines for one segment have been processed, the segment together with its Preface and Termination is transferred to Uniservo tape. This tape, containing all the segments in sequence, is the Object Program tape. A more explicit description of the methods used in modifying the relative coding follows.

In the initial stage of the Processor the Op File III for the segment to be processed is read from tape into High Speed Storage. When this transfer has been completed, the first subroutine is read from the Generated Routines Tape into the Tape Image in High Speed Storage. At this point the tape handling is temporarily suspended and the actual processing begun. The call word for the subroutine is checked against those listed in Op File III to determine if the subroutine is referenced in this particular segment. The word following the call word is then checked to see if it has a flag indicating a cross reference to another segment. If the call word is listed in the Op File III and is not flagged, the subroutine will be processed at this time. If the subroutine is not to be processed at this time, the next subroutine will be read into the Tape Image and the foregoing procedure repeated. When all the generated routines in the segment have been processed, the Fixed Library

and Standard Library routines are processed in like manner.

The first line to be processed in all cases is the entrance line of the subroutine. Following the modification of this line, each line subject to address modification is processed in order, beginning with the line indicated by the line count of the Tape Image. Each relative address is processed depending on the nature of the coding, to obtain the proper machine coded address.

All addresses within the range 01000 through 07777 are modified as addresses coded relative to 01000; hence, the corresponding absolute address is obtained by subtracting 01000 from the relative address and adding the High Speed Storage operating address for the subroutine in which the address appears. The High Speed Storage operating address for the routine is obtained from the word following the call word for the routine in Op File III for the segment. All other addresses to be modified are in the form of call words (see call word section).

Call words of the form 10xxx, 20xxx, 60xxx, and 70xxx are unique only within the routine in which they appear. The absolute addresses corresponding to such call words are obtained by adding the last three digits of the call word to the initial High Speed Storage operating address of the constant or temporary region associated with the call word. These initial addresses are calculated from information in the Prelude of the routine and provided as inputs to the Address Modification Subroutine.

Call words of the form 61xxx, 63xxx, and 76xxx are modified to obtain the corresponding absolute address, by adding the last two digits of the call word to the initial High Speed Storage operating address of the Pseudo Operation Input Region. The initial address for the Pseudo Operation Input

Region is that of the thirteenth word of the Termination Buffer, and is stored as a constant in this phase.

Absolute addresses corresponding to call words of the form 62xxx and 75xxx are obtained by adding the last two digits of the call word to the initial High Speed Storage operating address of the Function Input Region. The initial address of this Function Input Region is that of the first word of the Termination Buffer and is also stored as a constant in this phase.

Call words of the form 64xxx, 65xxx, or 66xxx are modified to obtain the corresponding absolute address, by adding the last three digits of the call word to the initial High Speed Storage operating address for the non-subscripted variables of the Object Program. This initial non-subscripted variable address is obtained from fixed location 00007.

Similarly, call words of the form 67xxx are modified to obtain the corresponding absolute address by adding the last three digits of the call word to the initial High Speed Storage operating address of the Constant Pool for the Object Program. This initial Constant Pool address is obtained from fixed location 00010.

Call words of the form 71xxx are used to reference absolute addresses in the range 01000 to 01777 and are modified to obtain the absolute address by subtracting 70000 from the call word.

Those call words which reference another routine are of the form 22xxx, 23xxx, 24xxx, 25xxx, 26xxx, 27xxx, 4xxxx, 5xxxx and those which reference a subscripted variable data array are of the form 77xxx. All such call words are considered to be cross-references of the routine, if they appear as addresses to be modified, and must be in Op File III for the segment. If they are not, ALARM 11. COMPILATION INCONSISTENCY (etc.), is typed on the

Flexowriter. With one exception, instructions containing call words of this type are modified by replacing the call word by the High Speed Storage running address of the referenced subroutine or data array. This running address is obtained from the word following the call word in Op File III. The one exception in which this method of modifying a cross reference does not apply is that in which the cross reference is to another segment. Due to restrictions imposed in this system of coding, a reference to another segment occurs only as a one way unconditional jump and is modified by replacing the entire line of coding by an interpret instruction designed to furnish the Control Section with the information necessary to accomplish the desired cross references. This interpret instruction is obtained from the word following the call word in Op File III. It contains the segment number from which the jump is made, the segment number to which the jump is made, and the High Speed Storage running address in the latter segment. When a reference is made to a line of another subroutine other than the entrance line, the line to be modified contains the call word of the referenced subroutine.

When a reference is made to a line in another subroutine other than the first line, the instruction in which the reference is made contains the call word of the referenced routine. This instruction is followed by a special line of coding of the form 10-xxxxx-xxxxx, called a "ten" line. This "ten" line contains the number of the referenced line relative to the first line of the referenced routine. This number will be in the same portion of the "ten" line, i.e., "u" or "v" address, as the call word in the referencing instruction. In processing a reference of this type, the call word is modified as previously mentioned, to obtain in the referencing instruction, the High Speed operating address of the first line of the referenced routine. After both

addresses of this instruction have been modified, the contents of the "ten" line, less the op. code, are added to the instruction to change the High Speed Storage address(es) from that of the first line of the referenced routine to that of the referenced line within the routine.

As the lines of a routine are modified, they are accumulated in the Tape Image and transferred in groups to locations in the Segment Image on drum, corresponding to their High Speed Storage locations during the running of the segment in the Object Program. When all the lines subject to address modification in the routine, i.e., instructions and relative constants, have been processed, the fixed (unmodifiable) constants for the routine are transferred to consecutive locations in the Segment Image, following the last modified line of the routine. Words of zeros, equal in number to the temporary storage locations required by the routine, follow these constants in the Segment Image.

Each generated subroutine and library routine required for the particular segment is processed in this manner. When all the required routines for a segment have been assembled and processed, the entire Segment Image load, including the proper Preface, Termination, and segment label block, is transferred to the output tape to form a segment of the final running program. The Generated Routines Tape is then rewound and the UNICODE System Tape and Standard Library Tapes are moved back to the beginning of the Fixed Library and Standard Library, respectively. The processing of the next segment is then begun.

Each succeeding segment is processed in exactly the same way until all the segments have been processed and written on the output tape. This tape, containing all the segments of the final running program, is then the Object

Program Tape.

In addition, during the execution of this phase, the Sentence Number List is built and stored on drum for use by the Program Listing Phase. (See Program Listing for format of this list.)

PROCESSOR SETUP BLOCK

Regional Assignments

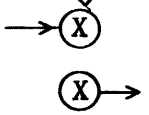
```
    RE   TH21          Tape Handler
    RE   UP421         Uniprint Routine
    RE   CK653         Processor
    RE   PS7230        Processor Setup Block
```

Processor Setup Routine

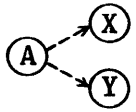
```
    IA   PS
 0  TP   15      6     Modified Dimension List length to fixed
                       location 00006.
 1  TP   PS26    TH3   Parameter to Tape Handler
 2  RJ   TH2     TH    Read Processor from Unicode System Tape
                       to core.
 3  TP   5       Q     Library indicators --> Q.
 4  QJ   PS5     PS5   Ignore Fixed Library indicator.
 5  QJ   PS6     PS10  Is Standard Library required?
 6  TP   PS27    TH3   Yes; parameter to Tape Handler.
 7  RJ   TH2     TH    Move Library Tape backward one block.
10  TP   PS13    UP3   Parameter to Uniprint routine
11  RJ   UP2     UP    Type:  PASS IV.  PROCESSING AND ADDRESS
                       MODIFICATION.
12  MJ   0       CK1   Jump to Processor.
13  00   PS14    12    Parameter for typeout.
14  01   01010   10101 Δ Δ Δ Δ Δ Δ
15  52   24656   50134 P A S S Δ I
16  70   22010   10101 V . Δ Δ Δ Δ
17  01   52545   12630 Δ P R O C E
20  65   65345   03201 S S I N G Δ
21  24   50270   12427 A N D Δ A D
22  27   54306   56501 D R E S S Δ
23  47   51273   43134 M O D I F I
24  26   24663   45150 C A T I O N
25  22   77777   77777 . 77 77 77 77 77
26  50   00601   CK    Parameter to read forward 6 blocks from
                       Uniservo 1
27  40   00102   0     Parameter to move backward 1 block on
                       Uniservo 2
    CA   PS30
```

⟹ Beginning of subroutine; where XX is regional (RECO) label for routine

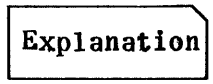
⟹ Exit from subroutine



⟹ Connectors; where X is connector number

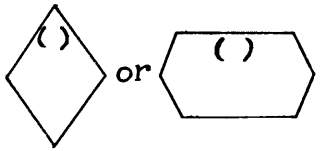


⟹ Switch; where "A" is symbol

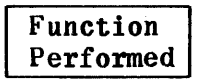


⟹ Explanatory note; no action implied.

⟹ Return jump reference (subroutine); where parenthesis enclose the connector number to which the reference is made.



⟹ Reference to general subroutine which is not part of this phase; where parenthesis enclose regional (RECO) label for routine

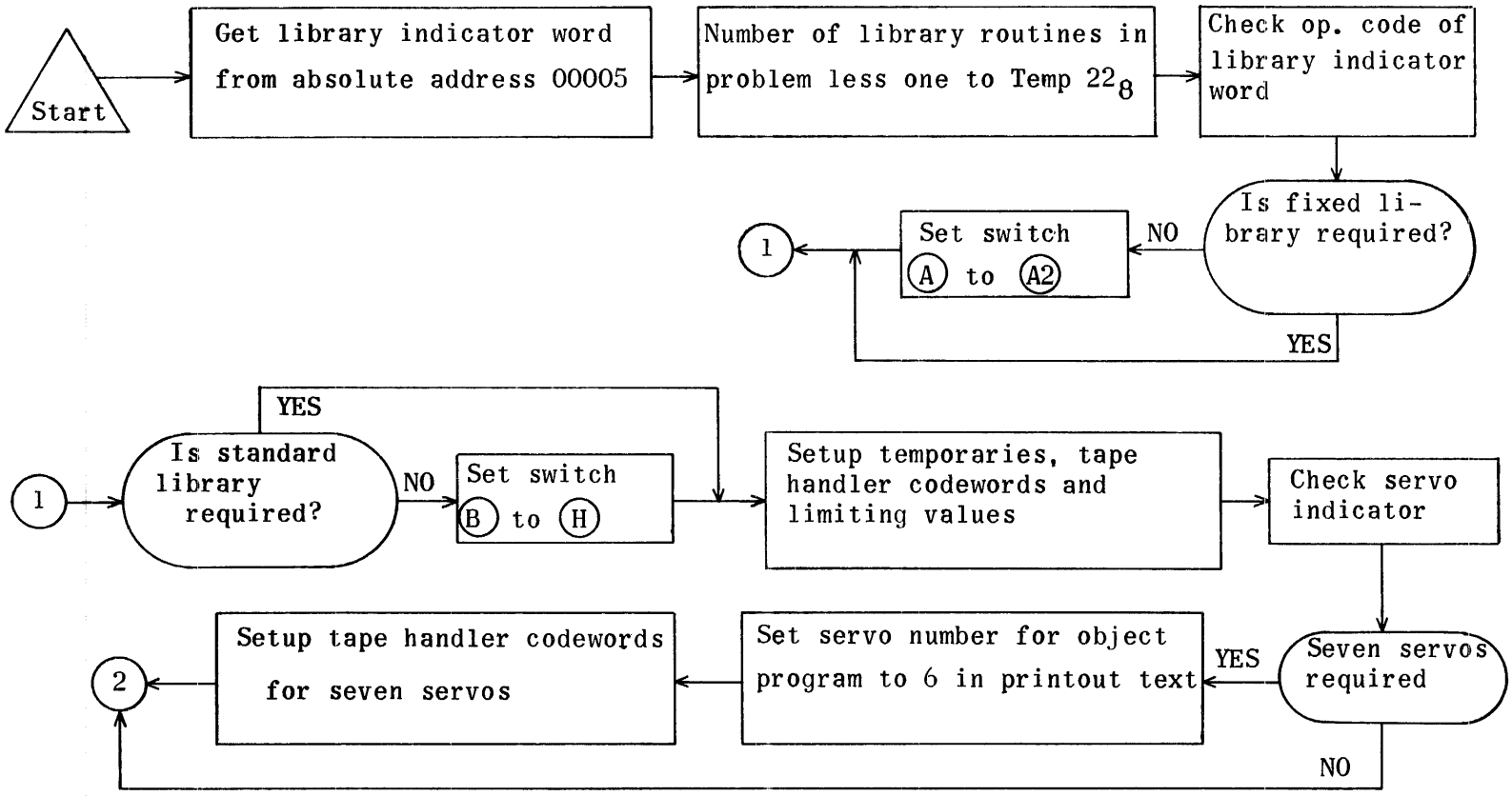


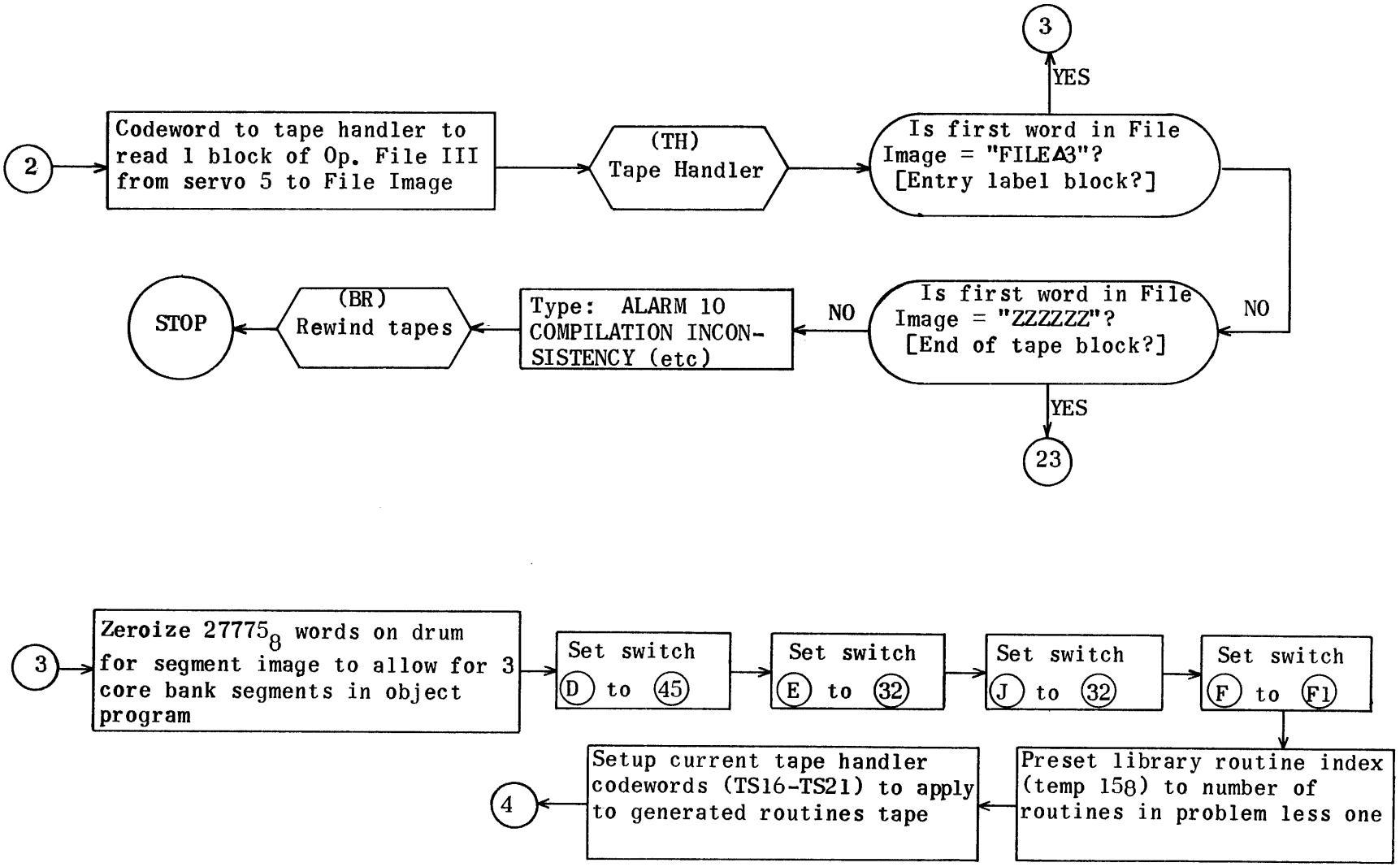
⟹ Operation Box

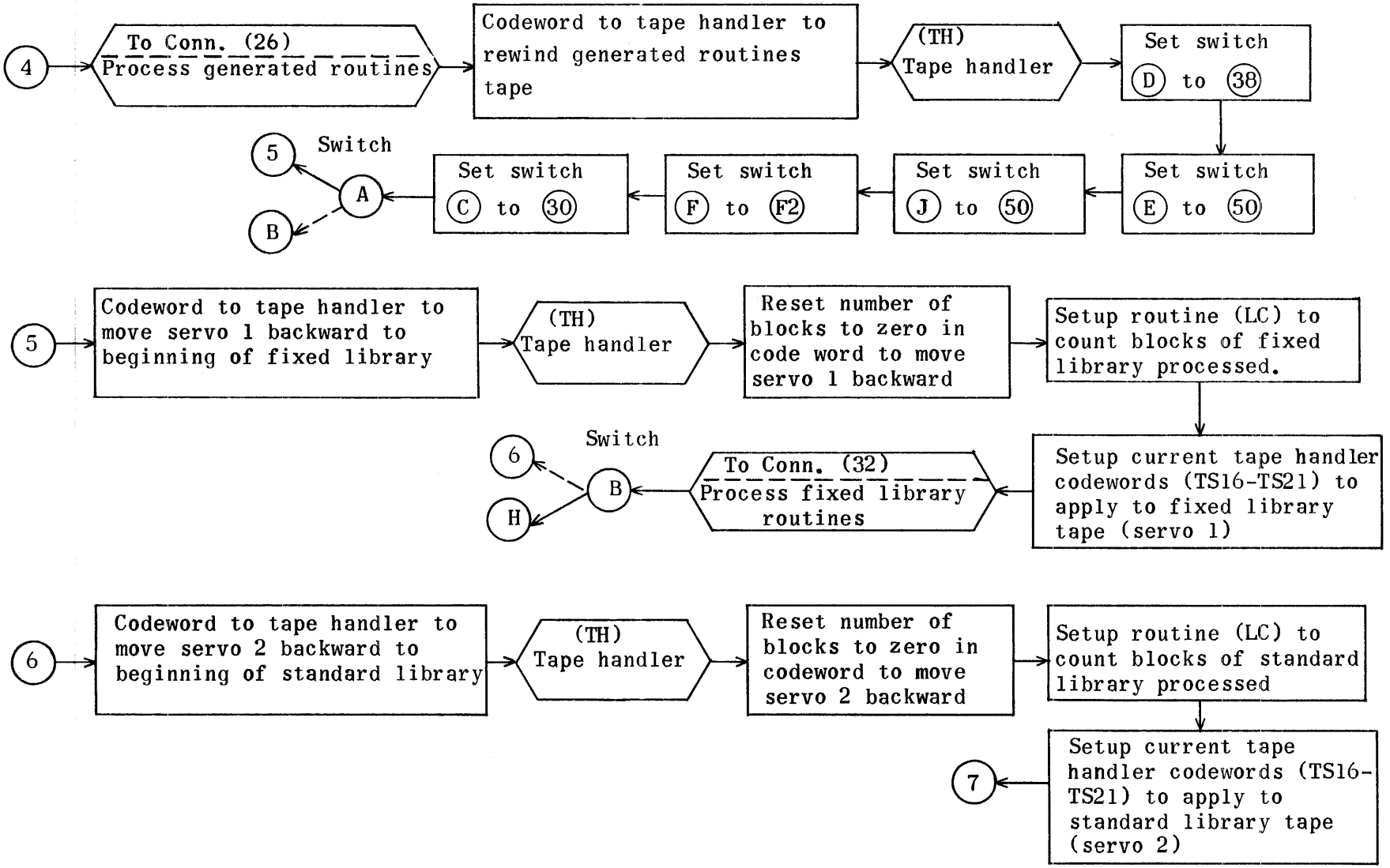
⟹ Decision Box

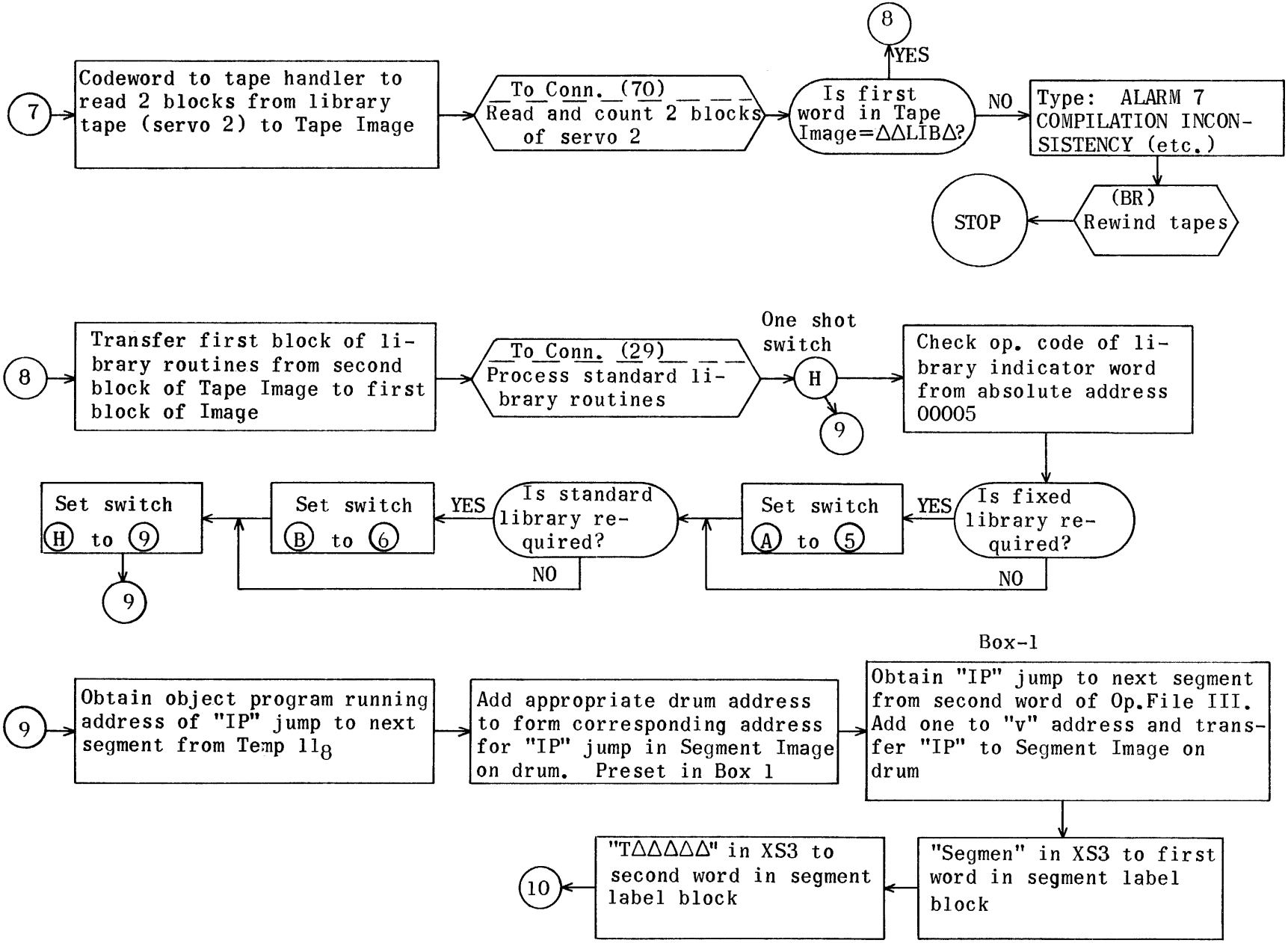
Key to Processor Flow Charts

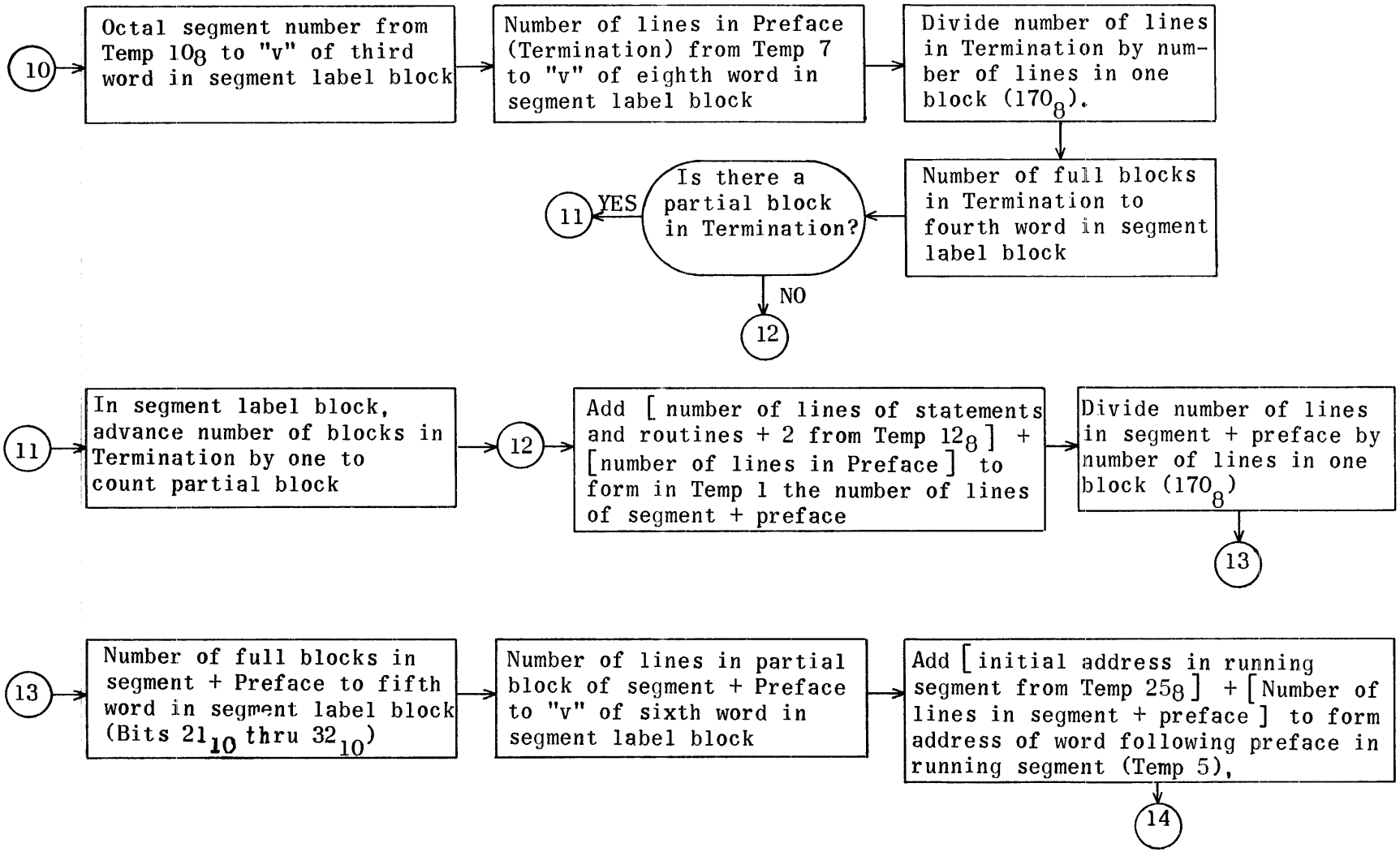
Processor Flow Chart

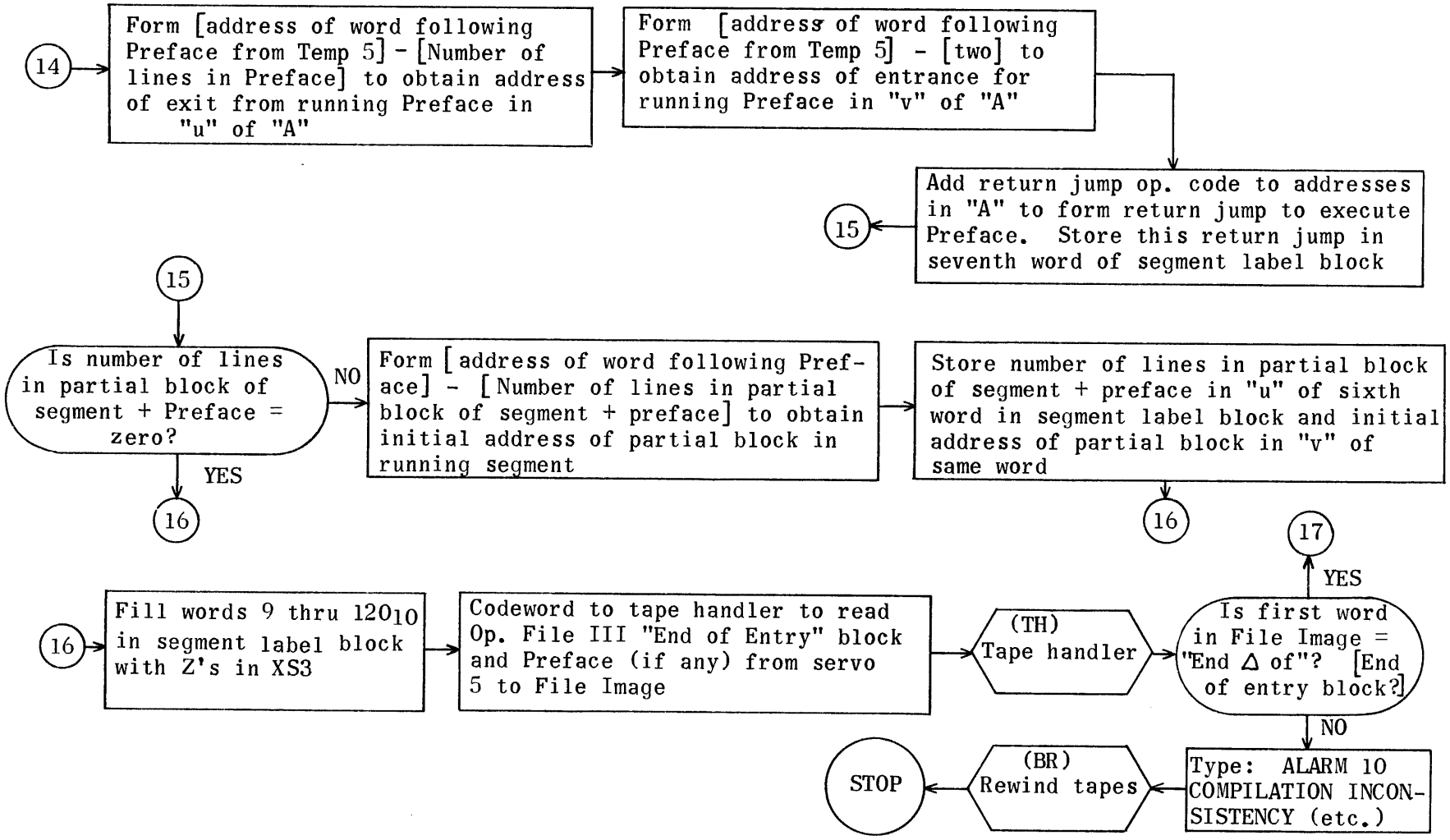


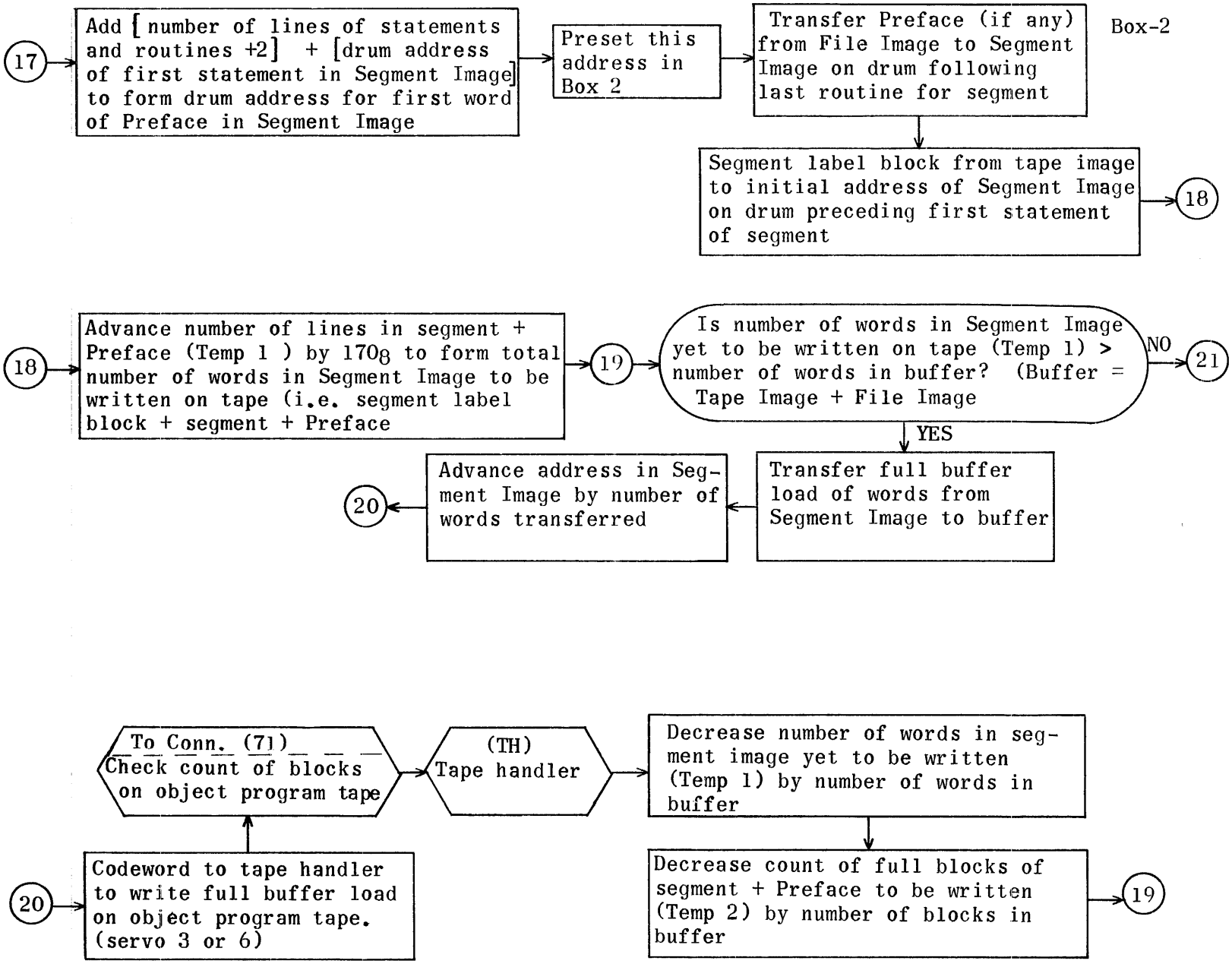

3
YES
2
Codeword to tape handler to read 1 block of Op. File III from servo 5 to File Image
(TH) Tape Handler
Is first word in File Image = "FILE△3"? [Entry label block?]
NO
Is first word in File Image = "ZZZZZZ"? [End of tape block?]
NO
Type: ALARM 10 COMPILATION INCONSISTENCY (etc)
(BR) Rewind tapes
STOP
YES
23
3
Zeroize 27775$_8$ words on drum for segment image to allow for 3 core bank segments in object program
Set switch (D) to (45)
Set switch (E) to (32)
Set switch (J) to (32)
Set switch (F) to (F1)
Preset library routine index (temp 158) to number of routines in problem less one
Setup current tape handler codewords (TS16-TS21) to apply to generated routines tape
4

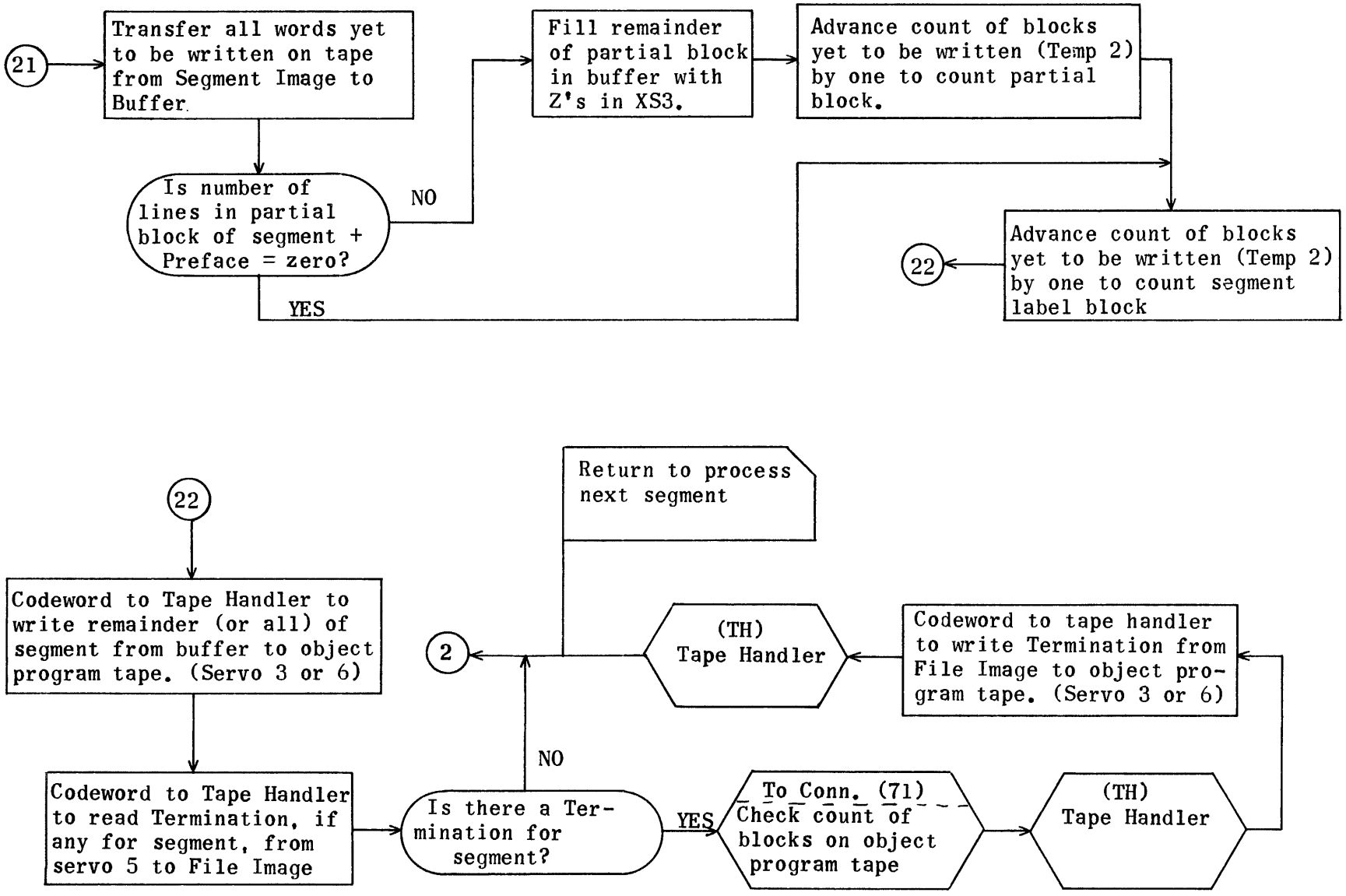

4
To Conn. (26)
Process generated routines
Codeword to tape handler to rewind generated routines tape
(TH)
Tape handler
Set switch
D to 38
Set switch
E to 50
Set switch
J to 50
Set switch
F to F2
Set switch
C to 30
5
Switch
A
B
5
Codeword to tape handler to move servo 1 backward to beginning of fixed library
(TH)
Tape handler
Reset number of blocks to zero in code word to move servo 1 backward
Setup routine (LC) to count blocks of fixed library processed.
Setup current tape handler codewords (TS16-TS21) to apply to fixed library tape (servo 1)
6
Switch
B
H
To Conn. (32)
Process fixed library routines
6
Codeword to tape handler to move servo 2 backward to beginning of standard library
(TH)
Tape handler
Reset number of blocks to zero in codeword to move servo 2 backward
Setup routine (LC) to count blocks of standard library processed
Setup current tape handler codewords (TS16-TS21) to apply to standard library tape (servo 2)
7

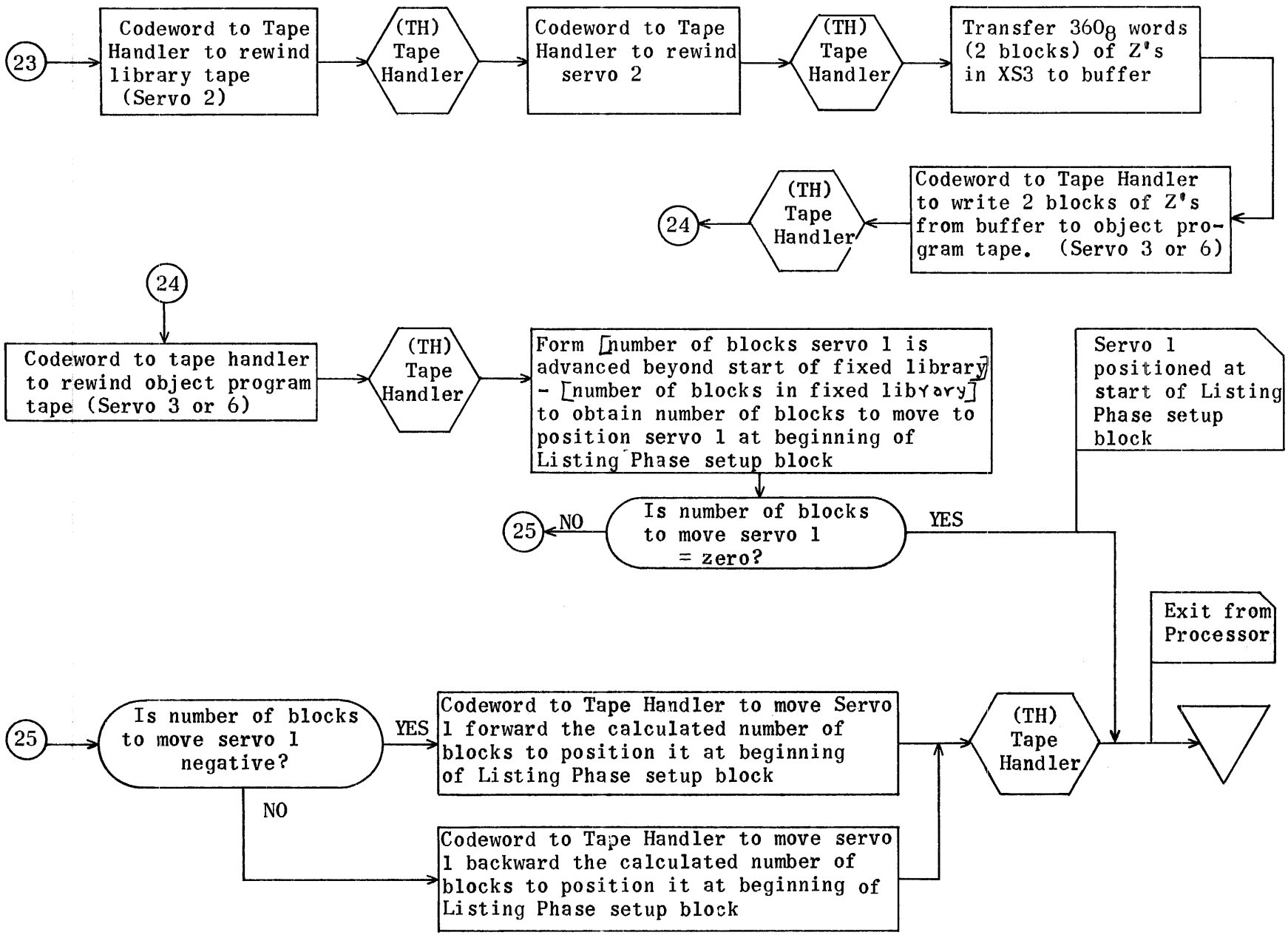

7
Codeword to tape handler to read 2 blocks from library tape (servo 2) to Tape Image
To Conn. (70)
Read and count 2 blocks of servo 2
Is first word in Tape Image=ΔΔLIBΔ?
8
YES
NO
Type: ALARM 7 COMPILATION INCONSISTENCY (etc.)
(BR)
Rewind tapes
STOP
8
Transfer first block of library routines from second block of Tape Image to first block of Image
To Conn. (29)
Process standard library routines
One shot switch
H
9
Check op. code of library indicator word from absolute address 00005
Is fixed library required?
YES
NO
Set switch A to 5
Is standard library required?
YES
NO
Set switch B to 6
Set switch H to 9
9
Box-1
9
Obtain object program running address of "IP" jump to next segment from Temp 11_8
Add appropriate drum address to form corresponding address for "IP" jump in Segment Image on drum. Preset in Box 1
Obtain "IP" jump to next segment from second word of Op.File III. Add one to "v" address and transfer "IP" to Segment Image on drum
"Segmen" in XS3 to first word in segment label block
"TΔΔΔΔΔ" in XS3 to second word in segment label block
10

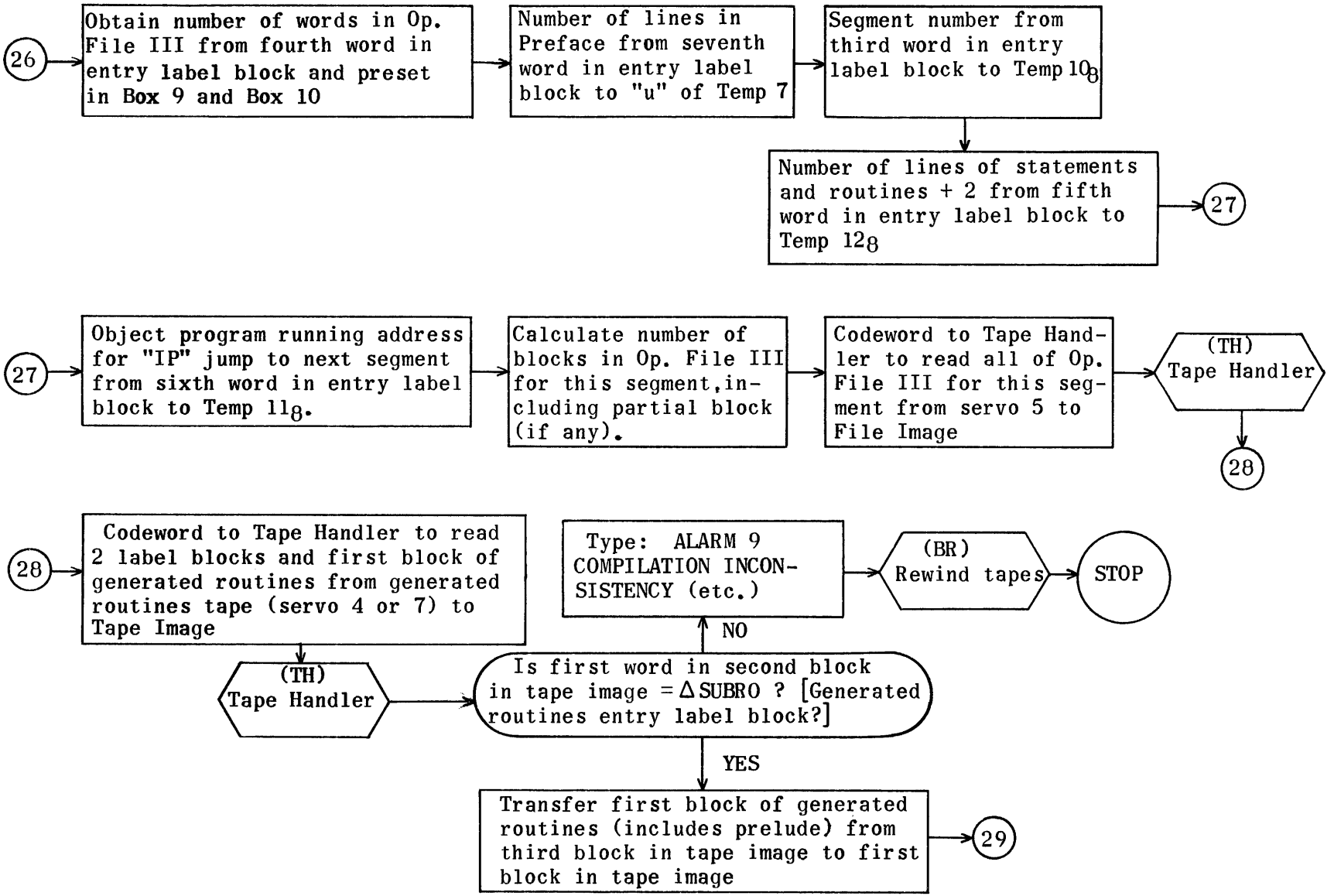

10
Octal segment number from Temp 10_8 to "v" of third word in segment label block
Number of lines in Preface (Termination) from Temp 7 to "v" of eighth word in segment label block
Divide number of lines in Termination by number of lines in one block (170_8).
Number of full blocks in Termination to fourth word in segment label block
Is there a partial block in Termination?
YES
11
NO
12
11
In segment label block, advance number of blocks in Termination by one to count partial block
12
Add [number of lines of statements and routines + 2 from Temp 12_8] + [number of lines in Preface] to form in Temp 1 the number of lines of segment + preface
Divide number of lines in segment + preface by number of lines in one block (170_8)
13
13
Number of full blocks in segment + Preface to fifth word in segment label block (Bits 21_{10} thru 32_{10})
Number of lines in partial block of segment + Preface to "v" of sixth word in segment label block
Add [initial address in running segment from Temp 25_8] + [Number of lines in segment + preface] to form address of word following preface in running segment (Temp 5),
14

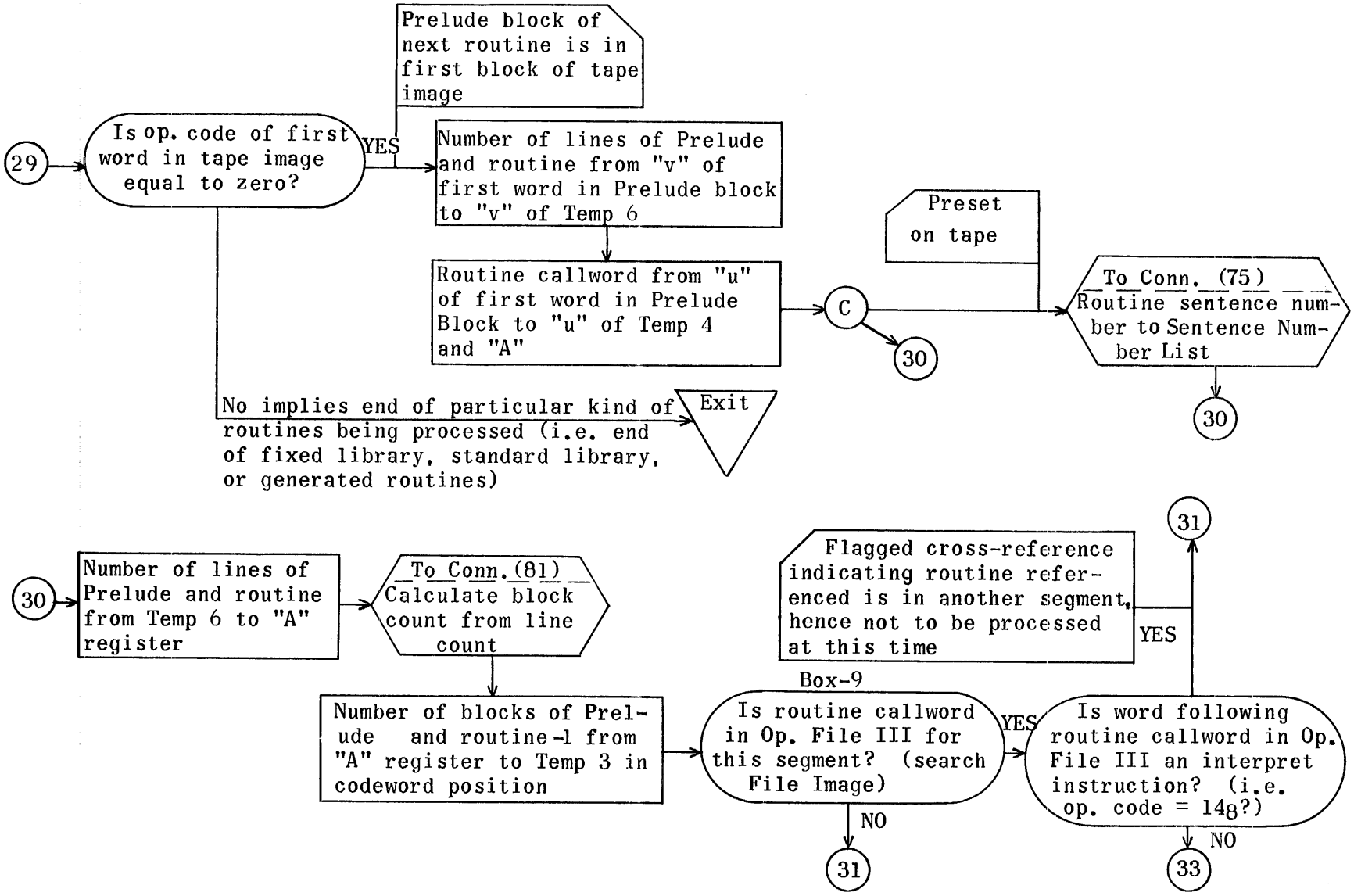

14
Form [address of word following Preface from Temp 5] - [Number of lines in Preface] to obtain address of exit from running Preface in "u" of "A"
Form [address of word following Preface from Temp 5] - [two] to obtain address of entrance for running Preface in "v" of "A"
15
Add return jump op. code to addresses in "A" to form return jump to execute Preface. Store this return jump in seventh word of segment label block
15
Is number of lines in partial block of segment + Preface = zero?
NO
Form [address of word following Preface] - [Number of lines in partial block of segment + preface] to obtain initial address of partial block in running segment
Store number of lines in partial block of segment + preface in "u" of sixth word in segment label block and initial address of partial block in "v" of same word
YES
16
16
17
16
Fill words 9 thru 120$_{10}$ in segment label block with Z's in XS3
Codeword to tape handler to read Op. File III "End of Entry" block and Preface (if any) from servo 5 to File Image
(TH) Tape handler
Is first word in File Image = "End Δ of"? [End of entry block?]
YES
NO
STOP
(BR) Rewind tapes
Type: ALARM 10 COMPILATION INCONSISTENCY (etc.)

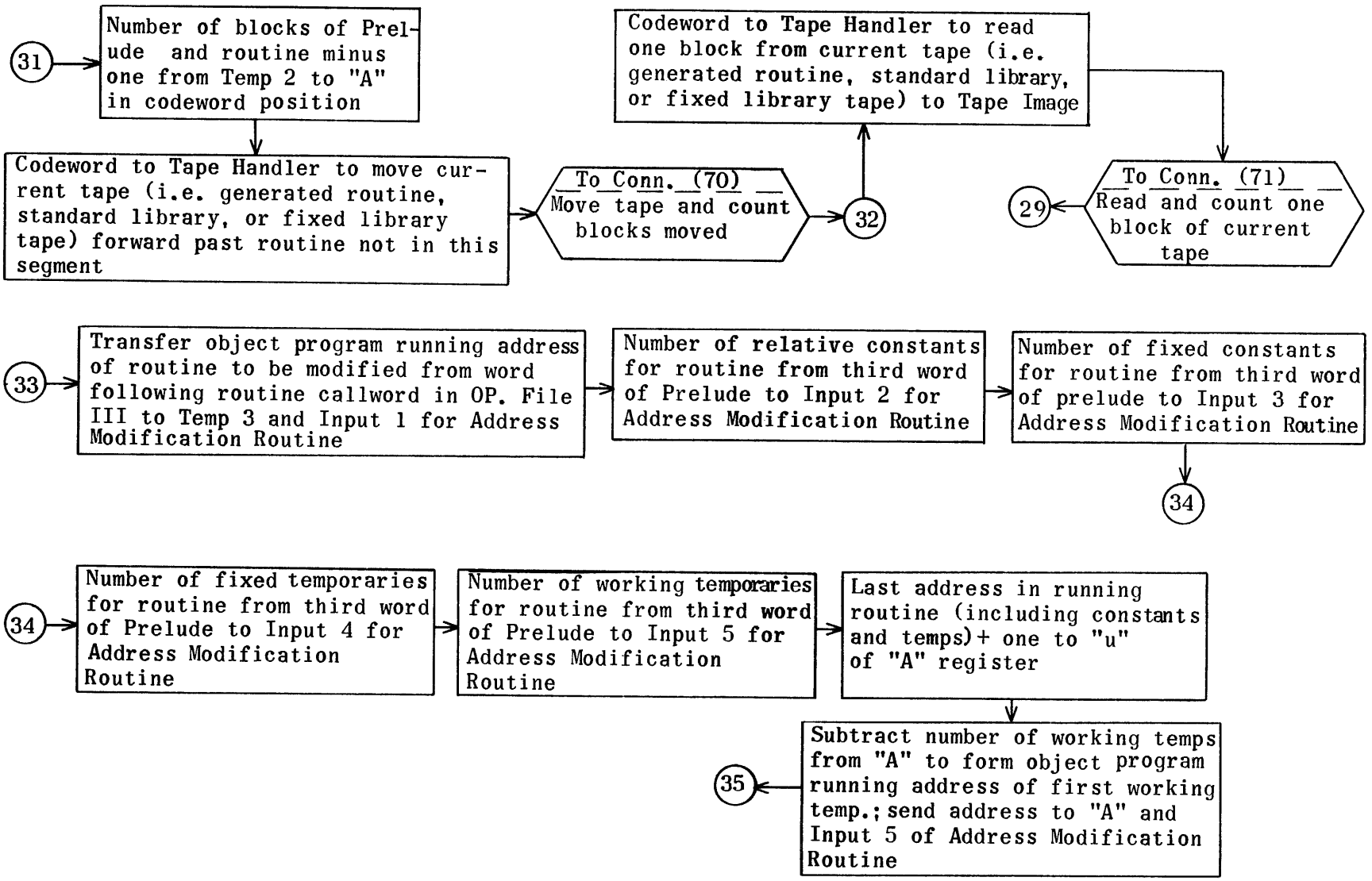

17
Add [number of lines of statements and routines +2] + [drum address of first statement in Segment Image] to form drum address for first word of Preface in Segment Image
Preset this address in Box 2
Transfer Preface (if any) from File Image to Segment Image on drum following last routine for segment
Box-2
Segment label block from tape image to initial address of Segment Image on drum preceding first statement of segment
18
18
Advance number of lines in segment + Preface (Temp 1) by 170$_8$ to form total number of words in Segment Image to be written on tape (i.e. segment label block + segment + Preface
19
Is number of words in Segment Image yet to be written on tape (Temp 1) > number of words in buffer? (Buffer = Tape Image + File Image
NO
21
YES
Transfer full buffer load of words from Segment Image to buffer
Advance address in Segment Image by number of words transferred
20
To Conn. (7)
Check count of blocks on object program tape
(TH)
Tape handler
Decrease number of words in segment image yet to be written (Temp 1) by number of words in buffer
Decrease count of full blocks of segment + Preface to be written (Temp 2) by number of blocks in buffer
19
20
Codeword to tape handler to write full buffer load on object program tape. (servo 3 or 6)

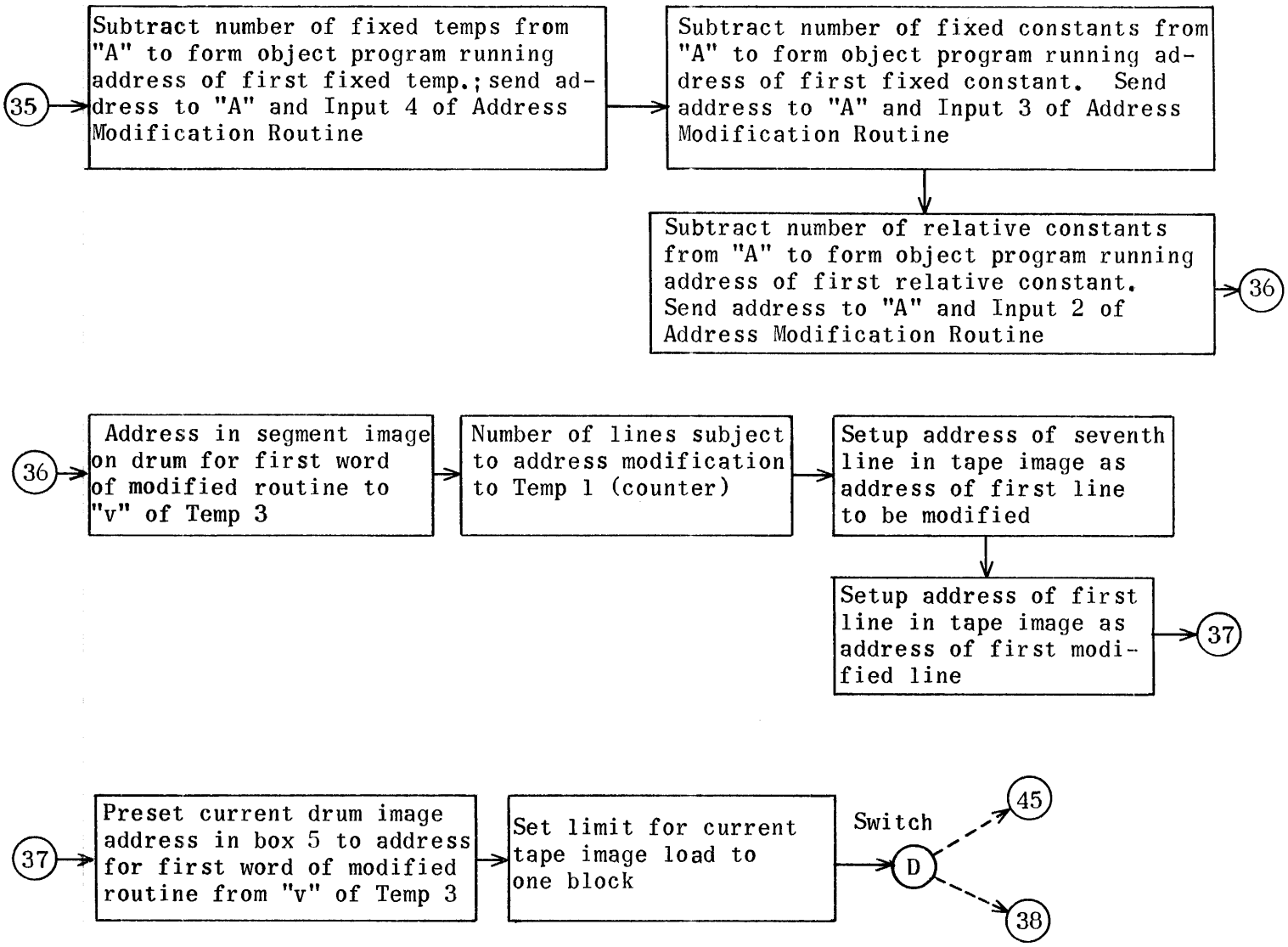

21
Transfer all words yet to be written on tape from Segment Image to Buffer.
Is number of lines in partial block of segment + Preface = zero?
NO
YES
Fill remainder of partial block in buffer with Z's in XS3.
Advance count of blocks yet to be written (Temp 2) by one to count partial block.
22
Advance count of blocks yet to be written (Temp 2) by one to count segment label block
22
Codeword to Tape Handler to write remainder (or all) of segment from buffer to object program tape. (Servo 3 or 6)
Codeword to Tape Handler to read Termination, if any for segment, from servo 5 to File Image
Is there a Termination for segment?
NO
YES
2
Return to process next segment
(TH) Tape Handler
Codeword to tape handler to write Termination from File Image to object program tape. (Servo 3 or 6)
To Conn. (71) Check count of blocks on object program tape
(TH) Tape Handler

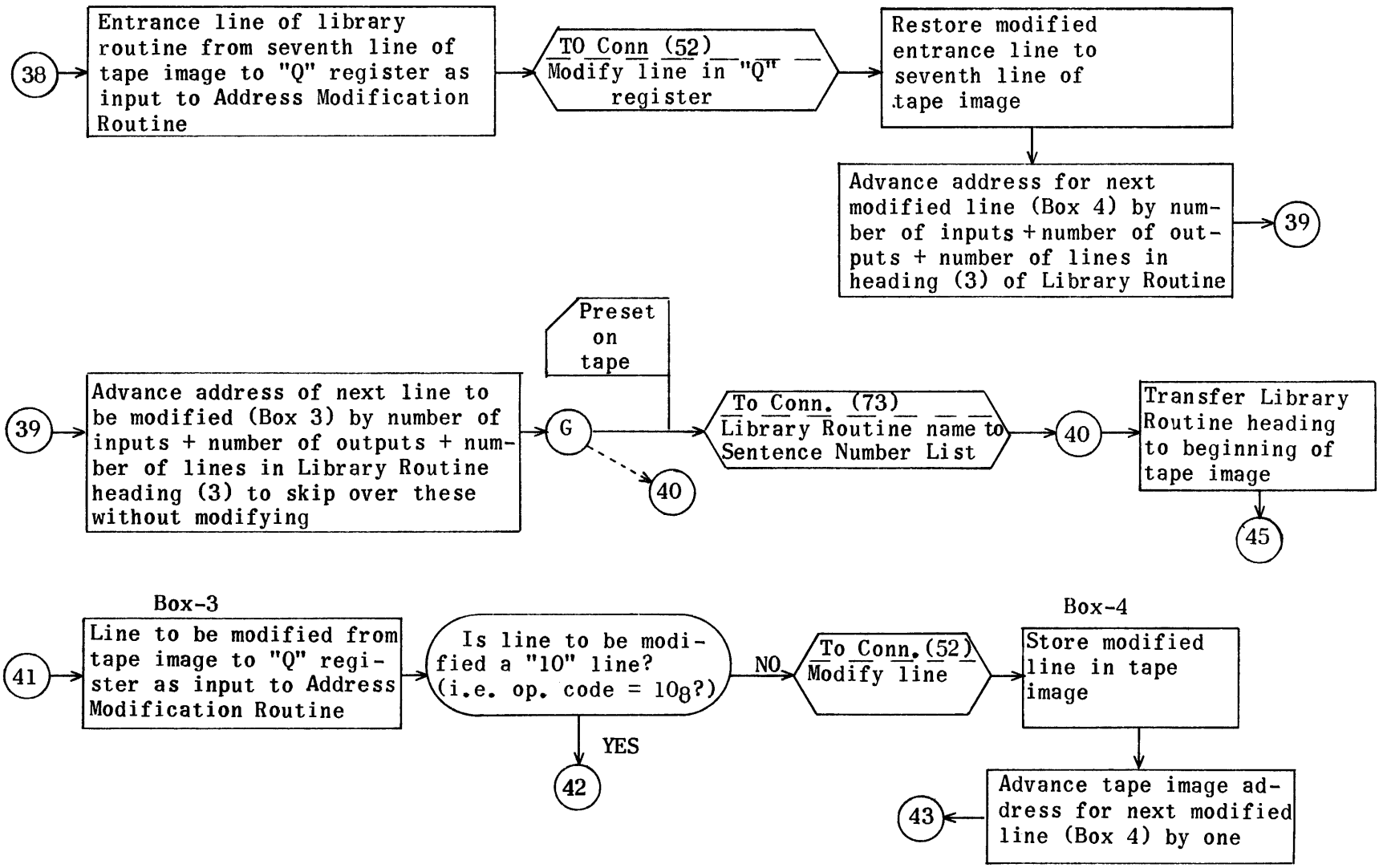

23
Codeword to Tape Handler to rewind library tape (Servo 2)
(TH) Tape Handler
Codeword to Tape Handler to rewind servo 2
(TH) Tape Handler
Transfer 360₈ words (2 blocks) of Z's in XS3 to buffer
Codeword to Tape Handler to write 2 blocks of Z's from buffer to object program tape. (Servo 3 or 6)
(TH) Tape Handler
24
24
Codeword to tape handler to rewind object program tape (Servo 3 or 6)
(TH) Tape Handler
Form [number of blocks servo 1 is advanced beyond start of fixed library] - [number of blocks in fixed library] to obtain number of blocks to move to position servo 1 at beginning of Listing Phase setup block
Servo 1 positioned at start of Listing Phase setup block
Is number of blocks to move servo 1 = zero?
NO
25
YES
Exit from Processor
25
Is number of blocks to move servo 1 negative?
YES
NO
Codeword to Tape Handler to move Servo 1 forward the calculated number of blocks to position it at beginning of Listing Phase setup block
Codeword to Tape Handler to move servo 1 backward the calculated number of blocks to position it at beginning of Listing Phase setup block
(TH) Tape Handler

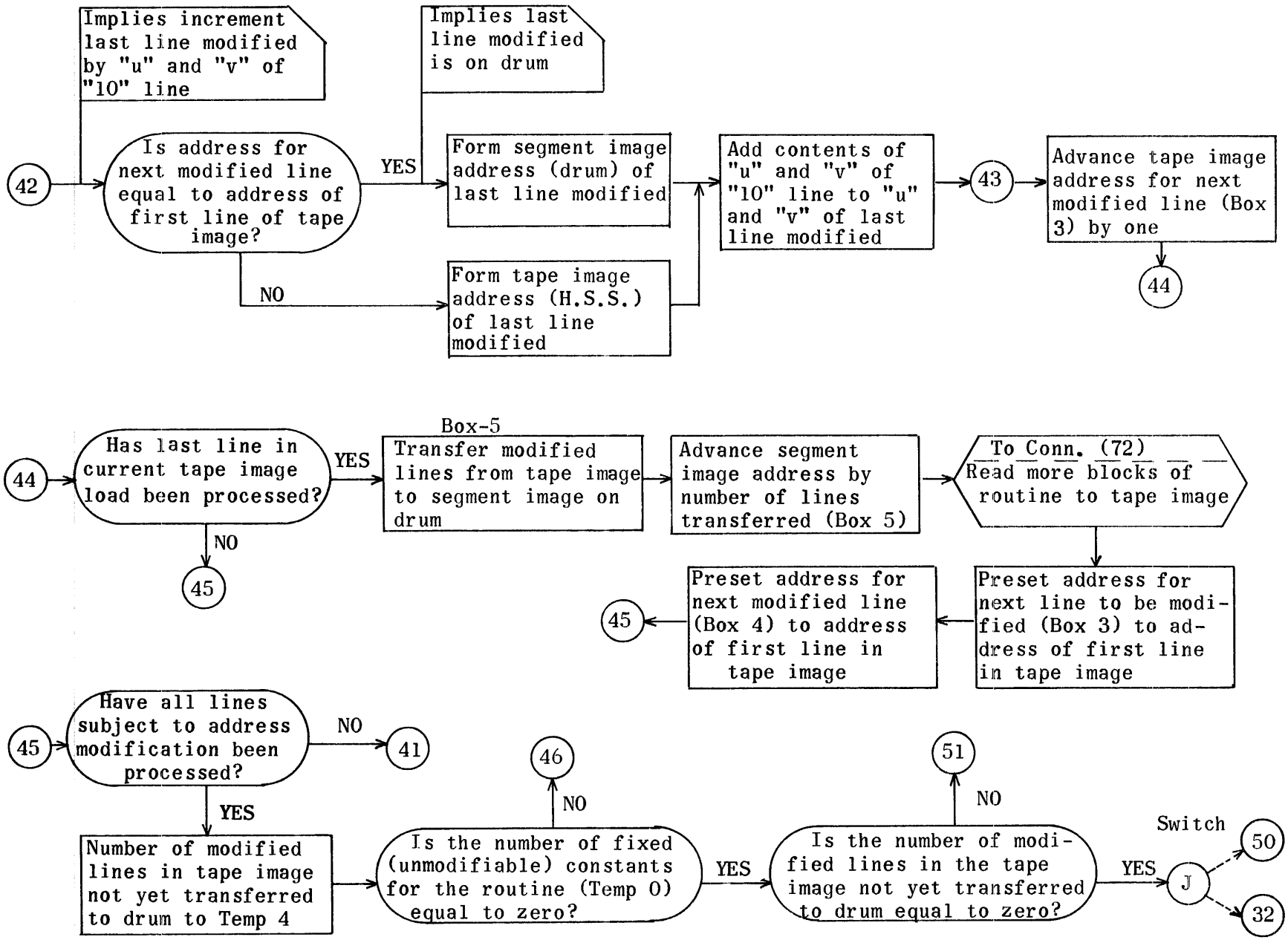

26
Obtain number of words in Op. File III from fourth word in entry label block and preset in Box 9 and Box 10
Number of lines in Preface from seventh word in entry label block to "u" of Temp 7
Segment number from third word in entry label block to Temp 10_8
Number of lines of statements and routines + 2 from fifth word in entry label block to Temp 12_8
27
27
Object program running address for "IP" jump to next segment from sixth word in entry label block to Temp 11_8.
Calculate number of blocks in Op. File III for this segment, including partial block (if any).
Codeword to Tape Handler to read all of Op. File III for this segment from servo 5 to File Image
(TH) Tape Handler
28
28
Codeword to Tape Handler to read 2 label blocks and first block of generated routines from generated routines tape (servo 4 or 7) to Tape Image
Type: ALARM 9 COMPILATION INCONSISTENCY (etc.)
(BR) Rewind tapes
STOP
NO
(TH) Tape Handler
Is first word in second block in tape image = ΔSUBRO ? [Generated routines entry label block?]
YES
Transfer first block of generated routines (includes prelude) from third block in tape image to first block in tape image
29

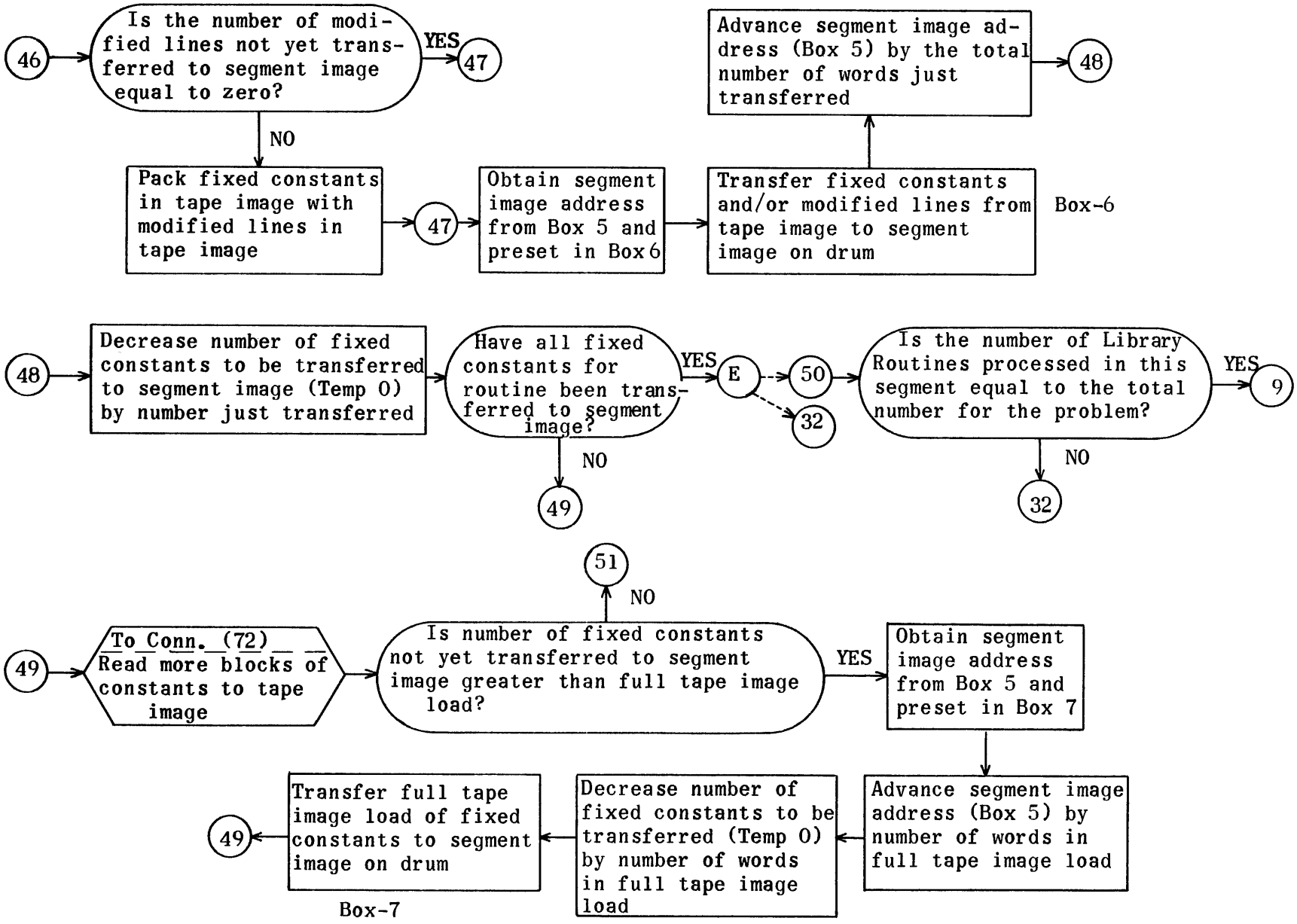

29
Is op. code of first word in tape image equal to zero?
YES
Prelude block of next routine is in first block of tape image
Number of lines of Prelude and routine from "v" of first word in Prelude block to "v" of Temp 6
Routine callword from "u" of first word in Prelude Block to "u" of Temp 4 and "A"
C
30
Preset on tape
To Conn. (75)
Routine sentence number to Sentence Number List
30
No implies end of particular kind of routines being processed (i.e. end of fixed library, standard library, or generated routines)
Exit
30
Number of lines of Prelude and routine from Temp 6 to "A" register
To Conn. (81)
Calculate block count from line count
Number of blocks of Prelude and routine -1 from "A" register to Temp 3 in codeword position
Box-9
Is routine callword in Op. File III for this segment? (search File Image)
YES
NO
31
Is word following routine callword in Op. File III an interpret instruction? (i.e. op. code = 14₈?)
NO
33
Flagged cross-reference indicating routine referenced is in another segment, hence not to be processed at this time
YES
31

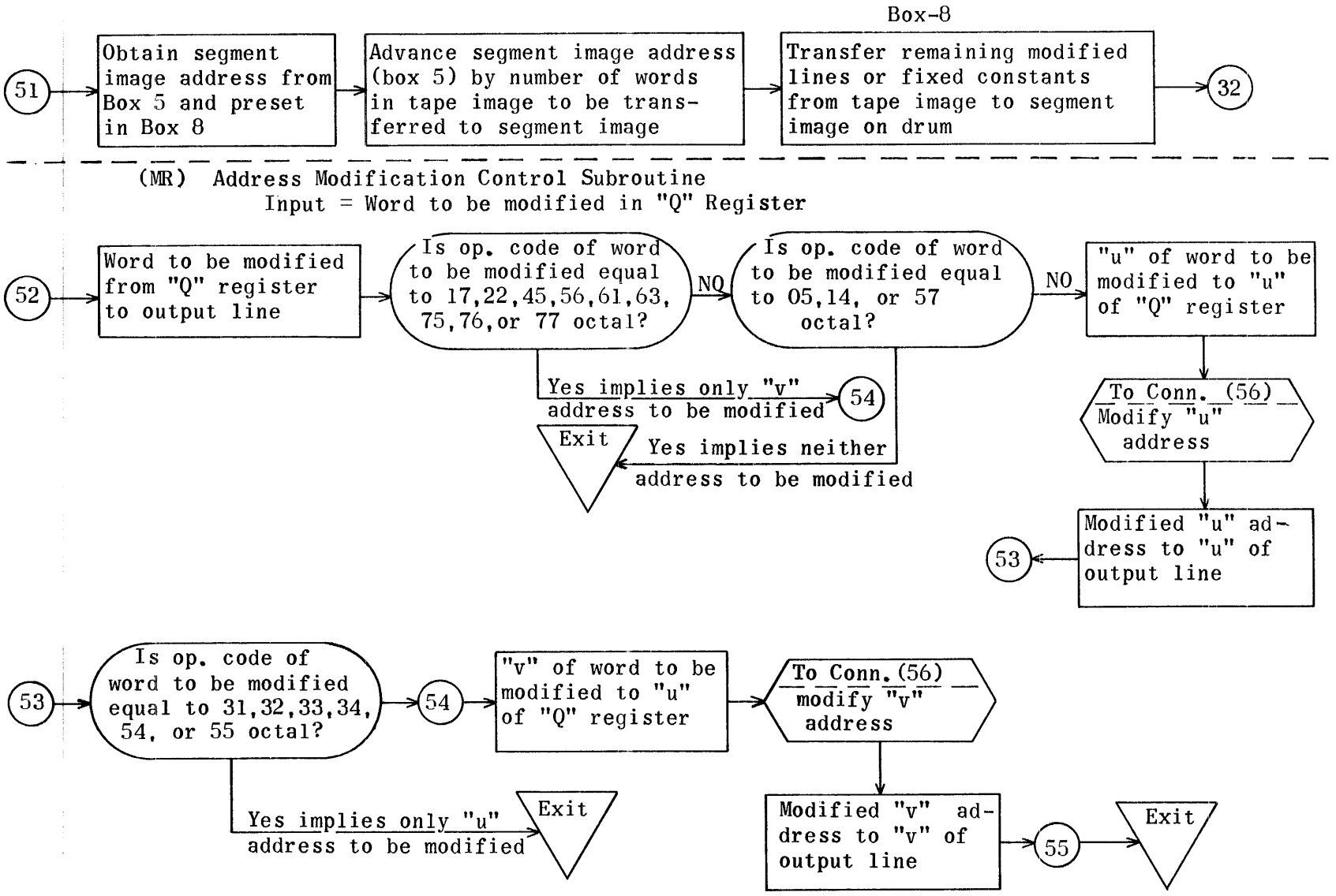

31
Number of blocks of Prelude and routine minus one from Temp 2 to "A" in codeword position
Codeword to Tape Handler to move current tape (i.e. generated routine, standard library, or fixed library tape) forward past routine not in this segment
To Conn. (70)
Move tape and count blocks moved
32
Codeword to Tape Handler to read one block from current tape (i.e. generated routine, standard library, or fixed library tape) to Tape Image
29
To Conn. (71)
Read and count one block of current tape
33
Transfer object program running address of routine to be modified from word following routine callword in OP. File III to Temp 3 and Input 1 for Address Modification Routine
Number of relative constants for routine from third word of Prelude to Input 2 for Address Modification Routine
Number of fixed constants for routine from third word of prelude to Input 3 for Address Modification Routine
34
34
Number of fixed temporaries for routine from third word of Prelude to Input 4 for Address Modification Routine
Number of working temporaries for routine from third word of Prelude to Input 5 for Address Modification Routine
Last address in running routine (including constants and temps)+ one to "u" of "A" register
35
Subtract number of working temps from "A" to form object program running address of first working temp.; send address to "A" and Input 5 of Address Modification Routine


35
Subtract number of fixed temps from "A" to form object program running address of first fixed temp.; send address to "A" and Input 4 of Address Modification Routine
Subtract number of fixed constants from "A" to form object program running address of first fixed constant. Send address to "A" and Input 3 of Address Modification Routine
Subtract number of relative constants from "A" to form object program running address of first relative constant. Send address to "A" and Input 2 of Address Modification Routine
36
36
Address in segment image on drum for first word of modified routine to "v" of Temp 3
Number of lines subject to address modification to Temp 1 (counter)
Setup address of seventh line in tape image as address of first line to be modified
Setup address of first line in tape image as address of first modified line
37
37
Preset current drum image address in box 5 to address for first word of modified routine from "v" of Temp 3
Set limit for current tape image load to one block
Switch
D
45
38


38
Entrance line of library routine from seventh line of tape image to "Q" register as input to Address Modification Routine
TO Conn (52)
Modify line in "Q" register
Restore modified entrance line to seventh line of tape image
Advance address for next modified line (Box 4) by number of inputs + number of outputs + number of lines in heading (3) of Library Routine
39
Preset on tape
39
Advance address of next line to be modified (Box 3) by number of inputs + number of outputs + number of lines in Library Routine heading (3) to skip over these without modifying
G
40
To Conn. (73)
Library Routine name to Sentence Number List
40
Transfer Library Routine heading to beginning of tape image
45
Box-3
41
Line to be modified from tape image to "Q" register as input to Address Modification Routine
Is line to be modified a "10" line? (i.e. op. code = 10₈?)
NO
To Conn. (52)
Modify line
Box-4
Store modified line in tape image
YES
42
43
Advance tape image address for next modified line (Box 4) by one

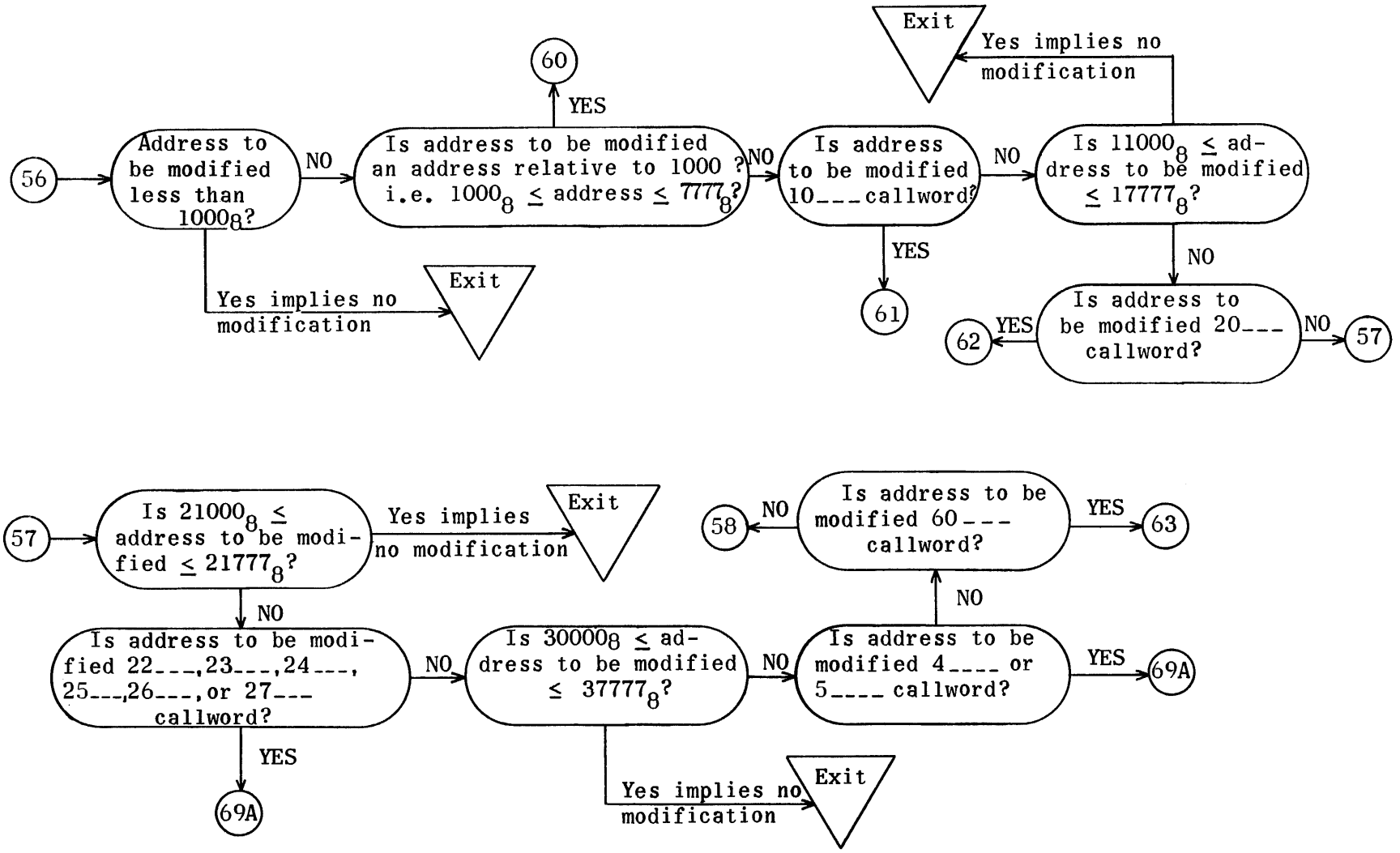

Implies increment last line modified by "u" and "v" of "10" line
Implies last line modified is on drum
42
Is address for next modified line equal to address of first line of tape image?
YES
NO
Form segment image address (drum) of last line modified
Form tape image address (H.S.S.) of last line modified
Add contents of "u" and "v" of "10" line to "u" and "v" of last line modified
43
Advance tape image address for next modified line (Box 3) by one
44
Box-5
44
Has last line in current tape image load been processed?
YES
NO
45
Transfer modified lines from tape image to segment image on drum
Advance segment image address by number of lines transferred (Box 5)
To Conn. (72)
Read more blocks of routine to tape image
Preset address for next line to be modified (Box 3) to address of first line in tape image
Preset address for next modified line (Box 4) to address of first line in tape image
45
45
Have all lines subject to address modification been processed?
NO
41
YES
Number of modified lines in tape image not yet transferred to drum to Temp 4
46
NO
Is the number of fixed (unmodifiable) constants for the routine (Temp 0) equal to zero?
YES
51
NO
Is the number of modified lines in the tape image not yet transferred to drum equal to zero?
YES
Switch
J
50
32

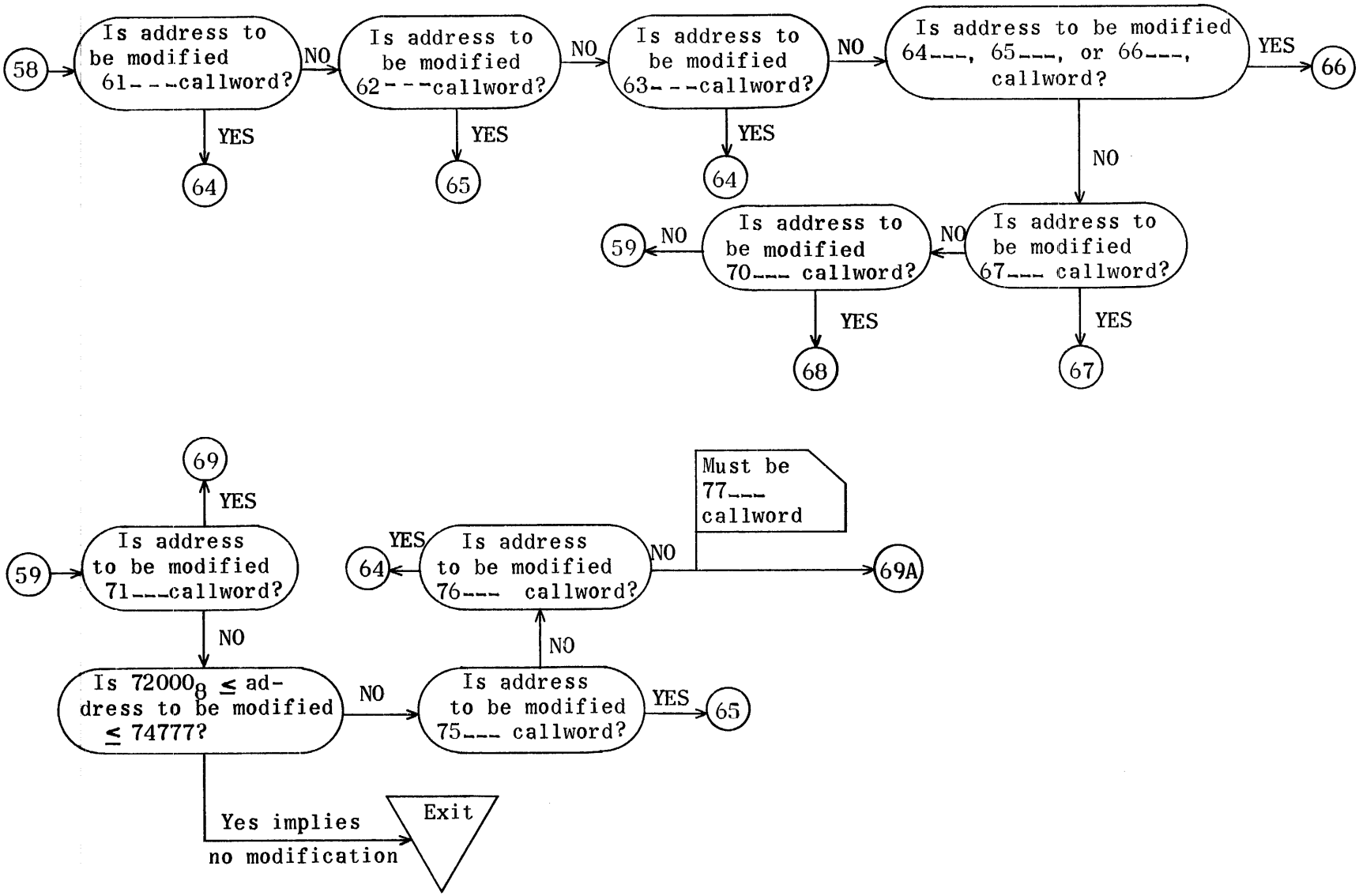

46
Is the number of modified lines not yet transferred to segment image equal to zero?
YES
47
NO
Pack fixed constants in tape image with modified lines in tape image
47
Obtain segment image address from Box 5 and preset in Box 6
Transfer fixed constants and/or modified lines from tape image to segment image on drum
Box-6
Advance segment image address (Box 5) by the total number of words just transferred
48
48
Decrease number of fixed constants to be transferred to segment image (Temp 0) by number just transferred
Have all fixed constants for routine been transferred to segment image?
YES
E
50
32
NO
49
Is the number of Library Routines processed in this segment equal to the total number for the problem?
YES
9
NO
32
51
NO
49
To Conn. (72) Read more blocks of constants to tape image
Is number of fixed constants not yet transferred to segment image greater than full tape image load?
YES
Obtain segment image address from Box 5 and preset in Box 7
Advance segment image address (Box 5) by number of words in full tape image load
Decrease number of fixed constants to be transferred (Temp 0) by number of words in full tape image load
49
Transfer full tape image load of fixed constants to segment image on drum
Box-7

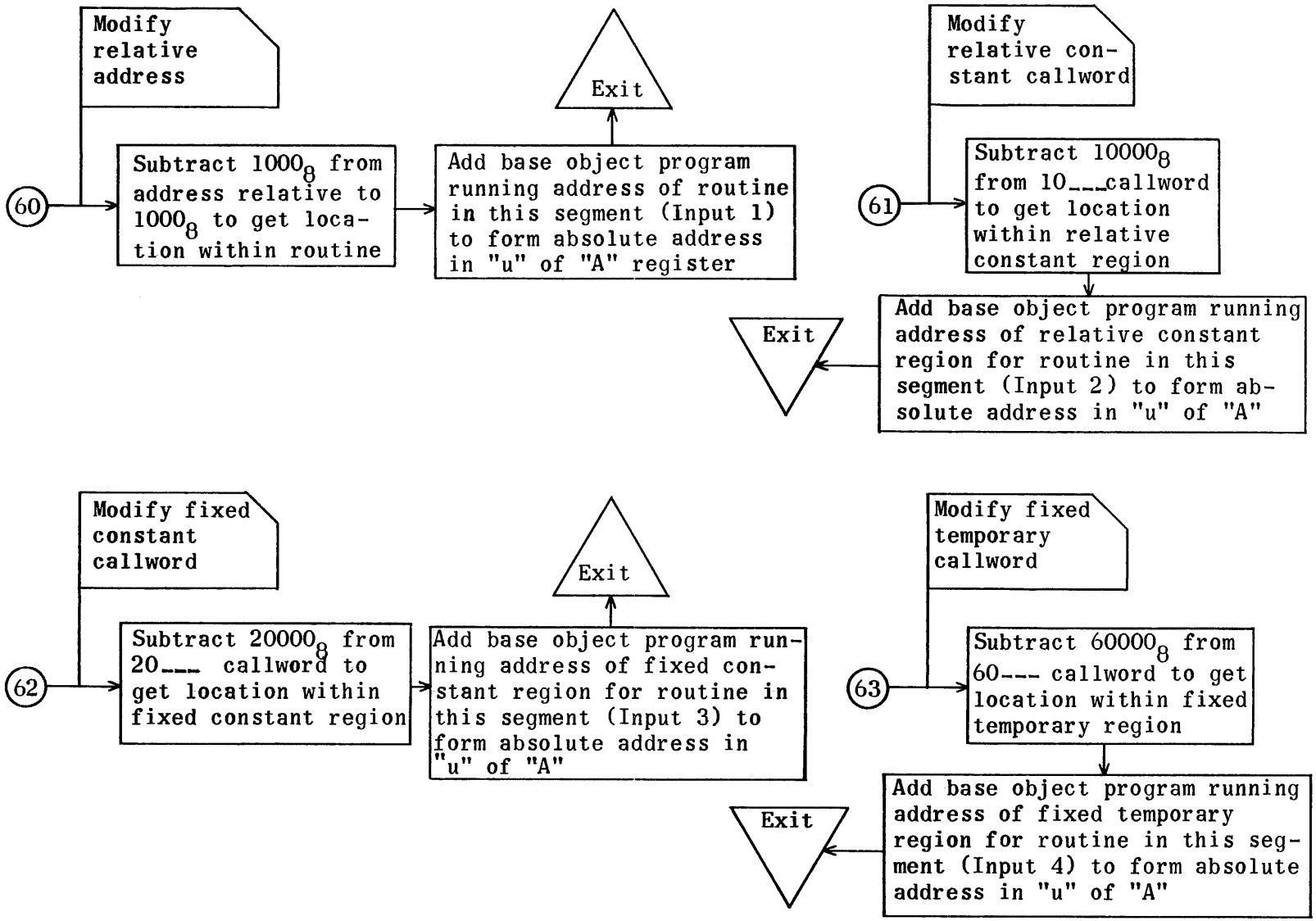

Box-8
51
Obtain segment image address from Box 5 and preset in Box 8
Advance segment image address (box 5) by number of words in tape image to be transferred to segment image
Transfer remaining modified lines or fixed constants from tape image to segment image on drum
32
(MR) Address Modification Control Subroutine
Input = Word to be modified in "Q" Register
52
Word to be modified from "Q" register to output line
Is op. code of word to be modified equal to 17,22,45,56,61,63, 75,76,or 77 octal?
NO
Is op. code of word to be modified equal to 05,14, or 57 octal?
NO
"u" of word to be modified to "u" of "Q" register
To Conn. (56)
Modify "u" address
Yes implies only "v" address to be modified
54
Exit
Yes implies neither address to be modified
Modified "u" address to "u" of output line
53
53
Is op. code of word to be modified equal to 31,32,33,34, 54, or 55 octal?
54
"v" of word to be modified to "u" of "Q" register
To Conn.(56)
modify "v" address
Yes implies only "u" address to be modified
Exit
Modified "v" address to "v" of output line
55
Exit

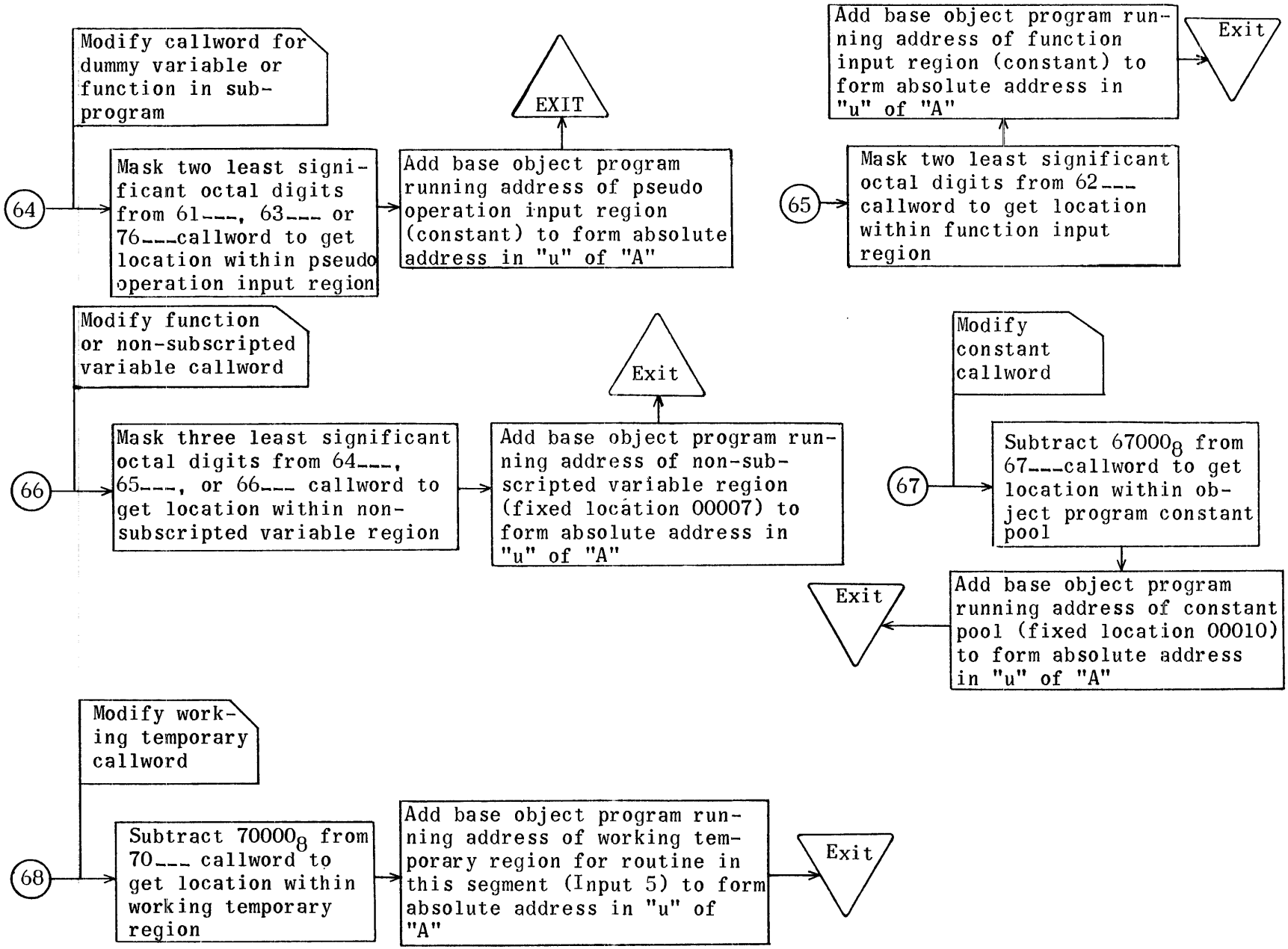
(MS) Modify Address Subroutine

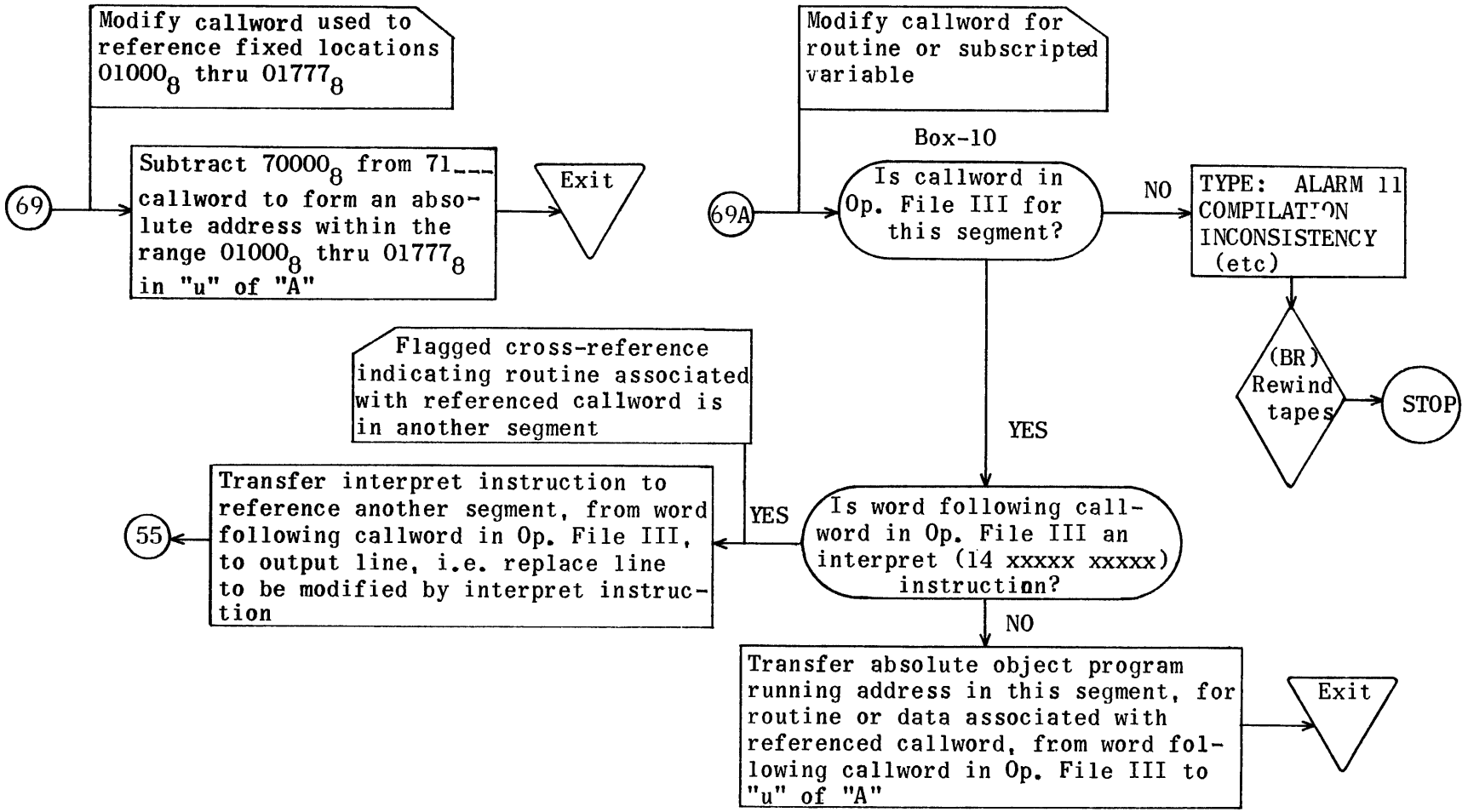
Input = Address to be modified in "u" of "Q" register
Output = Modified (absolute) address in "u" of "A" register



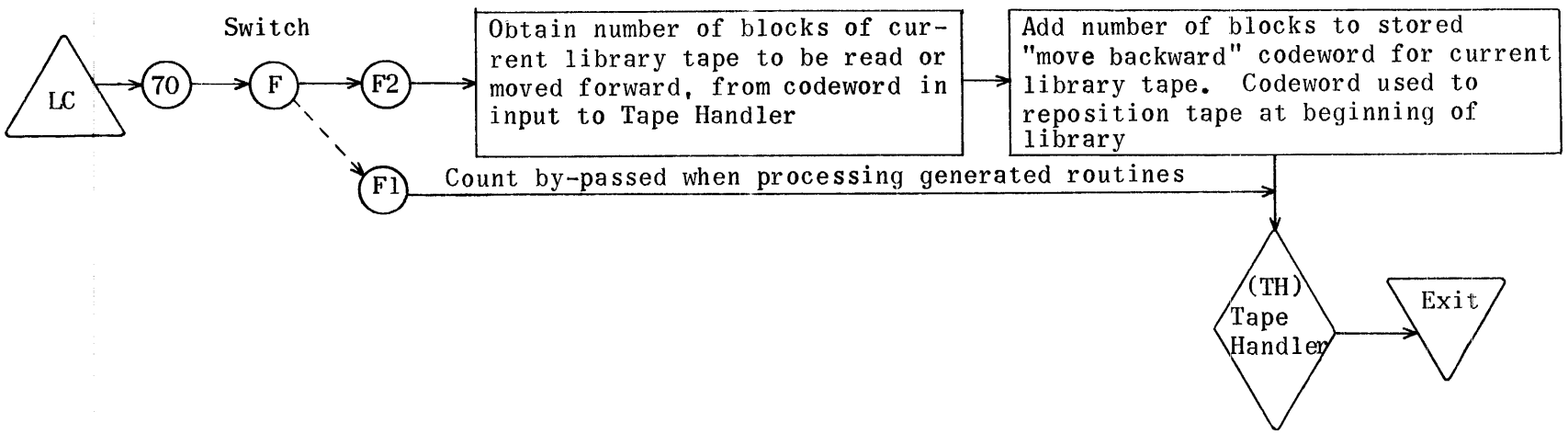

58
Is address to be modified 61---callword?
NO
Is address to be modified 62---callword?
NO
Is address to be modified 63---callword?
NO
Is address to be modified 64---, 65---, or 66---, callword?
YES
66
YES
64
YES
65
YES
64
NO
59
NO
Is address to be modified 70--- callword?
NO
Is address to be modified 67--- callword?
YES
68
YES
67
69
YES
59
Is address to be modified 71---callword?
NO
Is 72000$_8$ ≤ address to be modified ≤ 74777?
NO
Is address to be modified 75--- callword?
YES
65
Yes implies no modification
Exit
YES
64
Is address to be modified 76--- callword?
NO
Must be 77--- callword
69A


Modify relative address
60
Subtract 1000_8 from address relative to 1000_8 to get location within routine
Add base object program running address of routine in this segment (Input 1) to form absolute address in "u" of "A" register
Exit
Modify relative constant callword
61
Subtract 10000_8 from 10___callword to get location within relative constant region
Add base object program running address of relative constant region for routine in this segment (Input 2) to form absolute address in "u" of "A"
Exit
Modify fixed constant callword
62
Subtract 20000_8 from 20___ callword to get location within fixed constant region
Add base object program running address of fixed constant region for routine in this segment (Input 3) to form absolute address in "u" of "A"
Exit
Modify fixed temporary callword
63
Subtract 60000_8 from 60___ callword to get location within fixed temporary region
Add base object program running address of fixed temporary region for routine in this segment (Input 4) to form absolute address in "u" of "A"
Exit

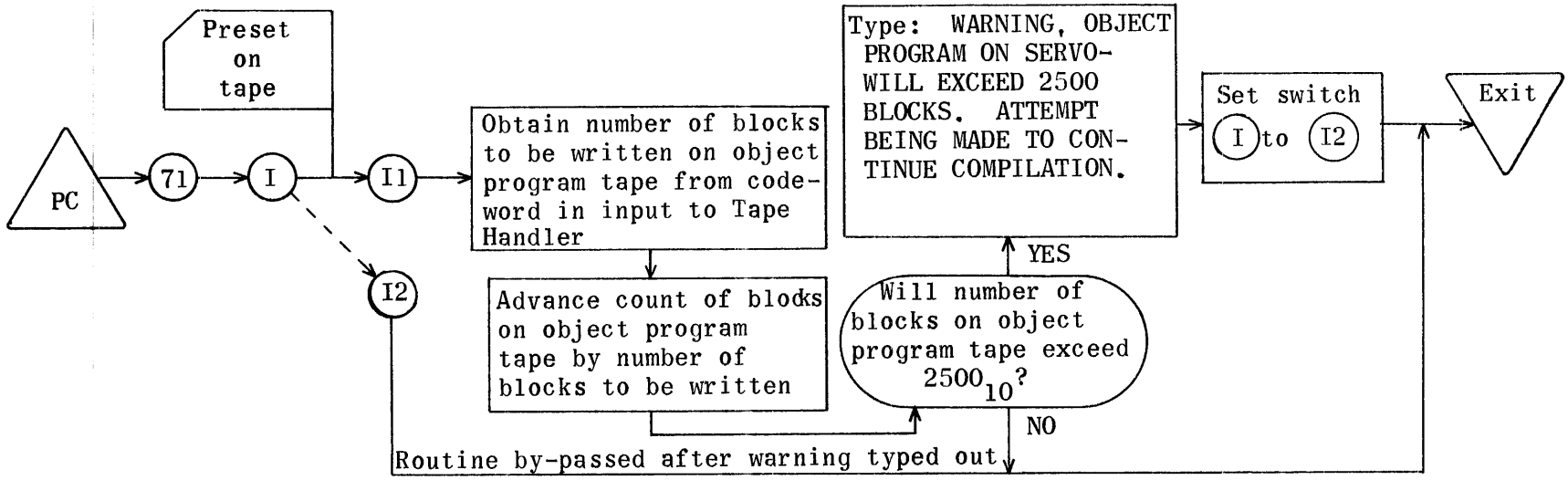

Modify callword for dummy variable or function in sub-program
64
Mask two least significant octal digits from 61---, 63--- or 76---callword to get location within pseudo operation input region
Add base object program running address of pseudo operation input region (constant) to form absolute address in "u" of "A"
EXIT
Add base object program running address of function input region (constant) to form absolute address in "u" of "A"
Exit
65
Mask two least significant octal digits from 62--- callword to get location within function input region
Modify function or non-subscripted variable callword
66
Mask three least significant octal digits from 64---, 65---, or 66--- callword to get location within non-subscripted variable region
Add base object program running address of non-subscripted variable region (fixed location 00007) to form absolute address in "u" of "A"
Exit
Modify constant callword
67
Subtract 67000_8 from 67---callword to get location within object program constant pool
Add base object program running address of constant pool (fixed location 00010) to form absolute address in "u" of "A"
Exit
Modify working temporary callword
68
Subtract 70000_8 from 70--- callword to get location within working temporary region
Add base object program running address of working temporary region for routine in this segment (Input 5) to form absolute address in "u" of "A"
Exit


Modify callword used to reference fixed locations 01000_8 thru 01777_8
69
Subtract 70000_8 from 71___ callword to form an absolute address within the range 01000_8 thru 01777_8 in "u" of "A"
Exit
Modify callword for routine or subscripted variable
Box-10
69A
Is callword in Op. File III for this segment?
NO
TYPE: ALARM 11 COMPILATION INCONSISTENCY (etc)
(BR) Rewind tapes
STOP
YES
Flagged cross-reference indicating routine associated with referenced callword is in another segment
Is word following callword in Op. File III an interpret (14 xxxxx xxxxx) instruction?
YES
Transfer interpret instruction to reference another segment, from word following callword in Op. File III, to output line, i.e. replace line to be modified by interpret instruction
55
NO
Transfer absolute object program running address in this segment, for routine or data associated with referenced callword, from word following callword in Op. File III to "u" of "A"
Exit

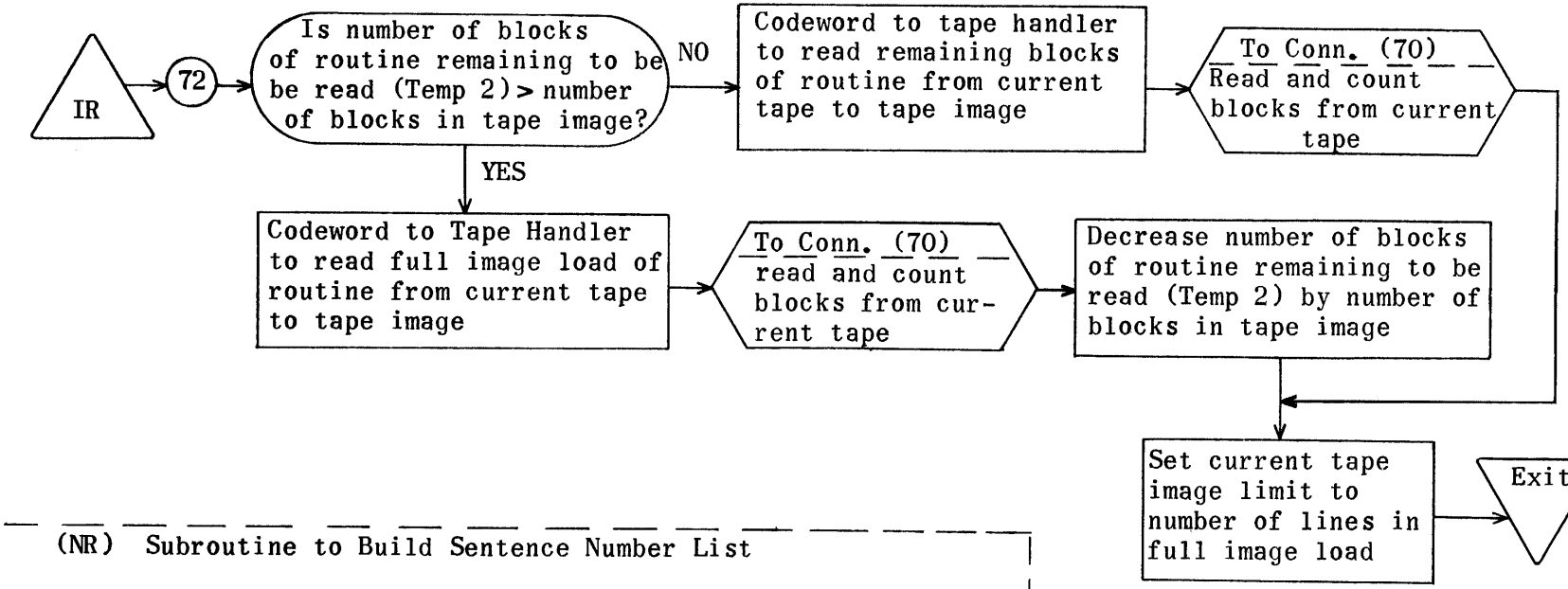
(LC) Subroutine to count blocks of Library (Fixed or Standard) Processed



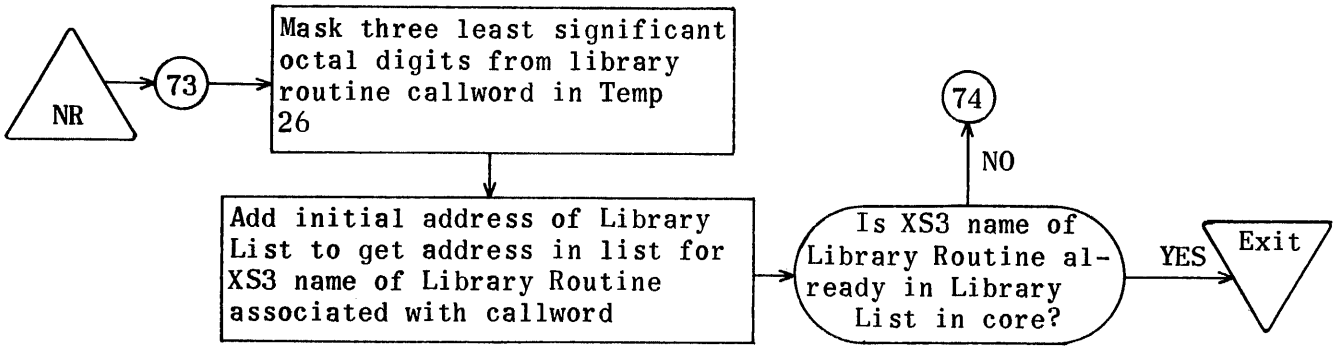
(PC) Subroutine to Count Blocks on Object Program Tape

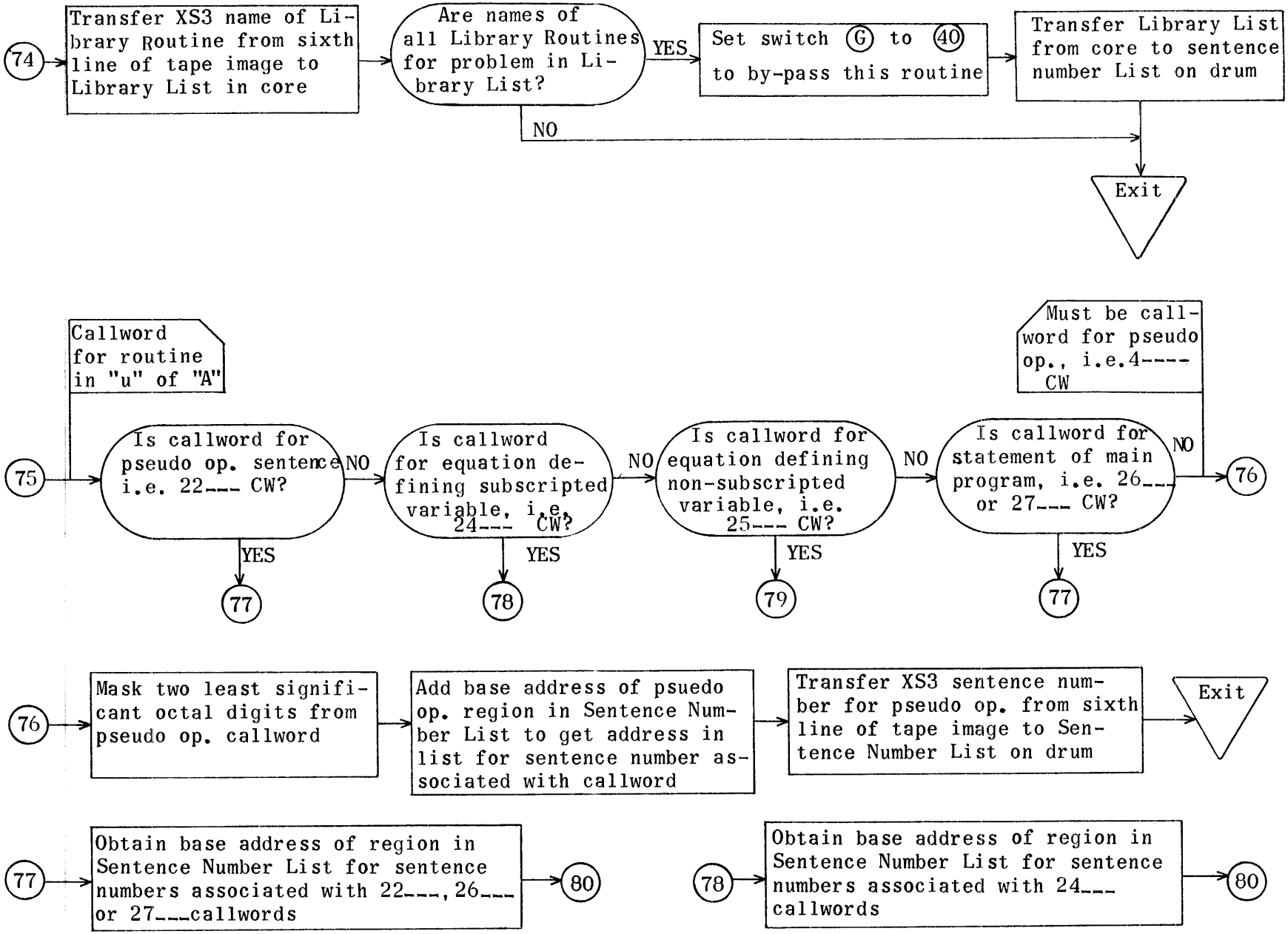


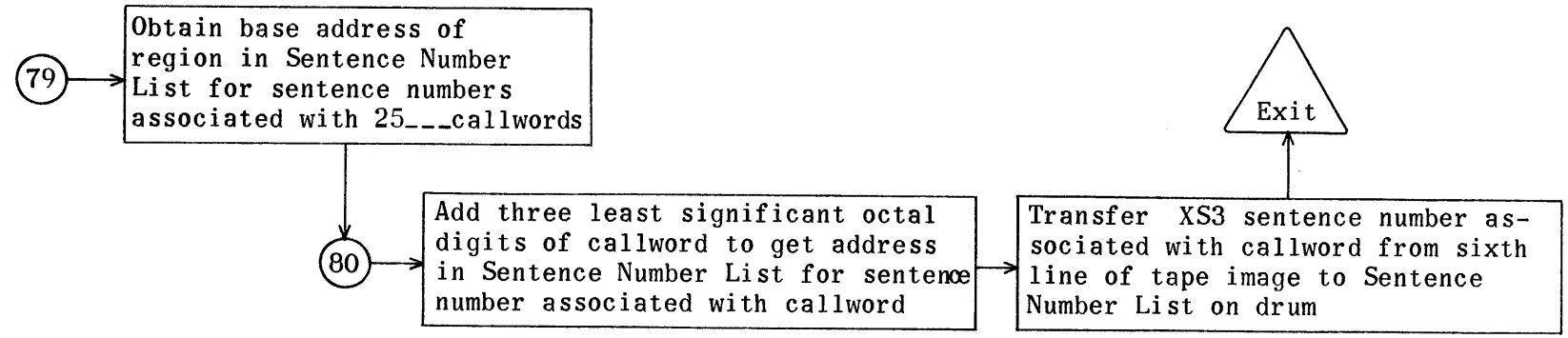
(IR) Input Routine



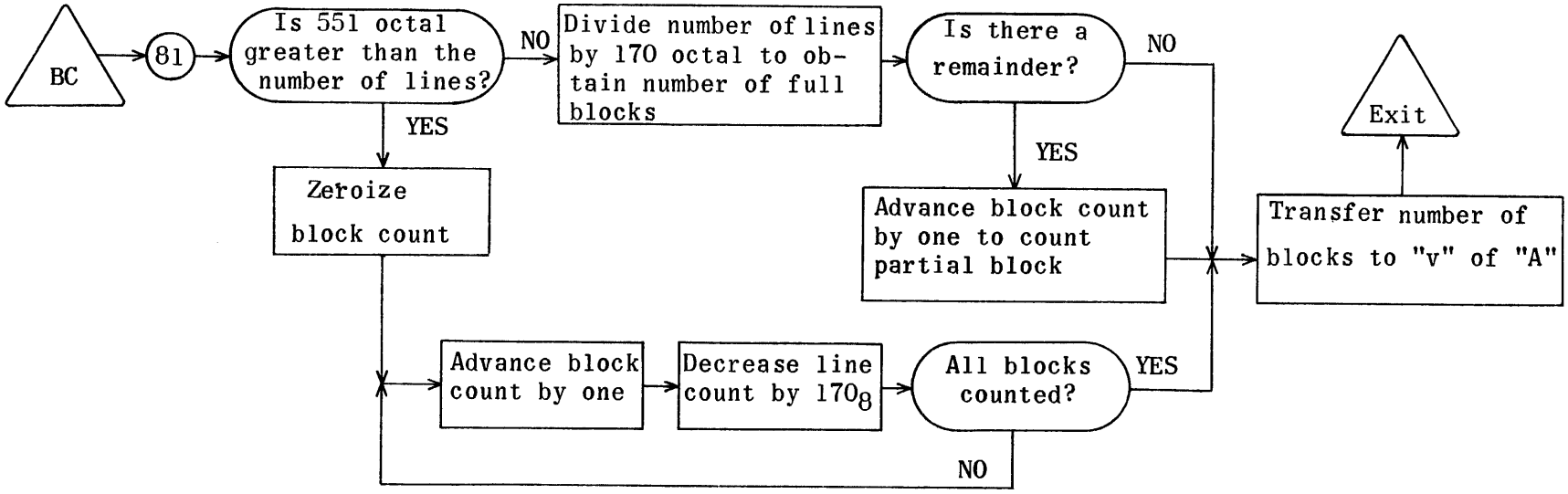
(NR) Subroutine to Build Sentence Number List




74
Transfer XS3 name of Library Routine from sixth line of tape image to Library List in core
Are names of all Library Routines for problem in Library List?
YES
Set switch G to 40 to by-pass this routine
Transfer Library List from core to sentence number List on drum
NO
Exit
Callword for routine in "u" of "A"
Must be callword for pseudo op., i.e.4---- CW
75
Is callword for pseudo op. sentence i.e. 22--- CW?
NO
Is callword for equation defining subscripted variable, i.e. 24--- CW?
NO
Is callword for equation defining non-subscripted variable, i.e. 25--- CW?
NO
Is callword for statement of main program, i.e. 26--- or 27--- CW?
NO
76
YES
77
YES
78
YES
79
YES
77
76
Mask two least significant octal digits from pseudo op. callword
Add base address of psuedo op. region in Sentence Number List to get address in list for sentence number associated with callword
Transfer XS3 sentence number for pseudo op. from sixth line of tape image to Sentence Number List on drum
Exit
77
Obtain base address of region in Sentence Number List for sentence numbers associated with 22---, 26--- or 27---callwords
80
78
Obtain base address of region in Sentence Number List for sentence numbers associated with 24--- callwords
80



(BC) Subroutine to calculate block count from line count
Input = Number of lines in "v" of "A"
Output = Number of blocks in "v" of "A"



PROCESSOR REGIONS

RE	TN20	Servo Indicator
RE	TH21	Tape handler
RE	UP421	Uniprint
RE	BR537	
RE	CK653	
RE	CL701	
RE	CM715	
RE	CN740	
RE	CP753	
RE	CQ1004	
RE	CR1033	
RE	CS1065	
RE	CT1117	
RE	CU1134	
RE	CV1174	
RE	CW1226	
RE	CX1251	
RE	CY1310	
RE	CZ1350	
RE	DA1401	
RE	LC1424	
RE	PC1433	
RE	IR1444	
RE	NR1460	
RE	BC1521	
RE	FC1536	
RE	RC1570	
RE	TC1627	
RE	TL1660	
RE	TO1667	
RE	LV1712	
RE	MR1724	
RE	MS1751	
RE	MT2001	
RE	MU2040	
RE	MC2056	
RE	MD2105	
RE	MI2131	
RE	TS2140	

```
  RE  LL2240      List of library routine names
* RE  TI3240      Tape image
* RE  FA4200      File image

  RE  DD40101     Modified dimension list
  RE  ND42102     Sentence number list
  RE  DI46202     Segment image on drum

  RE  IL740       Number of lines in tape image
  RE  FL3600      Number of lines in file image
  RE  BL4540      Number of lines in buffer, i.e.,
                  BL = IL + FL
  RE  IB4         Number of blocks in tape image
  RE  BB24        Number of blocks in buffer, i.e.,
                  tape image + file image
  RE  PB4705      Limit number of blocks on object
                  program tape
  RE  II4200      Limit address for full image load,
                  i.e., II = TI + IL
  RE  FI610
  RE  PI624
  RE  ZA77000     Entrance to Unicode service routines

  END
```

* NOTE: The tape image and file image form the buffer for writing the segment on tape; hence, they must be adjacent in memory with the tape image appearing first.

Processor

		IA	CK		Begin Processor
	0	MJ	0	ZA10	Exit → Unicode Service Routine
	1	TP	5	Q	Library Indicator Word → Q
	2	QT	FC5	A	# Library routines in problem → Av
	3	ST	FC3	TS22	# Library routines in problem → "V" of temp.
	4	QJ	CK6 (yes)	CK5 (no)	Fixed library required?
	5	TV	RC27	CM22	Set switch Ⓐ → Ⓐ2
①	6	QJ	CK10 (yes)	CK7 (no)	Standard library required?
	7	TV	RC31	CN12	Set switch Ⓑ → Ⓑ2
	10	LA	LV6	6	# blks in buffer → tape codeword position
	11	AT	TC26	TC26	Form codeword to write full buffer load on object program tape
	12	LQ	LV7	6	# blks in tape image → codeword position
	13	LQ	LV11	6	Limit # blks object program tape → codeword position
	14	TP	TS22	TS14	# Library routines - 1 → library list index
	15	TP	FC30	TS13	Preset count blks. binary tape → Max. # blks. initialization
	16	TP	12	Q	Segment image address → Qv
	17	QT	FC5	TS25	Segment image address → "v" of temp
	20	RS	RC17	TS25	Drum add. for seg. - Run. add. seg. = Drum add. corres. to loc. zero
	21	SP	TN	0	Servo layout indicator
	22	ZJ	CK23	CL	(A) = zero ⟹ 5 servos; (A) ≠ zero ⟹ 7 servos
	23	RA	T06	FC31	Set Object program servo # = 6 → printout
	24	RP	20012	CL	
	25	RA	TC17	TN	Setup tape codewords for 7 servo layout
		CA	CK26		

```
                IA  CL
②     0         TP  TC14        TH3
      1         RJ  TH2         TH
      2         TP  FA          A
      3         EJ  TL1         CL6     yes
      4         EJ  TL          DA
      5         MJ  0           BR12
③     6         RP  17777       CL10
      7         TP  FC          DI
     10         RP  17777       CL12
     11         TP  FC          DI7777
     12         RP  17777       CM
     13         TP  FC          DI17776
                CA  CL14
```

Read 1 blk. Op. File III (servo 5) → File image
1st word Op. File III image → A
1st word = File △ 3? Yes⇒entry label blk. for new segment
1st word = zzzzzz? Yes⇒End tape blk; End processing
Alarm 10

Zeroize 277758 word segment image on drum to allow for possible 3 core bank running segment.

		IA	CM		
	0	TV	RC1	CS31	Set switch Ⓓ→Ⓓ1
	1	TV	RC32	CV31	Set switch Ⓔ→Ⓔ1
	2	TV	RC32	CW2	Set switch Ⓙ→Ⓔ1
	3	TV	RC20	LC1	Set switch Ⓕ→Ⓕ1
	4	TP	TS22	TS15	# Library routines in problem - 1→Segment Index
	5	TP	TC22	TS16	Set current tape codeword to read [n] blks. Gen. tape
	6	TP	TC20	TS17	Set current tape codeword to read 1 blk. Gen. tape
	7	SP	LV7	0	
	10	AT	TC22	TS20	Set current tape codeword to read full image load Gen. tape
	11	TP	TC17	TS21	Set current tape codeword to read move forward [n] blks. Gen. tape
Ⓐ	12	RJ	CR	CQ	Read Op. File III → image and process generated routines
	13	TP	TC23	TH3	
	14	RJ	TH2	TH	Rewind generated routine tape
	15	TV	RC24	CS31	Set switch Ⓓ⇒Ⓓ2
	16	TV	RC33	CV31	Set switch Ⓔ→Ⓔ2
	17	TV	RC33	CW2	Set switch Ⓙ→Ⓔ2
	20	TV	RC21	LC1	Set switch Ⓕ→Ⓕ2
	21	TV	RC25	CR6	Set switch Ⓒ→Ⓒ2
Fixed Library Switch Ⓐ	22	MJ	0	[CN2]	
		CA	CM23		

		IA	CN		
⑤	0	TP	TC2	TH3	Move servo 1 backward to beginning of fixed library
	1	RJ	TH2	TH	
	2	TP	TC3	TC2	Reset move backward codeword → zero blks.
	3	TP	RC22	LC4	Set to count blks fixed library processed
	4	TP	TC5	TS16	Set current tape codeword to read [n] blks fixed library
	5	TP	TC4	TS17	Set current tape codeword to read 1 blk fixed library
	6	SP	LV7	0	
	7	AT	TC5	TS20	Set current tape codeword to read full image load fixed library
	10	TP	TC1	TS21	Set current tape codeword to move FW [n] blks
	11	RJ	CR	CR27	Process fixed library routines
Switch Ⓑ	12	MJ	0	[CP2]	
		CA	CN13		

		IA	CP			
⑥	0	TP	TS23	TH3		Move backword library tape
	1	RJ	TH2	TH		(servo 2) to library routines entry label.
	2	TP	TC7	TS23		Reset move backward codeword → zero blks
	3	TP	RC23	LC4		Setup to count blks of library tape processed
	4	TP	TC12	TS16		Set current codeword to read [N] blks library tape
	5	TP	TC10	TS17		Set current codeword to read 1 blk. library tape
	6	SP	LV7	0		
	7	AT	TC12	TS20		Set current codeword to read full image load library tape
	10	TP	TC6	TS21		Set current codeword to move [N] blks. library tape
⑦	11	TP	TC11	TH3		
	12	RJ	LC	LC1		Read 2 blks library tape
	13	TP	TI	A		1st word library routines entry label → A
	14	EJ	TL4	CP16		Label = △△L I B△△ (i.e. library tape positioned properly)
	15	MJ	0	BR7		Alarm 7
⑧	16	RP	30170	CP20	}	Transfer 1st block library routines
	17	TP	TI170	TI	}	from 2nd blk → 1st block tape image
	20	RJ	CR	CR1		Process STANDARD LIBRARY ROUTINES
Switch	21	MJ	0	[CP22]		
Ⓗ	22	TP	5	Q		
	23	QJ	CP24	yes CP25	no	Fixed library required?
	24	TV	RC26	CM22		Set switch Ⓐ → Ⓐ1 after 1st segment
	25	QJ	CP26	yes CP27	no	Standard library required?
	26	TV	RC30	CN12		Set switch Ⓑ → Ⓑ1 after 1st segment
	27	TV	CP30	CP21		By-Pass preceding setups after 1st segment
	30	MJ	0	CX		
		CA	CP31			

		IA	CQ		
(26)	0	SP	FA3	0	# words Op. File III → Au
	1	SA	FC1	0	Add j=2 to # words Op. File III to form jn
	2	TU	A	MU2	jn to search Op. File III → "RP" in Add. mod. rtn.
	3	TU	A	CR14	jn to search Op. File III → "RP" in processor
	4	TP	FA6	TS7	# lines in preface → "u" of Temp.
	5	TP	FA2	TS10	Segment No. → Temp.
	6	TP	FA4	TS12	# lines statements and routines + 2 → Temp.
(27)	7	TP	FA5	TS11	Address for "IP" jump to next segment → Temp.
	10	SP	FA3	25	# words Op. File III → "v" of A_1
	11	LT	0	A	# words Op. File III → A_r
	12	DV	FC2	Q	# words Op. File $3/170_8$ = # full blks. Op. File III
	13	ZJ	CQ14 yes	CQ15 no	Is there partial blk?
	14	RA	Q	FC3	Adv. # blks. by 1 to count partial block
	15	SP	Q	25	# blks. Op. File III → A in tape codeword position
	16	AT	TC15	TH3	Codeword to read [N] blks servo 5 → tape handler
	17	RJ	TH2	TH	Read Op. File III from servo 5 → Op. File III image
(28)	20	TP	TC21	TH3	Codeword to read 3 blks Gen. rtn. tape (4 or 7) → tape handler
	21	RJ	TH2	TH	Read 2 label blks and 1st blk. gen. rtns → tape image
	22	TP	TI170	A	1st word of 2nd label blk → A
	23	EJ	TL2	CQ25 yes	Label = △SUBRO? (i.e. gen. rtn. tape positioned correctly?)
	24	MJ	0	BR11	Alarm 9
	25	RP	30170	CR1	Trans. 1st blk. gen. rtns. (incl. prelude,) from 3rd blk. → 1st blk. tape image
	26	TP	TI360	TI	
		CA	CQ27		

			IA	CR		
	0		MJ	0	[30000]	
(29)	1		TP	TI	Q	1st word tape image → Q
	2		QT	MC13	A	Op. code → A
	3		ZJ	CR no	CR4 yes	Op. code = 0? No ⟹ end of fixed library, gen. rtns, or lib. rtns.
	4		QT	FC5	TS6	# lines prelude and routine → Temp.
	5		QT	MC	TS26	Routine callword → Au and Temp. 4
Switch (C)	6		RJ	NR	[NR17]	Sentence number for routine → sentence number List
(30)	7		TP	TS6	A	# lines prelude and routine → Av
	10		RJ	BC	BC1	# blks. prelude and routine → Av
	11		SS	FC3	25	# blks. prelude and routine-1 → Au in codeword position
	12		TP	A	TS2	# blks. prelude and routine-1 → Temp. 3 in codeword position
	13		SP	TS26	0	Routine callword → Au
	14		RP	[30000]	CR24	No ⟹ move past routine → 1st blk. next routine
	15		EJ	FA	CR16	Callword in Op. File III?
	16		SN	Q	17	-jn + r → Au
	17		SA	CR14	0	+r → Au
	20		SA	CR15	0	Address of word following callword in Op. File III → Au
	21		TU	A	CR22	Address of word following callword in Op. File III → NI
	22		TP	[30000]	A	Word following callword → A
	23		TJ	MC23	CS no	Word following callword "IP" inst? (i.e. 14-00000-00000 > (A)?)
(31)	24		SP	TS2	0	# blks prel. and rtn-1 → Au in codeword position
	25		AT	TS21	TH3	Codeword → move forward [N] blks. routine (gen. or lib.) tape
	26		RJ	LC	LC1	Move past routine and count blks moved
(32)	27		TP	TS17	TH3	Codeword to read 1 blk routine (prelude blk.) → G.T.H.
	30		RJ	LC	LC1	Read 1st block of next routine → tape image
	31		MJ	0	CR1	
			CA	CR32		

General Setup for Routine Modification

		IA	CS		
(33)	0	TP	A	Q	Word following callword in Op. File III → Q
	1	QT	FC5	TS3	H.S.S. running add. rtn. to be modified → temp 3
	2	LT	10017	MI1	H.S.S. running add. rtn. to be modified → input mod. rtn.
	3	QA	MC	MI6	H.S.S. running add. + # lines in rtn. → "u" of temp.
	4	TP	TI2	Q	3rd word or prelude → Q
	5	QT	FC4	TS	# fixed constants → temp. 0 in "v"
	6	LQ	Q	6	# relative constants → Qu
	7	QT	MC2	MI2	# relative constants → mod. rtn. input
	10	LQ	Q	11	# fixed constants → Qu
	11	QT	MC2	MI3	# fixed constants → mod. rtn. input
(34)	12	LQ	Q	11	# fixed temporaries → Qu
	13	QT	MC2	MI4	# fixed temporaries → mod. rtn. input
	14	LQ	Q	11	# working temporaries → Qu
	15	QT	MC2	MI5	# working temporaries → mod. rtn. input
	16	SP	MI6	0	Last address in running rtn. + 1 → Au
	17	ST	MI5	MI5	Initial running add. working temps → input mod. rtn.
(35)	20	ST	MI4	MI4	Initial running add. fixed temps → input mod. rtn.
	21	ST	MI3	MI3	Initial running add. fixed constants → input mod. rtn.
	22	ST	MI2	MI2	Initial running add. relative constants → input mod. rtn.
(36)	23	RA	TS3	RC17	Form drum image address of modified routine → "v" of temp 3
	24	TP	TI1	TS1	No. lines subject to add. mod. → temp 1 (counter 1)
	25	TP	RC34	CU	Preset add. 1st line to be modified → 7th line tape image
	26	TP	RC3	CU4	Preset add. for 1st modified line → 1st line tape image
(37)	27	TV	TS3	CU26	Preset drum image add. for rtn. to be modified
	30	TP	LV	LV2	Set current image limit → 1 blk.
Setup Switch (D)	31	MJ	0	[30000]	
		CA	CS32		

Special Setup For Library Routine Modification

		IA	CT		
(38)	0	TP	TI6	Q	Entrance line of library rtn. → Add. mod. rtn input
	1	RJ	MR	MR1	Modify entrance line
	2	TP	MI	TI6	Modified entrance line → routine heading
	3	RA	TI4	TI3	# inputs + # outputs
	4	AT	FC11	TI4	# lines in lib. rtn hdg. (3) + # inputs + # outputs → Av
	5	AT	CU4	CU4	Adv. add. for next modified line by # inputs + # outputs + 3
	6	RS	TS1	TI4	Decrease # lines subj. to add.mod. to exclude hdg.and inputs and outputs
	7	LA	TI4	17	# inputs + # outputs + 3 → Au
	10	AT	RC1	CT13	Setup jn of repeat to move hdg. → Beginning tape image
(39)	11	RA	CU	TI4	Adv. add of next line to be modified to skip hdg. + inputs + outputs
Switch (G)	12	RJ	NR	[NR1]	Library routine name → sent. no. List
(40)	13	[0	30000	30000]	
	14	TP	TI6	TI]	Move routine heading to beginning of tape image
		CA	CT15		

Process Lines Of Routine To Be Modified

		IA	CU		
(41)	0	TP	[30000]	Q	Line to be modified → Q
	1	QT	MC13	A	Op. code of line to be modified → A
	2	EJ	FC12	CU7	Op. code = 10? ⇒ increment last modified line by (u and v)
	3	RJ	MR	MR1	Modify line
	4	TP	MI	[30000]	Modified line → tape image
	5	RA	CU4	FC3	1 in "v" adv. → add. for next modified line
	6	MJ	0	CU20	
(42)	7	SP	CU4	0	Address for next modified line → Av
	10	EJ	RC3	CU13	Add. next mod. line = 1st line tape image? Yes⇒last mod. line on drum
	11	SS	FC3	17	H.S.S. address last line modified → Au
	12	MJ	0	CU15	
	13	SP	CU26	0	Address of line following last modified line on drum → Av
	14	SS	FC3	17	Drum address of last line modified → Au
	15	TU	A	CU17	
	16	RS	Q	FC12	"u" and "v" of "10" line → Q with zero Op. code
	17	RA	[30000]	Q	Add contents of "u" and "v" of "10" line → last modified line
(43)	20	RA	CU	FC13	1 in "u" adv. → address of next line to be modified
(44)	21	TJ	LV2	CU33 no	Was this last line in current image load?
	22	RS	CU4	RC3	Determine # modified lines → Av
	23	SA	FC14	17	Form jn of repeat to transfer modified lines → drum image
	24	TU	A	CU25	Preset jn of repeat
	25	RP	[30000]	CU27	}
	26	TP	TI	[30000]	} Transfer modified lines → drum image
	27	RA	CU26	CU4	Adv. add. in drum image by # lines transferred
	30	RJ	IR	IR1	Read more lines of gen. routine → tape image
	31	TP	RC2	CU	Preset address next line to be modified → 1st line tape image
	32	TP	RC3	CU4	Preset address for next modified line → 1st line tape image
(45)	33	IJ	TS1	CU	Have all lines subject to address modification been processed?
	34	SP	CU4	0	Address for next modified line in tape image → Av

35	ST	RC3	TS4	# modified lines not yet transferred to drum → temp
36	SP	TS	0	Number of fixed (unmodifiable) constants → Av
37	ZJ	CV no	CW yes	Number fixed constants = zero?
	CA	CU40		

		IA	CV		
(46)	0	SP	LV2	0	Limit for current image load → A
	1	SS	CU	25	Form # lines in image not processed → "v" of A_1
	2	LT	0	A	Form # lines in image not processed → Av
	3	TJ	TS	CV5 yes	# fixed constants > # lines in image not processed?
	4	SP	TS	0	# fixed constants (all const. for rtn) → Au
	5	TP	A	TS5	# fixed constants in image to be transferred to drum → temp. 5
	6	SP	TS4	0	# modified lines yet to be transferred to drum → Au
	7	ZJ	CV10 no	CV20 yes	# modified lines yet to be transferred to drum = Zero?
	10	TU	CU	CV17	Preset address for 1st fixed constant
	11	TV	CU4	CV17	Preset transfer add. for fixed const. → Add. for next mod. line
	12	SP	TS5	17	Preset jn to pack fixed constants with modified lines
	13	AT	RC4	CV16	
	14	RA	TS4	TS5	# modified lines + # fixed const. = # lines to be trans. to drum → temp.
	15	TU	RC2	CV26	Preset Add of 1st line to be trans. to drum → 1st line tape image
	16	[RP	[30000]	CV22]	Pack fixed constants with modified lines in tape image
	17	TP	[30000]	[30000]	
	20	TP	TS5	TS4	Set # lines to be trans. to drum = # fixed const. in tape image
	21	TU	CU	CV26	Preset add. of 1st line to be trans. to drum → add. 1st fixed const.
	22	SP	TS4	17	Preset jn to transfer fixed const. and/or modified lines to drum
	23	AT	RC5	CV25	
(47)	24	TV	CU26	CV26	Preset next available address in drum image
	25	[RP	[30000]	CV27]	Transfer fixed constants and/or modified lines → drum image
	26	TP	[30000]	[30000]	
	27	RA	CU26	TS4	Advance drum image address by # lines transferred
(48)	30	RS	TS	TS5	Decrease # fixed const. to be trans. by # just transferred
Switch (E)	31	ZJ	CW3 no	[30000] yes	All fixed constants for routine transferred → drum image
		CA	CV32		

```
                    IA  CW
          0         TP  TS4          TS              # modified lines yet to be trans-
                                                     ferred --> TS
          1         SP  TS4          17
Switch }  2         ZJ  CW7  no     [30000] yes     # Modified lines yet to be trans-
(J)       }                                          ferred = zero?
(49)      3         RJ  IR           IR1             Read more fixed constants from gen.
                                                     tape --> tape image
          4         SP  LV3          0               # lines full image load --> Au
          5         TJ  TS           CW14 yes        # fixed constants yet to be trans.
                                                     > full image load?
          6         SP  TS           17              # fixed constants yet to be trans.
                                                     --> Au
(51)      7         AT  RC6          CW12            Preset jn of repeat
         10         TV  CU26         CW13            Preset available drum image address
         11         RA  CU26         TS              Adv. drum image address by # lines
                                                     to be transferred
         12        [RP [30000]       CR27] }         Transfer remaining modified lines
         13         TP  TI          [30000] }        or fixed constants --> drum image
         14         TV  CU26         CW20            Preset avail. drum image address
         15         RA  CU26         LV3             Adv. drum image add. by # lines
                                                     full image load
         16         RS  TS           LV3             Reduce # fixed constants by # lines
                                                     full image load
         17         RP  IL30000      CW3  }
         20         TP  TI           [30000] }       Transfer full image load fixed
                                                     constants --> drum image
(50)     21         IJ  TS15         CR27 no         All library rtns for problem proc-
                                                     essed this segment?
         22         MJ  0            CX              --> End segment
                    CA  CW23
```

			IA	CX		
⑨	0		RA	TS11	RC17	Initial add. drum image + add. of "IP" jump to next seg. → temp. 7
	1		TV	A	CX3	Preset drum image address for "IP" instruction
	2		TP	FA1	A	"IP" Jump to next segment from 2nd word Op. File III → "A"
	3		AT	FC3	[30000]	Add one to "v" address and transfer "IP" to drum image
	4		TP	TL5	TI	SEGMEN → 1st word in segment label block
	5		TP	TL6	TI1	T△△△△△→2nd word in segment label block
⑩	6		SP	TS10	25	Octal segment no. → "v" of "A" left
	7		LT	0	TI2	Octal seg. no. → "v" of 3rd word in seg. label block
	10		SP	TS7	71	# lines in Preface → "v" of "A" right
	11		TP	A	TI7	# lines in Preface → "v" of 8th line seg. lab. blk.
	12		DV	FC2	TI3	# lines in Pref. (term.)/170_8 = full blks term. → 4th line seg. lab. blk.
	13		ZJ	CX14 yes	CX15 no	Is there partial block?
⑪	14		RA	TI3	FC3	Adv. # blks. Termination by one to count partial blk.
⑫	15		SP	TI7	0	# lines in preface → Av
	16		AT	TS12	TS1	# lines in Preface + # lines stmts and routines + 2 →temp 2
	17		DV	FC2	TI4	# full blocks segment+Preface → 2nd thru 5th octal digit positions of 5th line seg. lab. blk.
⑬	20		LQ	TI4	25	
	21		TP	A	TI5	# lines partial blk. seg. + Pref. → "v" of 6th line seg. lab. blk.
	22		TP	TS25	A	Seg. image address → A
	23		AT	TS1	TS5	Seg. image add. + # lines seg. + Pref. = add. line after Preface
⑭	24		SS	TI7	17	(A) - # lines Pref. = Pref. Exit add. → Au
	25		SA	TS5	0	Add. line following Pref. → Av
	26		SS	FC20	0	(A) - 2 = Pref. Ent. add. → Av
	27		AT	FC17	TI6	"RJ" inst. to execute Preface → 7th line seg. lab. blk.
⑮	30		SP	TI5	17	# lines partial blk. seg. + Preface → Au
	31		ZJ	CX32 no	CX34 yes	# lines partial blk. seg. + Preface =zero?

```
      32    SA  TS5      0          Address of line following preface
                                    ⟶ Av
      33    ST  TI5      TI5        # lines partial blk. seg. + pref.
                                    in "u" and H.S.S. part. blk. in "v"
                                    ⟶6th line seg. lab.
      34    TP  TI4      TS2        # full blks. seg. + pref. ⟶ temp.
                                    in codeword position
(16)  35    RP  10160    CY
      36    TP  TL       TI10       Z's ⟶ lines 9-120 of segment label
                                    blk.
            CA  CX37
```

```
          IA  CY
 0        SP  TI3      25          # blks. in pref. (term.) → A in
                                   codeword position
 1        AT  TC15     TS          Codeword to read Termination from
                                   tape → Temp.
 2        AT  FC7      TH3         Adv. by 1 to include Op. File III
                                   end entry blk.
 3        RJ  TH2      TH          Read Preface and/or Op. File III
                                   end entry blk. → File  image
 4        TP  FA       A           1st word File image → A
 5        EJ  TL3      CY7         1st word = END△OF? (i.e. tape posi-
                                   tioned properly)
 6        MJ  0        BR12        Alarm # 10
(17) 7    RA  TS7      FC15        Add 30000 to # lines in Preface
                                   →  Au
10        TU  A        CY13        Preset "u" of repeat
11        RA  TS12     RC35        # lines stmts. and rtns + 2 + drum
                                   add. init. stmt. = drum add. Preface
12        TV  A        CY14        Preset drum add. for Preface
13        RP  [30000]  CY15  }
14        TP  FA170    [30000]  }  Preface → Drum image
15        RP  30170    CY17  }
16        TP  TI       DI    }     Segment label block → drum image
(18) 17   RA  TS1      FC2         Adv. # lines segment by 170₈ to
                                   count label blk.
20        TU  RC11     CY26
(19) 21   SP  LV5      0           # lines in buffer (tape image +
                                   file image) → Av
22        TJ  TS1      CZ17 yes    # lines segment remaining > full
                                   buffer load?
(21) 23   SP  TS1      17
24        AT  RC7      CY25        Form jn of repeat → NI
25        [RP 30000    CY27]  }
26        TP  [30000]  TI     }    Segment + seg. label blk. → buffer
27        TP  MC       Q           "u" mask → Q
30        QT  DI5      Q           # lines partial blk. seg. + Pref.
                                   → Qu and Au
31        ZJ  CY32 no  CZ1 yes     # lines partial blk. seg. + Pref.
                                   = zero?
32        TP  RC10     A     }
33        ST  Q        CY36  }     Form "RP" to fill rest of partial
                                   blk. with Z's
34        TV  RC3      CY37        Preset "v" of "TP" to initial add.
                                   tape image
35        RA  CY37     TS1         Adv. by # lines segment + label
                                   → Add. for Z's in partial blk.
36        RP  [30000]  CZ
37        TP  TL       [30000]     Z's → fill remainder partial block
          CA  CY40
```

```
                IA  CZ

        0       RA  TS2         FC7         Adv. # full blks. seg. + Pref. by
                                            1 to count partial block
        1       RA  TS2         FC7         Adv. # full blks. seg. + Pref. by
                                            1 to count seg. label block
(22)    2       AT  TC24        TH3         Codeword --> tape handler
        3       RJ  PC          PC1         Adv. and check count of blks. on
                                            Binary program tape
        4       RJ  TH2         TH          Write remainder (or all) of segment
                                            on Binary program tape
        5       TP  TS          Q
        6       TP  Q           TH3         Codeword --> tape
        7       QT  FC21        TS          # blks. Termination --> A and temp.
                                            in codeword position
        10      ZJ  CZ11 no     CZ16 yes    # blks. Termination = zero?
        11      RJ  PC          PC1         Adv. and check count of blks. on
                                            Binary program tape
        12      RJ  TH2         TH          Read Termination from servo 5 -->
                                            File image
        13      SP  TS          0           # blks. Termination --> A
        14      AT  TC25        TH3         Codeword --> Tape Handler
        15      RJ  TH2         TH          Write Termination on Binary Program
                                            Tape
        16      MJ  0           CL          --> Process next segment
        17      TU  CY26        CZ21        Preset drum image add. of next
                                            buffer load
        20      RP  BL30000     CZ22 }      Full buffer load of segment from
                                             drum image --> buffer
        21      TP  [30000]     TI   }
        22      RA  CY26        LV10        Adv. drum image add. by # lines
                                            full buffer load
(20)    23      TP  TC26        TH3         Codeword to write full buffer load
                                            --> Tape Handler
        24      RJ  PC          PC1         Adv. and check count of blks. on
                                            Binary program tape
        25      RJ  TH2         TH          Write full buffer load on Binary
                                            program tape
        26      RS  TS1         LV5         Decrease # lines segment remaining
                                            by # lines full buffer
        27      RS  TS2         LV6         Decrease # full blocks seg. + Pref.
                                            by # blocks in buffer
        30      MJ  0           CY21
                CA  CZ31
```

		IA	DA		
(23)	0	TP	TC13	TH3	
	1	RJ	TH2	TH	Rewind library tape (servo #2)
	2	TP	TC16	TH3	
	3	RJ	TH2	TH	Rewind corrected problem tape (servo #5)
	4	RP	10360	DA6	2 blks. of Z's → buffer
	5	TP	TL	TI	
	6	TP	TC27	TH3	
	7	RJ	TH2	TH	Write 2 blks. of Z's on Binary program tape
(24)	10	TP	TC30	TH3	
	11	RJ	TH2	TH	Rewind Binary program tape (servo # 3 or 6)
	12	RS	TC2	TC3	# blks. fixed library advanced
	13	SS	TC	0	# blks. adv. - total # blks. fixed library
	14	ZJ	DA15 no	CK yes	(A) = Zero? Yes ⇒ servo 1 positioned at listing phase setup blk.
(25)	15	SJ	DA16 -	DA20 +	
	16	TN	A	A	# blks. to move forward → A
	17	TP	TC1	TC3	Replace move backward codeword by move fwd. CW
	20	AT	TC3	TH3	Move forward or backward codeword → G.T.H.
	21	RJ	TH2	TH	Position servo 1 at beginning listing phase setup block
	22	MJ	0	CK	
		CA	DA23		

Subroutine to Count Blocks of Library (Fixed or Standard) Processed

		IA	LC		
(70) Switch (F)	0	MJ	0	30000	
	1	MJ	0	[30000]	
	2	TP	TH3	Q	Tape handler codeword → Q
	3	QT	FC21	A	# blks. current routine to be read or moved
	4	[0	30000	30000]	Add # blks. to move backward codeword for current tape
	5	RJ	TH2	TH	→ tape handler
	6	MJ	0	LC	
		CA	LC7		

Subroutine to Count Blocks on Object (Binary) Program Tape

		IA	PC		
	0	MJ	0	[30000]	
(71) Switch (I)	1	TP	TH3	Q	Tape handler codeword → Q
	2	QT	FC16	A	# blks. to be written on Binary prog. tape → A
	3	AT	TS13	TS13	Adv. count of blks. Binary prog. tape by # blks. to be written
	4	TJ	LV11	PC	Limit # blks. > current # blks. Binary program tape
	5	TP	TO	UP3	Parameter → Uniprint
	6	RJ	UP2	UP	Print warning
	7	TP	PC10	PC1	
	10	MJ	0	PC	
		CA	PC11		

Input Routine

	IA	IR		
0	MJ	0	[30000]	
(72) 1	SP	LV7	0	
2	TJ	TS2	IR7yes	# blks. prelude and routine remaining to be read > # blks. tape image?
3	SP	TS2	0	
4	AT	TS16	TH3	Codeword to read [n] blks. current routine tape → tape handler
5	RJ	LC	LC1	Read remaining blks. current routine → image
6	MJ	0	IR12	
7	TP	TS20	TH3	Codeword to read full image load current routine → tape image
10	RJ	LC	LC1	Read full image load current routine → tape image
11	RS	TS2	LV7	
12	TP	LV1	LV2	Set current image limit → # lines full image load
13	MJ	0	IR	
	CA	IR14		

Subroutine to Build Sentence Number List

		IA	NR		
	0	MJ	0	[30000]	
(73)	1	SP	TS26	0	Library routine callword → A
	2	LT	22	Q	
	3	QT	FC4	A	
	4	AT	RC12	Q	Add. for lib. rtn. name in lib. list in core → Qv
	5	SP	A	17	Add. for lib. rtn. name in lib. list in core → Au
	6	TU	A	NR10	
	7	TP	TI5	A	XS3 library rtn name → A
	10	EJ	[30000]	NR yes	Name in list?
(74)	11	TV	Q	NR12	
	12	TP	A	[30000]	XS3 library name → library list in core
	13	IJ	TS14	NR no	Names of all library routines for problem in list?
	14	TV	RC36	CT12	Set switch (G) → (G2) to by-pass sent. no. routine
	15	RP	31000	NR	}
	16	TP	LL	ND3100	} Library list in core → sentence no. list on drum
(75)	17	TJ	FC24	NR30 yes	23000 > CW? Yes ⟹ pseudo Op. sentence
	20	TJ	FC25	NR32 yes	25000 > CW? Yes ⟹ subs. var. equation (NB → no routines with 23--- CW)
	21	TJ	FC26	NR34 yes	26000 > CW? Yes ⟹ non-subs. var. equation
	22	TJ	FC27	NR30 yes	30000 > CW? Yes ⟹ statement of main program
(76)	23	LT	17	Q	No ⟹ Pseudo Op.
	24	QT	FC22	A	}
	25	AT	RC16	NR26	} Form add. for pseudo op. sent. no.
	26	[00	30000	30000]	XS3 sent. no. for pseudo Op → sent. no. list on drum
	27	MJ	0	NR	
(77)	30	TP	RC13	A	Base add. for 22---, 26---, or 27--- CW
	31	MJ	0	NR35	
(78)	32	TP	RC14	A	Base add. for 24--- CW
	33	MJ	0	NR35	
(79)	34	TP	RC15	A	Base add. for 25--- CW
(80)	35	LQ	Q	25	CW → Qv
	36	QA	FC4	NR37	Form add. for sent. no.
	37	[0	30000	30000]	XS3 sent. no. → list
	40	MJ	0	NR	
		CA	NR41		

Routine to Calculate Block Count from Line Count

		IA	BC		Input = number of lines in "v" of "A"; Output = # blks. in Av
	0	MJ	0	[30000]	
(81)	1	TJ	FC6	BC6 yes	551_8 > # lines to be converted? (i.e. # blks. < 4?)
	2	DV	FC2	Q	# lines /170_8 = # full blks. → Q
	3	ZJ	BC4 yes	BC13 no	Is there partial block?
	4	RA	Q	FC3	Adv. count of # blks. by 1 to count partial blk.
	5	MJ	0	BC	
	6	TP	FC	Q	Zero → Q
	7	TN	A	TS24	Complement of # lines to be converted → temp.
	10	RA	Q	FC3	Adv. count of blks. by 1 in "v"
	11	RA	TS24	FC2	Adv. complement of # of lines by 170_8
	12	SJ	BC10	BC13 yes	All blks. counted?
	13	TP	Q	A	# full blks. → Av
	14	MJ	0	BC	
		CA	BC15		

Fixed Constants

	IA	FC	
0	0	0	0
1	0	20000	0
2	0	0	170
3	0	0	1
4	0	0	777
5	0	0	77777
6	0	0	551
7	0	100	0
10	0	0	7
11	0	0	3
12	10	0	0
13	0	1	0
14	0	0	30000
15	0	30000	0
16	0	7700	0
17	37	0	0
20	0	0	2
21	07	77700	0
22	0	0	77
23	0	50000	0
24	0	23000	0
25	0	25000	0
26	0	26000	0
27	0	30000	0
30	0	3000	0
31	0	0	300
	CA	FC32	

Relative Constants

	IA	RC		
0	0	0	DI	
1	RP	30000	CU33	D1 in "V"
2	TP	TI	Q	
3	TP	MI	TI	
4	RP	30000	CV22	
5	RP	30000	CV27	
6	RP	30000	CR27	
7	RP	30000	CY27	
10	RP	10170	CZ	
11	0	DI	0	
12	0	0	LL	Initial address lib. name list in core
13	TP	TI5	ND	
14	TP	TI5	ND1000	
15	TP	TI5	ND2000	
16	TP	TI5	ND3000	
17	0	0	[DI170]	Chged. by program to drum add. for segment — H.S.S. add. for run. seg.
20	0	0	LC5	
21	0	0	LC2	
22	AT	TC2	TC2	
23	AT	TS23	TS23	
24	0	0	CT	D2 in "V"
25	0	0	CR7	
26	0	0	CN	A1
27	0	0	CN12	A2
30	0	0	CP	B1
31	0	0	CP21	B2
32	0	0	CR27	E1
33	0	0	CW21	E2
34	TP	TI6	Q	
35	0	0	DI170	Segment image address for first statement of segment
36	0	0	CT13	
	CA	RC37		

Tape Handler Codewords

	IA	TC		
0	0[0	017]00	0	# blocks of fixed library
1	3[0	000]01	0	Move forward [n] blocks servo 1
2	[4[0	000]01	0]	Move backward codeword with count of fixed library advanced
3	4[0	000]01	0	Move backward [n] blks servo 1
4	5[0	001]01	TI	Read forward 1 blk servo 1
5	5[0	000]01	TI	Read forward n blks servo 1
6	3[0	000]02	0	Move forward n blks servo 2
7	4[0	000]02	0	Move backward n blks servo 2
10	5[0	001]02	TI	Read forward 1 blk servo 2
11	5[0	002]02	TI	Read forward 2 blks servo 2
12	5[0	000]02	TI	Read forward n blks servo 2
13	1 0	000 02	0	Rewind servo 2
14	5[0	001]05	FA	Read forward 1 blk servo 5
15	5[0	000]05	FA	Read forward n blks servo 5
16	1 0	000 05	0	Rewind servo 5
17	3[0	000]04	0	Move forward [n] blks servo 4 or 7
20	5[0	001]04	TI	Read forward 1 blk servo 4 or 7
21	5[0	003]04	TI	Read forward 3 blks servo 4 or 7
22	5[0	000]04	TI	Read forward n blks servo 4 or 7
23	1 0	000 04	0	Rewind servo 4 or 7
24	7 1	0[00]03	TI	Write [n] blks servo 3 or 6
25	7 1	0[00]03	FA	Write [n] blks servo 3 or 6
26	7 1	000 03	TI	Write full buffer servo 3 or 6
27	7 1	0[02]03	TI	Write 2 blks servo 3 or 6
30	1 0	000 03	0	Rewind servo 3 or 6
	CA	TC31		

Tape Labels

	IA	TL		
0	74	74747	47474	Z Z Z Z Z Z
1	31	34463	00106	F I L E △ 3
2	01	65672	55451	△ S U B R 0
3	30	50270	15131	E N D △ 0 F
4	01	01463	42501	△ △ L I B △
5	65	30324	73050	S E G M E N
6	66	01010	10101	T △ △ △ △ △
	CA	TL7		

Typeout

	IA	TO		
0	0	T01	22	
1	71	24545	03450	W A R N I N
2	32	21010	15125	G , △ △ 0 B
3	44	30266	60152	J E C T △ P
4	54	51325	42447	R 0 G R A M
5	01	51500	16530	△ 0 N △ S E
6	54	70510	10601	R V 0 △ 3 △
7	71	34464	60130	W I L L △ E
10	72	26303	02701	X C E E D △
11	05	10030	30125	2 5 0 0 △ B
12	46	51264	56522	L 0 C K S .
13	01	01246	66630	△ △ A T T E
14	47	52660	12530	M P T △ B E
15	34	50320	14724	I N G △ M A
16	27	30016	65101	D E △ T 0 △
17	26	51506	63450	C 0 N T I N
20	67	30012	65147	U E △ C 0 M
21	52	34462	46634	P I L A T I
22	51	50227	77777	0 N . 77 77 77
	CA	T023		

Limiting Values

	IA	LV		
0	TP	TI170	Q	Limit for 1 blk image load
1	TP	II	Q	Limit for full image load II = TI + IL
2	TP	30000	Q	Limit for current image load
3	0	0	IL	
4	0	0	FL	
5	0	0	BL	
6	0	BB	0	Shift to codeword position - # blks in buffer
7	0	IB	0	Shift to codeword position - # blks tape image
10	0	BL	0	# lines in buffer
11	0	PB	0	Limit # blks. Binary prog. tape (2501_{10}) in codeword position
	CA	LV12		

Address Modification Control Subroutine

		IA	MR		
					Input = word to be modified in Q
(55)	0	MJ	0	30000	
(52)	1	TP	Q	MI	Word to be modified → Output line
	2	QT	MC13	MI6	Oper. code of word to be modified → temp.
	3	TP	MI6	A	Oper. code of word to be modified → A
	4	RP	20011	MR6	Op. code = 17, 22, 45, 56, 61, 63, 75, 76, or 77 ⟹ only "v" address to be modified
	5	EJ	MC3	MR17	
	6	EJ	MC22	MR	Oper. code = 05? } Neither address to be modified
	7	EJ	MC23	MR	Oper. code = 14?
	10	EJ	MC24	MR	Oper. code = 57?
	11	TP	MI	Q	"u" of word to be modified → "u" of Q
	12	RJ	MS	MS1	Modify "u" address (result in "u" of A)
	13	TU	A	MI	Modified "u" address → output line
(53)	14	TP	MI6	A	Oper. code of word to be modified → A
	15	RP	20006	MR17	Op. code = 31, 32, 33, 34, 54, or 55 ⟹ only "u" address to be modified.
	16	EJ	MC14	MR	
(54)	17	SP	MI	17	"v" of word to be modified → "u" of A
	20	TP	A	Q	"v" of word to be modified → "u" of Q
	21	RJ	MS	MS1	Modify "v" address (result in "u" of A)
	22	LT	25	Q	Modified "v" add. → "v" of Q
	23	TV	Q	MI	Modified "v" add. → "v" of output
	24	MJ	0	MR	
		CA	MR25		

Modify Address Subroutine

		IA	MS		
	0	MJ	0	30000	
(56)	1	QT	MC	A	Address to be modified → Au with "op." and "v" = zero
	2	RP	30024	MU2	No ⇒ 77--- CW.
	3	TJ	MD	MS4	Search list to determine modification required
	4	MJ	0	MS	No modification; address < 1000_8 → EXIT
	5	MJ	0	MT	Address relative to 1000_8 (i.e. $1000_8 \leq$ address $\leq 7777_8$)
	6	MJ	0	MT3	10--- CW ; relative constant
	7	MJ	0	MS	No modification; $11000_8 \leq$ address $\leq 17777_8$ → EXIT
	10	MJ	0	MT6	20--- CW; fixed constant
(57)	11	MJ	0	MS	No modification; $21000_8 \leq$ address $\leq 21777_8$ → EXIT
	12	MJ	0	MU2	22---, 23---, 24---, 25---, 26---, or 27--- CW
	13	MJ	0	MS	No modification; $30000_8 \leq$ address $\leq 37777_8$ → EXIT
	14	MJ	0	MU2	4----, or 5---- CW.
	15	MJ	0	MT11	60--- CW; fixed temporary
(58)	16	MJ	0	MT14	61--- CW
	17	MJ	0	MT20	62--- CW
	20	MJ	0	MT14	63--- CW
	21	MJ	0	MT24	64---, 65---, or 66--- CW
	22	MJ	0	MT30	67--- CW
	23	MJ	0	MT34	70--- CW
(59)	24	MJ	0	MU	71--- CW
	25	MJ	0	MS	No modification; $72000_8 \leq$ address $\leq 74777_8$ → EXIT
	26	MJ	0	MT20	75--- CW
	27	MJ	0	MT14	76--- CW
		CA	MS30		

		IA	MT		
(60)	0	SS	MD	0	Address relative 1000_8 — 1000_8 = rel. loc. in rtn. → Au
	1	SA	MI1	0	Rel. loc. in rtn. + base running add. of rtn. = abs. add. → Au
	2	MJ	0	MS	
(61)	3	SS	MD1	0	10--- CW — 10000_8 = rel. loc. in rel. const. reg. → Au
	4	SA	MI2	0	Rel. loc. + base running add. rel. const. reg. = abs. add. → Au
	5	MJ	0	MS	
(62)	6	SS	MD3	0	20--- CW — 20000_8 = rel. loc. in fixed const. reg. → Au
	7	SA	MI3	0	Rel. loc. + base running add. fixed const. reg. = abs. add. → Au
	10	MJ	0	MS	
(63)	11	SS	MD10	0	60--- CW — 60000_8 = rel. loc. in fixed temp. reg. → Au
	12	SA	MI4	0	Rel. loc. + base running add. fixed temp. reg. = abs. add. → Au
	13	MJ	0	MS	
(64)	14	TP	MC1	Q	Mask (2 digits of "u") → Q
	15	QT	A	A	Rel. loc. in pseudo Op. input reg. → Au
	16	SA	MC26	0	Rel. loc. + base running add. pseudo Op. input reg. = abs. add. → Au
	17	MJ	0	MS	
(65)	20	TP	MC1	Q	Mask (2 digits of "u") → Q
	21	QT	A	A	Rel. loc. in function input region → Au
	22	SA	MC25	0	Rel. loc. + base running add. function input reg. = abs. add. → Au
	23	MJ	0	MS	
(66)	24	TP	MC2	Q	Mask (3 digits of "u") → Q
	25	QT	A	A	Rel. loc. in non-subs. var. region → Au
	26	SA	7	0	Rel. loc. + base running add. non-subs. var. region = abs. add. → Au
	27	MJ	0	MS	
(67)	30	ST	MD15	Q	67--- CW — 67000_8 = rel. loc. in constant pool → Qu
	31	SP	10	17	Base running add. constant pool → Au
	32	SA	Q	0	Rel. loc. + base running add. constant pool = abs. add. → Au
	33	MJ	0	MS	

(68)	34	SS	MD16	0	70---- CW - 70000_8 = rel. loc. in working temporary region ⟶ Au
	35	SA	MI5	0	Rel. loc. + base running add. working temp. reg. = abs. add. ⟶ Au
	36	MJ	0	MS	
		CA	MT37		

		IA	MU		
(69)	0	SS	MD16	0	71—— CW - 70000_8 = abs. add. ⟶ Au
	1	MJ	0	MS	
(69A)	2	RP	[30000]	BR13	No ⟹ alarm 11
	3	EJ	FA	MU4	Callword in Op. File III
	4	SN	Q	17	- jn + r ⟶ Au
	5	SA	MU2	0	+ r ⟶ Au
	6	SA	MU3	0	Address of word following callword in Op. File III ⟶ Au
	7	TU	A	MU10	
	10	TP	[30000]	A	Word following callword in Op. File III ⟶ A
	11	TJ	MC23	MU14	(A) = IP (14) command (i.e. flagged cross reference)?
	12	TP	A	MI	IP (14) instruction to reference other segment ⟶ output
	13	MJ	0	MR	Exit from add. modification routine
	14	SP	A	17	H.S.S. running add. for referenced routine ⟶ Au
	15	MJ	0	MS	Exit
		CA	MU16		

Modification Constants

	IA	MC		
0	0	77777	0	
1	0	77	0	
2	0	777	0	
3	17	0	0	
4	22	0	0	
5	45	0	0	
6	56	0	0	
7	61	0	0	
10	63	0	0	
11	75	0	0	
12	76	0	0	
13	77	0	0	
14	31	0	0	
15	32	0	0	
16	33	0	0	
17	34	0	0	
20	54	0	0	
21	55	0	0	
22	05	0	0	
23	14	0	0	
24	57	0	0	
25	0	FI	0	Base add. function input region ≡ init. add. term. buffer
26	0	PI	0	Base add. pseudo Op. input region ≡ 13_{10}^{th} add. term. buffer
	CA	MC27		

	IA	MD	
0	0	1000	0
1	0	10000	0
2	0	11000	0
3	0	20000	0
4	0	21000	0
5	0	22000	0
6	0	30000	0
7	0	40000	0
10	0	60000	0
11	0	61000	0
12	0	62000	0
13	0	63000	0
14	0	64000	0
15	0	67000	0
16	0	70000	0
17	0	71000	0
20	0	72000	0
21	0	75000	0
22	0	76000	0
23	0	77000	0
	CA	MD24	

Explanation of Modification Routine Inputs (MI)

MI0	[0	0	0]	Output = modified word
1	0	[30000]	0	H.S.S. running address for routine
2	0	[30000]	0	Initial running address relative constant region
3	0	[30000]	0	Initial running address fixed constant region
4	0	[30000]	0	Initial running address fixed temporary region
5	0	[30000]	0	Initial running address working temporary region
6	0	0	0	Temp.

Explanation of Temporary Storage Region (TS)

TS0	0	0	30000	# fixed constants with rtn. in "v"; Codeword to read Termination then # blks. Term. in codeword position
1	0	0	30000	# lines subj. add. modification in "v" ; # lines in segment in "v"
2	0[x	xxx] 00	0	# blks. prelude and rtn. - 1 in codeword position;# full blks. seg. + pref. in position
3	0	30000	30000	Routine callword in "u" W/zero fill; H.S.S. running add. rtn. in "v" W/zero fill
4	0	0	30000	# lines to be trans. to drum image in "v"
5	0	0	30000	# fixed const. in image to be trans. to drum in "v"; Add. following running Preface in "v"
6	0	0	30000	# lines prelude and routine in "v"; initial add. running segment in "v"
7	0	30000	0	# lines in Preface in "u"
10	0	30000	0	Segment # in "u"
11	0	0	30000	Address for "IP" jump to next segment in "v"
12	0	0	30000	# lines statements and routines (running program) + 2 in "v"
13	0[x	xxx]00	0	Count of blks. binary prog. tape in codeword position
14	0	0	[30000]	Index for count of # library routine names in library list
15	0	0	[30000]	Index for # library routines processed in segment
16	50	000 04	TI	Codeword to read [n] blks. current tape
17	50	001 04	TI	Codeword to read 1 blk. current tape
20	50	004 04	TI	Codeword to read full image load current tape
21	30	000 04	0	Codeword to move forward [n] blks. current tape
22	0	0	0	# library rtns. for problem - 1 in "v"
23	0	0	0	Count of blks. advanced on library tape
24	0	0	0	Working temp.
25	0	0	0	Add. running segment in "v"
26	0	0	0	Routine callword (temp 4)

VII. PROGRAM LISTING PHASE

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The function of this phase is to provide a record of the Object Program (absolute computer instructions), produced in response to the sentences of the Source Program (pseudo code sentences). The listing gives the absolute instructions which make up each segment of the Object Program, together with the sentence number or library routine name associated with each group of instructions. The instructions are listed four to a line and read from left to right, and down, in order of increasing High Speed Storage address. The first instruction of a routine, i.e., the group of instructions representing one sentence or one library routine, is positioned in the first line, such that, each instruction whose octal address ends in zero, will appear in the leftmost column of instructions in the listing. Each address ending in zero is listed to the left of the associated instruction. The first address of a routine is also listed in this column of addresses on the line with the first instruction. It is enclosed in parenthesis if it does not end in zero.

The listing also includes, in the same format as above, the pool of constants for the program, and the preface and termination instructions for each segment. The variables for the problem are listed in a different format. The symbol for each non-subscripted variable is listed together with its assigned High Speed Storage address. Initially, the symbol for each subscripted variable (array) is listed together with the range of drum addresses assigned to the array. In addition, each subscripted variable is listed in <u>each</u> segment in which it is referenced, together with the range of High Speed Storage addresses assigned to the array for the particular segment.

The title of the program, the subscripted variables on the drum, the non-subscripted variables, and the constant pool, are listed first, in that order.

Then in turn, each segment of the Object Program is listed. Each segment consists of the Preface (if any), the sentences and Library routines, the subscripted variables in High Speed Storage (if any), and the Termination (if any).

The listing is produced on magnetic tape edited for listing on the High Speed Printer. It is produced on Uniservo 7 if 7 Uniservos are being used and on Uniservo 5 if 5 Uniservos are being used. If the listing exceeds an arbitrary 1200 blocks, the current listing tape is terminated at the end of a page, with the statements, CURRENT LISTING TAPE FULL. PUT NEW 1500 FOOT TAPE ON SERVO ---. START TO CONTINUE LISTING., typed on the on-line Flexowriter. This allows the computer operator to change tapes and restart to continue the listing on a new tape. In addition, the statements, MOUNT NEXT LISTING TAPE ON PRINTER. DO NOT CHANGE POSITION OF PAPER., is included on the tape being terminated, together with a Printer Stop symbol. This informs the High Speed Printer operator that the listing is continued on another tape and allows him to mount the tape and continue. The statement, END OF LISTING., and a Printer Stop is included on the final tape of the listing to inform the printer operator of the end of the listing. The order in which the tapes are to be listed, in order to get a continuous listing, is the responsibility of the computer operator.

When the listing is completed the statements, PROGRAM LISTING ON TAPE ---. and END OF COMPILATION., are typed out. The computer then comes to a "56" stop.

The pages of the listing are numbered thru 999, after which the word CONTINUED is used in lieu of a page number.

The instructions of the Program Listing Phase are divided into four

groups. All four groups are read from the UNICODE System Tape into High Speed Storage; Groups II and III are then transferred to the drum. The instructions in Group I remain in High Speed Storage throughout the execution of this phase and consist of constants, temporaries and certain subroutines referenced by the instructions in the other groups.

The Group IV instructions produce the initial part of the listing, consisting of the program title, the subscripted variables on the drum, the non-subscripted variables, and the constant pool. When this part of the listing has been completed, these instructions are overlayed. In listing the subscripted variables on the drum, the information is obtained from the modified Dimension List, which contains the initial drum address and XS3 symbol for each subscripted variable, in order of increasing drum address. The modified Dimension List is assumed to be on the drum when the phase is referenced. In listing the non-subscripted variables, the XS3 symbols for the variables are obtained from the Symbol List, which contains these symbols in order of the increasing High Speed Storage addresses assigned to the variables. The High Speed Storage address associated with the first symbol in the list is obtained from fixed location 00007; the address for each succeeding variable is obtained by adding one to the address of the preceding variable. The Symbol List is read from Uniservo 5 to the List Buffer in this phase. Similarly, the Constant Pool, containing the constants in order of their increasing High Speed Storage address, is read from Uniservo 5 to the Dimension List region in the core. The High Speed Storage address of the first constant is obtained from fixed location 00010 and that of each succeeding constant is obtained by adding one to the address of the preceding constant. The program title is listed just as it appears on the UNICODE (source) Program Tape; hence, only

printable High Speed Printer characters should be used in the title.

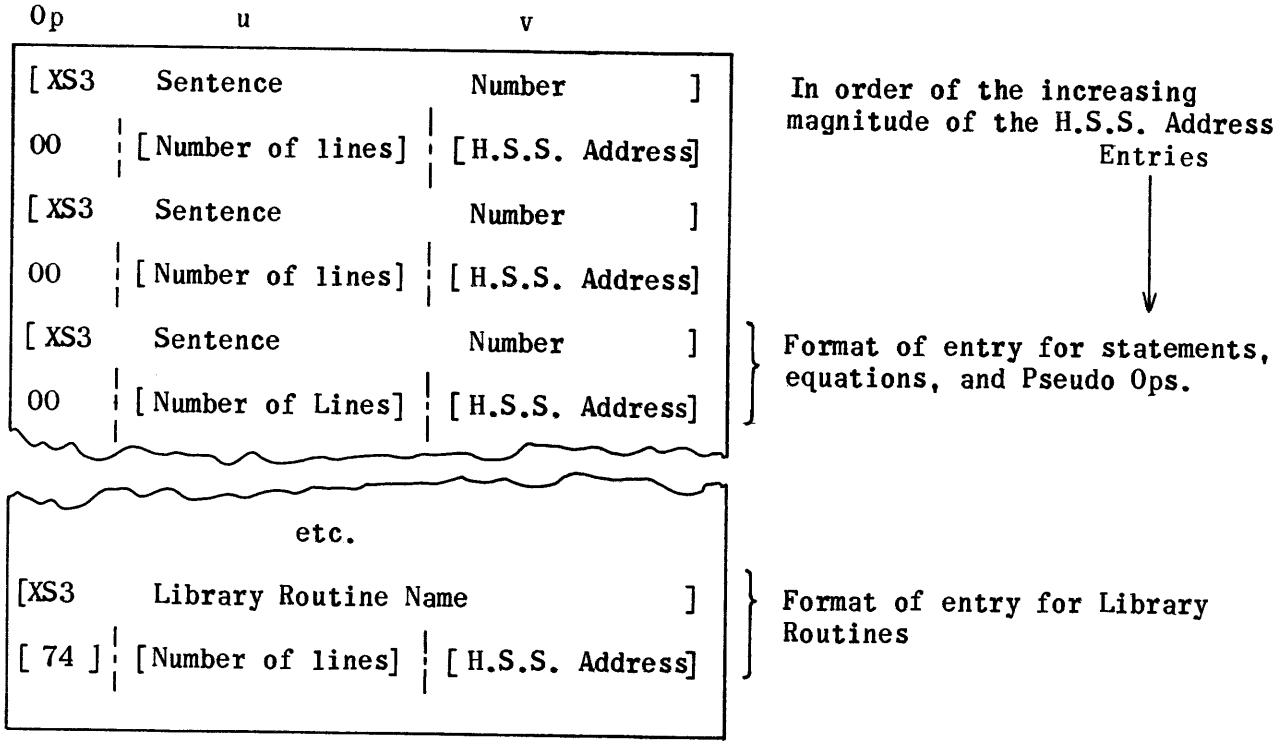
The Group II instructions, lists, etc., initially overlay the Group IV instructions and, thereafter, overlay the Group III instructions and lists. The Group II instructions are read from the drum to core whenever a new segment is to be listed and, finally, when the listing phase is to be terminated. The instructions in this group build Op. File IV for the segment to be listed and store it on drum; then they are overlayed by the Group III instructions, lists, etc. The information to build Op. File IV is obtained from Op. File III for each segment and from the Sentence Number List, which is produced by the Processor Phase and stored on the drum as input to this phase. Op. File III for each segment is read from Uniservo 5 to the File Buffer. The Group II instructions also terminate the final listing tape, rewind all tapes not yet rewound, and produce the Flexowriter typeouts at the completion of the phase.

The Group III instructions produce the listing of the segments. The Preface and Termination instructions for the segment to be listed are obtained, for listing, from Uniservo 5 following the Op. File III for the segment. The Preface is read from Uniservo 5 to the Input Buffer. The initial High Speed Storage address for the Preface is obtained from the seventh word of the Segment Label Block on the Object Program Tape, and the number of lines in the Preface is obtained from the eighth word. With these as inputs, the Preface is edited and written on the listing tape in the prescribed format, by an editing routine which is common for the Preface, Termination, Constant Pool, Sentences, and Library Routines. In listing the sentences and the library routines, the number of routines in the segment being listed is obtained from Temporary (CT5) which is set up by the routine which builds Op. File IV for the segment. The XS3 sentence number or library routine name for

a routine to be listed, the number of lines in the routine, and the initial High Speed Storage address of the routine are obtained from Op. File IV and provided as inputs to the common editing routine which edits and writes each routine on the listing tape. The sentences and library routines appear in Op. File IV in order of increasing High Speed Storage address. The Termination is read from Uniservo 5 to the Input Buffer prior to the listing of the subscripted variables in the core. In listing these variables the High Speed Storage address, in the segment being listed, is obtained in order, from the instructions of the Termination. The modified Dimension List is then searched for the drum address in order to find the XS3 symbol for the variable. The variables are then edited and listed in the prescribed format by an editing routine used in common to list the subscripted variables on the drum and in the core. The Termination is listed by sections, each representing one block of the Termination. The total number of lines in the Termination is obtained from the eighth word of the Segment Label Block. The initial High Speed Storage address of each section is merely the initial address of the Termination Buffer which is a constant. The number of lines in each section is 170 octal except for the last section which is the number of lines in the partial block remaining. Again, the common editing routine is used.

Because of the overlaying involved in the execution of the Program Listing Phase, considerable care should be exercised in making changes in the addresses or lengths of routines, lists, etc.

OP. FILE IV



Where:

Number of lines = The number of instructions, including constants and temporaries, in the routine in the Object Program associated with the preceding XS3 sentence number or name.

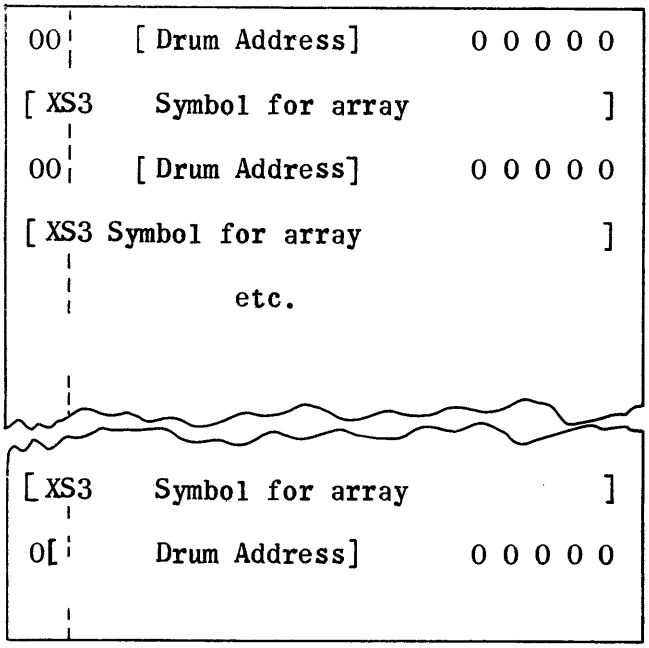
H.S.S. Address = The High Speed Storage running address of the routine in this segment of the Object Program.

The Op. File IV for each segment is built by the Program Listing Phase just prior to the listing of the segment. The information for the list is obtained from Op. File III for the segment and from the Sentence Number List.

Entries are made in Op. File IV for only those routines which are included in the segment to be listed. Sentence numbers, for which a callword appears in Op. File III followed by an "Interpret" instruction, are omitted from Op. File IV. The "Interpret" instruction indicates the routine is in another segment but is referenced from the segment being listed.

The Library Routine entries have a 74_8 in the Op. code of the second word to indicate that they are Library Routine entries. All other entries have a 00.

Modified Dimension List



In order of the increasing magnitude of the drum address entries

←

Last entry in list might $=100000_8$.

Where:

Drum Address = Initial address of array on drum during running of Object Program.

XS3 symbol = XS3 symbol for subscripted variable (array) to which preceding drum address applies.

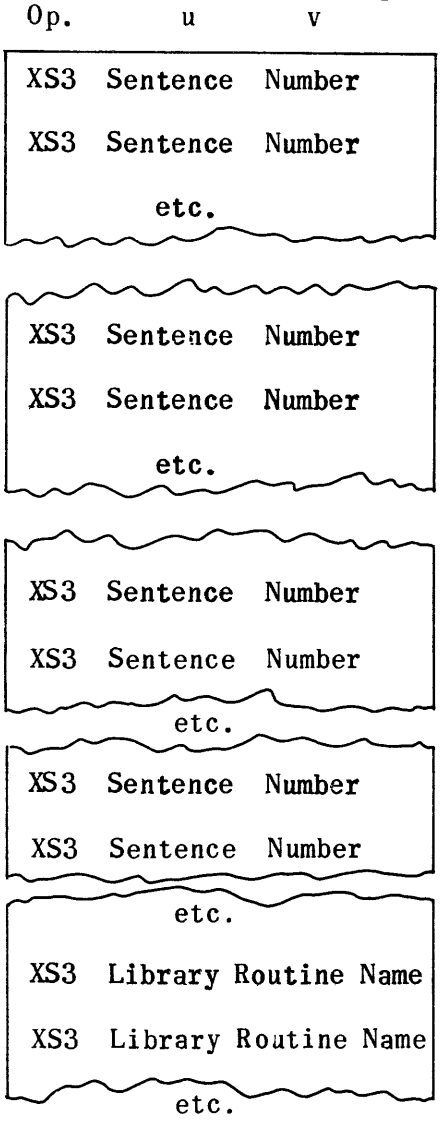
The modified Dimension List is built by a routine which operates during the Allocation Setup Phase. Information to build the list is obtained from the original Dimension List in the Combination List, which is still available at this time.

Fixed location 00010 is changed at the time the modified Dimension List is built to describe this new list.

The last entry in the list must always be the address following the last address of the last array on drum. If, therefore, the last address of the last array were 77777_8, the next address would be 100000_8. Although this is not a legitimate address, in this case it would have to be included as the last entry in the list.

Sentence Number List

(ND = Regional Address of List on Drum)



ND - Section for sentence numbers associated with 26---, 27---, and 22--- type callwords. (Maximum of 512_{10} such callwords)

$ND1000_8$ - Section for sentence numbers associated with 24--- type callwords. (Maximum of 512_{10} such callwords)

$ND2000_8$ - Section for sentence numbers associated with 25--- type callwords. (Maximum of 512_{10} such callwords)

$ND3000_8$ - Section for sentence numbers associated with 4---- type callwords. (Maximum of 64_{10} such callwords)

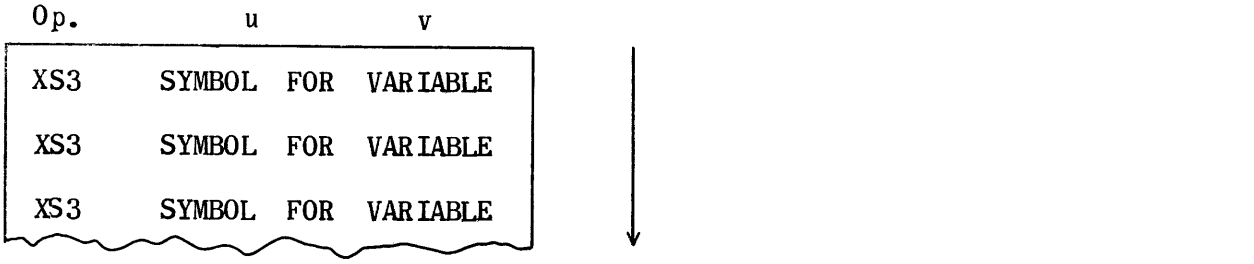
$ND3100_8$ - Section for names associated with 5---- type callwords. (Maximum of 512_{10} such callwords)

The Sentence Number List is built by a routine which operates during the Processor Phase, where the Prelude of each routine is still available. The callword of each routine, and the associated XS3 sentence number or Library Routine name, are obtained from the Prelude of the routine.

The entries in each section of the list are stored within the section relative to the last three octal digits of the callword, except for 4---- and 5---- type callwords. For the 4xxx - and 5xx-- type callwords, the digits marked "X" are used.

The sections of the list always remain at the same relative distances from the beginning of the list, as shown on the preceding diagram; hence the list is always 4100_8 locations long.

SYMBOL LIST FORMAT



Where:

XS3 SYMBOL = XS3 Symbol for each of the non-subscripted variables of the problem

This list is built and written on Uniservo 5 by routines which operate during the "End of Tape" generation phase. The list contains the XS3 symbols for all the functions (66--- callwords), floating point non-subscripted variables (65--- callwords), and fixed point variables (64--- callwords) of the problem. The symbols are in the list in order of the increasing High Speed Storage addresses assigned to the variables.

Program Listing Phase Setup Block
Regional Assignments:

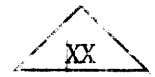
```
RE    TN20
RE    TH21
RE    UP421
RE    FP653
RE    PK2547
RE    LS7230
RE    LT7260
```

Setup Block

```
      IA    LS
0     SP    TN      0
1     ZJ    LS2     LS3       (A) = zero? ⟹ 5 servos; (A)
                                  ≠ 0 ⟹ 7 servos
2     RA    LT11    LS24      Adv. servo # in printout by 3 to
                                  set obj. prog. tape # = 6
3     TP    LT      UP3
4     RJ    UP2     UP        Typeout:  COMPUTER CODING PRODUCED
                                         ON TAPE 3 or 6
5     TP    LT12    UP3
6     RJ    UP2     UP        Typeout:  IF PROGRAM LISTING IS
                                         NOT DESIRED, SET A NOT
                                         = 0.  START.
7     SP    LS25    0         Set A = 0.
10    MS    0       LS11
11    ZJ    LS17    LS12      Program Listing desired?
12    TP    LS26    TH3
13    RJ    TH2     TH        Read program listing phase from
                                  servo 1 to core
14    TP    LS27    TH3
15    RJ    TH2     TH        Rewind servo 1
16    MJ    0       PK        Jump to program listing phase
17    TP    LS27    TH3
20    RJ    TH2     TH        Rewind servo 1
21    TP    LT25    UP3
22    RJ    UP2     UP        Typeout:  COMPILATION COMPLETED.
23    MS    0       LS23
24    0     0       300
25    0     0       0
26    50    01201   FP        Tape codeword to read listing
                                  phase to core
27    10    1       0         Tape codeword to rewind servo 1
      CA    LS30
```

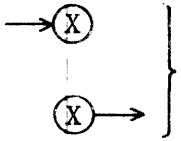
Listing Setup Typeout

	IA	LT		
0	0	LT1	11	
1	01	01010	10101	△ △ △ △ △ △
2	01	01010	10101	△ △ △ △ △ △
3	01	01010	10101	△ △ △ △ △ △
4	01	26514	75267	△ C O M P U
5	66	30540	12651	T E R △ C O
6	27	34503	20152	D I N G △ P
7	54	51276	72630	R O D U C E
10	27	01515	00166	D △ O N △ T
11	24	52300	10622	A P E △ 3 .
12	0	LT13	12	
13	34	31015	25451	I F △ P R O
14	32	54244	70146	G R A M △ L
15	34	65663	45032	I S T I N G
16	01	34650	15051	△ I S △ N O
17	66	01273	06534	T △ D E S I
20	54	30272	10165	R E D , △ S
21	30	66012	40150	E T △ A △ N
22	51	66017	60322	O T △ = O .
23	01	01656	62454	△ △ S T A R
24	66	22777	77777	T . 77 77 77 77
25	0	LT26	7	
26	01	01010	10101	△ △ △ △ △ △
27	01	01010	10101	△ △ △ △ △ △
30	01	01010	10101	△ △ △ △ △ △
31	01	26514	75234	△ C O M P I
32	46	24663	45150	L A T I O N
33	01	26514	75246	△ C O M P L
34	30	66302	72277	E T E D . 77
	CA	LT35		

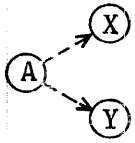


⟹ Beginning of subroutine; where XX is regional (RECO) label for routine

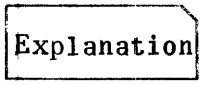
⟹ Exit from subroutine



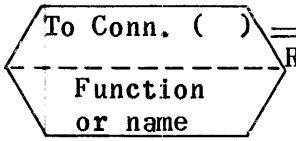
⟹ Connectors; where X is connector number



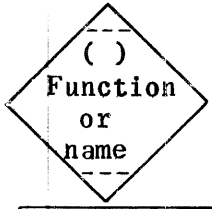
⟹ Switch; where "A" is symbol for switch and X and Y are connector numbers of different paths which may be taken at this point



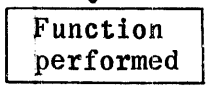
⟹ Explanatory Note; No action implied.



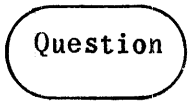
⟹ Return jump reference (subroutine); where parenthesis enclose the connector number to which the reference is made



⟹ Reference to general subroutine which is not part of this phase; where parenthesis enclose regional (RECO) label for routine



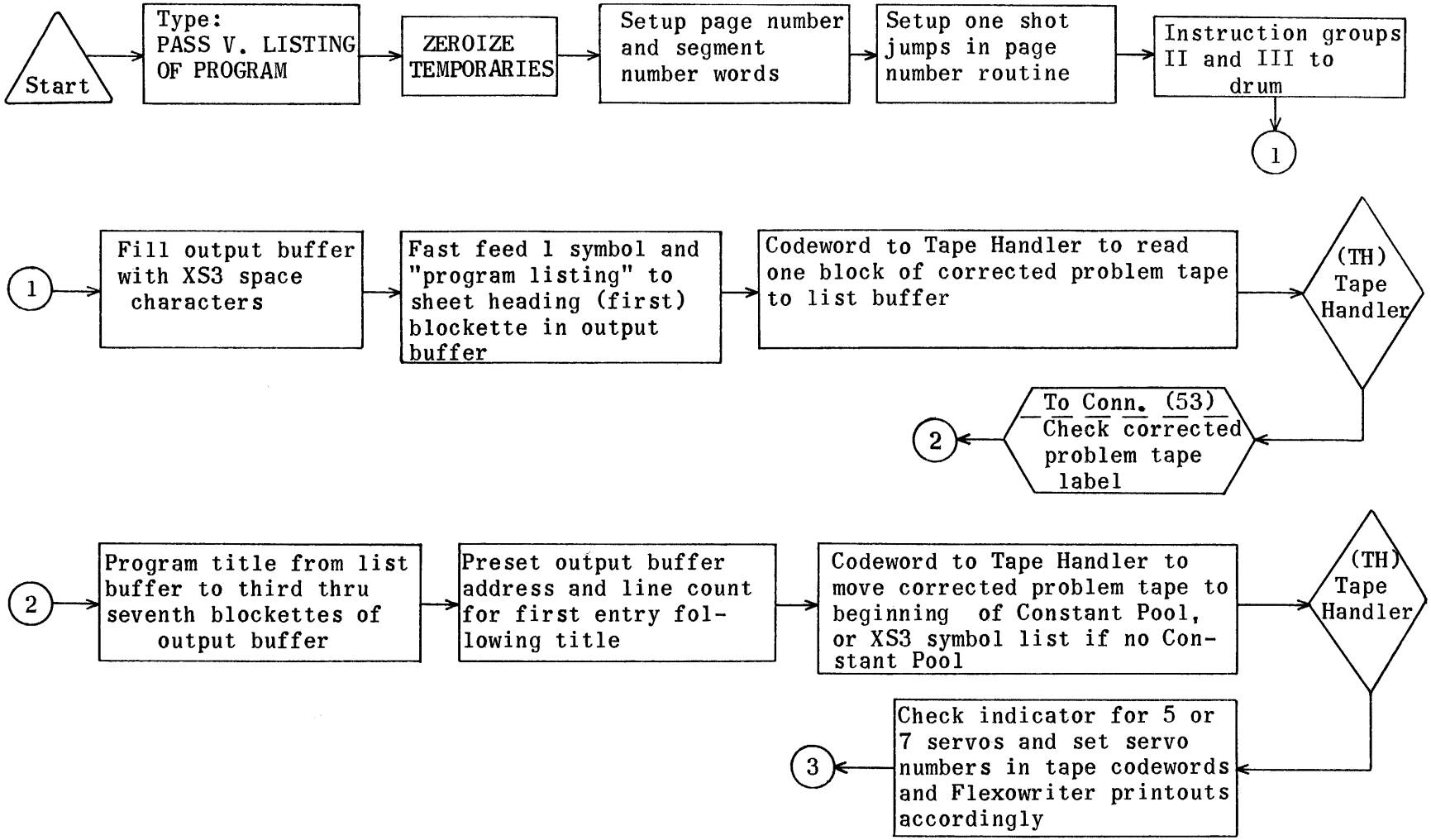
⟹ Operation Box

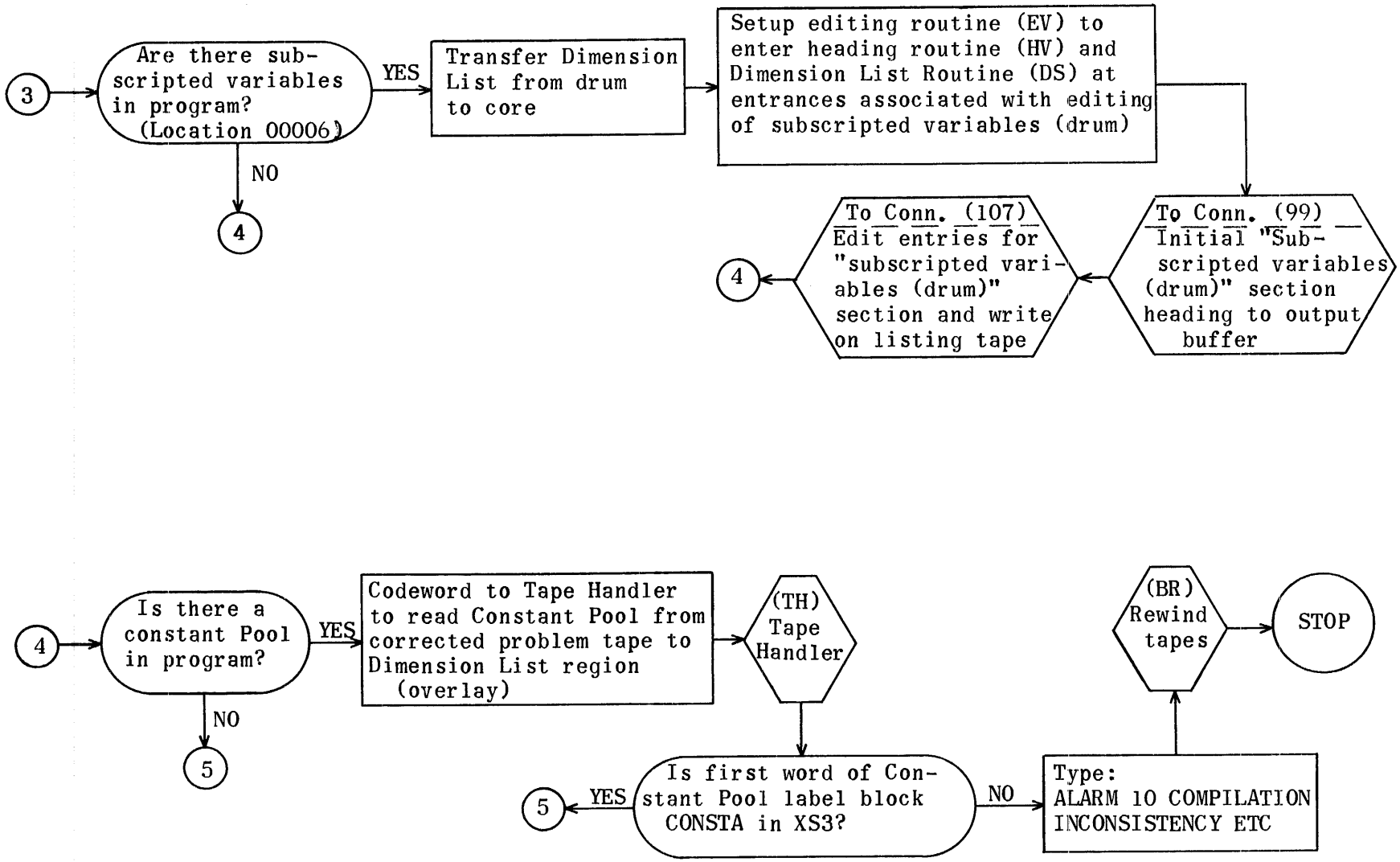


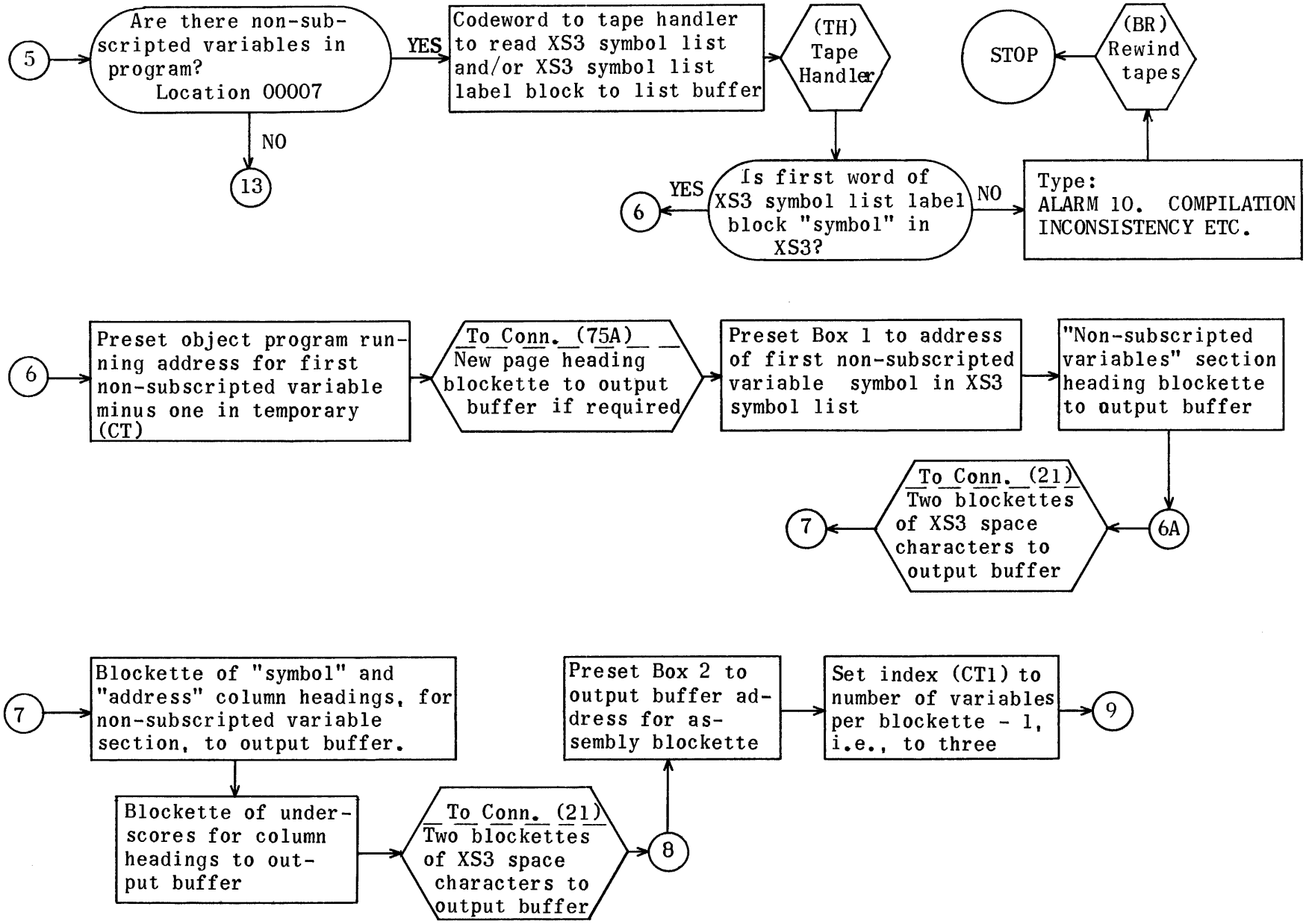
⟹ Decision Box

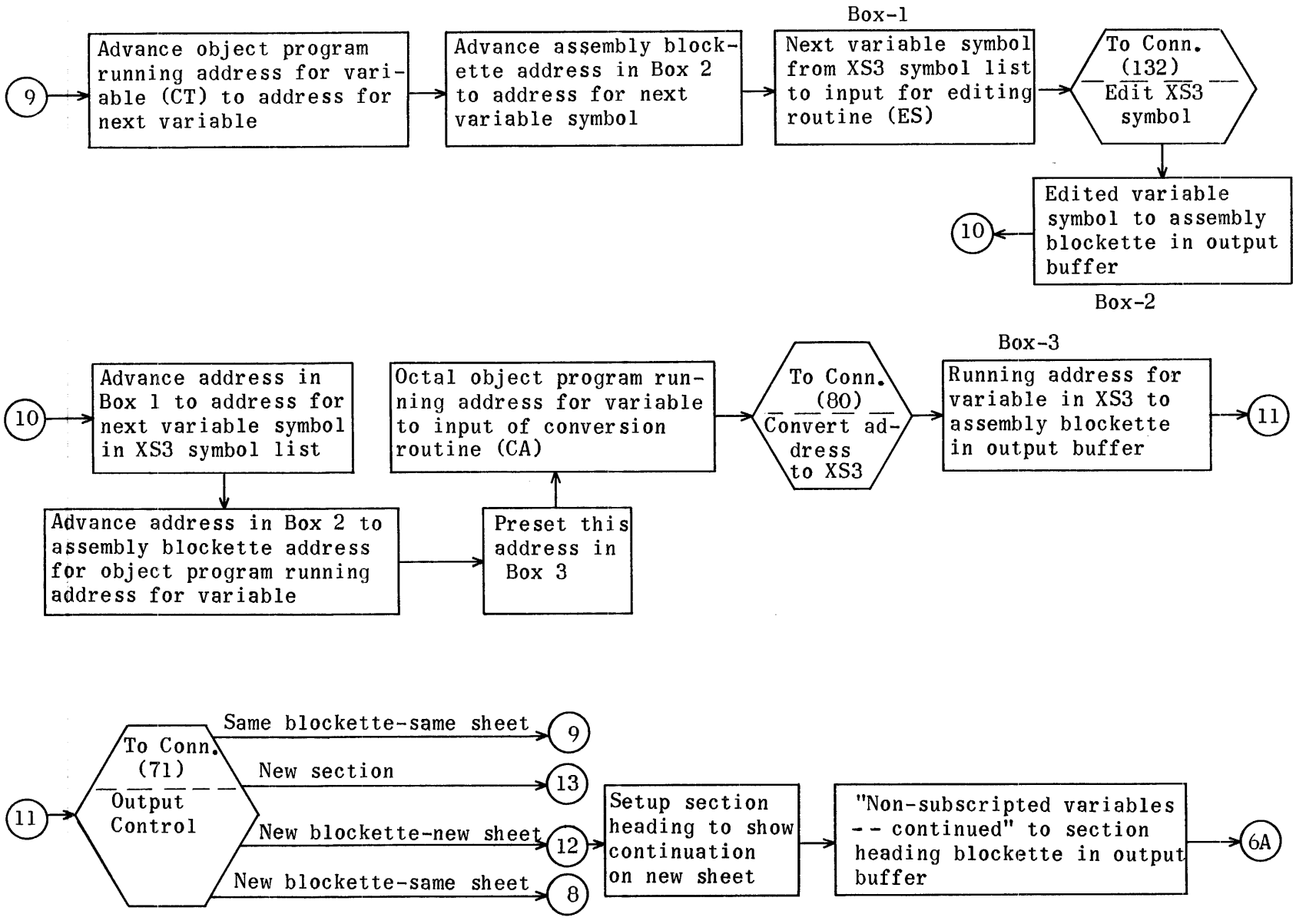
Key to Program Listing Phase Flow Chart

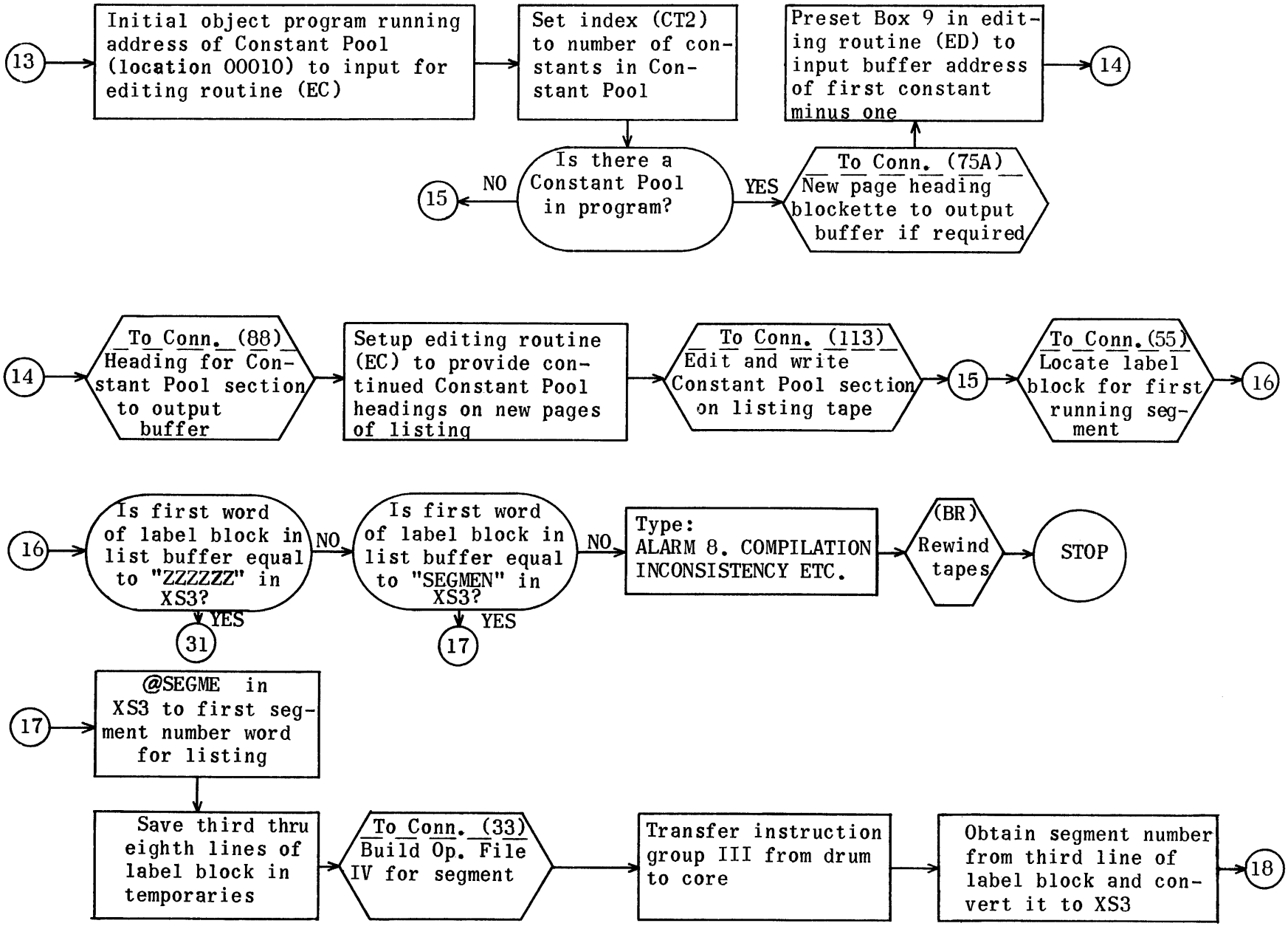
Program Listing Phase

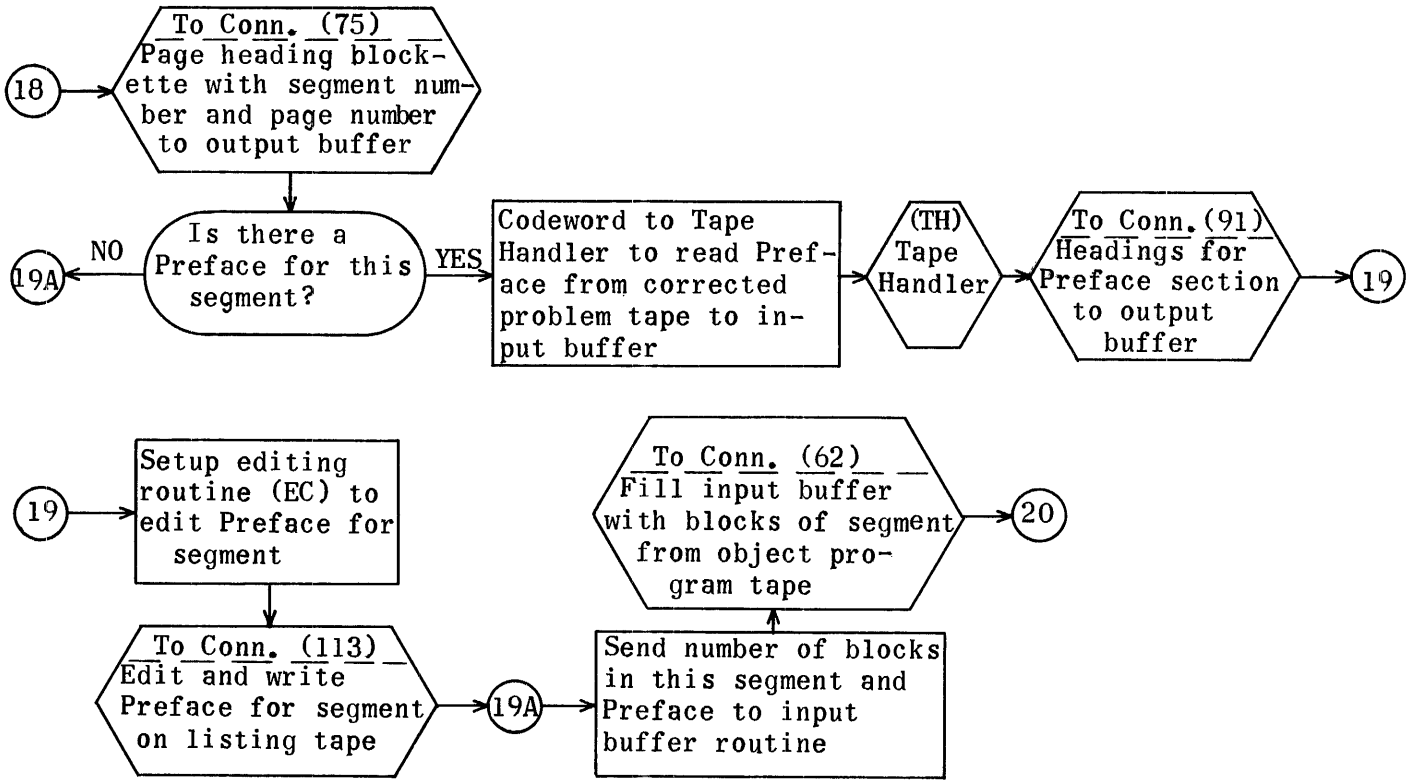


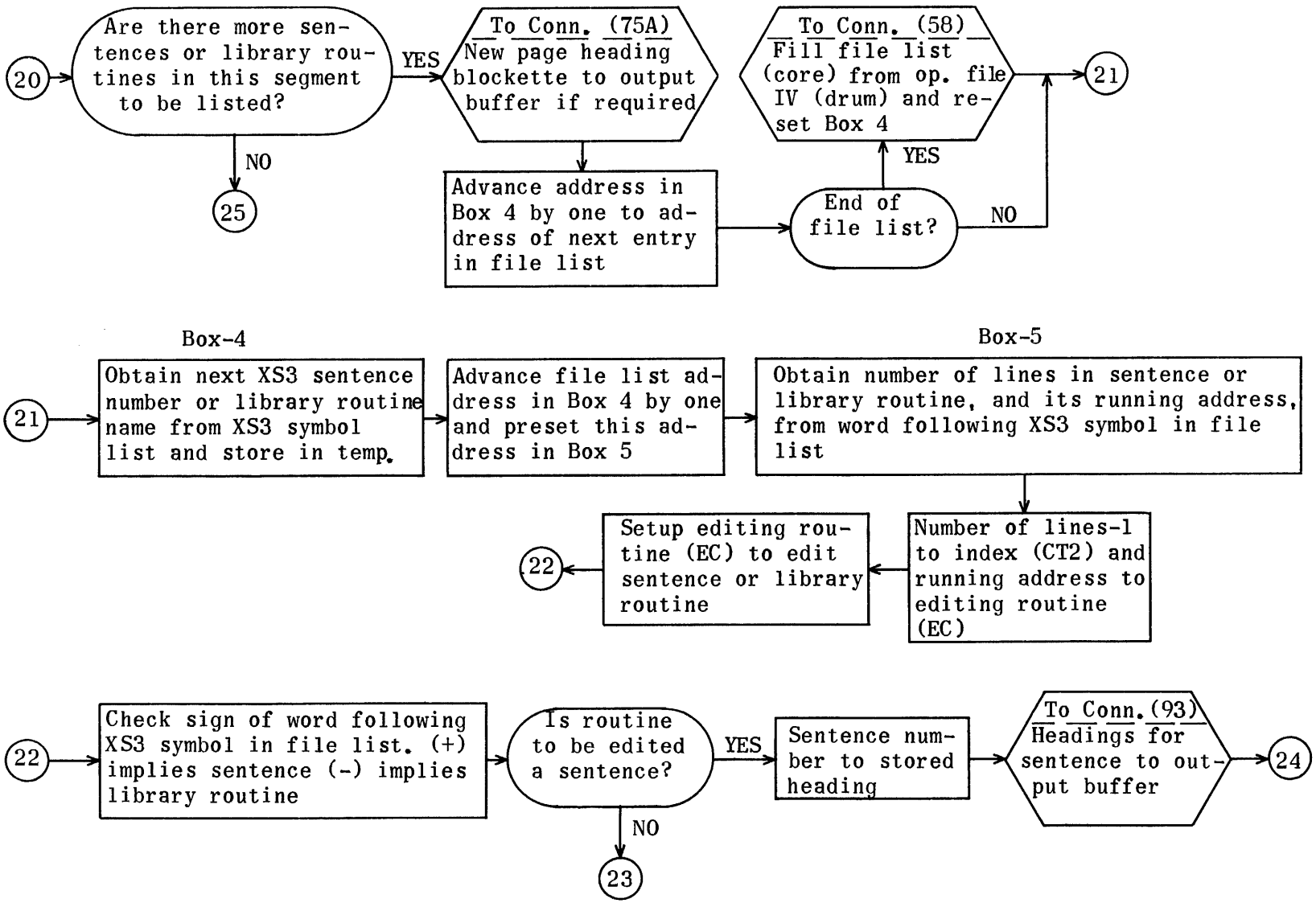

3
Are there sub-scripted variables in program? (Location 00006)
YES
Transfer Dimension List from drum to core
Setup editing routine (EV) to enter heading routine (HV) and Dimension List Routine (DS) at entrances associated with editing of subscripted variables (drum)
NO
4
To Conn. (99) Initial "Sub-scripted variables (drum)" section heading to output buffer
To Conn. (107) Edit entries for "subscripted vari-ables (drum)" section and write on listing tape
4
4
Is there a constant Pool in program?
YES
Codeword to Tape Handler to read Constant Pool from corrected problem tape to Dimension List region (overlay)
(TH) Tape Handler
NO
5
5
YES
Is first word of Con-stant Pool label block CONSTA in XS3?
NO
Type: ALARM 10 COMPILATION INCONSISTENCY ETC
(BR) Rewind tapes
STOP

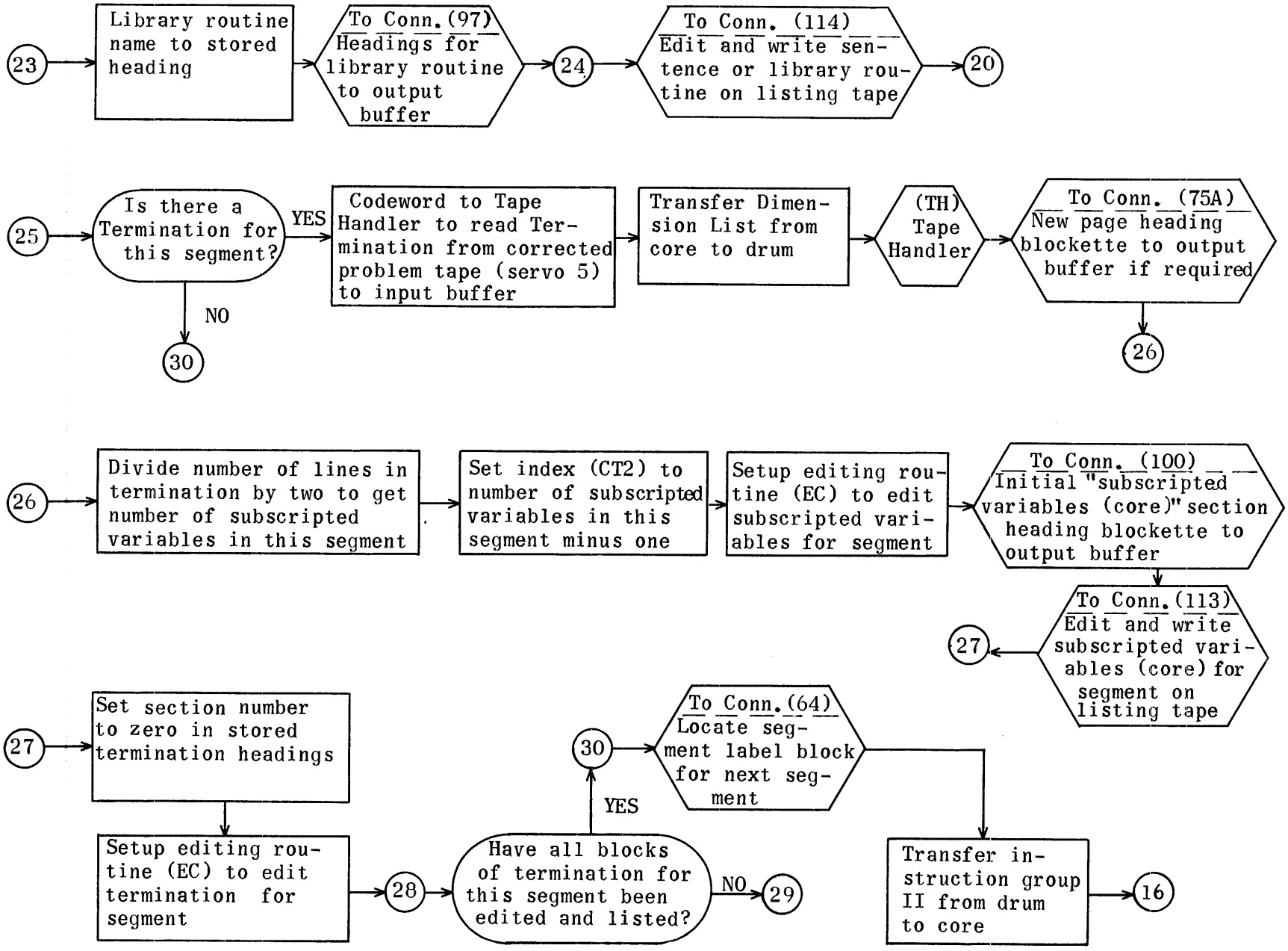

5
Are there non-subscripted variables in program?
Location 00007
YES
NO
13
Codeword to tape handler to read XS3 symbol list and/or XS3 symbol list label block to list buffer
(TH) Tape Handler
6
YES
Is first word of XS3 symbol list label block "symbol" in XS3?
NO
Type:
ALARM 10. COMPILATION INCONSISTENCY ETC.
(BR) Rewind tapes
STOP
6
Preset object program running address for first non-subscripted variable minus one in temporary (CT)
To Conn. (75A)
New page heading blockette to output buffer if required
Preset Box 1 to address of first non-subscripted variable symbol in XS3 symbol list
"Non-subscripted variables" section heading blockette to output buffer
6A
To Conn. (21)
Two blockettes of XS3 space characters to output buffer
7
7
Blockette of "symbol" and "address" column headings, for non-subscripted variable section, to output buffer.
Blockette of underscores for column headings to output buffer
To Conn. (21)
Two blockettes of XS3 space characters to output buffer
8
Preset Box 2 to output buffer address for assembly blockette
Set index (CT1) to number of variables per blockette - 1, i.e., to three
9

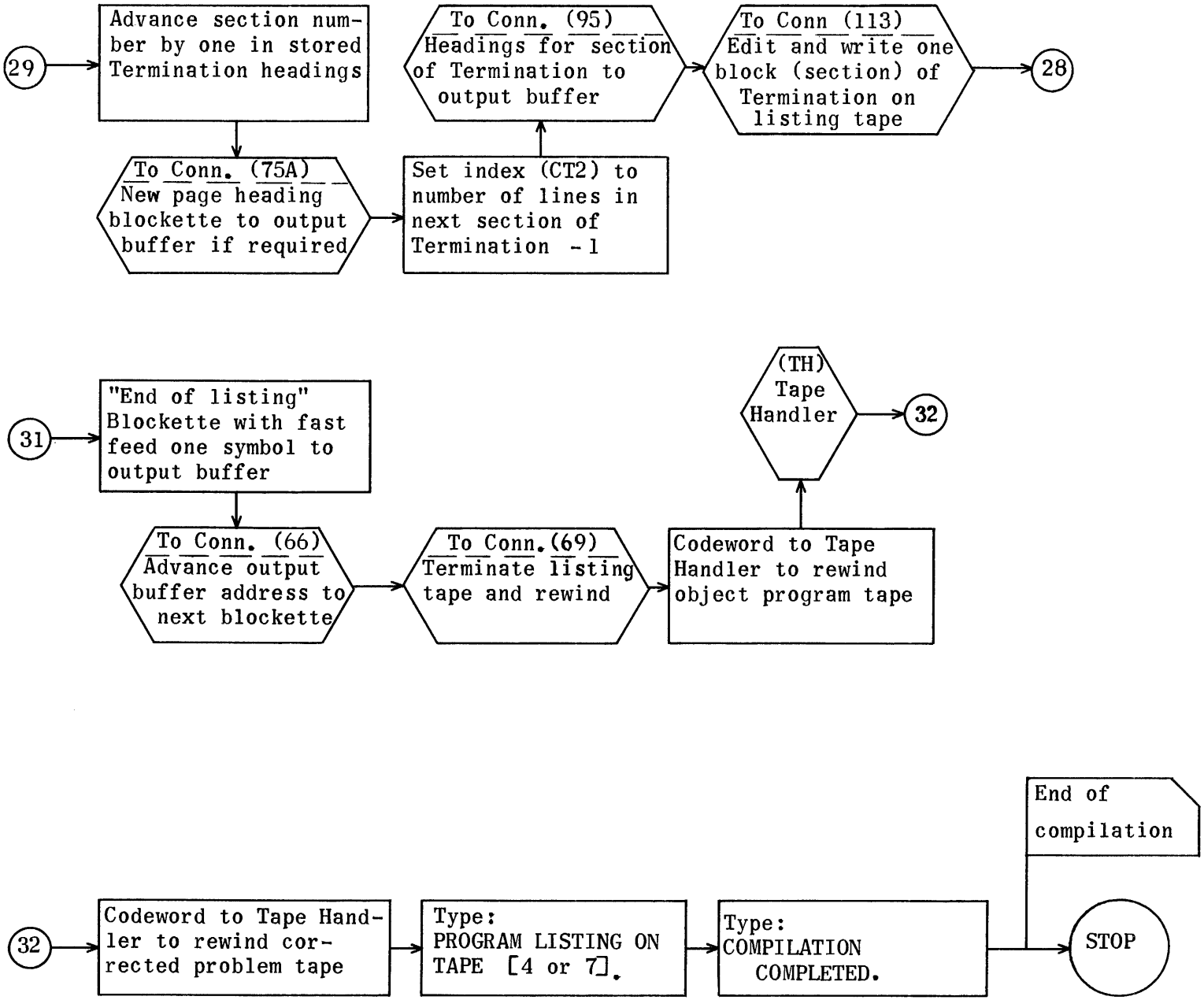

Box-1
9
Advance object program running address for variable (CT) to address for next variable
Advance assembly blockette address in Box 2 to address for next variable symbol
Next variable symbol from XS3 symbol list to input for editing routine (ES)
To Conn. (132) Edit XS3 symbol
Edited variable symbol to assembly blockette in output buffer
10
Box-2
10
Advance address in Box 1 to address for next variable symbol in XS3 symbol list
Octal object program running address for variable to input of conversion routine (CA)
To Conn. (80) Convert address to XS3
Box-3
Running address for variable in XS3 to assembly blockette in output buffer
11
Advance address in Box 2 to assembly blockette address for object program running address for variable
Preset this address in Box 3
11
To Conn. (71) Output Control
Same blockette-same sheet
9
New section
13
New blockette-new sheet
12
New blockette-same sheet
8
Setup section heading to show continuation on new sheet
"Non-subscripted variables -- continued" to section heading blockette in output buffer
6A

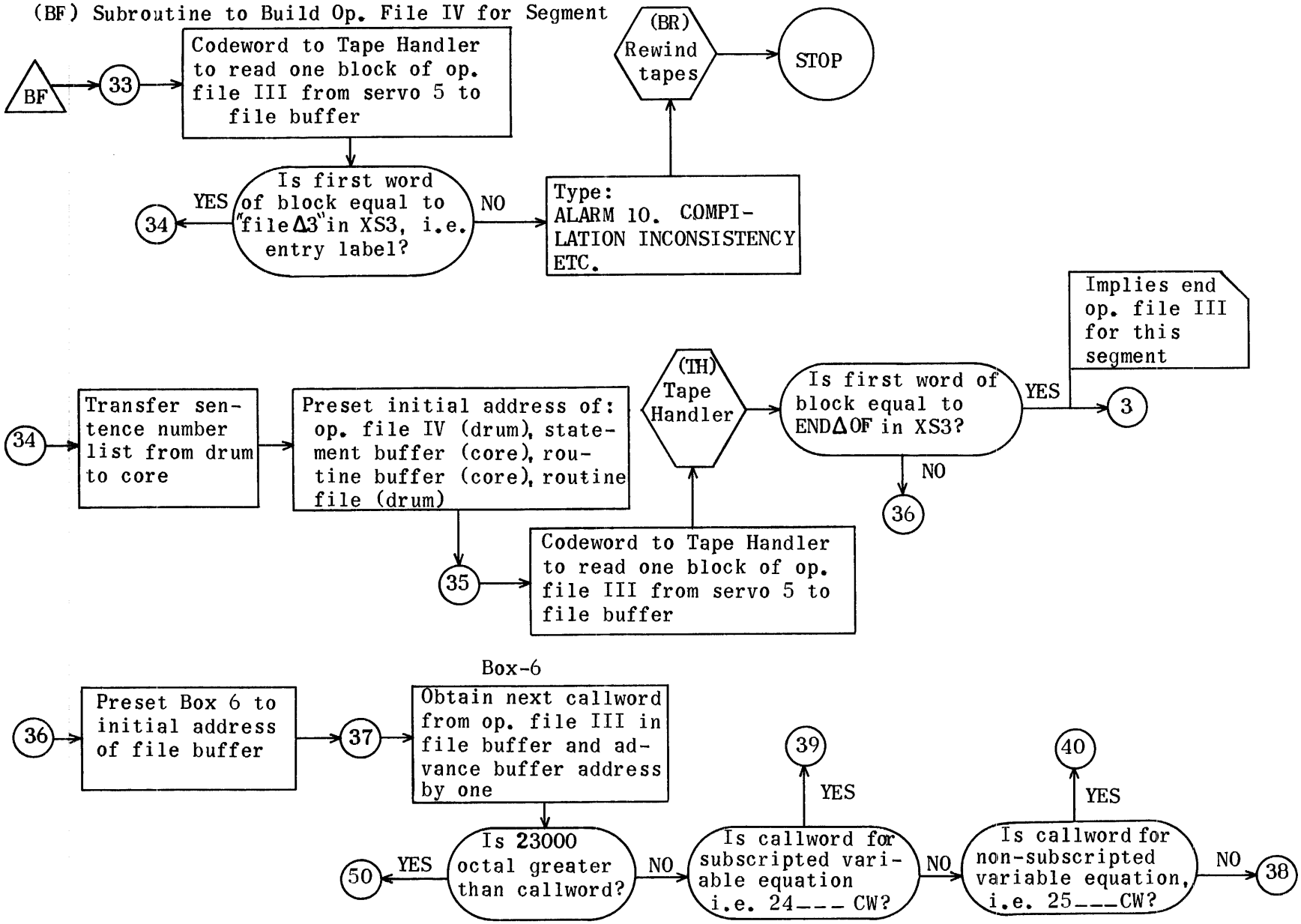

13
Initial object program running address of Constant Pool (location 00010) to input for editing routine (EC)
Set index (CT2) to number of constants in Constant Pool
Preset Box 9 in editing routine (ED) to input buffer address of first constant minus one
14
Is there a Constant Pool in program?
NO
15
YES
To Conn. (75A)
New page heading blockette to output buffer if required
14
To Conn. (88)
Heading for Constant Pool section to output buffer
Setup editing routine (EC) to provide continued Constant Pool headings on new pages of listing
To Conn. (113)
Edit and write Constant Pool section on listing tape
15
To Conn. (55)
Locate label block for first running segment
16
16
Is first word of label block in list buffer equal to "ZZZZZZ" in XS3?
NO
Is first word of label block in list buffer equal to "SEGMEN" in XS3?
NO
Type:
ALARM 8. COMPILATION INCONSISTENCY ETC.
(BR)
Rewind tapes
STOP
YES
31
YES
17
17
@SEGME in XS3 to first segment number word for listing
Save third thru eighth lines of label block in temporaries
To Conn. (33)
Build Op. File IV for segment
Transfer instruction group III from drum to core
Obtain segment number from third line of label block and convert it to XS3
18

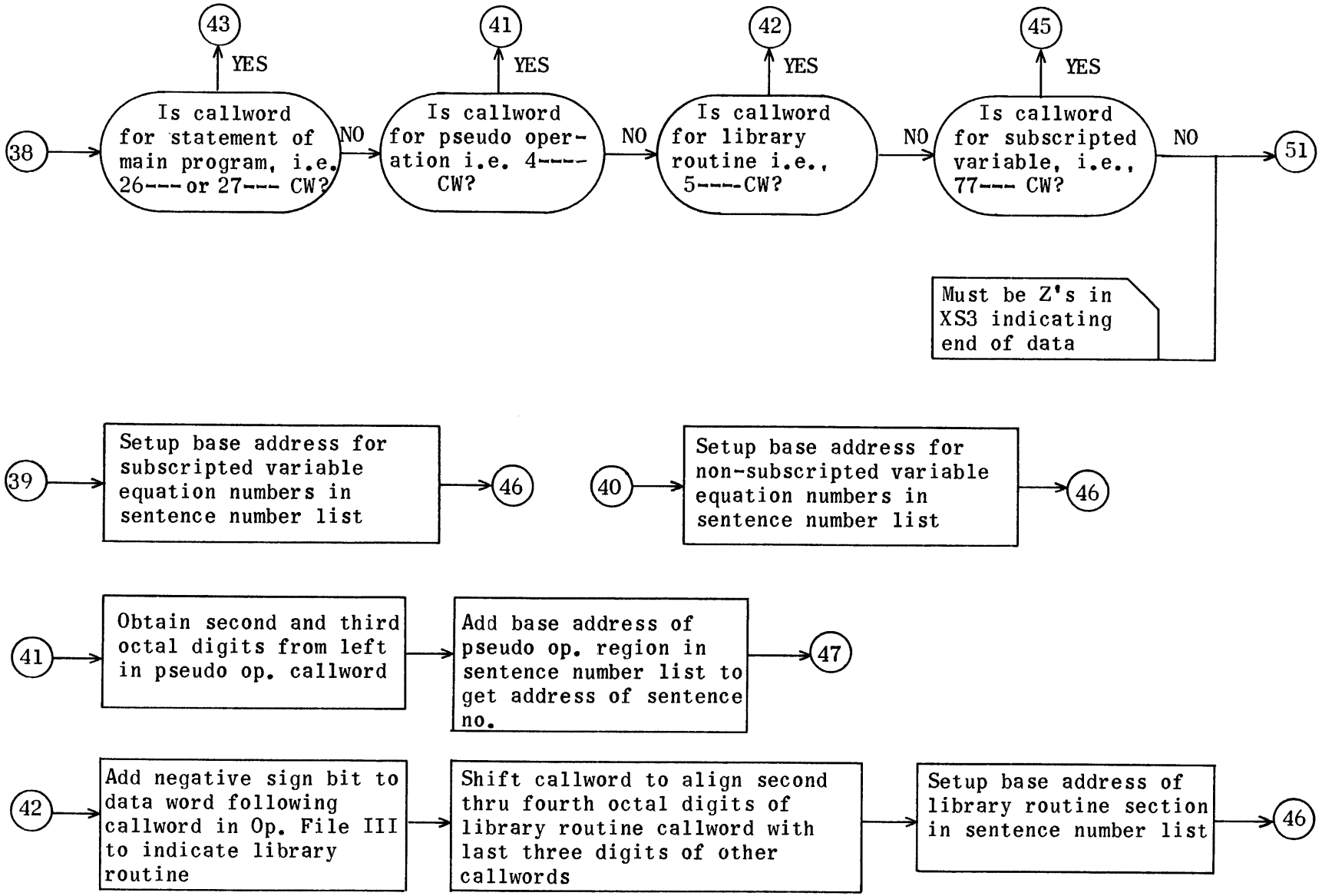

18
To Conn. (75)
Page heading block-ette with segment number and page number to output buffer
Is there a Preface for this segment?
NO
19A
YES
Codeword to Tape Handler to read Preface from corrected problem tape to input buffer
(TH) Tape Handler
To Conn. (91)
Headings for Preface section to output buffer
19
19
Setup editing routine (EC) to edit Preface for segment
To Conn. (113)
Edit and write Preface for segment on listing tape
19A
Send number of blocks in this segment and Preface to input buffer routine
To Conn. (62)
Fill input buffer with blocks of segment from object program tape
20

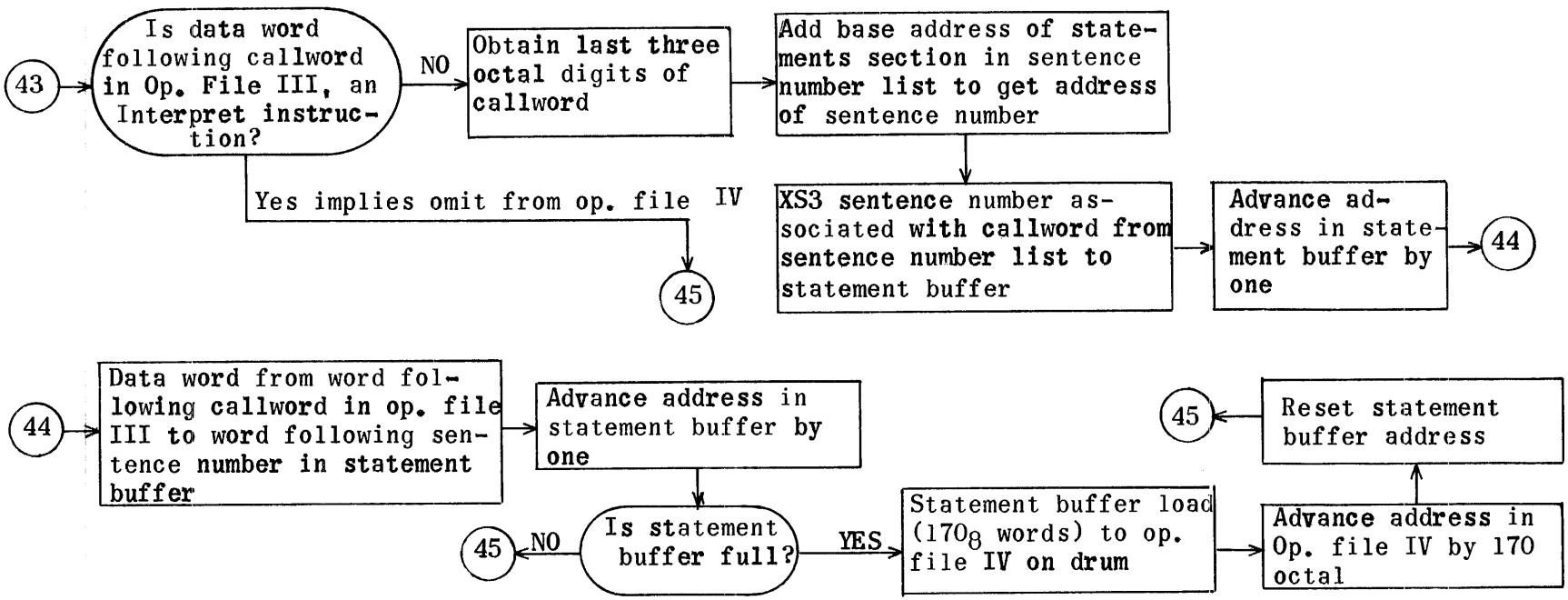

20
Are there more sentences or library routines in this segment to be listed?
YES
To Conn. (75A)
New page heading blockette to output buffer if required
To Conn. (58)
Fill file list (core) from op. file IV (drum) and reset Box 4
21
NO
25
Advance address in Box 4 by one to address of next entry in file list
End of file list?
YES
NO
Box-4
Box-5
21
Obtain next XS3 sentence number or library routine name from XS3 symbol list and store in temp.
Advance file list address in Box 4 by one and preset this address in Box 5
Obtain number of lines in sentence or library routine, and its running address, from word following XS3 symbol in file list
Number of lines-1 to index (CT2) and running address to editing routine (EC)
Setup editing routine (EC) to edit sentence or library routine
22
22
Check sign of word following XS3 symbol in file list. (+) implies sentence (-) implies library routine
Is routine to be edited a sentence?
YES
Sentence number to stored heading
To Conn. (93)
Headings for sentence to output buffer
24
NO
23

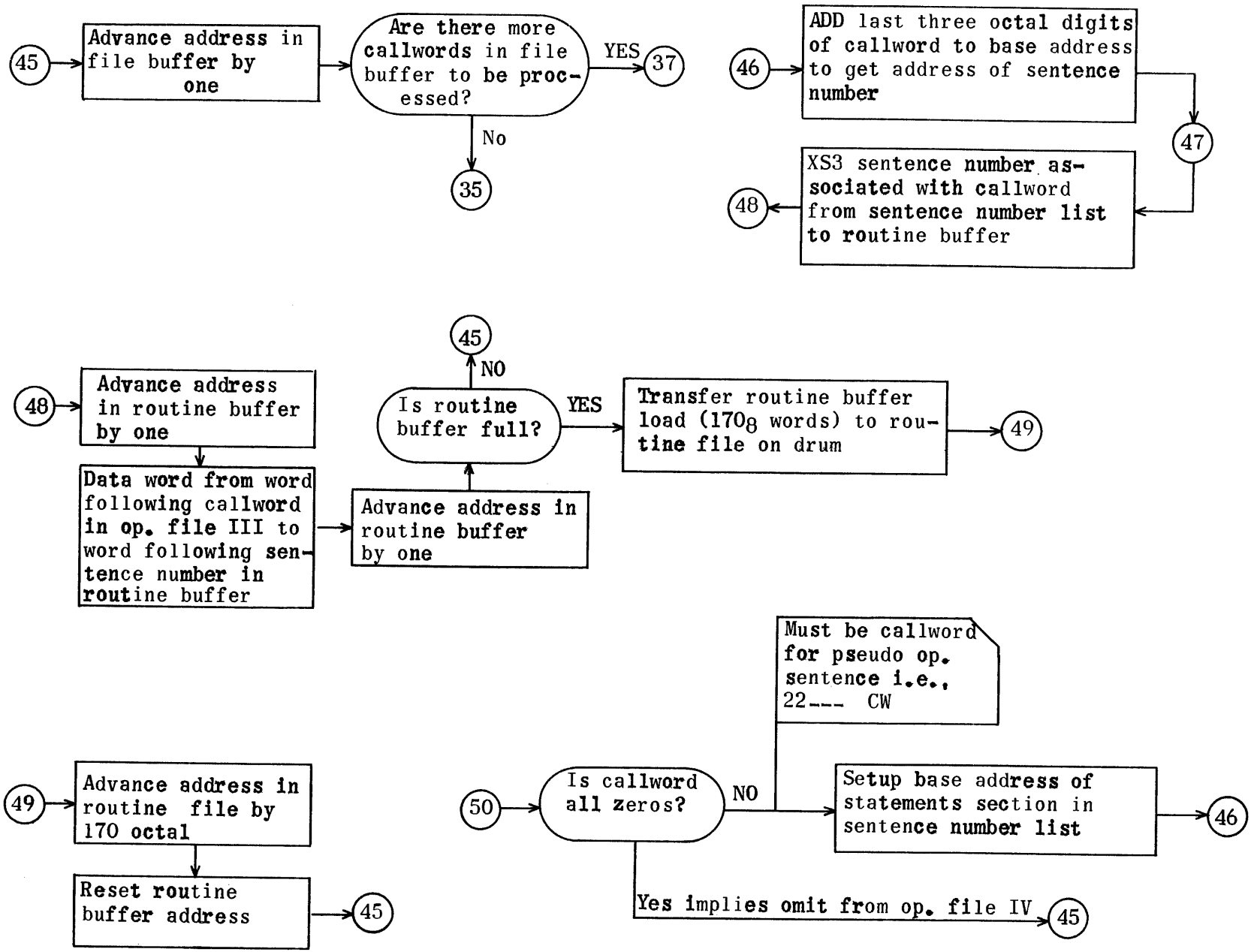

23
Library routine name to stored heading
To Conn. (97) Headings for library routine to output buffer
24
To Conn. (114) Edit and write sentence or library routine on listing tape
20
25
Is there a Termination for this segment?
YES
Codeword to Tape Handler to read Termination from corrected problem tape (servo 5) to input buffer
Transfer Dimension List from core to drum
(TH) Tape Handler
To Conn. (75A) New page heading blockette to output buffer if required
26
NO
30
26
Divide number of lines in termination by two to get number of subscripted variables in this segment
Set index (CT2) to number of subscripted variables in this segment minus one
Setup editing routine (EC) to edit subscripted variables for segment
To Conn. (100) Initial "subscripted variables (core)" section heading blockette to output buffer
To Conn. (113) Edit and write subscripted variables (core) for segment on listing tape
27
27
Set section number to zero in stored termination headings
Setup editing routine (EC) to edit termination for segment
28
Have all blocks of termination for this segment been edited and listed?
YES
30
To Conn. (64) Locate segment label block for next segment
NO
29
Transfer instruction group II from drum to core
16

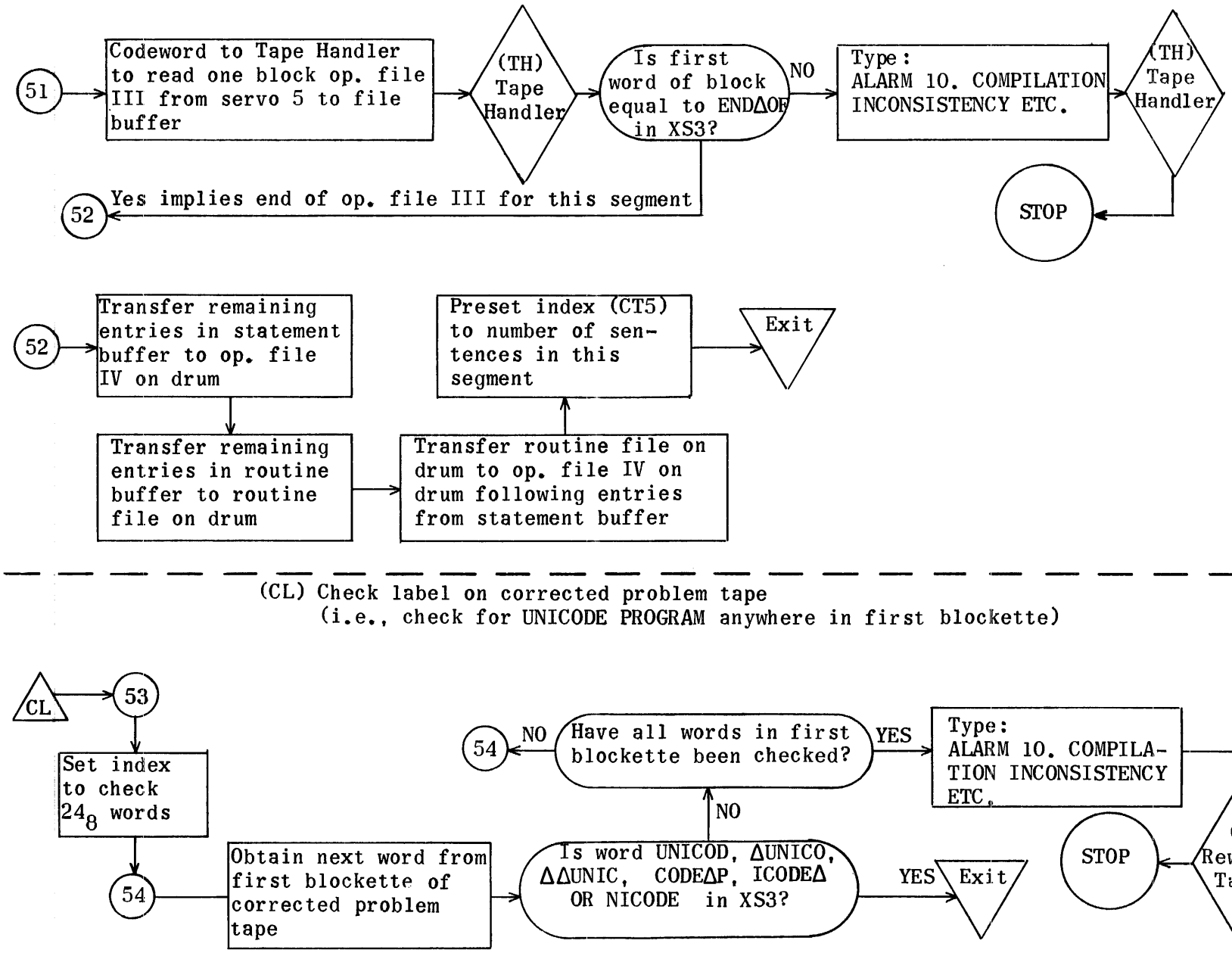

29
Advance section number by one in stored Termination headings
To Conn. (95)
Headings for section of Termination to output buffer
To Conn (113)
Edit and write one block (section) of Termination on listing tape
28
To Conn. (75A)
New page heading blockette to output buffer if required
Set index (CT2) to number of lines in next section of Termination - 1
31
"End of listing" Blockette with fast feed one symbol to output buffer
(TH)
Tape Handler
32
To Conn. (66)
Advance output buffer address to next blockette
To Conn. (69)
Terminate listing tape and rewind
Codeword to Tape Handler to rewind object program tape
End of compilation
32
Codeword to Tape Handler to rewind corrected problem tape
Type:
PROGRAM LISTING ON TAPE [4 or 7].
Type:
COMPILATION COMPLETED.
STOP


(BF) Subroutine to Build Op. File IV for Segment
BF
33
Codeword to Tape Handler to read one block of op. file III from servo 5 to file buffer
Is first word of block equal to "file Δ3" in XS3, i.e. entry label?
YES
34
NO
Type: ALARM 10. COMPILATION INCONSISTENCY ETC.
(BR) Rewind tapes
STOP
34
Transfer sentence number list from drum to core
Preset initial address of: op. file IV (drum), statement buffer (core), routine buffer (core), routine file (drum)
35
Codeword to Tape Handler to read one block of op. file III from servo 5 to file buffer
(TH) Tape Handler
Is first word of block equal to END Δ OF in XS3?
YES
Implies end op. file III for this segment
3
NO
36
Box-6
36
Preset Box 6 to initial address of file buffer
37
Obtain next callword from op. file III in file buffer and advance buffer address by one
Is 23000 octal greater than callword?
YES
50
NO
Is callword for subscripted variable equation i.e. 24___ CW?
YES
39
NO
Is callword for non-subscripted variable equation, i.e. 25___CW?
YES
40
NO
38

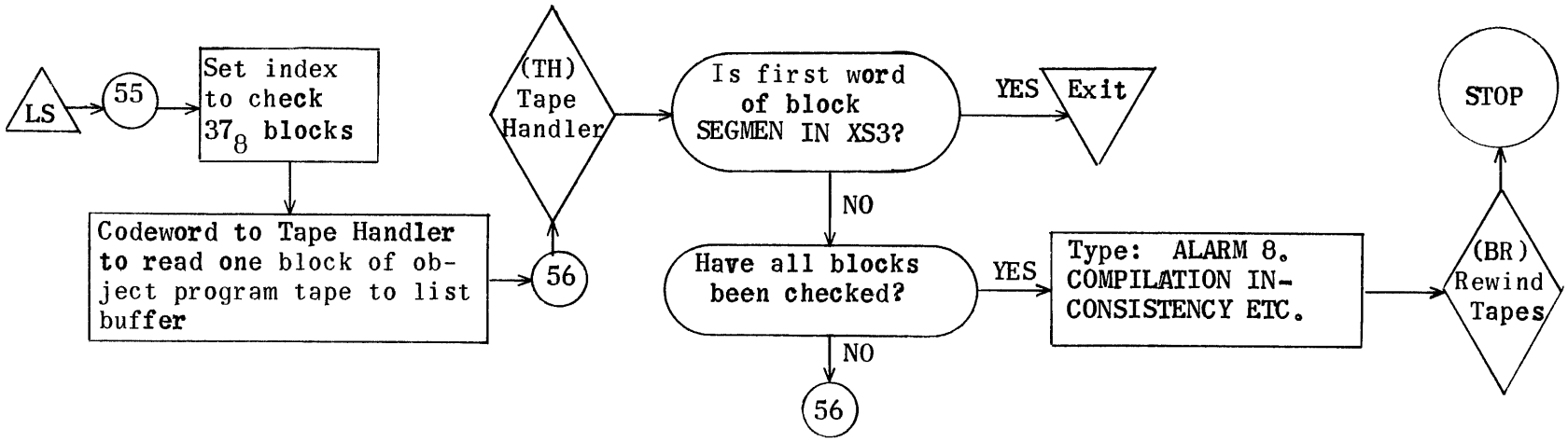

43
YES
41
YES
42
YES
45
YES
38
Is callword for statement of main program, i.e. 26--- or 27--- CW?
NO
Is callword for pseudo operation i.e. 4---- CW?
NO
Is callword for library routine i.e., 5----CW?
NO
Is callword for subscripted variable, i.e., 77--- CW?
NO
51
Must be Z's in XS3 indicating end of data
39
Setup base address for subscripted variable equation numbers in sentence number list
46
40
Setup base address for non-subscripted variable equation numbers in sentence number list
46
41
Obtain second and third octal digits from left in pseudo op. callword
Add base address of pseudo op. region in sentence number list to get address of sentence no.
47
42
Add negative sign bit to data word following callword in Op. File III to indicate library routine
Shift callword to align second thru fourth octal digits of library routine callword with last three digits of other callwords
Setup base address of library routine section in sentence number list
46


43
Is data word following callword in Op. File III, an Interpret instruction?
NO
Obtain last three octal digits of callword
Add base address of statements section in sentence number list to get address of sentence number
Yes implies omit from op. file IV
45
XS3 sentence number associated with callword from sentence number list to statement buffer
Advance address in statement buffer by one
44
44
Data word from word following callword in op. file III to word following sentence number in statement buffer
Advance address in statement buffer by one
45
Reset statement buffer address
45
NO
Is statement buffer full?
YES
Statement buffer load (170_8 words) to op. file IV on drum
Advance address in Op. file IV by 170 octal

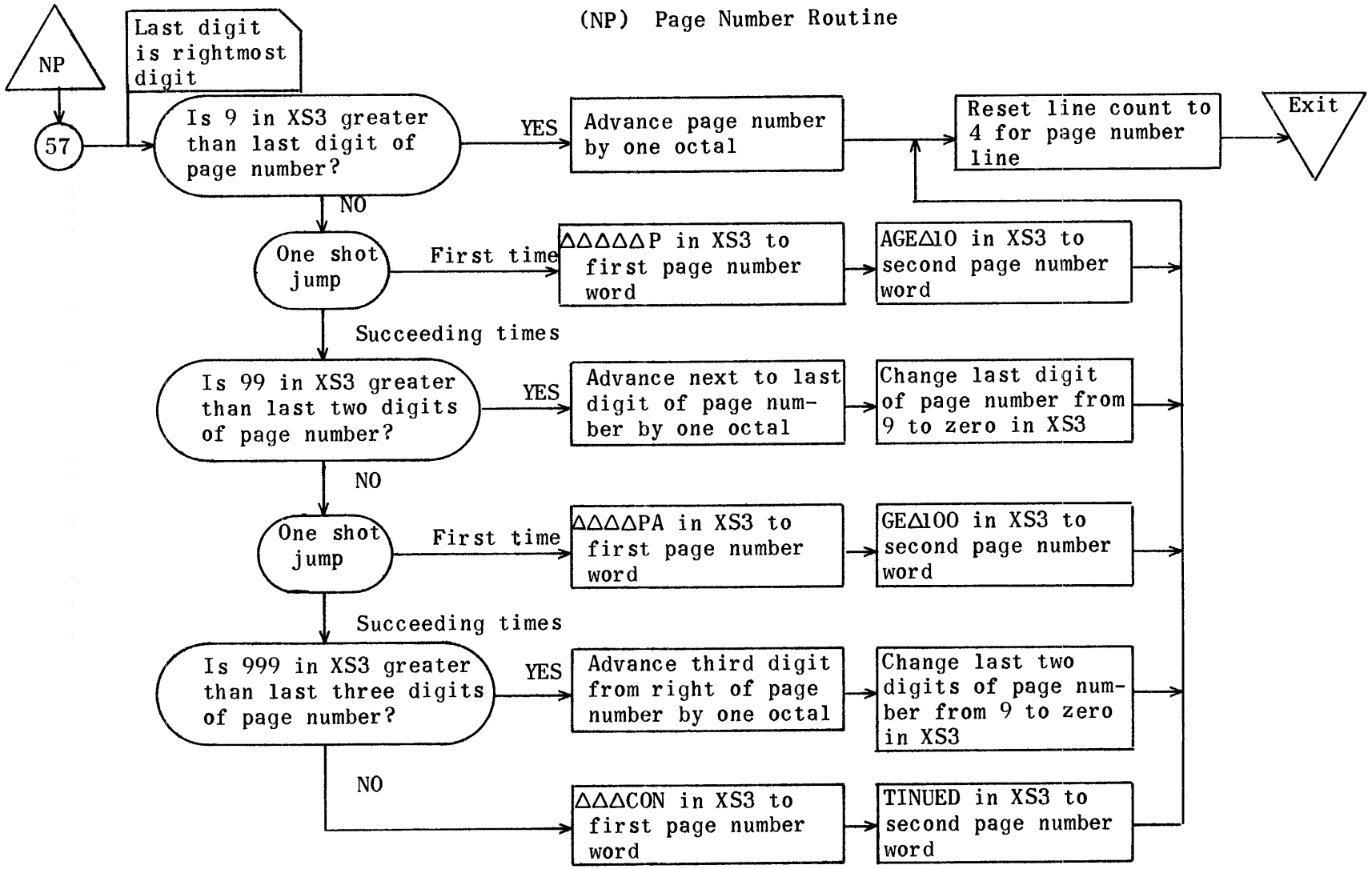

45
Advance address in file buffer by one
Are there more callwords in file buffer to be processed?
YES
37
No
35
46
ADD last three octal digits of callword to base address to get address of sentence number
47
48
XS3 sentence number associated with callword from sentence number list to routine buffer
48
Advance address in routine buffer by one
Data word from word following callword in op. file III to word following sentence number in routine buffer
Advance address in routine buffer by one
45
NO
Is routine buffer full?
YES
Transfer routine buffer load (170₈ words) to routine file on drum
49
49
Advance address in routine file by 170 octal
Reset routine buffer address
45
50
Is callword all zeros?
NO
Must be callword for pseudo op. sentence i.e., 22--- CW
Setup base address of statements section in sentence number list
46
Yes implies omit from op. file IV
45


51
Codeword to Tape Handler to read one block op. file III from servo 5 to file buffer
(TH) Tape Handler
Is first word of block equal to ENDΔOF in XS3?
NO
Type: ALARM 10. COMPILATION INCONSISTENCY ETC.
(TH) Tape Handler
STOP
52
Yes implies end of op. file III for this segment
52
Transfer remaining entries in statement buffer to op. file IV on drum
Preset index (CT5) to number of sentences in this segment
Exit
Transfer remaining entries in routine buffer to routine file on drum
Transfer routine file on drum to op. file IV on drum following entries from statement buffer
(CL) Check label on corrected problem tape
(i.e., check for UNICODE PROGRAM anywhere in first blockette)
CL
53
Set index to check 24₈ words
54
Obtain next word from first blockette of corrected problem tape
Is word UNICOD, ΔUNICO, ΔΔUNIC, CODEΔP, ICODEΔ OR NICODE in XS3?
YES
Exit
NO
54
NO
Have all words in first blockette been checked?
YES
Type: ALARM 10. COMPILATION INCONSISTENCY ETC.
STOP
(BR) Rewind Tapes

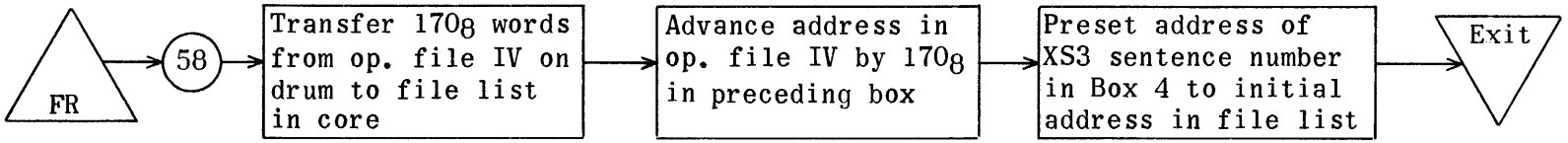
(LS) Locate segment label block for first segment on object program tape



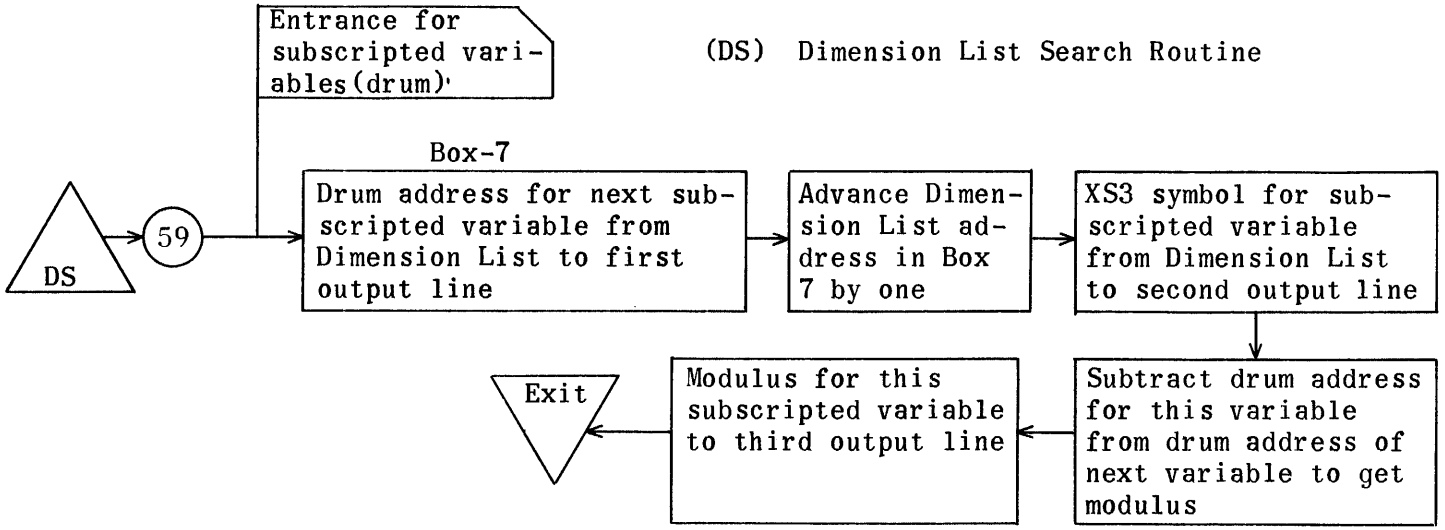
(NP) Page Number Routine

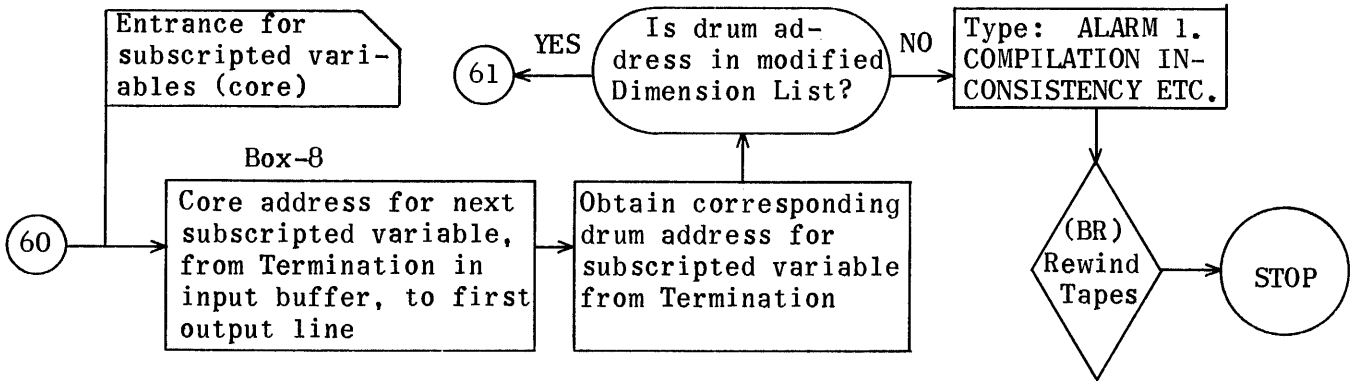


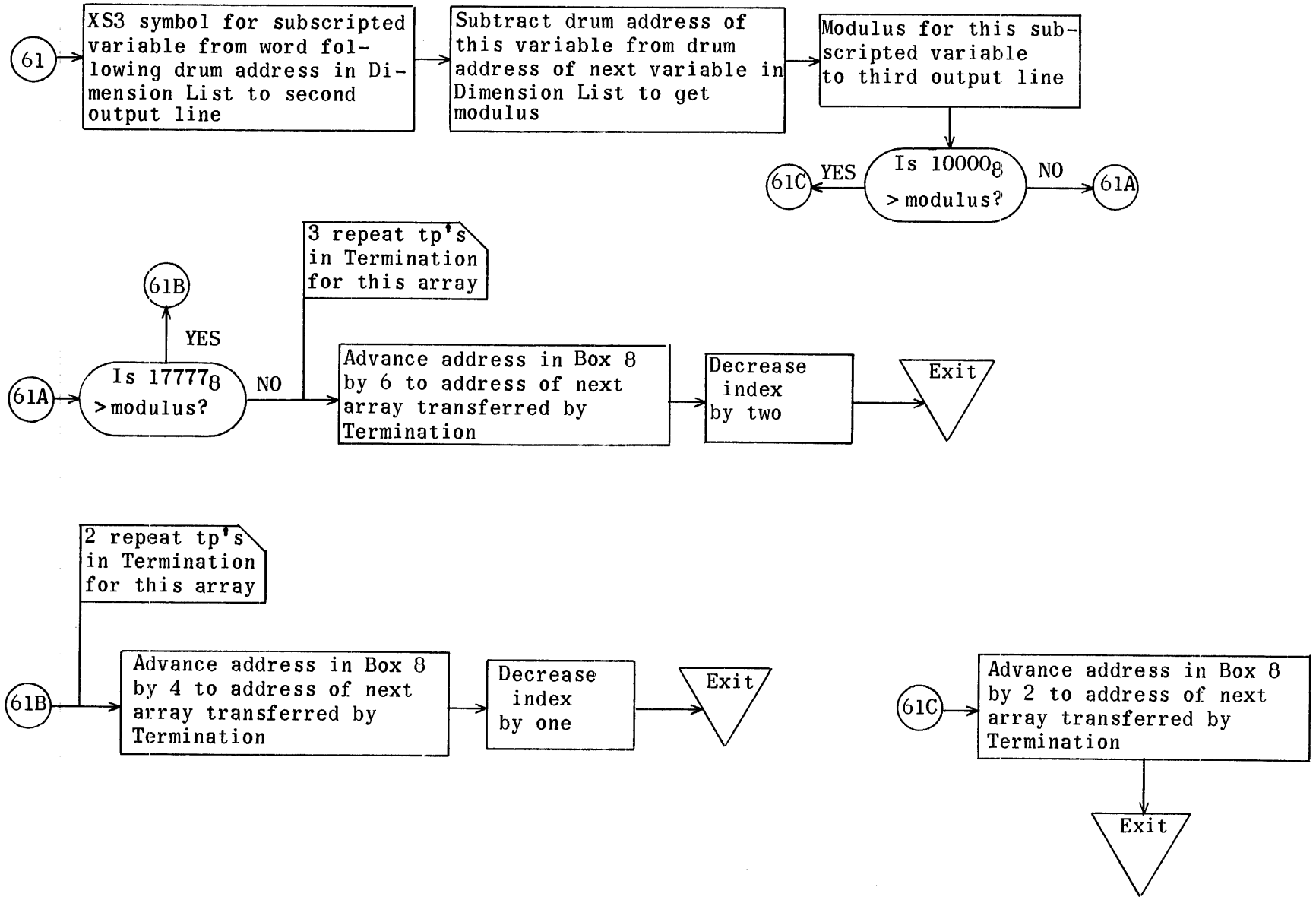
(FR) Op. File III Control Routine

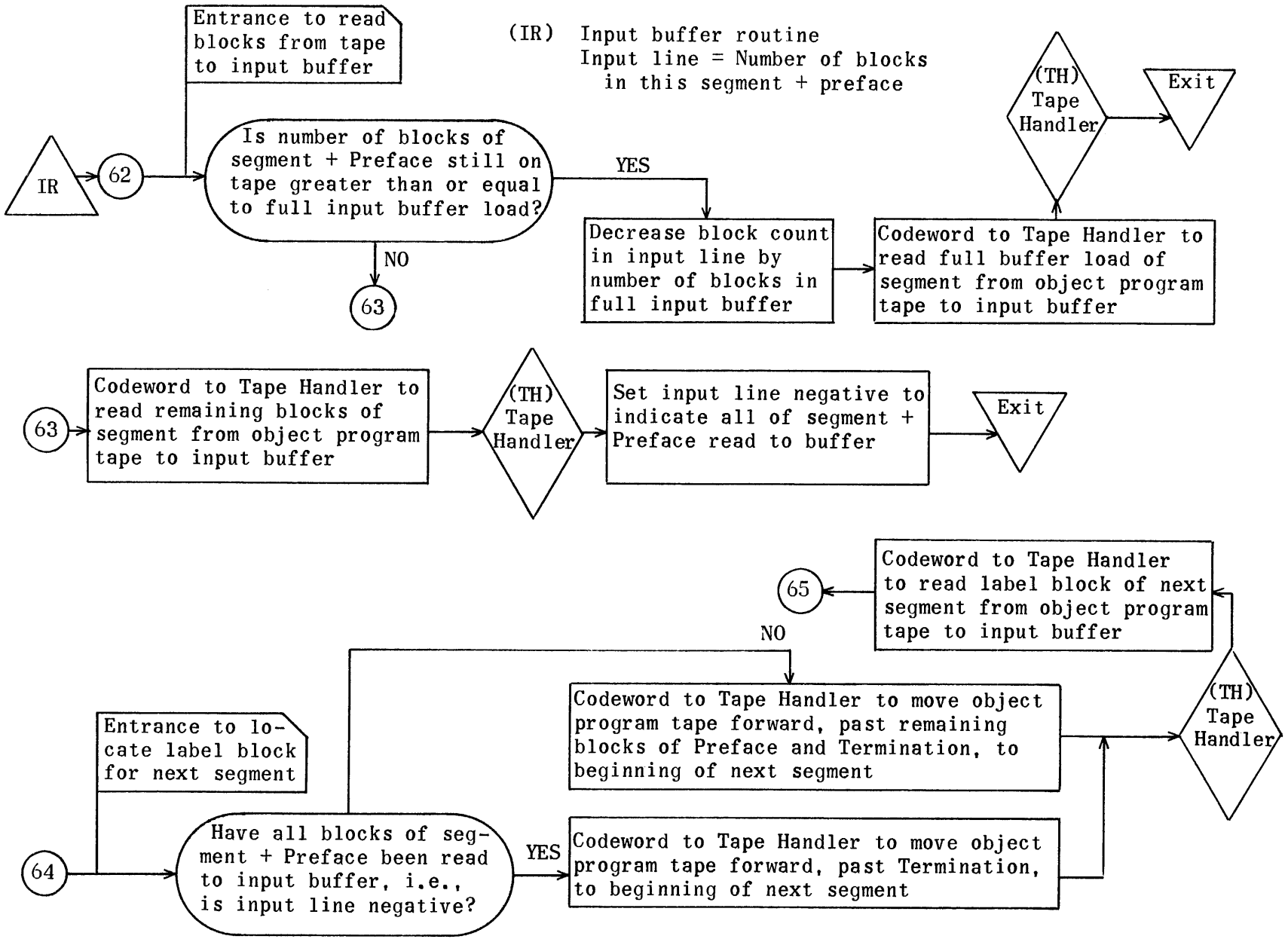


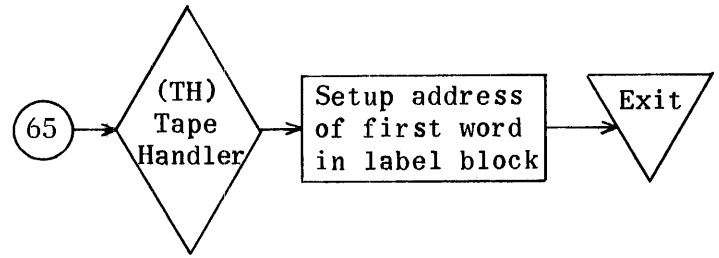
(DS) Dimension List Search Routine



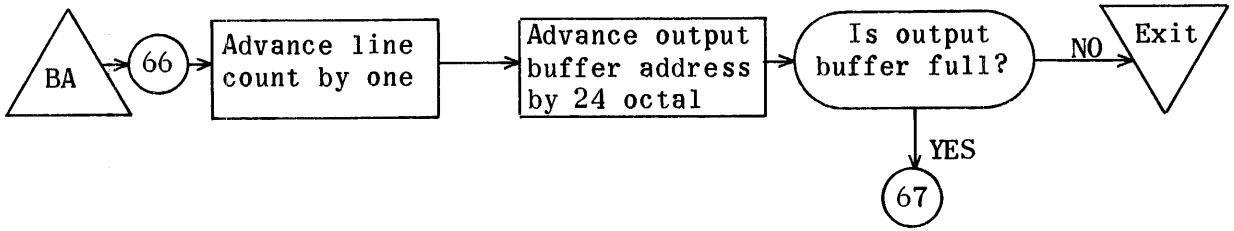


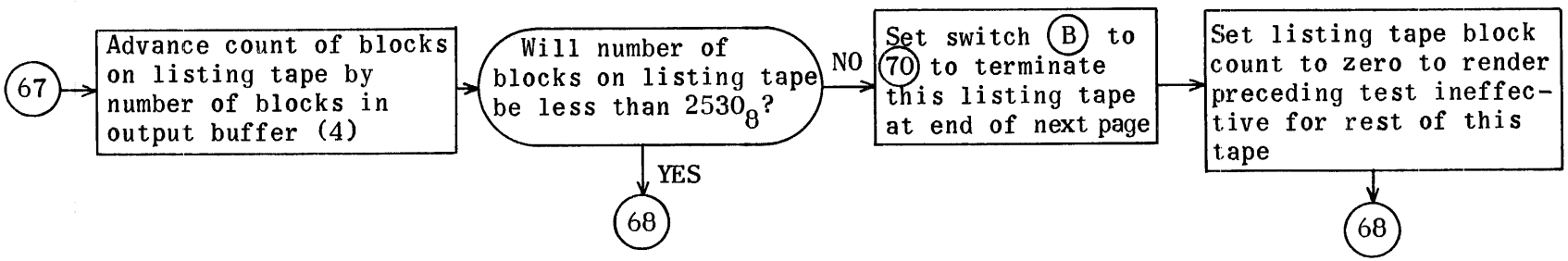

61
XS3 symbol for subscripted variable from word following drum address in Dimension List to second output line
Subtract drum address of this variable from drum address of next variable in Dimension List to get modulus
Modulus for this subscripted variable to third output line
Is 10000₈ > modulus?
YES
NO
61C
61A
61B
YES
61A
Is 17777₈ > modulus?
NO
3 repeat tp's in Termination for this array
Advance address in Box 8 by 6 to address of next array transferred by Termination
Decrease index by two
Exit
2 repeat tp's in Termination for this array
61B
Advance address in Box 8 by 4 to address of next array transferred by Termination
Decrease index by one
Exit
61C
Advance address in Box 8 by 2 to address of next array transferred by Termination
Exit

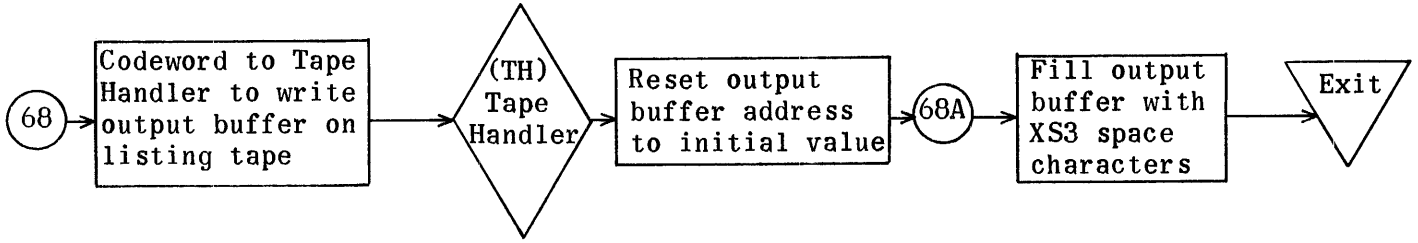

Entrance to read blocks from tape to input buffer
(IR) Input buffer routine
Input line = Number of blocks in this segment + preface
IR
62
Is number of blocks of segment + Preface still on tape greater than or equal to full input buffer load?
YES
NO
63
Decrease block count in input line by number of blocks in full input buffer
Codeword to Tape Handler to read full buffer load of segment from object program tape to input buffer
(TH) Tape Handler
Exit
63
Codeword to Tape Handler to read remaining blocks of segment from object program tape to input buffer
(TH) Tape Handler
Set input line negative to indicate all of segment + Preface read to buffer
Exit
65
Codeword to Tape Handler to read label block of next segment from object program tape to input buffer
NO
Codeword to Tape Handler to move object program tape forward, past remaining blocks of Preface and Termination, to beginning of next segment
(TH) Tape Handler
Entrance to locate label block for next segment
64
Have all blocks of segment + Preface been read to input buffer, i.e., is input line negative?
YES
Codeword to Tape Handler to move object program tape forward, past Termination, to beginning of next segment



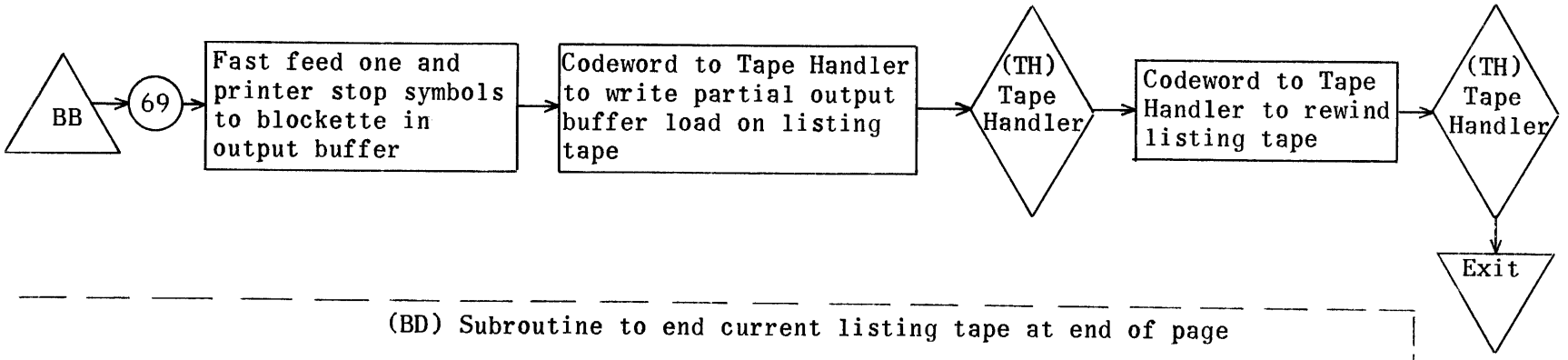
(BA) Subroutine to advance output buffer address



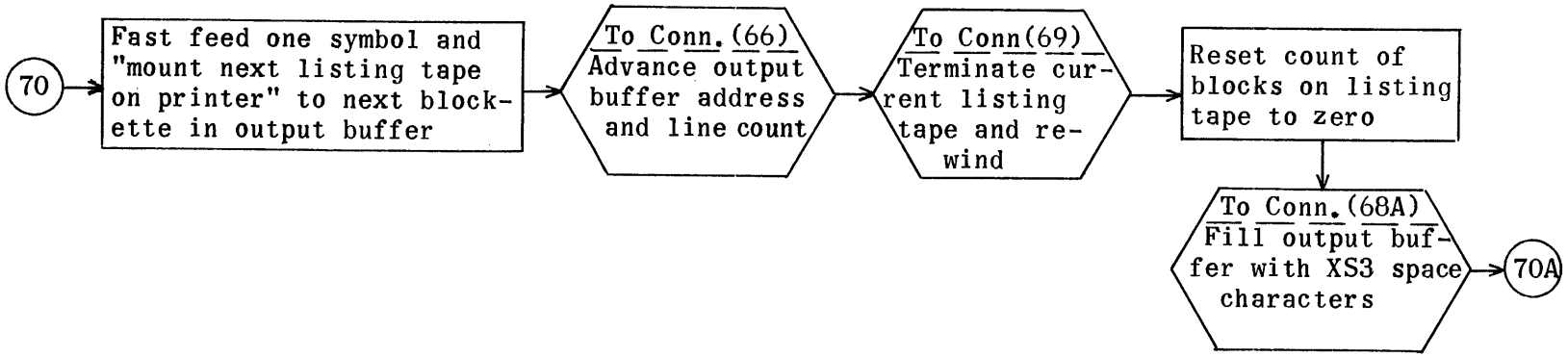


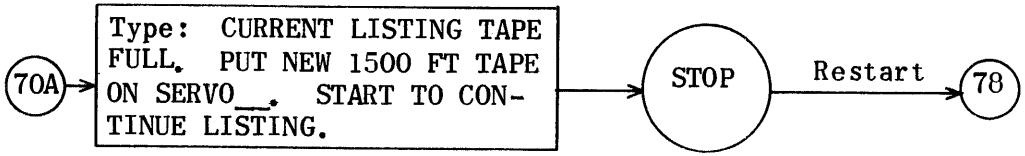


(BB) Subroutine to terminate current listing tape

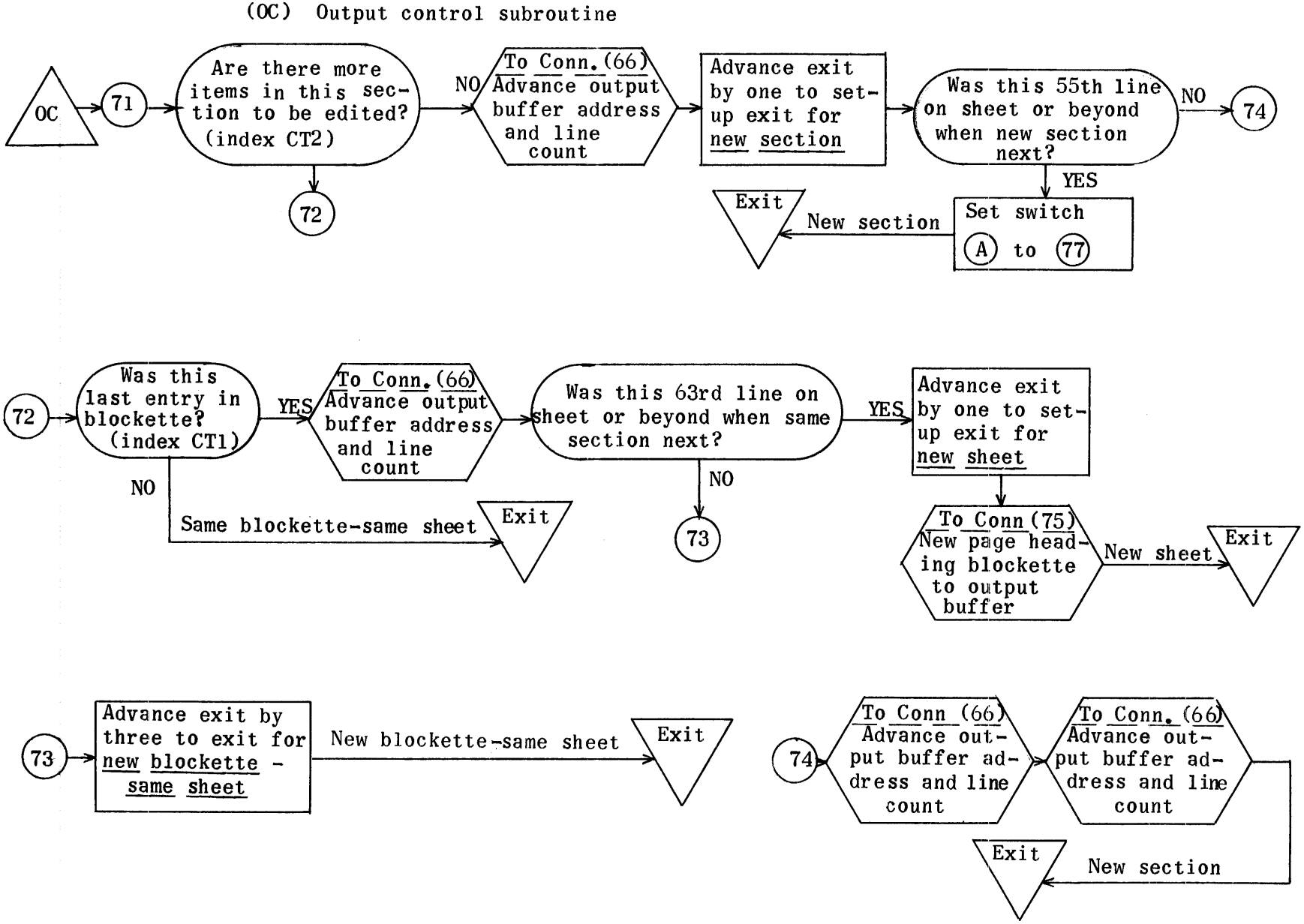


(BD) Subroutine to end current listing tape at end of page

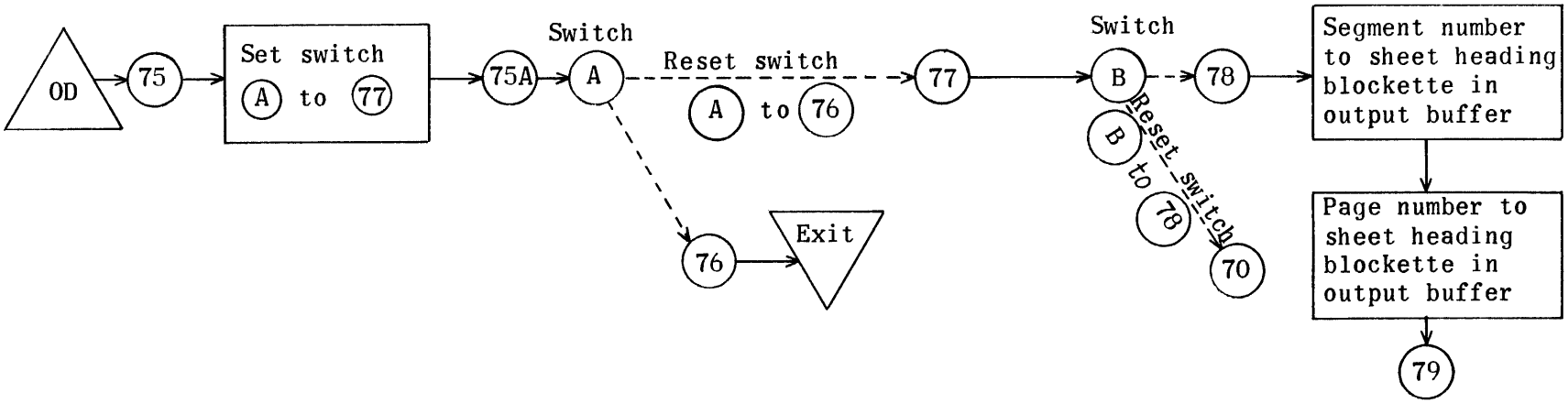


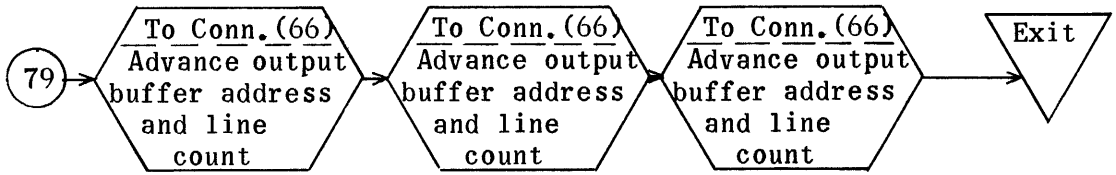


(OC) Output control subroutine



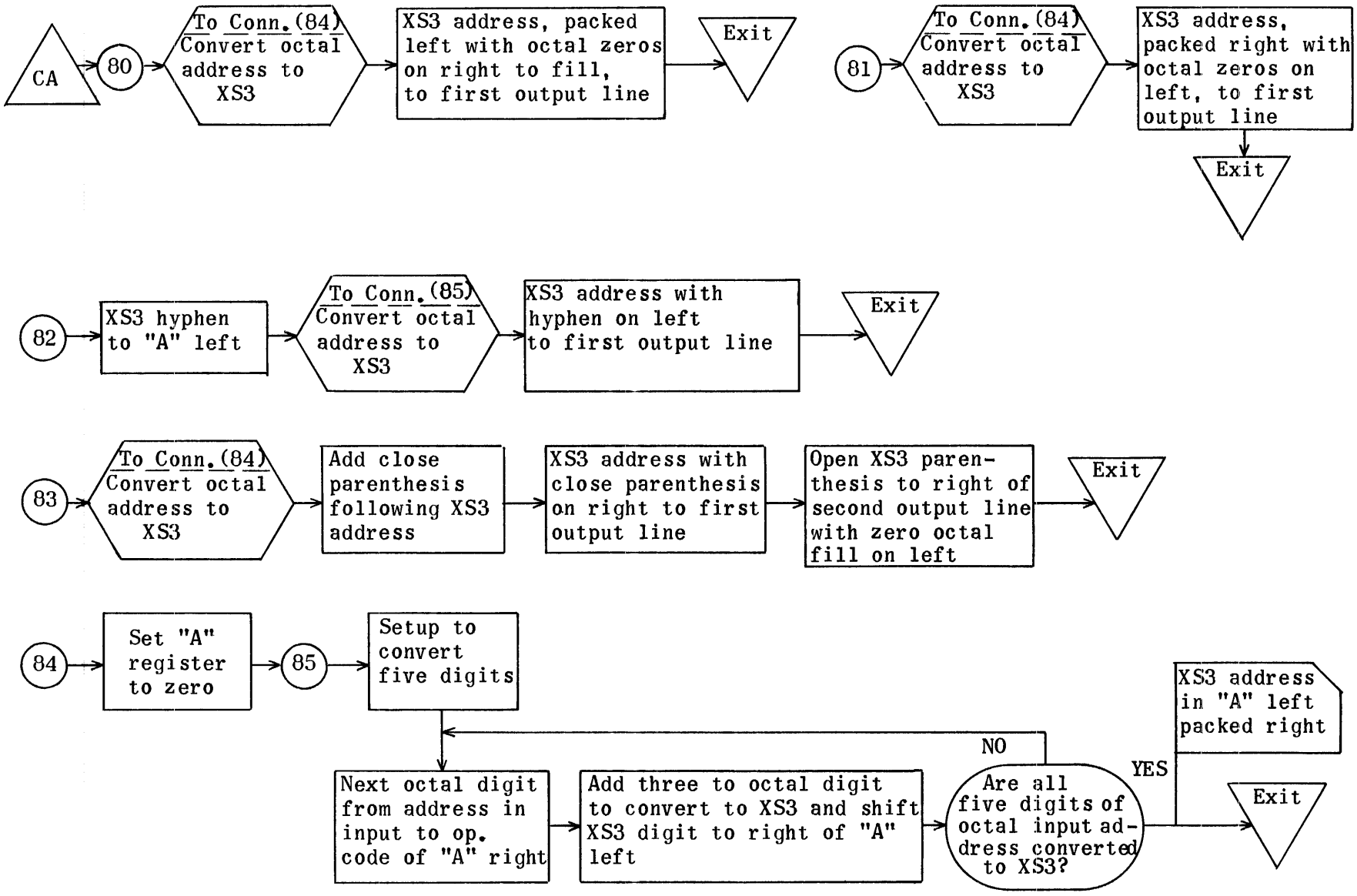
(OD) Page Heading Control Subroutine





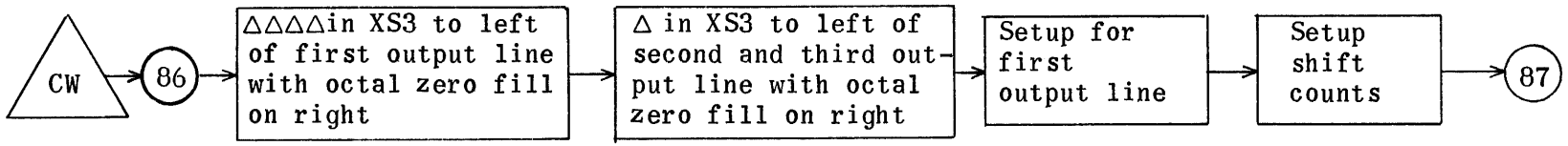
(CA) Convert octal address to XS3

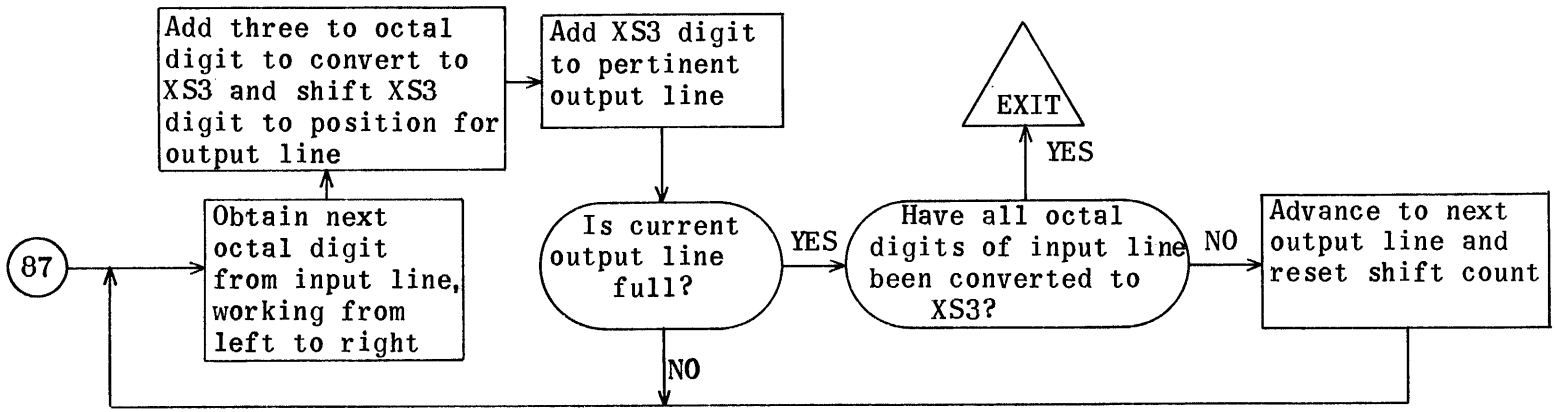
Input = Octal address Output = XS3 address



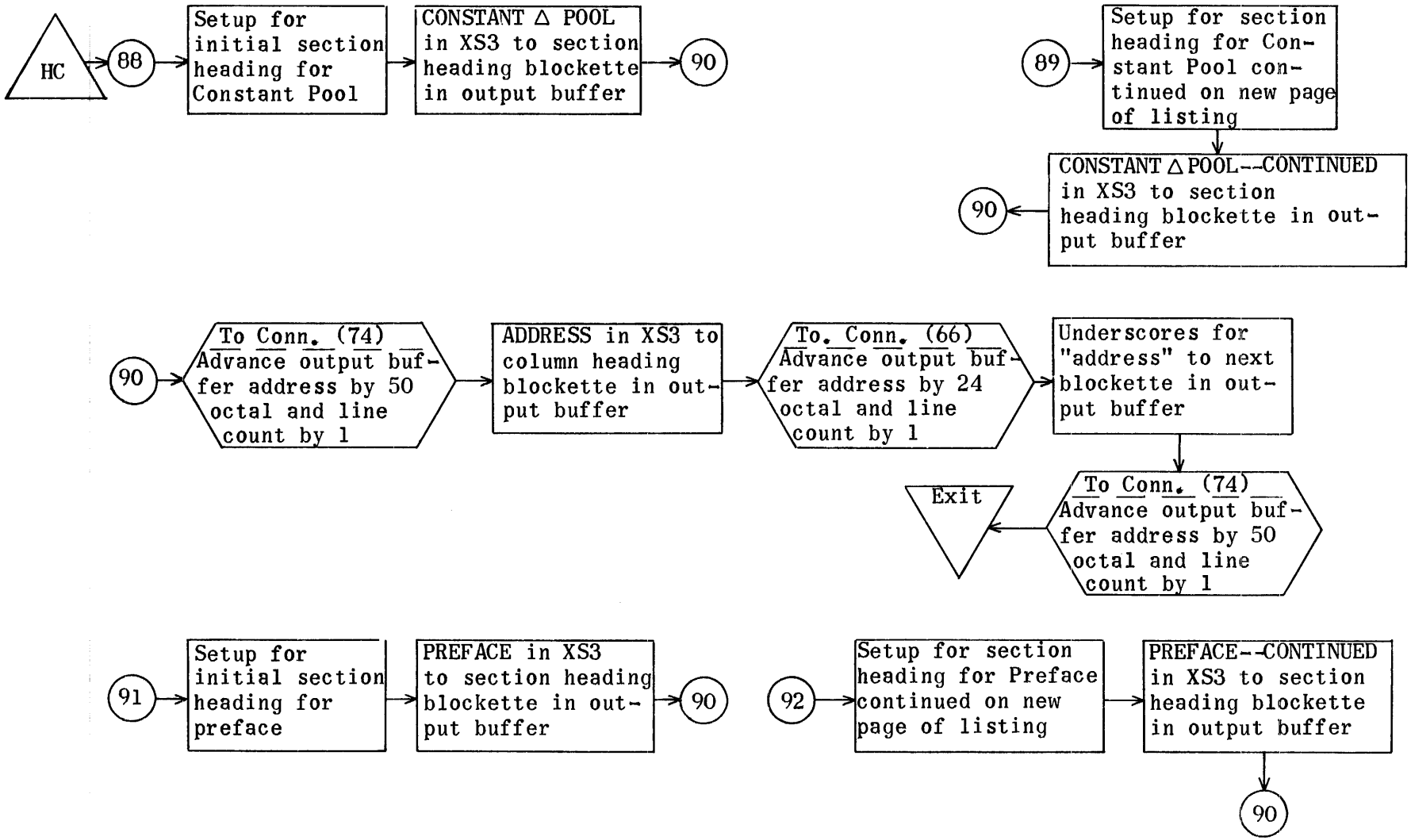
(CW) Convert Octal word to XS3
Input = octal computer word

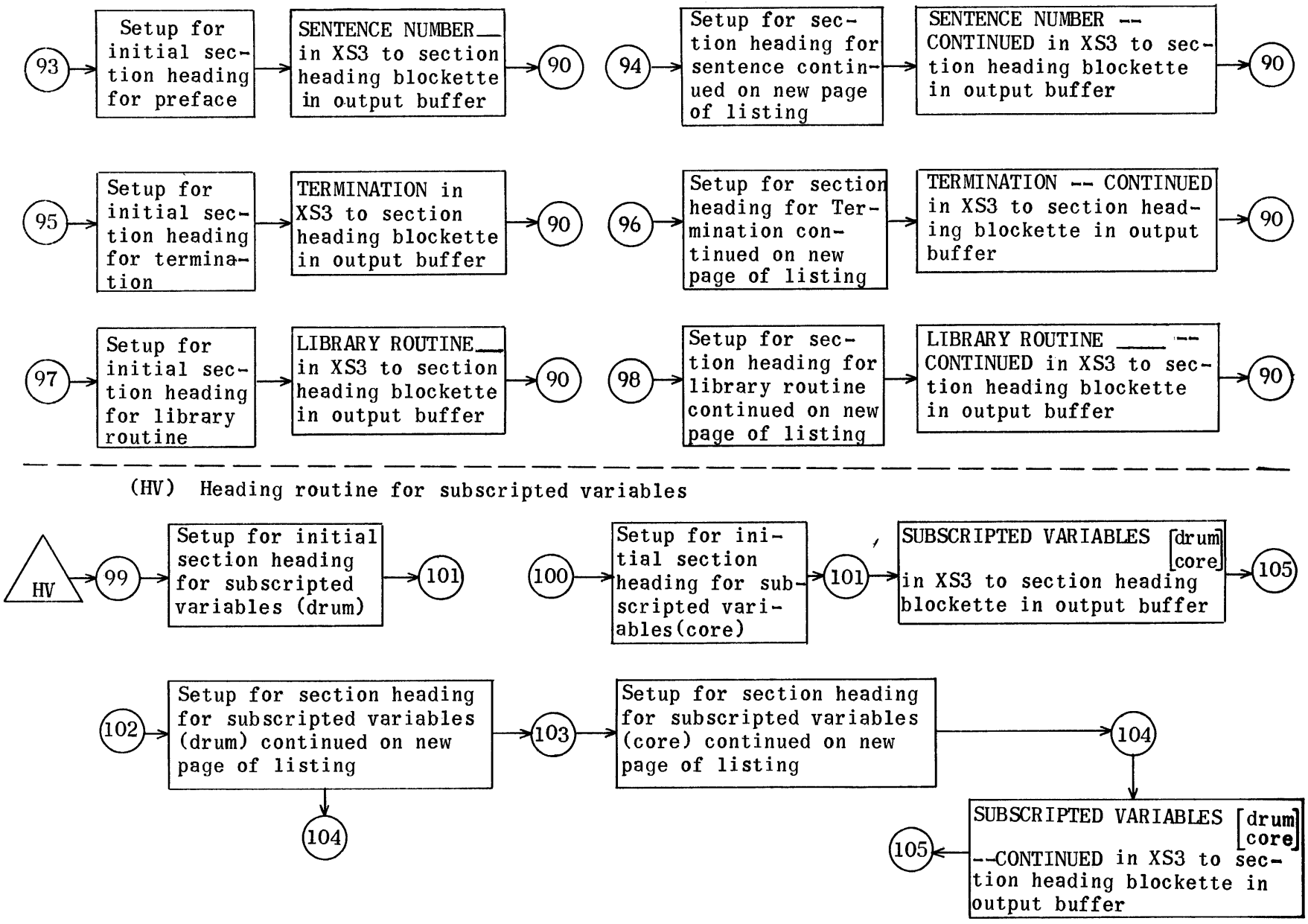
First output line = op. code in XS3
Second output line = "u" address in XS3
Third output line = "v" address in XS3

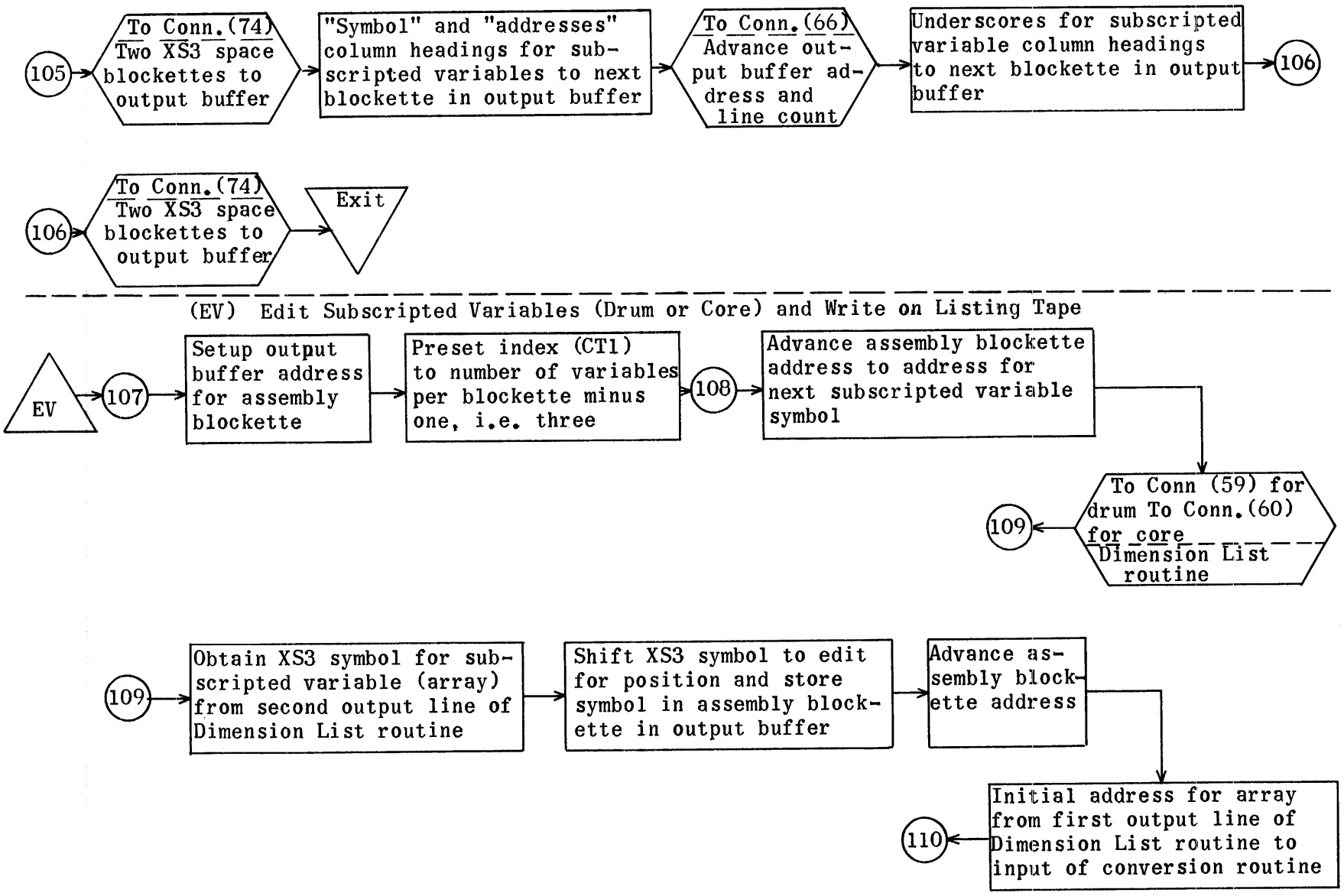


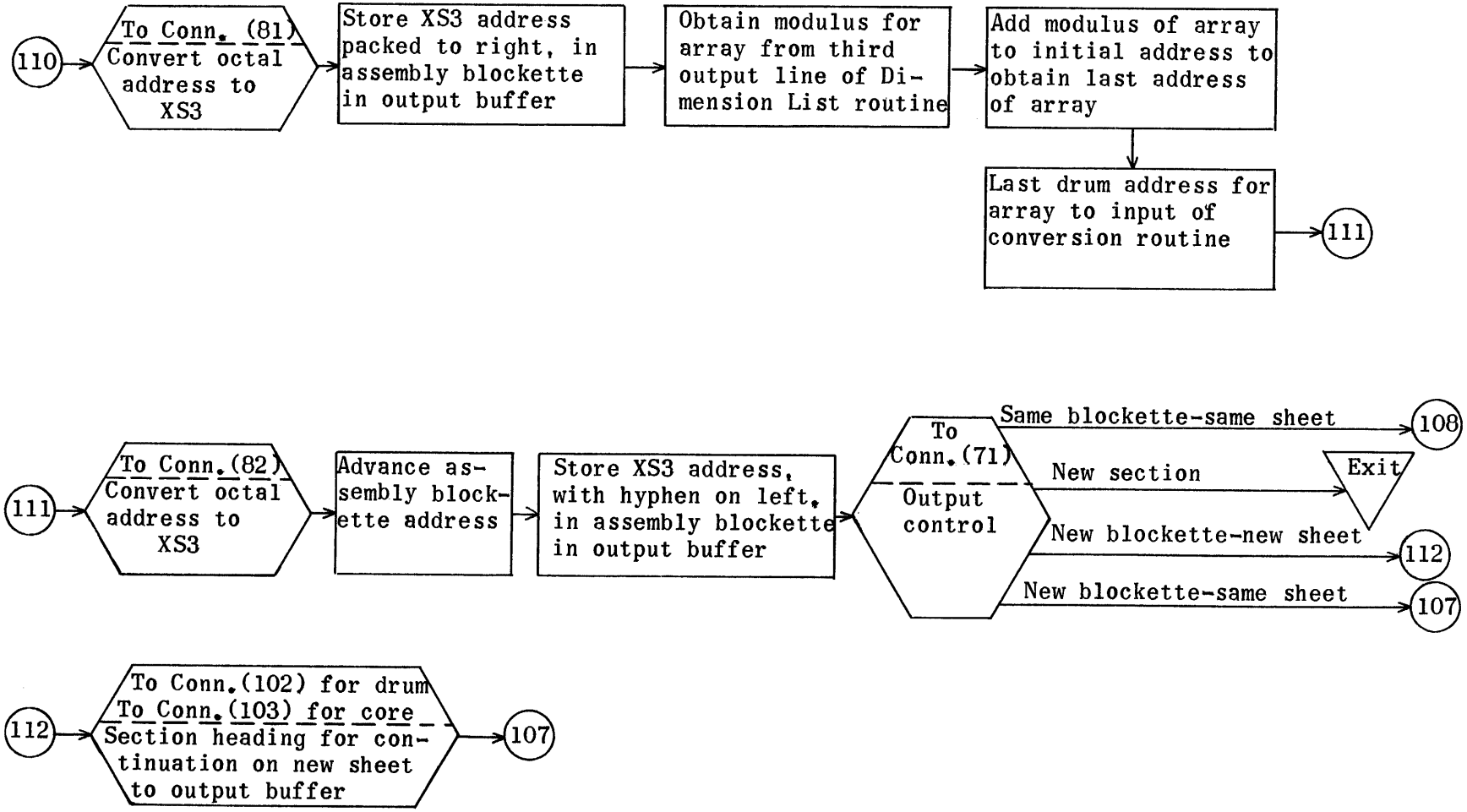


(HC) Heading Routine for Constant Pool, Preface, Sentence, Library Routine, and Termination Sections

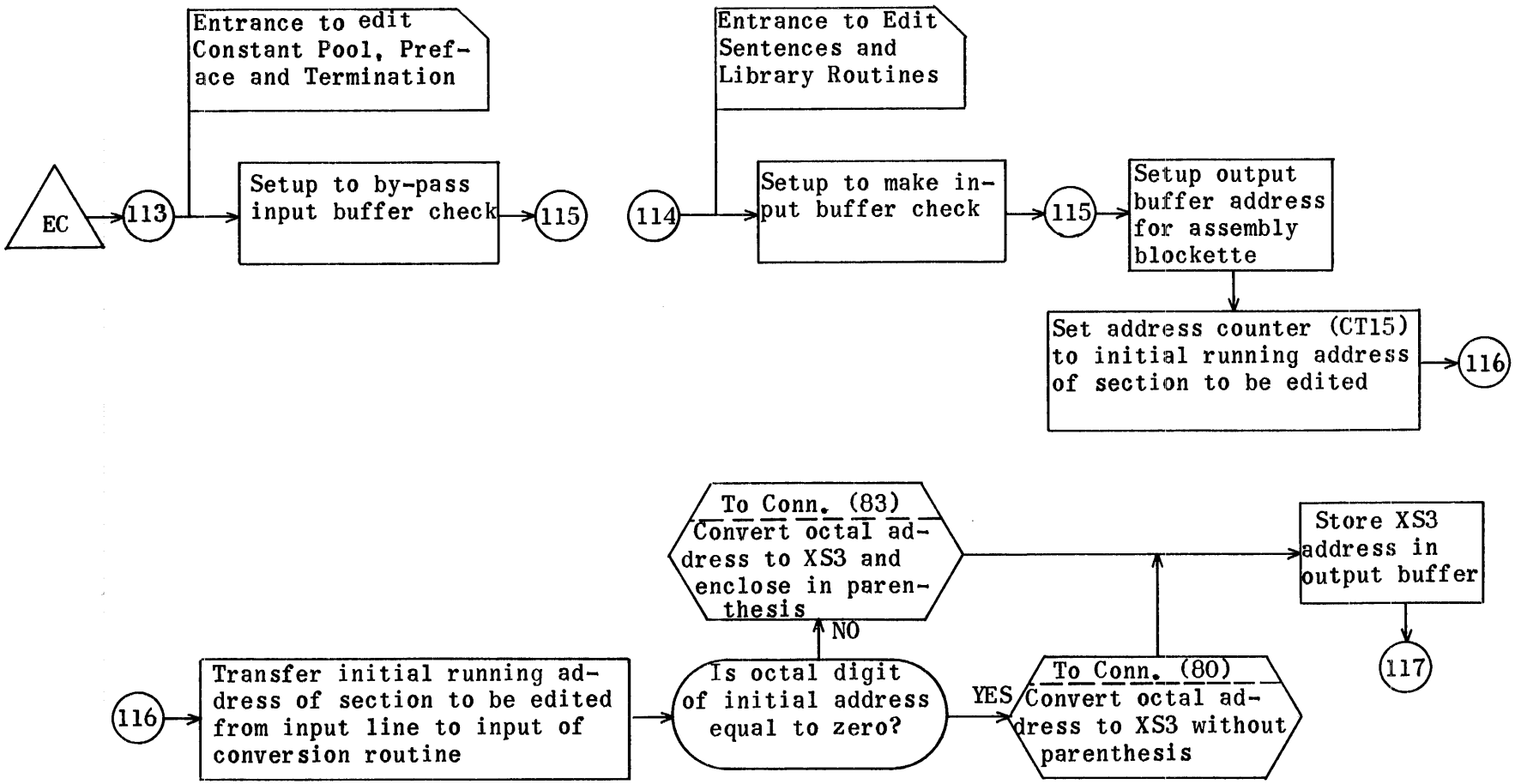


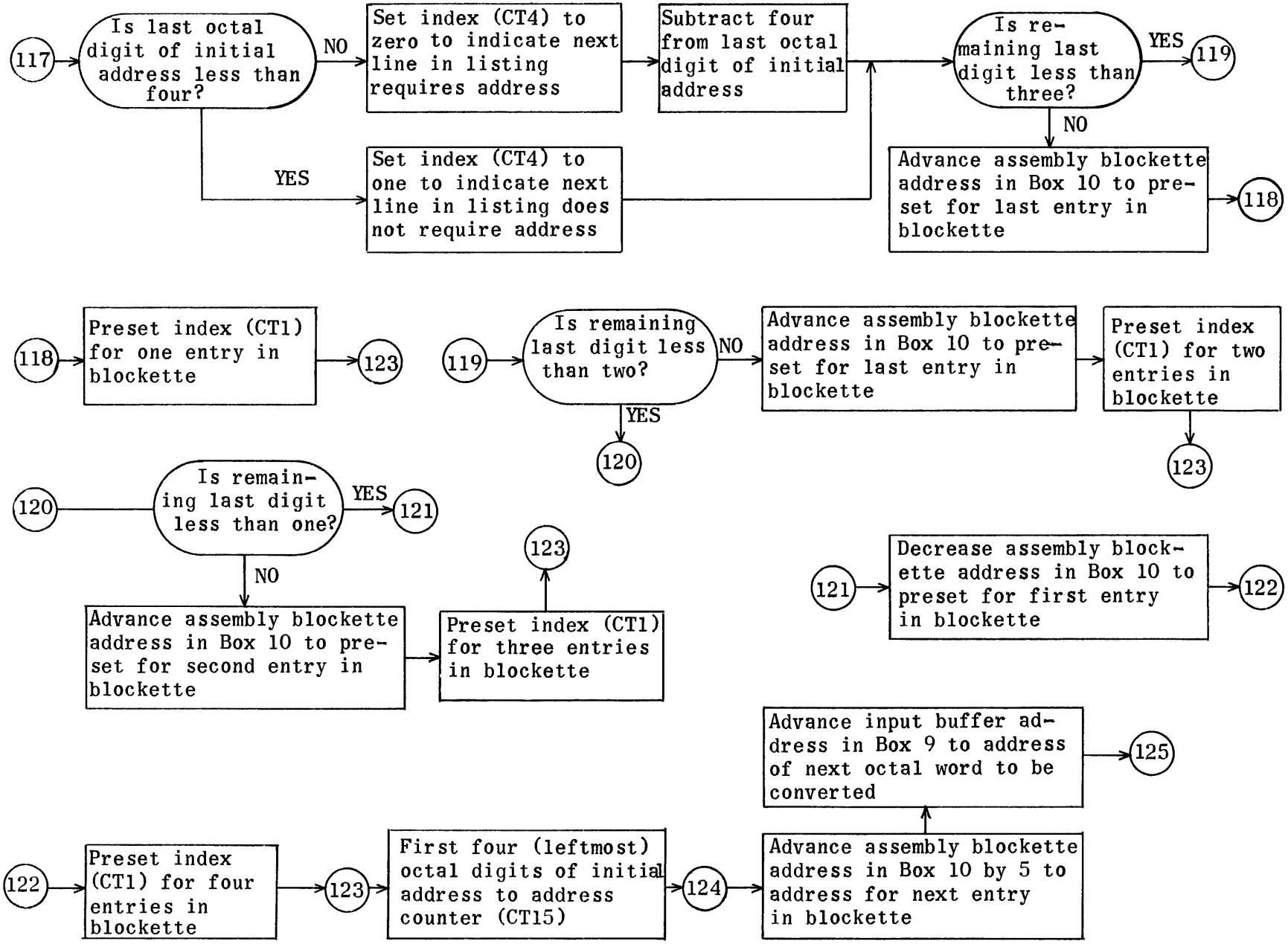

93
Setup for initial section heading for preface
SENTENCE NUMBER__ in XS3 to section heading blockette in output buffer
90
94
Setup for section heading for sentence continued on new page of listing
SENTENCE NUMBER -- CONTINUED in XS3 to section heading blockette in output buffer
90
95
Setup for initial section heading for termination
TERMINATION in XS3 to section heading blockette in output buffer
90
96
Setup for section heading for Termination continued on new page of listing
TERMINATION -- CONTINUED in XS3 to section heading blockette in output buffer
90
97
Setup for initial section heading for library routine
LIBRARY ROUTINE___ in XS3 to section heading blockette in output buffer
90
98
Setup for section heading for library routine continued on new page of listing
LIBRARY ROUTINE ____ -- CONTINUED in XS3 to section heading blockette in output buffer
90
(HV) Heading routine for subscripted variables
HV
99
Setup for initial section heading for subscripted variables (drum)
101
100
Setup for initial section heading for subscripted variables(core)
101
SUBSCRIPTED VARIABLES [drum core] in XS3 to section heading blockette in output buffer
105
102
Setup for section heading for subscripted variables (drum) continued on new page of listing
103
Setup for section heading for subscripted variables (core) continued on new page of listing
104
104
105
SUBSCRIPTED VARIABLES [drum core] --CONTINUED in XS3 to section heading blockette in output buffer

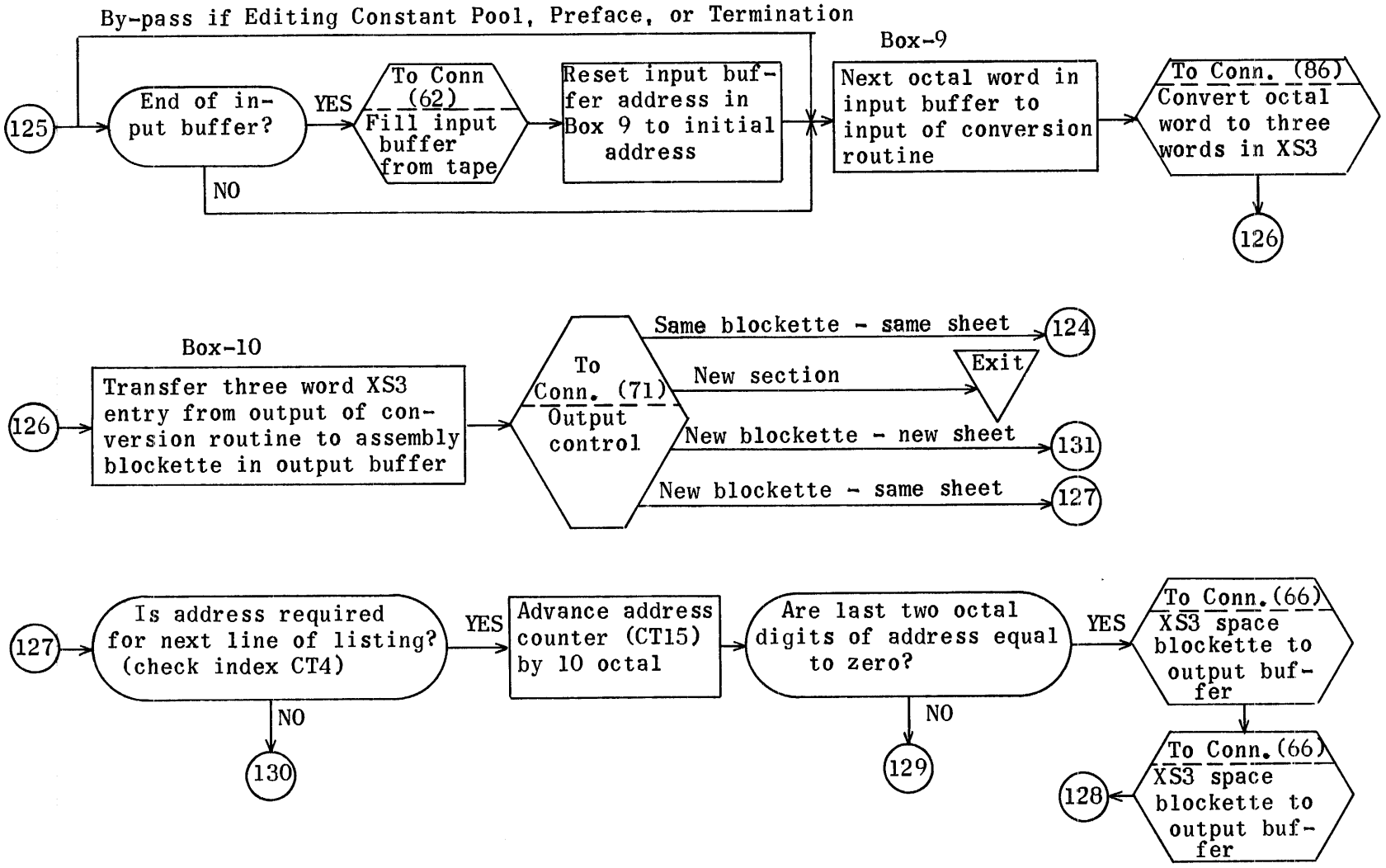

105
To Conn.(74) Two XS3 space blockettes to output buffer
"Symbol" and "addresses" column headings for subscripted variables to next blockette in output buffer
To Conn.(66) Advance output buffer address and line count
Underscores for subscripted variable column headings to next blockette in output buffer
106
106
To Conn.(74) Two XS3 space blockettes to output buffer
Exit
(EV) Edit Subscripted Variables (Drum or Core) and Write on Listing Tape
EV
107
Setup output buffer address for assembly blockette
Preset index (CT1) to number of variables per blockette minus one, i.e. three
108
Advance assembly blockette address to address for next subscripted variable symbol
109
To Conn (59) for drum To Conn.(60) for core Dimension List routine
109
Obtain XS3 symbol for subscripted variable (array) from second output line of Dimension List routine
Shift XS3 symbol to edit for position and store symbol in assembly blockette in output buffer
Advance assembly blockette address
110
Initial address for array from first output line of Dimension List routine to input of conversion routine

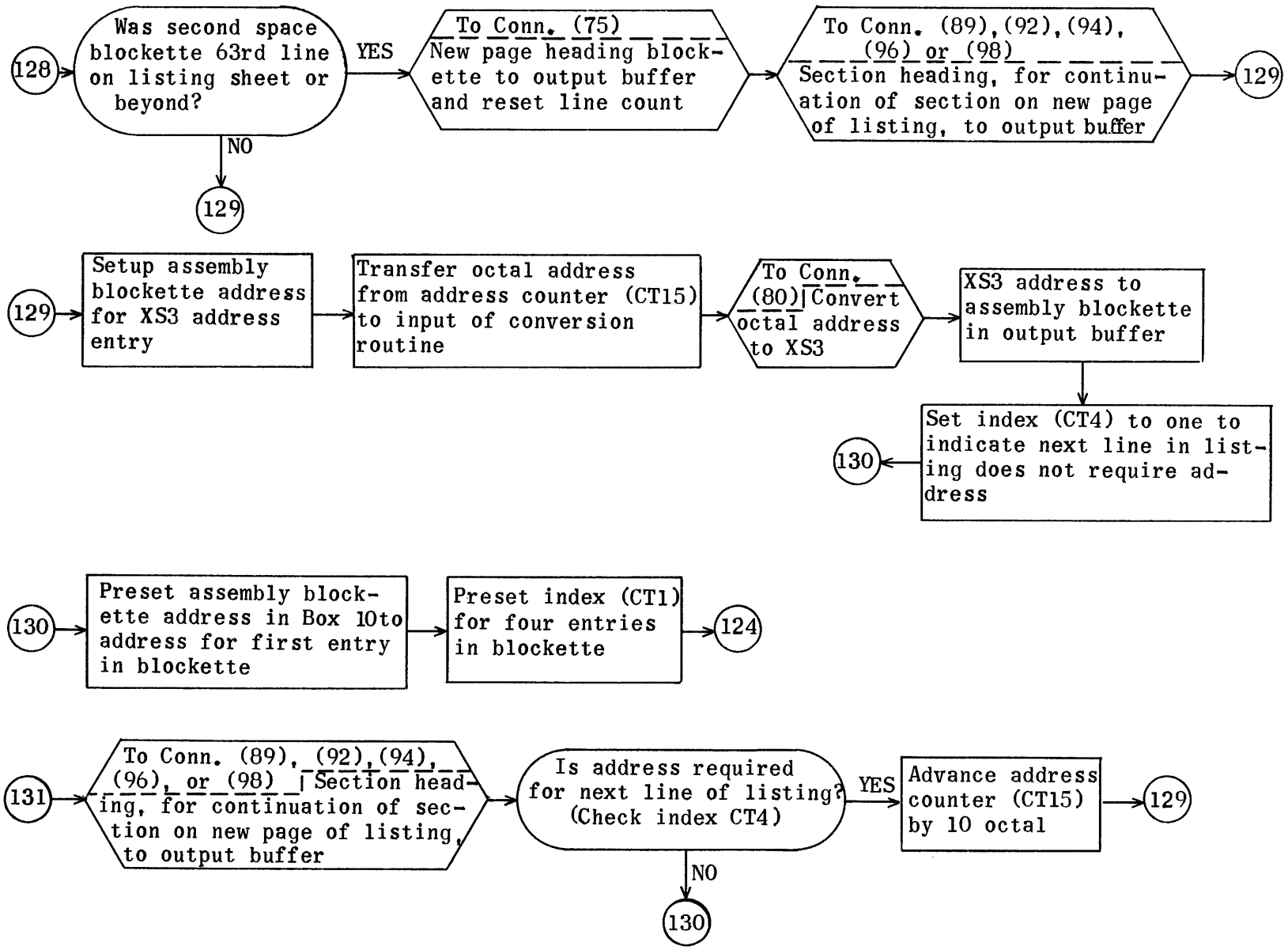

110
To Conn. (81)
Convert octal address to XS3
Store XS3 address packed to right, in assembly blockette in output buffer
Obtain modulus for array from third output line of Dimension List routine
Add modulus of array to initial address to obtain last address of array
Last drum address for array to input of conversion routine
111
111
To Conn.(82)
Convert octal address to XS3
Advance assembly blockette address
Store XS3 address, with hyphen on left, in assembly blockette in output buffer
To Conn.(71)
Output control
Same blockette-same sheet
108
New section
Exit
New blockette-new sheet
112
New blockette-same sheet
107
112
To Conn.(102) for drum
To Conn.(103) for core
Section heading for continuation on new sheet to output buffer
107

(EC) Edit octal coding or constants and write on listing tape
Input - Initial object program running address of section to be edited




117
Is last octal digit of initial address less than four?
NO
Set index (CT4) to zero to indicate next line in listing requires address
Subtract four from last octal digit of initial address
Is remaining last digit less than three?
YES
119
NO
YES
Set index (CT4) to one to indicate next line in listing does not require address
Advance assembly blockette address in Box 10 to preset for last entry in blockette
118
118
Preset index (CT1) for one entry in blockette
123
119
Is remaining last digit less than two?
NO
YES
120
Advance assembly blockette address in Box 10 to preset for last entry in blockette
Preset index (CT1) for two entries in blockette
123
120
Is remaining last digit less than one?
YES
121
NO
Advance assembly blockette address in Box 10 to preset for second entry in blockette
123
Preset index (CT1) for three entries in blockette
121
Decrease assembly blockette address in Box 10 to preset for first entry in blockette
122
Advance input buffer address in Box 9 to address of next octal word to be converted
125
122
Preset index (CT1) for four entries in blockette
123
First four (leftmost) octal digits of initial address to address counter (CT15)
124
Advance assembly blockette address in Box 10 by 5 to address for next entry in blockette

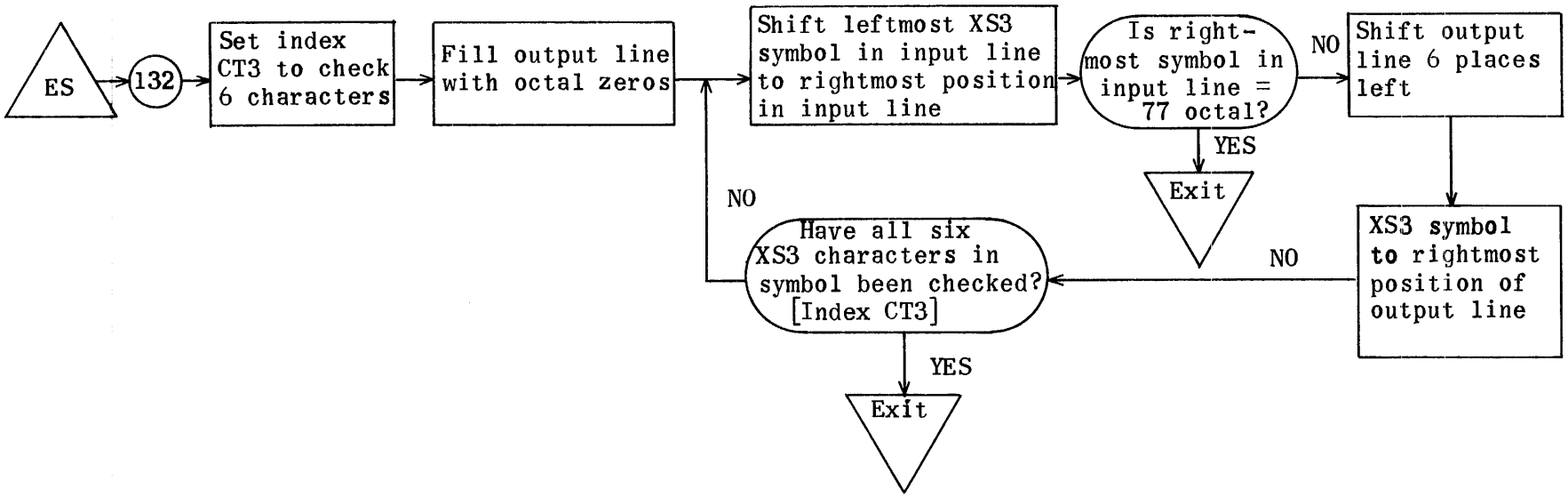

By-pass if Editing Constant Pool, Preface, or Termination
125
End of input buffer?
YES
To Conn (62)
Fill input buffer from tape
NO
Reset input buffer address in Box 9 to initial address
Box-9
Next octal word in input buffer to input of conversion routine
To Conn. (86)
Convert octal word to three words in XS3
126
Box-10
126
Transfer three word XS3 entry from output of conversion routine to assembly blockette in output buffer
To Conn. (71) Output control
Same blockette - same sheet
124
New section
Exit
New blockette - new sheet
131
New blockette - same sheet
127
127
Is address required for next line of listing? (check index CT4)
YES
Advance address counter (CT15) by 10 octal
Are last two octal digits of address equal to zero?
YES
To Conn. (66)
XS3 space blockette to output buffer
NO
130
NO
129
To Conn. (66)
XS3 space blockette to output buffer
128


128
Was second space blockette 63rd line on listing sheet or beyond?
YES
To Conn. (75)
New page heading blockette to output buffer and reset line count
To Conn. (89), (92), (94), (96) or (98)
Section heading, for continuation of section on new page of listing, to output buffer
129
NO
129
129
Setup assembly blockette address for XS3 address entry
Transfer octal address from address counter (CT15) to input of conversion routine
To Conn. (80) Convert octal address to XS3
XS3 address to assembly blockette in output buffer
Set index (CT4) to one to indicate next line in listing does not require address
130
130
Preset assembly blockette address in Box 10 to address for first entry in blockette
Preset index (CT1) for four entries in blockette
124
131
To Conn. (89), (92), (94), (96), or (98) Section heading, for continuation of section on new page of listing, to output buffer
Is address required for next line of listing? (Check index CT4)
YES
Advance address counter (CT15) by 10 octal
129
NO
130

1794

(ES) Edit XS3 Variable Symbol for Octal 77's

Input = XS3 symbol packed left with octal 77 fill
Output = XS3 symbol packed right with octal zero fill



Program Listing Phase Regions

	RE	BR537	Alarm routine
	RE	TH21	Tape handler
	RE	UP421	Uniprint routine
	RE	EP540	≡ BR1 Alarm 1
	RE	WP551	≡ BR12 Alarm 10
	RE	WQ551	≡ BR12 Alarm 10
	RE	WV547	≡ BR10 Alarm 8
	RE	YP551	≡ BR12 Alarm 10
	RE	YQ551	≡ BR12 Alarm 10
	RE	YV551	≡ BR12 Alarm 10
	RE	ZP547	≡ BR10 Alarm 8
Group I	RE	FP653	
	RE	TL732	
	RE	TC746	
	RE	XS772	
	RE	XT1072	
	RE	FC1146	
	RE	RC1252	
	RE	CT1316	
	RE	OD1342	
	RE	NP1363	
	RE	BA1415	
	RE	BB1432	
Group II	RE	PP1452	
	RE	PT1467	
	RE	BF1510	
	RE	BG1611	
Group III	RE	PQ1672	
	RE	PR1725	
	RE	PS1770	
	RE	EV2030	
	RE	EC2064	
	RE	ED2125	
	RE	EF2177	
	RE	FR2203	
	RE	IR2211	
	RE	DS2241	
	RE	OC2311	
	RE	BD2335	
	RE	HV2352	
	RE	HC2407	
	RE	CA2470	
	RE	CW2521	
Group IV	RE	PK2547	
	RE	PL2565	
	RE	PM2625	

```
RE    PN2660
RE    P02741
RE    CL2756
RE    LS2767
RE    ES3000

RE    LB3327      List Buffer
RE    DL5037      Modified Dimension list in core
RE    OB7040      Output buffer
RE    FB2170      File buffer
RE    SB2360      Statement buffer
RE    RB2550      Routine buffer
RE    NL2740      Sentence number list in core
RE    FL2557      Op. File IV list in core

RE    IB2747      Input buffer
RE    DD40101     Modified Dimension list on drum
RE    ND42102     Sentence number
RE    FD46202     Op. File IV on drum
RE    RF47202     Routine file for Op. File IV

RE    DQ52472     Group III instructions on drum
RE    ZZ655       Length of Group III

RE    DP53400     Group II instructions on drum
RE    YY220       Length of Group II

RE    TB610       Initial address of termination
                  buffer
RE    BL2260      Listing tape block limit
```

Memory Layout

```
          TH  21
              400
          UP 421
              216
          EP 537

          -----

GP. I     FP 653
          TL 732
          TC 746
          XS 772
          XT1072
          FC1146
          RC1252
          CT1316
          OD1342
          NP1363
          BA1415
          BB1432

          -------

GP. II    PP1452
          PT1467
          BF1510
          BG1611

          -----

GP. III   PQ1672
          PR1725
          PS1770
          EV2030
          EC2064
          ED2125
          EF2177
          FR2203
          IR2211
          DS2241
          OC2311
          BD2335
          HV2352
          HC2407
          CA2470
          CW2521

          -----
```

```
GP. IV    PK2547
          PL2565
          PM2625
          PN2660
          P02741
          CL2756
          LS2767
          ES3000

          -------

GP. IV    LB3327
(Lists &      1510
buffers)  DL5037
             2001

          OB7040
             740
          -------
          10000

GP. II    FB2170
(Lists &      170
buffers)  SB2360
              170
          RB2550
              170
          NL2740
             4100
          OB7040
              740
          -------
          10000

GP. III   FL2557
(Lists &      170
buffers)  IB2747
             2070
          DL5037
             2001
          OB7040
              740
          -------
          10000
```

```
          EP 537    ≡ BR
          WP 551    ≡ BR12
          WQ 551    ≡ BR12
          WV 547    ≡ BR10
          YP 551    ≡ BR12
          YQ 551    ≡ BR12
          YV 551    ≡ BR12
          ZP 547    ≡ BR10
```

Not included on region tape since referenced only by uniprint.

```
          FC 40 001
             100
          DD 40 101     Dimension List
           2 001
          ND 42 102     Sentence number
                        list
           4 100
          FD 46 202     Op. File IV on
                        drum
           1 000
          RF 47 202     Routine File on
                        drum
           3 270
          DQ 52 472     Group III on
                        drum
          ZZ   655      Length Group III

          DP 53 400     Group II on drum
          YY   220      Length Group II

          TB   610      Termination buffer
                        address
          BL  2260      Listing tape block
                        limit
```

Program Listing Phase

```
      IA    PK                    Program listing setup
0     TP    FP        UP3         Parameter --> uniprint
1     RJ    UP2       UP          Print:  LISTING OF PROGRAM
2     RP    10024     PK4
3     TP    FC        CT          Zeroize temporaries
4     TP    XS11      CT10        Preset 1st page no. word (assume
                                    no number 1st page)
5     TP    XS12      CT11        Preset 2nd page no. word
6     TP    XS        CT12        Preset 1st segment no. word
7     TP    XS11      CT13        Preset 2nd segment no. word
10    TV    RC24      NP4         Preset one shot jump in Page no. rtn.
11    TV    RC25      NP7         Preset one shot jump in Page no. rtn.
12    RP    YY30000   PK14 }
13    TP    PP        DP   }      Program Load II --> drum
14    RP    ZZ30000   PL   }
15    TP    PQ        DQ   }      Program Load III --> drum
      CA    PK16
```

Program Listing (Title Section)

		IA	PL		
①	0	RP	10740	PL2	
	1	TP	XS11	0B	Fill output buffer with space char.
	2	TP	XS	0B	Fast feed 1 sym → sheet hdg. blkt.
	3	RP	30004	PL5	
	4	TP	XT40	0B10	PROGRAM △ LISTING → Sheet Hdg. blkt.
	5	TP	TC	TH3	Codeword → G.T.H.
	6	RJ	TH2	TH	Read 1 blk. corrected problem tape → list buffer
	7	RJ	CL	CL1	Check corr. prob. tape label (i.e. UNICODE△PROGRAM)
②	10	RP	30144	PL12	
	11	TP	LB24	0B50	Prog. title → 3rd - 7th blkts in output buffer
	12	TP	RC3	CT6	Preset output buffer address
	13	TP	FC7	CT7	Preset line count (15_8) for 1st entry following title
	14	SP	14	0	# blks preceding XS3 sym. list lab → Av
	15	ST	FC1	Q	Decrease by 1 to exclude tape label blk. → Q_v
	16	LT	3	CT16	# blks. Const. Pool (incl. lab. blk. & End blk.) → "v" of temp.
	17	QT	FC32	A	# blks. to move tape to position at begin XS3 sym list lab.
	20	SS	CT16	25	Dec. by # blks. Const. Pool to get # blks. to move to begin const. pool
	21	AT	TC3	TH3	Codeword → G.T.H.
	22	RJ	TH2	TH	Move corr. prob. tape forward to begin Const. pool (or XS3 sym. list if no C.P.)
	23	MJ	10000	PL30	MJ1 off ⟹ 5 servos; MJ1 on ⟹ 7 servos
	24	TP	TC21	Q	Obj. prog. servo # = 3 → Q (5 servos)
	25	TP	FP55	FP20	Set listing tape # = 4 in flex. prints
	26	TP	FP55	FP47	Set listing tape # = 4 in flex. prints
	27	MJ	0	PL33	
	30	TP	FP56	FP20	Set listing tape # = 7 in flex. prints
	31	TP	FP56	FP47	Set listing tape # = 7 in flex. prints
	32	TP	TC22	Q	Obj. prog. servo # = 6 → Q (7 servos)
	33	RP	30010	PL35	

34	QT	TC6	TC6	Servo. no. → Obj. prog. tape codeword
35	RA	Q	FC2	Program listing servo no. → Q (1 in "u" adv.)
36	RP	30003	PM	
37	QT	TC16	TC16	Servo no. →program listing tape codewords
	CA	PL40		

Listing Phase (Subscripted Var. (Drum) Section)

		IA	PM			
③	0	TV	6	CT2		# 77--- CW's ⟶ Index C_2
	1	IJ	CT2	PM3	yes	Are there subscripted variables?
	2	MJ	0	PM15		No
	3	TP	6	A		jn for Dim.List of form 2----⟶Au
	4	AT	FC77	5		jn for Dim. List of form 3---- ⟶"u" of loc. 5
	5	TU	A	PM6		Dimension list from drum ⟶core
	6	RP	[30000]	PM10		
	7	TP	DD	DL		
	10	TU	RC33	DS4		Preset init. add. dim. list
	11	TV	RC42	EV7		Preset Dim. List rtn. ref. ⟶ subs. var. (drum) entry
	12	TV	RC5	EV32		Preset hdg. rtn. ref. ⟶ subs. var. (drum W/cont.) entry
	13	RJ	HV	HV1		Init. subs. var. (drum) hdgs. ⟶ sect. hdg. blkt.
	14	RJ	EV	EV1		Edit subs. var. (drum) & write on listing tape
④	15	SP	CT16	25		# blks const. pool (incl. lab. & end blks.) ⟶ A in codeword position
	16	ZJ	PM17	PN	yes / no	Is there const. pool?
	17	AT	TC5	TH3		Codeword ⟶ G.T.H.
	20	RJ	TH2	TH		Read const. pool (incl. lab. & end) from corr.prob. tape ⟶ Dim. List region
	21	TP	DL	A		1st word const. pool lab. blk. ⟶ A
	22	EJ	TL13	PN		1st word const. pool lab. blk. = C O N S T A ?
	23	MJ	0	WP		Alarm 10
	24	TP	14	Q		# blks XS3 sym. list incl. lab. & end blks. (If no sym. list, only
	25	QT	FC50	A		Lab. blk. appears & count = 1) ⟶ A in position for codeword
	26	AT	TC23	TH3		Codeword to read sym. list to list buffer ⟶ G.T.H.
	27	RJ	TH2	TH		Read XS3 sym. list (or lab. blk. if no list) ⟶ List buffer
	30	TP	LB	A		1st word XS3 sym. list lab. blk ⟶ A
	31	EJ	TL4	PN3		1st word XS3 sym. list lab. blk = S Y M B O L ?
	32	MJ	0	WQ		Alarm 10
		CA	PM33			

Non-Subscripted Variable Section

		IA	PN		
⑤	0	SP	7	0	Init. running add. non-subs. var. → Au, # non-subs. var. → Av
	1	ST	FC3	CT	Decrease running add. & # non-subs. var. each by 1 → temp
	2	SJ	P0 no	PM24 yes	Are there non-subs. var.? No ⟹ const. pool section
⑥	3	TV	CT	CT2	# non-subs. var. - 1 → index C_2
	4	TV	FC	CT	Zero → "v" of temp. containing non-subs. var. add. - 1
	5	RJ	OD	OD2	New page hdg. if required → output buffer
	6	TU	RC12	PN37	Preset initial add. in XS3 sym. list
	7	TP	XS53	XS50	Setup section hdg.
	10	TV	CT6	PN12	Preset add. sect. hdg. blkt = output buffer add.
	11	RP	30005	PN13	
	12	TP	XS44	[30000]	"Non-subscripted∆variables" Hdg. → Section hdg. blkt.
⑥A	13	TU	RC10	PN21	Preset "u" of TP → Add. of stored col. hdgs.
	14	RJ	OC	OC21	Two space blkts. → output buffer
⑦	15	TP	FC20	Q	Switch [06 | 00000 | 00000] → Q
	16	TV	CT6	PN21	Preset add. col. hdg. blkt. = output buffer add.
	17	RA	PN21	FC10	2 in "v" adv. → add. for 1st col. hdg. (or underscore)
	20	RP	30003	PN22	
	21	TP	[30000]	[30000]	Column hdg. (or underscores) → output buffer
	22	RA	PN21	FC21	5 in "v" adv. → Add. for next column hdg.
	23	QJ	PN24 yes	PN20 no	All column hdg. (or underscores) → output buffer?
	24	QJ	PN25 no	PN31 yes	Underscores transferred yet?
	25	RJ	BA	BA1	Adv. output buff. add. by 20_{10} (24_8)
	26	TU	RC11	PN21	Preset "u" of TP → Add. stored underscores
	27	TP	FC22	Q	Switch [04 | 00000 | 00000] → Q
	30	MJ	0	PN16	
	31	RJ	OC	OC21	Two space blkts → output buffer
⑧	32	TV	CT6	PN41	Set assem. blkt. add. = output buffer add.
	33	RS	PN41	FC1	Dec. assem. blkt. add. by 1 → preset for 1st var. sym.
	34	TP	FC11	CT1	Preset index C_1 → # variables/ blkt. - 1

⑨	35	RA	CT	FC2	1 in "u" adv. ⟶ running add. next var.
	36	RA	PN41	FC11	Adv. assem. blkt. add. by 3 ⟶ add. next sym.
	37	TP	[30000]	ES2	XS3 var. sym. packed left W/77_8
		CA	PN40		fill ⟶ input edit rtn.
		IA	PN40		
	40	RJ	ES	ES3	Pack symbol to right with $zero_8$ fill
	41	TP	ES1	[30000]	XS3 var. symbol packed right ⟶ output buffer
⑩	42	RA	PN37	FC2	1 in "u" advance to address next var. symbol
	43	RA	PN41	FC10	Adv. add. assem. blkt. by 2 in "v" ⟶ add. for next add. entry
	44	TV	A	PN47	Preset address for variable address entry
	45	TP	CT	CA2	Running add. for next var. ⟶ conversion routine
	46	RJ	CA	CA3	Convert octal add. ⟶ XS3 W/$zero_8$ on right
	47	TP	CA1	[30000]	Running address for variable ⟶ output buffer
⑪	50	RJ	OC	OC1	
	51	MJ	0	PN35	⟹ same blockette - same sheet
	52	MJ	0	P0	⟹ new section
	53	MJ	0	PN55	⟹ new blockette - new sheet
	54	MJ	0	PN32	⟹ new blockette - same sheet
⑫	55	TP	XS54	XS50	Set up section hdg. to continue on new sheet
	56	TV	CT6	PN60	Preset address section hdg. blkt. = output buffer add.
	57	RP	30007	PN13	
	60	TP	XS44	[30000]	Non-subscripted△variables -- continued ⟶ sect. hdg. blkt.
		CA	PN61		

Constant Pool Section

		IA	PO		
(13)	0	SP	10	17	Init. running add. const. pool ⟶ "u" of A
	1	TU	A	EC1	Init. running add. const. pool ⟶ input edit routine
	2	LT	6	Q	jn for constant pool ⟶ Qv
	3	QT	FC13	CT2	# const. in const. pool ⟶ index C_2
	4	IJ	CT2	PO6 yes	Is there const. pool?
	5	MJ	0	PO13	
	6	RJ	OD	OD2	New page hdg. if required ⟶ output buffer
(14)	7	TU	RC22	ED14	Preset input buff. add. for 1st const. - 1
	10	RJ	HC	HC1	Constant pool hdgs. ⟶ output buffer
	11	TV	RC33	EF	Preset ent. add. for const. pool hdgs. (W/cont.)
	12	RJ	EC	EC2	Edit const. pool & write on listing tape
(15)	13	RJ	LS	LS1	Locate 1st segment label blk.
	14	MJ	0	PP	
		CA	PO15		

Segment Section

		IA	PP		
(16)	0	TU	CT	PP1	Address seg. lab. blk. → "u" of NI
	1	TP	[30000]	A	1st word label blk. → A
	2	EJ	TL	PT yes	1st word label blk. = Z's? i.e. is this end obj. prog.?
	3	EJ	TL1	PP5	1st word label blk. = SEGMEN?
	4	MJ	0	WV	Alarm 8
(17)	5	TP	XS7	CT12	" @SEGME" → 1st seg. no. word
	6	RA	PP1	FC24	Adv. add. label blk. → Add. seg. no. (3rd line)
	7	TU	A	PP11	Preset add. seg. no. (3rd line lab. blk.)
	10	RP	30006	PP12 }	
	11	TP	[30000]	CT16 }	3rd - 8th line lab. blk. → temps.
	12	RJ	BF	BF1	Build Op. File IV this seg. and # sentences → "v" of index C_5
	13	RP	ZZ30000	PQ }	
	14	TP	DQ	PQ }	Program load III → core
		CA	PP15		

		IA	PQ		
	0	TP	CT16	A	Octal segment no. → Av
	1	TJ	FC100	PQ7 yes	12_8 (10_{10}) → seg. no.?
	2	DV	FC100	Q	Divide seg. no. by 12_8 (NB-max. seg. no. = 63_{10})
	3	LQ	Q	6	Tens digit seg. no. left 6
	4	SA	Q	0	Two digit seg. no. → Av
	5	SA	FC101	6	Convert two $digit_{10}$ seg. no. → XS3 and position in A
	6	MJ	0	PQ10	
	7	SA	FC11	14	Convert one $digit_{10}$ seg. no. → XS3 and position in A
	10	AT	XS10	CT13	NT△ [seg. no.] 0 → 2nd seg. no. word
(18)	11	RJ	OD	OD1	Sheet hdgs. (seg. no. & pg. no.) → output buffer
	12	SP	CT17	25	# blks Pref. (Term.) → A in codeword position
	13	ZJ	PQ14 yes	PQ26 no	Is there Preface?
	14	AT	TC1	TH3	Codeword → G.T.H.
	15	RJ	TH2	TH	Read Preface from corr. prob. tape → input buffer
	16	RJ	HC	HC23	Preface hdgs → output buffer
(19)	17	TU	CT22	EC1	Init. running add. Preface → input edit routine
	20	TV	RC34	EF	Preset ent. add. for Pref. hdgs. (W/continued) in edit rtn.
	21	TU	RC	ED14 }	Preset input buff. add. → init.
	22	RS	ED14	FC2 }	add. - 1 in edit rtn.
	23	SP	CT23	0	# lines Preface → Av
	24	ST	FC1	CT2	# lines Preface - 1 → index C_2
	25	RJ	EC	EC2	Edit Pref. and write on listing tape
(19A)	26	TP	CT21	Q	# lines partial blk. this segment → Q
	27	QT	FC23	A	# lines partial blk. segment + Preface → Qu
	30	TU	RC24	FR2	Preset initial add. Op. File IV (drum) in Op. File IV control routine
	31	TU	RC40	PR14	Preset add. File list → limiting add. initially
	32	ZJ	PR yes	PR1 no	Is there partial blk?
		CA	PQ33		

Sentence Section

		IA	PR			
	0	SP	FC2	6		Set blk. count = 1 in A in code-word position to count part. blk.
	1	AT	CT20	IR1		# blks. (incl. part. blk.) seg. + Pref. ⟶ input fill buffer rtn.
	2	RJ	IR	IR2		Fill input buffer
	3	TU	RC	ED14	}	
	4	RS	ED14	FC2	}	Preset input buff. add. ⟶ init. add - 1 in edit rtn.
(20)	5	IJ	CT5	PR10	yes	Are there more sentences this segment?
	6	SP	CT17	25		
(25)	7	ZJ	PR37	PS35	no	Is there Termination?
	10	RJ	OD	OD2		New page hdg. if required ⟶ output buffer
	11	RA	PR14	FC2		Adv. add. File list by 1 ⟶ add. next sent. no.
	12	TJ	RC40	PR14		Limit add. file list ⟶ current address?
	13	RJ	FR	FR1		Fill file list (core) from Op. file IV (drum)
(21)	14	TP	[30000]	CT		XS3 sent. no. from file list ⟶ temp.
	15	RA	PR14	FC2		Adv. add. file list ⟶ add. of word with # lines & running add. of sent.
	16	TU	A	PR17	}	# lines this sent. ⟶ Au; running
	17	TP	[30000]	A	}	add. this sent. ⟶ Av
	20	ST	FC2	Q		Decrease # lines sent. by 1 ⟶ Au
	21	LQ	Q	17	}	Running add. this sent. (or lib.
	22	TU	Q	EC1	}	rtn.) ⟶ input edit rtn.
	23	LQ	Q	6		
	24	TV	Q	CT2		# lines this sent. (or lib. rtn.) ⟶ index C_2
(22)	25	SJ	PR32	PR26		(+) ⟹ sentence ; (-) ⟹ library routine (Ck. left most bit of INFO word)
	26	TP	CT	XT3		Sent. no. ⟶ hdg.
	27	TV	RC4	EF		Preset add. sent. hdg. W/cont. in edit routine
	30	RJ	HC	HC33		Sent. hdgs. ⟶ output buffer
	31	MJ	0	PR35		
(23)	32	TP	CT	XT47		Library routine name ⟶ hdg.
	33	TV	RC22	EF		Preset add. lib. rtn. hdg. W/cont. in edit. rtn.
	34	RJ	HC	HC51		Lib. rtn. hdgs. ⟶ output buffer

(24)	35	RJ	EC	EC4	Edit sent. (or lib. rtn.) & write on listing tape
	36	MJ	0	PR5	
	37	AT	TC1	TH3	Codeword to tape handler
		CA	PR40		
		IA	PR40		
	40	TU	5	PR41	Preset jn of repeat to trans. Dim. List → core
	41	RP	[30000]	PS	}
	42	TP	DD	DL	} Dimension list from drum → core
		CA	PR43		

Subscripted Variables (core) and Termination Section

		IA	PS			
	0	RJ	TH2	TH		Read Termination → input buffer
	1	RJ	OD	OD2		New page hdg. if required → output buffer
(26)	2	SP	CT23	43		# lines Term. /2 = # subs. var. this seg. → A_L
	3	LT	0	A		# subs. var. this seg. → A_r
	4	ST	FC1	CT2		# subs. var. this seg.-1 → index
	5	TU	RC13	DS15		Preset add. initial array of this seg. in Term.
	6	TV	PS5	EV7		Preset Dim. List rtn. ref. → subs. var. (core) entry
	7	TU	6	DS21		Preset jn to search Dim. List. in Dim. List rtn.
	10	TV	RC11	EV32		Preset hdg. rtn. ref. → subs. var. (core) W/cont. entry
	11	RJ	HV	HV3		Init. subs. var. (core) hdgs. → Sect. hdg. blkt.
	12	RJ	EV	EV1		Edit subs. var. (core) and write on listing tape
(27)	13	TU	RC	ED14	}	Preset input buff. add. →init.
	14	RS	ED14	FC2	}	add.- 1 in edit rtn.
	15	TP	XT14	XT11		Set section no. = zero in stored Term. hdgs.
	16	TV	RC10	EF		Preset add. for Term hdgs (W/cont) in edit rtn.
	17	TP	CT17	CT5		# blks. Term. → index C_5
	20	TU	RC34	EC1		Init. running add. Term. buffer → input edit rtn.
	21	MJ	0	PS34		
(29)	22	RA	XT11	FC1		Adv. section no. by 1
	23	RJ	OD	OD2		New page hdg. if required → output buffer
	24	SP	CT23	0		# lines Termination → Av
	25	TJ	FC31	PS31	yes	171_8 > # lines Termination? (i.e. part. blk. Term. left?)
	26	ST	FC56	CT23		Decrease # lines Term. by 170_8
	27	TP	FC42	CT2		# lines full blk. Term. - 1 → index C_2
	30	MJ	0	PS32		
	31	ST	FC1	CT2		# lines partial blk. Term.- 1 → index C_2
	32	RJ	HC	HC41		Termination hdgs. → output buffer
	33	RJ	EC	EC2		Edit block of Termination and write on listing tape
(28)	34	IJ	CT5	PS22	no	All blks. Termination processed?
(30)	35	RJ	IR	IR14		Locate next segment label blk.

```
36    RP    YY30000  PP  }
37    TP    DP       PP  }        Program load II --> core
      CA    PS40
```

End Listing Phase

		IA	PT		
(31)	0	TV	CT6	PT1	Preset avail. add. output buffer
	1	TP	XS	[30000]	Fast feed 1 symbol → output buffer
	2	TV	CT6	PT5	Preset avail. add. output buff.
	3	RA	PT5	FC4	10_8 in "v" adv. → output buff. add. for "end of listing" blkt.
	4	RP	30004	PT6	
	5	TP	XT17	[30000]	END△OF△LISTING blkt. → output buffer
	6	RJ	BA	BA1	Adv. Output Buff. add. by 24_8 (20_{10}) in "u" and "v"
	7	RJ	BB	BB1	Terminate listing tape and rewind
	10	TP	TC7	TH3	
	11	RJ	TH2	TH	Rewind binary program tape
(32)	12	TP	TC2	TH3	
	13	RJ	TH2	TH	Rewind corrected problem tape
	14	TP	FP10	UP3	Parameter → uniprint
	15	RJ	UP2	UP	Print: PROGRAM LISTING ON TAPE[-].
	16	TP	FP21	UP3	Parameter → uniprint
	17	RJ	UP2	UP	Print: COMPILATION COMPLETED
	20	MS	0	PT20	
		CA	PT21		

Build Op. File IV for Segment

		IA	BF		
	0	MJ	0	[30000]	
(33)	1	TP	TC4	TH3	Codeword → G.T.H.
	2	RJ	TH2	TH	Read 1 blk. Op. File III → file buffer
	3	TP	FB	A	1st word file buffer →A
	4	EJ	TL2	BF6	1st word file buffer = FILE△3? (Op. File III entry label)
	5	MJ	0	YP	Alarm 10
(34)	6	RP	34100	BF10	
	7	TP	ND	NL	Sentence No. (XS3) List → core
	10	TV	RC27	BF73	Preset init. add. Op. File IV (drum)
	11	TV	RC26	BF61	Preset init. add. statement buff. (core)
	12	TV	RC30	BG2	Preset init. add. routine buff. (core)
	13	TP	RC35	BG14	Preset init. add. routine file (drum)
(35)	14	TP	TC4	TH3	Codeword →G.T.H.
	15	RJ	TH2	TH	Read 1 blk. Op. File III →File buffer
	16	TP	FB	A	1st word File buffer = END△OF ?
	17	EJ	TL3	BG25	Yes⇒ end Op. File III this segment
(36)	20	TU	BF16	BF21	Preset init. add. File Buff.
(37)	21	TP	30000	Q	Callword (or Z's) from File buff. →Q
	22	RA	BF21	FC2	1 in "u" adv. → ADD. of INFO. word assoc. W/callword
	23	SP	Q	0	Callword (or Z's) →Ar
	24	TJ	FC60	BG20	23000 > CW? (pseudo Op. sentence?)
	25	TJ	FC61	BF35	25000 > CW? (equat. for subs.var.?) NB → end of tape callword not in Op. File III
	26	TJ	FC62	BF37	26000 > CW? (equat. for non-subs. var.?)
(38)	27	TJ	FC63	BF52	30000 > CW? (statement of main prog.?)
	30	TJ	FC64	BF41	50000 > CW? (pseudo operation Hdg?)
	31	TJ	FC65	BF45	60000 > CW? (library routine?)
	32	QJ	BG21-	BF76 +	(+)⇒77---CW; (-)⇒word of Z's (end of information)
	33	TP	RC15	A	
	34	MJ	0	BG	
(39)	35	TP	RC16	A	
	36	MJ	0	BG	
(40)	37	TP	RC17	A	
		CA	BF40		

Build Op. File IV (cont.)

		IA	BF40			
	40	MJ	0	BG		
(41)	41	QT	FC50	A		Designating bits of pseudo Op. CW → A
	42	LT	36	A		Designating bits → "u" of Ar
	43	SA	RC20	0		Add. base add. pseudo Op. sect. in sent. no. list
	44	MJ	0	BG1		
(42)	45	TU	BF21	BF46		Add. info. word → "u" of NI
	46	RA	[30000]	FC34		Lib. rtn. ind. (76_8) → Op. code of info. word
	47	LQ	Q	41		Designating bits lib. rtn. C.W. → Qu
	50	TP	RC21	A		
	51	MJ	0	BG		
(43)	52	TU	BF21	BF53		Add. info. word → "u" of NI
	53	TP	[30000]	A		Info. word → A
	54	TJ	FC25	BF56	no	Does info. word have "IP" flag?
	55	MJ	0	BF76		Yes ⟹ omit from file
	56	QT	FC54	A		Last 3 digits of C.W. → Au
	57	SA	RC15	0		Add. base address statements in sent. no. list
	60	TU	A	BF61		Add. of XS3 sent. no. corresponding to CW → "u" of NI
	61	TP	[30000]	[30000]		XS3 sent. no. → statement buffer
	62	RA	BF61	FC1		Adv. add. in stmt. buff. by 1 in "v"
	63	TV	BF61	BF65		Preset next add. stmt. buff.
	64	TU	BF21	BF65		Info. word → stmt. buff.
	65	TP	[30000]	[30000]		Information word → stmt. buff.
	66	AT	FC1	BF61		Adv. add. in stmt. buff. by 1 in "v"
	67	TP	A	Q		
	70	QT	FC32	A		Next add. in stmt. buff. → Av
	71	TJ	RC36	BF76	no	Statement buffer full?
	72	RP	30170	BF74		
	73	TP	SB	[30000]		Stmt. buff. → Op. File IV (drum)
	74	RA	BF73	FC56		Adv. add. Op. File IV (drum) by 170_8
	75	TV	RC26	BF61		Preset add. stmt. buff. → init. add.
(45)	76	RA	BF21	FC2		Adv. Address file buff. by 1 in "u"
	77	TJ	RC23	BF21	yes	More entries in file buff. to be processed?
	100	MJ	0	BF14		
		CA	BF101			

Build Op. File IV (cont.)

		IA	BG		
(46)	0	QA	FC54	A	Base add. + last 3 digits CW = add. XS3 sent. no. → Au
(47)	1	TU	A	BG2	
	2	TP	[30000]	[30000]	XS3 sent. no. → routine buffer
(48)	3	RA	BG2	FC1	Adv. add. in routine buff. by 1 in "v"
	4	TU	BF21	BG6	Preset add. info. word
	5	TV	BG2	BG6	Preset add. routine buff.
	6	TP	[30000]	[30000]	Info. word → routine buff.
	7	AT	FC1	BG2	Adv. add. routine buff. by 1 in "v"
	10	TP	A	Q	
	11	QT	FC32	A	Next add. in routine buff. → Av
	12	TJ	RC37	BF76 no	Routine buff. full?
	13	RP	30170	BG15	
	14	[TP	RB	[30000]]	Routine buff. → routine file (drum)
(49)	15	RA	BG14	FC56	Adv. add. routine file (drum) by 170_8
	16	TV	RC30	BG2	Reset init. add. routine buffer
	17	MJ	0	BF76	
(50)	20	ZJ	BF33	BF76	
(51)	21	RJ	TH2	TH	Read 1 blk. Op. File III → file buffer
	22	TP	FB	A	1st word file buffer = END△OF ?
	23	EJ	TL3	BG25	Yes ⟹ end Op. file III this segment
	24	MJ	0	YQ	Alarm 10
	25	RS	BF61	RC26	
	26	SA	FC57	17	
	27	TU	A	BG31	
	30	TV	BF73	BG32	
	31	RP	[30000]	BG33	
	32	TP	SB	[30000]	Part. stmt. buff. → Op. File IV (drum)
	33	RS	BG2	RC30	
	34	SA	FC57	17	
	35	TU	A	BG37	
	36	TV	BG14	BG40	
	37	RP	[30000]	BG41	
		CA	BG40		

Build Op. File IV (cont.)

	IA	BG40		
40	TP	RB	[30000]	Part. routine buff. → routine file (drum)
41	SP	BG32	0	Add. Op. File IV → Av
42	SA	BF61	0	Adv. add. Op. file IV by # lines part. stmt. buff. → Av
43	TV	A	BG54	Preset add. Op. file IV
44	SS	FC1	17	Add. of info. word for last stmt. of seg. → Au
45	TU	A	BG46	Preset drum address of last stmt. info. word
46	RA	[30000]	FC24	Adv. # lines last stmt. Rtn. by 2 in "u" to count "Ip" and blank
47	RS	BG14	RC35	# lines routine file → Av
50	AT	BG2	Q	# lines routine file + # lines part. buff. = total # lines routine file
51	SA	FC57	17	jn to trans. routine file to Op. file IV → Au
52	TU	A	BG53	
53	RP	[30000]	BG55	
54	TP	RF	[30000]	Routine file (drum) → Op. file IV (drum)
55	RS	BG54	RC27	# lines Op. file IV (drum) before addition of routine file → Av
56	QA	FC32	A	# lines Op. file IV + # lines routine file = total # lines of Op. file IV → Q
57	LT	43	CT5	(# lines Op. file IV)/2 = # sentences this segment → "v" of C_5
60	MJ	0	BF	
	CA	BG61		

Locate 1st Segment Label Blk. on Obj. Prog. Tape

		IA	LS		
	0	MJ	0	[30000]	
(55)	1	TP	FC36	CT2	36_8 → index C_2
	2	TU	RC42	CT	Preset initial add. seg. lab. blk → 1st word list buffer
	3	TP	TC15	TH3	
(56)	4	RJ	TH2	TH	Read 1 blk. Object Prog. tape → list buffer
	5	TP	LB	A	1st word list buffer → A
	6	EJ	TL1	LS yes	(A) = SEGMEN ? (i.e. is blk. 1st seg. label blk.?)
	7	IJ	CT2	LS4 no	37_8 blocks checked?
	10	MJ	0	BR10	Alarm 8
		CA	LS11		

Check Label Corrected Prob. Tape

		IA	CL		
	0	MJ	0	[30000]	
(53)	1	TP	FC24	Q	Switch → Q (S.t. go back to begin loop 23_8 times)
	2	TU	RC42	CL3	Preset "u" of NI → Init. add. input buff.
(54)	3	TP	[30000]	A	Next word from corr. prob. title blkt. → A
	4	RP	20006	CL6	
	5	EJ	TL5	CL	Is this partial corr. prob. title?
	6	RA	CL3	FC2	Adv. add. in title blkt. by 1 in "u"
	7	QJ	CL10 yes	CL3 no	Was this last word in title blkt.?
	10	MJ	0	YV	Alarm 10
		CA	CL11		

Page Number Routine

	IA	NP			
	0	MJ	0	[30000]	
(57)	1	TP	CT11	Q	2nd page no. word → Q
	2	QT	FC12	A	Last digit page no. → A
	3	TJ	XS2	NP20 yes	9 in XS3 > last digit page no.?
	4	RJ	NP4	[30000]	One shot jump (1st time → Pn15; succeeding times → NI)
	5	QT	FC13	A	last two digits page no. → A
	6	TJ	XS4	NP25 yes	99 in XS3 > last two digits page NO?
	7	RJ	NP7	[30000]	One shot jump (1st time → Pn22; succeeding times → NI)
	10	QT	FC14	A	Last two digits page no. → A
	11	TJ	XS6	NP27 yes	999 in XS3 > last three digits page no.?
	12	TP	XS17	CT10	△△△CON → 1st page no. word
	13	TP	XS20	CT11	TINUED → 2nd page no. word
	14	MJ	0	NP30	
	15	TP	XS13	CT10	△△△△△P → 1st page no. word
	16	TP	XS14	CT11	AGE△10 → 2nd page no. word
	17	MJ	0	NP30	
	20	RA	CT11	FC1	Adv. page no. by 1_8
	21	MJ	0	NP30	
	22	TP	XS15	CT10	△△△△P A → 1st page no. word
	23	TP	XS16	CT11	GE△1 0 0 → 2nd page no. word.
	24	MJ	0	NP30	
	25	RA	CT11	FC15	Advance next to last digit of page
	26	MJ	0	NP30	number by one octal and change last digit to zero in XS3
	27	RA	CT11	FC16	Advance third digit from right by one octal and change last two digits to zero in XS3
	30	TP	FC5	CT7	Reset line count to four for page number line
	31	MJ	0	NP	
		CA	NP32		

Op. File IV Control Routine

		IA	FR		
	0	MJ	0	[30000]	
(58)	1	RP	30170	FR3	Fill file list in core from Op.
	2	TP	[30000]	FL	File IV on drum
	3	RA	FR2	FC55	Adv. Op. File IV drum add. by 170_8 in "u"
	4	TU	RC25	PR14	Preset XS3 sent. no. add. → init. add. file list
	5	MJ	0	FR	
		CA	FR6		

Dimension List Search Routine

	IA	DS		
0	MJ	0	[30000]	
1	0	30000	0	Subs. var. (core/drum) Add. in "u" } Output
2	0	30000	30000	Subs. var. XS3 symbol
3	0	30000	0	Modulus in "u"
(59) 4	TP	[30000]	DS1	Drum address → output
5	RA	DS4	FC2	Adv. add. in Dim. List by 1 → add. XS3 symbol
6	TU	A	DS7	
7	TP	[30000]	DS2	XS3 symbol → output
10	AT	FC2	DS4	Adv. add. in Dim List by 1 → add. for next drum add.
11	TU	A	DS12	
12	SP	[30000]	0	Drum add. for next array → Au
13	ST	DS1	DS3	Drum add. next array-drum add. curr. array=modulus → output
14	MJ	0	DS	→ Exit
(60) 15	TP	[30000]	Q	Core add. of array → Qu, drum add. of array → Qv
16	QT	FC23	DS1	Core add. of array → output
17	LQ	Q	17	
20	QT	FC23	CT15	Drum address of array to "u" of A
21	RP	[30000]	EP	Alarm 1
22	EJ	DL	DS23	Is drum address in modified Dimension List?
(61) 23	SN	Q	17	- jn+r → "u" of A
24	SA	DS21	0	+r → "u" of A
25	SA	DS22	0	DL+r (add. of XS3 symbol) → Au
26	TU	A	DS27	Preset NI
27	TP	[30000]	DS2	XS3 symbol → output
30	SA	FC2	0	Adv. add. in dim. list → add. for next drum add.
31	TU	A	DS32	Preset NI
32	SP	[30000]	0	Next drum add. in dim. list → Au
33	ST	CT15	DS3	Next drum add.-drum add. current array = modulus → output
34	TJ	FC77	DS44	10000_8 > Modulus? Yes ⟹ 1 repeat "TP" in Termination
35	TJ	FC102	DS41	17777_8 > Modulus? Yes ⟹ 2 repeat "TP"'s in Termination
36	RA	DS15	FC103	6 in "u" advance → address of next array transferred by Termination
37	RS	CT2	FC10	Decrease index by 2 in "v"
	CA	DS40		

		IA	DS40		
	40	MJ	0	DS	
(61B)	41	RA	DS15	FC37	Advance by 4 ⟶ address of next array trans. by Termination
	42	RS	CT2	FC1	Decrease index by 1 in "v"
	43	MJ	0	DS	
(61C)	44	RA	DS15	FC24	Advance by 2 ⟶ address of next array trans. by Termination
	45	MJ	0	DS	
		CA	DS46		

Input Buffer Routine

		IA	IR		
	0	MJ	0	[30000]	
	1	[0 [0	000]00	30000]	Input: # blks. seg. + pref. in codeword position
(62)	2	SP	IR1	0	# blks. seg. + pref. → A
	3	TJ	FC71	IR10 yes	Max. # blks. input buff. + 1 > # blks. seg.+pref. still on tape?
	4	ST	FC66	IR1	Decrease Blk. count in input line by # blks. full buffer
	5	TP	TC12	TH3	Codeword to read Obj. Prog. tape → G.T.H.
	6	RJ	TH2	TH	Fill input buffer with blks. seg. + pref.
	7	MJ	0	IR	→ exit
(63)	10	AT	TC11	TH3	Codeword to read Obj. Prog. tape → G.T.H.
	11	RJ	TH2	TH	Remaining blks. of seg. +pref. → input buff.
	12	TP	FC34	IR1	Neg. no. → input line
	13	MJ	0	IR	→ exit
(64)	14	TP	IR1	A	Input line → A
	15	SJ	IR26 yes	IR16 no	All blks. seg. + pref. read to buff.? (i.e. tape positioned for next seg.)
	16	SP	CT17	25	# blks. term. → A in position for codeword
	17	SA	IR1	0	# blks. term. + # blks. pref. not read to buff. → A
	20	AT	TC6	TH3	Codeword to move forward obj. prog. tape → G.T.H.
	21	RJ	TH2	TH	Move forward obj. prog. tape → begin next seg. lab. blk.
	22	TP	TC10	TH3	Codeword to read obj. prog. tape → G.T.H.
(65)	23	RJ	TH2	TH	Read next segment label blk. → 1st blk. input buff.
	24	TP	RC	CT	Preset add. 1st word label blk. → Init. add. 1st blk. input buff.
	25	MJ	0	IR	
	26	SP	CT17	25	# blks. term. → A in position for codeword
	27	MJ	0	IR20	
		CA	IR30		

Advance Output Buffer Address Routine

		IA	BA		
	0	MJ	0	[30000]	Exit
(66)	1	RA	CT7	FC1	Adv. line count by 1 in "v" → next avail. line no.
	2	RA	CT6	FC6	Adv. output buff. add. by 24_8 (20_{10}) in "u" & "v"
	3	TJ	RC41	BA yes	Limiting output buff. add. > Current buff. add?
(67)	4	RA	CT14	FC5	Adv. listing tape block count by # blks. (4) output buff.
	5	TJ	FC73	BA10 yes	2530_8 (1368_{10})> curr. # blks. on listing tape?
	6	TV	RC7	OD4	Set switch Ⓑ → Ⓑ2 (end current listing tape at end next page)
	7	TP	FC	CT14	Listing Tp. blk. count = zero to render test on blk. count ineffective
(68)	10	TP	TC16	TH3	Parameter → G.T.H.
	11	RJ	TH2	TH	Output Buffer → listing tape
	12	TP	RC1	CT6	Preset output buff. add. → initial value
	13	RP	10740	BA	Fill output buff. W/XS3 space characters and exit
	14	TP	XS11	OB	
		CA	BA15		

Terminate Listing Tape Routine

		IA	BB		
	0	MJ	0	[30000]	Exit
(69)	1	TV	CT6	BB2	Preset output buffer address
	2	TP	XT37	[30000]	Fast feed 1 & printer stop → output buffer
	3	RA	CT6	FC6	Adv. output buff. add. by 24_8 (20_{10}) in "u" & "v"
	4	ST	RC1	Q	# words in partial output buff. → "u" & "v" of Q
	5	QT	FC32	CT6	# words in partial output buff. → "v" of A & temp. 6
	6	TP	TC20	Q	Codeword to write 1 blk. output buff. → Q
	7	TJ	FC31	BB13	171_8 > # words partial output buffer?
	10	RA	Q	FC72	Adv. count blks. in part. output buffer?
	11	RS	CT6	FC56	Decrease # words part. output buffer by 1
	12	MJ	0	BB7	
	13	TP	Q	TH3	Parameter → G.T.H.
	14	RJ	TH2	TH	Partial output buffer → listing tape
	15	TP	TC17	TH3	
	16	RJ	TH2	TH	Rewind listing tape
	17	MJ	0	BB	
		CA	BB20		

End Current Listing Tape at End of Page

```
                IA      BD

(70) (B2)  0    TV      CT6     BD1          Preset avail. output buff. add.
           1    TP      XS      [30000]      Fast feed 1 --> output buffer
           2    TV      CT6     BD5          Preset avail. output buff. add.
           3    RA      BD5     FC5          Adv. output buff. add. --> add. for
                                             MOUNT △ NEXT △ LISTING △ TAPE , etc.
           4    RP      30014   BD6     }
           5    TP      XT23    [30000] }    MOUNT△NEXT △ LISTING△ TAPE △ ON
                                             △ PRINTER.,etc., --> output buffer
           6    RJ      BA      BA1          Adv. output buff. add. by 24(8) (20(10))
                                             in "u" & "v"
           7    RJ      BB      BB1          Terminate current listing tape
                                             and rewind
          10    TP      FC      CT14         Reset count of blks. on listing
                                             tape = zero
          11    RJ      BA      BA12         Fill output buffer with XS3 space
                                             characters
(70A)     12    TP      FP31    UP3     }    Type: CURRENT LISTING TAPE FULL.
                                          }  PUT NEW 1500 FT. TAPE ON SERVO___.
          13    RJ       UP2    UP      }    START TO CONTINUE LISTING.

          14    MS      0       OD5
                CA      BD15
```

Output Control Subroutine

		IA	OC		
	0	MJ	0	[30000]	
(71)	1	IJ	CT2	OC10	Are there quan. left this section?
	2	RJ	BA	BA1	No; adv. output buff. add. by 20_{10} and line count by 1
	3	RA	OC	FC1	Adv. exit add. by 1 in "v" ⟹ new section
	4	TP	CT7	A	Line count ⟶ A
	5	TJ	FC67	OC21 no	Was this 55th line on sheet or beyond when new section next
	6	TV	RC6	OD2	Set switch (A) ⟶ (A2)
	7	MJ	0	OC	
(72)	10	IJ	CT1	OC no	Was this last entry in blkt? No ⟹ same blkt. - same sheet exit
	11	RJ	BA	BA1	Yes; adv. Output buff. add. by 20_{10} and line count by 1
	12	TP	CT7	A	Line count ⟶ A
	13	TJ	FC70	OC17 no	Was this 63rd line on sheet or beyond when same section next
	14	RA	OC	FC10	Yes; adv. exit add. by 2 in "v" ⟹ new sheet exit
	15	RJ	OD	OD1	New page heading ⟶ output buffer
	16	MJ	0	OC	⟶ Exit
(73)	17	RA	OC	FC11	Adv. exit add. by 3 in "v" ⟹ new blkt.-same sheet exit
	20	MJ	0	OC	
(74)	21	RJ	BA	BA1	Adv. output buffer by 20_{10} and line count by 1 (space blkt.)
	22	RJ	BA	BA1	Adv. output buffer by 20_{10} and line count by 1 (space blkt.)
	23	MJ	0	OC	
		CA	OC24		

Page Heading Control Subroutine

		IA	OD		
	0	MJ	0	[30000]	
(75)	1	TV	RC6	OD2	Set switch (A) → (A2)
(75A)	2	RJ	OD2	[OD3]	Switch (A)
(76) (A1)	3	MJ	0	OD	
(77) (A2)	4	RJ	OD4	[OD5]	Switch (B) B1 = OD5 B2 = BD
(78) (B1)	5	RJ	NP	NP1	Adv. page no.
	6	TV	CT6	OD10	Preset add. 1st seg. no. word = avail. output buff. add.
	7	RP	30002	OD11	}
	10	TP	CT12	[30000]	} Segment no. words → sheet hdg. blkt.
	11	RA	OD10	FC17	22_8 in "v" adv. → add. for 1st page no. word
	12	TV	A	OD14	Preset add. for 1st page no. word
	13	RP	30002	OD15	}
	14	TP	CT10	[30000]	} Page no. words → sheet hdg. blkt.
(79)	15	RJ	BA	BA1	Adv. output buff. add. by 20_{10} and line count by 1 (Sheet hdg.blkt.)
	16	RJ	BA	BA1	Adv. output buff. add. by 20_{10} and line count by 1 (Space blkt.)
	17	RJ	BA	BA1	Adv. output buff. add. by 20_{10} and line count by 1 (Space blkt.)
	20	MJ	0	OD	
		CA	OD21		

Convert Octal Address to XS3

		IA	CA		
	0	MJ	0	[30000]	
	1	0	30000	30000	Output = XS3 address
	2	[0	30000	30000]	Input = Octal address in "u" W/zero (octal) fill
(80)	3	RJ	CA30	CA22	Convert address
	4	LT	6	CA1	XS3 add. W/octal zeros on right → output
	5	MJ	0	CA	
(81)	6	RJ	CA30	CA22	
	7	LT	0	CA1	XS3 address W/octal zeros on left → output
	10	MJ	0	CA	
(82)	11	SP	FC26	6	XS3 hyphen → rightmost digits A_L
	12	RJ	CA30	CA23	
	13	LT	0	CA1	Converted address W/hyphen left → output
	14	MJ	0	CA	
(83)	15	RJ	CA30	CA22	Converted address → A_L packed right
	16	SA	XS5	6	Add. close parent. following XS3 address
	17	LT	0	CA1	XS3 address W/close parent. → 1st output
	20	TP	XS3	CA2	Open parent. → 2nd output
	21	MJ	0	CA	
(84)	22	TP	FC	A	Zeroize A
(85)	23	TP	FC34	CT3	Set index = 4
	24	LQ	CA2	3	Next digit octal input add. → Qop
	25	QA	RC43	A	Add. next digit to be converted → Aop
	26	SA	FC74	6	Convert digit to XS3 and shift → A_L
	27	LQ	CT3	1	
	30	QJ	CA24 no	[30000]yes	All 5 digits converted? Yes; sub-exit. XS3 address in "A" left packed right
		CA	CA31		

Convert Address

Convert Octal Word to XS3

	IA	CW			
0	MJ	0	[30000]		
1	0	30000	30000		Output - XS3 Op. code
2	0	30000	30000		Output - XS3 "u" add.
3	0	30000	30000		Output - XS3 "v" add.
4	0	30000	30000		Input - octal computer word
(86) 5	TP	FC47	CW1		△△△△ W/zero fill → 1st word output
6	TP	FC25	CW2		△ W/zero fill → 2nd word output
7	TP	FC25	CW3		△W/zero fill → 3rd word output
10	TP	RC14	CW20		Preset add. 1st output word
11	TV	FC35	CW17		Preset shift count → 14_8
12	TP	FC46	Q		switch → Q [30 | 30200 | 00000]
(87) 13	RS	CW17	FC27		Decrease shift count by 6
14	SP	CW4	3		Next octal digit input word → 1st digit A_L
15	LT	10000	CW4		Shifted input word (A_r) → input line
16	LT	0	A		Digit to be converted → rightmost digit A_r
17	SA	FC11	[30000]		Conv. octal digit → XS3 and shift to position in A
20	[AT	CW1	CW1]		Converted digit → output word
21	QJ	CW22	CW13	yes / no	Output word full?
22	QJ	CW23	CW	no / yes	Entire octal input word converted?
23	RA	CW20	FC3		1 in "u" & "v" adv. → add. next output word
24	TV	FC36	CW17		Reset shift count → 36_8
25	MJ	0	CW13		
	CA	CW26			

Heading Rtn. for Const. Pool, Preface, Sentence and Termination

		IA	HC		
	0	MJ	0	[30000]	
(88)	1	TP	XS70	XS65	Setup const. pool sect. hdg. w/o continued
	2	TV	CT6	HC4	Preset add. sect. hdg. blkt = output buffer
	3	RP	30003	HC11	
	4	TP	XS63	[30000]	CONSTANT Δ POOL → sect. hdg. blkt.
(89)	5	TP	XS71	XS65	Setup Const. Pool sect. hdg. W/ continued
	6	TV	CT6	HC10	Preset add. sect. hdg. blkt. = output buffer
	7	RP	30005	HC11	
	10	TP	XS63	[30000]	CONSTANT Δ POOL — CONTINUED → sect. hdg. blkt.
(90)	11	RJ	OC	OC21	Adv. output buff. add. by 40_{10} (50_8)
	12	TV	CT6	HC14	
	13	RP	30002	HC15	
	14	TP	XS56	[30000]	ADDRESS → col. hdg. blkt.
	15	RJ	BA	BA1	Adv. output buff. add. by 20_{10} (24_8)
	16	TV	CT6	HC20	
	17	RP	30002	HC21	
	20	TP	XS61	[30000]	Underscores → output buffer
	21	RJ	OC	OC21	Adv. output buff. add. by 40_{10} (50_8)
	22	MJ	0	HC	
(91)	23	TP	XS76	XS73	Setup Preface sect. hdg. W/O continued
	24	TV	CT6	HC26	Preset add. sect. hdg. blkt = output buff. add.
	25	RP	30002	HC11	
	26	TP	XS72	[30000]	PREFACE → sect. hdg. blkt.
(92)	27	TP	XS77	XS73	Setup pref. sect. hdg. W/continued
	30	TV	CT6	HC32	Preset add. sect. hdg. blkt. = output buff. add.
	31	RP	30004	HC11	
	32	TP	XS72	[30000]	PREFACE — CONTINUED → sect. hdg. blkt.
(93)	33	TV	CT6	HC35	Preset add. sect. hdg. blkt. = output buff. add.
	34	RP	30004	HC11	
	35	TP	XT	[30000]	SENTENCE NUMBER [----] → sect. hdg. blkt.
(94)	36	TV	CT6	HC40	Preset add. sect. hdg. blkt. = output buff. add.
	37	RP	30006	HC11	
		CA	HC40		

Heading Routine (Cont.)

		IA	HC40		
	40	TP	XT	[30000]	SENTENCE NUMBER[----]-- CONTINUED ⟶ sect. hdg. blkt.
(95)	41	TV	CT6	HC44	Preset add. sect. hdg. blkt. = Output buffer add.
	42	TP	XT15	XT12	
	43	RP	30005	HC11	
	44	TP	XT6	[30000]	TERMINATION ⟶ sect. hdg. blkt.
(96)	45	TV	CT6	HC50	Preset add. sect. hdg. blkt = Output buffer add.
	46	TP	XT16	XT12	Setup stored hdg. W/continued
	47	RP	30006	HC11	TERMINATION (SECTION--) --
	50	TP	XT6	[30000]	CONTINUED ⟶ section hdg. blkt.
(97)	51	TP	XT52	XT50	Set up library routine hdg. W/O continued
	52	TV	CT6	HC54	Preset add. sect. hdg. blkt. = Output buffer add.
	53	RP	30005	HC11	
	54	TP	XT44	[30000]	LIBRARY ROUTINE ------ ⟶ sect. hdg. blkt.
(98)	55	TP	XT53	XT50	Set up lib. rtn. hdg W/continued
	56	TV	CT6	HC60	Set add. sect. hdg. blkt. = output buffer add.
	57	RP	30006	HC11	
	60	TP	XT44	[30000]	LIBRARY ROUTINE [------]-- CONTINUED ⟶ sect. hdg. blkt.
		CA	HC61		

Heading Routine for Subscripted Variables

		IA	HV		
	0	MJ	0	[30000]	
(99)	1	TP	XS30	XS25	Set up section hdg. for drum initial
	2	MJ	0	HV4	
(100)	3	TP	XS32	XS25	Set up section hdg. for core initial
(101)	4	TV	CT6	HV6	Set add. sect. hdg. blkt. = Output buffer add.
	5	RP	30005	HV15	
	6	TP	XS21	[30000]	SUBSCRIPTED VARIABLES [DRUM / CORE] → section hdg. blkt.
(102)	7	TP	XS31	XS25	Set up section hdg. for drum W/ continued
	10	MJ	0	HV12	
(103)	11	TP	XS33	XS25	Set up section hdg. for Core W/continued
(104)	12	TV	CT6	HV14	Set add. sect. hdg. blkt = Output buffer add.
	13	RP	30007	HV15	
	14	TP	XS21	[30000]	SUBSCRIPTED VARIABLES [DRUM / CORE] — CONTINUED → out. buffer
(105)	15	TU	RC4	HV23	Preset "u" of TP → add. of stored col. hdg.
	16	RJ	OC	OC21	Two space blkts → Output Buffer
	17	TP	FC20	Q	Switch [06 | 00000 | 00000] → Q
	20	TV	CT6	HV23	Preset add. col. hdg. blkt. = Output buffer add.
	21	RA	HV23	FC1	1 in "v" adv. → add. 1st col. hdg.
	22	RP	30004	HV24	
	23	TP	[30000]	[30000]	Column hdg. (or underscores) → output buffer
	24	RA	HV23	FC21	5 in "v" adv. → add. for next col. hdg. (or underscores)
	25	QJ	HV26 yes	HV22 no	All col. hdgs. (or underscores) → output buffer?
	26	QJ	HV27 no	HV33 yes	Underscores transferred yet?
	27	RJ	BA	BA1	Adv. output buff. add. by 20_{10} (24_8)
	30	TU	RC5	HV23	Preset "u" of TP → add. of stored underscores
	31	TP	FC22	Q	Switch [04 | 00000 | 00000] → Q
	32	MJ	0	HV20	
(106)	33	RJ	OC	OC21	Two space blkts. → output buffer
	34	MJ	0	HV	→ Exit
		CA	HV35		

Edit Subs. Var. and Write on Listing Tape

		IA	EV		
	0	MJ	0	[30000]	
(107)	1	TV	CT6	EV12	Set assem. blkt. add. = Output buff. add.
	2	RS	EV12	FC5	Dec. assem. blkt. add.→Preset for 1st sym.
	3	TP	FC11	CT1	Preset index C_1 → # variables/ blkt. - 1
(108)	4	RA	EV12	FC21	Adv. assem. blkt. add. → add. 1st part next sym.
	5	SA	FC1	0	1 in "v" adv. → add. last part next symbol
	6	TV	A	EV13	Preset add. for last part symbol
	7	RJ	DS	[30000]	Dimension list rtn. { DS1 = Add. of array in "u"; DS2 = XS3 sym.; DS3 = modulus -1 in "u"
(109)	10	SP	XS11	44	XS3 space char. → A_L
	11	SA	DS2	22	1st part XS3 sym. → A_1; last part sym. → A_r
	12	LT	0	[30000]	1st part XS3 sym. → output buff. (assem. blkt.)
	13	TP	A	[30000]	Last part XS3 sym. → output buff. (assem. blkt.)
	14	RA	EV13	FC1	1 in "V" adv. → add. for initial add. entry
	15	TV	A	EV20	Preset "u" of TP → add. for initial add. entry
	16	TP	DS1	CA2	Initial add. for array → conv. routine
(110)	17	RJ	CA	CA6	Conv. add. (CA) W/O hyphen. (CA1= XS3 add. packed to right)
	20	TP	CA1	[30000]	Add. entry → assem. blkt.
	21	RS	DS1	FC2	Init. add. of array - 1 → Au
	22	AT	DS3	CA2	Final add. of array → conv. routine
(111)	23	RJ	CA	CA11	Conv. address (CA) W/hyphen (CA1= XS3 add. packed to right)
	24	RA	EV20	FC1	ADv. assem. blkt. add. by 1 in "v"
	25	TV	A	EV26	Next assem. blkt. add. → "v" of TP
	26	TP	CA1	[30000]	Last address for array → assem. blkt.
	27	RJ	OC	OC1	→Output control
	30	MJ	0	EV4	Same blkt.; same sheet
	31	MJ	0	EV	New section
	32	RJ	HV	[30000]	New blkt.; new sht. ⇒ heading W/continued → output buff.
	33	MJ	0	EV1	New blkt.; same sht.
		CA	EV34		

Edit Coding or Constants Routine

		IA	EC		
	0	MJ	0	[30000]	Exit next section
	1	0	[30000]	0	Initial running add. this section
(113)	2	TP	RC32	ED11	Set MJ to by-pass TJ
	3	MJ	0	EC5	
(114)	4	TP	RC31	ED11	Set TJ for input buff. check
(115)	5	TV	CT6	EC16	Preset add. assem. blkt. = output buff. add.
	6	RA	EC16	FC1	Adv. assem. blkt. add. ⟶ add. for add. entry
	7	TP	EC1	Q	Running add. 1st word this section
	10	QT	FC33	CT15	Last digit initial add. ⟶ "u" temp. 2 and A
(116)	11	TP	EC1	CA2	Init. add. ⟶ input conv. routine
	12	ZJ	EC13 no	EC37 yes	Last digit init. add. = zero?
	13	RJ	CA	CA15	Convert octal address W/parents.
	14	TV	CT6	EC15	
	15	TP	CA2	[30000]	Open parent. (if 5 digit add. W/ parents) or zeros ⟶ output buffer
	16	TP	CA1	[30000]	XS3 address ⟶ output buffer
(117)	17	TP	CT15	A	Last octal digit initial add. ⟶ A
	20	TV	CT6	ED17	Preset assem. blkt. add. = output buffer
	21	TJ	FC37	EC25 yes	4 > last digit init. add.?
	22	TP	FC	CT4	Zero ⟶ blkt. index C_4 (i.e. odd line ⟹ next line has add.)
	23	SS	FC37	0	Dec. last digit of add. by 4 in "u" ⟶ A
	24	MJ	0	EC26	
	25	TP	FC1	CT4	Set blkt. index C_4 ⟶ 1 (i.e. even line ⟹ next line has no add.)
	26	TP	EC1	Q	Init. add. from input ⟶ Qu
	27	TJ	FC40	EC33 yes	3 > last digit add.?
	30	RA	ED17	FC35	Adv. assem. blkt. add. ⟶ Preset for last entry in blkt.
(118)	31	TP	FC	CT1	Preset index for 1 entry in blkt.
	32	MJ	0	ED6	
(119)	33	TJ	FC24	ED yes	2 > last digit add.?
	34	RA	ED17	FC76	Adv. assem. blkt. add. ⟶ preset for 3rd entry in blkt.
	35	TP	FC1	CT1	Set index for 2 entries in blkt.
	36	MJ	0	ED6	
	37	RJ	CA	CA3	Convert octal address W/octal zeros on right
	40	MJ	0	EC16	
		CA	EC41		

Edit Coding or Const. (Cont.)

		IA	ED		
(120)	0	TJ	FC2	ED4	1 > last digit add.?
	1	RA	ED17	FC10	Adv. assem. blkt. add. → Preset for 2nd entry in blkt.
	2	TP	FC10	CT1	Set index for 3 entries in blkt.
	3	MJ	0	ED6	
(121)	4	RS	ED17	FC11	Dec. assem. blkt. add. → Preset for add. 1st entry in blkt.
(122)	5	TP	FC11	CT1	Set index for 4 entrys in blkt.
(123)	6	QT	FC41	CT15	1st four digits init. add. → Temp. 2 (add. ctr.)
(124)	7	RA	ED17	FC21	Adv. assem. blkt. add. by 5 in "v" → add. for next entry
	10	RA	ED14	FC2	Adv. input buff. add. by one
(125)	11	[TJ	RC2	ED14]	Limiting value > input buff. add.
	12	RJ	IR	IR2	Fill input buff. from tape
	13	TU	RC	ED14	Preset input buff. add. → initial add.
	14	TP	[30000]	CW4	Next word from input buff. → Conv. routine.
	15	RJ	CW	CW5	Convert octal word → XS3
(126)	16	RP	30003	ED20	
	17	TP	CW1	[30000]	XS3 entry (3 words) → assem. blkt.
	20	RJ	OC	OC1	⇒ Output control
	21	MJ	0	ED7	⇒ same blkt.-same sheet
	22	MJ	0	EC	New section
	23	MJ	0	EF	New blockette-new sheet
(127)	24	IJ	CT4	ED46	New blockette-same sheet ⇒ add. entry required next blkt?
	25	RA	CT15	FC43	Yes; adv. ctr. (temp. 2) by 10_8 in "u"
	26	TP	FC75	Q	Mask → Q
	27	QT	A	A	Last 2 digits add. → A
	30	ZJ	ED40 no	ED31 yes	Last two digits add. = zero?
	31	RJ	BA	BA1	Adv. output buff. add. by 20_{10} (24_8) (space blkt. → buff.)
	32	RJ	BA	BA1	Space blkt. → output buffer
(128)	33	TP	CT7	A	Line count → A
	34	TJ	FC70	ED40 no	Was 2nd space blkt. 63rd line on sheet or beyond
	35	RJ	OD	OD1	New pg. hdg. blkt. → output buff. and reset line count = 4.
	36	TV	EF	ED37	
	37	RJ	HC	[30000]	Sect. hdgs. W/continued → output buffer
		CA	ED40		

Edit Coding or Const. (Cont.)

		IA	ED40		
(129)	40	TV	CT6	ED44	Preset add. assem. blkt.= output buff. add.
	41	RA	ED44	FC1	Adv. assem. blkt. add. → add. for XS3 add. entry
	42	TP	CT15	CA2	Octal address → input conv. routine
	43	RJ	CA	CA3	Convert octal address W/octal zero on right
	44	TP	CA1	[30000]	XS3 address entry → output buffer
	45	TP	FC1	CT4	Set blkt. index C_4 → 1 (No add. entry next blkt.)
(130)	46	TV	CT6	ED17	Preset assem. blkt. add. = output buffer add.
	47	RS	ED17	FC11	Dec. assem. blkt. add. → preset for add. 1st entry in blkt.
	50	TP	FC11	CT1	Preset index C_1 → # entries/blkt.
	51	MJ	0	ED7	
		CA	ED52		

Edit Coding or Const. (new blkt.-New Sheet Sect.)

		IA	EF		
(131)	0	RJ	HC	[30000]	Section heading W/continued → Output buffer
	1	IJ	CT4	ED46 no	Add. entry required next blkt?
	2	RA	CT15	FC43	Adv. address counter (temp. 2) by 10_8 in "u"
	3	MJ	0	ED40	
		CA	EF4		

Edit XS3 Variable Symbol for 77's

	IA	ES			
0	MJ	0	[30000]		
1	0	30000	30000		Output-XS3 symbol packed right W/0_8 fill
2	0	30000	30000		Input-XS3 symbol packed left W/77_8 fill
(132) 3	TP	FC21	CT3		Set index $C_3 = 5$
4	TP	FC	ES1		Zero ⟶ output line
5	LQ	ES2	6		Next XS3 symbol→rightmost digits of Q
6	QT	FC12	A		Next XS3 symbol→rightmost digits of A_L
7	TJ	FC12	ES11	yes	77_8 > symbol?
10	MJ	0	ES		Exit on first 77_8 encountered
11	LQ	ES1	6		
12	AT	ES1	ES1		Symbol ⟶ rightmost digits output
13	IJ	CT3	ES5	no	All XS3 char. of symbol checked?
14	MJ	0	ES		
	CA	ES15			

Tape Handler Codewords

	IA	TC			
0	5 0	001	05	LB	Read 1 blk. corrected prob. tape ⟶ list buffer
1	5[0	000]	05	IB	Read [0000] blks. corrected prob. tape ⟶ input buffer
2	1 0	000	05	0	Rewind corrected prob. tape
3	3[0	000]	05	0	Move forward [0000] blks. corrected prob. tape
4	5 0	001	05	FB	Read 1 blk. corrected prob. tape ⟶ file buffer
5	5[0	000]	05	DL	Read [0000] blks. corrected prob. tape ⟶ dim. list region
6	3[0	000]	[77]	0	Move forward [0000] blks. obj. prog. tape
7	1 0	000	[77]	0	Rewind obj. prog. tape
10	5 0	001	[77]	IB	Read 1 blk. obj. prog. tape ⟶ Input buffer
11	5[0	000]	[77]	IB	Read [0000] blks. obj. prog. tape ⟶ input buffer
12	5 0	011	[77]	IB	Read 9 blks. obj. prog. tape ⟶ input buffer
13	5 0	007	[77]	LB	Read 7 blks. obj. prog. tape ⟶ list buffer
14	5 0	005	[77]	LB	Read 5 blks. obj. prog. tape ⟶ list buffer
15	5 0	001	[77]	LB	Read 1 blk. obj. prog. tape ⟶ list buffer
16	7 4	204	[77]	0B	Write 4 blks. output buff. on listing tape
17	1 0	000	[77]	0	Rewind listing tape
20	7 4	201	[77]	0B	Write 1 blk. output buff. on listing tape
21	7 7	777	03	77777	Object prog. Uniservo 3 for 5 Servo layout
22	7 7	777	06	77777	Object prog. Uniservo 6 for 7 Servo layout
23	5[0	000]	05	LB	Read [0000] blks. corrected prob. tape ⟶ list buffer
	CA	TC24			

Tape Labels (XS3)

	IA	TL								
0	74	74747	47474	Z	Z	Z	Z	Z	Z	Word of Z's
1	65	30324	73050	S	E	G	M	E	N	
2	31	34463	00106	F	I	L	E	△	3	
3	30	50270	15131	E	N	D	△	0	F	
4	65	73472	55146	S	Y	M	B	0	L	
5	67	50342	65127	U	N	I	C	0	D	
6	01	67503	42651	△	U	N	I	C	0	
7	01	01675	03426	△	△	U	N	I	C	Source program
10	26	51273	00152	C	0	D	E	△	P	labels
11	34	26512	73001	I	C	0	D	E	△	
12	50	34265	12730	N	I	C	0	D	E	
13	26	51506	56624	C	0	N	S	T	A	
	CA	TL14								

XS3 Codes

	IA	XS			
0	37	01010	10101	@ △ △ △ △ △	Fast feed 1 symbol
1	00	00000	00004	0_8 0_8 0_8 0_8 0_8 1_x	
2	00	00000	00014	0_8 0_8 0_8 0_8 0_8 9	
3	00	00000	00017	0_8 0_8 0_8 0_8 0_8 $(_x$	XS3 open parent
4	00	00000	01414	0_8 0_8 0_8 0_8 9 9	
5	43	00000	00000	$)_x$ 0_8 0_8 0_8 0_8 0_8	XS3 close parent
6	00	00001	41414	0_8 0_8 0_8 9 9 9	
7	37	65303	24730	@ S E G M E	Segment
10	50	66010	0	N T △ - - -	number
11	01	01010	10101	△ △ △ △ △ △	setup
12	52	24323	00104	P A G E △ 1	
13	01	01010	10152	△ △ △ △ △ P	
14	24	32300	10403	A G E △ 1 0	Page
15	01	01010	15224	△ △ △ △ P A	number
16	32	30010	40303	G E △ 1 0 0	setups
17	01	01012	65150	△ △ △ C O N	
20	66	34506	73027	T I N U E D	
21	01	65672	56526	△ S U B S C	
22	54	34526	63027	R I P T E D	
23	01	70245	43424	△ V A R I A	Subscripted
24	25	46306	50117	B L E S △ (	Variables
25	0	0	0	[- - - - - -]	Section
26	02	26515	06634	— C O N T I	Heading
27	50	67302	70101	N U E D △ △	
30	27	54674	74301	D R U M) △	
31	27	54674	74302	D R U M) -	Setups for
32	26	51543	04301	C O R E) △	Preceeding
33	26	51543	04302	C O R E) -	Heading
34	01	01016	57347	△ △ △ S Y M	
35	25	51460	10101	B O L △ △ △	Subscripted
36	01	01242	72754	△ △ A D D R	Variable
37	30	65653	06501	E S S E S △	Column Headings
	CA	XS40			

XS3 Codes

	IA	XS40			
40	01	01010	20202	Δ Δ Δ - - -	Subscripted Variable Underscores
41	02	02020	10101	- - - Δ Δ Δ	
42	01	02020	20202	Δ Δ - - - -	
43	02	02020	20201	- - - - - Δ	
44	01	50515	00265	Δ N O N - S	Non-Subscripted Variables Section Heading
45	67	25652	65434	U B S C R I	
46	52	66302	70170	P T E D Δ V	
47	24	54342	42546	A R I A B L	
50	0	0	0	[- - - - - -]	
51	50	66345	06730	N T I N U E	
52	27	01010	10101	D Δ Δ Δ Δ Δ	
53	30	65010	10101	E S Δ Δ Δ Δ	Setups for Preceeding Heading
54	30	65020	22651	E S - - C O	
55	65	73472	55146	S Y M B O L	Non-Subscripted Variable column heading
56	01	01010	10124	Δ Δ Δ Δ Δ A	
57	27	27543	06565	D D R E S S	
60	02	02020	20202	- - - - - -	Non-Subscripted Variable Underscores
61	01	01010	10102	Δ Δ Δ Δ Δ -	
62	02	02020	20202	- - - - - -	
63	01	26515	06566	Δ C O N S T	Constant Pool section heading
64	24	50660	15251	A N T Δ P O	
65	0	0	0	[- - - - - -]	
66	50	66345	06730	N T I N U E	
67	27	01010	10101	D Δ Δ Δ Δ Δ	
70	51	46010	10101	O L Δ Δ Δ Δ	Setups for Const. Pool Sect. Hdg.
71	51	46020	22651	O L - - C O	
72	01	52543	03124	Δ P R E F A	Preface Section Heading
73	0	0	0	[- - - - - -]	
74	50	66345	06730	N T I N U E	
75	27	01010	10101	D Δ Δ Δ Δ Δ	
76	26	30010	10101	C E Δ Δ Δ Δ	Setups for Preface Section Heading
77	26	30020	22651	C E - - C O	
	CA	XS100			

XS3 Codes (Cont.)

	IA	XT			
0	01	65305	06630	△ S E N T E	
1	50	26300	15067	N C E △ N U	
2	47	25305	40101	M B E R △ △	
3	0	0	0	[Sent. no. in std. form]	Sentence
4	02	02265	15066	- - C O N T	Section
5	34	50673	02701	I N U E D △	Heading
6	01	66305	44734	△ T E R M I	
7	50	24663	45150	N A T I O N	
10	01	17653	02666	△ (S E C T	Termination
11	0	0	0	[Section No.]	Section
12	0	0	0	[- - - - - -]	Headings
13	66	34506	73027	T I N U E D	
14	34	51500	10003	I O N △ O Ø	
15	43	01010	10101	) △ △ △ △ △	Setups for
16	43	02022	65150	) - - C O N	Preceding
17	01	01010	10130	△ △ △ △ △ E	heading
20	50	27015	13101	N D △ O F △	
21	46	34656	63450	L I S T I N	
22	32	01010	10101	G △ △ △ △ △	
23	01	01475	16750	△ △ M O U N	
24	66	01503	07266	T △ N E X T	
25	01	46346	56634	△ L I S T I	
26	50	32016	62452	N G △ T A P	
27	30	01515	00152	E △ O N △ P	
30	54	34506	63054	R I N T E R	
31	22	01275	10150	. △ D O △ N	
32	51	66012	63324	O T △ C H A	
33	50	32300	15251	N G E △ P O	
34	65	34663	45150	S I T I O N	
35	01	51310	15224	△ O F △ P A	
36	52	30542	20101	P E R . △ △	
37	37	60606	06060	Σ Σ Σ Σ Σ Σ	Printer Stop Symbol
	CA	XT40			

	IA	XT40			
40	01	01010	10152	△ △ △ △ △ P	Heading for Listing
41	54	51325	42447	R O G R A M	
42	01	46346	56634	△ L I S T I	
43	50	32010	10101	N G △ △ △ △	
44	01	46342	55424	△ L I B R A	Library Routine Heading
45	54	73015	45167	R Y △ R O U	
46	66	34503	00101	T I N E △ △	
47	0	0	0	[Routine name.]	
50	0	0	0	[- - - - - -]	
51	66	34506	73027	T I N U E D	
52	01	01010	10101	△ △ △ △ △ △	Setups for Lib. Routine Heading
53	01	02022	65150	△ - - C O N	
	CA	XT54			

Flexowriter Printout

	IA	FP			
0	00	FP1	7		Codeword
1	01	01010	10101	Δ Δ Δ Δ Δ Δ	
2	52	24656	50170	P A S S Δ V	
3	22	01010	10101	. Δ Δ Δ Δ Δ	
4	01	46346	56634	Δ L I S T I	
5	50	32015	13101	N G Δ O F Δ	
6	52	54513	25424	P R O G R A	
7	47	22010	10101	M . Δ Δ Δ Δ	
10	00	FP11	10		Codeword
11	01	01010	10101	Δ Δ Δ Δ Δ Δ	
12	01	01010	10101	Δ Δ Δ Δ Δ Δ	
13	01	01010	10101	Δ Δ Δ Δ Δ Δ	
14	01	52545	13254	Δ P R O G R	
15	24	47014	63465	A M Δ L I S	
16	66	34503	20151	T I N G Δ O	
17	50	01662	45230	N Δ T A P E	
20	0	0	0	[ ]	Servo #
21	00	FP22	7		Codeword
22	01	01010	10101	Δ Δ Δ Δ Δ Δ	
23	01	01010	10101	Δ Δ Δ Δ Δ Δ	
24	01	01010	10101	Δ Δ Δ Δ Δ Δ	
25	01	26514	75234	Δ C O M P I	
26	46	24663	45150	L A T I O N	
27	01	26514	75246	Δ C O M P L	
30	30	66302	72201	E T E D . Δ	
31	00	FP32	23		Codeword
32	01	01010	10101	Δ Δ Δ Δ Δ Δ	
33	01	01010	10101	Δ Δ Δ Δ Δ Δ	
34	01	01010	10101	Δ Δ Δ Δ Δ Δ	
35	01	26675	45430	Δ C U R R E	
36	50	66014	63465	N T Δ L I S	
37	66	34503	20166	T I N G Δ T	
	CA	FP40			

Flexowriter Printouts (cont.)

	IA	FP40			
40	24	52300	13167	A P E △ F U	
41	46	46220	15267	L L . △ P U	
42	66	01503	07101	T △ N E W △	
43	04	10030	30131	1 5 0 0 △ F	
44	51	51660	16624	0 0 T △ T A	
45	52	30015	15001	P E △ 0 N △	
46	65	30547	05177	S E R V 0 77	
47	0	0	0	[ ]	
50	65	66245	46601	S T A R T △	
51	66	51012	65150	T 0 △ C 0 N	
52	66	34506	73001	T I N U E △	
53	46	34656	63450	L I S T I N	
54	32	22010	10101	G . △ △ △ △	
55	01	07220	10101	△ 4 . △ △ △ }	Optional listing tape numbers for 5 or 7 servo layout
56	01	12220	10101	△ 7 . △ △ △ }	
	CA	FP57			

	IA	FC		
0	0	0	0	Zero
1	0	0	1	1 in "v"
2	0	1	0	1 in "u"
3	0	1	1	1 in "u" & "v"
4	0	0	10	
5	0	0	4	
6	0	24	24	20_{10}
7	0	0	15	
10	0	0	2	
11	0	0	3	
12	0	0	77	Mask 1st XS3 digit
13	0	0	7777	Mask 1st & 2nd XS3 digits
14	0	7	77777	Mask 1st, 2nd & 3rd XS3 digits
15	0	0	67	
16	0	0	6667	
17	0	0	22	
20	06	0	0	
21	0	0	5	
22	04	0	0	
23	0	77777	0	"u" mask
24	0	2	0	
25	01	0	0	XS3 space
26	02	0	0	
27	0	0	6	
30	0	0	30	
31	0	0	171	
32	0	0	77777	
33	0	7	0	
34	76	0	0	
35	0	0	14	
36	0	0	36	
37	0	4	0	
40	0	3	0	
41	0	77770	0	
42	0	0	167	
43	0	10	0	
44	0	0	16	
45	0	0	11	
46	30	30200	0	
47	01	01010	10000	
50	0	7700	0	
51	0	07777	0	
52	0	166	10	# const. allowed in 1st blk. Const. Pool on obj. prog. tape (u). Minimum # blks. preceding 1st seg. lab. blk. on obj. prog. tape (v).
53	0	167	1	
54	0	777	0	
55	0	170	0	

56	0	0	170	
57	0	0	30000	
60	0	23000	0	
61	0	25000	0	
62	0	26000	0	
63	0	30000	0	
64	0	50000	0	
65	0	60000	0	
66	0	1100	0	Max. # blks. input buffer (9_{10} or 11_8)
67	0	0	70	Limit for line count when new section next (56_{10})
70	0	0	100	Limit for line count when same section next (64_{10})
71	0	1200	0	Max. # blks. + 1 (10_{10} or 12_8) in input buffer
72	0	100	0	
73	0	0	BL	Listing tape block limit (1200_{10} per Univac sys. convention)
74	03	0	0	
75	0	77	0	
76	0	0	7	
77	0	10000	0	
100	0	0	12	
101	0	0	303	
	CA	FC102		

Relative Constants

	IA	RC		
0	0	IB	0	Init. add. input buff.
1	0	OB	OB	Init. add. output buff.
2	TP	IB2070	CW4	Last add. input buffer + 1
3	0	OB264	OB264	
4	0	XS34	HC36	Add. stored subs. var. col. hdg.; ent. add. sent. hdgs W/cont.
5	0	XS40	HV7	Add. stored subs. var. underscores; ent. add. subs. var. drum W/cont.
6	0	0	OD4	To preset Ⓐ → Ⓐ2
7	0	0	BD	To preset Ⓑ → Ⓑ2
10	0	XS55	HC45	Add. stored non-subs. var. col. hdg.;ent. add. term. hdgs W/cont.
11	0	XS60	HV11	Add. stored non-subs. var. underscores;ent. add. subs. var. (core) hdgs. W/cont.
12	0	LB170	0	Init. add. XS3 Sym. list
13	0	IB1	0	
14	AT	CW1	CW1	
15	0	NL	0	Base add. statements in sent. no. list
16	0	NL1000	0	Base add. subs. var. EQ. in sent. no. list
17	0	NL2000	0	Base add.non-subs. var. EQ. in sent. no. list
20	0	NL3000	0	Base add. pseudo Ops. in sent. no. list
21	40	NL3100	0	Base add. lib. rtns. in sent. no. list (Ind. bit in Op. code)
22	0	DL167	HC55	Add. 1st const. - 1 in input buffer
23	TP	FB170	Q	
24	0	FD	NP15	Init. add. Op. file IV on drum; Preset one shot jump page no. rtn.
25	0	FL	NP22	Init. add. Op. file IV in core; Preset one shot jump page no. rtn.
26	0	0	SB	Init. add. statement buffer
27	TP	RF	FD	Init. add. Op. file IV (drum) buffer in "v"
30	0	0	RB	Init add routine buffer
31	TJ	RC2	ED14	
32	MJ	0	ED14	
33	0	DL	HC5	
34	0	TB	HC27	
35	TP	RB	RF	Init. add. routine file (drum) in "v"
36	0	0	SB170	Limit value for statement buff. (last add. + 1)
37	0	0	RB170	Limit value for routine buff. (last add. + 1

40	TP	FL170	CT	Limit value file list (last add. + 1 in "u")
41	0	OB740	OB740	Limit value output buff. (last add. + 1)
42	0	LB	DS4	Init. add. list buffer
43	07	0	0	
	CA	RC44		

Explanation of Counters, Indexes, Temps., Etc. (CT)

CT0	[0	0	0]	Temp. 1 curr. subs. var. CW. running add. etc.	
1	0	0	[0]	Index C_1	
2	0	0	[0]	Index C_2	
3	0	0	[0]	Index C_3	
4	0	0	[0]	Index C_4	
5	0	0	[0]	Index C_5	
6	0	[0]	[0]	Output buff. add. (next avail. blkt.)	
7	0	0	[0]	Line count (next avail. line)	
10	0	0	0	1st page no. word	
11	0	0	0	2nd page no. word	
12	0	0	0	1st segment no. word	
13	0	0	0	2nd segment no. word	
14	0	0	0	Count of blocks on listing tape	
15	[0	0	0]	Temp. 2	3rd-8th Lines seg. lab. blk.
16	0	0	[0]	Seg. no. (octal)	
17	0	0	[0]	# blks. in Term.	
20	0 [0	000] 00	0	# full blks. seg. + Pref.	
21	0	[0]	[0]	# lines part. blk. and H.S.S.	
22	RJ	[0]	[0]	Pref. exit and entry in "u" & "v"	
23	0	0	[0]	# lines preface	