TECHNICAL DOCUMENTATION

for

U N I C O D E

Automatic Programming System for Univac Scientific 1103A and 1105

Volume II

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List String-Out Routine

```
         IA   LA               Begin List String-out
     0   MJ   0        CT      Exit to string-out control
     1   TV   LW12     LP17    Preset add. 1st var. ind. word -1
     2   TU   LW12     LP23    Preset inst. to preset add. in assem.
                               blk.
     3   TP   LW13     EW3     Preset add. of 1st C.W. in S.O. -1 in
                               "C.W. to S.O." rtn.
     4   TP   LV12     WL5     Zeroize variable count in String-out
                               List.
     5   RP   10074    LA7
     6   TP   LV12     LZ      Zeroize Heading List
     7   TP   LV22     Q  }
    10   QS   Q        12 }    Set "list" indicator in fixed
                               location 12.
    11   RP   10051    LB
    12   TP   LV12     LY      Zeroize assem. blk & temps.
         CA   LA13

         IA   LB
     0   RJ   SY       SY1     Get next symbol (1st six char. sym.
                               ⟶ A)
     1   EJ   LX14     LB      Sym. = comma?
     2   EJ   LX15     LB      Sym. = semi-colon?
     3   EJ   LX12     ZA      1st var. = "tape"?  Yes⟶Alarm #1
①    4   TP   SY7      Q       Var. ind.⟶Q
     5   QJ   LC yes   LB6 no  Sym. = variable?
     6   TP   SY11     Q       Digit or dec. pt. ind.⟶ Q
     7   QJ   LB10 yes LB12 no Sym. possibly = constant?
    10   TP   SY12     Q       Sym. contains letter ind. ⟶Q
    11   QJ   LB12 no  ZA4 yes Sym. = constant?  Yes⟶ Alarm #2
    12   EJ   LX13     ZA13    Sym. = "Δ ."?  Yes ⟶ Alarm #3
    13   EJ   LX14     LB22 yes Sym. = comma?
    14   EJ   LX15     LB22 yes Sym. = semi-colon?
    15   EJ   LX16     ZA17 yes Sym. = open parenthesis?  Yes ⟹
                               Alarm #4
    16   EJ   LX17     LB20    Sym. = close parenthesis?
    17   MJ   0        ZA30    No⟹Alarm #6
    20   IJ   LY44     LB22 no Decrease parenthesis level; close
                               parenthesis on level zero?
    21   MJ   0        ZA24    Yes ⟹Alarm #5
③   22   RJ   SY       SY1     Get next symbol
③A  23   EJ   LX12     LB25    Sym. = tape?  Yes ⟶ tape designation
                               phase
    24   MJ   0        LB4     No⟶ ①
    25   TP   LY44     A
    26   ZJ   ZA37 no  LF yes  "Tape" on parenthesis level zero?
                               No⟹printout #7
         CA   LB27
```

Variable Phase (Fix & Fl. Pt. Var. Section)

		IA	LC		
4	0	RJ	RH	RH1	Check for legal variable sym.
	1	TP	SY2	LY16	Variable Sym. $\longrightarrow$ temp.
	2	TP	LV2	A	6 in "V" $\longrightarrow$ A
	3	TJ	SY5	MC6 yes	# char. in sym. > 6?
	4	RJ	TA	TA1	Var. in Combination List?
	5	MJ	0	LC17	Not in List
	6	TP	TA4	Q	Var. in Comb. List $\longrightarrow$ CW $\longrightarrow$ Q_V
	7	TP	Q	TF2	
	10	QT	LV5	A	1st two octal digits of CW $\longrightarrow$ A
	11	EJ	LV5	LD	Subscripted var. (77---) CW?
	12	EJ	LV6	LE	Function (66---) CW?
	13	EJ	LV7	MC6	Floating point var. (65---) CW?
	14	EJ	LV10	MC2	Fixed point var. (64---) CW?
	15	TJ	LV43	ZB	Pseudo Op. (5----) CW? $\longrightarrow$ Alarm #8
	16	MJ	0	ZB5	No; Library (4----) CW? $\Longrightarrow$ Alarm #9
	17	TP	LV11	TF	Number of words in file (3 in "u") $\longrightarrow$ 1st line file build-up
	20	TP	SY2	TF1	XS3 sym. $\longrightarrow$ 2nd line file build-up
	21	TP	LV12	TF3	Format (zero) $\longrightarrow$ 4th line file build-up
	22	RJ	TK	TK1	Obtain avail. last 3 digits for 65---- or 64--- CW
	23	TP	SY10	Q	Fix. pt. ind. $\longrightarrow$ Q
	24	QJ	MC yes	MC4 no	
		CA	LC25		

Non-Subs (Fix & Fl. Pt.) Var. Section

		IA	MC		
	0	AT	LV10	TF2	64--- C.W. $\longrightarrow$ 3rd line file build-up
	1	RJ	TE	TE1	Add fix pt. var. file $\longrightarrow$ Combination List
Fix. Pt.	2	RJ	LP	LP4	Adv. & ck. var. count & set fix pt. ind. bit.
Var.	3	MJ	0	MC7	
	4	AT	LV7	TF2	65--- C.W. $\longrightarrow$ 3rd line file build-up
	5	RJ	TE	TE1	Add fl. pt. var. file $\longrightarrow$ Combination List
Fl. Pt.	6	RJ	LP	LP1	Adv. & ck. var. count & set fl. pt. ind. bit
Var.	7	TP	TF2	Q	64--- or 65--- C.W. $\longrightarrow$ Q_V (input var. list S.O.)
	10	RJ	LO	LO1	64--- or 65--- C.W. $\longrightarrow$ var. list S.O.
	11	RJ	LR	LR1	Store XS3 sym. for Hdg. Edit
	12	RJ	SY	SY1	Get next sym.
7A	13	EJ	LX14	LB22	Sym. = comma?
	14	EJ	LX15	LB22	Sym. = semi-colon?
	15	MJ	0	ZB12	No. $\Longrightarrow$ Alarm #10
		CA	MC16		

Subscripted Variable Section

		IA	LD		
8	0	RJ	LO	LO1	77---- CW → Var. List S.O.
	1	RJ	LP	LP1	Adv. & check var. count & set Fl. Pt. Ind. bit
	2	RJ	LR	LR1	Store XS3 sym. for Heading Edit
	3	TV	TA5	LY	No. of subscripts → Index ctr (c_1)
	4	TP	LV12	LY45	Zeroize count of subscripts processed
	5	RJ	SY	SY1	Get next sym.
	6	EJ	LX16	LD10	Sym. = open parenthesis?
	7	MJ	0	ZB21	No ⟹ Alarm #11
	10	TP	LV12	LY46	Set subscript parenthesis level = zero
8A	11	RJ	LR	LR1	Store XS3 sym. for Hdg. Edit
10	12	RJ	SY	SY1	Get next sym.
10A	13	TP	SY7	Q	Variable ind. → Q
	14	QJ	MD yes	LD15 no	Sym. = variable?
	15	TP	SY11	Q	Digit or dec. pt. ind. → Q
	16	QJ	ND yes	LD17 no	Sym. possible = constant? (1st char. = digit or dec. pt.)
	17	EJ	LX17	ND20	Sym. = close parenthesis?
	20	EJ	LX13	ZB27	Sym. = Δ .? Yes ⟹ Alarm #12
	21	EJ	LX14	LD12	Sym. = comma?
	22	EJ	LX15	LD12	Sym. = semi-colon?
	23	EJ	LX16	ZC	Sym. = open parenthesis? Yes ⟹ Alarm #13
	24	MJ	0	ZC6	No ⟹ Alarm #14
		CA	LD25		

		IA	MD		
11	0	EJ	LX12	ZC14	Variable = "Tape"? Yes ⟹ Alarm #15
	1	RJ	RH	RH1	Legal variable sym. (No; Alarm string-out subs)
	2	TP	LV2	A	6 in "v" ⟶ A
	3	TJ	SY5	MD31 yes	No. char. in sym. > 6?
	4	RJ	TA	TA1	Var. in Comb. List?
	5	MJ	0	MD17	Not in list
	6	TP	TA4	Q	Var. in list ⟹ CW ⟶ Q_v
	7	QT	LV5	A	1st two octal digits of CW ⟶ A
	10	EJ	LV10	ND7	64--- CW? (Fix Pt. Var.)
	11	TJ	LV7	MD15	4---- or 5---- CW? (Lib. Rtn. or Pseudo Op.)
12	12	TJ	LV6	ZC21	65--- CW? (fl. pt. var.) Yes ⟹ Alarm #16
	13	TJ	LV5	ZD	66--- C.W.? (function) Yes ⟹ Alarm #17
13	14	MJ	0	ZE	77--- C.W.? (subs. var.) ⟹ Alarm #18
	15	TJ	LV43	ZF6	4---- C.W.? (pseudo op.) Yes ⟹ Alarm #20
	16	MJ	0	ZF	5---- CW? (library rtn.) ⟹ Alarm #19
16	17	TP	SY10	Q	Fix pt. var. ind. ⟶ Q
	20	QJ	MD21	ZC21 no	Sym. = fix pt. var? No ⟹ Alarm #16
	21	TP	LV11	TF	No. of words in file (3 in "u") ⟶ 1st line file build-up
	22	TP	SY2	TF1	XS3 sym. ⟶ 2nd line file build-up
	23	TP	LV12	TF3	Format (zero) ⟶ 4th line file build-up
	24	RJ	TK	TK1	Obtain avail. last 3 digits for 64--- CW
	25	AT	LV10	TF2	64--- CW ⟶ 3rd line file build-up
	26	RJ	TE	TE1	Add fix pt. var. file ⟶ Combination List
	27	TP	TF2	Q	64--- CW ⟶ Q_v (input for var. list S.O.)
	30	MJ	0	ND7	
17	31	TP	SY10	Q	Fix pt. var. ind. ⟶ Q
	32	QJ	ND11 yes	ZC21 no	Sym. = fix pt. var.? No ⟹ Alarm #16
		CA	MD33		

```
            IA   ND
(18)    0   TP   SY13       Q          Superscript indicator → Q
        1   QJ   ZF14 yes   ND2 no     Sym.= Superscript const.; Yes ⇒ Alarm
                                       #21
        2   RJ   RD         RD1        Const.= fix pt.? (No; Alarm in string-out
                                       subs)
        3   TP   SY2        RS4        XS3 fix point constant → input conversion
                                       routine
        4   RJ   RS2        RS         Convert XS3 const. → octal
        5   TP   RS3        A          Octal constant → A
        6   RJ   GW         GW1        Constant → Const. Pool & Const. CW
                                       Q_V
(18A)   7   RJ   LO         LO1        64---- or 67---- CW → var. list
                                       string-out
       10   RJ   LR         LR1        Store XS3 sym. for Hdg. Edit
(18B)  11   RA   LY45       LV         Adv. count of subscripts processed
       12   RJ   SY         SY1        Get next sym.
       13   EJ   LX14       LD11       Symbol = comma?
       14   EJ   LX15       LD11       Symbol = semi-colon?
(19)   15   EJ   LX13       ZB27 yes   Sym.= End sent. sym ?  Yes ⇒ Alarm #12
       16   EJ   LX17       ND20       Sym.= close parent.?
       17   MJ   0          ZF24       No ⇒ Alarm #22
       20   IJ   LY46       LD12 no    Is this close subscript parent.? (i.e.
                                       parent. on level zero)
       21   RJ   LR         LR1        Store XS3 close parent. for Hdg. Edit
       22   TP   LY45       A          No. of valid subscripts processed → A
       23   EJ   LY         ND25       Correct no. of subscripts for subs. var.?
       24   MJ   0          ZG         No ⇒ Alarm #23
       25   RJ   SY         SY1        Get next sym.
       26   EJ   LX14       LB22       Sym.= comma?
       27   EJ   LX15       LB22       Sym.= semi-colon?
(20)   30   EJ   LX13       ZG5        Sym.= end sent. sym.?  Yes ⇒ Alarm #24
       31   MJ   0          ZG12       No ⇒ Alarm #25
            CA   ND32
```

		IA	LE		
21	0	RJ	LO	LO1	66--- CW ⟶ Var. list string-out
	1	RJ	LP	LP1	Adv. & check var. count. & set ind. bit (fl. pt.)
	2	RJ	LR	LR1	Store XS3 symbol for Hdg. Edit
	3	RJ	SY	SY1	Get next sym.
	4	EJ	LX16	ZG16	Sym.= open parent.? Yes ⟹ Alarm #26
	5	MJ	0	MC13	No ⟹ function symbol w/o arguments
Subroutine to handle arguments of function. (Ref. by Alarm #17A & 26)	6	TV	LW26	LE11	
	7	TP	LV12	LY47	Set function parent. level ⟶ zero
	10	TP	SZ2	LY50	Function symbol ⟶ temp.
	11	RJ	SY	[SY1]	
	12	EJ	LX17	LE20 yes	Sym.= close parenthesis?
	13	EJ	LX16	LE17 yes	Sym.= open parenthesis?
	14	EJ	LX12	ZG27 yes	Sym.= "Tape"? Yes ⟹ Alarm #27
	15	EJ	LX13	ZG33 yes	Sym.= space-period (Δ.)? Yes ⟹ Alarm #28
	16	MJ	0	LE11	
	17	RA	LY47	LV1	Advance function parent. level by two
	20	IJ	LY47	LE11	Close parent. for arguments of function?
	21	MJ	0	[30000]	
		CA	LE22		

Tape Designation Phase

		IA	LF		
22	0	RJ	SY	SY1	Get next symbol
	1	EJ	LX13	ZH	Sym.= " Δ ."? Yes ⟹ Alarm #29
	2	TP	SY11	Q	Digit or dec. pt. ind. ⟶Q
	3	QJ	NF yes	LF4 no	Tape sym.= constant?
	4	TP	SY7	Q	Var. ind.⟶Q
	5	QJ	LF13 yes	LF6 no	Tape sym.= variable?
	6	EJ	LX14	ZH4 yes	Sym.= comma? Yes ⟹Alarm #30
	7	EJ	LX15	ZH4 yes	Sym.= semi-colon? Yes ⟹ Alarm #30
23	10	EJ	LX16	ZH10 yes	Sym.= open parent.? Yes ⟶ Alarm #31
	11	EJ	LX17	ZH14 yes	Sym.= close parent.? Yes⟶Alarm #32
	12	MJ	0	ZH20	No ⟹ Alarm #33
24	13	RJ	RH	RH1	Sym.= legal variable? (Alarm in string-out subs)
	14	TP	LV2	A	6 in "v"⟶A
	15	TJ	SY5	LF42 yes	No. of char. in sym. > 6?
	16	RJ	TA	TA1	Var. in Combination List
	17	MJ	0	LF26	Not in list
	20	TP	TA4	Q	Var. in list⟹CW > Q_v
	21	QT	LV5	A	1st two octal digits of CW ⟶ A
	22	EJ	LV10	LF40 yes	64--- CW? (fix pt. var.)
	23	TJ	LV43	ZH32 yes	4---- CW? Pseudo Op.) Yes⟹ Alarm #35
	24	TJ	LV10	ZH25 yes	5---- CW? (Lib. Rtn.) Yes ⟹Alarm #34
	25	MJ	0	ZI	No ⟹ Alarm #36
	26	TP	SY10	Q	Fix. pt. var. ind.⟶ Q
25	27	QJ	LF30 yes	ZI no	Sym.= fix pt. var.? No⟹ Alarm #36
	30	TP	LV11	TF	No. of words in file (3 in "u")⟶1st line file build-up
	31	TP	SY2	TF1	XS3 sym.⟶ 2nd line file build-up
	32	TP	LV12	TF3	Format (zero) ⟶ 4th line file build-up
	33	RJ	TK	TK1	Obtain avail. last 3 digits for 64--- CW
	34	AT	LV10	TF2	64--- CW ⟶ 3rd line file build-up
	35	RJ	TE	TE1	Add. file to Comb. List
	36	SP	TF2	17	64--- CW ⟶ "u" of A
	37	MJ	0	NF12	
	40	SP	TA4	17	64--- CW ⟶ "u" of A
	41	MJ	0	NF12	
26	42	TP	SY10	Q	Fix. pt. ind.⟶ Q
	43	QJ	NF26 yes	ZI no	Sym.= fix. pt var.? No ⟹Alarm #36
		CA	LF44		

Tape Designation Phase (cont.)

```
               IA    NF
(27)    0      RP    20011      NF2
        1      EJ    LX1        NF5        Tape sym.= XS3 {2,3,4,5,6,7,8,9,10
        2      EJ    LX         ZM         Tape number =1?  Yes ==> Alarm #56
        3      RJ    RD         RD1        Tape number = fixed point? (Alarm in
                                           string-out subs)
        4      MJ    0          ZI7         ==> Alarm #37
(28)    5      TP    A          RS4
        6      RJ    RS2        RS         Convert XS3 tape number.
        7      TP    RS3        A          Octal tape # --> A
       10      RJ    GW         GW1        Tape number --> const. pool & const. CW
                                           ==> Qv
       11      SP    Q          17         67---- CW   (const. tape #) --> "u" of A
(28A)  12      TP    A          WL4        Tape # CW   (67---- or 64----) --> S.O.
                                           list.
       13      TU    WR         NF14
       14      RP    [30000]    NF16
       15      EJ    WR1        NF26 yes   Tape # CW   in Rewind List
       16      SP    WR         0          Count of Tape # CW's   in Rewind List
                                           --> A
       17      TJ    LW24       NF22 no    Max. no. CW's   in Rewind List (18_10)
       20      TP    A          Q
       21      QJ    NF26       ZM4        (Q+) ==> Alarm #57 printout
                                           (Q-) ==> Printout made previously
       22      RA    WR         LV15       Adv. (1 in "u" & "v") count of CW's
                                           in Rewind List
       23      SA    LW25       0          Form next avail. add. in Rewind List
       24      TV    A          NF25
(29)   25      TP    WL4        [30000]    Tape # CW  --> Rewind List
(30)   26      RJ    SY         SY1        Get next symbol
       27      EJ    LX13       NF35       Sym.=     " Δ."?
       30      EJ    LX14       NF35       Sym.= comma?
       31      EJ    LX15       NF35       Sym.= semi-colon?
       32      EJ    LX16       ZI16       Sym.= open parent.?  Yes --> Alarm
                                           #38
       33      EJ    LX17       ZI22       Sym.= close parent.?  Yes --> Alarm
                                           #39
       34      MJ    0          ZI26       No ==> Alarm #40
       35      TP    UZ3        A          Error count for sentence
       36      ZJ    ZI35 yes   LG no      Has there been error?  Yes ==> Warning
               CA    NF37                  #41
```

Heading Phase (Edit Variable Names)

		IA	LG		
32	0	TP	LV17	A	5 in "v" ⟶ A
	1	SS	WL5	1	(5 - # var.) x 2 ⟹ "v" of A
	2	AT	LW21	LY2	(A) + add. in Hdg. List ⟶ preset add. 1st var. in Hdg. List - 4
	3	ST	LV42	LY3	Address 1st col. Hdg. - 4 ⟶ temp.
	4	TU	LW22	LG22	Preset add. of 1st var. ind. word
	5	TP	WL5	LY	Variable count ⟶ index counter (C_1)
	6	TP	LW23	LY1	Preset avail. add. in assem. blk. ⟶ Init. add.
33	7	IJ	LY	LG21 no	All variable names edited?
34	10	TP	SY2	A	
	11	EJ	LX13	LJ	Sym.= " Δ ."? Yes ⟶ End list string-out
	12	RJ	SY	SY1	Get next symbol
	13	EJ	LX14	LG12 yes	Sym.= comma?
	14	EJ	LX15	LG12 yes	Sym.= semi-colon?
	15	EJ	LX16	LG26	Sym.= open parent.? Yes ⟶ Title or column heading.
	16	EJ	LX17	ZJ	Sym.= close parent.? Yes ⟶ Alarm #42
	17	EJ	LX13	LJ	Sym.= " Δ ."? Yes ⟶ end list string-out
	20	MJ	0	ZJ4	No ⟹ Warning #43
	21	RA	LG22	LV22	Adv. "u" of NI ⟶ add. next var. ind. word
	22	TP	[30000]	LT1	Var. ind. word ⟶ input edit. var. subroutine
	23	RJ	LT	LT2	Edited variable ⟶ Hdg. List
	24	RA	LY1	LV32	Adv. avail. assem. blk. add. by 4 ⟶ add. next var.
	25	MJ	0	LG7	
	26	RP	10025	LH	
	27	TP	LV12	LY17	Zeroize assem. blk. (25_8 words)
		CA	LG30		

```
             IA   LH
(35)    0    TP   GN4        A         Get next character ⟶ A
        1    EJ   LV30       LI        Char.= open parent.?  Yes ⟶ title
                                       section
(42)    2    TU   LW22       LH21      Preset "u" of TP ⟶ Add. 1st var. ind.
                                       word - 1
        3    TP   LY3        LY2       Preset avail. add. in Hdg. List ⟶ add.
                                       1st col. hdg. - 4
        4    RA   LY13       LV13      Set col. hdg. bit in hdg. ind. ⟶ 1
(42A)   5    RJ   LP         LP27      Adv. & ck. col. hdg. count
        6    TP   LV12       LY        Set level indicator (C1) ⟶ zero
(43)    7    TP   GN4        A
(44)   10    EJ   LX20       LH16      Char. = close parent.
       11    EJ   LV30       LH34      Char. = open parent.
       12    EJ   LV         LH41      Char. = " Δ "?
(45)   13    RJ   LQ         LQ1       Store XS3 character for hdg. edit.
       14    RJ   GN         GN1       Get next char. ⟶ A
       15    MJ   0          LH10
(46)   16    IJ   LY         LH13 no   Close parent. on level zero?
       17    TP   LW23       LY1       Preset avail. assem. blk. add. ⟶ initial
                                       add.
       20    RA   LH21       LV22      Adv. "u" of NI ⟶ Add. next var. ind.
                                       word
       21    TP   [30000]    LT1       Var. ind. word ⟶ input edit col. hdg.
                                       routine
       22    TV   LY15       LT1       Char. count ⟶input edit col. hdg.
                                       routine
       23    RJ   LT         LT2       Edit col. hdg.
       24    RJ   GN         GN1       Get next char. (throw away close parent.)

(47)   25    RJ   SY         SY1       Get next sym.
       26    EJ   LX14       LH25      Sym.= comma?
       27    EJ   LX15       LH25      Sym.= semi-colon?
       30    EJ   LX13       LJ        Sym.= " Δ ."? ⟶ end list S.O.
       31    EJ   LX16       LH36      Sym.= open parent.?
       32    EJ   LX17       ZJ13      Sym.= close parent.?  Yes ⟶ Warning
                                       #44
       33    MJ   0          ZJ17      No ⟶ Warning #45
       34    RA   LY         LV        Adv. parent. level by 1
       35    MJ   0          LH13
       36    TP   GN4        A         Char. ⟶ A
       37    RP   10025      LH5
       40    TP   LV12       LY17      Zeroize assem. blk.
       41    RJ   LQ         LQ1       Store XS3 char. for Hdg. Edit
       42    RJ   GN         GN1       Get next char.
       43    EJ   LX21       ZJ25      Char. = period?  Yes ⟹ Warning #46
       44    MJ   0          LH10
             CA   LH45
```

Heading Phase (Title Section)

		IA	LI		
	0	TP	LV12	LY	Set level ind. = zero
	1	RA	LY13	LV33	Set title bit in hdg.indicator ⟶ 1
	2	TP	LV23	LY11	Preset index (C_2)
	3	TV	LV20	LQ10	Preset char. shift
	4	TP	LW4	LQ11	Preset initial add. in assem. blk.
	5	TP	LV12	LY15	Zeroize char. count.
36	6	RJ	GN	GN1	Get next char.
36A	7	EJ	LX20	LI16	Char.= close parent.?
38	10	EJ	LV30	LI14	Char.= open parent.?
	11	EJ	LV	LI36	Char.= " Δ "?
37	12	RJ	LQ	LQ22	Store XS3 character for title edit
	13	MJ	0	LI6	⟶ 36
	14	RA	LY	LV	Adv. parent. level by 1
	15	MJ	0	LI12	
	16	IJ	LY	LI12	Close parent. on level zero?
39	17	RJ	GN	GN1	Get next char.
	20	EJ	LX20	LI22	Char.= close parent.
	21	MJ	0	ZJ32	No ⟹ Alarm #47
	22	RJ	LS	LS1	Edit and store title for edit
40	23	RJ	GN	GN1	Get next char. (Throw away close parent.)
41	24	RJ	SY	SY1	Get next sym.
	25	EJ	LX14	LI24	Sym.= comma?
	26	EJ	LX15	LI24	Sym.= semi-colon?
	27	EJ	LX16	LI33	Sym.= open parent.?
	30	EJ	LX13	LJ	Sym.= " Δ ."? ⟶ end list S.O.
	31	EJ	LX17	ZK	Sym.= close parent.? Yes ⟶ Printout #48
	32	MJ	0	ZK4	No ⟹ Printout #49
	33	TP	GN4	A	
	34	RP	10025	LH2	⟶ 42
	35	TP	LV12	LY17	Zeroize assem. blk.
	36	RJ	LQ	LQ22	Store char. (Δ) for title edit
	37	RJ	GN	GN1	Get next char.
	40	EJ	LX21	ZK13	Char.= period? Yes ⟹ Warning #50
	41	MJ	0	LI7	
		CA	LI42		

End List String-out

		IA	LJ		
49	0	TP	EW3	LY15	Add. of last entry in string-out ⟶ temp.
	1	RA	LY15	LV15	1 in "u" & "v" adv. ⟶ initial add. for headings in string-out.
	2	TP	LY13	Q	Hdg. ind. ⟶ Q
	3	QJ	LJ4 yes	LJ5 no	Are there column hdgs.?
	4	QJ	LJ6 yes	LJ13 no	Is there title? (w/col. hdgs.)
50	5	QJ	LJ16 yes	LJ27 no	Is there title? (w/o col. hdgs.)
Title,	6	TV	LY15	LJ10	
col.hdgs. & var.	7	RP	30074	LJ11	
names	10	TP	LZ	[30000]	Hdg. list (title-col. hdgs.-var. names) ⟶ S.O.
	11	TP	LV37	WL6	Hdg. count (60_{10}) ⟶ S.O.
	12	MJ	0	LJ33	
51 Col.	13	TV	LY15	LJ15	
hdgs.	14	RP	30050	LJ25	
& var.	15	TP	LZ24	[30000]	Hdg. List (col. hdg. and var. names) ⟶ S.O.
names					
Title&	16	TV	LY15	LJ20	
var. names	17	RP	30024	LJ21	
	20	TP	LZ	[30000]	Title ⟶ S.O.
	21	TV	LJ20	LJ24	
	22	RA	LJ24	LV42	Adv. by 20_{10} ⟶ Add. following title in string-out
	23	RP	30024	LJ25	
	24	TP	LZ50	[30000]	Var. names ⟶ S.O.
52	25	TP	LV41	WL6	Hdg. count (40_{10}) ⟶ S.O.
	26	MJ	0	LJ33	
53	27	TV	LY15	LJ31	
Var.	30	RP	30024	LJ32	
names	31	TP	LZ50	[30000]	Hdg. List (var. names) ⟶ S.O.
	32	TP	LV42	WL6	Hdg. count (20_{10}) ⟶ S.O.
54	33	TU	LY15	LJ34	Preset "u" of NI ⟶ add. of 1st word of hdgs. in string-out
	34	CC	30000	LX22	Fast feed 1 sym. ⟶ 1st char. of hdgs. in string-out
	35	RS	LY15	LW16	No. of words in S.O. w/o hdgs. ⟶ "u" & "v" of A
	36	AT	WL6	Q	No. of words in S.O. including hdgs. ⟶ Q
	37	QT	LV40	WL	Word count ⟶ "v" of 1st word of S.O.
	40	RJ	WT	WT1	String-out ⟶ tape
	41	MJ	0	LA	⟶ String-out Exit
		CA	LJ42		

Adv. and Ck. Var. (Col. Hdg.) Count Subroutine

```
                 IA   LP
           0     MJ   0         [30000]
Fl. Pt.    1     TU   LW        LP17       Set up inst. for fl. pt. ind.
Ent.       2     TU   LW2       LQ3        Preset add. of fl. pt. char. limit
           3     MJ   0         LP6
Fix Pt.    4     TU   LW1       LP17
Ent.       5     TU   LW3       LQ3        Preset add. of fix pt. char. limit
55         6     SP   WL5       0          Var. count ⟶ A
Delete     7     TJ   LV17      LP15 yes   5 > # variables?
sym.      10     MJ   0         ZK17       No ⟹ Printout #51
before   {11     RJ   SY        SY1        Get next sym.
"Tape".  {12     EJ   LX12      LF         Sym. = tape? ⟶ tape designation phase
56       {13     EJ   LX13      ZA13       Sym. = " Δ  ."?  Yes ⟹ Alarm #3
         {14     MJ   0         LP11
57        15     AT   LV        WL5        Adv. var. count ⟶ list string-out
          16     RA   LP17      LV
Preset    17     TP   [30000]   [30000]    Fix or fl. pt. ind. ⟶ var. ind. word
at be-    20     SP   LP17      17
gin       21     TU   A         LQ2        Preset add. of char. count (var. ind.
 list S.O.                                 word)
          22     RA   LP23      LV22       Adv. NI to preset next add. in assem. blk.
Preset    23     TP   [30000]   LQ11       Preset add. in assem. blk.
at        24     TV   LW20      LQ1        Preset ent. ⟶ store XS3 char. for var.
begin                                      name
list      25     TU   LQ11      ZL2        Add in assem. blk. ⟶ trans. inst. for
S.O.                                       warning print
          26     MJ   0         LP36
Col.      27     SP   LY14      0          Col. hdg. count ⟶ A
Hdg.      30     TJ   WL5       LP32 yes   # Variables > # col. hdgs.?
Ent.      31     MJ   0         ZK26       No ⟹ Warning #52
          32     AT   LV        LY14       Adv. col. hdg. count by 1
          33     TP   LW4       LQ11       Preset add. in assem. blk.
          34     TP   LV12      LY15       Zeroize char. count
          35     TV   LW11      LQ1        Preset ent. ⟶ store XS3 char. for
                                           column hdg.
58        36     TP   LV23      LY11       Preset index (C2)
          37     TV   LV20      LQ10       Preset char. shift
          40     MJ   0         LP             Exit
                 CA   LP41
```

Call Word ⟶ Var. List String-out

```
                 IA   LO
           0     MJ   0         [30000]
           1     TP   Q         EW2        Call word ⟶ "v" of EW2
           2     RJ   EW        EW1        Call word ⟶ string-out
           3     MJ   0         LO
                 CA   LO4
```

Store XS3 Char. for Hdg. Edit

		IA	LQ		Input: XS3 char. in "v" of A
61	0	MJ	0	[30000]	
Preset	1	MJ	0	[30000]	"v" preset → LQ2 or LQ17
in	2	TP	[30000]	A	Char. count → A
var.	3	TJ	[30000]	LQ5	23_{10} (27_8) > # char.?
count	4	MJ	0	ZL	No ⇒ Warning #53
rtn.	5	TU	LQ2	LQ6	Preset "u" of NI → char. count add.
Var. Ent. Preset in var. count rtn.	6	RA	[30000]	LV	Adv. char. count by 1 in "v"
59	7	RS	LQ10	LV2	Decrease shift count
Preset in Var. count rtn.	10	SP	Q	[30000]	Position char. in A
Preset in var. count rtn.	11	AT	[30000]	[30000]	Char. → current word in assem. blk.
60	12	IJ	LY11	LQ	Current word full? (index preset by var. count routine)
	13	RA	LQ11	LV15	Adv. current assem. blk. address
	14	TV	LV16	LQ10	Reset shift count
	15	TP	LV17	LY11	Reset index
	16	MJ	0	LQ	
Col. →	17	TP	LY15	A	Char. count → A
Hdg.	20	TJ	LV14	LQ25 yes	23_{10} (27_8) > # char.?
Ent.	21	MJ	0	ZL10	No ⇒ Warning #54
Title → Ent.	22	[TP	LY15	A]	Title char. count → A (reset → MJ-0-LQ after printout; not preset, transferred from drum before operating)
	23	TJ	LV34	LQ25 yes	119_{10} (167_8) > # char.?
	24	MJ	0	ZL20	No ⇒ Warning #55
62	25	RA	LY15	LV	Adv. title (col. hdg.) char. count by 1 in "v"
	26	TP	GN4	Q	
	27	MJ	0	LQ7	
		CA	LQ30		

Store XS3 Sym. for Heading Edit

```
        IA   LR                Input:  XS3 sym. in SY2, # char. in SY5
    0   MJ   0      [30000]
    1   TP   SY5    LY12       # Char in sym. ⟶ index ctr. (C3)
    2   TP   SY2    LY3        XS3 sym. ⟶ temp.
63  3   IJ   LY12   LR5        All char. trans. ⟶ Assem. blk.
    4   MJ   0      LR
    5   LQ   LY3    6          Next XS3 char. in sym. ⟶ "v" of Q
    6   QT   LV52   Q          XS3 char. ⟶ "v" of Q
    7   RJ   LQ     LQ1        Store XS3 char. for Hdg. Edit
   10   MJ   0      LR3
        CA   LR11
```

Edit Title Subroutine

		IA	LS		
64	0	MJ	0	[30000]	
	1	TV	LW14	LS31	Preset hdg. list add. → middle add. of title
	2	SP	LY15	0	Char. count → A
	3	DV	LV31	Q	$\frac{\#\text{char.}}{12}$; # full words in 1/2 title → Q
	4	ZJ	LS5 yes	LS6 no	Is there partial word?
	5	RA	Q	LV	Adv. Q by 1 ⟹ total # words in 1/2 title → Q_V
	6	RS	LS31	Q	Decrease hdg. list add. → add. initial title word in hdg. list
65	7	SP	Q	1	(# words in 1/2 title) * 2 = total # words in title → A
	10	ST	LV	LY11	# Words in title - 1 → index ctr. (C_2)
	11	SP	LY15	0	# Char. → A
	12	EJ	LV34	LS44	# Char.= 119_{10}
66	13	SA	LV26	0	# Char. + 3 → A
	14	DV	LV1	A	$\frac{\#\text{char.} + 3}{2}$ → A
	15	DV	LV2	Q	# Char. to shift → A
	16	ZJ	LS17 no	LS37 yes	# Char. to shift = zero? No ⟹ shift 1 char.
67	17	TJ	LV1	LS23	2 > # char. to shift?
	20	TU	LW23	LS27	Preset "SP" → add. of 1st word in assem. blk.
	21	TU	LW4	LS30	Preset "SA" → add. of 2nd word in assem. blk.
	22	MJ	0	LS25	
	23	TU	LW4	LS27	Preset "SP" → add. of 2nd word in assem. blk.
	24	TU	LW26	LS30	Preset "SA" → add. of 3rd word in assem. blk.
	25	MP	A	LV2	(# char. to shift) x 6 = shift count
	26	TV	A	LS30	Preset shift count in "SA"
68	27	SP	[30000]	44	Current title word from assem. blk. → A
	30	SA	[30000]	[30000]	Position edited title word in A_L
	31	LT	0	[30000]	Edited title word → hdg. list add.
	32	RA	LS27	LV22	Adv. "u" of "SP" by 1
	33	RA	LS30	LV22	Adv. "u" of "SA" by 1
	34	RA	LS31	LV	Adv. "v" of "LT" by 1
	35	IJ	LY11	LS27 no	All of edited title → hdg. list?
	36	MJ	0	LS	
	37	SP	Q	20	# words edited title → "u" of A
	40	AT	LW15	LS42	Add. "w" to dummy repeat
	41	TV	LS31	LS43	Preset add. of initial title word in hdg. list
	42	[RP	30000	LS]	
	43	TP	LY20	[30000]	Trans. edited title → hdg. list

```
44   RP   30024   LJ
45   TP   LY20    LZ        Trans. 119₁₀ char. title ⟶ hdg. list.
     CA   LS46
```

Edit Variable (Col. Hdg.) Subroutine

		IA	LT		
83	0	MJ	0	[30000]	Exit
	1	[0	30000	30000]	Input
	2	RA	LY2	LV23	Adv. avail. add. hdg. list by 4 in "u" → add. next var. in hdg. list
	3	TV	A	LU15	Preset "v" of trans. inst. → add. next var. in hdg. list.
	4	TU	LY1	LU13	Preset "SP" inst. → add. next var. - 1 in assem. blk.
	5	TU	LY1	LU14	Preset "SA" inst. → add. next var. - 1 in assem. blk.
	6	RA	LU14	LV22	Adv. "u" of "SA" by 1 → add. next var. - in assem. blk.
	7	TP	LT1	Q	Var. ind. word → Q
	10	QT	LV40	LT1	# Char. → A_v & input line
69	11	EJ	LV25	LU23 yes	# Char.= 23_{10} (27_8)?
	12	QJ	LT24 no	LT13 yes	Variable floating pt. quan?
	13	TJ	LV27	LT16 yes	13_{10} > # char.?
	14	TP	LV26	LY11	Index = 3 to trans. 4 words → hdg. list
	15	MJ	0	LT20	→ 71
70	16	TP	LV	LY11	Index = 1 to trans. 2 words → hdg. list
	17	RA	LU15	LV	Adv. "v" trans. inst. by 1 → next add. hdg. list
71	20	TP	LT1	A	# Char. → A
	21	SA	LV26	0	# Char. + 3 → A
	22	DV	LV1	A	$\frac{\text{\# Char. + 3}}{2}$; Quot → A
	23	MJ	0	LU2	→ 77
72	24	TJ	LV31	LT33 yes	12_{10} > # char.?
	25	TJ	LV53	LT30 yes	19_{10} > # char.?
	26	TP	LV26	LY11	Index = 3 to trans. 4 words → hdg. list
	27	MJ	0	LT35	→ 75
73	30	TP	LV1	LY11	Index = 2 to trans. 3 words → hdg. list
	31	RA	LU15	LV	Adv. "v" trans. inst. by 1 → next add. hdg. list
	32	MJ	0	LT35	→ 75
74	33	TP	LV	LY11	Index = 1 to trans. 2 words → hdg. list
	34	RA	LU15	LV1	Adv. "v" of trans. inst. by 2 → add. in hdg. list.
75	35	TP	LT1	A	# Char. → A_v
	36	TJ	LV30	LU yes	15_{10} > # char.?
	37	SA	LV	0	# Char. + 1 → A
	40	MJ	0	LU2	
		CA	LT41		

Edit Var. (Col. Hdg.) Subroutine (cont.)

		IA	LU		
76	0	DV	LV1	A	#char/2; Quot ⟶ A
	1	LV1	LV1	0	Quot + 2 ⟶ A
77	2	DV	LV2	Q	(A)/6 ⟹ Rem. = # char. to shift ⟶ A
	3	ZJ	LU4 no	LU23 yes	# Char. to shift = zero?
	4	MP	A	LV2	# Char. to shift x 6 = shift count ⟶ A
78	5	TV	A	LU14	Preset shift count in "v" of SA inst.
	6	TJ	LV24	LU11 yes	7 > shift count? (i.e., # char. to shift = 1)
	7	TP	LV12	A	Zero ⟶ A
	10	MJ	0	LU14	
	11	RA	LU13	LV22	Adv. "u" of SP by 1 ⟶ add. of 1st var. word
	12	RA	LU14	LV22	Adv. "u" of SA by 1 ⟶ add. of 2nd var. word
79	13	SP	[30000]	44	Variable word from assem. blk. ⟶ A_L
80	14	SA	[30000]	[30000]	Add. next word to A_R & shift to position in A_L
	15	LT	0	[30000]	Edited word from assembly block ⟶ heading list
	16	RA	LU13	LV22	Adv. "u" of SP by 1
	17	RA	LU14	LV22	Adv. "u" of SA by 1
	20	RA	LU15	LV	Adv "v" of trans. inst. by 1 ⟶ next add. in hdg. list
81	21	IJ	LY11	LU13	All words trans. from assem. blk. ⟶ hdg. list
	22	MJ	0	LT	
	23	TU	LU14	LU26	Add. 1st word of var. in assem. blk. ⟶ "u" of TP
	24	TV	LU15	LU26	Add. for variable in hdg. list ⟶ "v" of TP
	25	RP	30004	LT	
	26	TP	[30000]	[30000]	Trans. words from assem. blk. ⟶ hdg. list w/o editing.
		CA	LU27		

Fixed Constants

	IA	LV		
0	0	0	1	XS3 space char. (△)
1	0	0	2	
2	0	0	6	
3	0	0	11	
4	0	0	12	
5	0	0	77000	
6	0	0	66000	
7	0	0	65000	
10	0	0	64000	
11	0	3	3	
12	0	0	0	Fl. pt. ind.
13	40	0	0	Fix pt. ind.
14	0	0	27	Fl. pt. char. limit (23 = maximum # char.)
15	0	1	1	
16	0	0	44	
17	0	0	5	
20	0	0	36	
21	40	0	27	
22	0	1	0	
23	0	0	4	
24	0	0	7	
25	0	0	27	
26	0	0	3	
27	0	0	15	
30	0	0	17	XS3 open parent. character
31	0	0	14	
32	0	4	4	
33	20	0	0	
34	0	0	167	
35	0	0	170	
36	0	24	24	
37	0	0	74	
40	0	0	77777	
41	0	0	50	
42	0	0	24	
43	0	0	50000	
44	0	55000	0	
45	0	550	0	
46	0	55740	0	
47	0	557	40000	
50	17	0	0	
51	0	0	40000	
52	0	0	77	
53	0	0	23	
	CA	LV54		

Relative Constants

	IA	LW		
0	0	LV12	0	Add. fl. pt. ind.
1	0	LV13	0	Add. fix. pt. ind.
2	0	LV14	0	Add. fl. pt. character limit
3	0	LV21	0	Add. fix pt. character limit
4	AT	LY20	LY20	
5	AT	LY24	LY24	To preset add. in assembly block for
6	AT	LY30	LY30	XS3 sym. or character store routine
7	AT	LY34	LY34	
10	AT	LY40	LY40	
11	0	0	LQ17	
12	0	LW3	LY3	To preset inst. to present add. in assembly block. To preset add. of first var. ind. word - 1
13	0	WL6	WL6	To preset EW3 —> Add. of 1st CW in S.O. - 1
14	0		LZ12	Middle add. of title in hdg. list.
15	RP	30000	LS	
16	0	WL	WL	Initial add. in S.O. list
17	0	0	LQ	
20	0	0	LQ2	
21	0	0	LZ44	To preset add. in hdg. list.
22	0	LY3	0	To preset add. of var. ind. word
23	0	LY17	LY17	Initial address in assem. block
24	0	WP20000	WP	WP = max. no. of tape CW's in Rewind List
25	0	0	WR	Initial add. in Rewind List
26	0	LY21	SY1	
	CA	LW27		

XS3 Codes

	IA	LX		
0	04	77777	77777	1
1	05	77777	77777	2
2	06	77777	77777	3
3	07	77777	77777	4
4	10	77777	77777	5 Servo numbers
5	11	77777	77777	6
6	12	77777	77777	7
7	13	77777	77777	8
10	14	77777	77777	9
11	04	03777	77777	10
12	66	24523	07777	TAPE
13	01	22777	77777	△
14	21	77777	77777	Comma symbol
15	23	77777	77777	Semi-colon symbol
16	17	77777	77777	Open parent. symbol "("
17	43	77777	77777	Close parent. symbol ")"
20	00	00000	00043	Close parent. char.
21	00	00000	00022	Period char.
22	37	00000	00000	Fast feed 1 sym. (packed to left w/zero fill)
23	00	00000	00021	Comma character.
24	00	00000	00023	Semi-colon character
	CA	LX25		

		IA	ZA		
Alarm	0	RJ	WA	WA1	
#1	1	TP	PB	UP3	
	2	RJ	UP2	UP	
	3	MJ	0	LA	⟶ Exit
Alarm	4	RJ	WA	WA1	
#2	5	TP	SY2	PB22	
	6	TP	SY3	PB23	
	7	TP	SY4	PB24	
	10	TP	PB17	UP3	
	11	RJ	UP2	UP	
	12	MJ	0	LB22	⟶ Exit
Alarm	13	RJ	WA	WA1	
#3	14	TP	PC	UP3	
	15	RJ	UP2	UP	
	16	MJ	0	LA	⟶ Exit
Alarm	17	RJ	WA	WA1	
#4	20	TP	PC17	UP3	
	21	RJ	UP2	UP	
	22	RA	LY44	LV	Adv. Parenthesis Level
	23	MJ	0	LB22	⟶ Var. Phase
Alarm	24	RJ	WA	WA1	
#5	25	TP	PD	UP3	
	26	RJ	UP2	UP	
	27	MJ	0	LB22	⟶ Var. Phase
Alarm	30	RJ	WA	WA1	
#6	31	TP	SY2	PD22	
	32	TP	SY3	PD23	
	33	TP	SY4	PD24	
	34	TP	PD17	UP3	
	35	RJ	UP2	UP	
	36	MJ	0	LB22	⟶ Var. Phase
Alarm	37	RJ	WA	WA1	
#7	40	TP	PE	UP3	
	41	RJ	UP2	UP	
	42	MJ	0	LF	⟶ Tape Designation Phase
		CA	ZA43		

```
               IA    ZB
Alarm    0     RJ    WA       WA1       Print hdg. & set error bit
#8       1     TP    SY2      PG6       Pseudo op. sym.—> printout
         2     TP    PG       UP3
         3     RJ    UP2      UP        Printout #8
         4     MJ    0        LB22
Alarm    5     RJ    WA       WA1       Print hdg. & set error bit
#9       6     TP    SY2      PG23      Library rtn. sym. —> printout
         7     TP    PG16     UP3
        10     RJ    UP2      UP        Printout #9
        11     MJ    0        LB22
Alarm   12     RJ    WA       WA1       Print hdg. & set error bit
#10     13     TP    SZ2      PH7   ⎫
        14     TP    SZ3      PH10  ⎬   Symbol —> Printout
        15     TP    SZ4      PH11  ⎭
        16     TP    PH       UP3
        17     RJ    UP2      UP        Printout #10
        20     MJ    0        ZB25
Alarm   21     RJ    WA       WA1       Print hdg. & set error bit
#11     22     TP    LY16     PH20      Subs. var. symbol —> printout
        23     TP    PH13     UP3
        24     RJ    UP2      UP        Printout #11
        25     TP    SY2      A
        26     MJ    0        LB23
Alarm   27     RJ    WA       WA1       Print hdg. & set error bit
#12     30     TP    LY16     PI11      Subs. var. sym. —> printout
        31     TP    PI       UP3
        32     RJ    UP2      UP
        33     MJ    0        LA        —> Exit
        34     CA    ZB34
```

```
               IA   ZC
Alarm   0      RJ   WA      WA1        Print hdg. and set error bit
#13     1      TP   LY16    PI31       Subs. Var. sym. ⟶ printout
        2      TP   PI21    UP3
        3      RJ   UP2     UP         Printout #13
        4      RA   LY46    LV         Adv. subs. parent. level by 1
        5      MJ   0       LD12
Alarm   6      RJ   WA      WA1        Print hdg. & set error bit
#14     7      TP   SY2     PJ3        Illegal sym. ⟶ printout
       10      TP   LY16    PJ12       Subs. var. sym. ⟶ printout
       11      TP   PJ      UP3
       12      RJ   UP2     UP         Printout #14
       13      MJ   0       LD12
Alarm  14      RJ   WA      WA1        Print hdg. & set error bit
#15    15      TP   LY16    PJ24       Subs. var. sym. ⟶ printout
       16      TP   PJ14    UP3
       17      RJ   UP2     UP         Printout #15
       20      MJ   0       LF
Alarm  21      RJ   WA      WA1        Print hdg. and set error bit
#16    22      TP   SY2     PK15 ┐
       23      TP   SY3     PK16 ├     Symbol ⟶ Printout
       24      TP   SY4     PK17 ┘
       25      TP   LY16    PK4
       26      TP   PK      UP3
       27      RJ   UP2     UP
       30      MJ   0       LD12
               CA   ZC31

               IA   ZD
Alarm   0      RJ   WA      WA1        Print hdg. & set error bit
#17     1      TP   SY2     PK25       Function symbol ⟶ printout
        2      TP   LY16    PK32       Sub. var. sym. ⟶ printout
        3      RJ   SY      SY1        Get next symbol
        4      EJ   LX16    ZD11 yes   Sym. = open parenthesis? (i.e., are there
                                       arguments w/function)
        5      TP   PK21    UP3        Parameter for #17 ⟶ Uniprint
        6      RJ   UP2     UP         Printout #17
        7      TP   SY2     A          Current sym. ⟶ A
       10      MJ   0       LD13       ⟶ Subs. var. section
       11      TP   PK22    UP3        Parameter for #17A ⟶ Uniprint
       12      RJ   UP2     UP         Printout #17A
       13      RJ   LE21    LE6        Delete arguments of function
       14      MJ   0       LD12       ⟶ Subs. var. section
               CA   ZD15
```

```
                IA   ZE
Alarm    0      RJ   WA       WA1        Print hdg. & set error bit
#18      1      TP   SY2      PL6        Latest subs. var.—> printout
         2      TP   LY16     PL14       Prior subs. var. —> printout
         3      RJ   SY       SY1        Get next symbol
         4      EJ   LX16     ZE11 yes   Symbol = open parenthesis
         5      TP   PL       UP3        Parameter for #18 —> printout
         6      RJ   UP2      UP         Printout #18
         7      TP   SY2      A          Current sym. —> A
        10      MJ   0        LD13       —> Subs. var. section
        11      TP   PL1      UP3        Parameter for #18A —> Printout
        12      RJ   UP2      UP         Printout #18A
        13      TP   LV12     LY47       Set parenthesis level = zero
        14      TP   SZ2      LY50       Latest subs. var. sym. —> temp.
14      15      RJ   SY       SY1        Get next symbol
        16      EJ   LX17     ZE23 yes   Sym. = close parenthesis?
        17      EJ   LX16     ZE25       Sym. = open parenthesis?
        20      EJ   LX12     ZE27 yes   Sym. = "tape"?  yes ==> printout #15
        21      EJ   LX13     ZE34 yes   Sym. = space-period ( Δ .)?  yes —>
                                         printout #12
        22      MJ   0        ZE15
        23      IJ   LY47     ZE15 no    Close parent. for subscripts?  (level
                                         zero)
        24      MJ   0        LD12
        25      RA   LY47     LV         Adv. parent. level by 1
        26      MJ   0        ZE15
        27      RJ   WA       WA1
        30      TP   LY50     PJ24
        31      TP   PJ14     UP3
        32      RJ   UP2      UP         Printout #15
        33      MJ   0        LF         —> Tape designation phase
        34      RJ   WA       WA1
        35      TP   LY50     PI11
        36      TP   PI       UP3        Printout #12
        37      RJ   UP2      UP
        40      MJ   0        LA         —> Exit
                CA   ZE41
```

```
              IA   ZF
Alarm   0     RJ   WA      WA1       Print hdg. & set error bit
#19     1     TP   SY2     PM5       Lib. rtn. sym. ──> printout
        2     TP   LY16    PM13
        3     TP   PM      UP3
        4     RJ   UP2     UP        Printout #19
        5     MJ   0       LD12
Alarm   6     RJ   WA      WA1       Print hdg. & set error bit
#20     7     TP   SY2     PM23
       10     TP   LY16    PM31
       11     TP   PM15    UP3
       12     RJ   UP2     UP        Printout #20
       13     MJ   0       LD12
Alarm  14     RJ   WA      WA1       Print hdg. & set error bit
#21    15     TP   SY2     PN14
       16     TP   SY3     PN15
       17     TP   SY4     PN16
       20     TP   LY16    PN4
       21     TP   PN      UP3
       22     RJ   UP2     UP
       23     MJ   0       LD12
Alarm  24     RJ   WA      WA1       Print hdg. & set error bit
#22    25     TP   SZ2     PO13
       26     TP   SZ3     PO14
       27     TP   SZ4     PO15
       30     TP   LY16    PO7
       31     TP   PO      UP3
       32     RJ   UP2     UP
       33     TP   SY2     A
       34     MJ   0       LD13
              CA   ZF35
```

```
                IA   ZG
Alarm   0       RJ   WA      WA1
#23     1       TP   LY16    P027
        2       TP   P017    UP3
        3       RJ   UP2     UP
        4       MJ   0       LB22       ——> Var. phase
Alarm   5       RJ   WA      WA1
#24     6       TP   LY16    PP15
        7       TP   PP      UP3
        10      RJ   UP2     UP
        11      MJ   0       LA         ——> Exit
Alarm   12      RJ   WA      WA1
#25     13      TP   LY16    PP36
        14      TP   PP23    UP3
        15      MJ   0       ZB24
Alarm   16      RJ   WA      WA2
#26     17      TP   SZ2     PQ5
        20      TP   PQ      UP3
        21      RJ   UP2     UP
        22      RJ   LE11    LE7    }
        23      RJ   LR      LR1    }
        24      RJ   LE21    SY1    }   Save arguments of function
        25      RJ   LR      LR1    }
        26      MJ   0       LB22
Alarm   27      RJ   WA      WA1
#27     30      TP   LY50    PQ27
        31      TP   PQ15    UP3
        32      MJ   0       LB22
Alarm   33      RJ   WA      WA1
#28     34      TP   LY50    PR12
        35      TP   PR      UP3
        36      RJ   UP2     UP
        37      MJ   0       LA         ——> Exit
                CA   ZG40
```

```
                IA   ZH
Alarm   0       RJ   WA        WA1
#29     1       TP   PR21      UP3
        2       RJ   UP2       UP
        3       MJ   0         LA          ⟶ Exit
Alarm   4       RJ   WA        WA1
#30     5       TP   PT        UP3
        6       RJ   UP2       UP
        7       MJ   0         LA          ⟶ Exit
Alarm   10      RJ   WA        WA1
#31     11      TP   PT21      UP3
        12      RJ   UP2       UP
        13      MJ   0         LA          ⟶ Exit
Alarm   14      RJ   WA        WA1
#32     15      TP   PU        UP3
        16      RJ   UP2       UP
        17      MJ   0         LA          ⟶ Exit
Alarm   20      RJ   WA        WA1
#33     21      TP   SY2       PU30
        22      TP   PU21      UP3
        23      RJ   UP2       UP
        24      MJ   0         LA          ⟶ Exit
Alarm   25      RJ   WA        WA1
#34     26      TP   SY2       PV12
        27      TP   PV        UP3
        30      RJ   UP2       UP
        31      MJ   0         LA          ⟶ Exit
Alarm   32      RJ   WA        WA1
#35     33      TP   SY2       PV36
        34      TP   PV24      UP3
        35      RJ   UP2       UP
        36      MJ   0         LA          ⟶ Exit
        37      CA   ZH37
```

```
                IA    ZI
Alarm     0     RJ    WA      WA1
#36       1     TP    SY2     PW16
          2     TP    SY3     PW17
          3     TP    SY4     PW20
          4     TP    PW      UP3
          5     RJ    UP2     UP
          6     MJ    0       LA        ---> Exit
Alarm     7     RJ    WA      WA1
#37      10     TP    SY2     PX15
         11     TP    SY3     PX16
         12     TP    SY4     PX17
         13     TP    PX      UP3
         14     RJ    UP2     UP
         15     MJ    0       LA        ---> Exit
Alarm    16     RJ    WA      WA1
#38      17     TP    PY      UP3
         20     RJ    UP2     UP
         21     MJ    0       LA        ---> Exit
Alarm    22     RJ    WA      WA1
#39      23     TP    PY24    UP3
         24     RJ    UP2     UP
         25     MJ    0       LA        ---> Exit
Alarm    26     RJ    WA      WA1
#40      27     TP    SY2     PZ14
         30     TP    SY3     PZ15
         31     TP    SY4     PZ16
         32     TP    PZ      UP3
         33     RJ    UP2     UP
         34     MJ    0       LA        ---> Exit
Alarm    35     RJ    WA      WA2
#41      36     TP    SA      UP3
         37     RJ    UP2     UP
         40     MJ    0       LA        ---> Exit
                CA    ZI41
```

```
             IA   ZJ
Warn-    0   RJ   WA     WA2      Print hdg.; do not set error bit
ing      1   TP   SA16   UP3
#42      2   RJ   UP2    UP
         3   MJ   0      LJ       → End list string-out
Warn-    4   RJ   WA     WA2      Print hdg.; do not set error bit
ing      5   TP   SY2    SB26
#43      6   TP   SY3    SB27     Symbol → printout
         7   TP   SY4    SB30
        10   TP   SB     UP3
        11   RJ   UP2    UP
        12   MJ   0      LJ       → End list string-out
Warn-   13   RJ   WA     WA2
ing     14   TP   SC     UP3
#44     15   RJ   UP2    UP
        16   MJ   0      LJ       → End list string-out
Warn-   17   RJ   WA     WA2
ing     20   TP   SY2    SD26
#45     21   TP   SY3    SD27     Symbol → printout
        22   TP   SY4    SD30
        23   TP   SD     UP3
        24   MJ   0      ZJ15
Warn-   25   RJ   WA     WA2
ing     26   TP   SE     UP3
#46     27   RJ   UP2    UP
        30   TP   LX13   SY2
        31   MJ   0      LJ
Warn-   32   RJ   WA     WA2
ing     33   TP   SE16   UP3
#47     34   RJ   UP2    UP
        35   MJ   0      LJ       → End list string-out
             CA   ZJ36
```

```
             IA   ZK
Warn-    0   RJ   WA      WA2
ing      1   TP   SF      UP3
#48      2   RJ   UP2     UP
         3   MJ   0       LJ      ——> End list string-out
Warn-    4   RJ   WA      WA2
ing      5   TP   SY2     SF47
#49      6   TP   SY3     SF50
         7   TP   SY4     SF51
        10   TP   SF22    UP3
        11   RJ   UP2     UP
        12   MJ   0       LJ      ——> End list string-out
Warn-   13   RJ   WA      WA2     Print hdg.; do not set error bit
ing     14   TP   SG      UP3
#50     15   RJ   UP2     UP
        16   MJ   0       LJ
Alarm   17   RJ   WA      WA1     Print hdg.; set error bit
#51     20   TP   SY2     SG31
        21   TP   SY3     SG32
        22   TP   SY4     SG33
        23   TP   SG15    UP3
        24   RJ   UP2     UP
        25   MJ   0       LP11    ——> Var. count subroutine
Warn-   26   RJ   WA      WA2     Print hdg.; do not set error bit
ing     27   TP   SH      UP3
#52     30   RJ   UP2     UP
        31   MJ   0       LJ      ——> End list string-out
             CA   ZK32
```

```
                 IA   ZL
Warn-     0      RJ   WA        WA2
ing#53    1      RP   30004     ZL3   ]
Preset    2      TP   [30000]   SH32  }   Truncated var. name (23 char.)⟶
in var.                               ]   printout
count     3      RA   SH32      LV50      Put open parent. preceding var. name in
rtn.                                      printout
          4      TP   SH14      UP3
          5      RJ   UP2       UP
          6      TV   LW17      LQ1       Reset ent. ⟶ LQ
          7      MJ   0         LQ
Warn-     10     RJ   WA        WA2
ing       11     RP   30004     ZL13  ]
#54       12     TP   LY20      SI16  }   Truncated column heading (23 char.)⟶
                                      ]   printout
          13     RA   SI16      LV50      Put open parent. preceding col. hdg. in
                                          printout
          14     TP   SI        UP3
          15     RJ   UP2       UP
          16     TV   LW17      LQ1       Reset ent. ⟶ LQ
          17     MJ   0         LQ
Warn-     20     RJ   WA        WA2
ing       21     RP   30024     ZL23  }
#55       22     TP   LY20      SK15  }   Truncated title (20 words) ⟶ Printout
          23     RA   SK15      LV50      Put open parent. preceding title in
                                          printout
          24     TP   SK        UP3
          25     RJ   UP2       UP
          26     TP   ZL27      LQ22      Reset to by-pass printout for remaining
                                          char. of title
          27     MJ   0         LQ        NB ⟶ this instruction used to reset
                                          by preceding instruction
                 CA   ZL30

                 IA   ZM
Alarm     0      RJ   WA        WA1
#56       1      TP   SL        UP3
          2      RJ   UP2       UP
          3      MJ   0         LA        ⟶Exit
Alarm     4      RJ   WA        WA1
#57       5      CC   WR        LV13
          6      TP   SL21      UP3
          7      RJ   UP2       UP
          10     MJ   0         NF26
                 CA   ZM11
```

List String-out Alarm Texts (Alarm Heading 27_{10})

	IA	PB								
0	40	PB1	16							Printout #1
1	71	51542	72101	W	O	R	D	,	△	
2	66	24523	02101	T	A	P	E	,	△	
3	24	52523	02454	A	P	P	E	A	R	
4	65	01246	50131	S	△	A	S	△	F	
5	34	54656	60170	I	R	S	T	△	V	
6	24	54342	42546	A	R	I	A	B	L	
7	30	01665	10125	E	△	T	O	△	B	
10	30	01463	46566	E	△	L	I	S	T	
11	30	27220	10154	E	D	.	△	△	R	
12	30	65660	15131	E	S	T	△	O	F	
13	01	65305	06630	△	S	E	N	T	E	
14	50	26300	15051	N	C	E	△	N	O	
15	66	01263	33026	T	△	C	H	E	C	
16	45	30272	27777	K	E	D	.	77	77	
17	40	PB20	13							Printout #2
20	26	51506	56624	C	O	N	S	T	A	
21	50	66210	17777	N	T	,	△	77	77	
22	0	0	0	-	-	-	-	-	-	
23	0	0	0	-	-	-	-	-	-	
24	0	0	0	-	-	-	-	-	-	
25	21	01244	75150	,	△	A	M	O	N	
26	32	01702	45434	G	△	V	A	R	I	
27	24	25463	06501	A	B	L	E	S	△	
30	66	51012	53001	T	O	△	B	E	△	
31	46	34656	63027	L	I	S	T	E	D	
32	22	77777	77777	.	77	77	77	77	77	
	CA	PB33								

	IA	PC								
0	40	PC1	16							Printout #3
1	30	50270	15131	E	N	D	△	O	F	
2	01	65305	06630	△	S	E	N	T	E	
3	50	26300	16573	N	C	E	△	S	Y	
4	47	25514	60124	M	B	O	L	△	A	
5	47	51503	20170	M	O	N	G	△	V	
6	24	54342	42546	A	R	I	A	B	L	
7	30	65016	65101	E	S	△	T	O	△	
10	25	30014	63465	B	E	△	L	I	S	
11	66	30272	20101	T	E	D	.	△	△	
12	54	30656	60151	R	E	S	T	△	O	
13	31	01653	05066	F	△	S	E	N	T	
14	30	50263	00150	E	N	C	E	△	N	
15	51	66012	63330	O	T	△	C	H	E	
16	26	45302	72201	C	K	E	D	.	△	
17	40	PC20	23							Printout #4
20	51	52305	00152	O	P	E	N	△	P	
21	24	54305	06633	A	R	E	N	T	H	
22	30	65346	52101	E	S	I	S	,	△	
23	71	33342	63301	W	H	I	C	H	△	
24	34	65015	05166	I	S	△	N	O	T	
25	01	52543	02630	△	P	R	E	C	E	
26	27	30270	12573	D	E	D	△	B	Y	
27	01	24274	42426	△	A	D	J	A	C	
30	30	50660	10165	E	N	T	△	△	S	
31	67	25652	65434	U	B	S	C	R	I	
32	52	66302	70170	P	T	E	D	△	V	
33	24	54342	42546	A	R	I	A	B	L	
34	30	21012	45252	E	,	△	A	P	P	
35	30	24546	50124	E	A	R	S	△	A	
36	47	51503	20170	M	O	N	G	△	V	
37	24	54342	42546	A	R	I	A	B	L	
40	30	65016	65101	E	S	△	T	O	△	
41	25	30014	63465	B	E	△	L	I	S	
42	66	30272	27777	T	E	D	.	77	77	
	CA	PC43								

	IA	PD			
0	40	PD1	16		Printout #5
1	26	46516	53001	C L O S E △	
2	52	24543	05066	P A R E N T	
3	33	30653	46501	H E S I S △	
4	71	34663	35167	W I T H O U	
5	66	01265	15454	T △ C O R R	
6	30	65525	15027	E S P O N D	
7	34	50320	15152	I N G △ O P	
10	30	50012	45252	E N △ A P P	
11	30	24546	50124	E A R S △ A	
12	47	51503	20170	M O N G △ V	
13	24	54342	42546	A R I A B L	
14	30	65016	65101	E S △ T O △	
15	25	30014	63465	B E △ L I S	
16	66	30272	27777	T E D . 77 77	
17	40	PD20	12		Printout #6
20	65	73472	55146	S Y M B O L	
21	21	01777	77777	, △ 77 77 77 77	
22	0	0	0		
23	0	0	0		
24	0	0	0		
25	21	01244	75150	, △ A M O N	
26	32	01346	63047	G △ I T E M	
27	65	01665	10125	S △ T O △ B	
30	30	01463	46566	E △ L I S T	
31	30	27227	77777	E D . 77 77 77	
	CA	PD32			

	IA	PE			
0	40	PE1	12		Printout #7
1	52	24543	05066	P A R E N T	
2	33	30653	06501	H E S E S △	
3	52	54302	63027	P R E C E D	
4	34	50320	17151	I N G △ W O	
5	54	27210	16624	R D , △ T A	
6	52	30210	15051	P E , △ N O	
7	66	01525	45152	T △ P R O P	
10	30	54467	30101	E R L Y △ △	
11	01	01010	10152	△ △ △ △ △ P	
12	24	34543	02722	A I R E D .	
	CA	PE13			

	IA	PG								
0	40	PG1	15							Printout #8
1	52	65306	72751	P	S	E	U	D	O	
2	01	51523	05424	Δ	O	P	E	R	A	
3	66	34515	00165	T	I	O	N	Δ	S	
4	73	47255	14621	Y	M	B	O	L	,	
5	01	77777	77777	Δ	77	77	77	77	77	
6	0	0	0	–	–	–	–	–	–	
7	21	01244	75150	,	Δ	A	M	O	N	
10	32	01702	45434	G	Δ	V	A	R	I	
11	24	25463	06501	A	B	L	E	S	Δ	
12	66	51010	10101	T	O	Δ	Δ	Δ	Δ	
13	01	01012	53001	Δ	Δ	Δ	B	E	Δ	
14	46	34656	63027	L	I	S	T	E	D	
15	22	77777	77777	.	77	77	77	77	77	
16	40	PG17	13							Printout #9
17	46	34255	42454	L	I	B	R	A	R	
20	73	01545	16766	Y	Δ	R	O	U	T	
21	34	50300	16573	I	N	E	Δ	S	Y	
22	47	25514	62101	M	B	O	L	,	Δ	
23	0	0	0	–	–	–	–	–	–	
24	21	01244	75150	,	Δ	A	M	O	N	
25	32	01702	45434	G	Δ	V	A	R	I	
26	24	25463	06501	A	B	L	E	S	Δ	
27	66	51012	53001	T	O	Δ	B	E	Δ	
30	01	01010	14634	Δ	Δ	Δ	Δ	L	I	
31	65	66302	72277	S	T	E	D	.	77	
	CA	PG32								

	IA	PH								
0	40	PH1	12							Printout #10
1	26	51474	72401	C	O	M	M	A	△	
2	47	34656	53450	M	I	S	S	I	N	
3	32	01315	14646	G	△	F	O	L	L	
4	51	71345	03201	O	W	I	N	G	△	
5	70	24543	42425	V	A	R	I	A	B	
6	46	30210	17777	L	E	,	△	77	77	
7	0	0	0	-	-	-	-	-	-	
10	0	0	0	-	-	-	-	-	-	
11	0	0	0	-	-	-	-	-	-	
12	22	77777	77777	.	77	77	77	77	77	
13	40	PH14	22							Printout #11
14	65	67256	52654	S	U	B	S	C	R	
15	34	52663	02701	I	P	T	E	D	△	
16	70	24543	42425	V	A	R	I	A	B	
17	46	30210	17777	L	E	,	△	77	77	
20	0	0	0	-	-	-	-	-	-	
21	21	01505	16601	,	△	N	O	T	△	
22	31	51464	65171	F	O	L	L	O	W	
23	30	27012	57301	E	D	△	B	Y	△	
24	51	52305	00101	O	P	E	N	△	△	
25	01	01010	10101	△	△	△	△	△	△	
26	52	24543	05066	P	A	R	E	N	T	
27	33	30653	46522	H	E	S	I	S	.	
30	01	65672	56526	△	S	U	B	S	C	
31	54	34526	66501	R	I	P	T	S	△	
32	24	65656	74730	A	S	S	U	M	E	
33	27	01665	10125	D	△	T	O	△	B	
34	30	01473	46565	E	△	M	I	S	S	
35	34	50322	27777	I	N	G	.	77	77	
	CA	PH36								

	IA	PI								
0	40	PI1	20							Printout #12
1	30	50270	15131	E	N	D	Δ	O	F	
2	01	65305	06630	Δ	S	E	N	T	E	
3	50	26300	16573	N	C	E	Δ	S	Y	
4	47	25514	60124	M	B	O	L	Δ	A	
5	47	51503	20165	M	O	N	G	Δ	S	
6	67	25652	65434	U	B	S	C	R	I	
7	52	66650	13151	P	T	S	Δ	F	O	
10	54	01777	77777	R	Δ	77	77	77	77	
11	0	0	0	-	-	-	-	-	-	
12	22	01010	10101	.	Δ	Δ	Δ	Δ	Δ	
13	01	01015	43065	Δ	Δ	Δ	R	E	S	
14	66	01513	10165	T	Δ	O	F	Δ	S	
15	30	50663	05026	E	N	T	E	N	C	
16	30	01505	16601	E	Δ	N	O	T	Δ	
17	26	33302	64530	C	H	E	C	K	E	
20	27	22777	77777	D	.	77	77	77	77	
21	40	PI22	11							Printout #13
22	51	52305	00152	O	P	E	N	Δ	P	
23	24	54305	06633	A	R	E	N	T	H	
24	30	65346	50124	E	S	I	S	Δ	A	
25	47	51503	20165	M	O	N	G	Δ	S	
26	67	25652	65434	U	B	S	C	R	I	
27	52	66650	13151	P	T	S	Δ	F	O	
30	54	01777	77777	R	Δ	77	77	77	77	
31	0	0	0	-	-	-	-	-	-	
32	22	77777	77777	.	77	77	77	77	77	
	CA	PI33								

	IA	PJ									
0	40	PJ1	13								Printout #14
1	65	73472	55146	S	Y	M	B	O	L		
2	21	01777	77777	,	△	77	77	77	77		
3	0	0	0	-	-	-	-	-	-		
4	21	01245	25230	,	△	A	P	P	E		
5	24	54650	12447	A	R	S	△	A	M		
6	51	50320	16567	O	N	G	△	S	U		
7	25	65265	43452	B	S	C	R	I	P		
10	66	65013	15154	T	S	△	F	O	R		
11	01	77777	77777	△	77	77	77	77	77		
12	0	0	0	-	-	-	-	-	-		
13	22	77777	77777	.	77	77	77	77	77		
14	40	PJ15	11								Printout #15
15	71	51542	72101	W	O	R	D	,	△		
16	66	24523	02101	T	A	P	E	,	△		
17	24	52523	02454	A	P	P	E	A	R		
20	65	01244	75150	S	△	A	M	O	N		
21	32	01656	72565	G	△	S	U	B	S		
22	26	54345	26665	C	R	I	P	T	S		
23	01	31515	40177	△	F	O	R	△	77		
24	0	0	0	-	-	-	-	-	-		
25	22	77777	77777	.	77	77	77	77	77		
	CA	PJ26									

	IA	PK								
0	40	PK1	20							Printout #16
1	65	67256	52654	S	U	B	S	C	R	
2	34	52666	50131	I	P	T	S	Δ	F	
3	51	54017	77777	O	R	Δ	77	77	77	
4	0	0	0	-	-	-	-	-	-	
5	01	34502	64667	Δ	I	N	C	L	U	
6	27	30016	63330	D	E	Δ	T	H	E	
7	01	31465	12466	Δ	F	L	O	A	T	
10	34	50320	15251	I	N	G	Δ	P	O	
11	34	50660	10101	I	N	T	Δ	Δ	Δ	
12	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ	
13	01	70245	43424	Δ	V	A	R	I	A	
14	25	46302	10177	B	L	E	,	Δ	77	
15	0	0	0	-	-	-	-	-	-	
16	0	0	0	-	-	-	-	-	-	
17	0	0	0	-	-	-	-	-	-	
20	22	77777	77777	.	77	77	77	77	77	
21	40	PK23	11							Printout #17
22	40	PK23	17							#17A
23	31	67502	66634	F	U	N	C	T	I	
24	51	50210	17777	O	N	,	Δ	77	77	
25	0	0	0	-	-	-	-	-	-	
26	21	01244	75150	,	Δ	A	M	O	N	
27	32	01656	72565	G	Δ	S	U	B	S	
30	26	54345	26665	C	R	I	P	T	S	
31	01	31515	40177	Δ	F	O	R	Δ	77	
32	0	0	0	-	-	-	-	-	-	
33	22	01010	10101	.	Δ	Δ	Δ	Δ	Δ	
34	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ	
35	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ	
36	24	54326	74730	A	R	G	U	M	E	
37	50	66650	16567	N	T	S	Δ	S	U	
40	52	30543	14667	P	E	R	F	L	U	
41	51	67652	27777	O	U	S	.	77	77	
	CA	PK42								

	IA	PL									
0	40	PL2	14								Printout #18
1	40	PL2	24								#18A
2	65	67256	52654	S	U	B	S	C	R		
3	34	52663	02701	I	P	T	E	D	△		
4	70	24543	42425	V	A	R	I	A	B		
5	46	30210	17777	L	E	,	△	77	77		
6	0	0	0	-	-	-	-	-	-		
7	21	01244	75150	,	△	A	M	O	N		
10	32	01656	72565	G	△	S	U	B	S		
11	26	54345	26665	C	R	I	P	T	S		
12	01	31515	40101	△	F	O	R	△	△		
13	01	01010	10101	△	△	△	△	△	△		
14	0	0	0	-	-	-	-	-	-		
15	22	77777	77701	.	77	77	77	77	△		
16	65	67256	52654	S	U	B	S	C	R		
17	34	52666	50131	I	P	T	S	△	F		
20	51	54014	62466	O	R	△	L	A	T		
21	30	65660	17024	E	S	T	△	V	A		
22	54	34242	54630	R	I	A	B	L	E		
23	01	50516	60126	△	N	O	T	△	C		
24	33	30264	53027	H	E	C	K	E	D		
25	22	77777	77777	.	77	77	77	77	77		
	CA	PL26									

	IA	PM								
0	40	PM1	14							Printout #19
1	46	34255	42454	L	I	B	R	A	R	
2	73	01545	16766	Y	△	R	O	U	T	
3	34	50300	16573	I	N	E	△	S	Y	
4	47	25514	62101	M	B	O	L	,	△	
5	0	0	0	-	-	-	-	-	-	
6	21	01244	75150	,	△	A	M	O	N	
7	32	01656	72565	G	△	S	U	B	S	
10	26	54345	26665	C	R	I	P	T	S	
11	01	31515	40101	△	F	O	R	△	△	
12	01	01010	17777	△	△	△	△	77	77	
13	0	0	0	-	-	-	-	-	-	
14	22	77777	77777	.	77	77	77	77	77	
15	40	PM16	15							Printout #20
16	52	65306	72751	P	S	E	U	D	O	
17	01	51523	05424	△	O	P	E	R	A	
20	66	34515	00165	T	I	O	N	△	S	
21	73	47255	14621	Y	M	B	O	L	,	
22	01	77777	77777	△	77	77	77	77	77	
23	0	0	0	-	-	-	-	-	-	
24	21	01244	75150	,	△	A	M	O	N	
25	32	01656	72565	G	△	S	U	B	S	
26	26	54345	26665	C	R	I	P	T	S	
27	01	31515	40101	△	F	O	R	△	△	
30	01	01017	77777	△	△	△	77	77	77	
31	0	0	0	-	-	-	-	-	-	
32	22	77777	77777	.	77	77	77	77	77	
	CA	PM33								

	IA	PN								
0	40	PN1	17							Printout #21
1	65	67256	52654	S	U	B	S	C	R	
2	34	52666	50131	I	P	T	S	△	F	
3	51	54017	77777	O	R	△	77	77	77	
4	0	0	0	-	-	-	-	-	-	
5	01	34502	64667	△	I	N	C	L	U	
6	27	30016	56752	D	E	△	S	U	P	
7	30	54652	65434	E	R	S	C	R	I	
10	52	66012	65150	P	T	△	C	O	N	
11	65	66245	06621	S	T	A	N	T	,	
12	01	01010	10101	△	△	△	△	△	△	
13	01	77777	77777	△	77	77	77	77	77	
14	0	0	0	-	-	-	-	-	-	
15	0	0	0	-	-	-	-	-	-	
16	0	0	0	-	-	-	-	-	-	
17	22	77777	77777	.	77	77	77	77	77	
	CA	PN20								

	IA	PO								
0	40	P01	16							Printout #22
1	26	51474	72401	C	O	M	M	A	△	
2	47	34656	53450	M	I	S	S	I	N	
3	32	01244	75150	G	△	A	M	O	N	
4	32	01656	72565	G	△	S	U	B	S	
5	26	54345	26665	C	R	I	P	T	S	
6	01	31515	40177	△	F	O	R	△	77	
7	0	0	0	-	-	-	-	-	-	
10	21	01315	14646	,	△	F	O	L	L	
11	51	71345	03221	O	W	I	N	G	,	
12	01	01010	10177	△	△	△	△	△	77	
13	0	0	0	-	-	-	-	-	-	
14	0	0	0	-	-	-	-	-	-	
15	0	0	0	-	-	-	-	-	-	
16	22	77777	77777	.	77	77	77	77	77	
17	40	P020	11							Printout #23
20	34	50265	15454	I	N	C	O	R	R	
21	30	26660	15067	E	C	T	△	N	U	
22	47	25305	40151	M	B	E	R	△	O	
23	31	01702	44634	F	△	V	A	L	I	
24	27	01656	72565	D	△	S	U	B	S	
25	26	54345	26665	C	R	I	P	T	S	
26	01	31515	40177	△	F	O	R	△	77	
27	0	0	0	-	-	-	-	-	-	
30	22	77777	77777	.	77	77	77	77	77	
	CA	P031								

	IA	PP								
0	40	PP1	22							Printout #24
1	30	50270	15131	E	N	D	△	O	F	
2	01	65305	06630	△	S	E	N	T	E	
3	50	26300	16573	N	C	E	△	S	Y	
4	47	25514	60131	M	B	O	L	△	F	
5	51	46465	17165	O	L	L	O	W	S	
6	01	26465	16530	△	C	L	O	S	E	
7	01	65672	56526	△	S	U	B	S	C	
10	54	34526	60101	R	I	P	T	△	△	
11	01	01010	10152	△	△	△	△	△	P	
12	24	54305	06633	A	R	E	N	T	H	
13	30	65346	50131	E	S	I	S	△	F	
14	51	54017	77777	O	R	△	77	77	77	
15	0	0	0	-	-	-	-	-	-	
16	22	01543	06566	.	△	R	E	S	T	
17	01	51310	16530	△	O	F	△	S	E	
20	66	30502	63001	T	E	N	C	E	△	
21	50	51660	12633	N	O	T	△	C	H	
22	30	26453	02722	E	C	K	E	D	△	
23	40	PP24	14							Printout #25
24	26	51474	72401	C	O	M	M	A	△	
25	47	34656	53450	M	I	S	S	I	N	
26	32	01315	14646	G	△	F	O	L	L	
27	51	71345	03201	O	W	I	N	G	△	
30	26	46516	53001	C	L	O	S	E	△	
31	65	67256	52654	S	U	B	S	C	R	
32	34	52660	15224	I	P	T	△	P	A	
33	54	30506	63330	R	E	N	T	H	E	
34	65	34650	10131	S	I	S	△	△	F	
35	51	54017	77777	O	R	△	77	77	77	
36	0	0	0	-	-	-	-	-	-	
37	22	77777	77777	.	77	77	77	77	77	
	CA	PP40								

	IA	PQ								
0	40	PQ1	14							Printout #26
1	71	24545	03450	W	A	R	N	I	N	
2	32	21012	45432	G	,	△	A	R	G	
3	67	47305	06617	U	M	E	N	T	(	
4	65	43015	13101	S	)	△	O	F	△	
5	0	0	0							
6	77	01656	75230	77	△	S	U	P	E	
7	54	31466	75167	R	F	L	U	O	U	
10	65	22012	45432	S	.	△	A	R	G	
11	67	47305	06665	U	M	E	N	T	S	
12	01	01010	10150	△	△	△	△	△	N	
13	51	66012	63330	O	T	△	C	H	E	
14	26	45302	72277	C	K	E	D	.	77	
15	40	PQ16	13							Printout #27
16	71	51542	72101	W	O	R	D	,	△	
17	66	24523	02101	T	A	P	E	,	△	
20	24	52523	02454	A	P	P	E	A	R	
21	65	01244	75150	S	△	A	M	O	N	
22	32	01245	43267	G	△	A	R	G	U	
23	47	30506	66501	M	E	N	T	S	△	
24	51	31013	16750	O	F	△	F	U	N	
25	26	66345	15021	C	T	I	O	N	,	
26	01	77777	77777	△	77	77	77	77	77	
27	0	0	0	-	-	-	-	-	-	
30	22	77777	77777	.	77	77	77	77	77	
	CA	PQ31								

	IA	PR								
0	40	PR1	20							Printout #28
1	30	50270	15131	E	N	D	△	O	F	
2	01	65305	06630	△	S	E	N	T	E	
3	50	26300	16573	N	C	E	△	S	Y	
4	47	25514	60124	M	B	O	L	△	A	
5	47	51503	20124	M	O	N	G	△	A	
6	54	32674	73050	R	G	U	M	E	N	
7	66	65015	13101	T	S	△	O	F	△	
10	31	67502	66634	F	U	N	C	T	I	
11	51	50210	10177	O	N	,	△	△	77	
12	0	0	0	-	-	-	-	-	-	
13	22	01543	06566	.	△	R	E	S	T	
14	01	51310	16530	△	O	F	△	S	E	
15	50	66305	02630	N	T	E	N	C	E	
16	01	50516	60126	△	N	O	T	△	C	
17	33	30264	53027	H	E	C	K	E	D	
20	22	77777	77777	.	77	77	77	77	77	
21	40	PR22	21							Printout #29
22	34	50702	44634	I	N	V	A	L	I	
23	27	01662	45230	D	△	T	A	P	E	
24	01	27306	53432	△	D	E	S	I	G	
25	50	24663	45150	N	A	T	I	O	N	
26	22	01305	02701	.	△	E	N	D	△	
27	51	31016	53050	O	F	△	S	E	N	
30	66	30502	63001	T	E	N	C	E	△	
31	65	73472	55146	S	Y	M	B	O	L	
32	01	01010	10131	△	△	△	△	△	F	
33	51	46465	17165	O	L	L	O	W	S	
34	01	71515	42721	△	W	O	R	D	,	
35	01	66245	23022	△	T	A	P	E	.	
36	01	54306	56601	△	R	E	S	T	△	
37	51	31016	53050	O	F	△	S	E	N	
40	66	30502	63001	T	E	N	C	E	△	
41	50	51660	12633	N	O	T	△	C	H	
42	30	26453	02722	E	C	K	E	D	.	
	CA	PR43								

	IA	PT								
0	40	PT1	20							Printout #30
1	34	50702	44634	I	N	V	A	L	I	
2	27	01662	45230	D	△	T	A	P	E	
3	01	27306	53432	△	D	E	S	I	G	
4	50	24663	45150	N	A	T	I	O	N	
5	22	01265	14747	.	△	C	O	M	M	
6	24	01515	40165	A	△	O	R	△	S	
7	30	47340	22651	E	M	I	-	C	O	
10	46	51500	13151	L	O	N	△	F	O	
11	46	46517	16501	L	L	O	W	S	△	
12	71	51542	72101	W	O	R	D	,	△	
13	66	24523	02201	T	A	P	E	.	△	
14	54	30656	60151	R	E	S	T	△	O	
15	31	01653	05066	F	△	S	E	N	T	
16	30	50263	00150	E	N	C	E	△	N	
17	51	66012	63330	O	T	△	C	H	E	
20	26	45302	72277	C	K	E	D	.	77	
21	40	PT22	20							Printout #31
22	34	50702	44634	I	N	V	A	L	I	
23	27	01662	45230	D	△	T	A	P	E	
24	01	27306	53432	△	D	E	S	I	G	
25	50	24663	45150	N	A	T	I	O	N	
26	22	01515	23050	.	△	O	P	E	N	
27	01	52245	43050	△	P	A	R	E	N	
30	66	33306	53465	T	H	E	S	I	S	
31	01	31514	64651	△	F	O	L	L	O	
32	71	65010	10171	W	S	△	△	△	W	
33	51	54272	10166	O	R	D	,	△	T	
34	24	52302	20154	A	P	E	,	△	R	
35	30	65660	15131	E	S	T	△	O	F	
36	01	65305	06630	△	S	E	N	T	E	
37	50	26300	15051	N	C	E	△	N	O	
40	66	01263	33026	T	△	C	H	E	C	
41	45	30272	27777	K	E	D	.	77	77	
	CA	PT42								

	IA	PU								
0	40	PU1	20							Printout #32
1	34	50702	44634	I	N	V	A	L	I	
2	27	01662	45230	D	△	T	A	P	E	
3	01	27306	53432	△	D	E	S	I	G	
4	50	24663	45150	N	A	T	I	O	N	
5	22	01264	65165	.	△	C	L	O	S	
6	30	01522	45430	E	△	P	A	R	E	
7	50	66333	06534	N	T	H	E	S	I	
10	65	01315	14646	S	△	F	O	L	L	
11	51	71650	10171	O	W	S	△	△	W	
12	51	54272	10166	O	R	D	,	△	T	
13	24	52302	20154	A	P	E	.	△	R	
14	30	65660	15131	E	S	T	△	O	F	
15	01	65305	06630	△	S	E	N	T	E	
16	50	26300	15051	N	C	E	△	N	O	
17	66	01263	33026	T	△	C	H	E	C	
20	45	30272	27777	K	E	D	.	77	77	
21	40	PU22	21							Printout #33
22	34	50702	44634	I	N	V	A	L	I	
23	27	01662	45230	D	△	T	A	P	E	
24	01	27306	53432	△	D	E	S	I	G	
25	50	24663	45150	N	A	T	I	O	N	
26	22	01657	34725	.	△	S	Y	M	B	
27	51	46210	17777	O	L	,	△	77	77	
30	0	0	0	–	–	–	–	–	–	
31	21	01315	14646	,	△	F	O	L	L	
32	51	71650	10101	O	W	S	△	△	△	
33	01	01010	10101	△	△	△	△	△	△	
34	71	51542	72101	W	O	R	D	,	△	
35	66	24523	02201	T	A	P	E	.	△	
36	54	30656	60151	R	E	S	T	△	O	
37	31	01653	05066	F	△	S	E	N	T	
40	30	50263	00150	E	N	C	E	△	N	
41	51	66012	63330	O	T	△	C	H	E	
42	26	45302	72277	C	K	E	D	.	77	
	CA	PU43								

	IA	PV								
0	40	PV1	23							Printout #34
1	34	50702	44634	I	N	V	A	L	I	
2	27	01662	45230	D	△	T	A	P	E	
3	01	27306	53432	△	D	E	S	I	G	
4	50	24663	45150	N	A	T	I	O	N	
5	22	01463	42554	.	△	L	I	B	R	
6	24	54730	15451	A	R	Y	△	R	O	
7	67	66345	03001	U	T	I	N	E	△	
10	65	73472	55146	S	Y	M	B	O	L	
11	21	01010	10177	,	△	△	△	△	77	
12	0	0	0	-	-	-	-	-	-	
13	21	01315	14646	,	△	F	O	L	L	
14	51	71650	17151	O	W	S	△	W	O	
15	54	27210	16624	R	D	,	△	T	A	
16	52	30220	15430	P	E	.	△	R	E	
17	65	66015	13101	S	T	△	O	F	△	
20	65	30506	63050	S	E	N	T	E	N	
21	26	30015	05166	C	E	△	N	O	T	
22	01	26333	02645	△	C	H	E	C	K	
23	30	27227	77777	E	D	.	77	77	77	
24	40	PV25	23							Printout #35
25	34	50702	44634	I	N	V	A	L	I	
26	27	01662	45230	D	△	T	A	P	E	
27	01	27306	53432	△	D	E	S	I	G	
30	50	24663	45150	N	A	T	I	O	N	
31	22	01526	53067	.	△	P	S	E	U	
32	27	51015	15230	D	O	△	O	P	E	
33	54	24663	45150	R	A	T	I	O	N	
34	01	65734	72551	△	S	Y	M	B	O	
35	46	21010	10177	L	,	△	△	△	77	
36	0	0	0	-	-	-	-	-	-	
37	21	01315	14646	,	△	F	O	L	L	
40	51	71650	17151	O	W	S	△	W	O	
41	54	27210	16624	R	D	,	△	T	A	
42	52	30220	15430	P	E	.	△	R	E	
43	65	66015	13101	S	T	△	O	F	△	
44	65	30506	63050	S	E	N	T	E	N	
45	26	30015	05166	C	E	△	N	O	T	
46	01	26333	02645	△	C	H	E	C	K	
47	30	27227	77777	E	D	.	77	77	77	
	CA	PV50								

Printout #36

	IA	PW							
0	40	PW1	24						
1	34	50702	44634	I	N	V	A	L	I
2	27	01662	45230	D	△	T	A	P	E
3	01	65734	72551	△	S	Y	M	B	O
4	46	23015	43065	L	;	△	R	E	S
5	66	01513	10165	T	△	O	F	△	S
6	30	50663	05026	E	N	T	E	N	C
7	30	01675	02633	E	△	U	N	C	H
10	30	26453	02722	E	C	K	E	D	.
11	01	50515	00231	△	N	O	N	-	F
12	34	72302	70152	I	X	E	D	△	P
13	51	34506	60170	O	I	N	T	△	V
14	24	54342	42546	A	R	I	A	B	L
15	30	21017	77777	E	,	△	77	77	77
16	0	0	0	-	-	-	-	-	-
17	0	0	0	-	-	-	-	-	-
20	0	0	0	-	-	-	-	-	-
21	21	01315	14646	,	△	F	O	L	L
22	51	71650	17151	O	W	S	△	W	O
23	54	27210	16624	R	D	,	△	T	A
24	52	30227	77777	P	E	.	77	77	77
	CA	PW25							

Printout #37

	IA	PX							
0	40	PX1	23						
1	34	50702	44634	I	N	V	A	L	I
2	27	01662	45230	D	△	T	A	P	E
3	01	50674	72530	△	N	U	M	B	E
4	54	23015	43065	R	;	△	R	E	S
5	66	01513	10165	T	△	O	F	△	S
6	30	50663	05026	E	N	T	E	N	C
7	30	01505	16601	E	△	N	O	T	△
10	26	33302	64530	C	H	E	C	K	E
11	27	22010	10124	D	.	△	△	△	A
12	65	65674	73027	S	S	U	M	E	D
13	01	26515	06566	△	C	O	N	S	T
14	24	50662	10177	A	N	T	,	△	77
15	0	0	0	-	-	-	-	-	-
16	0	0	0	-	-	-	-	-	-
17	0	0	0	-	-	-	-	-	-
20	21	01315	14646	,	△	F	O	L	L
21	51	71650	17151	O	W	S	△	W	O
22	54	27210	16624	R	D	,	△	T	A
23	52	30227	77777	P	E	.	77	77	77
	CA	PX24							

	IA	PY								
0	40	PY1	23							Printout #38
1	51	52305	00152	O	P	E	N	△	P	
2	24	54305	06633	A	R	E	N	T	H	
3	30	65346	50131	E	S	I	S	△	F	
4	51	46465	17165	O	L	L	O	W	S	
5	01	66245	23001	△	T	A	P	E	△	
6	27	30653	43250	D	E	S	I	G	N	
7	24	66345	15022	A	T	I	O	N	.	
10	01	65335	16746	△	S	H	O	U	L	
11	27	01253	00177	D	△	B	E	△	77	
12	26	51474	72401	C	O	M	M	A	△	
13	51	54013	05027	O	R	△	E	N	D	
14	01	51310	16530	△	O	F	△	S	E	
15	50	66305	02630	N	T	E	N	C	E	
16	01	65734	72551	△	S	Y	M	B	O	
17	46	22015	43065	L	.	△	R	E	S	
20	66	01513	10165	T	△	O	F	△	S	
21	30	50663	05026	E	N	T	E	N	C	
22	30	01675	02633	E	△	U	N	C	H	
23	30	26453	02722	E	C	K	E	D	.	
24	40	PY25	23							Printout #39
25	26	46516	53001	C	L	O	S	E	△	
26	52	24543	05066	P	A	R	E	N	T	
27	33	30653	46501	H	E	S	I	S	△	
30	31	51464	65171	F	O	L	L	O	W	
31	65	01662	45230	S	△	T	A	P	E	
32	01	27306	53432	△	D	E	S	I	G	
33	50	24663	45150	N	A	T	I	O	N	
34	22	01653	35167	.	△	S	H	O	U	
35	46	27012	53001	L	D	△	B	E	△	
36	26	51474	72401	C	O	M	M	A	△	
37	51	54013	05027	O	R	△	E	N	D	
40	01	51310	16530	△	O	F	△	S	E	
41	50	66305	02630	N	T	E	N	C	E	
42	01	65734	72551	△	S	Y	M	B	O	
43	46	22015	43065	L	.	△	R	E	S	
44	66	01513	10165	T	△	O	F	△	S	
45	30	50663	05026	E	N	T	E	N	C	
46	30	01675	02633	E	△	U	N	C	H	
47	30	26453	02722	E	C	K	E	D	.	
	CA	PY50								

	IA	PZ								
0	40	PZ1	23							Printout #40
1	26	51474	72401	C	O	M	M	A	Δ	
2	51	54013	05027	O	R	Δ	E	N	D	
3	01	51310	16530	Δ	O	F	Δ	S	E	
4	50	66305	02630	N	T	E	N	C	E	
5	01	65734	72551	Δ	S	Y	M	B	O	
6	46	01473	46565	L	Δ	M	I	S	S	
7	34	50322	20166	I	N	G	.	Δ	T	
10	24	52300	16573	A	P	E	Δ	S	Y	
11	47	25514	60131	M	B	O	L	Δ	F	
12	51	46465	17130	O	L	L	O	W	E	
13	27	01257	30177	D	Δ	B	Y	Δ	77	
14	0	0	0	-	-	-	-	-	-	
15	0	0	0	-	-	-	-	-	-	
16	0	0	0	-	-	-	-	-	-	
17	22	01543	06566	.	Δ	R	E	S	T	
20	01	51310	16530	Δ	O	F	Δ	S	E	
21	50	66305	02630	N	T	E	N	C	E	
22	01	67502	63330	Δ	U	N	C	H	E	
23	26	45302	72277	C	K	E	D	.	77	
	CA	PZ24								

	IA	SA								
0	40	SA1	15							Printout #41
1	65	30506	63050	S	E	N	T	E	N	
2	26	30015	05166	C	E	△	N	O	T	
3	01	26333	02645	△	C	H	E	C	K	
4	30	27012	53073	E	D	△	B	E	Y	
5	51	50270	16624	O	N	D	△	T	A	
6	52	30012	73065	P	E	△	D	E	S	
7	34	32502	46634	I	G	N	A	T	I	
10	51	50012	53026	O	N	△	B	E	C	
11	24	67653	00151	A	U	S	E	△	O	
12	31	01525	43026	F	△	P	R	E	C	
13	30	27345	03201	E	D	I	N	G	△	
14	30	54545	15465	E	R	R	O	R	S	
15	22	77777	77777	.	77	77	77	77	77	
16	40	SA17	23							Printout #42
17	71	24545	03450	W	A	R	N	I	N	
20	32	21010	12646	G	,	△	△	C	L	
21	51	65300	15224	O	S	E	△	P	A	
22	54	30506	63330	R	E	N	T	H	E	
23	65	34650	17134	S	I	S	△	W	I	
24	66	33516	76601	T	H	O	U	T	△	
25	26	51545	43065	C	O	R	R	E	S	
26	52	51502	73450	P	O	N	D	I	N	
27	32	01010	10151	G	△	△	△	△	O	
30	52	30500	13151	P	E	N	△	F	O	
31	46	46517	16501	L	L	O	W	S	△	
32	66	24523	00127	T	A	P	E	△	D	
33	30	65343	25024	E	S	I	G	N	A	
34	66	34515	02201	T	I	O	N	.	△	
35	54	30656	60151	R	E	S	T	△	O	
36	31	01653	05066	F	△	S	E	N	T	
37	30	50263	00134	E	N	C	E	△	I	
40	32	50515	43027	G	N	O	R	E	D	
41	22	77777	77777	.	77	77	77	77	77	
	CA	SA42								

	IA	SB								
0	40	SB1	35							Printout #43
1	71	24545	03450	W	A	R	N	I	N	
2	32	21010	16624	G	,	△	△	T	A	
3	52	30012	73065	P	E	△	D	E	S	
4	34	32502	46634	I	G	N	A	T	I	
5	51	50016	53026	O	N	△	S	E	C	
6	66	34515	00165	T	I	O	N	△	S	
7	30	51674	62701	H	O	U	L	D	△	
10	25	30013	15146	B	E	△	F	O	L	
11	46	51713	02701	L	O	W	E	D	△	
12	25	73016	63330	B	Y	△	T	H	E	
13	01	30502	70151	△	E	N	D	△	O	
14	31	01653	05066	F	△	S	E	N	T	
15	30	50263	00165	E	N	C	E	△	S	
16	73	47255	14601	Y	M	B	O	L	△	
17	51	54012	45001	O	R	△	A	N	△	
20	51	52305	00133	O	P	E	N	△	H	
21	30	24273	45032	E	A	D	I	N	G	
22	01	52245	43050	△	P	A	R	E	N	
23	66	33306	53465	T	H	E	S	I	S	
24	21	34506	56630	,	I	N	S	T	E	
25	24	27015	13101	A	D	△	O	F	△	
26	0	0	0	-	-	-	-	-	-	
27	0	0	0	-	-	-	-	-	-	
30	0	0	0	-	-	-	-	-	-	
31	22	01543	06566	.	△	R	E	S	T	
32	01	51310	16530	△	O	F	△	S	E	
33	50	66305	02630	N	T	E	N	C	E	
34	01	34325	05154	△	I	G	N	O	R	
35	30	27227	77777	E	D	.	77	77	77	
	CA	SB36								

	IA	SC								
0	40	SC1	23							Printout #44
1	71	24545	03450	W	A	R	N	I	N	
2	32	21010	12646	G	,	△	△	C	L	
3	51	65300	15224	O	S	E	△	P	A	
4	54	30506	63330	R	E	N	T	H	E	
5	65	34650	17134	S	I	S	△	W	I	
6	66	33516	76601	T	H	O	U	T	△	
7	26	51545	43065	C	O	R	R	E	S	
10	52	51502	73450	P	O	N	D	I	N	
11	32	01010	10151	G	△	△	△	△	O	
12	52	30500	12452	P	E	N	△	A	P	
13	52	30245	46501	P	E	A	R	S	△	
14	24	47515	03201	A	M	O	N	G	△	
15	26	51466	74750	C	O	L	U	M	N	
16	01	33302	42734	△	H	E	A	D	I	
17	50	32652	20154	N	G	S	.	△	R	
20	30	65660	15131	E	S	T	△	O	F	
21	01	65305	06630	△	S	E	N	T	E	
22	50	26300	13432	N	C	E	△	I	G	
23	50	51543	02722	N	O	R	E	D	.	
	CA	SC24								

	IA	SD								
0	40	SD1	35							Printout #45
1	71	24545	03450	W	A	R	N	I	N	
2	32	21010	15254	G	,	△	△	P	R	
3	30	26302	73450	E	C	E	D	I	N	
4	32	01265	14667	G	△	C	O	L	U	
5	47	50013	33024	M	N	△	H	E	A	
6	27	34503	20165	D	I	N	G	△	S	
7	33	51674	62701	H	O	U	L	D	△	
10	25	30013	15146	B	E	△	F	O	L	
11	46	51713	02701	L	O	W	E	D	△	
12	25	73015	15230	B	Y	△	O	P	E	
13	50	01265	14667	N	△	C	O	L	U	
14	47	50013	33024	M	N	△	H	E	A	
15	27	34503	20152	D	I	N	G	△	P	
16	24	54305	06633	A	R	E	N	T	H	
17	30	65346	50151	E	S	I	S	△	O	
20	54	01305	02701	R	△	E	N	D	△	
21	51	31016	53050	O	F	△	S	E	N	
22	66	30502	63001	T	E	N	C	E	△	
23	65	73472	55146	S	Y	M	B	O	L	
24	21	34506	56630	,	I	N	S	T	E	
25	24	27015	13101	A	D	△	O	F	△	
26	0	0	0	-	-	-	-	-	-	
27	0	0	0	-	-	-	-	-	-	
30	0	0	0	-	-	-	-	-	-	
31	22	01543	06566	.	△	R	E	S	T	
32	01	51310	16530	△	O	F	△	S	E	
33	50	66305	02630	N	T	E	N	C	E	
34	01	34325	05154	△	I	G	N	O	R	
35	30	27227	77777	E	D	.	77	77	77	
	CA	SD36								

	IA	SE								
0	40	SE1	15							Printout #46
1	71	24545	03450	W	A	R	N	I	N	
2	32	21010	13050	G	,	△	△	E	N	
3	27	01513	10165	D	△	O	F	△	S	
4	30	50663	05026	E	N	T	E	N	C	
5	30	01657	34725	E	△	S	Y	M	B	
6	51	46013	45001	O	L	△	I	N	△	
7	26	51466	74750	C	O	L	U	M	N	
10	01	33302	42734	△	H	E	A	D	I	
11	50	32220	10154	N	G	.	△	△	R	
12	30	65660	15131	E	S	T	△	O	F	
13	01	65305	06630	△	S	E	N	T	E	
14	50	26300	13432	N	C	E	△	I	G	
15	50	51543	02722	N	O	R	E	D	.	
16	40	SE17	22							Printout #47
17	71	24545	03450	W	A	R	N	I	N	
20	32	21010	12427	G	,	△	△	A	D	
21	44	24263	05066	J	A	C	E	N	T	
22	01	26465	16530	△	C	L	O	S	E	
23	01	52245	43050	△	P	A	R	E	N	
24	66	33306	53065	T	H	E	S	E	S	
25	01	24525	23024	△	A	P	P	E	A	
26	54	01665	10125	R	△	T	O	△	B	
27	30	01010	10147	E	△	△	△	△	M	
30	34	65653	45032	I	S	S	I	N	G	
31	01	31514	64651	△	F	O	L	L	O	
32	71	34503	20166	W	I	N	G	△	T	
33	34	66463	02201	I	T	L	E	.	△	
34	54	30656	60151	R	E	S	T	△	O	
35	31	01653	05066	F	△	S	E	N	T	
36	30	50263	00134	E	N	C	E	△	I	
37	32	50515	43027	G	N	O	R	E	D	
40	22	77777	77777	.	77	77	77	77	77	
	CA	SE41								

	IA	SF								
0	40	SF1	21							Printout #48
1	71	24545	03450	W	A	R	N	I	N	
2	32	21010	12646	G	,	△	△	C	L	
3	51	65300	15224	O	S	E	△	P	A	
4	54	30506	63330	R	E	N	T	H	E	
5	65	34650	17134	S	I	S	△	W	I	
6	66	33516	76601	T	H	O	U	T	△	
7	26	51545	43065	C	O	R	R	E	S	
10	52	51502	73450	P	O	N	D	I	N	
11	32	01010	10151	G	△	△	△	△	O	
12	52	30500	13151	P	E	N	△	F	O	
13	46	46517	16501	L	L	O	W	S	△	
14	66	34664	63022	T	I	T	L	E	.	
15	01	54306	56601	△	R	E	S	T	△	
16	51	31016	53050	O	F	△	S	E	N	
17	66	30502	63001	T	E	N	C	E	△	
20	34	32505	15430	I	G	N	O	R	E	
21	27	22777	77777	D	.	77	77	77	77	
22	40	SF23	34							Printout #49
23	71	24545	03450	W	A	R	N	I	N	
24	32	21010	16634	G	,	△	△	T	I	
25	66	46300	16530	T	L	E	△	S	E	
26	26	66345	15001	C	T	I	O	N	△	
27	65	33516	74627	S	H	O	U	L	D	
30	01	25300	13151	△	B	E	△	F	O	
31	46	46517	13027	L	L	O	W	E	D	
32	01	25730	13050	△	B	Y	△	E	N	
33	27	01513	10165	D	△	O	F	△	S	
34	30	50663	05026	E	N	T	E	N	C	
35	30	01657	34725	E	△	S	Y	M	B	
36	51	46015	15401	O	L	△	O	R	△	
37	51	52305	00126	O	P	E	N	△	C	
40	51	46674	75001	O	L	U	M	N	△	
41	33	30242	73450	H	E	A	D	I	N	
42	32	01522	45430	G	△	P	A	R	E	
43	50	66333	06534	N	T	H	E	S	I	
44	65	21013	45065	S	,	△	I	N	S	
45	66	30242	70101	T	E	A	D	△	△	
46	51	31017	77777	O	F	△	77	77	77	
47	0	0	0	-	-	-	-	-	-	
50	0	0	0	-	-	-	-	-	-	
51	0	0	0	-	-	-	-	-	-	
52	22	01543	06566	.	△	R	E	S	T	
53	01	51310	16530	△	O	F	△	S	E	
54	50	66305	02630	N	T	E	N	C	E	
55	01	34325	05154	△	I	G	N	O	R	
56	30	27227	77777	E	D	.	77	77	77	
	CA	SF57								

	IA	SG									
0	40	SG1	14								Printout #50
1	71	24545	03450	W	A	R	N	I	N		
2	32	21010	13050	G	,	△	△	E	N		
3	27	01513	10165	D	△	O	F	△	S		
4	30	50663	05026	E	N	T	E	N	C		
5	30	01657	34725	E	△	S	Y	M	B		
6	51	46013	45001	O	L	△	I	N	△		
7	66	34664	63022	T	I	T	L	E	.		
10	01	54306	56601	△	R	E	S	T	△		
11	51	31010	10165	O	F	△	△	S	△		
12	30	50663	05026	E	N	T	E	N	C		
13	30	01343	25051	E	△	I	G	N	O		
14	54	30272	27777	R	E	D	.	77	77		
15	40	SG16	21								Printout #51
16	47	51543	00166	M	O	R	E	△	T		
17	33	24500	13134	H	A	N	△	F	I		
20	70	30017	02454	V	E	△	V	A	R		
21	34	24254	63065	I	A	B	L	E	S		
22	01	66510	12530	△	T	O	△	B	E		
23	01	46346	56630	△	L	I	S	T	E		
24	27	22017	02454	D	.	△	V	A	R		
25	34	24254	63065	I	A	B	L	E	S		
26	01	01010	10131	△	△	△	△	△	F		
27	51	46465	17134	O	L	L	O	W	I		
30	50	32017	77777	N	G	△	77	77	77		
31	0	0	0	-	-	-	-	-	-		
32	0	0	0	-	-	-	-	-	-		
33	0	0	0	-	-	-	-	-	-		
34	01	50516	60126	△	N	O	T	△	C		
35	33	30264	53027	H	E	C	K	E	D		
36	22	77777	77777	.	77	77	77	77	77		
	CA	SG37									

	IA	SH								
0	40	SH1	13							Printout #52
1	71	24545	03450	W	A	R	N	I	N	
2	32	21010	14751	G	,	△	△	M	O	
3	54	30012	65146	R	E	△	C	O	L	
4	67	47500	13330	U	M	N	△	H	E	
5	24	27345	03265	A	D	I	N	G	S	
6	01	66332	45001	△	T	H	A	N	△	
7	70	24543	42425	V	A	R	I	A	B	
10	46	30652	20130	L	E	S	.	△	E	
11	72	26306	56501	X	C	E	S	S	△	
12	27	30463	06630	D	E	L	E	T	E	
13	27	22777	77777	D	.	77	77	77	77	
14	40	SH15	22							Printout #53
15	71	24545	03450	W	A	R	N	I	N	
16	32	21010	14751	G	,	△	△	M	O	
17	54	30016	63324	R	E	△	T	H	A	
20	50	01050	60126	N	△	2	3	△	C	
21	33	24542	42666	H	A	R	A	C	T	
22	30	54650	13450	E	R	S	△	I	N	
23	01	70245	43424	△	V	A	R	I	A	
24	25	46300	15024	B	L	E	△	N	A	
25	47	30220	10130	M	E	.	△	△	E	
26	72	26306	56501	X	C	E	S	S	△	
27	27	30463	06630	D	E	L	E	T	E	
30	27	01463	02470	D	△	L	E	A	V	
31	34	50320	17777	I	N	G	△	77	77	
32	0	0	0	-	-	-	-	-	-	
33	0	0	0	-	-	-	-	-	-	
34	0	0	0	-	-	-	-	-	-	
35	0	0	0	-	-	-	-	-	-	
36	43	22777	77777	)	.	77	77	77	77	
	CA	SH37								

	IA	SI									
0	40	SI1	22								Warning #54
1	71	24545	03450	W	A	R	N	I	N		
2	32	21010	14751	G	,	△	△	M	O		
3	54	30016	63324	R	E	△	T	H	A		
4	50	01050	60126	N	△	2	3	△	C		
5	33	24542	42666	H	A	R	A	C	T		
6	30	54650	13450	E	R	S	△	I	N		
7	01	26514	66747	△	C	O	L	U	M		
10	50	01333	02427	N	△	H	E	A	D		
11	34	50322	20130	I	N	G	.	△	E		
12	72	26306	56501	X	C	E	S	S	△		
13	27	30463	06630	D	E	L	E	T	E		
14	27	01463	02470	D	△	L	E	A	V		
15	34	50320	17777	I	N	G	△	77	77		
16	0	0	0	-	-	-	-	-	-		
17	0	0	0	-	-	-	-	-	-		
20	0	0	0	-	-	-	-	-	-		
21	0	0	0	-	-	-	-	-	-		
22	43	22777	77777	)	.	77	77	77	77		
	CA	SI23									

Warning #55

	IA	SK							
0	40	SK1	41						
1	71	24545	03450	W	A	R	N	I	N
2	32	21010	14751	G	,	Δ	Δ	M	O
3	54	30016	63324	R	E	Δ	T	H	A
4	50	01040	41401	N	Δ	1	1	9	Δ
5	26	33245	42426	C	H	A	R	A	C
6	66	30546	50134	T	E	R	S	Δ	I
7	50	01663	46646	N	Δ	T	I	T	L
10	30	22013	07226	E	.	Δ	E	X	C
11	30	65650	10127	E	S	S	Δ	Δ	D
12	30	46306	63027	E	L	E	T	E	D
13	01	46302	47034	Δ	L	E	A	V	I
14	50	32017	77777	N	G	Δ	77	77	77
15	0	0	0	-	-	-	-	-	-
16	0	0	0	-	-	-	-	-	-
17	0	0	0	-	-	-	-	-	-
20	0	0	0	-	-	-	-	-	-
21	0	0	0	-	-	-	-	-	-
22	0	0	0	-	-	-	-	-	-
23	0	0	0	-	-	-	-	-	-
24	0	0	0	-	-	-	-	-	-
25	0	0	0	-	-	-	-	-	-
26	0	0	0	-	-	-	-	-	-
27	0	0	0	-	-	-	-	-	-
30	0	0	0	-	-	-	-	-	-
31	0	0	0	-	-	-	-	-	-
32	0	0	0	-	-	-	-	-	-
33	0	0	0	-	-	-	-	-	-
34	0	0	0	-	-	-	-	-	-
35	0	0	0	-	-	-	-	-	-
36	0	0	0	-	-	-	-	-	-
37	0	0	0	-	-	-	-	-	-
40	0	0	0	-	-	-	-	-	-
41	43	22777	77777	)	.	77	77	77	77
	CA	SK42							

	IA	SL								
0	40	SL1	20							Alarm #56
1	34	50702	44634	I	N	V	A	L	I	
2	27	01662	45230	D	△	T	A	P	E	
3	01	27306	53432	△	D	E	S	I	G	
4	50	24663	45150	N	A	T	I	O	N	
5	22	01662	45230	.	△	T	A	P	E	
6	01	50674	72530	△	N	U	M	B	E	
7	54	01040	15051	R	△	1	△	N	O	
10	66	01244	64651	T	△	A	L	L	O	
11	71	30270	10124	W	E	D	△	△	A	
12	65	01516	76652	S	△	O	U	T	P	
13	67	66016	62452	U	T	△	T	A	P	
14	30	22015	43065	E	.	△	R	E	S	
15	66	01513	10165	T	△	O	F	△	S	
16	30	50663	05026	E	N	T	E	N	C	
17	30	01343	25051	E	△	I	G	N	O	
20	54	30272	27777	R	E	D	.	77	77	
21	40	SL22	15							Alarm #57
22	66	51510	14724	T	O	O	△	M	A	
23	50	73012	73431	N	Y	△	D	I	F	
24	31	30543	05066	F	E	R	E	N	T	
25	01	66245	23001	△	T	A	P	E	△	
26	27	30653	43250	D	E	S	I	G	N	
27	24	66345	15065	A	T	I	O	N	S	
30	01	24475	15032	△	A	M	O	N	G	
31	01	46346	56601	△	L	I	S	T	△	
32	01	01010	10165	△	△	△	△	△	S	
33	30	50663	05026	E	N	T	E	N	C	
34	30	65015	13101	E	S	△	O	F	△	
35	52	54512	54630	P	R	O	B	L	E	
36	47	22777	77777	M	.	77	77	77	77	
37	CA	SL37								

Explanation of Indicators, Counters, Temporaries, etc.

LY0	Index counter (C_1) -(# subscripts)
1	Avail. add. in assem. blk. ("u" & "v")
2	Avail. add. in hdg. list.
3	Temp. or add. for 1st col. hdg. in hdg. list - 1
4	Indicator 1st var.
	00 ←fl. pt. ind. / 40 ←fix pt. ind. | char. count
5	Indicator 2nd var.
6	Indicator 3rd var.
7	Indicator 4th var.
10	Indicator 5th var.
11	Index counter (C_2) - (#char. in assem. blk. word)
12	Index counter (C_3)
13	Heading indicator (1st bit = 1 $\Longrightarrow$ col. hdg. present; 2nd bit = 1 $\Longrightarrow$ title present)
14	Col. hdg. count
15	Char. count (v) or string-out count ("u" & "v")
16	Current variable XS3 symbol
17	
20	
21	
22	
23	
24	
25	
26	
27	
30	
31	Assembly Block (25_8)
32	
33	
34	
35	
36	
37	
40	
41	
42	
43	
44	Parenthesis level
45	Count of subscripts processed
46	Subscript parenthesis level
47	Function parent. level (subs. var. within subs.)
50	Function symbol or subs. var. within subscript sym.

PRINT STRING-OUT

Print string-out uses three lines of GN (Get Next Character Routine) with the following understanding concerning their function. GN2 holds the buffer input VK address in u and v of the line from which the last character has been obtained. GN3 holds the shift that has been needed to extract the last character. It will vary from 6 to 44_8. GN6 holds the number of the blockette from which the last character has been obtained. This number varies from 0 to 5 for the 6 blockettes of the block of input data.

When the Print Routine has been entered from CT, Control Routine, the divider following PRINT is the last character. It should be a space, but whatever it is, it is not included in the group of XS3 codes stored in the output for later conversion and printing.

The current line containing the last character is replaced by a line in which 77's replace all characters already obtained from it. GN3 is used to make up the masking QS instruction to secure this replacement.

The current blockette is examined from the last line backward to find the last line in the blockette which is not a line of spaces. From the address of this line is subtracted the address of the current line to get the number of lines of print data to be transferred to the buffer region output, VN. A search for $\triangle$. is made of the last two lines in the blockette that are not lines of spaces. If a $\triangle$. is found, the Print String-out is terminated. If it is not found, the first line of the next blockette is examined. If this is a line of spaces, all lines from the second on to the last line of the blockette which is not a line of spaces are transferred to the output. IF this next blockette first line is not a line of spaces, it is assumed to be a line number, and this causes a termination of the Print String-out.

Continuing in this manner, each blockette is successively examined until a $\triangle$ .is found as indicated, or until a line number is found in the following blockette. However, if or when print data in 6 blockettes has been transferred to output, the routine is automatically terminated.

When the routine is terminated, GN2 is set to the address of the first line of the blockette following the last one from which data has been transferred.

GN6 is given the proper number of this blockette. The exit to the Control Routine eventually puts future analysis in the Get Next Sentence Routine. This routine checks GN2 against a set of addresses of blockette first lines and if an equality is found, gets the next sentence from the blockette in which the address in GN2 is found. Otherwise, if no equality is found, the Get Next Sentence Routine gets the next sentence from the following blockette. Following a print instruction, of course, such an equality is always found.

When blockette 5, the last of 6 in the block, is one of the group examined, a new block of data is read in by the routine and GN2 and GN6 reset as needed.

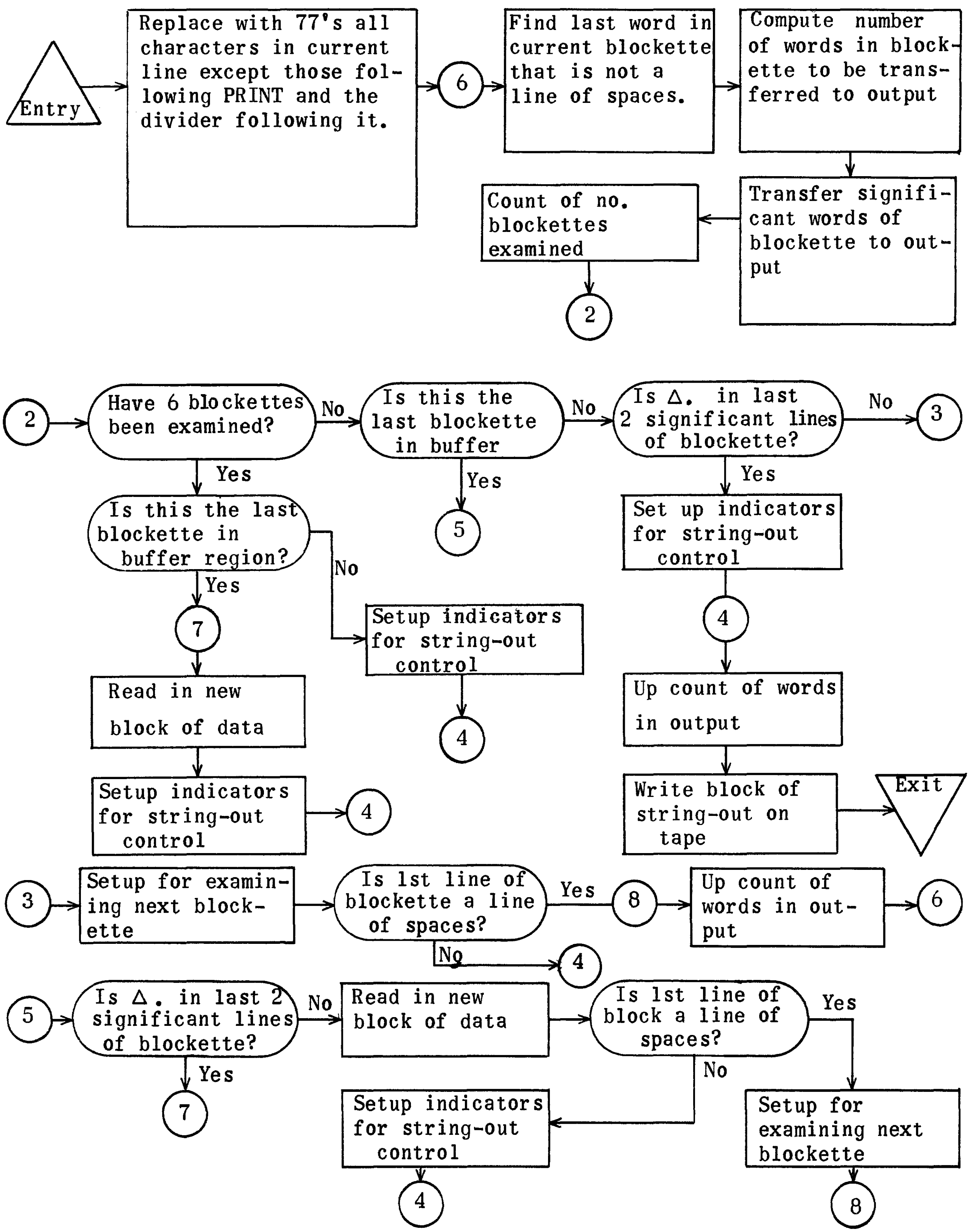
When a print instruction is set on the Unityper, a line number goes in the first 6 places on the first Unityper line. The tab key should be set and used for all runover lines so that a hanging indention of 6 spaces starts each runover line. Failure to do so will cause a premature termination of the Print String-out and an error print-out originating from a string-out subroutine.

Preferably words should be set right out to the end of any one Unityper line without any excess spacing. No hyphens should be used to break words at the end. If all of a word does not go in one line, as many letters as possible should be put on the top line and the remaining letters should start on the 7th position following the 6 spaces in the runover line.

However, the routine does not require such close typing right out to the end preceding a runover. Much of the excess spacing that might be put in by ragged indentions on the right is eliminated by the routine. As much as 5 spaces may be left to occur in the print-out by the present system of assembling data from blockettes. If excess spacing is left starting from the 7th position on, or if excess spacing is left between words in a line, such excess will be fully duplicated in the final print-out.

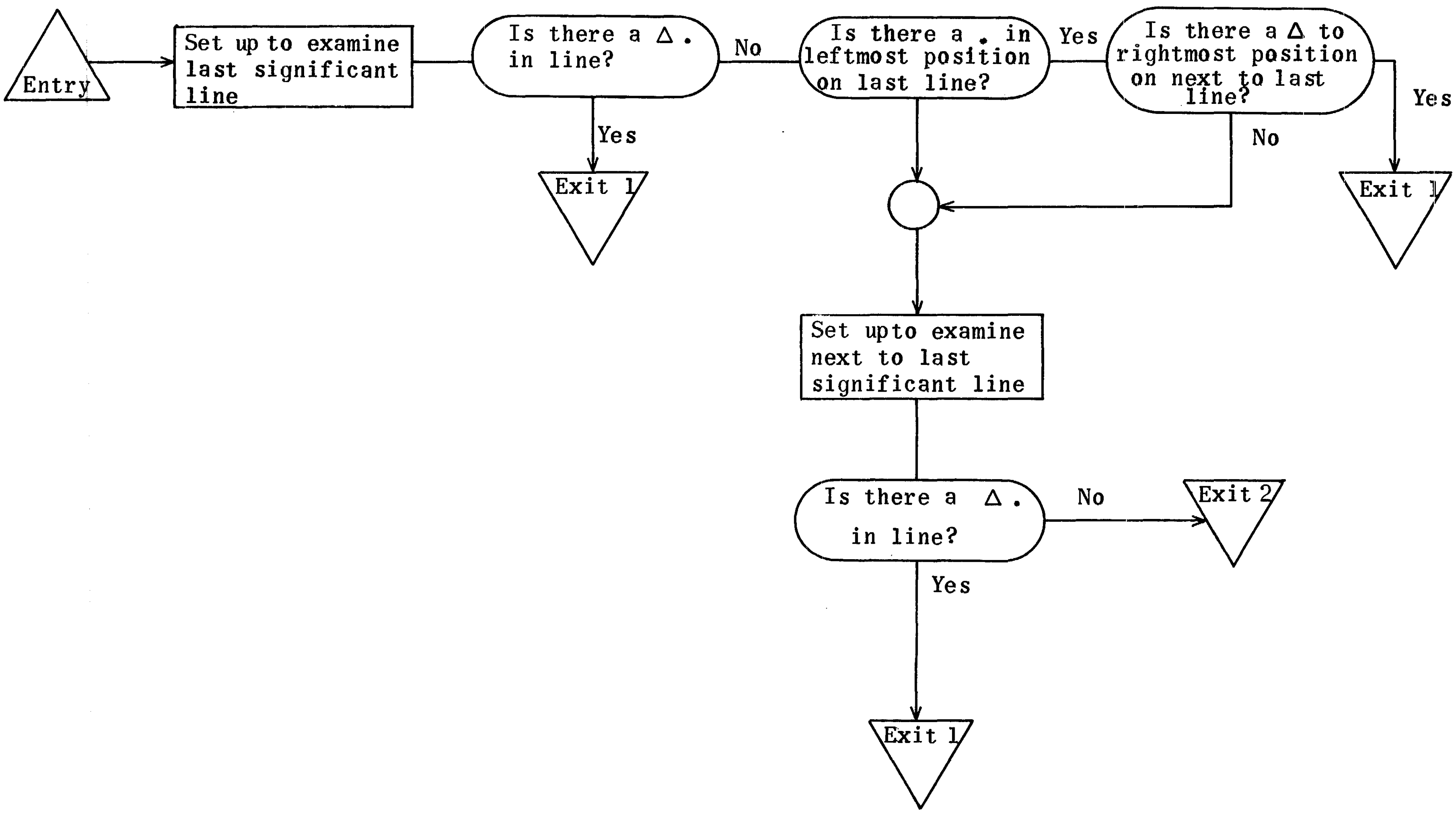
Δ .'s, as explained, when occurring in the last two non-space-filler words in a Unityper line or blockette, have the same effect of ending a sentence as in the rest of UNICODE. However, their use elsewhere in the print-out data does not have this effect because this data is not examined symbol by symbol. The blanket rule of eliminating Δ.'s, except at the end of a sentence, prevents possible confusion concerning their use. Likewise, they may be eliminated from the end of a Print instruction since a following line number in the next blockette serves the same purpose of termination. However, their inclusion at the end speeds up the program.

Flow Chart for PRINT String-Out Routine Page 1 of 2



Flow Chart for PRINT String-Out Routine-Cont. Page 2 of 2

Flow Chart for Subroutine that looks for Δ . in Two Lines



PRINT STRING-OUT REGIONS

```
RE VN3507
RE WT3207
RE VK3317      String-out subroutine
RE GT21        regions used.
RE GN1324
RE CT714

RE PS4400
RE TZ4445
RE HT4477
RE NR4527
RE VR4551
RE BB4562
RE ZP4605
RE WP4631
```

		IA	PS		
	0	MJ	0	CT	Exit
	1	TV	GN2	PS7	Current address to v of PS7
	2	TP	GN3	A	Shift$_6$ → A
	3	DV	ZP	A	
	4	SA	BB16	17	
	5	TU	A	PS6	Getting proper mask into Q
	6	TP	30000	Q	
	7	QS	ZP23	30000	Replacing current line with 77^s and any characters other than divider to be printed
	10	TP	ZP6	WP5	Clearing counter of blockettes used
	11	TP	ZP14	WP6	Number of lines accumulated (4) to line accumulative counter
	12	TP	GN6	A	Blockette count to A
	13	SA	BB15	17	Getting address of address of last line
	14	TU	A	PS15	of current blockette to u of PS15
	15	SP	30000	17	
	16	TU	A	PS17	Getting address of last line of current blockette to u of PS17
Loop to find last line in a	17	TP	30000	A	Contents of last line of current blockette to A
blockette that	20	EJ	ZP2	PS22	Is it a line of spaces?
is not a line	21	MJ	0	PS24	
of spaces.	22	RS	PS17	ZP3	Reducing u of PS17 by one
	23	MJ	0	PS17	
	24	TU	PS17	WP1	Address of last significant line in a
Computation of	25	LQ	WP1	25	blockette to WP1.
number of lines	26	QT	ZP4	WP1	
to be trans-	27	TV	GN2	WP2	
ferred to VN	30	TP	ZP4	Q	Current address to v of WP2 and v of A
from VK block-	31	QT	WP2	WP2	
ette	32	TN	A	A	
	33	AT	WP1	A	Number of lines in blockette to be
	34	AT	ZP1	WP2	transferred to WP2
	35	LA	A17	17	Setting up u of PS43 so that right
	36	TU	A	PS43	number of lines will be transferred to
	37	RA	PS43	ZP12	output region
	40	TU	GN2	PS44	Setting up u of PS44 so transfer to VN can be started
	41	TV	WP6	PS44	Getting right address in VN to which
	42	RA	PS44	BB20	transfer of lines is to be made
	43	RP	30000	HT	Transfer of excess-three-coded lines of
	44	TP	30000	30000	print data to output region
		CA	PS45		
		IA	TZ		
	0	RA	WP6	WP2	Number of lines accumulated plus number of lines transferred from last blockette gives total accumulated in WP6 to date.
	1	TP	A	VN	Total number of lines in output to first line of output.

```
 2  RJ   WT      WT1     Getting output written on tape
 3  MJ   0       PS      Exit
 4  RJ   HT24    HT20    Getting new block read in and getting
                         GN6 reset to zero
 5  TP   VK      A    }  Is 1st line of new block a line of
 6  EJ   ZP2     TZ26 }  spaces? If not, it is assumed to be a
                         line number and print is terminated
 7  SP   BB      17   }
10  AT   BB      GN2  }  Putting 0 VK VK into GN2
11  MJ   0       TZ
12  RJ   TZ25    TZ17    Setting up GN to proper 1st line ad-
                         dress of next blockette
13  TU   GN2     TZ14 }  Is 1st line of blockette a line of
14  TP   30000   A    }  spaces? If not, it is assumed to be
15  EJ   ZP2     TZ27 }  a line number and print is terminated
16  MJ   0       TZ

Setting up GN2 to proper 1st line address of next blockette to be examined:
17  TP   GN6     A
20  SA   BB21    17      Getting address of address of 1st
                         line of current blockette to Au
21  TU   A       TZ23 }  Setting up u of next 2 instructions to
22  TU   A       TZ24 }  this address of address of 1st line.
23  SP   30000   17      Address of 1st line to Au
24  AT   30000   GN2     Address of 1st line to GN2 both in u
25  MJ   0       30000   and v

26  RJ   TZ25    TZ17 }  Setting up GN2 to proper 2d line ad-
27  RA   GN2     ZP15 }  dress of blockette to be examined
30  RA   WP6     WP2     Bringing up accumulative addition to
                         date of number of lines in output
31  MJ   0       PS12
    CA   TZ32


    IA   HT
 0  RA   WP5     ZP1     Counts no. blockettes used
 1  EJ   ZP      HT11    Have 6 blockettes been used?
 2  TP   GN6     A    }  Is this the last blockette in the
 3  EJ   ZP13    HT25 }  block?
 4  RA   GN6     ZP1     Adding one to ordinal number of
                         blockette to be checked
 5  TV   BB22    NR1     TZ12 to v of NR1
 6  RJ   NR      NR2     Check to see if Δ. is in last block-
                         ette in last 2 significant lines.
                         If not, return to TZ12.
 7  RJ   TZ25    TZ17    Setting up GN2 to proper 1st line
                         address of next blockette
10  MJ   0       TZ
11  TP   GN6     A    }  Is the current blockette No. 5 and
12  EJ   ZP13    HT16 }  hence the last one in block?
13  AT   ZP1     GN6     Increasing blockette number by one as
                         we go on to next
14  RJ   TZ25    TZ20    Setting up GN2 to address of 1st line
                         of blockette next to be examined by
                         String-out Control
```

```
                      15  MJ   0      TZ
                      16  RJ   HT24   HT20     Getting a new block of data in
                      17  MJ   0      TZ7
                     (20  TP   BB17   GT3  )   Reading in another block of data
                                           )   to VK
Getting new          (21  RA   13     ZP1  )   Keeping up count of number of blocks
block in.            (22  RJ   GT2    GT   )   read in by string-out
                     (23  TP   ZP6    GN6
                     (24  MJ   0      30000
                      25  TV   BB6    NR1      TZ4 to v of NR1
                      26  RJ   NR     NR2      Check for Δ . in last 2 significant
                                               lines in blockette.  (Goes to TZ4 if
                                               no Δ . is found)
                      27  MJ   0      HT16     Returns here if Δ . has been found
                          CA   HT30


                          IA   NR
                       0  MJ   0      30000    Exit if a Δ . is found
                       1  MJ   0      30000    Exit if no Δ . is found
                       2  SP   WP1    17   )   Address of last significant line of
                       3  TU   A      VR5  )   blockette is sent to u of VR5
                       4  RJ   VR10   VR       Check for Δ . in last significant
                                               line
                       5  TU   VR5    NR7  )
                       6  TP   ZP5    Q    )   Check for   . in leftmost position on
                       7  QT   30000  A    )   last line
                      10  EJ   ZP7    NR12 )
                      11  MJ   0      NR17
                      12  TU   VR5    NR15 )   Check for Δ in rightmost position
                      13  RS   NR15   ZP3  )   on next to last significant line
                      14  TP   ZP16   Q    )
                      15  QT   30000  A    )
                      16  EJ   ZP1    NR   )
                      17  RS   VR5    ZP3  )   Check for Δ . in next to last
                      20  RJ   VR10   VR   )   significant line
                      21  MJ   0      NR1
                          CA   NR22


                          IA   VR
                       0  TP   ZP14   WP       Index 4 to WP
                       1  TP   ZP10   WP4      Mask to WP4
                       2  TP   ZP11   WP3      Δ . to WP3
                      (3  LQ   WP3    6        Δ . shifted 6 places
                      (4  LQ   WP4    6        7777 shifted 6 places
Loop to               (5  QT   30000  A        Portion of line is masked out
locate Δ .            (6  EJ   WP3    NR       Is it equal to Δ . in shifted
                      (7  IJ   WP     VR3      position?
                      10  MJ   0      30000
                          CA   VR11
```

	IA	BB		
0	0	0	VK	
1	0	0	VK24	Address of beginning lines of
2	0	0	VK50	blockettes in input
3	0	0	VK74	
4	0	0	VK120	
5	0	0	VK144	
6	0	0	TZ4	
7	0	0	VK23	
10	0	0	VK47	
11	0	0	VK73	Addresses of last lines of blockettes
12	0	0	VK117	in input
13	0	0	VK143	
14	0	0	VK167	
15	0	0	BB7	Address of address of last line of 1st blockette
16	0	0	ZP15	Used to help to get proper mask for changing 1st line of blockette that is to be printed
17	50	00105	VK	Parameter to use GT in reading in another block
20	0	0	VN	Address of 1st line of output
21	0	0	BB	Address of address of 1st line of 1st blockette
22	0	0	TZ12	
	CA	BB23		

	IA	ZP		
0	0	0	6	
1	0	0	1	
2	01	01010	10101	Line of spaces
3	0	1	0	
4	0	0	77777	Masks
5	77	0	0	
6	0	0	0	
7	22	0	0	Period
10	77	0	77	Mask
11	22	0	01	. 0 Δ
12	0	30000	0	
13	0	0	5	
14	0	0	4	Index
15	0	1	1	
16	0	0	77	
17	0	0	7777	
20	0	7	77777	Masks
21	0	777	77777	
22	0	77777	77777	
23	77	77777	77777	
	CA	ZP24		

Temporary Region - WP

0 Index for search for Δ.
1 Holds address of last significant line in blockette
2 Number of lines transferred per blockette
3 Holds Δ. shifted for comparison
4 Holds mask shifted
5 Counter for number of blockettes examined
6 Number of output lines - accumulative

IF STRING-OUT

There are two separate analyses in this routine - one of the first clause started by IF subroutine and the second of one or two succeeding clauses started in IU subroutine. Each of these control routines has in turn several subroutines which handle different facets of the string-out.

Examples of typical IF sentences are shown below:

24. If X < Y jump to sentence 7, if X > Y jump to sentence 74, if X = Y jump to sentence 32.5 Δ.

36. If X > = Y jump to sentence 65, if X < Y jump to sentence 44 Δ.

13.1 If X NOT = Y jump to sentence 2, if X = Y jump to sentence 36 Δ.

12. If X > Y jump to sentence 6, if X < = Y jump to sentence 52 Δ.

11. If X = Y jump to sentence 41, if X NOT = Y jump to sentence 31 Δ.

40.4 If X < Y jump to sentence 30, if X = Y jump to sentence 4 Δ.

76. If X = Y jump to sentence 50 Δ.

72.3 If X < = Y jump to sentence 42 Δ.

21.2 If X (i,j,k,l) > Y(i,j) jump to sentence 3, if X(i,j,k,l) < =Y (i,j) jump to sentence 5.2

Only one set of variables or constants is permitted in any one IF sentence. Each of the first five examples above exhausts all the possible relations between X and Y. No duplication of relations is permitted in separate clauses.

Throughout this write-up the set of variables or constants will be referred to as X and Y, X being the left-hand value and Y the value on the right of the relation symbol. In actual use, of course, X and Y may assume any and all of the combinations of letters and figures that constitute variables and constants. No distinction is made between X and Y. Restrictions on any one apply equally to the other.

X and Y may be numbers in scientific notation form. The latter ideally is a number in decimal form between 1 and 10 times a power of 10. Actually any number up to 12 decimal digits is permitted to be the left-hand member of a scientific notation number. Other variations taken care of by the program are revealed in the examples given below:

1.234 e 34

3.4567235641 * 10^{20}

6.8924 * 10 POW 29

9.67 * 10 POW ^{18}

8.3276 e -23

-5.298765 * 10 33

2.3678987654 * 10 -16

4.7 * 10^{-22}

3.56 * 10 -^{34}

-2.6784 e ¯39

-2.6784 e -39

-2.6784 e -^{39}

3.3786 * 10¯23

The asterisk, used as a multiplication sign in UNICODE, is the only binary operator permitted in the IF sentence, and it is only allowed in scientific notation. Note that the superior negative sign may be used in front of the power of 10 instead of the regular negative sign, but the superior sign may not be used in front of the left-hand member of a scientific notation number. Following an asterisk 10 must appear. The next number is assumed to be the power of 10 whether superior or lower-case. Following e (exponent) the next number occurring is assumed to be the power of 10.

Too high a value of exponent may give a floating-point number which is too large to represent. Ordinarily such a number would cause a machine fault and stop. A subroutine IQ is used in this connection to locate such discrepancies, avoid the machine-faulting stop, and give an error print-out. See separate write-up on this subroutine.

No expressions are allowed in the IF sentence. No plus signs are permitted. The absence of a negative sign indicates positive. Thus, some examples of what X and Y may *not* be are: $a + b$, $a - b$, a/b, $Z + a * b$, a^2, b^a, $a^{3/2}$.

If such evaluations are to be compared, they must be computed separately by other instructions first and then referred to in the IF sentence by the simple variable to which they have been equated.

In the following chart are given the relation symbols permitted by the IF routine. NOT, occurring in the second position of a symbol set, is not acceptable. Thus, NOT NOT is not acceptable, but other double-up relation symbols are interpreted as single symbols. For example, < < is taken as meaning <. If NOT occurs alone as a single relation, it is accepted without error reference with the print-out: (NOT) interpreted to mean (NOT EQUAL).

Preferred Form	Acceptable Variations			Code Figures Assigned to Relations
<	< <			2
=	= =			3
>	> >			4
< =	= <	NOT >		5
NOT =	<>	><	NOT	6
> =	= >	NOT <		7

The code figures assigned to these relations are used by the routine to check on non-duplication of relations and to facilitate the reversal of a relation symbol when needed. $6 - \{2,3,4\} = \{4,3,2\}$ and $12 - \{5,6,7\} = \{7,6,5\}$. This enables < to be changed to > and ≤ to ≥ , and vice versa. = is never changed to NOT =, and vice versa. A total of three single-relation code figures is always 9 when all possible relations of X and Y have been postulated and there is no duplication. Similarly, the total of a double-relation and a single-relation, non-duplicating symbol is 9.

The X and Y initially examined in the first clause form the set that is stored for later comparison in the running program. The sets of X and Y that appear in the second and third clauses are compared to the first set as a check on the validity of the sentence.

Ideally any set of X and Y should be repeated with the same order and with the same set of signs in the second and third clauses as it had in the first. If care is taken to do this, the routine operation is speeded up. However, failure to do this does not necessarily invalidate the sentence. If it can be done without changing the meaning, the program will reverse the relation symbol to correct altered order and signs. See section describing technical operation of JF for details on the theory back of relation-symbol reversal. An example of how it works is the following: Let $X < -Y$ be contained in the first clause and $-Y < X$ in the second clause. The routine interprets the latter as $X > -Y$, and stores the $>$ symbol in output.

If the second or third variable set cannot be equated to the initial set by a consistent sign change, an error print-out will occur. All that is stored from the second and third clauses of an IF sentence for use in the running program are the line numbers to which jumps are to be made and the relation code figure for the second test, if any.

No more than two tests are needed in a running program for an IF sentence. A third IF situation following two tests is always an unconditional jump. Similarly, if the first test is for a double relation, its failure makes a second IF hypothesis true, necessitating an unconditional jump, and vice versa. In the last situation VN6 and VN7 (the second test and line number storage) are left empty, VN10 gets the line number of the unconditional jump, and VN4 and VN5 take the first test code and line number, respectively. See attached sheet explaining output.

To return to additional specifications in writing X and Y, a <u>superior</u> minus sign is not permitted to indicate negative value of X or Y. If an absolute sign has already appeared, a negative sign following it will be ignored since the absolute sign negates its meaning. An absolute sign causes the indicator for such to be put into the proper line, regardless of the previous appearance of a negative sign.

An absolute sign appearing in front of a variable or constant applies only to that variable or constant. The absence of a closing absolute sign after the value is not noted. However, the appearance of a closing absolute sign causes a check to see if an open absolute sign has been recorded. If not, there is an error print-out.

Only a single value is stored for a function in UNICODE. The use of a variable function in an IF sentence presupposes its computation or read-in via a previous instruction. Hence arguments following a function, whether of constants or variables, are ignored both in analysis of the first clause and in analysis of the second and third clauses. Also differences between these superfluous arguments between clauses are not noted.

If either X or Y is a fixed-point variable, the other must be a fixed-point constant or fixed-point variable. If either X or Y is a floating-point variable, the other must be a floating-point number or variable. Based upon such considerations, the routine translates numbers to octal or floating point, gives them call words, and stores them in list CL.

If both X and Y are constants, they are sent to the subroutine IT, where an immediate comparison is made of them. If the test shows the relation true, the sentence is changed to a jump sentence and the string-out output modified accordingly. G_9 (see print-out schedule) alerts the operator to this decision without error reference.

If the test fails, a jump is made to the beginning of the IF routine and the remaining sentence clauses (if any) are processed as a separate IF sentence. This is the reason recognition of the IF symbol is built into the first part of IF string-out.

If specific sets of arrays of values of unknowns are to be compared, subscripted variables should be used. Up to four subscripts may be used for each variable. Subscripts in an IF sentence may not be expressions. However, a subscripted variable used for X or Y in the second or third clauses must agree in every particular with that used in the first clause. As an example, suppose "X(i,j,k) < Y(i,j,k,l)" is in the first clause; X(i,j,k) and Y(i,j,k,l) must also appear in the second and third clauses.

All print-outs include as a first element, Sentence______(IF), where the dash indicates a line number which will be typed out. Some print-outs merely give information on how the program has handled an unusual situation. These do not cause a reference to the error routine or termination of the IF string-out. Other print-outs are accompanied by an error reference but not termination. The more serious type includes both error-referencing and IF string-out termination. Some without built-in termination are used most of the time with external termination. In the attached chart of print-outs, subscripted G's are assigned for simplification of following technical description of the segments of the IF string-out.

Error Reference	Identification	Print-Out	Built-In If Termination
	G_1	Sentence_________(IF)	
✓	G_2	Inconsistent sign change	✓
	G_3	Symbol rejected________	
✓	G_4	Disallowable character in Exponent __________	
✓	G_5	Incorrectly written______*	
✓	G_6	Scientific notation incorrectly written	✓
✓	G_7	Open absolute sign missing	
	G_8	TO should follow jump	
	G_9	Becomes Unconditional Jump to Sentence_________	
✓	G_{10}	Space period occurs before sufficient data given	
✓	G_{11}	Comparison symbols ambiguous	✓
✓	G_{12}	Set of variables differs from initial set	✓
	G_{13}	(NOT) interpreted as (not equal)	
✓	G_{14}	Fixed and floating point values are not comparable	✓

*The symbol being examined when this print-out occurs is given here. It indicates how far in the sentence analysis has gone before external termination.

IF Control

IF subroutine is the control of analysis of the first clause of the IF sentence. It clears VN output lines (except for first four) and clears temporary storage lines VN71-121. See attached charts for explanation of data stored in these addresses. VN71-121 is used first to accumulate data on X. Then this data is transferred to VN40-70, leaving VN71-121 for use in accumulating data on Y.

The divider routine II is set up so that it can be entered only once without error during the first-clause analysis. The first two symbol output lines are sent to temporary storage. A pseudo-op indicator is put in VN33, if needed.

Recognition of , ; IF (causes a return to the SY referencing instruction that gets the next symbol. Δ . recognition sends analysis to the IK termination routine. If the symbol is a constant, control goes to IE. IG takes over for a fixed-point variable and IH assumes control for all other variables.

A character not identified causes print-out G_3 and then a return to get next symbol.

IK-- Δ. Termination

Zero value is checked for successively in VN5, VN4, VN14, and VN24. If found in any, print-out G_{10} ensues with termination. If not found, WT, the tape-write routine, is referenced to get completed data written on tape before return to CT, the String-out Control Routine.

From the analyses of the second or third clauses, an entry is made to IK14. The absence of zero in VN10 sends the routine to the loop mentioned above. If a zero is found in VN10, a check is made if VN34 equals 00 00003 00000. If yes, G_{10} occurs with termination. If no, VN7 and VN6 are successively examined for zero. If found, G_{10} occurs with termination. If not found, a jump is made to the loop of zero checking described above.

IE Constant Analysis

Reference is made to RB for checking validity of a constant. A constant indicator is stored in VN31 for X and VN32 for Y.

If the number of characters is > 6, the number is converted to floating point via proper subroutine. Also, a floating-point constant indicator is filled with 40 0 0. This is necessary because a floating-point number may be zero and its presence as such in regular floating-point location could not be recognized.

Either a superior or regular dash is permitted to indicate a negative sign following e or * in scientific notation. Failure of a figure to follow this sign causes G_6. 10 not following * causes G_6. 10 may not be a superior figure. After 10, there may be POW, but after this either a negative sign or figure must be next to avoid G_6.

An exponent is checked by RD subroutine. If superscript, it is sent to IN, the Superior to Lower-Case Translator, where G_4 may occur. See separate write-up on this subroutine.

The exponent is then converted to octal by use of RS subroutine and transferred to proper input line IQ2 either as a positive or negative number. After checking and conversion to floating point in IQ (see separate write-up), the number is changed to negative, if desired.

Failure to find an open absolute sign when a closed one has shown up causes G_7.

A relation symbol < , > , =, or NOT causes a jump to II subroutine. JUMP symbol sends control to IJ subroutine. Characters ( ) , ; initiate a return to beginning of loop to get next symbol. An unrecognized symbol causes G_3 without termination. This loop, starting at IE115, is used frequently as an exit by other subroutines.

IG--Fixed-Point Variable Analysis

After a reference to RH to check for validity of variable, the call word is obtained from TS if it is there, or from TA when it is in the Combination List. If the call word is not in the latter or the pseudo-op list, it is secured by adding 64000 to a number put in A by RJ tk tk1. It is then added to the combination list by using TF and TE. Explanation of uses of these routines is found in separate write-ups on each.

IH and IL--Floating-Point Variable Analysis

On entry to IH, two separate courses are taken, depending on whether the sentence is within a pseudo operation or not.

If a subscripted variable is identified, the modulus (the number of words stored for the variable) is assigned a call word, and this call word put in the u position of an output line. In the same word in the v position is put the number of subscripts.

The format of the data on a subscripted variable obtained from the combination list is as follows:

TA4	0	0	(call word)
TA5	0	(modulus)	(number of subscripts)
TA6	0	(2d subscript multiplier)	(1st subscript multiplier)
TA7	0	0	(3d subscript multiplier)

The proper multipliers for the subscripts of variables not in the pseudo-op list are obtained from region TA by means of a small subroutine entered via 2 one-shot RJ switches. The order of entry (only three for any set of subscripts) determines which multiplier is secured. The Constant call word assigned to it is then transferred to the u position of the output line. The v position of this line is later filled with the call word of the fixed-point variable or constant involved.

The call word of the pseudo-op subscripted variable is in the form 0 0 76ZRR where Z is the number of subscripts and RR the current pseudo-op variable number. Thus, if 3 single-valued variables have been assigned positions in the pseudo-op list, (0,1,2), RR will equal 3. The routine extracts the Z and sets up an index for processing the subscripts. To the extracted RR is added 63000. This number becomes the call word of the subscripted variable. The number of subscripts is added to 630RR to give a call word assigned to the modulus. The call words of the subscript multipliers start with (630RR + 1). As subscripts are encountered, they are supposed to have call words starting with (630RR + Z + 1). Below is given an example of pseudo-op input region for the case of three subscripts.

Assigned Call word

630RR	Subscripted variable
630RR + 1	I_M - 1st multiplier
630RR + 2	J_M - 2d multiplier
630RR + 3	Modulus
630RR + 4	Subscript 1
630RR + 5	Subscript 2
630RR + 6	Subscript 3

A subscripted variable in a pseudo operation may be a regular floating-point variable or pseudo-op variable. Whichever it is, it may have fixed-point variable subscripts located either in the pseudo-op list or combination list. If these subscripts are found in neither list, they are assigned call words in the 64000 range and put in the combination list. Note that if a subscript is a constant, it will not be in the pseudo-op list.

If a subscript of a subscripted variable fails to be either a constant or a fixed-point variable, G_5 occurs with termination.

When the call word of a nonsubscripted variable has been stored, it is examined to see if it is that of a function. If so, analysis goes to an IL exit subroutine in which any arguments that might be inadvertently put following the function are ignored. Exits and print-outs are the same as those in the IE exit subroutine. If the call word is not that of a function, the exit from IL is made via the IE exit subroutine.

II--Relation Symbol Analysis

No more than one entry can be made to this routine during an IF instruction. A second entry causes G_5 with termination. Failure to have a second relation symbol in the clause follow immediately after the first will create this error. A "NOT" occurring in the second position causes the same error termination.

The data gathered on X is transferred by this coding from VN71-121 to VN40-70 and the first region is cleared for succeeding data to be gathered on Y.

IJ--Jump Subroutine

Failure of the next symbol to be "TO" causes G_8 without error reference. A loop of symbol recognition similar to that used in the separate jump instruction string-out is included at the start. See the write-up on this routine. Failure to meet the specifications of the loop causes G_5 with termination. Getting the assumed line number into proper form terminates this first loop and may cause error print-outs explained in the line-number-routine write-up. Regardless of what happens in the line-number routine, its output is transferred to VN5 and the string-out continued. The referenced number is sent via IX routine to reference list IZ where it is later given a call word by other routines.

Variables or constants X and Y are compared in the second part of this subroutine. Combinations of floating-point and fixed-point values cause G_{14}.

Fixed-point numbers or those assumed to be such are not translated from excess-three decimal code until the analysis of this subroutine. Then they may be translated either to octal or floating point, depending upon the nature of the corresponding variable or constant.

VN11 to VN30 output lines are now filled with the data that has been gathered in the temporary storage regions.

The closing loop checks for parentheses, comma, semicolon, space period, and IF. G_5 ensues with termination if none occur. Recognition of IF sends the analysis to IU, the beginning control routine for analysis of the second clause.

IU--Second and Third Clause Control

The absolute sign indicators for X and Y are transferred to the temporary storage lines directly above the excess-three representation of X and Y, respectively. Thus 11 identifying lines on each of X and Y are in one location for future reference.

Exits from this control routine are IY, IY33, JB, and IK14, depending on whether X or Y is a constant, fixed-point variable, or floating-point variable, or whether Δ . has been encountered. Temporary storage region VN150-164 is cleared for gathering of data on X or Y. G_3 occurs without error reference for an unrecognized symbol.

IY--Number Analysis

This routine (the counterpart to IE) has similar checks on scientific notation. G_6 or G_{12} follow a misuse of the latter. Excess-three storage of data on X and Y is continued in it. The exit loop is in JB6-JB17 and is shared with variable subroutines. G_3 occurs if indicated following use of this loop.

JB--Floating-Point Variables

If a floating-point-variable symbol is not found in either the combination list or the pseudo-op list, it cannot be the same as any of the symbols encountered in the first clause. Hence G_{12} follows.

Excess-three representations of subscripts are stored in VN156-161.

The exit loop sends analysis to JC for a relation symbol, JF for a jump symbol, and IK14 for Δ. Additional errors and print-outs are similar to those of IH and IL.

JC--Relation Symbol Subroutine

Count and storage of excess-three relation symbols is the function of this routine. Also data on X is transferred to VN130-144, and region VN150-164 is cleared for use of Y data accumulation. If two relation symbols have been found, control is transferred to IU5 to get next symbol. Otherwise, the jump is made to IU6 since an unidentified symbol has still to be examined. G_5 followed by termination occurs if routine is referenced twice in a single clause analysis or if second symbol is "NOT".

JI--Relation-Symbol Check

Referenced from JF, JI examines the count of relation symbols, checks their consistency with previous counts, and assigns a code figure to the symbol either in VN6 or temporary location JI123 if all relations have been used in a sentence. An accumulative excess number (over 3) of relation symbols causes G_{11}.

JF--Second Jump Subroutine

Let us call the X symbol the second or third time through X_2 and the Y symbol Y_2. This routine compares excess-three data gathered on X_2 in VN131-141 with similar data gathered on X the first time through. If an inequality is found, Y_2 data in VN151-161 is compared to X data. Similarly, as the situation requires, Y data is compared with Y_2 data and later, if needed, with X_2 data. Next signs are compared.

Since the only values obtained from the second and third clauses other than the line numbers are the relation symbols, it was convenient in a few lines to use a theory of symbol reversal to correct what might ordinarily have been errors in position and sign of variables. X(s) means sign of X. Following are the rules that govern such reversal.

Variables	Signs	Symbol Reversal
$X = X_2$, $Y = Y_2$	$X(s) = X_2(s)$, $Y(s) = Y_2(s)$	No
	$X(s) \neq X_2(s)$, $Y(s) \neq Y_2(s)$	Yes
$X = Y_2$, $Y = X_2$	$X(s) = Y_2(s)$, $Y(s) = X_2(s)$	Yes
	$X(s) \neq Y_2(s)$, $Y(s) \neq X_2(s)$	No

All sign combinations other than the above cause G_2. Failures to find equality of $\{X,Y\}$ with $\{X_2,Y_2\}$, exclusive of sign, in any order causes G_{12}.

After symbol reversal, if needed, the relation codes are compared for uniqueness and internal consistency. A loop to get the line number operates similarly to the one in IJ.

If VN10 has been filled with a line number, the next loop is the final exit. If only VN7 has a line number, a loop is entered which, on recognition of an IF symbol, will send analysis back to IU2 for the third and final analysis of an IF clause. The final exit loop permits only a closed parenthesis and Δ. The other loop permits ( ) , ; Δ. IF. Failure of either to recognize a symbol causes G_5 with termination.

Prior to analysis of the third clause, this routine puts 00 00003 00000 in VN34. This indicator is later used to check if sufficient data is given in the third clause to complete the sentence string-out.

Output VN

0	0	0	34	Number of lines of output in v
1	Line Number			
2	IF77777777			Name of instruction
3	0	0	v	v = call word of line number.
4				Holds code figure $\in\{2,3,4,5,6,7\}$ to indicate relation test
5				Line number of sentence to be jumped to on first test.
6				Holds code figure in v for second relation test
7				Holds line number of sentence to be jumped to on second test
10				Holds line number of sentence to be jumped to unconditionally
11	0	u	v	u = Call word of modulus. v = number of subscripts of X
12				Negative value desired if 40 0 0, otherwise cleared
13				Absolute value desired if 40 0 0, otherwise clear
14	0	0	v	Call word of X
15	0	u	v	u = call word of I multiplier. v = call word of I
16	0	u	v	u = call word of J multiplier. v = call word of J
17	0	u	v	u = call word of K multiplier. v = call word of K
20	0	0	v	v = call word of L
21	0	u	v	u = call word of modulus. v = number of subscripts of Y
22				Negative value indicator
23				Absolute value indicator
24	0	0	v	Call word of Y
25	0	u	v	u = call word of subscript multipliers v = call word of subscripts of Y
26	0	u	v	
27	0	u	v	
30	0	0	v	
31				If X is a constant, 40 0 0, otherwise clear
32				If Y is a constant, 40 0 0, otherwise clear
33				Pseudo-op indicator, 40 0 0, otherwise clear

*Temporary Storage in VN

X	Y	
40	71	Floating-point constant
41	72	Fixed-point constant in excess-three
42	73	Used in making call word of multiplier
43	74	Indicator of fixed-point variable (40 0 0) Holds absolute-sign indicator during comparison
44	75	sy^2 Excess-three representation of variable
45	76	sy^3
46	77	Sign of exponent indicator (40 0 0)
47	100	Exponent of 10 in excess three
50	101	Subscript 1 in excess three
51	102	Subscript 2 in excess three
52	103	Subscript 3 in excess three
53	104	Subscript 4 in excess three
54	105	u = call word of modulus; v = number of subscripts
55	106	Negative sign indicator (40 0 0)
56	107	Absolute sign indicator (40 0 0)
57	110	Call word in v
60	111	u = call word of I multiplier; v = call word of I subscript
61	112	u = call word of J multiplier; v = call word of J subscript
62	113	u = call word of K multiplier; v = call word of K subscript
63	114	v = call word of L subscript
64	115	Index for subscript assembly
65	116	Count of relation symbols
66	117	First relation symbol
67	120	Second relation symbol
70	121	Floating-point constant indicator (40 0 0)

X_2	Y_2	
130	150	Negative sign indicator (40 0 0)
131	151	Absolute sign indicator (40 0 0)
132	152	sy^2 Excess-three representation of variable
133	153	sy^3

134	154	Sign of exponent indicator (40 0 0)
135	155	Exponent of 10 in excess-three
136	156	Subscript 1 in excess-three
137	157	Subscript 2 in excess-three
140	160	Subscript 3 in excess-three
141	161	Subscript 4 in excess-three
142	162	Count of relation symbols
143	163	First relation symbol
144	164	Second relation symbol

*Braced portions are those compared during analyses of second and third clauses to determine equality of variables.

Scientific Notation Checking Routine

The purpose of this routine is to check the size of a number in scientific notation form and then convert it to floating point. If it is too large for floating-point representation, the error routine is referenced and the following error print-out is given: Sentence_______(_______)--Absolute Value of Number Too Large. If too small, the floating-point representation is set to zero and this print-out occurs: Sentence_______(_______)--Absolute Value of Number Too Small--Given Zero Value. In the latter case, the error routine is not referenced.

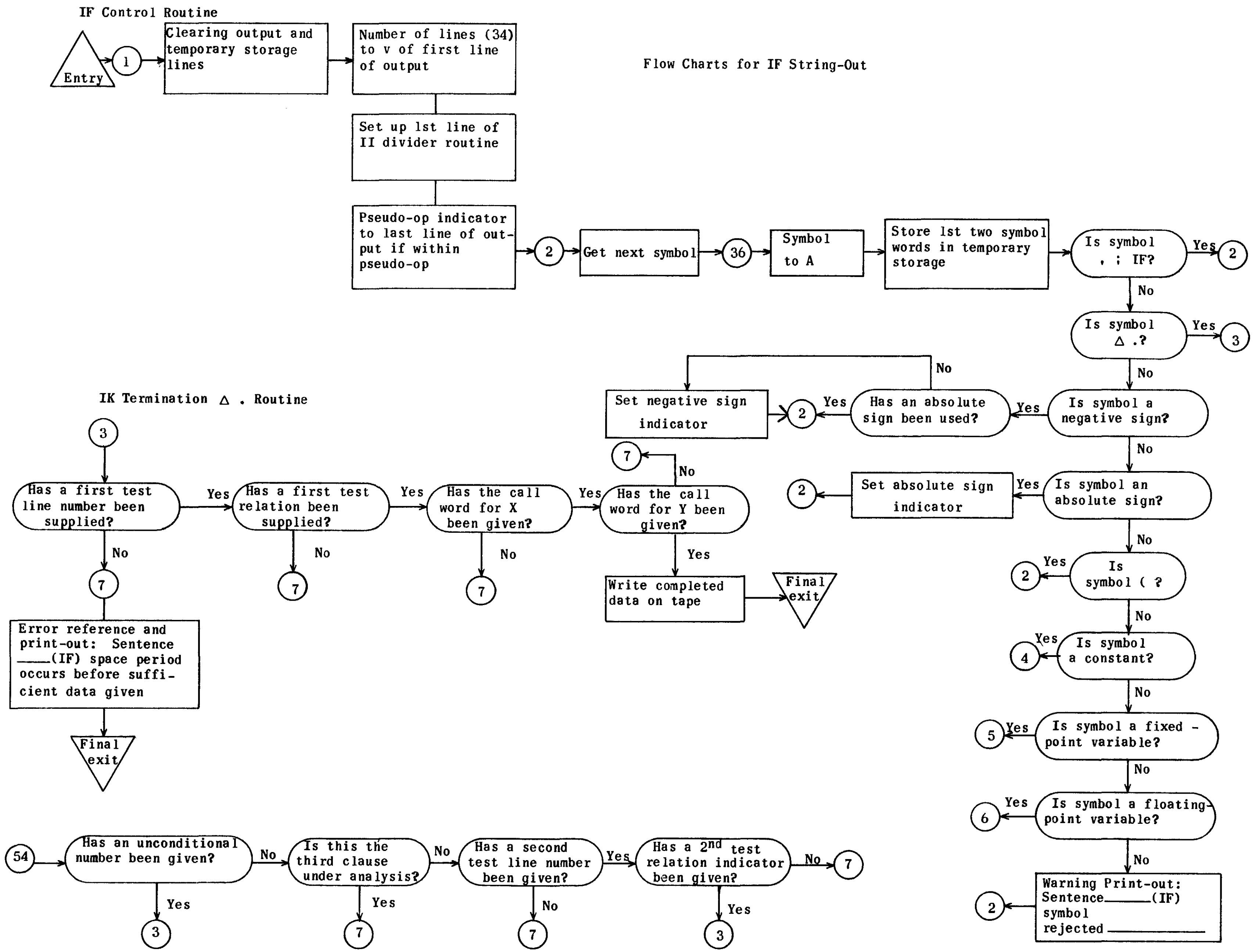
To use the routine a number to the left of e or * is first converted to floating point by use of the "excess-three decimal to floating-point" routine. This floating point number, either positive or negative, is put in input line IQ2. The exponent of 10 after conversion to octal by means of the proper routine is put in input line IQ3. It also may be either positive or negative. Instruction RJ IQ IQ1 then performs the check and, if the absolute value of the number is not too large, puts the correct floating-point representation into IQ2 as the output.

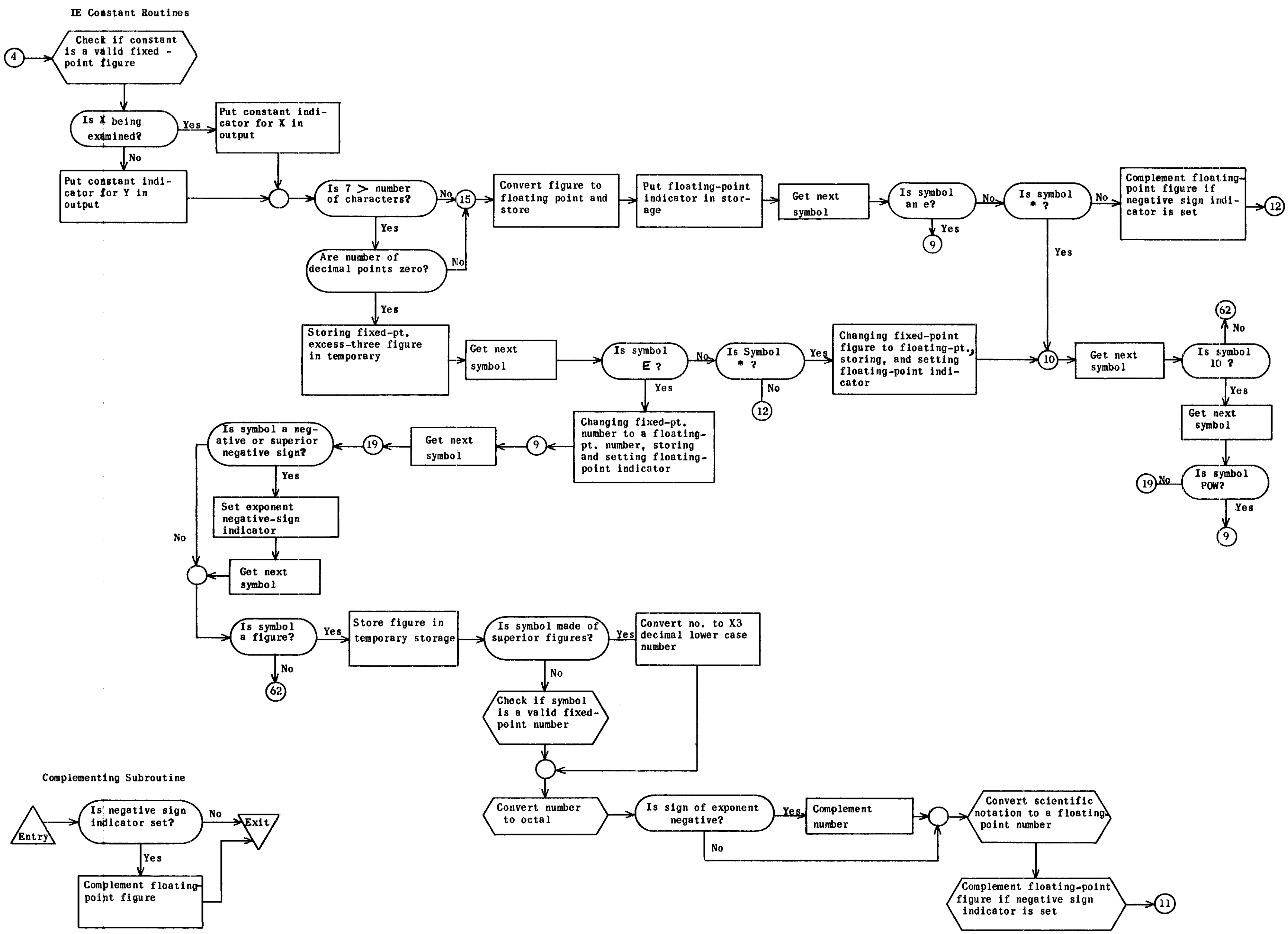
Superior To Lower-Case Translation of Figures

Input to this routine is one line of superscript figures packed starting at the left with 77 fillers at the right. No characters other than superscript figures are permitted. Thus periods are not allowed, and only integral figures are translated. Both the input and output are in excess-three decimal code. The input line, in2, becomes the output line on termination of the referencing instruction, RJ in in1.

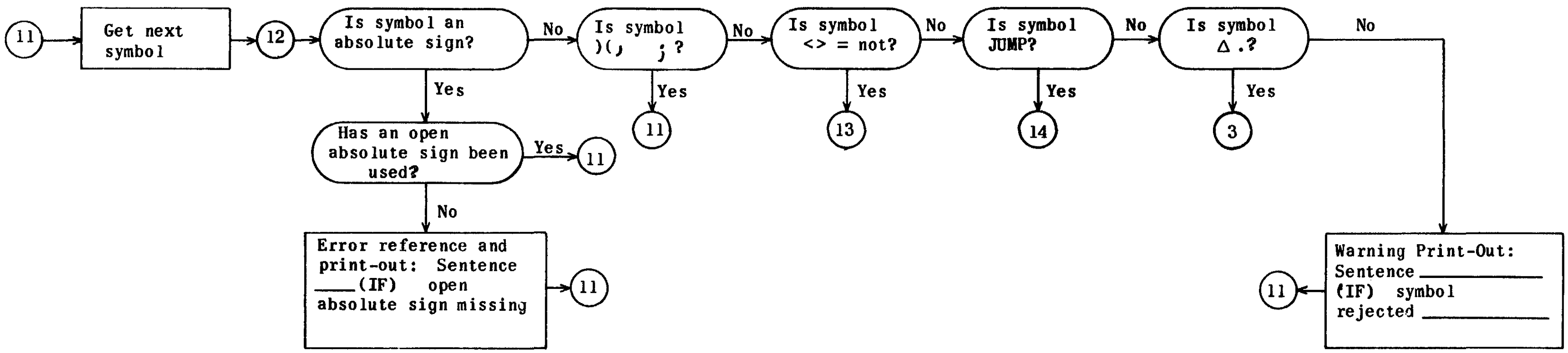
If the first character on the left is 77, no translation is performed. The input line, in effect, is untouched.

If a character is not a figure or a 77, the error routine uz is referenced and there is a print-out: Sentence_______(_______). Disallowable Character in Exponent_______. In the last blank is given the print-out of the character. This print-out occurs for every erroneous character in the line prior to the first 77. When a 77 is encountered, no further analysis or translation of the line occurs. What has been translated is packed at the left, and the balance of the line is retained the same as it was in the original input.

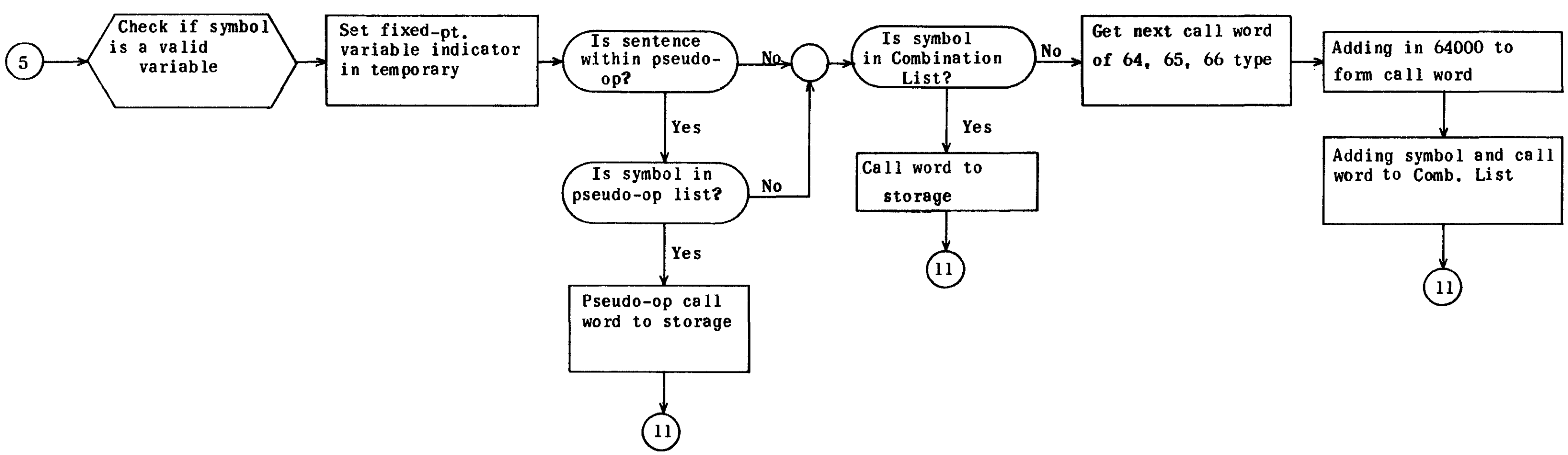

IF Control Routine
Flow Charts for IF String-Out
Entry
1
Clearing output and temporary storage lines
Number of lines (34) to v of first line of output
Set up 1st line of II divider routine
Pseudo-op indicator to last line of output if within pseudo-op
2
Get next symbol
36
Symbol to A
Store 1st two symbol words in temporary storage
Is symbol , ; IF?
Yes
No
Is symbol Δ .?
Is symbol a negative sign?
Has an absolute sign been used?
Set negative sign indicator
Is symbol an absolute sign?
Set absolute sign indicator
Is symbol (?
Is symbol a constant?
Is symbol a fixed - point variable?
Is symbol a floating-point variable?
Warning Print-out: Sentence____(IF) symbol rejected ______
IK Termination Δ . Routine
3
Has a first test line number been supplied?
Has a first test relation been supplied?
Has the call word for X been given?
Has the call word for Y been given?
Write completed data on tape
Final exit
7
Error reference and print-out: Sentence ____(IF) space period occurs before sufficient data given
54
Has an unconditional number been given?
Is this the third clause under analysis?
Has a second test line number been given?
Has a 2nd test relation indicator been given?
4
5
6


IE Constant Routines
4
Check if constant is a valid fixed - point figure
Is X being examined?
Yes
Put constant indicator for X in output
No
Put constant indicator for Y in output
Is 7 > number of characters?
No
15
Yes
Are number of decimal points zero?
No
Yes
Convert figure to floating point and store
Put floating-point indicator in storage
Get next symbol
Is symbol an e?
Yes
9
No
Is symbol * ?
No
Complement floating-point figure if negative sign indicator is set
12
Yes
Storing fixed-pt. excess-three figure in temporary
Get next symbol
Is symbol E ?
No
Is Symbol * ?
Yes
No
12
Changing fixed-point figure to floating-pt., storing, and setting floating-point indicator
10
Get next symbol
Is symbol 10 ?
No
62
Yes
Get next symbol
Is symbol POW?
No
19
Yes
9
Yes
Changing fixed-pt. number to a floating-pt. number, storing and setting floating-point indicator
9
Get next symbol
19
Is symbol a negative or superior negative sign?
Yes
Set exponent negative-sign indicator
No
Get next symbol
Is symbol a figure?
No
62
Yes
Store figure in temporary storage
Is symbol made of superior figures?
Yes
Convert no. to X3 decimal lower case number
No
Check if symbol is a valid fixed-point number
Convert number to octal
Is sign of exponent negative?
Yes
Complement number
No
Convert scientific notation to a floating-point number
Complement floating-point figure if negative sign indicator is set
11
Complementing Subroutine
Entry
Is negative sign indicator set?
No
Exit
Yes
Complement floating-point figure

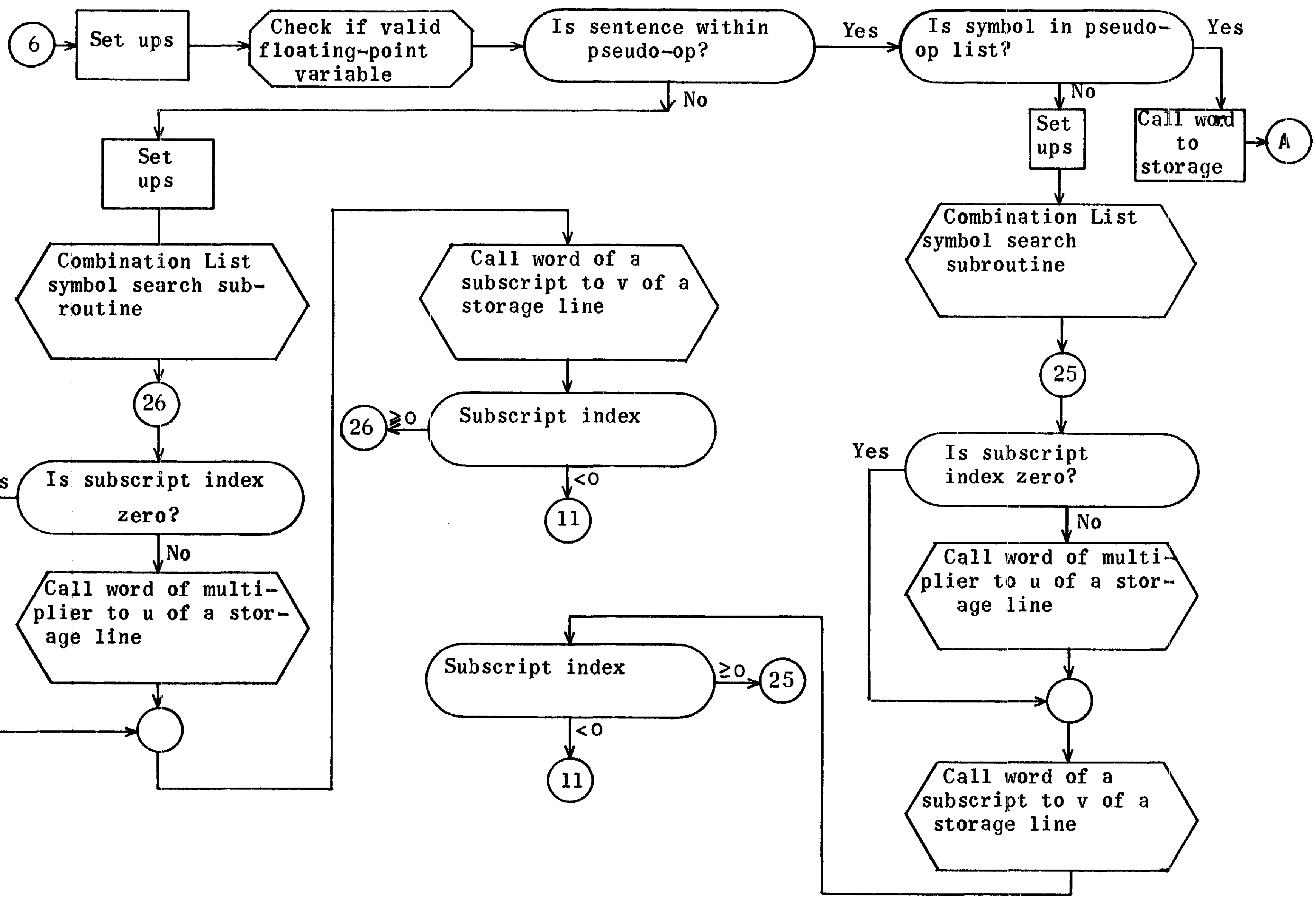
Constant Termination Loop

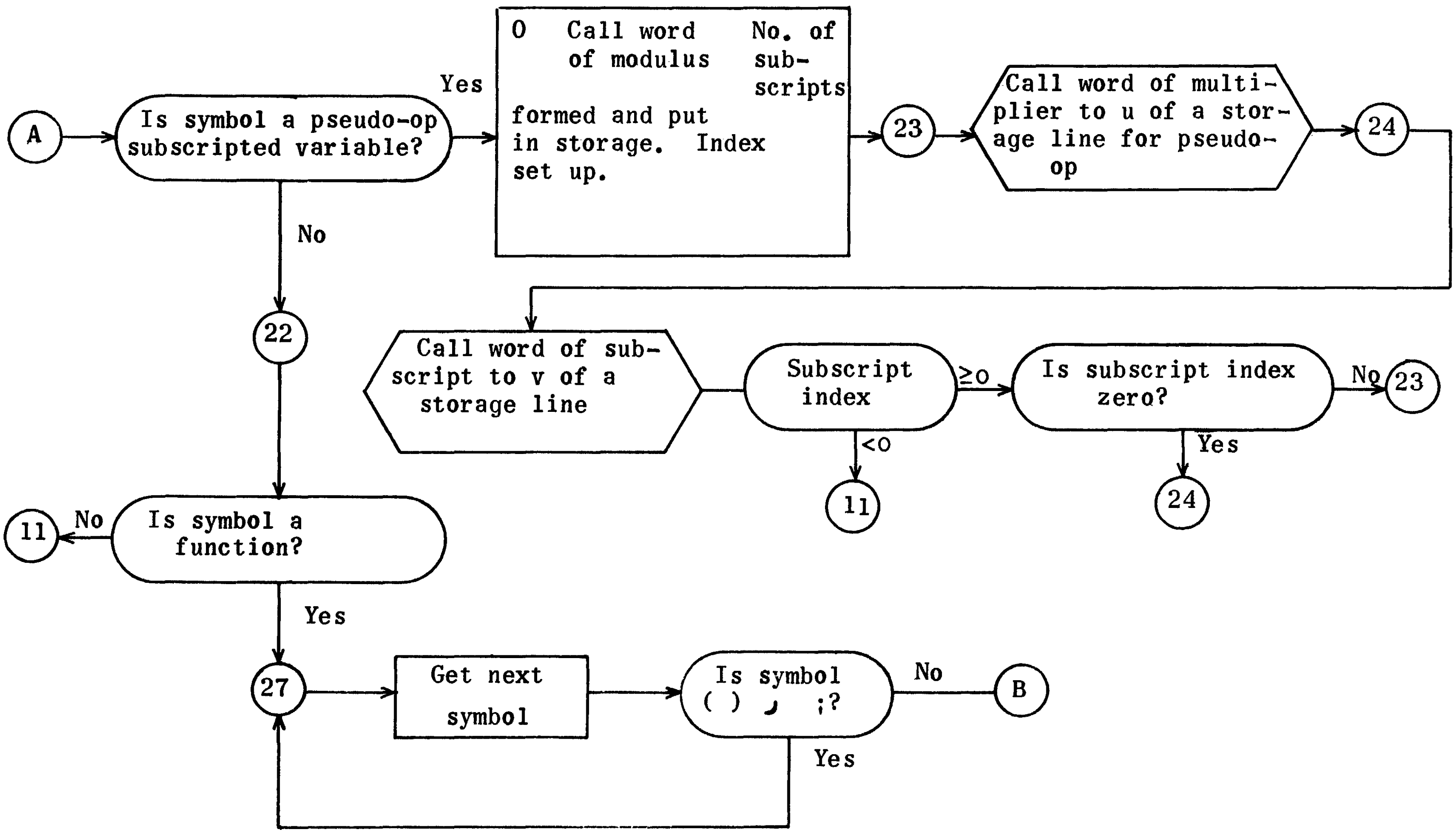


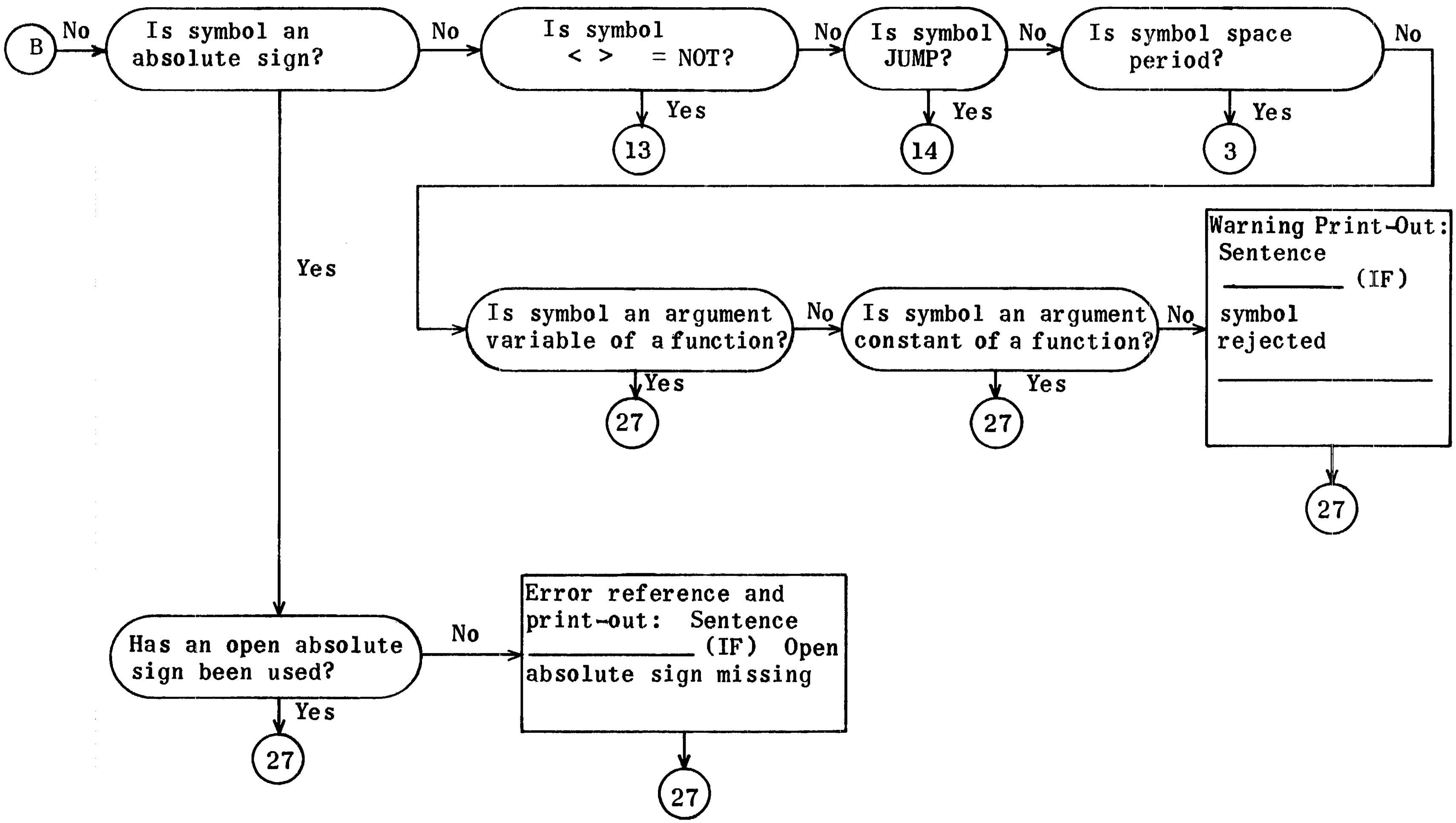
IG Fixed-Point Variable Routine



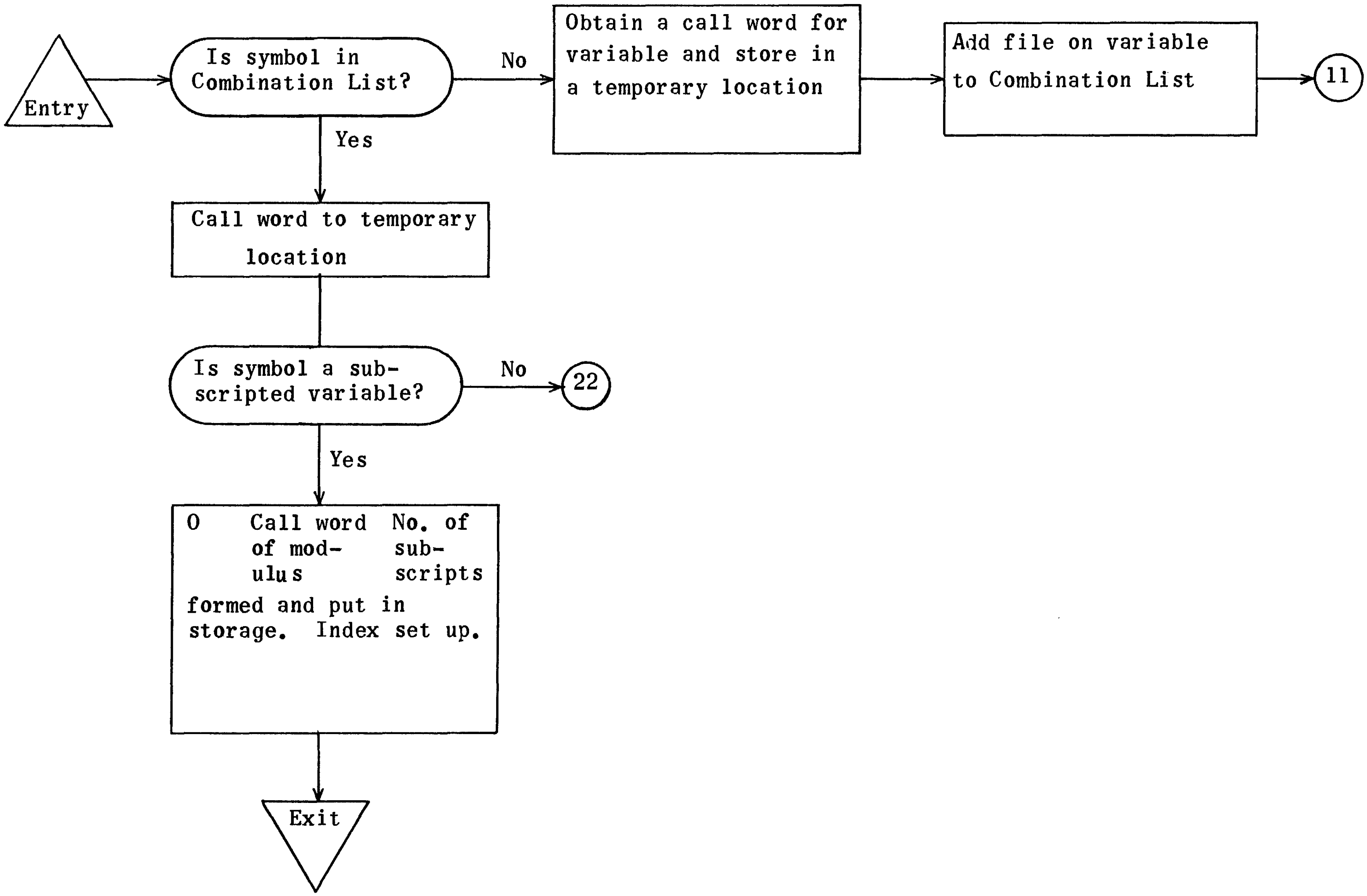
IH and IL Floating-Point Variable Routines



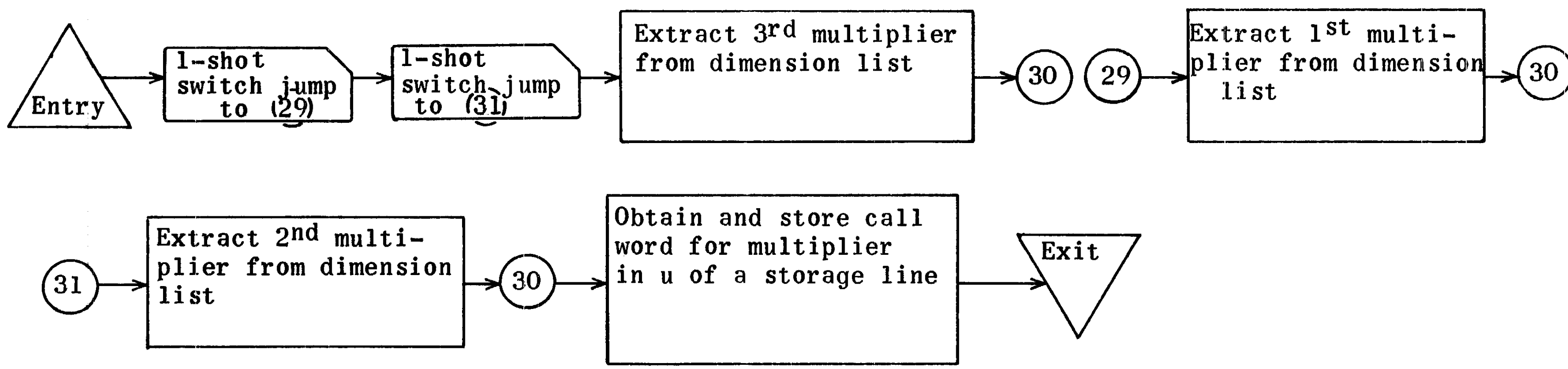

A
Is symbol a pseudo-op subscripted variable?
Yes
0 Call word of modulus No. of sub-scripts
formed and put in storage. Index set up.
23
Call word of multi-plier to u of a stor-age line for pseudo-op
24
No
22
Call word of sub-script to v of a storage line
Subscript index
≥0
<0
11
Is subscript index zero?
No
23
Yes
24
11
No
Is symbol a function?
Yes
27
Get next symbol
Is symbol ( ) , ;?
No
B
Yes


B
No
Is symbol an absolute sign?
No
Is symbol < > = NOT?
Yes
13
No
Is symbol JUMP?
Yes
14
No
Is symbol space period?
Yes
3
No
Yes
Is symbol an argument variable of a function?
Yes
27
No
Is symbol an argument constant of a function?
Yes
27
No
Warning Print-Out: Sentence ________ (IF) symbol rejected ____________
27
Has an open absolute sign been used?
Yes
27
No
Error reference and print-out: Sentence ________ (IF) Open absolute sign missing
27

Combination List Symbol Search Subroutine

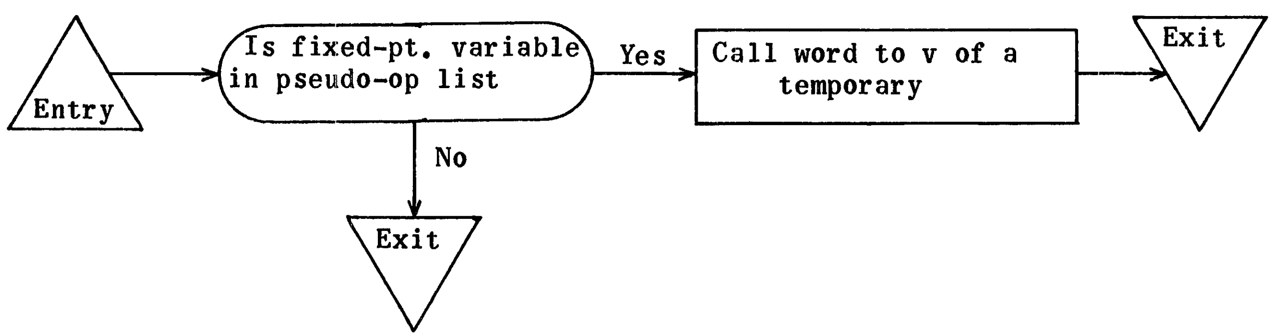


Subroutine to put call word of subscript multiplier (not for a pseudo-op sub variable) to u of a storage line

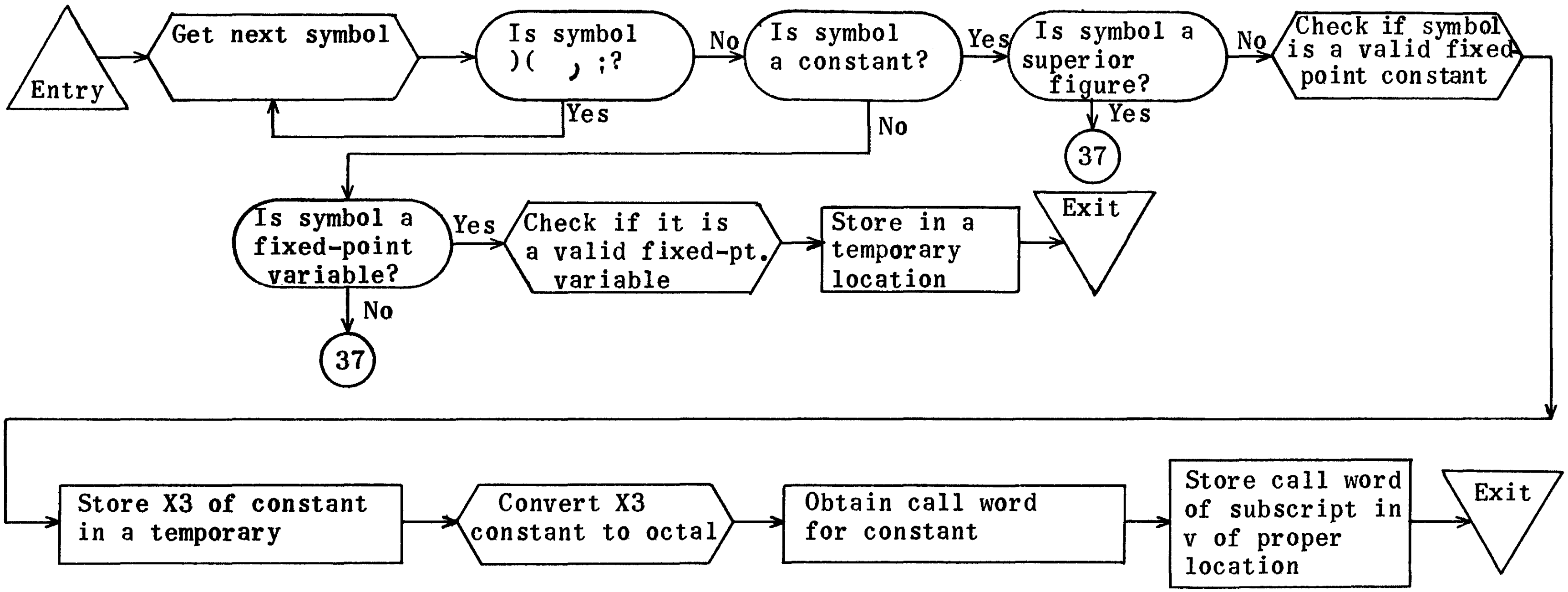


3 Subroutines to put call word of a subscript to v of a storage line:

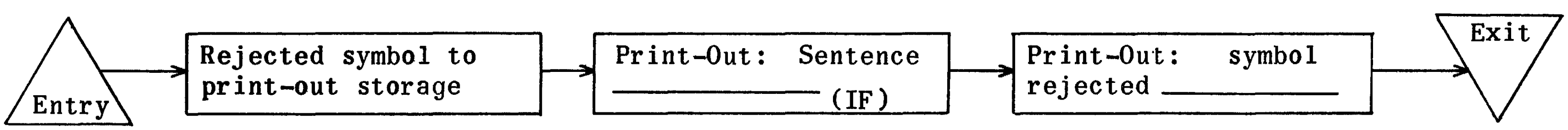
2 - Checking if fixed-point variable is in pseudo-op list and getting call word, if so.



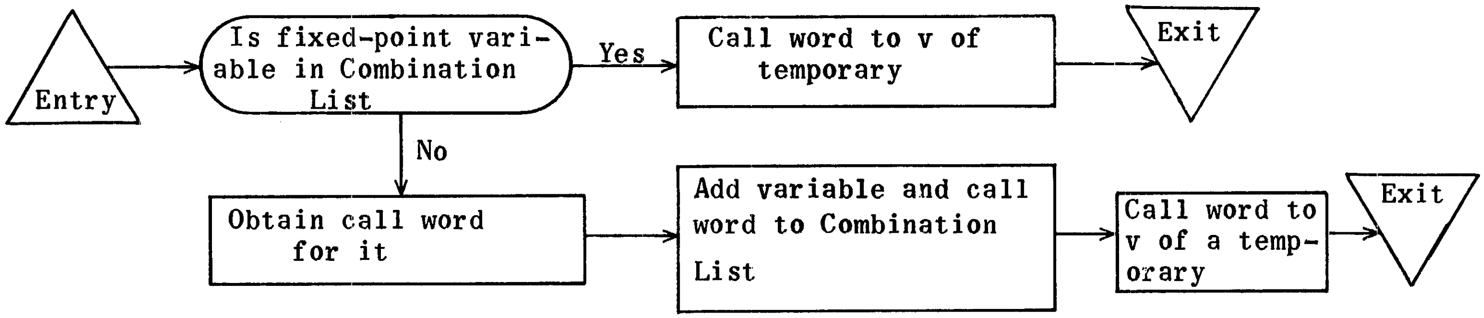
1-Handling subscript if a constant and checking if it is a fixed-point variable



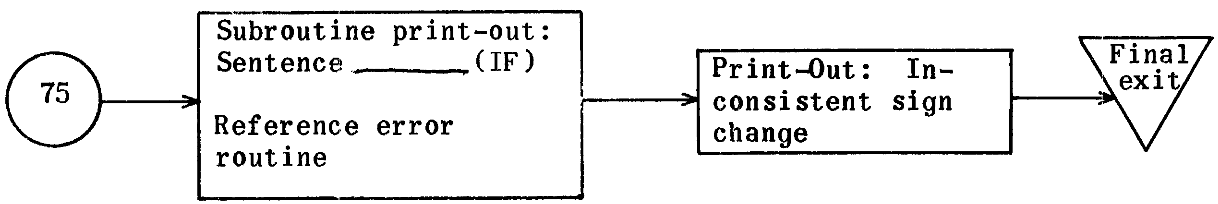
Sentence ______(IF) Symbol Rejected _____(Warning only)



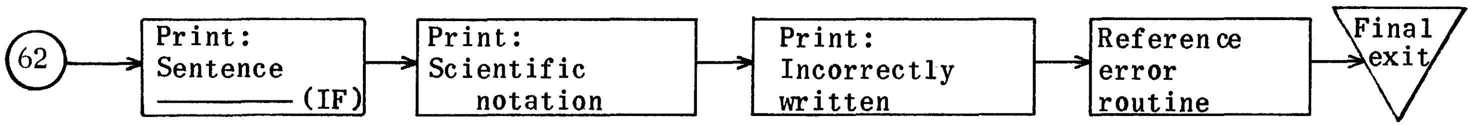
3-Checking if fixed-point variable is in Combination List and, if not, adding it in. Call word to location.



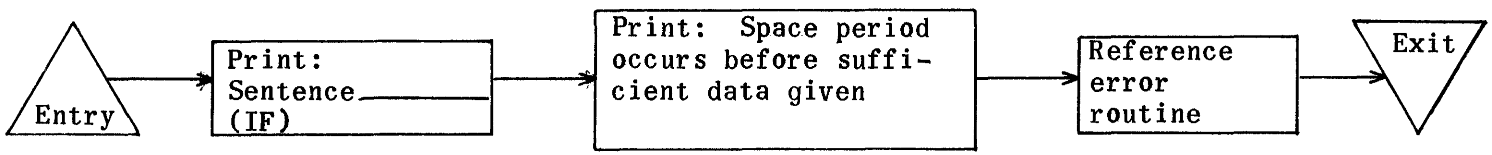
ID Print-Out Subroutine Sentence____ (IF) Inconsistent Sign Change



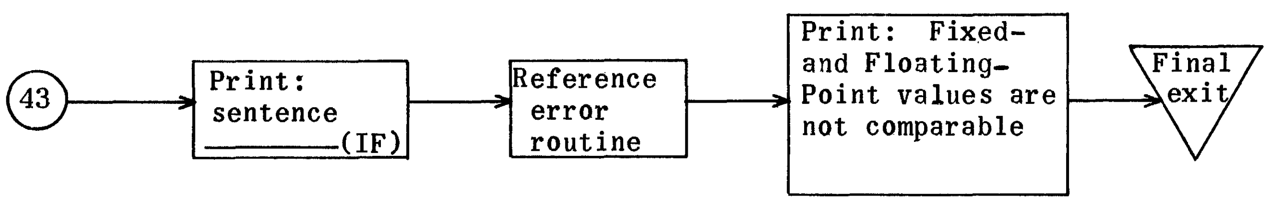
Sentence ______(IF) Scientific Notation Incorrectly Written



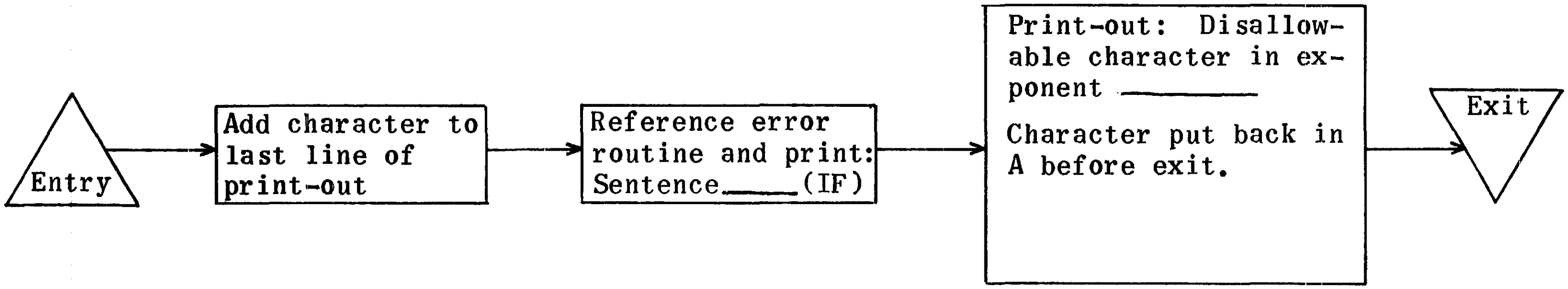
Sentence ______(IF) Space Period Occurs Before Sufficient Data Given



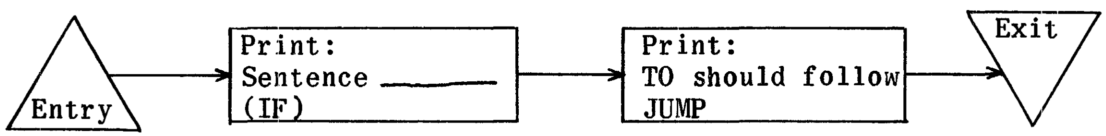
Sentence ______(IF) Fixed- and Floating-Point Values Are Not Comparable



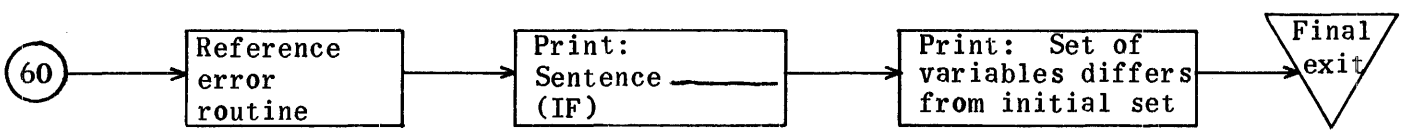
Sentence______(IF) Disallowable Character in Exponent ________



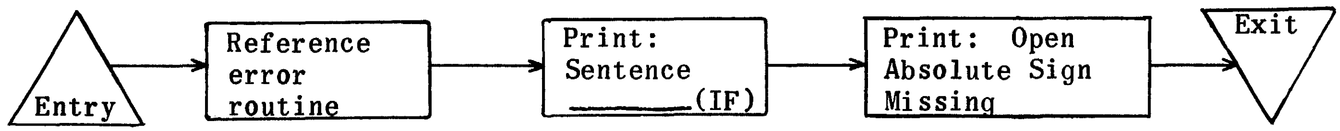
Sentence______(IF) TO Should Follow JUMP (Warning only)



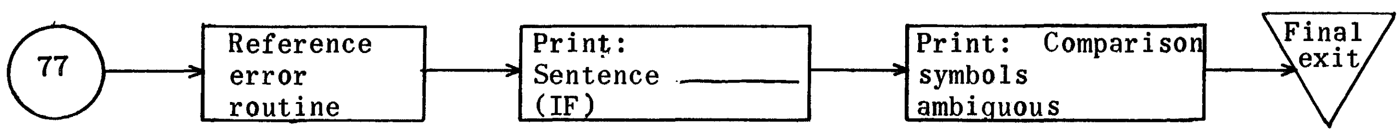
Sentence_____(IF) Set of Variables Differs From Initial Set



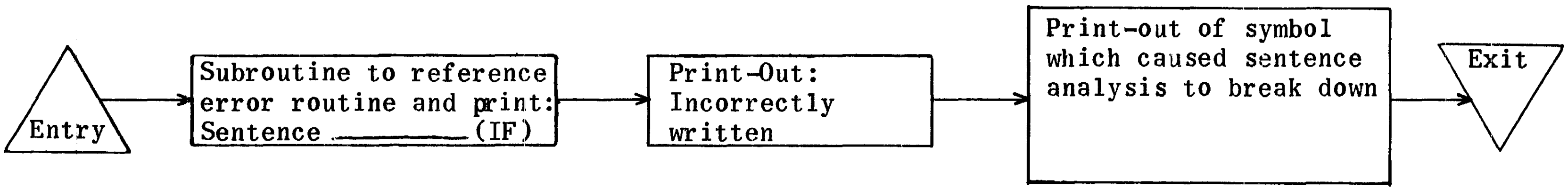
Sentence _____(IF) Open Absolute Sign Missing



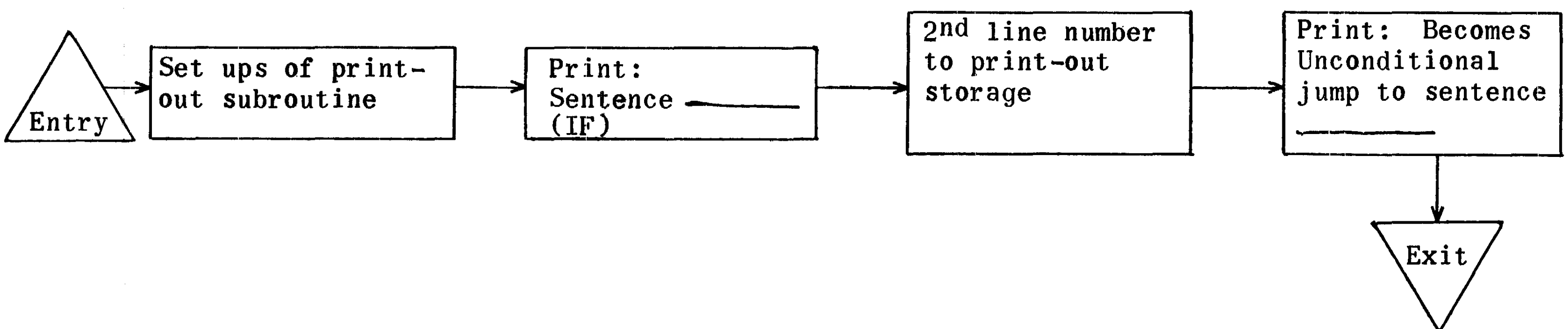
Sentence _____(IF) Comparison Symbols Ambiguous



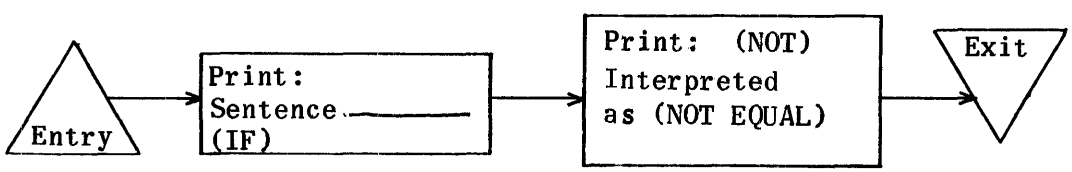
Sentence ______ (IF) Incorrectly Written ______



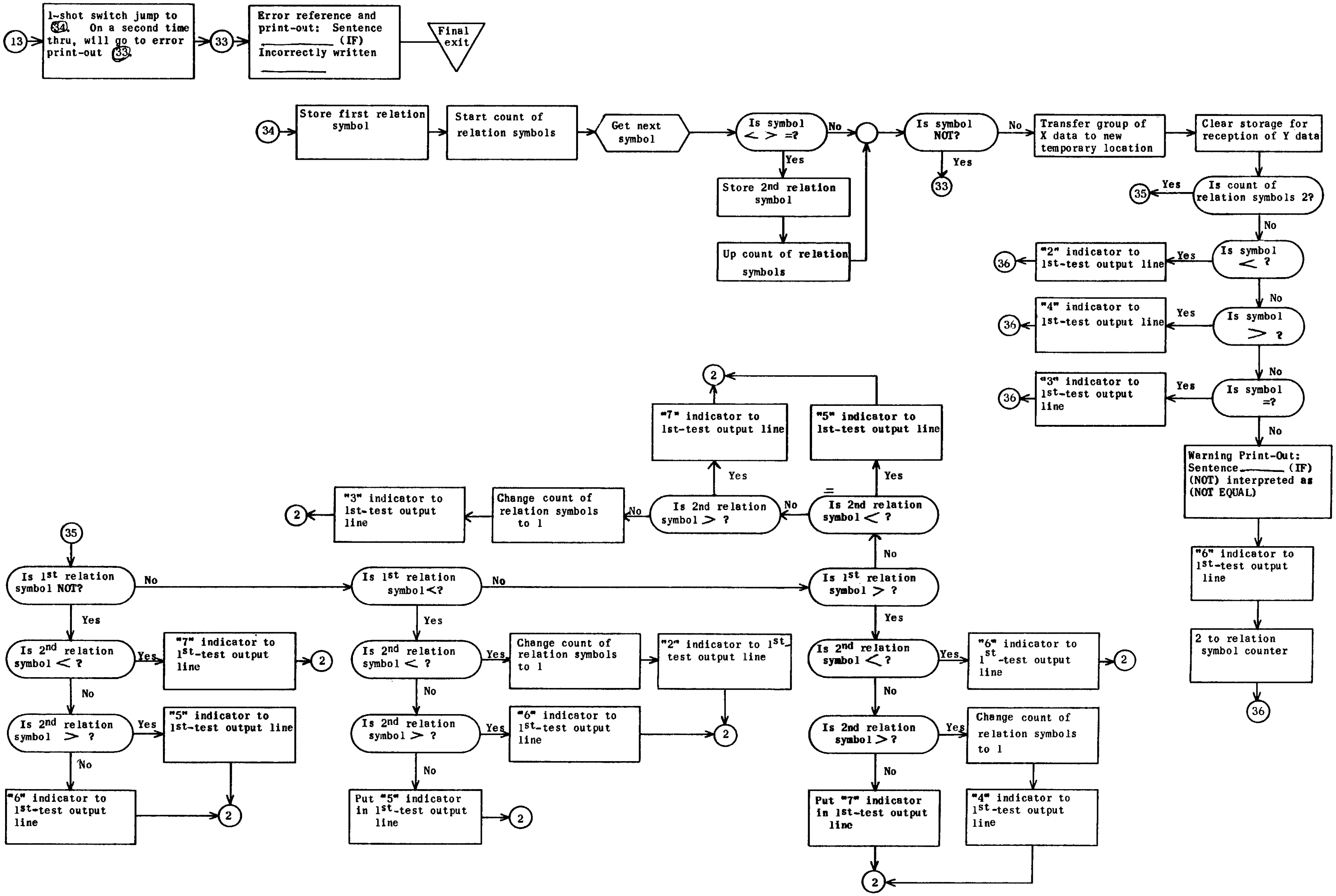
Sentence ____ (IF) Becomes Unconditional Jump to Sentence ____ (Warning only)



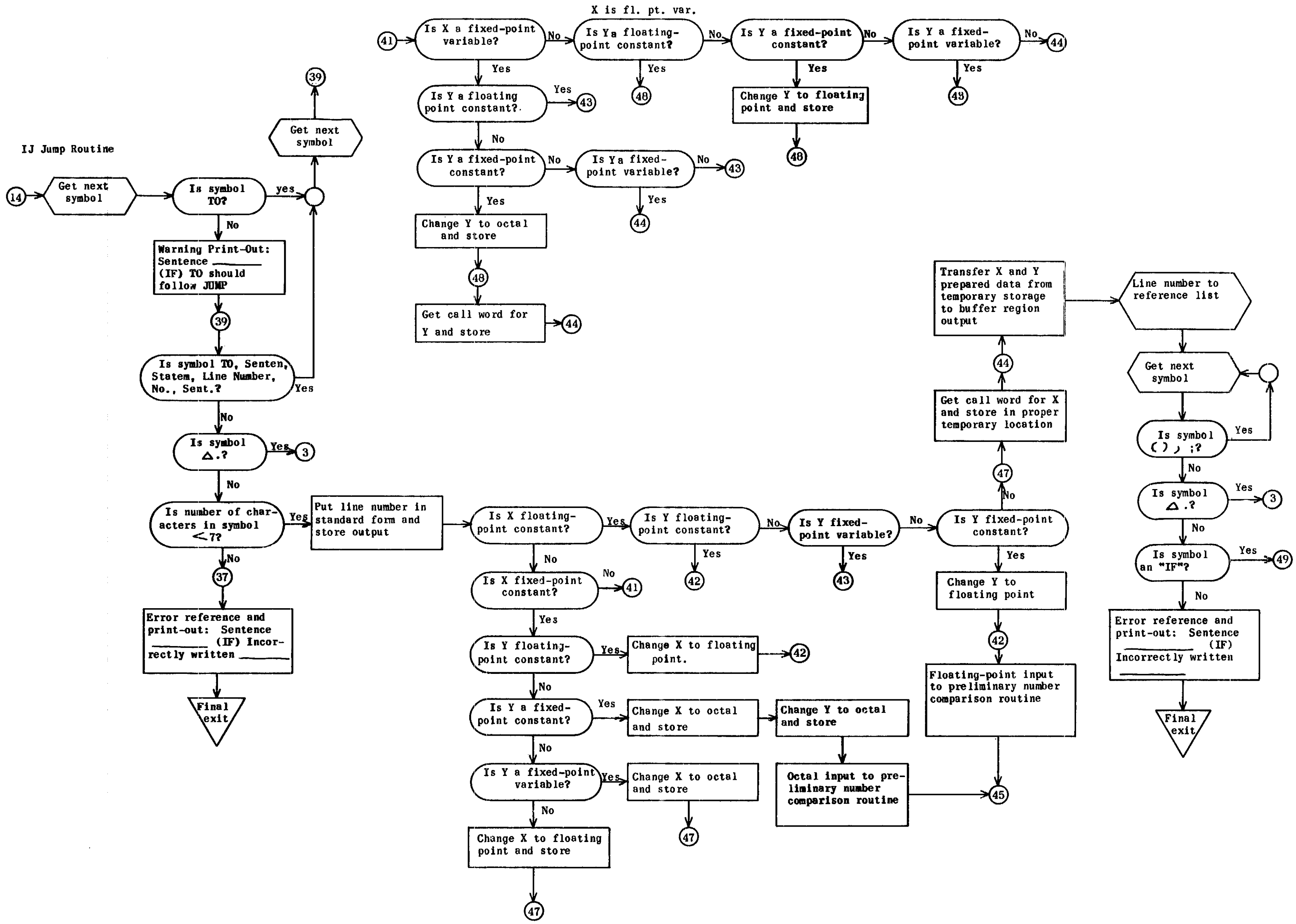
Sentence ____ (IF) (NOT) Interpreted as (NOT EQUAL)
(Warning only)



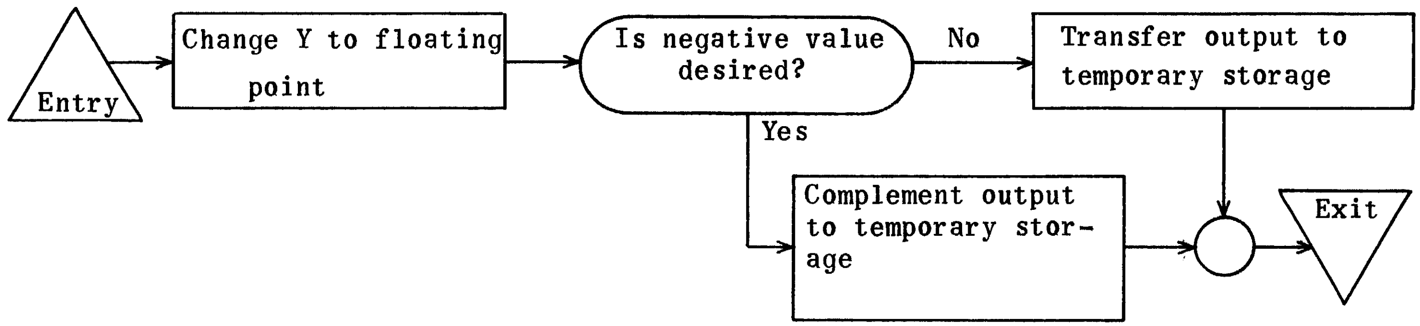
II Divider Routine



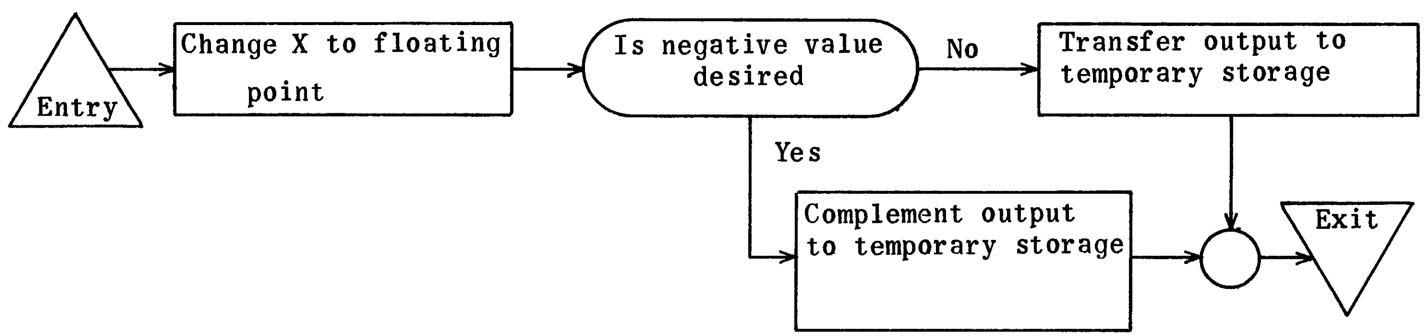
IJ Jump Routine



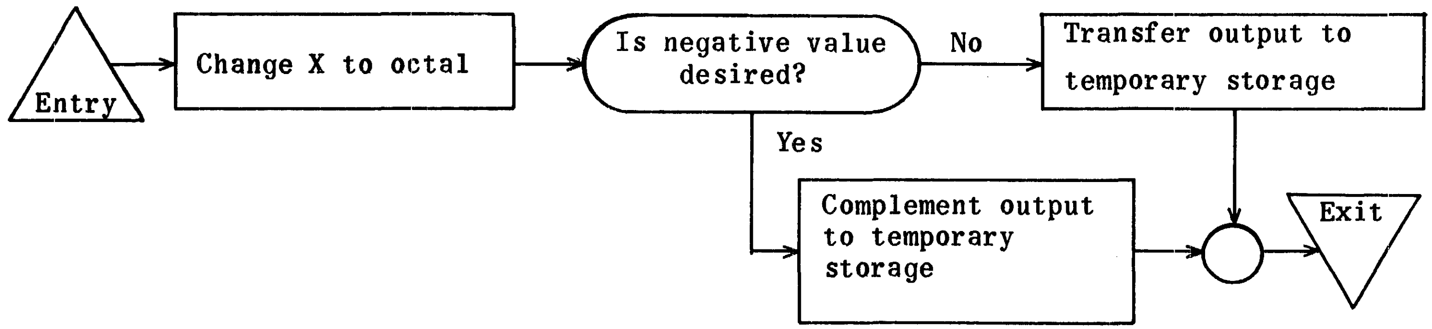
Subroutine to change Y to floating point and store



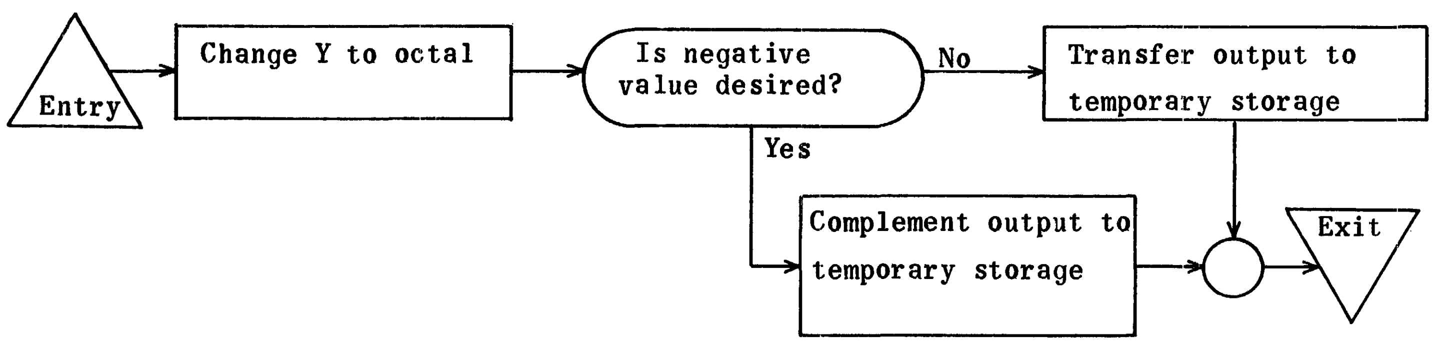
Subroutine to change X to floating point and store



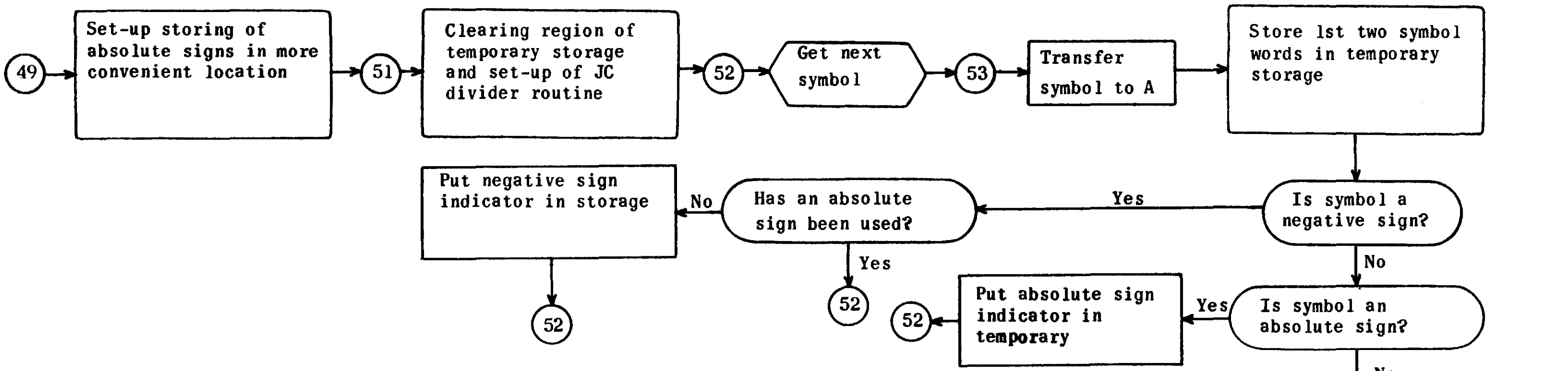
Subroutine to change X to octal and store

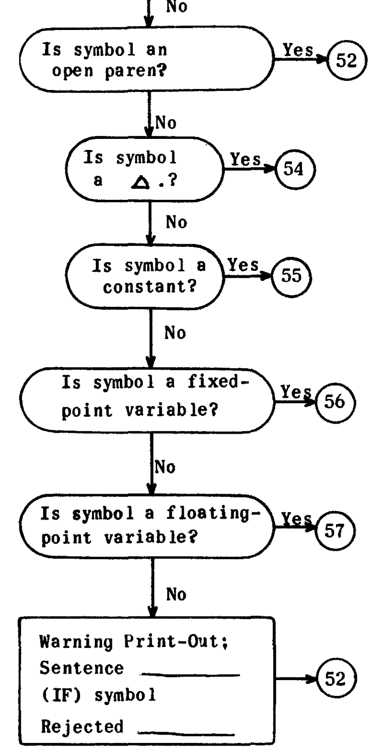


Subroutine to change Y to octal and store

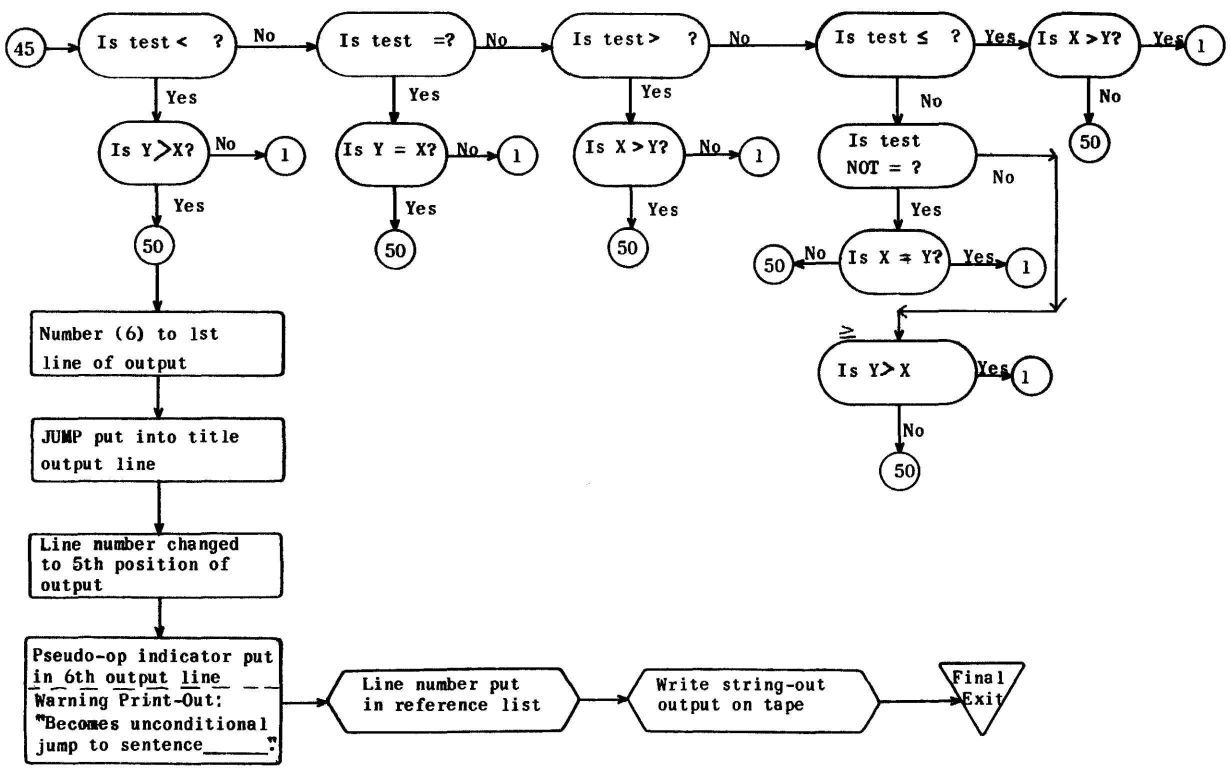


IU - Initial Control for Second or Third Clause



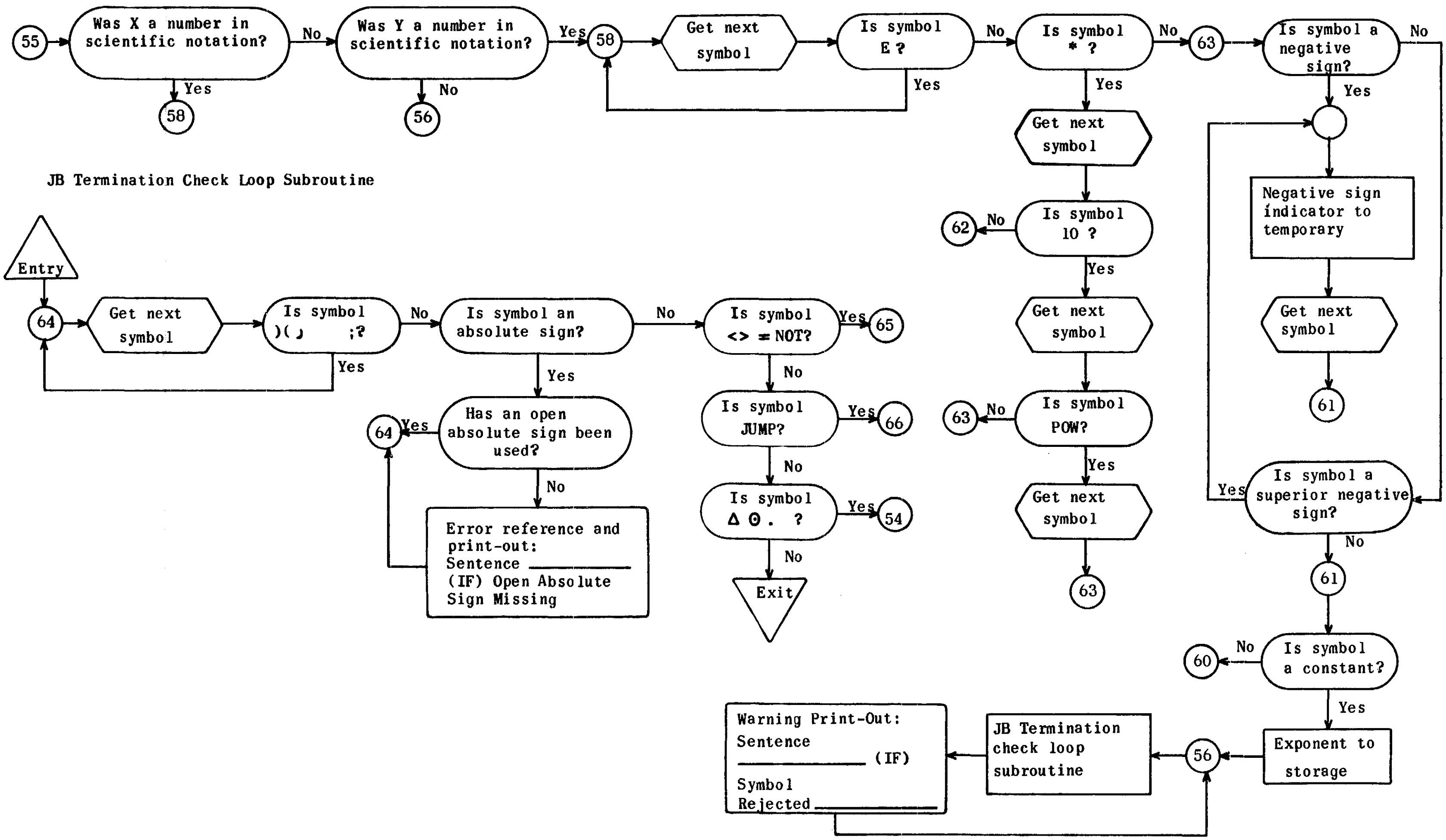


IT Preliminary Number Comparison Routine

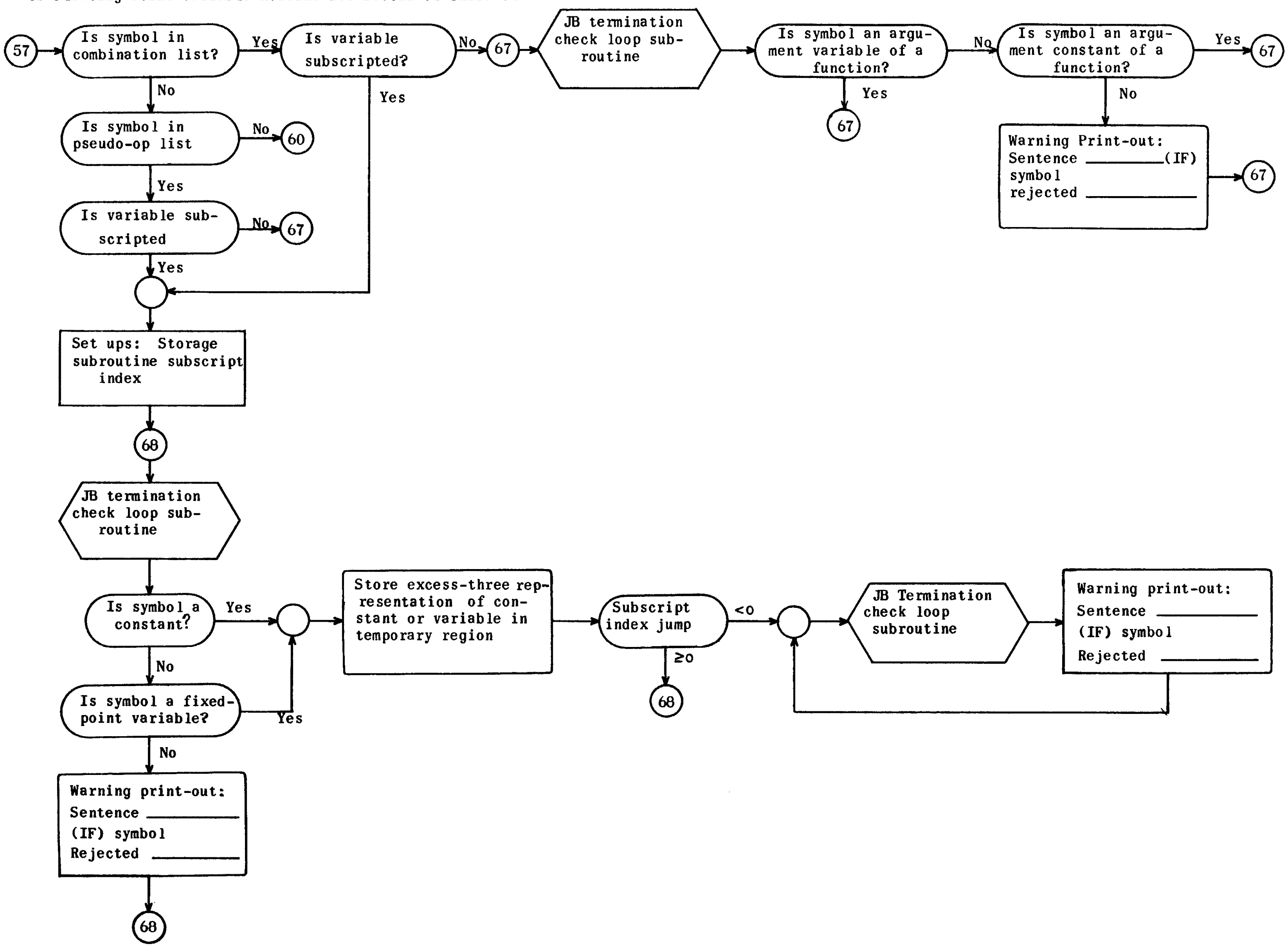


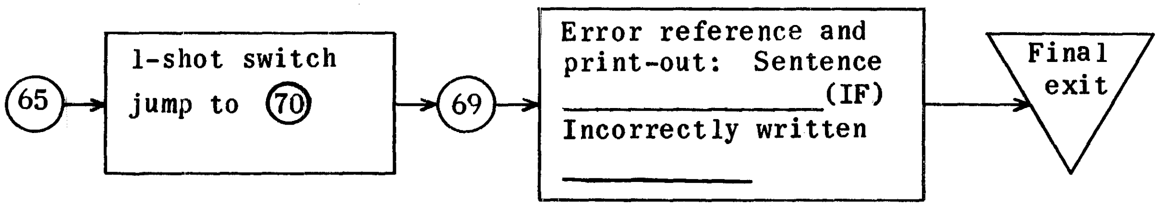
IY Constant and Fixed-Point Variable Routine for Second or Third Clause

JB Termination Check Loop Subroutine

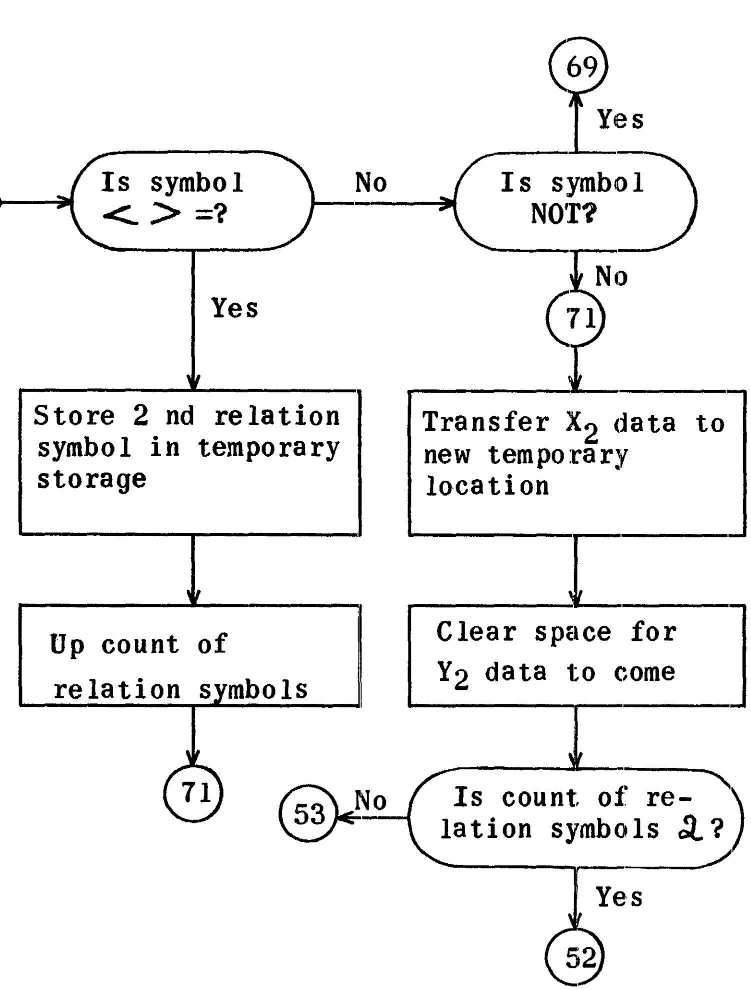


JB Floating-Point Variable Routine for Second or Third Clause





JC Relation Symbol Routines for Second or Third Clause



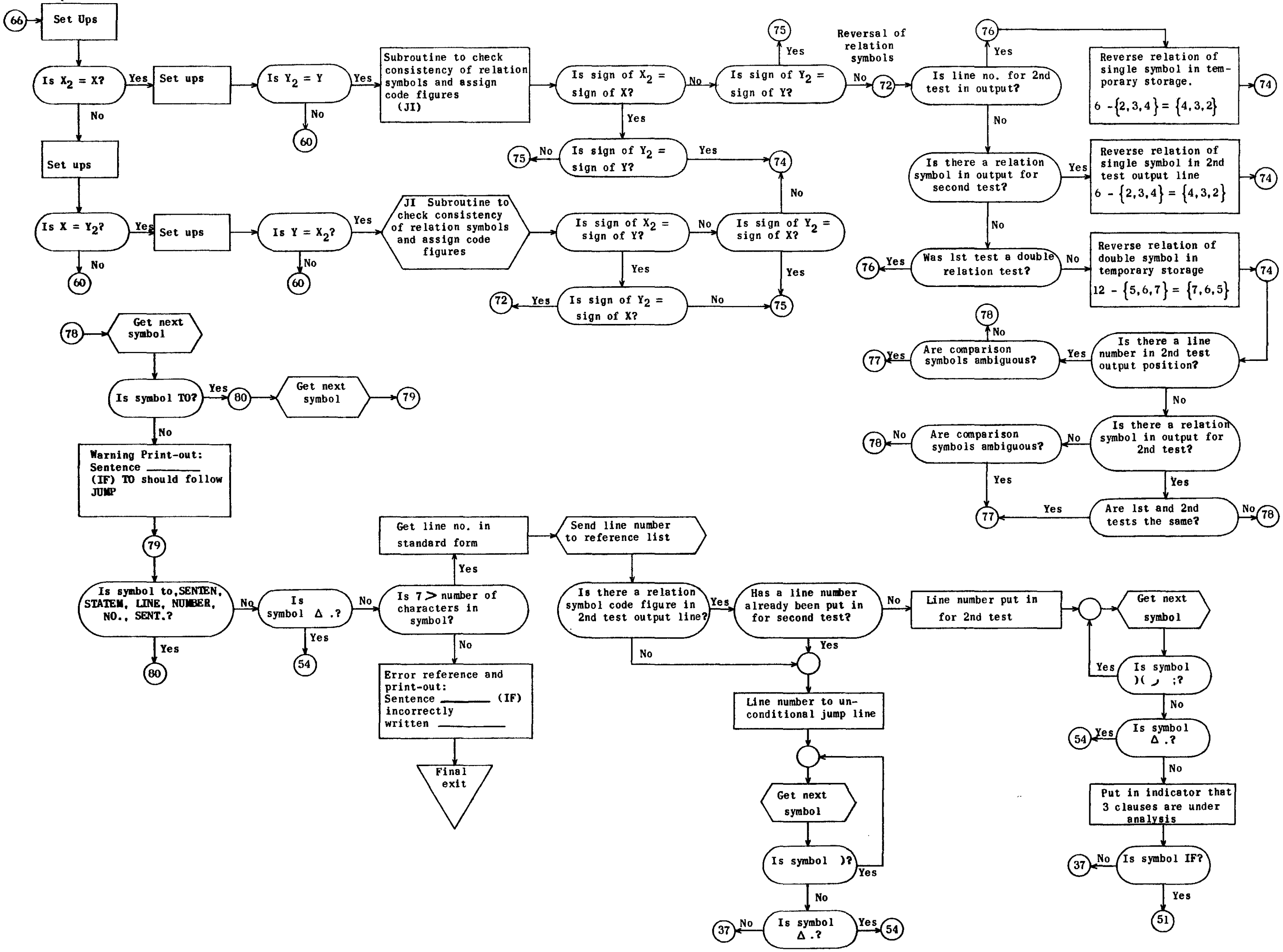
X = 1st variable or constant in 1st clause of IF.

X_2 = 1st variable or constant in 2nd or 3rd clause of IF.

Y = 2nd variable or constant in 1st clause of IF.

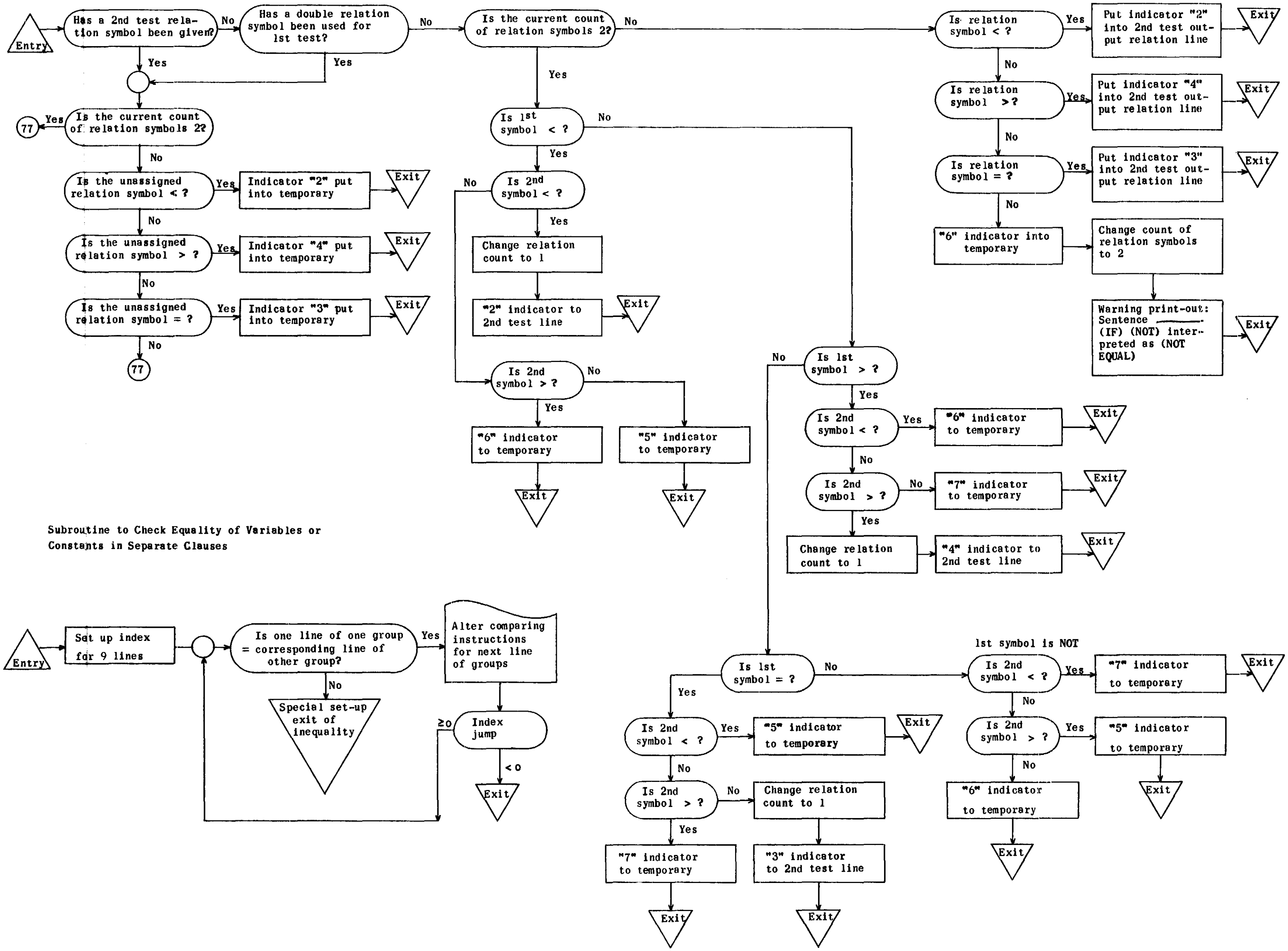
Y_2 = 2nd variable or constant in 2nd or 3rd clause of IF.

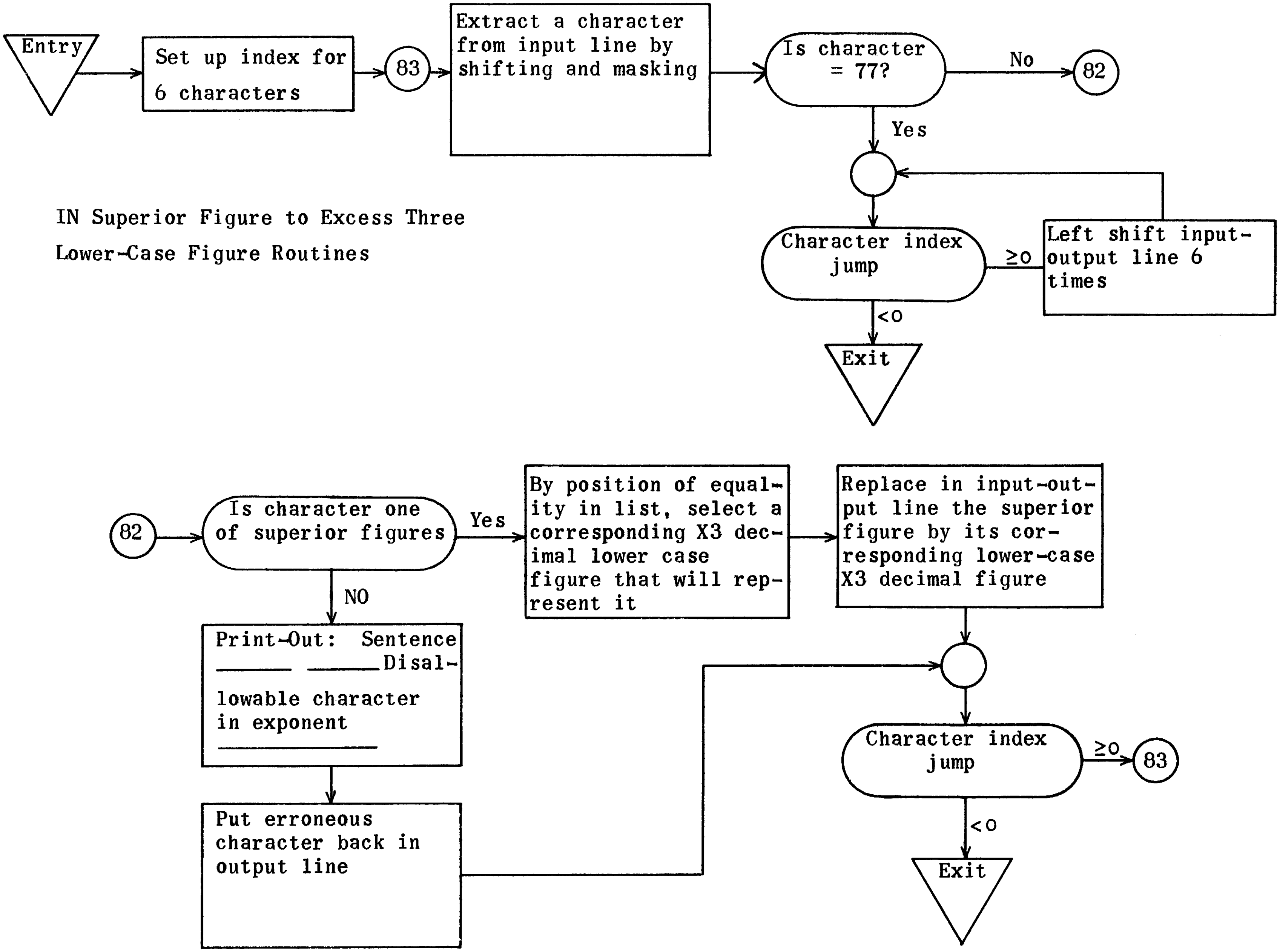
JF Jump Routine for Second or Third Clause



JI Subroutine to Check Consistency of Relation Symbols and Assign Code Figures

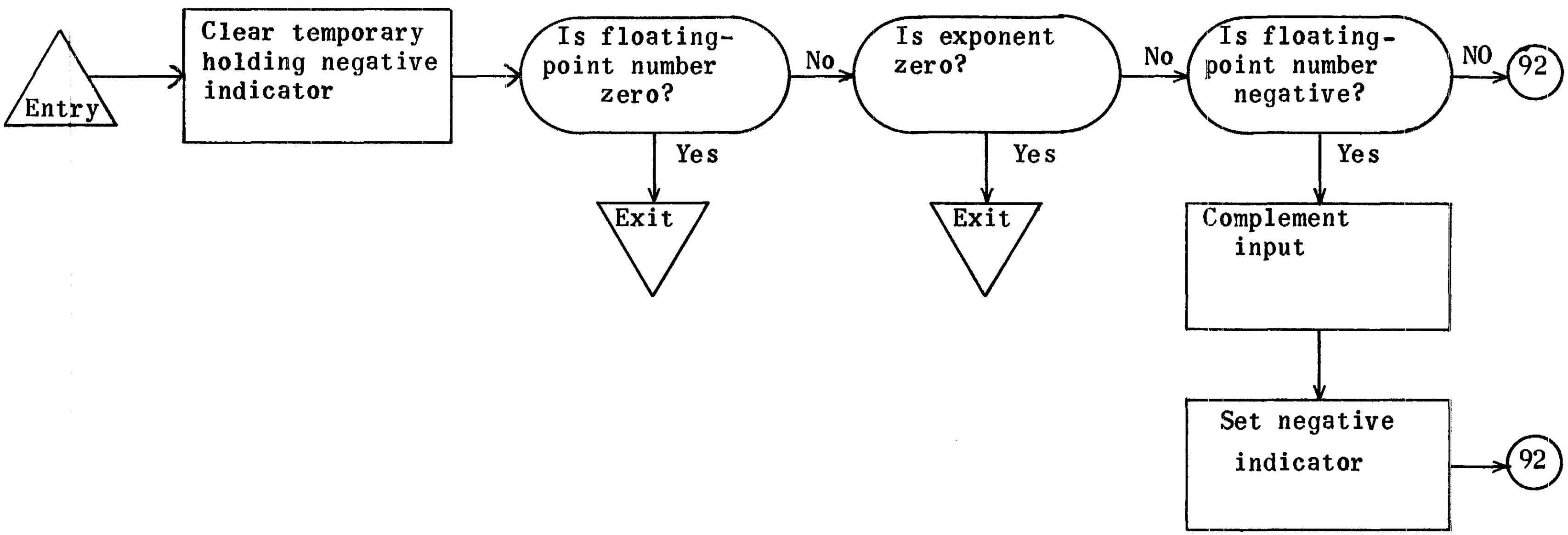
Subroutine to Check Equality of Variables or Constants in Separate Clauses

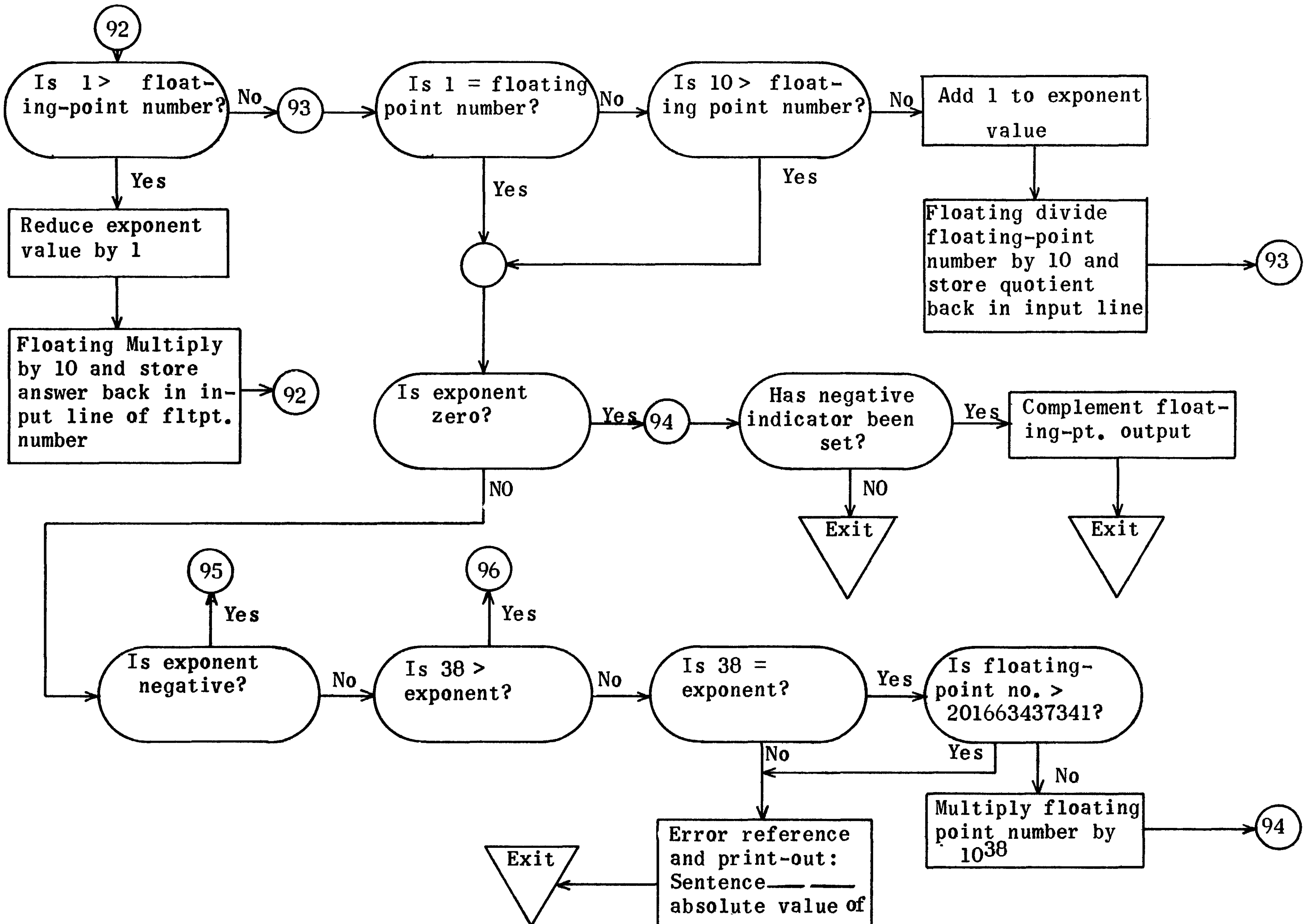


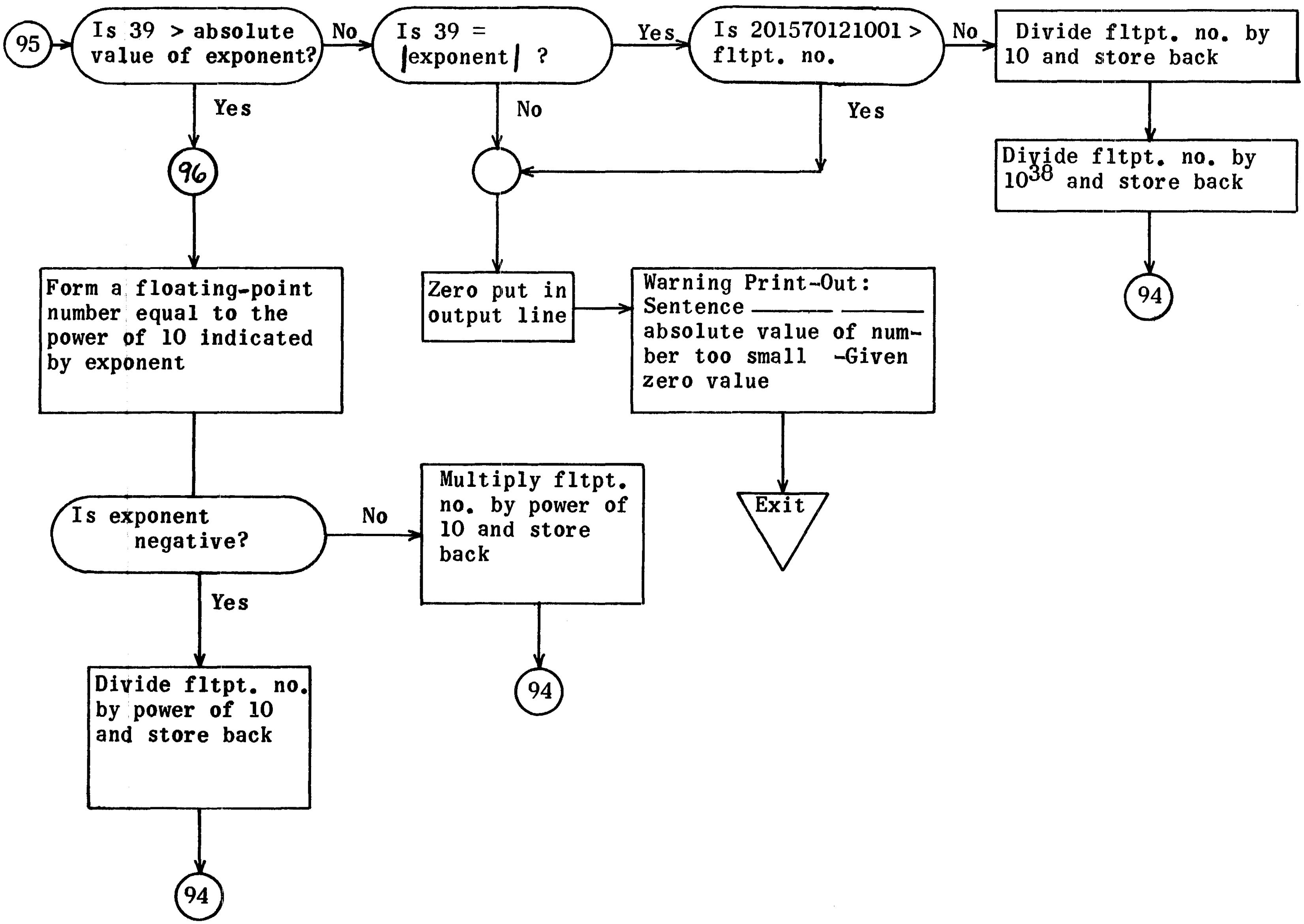


IN Superior Figure to Excess Three Lower-Case Figure Routines

Flow Chart for IQ - Scientific Notation Evaluation Routine




92
Is 1 > floating-point number?
No
93
Is 1 = floating point number?
No
Is 10 > floating point number?
No
Add 1 to exponent value
Yes
Reduce exponent value by 1
Yes
Yes
Floating divide floating-point number by 10 and store quotient back in input line
93
Floating Multiply by 10 and store answer back in input line of fltpt. number
92
Is exponent zero?
Yes
94
Has negative indicator been set?
Yes
Complement floating-pt. output
NO
NO
Exit
Exit
95
96
Yes
Yes
Is exponent negative?
No
Is 38 > exponent?
No
Is 38 = exponent?
Yes
Is floating-point no. > 201663437341?
No
Yes
No
Multiply floating point number by 10^38
94
Exit
Error reference and print-out: Sentence___ ___ absolute value of number too large


95
Is 39 > absolute value of exponent?
No
Is 39 = |exponent| ?
Yes
Is 201570121001 > fltpt. no.
No
Divide fltpt. no. by 10 and store back
Yes
96
No
Yes
Divide fltpt. no. by 10^38 and store back
Form a floating-point number equal to the power of 10 indicated by exponent
Zero put in output line
Warning Print-Out: Sentence ______ ______ absolute value of number too small -Given zero value
94
Is exponent negative?
No
Multiply fltpt. no. by power of 10 and store back
Exit
Yes
Divide fltpt. no. by power of 10 and store back
94
94

IF STRING-OUT REGIONS

RE	SC4417	Two auxiliary print-out routines
RE	IE4430	Constant routine
RE	IF4565	Control routine
RE	IG4631	Fixed point variable routine
RE	IH4655	Floating point variable routine
RE	II4777	Relation symbol routine
RE	IJ5120	Jump routine
RE	IK5316	Termination space period routine
RE	IL5340	Floating point variable routine
RE	IM5503	Excess-Three Print-out storage
RE	IN5617	Superior to lower-case figure routine
RE	IO5647	Storage for "IN"
RE	IQ5676	Scientific notation check
RE	IR6025	Constants for IQ
RE	IS6037	Three temps. for IQ
RE	IT6042	Preliminary number comparison routine
RE	IU6105	2nd control routine
RE	IY6141	2nd constant and fixed-point variable routine
RE	JB6177	2nd floating-point variable routine
RE	JC6261	2nd relation symbol routine
RE	JF6305	2nd jump routine
RE	JI6470	Relation code assignment and consistency
RE	UF6614	Constant storage
RE	ID6702	Error print-out routines.

String-Out Subroutine regions are also needed to assemble the IF tapes.

IF String-Out (Tape 1)

Auxiliary Print-Out Routines

	IA	SC		
0	TP	VN1	WB3	
1	TP	UF2	WB5	Assists in warning that "if" sentence to
2	TP	WB10	WB6	"jump" change has been made.
3	RJ	WA	WA12	
4	MJ	0	30000	
5	TP	SC10	UP3	
6	RJ	UP2	UP	Prints symbol occurring in sentence at
7	MJ	0	30000	point where analysis breaks down in
10	40	SY2	1	print-out: Incorrectly written ______
	CA	SC11		

Control Routine

	IA	IF			
0	MJ	0	CT		Exit
1	RP	10031	IF3		Clearing lines to be used for output
2	TP	UF7	VN4		
3	RP	10031	IF5		Clearing temporary storage lines
4	TP	UF7	VN71		
5	TP	UF30	VN		Number of lines (34) to of VN
6	TV	IF43	II		Setting up first line of relation routine.
7	TP	TS4	Q		Pseudo-op test
10	QJ	IF11	IF12		
11	TP	UF27	VN33		Pseudo-op indicator to VN33
12	RJ	SY	SY1		Getting next symbol
13	TP	SY2	A		Symbol to A
14	TP	SY2	VN75		First 2 symbol output lines to
15	TP	SY3	VN76		temporary storage
16	EJ	UF20	IF12	,	
17	EJ	UF21	IF12	;	Get next symbol.
20	EJ	UF2	IF12	if	
21	EJ	UF14	IK	Δ.	Jump to space, period routine
22	EJ	UF4	IF35	—	Jump to negative sign subroutine
23	EJ	UF3	IF41	|	Jump to absolute sign subroutine
24	EJ	UF17	IF12	(	Get next symbol
25	TP	SY11	Q		Is symbol a constant? If so, jump to
26	QJ	IE	IF27		constant routine, ie
27	TP	SY10	Q		Is symbol a fixed-point variable. If so,
30	QJ	IG	IF31		jump to IG, fixed-point variable routine
31	TP	SY7	Q		Is symbol a floating-point variable?
32	QJ	IH	IF33		Jump to IH
33	RJ	ID16	ID13		Sentence -- (If) Symbol Rejected --
34	MJ	0	IF12		
35	TP	VN107	Q		Puts negative sign indicator in proper
36	QJ	IF12	IF37		storage if an absolute sign has not
37	TP	UF27	VN106		preceded it.
40	MJ	0	IF12		

41	TP	UF27	VN107	Puts absolute sign indicator in proper storage space
42	MJ	0	IF12	
43	0	0	II3	
	CA	IF44		

Constant Routine

	IA	IE		
0	RJ	RB	RB1	Checks if figure has: 1 or fewer .'s; 12 or less characters; no letters
1	TP	II	A	Check if right of relation symbol
2	EJ	IE134	IE5	
3	TP	UF27	VN31	Constant indicator for X figure to output
4	MJ	0	IE6	
5	TP	UF27	VN32	Constant indicator for Y figure to output
6	TP	SY5	A	Is 7 > number of characters?
7	TJ	UF23	IE27	
10	TP	VN75	GG4	Conversion of figure to floating point
11	TP	VN76	GG5	
12	RJ	GG2	GG	
13	TP	GG3	VN71	Floating-point output to proper storage
14	TP	UF27	VN121	Floating-point indicator to storage
15	RJ	SY	SY1	Get next symbol
16	TP	SY2	A	
17	EJ	UF	IE46	Is symbol an e?
20	EJ	UF1	IE102	Is symbol a * ?
21	RJ	IE26	IE23	Jump to negative-value subroutine
22	MJ	0	IE117	
23	TP	VN106	Q	Is negative value desired?
24	QJ	IE25	IE26	
25	TN	VN71	VN71	Changing floating point figure to negative figure
26	MJ	0	30000	
27	TP	SY6	A	Are number of decimal points zero?
30	ZJ	IE10	IE31	
31	TP	VN75	VN72	Storing fixed-point X3 figure
32	RJ	SY	SY1	Getting next symbol
33	TP	SY2	A	
34	EJ	UF	IE45	Is e next symbol?
35	EJ	UF1	IE101	Is * next symbol?
36	MJ	0	IE117	Continuation beyond scientific-notation analysis
37	TP	VN72	GG4	Changing fixed-point X3 decimal figure to a floating-point number
40	TP	UF31	GG5	
41	RJ	GG2	GG	
42	TP	GG3	VN71	
43	TP	UF27	VN121	Floating-point indicator to storage
44	MJ	0	30000	
45	RJ	IE44	IE37	Changing fixed-point no. to a floating-point no.
46	RJ	SY	SY1	Getting next symbol
47	TP	SY2	A	

50	EJ	UF4	IE112	Is symbol a negative sign?
51	EJ	UF5	IE112	Is symbol a superior negative sign?
52	TP	SY11	Q	Is symbol a figure?
53	QJ	IE54	ID42	If not, print-out. Sentence - - Scientific notation incorrectly written
54	TP	SY2	VN100	Storing figure
55	TP	SY13	Q	Is symbol an exponent figure? if not, go directly to X3 decimal to octal conversion at IE63
56	QJ	IE57	IE63	
57	TP	SY2	IN2	Conversion of exponent to X3 decimal figure
60	RJ	IN	IN1	
61	TP	IN2	RS4	Output to RS 4 and jump to octal conversion routine
62	MJ	0	IE65	
63	RJ	RD	RD1	Check if symbol is a legitimate fixed-point figure
64	TP	SY2	RS4	Conversion of figure to octal
65	RJ	RS2	RS	
66	TP	VN77	Q	Check if sign of figure is negative
67	QJ	IE70	IE72	
70	TN	RS3	IQ3	Complementing figure and putting into scientific notation routine input
71	MJ	0	IE73	
72	TP	RS3	IQ3	Figure to input of scientific notation routine
73	TP	VN71	IQ2	Floating-point figure to input of IQ scientific notation routine
74	MJ	0	IE75	Dummy jump (replaces a discarded instruction)
75	RJ	IQ	IQ1	Check of scientific notation figures and converts to floating point
76	TP	IQ2	VN71	Output to storage
77	RJ	IE26	IE23	Changing output to negative if desired
100	MJ	0	IE115	Continuation beyond scientific notation
101	RJ	IE44	IE37	Changing fixed point to floating point no.
102	RJ	SY	SY1	Getting next symbol
103	TP	SY2	A	
104	EJ	UF22	IE106	Is next symbol a 10?
105	MJ	0	ID42	Print-out: Sentence -- Scientific notation incorrectly written
106	RJ	SY	SY1	Getting next symbol
107	TP	SY2	A	
110	EJ	UF25	IE46	Is symbol = POW?
111	MJ	0	IE50	If not, jump to other equality tests.
112	TP	UF27	VN77	Negative sign indicator storage for exponent
113	RJ	SY	SY1	Getting next symbol
114	MJ	0	IE52	
115	RJ	SY	SY1	Getting next symbol
116	TP	SY2	A	
117	EJ	UF3	IE130	Is symbol an absolute sign?
120	RP	20004	IE122	Is symbol) (, ; ?
121	EJ	UF16	IE115	
122	RP	20004	IE124	If symbol is < > = NOT jump to II relation symbol routine
123	EJ	UF10	II	

```
124  EJ  UF15   IJ      If symbol is JUMP, go to IJ jump routine
125  EJ  UF14   IK      Δ. exit
126  RJ  ID16   ID13    Print-out:  Sentence -- Symbol Rejected --
127  MJ  0      IE115
130  TP  VN107  Q       Has an open absolute sign been encountered?
131  QJ  IE115  IE132   If not, reference error routine and print-
132  RJ  ID56   ID52    out:Sentence- -Open absolute sign missing.
133  MJ  0      IE115
134  RJ  II     II1
     CA  IE135
```

Fixed-Point Variable Routine

```
Fixed-point      IA  IG
variable      0  RJ  RH     RH1     Check if symbol is a valid variable
routine -     1  TP  UF27   VN74    Set fixed-point variable indicator
1st letter    2  TP  TS4    Q       Is "if" sentence within Pseudo-Operation
i,j,k,l, or   3  QJ  IG4    IG10
m             4  RJ  TS     TS1     Is symbol in Pseudo-Op list?
              5  MJ  0      IG10    No
              6  TP  TS3    VN110   Yes.  Pseudo-Op call word to location
              7  MJ  0      IE115
             10  RJ  TA     TA1     Is symbol in Combination List?
             11  MJ  0      IG14    No
             12  TP  TA4    VN110   Yes
             13  MJ  0      IE115   Exit for terminating characters before
                                    a divide or jump
             14  RJ  TK     TK1     Get next call word of 64, 65, 66 type
             15  AT  UF32   VN110   Adding in 64000 (fixed-point variable call-
                                    word base)
             16  TP  UF33   TF
             17  TP  SY2    TF1     Building up file for addition of item
             20  TP  A      TF2     to Combination List
             21  TP  UF7    TF3
             22  RJ  TE     TE1     Adding file to Combination List
             23  MJ  0      IE115   Exit for terminating characters before a
                                    divide or jump
                 CA  IG24
```

Floating-Point Variable Routine

```
     IA  IH
 0   TV  IL136  IL40
 1   TV  IL136  IL20
 2   TV  IL136  IL32
 3   TV  IL131  IL61    Set-ups
 4   TV  IL132  IL56
 5   TV  IL132  IL53
 6   TV  IL137  IL112
 7   TV  IL140  IL113
10   RJ  RH     RH1     Check if valid variable.
11   TP  TS4    Q       Check if within pseudo-operation
12   QJ  IH13   IH61
```

Within Pseudo-Op	13	RJ	TS	TS1	Is symbol in pseudo-op list?
	14	MJ	0	IH46	No
	15	TP	TS3	VN110	Yes. Call word to temporary location
	16	TP	UF34	A	Is call word > 76000?
	17	TJ	VN110	IH21	
	20	MJ	0	IL64	Exit subroutine
Ps-Op Sub. Var.	21	TP	UF37	Q	Number of subscripts to $(vn105)_v$
	22	QT	VN110	VN105	
	23	LQ	VN105	36	
	24	RS	Q	UF6	Subscript index set up
	25	TP	Q	VN115	
	26	TP	UF40	Q	630 RR to A_u
	27	QT	VN110	A	
	30	SA	UF41	17	
	31	TP	A	VN73	630 (RR + no. subscripts), call word of modulus, to $(vn105)_u$
	32	LQ	VN105	A17	
	33	AT	VN73	A	
	34	TU	A	VN105	
	35	TP	VN115	A	Is subscript index zero?
	36	ZJ	IH37	IH41	
	37	RA	VN73	UF42	Call word of multiplier formed in $(vn73)_u$
	40	RJ	IL60	IL56	Multiplier call word to u of proper location
	41	RJ	IL25	IL	Handling subscript as constant & checking on variable.
	42	RJ	IL33	IL26	Checking if fixed-point variable is in pseudo-op list and getting call word, if so
	43	RJ	IL52	IL34	Checking if fixed-point variable is in combination List and, if not, adding it in. Call word to location.
	44	IJ	VN115	IH36	
	45	MJ	0	IE115	
	46	TV	IL141	IL20	
	47	TV	IL141	IL40	
	50	TV	IL141	IL32	
	51	RJ	IH121	IH72	Check if symbol is in Comb. List and, if not, adding it in
	52	ZJ	IH53	IH54	Is index vn115 zero?
	53	RJ	IL130	IL112	Call word for multiplier to location
	54	RJ	IL25	IL	Constant or fixed-point variable subscript to location. Constant call wd to location.
	55	RJ	IL33	IL26	Search for call word of var. in pseudo-op list
	56	RJ	IL52	IL34	Search for call word of var. in Comb. List and adding it in if not found

```
              57  IJ  VN115   IH52
              60  MJ  0       IE115
Not within    61  TV  IL142   IL20
Pseudo-Op     62  TV  IL142   IL40
              63  RJ  IH121   IH72     Check if symbol is in Comb. List and,
                                       if not, adding it in
              64  ZJ  IH65    IH66     Is subscript index zero?
              65  RJ  IL130   IL112    Call word for multiplier to location
              66  RJ  IL25    IL       Handling subscripts as constant
                                       & checking on variable
              67  RJ  IL52    IL34     Checking if fixed-point variable is
                                       in Comb. List and, if not, adding it
                                       in.  Call word to location.
              70  IJ  VN115   IH64
              71  MJ  0       IE115
              72  RJ  TA      TA1      Check if symbol is in Combination List
              73  MJ  0       IH100    Not in
              74  TP  TA4     VN110    Is in.  Putting call word into loca-
                                       tion
              75  TP  UF36    A        Check if symbol is a subscripted var-
              76  TJ  VN110   IH110    iable of 77 --- type
              77  MJ  0       IL64
             100  RJ  TK      TK1      To get call word of 64, 65, 66 types
             101  AT  UF43    VN110    Adding in 65000 (has to be fl. pt.
                                       var.) and storing
             102  TP  UF33    TF
             103  TP  SY2     TF1
             104  TP  A       TF2      Adding file to Combination List
             105  TP  UF7     TF3
             106  RJ  TE      TE1
             107  MJ  0       IE115
             110  TP  UF44    Q
             111  QT  TA5     VN105    Number of subscripts to (vn105)v
             112  ST  UF6     VN115    Setting up index
             113  TP  UF45    Q
             114  QT  TA5     A        Modulus to Av
             115  LQ  A       25
             116  RJ  GW      GW1
             117  TU  A       VN105    Call word of modulus to (vn105)u
             120  TP  VN115   A
             121  MJ  0       30000
                  CA  IH122
```

		IA	IL		
Subscript a constant	0	RJ	SY	SY1	Getting next symbol
	1	TP	SY2	A	
	2	RP	20004	IL4	Is symbol) (, ; ?
	3	EJ	UF16	IL	
	4	TP	SY11	Q	Is symbol a constant?
	5	QJ	IL6	IL21	
	6	TP	SY13	Q	If symbol is a superior figure, error
	7	QJ	IJ12	IL10	ref. and print-out occurs: Sentence -- (If) Incorrectly Written --
	10	RJ	RD	RD1	Check for validity of fixed-point constant
	11	RJ	IL63	IL61	Put constant in temporary location
	12	TP	SY2	RS4	Converting constant to octal
	13	RJ	RS2	RS	
	14	TP	RS3	A	Getting call word for constant
	15	RJ	GW	GW1	
	16	TU	UF35	IL53	Constant call word to temp. location
	17	RJ	IL55	IL53	
	20	MJ	0	[IH44]	Jump index check for subscripts of pseudo ops. IH57 or IH70 in v occasionally
	21	TP	SY10	Q	Test if symbol is a fixed-point variable. If not, error print: Sentence incorrectly written --
	22	QJ	IL23	IJ12	
Subscript a fixed-point variable	23	RJ	RH	RH1	Check for validity of variable
	24	RJ	IL63	IL61	Variable to temp. location
	25	MJ	0	30000	
	26	RJ	TS	TS1	Check if variable is in pseudo-op list
	27	MJ	0	IL33	Not in list
Getting call word for var. in pseudo-op list	30	TU	IL135	IL53	Is in list. Putting call word in location
	31	RJ	IL55	IL53	
	32	MJ	0	[IH44]	Or IH 57 in v
	33	MJ	0	30000	
	34	RJ	TA	TA1	Check if fixed-point variable is in Combination List
	35	MJ	0	IL41	Not in list

Getting	36	TU	IL134	IL53	Is in List
call word	37	RJ	IL55	IL53	Call word to location
for var.	40	MJ	0	[IH44]	Jump to subscript index for pseudo-op.
in Comb.					(IH57 or IH70 in v occasionally)
List	41	RJ	TK	TK1	To get call word (next) of 64, 65, 66
Putting	42	AT	UF32	TF2	Adding in 64000
call word	43	TP	UF33	TF	
for var.	44	TP	SY2	TF1	Adding variable and call word to
in Comb.	45	TP	UF7	TF3	Combination List
List and	46	RJ	TE	TE1	
temp.	47	TP	TF2	Q	
location	50	TU	UF35	IL53	Putting call word in location
	51	RJ	IL55	IL53	
	52	MJ	0	30000	
	53	TV	[Q]	[VN111]	Call word to location
	54	RA	IL53	UF6	
	55	MJ	0	30000	
	56	TU	VN73	[VN111]	
	57	RA	IL56	UF6	Call word for multiplier to location
	60	MJ	0	30000	
	61	TP	SY2	[VN101]	
	62	RA	IL61	UF6	Storage of X3 for subscripts
	63	MJ	0	30000	
	64	TP	VN110	A	
Exit	65	TJ	UF46	IL67	Is it a dummy function ?
subroutine	66	TJ	UF47	IE115	Is it not a function?
	67	RJ	SY	SY1	Get next symbol
	70	TP	SY2	A	
	71	RP	20004	IL72	( ) , ; checks
	72	EJ	UF16	IL67	
	73	EJ	UF3	IL106	| sign check
	74	RP	20004	IL76	
	75	EF	UF10	II	< > = NOT
	76	EJ	UF15	IJ	JUMP
	77	EJ	UF14	IK	Δ .
	100	TP	SY7	Q	Test if symbol is a variable used as
	101	QJ	IL67	IL102	argument of single-valued function
	102	TP	SY11	Q	Test if symbol is a constant used as
	103	QJ	IL67	IL104	argument of single-valued function
	104	RJ	ID16	ID13	Error Print: Symbol Rejected --
	105	MJ	0	IL67	
	106	TP	VN107	Q	
Check for	107	QJ	IL67	IL110	Test if there has been an open abso-
open ab-					lute sign
solute	110	RJ	ID56	ID52	Error print: Open absolute sign
sign					missing
	111	MJ	0	IL67	
	112	RJ	IL112	[IL117]	1-shot switch
	113	RJ	IL113	[IL122]	1-shot switch
	114	TP	UF44	Q	3rd Multiplier → A
	115	QT	TA7	A	
	116	MJ	0	IL125	

```
117  TP   UF44    Q         1st Multiplier ⟶ A
120  QT   TA6     A
121  MJ   0       IL125
122  TP   UF45    Q
123  QT   TA6     A         2nd Multiplier ⟶ A
124  LQ   A       25
125  RJ   GW      GW1       Call word for multiplier to (VN73)u
126  TU   A       VN73
127  RJ   IL60    IL56      Call word to proper temporary loca-
                            tion
130  MJ   0       30000
131  0    0       VN101
132  0    0       VN111
133  0    VN73    0
134  0    TA4     0
135  0    TS3     0         Pseudo-op list routine location
136  0    0       IH44
137  0    0       IL117
140  0    0       IL122
141  0    0       IH57
142  0    0       IH70
     CA   IL143
```

Relation Symbol Routine

```
     IA   II
  0  RJ   II      II3
  1  RJ   ID40    ID34      Error Print:  Sentence (IF) Incor-
                            rectly written --
  2  MJ   0       IF
  3  TP   A       VN117     Store 1st relation symbol
  4  TP   UF6     VN116     Start count of relation symbols
  5  RJ   SY      SY1       Get next symbol
  6  TP   SY2     A
  7  RP   20003   II13      <  >  = tests
 10  EJ   UF10    II11
 11  TP   A       VN120     Store 2nd relation symbol
 12  RA   VN116   UF6       Up count of relation symbols
 13  EJ   UF13    II1       Not?
 14  RP   30031   II16      Transfer block of X data to new tem-
 15  TP   VN71    VN40      porary location
 16  RP   10031   II20      Clearing storage for reception of Y
 17  TP   UF7     VN71      data
 20  TP   VN65    A         Is count of relation symbols equal
 21  EJ   UF26    II41      to 2?
```

```
One            22   TP   VN66     A
relation       23   EJ   UF10     II27        <
symbol         24   EJ   UF11     II31        >    Symbol tests
               25   EJ   UF12     II33        =
               26   MJ   0        II35        NOT
               27   TP   UF26     VN4         < "2" indicator to output
               30   MJ   0        IF13        Return to if control routine to
                                              examine symbol not used        •
               31   TP   UF61     VN4         >  "4" indicator to output
               32   MJ   0        IF13
               33   TP   UF60     VN4         = "3" indicator to output
               34   MJ   0        IF13
               35   RJ   ID121    ID116       Sentence -- NOT interpreted as NOT
                                              EQUAL
               36   TP   UF63     VN4         NOT = "6" indicator to output
               37   TP   UF26     VN65        Putting 2 in relation-symbol counter
               40   MJ   0        IF13
When there     41   TP   VN66     A
are two        42   EJ   UF13     II46        NOT?
relation       43   EJ   UF10     II60        < ?
symbols        44   EJ   UF11     II73        > ?
               45   MJ   0        II106       =
  NOT         {46   TP   VN67     A
              {47   EJ   UF10     II52        < ?
              {50   EJ   UF11     II54        > ?
              {51   MJ   0        II56        =
               52   TP   UF64     VN4         NOT< indicator "7" to output line for
                                              1st test
               53   MJ   0        IF12        Return to if control routine to get
                                              next symbol
               54   TP   UF62     VN4         NOT > indicator "5" to output line
                                              for 1st test
               55   MJ   0        IF12
               56   TP   UF63     VN4         NOT = indicator "6" to output line
                                              for 1st test
               57   MJ   0        IF12
    <          60   TP   VN67     A
               61   EJ   UF10     II64        <<?
               62   EJ   UF11     II67        <>?
               63   MJ   0        II71        < =
               64   TP   UF6      VN65        <<
               65   TP   UF26     VN4
               66   MJ   0        IF12
               67   TP   UF63     VN4         <>or NOT = indicator "6" to output
               70   MJ   0        IF12
               71   TP   UF62     VN4        <=indicator "5" to output
               72   MJ   0        IF12
    >          73   TP   VN67     A
               74   EJ   UF10     II77        ><?
               75   EJ   UF11     II101       >>?
```

```
              76   MJ   0       II104     > =
              77   TP   UF63    VN4       NOT = indicator "6" to output
             100   MJ   0       IF12
             101   TP   UF6     VN65      >>  Count of relation symbols reduced
                                          to 1
             102   TP   UF61    VN4       Indicator "4" to output
             103   MJ   0       IF12
             104   TP   UF64    VN4       >   = indicator "7" to output
             105   MJ   0       IF12
      =      106   TP   VN67    A
             107   EJ   UF10    II112     = < ?
             110   EJ   UF11    II114     = > ?
             111   MJ   0       II116     = =
             112   TP   UF62    VN4       = <  indicator "5" to output
             113   MJ   0       IF12
             114   TP   UF64    VN4       = >  indicator "7" to output
             115   MJ   0       IF12
             116   TP   UF6     VN65      = = Count of relation symbols reduced
                                          to 1
             117   TP   UF60    VN4       Indicator "3" to output
             120   MJ   0       IF12
                   CA   II121
```

Relation Symbol Code Assignment and Consistency Routine

```
                   IA   JI
               0   MJ   0       30000
               1   TP   UF7     JI123     Clearing temporary
Relation       2   TP   VN6     A
symbols        3   ZJ   J14     JI21      Has a 2nd-test relation symbol been
in vn4 and                                supplied?
vn6            4   TP   VN142   A
               5   EJ   UF26    JI12      Is the count of relation symbols 2?
               6   TP   VN143   A
1 in           7   EJ   UF10    JI13      < ?
vn142         10   EJ   UF11    JI15      >  ?
count         11   EJ   UF12    JI17      =  ?
              12   MJ   0       ID103     Error Print:  Comparison symbols
                                          ambiguous
              13   TP   UF26    JI123     <  Indicator "2" to temporary
              14   MJ   0       JI
              15   TP   UF61    JI123     >  Indicator "4" to temporary
              16   MJ   0       JI
              17   TP   UF60    JI123     =  Indicator "3" to temporary
              20   MJ   0       JI
              21   TP   VN65    A         If 2 relation symbols in 1st part of
              22   EJ   UF26    JI4       if or in vn4, go to above
              23   TP   VN142   A
1 in vn4      24   EJ   UF26    JI44      Is the current count of relation
2 coming                                  symbols 2?
up
```

```
              25   TP   VN143   A
              26   EJ   UF10    JI32     <  ?
1 in vn4      27   EJ   UF11    JI34     >  ?
1 coming      30   EJ   UF12    JI36     =  ?
up to go      31   MJ   0       JI40     NOT
in vn6        32   TP   UF26    VN6      <  Indicator "2" to 2nd test output
                                         line
              33   MJ   0       JI
              34   TP   UF61    VN6      >  Indicator "4" to 2nd test output
                                         line
              35   MJ   0       JI
              36   TP   UF60    VN6      =  Indicator "3" to 2nd test output
                                         line
              37   MJ   0       JI
              40   TP   UF63    JI123 }  "NOT" occurring alone was miscounted
                                      }  as one. Recounted as 2
              41   TP   UF26    VN142 }
              42   RJ   ID121   ID116    Print:  NOT interpreted as NOT EQUAL
              43   MJ   0       JI
2 relation    44   TP   VN143   A
symbols.      45   EJ   UF10    JI62     <  ?
Nothing       46   EJ   UF11    JI110    >  ?
in vn6,       47   EJ   UF12    JI75     =  ?
1 in vn4      50   TP   VN144   A        NOT
              51   EJ   UF10    JI54     NOT  < ?
              52   EJ   UF11    JI56     NOT  > ?
              53   MJ   0       JI60     NOT  =
              54   TP   UF64    JI123    NOT <Indicator "7" to temporary
              55   MJ   0       JI
              56   TP   UF62    JI123    NOT >Indicator "5" to temporary
              57   MJ   0       JI
              60   TP   UF63    JI123    NOT  = Indicator "6" to temporary
              61   MJ   0       JI
              62   TP   VN144   A
              63   EJ   UF10    JI66      < <   ?
              64   EJ   UF11    JI71      < >   ?
              65   MJ   0       JI73      <     =
1 in vn 4     66   TP   UF6     VN142 }   << Correction of 2 count to 1 count
1 in vn 6     67   TP   UF26    VN6   }      Indicator "2" in 2nd test output
                                             line
              70   MJ   0       JI
              71   TP   UF63    JI123     <> Indicator "6" to temporary
              72   MJ   0       JI
              73   TP   UF62    JI123     < = Indicator "5" to temporary
              74   MJ   0       JI
              75   TP   VN144   A
              76   EJ   UF10    JI101    = < ?
              77   EJ   UF11    JI103    = > ?
             100   MJ   0       JI105    = =
             101   TP   UF62    JI123    = < Indicator "5" to temporary
             102   MJ   0       JI
             103   TP   UF64    JI123    = > Indicator "7" to temporary
```

```
           104  MJ   0       JI
1 in vn4   105  TP   UF6     VN142    = =) Correction of 2 count to 1
1 in vn6   106  TP   UF60    VN6         > count. Indicator 3 to 2nd test
                                         ) output line
           107  MJ   0       JI
           110  TP   VN144   A
           111  EJ   UF10    JI114      >< ?
           112  EJ   UF11    JI116      >> ?
           113  MJ   0       JI121    >  =
           114  TP   UF63    JI123    <>   Indicator 6 to temporary
           115  MJ   0       JI
1 in vn4   116  TP   UF6     VN142    >>  ) Corr. of 2 count to 1
1 in vn6   117  TP   UF61    VN6          > Indicator "4" to 2nd test
                                          ) output line
           120  MJ   0       JI
           121  TP   UF64    JI123   >=  Indicator "7" to temporary
           122  MJ   0       JI
           123  0    0       0
                CA   JI124
```

Constant Storage

	IA	UF		
0	30	77777	77777	e
1	56	77777	77777	*
2	34	31777	77777	if
3	42	77777	77777	|
4	02	77777	77777	-
5	00	77777	77777	∀/
6	0	0	1	
7	0	0	0	
10	37	77777	77777	<
11	16	77777	77777	>
12	76	77777	77777	=
13	50	51667	77777	NOT
14	01	22777	77777	Δ .
15	44	67475	27777	JUMP
16	43	77777	77777	)
17	17	77777	77777	(
20	21	77777	77777	,
21	23	77777	77777	;
22	04	03777	77777	10
23	0	0	7	
24	0	0	14	12
25	52	51717	77777	POW
26	0	0	2	<
27	40	0	0	
30	0	0	34	
31	77	77777	77777	
32	0	0	64000	
33	0	3	3	
34	0	0	76000	

35	0	31000	0	
36	0	0	76777	
37	0	0	00700	
40	0	0	00077	
41	0	0	63000	
42	0	1	0	
43	0	0	65000	
44	0	0	77777	
45	0	77777	0	
46	0	0	62000	
47	0	0	66000	
50	0	0	11	9
51	66	51777	77777	TO
52	65	30506	63050	SENTEN
53	65	66246	63047	STATEM
54	46	34503	07777	LINE
55	50	67472	53054	NUMBER
56	50	51227	77777	NO.
57	65	30506	62277	SENT.
60	0	0	3	=
61	0	0	4	>
62	0	0	5	≤
63	0	0	6	NOT =
64	0	0	7	≥
65	0	0	10	
	CA	UF66		

If String-Out (Tape 2)

Error Print-Out Routines

	IA	ID		
0	TP	SY2	ID22	Storing rejected symbol and referencing
1	RJ	WA	WA2	sentence number routine
2	MJ	0	30000	
3	RJ	WA	WA1	
4	TP	ID7	UP3	Sentence -- (If)
5	RJ	UP2	UP	Inconsistent sign change
6	MJ	0	IF	
7	40	IM3	4	Error routine referenced
10	40	ID17	4	
11	0	IM	3	
12	0	0	0	
13	RJ	ID2	ID	
14	TP	ID10	UP3	Sentence -- (If) Symbol Rejected --
15	RJ	UP2	UP	
16	MJ	0	30000	
17	65	73472	55146	
20	01	54304	43026	
21	66	30270	10101	Warning only
22	0	0	0	
23	TP	A	ID33	
24	AT	IM16	IM15	
25	RJ	WA	WA1	Sentence -- (_____) Disallowable char-
26	TP	ID32	UP3	acter in exponent ______
27	RJ	UP2	UP	
30	TP	ID33	A	
31	MJ	0	30000	
32	40	IM7	7	
33	0	0	0	Error routine referenced
34	RJ	WA	WA1	
35	TP	ID41	UP3	Sentence -- (If) Incorrectly Written
36	RJ	UP2	UP	
37	RJ	SC7	SC5	
40	MJ	0	30000	
41	40	IM17	4	Error routine referenced
42	RJ	WA	WA2	
43	TP	ID51	UP3	
44	RJ	UP2	UP	Sentence -- (If) Scientific notation
45	TP	ID41	UP3	Incorrectly written
46	RJ	UP2	UP	
47	RJ	UZ	UZ1	Error routine referenced
50	MJ	0	IF	
51	40	IM23	4	
52	RJ	UZ	UZ1	
53	RJ	WA	WA2	Sentence -- (If) Open absolute sign
54	TP	ID57	UP3	missing
55	RJ	UP2	UP	
56	MJ	0	30000	
57	40	IM27	5	Error routine referenced

60	RJ	WA	WA2	
61	TP	ID64	UP3	Sentence -- (If) "To" should follow "Jump"
62	RJ	UP2	UP	Warning only
63	MJ	0	30000	
64	40	IM34	4	
65	RJ	SC4	SC	
66	TP	VN4	IM47	Sentence -- (If) becomes unconditional
67	TP	ID72	UP3	Jump to Sentence ________
70	RJ	UP2	UP	
71	MJ	0	30000	Warning only
72	40	IM40	10	
73	RJ	WA	WA2	
74	TP	ID100	UP3	Sentence -- (If) Space period occurs
75	RJ	UP2	UP	before sufficient data given
76	RJ	UZ	UZ1	Reference error routine
77	MJ	0	30000	
100	40	IM50	11	
101	40	IM61	7	
102	40	IM70	5	
103	RJ	UZ	UZ1	Sentence -- (If) Comparison symbols
104	RJ	WA	WA2	ambiguous
105	TP	ID102	UP3	
106	RJ	UP2	UP	Error routine referenced. Terminate
107	MJ	0	IF	analysis of sentence
110	RJ	UZ	UZ1	
111	RJ	WA	WA2	Sentence -- (If) Set of variables differs
112	TP	ID101	UP3	From Initial Set
113	RJ	UP2	UP	
114	MJ	0	IF	Error routine referenced. Analysis
115	40	IM75	6	of sentence terminated.
116	RJ	WA	WA2	
117	TP	ID115	UP3	Sentence -- (If) (NOT) interpreted as
120	RJ	UP2	UP	(NOT EQUAL)
121	MJ	0	30000	Warning only
122	RJ	WA	WA2	
123	RJ	UZ	UZ1	Sentence -- (If) Fixed- and Floating-pt.
124	TP	ID127	UP3	Values are not comparable
125	RJ	UP2	UP	
126	MJ	0	IF	Error routine referenced. Analysis of
127	40	IM103	11	sentence discontinued.
	CA	ID130		

Excess-Three Print-Out Storage

	IA	IM		
0	65	30506	63050	S E N T E N
1	26	30017	77777	C E Δ
2	0	0	0	
3	34	50265	15065	I N C O N S
4	34	65663	05066	I S T E N T

5	01	65343	25001	Δ	S	J	G	N	Δ
6	26	33245	03230	C	H	A	N	G	E
7	01	27346	52446	Δ	D	I	S	A	L
10	46	51712	42546	L	O	W	A	B	L
11	30	01263	32454	E	Δ	C	H	A	R
12	24	26663	05477	A	C	T	E	R	Δ
13	01	34500	13072	Δ	I	N	Δ	E	X
14	52	51503	05066	P	O	N	E	N	T
15	0	0	0						
16	77	77010	10100			Δ	Δ	Δ	
17	01	34502	65154	Δ	I	N	C	O	R
20	54	30266	64673	R	E	C	T	L	Y
21	01	71543	46666	Δ	W	R	I	T	T
22	30	50010	17777	E	N	Δ	Δ	Δ	Δ
23	01	65263	43050	Δ	S	C	I	E	N
24	66	34313	42601	T	I	F	I	C	Δ
25	50	51662	46634	N	O	T	A	T	I
26	51	50777	77777	O	N				
27	01	51523	05001	Δ	O	P	E	N	Δ
30	24	25655	14667	A	B	S	O	L	U
31	66	30016	53432	T	E	Δ	S	I	G
32	50	01473	46565	N	Δ	M	I	S	S
33	34	50327	77777	I	N	G			
34	01	01665	10165	Δ	Δ	T	O	Δ	S
35	33	51674	62701	H	O	U	L	D	Δ
36	31	51464	65171	F	O	L	L	O	W
37	01	44674	75277	Δ	J	U	M	P	Δ
40	01	25302	65147	Δ	B	E	C	O	M
41	30	65010	16750	E	S	Δ	Δ	U	N
42	26	51502	73466	C	O	N	D	I	T
43	34	51502	44601	I	O	N	A	L	Δ
44	44	67475	20166	J	U	M	P	Δ	T
45	51	01653	05066	O	Δ	S	E	N	T
46	30	50263	00177	E	N	C	E	Δ	
47	0	0	0						
50	01	65522	42630	Δ	S	P	A	C	E
51	01	01523	05434	Δ	Δ	P	E	R	I
52	51	27015	12626	O	D	Δ	O	C	C
53	67	54650	12530	U	R	S	Δ	B	E
54	31	51543	00165	F	O	R	E	Δ	S
55	67	31313	42634	U	F	F	I	C	I
56	30	50660	12724	E	N	T	Δ	D	A
57	66	24013	23470	T	A	Δ	G	I	V
60	30	50777	77777	E	N				
61	01	65306	60151	Δ	S	E	T	Δ	O
62	31	01702	45434	F	Δ	V	A	R	I
63	24	25463	06501	A	B	L	E	S	Δ
64	27	34313	13054	D	I	F	F	E	R
65	65	01315	45147	S	Δ	F	R	O	M
66	01	34503	46634	Δ	I	N	I	T	I
67	24	46016	53066	A	L	Δ	S	E	T
70	01	26514	75224	Δ	C	O	M	P	A

71	54	34655	15001	R	I	S	O	N	△
72	65	73472	55146	S	Y	M	B	O	L
73	65	01244	72534	S	△	A	M	B	I
74	32	67516	76522	G	U	O	U	S	.
75	01	17505	16643	△	(	N	O	T	)
76	01	34506	63054	△	I	N	T	E	R
77	52	54306	63027	P	R	E	T	E	D
100	01	24650	11750	△	A	S	△	(	N
101	51	66013	05367	O	T	△	E	Q	U
102	24	46437	77777	A	L	)			
103	31	34723	02776	F	I	X	E	D	-
104	01	24502	70131		A	N	D	△	F
105	46	51246	63450	L	O	A	T	I	N
106	32	76525	13450	G	-	P	O	I	N
107	66	01702	44667	T	△	V	A	L	U
110	30	65012	45430	E	S	△	A	R	E
111	01	50516	60126	△	N	O	T	△	C
112	51	47522	45424	O	M	P	A	R	A
113	25	46307	77777	B	L	E			
	CA	IM114							

Superior to Lower-Case Figure Routine

	IA	IN		
0	MJ	0	30000	Exit
1	MJ	0	IN3	Entry
2	0	0	0	Input-Output Line
3	TP	I02	I01	Setting up index for 6 characters
4	LQ	IN2	6	Masking out 1st character to A
5	QT	I0	A	
6	EJ	I0	IN23	Is character equal to 77?
7	RP	20012	IN25	Is character one of superior X3 decimal figures?
10	EJ	I03	IN11	
11	SN	Q	17	-n, - (j-r)
12	SA	IN7	0	-n, -(j-r) + n, j = r in u position
13	TU	A	IN15	(io15+r) $\longrightarrow$ $in15_u$
14	RA	IN15	IN27	X3 decimal figure representation $\longrightarrow A_v$
15	TP	30000	A	
16	TP	I0	Q	Translated figure is incorporated into Input-Output line
17	QS	A	IN2	
20	IJ	I01	IN4	Index of input exhaustion
21	MJ	0	IN	To exit
22	LQ	IN2	6	When 1st character = 77, no further translation to X3 decimal is performed. The I-O line is merely returned to original position.
23	IJ	I01	IN22	
24	MJ	0	IN	Exit
25	RJ	ID31	ID23	Sentence ---(______) Disallowable character in exponent __________.
26	MJ	0	IN16	
27	0	I014	0	Parameter
	CA	IN30		

Storage for "IN"

	IA	IO		
0	0	0	77	
1	0	0	[5]	
2	0	0	5	
3	0	0	60	0
4	0	0	61	1
5	0	0	40	2
6	0	0	20	3
7	0	0	41	4
10	0	0	35	5
11	0	0	55	6
12	0	0	75	7
13	0	0	36	8
14	0	0	57	9
15	0	0	3	0
16	0	0	4	1
17	0	0	5	2
20	0	0	6	3
21	0	0	7	4
22	0	0	10	5
23	0	0	11	6
24	0	0	12	7
25	0	0	13	8
26	0	0	14	9
	CA	IO27		

		IA	IQ		
Scientific	0	MJ	0	30000	Exit
Notation	1	MJ	0	IQ4	Entry
Evaluation Routine	2	0	0	0	Input in fltpt. of no. to left of e or *. May be neg. or pos. Also output line
	3	0	0	0	Exponent of 10 in octal. May be negative or positive
	4	MJ	0	IQ107	
	5	TP	IQ3	A	If exponent is zero, goes to exit
	6	ZJ	IQ7	IQ	
	7	TP	IQ2	A	Is floating point number negative?
	10	SJ	IQ11	IQ14	
	11	TM	A	IQ2	Changing fltpt. no. to positive and putting negative indicator into is2
	12	TP	IR11	IS2	
	13	TP	IQ2	A	
	14	TJ	IR1	IQ24	Is 1 > floating point input
	15	EJ	IR1	IQ30	Is 1 = floating point input
	16	TJ	IR	IQ30	Is 10 > floating point input
	17	RA	IQ3	IR2	Loop to reduce floating-point number to one between 1 and 10 such that 1 ≤ floating point no. < 10
	20	FD	IQ2	IR	
	21	TP	Q	IQ2	
	22	TP	Q	A	
	23	MJ	0	IQ15	
	24	RS	IQ3	IR2	Loop to increase floating-point number such that 1 ≤ floating-point no. < 10
	25	FM	IQ2	IR	
	26	TP	Q	IQ2	
	27	MJ	0	IQ13	

```
 30  TP  IQ3    A
 31  ZJ  IQ32   IQ45     Is exponent zero?
 32  SJ  IQ33   IQ51     Is exponent negative?
 33  TM  A      A        Is 39 >  |exponent|
 34  TJ  IR4    IQ54
 35  EJ  IR4    IQ37     Is 39 = |exp.|
 36  MJ  0      IQ101    Output to zero. Sentence ___(_______)
                           absolute value of number too small -
                           given zero value
 37  TP  IQ2    A        Is (IR7) > (IQ2)? Same printout and
 40  TJ  IR7    IQ101      action as above.
 41  FD  IQ2    IR       Dividing IQ2 by 10 and storing in IQ2
 42  TP  Q      IQ2
 43  FD  IQ2    IR10     Dividing IQ2 by 10^38 and storing in IQ2
 44  TP  Q      IQ2
 45  TP  IS2    Q        Is negative value of floating point
 46  QJ  IQ47   IQ         desired?
 47  TN  IQ2    IQ2      Making floating-point output negative
 50  MJ  0      IQ
 51  TJ  IR5    IQ54     Is 38 > exp.?
 52  EJ  IR5    IQ71     Is 38 = exp.?
 53  MJ  0      IQ75     Jump to error print-out section
 54  ST  IR2    IS       Setting up index for multiplication
 55  TP  IR     IS1      10 --> IS1
 56  IJ  IS     IQ60     Index jump
 57  MJ  0      IQ63
 60  FM  IS1    IR       Multiplying 10 to power desired in
 61  TP  Q      IS1        floating-point
 62  MJ  0      IQ56
 63  TP  IQ3    A        Is exponent negative?
 64  SJ  IQ65   IQ67
 65  FD  IQ2    IS1      Dividing fltpt. no. by power of 10
                           desired
 66  MJ  0      IQ44
 67  FM  IQ2    IS1      Multiplying fltpt. no. by power of 10
                           desired
 70  MJ  0      IQ44
 71  TP  IR6    A        Is (IQ2) > (IR6) ?  If so, too large.
 72  TJ  IQ2    IQ75
 73  FM  IQ2    IR10     Multiplying by 10^38
 74  MJ  0      IQ44

 75  RJ  WA     WA1
 76  TP  IQ112  UP3      Sentence ___(____) absolute value of
 77  RJ  UP2    UP         number too large
100  MJ  0      IQ       Error routine referenced
101  TP  IR3    IQ2
102  RJ  WA     WA2      Sentence____(____) absolute value of
103  TP  IQ113  UP3        number too small - given zero value
104  RJ  UP2    UP
105  TP  IQ114  UP3      Warning only
106  MJ  0      IQ77
107  TP  IR3    IS2      Clearing is 2
```

110	TP	IQ2	A	If floating point input is zero, goes to exit
111	ZJ	IQ5	IQ	
112	40	IQ115	6	
113	40	IQ115	5	
114	40	IQ123	4	
115	01	01242	56551	Δ Δ A B S O
116	46	67663	00170	L U T E Δ V
117	24	46673	00151	A L U E Δ O
120	31	01506	74725	F Δ N U M B
121	30	54016	65151	E R Δ T O O
122	01	46245	43230	Δ L A R G E
123	01	65472	44646	Δ S M A L L
124	02	02323	47030	- - G I V E
125	50	01743	05451	N Δ Z E R O
126	01	70244	66730	Δ V A L U E
	CA	IQ127		

Constants for IQ

	IA	IR			
0	20	45000	0		10
1	20	14000	0		1
2	0	0	1		
3	0	0	0		
4	0	0	47		39
5	0	0	46		38
6	20	16634	37341	≈	1.70141184
7	20	15701	21001	≈	1.46936801
10	37	74547	32316		10^{38}
11	40	0	0		Indicator
	CA	IR12			

Temporary Storage

IS	0	Multiplication index
	1	Multiplication storage
	2	Negative answer indicator

Jump Routine

		IA	IJ		
	0	RJ	SY	SY1	
	1	TP	SY2	A	
	2	EJ	UF51	IJ14	TO?
	3	RJ	ID63	ID60	Sentence -- (If) "To" should follow "JUMP"
	4	TP	SY2	A	
	5	RP	20007	IJ7	TO, Sentence, Statement, line, number,
	6	EJ	UF51	IJ14	No., Sent.?
	7	EJ	UF14	IK	Δ .
	10	TP	SY5	A	Are no. of chars. of what should be figure < 7?
	11	TJ	UF23	IJ16	
	12	RJ	ID40	ID34	Sentence -- (If) Incorrectly Written --
	13	MJ	0	IF	
	14	RJ	SY	SY1	Get next symbol
	15	MJ	0	IJ4	
	16	TP	SY2	LN4	Getting line number in proper form and storing output
	17	RJ	LN2	LN	
	20	TP	LN3	VN5	
	21	TP	VN70	Q	
	22	QJ	IJ23	IJ53	Is X floating-point constant?
	23	TP	VN121	Q	
	24	QJ	IJ25	IJ30	Is Y floating-point constant?
	25	TP	VN40	IT	
	26	TP	VN71	IT1	Sent to preliminary number comparison
	27	MJ	0	IT2	
	30	TP	VN74	Q	Is Y fixed-point variable?
	31	QJ	ID122	IJ32	
X is floating-point constant	32	TP	VN72	A	Is Y fixed-point constant?
	33	ZJ	IJ40	IJ34	
	34	TP	VN40	A	Y is a floating-point variable. Call word for X constant to VN57
	35	RJ	GW	GW1	
	36	TP	Q	VN57	
	37	MJ	0	IJ160	Jump to end
	40	RJ	IJ52	IJ42	Y to floating-point
	41	MJ	0	IJ25	Jump to comparison
	42	TP	VN72	GG4	
	43	TP	UF31	GG5	Translation of Y fixed-point constant to floating-point and storage
	44	RJ	GG2	GG	
	45	TP	VN106	Q	
	46	QJ	IJ47	IJ51	
	47	TN	GG3	VN71	
	50	MJ	0	IJ52	
	51	TP	GG3	VN71	
	52	MJ	0	30000	
	53	TP	VN41	A	Is X fixed-point constant?
	54	ZJ	IJ55	IJ131	

```
X is        55  TP  VN121  Q       Is Y floating-point constant?
fixed-      56  QJ  IJ57   IJ72
point       57  RJ  IJ71   IJ61    X to floating-point
constant    60  MJ  0      IJ25    Jump to comparison
            61  TP  VN41   GG4
            62  TP  UF31   GG5
            63  RJ  GG2    GG
            64  TP  VN55   Q
            65  QJ  IJ66   IJ70    Translation of X fixed-point constant
            66  TN  GG3    VN40      to floating-point constant and storage
            67  MJ  0      IJ71
            70  TP  GG3    VN40
            71  MJ  0      30000
X is        72  TP  VN72   A       Is Y fixed-point constant?
fixed-      73  ZJ  IJ74   IJ122
point       74  RJ  IJ106  IJ77    X to octal and storage
constant    75  RJ  IJ116  IJ107   Y to octal and storage
            76  MJ  0      IJ117   Jump to fixed-point comparison
            77  TP  VN41   RS4
           100  RJ  RS2    RS
           101  TP  VN55   Q       Translation of X excess-three decimal to
           102  QJ  IJ103  IJ105     octal and storage
           103  TN  RS3    VN41
           104  MJ  0      IJ106
           105  TP  RS3    VN41
           106  MJ  0      30000
           107  TP  VN72   RS4
           110  RJ  RS2    RS      Translation of Y excess-three decimal
           111  TP  VN106  Q         to octal and storage
           112  QJ  IJ113  IJ115
           113  TN  RS3    VN72
           114  MJ  0      IJ116
           115  TP  RS3    VN72
           116  MJ  0      30000
           117  TP  VN41   IT      Fixed-point numbers to preliminary
           120  TP  VN72   IT1       comparison
           121  MJ  0      IT2
           122  TP  VN74   Q       Is Y fixed-point variable?
           123  QJ  IJ124  IJ127
X is       124  RJ  IJ106  IJ77    X to octal and storage
fixed-     125  TP  VN41   A       Getting call word for X and storing
pt. con-   126  MJ  0      IJ35
stant      127  RJ  IJ71   IJ61    X to floating point and storing
           130  MJ  0      IJ34    Getting call word for X and storing
           131  TP  VN43   Q       Is X fixed-point variable?
           132  QJ  IJ133  IJ146
           133  TP  VN121  Q       Is Y floating-point constant?
           134  QJ  ID122  IJ135
           135  TP  VN72   A       Is Y fixed-point constant?
           136  ZJ  IJ137  IJ144
```

	137	RJ	IJ116	IJ107	Y to octal and storage
X is	140	TP	VN72	A	
fixed-	141	RJ	GW	GW1	Getting call word for Y and storing
point	142	TP	Q	VN110	
variable	143	MJ	0	IJ160	
	144	TP	VN74	Q	Is Y fixed-point variable?
	145	QJ	IJ160	ID122	
	146	TP	VN121	Q	Is Y floating-point constant?
	147	QJ	IJ156	IJ150	
	150	TP	VN72	A	Is Y fixed-point constant?
	151	ZJ	IJ152	IJ154	
X is	152	RJ	IJ52	IJ42	Y to floating-point constant
float-	153	MJ	0	IJ156	
ing	154	TP	VN74	Q	Is Y fixed-point variable?
point	155	QJ	ID122	IJ160	
varia-	156	TP	VN71	A	Getting call word for Y and storing
ble	157	MJ	0	IJ141	
	160	RP	30010	IJ162	
	161	TP	VN54	VN11	Transfer of prepared data to output region
	162	RP	30010	IJ164	
	163	TP	VN105	VN21	
	164	TP	VN5	A	
	165	RJ	IX	IX1	
	166	RJ	SY	SY1	
	167	TP	SY2	A	
	170	RP	20004	IJ172	( ) , ; tests
	171	EJ	UF16	IJ166	
	172	EJ	UF14	IK	Δ . check
	173	EJ	UF2	IU	"if" check
	174	RJ	ID40	ID34	Sentence -- (if) Incorrectly Written --
	175	MJ	0	IF	
		CA	IJ176		

Preliminary Number Comparison Routine

		IA	IT		
	0	0	0	0	1st no. X
	1	0	0	0	2nd no. Y
	2	TP	VN4	A	
	3	EJ	UF26	IT11	< ?
	4	EJ	UF60	IT14	= ?
	5	EJ	UF61	IT17	> ?
	6	EJ	UF62	IT22	< ?
	7	EJ	UF63	IT25	≠ ?
	10	MJ	0	IT30	≥
<	11	TP	IT	A	
	12	TJ	IT1	IT32	Change "if" sentence to a "jump"sentence
	13	MJ	0	IF1	Jump back to start of IF
=	14	TP	IT	A	
	15	EJ	IT1	IT32	
	16	MJ	0	IF1	
>	17	TP	IT1	A	

```
          20  TJ  IT     IT32
          21  MJ  0      IF1
     ≤    22  TP  IT1    A
          23  TJ  IT     IF1
          24  MJ  0      IT32
     ≠    25  TP  IT     A
          26  EJ  IT1    IF1
          27  MJ  0      IT32
     ≥    30  TP  IT     A
          31  TJ  IT1    IF1
          32  TP  UF63   VN     Number (6) to 1st line of output
Changing  33  TP  UF15   VN2    JUMP put into title output line
IF to a   34  TP  VN5    VN4    Line number changed to 5th position of
Jump                              output
Sentence  35  TP  VN33   VN5    Pseudo-op indicator to 6th output line
          36  RJ  ID71   ID65   Sentence -- (If) Becomes Unconditional
                                  Jump to Sentence --
          37  TP  VN4    A    }
          40  RJ  IX     IX1  } Line number to reference list
          41  RJ  WT     WT1    Write string-out on tape
          42  MJ  0      IF
              CA  IT43
```

Termination Space Period Routine

```
              IA  IK
           0  TP  VN5    A    }
           1  ZJ  IK2    IK12 } Has a 1st number been filled in?
           2  TP  VN4    A    }
           3  ZJ  IK4    IK12 } Has a 1st relation been filled in?
           4  TP  VN14   A    }
           5  ZJ  IK6    IK12 } Is there a call word for X?
           6  TP  VN24   A    }
           7  ZJ  IK10   IK12 } Is there a call word for Y?
          10  RJ  WT     WT1    To write completed data on tape
          11  MJ  0      IF     Exit
          12  RJ  ID77   ID73   Sentence -- (If) Space period occurs
                                  before sufficient data given
          13  MJ  0      IF
          14  TP  VN10   A    }
          15  ZJ  IK     JF141} Has a 3rd no. been filled in?
          16  TP  VN7    A    }
          17  ZJ  IK20   IK12 } Has a 2nd no. been filled in?
          20  TP  VN6    A    }
          21  ZJ  IK     IK12 } Has a 2nd relation been filled in?
              CA  IK22
```

2nd Control Routine

```
              IA  IU
Initial    0  TP  VN56   VN43   Abs. sign of X to more convient location
Control-   1  TP  VN107  VN74   Abs. sign of Y to more convient location
2nd or     2  RP  10015  IU4    Clearing region of temporary Storage
3rd time   3  TP  UF7    VN150
thru       4  TV  IU33   JC     Setting up divider routine for 2nd or
                                  3rd time thru
```

```
 5   RJ   SY      SY1        Get next symbol
 6   TP   SY2     A
 7   TP   SY2     VN152 }    Store 1st two symbol words in temporary
10   TP   SY3     VN153 }      storage
11   EJ   UF4     IU25       -?
12   EJ   UF3     IU31       |?
13   EJ   UF17    IU5        (?
14   EJ   UF14    IK14       Δ. termination
15   TP   SY11    Q     }
16   QJ   IY      IU17  }    Is symbol a constant?
17   TP   SY10    Q     }
20   QJ   IY33    IU21  }    Is symbol a fixed-point variable?
21   TP   SY7     Q     }
22   QJ   JB      IU23  }    Is symbol a floating-point variable?
23   RJ   ID16    ID13       Sentence -- (If) Symbol Rejected --
24   MJ   0       IU5
25   TP   VN151   Q     }
26   QJ   IU5     IU27  }    Negative sign if no previous absolute sign
27   TP   UF27    VN150 }
30   MJ   0       IU5   }
31   TP   UF27    VN151      Absolute sign indicator to temporary
                              location
32   MJ   0       IU5
33   0    0       JC3
     CA   IU34
```

2nd Constant and Fixed-Point Variable Routine

```
                   IA   IY
Constant       0   TP   VN47    A     }
& Fix-Pt.      1   ZJ   IY4     IY2   }    Did X have a number in scientific notation?
Var.           2   TP   VN100   A     }
Routine -      3   ZJ   IY4     IY33  }    Did Y have a number in scientific notation?
2nd or         4   RJ   SY      SY1        Get next symbol
3rd time       5   TP   SY2     A
Thru           6   EJ   UF      IY4        e?
               7   EJ   UF1     IY21       *?
              10   EJ   UF4     IY16       -?
              11   EJ   UF5     IY16       -?
              12   TP   SY11    Q     }
              13   QJ   IY14    ID110 }    Constant?
              14   TP   SY2     VN155      Exponent to storage
              15   MJ   0       IY33
              16   TP   UF27    VN154      Negative sign indicator (40 0 0) to storage
              17   RJ   SY      SY1        Get next symbol
              20   MJ   0       IY12
              21   RJ   SY      SY1        Get next symbol
              22   TP   SY2     A
              23   EJ   UF22    IY25       10?
              24   MJ   0       ID42
              25   RJ   SY      SY1        Get next symbol
              26   TP   SY2     A
              27   EJ   UF25    IY31       POW?
```

```
              30   MJ   0       IY10
              31   RJ   SY      SY1       Get next symbol
              32   MJ   0       IY10
              33   RJ   JB17    JB6   }
              34   RJ   ID16    ID13  }   Termination check loop
              35   MJ   0       IY33  }
                   CA   IY36
```

2nd Floating-Point Variable Routine

```
                   IA   JB
2nd or         0   RJ   TA      TA1       Is symbol in Comb. List?
3rd time       1   MJ   0       JB32      Not in
thru           2   TP   UF36    A         Is in
               3   TJ   TA4     JB37      Go to subscripted variable portion
Nonsub-        4   RJ   JB17    JB6
script-        5   MJ   0       JB24
ed var-        6   RJ   SY      SY1       Get next symbol
iable          7   TP   SY2     A
              10   RP   20004   JB12  }
              11   EJ   UF16    JB6   }   ) ( , ; tests
Termi-        12   EJ   UF3     JB20      Abs. sign test
nation        13   RP   20004   JB15  }
Loop          14   EJ   UF10    JC    }   < >  = NOT tests
              15   EJ   UF15    JF        JUMP?
              16   EJ   UF14    IK14      Δ.
              17   MJ   0       30000
              20   TP   VN151   Q     }
              21   QJ   JB6     JB22  }   Has open absolute sign been given?
              22   RJ   ID56    ID52      "Sentence -- (If) Open absolute sign
                                            missing" Error routine reference and
              23   MJ   0       JB6         continuation of analysis

              24   TP   SY7     Q     }
              25   QJ   JB4     JB26  }   Is symbol a variable? If either a variable
              26   TP   SY11    Q     }                         or constant, it is
              27   QJ   JB4     JB30  }   Is symbol a constant? assumed to be re-
                                                                dundant argument
                                                                of a single valued
                                                                function and no
                                                                notice is taken
                                                                of it
              30   RJ   ID16    ID13      Sentence -- If Symbol Rejected --
              31   MJ   0       JB4
              32   RJ   TS      TS1       Is symbol in pseudo-op list?
Not in        33   MJ   0       ID110     Sentence -- (If)Set of variables differs
                                            from Initial Set
Is in         34   TP   UF34    A     }
              35   TJ   TS3     JB37  }   Is variable subscripted?
              36   MJ   0       JB4       No
Sub-          37   TV   JB60    JB55      Setting up v of storage subroutine
scripted      40   TP   UF60    JB61      Setting up index
variable      41   RJ   JB17    JB6       Termination check
              42   TP   SY11    Q     }
              43   QJ   JB50    JB44  }   Is symbol a constant?
```

	44	TP	SY10	Q	Is symbol a fixed-point variable?
	45	QJ	JB50	JB46	
	46	RJ	ID16	ID13	Sentence -- (If) Symbol Rejected --
	47	MJ	0	JB41	
	50	RJ	JB57	JB55	Storing const. or fix.-pt. var. XS3 representation
	51	IJ	JB61	JB41	Index jump to start of loop
	52	RJ	JB17	JB6	
	53	RJ	ID16	ID13	Termination check loop
	54	MJ	0	JB52	
	55	TP	SY2	[VN156]	Storage subroutine
	56	RA	JB55	UF6	
	57	MJ	0	30000	
	60	0	0	VN156	
	61	0	0	0	Index temporary
		CA	JB62		
		IA	JC		
Relation	0	RJ	JC	JC3	Sentence -- (If) Incorrectly Written --
Symbol	1	RJ	ID40	ID34	
Routine-	2	MJ	0	IF	
2nd or	3	TP	A	VN163	1st relation symbol to storage
3rd time thru	4	TP	UF6	VN162	Starting count in counter of relation symbols
	5	RJ	SY	SY1	Get next symbol
	6	TP	SY2	A	
	7	RP	20003	JC14	<> = ?
	10	EJ	UF10	JC11	
	11	TP	A	VN164	2nd relation symbol to storage
	12	RA	VN162	UF6	Count of relation symbols increased
	13	MJ	0	JC15	
	14	EJ	UF13	JC1	Is 2nd symbol NOT?
	15	RP	30015	JC17	Transferring data of X_2 to VN130-144
	16	TP	VN150	VN130	
	17	RP	10015	JC21	Clearing VN150-164 for use of Y_2 data accumulation
	20	TP	UF7	VN150	
	21	TP	VN142	A	Is 2 > no. of relation symbols, some value of SY2 hasn't yet been identified and stored
	22	TJ	UF26	IU6	
	23	MJ	0	IU5	Return to gather data on Y
		CA	JC24		

2nd Jump Routine

Jump		IA	JF		
Routine-	0	TU	JF156	JF145	
2nd or	1	TU	JF160	JF146	
3rd time	2	TV	JF154	JF147	
thru	3	RJ	JF153	JF144	Check if $X_2 = X$
	4	TU	JF157	JF145	
	5	TU	JF161	JF146	
	6	TV	JF155	JF147	
	7	RJ	JF153	JF144	Check if $Y_2 = Y$

	10	RJ	JI	JI1	Checks consistency of relation symbols and assigns code figures
	11	TP	VN130	A	
	12	EJ	VN55	JF16	1st left sign = 2nd left sign $X_2(s)=X(s)$
	13	TP	VN150	A	1st left $\neq$ 2nd left $X_2(s) \neq X(s)$
	14	EJ	VN106	ID3	Inconsistent sign change $Y_2(s) = Y(s)$
	15	MJ	0	JF41	Double sign inequality. Relation reversal needed. $Y_2(s) \neq Y(s)$
	16	TP	VN150	A	$Y_2(s) = Y(s)$
	17	EJ	VN106	JF57	Sign of 2nd rt. = sign of 1st rt. Signs O.K. Reversal of relation not needed
	20	MJ	0	ID3	Inconsistent sign change. $Y_2 \neq Y$
	21	TU	JF156	JF145	
	22	TU	JF161	JF146	
	23	TV	JF155	JF147	
	24	RJ	JF153	JF144	Left = Right. Check if $X = Y_2$
	25	TU	JF157	JF145	
	26	TU	JF160	JF146	
	27	RJ	JF153	JF144	Right = Left. Check if $Y = X_2$
	30	RJ	JI	JI1	Checks consistency of relation symbols and assigns code figures
	31	TP	VN130	A	
	32	EJ	VN106	JF36	Sign follows group equality #1 $X_2(s) = Y(s)$
	33	TP	VN150	A	$X_2(s) \neq Y(s)$
	34	EJ	VN55	ID3	Inconsistent sign change $Y_2(s) = X(s)$
	35	MJ	0	JF57	$Y_2(s) \neq X(s)$ Double inequality of signs and reverse equality of no. series means relation reversal not needed
	36	TP	VN150	A	
	37	EJ	VN55	JF41	$Y_2(s) = X(s)$. Sign follows group reverse equality 2nd time. Relation reversal needed
	40	MJ	0	ID3	Inconsistent sign change. $Y_2(s) \neq X(s)$
	41	TP	VN7	A	Is line no. for 2nd test in output?
Reversal	42	ZJ	JF43	JF46	
of re- lation	43	TP	UF63	A	Reversing relation of single symbol in temp. storage $6-\{2,3,4\}=\{4,3,2\}$
symbols	44	ST	JI123	JI123	
due to	45	MJ	0	JF57	
changing	46	TP	VN6	A	Is 2nd test line $\neq$ 0?
of signs	47	ZJ	JF50	JF53	
or alter- ing of	50	TP	UF63	A	Reversing relation of 2nd test line. $6-\{2,3,4\}=\{4,3,2\}$
position	51	ST	VN6	VN6	
of X & Y	52	MJ	0	JF57	
the 2nd	53	TP	VN65	A	Was 1st test a double relation test?
or 3rd	54	EJ	UF26	JF43	
time	55	TP	UF24	A	$12-\{5,6,7\}=\{7,6,5\}$
thru	56	ST	JI123	JI123	

```
Check of     57   TP   VN7     A         Is line no. for 2nd test zero?
consis-      60   ZJ   JF61    JF66
tency of     61   TP   UF50    A
relation     62   ST   VN4     A         [9 - (VN4) - (VN6)]  = (JI123)
symbols      63   ST   VN6     A
             64   EJ   JI123   JF76      Symbol OK. Can get on to rest of jumps
             65   MJ   0       ID103     now
             66   TP   VN6     A         Is 2nd test line = 0?
             67   ZJ   JF70    JF72
             70   EJ   VN4     ID103     Is (VN6) = (VN4)?
             71   MJ   0       JF76
             72   TP   UF50    A         [9 - (VN4)] should equal  (JI123)
             73   ST   VN4     A
             74   EJ   JI123   JF76
             75   MJ   0       ID103     Comparison symbols ambiguous
             76   RJ   SY      SY1       Start of procedure to get line no.
                                           Getting next symbol
Loop to      77   TP   SY2     A
get line    100   EJ   UF51    JF112     Is symbol TO
number      101   RJ   ID63    ID60      TO should follow Jump      (Warning)
            102   TP   SY2     A
            103   RP   20007   JF105     Is symbol TO, SENTEN, STATEM, LINE,
            104   EJ   UF51    JF112       NUMBER, NO., SENT.?
            105   EJ   UF14    IK14      Δ. test
            106   TP   SY5     A         Is 7 > no. of chars.
            107   TJ   UF23    JF114
            110   RJ   ID40    ID34      Incorrectly Written --
            111   MJ   0       IF        Exit
            112   RJ   SY      SY1       Get next symbol
            113   MJ   0       JF102
            114   TP   SY2     LN4
            115   RJ   LN2     LN        Getting line number in standard form
            116   TP   LN3     A
            117   RJ   IX      IX1       Sending line number to reference list
            120   TP   VN6     A         Is 2nd test line zero?
            121   ZJ   JF122   JF124
            122   TP   VN7     A         Has a line number already been put in VN7?
            123   ZJ   JF124   JF131
 Exit       124   TP   LN3     VN10      Line number to unconditional jump line
 loop       125   RJ   SY      SY1
 after      126   EJ   UF16    JF125     ) ?
 final      127   EJ   UF14    IK14      Δ. routine of 2nd or 3rd time thru
 line no.   130   MJ   0       IJ12      Incorrectly Written ______
 is ob-     131   TP   LN3     VN7       Line no. to VN7
 tained     132   RJ   SY      SY1
            133   RP   20004   JF135     ) ( , ; ?
Exit        134   EJ   UF16    JF132
loop        135   EJ   UF14    IK14      Δ . test?
after       136   TP   UF60    VN34      Putting indicator "3" in output to in-
line no.                                   dicate there are to be 3 clauses
for VN7     137   EJ   UF2     IU2       Start of 3rd time thru with recognition
is ob-                                     of "IF"
tained.     140   MJ   0       IJ12      Incorrectly Written --
May be
start of 3rd
time thru if an
"if" is recognized
```

```
141   TP   VN34     A          Is this the third clause being analyzed?
142   EJ   UF60     IK12
143   MJ   0        IK16
144   TP   UF65     JF162      Index set up
145   TP   [VN43 ]  A
146   EJ   [VN131]  JF150      Check if storage of data for a constant
147   MJ   0        JF21         or variable is equal to same data
150   RA   JF145    UF42         gathered for one on the first part of
151   RA   JF146    UF42         an "if" sentence
152   IJ   JF162    JF145
153   MJ   0        30000
154   0    0        JF21
155   0    0        ID110
156   0    VN43     0          X absolute
157   0    VN74     0          Y absolute
160   0    VN131    0
161   0    VN151    0
162   0    0        0          Index temporary storage
      CA   JF163
```

VARY Translation Routine

The VARY translation routine builds from the input VARY sentence the required lists of symbols for generating the VARY coding and for providing the necessary connections so that the stated looping processes can be accomplished. These lists are called the VARY String-out, the VARY File, and the Variable List. In addition to these tasks, this routine makes appropriate checks, where possible, for the writing of VARY sentences containing non-ending loops. It also checks for compatibility of fixed- or floating-point variables and constants within a Modify Component of a VARY sentence.

String-Out Form for VARY Sentence

WL0	0 0 0 0 0 0 0 0 0 t t t	ttt = number of words in string-out	
1	_ _ _ . _ _	Sentence number in standard form	
2	V A R Y 7 7 7 7	XS-3 sentence identifier	
3	0 0 0 0 0 0 0 s s s s s	sssss = sentence call word	
4	0 0 0 0 0 0 0 0 0 0 y y	YY = number of WITH words (max. 17_8)	
5	_ _ _ . _ _	Sentence number of first in range	
6	_ _ _ . _ _	Sentence number of last in range	
7	_ _ _ . _ _	Sentence number of transfer, if stated (zero otherwise)	
10	r 0 0 0 0 0 0 0 0 0 0 0	r = 4 if WL7 is RESUME number (zero otherwise)	
11	0 0 0 0 0 W X 0 0 0 0 0	WX = indicator for tests of first variable	
12	P 0 Call word$_0$ Call word$_0$	Variable. P=4 if call word$_0$ is 63--- and floating. (zero otherwise)	
13	q_1 0 Call word$_1$ Call word$_1$	Initial value	q_i=4 if absolute value is specified (except constants)
14	q_2 0 Call word$_2$ Call word$_2$	Increment	
15	q_3 0 Call word$_3$ Call word$_3$	Limit	
16	0 0 0 0 0 W X_1 0 0 0 0 0	WX_1=indicator for tests of second variable	
17	P^1 0 CW^1_0 CW^1_0	Variable	P and q_i have same meaning as above
20	q^1_2 0 CW^1_1 CW^1_1	Initial value	
21	q^1_3 0 CW^1_2 CW^1_2	Increment	
22	q^1_4 0 CW^1_3 CW^1_3	Limit	
			Additional 5 word components as required

The WX indicators in the String-out provide to the VARY generator the information required so that the necessary tests, if any, may be built to guard against indefinite loops within the VARY cycle. These indicators may be explained by the modify component.

VARY α a(b) c . . . . ,

where α denotes the fixed or floating variable, and a, b, and c are fixed-or floating-point variables and/or constants.

Then, WX = 00 if a, b, and c are all constants. No test coding will be generated

WX = 10 if a and/or c are variable and b is a stated constant > 0.

WX = 14, if a and/or c are variable and b is a stated constant < 0.

WX = 20, if b is a variable, and a <u>and</u> c are constants such that c-a > 0.

WX = 21, if b is a variable, and a <u>and</u> c are constants such that c-a < 0.

WX = 22, if b is a variable, and a <u>and</u> c are constants such that c-a = 0

WX = 30, if b is a variable, and a and/or c are variable.

Since the test coding that is built by the VARY generator for all cases except WX = 00 is only executed at the beginning of the looping process, none of the variables α , b, or c may be changed by other sentences within the VARY's range. In order to check that these variables are not altered by their appearance in other Modify components of this or other VARY sentences, or in COMPUTE sentences, or on the left of equations, the Variable List is built by the VARY translator. This list consists of three word entries for each modify component of VARY sentences. These entries remain in the list only until the translation process has progressed beyond the range of the VARY.

Example: VARY X 0(1)Y with J I(K)100 Sentences 10 thru 20 .

After the insertion of the 2 three-word items for this sentence, the Variable List would appear as follows:

VLO	0 0 | address counter | address counter	
	. . . . .	Previous entries in the list, if any
3 word item	←—XS-3 for X —→	
	0 0 0 0 0 0 0 0 0 0 0 0	For constant 1
	←—XS-3 for Y —→	
3 word item	←—XS-3 for J —→	
	←—XS-3 for K —→	
	0 0 0 0 0 0 0 0 0 0 0 0	For constant 100

When a constant appears for b or c in the Modify component, the corresponding word in the Variable List is cleared.

The three-word items entered for the above sentence remain in the list for checking by the COMPUTE and Equation translators until sentence 20 has been processed. Then the VE routine of the Translation subroutines removes these items from the list.

The first entries into the VARY File are also made by the VARY translator. This file is used later, to:

1. Determine when items are to be removed from the Variable List.
2. Provide exits from VARY sentences when transfer components are not stated.
3. Establish the continuation of the VARY loop from the last sentence in its range.

A VARY File item consists of two words for each VARY sentence:

X	Y	CW_1	CW_2

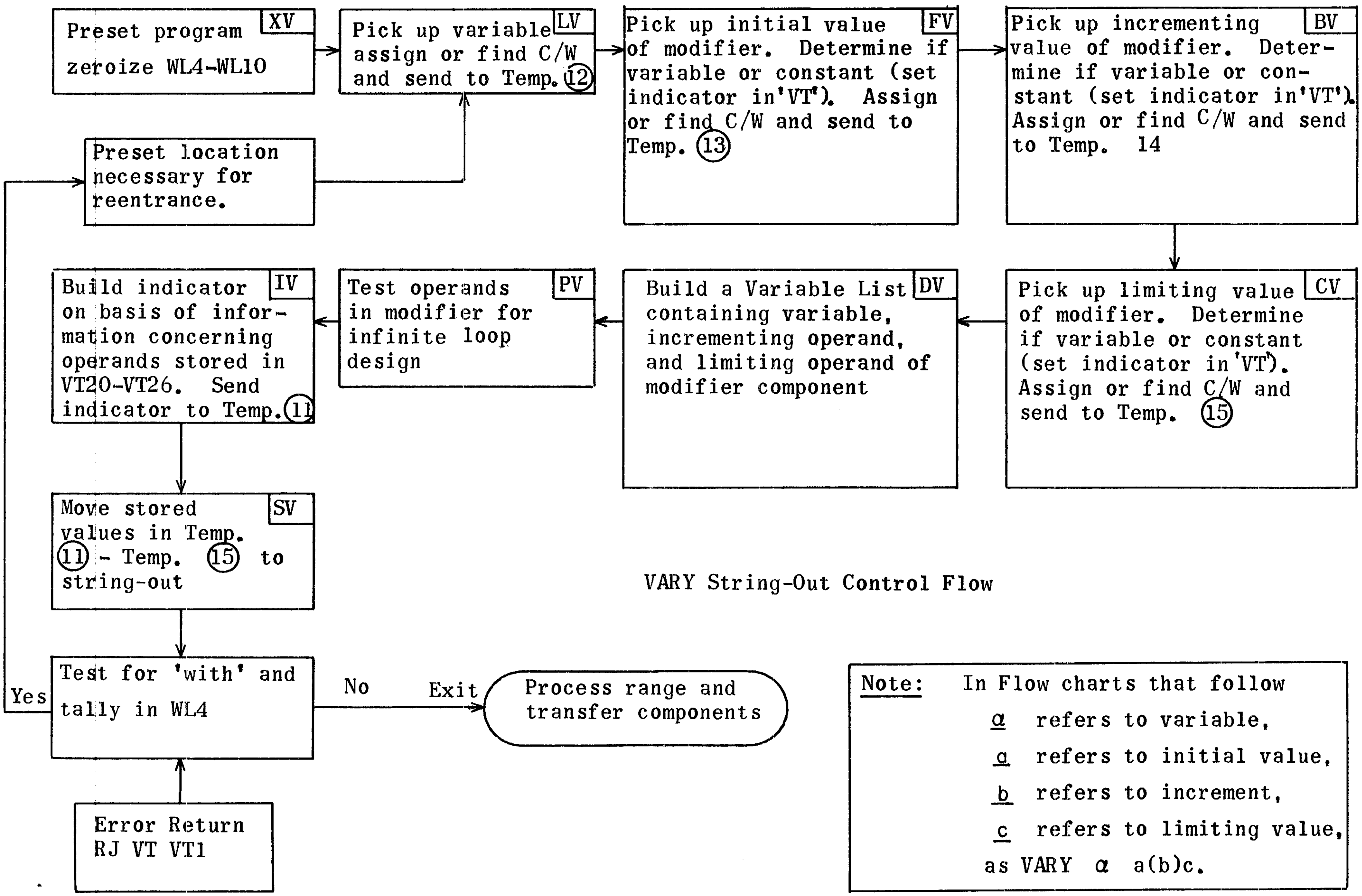
Sentence number of last sentence in range.
CW_2 = Call word of VARY sentence.
CW_1 = Call word of sentence to which exit is made.
Y(4 bits) = number of WITH words.
X(2 bits) = 10 if exit is normal transfer.
= 11 if exit is RESUME of previous VARY.

All entries in the VARY File item except CW1 and X are made by the VARY translator. The item is completed later by the VE routine of the Translation Subroutines (see Section III, 3,a).

Error Print-Outs Used in VARY Translator

ZA	_______ is not a variable symbol.
ZB	Format error i.e., no parenthesis.
ZC	Inconsistent use of fixed or floating point operands.
ZD	Minus sign illegal prefix to variable.
ZE	Inconsistent use of absolute value signs.
ZF	__________type symbol is illegal in scientific notation format.
ZG	Illegal scientific notation format.
ZH	Change modifiers to eliminate infinite loop.
ZI	The number of modifier components exceed 15. Rest of sentence not checked.
ZJ	Misspelling or no referenced sentence.
ZK	No space period symbol.
ZL	Incomplete sentence i.e., no (range) component.
ZM	Variable _________must not change values within VARY loop.
ZN	Error in transfer component.
IN	Disallowable character in exponent _________
IQ	Absolute value of number too small - given zero value Absolute value of number too large
NV	Too many vary sentences in program. VARY must not be last sentence in range of any VARY. Range of inner VARY extends beyond range of outer VARY.

Vary Translator Flow Charts



VARY String-Out Control Flow

Note: In Flow charts that follow

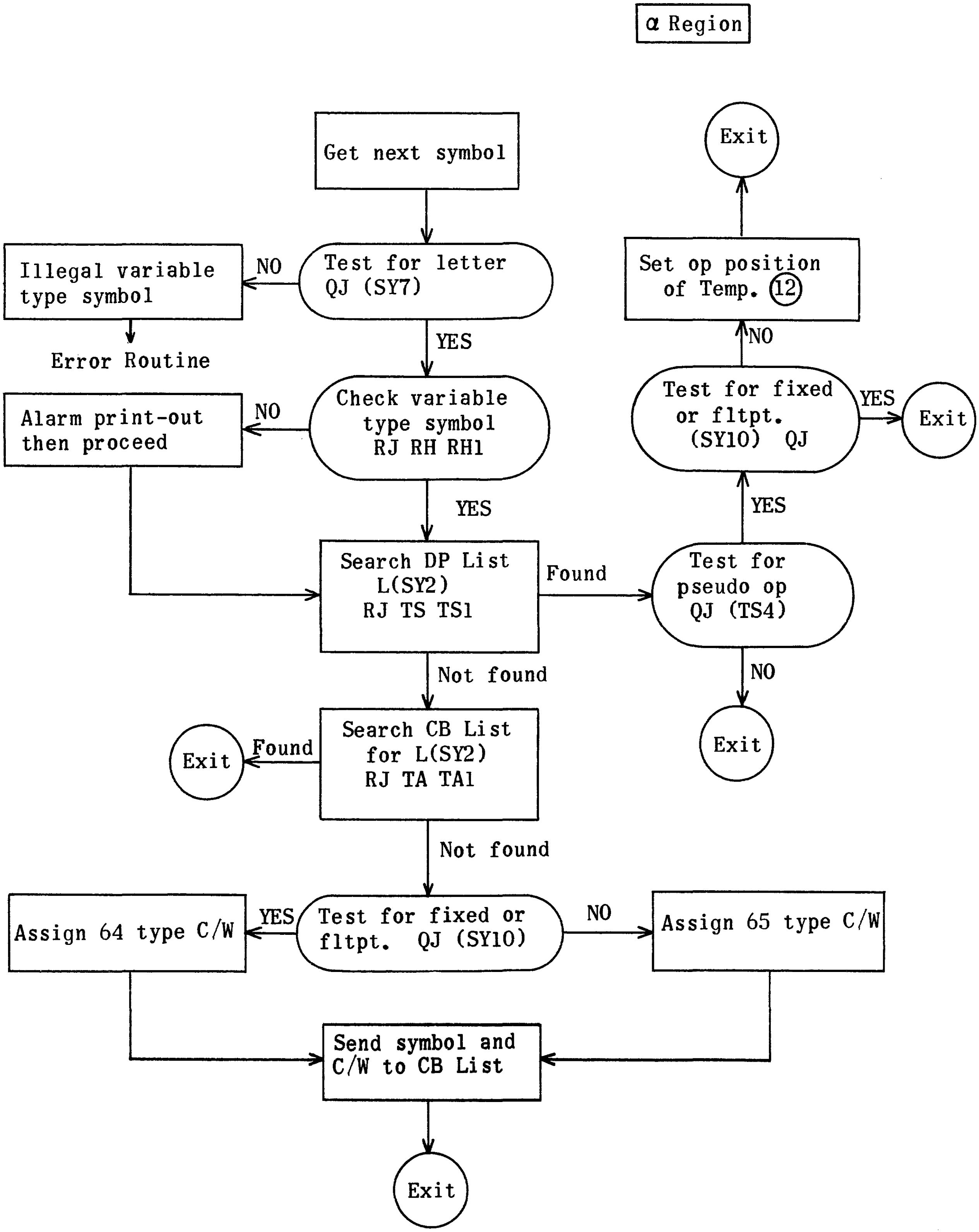
α refers to variable,

a refers to initial value,

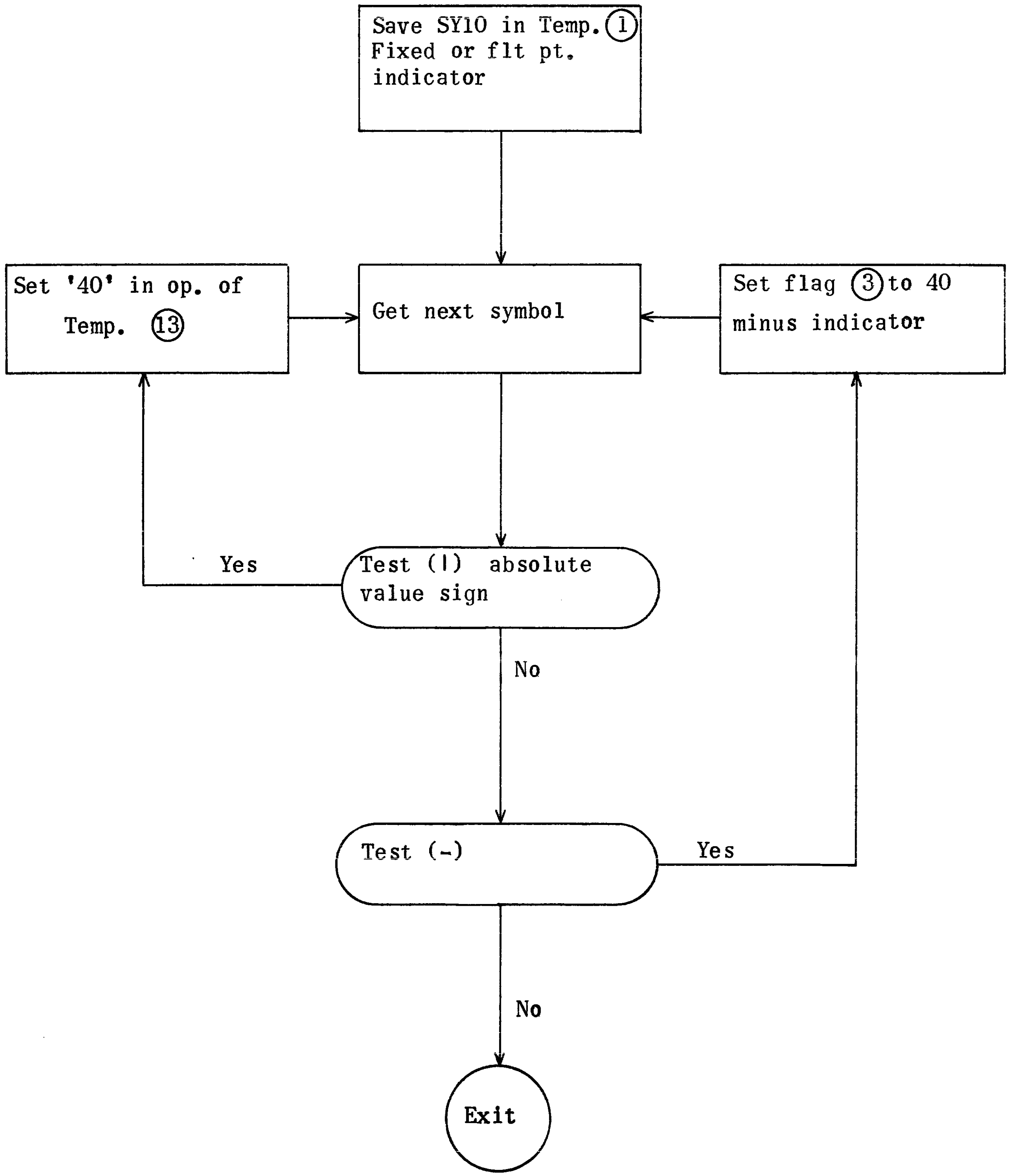
b refers to increment,

c refers to limiting value,

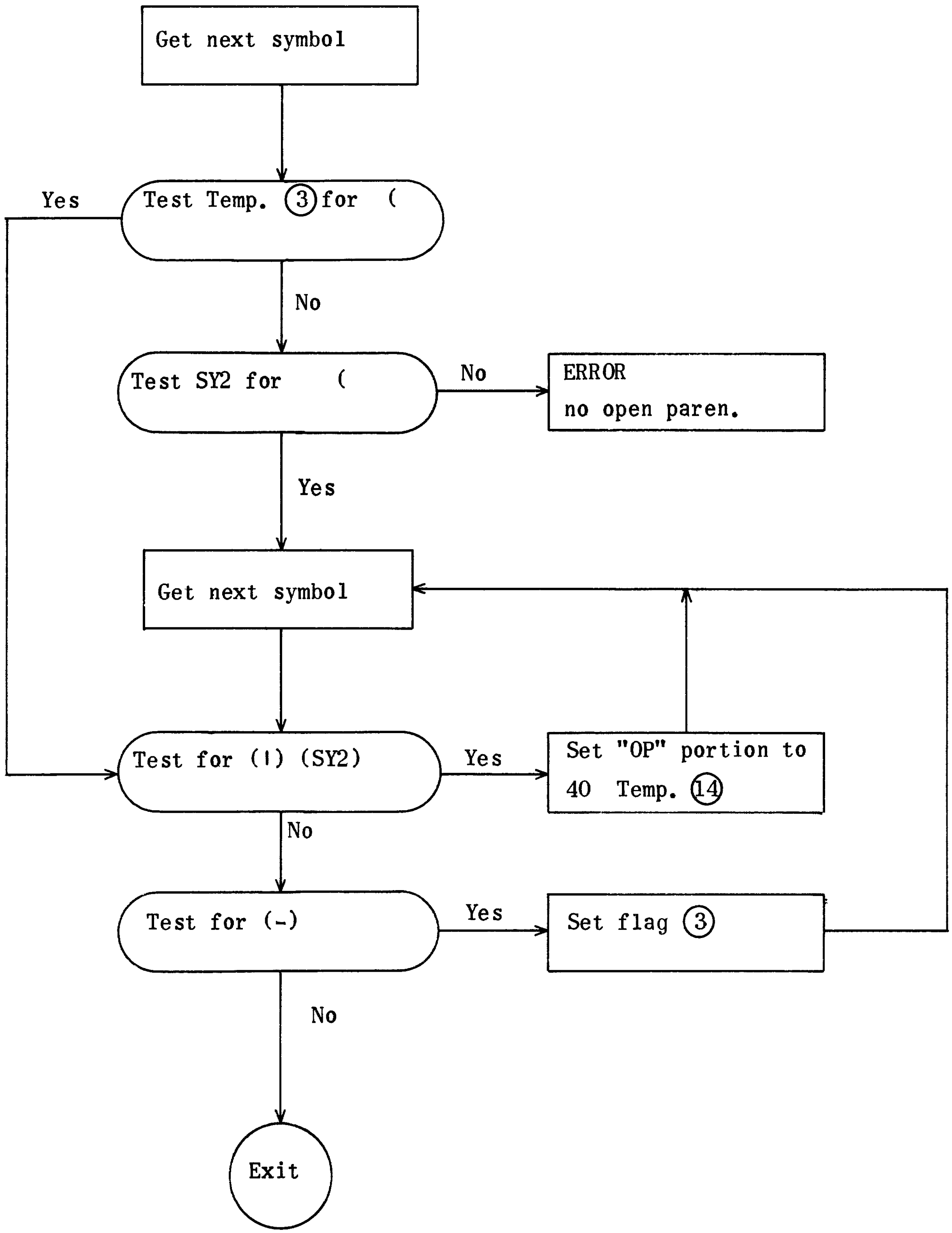
as VARY α a(b)c.


α Region
Get next symbol
Test for letter QJ (SY7)
NO
Illegal variable type symbol
Error Routine
YES
Check variable type symbol RJ RH RH1
NO
Alarm print-out then proceed
YES
Search DP List L(SY2) RJ TS TS1
Found
Test for pseudo op QJ (TS4)
NO
Exit
YES
Test for fixed or fltpt. (SY10) QJ
YES
Exit
NO
Set op position of Temp. 12
Exit
Not found
Search CB List for L(SY2) RJ TA TA1
Found
Exit
Not found
Test for fixed or fltpt. QJ (SY10)
YES
Assign 64 type C/W
NO
Assign 65 type C/W
Send symbol and C/W to CB List
Exit

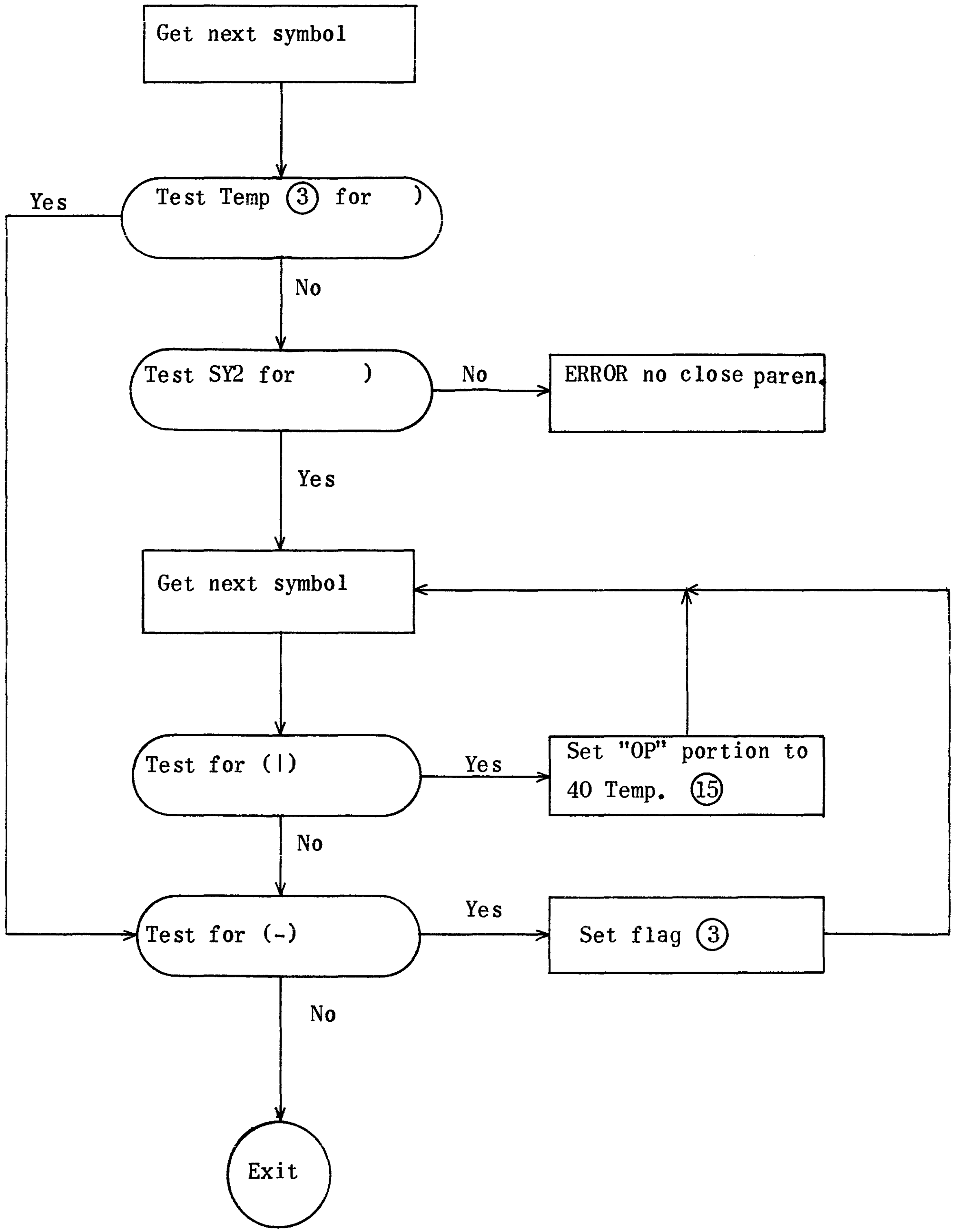
First value region 'a' FV

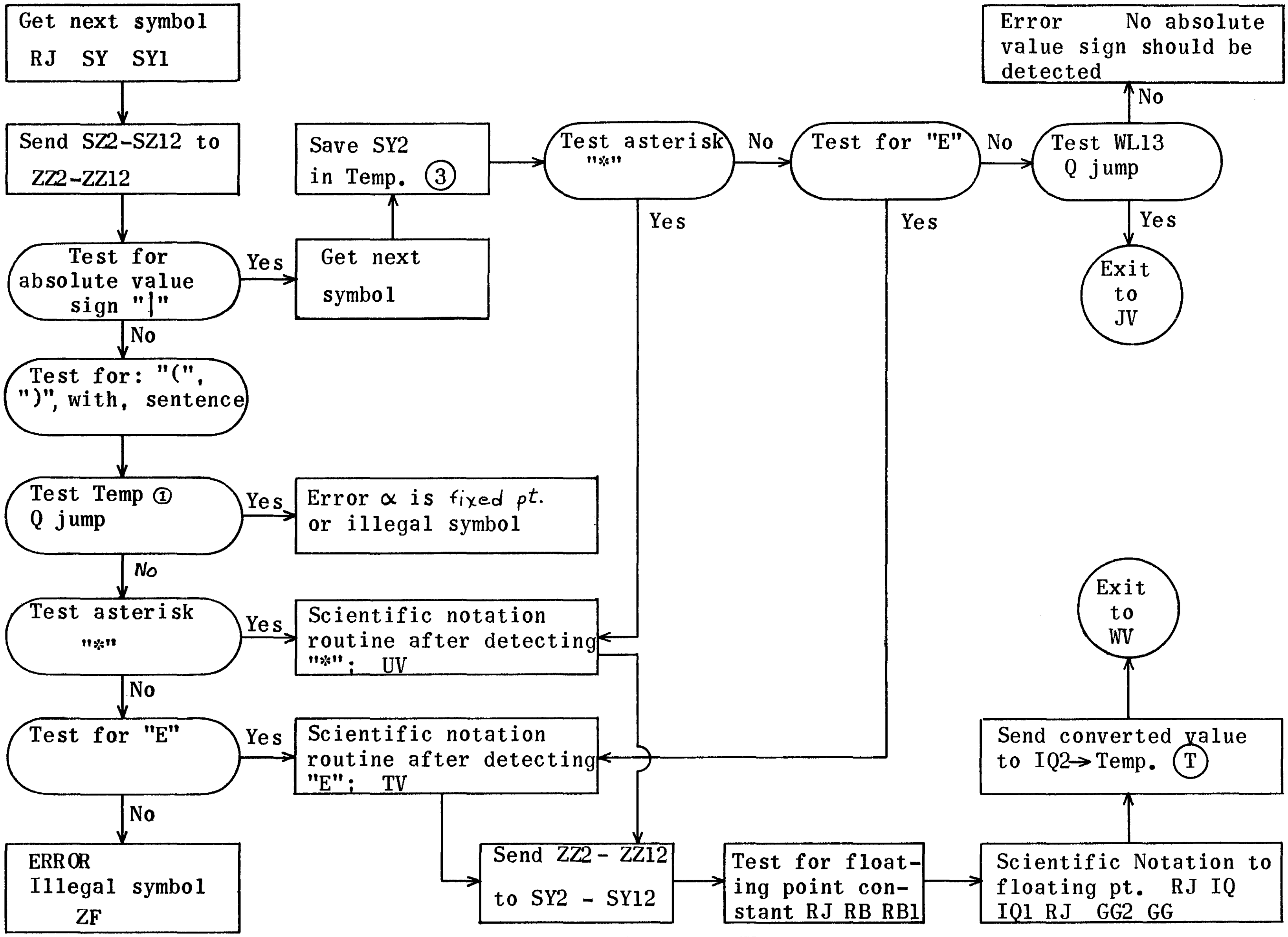


Increment Region 'b' BV



Bound Phase or Region 'C' CV

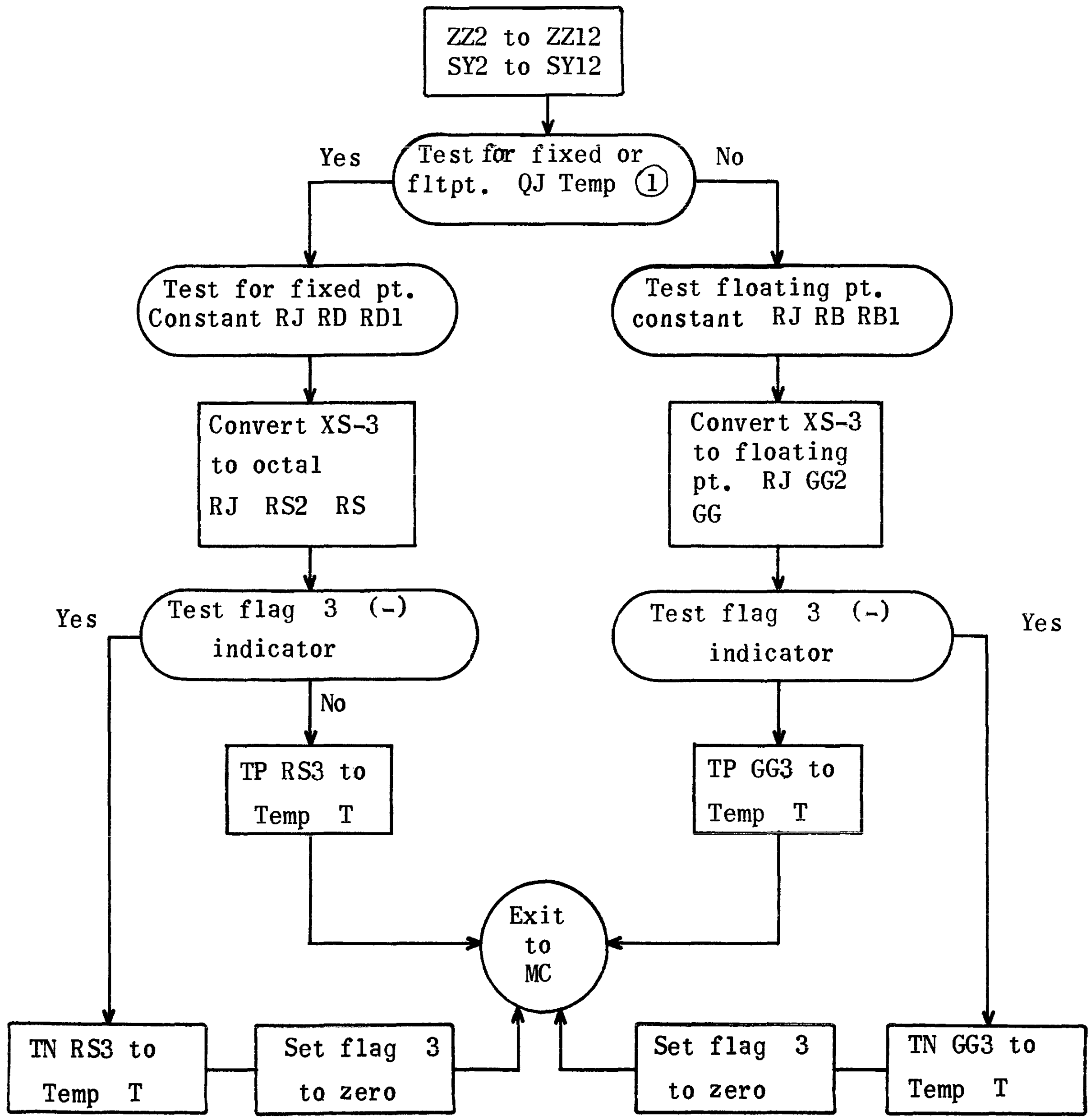


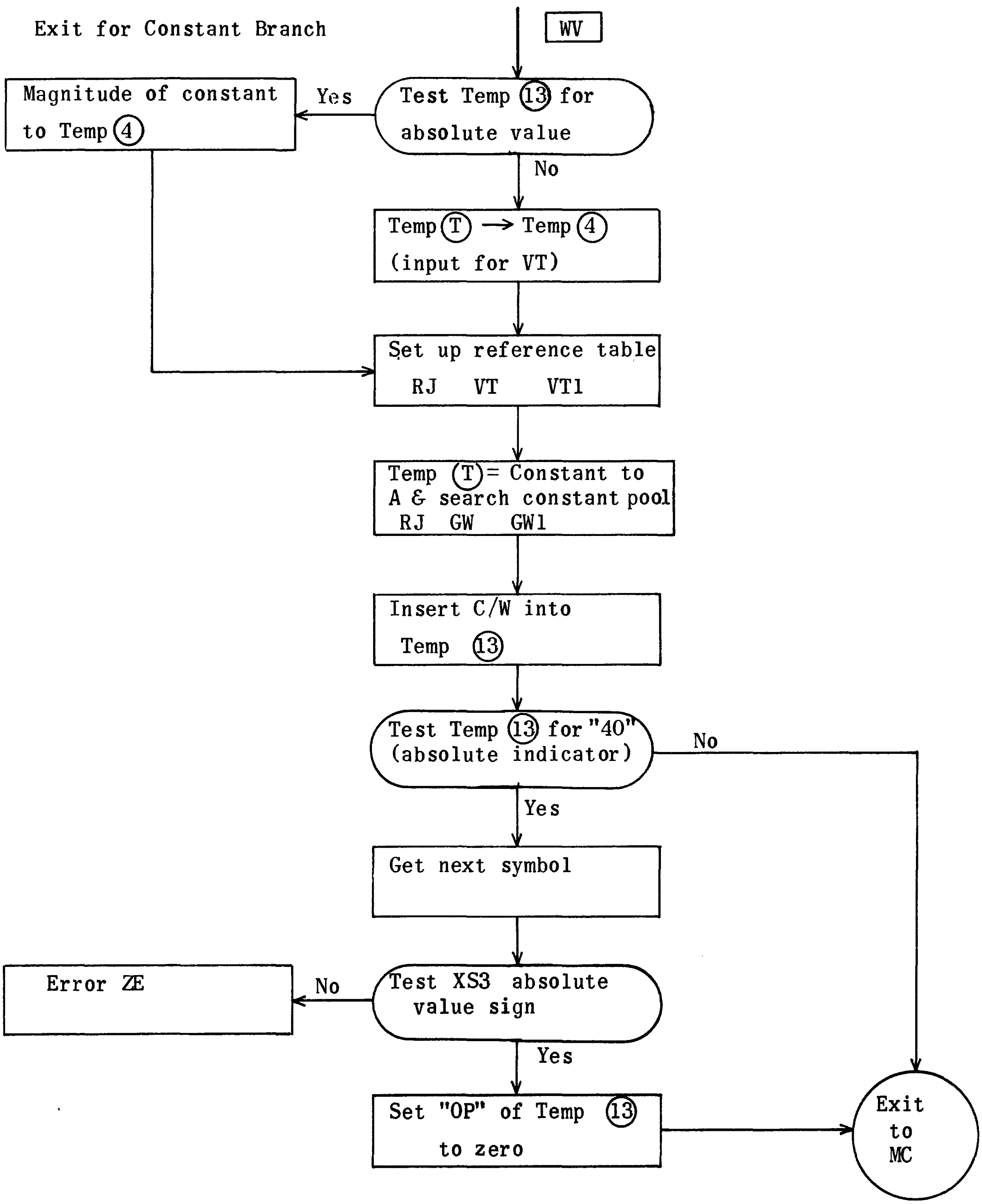


Vary Translator Flow Charts - HV-Constant Branch

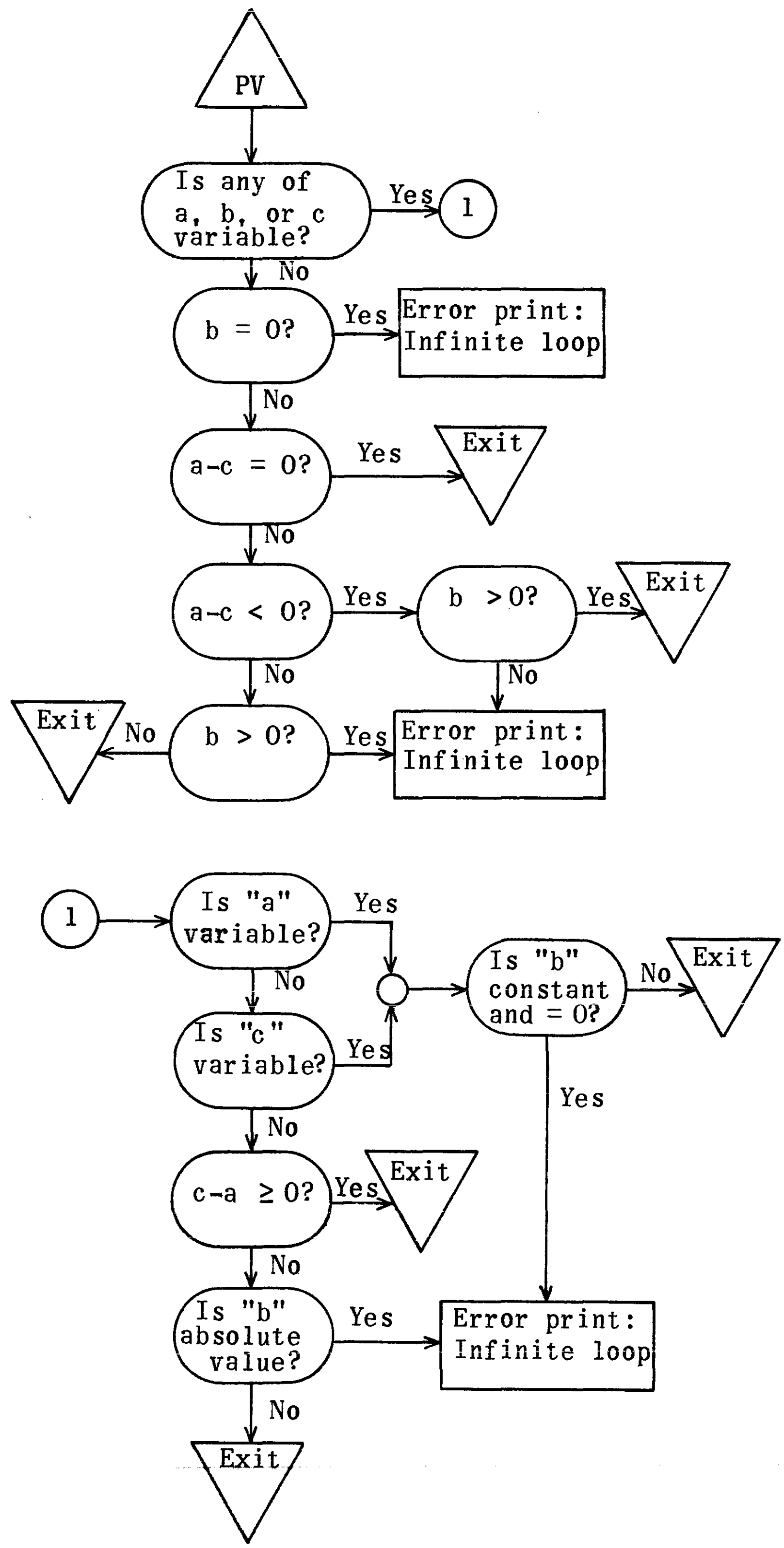
Fixed or floating point
constant branch

JV

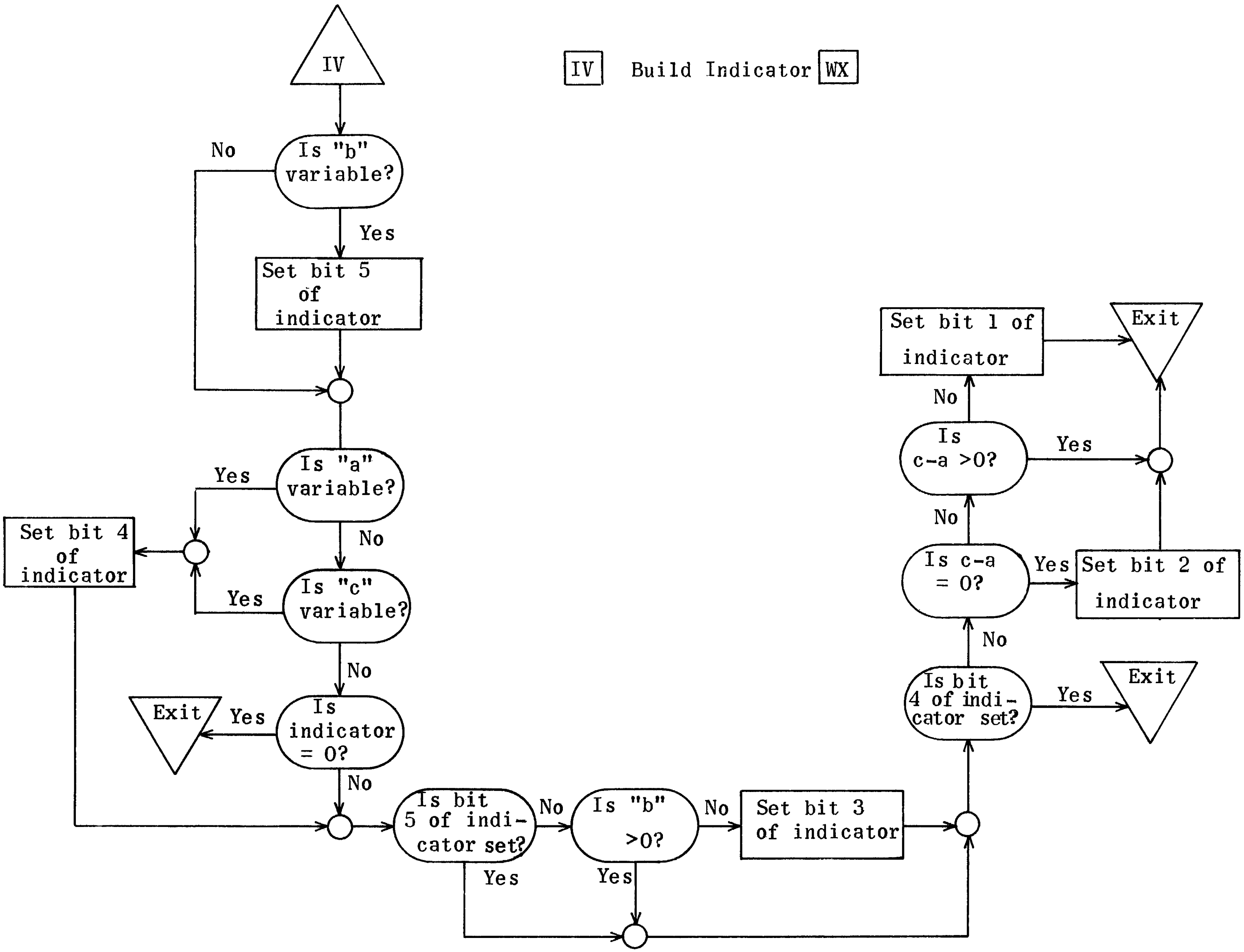



Exit for Constant Branch
WV
Test Temp 13 for absolute value
Yes
Magnitude of constant to Temp 4
No
Temp T → Temp 4 (input for VT)
Set up reference table RJ VT VT1
Temp T = Constant to A & search constant pool RJ GW GW1
Insert C/W into Temp 13
Test Temp 13 for "40" (absolute indicator)
No
Yes
Get next symbol
Test XS3 absolute value sign
No
Error ZE
Yes
Set "OP" of Temp 13 to zero
Exit to MC

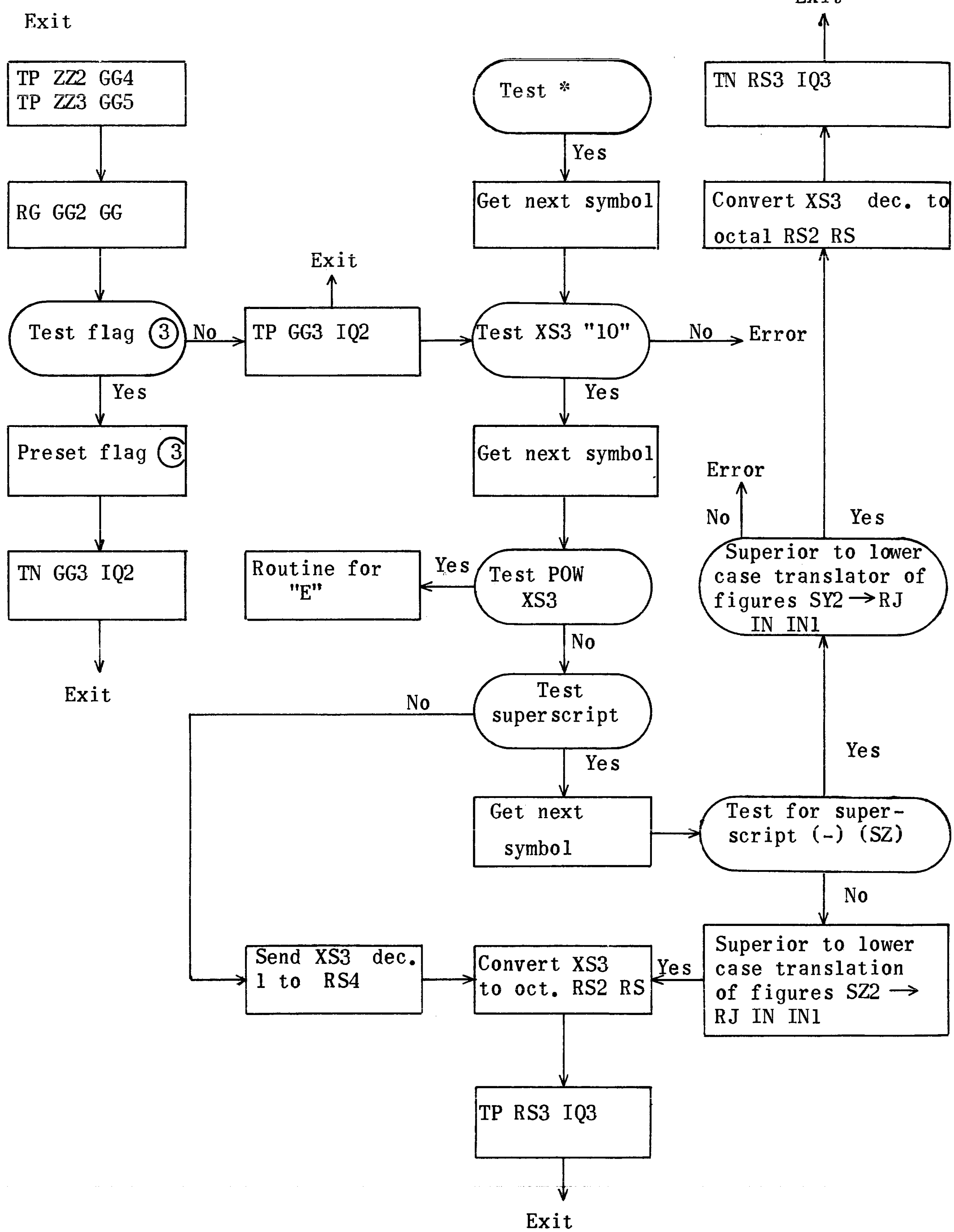
PV Preface for Indicator Region



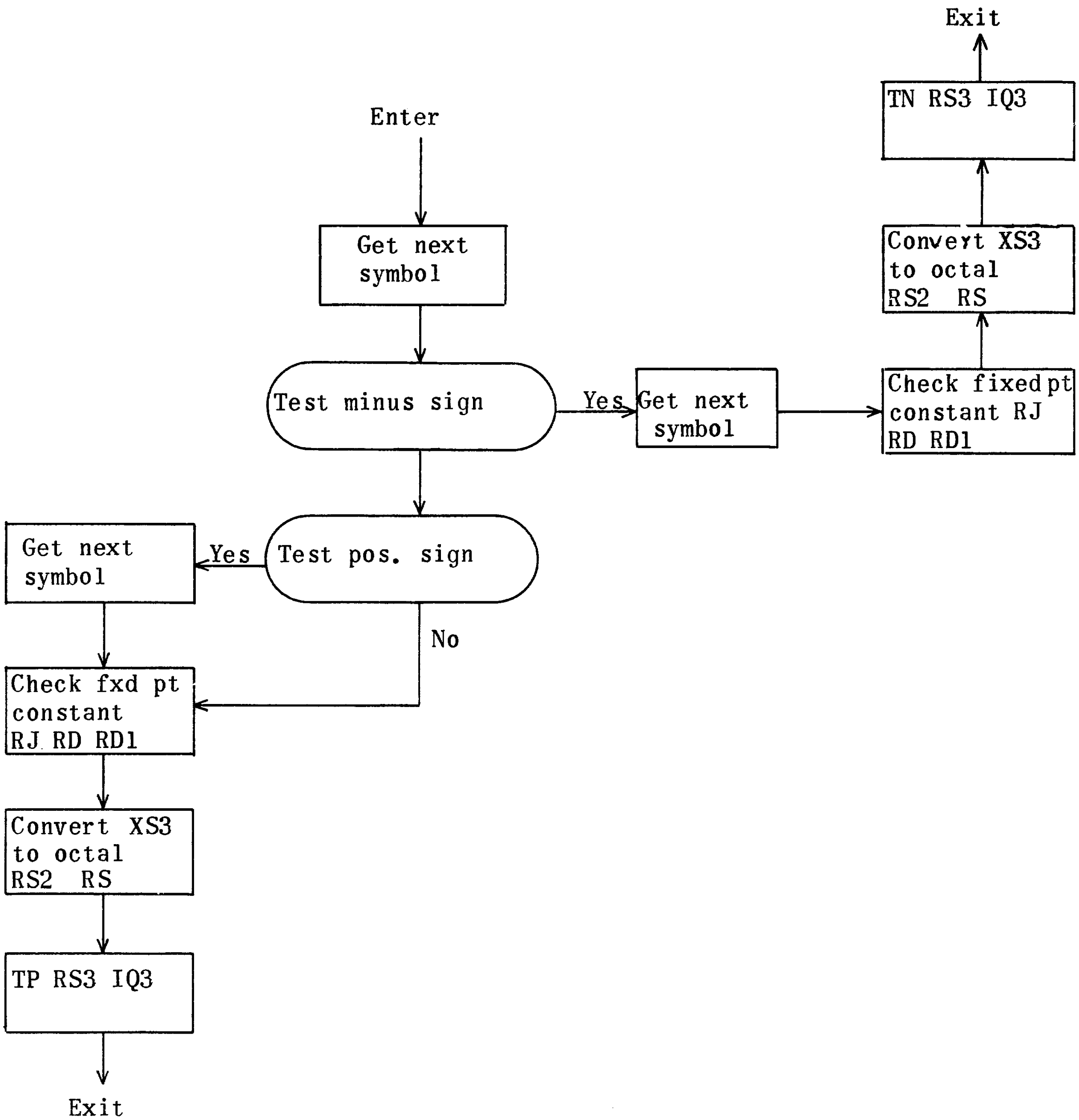
IV Build Indicator WX

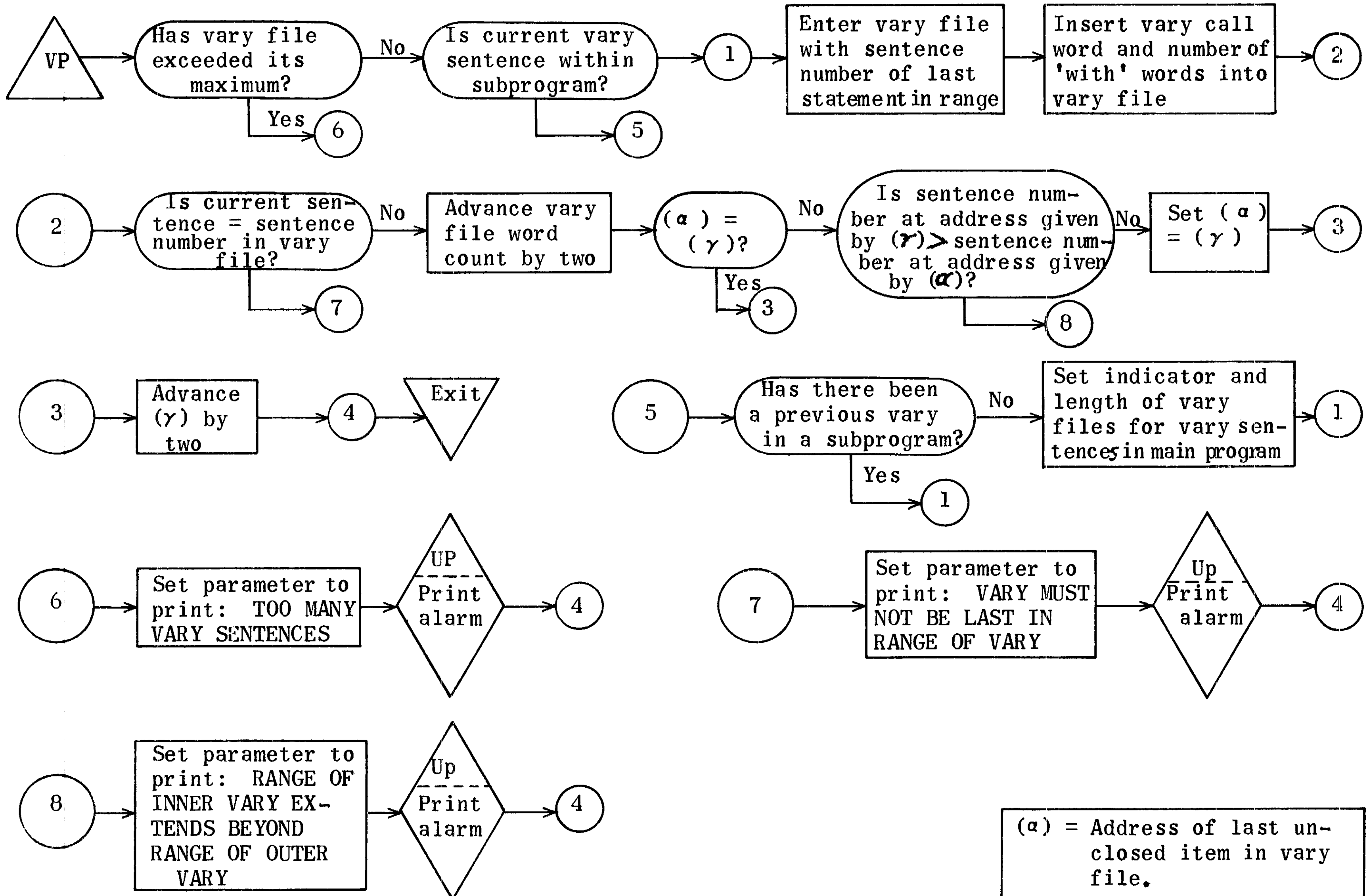


Detection of *(asterisk) proceedings UV



Detection of "E" Procedings TV





Vary Translator Flow Charts - Build Vary File

(α) = Address of last unclosed item in vary file.

(γ) = Address for inserting next item in vary file.

Regions-VARY Translator

RE	MC4400
RE	LV4566
RE	VV4635
RE	FV4650
RE	BV4663
RE	CV4704
RE	GV4725
RE	HV5040
RE	JV5117
RE	WV5151
RE	DV5214
RE	PV5243
RE	IV5310
RE	SV5362
RE	VZ5417
RE	UV5433
RE	TV5465
RE	EV5506
RE	VT5521
RE	PL5553
RE	ID5613
RE	IM5743
RE	IN6057
RE	IO6107
RE	IQ6136
RE	IR6265
RE	ZA6277
RE	ZB6314
RE	ZC6330
RE	ZD6347
RE	ZE6364
RE	ZF6401
RE	ZG6423
RE	ZH6437
RE	ZI6455
RE	ZJ6500
RE	ZK6521
RE	ZL6533
RE	ZM6551
RE	VP6573
RE	VQ6633
RE	VS6647
RE	NV6655
RE	IS6711
RE	ZZ6714
RE	SC6726

RE	IF6727
RE	XV6730
RE	XU6735
RE	ZN6760

Translation Subroutine regions are also needed to assemble the VARY Translator tapes.

Also included, in the reco tapes of the VARY Translator are ID (130_8 lines in length), IM(114_8), IN(30_8), IO(27_8), IQ(127_8), IR(12_8), and IS (a set of 3 addresses used as temporaries). With one 2-line exception, this reco coding is identical to the regions similarly named in the IF String-Out where they are annotated and reproduced in this manual.

The 2-line exception is:

IA	ID3		
RJ	DV	DV1	Build Variable List File
MJ	0	MC40	Jump back to vary Translator Control
CA	ID5		

Master Control for Vary Translator

	IA	MC			
0	MJ	0	CT		
1	MJ	0	XV	Jump out for correction; then process	
2	RJ	VV	VV1	Test duplication of variable	
3	RJ	FV	FV1	First value region or 'a'	
4	TP	SY11	Q	Test for digit or decimal pt.	
5	QJ	MC6	MC12		
6	RJ	HV	HV1		
7	RJ	JV	JV1	Constant branch	a
10	RJ	WV	WV1		
11	MJ	0	MC13		
12	RJ	GV	GV1	Variable branch	
13	RA	PL10	PL2	Increase CTR+1 ⟶ CTR	
14	RJ	BV	BV1	Increment region or "b"	
15	TP	SY11	Q		
16	QJ	MC17	MC23		
17	RJ	HV	HV1		b
20	RJ	JV	JV1	Constant branch	
21	RJ	WV	WV1		
22	MJ	0	MC24		
23	RJ	GV	GV1	Variable branch	
24	RA	PL10	PL2		
25	RJ	CV	CV1	Bound phase or "c"	
26	TP	SY11	Q		
27	QJ	MC30	MC34		c
30	RJ	HV	HV1		
31	RJ	JV	JV1	Constant branch	
32	RJ	WV	WV1		
33	MJ	0	MC35		
34	RJ	GV	GV1	Variable branch	
35	RJ	DV	DV1	Build Variable File	
36	RJ	PV	PV1	Build preface region to indicator	
37	RJ	IV	IV1	Build indicator	
40	RJ	SV	SV1	Mover region	
41	TP	PL33	A	Possible WITH or SENTEN	
42	EJ	MC154	MC47	Test WITH	
43	EJ	MC152	ZL1	Test Δ. (Incomplete sentence)	
44	EJ	MC153	MC54	Test SENTEN	
45	RJ	SY	SY1	Get next symbol	
46	MJ	0	MC42	Go back & test for (WITH, Δ. , SENTEN)	
47	RA	WL4	PL1		
50	TJ	MC155	MC52	Test no. of WITH words $\leq 17_8$	
51	MJ	0	ZI1		
52	RJ	VZ	VZ1	Presetting region	
53	MJ	0	MC1	Continue processing modifiers	
54	RJ	SY	SY1	Get next symbol which should be digit	
55	TP	SY11	Q	Is it digit? No ⟶ Error	
56	QJ	MC57	ZJ1		
57	TP	SY2	LN4		

60	RJ	LN2	LN	Put line number in proper form
61	TP	LN3	WL5	Line number → string-out
62	TP	LN3	A	
63	RJ	IX	IX1	Put line number in IZ list
64	RJ	SY	SY1	
65	EJ	MC146	MC70	Test THRU
66	EJ	MC147	MC70	Test THROUGH
67	MJ	0	MC157	Jump out to Test Δ.
70	RJ	SY	SY1	Look for sentence number
71	EJ	MC153	MC70	Test SENTENCE
72	TP	SY11	Q	
73	QJ	MC74	ZJ1	Test sentence number
74	TP	SY2	LN4	
75	RJ	LN2	LN	Put line number in proper form
76	MJ	0	MC163	→ TP LN3 WL6 insert
77	RJ	IX	IX1	Put line no. in IZ list
100	MJ	0	MC102	
101	TP	WL5	WL6	THRU - THROUGH, not detected
102	RJ	SY	SY1	
103	EJ	MC152	MC136	Test "Δ."
104	EJ	MC151	MC122	Test "TO"
105	EJ	MC150	MC107	Test RESUME
106	MJ	0	XU10	Jump for correction
107	RJ	SY	SY1	
110	EJ	MC153	MC107	Test SENTENCE
111	TP	SY11	Q	
112	QJ	MC113	ZJ1	RESUME: Test for digit
113	TP	SY2	LN4	
114	RJ	LN2	LN	Process line number
115	TP	LN3	WL7	Line number → string-out
116	TP	LN3	A	
117	RJ	IX	IX1	Line number → list IZ
120	TP	PL4	WL10	
121	MJ	0	MC133	Jump to test for Δ.
122	RJ	SY	SY1	
123	EJ	MC153	MC122	Test SENTENCE
124	TP	SY11	Q	
125	QJ	MC126	ZJ1	Test for digit
126	TP	SY2	LN4	
127	RJ	LN2	LN	Process line number
130	TP	LN3	WL7	Line number → string-out
131	TP	LN3	A	
132	RJ	IX	IX1	Line number → list IZ
133	RJ	SY	SY1	
134	EJ	MC152	MC136	Test Δ.
135	MJ	0	ZK1	
136	RJ	VP	VP1	Build Vary File
137	RJ	VZ	VZ1	Presetting region
140	TV	SV11	PL30	WL_{n+1} → A
141	TP	PL30	A	WL_{n+1} - WL = n
142	ST	MC156	A	
143	AT	PL	WL	Put no. of words in string-out → WL

```
144   RJ   SS      SS1
145   MJ   0       MC
146   66   33546   77777     THRU
147   66   33545   16732     THROUGH
150   54   30656   74730     RESUME
151   66   51777   77777     TO
152   01   22777   77777     Δ .
153   65   30506   63050     SENTENCE
154   71   34663   37777     WITH
155   0    0       20        (20)8
156   0    0       WL
157   EJ   MC152   MC161
160   MJ   0       MC101     Test Δ.
161   TP   WL5     WL6
162   MJ   0       MC136
163   TP   LN3     WL6
164   TP   LN3     A
165   MJ   0       MC77
      CA   MC166
```

Process α Region

```
     IA   LV
 0   MJ   0      30000
 1   RJ   SY     SY1
 2   TP   SY7    Q        Test for 1st character, a letter
 3   QJ   LV4    ZA1
 4   TP   SY2    VT20     α → Temp α
 5   RJ   RH     RH1      Test variable type symbol
 6   RJ   TS     TS1      Search DP list
 7   MJ   0      LV23     Not in list return
10   TP   TS3    A
11   TJ   LV45   ZA1      Test 62777 < CW ≤ 66777
12   TJ   LV46   LV14
13   MJ   0      ZA1
14   TP   TS3    SV22     C/W → Temp (12)
15   TP   TS4    Q        Test for Pseudo op
16   QJ   LV17   LV
17   TP   SY10   Q        Test for fixed or fltpt.
20   QJ   LV     LV21
21   RA   SV22   PL4      Op. portion of Temp (12) to 40
22   MJ   0      LV
23   RJ   TA     TA1      Search Combination List
24   MJ   0      LV33     Not in list return
25   TP   TA4    A
26   TJ   LV45   ZA1         Test 62777 < C/W ≤ 66777
27   TJ   LV46   LV31
30   MJ   0      ZA1
31   TP   TA4    SV22     C/W of symbol in list → Temp (12)
32   MJ   0      LV
33   TP   SY10   Q        Test for fixed or fltpt.
34   QJ   LV35   LV40
35   RJ   TK     TK1      Sequence number → A
36   AT   PL14   SV22     Fixed pt.; 64000 C/W → Temp (12)
37   MJ   0      LV42
40   RJ   TK     TK1      Sequence number → A
41   AT   PL15   SV22     65000 C/W → Temp (12)
42   TJ   LV45   ZA1
43   TJ   LV46   XU       Jump out for correction
44   MJ   0      ZA1
45   0    0      63000
46   0    0      67000
     CA   LV47
```

Search Variable List "VL" for Modifiers Previously Mentioned

	IA	VV		
0	MJ	0	30000	
1	SP	VL	0	$VL_{n+1} \rightarrow A$
2	SS	VV11	0	-VL1 = n = # words - 1
3	SA	VV12	0	Add J value
4	TU	A	VV6	
5	SP	VT20	0	Variable $\longrightarrow$ A
6	RP	[30000]	VV	Search list VL
7	EJ	VL1	ZM1	
10	MJ	0	VV	
11	0	VL1	0	
12	0	20000	0	
	CA	VV13		

First Value "a" Region

	IA	FV		
0	MJ	0	30000	
1	TP	SY10	PL31	Set Temp 1 indicator for fixed or floating point
2	RJ	SY	SY1	
3	EJ	PL16	FV5	Test (-)
4	MJ	0	FV7	
5	TP	PL4	PL23	L(40,0,0) $\rightarrow$ flag 3
6	MJ	0	FV2	
7	EJ	PL13	FV11	Test (|)
10	MJ	0	FV	Exit to Control (MC)
11	RA	SV23	PL4	Set Op. of Temp 13 to '40'
12	MJ	0	FV2	
	CA	FV13		

Increment Region "b"

```
      IA   BV
 0    MJ   0       30000      Exit
 1    RJ   SY      SY1
 2    TP   PL33    A          Temp 3 ∈(( ) → A
 3    EJ   PL17    BV10       Test ( ( )
 4    TP   SY2     A          Test
 5    EJ   PL17    BV7           ( ( )
 6    MJ   0       ZB1        Error print and exit
 7    RJ   SY      SY1
10    TP   SY2     A             Test
11    EJ   PL13    BV13                (|)
12    MJ   0       BV15
13    RA   SV24    PL4        Set Op. of Temp  14  to '40'
14    MJ   0       BV7
15    EJ   PL16    BV17       Test for (-)
16    MJ   0       BV
17    TP   PL4     PL23       Set Op. of flag 3 to '40' minus ind.
20    MJ   0       BV7
      CA   BV21
```

Bound Phase or Region "c"

```
      IA   CV
 0    MJ   0       30000
 1    RJ   SY      SY1        Pick up  )
 2    TP   PL33    A          Temp 3 ∈ ( ) ) → A
 3    EJ   PL20    CV10       Test  ( ) )
 4    TP   SY2     A          Test  ( ) )
 5    EJ   PL20    CV7
 6    MJ   0       ZB1        Error print and exit
 7    RJ   SY      SY1        4
10    TP   SY2     A          Test   (|)
11    EJ   PL13    CV13
12    MJ   0       CV15
13    RA   SV25    PL4        Set Op. of Temp 15 to "40"
14    MJ   0       CV7
15    EJ   PL16    CV17       Test for  (-)
16    MJ   0       CV
17    TP   PL4     PL23       Set Op. of flag 3 to "40" minus ind.
20    MJ   0       CV7
      CA   CV21
```

Variable Branch

	IA	GV			
0	MJ	0	30000		
1	TP	PL4	PL22	Set flag 2 for VT to '40'	
2	TP	PL31	A	Temp 1 = SY10 $\alpha \rightarrow$ A	
3	EJ	SY10	GV56	Test consistency of fixed or fltpt.	
4	MJ	0	ZC1	Error print	
5	RJ	TS	TS1	Search DP list	
6	MJ	0	GV13	Not in list - go search CB	
7	RA	GV10	PL10		
10	RA	[SV23]	TS3	C/W $\rightarrow$ Temp (13,14,15)	
11	TP	GV46	GV10	Preset GV10	
12	MJ	0	XU21	Go to build table	
13	RJ	TA	TA1	Search CB list	
14	MJ	0	GV21	Not in list - go assign C/W	
15	RA	GV16	PL10		
16	RA	[SV23]	TA4	C/W $\rightarrow$ Temp (13,14,15)	
17	TP	GV47	GV16	Preset GV16	
20	MJ	0	XU21	Go build table	
21	TP	PL31	Q	Temp 1 = SY10 $\alpha \rightarrow$ Q	
22	QJ	GV23	GV34	Test for fixed or fltpt. variable	
23	RA	GV27	PL10	Modifiers	
24	RA	GV31	PL10		
25	RJ	TK	TK1	Obtain proper sequence # $\rightarrow$ A	
26	TP	A	PL30	A $\rightarrow$ Temp T	
27	RA	[SV23]	PL30		
30	TP	GV50	GV27	Preset GV27	Fxd. pt.
31	RA	[SV23]	GV54	Temp (13,14,15) + 64000	
32	TP	GV51	GV31	Preset GV31	
33	MJ	0	GV44	Go build table	
34	RA	GV40	PL10	Modifiers	
35	RA	GV42	PL10		
36	RJ	TK	TK1		
37	TP	A	PL30		
40	RA	[SV23]	PL30		
41	TP	GV50	GV40	Preset GV40	
42	RA	SV23	GV55	Temp (13,14,15) + 65000	
43	TP	GV52	GV42	Preset GV42	
44	RJ	VT	XU13	Build table, but make correction first	
45	MJ	0	GV76		
46	RA	SV23	TS3		
47	RA	SV23	TA4		
50	RA	SV23	PL30	Presetters	
51	RA	SV23	GV54		
52	RA	SV23	GV55		
53	0	0	0		
54	0	0	64000		
55	0	0	65000		
56	TP	PL23	Q	Flag 3 $\rightarrow$ Q (minus sign indicator)	
57	QJ	GV60	GV62		
60	TP	PL	PL23	Reset flag 3 to 0	

```
61   MJ   0       ZD1       Error print
62   TP   SY7     Q         Test
63   QJ   GV64    ZA1       Error for first character a letter
64   RJ   RH      RH1       Test for variable type symbol
65   MJ   0       GV5
66   RA   GV67    PL10
67   TP   [SV23]  Q
70   TP   GV75    GV67
71   QJ   GV72    GV        Test for opening absolute value sign
72   RJ   SY      SY1       Detected
73   EJ   PL13    GV        Test for closing absolute value sign
74   MJ   0       ZE1       Error print; inconsistent use of absolute
75   TP   SV23    Q         Presetter
76   RA   GV77    PL10
77   TP   SV23    A
100  TP   GV106   GV77
101  MJ   0       GV107
102  TJ   GV105   GV66
103  MJ   0       ZA1
104  0    0       63000
105  0    0       67000
106  TP   SV23    A
107  TP   UV31    Q         L(0,77777,77777) —> Q
110  QT   A       A
111  TJ   GV104   ZA1
112  MJ   0       GV102
     CA   GV113
```

Constant Branch

```
     IA   HV
 0   MJ   0       [30000]
 1   RJ   SY      SY1       Senten: 1
 2   RP   30011   HV4
 3   TP   SZ2     ZZ2       Save this information
 4   EJ   PL13    HV6       Test (|) (absolute sign)
 5   MJ   0       HV17      No.(|)detected
 6   RJ   SY      SY1       (
 7   MJ   0       HV45      Test (*) --> set up routine
10   EJ   PL6     TV1       Test (E)--> set up routine
11   RA   HV12    PL10
12   TP   [SV23]  Q                                          (|) detected
13   TP   HV41    HV12      Preset HV12
14   QJ   HV16    HV15
15   MJ   0       ZE1       Error print and exit
16   MJ   0       HV        Go to JV via MC
17   EJ   PL17    HV22      Test (()
20   EJ   PL20    HV22      Test ())
21   MJ   0       HV42      Jump out for correction
22   TP   SY2     PL33      (() or ()) --> Temp 3
23   MJ   0       HV        Go to JV via MC
24   TP   PL31    Q         Temp 1 --> Q
25   QJ   HV26    HV55      Test fixed or floating point
26   MJ   0       ZC1       Error print and exit
27   EJ   PL7     UV1       Test (*)--> set up routine
30   EJ   PL6     TV1       Test (E)--> set up routine
31   MJ   0       ZF1       Error print and exit
32   RP   30011   HV34
33   TP   ZZ2     SY2
34   RJ   RB      RB1
35   RJ   IQ      IQ1
36   TP   IQ2     PL30      Send value to temp T
37   RA   HV      PL1       Set up for return to WV
40   MJ   0       HV
41   TP   SV23    Q         Presetter for HV12
42   EJ   MC154   HV22      Test WITH
43   EJ   MC153   HV22      Test SENTEN
44   MJ   0       HV50
45   TP   SY2     PL33
46   EJ   PL7     UV1
47   MJ   0       HV10
50   RA   HV51    PL10      No presetter
51   TP   [SV23]  Q         Test for previous mention of absolute value sign
52   TP   HV54    HV51
53   QJ   ZE1     HV24
54   TP   SV23    Q
55   TP   SY2     A
56   MJ   0       HV27
     CA   HV57
```

Fixed or Floating Point Constant Branch

	IA	JV			
0	MJ	0	30000		
1	RP	30011	JV3		
2	TP	ZZ2	SY2		
3	TP	PL31	Q	Fixed or fltpt. indicator → Q	
4	QJ	JV5	JV17		
5	RJ	RD	RD1	Fixed-pt. test	Fixed Pt.
6	TP	SY2	RS4	XS-3 to octal conversion	Fixed Pt.
7	RJ	RS2	RS		Fixed Pt.
10	TP	PL23	Q	Test flag 3 for (-) indication	Fixed Pt.
11	QJ	JV12	JV15		Fixed Pt.
12	TN	RS3	PL30	Negative value → Temp T	Fixed Pt.
13	TP	PL	PL23	0 → flag 3	Fixed Pt.
14	MJ	0	JV	Exit to WV via MC	Fixed Pt.
15	TP	RS3	PL30	Positive value → Temp T	Fixed Pt.
16	MJ	0	JV	Exit to WV via MC	Fixed Pt.
17	RJ	RB	RB1		Floating Pt.
20	TP	SY2	GG4		Floating Pt.
21	TP	SY3	GG5		Floating Pt.
22	RJ	GG2	GG		Floating Pt.
23	TP	PL23	Q		Floating Pt.
24	QJ	JV25	JV30		Floating Pt.
25	TN	GG3	PL30	Negative value → Temp T	Floating Pt.
26	TP	PL	PL23		Floating Pt.
27	MJ	0	JV	Exit to WV via MC	Floating Pt.
30	TP	GG3	PL30	Positive value → Temp T	Floating Pt.
31	MJ	0	JV	Exit to WV via MC	Floating Pt.
	CA	JV32			

Exit for Constant Branch

```
     IA     WV

 0   MJ   0        30000
 1   RA   WV2      PL10
 2   TP   [SV23]   Q          Set up for (|) detection
 3   TP   WV36     WV2
 4   QJ   WV5      WV7
 5   TM   PL30     PL34       Magnitude of constant → Temp ④
 6   MJ   0        WV10
 7   TP   PL30     PL34       Constant → Temp ④
10   RJ   VT       VT1        Set up reference table
11   TP   PL34     A
12   RJ   GW       GW1        Search and assign C/W from constant pool
13   RA   WV14     PL10
14   RA   [SV23]   Q          C/W → Temp ⑬
15   TP   WV37     WV14
16   TP   A        Q
17   QJ   WV20     WV         Test for '40' indicator
20   TP   WV35     Q          L(3777....) → Q
21   RA   WV22     PL10
22   QT   [SV23]   PL30       Mask C/W → Temp Ⓣ
23   TP   WV40     WV22
24   TP   PL10     Q          Shift counter PL10 to V
25   LQ   Q        25
26   RA   WV27     Q
27   TP   PL       [SV23]     Clear cell (set Op. to 0)
30   TP   WV41     WV27
31   RA   WV32     PL10
32   RA   [SV23]   PL30       C/W → Temp ⑬
33   TP   WV42     WV32
34   MJ   0        WV
35   37   77777    77777
36   TP   SV23     Q
37   RA   SV23     Q
40   QT   SV23     PL30
41   TP   PL       SV23
42   RA   SV23     PL30
     CA   WV43
```

Build Variable List

```
    IA  DV
0   MJ  0     30000
1   TV  VL    DV2        Counter → DV2v
2   TP  VT20  [30000]    α → VLn ; n ≥ 1
3   RA  VL    PL3        Increase counter VL by (0,1,1)
4   TP  VT25  Q          Test "b" for variable
5   QJ  DV12  DV6
6   TV  VL    DV7
7   TP  PL    [30000]    No variable∴ 0 → VL list
10  RA  VL    PL3        Increase Counter VL by (0,1,1) to test"c"
11  MJ  0     DV15
12  TV  VL    DV13
13  TP  VT22  [30000]    Insert variable in list
14  RA  VL    PL3        Increase counter VL by (0,1,1)
15  TP  VT26  Q          Test "c" for variable
16  QJ  DV23  DV17
17  TV  VL    DV20
20  TP  PL    [30000]    No variable∴ 0 → VL list
21  RA  VL    PL3
22  MJ  0     DV         To preface region PV via MC
23  TV  VL    DV24
24  TP  VT23  [30000]    Insert variable in list
25  RA  VL    PL3
26  MJ  0     DV         Exit to preface region PV via MC
    CA  DV27
```

Preface for Indicator Region

```
          IA   PV
      0   MJ   0      30000
Test  1   TP   VT24   Q          a' --> Q
2.    2   QJ   PV21   PV3        PV21 = (1)
      3   TP   VT25   Q          b' --> Q
      4   QJ   PV21   PV5        PV21 = (1)
      5   TP   VT26   Q          C' --> Q
      6   QJ   PV21   PV7        PV21 = (1)
      7   TP   VT22   A    }     Test b = 0
     10   ZJ   PV11   ZH1  }     Error print infinite loop designed
     11   TP   VT21   A          a --> A
     12   ST   VT23   A          a-c --> A
     13   ZJ   PV14   PV
     14   SJ   PV15   PV17       0 --> A
     15   TP   VT22   A    }     Test b > 0; if not, error print,
     16   SJ   ZH1    PV   }     Infinite loop designed
     17   TP   VT22   A    }     Test b < 0
     20   SJ   PV     ZH1  }     Error print, infinite loop designed
(1)  21   TP   VT24   Q          a' --> Q
     22   QJ   PV35   PV23       Go to test 4
     23   TP   VT26   Q          c' --> Q
     24   QJ   PV35   PV25
     25   TP   VT23   A          c' --> A
     26   ST   VT21   A          c-a --> A
     27   ZJ   PV30   PV
     30   SJ   PV31   PV33       Test c-a > 0
     31   TP   SV24   Q    }     Test Temp (14) ∈ b for absolute value
     32   QJ   ZH1    PV33 }     Error print, infinite loop
     33   MJ   0      PV
     34   0    0      0
Test 35   TP   VT25   Q    }     Test b', if variable, then exit
4    36   QJ   PV     PV37 }
     37   TP   VT24   Q
     40   QJ   PV43   PV41
     41   TP   VT26   Q
     42   QJ   PV43   PV
     43   TP   VT22   A    }     Test b = 0. If so,
     44   ZJ   PV     ZH1  }     error print, infinite loop designed
          CA   PV45
```

Build Indicator WX

		IA	IV		
	0	MJ	0	30000	
	1	TP	VT25	Q	Test b'
	2	QJ	IV3	IV4	
	3	RA	SV21	IV47	1 ⟶ B5
	4	TP	VT24	Q	Test a'
	5	QJ	IV6	IV10	
	6	RA	SV21	IV46	1 ⟶ B4
	7	MJ	0	IV12	
	10	TP	VT26	Q	Test c'
	11	QJ	IV6	IV50	
Constant	12	TP	SV21	Q	
	13	LQ	Q	20	Test bit 5 = 1
	14	QJ	IV22	IV15	
	15	TP	IV42	A	Test b > 0
	16	TJ	VT22	IV22	
	17	TP	VT22	Q	Test b < 0
	20	QJ	IV21	IV22	
	21	RA	SV21	IV45	1 ⟶ B3
	22	TP	SV21	Q	
	23	LQ	Q	21	Test bit 4 = 1
	24	QJ	IV	IV25	
	25	TP	VT23	A	
	26	ST	VT21	A	Text c-a = 0
	27	ZJ	IV32	IV30	
	30	RA	SV21	IV44	1 ⟶ B2
	31	MJ	0	IV	
	32	TP	SV21	Q	
	33	LQ	Q	21	Test bit 4 = 1
	34	QJ	IV	IV35	
	35	TP	VT23	A	
	36	ST	VT21	A	Test c-a> 0
	37	SJ	IV40	IV	
	40	RA	SV21	IV43	1 ⟶ B1
	41	MJ	0	IV	
	42	0	0	0	
	43	0	1	0	
	44	0	2	0	
	45	0	4	0	
	46	0	10	0	
	47	0	20	0	
	50	TP	SV21	A	
	51	ZJ	IV12	IV	
		CA	IV52		

Mover Region

```
     IA   SV
 0   MJ   0       30000
 1   TP   [SV22]  A         (OP, 0, C/W) --> A
 2   LA   A       17        (OP, 0, C/W) -->(0, C/W, 0)--> A
 3   TU   A       [SV22]    (OP, C/W, C/W)--> Temp (12)
 4   RA   SV1     PL2
 5   RA   SV3     PL1
 6   IJ   SV16    SV1       Reset SV16
 7   TP   SV26    SV1
10   TP   SV27    SV3
11   TP   [SV21]  [WL11]
12   RA   SV11    PL3
13   IJ   SV17    SV11      Move Temp --> WL
14   TU   SV20    SV11
15   MJ   0       SV30
16   0    0       3         Index
17   0    0       4         Index
20   0    SV21    0
21   0    0       0         Temp (11)
22   0    0       0         Temp (12)
23   0    0       0         Temp (13)
24   0    0       0         Temp (14)
25   0    0       0         Temp (15)
26   TP   SV22    A
27   TU   A       SV22
30   TP   SV33    SV16      Reset Index
31   TP   SV34    SV17
32   MJ   0       SV
33   0    0       3
34   0    0       4
     CA   SV35
```

Presetter Region for Re-entry to LV

```
        IA    VZ
 0      MJ    0        30000
 1      TP    PL       PL10       0 ⟶ CTR
 2      TP    PL       PL11       0 ⟶ CTR1
 3      RP    10003    VZ5        0 ⟶ flags
 4      TP    PL       PL21
 5      RP    10007    VZ7        0 ⟶ storage
 6      TP    PL       VT20
 7      RP    10005    VZ11       0 ⟶ Temps  11  -  15
10      TP    PL       SV21
11      RP    10006    VZ13
12      TP    PL       PL30
13      MJ    0        VZ
        CA    VZ14
```

Subroutine for Detection of Asterisk*

```
        IA    UV
 0      MJ    0        EV1        Jump to Exit
 1      RJ    SY       SY1
 2      EJ    PL25     UV4        Test for XS-3  '10'
 3      MJ    0        ZG1        Error print
 4      RJ    SY       SY1
 5      EJ    PL5      TV1        Test for XS-3 POW
 6      TP    SY13     Q          Test
 7      QJ    UV10     UV21         for superscript
10      RJ    SY       SY1
11      TP    SZ2      A
12      EJ    UV31     UV21       Test for superscript (-)
13      TP    SZ2      IN2
14      RJ    IN       IN1
15      TP    IN2      RS4        No superscript (-)
16      RJ    RS2      RS
17      TP    RS3      IQ3
20      MJ    0        UV
21      TP    SY2      IN2
22      RJ    IN       IN1
23      TP    IN2      RS4
24      RJ    RS2      RS
25      TN    TS3      IQ3
26      MJ    0        UV
27      TP    PL26     RS4        XS-3 (1) → RS4
30      MJ    0        UV16
31      00    77777    77777      Superscript (-)
        CA    UV32
```

Subroutine for Detection of "E"

```
     IA   TV
 0   MJ   0      EV1       Exit
 1   RJ   SY     SY1
 2   EJ   PL16   TV13      Test (-)
 3   EJ   PL36   TV5       Test (+)
 4   MJ   0      TV6
 5   RJ   SY     SY1
 6   RJ   RD     RD1       Check fixed pt. constant
 7   TP   SY2    RS4 }     Decimal
10   RJ   RS2    RS  }        to octal conversion
11   TP   RS3    IQ3
12   MJ   0      TV
13   RJ   SY     SY1
14   RJ   RD     RD1       Check fixed pt. constant
15   TP   SY2    RS4 }     Decimal
16   RJ   RS2    RS  }        to octal conversion
17   TN   RS3    IQ3
20   MJ   0      TV
     CA   TV21
```

Exit for Scientific Notation Set-up Routine

```
     IA   EV
 0   MJ   0      HV32
 1   TP   ZZ2    GG4
 2   TP   ZZ3    GG5
 3   RJ   GG2    GG
 4   TP   PL23   Q
 5   QJ   EV6    EV11      Test flag 3
 6   TP   PL     PL23      Reset flag 3
 7   TN   GG3    IQ2
10   MJ   0      EV
11   TP   GG3    IQ2
12   MJ   0      EV
     CA   EV13
```

Set Up Reference Table Used by VL, "WX", and Preface

		IA	VT		
	0	MJ	0	[30000]	Exit
	1	RA	PL11	PL1	Entrance. CTR1 + 1 → CTR1
	2	TP	PL22	Q	Flag ② → Q
	3	QJ	VT10	VT4	Test for variable (-)
	4	RA	VT5	PL11	Constant
	5	TP	PL34	[VT20]	VT20 = Beginning of table
	6	TP	VT27	VT5	Preset VT5
	7	MJ	0	VT16	
	10	RA	VT11	PL11	Variable
	11	TP	PL4	[VT23]	L(40,0,0) → Table
	12	TP	VT30	VT11	Preset VT11
	13	RA	VT14	PL11	
	14	TP	SY2	[VT20]	Symbol → Table
	15	TP	VT31	VT14	Preset VT14
	16	TP	PL	PL22	Reset flag ② to 0
	17	MJ	0	VT	
Table	20	0	0	0	α, the variable
	21	0	0	0	a, the lower limit
	22	0	0	0	b, the incrementing value
	23	0	0	0	c, the upper limit
	24	0	0	0	a'
	25	0	0	0	b' (-) indicates Variable
	26	0	0	0	c'
	27	TP	PL34	VT20	
	30	TP	PL4	VT23	
	31	TP	SY2	VT20	
		CA	VT32		

Constant Pool

	IA	PL		
0	0	0	0	
1	0	0	1	
2	0	1	0	
3	0	1	1	
4	40	0	0	
5	52	77777	77777	POW
6	30	77777	77777	E
7	56	77777	77777	*
10	0	0	0	CTR Slot for Temp 11 - Temp 15
11	0	0	0	CTR1 Slot for a - c ; a' - c'
12	0	0	0	
13	42	77777	77777	I
14	0	0	64000	
15	0	0	65000	
16	02	77777	77777	- lower case minus
17	17	77777	77777	(
20	43	77777	77777	)
21	0	0	0	Flag 1
22	0	0	0	Flag 2
23	0	0	0	Flag 3
24	0	0	0	
25	04	03777	77777	X-S3 10
26	04	77777	77777	1
27	0	0	0	
30	0	0	0	Temp T
31	0	0	0	Temp 1
32	0	0	0	Temp 2
33	0	0	0	Temp 3
34	0	0	0	Temp 4
35	0	0	0	
36	63	77777	77777	+ lower case plus
37	77	77777	77777	
	CA	PL40		

	IA	XV		
0	RJ	XV	XV3	
1	RJ	LV	LV1	
2	MJ	0	MC2	
3	RP	10005	XV1	Zeroizes critical part
4	TP	PL	WL4	of Vary Stringout WL4 - WL10
	CA	XV5		

```
      IA   XU
  0   TP   XU6     TF          
  1   TP   SY2     TF1         SY2
  2   TP   A       TF2
  3   TP   XU7     TF3         Put C/W and XS-3 symbol in CB list
  4   RJ   TE      TE1           for variable α
  5   MJ   0       LV
  6   0    3       3
  7   0    0       0
 10   RJ   SY      SY1
 11   EJ   MC152   ZN1
 12   MJ   0       MC104
 13   TP   XU17    XU5
 14   MJ   0       XU
 15   TP   XU20    XU5         Put C/W and XS-3 symbol in CB list
 16   MJ   0       VT1           for a, b, and c
 17   MJ   0       XU15
 20   MJ   0       LV
 21   RJ   VT      VT1         Builds table
 22   MJ   0       GV45
      CA   XU23
```

Error Prints

```
      IA   ZA
  0   MJ   0       ID3
  1   RJ   WA      WA1
  2   TP   SY2     ZA6
  3   TP   ZA14    UP3
  4   RJ   UP2     UP
  5   MJ   0       ZA
  6   77   77777   77777       0  0  0  0  0  0
  7   01   34650   15051       Δ  I  S  Δ  N  O
 10   66   01240   17024       T  Δ  A  Δ  V  A
 11   54   34242   54630       R  I  A  B  L  E
 12   01   65734   72551       Δ  S  Y  M  B  O
 13   46   22777   77777       L  .  77 77 77 77
 14   40   ZA6     6
      CA   ZA15
```

```
      IA   ZB
 0    MJ   0       ID3
 1    RJ   WA      WA1
 2    TP   ZB13    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZB
 5    31   51544   72466     F  O  R  M  A  T
 6    01   30545   45154     Δ  E  R  R  O  R
 7    01   34223   02201     Δ  I  .  E  .  Δ
10    50   51015   22454     N  O  Δ  P  A  R
11    30   50663   33065     E  N  T  H  E  S
12    34   65227   77777     I  S  .
13    40   ZB5     6
      CA   ZB14

      IA   ZC
 0    MJ   0       ID3
 1    RJ   WA      WA1
 2    TP   ZC16    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZC
 5    34   50265   15065     I  N  C  O  N  S
 6    34   65663   05066     I  S  T  E  N  T
 7    01   67653   00151     Δ  U  S  E  Δ  O
10    31   01313   47230     F  Δ  F  I  X  E
11    27   01515   40131     D  Δ  O  R  Δ  F
12    46   51246   63450     L  O  A  T  I  N
13    32   01525   13450     G  Δ  P  O  I  N
14    66   01515   23054     T  Δ  O  P  E  R
15    24   50276   52277     A  N  D  S  .
16    40   ZC5     11
      CA   ZC17

      IA   ZD
 0    MJ   0       ID3
 1    RJ   WA      WA1
 2    TP   ZD14    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZD
 5    47   34506   76501     M  I  N  U  S  Δ
 6    65   34325   00134     S  I  G  N  Δ  I
 7    46   46303   22446     L  L  E  G  A  L
10    01   52543   03134     Δ  P  R  E  F  I
11    72   01665   10170     X  Δ  T  O  Δ  V
12    24   54342   42546     A  R  I  A  B  L
13    30   22777   77777     E  .
14    40   ZD5     7
      CA   ZD15
```

```
     IA   ZE
 0   MJ   0       ID3
 1   RJ   WA      WA1
 2   TP   ZE14    UP3
 3   RJ   UP2     UP
 4   MJ   0       ZE
 5   34   50265   15065     I  N  C  O  N  S
 6   34   65663   05066     I  S  T  E  N  T
 7   01   67653   00151     △  U  S  E  △  O
10   31   01242   56551     F  △  A  B  S  O
11   46   67663   00170     L  U  T  E  △  V
12   24   46673   00165     A  L  U  E  △  S
13   34   32506   52277     I  G  N  S  .
14   40   ZE5     7
     CA   ZE15

     IA   ZF
 0   MJ   0       ID3
 1   RJ   WA      WA1
 2   TP   SY2     ZF6
 3   TP   ZF21    UP3
 4   RJ   UP2     UP
 5   MJ   0       ZF
 6   77   77777   777777    0  0  0  0  0  0
 7   01   66735   23001     △  T  Y  P  E  △
10   65   73472   55146     S  Y  M  B  O  L
11   01   34650   13446     △  I  S  △  I  L
12   46   30322   44601     L  E  G  A  L  △
13   34   50016   52634     I  N  △  S  C  I
14   30   50663   43134     E  N  T  I  F  I
15   26   01505   16624     C  △  N  O  T  A
16   66   34515   00101     T  I  O  N  △  △
17   01   01010   10131     △  △  △  △  △  F
20   51   54472   46622     O  R  M  A  T  .
21   40   ZF6     13
     CA   ZF22
```

```
      IA   ZG
 0    MJ   0       ID3
 1    RJ   WA      WA1
 2    TP   ZG13    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZG
 5    34   46463   03224      I  L  L  E  G  A
 6    46   01652   63430      L  Δ  S  C  I  E
 7    50   66343   13426      N  T  I  F  I  C
10    01   50516   62466      Δ  N  O  T  A  T
11    34   51500   13151      I  O  N  Δ  F  O
12    54   47246   62277      R  M  A  T  .
13    40   ZG5     6
      CA   ZG14

      IA   ZH
 0    MJ   0       ID3
 1    RJ   WA      WA1
 2    TP   ZH15    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZH
 5    26   33245   03230      C  H  A  N  G  E
 6    01   47512   73431      Δ  M  O  D  I  F
 7    34   30546   50166      I  E  R  S  Δ  T
10    51   01304   63447      O  Δ  E  L  I  M
11    34   50246   63001      I  N  A  T  E  Δ
12    34   50313   45034      I  N  F  I  N  I
13    66   30014   65151      T  E  Δ  L  O  O
14    52   22777   77777      P  .
15    40   ZH5     10
      CA   ZH16
```

```
     IA   ZI
 0   MJ   0      MC
 1   RJ   WA     WA1
 2   TP   ZI22   UP3
 3   RJ   UP2    UP
 4   MJ   0      ZI
 5   66   33300  15067     T  H  E  Δ  N  U
 6   47   25305  40151     M  B  E  R  Δ  0
 7   31   01475  12734     F  Δ  M  0  D  I
10   31   34305  40126     F  I  E  R  Δ  C
11   51   47525  15030     0  M  P  0  N  E
12   50   66650  13072     N  T  S  Δ  E  X
13   26   30302  70104     C  E  E  D  Δ  1
14   10   22015  43065     5  .  Δ  R  E  S
15   66   01513  10165     T  Δ  0  F  Δ  S
16   30   50663  05026     E  N  T  E  N  C
17   30   01505  16601     E  Δ  N  0  T  Δ
20   26   33302  64530     C  H  E  C  K  E
21   27   22777  77777     D  .  77 77 77 77
22   40   Z15    15
     CA   ZI23

     IA   ZJ
 0   MJ   0      MC
 1   RJ   WA     WA1
 2   TP   ZJ20   UP3
 3   RJ   UP2    UP
 4   MJ   0      ZJ
 5   47   34656  55230     M  I  S  S  P  E
 6   46   46345  03201     L  L  I  N  G  Δ
 7   51   54015  05101     0  R  Δ  N  0  Δ
10   54   30313  05430     R  E  F  E  R  E
11   50   26302  70165     N  C  E  D  Δ  S
12   30   50663  05026     E  N  T  E  N  C
13   30   22777  77777     E  .
14   01   51310  16530  }
15   50   66305  02630  }  Unused area
16   01   50516  60126  }
17   33   30264  52722  }
20   40   ZJ5    7
     CA   ZJ21
```

```
      IA   ZK
 0    MJ   0       WC
 1    RJ   WA      WA1
 2    TP   ZK11    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZK
 5    50   51016   55224      N  0  △  S  P  A
 6    26   30015   23054      C  E  △  P  E  R
 7    34   51270   16573      I  0  D  △  S  Y
10    47   25514   62277      M  B  0  L  .
11    40   ZK5     4
      CA   ZK12
```

```
      IA   ZL
 0    MJ   0       MC
 1    RJ   WA      WA1
 2    TP   ZL15    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZL
 5    34   50265   14752      I  N  C  0  M  P
 6    46   30663   00165      L  E  T  E  △  S
 7    30   50663   05026      E  N  T  E  N  C
10    30   01342   23022      E  △  I  .  E  .
11    01   50510   11754      △  N  0  △  '  R
12    24   50323   04301      A  N  G  E  '  △
13    26   51475   25150      C  0  M  P  0  N
14    30   50662   27777      E  N  T  .  77 77
15    40   ZL5     10
      CA ZL16
```

```
      IA   ZM
 0    MJ   0       ID3
 1    RJ   WA      WA1
 2    TP   VT20    ZM10
 3    TP   ZM21    UP3
 4    RJ   UP2     UP
 5    MJ   Q       ZM
 6    70   24543   42425     V  A  R  I  A  B
 7    46   30017   77777     L  E  Δ  77 77 77
10    01   01010   10101     Δ  Δ  Δ  Δ  Δ  Δ
11    01   47676   56601     Δ  M  U  S  T  Δ
12    50   51660   12633     N  O  T  Δ  C  H
13    24   50323   00170     A  N  G  E  Δ  V
14    24   46673   06501     A  L  U  E  S  Δ
15    71   34663   33450     W  I  T  H  I  N
16    01   70245   47301     Δ  V  A  R  Y  Δ
17    77   77777   77777     77 77 77 77 77 77
20    46   51515   22277     L  O  O  P  .
21    40   ZM6     13
      CA   ZM22
```

```
      IA   ZN
 0    MJ   0       MC
 1    RJ   WA      WA1
 2    TP   ZN21    UP3
 3    RJ   UP2     UP
 4    MJ   0       ZN
 5    30   54545   15401     E  R  R  O  R  Δ
 6    34   50016   65424     I  N  Δ  T  R  A
 7    50   65313   05401     N  S  F  E  R  Δ
10    26   51475   25150     C  O  M  P  O  N
11    30   50660   13422     E  N  T  Δ  I  .
12    30   22014   73465     E  .  Δ  M  I  S
13    65   52304   64630     S  P  E  L  L  E
14    27   01715   15427     D  Δ  W  O  R  D
15    01   51540   10134     Δ  O  R  Δ  Δ  I
16    50   26515   45430     N  C  O  R  R  E
17    26   66013   15154     C  T  Δ  F  O  R
20    47   24662   27777     M  A  T  .  77 77
21    40   ZN5     14
      CA   ZN22
```

Build VARY File

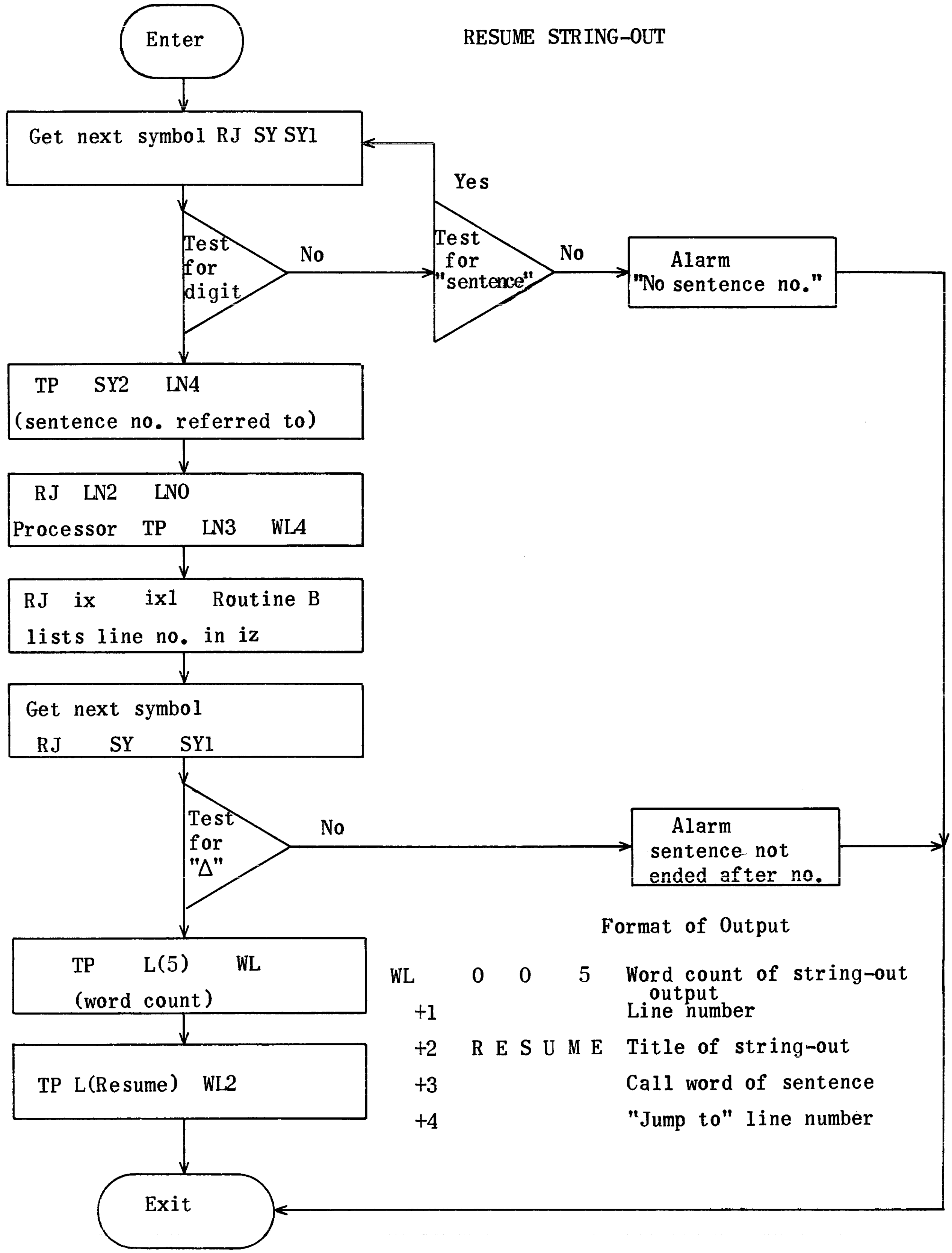
(Entered after processing sentence number of last statement in range)

```
        IA   VP
    0   MJ   0      30000
    1   SP   VS5    0        Has Vary File exceeded its maximum?
    2   TJ   VF     VQ
    3   SP   WL3    0        No
    4   TJ   VS4    VP31     Is 23000 > sentence call word?
①   5   TV   VI2    VP6      No, enter sentence number of last statement in
    6   TP   WL6    30000      range into Vary File
    7   SP   VI2    0
   10   SA   VS     0
   11   TV   A      VP13     Insert call word and no. of WITH words in
   12   SP   WL4    36         next word of Vary File
   13   AT   WL3    30000
   14   TU   VI     VP15
   15   SP   30000  0        Is current sentence number = sentence number in
   16   EJ   WL1    VQ4        Vary File ?
   17   RA   VF     VS2      Increase VF by two
   20   SP   VI     0        (α) = (γ)?
   21   EJ   VI2    VP27
   22   TU   A      VP24     Is sentence number at address given by (γ)
   23   TU   VI2    VP25      > sentence number at address given by (α)?
   24   SP   30000  0
   25   TJ   30000  VQ10
   26   TP   VI2    VI       No, so set (α) = (γ)
③  27   RA   VI2    VS1      Advance (γ) by two
   30   MJ   0      VP       Exit
⑤  31   TP   VF     Q
   32   QT   VS3    A        Is indicator set? (i.e., has there been a
                               22---Vary before?)
   33   ZJ   VP5    VP34
   34   LQ   Q      25       No, so set u of VFO into v of VFO
   35   QT   VS3    A
   36   TV   A      VF
   37   MJ   0      VP5
        CA   VP40
```

```
          IA   VQ
⑥    0    RJ   WA      WA1
     1    TP   NV      UP3
     2    RJ   UP2     UP
     3    MJ   0       VP
⑦    4    RJ   WA      WA1
     5    TP   NV7     UP3
     6    RJ   UP2     UP
     7    MJ   0       VP
⑧    10   RJ   WA      WA1
     11   TP   NV21    UP3
     12   RJ   UP2     UP
     13   MJ   0       VP
          CA   VQ14

          IA   VS
     0    0    1       1
     1    0    2       2
     2    0    2       0
     3    0    0       07777
     4    0    0       230000
     5    0    20143   0        144 = max. length of Vary File (excluding VF0)
                                  (50 Vary statements in problem maximum)
          CA   VS6
```

	IA	NV							
0	40	NV1	6						
1	66	51510	14724	T	O	O	△	M	A
2	50	73017	02454	N	Y	△	V	A	R
3	73	01653	05066	Y	△	S	E	N	T
4	30	50263	06501	E	N	C	E	S	△
5	34	50015	25451	I	N	△	P	R	O
6	32	54244	72201	G	R	A	M	.	△
7	40	NV10	11						
10	70	24547	30147	V	A	R	Y	△	M
11	67	65660	15051	U	S	T	△	N	O
12	66	01253	00146	T	△	B	E	△	L
13	24	65660	16530	A	S	T	△	S	E
14	50	66305	02630	N	T	E	N	C	E
15	01	34500	15424	△	I	N	△	R	A
16	50	32300	15131	N	G	E	△	O	F
17	01	24507	30170	△	A	N	Y	△	V
20	24	54732	27777	A	R	Y	.		
21	40	NV22	12						
22	54	24503	23001	R	A	N	G	E	△
23	51	31013	45050	O	F	△	I	N	N
24	30	54017	02454	E	R	△	V	A	R
25	73	01307	26630	Y	△	E	X	T	E
26	50	27650	12530	N	D	S	△	B	E
27	73	51502	70154	Y	O	N	D	△	R
30	24	50323	00151	A	N	G	E	△	O
31	31	01516	76630	F	△	O	U	T	E
32	54	01010	10101	R	△	△	△	△	△
33	70	24547	32277	V	A	R	Y	.	
	CA	NV34							

RESUME STRING-OUT



Format of Output

WL	0 0 5	Word count of string-out output
+1		Line number
+2	R E S U M E	Title of string-out
+3		Call word of sentence
+4		"Jump to" line number

RESUME STRING-OUT

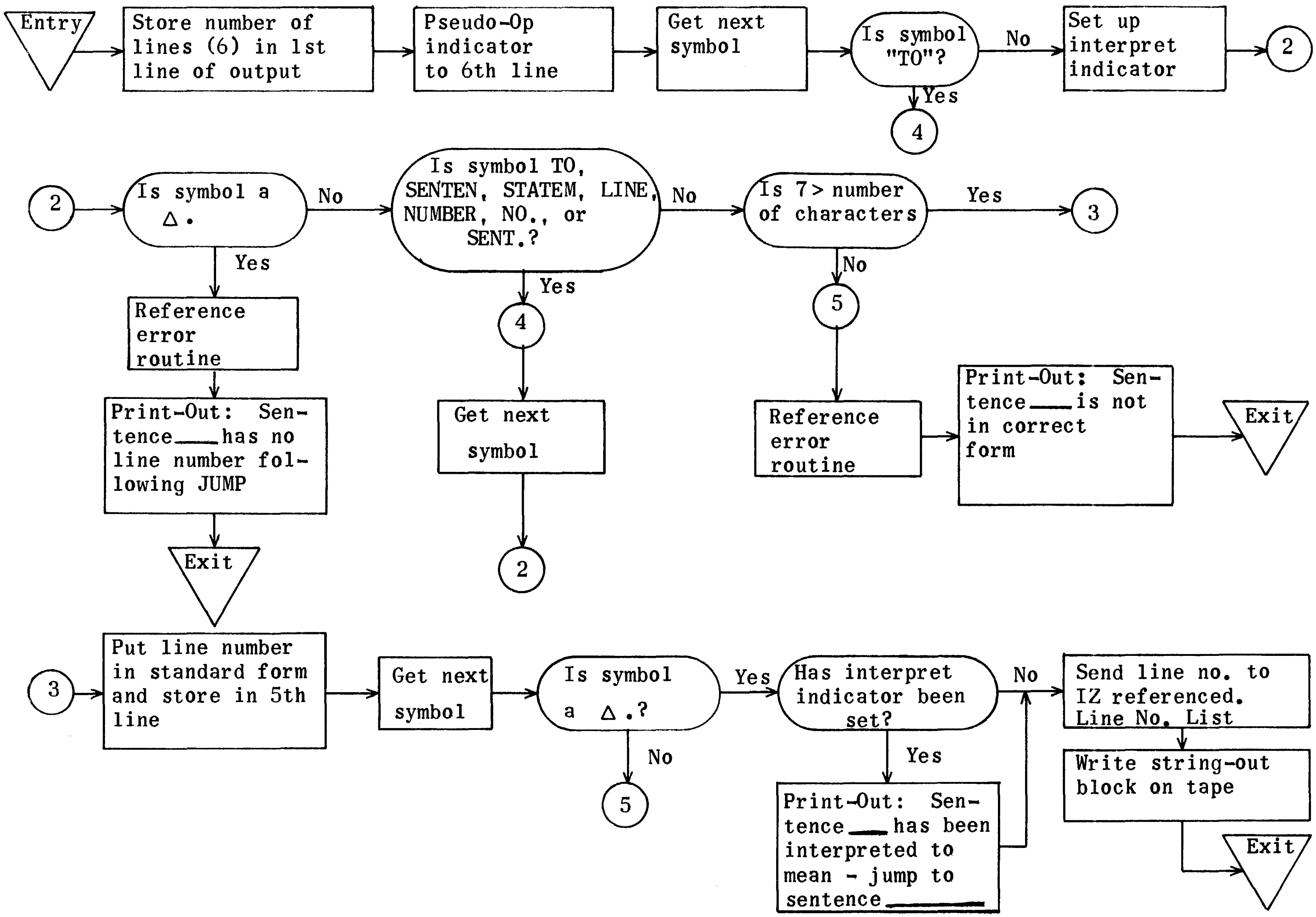
```
    RE   RT4400
    RE   NA4431
    RE   NB4446
```

Translation subroutine regions are also needed to assemble this tape.

```
     IA   RT
 0   MJ   0       CT        Exit
 1   RJ   SY      SY1       Get next symbol
 2   TP   SY11    Q
 3   QJ   RT4     RT5       Is symbol a line number?
 4   MJ   0       RT10
 5   EJ   RT27    RT7       Is symbol SENTEN?
 6   MJ   0       NA1       Error print-out: Sentence -- (Resume) Failed
                              to Reference (VARY) SENTENCE
 7   MJ   0       RT1
10   TP   SY2     LN4       Getting line number in proper form and putting
11   RJ   LN2     LN          in output
12   TP   LN3     WL4
13   RJ   IX      IX1       Putting referenced line number in Referenced
                              Line Number List
14   RJ   SY      SY1
15   TP   SY2     A         Is next symbol Δ. ?
16   EJ   RT24    RT20
17   MJ   0       NB1       Error print-out: Sentence -- (Resume) No
                              Space Period Symbol
20   TP   RT26    WL        Word count to output
21   TP   RT25    WL2       "RESUME" to title line of output
22   RJ   SS      SS1       Get output block written on tape
23   MJ   0       RT        Exit
24   01   22777   77777     Δ .
25   54   30656   74730     R  E  S  U  M  E
26   0    0       5
27   65   30506   63050     S  E  N  T  E  N

     CA   RT30

     IA   NA
 0   MJ   0       RT
 1   RJ   WA      WA1       Print-Out and Error Reference: Sentence --
                              (Resume):
 2   TP   NA14    UP3       Print-Out: Failed to Reference (VARY) Sentence
 3   RJ   UP2     UP
 4   MJ   0       NA        Exit
 5   31   24344   63027     F  A  I  L  E  D
 6   01   66510   15430     Δ  T  O  Δ  R  E
 7   31   30543   05026     F  E  R  E  N  C
```

```
10  30  01240  11770    E △ A △ ( V
11  24  54734  30165    A R Y ) △ S
12  30  50663  05026    E N T E N C
13  30  22777  77777    E.
14  40  NA5    7
    CA  NA15

    IA  NB
 0  MJ  0      RT20
 1  RJ  WA     WA1      Error Reference and Print-Out:  Sentence --
                          (Resume)
 2  TP  NB11   UP3 }    Print-Out:  No Space Period Symbol
 3  RJ  UP2    UP  }
 4  MJ  0      NB       Exit
 5  50  51016  55224    N O △ S P A
 6  26  30015  23054    C E △ P E R
 7  34  51270  16573    I O D △ S Y
10  47  25514  62277    M B O L .
11  40  NB5    4
    CA  NB12
```

Flow Chart for Jump String-Out



JUMP STRING-OUT

Following JUMP in this instruction there should be the word TO. If this word does not appear in this sequence, the following print-out occurs after string-out has been completed: Sentence_______ Hasbeen interpreted To Mean -- Jump To Sentence_______. No reference is made to the error routine with this print-out.

Any combination of the symbols - TO, SENTEN, STATEM, LINE, NUMBER, NO., SENT. - may occur following Jump. The only essential requirement that the routine makes is that, if or when none of the above symbols appear, the symbol under surveillance must be the line number to which the jump is to be made. Of course, the symbols as shown above are merely the beginning in some instances of a more complete word. For example, STATEM is the first line output of the symbol STATEMENT. The routine only examines the first-line output of any symbol.

Each time one of the above symbols is recognized, a return is made to the "Get Next Symbol Routine" for the next symbol. Eventually the loop of recognition of these symbols must be broken by a symbol not in the group.

If a Δ . occurs before the line number has appeared, the error routine is referenced and the print-out is given: Sentence_______Has No Line Number Following Jump.

If the loop of recognition of the 7 above-named symbols is broken by a symbol which exceeds 6 characters, the error routine is referenced, the string-out is terminated, and the print-out reads: Sentence_______Is Not In Correct Form. The theory behind this step is that this non-recognized symbol should be the line number and, as such, have less than 7 characters.

If this assumed line number does have less than 7 characters, it is sent to the line-number routine to be put into standard form. See the Write-up on the line-number routine for what may happen to it here if it fails to meet the requirements of a line number.

The output from the line-number routine is put in the proper place in the output. See jump generation write-up for the format of the jumpstring-out output.

Now a final reference is made to the "Get Next Symbol Routine." If the next symbol is not a Δ . , the error routine is referenced, the string-out is terminated, and the print-out is given: Sentence______Is Not in Correct Form.

If this symbol is a Δ . , a check is made if the sentence is within a pseudo op and the proper entry made in the output accordingly. Next the referenced line number is sent to the reference list by using the IX routine. Finally the completed string-out is transferred to tape by using the WT tape-write routine.

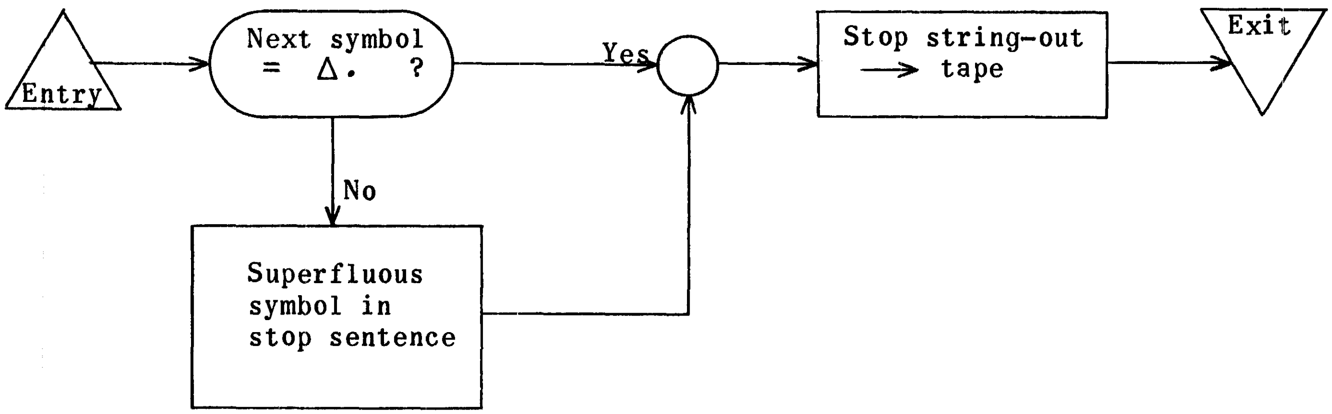
Jump String-Out Regions

RE	VN3507	
RE	SY2466	
RE	LN2037	
RE	IX1552	
RE	WT3207	Subroutine regions used
RE	UP421	
RE	CT714	
RE	TS2762	
RE	UZ3067	
RE	SJ4700	
RE	NQ4730	
RE	JK4745	
RE	CN5020	

```
     IA   SJ
 0   MJ   0      CT       Exit
 1   TP   CN     VN       Number of lines output (6) to 1st line of VN
 2   TP   TS4    VN5      Pseudo-op indicator to VN5
 3   TP   CN2    SJ27     Indicator 1 to SJ27
 4   RJ   SY     SY1      Get next symbol
 5   EJ   CN5    SJ10     Is symbol "TO"?
 6   TP   CN3    SJ27     No. Clearing SJ27
 7   RJ   NQ14   NQ6      Comparison subroutine
10   RJ   SY     SY1      Get next symbol
11   RJ   NQ14   NQ6      Comparison subroutine
12   MJ   0      SJ10
13   TP   SY2    LN4
14   RJ   LN2    LN       Getting line no. in standard form in VN4
15   TP   LN3    VN4
16   RJ   SY     SY1      Get next symbol
17   EJ   CN1    SJ21     Is symbol△. ?
20   MJ   0      NQ
21   TP   SJ27   A        If zero, without error, print:  Sentence______
22   ZJ   SJ23   NQ2        has been interpreted to mean, etc.
23   TP   VN4    A
24   RJ   IX     IX1      Line no. to ref. list
25   RJ   WT     WT1      Writing block on tape
26   MJ   0      SJ
27   0    0      0
     CA   SJ30

     IA   NQ
 0   RJ   UZ     UZ1      Error reference
 1   MJ   0      JK4
 2   TP   VN4    JK43     Line no. to print-out
 3   MJ   0      JK10
 4   RJ   UZ     UZ1      Reference error routine
 5   MJ   0      JK14
 6   EJ   CN1    NQ4      Is symbol a space period?
 7   RP   20007  NQ11     Is symbol TO, SENTEN, STATEM, LINE NUMBER,
10   EJ   CN5    NQ14       NO., SENT.?
11   TP   SY5    A
12   TJ   CN4    SJ13     Is 7 > no. of chars.?
13   MJ   0      NQ
14   MJ   0      30000
     CA   NQ15

     IA   JK
 0   TP   VN1    JK26     Line no. to print-out space
 1   TP   JK20   UP3
 2   RJ   UP2    UP       Sentence_______
 3   MJ   0      30000
 4   RJ   JK3    JK       Sentence_______
```

```
 5  TP   JK21   UP3
 6  RJ   UP2    UP        is not in correct form
 7  MJ   0      SJ
10  RJ   JK3    JK
11  TP   JK22   UP3       Sentence_______has been interpreted to mean-
12  RJ   UP2    UP          Jump to sentence_______
13  MJ   0      SJ23
14  RJ   JK3    JK
15  TP   JK23   UP3       Sentence _________ has no line number follow-
16  RJ   UP2    UP          ing jump
17  MJ   0      SJ
20  0    JK24   3
21  40   JK27   4
22  40   JK33   12
23  40   JK45   6
24  65   30506  63050     Sentence △
25  26   30017  77777
26  0    0      0
27  01   34650  15051
30  66   01345  00126     is not in correct form
31  51   54543  02666
32  01   31515  44722
33  01   33246  50125
34  30   30500  13450
35  66   30545  25430     Has been interpreted to mean ____
36  66   30270  16651       Jump to sentence______ △.
37  01   47302  45002
40  02   44674  75201
41  66   51016  53050
42  66   30502  63001
43  0    0      0
44  01   22777  77777
45  01   33246  50150
46  51   01463  45030     Has no line number following jump
47  01   50674  72530
50  54   01315  14646
51  51   71345  03201
52  44   67475  22277
    CA   JK53

    IA   CN
 0  0    0      6
 1  01   22777  77777     △.
 2  0    0      1
 3  0    0      0
 4  0    0      7
 5  66   51777  77777     T  O
 6  65   30506  63050     S  E  N  T  E  N
 7  65   66246  63047     S  T  A  T  E  M
10  46   34503  07777     L  I  N  E
11  50   67472  53054     N  U  M  B  E  R
12  50   51227  77777     N  O  .
13  65   30506  62277     S  E  N  T  .
    CA   CN14
```

Stop String-out Flow Chart



STOP STRING-OUT

RE SV4400

String-Out Subroutine regions are needed for assembly of this tape.

```
     IA   SV
 0   RJ   SY      SY1      Get next symbol
 1   EJ   SV7     SV5      = Δ. ?
 2   RJ   WA      WA1      No-error
 3   TP   SV10    UP3      Print-out
 4   RJ   UP2     UP
 5   RJ   SS      SS1      Yes - string-out ⟶ tape
 6   MJ   0       CT
 7   01   22777   77777
10   40   SV11    6
11   65   67523   05431    S  U  P  E  R  F
12   46   67516   76501    L  U  O  U  S  Δ
13   65   73472   55146    S  Y  M  B  O  L
14   01   34500   16566    Δ  I  N  Δ  S  T
15   51   52016   53050    O  P  Δ  S  E  N
16   66   30502   63022    T  E  N  C  E  .
     CA   SV17
```

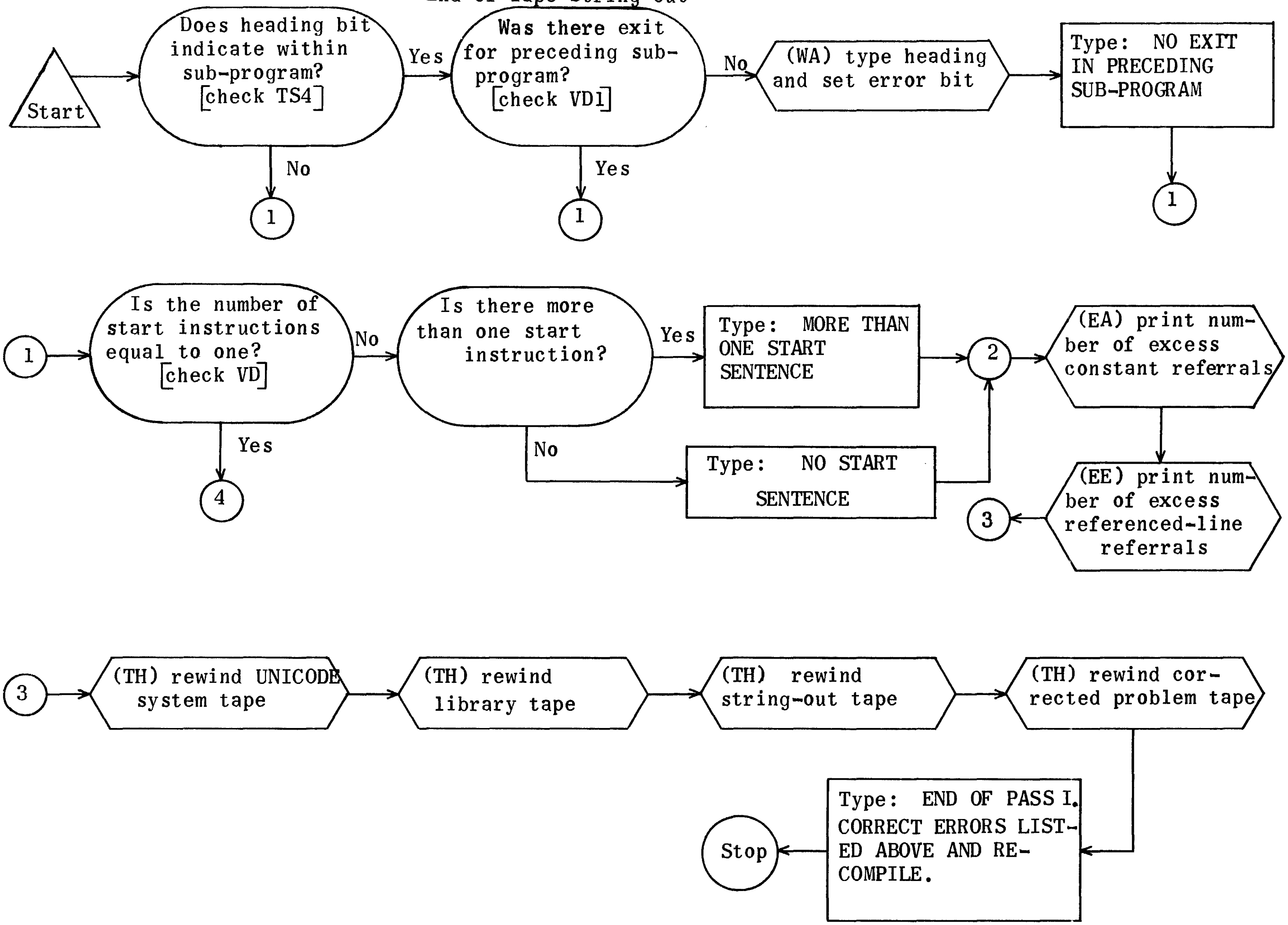
END OF TAPE STRING-OUT

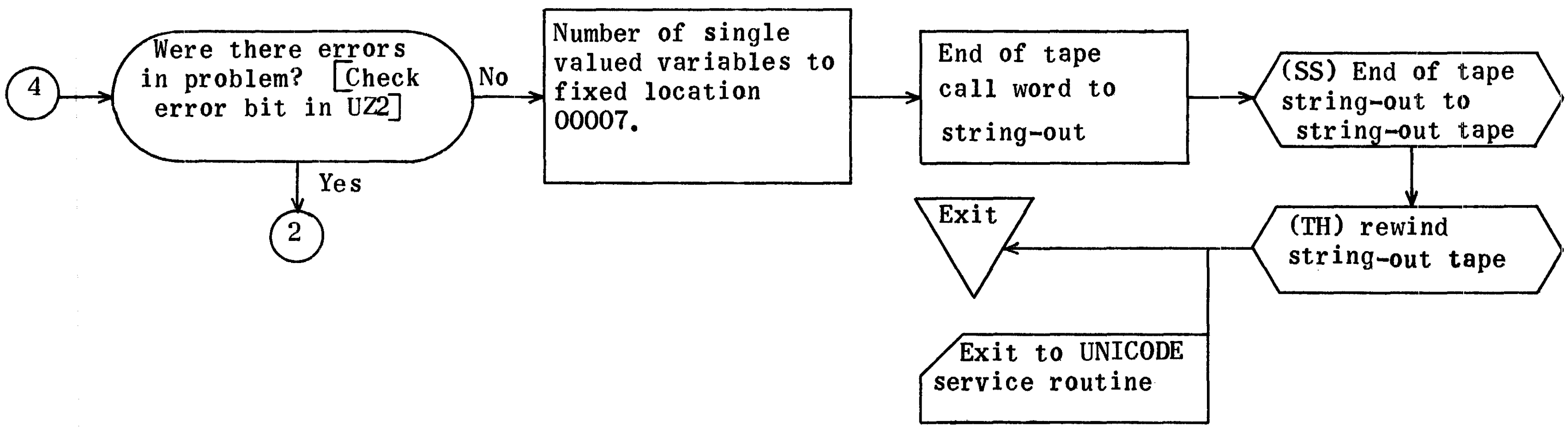
The End of Tape string-out routine closes out the translation phase (Pass I) of the Unicode compilation run. If there was a sub-program preceding the "End of Tape" sentence in the input program, the routine checks to see if an "Exit" instruction was included in the sub-program. If not, the error bit is set and "No exit in preceding sub-program." is typed on the on-line Flexowriter. The routine also checks to see if there was exactly one "Start" sentence in the input program and if not, types "More than one start sentence" or "No start sentence." on the Flexowriter, whichever applies.

If there were previous errors in the program or if there was not exactly one "Start" sentence, the routine prints the number of excess constant referrals and the number of excess referenced-line referrals. The routine then rewinds the Unicode System Tape (Servo 1), the Library Tape (Servo 2), the String-out Tape (Servo 3 or 6) and the Corrected Problem Tape (Servo 5). The routine then types "End of Pass I. Correct errors listed above and recompile." on the on-line Flexowriter and stops.

If there were no errors in the problem, the number of single valued variables is stored in fixed location 00007, the End of Tape callword (23000) is stored in the string-out, and the string-out is written on tape. The String-out Tape is then rewound and the routine exits to the Unicode Service Routine in preparation for the next phase of compilation.

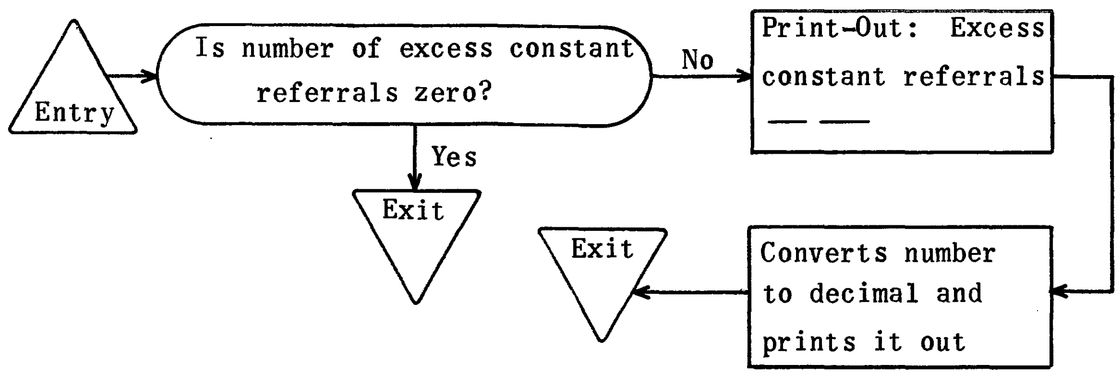
End of Tape String-out



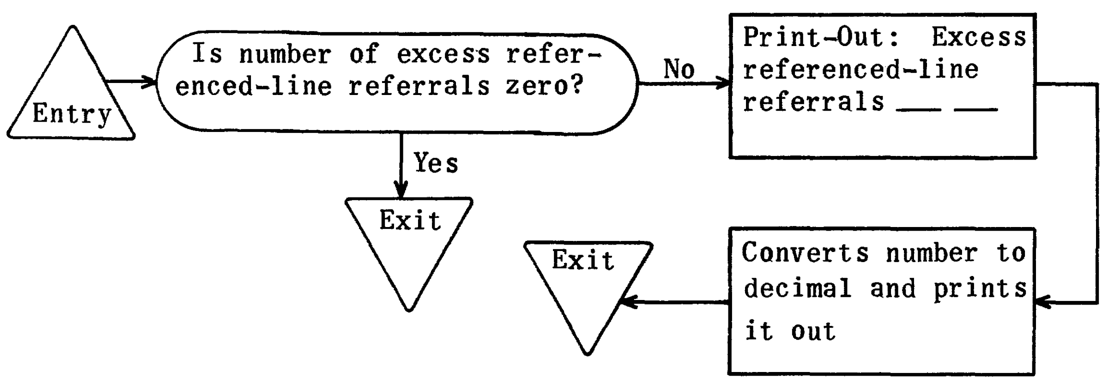

4
Were there errors in problem? [Check error bit in UZ2]
No
Yes
2
Number of single valued variables to fixed location 00007.
End of tape call word to string-out
(SS) End of tape string-out to string-out tape
(TH) rewind string-out tape
Exit
Exit to UNICODE service routine

Flow Charts for Subroutines Supplied to End-of-Tape String-Out

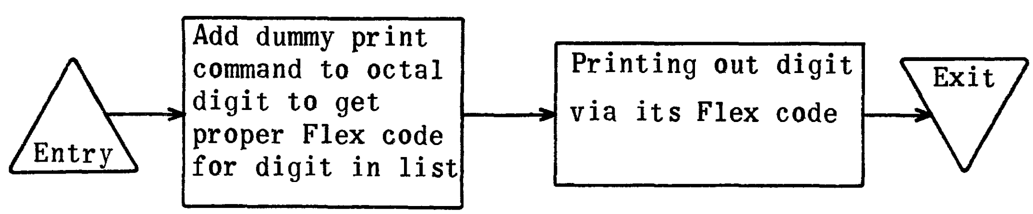
Print-Out of FX13, Number of Excess Constant Referrals



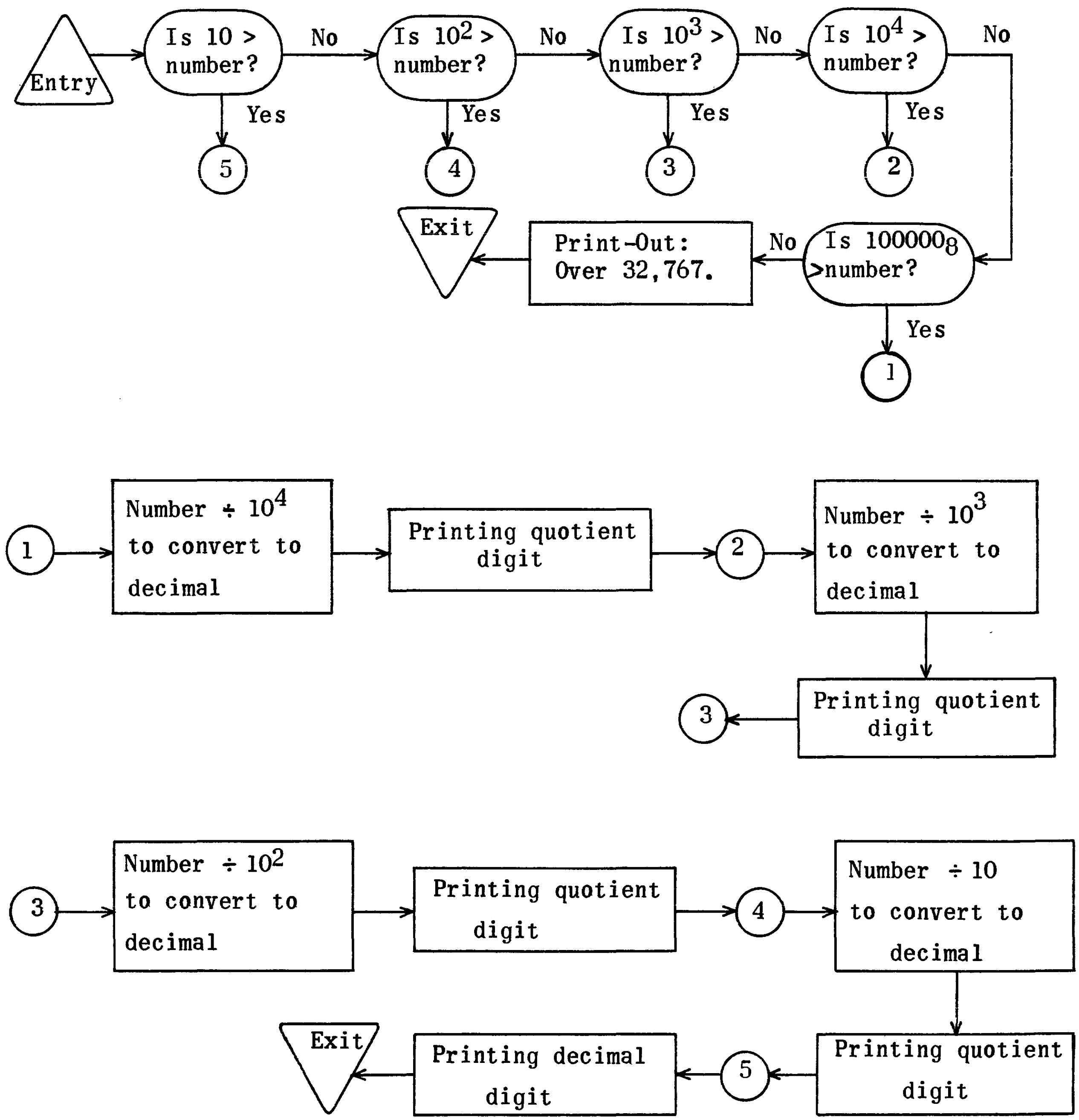
Print-Out of IX47, Number of Excess Referenced-Line Referrals



Single Digit Print-Out



Octal to Decimal Print-Out for Numbers ≤ 77777_8 and ≥ 0



Regions for End of Tape String-Out
(String-out Subroutine Regions Also Required)

```
     RE   ZA77000
     RE   TV4400
     RE   TW4435
     RE   TX4447
     RE   TY4455
     RE   EA4502
     RE   EE4520
     RE   NU4537
     RE   ZU4555

          IA   TV
      0   MJ   0       ZA10     Exit → UNICODE serv. rtn. (read 1 blk UNICODE
                                  tape & jump to 1st word)
      1   TP   TS4     Q        Heading bit → Q35
      2   QJ   TV3     TV10     Within sub-program (pseudo operation)?
      3   TP   VD1     Q        Exit bit → Q35
      4   QJ   TV10    TV5      Was there exit inst. for preceding sub-program
      5   RJ   WA      WA1
      6   TP   75552   UP3      Parameter →Uniprint
      7   RJ   UP2     UP       Print:  NO EXIT IN PRECEDING SUB-PROGRAM
1    10   TP   VD      A        #Start instructions → A
     11   EJ   TX      TW       #Start inst. = 1?
     12   ZJ   TV13    TV15     #Start inst. = 0? No → more than 1 start inst.
     13   TP   TY      UP3      Alarm #1 parameter → Uniprint
     14   MJ   0       TV16
     15   TP   TY6     UP3      Alarm #2 parameter → Uniprint
     16   RJ   UP2     UP       Print alarm
2    17   RJ   EA      EA1      Print #excess constant referrals
     20   RJ   EE      EE1      Print # excess referenced-line referrals
     21   TP   TX2     TH3
     22   RJ   TH2     TH       Rewind UNICODE tape (servo #1)
     23   TP   TX3     TH3
     24   RJ   TH2     TH       Rewind library tape (servo #2)
     25   TP   TX4     A        Codeword to rewind stringout tape (servo #3)
                                → A
     26   AT   TN      TH3      Adv. servo no. by 3 →servo #6 if 7 servos
     27   RJ   TH2     TH       Rewind stringout tape (servo #3 or #6)
     30   TP   TX5     TH3
     31   RJ   TH2     TH       Rewind corrected problem tape (servo #5)
     32   TP   TY12    UP3
     33   RJ   UP2     UP       Print:  END OF PASS I.  CORRECT ERRORS ETC.
     34   MS   0       TV34
          CA   TV35
```

```
④       IA   TW
   0    TP   UZ2     A       # errors in problem —> A
   1    ZJ   TV17    TW2     Were there errors in program?
   2    TP   VB1     A       # single valued variables less 1 —> A
   3    AT   TX      7       # single valued variables —>"v" of fixed
                             loc. 7
   4    TP   TX1     WL3     End of tape callword (23000)—> string-out
   5    RJ   SS      SS1     End of tape string-out—> tape
   6    TP   TX4     A       Codeword to rewind string-out tape (servo #3)
                             —> A
   7    AT   TN      TH3     Adv. servo no. by 3—> Servo #6 if 7 servos
  10    RJ   TH2     TH      Rewind string-out tape
  11    MJ   0       TV
        CA   TW12


        IA   TX
   0    0    0       1
   1    0    0       23000
   2    10   1       0       Codeword to rewind UNICODE tape
   3    10   2       0       Codeword to rewind library tape
   4    10   3       0       Codeword to rewind string-out tape (5 servos)
   5    10   5       0       Codeword to rewind corrected problem tape
        CA   TX6


        IA   TY
   0    00   TY1     5
   1    47   51543   00166      M  O  R  E  Δ  T
   2    33   24500   15150      H  A  N  Δ  O  N
   3    30   01656   62454      E  Δ  S  T  A  R
   4    66   01653   05066      T  Δ  S  E  N  T
   5    30   50263   02277      E  N  C  E  .  77
   6    00   TY7     3
   7    50   51016   56624      N  O  Δ  S  T  A
  10    54   66016   53050      R  T  Δ  S  E  N
  11    66   30502   63022      T  E  N  C  E  .
  12    00   TY13    12
  13    30   52070   15131      E  N  D  Δ  O  F
  14    01   52246   56501      Δ  P  A  S  S  Δ
  15    34   22010   12651      I  .  Δ  Δ  C  O
  16    54   54302   66601      R  R  E  C  T  Δ
  17    30   54545   15465      E  R  R  O  R  S
  20    01   46346   56630      Δ  L  I  S  T  E
  21    27   01242   55170      D  Δ  A  B  O  V
  22    30   01245   02701      E  Δ  A  N  D  Δ
  23    54   30265   14752      R  E  C  O  M  P
  24    34   46302   27777      I  L  E  .  77 77
        CA   TY25
```

Print-Out of FX13, Number of Excess Constant Referrals

```
     IA   EA
 0   MJ   0       30000     Exit
 1   TP   FX13    A         Is the number in FX13 zero?
 2   ZJ   EA3     EA
 3   TP   EA10    UP3       Print-Out: EXCESS CONSTANT REFERRALS --
 4   RJ   UP2     UP
 5   TP   FX13    A         Converts number to decimal and prints it out
 6   RJ   ZU      ZU1
 7   MJ   0       EA
10   0    EA11    5         Parameter for print-out
11   30   72263   06565     E  X  C  E  S  S
12   01   26515   06566     Δ  C  O  N  S  T
13   24   50660   15430     A  N  T  Δ  R  E
14   31   30545   42446     F  E  R  R  A  L
15   65   02027   77777     S  -  -
     CA   EA16
```

Print-Out of IX47, Number of Excess Referenced-Line Referrals

```
     IA   EE
 0   MJ   0       30000     Exit
 1   TP   IX47    A         Is the number zero?
 2   ZJ   EE3     EE
 3   TP   EE10    UP3       Print-Out: EXCESS REFERENCED-LINE REFERRALS __
 4   RJ   UP2     UP
 5   TP   IX47    A         Converts number to decimal and prints it out
 6   RJ   ZU      ZU1
 7   MJ   0       EE
10   0    EE11    6         Parameter for Print-Out
11   30   72263   06565     E  X  C  E  S  S
12   01   54303   13054     Δ  R  E  F  E  R
13   30   50263   02702     E  N  C  E  D  -
14   46   34503   00154     L  I  N  E  Δ  R
15   30   31305   45424     E  F  E  R  R  A
16   46   65020   27777     L  S  -  -
     CA   EE17
```

Input Digit in A_V. Single Digit Print-Out Routine

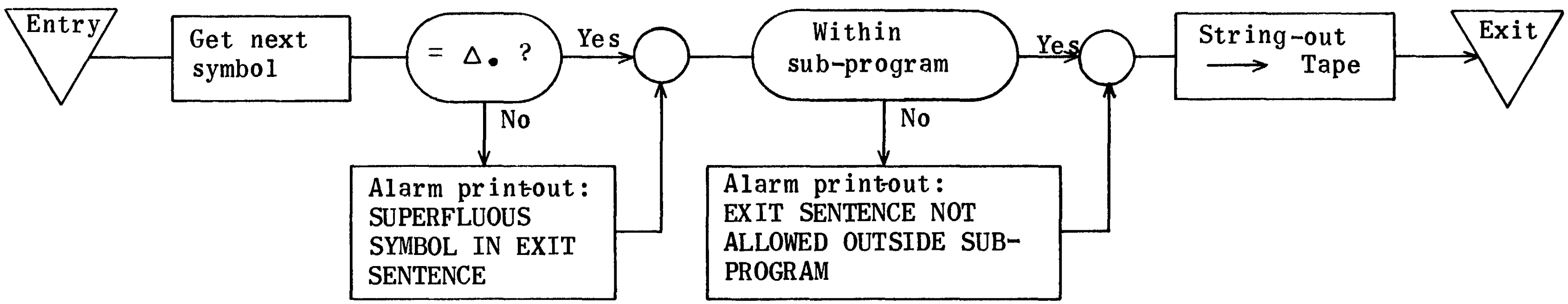
```
           IA   NU
       0   AT   NU3   NU1     Entry. Adds dummy print command to octal
                                digit & puts into next instruction
       1   PR   0     0       Prints out decimal digit
       2   MJ   0     30000   Exit
       3   PR   0     NU4     Dummy Print Command
       4   0    0     37      0
       5   0    0     52      1
Flex   6   0    0     74      2
Codes  7   0    0     70      3
```

	10	0	0	64	4
	11	0	0	62	5
Flex	12	0	0	66	6
Codes	13	0	0	72	7
	14	0	0	60	8
	15	0	0	33	9
		CA	NU16		

Input in A_V. Octal to Decimal Print-Out for Numbers ≤ 77777
Print-Out for Numbers > 77777 is: OVER 32,767

	IA	ZU		
0	MJ	0	30000	Exit
1	TJ	ZU32	ZU21	Entry. Is 10 > no.?
2	TJ	ZU33	ZU17	Is 10^2 > no?
3	TJ	ZU34	ZU15	Is 10^3 > no.?
4	TJ	ZU35	ZU13	Is 10^4 > no.?
5	TJ	ZU41	ZU11	Is 100 000_8 > no.?
6	TP	ZU31	UP3	Error print-out: OVER 32,767
7	RJ	UP2	UP	
10	MJ	0	ZU	Jump to exit
11	DV	ZU35	Q	$\div$ 10^4 to convert to decimal
12	RJ	ZU30	ZU24	Printing out digit
13	DV	ZU34	Q	$\div$ 10^3 to convert to decimal
14	RJ	ZU30	ZU24	Printing digit
15	DV	ZU33	Q	$\div$ 10^2 to convert to decimal
16	RJ	ZU30	ZU24	Printing digit
17	DV	ZU32	Q	$\div$ 10 to convert to decimal
20	RJ	ZU30	ZU24	Printing digit
21	RJ	NU2	NU	Printing digit
22	PR	0	ZU36	Printing carriage return
23	MJ	0	ZU	Jump to exit
24	TP	A	ZU42	
25	TP	Q	A	Subroutine to facilitate continued conversion
26	RJ	NU2	NU	of octal number to decimal and print out
27	TP	ZU42	A	decimal digit obtained
30	MJ	0	30000	
31	40	ZU37	2	Parameter for print-out: OVER 32,767
32	0	0	12	10
33	0	0	144	10^2
34	0	0	1750	10^3
35	0	0	23420	10^4
36	0	0	45	Carriage return
37	51	70305	40106	O V E R Δ 3
40	05	23121	11222	2 , 7 6 7 .
41	0	1	0	$100{,}000_8 < 10^5$
42	0	0	0	Temporary
	CA	ZU43		

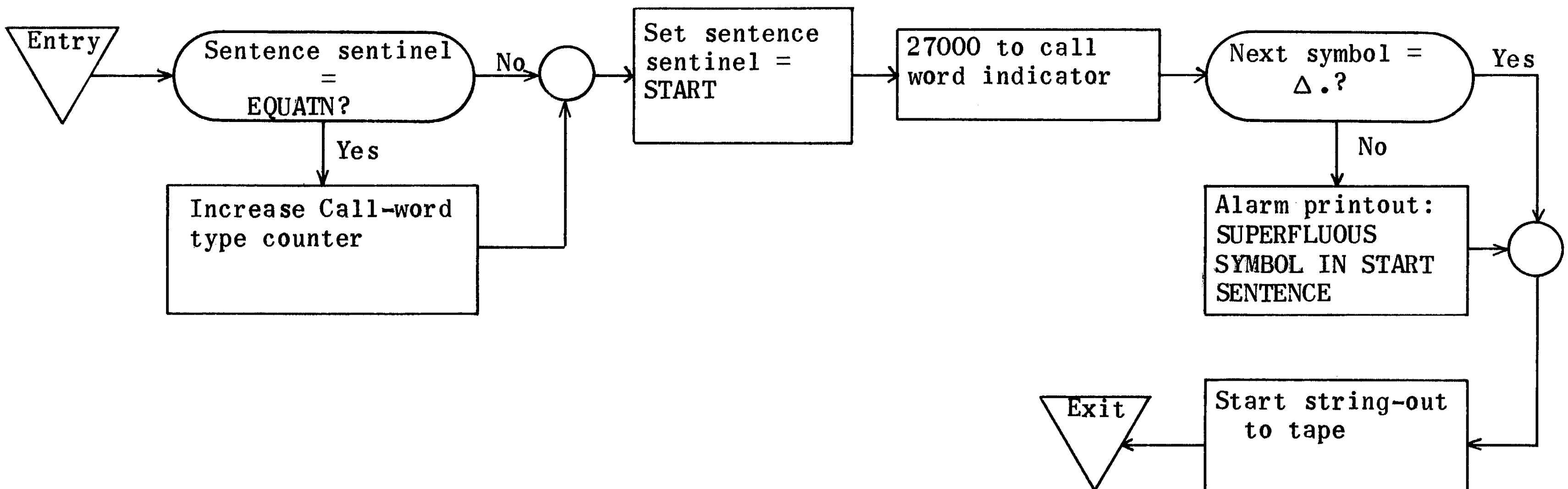
Exit String-out Flow Chart



Exit String-Out

```
     RE   SW4400
     RE   SX4416

     String-Out Subroutine regions also needed to assemble this tape

     IA   SW
 0   RJ   SY      SY1      Get next symbol
 1   EJ   SX      SW5      = Δ. ?
 2   RJ   WA      WA1      No; get heading &
 3   TP   SX1     UP3      Print out error sentence
 4   RJ   UP2     UP
 5   TP   TS4     Q        Yes;
 6   QJ   SW12    SW7      Op of TS4 = 40? (Within Subprogram?)
 7   RJ   WA      WA1      No; get heading &
10   TP   SX12    UP3      Print out alarm  sentence
11   RJ   UP2     UP
12   TV   TS4     WL4      Yes, call word ⟶ WL4
13   RJ   SS      SS1      Output to tape
14   TP   SX11    VD1      Indicator to VD1 that an Exit has been found
                             in the last pseudo operation
15   MJ   0       CT       Exit
     CA   SW16

     IA   SX
 0   01   22777   77777    Δ.
 1   40   SX2     6
 2   65   67523   05431    S  U  P  E  R  F
 3   46   67516   76501    L  U  O  U  S  Δ
 4   65   73472   55146    S  Y  M  B  O  L
 5   01   34500   13072    Δ  I  N  Δ  E  X
 6   34   66016   53050    I  T  Δ  S  E  N
 7   66   30502   63022    T  E  N  C  E  .
10   77   0       0        mask
11   40   0       0
12   40   SX13    10
13   30   72346   60165    E  X  I  T  Δ  S
14   30   50663   05026    E  N  T  E  N  C
15   30   01505   16601    E  Δ  N  O  T  Δ
16   24   46465   17130    A  L  L  O  W  E
17   27   01516   76665    D  Δ  O  U  T  S
20   34   27300   16567    I  D  E  Δ  S  U
21   25   01525   45132    B  Δ  P  R  O  G
22   54   24472   27777    R  A  M  .
     CA   SX23
```

Start String-out Flow Chart



START STRING-OUT

```
    RE   SU4400

    String-Out Subroutine regions are needed for assembly of this tape

    IA   SU
 0  RA   VD     SU17     Increase VD by 1
 1  SP   WL2    0     }
 2  EJ   SU20   SU4   }  WL2 = EQUATN ?
 3  MJ   0      SU5      No; do not increase VB4
 4  RJ   XJ     XJ1      Yes; increase VB4
 5  TP   SU21   WL2      START --> WL2
 6  TP   SU22   A     }
 7  AT   VB4    WL3   }  Call word + (VB4) --> WL3
10  RJ   SY     SY1      Get next symbol
11  EJ   SU23   SU15     = Δ . ?
12  RJ   WA     WA1   }  No; error
13  TP   SU24   UP3   }  Print-out
14  RJ   UP2    UP    }
15  RJ   SS     SS1      String-out --> tape
16  MJ   0      CT       Exit
17  0    0      1
20  30   53672  46650    E  Q  U  A  T  N
21  65   66245  46677    S  T  A  R  T  Δ
22  0    0      27000    C/W
23  01   22777  77777    Δ  .
24  40   SU25   7
25  65   67523  05431    S  U  P  E  R  F
26  46   67516  76501    L  U  O  U  S  Δ
27  65   73472  55146    S  Y  M  B  O  L
30  01   34500  16566    Δ  I  N  Δ  S  T
31  24   54660  16530    A  R  T  Δ  S  E
32  50   66305  02630    N  T  E  N  C  E
33  22   77777  77777    .
    CA   SU34
```

EQUATION TRANSLATION ROUTINE

When an equation is encountered in a UNICODE Program the translation control transfers this routine from drum to core and jumps to it. The main functions of the routine are to make up a translation list to be used to generate machine code, assign call words to symbols, and detect and type out errors.

The translation list is made up by each translation routine as an output (Region WL). The equation translation routine is unique in one use of this list in that it keeps another list within the translation list. This is called the function dummies list and occupies locations WL4-WL23 or 16_{10} locations. Hence there is room for 8 two-word items, the first word being the excess-three code for the symbol and the second word the dummy call word of this symbol. WL0-WL3 is the heading and the coded symbols start at WL24.

In an equation before START, the symbol is assigned a call word as follows:

1) If the symbol is in the Combination List, it already has a call word which determines the type of symbol with one exception. If the call word is 65xxx and the next symbol is an open parenthesis, the call word is changed to 66xxx and case 3 applies. If the symbol is that of a subscripted variable, the subscripts are assigned dummy call words and put in the list at WL4-WL23 and are handled similarly to the dummy arguments of a function.

2) If its first character is I, J, K, L or M, it is assigned a 64xxx call word and the equation is assumed to be fixed point.

3) If neither of the above cases applies, the next symbol is checked and if it is an open parenthesis the variable is assigned a 66xxx call word and a function mode is set. In this case all variables within the set of parentheses on the left are function dummies and put in the list at WL4-WL23. These dummies apply <u>only</u> to this particular equation.

After START no function call words are assigned by the equation translator but the pseudo operation heading translator assigns symbols dummy function call words, if equated to a real function by a COMPUTE. In an equation no arguments should be written with a function if the function appears on the right or if it appears after START.

Operation symbols are determined to be fixed point if they appear in a fixed-point equation (determined by the first symbol) or if they appear when in the subscript mode; otherwise they are assumed to be floating point. The list of errors found in this paper suggest what cannot be written in an equation.

The following pages contain:

1) A list of call words or special codes assigned by the equation translator.

2) An example of the output for a function.

3) A list of error prints.

4. Explanations of some of the subroutines.

Special Codes Used by Equation Translation

Op	u	v	
0	0	10	Absolute value (open), floating and fixed
0	0	12	Absolute value (closed), floating
0	0	11	Absolute value (closed), fixed
0	0	20	+ floating
0	0	21	+ fixed
0	0	30	- floating binary
0	0	31	- fixed binary
0	0	32	- floating unary
0	0	33	- fixed unary
0	0	40	, ; comma or semicolon
0	0	50	= equals sign
0	0	60	* floating multiply
0	0	61	* fixed multiply
0	0	70	/ floating divide
0	0	71	/ fixed divide
0	0	100	POW
0	0	120	$\triangle$. (space period)
0	1	0	(open parenthesis
0	2	0	) closed parenthesis
0	0	17100	Superscript = -1 (superscript 1 is ignored)
0	0	16000	Superscript = 1/2
0	0	16100	Superscript = -1/2
0	0	15000	Superscript = 2
0	0	15100	Superscript = -2
0	0	14000	Superscript = 3
0	0	14100	Superscript = -3
0	0	130xx	Superscript = +4 to $+77_8$ ($4 \leqq xx \leqq 77$)
0	0	131xx	Superscript = -4 to -77_8 ($4 \leqq xx \leqq 77$)
0	0	101	$\lvert$Integral POW$\rvert$ >63
0	0	25xxx	In equation for 66xxx, 65xxx or 64xxx symbol, before START
0	0	24xxx	Equation for 77xxx type symbol, before START.

EXAMPLE

Output of Equation Translators for an equation which occurs before START:

F(x1, x2 (I)) = - | x1 | ^{3} + x2 (J) *S2 (I, L) /R POW SIN Y△.

	OP	u	v		
WL	0	0	55	# words in list	
WL1	01	06142	21001	Line number (excess 3) 39.5	Heading
WL2	30	53672	46650	EQUATN (excess three)	
WL3	0	0	25xxx	Sentence call word (x=octal digit)	
WL4	72	04777	77777	x1 (excess three)	
WL5	0	0	62000	Call word of x1	The function dummy list for this equation.
WL6	72	05777	77777	x2	
7	0	0	75001	Call word of x2	
10	34	77777	77777	I	
11	0	0	62003	Call word of I	
				} WL12-WL23=0	
WL24	0	0	66000	F	
	0	0	50	=	
	0	0	32	-	
	0	0	10	|	
	0	0	62000	x1	
	0	0	12	|	
	0	0	14000	Superscript 3	
	0	0	20	+	
	0	0	75001	x2	
	0	1	0	(	The Translated Equation
	0	0	64xxx	J	
	0	2	0	)	
	0	0	60	*	
	0	0	77xxx	S2	
	0	1	0	(	
	0	0	62003	I	
	0	0	40	,	
	0	0	64xxx	L	
	0	2	0	)	
	0	0	70	/	
	0	0	65xxx	R	
	0	0	100	POW	
	0	0	5xxxx	SIN	
	0	0	65xxx	Y	
	0	0	120	△.	

Error Texts for Equations

E1. Function symbol, ----, (sub program dummy) in fixed point equation.

E2. Subscripted variable symbol, ----, (sub program dummy) in fixed point equation.

E3. Floating point variable, ----, (sub program dummy) used in fixed point equation.

E4. Function symbol, ----, (sub program dummy) among subscripts of ----.

E5. Subscripted variable symbol, ----, (sub program dummy) among subscripts of ----.

E6. Floating point variable, ----, (sub program dummy) among subscripts of ----.

E7. Fixed point variable, ----, (sub program dummy) in floating pt. equation.

E8. Subscripted variable symbol, ----, among subscripts of ----.

E9. Library routine, ----, among subscripts of ----.

E10. Function, ----, among subscripts of ----.

E11. Floating point variable, ----, among subscripts of ----.

E12. Fixed point variable, ----, in floating point equation.

E13. Library routine, ----, in fixed point equation.

E14. Floating point symbol, in fixed point equation.

E15. Function, ----, in fixed point equation.

E16. Subscripted variable symbol, ----, in fixed point equation.

E17. Library routine symbol, ----, with more than one argument, not followed by open parenthesis.

E18. Subscripted variable symbol, ----, not followed by an open parenthesis.

E19. Subscripted variable symbol, ----, (sub program dummy) not followed by an open parenthesis.

E20. Subscripted variable symbol, ----, (function dummy) among subscripts of ----.

E21. Floating point variable, ----, (function dummy) among subscripts of ----.

E22. Fixed point variable, ----, (function dummy) in floating point equation.

E23. Subscripted variable symbol, ----, (function dummy) not followed by an open parenthesis.

E24. More than one separate equation for ----.

E25. Superfluous symbols on left.

E26. Function, ----, on left, not followed by an open parenthesis. Rest of this sentence not checked.

E27. Library routine symbol, ----, is first symbol of sentence. Rest of sentence not checked.

E28. An Equation for ---- in the range of a VARY sentence in which ---- appears.

E29. Illegal symbol (----) for left of equation.

E30. More than one subscript on ----, an argument of the function ----.

E31. Library routine symbol, ----, on left, among arguments of the function ----.

E32. Superscript symbol, ----, among subscripts of ----.

E33. Superscript symbol, ----, in fixed point equation.

E34. More than four superscript symbols in sequence.

E35. POW operation symbol among subscripts of ----.

E36. POW operation symbol in fixed point equation.

E37. Number of library routine operands (by comma count) not equal to number listed for this routine.

E38. Interlocking parenthesis and absolute value signs. (|) |

E39. Closed parenthesis appears with no corresponding open.

E40. Number of subscripts on ---- (by comma count) is not equal to number obtained from dimension sentence.

E41. Open parenthesis among subscripts of ----.

E42. Illegal symbol, ----, for right of equation.

E43. Incorrect use of comma.

E44. Number of equals signs not equal to one.

E45. Some open parentheses not closed.

E46. Number of open absolute value signs not equal to number of closed.

E47. Number of open parentheses on left not equal to number of closed.

E48. Superfluous arguments on function ----.

E49. Within arguments of more than 7 library routines. Arguments of ---- not checked.

E50. Too many dummy arguments on function ----. Rest of this sentence not checked.

E51. Pseudo operation symbol, ----, on right.

E52. Incorrect symbol sequence. $\underset{\text{---}}{\text{sym}}$ $\underset{\text{---}}{\text{sym}}$

E53. Closed absolute value appears with no corresponding open.

E54. Open parenthesis, on left, among subscripts of ----.

E55. Incorrect use of open parenthesis on left among arguments of ----.

E56. Incorrect use of comma among arguments of ----.

E57. More than 29 unclosed open parentheses and/or absolute value signs.

E58. Constant illegal on left, before start.

SYMBOL PAIR CHECKER

Almost every pair of symbols is checked by this routine. The bit in the array on the following page corresponding to the symbol pair consisting of the last two symbols picked up is checked. If it is a 1, the pair is illegal and the error is printed. The left symbol is picked up from SZ2 and the right from SY2.

After checking a pair the routine sets the right symbol as the left symbol for the next check. Hence, before entering the routine, the new right symbol must be set as an input.

The left symbol is indicated by an address in PC2 and the right symbol by a shift count in PC3. The addresses range from PD2 to PD22 and the shifts from 0 to 20. Notice from the way that the array is set up that to change a shift count to an address it is only necessary to add the shift count to address PD2. This is the way a right symbol becomes the next left symbol.

If for some reason it is desired that no error be printed out for a symbol, the shift count is set to 20 and the symbol pairs with any other legally.

The codes for the error print of this routine are with those of the translation subroutines. It is called F18 and is in region FI.

Meaning of Region PD Used by Symbol Pair Checker (PC)

Right Symbol

Left Symbol	Doesn't matter	| (open)	Δ.	=	LIB	POW	Up/	Up-	Up Const.	* or /	+ or -	, or ;	FTN	Sub. Var.	VAR. or Const.	) or | (closed)	(	Address		Octal
(	0	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	0	PD2	=	67642
) or | (closed)	0	1	0	0	1	0	1	0	0	0	0	0	1	1	1	0	1	PD3	=	112035
VAR. or Const.	0	1	0	0	1	0	1	0	0	0	0	0	1	1	1	0	1	PD4	=	112035
Sub. Var.	0	1	0	0	1	0	1	0	0	0	0	0	1	1	1	0	0	PD5	=	112034
FTN	0	1	0	0	1	0	1	0	0	0	0	0	1	1	1	0	0	PD6	=	112034
, or ;	0	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	0	PD7	=	67642
+ or -	0	0	1	0	0	1	1	1	1	1	1	1	0	0	0	1	0	PD10	=	47742
* or /	0	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	0	PD11	=	67642
Up Const.	0	1	0	0	1	0	0	1	1	0	0	0	1	1	1	0	1	PD12	=	111435
Up -	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	PD13	=	157377
Up /	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	PD14	=	177377
POW	0	0	1	0	0	1	1	1	1	1	0	1	0	0	0	1	0	PD15	=	47642
LIB	0	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	0	PD16	=	67642
=	0	0	1	1	0	1	1	1	1	1	0	1	0	0	0	1	0	PD17	=	67642
Δ.	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	PD20	=	177777
| (open)	0	0	1	0	0	1	1	1	1	1	0	1	0	0	0	1	0	PD21	=	47642
Doesn't matter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	PD22	=	0

To see if a symbol pair is legal, find the left symbol in the column on the left and the right symbol in the row at the top. If the box of intersection of the row and column of this symbol pair contains a 1, the pair is illegal. If it contains a zero, the pair is legal.

0 = legal symbol pair

1 = illegal symbol pair

Get Call Word from Dummy Function List

This routine searches addresses WL4 - WL23 for the symbol in SY2. If the symbol is found it is put in TU2 and its call word is in TU3 in the v address. Reference the routine as follows:

```
RJ      TU      TU1
MJ       0      (Not in list)
MJ       0      (In list)
```

Send Call Word to Dummy Function List

The XS3 code for the symbol is sent to TP2 and the dummy call word to TP3 then

```
RJ  TP  TP1
```

sends the two-word file to the list WL4 - WL23.

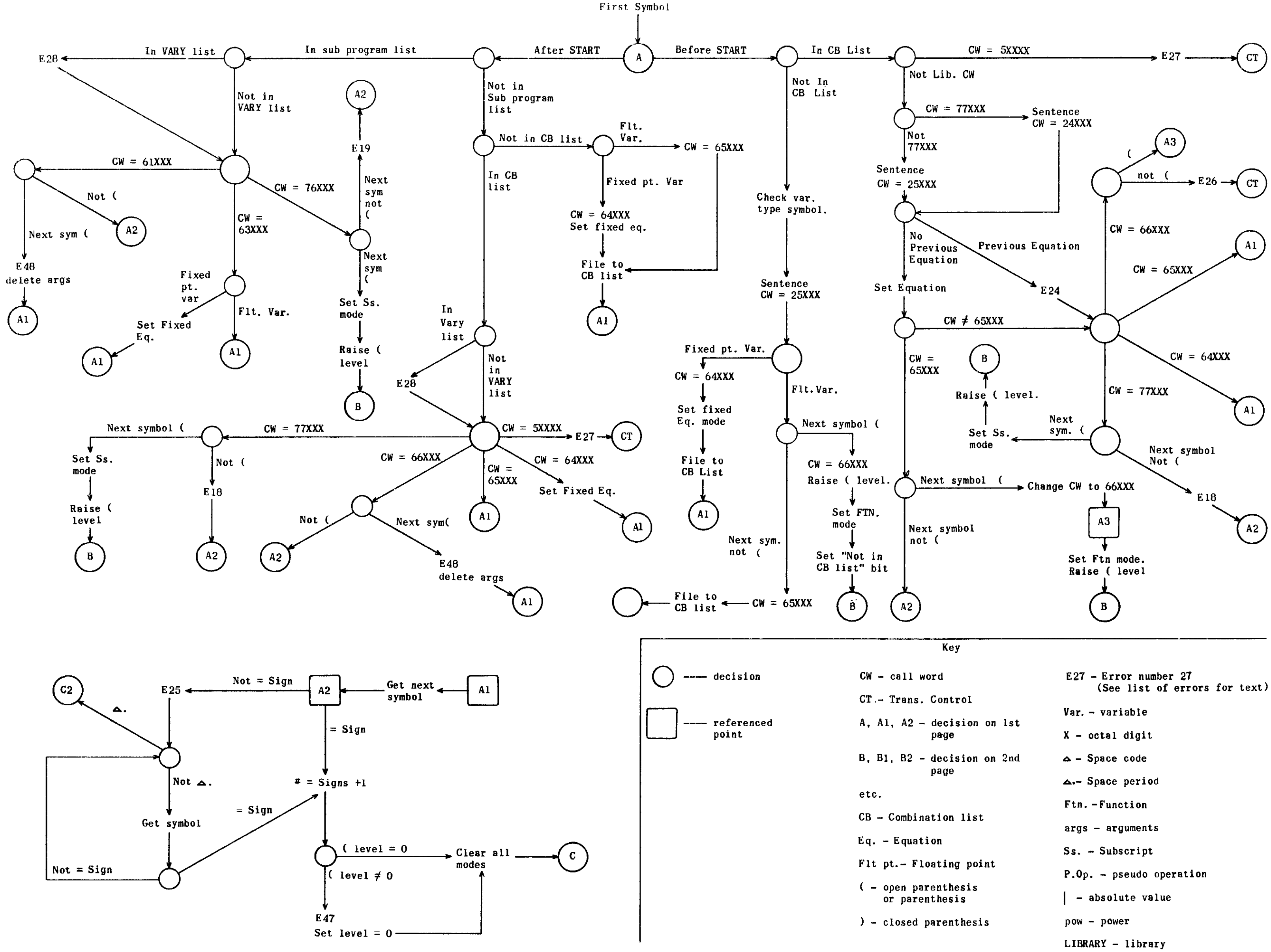
Delete Library or Function Arguments, or Subscripts

Sometimes an error is encountered and the arguments of a function or library routine or subscripts of a variable should be ignored without checking so the number of errors doesn't become excessive.

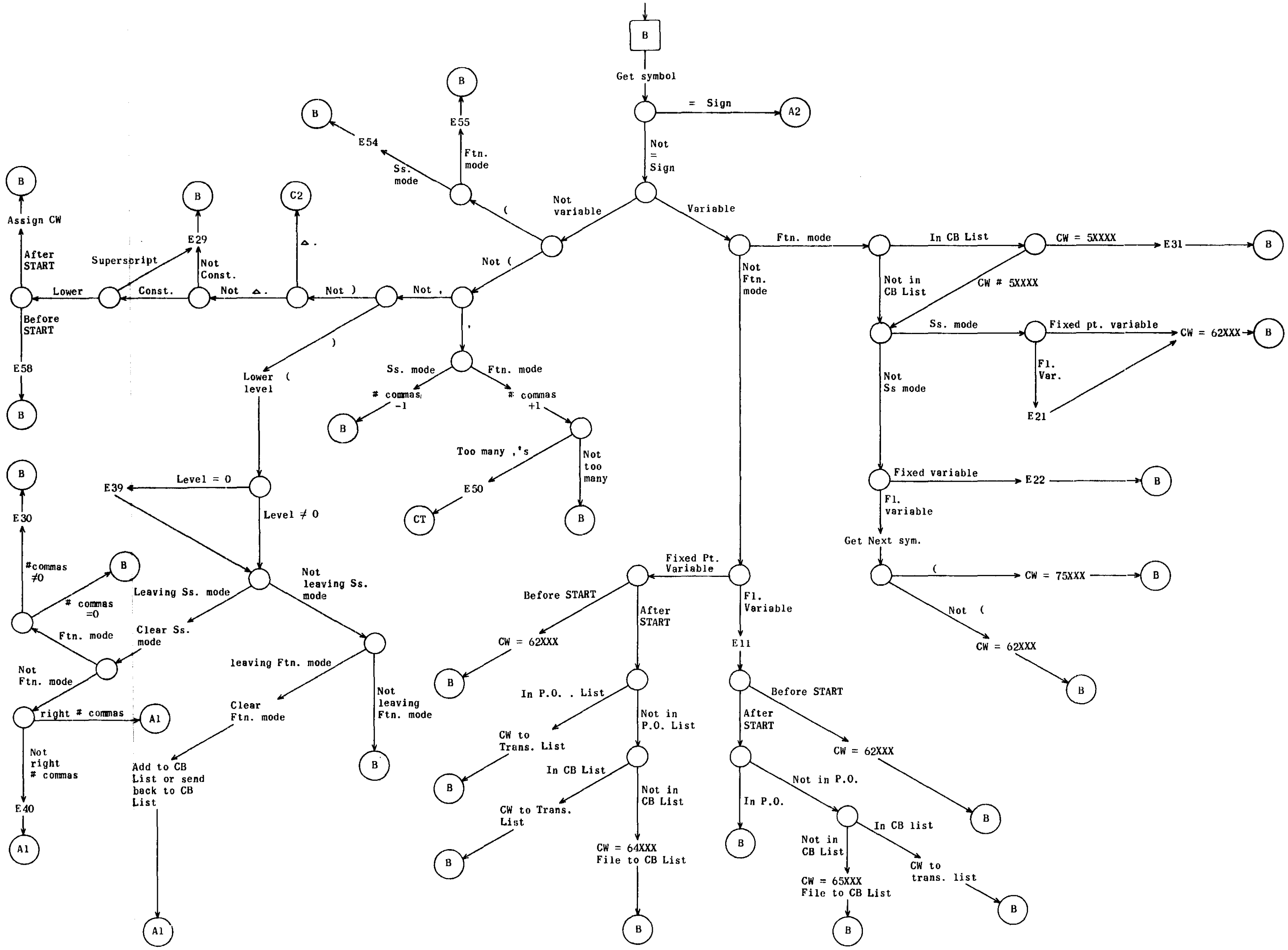
To use the routine

```
RJ  FV   FV1
MJ  0    (If△. is encountered)
MJ  0    (after deletion)
```

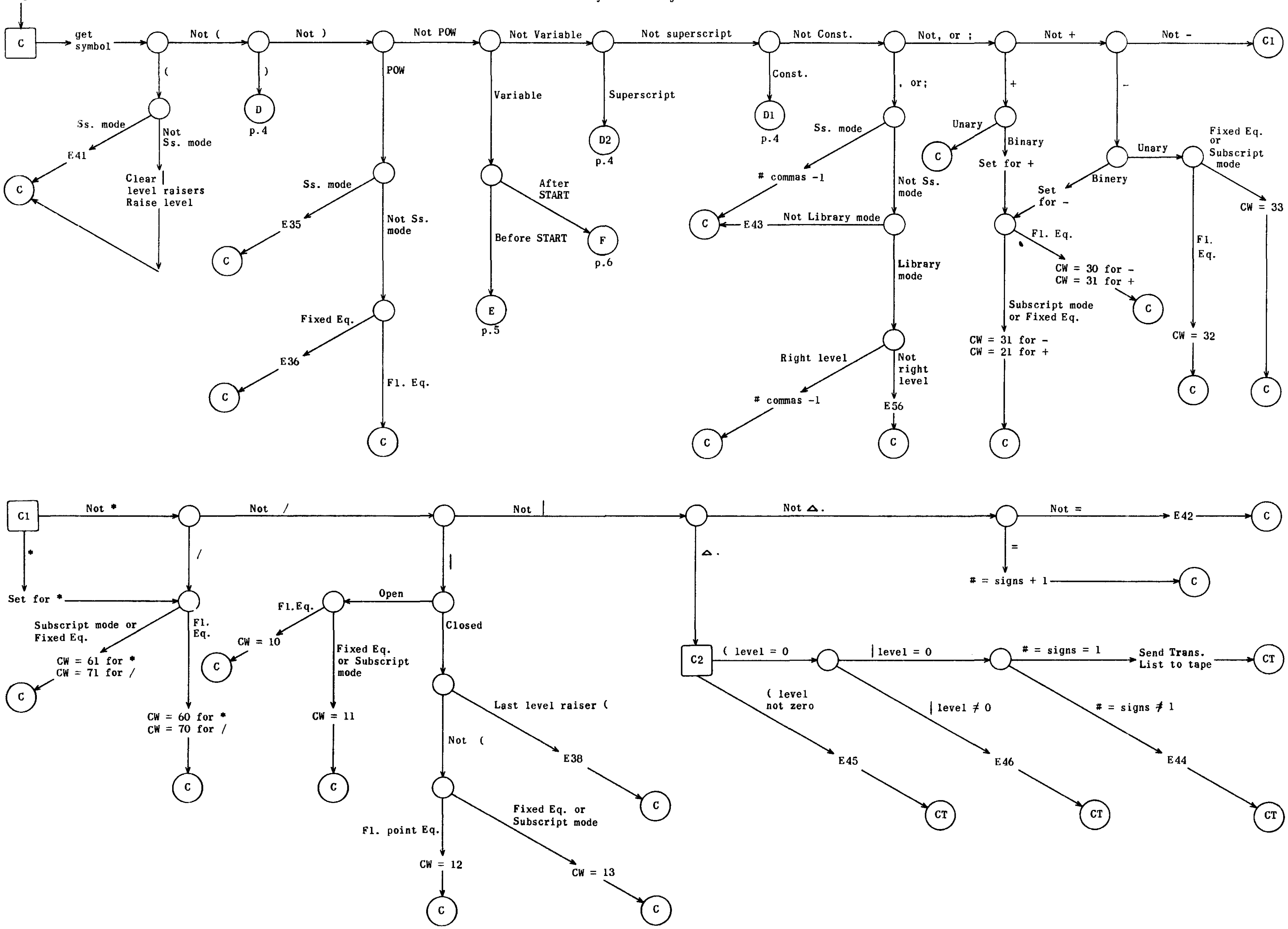
Equation Translation (Page 1)
Left
First Symbol



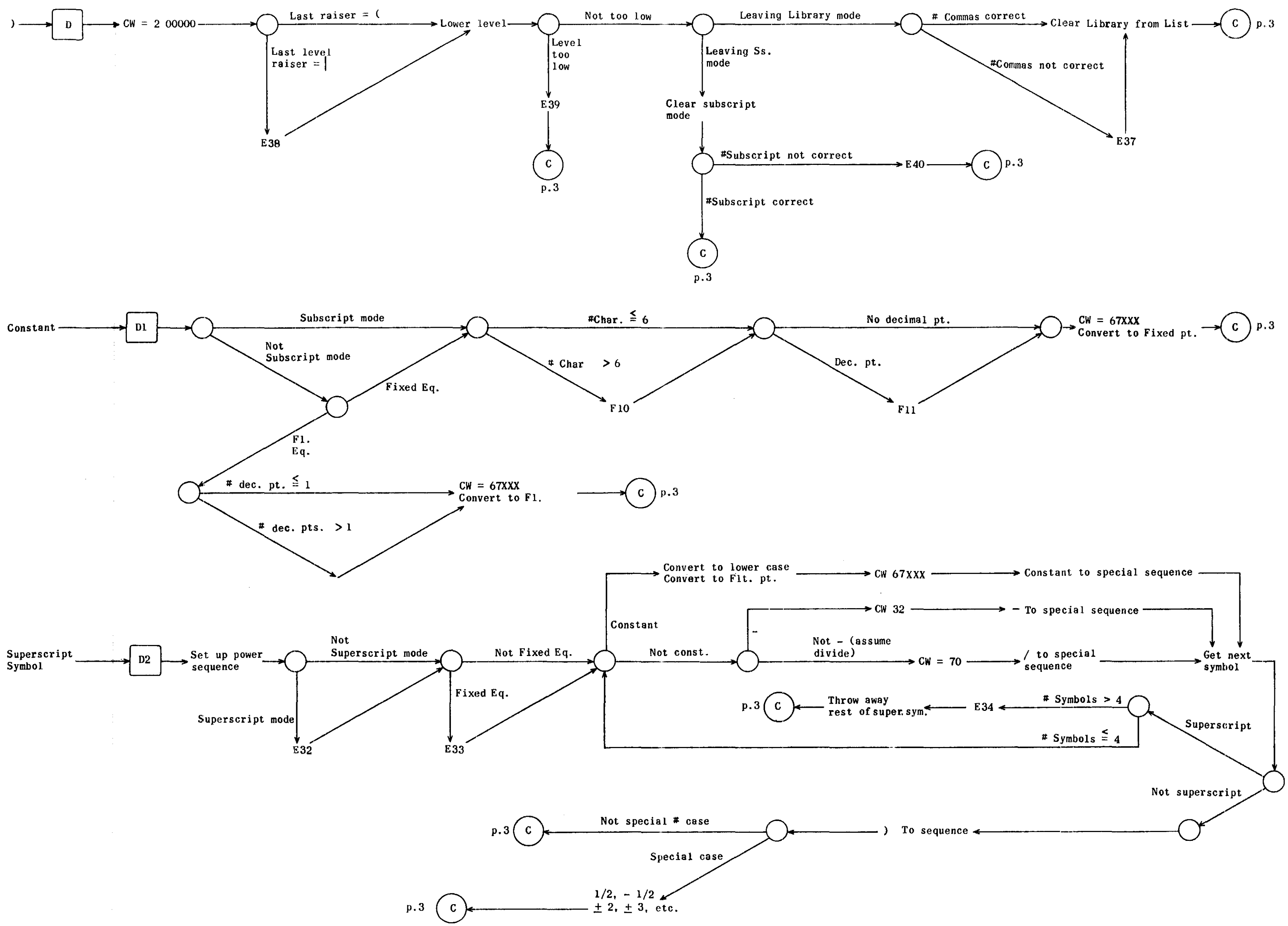
Equation Translation (Page 2)
Left
Not First Symbol



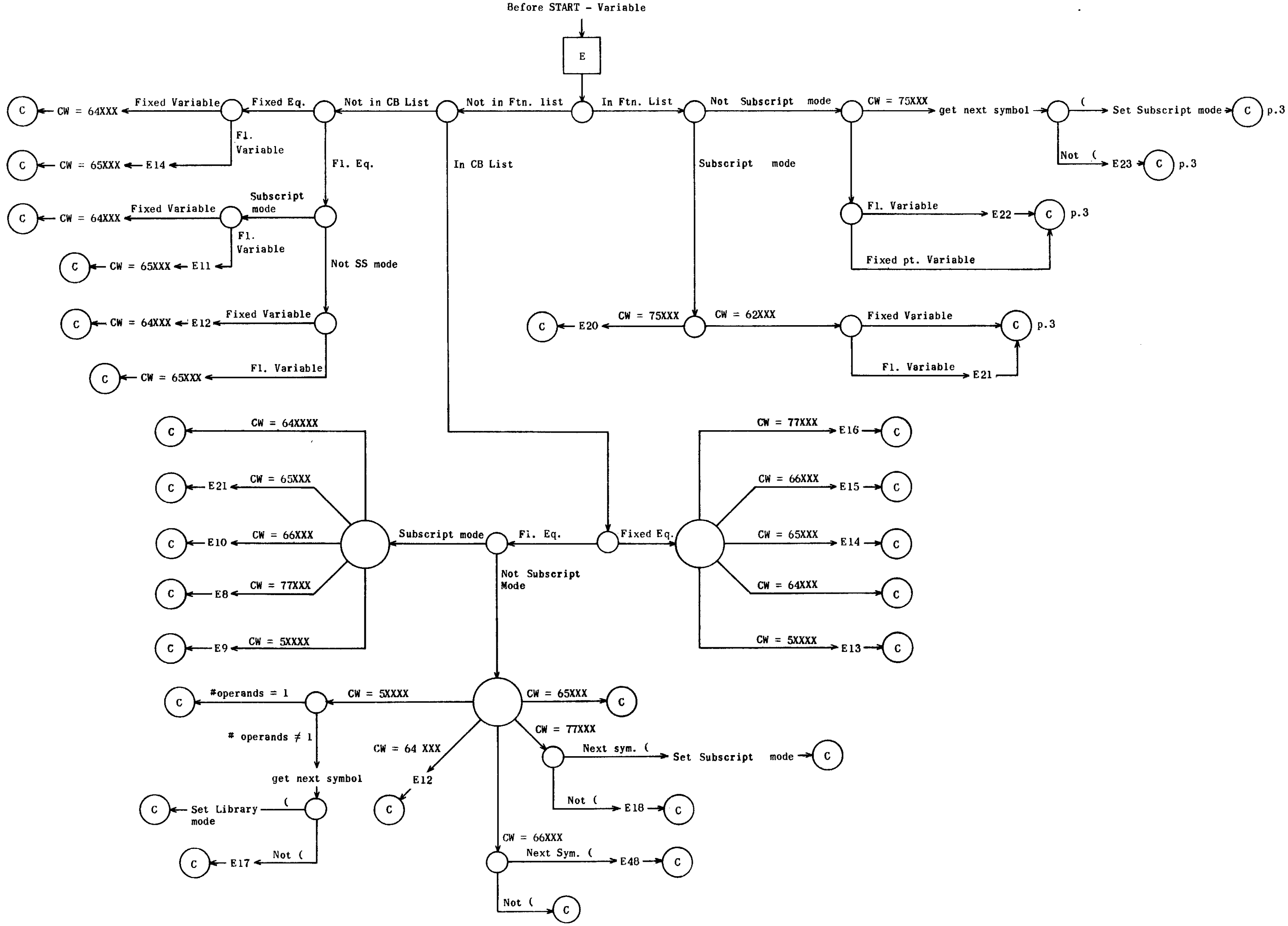
Equation Translation (Page 3)
Symbols on Right



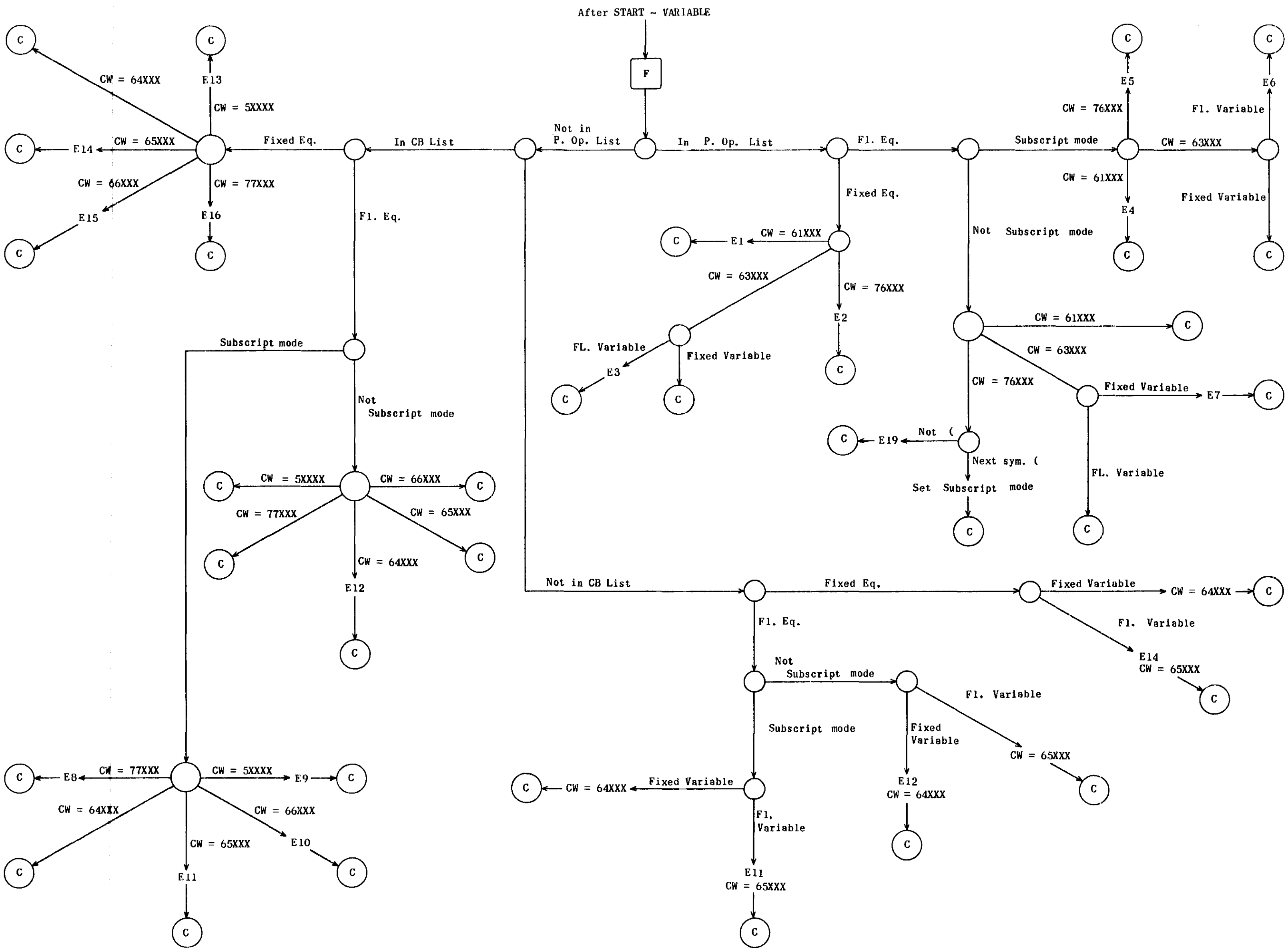
Equation Translation (Page 4)
Symbols on Right (Cont.)



Equation Translation (Page 5)
Right (Cont.)



Equation Translation (Page 6)
Right (Cont.)



Equation Translation Routine

RE	FR04000	Setups
RE	CA04027	
RE	CG04067	
RE	CH04127	Constants
RE	CI04167	
RE	CK04227	
RE	DA04243	Left
RE	FJ04260	
RE	FK04271	
RE	FL04303	
RE	FM04313	Right
RE	FN04323	
RE	FP04337	
RE	FU04343	
RE	FV04361	Subroutine
RE	HC04405	
RE	HF04412	
RE	HG04417	
RE	HH04432	
RE	HK04444	
RE	HL04455	
RE	HM04474	
RE	HN04506	
RE	HQ04515	
RE	HR04524	
RE	HS04535	
RE	HU04551	
RE	HV04564	
RE	HW04623	
RE	HX04645	
RE	HY04666	
RE	HZ04673	
RE	MA04702	
RE	MB04717	
RE	MC04724	
RE	MD04753	
RE	ME05001	Right
RE	MG05032	
RE	MH05046	
RE	MI05067	
RE	MJ05211	
RE	MK05220	
RE	ML05236	
RE	MM05253	
RE	MN05300	
RE	MP05310	
RE	MQ05315	
RE	MS05337	
RE	MT05343	

RE	MU05372	
RE	MV05404	
RE	MW05410	
RE	MX05412	
RE	MY05415	
RE	MZ05431	
RE	NA05434	
RE	NB05447	
RE	NC05461	
RE	ND05471	
RE	NE05502	
RE	NF05511	
RE	NG05532	
RE	NH05551	
RE	NI05576	
RE	NJ05621	
RE	NK05626	
RE	NL05645	Right
RE	NN05652	
RE	NP05670	
RE	NS05676	
RE	NV05715	
RE	NW05733	
RE	NX05740	
RE	NY05745	
RE	NZ05753	
RE	PC05762	
RE	PD06006	
RE	TP06031	Subroutines
RE	TU06057	
RE	WC06077	
RE	WD06104	
RE	XC06115	
RE	XD06123	
RE	XE06152	Right
RE	XF06205	
RE	XG06220	
RE	XH06237	
RE	XI06251	
RE	XL06260	Subroutine
RE	XQ06276	
RE	XR06317	
RE	XT06344	Right
RE	XV06362	
RE	XW06400	
RE	XY06405	
RE	XZ06432	
RE	YB06444	
RE	YC06511	
RE	YD06532	Left
RE	YE06537	
RE	YF06541	

RE	YG06560	
RE	YH06571	
RE	YI06603	
RE	YJ06611	
RE	YK06623	Left
RE	YL06644	
RE	YM06673	
RE	YN06705	
RE	YP06723	
RE	YQ06731	
RE	YR06745	
RE	YS06751	
RE	YT06765	
RE	YU07003	
RE	YV07016	Δ.
RE	YW07054	
RE	YX07075	
RE	YY07115	
RE	YZ07135	
RE	ZA07151	
RE	ZB07163	Left
RE	ZC07212	
RE	ZD07226	
RE	ZE07262	
RE	ZF07271	
RE	ZG07300	
RE	ZH07313	
RE	ZI07330	
RE	ZJ07341	
RE	ZK07346	
RE	ZL07353	
RE	ZM07364	
RE	ZN07416	
RE	ZQ07434	
RE	ZR07452	Right
RE	ZT07464	
RE	ZV07510	
RE	ZW07525	
RE	ZX07556	
RE	ZY07571	
RE	ZZ07615	
RE	KX07620	Left
RE	KY07645	
RE	VA07663	Variables
RE	VC07725	
RE	EF73047	
RE	EG73106	
RE	EH73146	
RE	EI73212	Error Text Constants
RE	EJ73251	
RE	EK73300	
RE	EL73334	

```
RE      EM73362
RE      EN73410
RE      EP73452
RE      ER73515
RE      EX73556
RE      GA73611
RE      GB73643      Error Text Constants
RE      GC73706
RE      GD73737
RE      GE74000
RE      GF74027
RE      GH74052
RE      GI74113
RE      GJ74151
RE      GK74202
RE      GL74225
RE      GM74255
RE      GP74306
RE      GQ74343
RE      GV74375
RE      FQ74444
RE      GY74461
RE      GZ74510
```

Equation Translation - Setups and Subroutines

Region	Name
FR	Setups
TU	Get CW from dummy Ftn. list
TP	Send CW to dummy Ftn. list
XL	Lower (level on left
FV	Delete Lib., Ss., Ftn.
WC	Constants & variables
WD	Superfluous args. error
PC	Symbol pair checker
PD	Constants
MI	Lower upper case XS3 constant

Setups

```
    IA  FR
0   MJ  0      CT      Exit
1   RP  10042  FR3  }  Clear VA
2   TP  CA27   VA   }
3   RP  10040  FR5  }  Clear VC
4   TP  CA27   VC   }
5   TP  CH15   VA15    =     0     2     2
6   TP  CH31   VA23    =     0     0     100
7   TP  CH22   VA24    =     0     1     0
10  TP  CI31   VA40    =     0     0     7
11  TP  CA3    VA1     =     0     0     1
12  TP  CA3    VA2     =     0     0     1
13  TP  CK1    VC10    =     0     VC10  VC10
14  TP  CK2    VC20    =     0     VC20  VC20
15  TP  CK3    VC30    =     0     VC30  VC30
16  TP  CK4    EW3     EW3   = 0   WL23  WL23
17  TP  CK5    TP4     TP4   = 0   WL4   WL4
20  TP  CA27   XL2     Clear print ind.
21  TP  VD     A    }  After ↓ Before → FR24
22  ZJ  FR23   FR24 }
23  TP  WB11   WL2     WL2 = EQUATI
24  TP  CK6    VB3     VB3 = -1
25  RP  10020  YB   }  Clear dummy list → A
26  TP  CA27   WL4  }
    CA  FR27
```

Get CW from Dummy Function List

```
                                                RJ   TU   TU1
                                                MJ   0    Not in list
     IA   TUO                                   MJ   0    In list
 0   MJ   0       (30000)   Exit
 1   MJ   0       TU4       Start
 2   0    0       0         XS3
 3   0    0       0         CW
 4   TP   SY2     A         Sym. --> A
 5   RP   20020   TU0       Not in list --> TU0 (Exit)
 6   EJ   WL4     TU7         In list
 7   SP   TU15    0     }
10   SS   Q       17    }   r --> Au
11   AT   TU16    TU14      WL3 + r --> TU14
12   RA   TU0     TU17      Set for in list
13   RP   30002   TU0   }   File --> output --> Exit
14   0    0       0     }
15   0    0       20020     JN
16   TP   WL3     TU2
17   0    0       1
     CA   TU20
```

Send Dummy CW to Function List

```
     IA   TP
 0   MJ   0       (30000)   Exit
 1   MJ   0       TP6       Start
 2   0    0       0         XS3
 3   0    0       (0)       CW
 4   0    (WL4)   (WL4)     Add. of next file in dummy list
 5   0    WL24    WL24      Limit add.
 6   TP   TP4     A     }
 7   TJ   TP5     TP20  }   O.K. --> TP20   No ↓
10   TP   VA37    Q     }
11   QJ   TP12    TP13  }   Not in CB List ↓   in --> TP13
12   RJ   TE      TE1       Add to list
13   RJ   WA      WA1   }
14   TP   GQ      UP3   }
15   TP   VA10    GQ10  }   E50
16   RJ   UP2     UP    }
17   MJ   0       FR     -->Exit
20   TV   TP4     TP22      Set address
21   RP   30002   TP23  }
22   TP   TP2    (30000)}   File --> list
23   RA   TP4     TP25      Modify
24   MJ   0       TP        Exit
25   0    2       2
     CA   TP26
```

Lower (Level on Left

```
     IA  XL
 0   MJ  0      (30000)  Exit
 1   MJ  0      XL3      Start
 2   0   0      0        Ind.
 3   RS  VA1    CA3      Lower ( level
 4   TJ  CA3    XL6      0 K ↓ < 1 → XL6
 5   MJ  0      XL       Exit
 6   TP  CA3    VA1      Set level = 1
 7   TP  XL2    Q        Pre. point →exit
10   QJ  XL     XL11     No ↓
11   RJ  WA     WA1
12   TP  GI     UP3      E39
13   RJ  UP2    UP
14   TP  CA24   XL2      Set print
15   MJ  0      XL       Exit
     CA  XL16
```

Delete LIB, SS, FTN

```
                                 Y RJ  FV   FV1
                               Y+1 MJ  0    (Δ. exit)
                               Y+2  Normal exit

    IA  FV
0   MJ  0     (30000)     Exit
1   TP  WC1   WC          Level = 1
2   RJ  SY    SY1         Sym → A
3   EJ  WC2   FV7         ( → FV7
4   EJ  WC3   FV11        ) → FV11
5   EJ  WC4   FV17        Δ . → FV17
6   MJ  0     FV2         Return
7   RA  WC    WC1         Raise level
10  MJ  0     FV2         Return
11  RS  WC    WC1         Lower level
12  ZJ  FV2   FV13        Level zero ↓  no → return
13  RA  FV    WC1         Increase exit
14  TP  CA5   A      }    Set PC with )
15  AT  PD1   PC2    }
16  MJ  0     FV
17  TP  CA36  A      }    Set PC with doesn't
20  AT  PD1   PC2    }      matter
21  RA  VA1   WC          Raise level
22  RJ  DA    DA1         Check level
23  MJ  0     FV          → Exit
    CA  FV24

    IA  WC
0   0   0     0           Level
1   0   0     1           Const.
2   17  77777 77777       (
3   43  77777 77777       )
4   01  22777 77777       Δ.
    CA  WC5
```

Superfluous Argument Error

```
    IA  WD
0   RJ  WA    WA1   }
1   TP  SZ2   GM7   }     E48
2   TP  GM    UP3   }
3   RJ  UP2   UP    }
4   TP  GP    UP3   }
5   RJ  UP2   UP    }     "Args. not checked"
6   RJ  FV    FV1         Delete FTN
7   MJ  0     YV          Δ. → C2
10  MJ  0     ZM1         → C
    CA  WD11
```

Pair Checker PC

```
     IA  PC
 0   MJ  0       (30000)    Exit
 1   MJ  0       PC4        Start
 2   0   PD22    PD22       Address (left symbol)
 3   0   20      20         Shift count (right symbol)
 4   TU  PC2     PC5        Code word → Q
 5   TP  (30000)Q
 6   TV  PC3     PC7        Shift bit → A
 7   SP  PD      (30000)
10   QT  A       A          Ind. → A
11   ZJ  PC12    PC21       OK → PC21   No ↓
12   RJ  WA      WA1
13   RP  30003   PC15       Left sym.
14   TP  SZ2     FQ6                     E52
15   RP  30003   PC17       Right sym.
16   TP  SY2     FQ12
17   TP  FQ      UP3
20   RJ  UP2     UP
21   SP  PD1     0          Set for next check
22   AT  PC3     PC2
23   MJ  0       PC         Exit
     CA  PC24
```

```
     IA  PD
 0   0   0       1          Shift bit
 1   0   PD2     PD2        1st address of code words
 2   0   0       67642      (
 3   0   1       12035      ) or | (closed)
 4   0   1       12035      Var. or const.
 5   0   1       12034      Sub. Var.
 6   0   1       12034      FTN
 7   0   0       67642      , or ;
10   0   0       47742      + or -
11   0   0       67642      * or /
12   0   1       11435      Up const.
13   0   1       57377      Up -
14   0   1       77377      Up /
15   0   0       47642      POW
16   0   0       67642      LIB
17   0   0       67642      =
20   0   1       77777      Δ.
21   0   0       47642      | (open)
22   0   0       0          "Doesn't matter"
     CA  PD23
```

Conversion of Upper Case XS-3 Constant to Lower Case

	IA	MI		
0	MJ	0	(30000)	
1	MJ	0	MI6	
2	0	0	0	Output data
3	0	0	0	
4	0	0	0	Input data
5	0	0	0	
6	TP	MI121	MI104	Zeroize temp.
7	TP	MI121	MI105	Zeroize temp.
10	TP	MI4	MI46	Store input
11	TP	MI5	MI47	Store input
12	TP	MI103	MI110	Set Index
13	TP	MI106	MI107	Set Index
14	TP	MI111	MI25	Set store command
15	LQ	MI46	00006	
16	QT	MI50	A	
17	RP	20013	MI25	
20	EJ	MI51	MI21	
21	TP	MI101	A	
22	ST	Q	MI117	
23	LA	MI117	00017	Convert and Store
24	RA	MI25	MI117	
25	TP	MI64	Q	
26	QT	MI50	MI45	
27	LQ	MI104	00006	
30	RA	MI104	MI45	
31	IJ	MI107	MI14	
32	RA	MI30	MI102	
33	RA	MI27	MI102	Reset for second word
34	RA	MI15	MI102	
35	IJ	MI110	MI13	
36	TP	MI104	MI2	
37	TP	MI105	MI3	
40	TP	MI111	MI25	Preset for second set of
41	TP	MI112	MI15	input data
42	TP	MI113	MI30	
43	TP	MI114	MI27	
44	MJ	0	MI	
45	0	0	0	
46	0	0	0	
47	0	0	0	
50	0	0	00077	
51	0	0	00060	Upper Case
52	0	0	00061	
53	0	0	00040	
54	0	0	00020	
55	0	0	00041	
56	0	0	00035	
57	0	0	00055	

60	0	0	00075	
61	0	0	00036	
62	0	0	00057	
63	0	0	00062	
64	0	0	00077	
65	0	0	00003	Lower Case
66	0	0	00004	
67	0	0	00005	
70	0	0	00006	
71	0	0	00007	
72	0	0	00010	
73	0	0	00011	
74	0	0	00012	
75	0	0	00013	
76	0	0	00014	
77	0	0	00022	
100	0	0	00077	Lower Case
101	0	0	20013	
102	0	00001	0	
103	0	0	00001	
104	0	0	0	
105	0	0	0	
106	0	0	00005	
107	0	0	0	
110	0	0	0	
111	TP	MI64	Q	
112	LQ	MI46	00006	
113	RA	MI104	MI45	
114	LQ	MI104	00006	
115	PR	0	MI120	Parameter Error
116	MS	0	40000	
117	0	00007	0	
120	0	0	00015	
121	0	0	0	
	CA	MI122		

Constants

	IA	CAO			
0	04	0	0		
1	06	0	0		
2	0	0	77777		
3	0	0	1		
4	0	0	0	(	
5	0	1	1	) or | (closed)	
6	0	2	2	Variable or const.	
7	0	3	3	Ss. Var.	
10	0	4	4	FTN	
11	0	5	5	, or ;	for PC
12	0	6	6	+ or -	
13	0	7	7	* or /	
14	0	10	10	Upper Const.	
15	0	11	11	Upper -	
16	0	12	12	Upper /	
17	0	13	13	POW	
20	0	14	14	LIB	
21	0	15	15	BY or =	
22	0	16	16	Δ .	
23	0	17	17	| (open)	
24	40	0	0		
25	0	0	64000		
26	0	3	3		
27	0	0	0	Zero	
30	17	77777	77777	(77 77 77 77 77	
31	0	0	65000		
32	0	0	777		
33	0	0	66000		
34	06	0	3		
35	0	0	62000		
36	0	20	20	O.K. for P.C.	
37	0	0	01000		
	CA	CA40			

Constants (cont.)

	IA	CG		
0	11	11111	11111	Fltpt.
1	22	22222	22222	Fixed pt.
2	33	33333	33333	Ftn.
3	44	44444	44444	Sub. var.
4	21	77777	77777	, 77 77 77 77 77
5	23	77777	77777	; 77 77 77 77 77
6	43	77777	77777	) 77 77 77 77 77
7	76	77777	77777	= →
10	25	73777	77777	BY →
11	01	22777	77777	Δ. →
12	00	77777	77777	- 77 77 77 77 77
13	15	77777	77777	/ 77 77 77 77 77
14	42	77777	77777	| →
15	0	0	50	=
16	0	0	120	Δ.
17	0	0	77000	
20	0	0	70	Mask
21	0	0	61000	
22	0	0	63000	
23	0	0	76000	
24	0	1	0	(
25	0	0	00700	Mask
26	0	VL1	VL1	
27	0	07777	0	Mask
30	0	0	70000	
31	0	0	40000	
32	0	0	50000	
33	02	0	0	
34	0	2	0	)
35	0	70000	0	
36	0	0	40	,
37	0	10000	0	
	CA	CG40		

Constants (cont.)

	IA	CHO		
0	0	CH35	0	Fltpt. /
1	0	CI11	0	Fixed pt. /
2	0	CI13	0	Fltpt. *
3	0	CI12	0	Fixed pt. *
4	0	0	75000	
5	52	51717	77777	PO W 77 77 77
6	63	77777	77777	+ 77 77 77 77 77
7	02	77777	77777	- ⟶
10	56	77777	77777	* ⟶
11	64	77777	77777	/ ⟶
12	0	0	12	| (closed) floating
13	0	0	13	| (closed) fixed
14	0	0	10	| (open) fl. and fixed
15	0	2	2	
16	0	0	5	
17	0	0	VA24	Base add. for sequence
20	0	0	VA31	for comparison
21	TP	CG34	0	
22	0	1	0	
23	0	1	1	
24	0	0	3	
25	0	0	2	
26	0	CI0	0	
27	0	VA32	0	
30	0	0	16100	
31	0	0	100	
32	0	0	77	
33	0	0	16000	
34	0	CI1	0	
35	0	0	70	/
36	0	0	32	-
37	0	0	00100	To set VC3 & POW
	CA	CH40		

Constants (cont.)

	IA	CI0		
0	00	77777	77777	-
1	20	14000	0	1
2	15	77777	77777	/
3	20	24000	0	2
4	20	26000	0	3
5	0	0	13000	CW for 4 to 63 & -4 to -63
6	0	0	15000	2 & -2
7	0	0	14000	3 & -3
10	0	0	17100	-1
11	0	0	71	Fixed /
12	0	0	61	Fixed *
13	0	0	60	Fl. *
14	0	0	60000	
15	0	0	10000	
16	0	0	33	Fixed unary -
17	0	0	32	
20	0	0	31	
21	0	0	30	
22	0	0	21	Fixed +
23	0	0	20	Fl. +
24	0	3	3	
25	0	0	75000	
26	30	0	0	
27	0	0	0	Base add. of print list
30	0	20000	0	
31	0	0	7	Mask
32	0	VC20	VC20	Limits on LIB modes
33	0	VC30	VC30	
34	0	07000	0	
35	0	CI20	0	Fixed -
36	0	CI21	0	Fl. -
37	0	CI22	0	Fixed +
	CA	CI40		

Constants (cont.)

	IA	CK0		
0	0	CI23	0	Fl. +
1	0	VC10	VC10	
2	0	VC20	VC20	
3	0	VC30	VC30	
4	0	WL23	WL23	Set EW3
5	0	WL4	WL4	
6	77	77777	77776	
7	0	0	25000	64,65,66xxx separate Eq.
10	0	0	24000	77xxx separate Eq.
11	0	0	WL	
12	0	0	67000	Const. CW
13	0	30000	0	Const.
	CA	CK14		

Variables for Equation Translation

	IA	VAO		
0	0	0	0	Print ind.
1	0	0	1	(level bit
2	0	0	1	1 level bit
3	0	0	0	# (level raisers in sequence
4	0	0	0	# 1 level raisers in sequence
5	0	0	0	Ss. mode level
6	0	0	0	XS3 of Ss. variable
7	0	0	0	Ftn. mode level
10	0	0	0	XS3 of Ftn.
11	0	0	0	Level of subscripts for FTN.
12	0	0	0	Lib. mode
13	0	0	0	# commas for Lib.
14	0	0	0	# of ='s
15	0	2	2	# of words in up. c. sequence for string-out
16	0	0	0	Fixed 40 - floating 00
17	0	0	0	# commas, SV mode (count)
20	0	0	0	# commas, FTN mode (count)
21	0	0	0	# commas, Lib. mode (count)
22	0	0	0	# upper case symbols in sequence
23	0	0	100	POW (
24	0	1	0	Upper case sequence
25	0	0	0	for string-out
26	0	0	0	(Call words)
27	0	0	0	
30	0	0	0	
31	0	0	0	
32	0	0	0	Upper case sequence
33	0	0	0	for special call word
34	0	0	0	comparison (XS3)
35	0	0	0	
36	0	0	0	# Ss. -1 (from dimension list)
37	0	0	0	not in CB List bit
40	0	0	7	Ftn. mode format mask
41	0	(0)	0	Address in CB List
	CA	VA42		

Variables (cont.)

	IA	VC		
0	0	0	0	Any decimal points in sequence
1	0	0	0	Index
2	0	0	0	Constant CW temp.
3	0	0	0	Add in to constant CW for -
4	0	0	0	Save const. CW
5	0	0	0	Ind. print for "more than 29 ('s etc."
6	0	0	0	
7	0	0	0	
10	0	VC10	VC10	Address of Lib. level
11	0	0	0	
12	0	0	0	
13	0	0	0	Level of Lib.
14	0	0	0	
15	0	0	0	
16	0	0	0	
17	0	0	0	
20	0	VC20	VC20	Address of # of commas for Lib.
21	0	0	0	
22	0	0	0	
23	0	0	0	# commas for Lib.
24	0	0	0	
25	0	0	0	
26	0	0	0	
27	0	0	0	
30	0	VC30	VC30	
31	0	0	0	
32	0	0	0	
33	0	0	0	XS3 of Lib.
34	0	0	0	
35	0	0	0	
36	0	0	0	
37	0	0	0	
	CA	VC40		

Equation Translation Left

Section A - First Symbol, Before START
Section B - First Symbol, After START
Section C - Not First Symbol

Region	Section
YB	A
YH	A
YK	A
YG	A
YF	A
YJ	A
YE	A
YD	A
YI	A
YC	A
YM	A
YN	A
YW	B
YS	B
YR	B
YQ	B
YP	B
YU	B
YT	B
YX	C
ZA	C
ZC	C
ZB	C
YZ	C
YY	C
YL	C
ZF	C
ZG	C
ZH	C

Region	Section
ZE	C
ZD	C
ZI	C
ZJ	C
ZK	C
ZL	C
DA	C
KX	C
KY	C

Letters on left of coding sheets are connectors (They are also on the flow charts) i.e., B, A_2 , etc.

Connector	Section
A	A
A1	A
A2	A
B	C

Left-Before START-1st Symbol

```
        IA   YB
    0   TP   VD      A       After → YW
A   1   ZJ   YW      YB2     Before ↓
    2   RJ   TA      TA1     Not in CB List → YC
    3   MJ   0       YC      In ↓
    4   TP   TA4     Q
    5   QT   CG30    A       Lib. → YD
    6   EJ   CG32    YD      No ↓
    7   TP   TA4     EW2     CW → string
   10   RJ   EW      EW1
   11   TP   TA4     Q
   12   QT   CG17    A       CW = 77XXX → YB17
   13   EJ   CG17    YB17    No ↓
   14   QT   CA32    A
   15   AT   CK7     WL3     25XXX CW → WL3
   16   MJ   0       YB21
   17   QT   CA32    A
   20   AT   CK10    WL3     24XXX CW → WL3
   21   TP   TA5     Q
   22   QT   CA1     A       No prev. Eq. → YI
   23   ZJ   YB24    YI      Prev. Eq. ↓
   24   RJ   WA      WA1
   25   TP   SY2     EX31    E24
   26   TP   EX22    UP3
   27   RJ   UP2     UP
   30   TP   TA4     Q       CW → A
   31   QT   CG17    A
   32   EJ   CA25    YE      64XXX → YE
   33   EJ   CA31    YH      65XXX → YH
   34   EJ   CA33    YG      66XXX → YG
   35   RJ   SY      SY1     Sym. → A  77XXX ↓
   36   EJ   CA30    YJ       → YJ   No ↓
   37   RJ   WA      WA1
   40   TP   SZ2     EN30
   41   TP   EN22    UP3     E18
   42   RJ   UP2     UP
   43   TP   SY2     A       Sym. → A
   44   MJ   0       YH10    → A1
        CA   YB45
```

End of Left Symbols

```
              IA  YH
          0   RJ  SY       SY1
A2 {      1   EJ  CG7      YK       = ⟶YK
          2   RJ  WA       WA1 }
          3   TP  GA       UP3 }    E25
          4   RJ  UP2      UP  }
          5   TP  SY2      A   }
          6   EJ  CG11     YV     Δ,  ⟶ C2
A1 {      7   RJ  SY       SY1      Sym ⟶ A
         10   EJ  CG7      YK       = ⟶YK
         11   MJ  0        YH6
              CA  YH12
```

```
              IA  YK
          0   RA  VA14     CA3      # ='s + 1
          1   TP  VA1      A
          2   EJ  CA3      YK7      level zero ⟶YK7  no ↓
          3   RJ  WA       WA1 }
          4   TP  GL14     UP3 }    E47
          5   RJ  UP2      UP  }
          6   TP  CA3      VA1      set to ( level zero
          7   RP  10011    YK11 }
         10   TP  CA27     VA3  }   Clear all modes
         11   RP  10004    YK13 }
         12   TP  CA27     VA17 }
         13   TP  CA27     VA36     Clear #SS
         14   TP  CA21     A   }
         15   AT  PD1      PC2 }    set left of PC with =
         16   TP  CG15     EW2 }    CW ⟶ list
         17   RJ  EW       EW1 }
         20   MJ  0        ZM1      ⟶ C
              CA  YK21
```

66XXX

```
     IA   YG
0    RJ   SY      SY1      Sym ⟶ A
1    EJ   CA30    YG7      ( ⟶ YG7    no  ↓
2    RJ   WA      WA1
3    TP   SZ2     GA11     E26
4    TP   GA6     UP3
5    RJ   UP2     UP
6    MJ   0       FR       ⟶ Exit to trans. control
7    LQ   TA31    25
10   MJ   0       YF4
     CA   YG11
```

65XXX

```
     IA   YF
0    RJ   SY      SY1      Sym ⟶ A        ↓
1    EJ   CA30    YF3      ( ⟶ YF3   no   ↓
2    MJ   0       YH1      ⟶ A2
3    RA   TA4     CA37     CW = 66XXX
4    TP   TA31    VA41     Save address in VA41
5    RA   VA41    CA3
6    TP   VA1     VA7      Set Ftn. mode
7    TP   SZ2     VA10     XS3 of Ftn.
10   RA   VA1     CA3      Raise ( level
11   TP   PD1     PC2      Set PC
12   TP   CA26    TF       # words = 3
13   TP   CA34    TF3      Set format
14   TP   CG20    VA40     Set mask
15   RP   30002   YX1      Set up to return to
16   TP   TA3     TF1      CB list then ⟶ B
     CA   YF17
```

77XXX (

```
     IA   YJ
0    TP   VA1      VA5      Set Ss. mode
1    TP   TA5      Q          #Ss. → VA 36
2    QT   CA2      VA36
3    RA   VA1      CA3      Raise level
4    TP   PD1      PC2      Set PC
5    TP   CG24     EW2      CW → list
6    RJ   EW       EW1
7    RS   VA36     CA3      #Ss.-1
10   TP   SZ2      VA6      XS3 of Ss. variable
11   MJ   0        YX1      → B
     CA   YJ12
```

64XXX

```
     IA   YE
0    TP   CA24     VA16     Set fixed equation
1    MJ   0        YH       → A2
     CA   YE2
```

Lib. = 5XXXX

```
     IA   YD
0    RJ   WA       WA1
1    TP   SY2      GB5      E27
2    TP   GB       UP3
3    RJ   UP2      UP
4    MJ   0        FR       → trans. control
     CA   YD5
```

No previous Equation

```
     IA   YI
0    RA   TA5     CA1      Set eq.
1    RJ   TD      TD1      Return to list
2    TP   TA4     Q
3    QT   CG17    A        CW ⟶ A
4    EJ   CA31    YF       65XXX ⟶ YF    no ↓
5    MJ   0       YB30
     CA   YI6
```

Not in CB List

```
     IA   YC
0    RJ   RH      RH1      Check Var. symbol
1    RJ   TK      TK1      Increase CW.
2    AT   CK7     WL3      25XXX CW ⟶ WL3
3    TP   SY10    Q        IJKLM ⟶ YM
4    QJ   YM      YC5         No ↓
5    RJ   SY      SY1      Sym ⟶ A
6    EJ   CA30    YN       ( ⟶ YN      no ↓
7    TP   VB1     A
10   AT   CA31    EW2      CW = 65XXX
11   TP   A       TF2
12   RJ   EW      EW1      CW ⟶ list
13   TP   CA26    TF
14   TP   SZ2     TF1      File ⟶ CB list
15   TP   CA1     TF3
16   RJ   TE      TE1
17   TP   SY2     A        Sym ⟶ A
20   MJ   0       YH1      ⟶ A2
     CA   YC21
```

Not in CB List 1st Letter IJKLM

```
     IA    YM
0    TP    VB1     A          64XXX
1    AT    CA25    EW2
2    TP    A       TF2
3    RJ    EW0     EW1        CW ——>list
4    TP    CA24    VA16       Set fixed equation
5    TP    SY2     TF1        Sym. ——>TF1
6    TP    CA26    TF0
7    TP    CA1     TF3        CW ——>CB List
10   RJ    TE0     TE1
11   MJ    0       YH       ——> A2
     CA    YM12
```

NOT IJKLM Next Sym. (

```
     IA    YN
0    TP    VB1     A          66XXX
1    AT    CA33    EW2
2    TP    A       TF2
3    RJ    EW0     EW1        CW ——>list
4    TP    SZ2     TF1        XS3 of Ftn.
5    TP    SZ2     VA10
6    TP    CA34    TF3        Store format
7    TP    CA26    TF0
10   TP    VA1     VA7        Set Ftn.
11   RA    VA1     CA3        Increase level
12   TP    PD1     PC2        Set P. C.
13   TP    CA24    VA37       Set "not in CB List" bit
14   TP    CG20    VA40       Set mask
15   MJ    0       YX1      ——> B
     CA    YN16
```

Left After Start 1st symbol

```
        IA    YW

 0      RJ    TS      TS1       Not in P. Op. list ---> YP
 1      MJ    0       YP        In ↓
 2      TP    TS3     EW2       CW     ---> list
 3      RJ    EW      EW1
 4      RJ    KY      KY1       Check Vary List
 5      TP    TS3     Q              XX000 ---> A
 6      QT    CG17    A
 7      EJ    CG21    YQ        61XXX ---> YQ
10      EJ    CG22    YR        63XXX ---> YR
11      RJ    SY      SY1       76YXX ↓          Sym ---> A
12      EJ    CA30    YS        ( ---> YS      no ↓
13      RJ    WA      WA1
14      TP    SZ2     EP6       E19
15      TP    EP      UP3
16      RJ    UP2     UP
17      TP    SY2     A         Sym ---> A
20      MJ    0       YH1       ---> A2
        CA    YW21
```

```
        IA    YS0
 0      TP    CG24    EW2       ( ---> string
 1      RJ    EW0     EW1
 2      TP    SZ2     VA6       Set Ss. mode
 3      TP    VA1     VA5
 4      RA    VA1     CA3       Raise level
 5      TP    TS3     Q
 6      QT    CG25    Q         Store # Ss.
 7      LQ    Q       36
10      TP    Q       VA36
11      TP    PD1     PC2       Set P.C.
12      RS    VA36    CA3          Ss. - 1
13      MJ    0       YX1       ---> B
        CA    YS14
```

63XXX ↓

```
     IA   YR0
0    TP   SY10    Q       1st letter IJKLM ⟶ YR2
1    QJ   YR2     YH      No ⟶ B
2    TP   CA24    VA16    Set fixed eq.
3    MJ   0       YH      ⟶ B
     CA   YR4
```

61XXX

```
     IA   YQ
0    RJ   SY      SY1     Sym ⟶ A
1    EJ   CA30    YQ3     ( ⟶ YQ3     no ↓
2    MJ   0       YH1     ⟶ A2
3    RJ   WA      WA1
4    TP   SZ2     GM7     E48
5    TP   GM      UP3
6    RJ   UP2     UP
7    TP   GP      UP3     "Args. not checked"
10   RJ   UP2     UP
11   RJ   FV      FV1     Delete Ftn.
12   MJ   0       YV      Δ. ⟶ C2
13   MJ   0       YH      ⟶ A2
     CA   YQ14
```

Not in P.Op. List-After START-1st Sym

```
     IA   YP
0    RJ   TA      TA1     Not in CB List ⟶ YT
1    MJ   0       YT      In ↓
2    TP   TA4     EW2     CW ⟶ list
3    RJ   EW      EW1
4    RJ   KY      KY1     Check Vary List
5    MJ   0       YU
     CA   YP6
```

Not in Vary List

```
     IA   YU
 0   TP   TA4     Q   }
 1   QT   CG30    A   }       X0000 ⟶ A
 2   EJ   CG32    YD          5XXXX ⟶ YD
 3   QT   CG17    A           XX000 ⟶ A
 4   EJ   CA25    YE          64XXX ⟶ YE
 5   EJ   CA31    YH          65XXX ⟶ YH
 6   EJ   CA33    YQ          66XXX ⟶ YQ
 7   TP   CG33    Q           77XXX ↓
10   QS   CG33    TA5         Set Equation bit
11   RJ   TD      TD1         Return to CB List
12   MJ   0       YB35
     CA   YU13
```

Not in CB List

```
     IA   YT
 0   RJ   TK      TK1         Increase CW counter
 1   TP   SY10    Q    }      1st letter IJKLM ⟶ YT3
 2   QJ   YT3     YT14 }      No ⟶ YT14
 3   AT   CA25    EW2  }      CW = 64XXX
 4   TP   CA24    VA16 }      Set fixed Equation
 5   TP   A       TF2  }
 6   TP   CA26    TF   }      Build file
 7   TP   SY2     TF1  }
10   TP   CG33    TF3  }
11   RJ   EW      EW1         CW ⟶ list
12   RJ   TE      TE1         File ⟶ CB List
13   MJ   0       YH          ⟶ A2
14   AT   CA31    EW2         CW = 65XXX
15   MJ   0       YT5
     CA   YT16
```

Left - Not 1st symbol

```
          IA   YX
     0    RJ   PC      PC1     Pair Check
B    1    RJ   SY      SY1     Sym ⟶ A
     2    EJ   CG7     YK      = ⟶ YK
     3    TP   SY7     Q
     4    QJ   YL      YX5     Var. ⟶ YL   no ↓
     5    EJ   CA30    YY      ( ⟶ YY
     6    EJ   CG4     YZ
     7    EJ   CG5     YZ      , or ; ⟶ YZ
    10    EJ   CG6     ZA      ) ⟶ ZA
    11    MJ   0       KX      Δ  . ⟶ KX ⟶ C2
    12    TP   SY2     GC4
    13    RJ   WA      WA1
    14    TP   GC      UP3     E29
    15    RJ   UP2     UP
    16    TP   CA36    PC3     Set PC
    17    MJ   0       YX      ⟶ B
          CA   YX20
```

Left, not 1st sym.
)

```
        IA   ZA
 0      TP   CA5     PC3        Set PC
 1      RJ   XL      XL1        Level checker
 2      TP   VA1     A          No ↓
 3      EJ   VA5     ZB         Leaving Ss. mode ⟶ZB
 4      EJ   VA7     ZC         Leaving Ftn. mode⟶ZC
 5      TP   VA7     A    }     In Ftn. mode ⟶YX
 6      ZJ   YX      ZA7  }     No ↓
 7      TP   CG34    EW2  }     CW⟶list
10      RJ   EW      EW1  }
11      MJ   0       YX         ⟶ B
        CA   ZA12
```

) Leaving Ftn. mode

```
        IA   ZC
 0      TP   CA27    VA7           Clear Ftn. mode
 1      RJ   PC      PC1           ⟶PC
 2      TP   CG35    Q       }     # commas⟶list
 3      QS   VA20    TF3     }
 4      TP   VA37    Q       }     "Not in CB List" bit set ↓
 5      QJ   ZC6     ZC11    }     Not set⟶ZC11
 6      RJ   TE      TE1           Add to CB List
 7      TP   CA27    VA37          Clear "not" bit
10      MJ   0       YH            ⟶A2
11      TV   VA41    ZC13    }     Send back to CB List
12      RP   30003   YH      }     ⟶A2
13      TP   TF1     (30000) }
        CA   ZC14
```

Left)-leaving Ss. mode

```
     IA   ZB
 0   RJ   PC      PC1      Do PC
 1   TP   CA27    VA5      Clear Ss. mode
 2   TP   VA7     A
 3   ZJ   ZB4     ZB14     Ftn. mode ↓   no → ZB14
 4   TP   VA36    A        # commas = 0 → B
 5   ZJ   ZB6     YX1      No ↓
 6   RJ   WA      WA1
 7   TP   VA6     GC20
10   TP   GC12    UP3      E30
11   TP   VA10    GC27
12   RJ   UP2     UP
13   MJ   0       YX1      → B
14   TP   CG34    EW2      CW → list
15   RJ   EW      EW1
16   TP   VA36    A        Right # commas → ZB24
17   ZJ   ZB20    ZB24     No ↓
20   RJ   WA      WA1
21   TP   VA6     GI17     E40
22   TP   GI12    UP3
23   RJ   UP2     UP
24   TP   CA27    VA17     Clear # Ss.
25   TP   CA27    VA36
26   MJ   0       YH       → A2
     CA   ZB27
```

Left , or ;

```
     IA   YZ0
 0   TP   CA11    PC3      Set PC
 1   TP   VA5     A
 2   ZJ   YZ3     YZ7      Ss. mode ↓  no → YZ7
 3   RS   VA36    CA3      Commas - 1
 4   TP   CG36    EW2      C.W. → list
 5   RJ   EW0     EW1
 6   MJ   0       YX       → B
 7   RA   VA20    CG37     Commas + 1
10   TP   CK13    A        Too many operands → TP10
11   TJ   VA20    TP10     No ↓
12   LQ   VA40    3        Shift mask
13   MJ   0       YX       → B
     CA   YZ14
```

Left (

```
      IA   YY
 0    TP   CA4     PC3     Set PC
 1    RA   VA1     CA3     Increase level
 2    TP   VA7     A
 3    ZJ   YY4     YY11    Ftn. mode ↓  Ss. mode →YY11
 4    RJ   WA      WA1
 5    TP   VA10    GV45    E55
 6    TP   GV31    UP3
 7    RJ   UP2     UP
10    MJ   0       YX      → B
11    RJ   WA      WA1
12    TP   VA6     GV27    E54
13    TP   GV15    UP3
14    RJ   UP2     UP
15    TP   CG24    EW2     CW →list
16    RJ   EW      EW1
17    MJ   0       YX      → B
      CA   YY20
```

Left-not First Symbol-Var.

```
      IA   YL0
 0    RJ   RH0     RH1     Check symbol
 1    TP   CA6     PC3     Set PC
 2    TP   VA7     A       Not Ftn. mode →ZD
 3    ZJ   YL4     ZD      Ftn. mode ↓
 4    RJ   TA0     TA1     Not in CB List →YL11
 5    MJ   0       YL11    In ↓
 6    TP   TA4     Q
 7    QT   CG30    A       Lib.→ZE
10    EJ   CG32    ZE      No ↓
11    TP   VA5     A
12    ZJ   YL13    ZF      Ss. mode ↓  no →ZF
13    TP   SY10    Q
14    QJ   YL22    YL15    Not IJKLM ↓  yes →YL22
15    RJ   WA      WA1
16    TP   SY2     ER6
17    TP   VA6     ER20    E21
20    TP   ER      UP3
21    RJ   UP2     UP
22    TP   SY2     TP2
23    RA   VB3     CA3     Assign dummy CW
24    AT   CA35    TP3
25    RJ   TP      TP1     CW → dummy list
26    MJ   0       YX      → B
      CA   YL27
```

Var.-Ftn. mode-not Ss. mode

```
      IA    ZF0
0     TP    SY10    Q
1     QJ    ZF2     ZG0       IJKLM ↓  no ──> ZG0
2     RJ    WA      WA1
3     TP    ER22    UP3       E22
4     TP    SY2     ER27
5     RJ    UP2     UP
6     MJ    0       YL22.     Return
      CA    ZF7
```

Not IJKLM

```
      IA    ZG
0     RJ    PC      PC1       PC
1     RJ    SY      SY1       Symbol ──> A
2     EJ    CA30    ZH        ( ──> ZH    no ↓
3     RA    VB3     CA3
4     AT    CA35    TP3       62XXX CW ──> dummy list
5     TP    SZ2     TP2
6     RJ    TP0     TP1
7     TP    VA40    Q         Fltpt. ──> format
10    QS    CG      TF3
11    TP    SY2     A         Sym ──> A
12    MJ    0       YX2       ──> B
      CA    ZG13
```

Ftn. mode-Var. (

```
        IA    ZH0
   0    RA    VB3     CA3
   1    AT    CH4     TP3       75XXX  CW ——> dummy list
   2    TP    SZ2     TP2
   3    RJ    TP0     TP1
   4    RA    VB3     CA3       Leave space for Ss.
   5    TP    PD1     PC2       Set PC
   6    TP    VA40    Q         Ss. var ——> format
   7    QS    CG3     TF3
  10    TP    VA1     VA5       Set Ss. mode
  11    TP    SZ2     VA6
  12    TP    CA27    VA36      # Ss. - 1 = 0
  13    RA    VA1     CA3       Raise level
  14    MJ    0       YX1       ——> B
        CA    ZH15
```

Lib. 5XXXX

```
        IA    ZE0
   0    RJ    WA      WA1
   1    TP    SY2     GD5
   2    TP    VA10    GD17      E31
   3    TP    GD      UP3
   4    RJ    UP2     UP
   5    TP    CA36    PC3       Set PC "doesn't matter"
   6    MJ    0       YX        ——> B
        CA    ZE7
```

```
              Left - Not 1st symbol
                     Not Ftn. mode
                         Var.

     IA   ZD
 0   TP   SY10   Q         IJKLM ——> ZI
 1   QJ   ZI     ZD2       no ↓
 2   RJ   WA     WA1
 3   TP   SY2    EK6
 4   TP   VA6    EK16      E11
 5   TP   EK     UP3
 6   RJ   UP2    UP
 7   TP   VD     A         Before ——> ZI2
10   ZJ   ZD11   ZI2       After ↓
11   RJ   TS     TS1       Not in P.Op. list ——> ZD16
12   MJ   0      ZD16      In ↓
13   TP   TS3    EW2       CW ——> list
14   RJ   EW     EW1
15   MJ   0      YX        ——> B
16   RJ   TA     TA1       Not in CB list —— ZD23
17   MJ   0      ZD23      In ↓
20   TP   TA4    EW2       CW ——> string
21   RJ   EW     EW1
22   MJ   0      YX        ——> B
23   RJ   TK     TK1       Increase CW
24   AT   CA31   EW2       Assign 65XXX CW
25   TP   A      TF2
26   TP   CA26   TF        File ——> CB list
27   TP   SY2    TF1
30   TP   CA27   TF3
31   RJ   TE     TE1
32   RJ   EW     EW1       CW ——> list
33   MJ   0      YX        ——> B
     CA   ZD34
```

1st Letter IJKLM

```
     IA   ZI
0    TP   VD     A       Before START ↓
1    ZJ   ZJ     ZI2     No ⟶ ZJ
2    RA   VB3    CA3
3    AT   CA35   TP3
4    TP   A      EW2     Dummy CW = 62XXX ⟶ list
5    TP   SY2    TP2
6    RJ   TP0    TP1
7    RJ   EW0    EW1     CW ⟶ list
10   MJ   0      YX      ⟶ B
     CA   ZI11
```

After START

```
     IA   ZJ0
0    RJ   TS0    TS1
1    MJ   0      ZK      In P.Op. list ↓ no ⟶ ZK
2    TP   TS3    EW2     CW ⟶ list
3    RJ   EW     EW1
4    MJ   0      YX      ⟶ B
     CA   ZJ5
```

Not in P.Op. list

```
     IA   ZK0
0    RJ   TA0    TA1     Not in CB List ⟶ ZL0
1    MJ   0      ZL      In ↓
2    TP   TA4    EW2     CW ⟶ list
3    RJ   EW     EW1
4    MJ   0      YX      ⟶ B
     CA   ZK5
```

Not in CB List

```
     IA   ZL
0    RJ   TK     TK1     Assign 64XXX CW
1    AT   CA25   EW2
2    TP   A      TF2
3    TP   CA26   TF      New file ⟶ CB list
4    TP   SY2    TF1
5    TP   CA27   TF3
6    RJ   TE     TE1
7    RJ   EW     EW1     CW ⟶ list
10   MJ   0      YX      ⟶ B
     CA   ZL11
```

Level Checking Sub.

	IA	DA		
0	MJ	0	(30000)	Exit
1	MJ	0	DA3	Start
2	0	0	40	32_{10}
3	TP	VA1	A	
4	AT	VA2	A	| level +(level → A
5	TJ	DA2	DA	O.K. → exit no ↓
6	TP	VC5	Q	Prev. print → exit
7	QJ	DA	DA10	No ↓
10	RJ	WA	WA1	
11	TP	GY12	UP3	E57
12	RJ	UP2	UP	
13	TP	CA24	VC5	Set ind.
14	MJ	0	DA	Exit
	CA	DA15		

Inserted in region YX with jump at YX11 = MJ 0 KX

	IA	KX		
0	EJ	CG11	YV	Δ . → C2
1	TP	SY11	Q	
2	QJ	KX3	YX12	Const. ↓ no → YX12
3	TP	SY13	Q	
4	QJ	YX12	KX5	Superscript → YX12 no ↓
5	TP	VD	A	
6	ZJ	KX7	KX20	After ↓ before → KX20
7	RJ	RD	RD1	Check fixed pt. const.
10	TP	SY2	RS4	
11	RJ	RS2	RS	Convert to octal
12	TP	RS3	A	Assign CW
13	RJ	GW	GW1	
14	TP	Q	EW2	CW → list
15	RJ	EW	EW1	
16	TP	CA6	PC3	Set PC
17	MJ	0	YX	→ B
20	RJ	WA	WA1	E58
21	TP	GZ	UP3	
22	RJ	UP2	UP	
23	TP	CA36	PC3	Set PC with doesn't matter.
24	MJ	0	YX	→ B
	CA	KX25		

Check Vary List

```
        IA    KY
 0      MJ    0        (30000)
 1      TP    VL       A
 2      ST    CG26     A
 3      TP    CG27     Q          Set up N of RP
 4      QS    A        KY6
 5      TP    SY2      A          Sym ——>A
 6      RP    20000    KY         Not in Vary List ——>exit
 7      EJ    VL1      KY10       In ↓
10      RJ    WA       WA1
11      TP    SY2      GB26
12      TP    SY2      GB40       E28
13      TP    GB22     UP3
14      RJ    UP2      UP
15      MJ    0        KY         Exit
        CA    KY16
```

Equation Translation
Right

Section D - Switch = | / * - + , ; constant
Section E - Superscript symbols
Section G - POW) (
Section H - VAR Before START
Section I - VAR After START, In pseudo Op. list
Section F - VAR After START, Not in pseudo Op. list
Section F - also Δ .

Region	Section	Region	Section	Region	Section
ZM	D			HL	H
MB	D	ZR	G	XQ	H
MD	D	NY	G	HS	H
ME	D	ZQ	G	HR	H
MA	D	FN	G	HU	H
ZZ	D	FM	G	HQ	H
ZY	D	FL	G		
MY	D	FP	G		
ZX	D	ZN	G	XD	I
MZ	D			NA	I
ZW	D			HZ	I
ZV	D	ZT	H	HY	I
XC	D	XG	H	HX	I
		XF	H	HW	I
		XH	H	ND	I
MC	E	XI	H	NE	I
MH	E	XE	H	NC	I
MJ	E	XW	H	NB	I
ML	E	XV	H		
MN	E	XT	H		
MM	E	XR	H	HV	F
MQ	E	HG	H	NL	F
MG	E	HH	H	NJ	F
MP	E	HF	H	NI	F
MK	E	HC	H	NH	F
MU	E	XZ	H	NS	F
MT	E	HK	H	NP	F
MS	E	XY	H	NK	F
MV	E	HN	H	NG	F
MX	E	HM	H	NX	F
MW	E				
				NW	F
				NV	F
				NN	F
				FU	F
				NF	F
				FK	F
				FJ	F
				NZ	F
				YV	F

Sections of connectors;

Connector	Section
C	D
C2	F
D1	D
D2	E
E	H
F	I

Equation Translation   Right

```
     IA   ZM
 0   RJ   PC      PC1       Pair check
 1   RJ   SY      SY1       Symbol --> A
 2   EJ   CA30    ZN        ( --> ZN
 3   EJ   CG6     ZQ        ) --> ZQ
 4   EJ   CH5     ZR        POW --> ZR
 5   TP   SY7     Q         Var. --> ZT     no ↓
 6   QJ   ZT      ZM7
 7   TP   SY13    Q         Superscript --> D2     no ↓
10   QJ   MC      ZM11
11   TP   SY11    Q         Constant --> ZV
12   QJ   ZV      ZM13      No ↓
13   EJ   CG4     ZW        , or ; --> ZW
14   EJ   CG5     ZW        no ↓
15   EJ   CH6     ZX        + --> ZX
16   EJ   CH7     ZY        - --> ZY
17   EJ   CH10    ZZ        * --> ZZ
20   EJ   CH11    MA        / --> MA
21   EJ   CG14    MD        | --> MD
22   EJ   CG11    YV        Δ . --> C2
23   EJ   CG7     MB        = --> MB
24   RJ   WA      WA1
25   TP   SY2     GJ16
26   TP   GJ12    UP3       E42
27   RJ   UP2     UP
30   TP   CA36    PC3       Set PC
31   MJ   0       ZM        C
     CA   ZM32
```

Right =

```
     IA   MB
 0   RA   VA14    CA3       # ='s + 1
 1   TP   CA21    PC3       Set PC
 2   TP   CG15    EW2       CW --> list
 3   RT   EW0     EW1
 4   MJ   0       ZM        --> C
     CA   MB5
```

Right Absolute Value

| open

```
    IA  MD
0   TP  SZ2     A
1   EJ  CG7     MD17      =
2   RP  20005   MD6   }   + POW
3   EJ  CH5     MD17  }   - * / ---> MD17
4   0   0       0                         ---> open |
5   0   0       0
6   EJ  CA30    MD17      (
7   EJ  CG4     MD17      ,
10  EJ  CG5     MD17      ;
11  TP  EW2     Q
12  QT  CG30    A     }
13  EJ  CG32    MD17  }   Lib. ---> open
14  TP  Q       A     }
15  EJ  CH14    MD17  }   | o ---> open
16  MJ  0       ME        Closed ---> ME
17  TP  CA23    PC3       Set PC with open
20  TP  CH14    EW2   }
21  RJ  EW      EW1   }   CW ---> string
22  TP  CA27    VA3       Clear (level raisers
23  RA  VA4     CA3       | level raisers + 1
24  RA  VA2     CA3       Raise | level
25  MJ  0       ZM        ---> C
    CA  MD26
```

Absolute Value
| (Closed)

```
     IA   ME
 0   TP   CA5     PC3      Set PC
 1   RS   VA2     CA3      Lower level
 2   TJ   CA3     ME4      Level too low ⟶ ME4
 3   MJ   0       ME10     OK ⟶ ME10
 4   TP   CA3     VA2      Set level = |
 5   RJ   WA      WA1  }
 6   TP   GV      UP3  }   E53
 7   RJ   UP2     UP   }
10   TP   VA3     A    }   ( Raisers = 0 ⟶ ME15
11   ZJ   ME12    ME15 }   No ↓
12   RJ   WA      WA1  }
13   TP   GH24    UP3  }   E38
14   RJ   UP2     UP   }
15   TP   VA4     A    }   1 > | Level raisers ⟶ ME20
16   TJ   CA3     ME20 }   No ↓
17   RS   VA4     CA3      Raisers - |
20   TP   VA5     A    }
21   ZJ   ME22    ME25 }   Ss. mode ↓  no ⟶ ME25
22   TP   CH13    EW2  }   Fixed CW ⟶ list
23   RJ   EW      EW1  }
24   MJ   0       ZM       ⟶ (C)
25   TP   VA16    Q    }   Fixed Eq. ⟶ ME22
26   QJ   ME22    ME27 }   No ↓
27   TP   CH12    EW2  }   Floating CW ⟶ list
30   MJ   0       ME23 }
     CA   ME31
```

Right
/

```
     IA   MA0
0    TU   CH0       MA12    Set for /
1    TU   CH1       MA5
2    TP   CA13      PC3     Set P.C.
3    TP   VA5       A
4    ZJ   MA5       MA10    Ss. mode ↓  no →MA10
5    TP   (30000)   EW2     Fixed CW→list
6    RJ   EW0       EW1
7    MJ   0         ZM      →C
10   TP   VA16      Q       Fixed eq. →MA5
11   QJ   MA5       MA12    No ↓
12   TP   (30000)   EW2     Fl. C.W.→list
13   RJ   EW0       EW1
14   MJ   0         ZM      →C
     CA   MA15
```

Right
*

```
     IA   ZZ0
0    TU   CH2       MA12    Fltpt. *
1    TU   CH3       MA5     Fixed Pt. *
2    MJ   0         MA2     →/ sequence
     CA   ZZ3
```

Right
- (minus)

```
          IA   ZY
       0  TP   CA12      PC3      Set P.C.
       1  TP   EW2       Q        Last CW→Q
       2  QT   CG30      A
       3  EJ   CG30      MY       Var.
       4  EJ   CI14      MY       Const.        →MY0
       5  EJ   CI15      MY       Spec. CW
       6  TP   Q         A
       7  EJ   CH12      MY       | (closed)→MY0
      10  EJ   CH13      MY
      11  EJ   CG34      MY       )→MY0
Unary - 12  TP   VA5       A        Ss. mode→ZY16
      13  ZJ   ZY16      ZY14     No ↓
      14  TP   VA16      Q
      15  QJ   ZY16      ZY21     Fixed eq. ↓  no→ZY21
      16  TP   CI16      EW2      Fixed unary -→string
      17  RJ   EW0       EW1
      20  MJ   0         ZM       →C
      21  TP   CI17      EW2      Floating unary -→string
      22  RJ   EW0       EW1
      23  MJ   0         ZM       →C
          CA   ZY24
```

Binary - (minus)
or
+ (plus)

```
          IA   MY0
       0  TU   CI35      MY6      Set for -
       1  TU   CI36      MY11
       2  TP   VA5       A        Ss. mode →MY6
       3  ZJ   MY6       MY4      No ↓
       4  TP   VA16      Q
       5  QJ   MY6       MY11     Fixed eq. ↓  no→MY11
       6  TP   (30000)   EW2      Fixed ∓→string
       7  RJ   EW0       EW1
      10  MJ   0         ZM       →C
      11  TP   (30000)   EW2      Floating ∓ →string
      12  RJ   EW0       EW1
      13  MJ   0         ZM       →C
          CA   MY14
```

Right +

```
        IA   ZX0
0       TP   CA12      PC3      Set PC
1       TP   EW2       Q        Last CW →Q
2       QT   CG30      A
3       EJ   CG30      MZ0      Var., Const. or
4       EJ   CI14      MZ0      Spec. CW→MZ0
5       EJ   CI15      MZ0
6       TP   Q         A
7       EJ   CH12      MZ0      | (closed)→MZ0
10      EJ   CH13      MZ0
11      EJ   CG34      MZ0      ) →MZ0
Unary +12 MJ 0         ZM       → C
        CA   ZX13
```

Binary +

```
        IA   MZ0
0       TU   CI37      MY6      Set for +
1       TU   CK0       MY11
2       MJ   0         MY2
        CA   MZ3
```

Right , or ;

```
        IA   ZW
0       TP   CA11      PC3      Set PC
1       TP   VA5       A
2       ZJ   ZW3       ZW7      Ss. mode ↓  no →ZW7
3       RS   VA36      CA3      # commas - 1
4       TP   CG36      EW2      CW →list
5       RJ   EW        EW1
6       MJ   0         ZM       → C
7       TP   VC10      A
10      EJ   CK1       ZW25     Lib. mode ↓  no→ ZW25
11      TU   VC10      ZW12
12      TP   (30000)   A        Right level →ZW22
13      AT   CA3       A
14      EJ   VA1       ZW22     No ↓
15      RJ   WA        WA1
16      TU   VC30      ZW17
17      TP   (30000)   GY10     E56
20      TP   GY        UP3
21      RJ   UP2       UP
22      TU   VC20      ZW23     # commas - 1
23      RS   (30000)   CA3
24      MJ   0         ZW4
25      RJ   WA        WA1
26      TP   GJ24      UP3      E43
27      RJ   UP2       UP
30      MJ   0         ZW4
        CA   ZW31
```

1st Superscript Symbol

```
               IA   MC
D2        0    RP   10010      MC2        Clear variables
          1    TP   CA27       VC
          2    TP   CH31       VA23       Set POW sequence
          3    TP   CH22       VA24
          4    TP   CA3        VA22       Set count = 1
          5    TP   CH15       VA15       Set seq.
          6    TP   VA5        A
          7    ZJ   MC10       MC17       Ss. mode ↓  no ⟶MC17
         10    RJ   WA         WA1
         11    TP   VA6        GD37
         12    TP   SY2        GD26
         13    TP   SY3        GD27       E32
         14    TP   GD21       UP3
         15    RJ   UP2        UP
         16    MJ   0          MK
         17    TP   VA16       Q
         20    QJ   MC21       MK         Fixed eq. ↓
         21    RJ   WA         WA1
         22    TP   SY2        GE5
         23    TP   SY3        GE6        E33
         24    TP   GE         UP3
         25    RJ   UP2        UP
         26    MJ   0          MK
               CA   MC27
```

Sequence Loop

```
               IA   MH
          0    RJ   PC         PC1        P.C.
          1    RJ   SY         SY1        Sym. ⟶A
          2    TP   SY13       Q
          3    QJ   MH4        MJ         Superscript ↓  no ⟶MJ
          4    RA   VA22       CA3        Count symbols
          5    TJ   CH16       MK         5 >  # sym. ⟶MK      no ↓
          6    RJ   WA         WA1
          7    TP   GE16       UP3        E34
         10    RJ   UP2        UP
         11    RJ   SY         SY1        Sym.⟶A          5
         12    TP   SY13       Q          Superscript
         13    QJ   MH11       MH14       No ↓
         14    TP   CA36       A          Set PC with "doesn't matter"
         15    AT   PD1        PC2
         16    TP   CG34       EW2        CW = )
         17    TP   SY2        A          Sym. ⟶A
         20    MJ   0          ZM2        ⟶C
               CA   MH21
```

Sym ≦ 4

```
     IA   MJ                     Not superscript  ↓
 0   TP   CH17     A
 1   AT   CH21     A             ) → Sequence
 2   AT   VA22     A
 3   AT   CA3      MJ4
 4    0   30000    30000         TP CG34    VA+
 5   TP   VC       Q             Dec. pt. in seq. → ML     no → MM
 6   QJ   ML       MM
     CA   MJ7
```

Dec. pt. in seq., i.e., not spec. case ↓

```
     IA   ML
 0   SP   VA22     17
 1   SA   VA22     0             # sym in seq. → A → VA15
 2   AT   CA26     VA15
 3   AT   EW3      A             Add. → A
 4   TJ   CJ10     MN            Fit in list → MN    no ↓
 5   TP   EW4      Q
 6   QJ   ML12     ML7           Prev. print → ML12  no ↓
 7   RJ   WA       WA1
10   TP   FI       UP3           F16
11   RJ   UP2      UP
12   TP   CJ10     EW3           Set limit
13   TP   CA24     EW4           Set ind.
14   MJ   0        MH16
     CA   ML15
```

Seq. Fits in List

```
     IA   MN
 0   TV   EW3      MN5           Fix address
 1   RA   MN5      CA3
 2   TP   CG27     Q             Set n of repeat
 3   QS   VA15     MN4
 4   RP   30000    MN6
 5   TP   VA23     (30000)       Seq. → list
 6   RA   EW3      VA15          Set address.
 7   MJ   0        MH16
     CA   MN10
```

Possible Special Case

```
     IA   MMO
 0   TP   VA32      A      - → MM4
 1   EJ   CI0       MM4
 2   TP   CA27      VC3    Clear VC3
 3   MJ   0         MM5
 4   TP   CH37      VC3    Set VC3 for -
 5   TP   VA22      A      # symbols = 3 → MG0
 6   EJ   CH24      MG     No ↓
 7   EJ   CA3       MP     = 1 → MP0
10   EJ   CH25      MQ     = 2 → MQ0      4 ↓
11   TU   CH26      MM14   Set loop addresses
12   TU   CH27      MM15
13   TP   CH24      VC1    Set index
14   TP   (30000)   A      - 1/2 → A
15   EJ   (30000)   MM17   = → MM17 ≠  → ML0
16   MJ   0         ML0
17   RA   MM14      CH22   Modify
20   RA   MM15      CH22
21   IJ   VC1       MM14   Return
22   TP   CH30      EW2    16100 → CW of - 1/2 → list
23   RJ   EW0       EW1
24   MJ   0         MH17   → C
     CA   MM25
```

Two Symbols in Sequence

```
     IA   MQ
 0   TP   VA32      A      - → MQ3
 1   EJ   CI        MQ3
 2   MJ   0         ML     No → ML
 3   TP   VA33      A
 4   EJ   CI1       MX     Next sym. = 1 → MX
 5   EJ   CI3       MS               = 2 → MS
 6   EJ   CI4       MV               = 3 → MV      no
 7   TP   SZ11      Q
10   QJ   MQ11      ML     Constant ↓   No → ML
11   TP   MI2       RS4
12   RJ   RS2       RS     Convert to octal
13   TP   CH32      A      # > 77 → MW
14   TJ   RS3       MW           no ↓
15   SP   RS3       0      130xx
16   SA   VC3       0      131xx → list
17   AT   CI5       EW2
20   RJ   EW        EW1
21   MJ   0         MH16
     CA   MQ22
```

symbols in sequence = 3

```
     IA   MG
 0   TU   CH34      MG3     Set loop addresses
 1   TU   CH27      MG4
 2   TP   CH25      VC1     Set index = 2
 3   TP   (30000)   A       1/2 → A
 4   EJ   (30000)   MG6     = Special case → MG6
 5   MJ   0         ML      ≠ → ML
 6   RA   MG3       CH22    Modify addresses
 7   RA   MG4       CH22
10   IJ   VC1       MG3
11   TP   CH33      EW2     CW → list
12   RJ   EW        EW1
13   MJ   0         MH17    → C
     CA   MG14
```

symbols = 1

```
     IA   MP
 0   TP   VA32      A
 1   EJ   CI1       MH16    = 1 → C
 2   EJ   CI3       MS      = 2 → MS
 3   EJ   CI4       MV      = 3 → MV
 4   MJ   0         MQ7     → MQ7
     CA   MP5
```

Superscript Symbol

```
        IA    MK0
  0     TP    SY11        Q              Constant ⟶MTO
  1     QJ    MTO         MK2            no ↓
  2     TP    SY2         A              - ⟶MU
  3     EJ    CG12        MU             No (assume /)   ↓
  4     TP    CA16        PC3            Set PC
  5     TP    VA22        A
  6     AT    CH17        A              / ⟶sequence
  7     TV    A           MK10
 10     TP    CH35        (30000)
 11     TP    VA22        A
 12     AT    CH20        A              / ⟶ special sequence
 13     TV    A           MK14
 14     TP    SY2         (30000)
 15     MJ    0           MH             ⟶get next symbol of sequence
        CA    MK16
```

Superscript -

```
        IA    MU0
  0     TP    CA15        PC3            Set PC
  1     TP    VA22        A
  2     AT     CH17       A              - ⟶sequence
  3     TV    A           MU4
  4     TP    CH36        (30000)
  5     TP    VA22        A
  6     AT    CH20        A              - ⟶special sequence
  7     TV    A           MU10
 10     TP    SY2         (30000)
 11     MJ    0           MH             ⟶return
        CA    MU12
```

Superscript Up Constant

```
     IA   MT
 0   TP   CA14     PC3       Set PC
 1   RJ   RB       RB1       Check constant
 2   TP   SY2      MI4
 3   TP   SY3      MI5       Lower constant
 4   RJ   MI       MI1
 5   TP   MI2      GG4
 6   TP   MI3      GG5       Convert to floating point
 7   RJ   GG2      GG
10   TP   GG3      A         Assign CW
11   RJ   GW       GW1
12   TP   Q        VC2       Store CW
13   TP   VA22     A
14   AT   CH17     A         CW → sequence
15   TV   A        MT16
16   TP   VC2      (30000)
17   TP   VA22     A
20   AT   CH20     A         Fltpt. const. →
21   TV   A        MT22      Special sequence
22   TP   GG3      (30000)
23   TP   SY6      A
24   ZJ   MT25     MH        Pt. in sequence ↓  no → MH
25   TP   CA24     VC        Set ind.
26   MJ   0        MH        → return
     CA   MT27
```

Constant = 2

```
     IA   MS
 0   TP   VC3      A
 1   AT   CI6      EW2       CW → list
 2   RJ   EW       EW1
 3   MJ   0        MH17
     CA   MS4
```

Constant = 3

```
     IA   MV
0    TP   VC3       A
1    AT   CI7       EW2      CW → list
2    RJ   EW        EW1
3    MJ   0         MH17     → C
     CA   MV4
```

Constant = 1

```
     IA   MX
0    TP   CI10      EW2      CW → list
1    RJ   EW        EW1
2    MJ   0         MH17     → C
     CA   MX3
```

| Const. | > 77

```
     IA   MW
0    RA   VA23      CA3      Change POW to 101
1    MJ   0         ML
     CA   MW2
```

Right POW

```
     IA   ZR
0    TP   CH37     EW2        CW → string
1    RJ   EW0      EW1
2    TP   CA17     PC3        Set PC
3    TP   VA5      A
4    ZJ   ZR5      NY         Ss. mode ↓   no → NY
5    RJ   WA       WA1
6    TP   VA6      GF10
7    TP   GF       UP3        E35
10   RJ   UP2      UP
11   MJ   0        ZM         → C
     CA   ZR12
```

Not Ss. mode

```
     IA   NY
0    TP   VA16     Q          Floating pt. eq. → ZM
1    QJ   NY2      ZM         No ↓
2    RJ   WA       WA1
3    TP   GF12     UP3        E36
4    RJ   UP2      UP
5    MJ   0        ZM         → C
     CA   NY6
```

Right)

```
     IA   ZQ
0    TP   CA5      PC3        Set PC
1    TP   CG34     EW2        CW → string
2    RJ   EW0      EW1
3    TP   VA4      A          Last raiser | → FP
4    ZJ   FP       ZQ5        no ↓
5    TP   VA3      A          ( raisers = 0 → ZQ10
6    ZJ   ZQ7      ZQ10       No ↓
7    RS   VA3      CA3        ( raisers - 1
10   RS   VA1      CA3        Lower level
11   TJ   CA3      FL0        Too low → FL0
12   EJ   VA5      FM         Leaving Ss. mode → FM0
13   TU   VC10     ZQ14       Leaving Lib. → FN0
14   EJ   (30000)  FN
15   MJ   0        ZM         → C
     CA   ZQ16
```

Leaving Lib.

```
      IA   FN
 0    TU   VC20      FN1      # commas correct ⟶ FN10
 1    TP   (30000)   A
 2    ZJ   FN3       FN10     No ↓
 3    RJ   WA        WA1
 4    TU   VC30      FN5
 5    TP   (30000)   GH13     E37
 6    TP   GH        UP3
 7    RJ   UP2       UP
10    RS   VC10      CH23
11    RS   VC20      CH23     Take Lib. off list
12    RS   VC30      CH23
13    MJ   0         ZM       ⟶ C
      CA   FN14
```

Leaving Ss. mode

```
      IA   FM
 0    TP   CA27      VA5      Clear Ss. mode
 1    TP   VA36      A        # Ss. correct ⟶ C
 2    ZJ   FM3       ZM       No ↓
 3    RJ   WA        WA1
 4    TP   VA6       GI17
 5    TP   GI12      UP3      E40
 6    RJ   UP2       UP
 7    MJ   0         ZM       ⟶ C
      CA   FM10
```

Level too Low

```
      IA   FL
 0    TP   CA3       VA1      Set level = 0
 1    TP   VA        Q        Previous point ⟶ ZM
 2    QJ   ZM        FL3      No ↓
 3    RJ   WA        WA1
 4    TP   GI        UP3      E39
 5    RJ   UP2       UP
 6    TP   CA24      VA       Set point
 7    MJ   0         ZM       ⟶ C
      CA   FL10
```

Interlocking (and |

```
     IA   FP
0    RJ   WA      WA1
1    TP   GH24    UP3       E38
2    RJ   UP2     UP
3    MJ   0       ZQ10      ──> ) Section
     CA   FP4
```

Right (

```
     IA   ZN0
0    TP   CA4     PC3       Set PC
1    TP   CG24    EW2       CW ──> string
2    RJ   EW      EW1
3    TP   VA5     A         Not Ss. mode ──> ZN11
4    ZJ   ZN5     ZN11      Ss. mode ↓
5    RJ   WA      WA1
6    TP   VA6     GJ10      E41
7    TP   GJ      UP3
10   RJ   UP2     UP
11   TP   CA27    VA4       Clear | level raisers
12   RA   VA3     CA3       Raise level
13   RA   VA1     CA3
14   MJ   0       ZM        ──> C
     CA   ZN15
```

Right-Constant

```
          IA   ZV0
D1     0  TP   CA6      PC3        Set PC
       1  TP   VA5      A     }    Ss. mode ──>ZV5
       2  ZJ   ZV5      ZV3   }    No ↓
       3  TP   VA16     Q     }
       4  QJ   ZV5      XC0   }    Fixed eq. ↓  no ──>XC0
       5  RJ   RD       RD1        Check const.
       6  TP   SY2      RS4   }    Convert to fixed point
       7  RJ   RS2      RS0   }
      10  TP   RS3      A     }    Assign CW
      11  RJ   GW0      GW1   }
      12  TP   Q        EW2   }    CW──> string-out
      13  RJ   EW0      EW1   }
      14  MJ   0        ZM         New CW──>list }   crr. #1
          CA   ZV15                ──> C         }
```

Floating Point Constant

```
          IA   XC0
       0  RJ   RB0      RB1        Check const.
       1  TP   SY2      GG4   }
       2  TP   SY3      GG5   }    Convert to fltpt.
       3  RJ   GG2      GG0   }
       4  TP   GG3      A          Const. ──>A
       5  MJ   0        ZV11
          CA   XC6
```

E

Right - Var. - Before

```
        IA   ZT
  0     TP   VD      A         Before → ZT2
  1     ZJ   XD      ZT2       After → XD = F
  2     RJ   TU      TU1       Not in Ftn. list → XE
  3     MJ   0       XE        In ↓
  4     TP   TU3     EW2       CW → string
  5     RJ   EW      EW1
  6     TP   VA5     A
  7     ZJ   ZT10    XF        Ss. mode ↓   no → XF
 10     TP   TU3     Q         CW → A
 11     QT   CG17    A
 12     EJ   CI25    XG        75xxx → XG      no ↓
 13     TP   SY10    Q         Assume 62xxx
 14     QJ   ZT22    ZT15      IJKLM → ZT22 no ↓
 15     RJ   WA      WA1
 16     TP   SY2     ER6
 17     TP   VA6     ER20      E21
 20     TP   ER      UP3
 21     RJ   UP2     UP
 22     TP   CA6     PC3       Set PC
 23     MJ   0       ZM        → C
        CA   ZT24
```

Right - In Ftn. list Ss. mode 75xxx

```
        IA   XG
  0     TP   CA7     PC3       → PC
  1     RJ   PC      PC1
  2     RJ   WA      WA1
  3     TP   SY2     EP30
  4     TP   VA6     EP41      E20
  5     TP   EP22    UP3
  6     RJ   UP2     UP
  7     RJ   SY      SY1       Sym → A
 10     EJ   CA30    XG12      ( → XG12     no ↓
 11     MJ   0       ZM3       → C
 12     TP   GP17    UP3       "Ss. not checked"
 13     RJ   UP2     UP
 14     RJ   FV      FV1       delete Ss.
 15     MJ   0       YV        Δ . → C2
 16     MJ   0       ZM1       → C
        CA   XG17
```

Not Ss. mode-in Ftn. list

	IA	XF		
0	TP	TU3	Q	xx000 → A
1	QT	CG17	A	
2	EJ	CI25	XH	75xxx → XH no ↓
3	TP	SY10	Q	
4	QJ	XF5	XF11	IJKLM ↓ no → XF11
5	RJ	WA	WA1	
6	TP	SY2	ER27	E22
7	TP	ER22	UP3	
10	RJ	UP2	UP	
11	TP	CA6	PC3	Set PC
12	MJ	0	ZM	→ C
	CA	XF13		

75xxx

	IA	XH		
0	TP	CA7	PC3	Do PC
1	RJ	PC	PC1	
2	RJ	SY	SY1	Sym → A
3	EJ	CA30	XI	(→ XI no ↓
4	RJ	WA	WA1	
5	TP	SZ2	EX6	E23
6	TP	EX	UP3	
7	RJ	UP2	UP	
10	TP	SY2	A	Sym → A
11	MJ	0	ZM3	→ C
	CA	XH12		

75xxx (

	IA	XI		
0	TP	CA4	PC3	Set PC
1	TP	VA1	VA5	Set Ss. mode
2	TP	SZ2	VA6	
3	TP	CA27	VA36	Clear # commas
4	TP	CG24	EW2	CW → list
5	RJ	EW	EW1	
6	MJ	0	ZN11	→ (→ C
	CA	XI7		

Right-Before-Var.
Not in Ftn. list

```
      IA   XE
 0    RJ   TA       TA1
 1    MJ   0        XQ       Not in CB List ⟶ XQ     in ↓
 2    TP   TA4      EW2      CW ⟶ list
 3    RJ   EW       EW1
 4    TP   CA6      PC3      Set PC
 5    TP   VA16     Q        Not fixed eq. ⟶ XR
 6    QJ   XE7      XR       Fixed ↓
 7    TP   TA4      Q
10    QT   CG17     A
11    EJ   CG17     XT       77xxx ⟶ XT
12    EJ   CA33     XV       66xxx ⟶ XV
13    EJ   CA31     XW       65xxx ⟶ XW
14    EJ   CA25     ZM       64xxx ⟶ C
15    TP   CA20     PC3      5xxxx ↓
16    RJ   PC       PC1      Do PC
17    RJ   WA       WA1      E13
20    TP   SY2      EL4
21    TP   EL       UP3
22    RJ   UP2      UP
23    RJ   SY       SY1      Sym ⟶ A
24    EJ   CA30     XE26     ( ⟶ XE26
25    MJ   0        ZM3      No ⟶ C
26    TP   GP       UP3      "Args not checked"
27    RJ   UP2      UP
30    RJ   FV       FV1      Delete LIB
31    MJ   0        YV       Δ. ⟶ C2
32    MJ   0        ZM1      ⟶ C
      CA   XE33
```

65xxx

```
      IA   XW
 0    RJ   WA       WA1
 1    TP   SY2      EL17     E14
 2    TP   EL12     UP3
 3    RJ   UP2      UP
 4    MJ   0        ZM       ⟶ C
      CA   XW5
```

66xxx

```
     IA   XV
 0   TP   CA10      PC3
 1   RJ   PC        PC1       Do PC
 2   RJ   WA        WA1
 3   TP   SY2       EM3       E15
 4   TP   EM        UP3
 5   RJ   UP2       UP
 6   RJ   SY        SY1       Sym ⟶ A
 7   EJ   CA30      XV11      ( ⟶ XV11     no ↓
10   MJ   0         ZM3       ⟶ C
11   TP   GP        UP3       "Args not checked"
12   RJ   UP2       UP
13   RJ   FV        FV1       Delete Ftn.
14   MJ   0         YV        Δ . ⟶ C2
15   MJ   0         ZM1       ⟶ C
     CA   XV16
```

77xxx

```
     IA   XT
 0   TP   CA7       PC3
 1   RJ   PC        PC1       Do PC
 2   RJ   WA        WA1
 3   TP   SY2       EM17
 4   TP   EM11      UP3       E16
 5   RJ   UP2       UP
 6   RJ   SY        SY1       Sym ⟶ A
 7   EJ   CA30      XT11      ( ⟶ XT11
10   MJ   0         ZM3       No ⟶ C
11   TP   GP17      UP3
12   RJ   UP2       UP        "Ss. not checked"
13   RJ   FV        FV1       Delete Ss.
14   MJ   0         YV        Δ . ⟶ C2
15   MJ   0         ZM1       ⟶ C
     CA   XT16
```

Var.
Before - In CB List
Floating Point Equation

	IA	XR		
0	TP	VA5	A	Ss. mode → XY
1	ZJ	XY	XR2	No
2	TP	TA4	Q	
3	QT	CG17	A	xx000 → A
4	EJ	CG17	XZ	77xxx → XZ
5	EJ	CA33	HC	66xxx → HC
6	EJ	CA31	ZM	65xxx → C
7	EJ	CA25	HF	64xxx → HF
10	TP	CA20	PC3	5xxxx ↓ pair check
11	RJ	PC	PC1	
12	TP	TA4	Q	# operands = 1 → C
13	QT	CI31	VA13	↓
14	TJ	CH25	ZM1	No ↓
15	RJ	SY	SY1	Sym → A ↓
16	EJ	CA30	HG	(→ HG no ↓
17	TP	SZ2	EN5	
20	RJ	WA	WA1	
21	TP	EN	UP3	E17
22	RJ	UP2	UP	
23	TP	SY2	A	Sym → A
24	MJ	0	ZM2	→ C
	CA	XR25		

Lib. (

	IA	HG		
0	TP	VA1	VA12	Set Lib.
1	RA	VC20	CH23	Room for Lib. → HH
2	TJ	CI33	HH	No ↓
3	RS	VC20	CH23	Add. - 1
4	RJ	WA	WA1	
5	TP	SZ2	GM25	
6	TP	GM11	UP3	E49
7	RJ	UP2	UP	
10	RJ	FV	FV1	Delete Lib. args
11	MJ	0	YV	Δ . → C2
12	MJ	0	ZM1	→ C
	CA	HG13		

Room for Lib.

```
    IA   HH
0   TV   A       HH2
1   TP   VA13    A          # commas → list
2   ST   CA3     (30000)
3   RA   VC10    CH23
4   TV   A       HH5        Lib. level → list
5   TP   VA12    (30000)
6   RA   VC30    CH23
7   TV   A       HH10       XS3 of Lib. → list
10  TP   SZ2     (30000)
11  MJ   0       ZN         → ( section
    CA   HH12
```

64xxx

```
    IA   HF
0   RJ   WA      WA1
1   TP   SY2     EK25       E12
2   TP   EK20    UP3
3   RJ   UP2     UP
4   MJ   0       ZM         → C
    CA   HF5
```

Floating Pt. Eq. Right

66xxx ↓

```
    IA   HC
0   TP   CA10    PC3        Pair check
1   RJ   PC      PC1
2   RJ   SY      SY1        Sym → A            ↓
3   EJ   CA30    WD         ( → WD      no
4   MJ   0       ZM3        → C
    CA   HC5
```

77xxx ↓

```
      IA   XZ
 0    TP   CA7      PC3     Pair check
 1    RJ   PC       PC1
 2    RJ   SY       SY1     Sym ⟶ A
 3    EJ   CA30     HK      ( ⟶ HK     no ↓
 4    RJ   WA       WA1
 5    TP   SZ2      EN30    E18
 6    TP   EN22     UP3
 7    RJ   UP2      UP
10    TP   SY2      A       Sym ⟶ A
11    MJ   0        ZM3     ⟶ C
      CA   XZ12
```

77xxx (

```
      IA   HK
 0    TP   VA1      VA5     Set Ss. mode
 1    TP   TA5      Q
 2    QT   CA2      A       Ss. - 1 ⟶ VA36
 3    ST   CA3      VA36
 4    TP   SZ2      VA6     Store XS3 of variable
 5    TP   CA4      PC3     Set PC
 6    TP   CG24     EW2     ( ⟶ list
 7    RJ   EW       EW1
10    MJ   0        ZN11    ⟶ ( ⟶ C
      CA   HK11
```

Ss. mode - Right - In CB List

	IA	XY		
0	TP	TA4	Q	
1	QT	CG17	A	xx000 → A
2	EJ	CG17	HL	77xxx → HL
3	EJ	CA33	HM	66xxx → HM
4	EJ	CA31	HN	65xxx → HN
5	EJ	CA25	ZM	64xxx → C
6	TP	CA20	PC3	5xxxx ↓
7	RJ	PC	PC1	Do pair check
10	RJ	WA	WA1	
11	TP	SY2	EJ4	
12	TP	VA6	EJ13	E9
13	TP	EJ	UP3	
14	RJ	UP2	UP	
15	RJ	SY	SY1	Sym → A
16	EJ	CA30	XY20	(→ XY20 no ↓
17	MJ	0	ZM3	→ C
20	TP	GP25	UP3	
21	RJ	UP2	UP	"Args not checked"
22	RJ	FV	FV1	Delete Lib.
23	MJ	0	YV	→ C2
24	MJ	0	ZM1	→ C
	CA	XY25		

65xxx

	IA	HN		
0	TP	CA6	PC3	Set PC
1	RJ	WA	WA1	
2	TP	SY2	ER6	
3	TP	VA6	ER20	E21
4	TP	ER	UP3	
5	RJ	UP2	UP	
6	MJ	0	ZM	→ C
	CA	HN7		

66xxx

```
     IA    HM
 0   TP    CA10       PC3
 1   RJ    PC         PC1       Do PC
 2   RJ    WA         WA1
 3   TP    SY2        EJ20
 4   TP    VA6        EJ25      E10
 5   TP    EJ15       UP3
 6   RJ    UP2        UP
 7   RJ    SY         SY1       Sym ⟶ A
10   EJ    CA30       WD        ( ⟶ WD      no ↓
11   MJ    0          ZM3       ⟶ C
     CA    HM12
```

77xxx

```
     IA    HL
 0   TP    CA7        PC3
 1   RJ    PC         PC1       Do PC
 2   RJ    WA         WA1
 3   TP    SY2        EI26
 4   TP    VA6        EI35      E8
 5   TP    EI20       UP3
 6   RJ    UP2        UP
 7   RJ    SY         SY1       Sym ⟶ A
10   EJ    CA30       HL12      ( ⟶ HL12    no ↓
11   MJ    0          ZM3       ⟶ C
12   TP    GP17       UP3
13   RJ    UP2        UP        "Ss. not checked"
14   RJ    FV         FV1       Delete Ss.
15   MJ    0          YV        Δ. ⟶ C2
16   MJ    0          ZM1       ⟶ C
     CA    HL17
```

Variable Right - Before Not in Ftn. or CB Lists

```
     IA   XQ
 0   RJ   RH      RH1       Check symbol
 1   TP   CA27    TF3       Set to add to CB List
 2   TP   CA26    TF
 3   TP   SY2     TF1
 4   TP   VA16    Q         Fixed →HQ
 5   QJ   HQ      XQ6       No ↓
 6   TP   VA5     A         Not Ss.→HR
 7   ZJ   XQ10    HR        Ss. ↓
10   TP   SY10    Q         Not IJKLM→HS
11   QJ   XQ12    HS        Yes ↓
12   RJ   TK      TK1       CW = 64xxx
13   AT   CA25    TF2
14   TP   A       EW2       CW →list
15   RJ   EW      EW1
16   RJ   TE      TE1       File →CB List
17   TP   CA6     PC3       Set PC
20   MJ   0       ZM        → C
     CA   XQ21
```

Not IJKLM

```
     IA   HS
 0   RJ   WA      WA1
 1   TP   SY2     EK6
 2   TP   VA6     EK16      E11
 3   TP   EK      UP3
 4   RJ   UP2     UP
 5   RJ   TK      TK1
 6   AT   CA31    EW2       Assign 65xxx CW
 7   TP   A       TF2
10   RJ   EW      EW1       CW →list
11   RJ   TE      TE1       file→CB List
12   TP   CA6     PC3       Set PC
13   MJ   0       ZM        → C
     CA   HS14
```

Not Ss. Mode

	IA	HR		
0	TP	CA6	PC3	Set PC
1	TP	SY10	Q	IJKLM → HU
2	QJ	HU	HR3	No ↓
3	RJ	TK	TK1	65xxx CW
4	AT	CA31	TF2	
5	TP	A	EW2	CW → list
6	RJ	EW	EW1	
7	RJ	TE	TE1	File → CB List
10	MJ	0	ZM	→ C
	CA	HR11		

IJKLM

	IA	HU		
0	RJ	WA	WA1	
1	TP	SY2	ER25	E12
2	TP	EK20	UP3	
3	RJ	UP2	UP	
4	RJ	TK	TK1	Assign 64xxx CW
5	AT	CA25	TF2	
6	TP	A	EW2	CW → list
7	RJ	EW	EW1	
10	RJ	TE	TE1	File → CB List
11	TP	CA6	PC3	Set PC
12	MJ	0	ZM	→ C
	CA	HU13		

Fixed Equation

	IA	HQ		
0	TP	SY10	Q	IJKLM → XQ11
1	QJ	XQ11	HQ2	No ↓
2	RJ	WA	WA1	
3	TP	SY2	EL17	E14
4	TP	EL12	UP3	
5	RJ	UP2	UP	
6	MJ	0	HS5	→ 65xxx CW
	CA	HQ7		

Right-After-Var. In P.Op. List

```
F
        IA   XD
   0    RJ   TS      TS1     Not in P.Op. list → HV
   1    MJ   0       HV      In ↓
   2    TP   TS3     EW2     CW → string
   3    RJ   EW      EW1
   4    TP   CA6     PC3     Set PC
   5    TP   VA16    Q       Fixed eq. → HW
   6    QJ   HW      XD7     No ↓
   7    TP   VA5     A       Ss. mode → HX
  10    ZJ   HX      XD11    No ↓
  11    TP   TS3     Q
  12    QT   CG17    A       xx000 → A
  13    EJ   CG21    HY      61xxx → HY
  14    EJ   CG22    HZ      63xxx → HZ
  15    TP   CA7     PC3     76Yxx ↓
  16    RJ   PC      PC1     Do PC
  17    RJ   SY      SY1     Sym → A
  20    EJ   CA30    NA      ( → NA      no ↓
  21    RJ   WA      WA1
  22    TP   SZ2     EP6     E19
  23    TP   EP      UP3
  24    RJ   UP2     UP
  25    TP   SY2     A       Sym → A
  26    MJ   0       ZM3     → C
        CA   XD27
```

```
                             76Yxx   (

        IA   NA
   0    TP   TS3     Q
   1    QT   CG25    Q       #Ss. → Q
   2    LQ   Q       36
   3    TP   Q       A       # commas → VA36
   4    ST   CA3     VA36
   5    TP   VA1     VA5     Set Ss. mode
   6    TP   SZ2     VA6
   7    TP   CG24    EW2     ( CW → list
  10    RJ   EW      EW1
  11    TP   CA4     PC3     Set PC
  12    MJ   0       ZN11    → ( → C
        CA   NA13
```

63xxx

```
    IA  HZ
0   TP  SY10   Q        
1   QJ  HZ2    ZM        IJKLM ↓   no → 92
2   RJ  WA     WA1
3   TP  SY2    EI5
4   TP  EI     UP3       E7
5   RJ  UP2    UP
6   MJ  0      ZM        → C
    CA  HZ7
```

61xxx

```
    IA  HY
0   TP  CA10   PC3       Do PC
1   RJ  PC     PC1
2   RJ  SY     SY1       Sym → A
3   EJ  CA30   WD        ( → WD    no  ↓
4   MJ  0      ZM3       → C
    CA  HY5
```

SS Mode

```
     IA  HX
0    TP  TS3    Q        xx000 → A
1    QT  CG17   A
2    EJ  CG21   NB       61xxx → NB
3    EJ  CG22   NC       63xxx → NC
4    TP  CA7    PC3      76Yxx ↓
5    RJ  PC     PC1      Do PC
6    RJ  WA     WA1
7    TP  SY2    EH6
10   TP  VA6    EH20     E5
11   TP  EH     UP3
12   RJ  UP2    UP
13   RJ  SY     SY1      Sym → A
14   EJ  CA30   HX16     ( → HX16
15   MJ  0      ZM3      → C
16   RJ  FV     FV1      Delete SS
17   MJ  0      YV       Δ → C2
20   MJ  0      ZM1      → C
     CA  HX21
```

Fixed Equation

```
      IA    HW
 0    TP    TS3     Q       xx000 → A
 1    QT    CG17    A
 2    EJ    CG21    ND      61xxx → ND
 3    EJ    CG22    NE      63xxx → NE
 4    TP    CA7     PC3     76Yxx ↓
 5    RJ    PC      PC1     Do PC
 6    RJ    WA      WA1
 7    TP    SY2     EF24    E2
10    TP    EF16    UP3
11    RJ    UP2     UP
12    RJ    SY      SY1     Sym → A
13    EJ    CA30    HW15    ( → HW15
14    MJ    0       ZM3     → C
15    TP    GP10    UP3
16    RJ    UP2     UP      "Ss. not checked"
17    RJ    FV      FV1     Delete Ss.
20    MJ    0       YV      Δ  . → C2
21    MJ    0       ZM1     → C
      CA    HW22
```

61xxx

```
      IA    ND
 0    TP    CA10    PC3
 1    RJ    PC      PC1     Do PC
 2    RJ    WA      WA1
 3    TP    SY2     EF4
 4    TP    EF      UP3     E1
 5    RJ    UP2     UP
 6    RJ    SY      SY1     Sym → A
 7    EJ    CA30    WD      ( → WD      no ↓
10    MJ    0       ZM3     → C
      CA    ND11
```

63xxx

```
     IA   NE
0    TP   SY10     Q          IJKLM → C
1    QJ   ZM       NE2           no ↓
2    RJ   WA       WA1
3    TP   SY2      EG6        E3
4    TP   EG       UP3
5    RJ   UP2      UP
6    MJ   0        ZM      → C
     CA   NE7
```

SS Mode 63xxx

```
     IA   NC
0    TP   SY10     Q          IJKLM → C
1    QJ   ZM       NC2        No  ↓
2    RJ   WA       WA1
3    TP   SY2      EH30
4    TP   VA6      EH42       E6
5    TP   EH22     UP3
6    RJ   UP2      UP
7    MJ   0        ZM         → C
     CA   NC10
```

61xxx

```
     IA   NB
0    TP   CA10     PC3
1    RJ   PC       PC1        Do PC
2    RJ   WA       WA1
3    TP   SY2      EG24
4    TP   VA6      EG36       E4
5    TP   EG20     UP3
6    RJ   UP2      UP
7    RJ   SY       SY1        Sym → A
10   EJ   CA30     WD         ( → WD
11   MJ   0        ZM3        → C
     CA   NB12
```

Right, After, Var. Not in Pseudo Op. List

```
        IA    HV
 0      RJ    TA        TA1      
 1      MJ    0         NF        Not in CB List→NF     in ↓
 2      TP    TA4       Q         4xxxx→FU
 3      QT    CG30      A
 4      EJ    CG31      FU        No ↓
 5      TP    TA4       EW2
 6      RJ    EW        EW1       CW→list
 7      TP    CA6       PC3       Set PC
10      TP    VA16      Q         Fixed→NG
11      QJ    NG        HV12      Floating ↓
12      TP    VA5       A         Ss. mode→NH
13      ZJ    NH        HV14      No ↓
14      TP    TA4       Q
15      QT    CG17      A         CW→A
16      EJ    CG17      NI        77xxx→NI
17      EJ    CA25      NJ        64xxx→NJ
20      EJ    CA31      ZM        65xxx→C
21      EJ    CA33      NL        66xxx→NL
22      TP    CA20      PC3       5xxxx ↓
23      RJ    PC        PC1       Do PC
24      TP    TA4       Q         CW→A→VA13
25      QT    CI31      VA13
26      TJ    CH25      ZM1       # operands = 1→C      no ↓
27      RJ    SY        SY1       Sym.→A
30      EJ    CA30      HG        (→HG     no ↓
31      RJ    WA        WA1
32      TP    SZ2       EN5       E17
33      TP    EN        UP3
34      RJ    UP2       UP
35      TP    SY2       A         Sym.→A
36      MJ    0         ZM3       →C
        CA    HV37
```

66xxx

```
        IA    NL
 0      TP    CA10      PC3       Pair check
 1      RJ    PC        PC1
 2      RJ    SY        SY1       Sym→A
 3      EJ    CA30      WD        (→WD
 4      MJ    0         ZM3       →C
        CA    NL5
```

```
                              64xxx

     IA   NJ
0    RJ   WA          WA1
1    TP   SY2         EK25
2    TP   EK20        UP3     E12
3    RJ   UP2         UP
4    MJ   0           ZM      ——> C
     CA   NJ5
```

```
                              77xxx

     IA   NI
0    TP   CA7         PC3     Do PC
1    RJ   PC          PC1
2    RJ   SY          SY1     Sym. ——> A
3    EJ   CA30        NI12    ( ——>NI12     no ↓
4    RJ   WA          WA1
5    TP   SZ2         EN30    E18
6    TP   EN22        UP3
7    RJ   UP2         UP
10   TP   SY2         A       Sym ——> A
11   MJ    0          ZM3     ——> C
12   TP   VA1         VA5     Set Ss. mode
13   TP   SZ2         VA6
14   TP   TA5         Q
15   QT   CA2         A       Ss. - 1 ——> storage
16   ST   CA3         VA36
17   TP   CG24        EW2     ( ——> list
20   RJ   EW          EW1
21   TP   CA4         PC3     Set PC
22   MJ   0           ZN11    ——> ( section ——> C
     CA   NI23
```

Ss. Mode

```
     IA   NH
 0   TP   TA4    Q        xx000 → A
 1   QT   CG17   A
 2   EJ   CG17   NK       77xxx → NK
 3   EJ   CA25   ZM       64xxx → C
 4   EJ   CA31   NP       65xxx → NP
 5   EJ   CA33   NS       66xxx → NS
 6   TP   CA20   PC3      5xxxx ↓
 7   RJ   PC     PC1      Do PC
10   RJ   WA     WA1
11   TP   SY2    EJ4
12   TP   VA6    EJ13     E9
13   TP   EJ     UP3
14   RJ   UP2    UP
15   RJ   SY     SY1      Sym. → A
16   EJ   CA30   NH20     ( → NH20     no ↓
17   MJ   0      ZM3      → C
20   TP   GP25   UP3      "Args not checked"
21   RJ   UP2    UP
22   RJ   FV     FV1      Delete Lib.
23   MJ   0      YV       Δ  → YV
24   MJ   0      ZM1      → C
     CA   NH25
```

66xxx

```
     IA   NS
 0   TP   CA10   PC3
 1   RJ   PC     PC1      Do pair check
 2   RJ   WA     WA1
 3   TP   SY2    EJ20
 4   TP   VA6    EJ25     E10
 5   TP   EJ15   UP3
 6   RJ   UP2    UP
 7   RJ   SY     SY1      Sym → A
10   EJ   CA30   NS12     ( → NS12     no ↓
11   MJ   0      ZM3      → C
12   TP   GP     UP3
13   RJ   UP2    UP       "Args not checked"
14   RJ   FV     FV1      Delete arguments
15   MJ   0      YV       Δ, → C2
16   MJ   0      ZM1      → C
     CA   NS17
```

65xxx

```
    IA   NP
0   RJ   WA      WA1
1   TP   SY2     EK6
2   TP   VA6     EK16     E11
3   TP   EK      UP3
4   RJ   UP2     UP
5   MJ   0       ZM       --> C
    CA   NP6
```

77xxx

```
    IA   NK
0   TP   CA7     PC3
1   RJ   PC      PC1      Do PC
2   RJ   WA      WA1
3   TP   SY2     EI26
4   TP   VA6     EI35     E8
5   TP   EI20    UP3
6   RJ   UP2     UP
7   RJ   SY      SY1      Sym --> A
10  EJ   CA30    NK12     (--> NK12      no ↓
11  MJ   0       ZM3      --> C
12  TP   GP17    UP3
13  RJ   UP2     UP       "Ss. not checked"
14  RJ   FV      FV1      Delete Ss.
15  MJ   0       YV       Δ. --> C2
16  MJ   0       ZM1      --> C
    CA   NK17
```

Fixed Equation

```
    IA  NG
0   TP  TA4    Q   }   xx000 → A
1   QT  CG17   A   }
2   EJ  CG17   NN      77xxx → NN
3   EJ  CA33   NV      66xxx → NV
4   EJ  CA31   NW      65xxx → NW
5   EJ  CA25   ZM      64xxx → C
6   TP  CA20   PC3 }   5xxxx
7   RJ  PC     PC1 }   Do PC
10  RJ  WA     WA1
11  TP  SY2    EL4
12  TP  EL     UP3     E13
13  RJ  UP2    UP
14  RJ  SY     SY1     Sym → A
15  EJ  CA30   NX      ( → NX    no ↓
16  MJ  0      ZM3     → C
    CA  NG17
```

5xxxx (

```
    IA  NX
0   TP  GP     UP3 }   "Args not checked"
1   RJ  UP2    UP  }
2   RJ  FV     FV1     Delete Lib.
3   MJ  0      YV      Δ . → C2
4   MJ  0      ZM1     → C
    CA  NX5
```

65xxx

```
    IA  NW
0   RJ  WA     WA1  }
1   TP  SY2    EL17 }  E14
2   TP  EL12   UP3  }
3   RJ  UP2    UP   }
4   MJ  0      ZM      → C
    CA  NW5
```

66xxx

	IA	NV		
0	TP	CA10	PC3	
1	RJ	PC	PC1	Do PC
2	RJ	WA	WA1	
3	TP	SY2	EM3	E15
4	TP	EM	UP3	
5	RJ	UP2	UP	
6	RJ	SY	SY1	Sym → A
7	EJ	CA30	NV11	(→ NV11
10	MJ	0	ZM3	→ C
11	TP	GP	UP3	
12	RJ	UP2	UP	"Args not checked"
13	RJ	FV	FV1	Delete args
14	MJ	0	YV	→ C2
15	MJ	0	ZM1	→ C
	CA	NV16		

77xxx

	IA	NN		
0	TP	CA7	PC3	
1	RJ	PC	PC1	Do PC
2	RJ	WA	WA1	
3	TP	SY2	EM17	
4	TP	EM11	UP3	E16
5	RJ	UP2	UP	
6	RJ	SY	SY1	Sym. → A
7	EJ	CA30	NN11	(→ NN11 no ↓
10	MJ	0	ZM3	→ C
11	TP	GP17	UP3	
12	RJ	UP2	UP	"Ss. not checked"
13	RJ	FV	FV1	Delete Ss.
14	MJ	0	YV	Δ. → C2
15	MJ	0	ZM1	→ C
	CA	NN16		

Right, After, Not in P.Op. list

4xxxx

```
    IA  FU
0   TP  CA6     PC3      
1   RJ  PC      PC1      Do PC
2   RJ  WA      WA1
3   TP  SY2     GQ27
4   TP  GQ21    UP3      E51
5   RJ  UP2     UP
6   RJ  SY      SY1      Sym. ⟶ A
7   EJ  CA30    FU11     (⟶FU11    no ↓
10  MJ  0       ZM3      ⟶ C
11  TP  GP26    UP3      "Operands not checked"
12  RJ  UP2     UP
13  RJ  FV      FV1      Delete operands
14  MJ  0       YV       Δ.⟶ C2
15  MJ  0       ZM1      ⟶ C
    CA  FU16
```

Var. - Right - After   Not in P.Op. List
Not in CB List

```
    IA  NF
0   RJ  RH      RH1      Check Var. sym.
1   TP  CA26    TF       Set to add to
2   TP  SY2     TF1      CB List
3   TP  CA27    TF3
4   TP  CA6     PC3      Set PC
5   TP  VA16    Q        Fixed eq. ⟶ NZ
6   QJ  NZ      NF7      No ↓
7   TP  VA5     A        Ss. mode ⟶ FJ
10  ZJ  FJ      NF11     No ↓
11  TP  SY10    Q        IJKLM ⟶ FK
12  QJ  FK      NF13     No ↓
13  RJ  TK      TK1      Increase CW
14  AT  CA31    EW2      65xxx  CW ⟶ list
15  RJ  EW      EW1
16  TP  EW2     TF2      ⟶ CB List
17  RJ  TE      TE1
20  MJ  0       ZM       ⟶ C
    CA  NF21
```

Not SS mode - IJKLM

```
     IA   FK
 0   RJ   WA      WA1
 1   TP   SY2     EK25
 2   TP   EK20    UP3       E12
 3   RJ   UP2     UP
 4   RJ   TK      TK1       Increase CW counter
 5   AT   CA25    EW2       64xxx  CW → list
 6   TP   A       TF2
 7   RJ   EW      EW1
10   RJ   TE      TE1       CW → CB list
11   MJ   0       ZM        → C
     CA   FK12
```

Ss. Mode

```
     IA   FJ
 0   TP   SY10    Q         IJKLM → FK4
 1   QJ   FK4     FJ2       No ↓
 2   RJ   WA      WA1
 3   TP   SY2     EK6       E11
 4   TP   EK      UP3
 5   RJ   UP2     UP
 6   MJ   0       NF13
 7   TP   VA6     EK16
10   MJ   0       FJ2
     CA   FJ11
```

Fixed Equation

```
     IA   NZ
 0   TP   SY10    Q         IJKLM —— FK4
 1   QJ   FK4     NZ2       No ↓
 2   RJ   WA      WA1
 3   TP   SY2     EL17      E14
 4   TP   EL12    UP3
 5   RJ   UP2     UP
 6   MJ   0       NF13
     CA   NZ7
```

Δ .

```
C2      IA   YV
     0  TP   CG16     EW2
     1  RJ   EW       EW1         C.W. → list
     2  TP   VA7      A
     3  ZJ   YV4      YV7         Ftn. ↓  no → YV7
     4  TP   VA37     Q
     5  QJ   YV6      YV7         Not in CB List ↓  in → YV7
     6  RJ   TE       TE1         Add to list
     7  TP   VA14     A
    10  EJ   CA3      YV14        # = 's = 1 → YV14  no ↓
    11  RJ   WA       WA1
    12  TP   GK       UP3         E44
    13  RJ   UP2      UP
    14  TP   VA1      A           On ( level zero → YV21
    15  EJ   CA3      YV21        No ↓
    16  RJ   WA       WA1
    17  TP   GK10     UP3         E45
    20  RJ   UP2      UP
    21  TP   VA2      A           On | level zero → YV26
    22  EJ   CA3      YV26        No ↓
    23  RJ   WA       WA1
    24  TP   GL       UP3         E46
    25  RJ   UP2      UP
    26  TP   CA22     PC3
    27  RJ   PC       PC1          → PC
    30  TP   EW3      Q
    31  QT   CA2      A           Word count → WL
    32  ST   CK11     A
    33  AT   CA3      WL
    34  RJ   SS       SS1         Send S.O. to tape
    35  MJ   0        FR          Exit → Control
        CA   YV36
```

Equation Translation

Error Prints

Region	Error Numbers
EF	E1,E2
EG	E3,E4
EH	E5,E6
EI	E7,E8
EJ	E9,E10
EK	E11,E12
EL	E13,E14
EM	E15,E16
EN	E17,E18
EP	E19,E20
ER	E21,E22
EX	E23,E24
GA	E25,E26
GB	E27,E28
GC	E29,E30
GD	E31,E32
GE	E33,E34
GF	E35,E36
GH	E37,E38
GI	E39,E40
GJ	E41,E42,E43
GK	E44,E45
GL	E46,E47
GM	E48,E49
GP	Suffixes of error prints
GQ	E50,E51
FQ	E52
GV	E53,E54,E55
GY	E56,E57
GZ	E58

Error Prints for Equation Translation

		IA	EF							
	0	40	EF1	15						
E1	1	31	67502	66634	F	U	N	C	T	I
	2	51	50016	57347	O	N	Δ	S	Y	M
	3	25	51462	10177	B	O	L	,	Δ	77
	4	0	0	0	Sym.					
	5	01	21011	76567	Δ	,	Δ	(	S	U
	6	25	01525	45132	B	Δ	P	R	O	G
	7	54	24470	12767	R	A	M	Δ	D	U
	10	47	47734	30134	M	M	Y	)	Δ	I
	11	50	01010	10101	N	Δ	Δ	Δ	Δ	Δ
	12	01	31347	23027	Δ	F	I	X	E	D
	13	01	52513	45066	Δ	P	O	I	N	T
	14	01	30536	72466	Δ	E	Q	U	A	T
	15	34	51502	27777	I	O	N	.	77	77
E2	16	40	EF17	20						
	17	65	67256	52654	S	U	B	S	C	R
	20	34	52663	02701	I	P	T	E	D	Δ
	21	70	24543	42425	V	A	R	I	A	B
	22	46	30016	57347	L	E	Δ	S	Y	M
	23	25	51462	10177	B	O	L	,	Δ	77
	24	0	0	0	Sym.					
	25	01	21011	76567	Δ	,	Δ	(	S	U
	26	25	01010	10101	B	Δ	Δ	Δ	Δ	Δ
	27	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ
	30	01	52545	13254	Δ	P	R	O	G	R
	31	24	47012	76747	A	M	Δ	D	U	M
	32	47	73430	13450	M	Y	)	Δ	I	N
	33	01	31347	23027	Δ	F	I	X	E	D
	34	01	52513	45066	Δ	P	O	I	N	T
	35	01	30536	72466	Δ	E	Q	U	A	T
	36	34	51502	27777	I	O	N	.	77	77
		CA	EF37							

		IA	EG							
E3	0	40	EG1	17						
	1	31	46512	46634	F	L	O	A	T	I
	2	50	32015	25134	N	G	Δ	P	O	I
	3	50	66017	02454	N	T	Δ	V	A	R
	4	34	24254	63021	I	A	B	L	E	.
	5	01	77777	77777	Δ	77	77	77	77	77
	6	0	0	0	Var.					
	7	01	21011	76567	Δ	,	Δ	(	S	U
	10	25	01525	45132	B	Δ	P	R	O	G
	11	54	24470	10101	R	A	M	Δ	Δ	Δ
	12	01	01010	10127	Δ	Δ	Δ	Δ	Δ	D
	13	67	47477	34301	U	M	M	Y	)	Δ
	14	34	50013	13472	I	N	Δ	F	I	X
	15	30	27015	25034	E	D	Δ	P	O	I
	16	50	66013	05367	N	T	Δ	E	Q	U
	17	24	66345	15022	A	T	I	O	N	.
E4	20	40	EG21	17						
	21	31	67502	66634	F	U	N	C	T	I
	22	51	50016	57347	O	N	Δ	S	Y	M
	23	25	51462	10177	B	O	L	,	Δ	77
	24	0	0	0	Sym.					
	25	01	21011	76567	Δ	,	Δ	(	S	U
	26	25	01525	45132	B	Δ	P	R	O	G
	27	54	24470	12767	R	A	M	Δ	D	U
	30	47	47734	30101	M	M	Y	)	Δ	Δ
	31	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ
	32	01	24475	15032	Δ	A	M	O	N	G
	33	01	65672	56526	Δ	S	U	B	S	C
	34	54	34526	66501	R	I	P	T	S	Δ
	35	51	31017	77777	O	F	Δ	77	77	77
	36	0	0	0	Sym.					
	37	22	77777	77777	.	77	77	77	77	77
		CA	EG40							

		IA	EH		
E5	0	40	EH1	21	
	1	65	67256	52654	S U B S C R
	2	34	52663	02701	I P T E D Δ
	3	70	24543	42425	V A R I A B
	4	46	30016	57347	L E Δ S Y M
	5	25	51462	10177	B 0 L , Δ 77
	6	0	0	0	Sym.
	7	01	21011	76567	Δ , Δ (S U
	10	25	01010	10101	B Δ Δ Δ Δ Δ
	11	01	01010	10101	Δ Δ Δ Δ Δ Δ
	12	01	52545	13254	Δ P R 0 G R
	13	24	47012	76747	A M Δ D U M
	14	47	73430	12447	M Y) Δ A M
	15	51	50320	16567	0 N G Δ S U
	16	25	65265	43452	B S C R I P
	17	66	65015	13101	T S Δ 0 F Δ
	20	0	0	0	Sym.
	21	22	77777	77777	. 77 77 77 77 77
E6	22	40	EH23	21	
	23	31	46512	46634	F L 0 A T I
	24	50	32015	25134	N G Δ P 0 I
	25	50	66017	02454	N T Δ V A R
	26	34	24254	63021	I A B L E ,
	27	01	77777	77777	Δ 77 77 77 77 77
	30	0	0	0	Var.
	31	01	21011	76567	Δ , Δ (S U
	32	25	01525	45132	B Δ P R 0 G
	33	54	24470	10101	R A M Δ Δ Δ
	34	01	01010	10127	Δ Δ Δ Δ Δ D
	35	67	47477	34301	U M M Y) Δ
	36	24	47515	03201	A M 0 N G Δ
	37	65	67256	52654	S U B S C R
	40	34	52666	50151	I P T S Δ 0
	41	31	01777	77777	F Δ 77 77 77 77
	42	0	0	0	Sym.
	43	22	77777	77777	. 77 77 77 77 77
		CA	EH44		

		IA	EI		
E7	0	40	EI1	17	
	1	31	34723	02701	F I X E D △
	2	52	51345	06601	P O I N T △
	3	70	24543	42425	V A R I A B
	4	46	30210	17777	L E , △ 77 77
	5	0	0	0	Var.
	6	01	21011	76567	△ , △ (S U
	7	25	01525	45132	B △ P R O G
	10	54	24470	10101	R A M △ △ △
	11	01	01010	10101	△ △ △ △ △ △
	12	01	01276	74747	△ △ D U M M
	13	73	43013	45001	Y) △ I N △
	14	31	46512	46634	F L O A T I
	15	50	32015	25134	N G △ P O I
	16	50	66013	05367	N T △ E Q U
	17	24	66345	15022	A T I O N .
E8	20	40	EI21	16	
	21	65	67256	52654	S U B S C R
	22	34	52663	02701	I P T E D △
	23	70	24543	42425	V A R I A B
	24	46	30016	57347	L E △ S Y M
	25	25	51462	10177	B O L , △ 77
	26	0	0	0	Var.
	27	01	21012	44751	△ , △ A M O
	30	50	32010	10101	N G △ △ △ △
	31	01	01010	10101	△ △ △ △ △ △
	32	01	65672	56526	△ S U B S C
	33	54	34526	66501	R I P T S △
	34	51	31017	77777	O F △ 77 77 77
	35	0	0	0	Var.
	36	22	77777	77777	. 77 77 77 77 77
		CA	EI37		

		IA	EJ		
E9	0	40	EJ1	14	
	1	46	34255	46766	L I B R A R
	2	73	01545	16766	Y Δ R O U T
	3	34	50302	10177	I N E , Δ 77
	4	0	0	0	Sym.
	5	01	21012	44751	Δ , Δ A M O
	6	50	32016	56725	N G Δ S U B
	7	65	26543	45266	S C R I P T
	10	65	01513	10101	S Δ O F Δ Δ
	11	01	01010	10101	Δ Δ Δ Δ Δ Δ
	12	01	01017	77777	Δ Δ Δ 77 77 77
	13	0	0	0	Sym.
	14	22	77777	77777	. 77 77 77 77 77
E10	15	40	EJ16	11	
	16	31	67502	66634	F U N C T I
	17	51	50210	17777	O N , Δ 77 77
	20	0	0	0	Sym.
	21	01	21012	44751	Δ , Δ A M O
	22	50	32016	56725	N G Δ S U B
	23	65	26543	45266	S C R I P T
	24	65	01513	10177	S Δ O F Δ 77
	25	0	0	0	Sym.
	26	22	77777	77777	. 77 77 77 77 77
		CA	EJ27		

		IA	EK		
E11	0	40	EK1	17	
	1	31	46512	46634	F L O A T I
	2	50	32015	25134	N G △ P O I
	3	50	66017	02454	N T △ V A R
	4	34	24254	63021	I A B L E ,
	5	01	77777	77777	△ 77 77 77 77 77
	6	0	0	0	Var.
	7	01	21012	44751	△ , △ A M O
	10	50	32010	10101	N G △ △ △ △
	11	01	01010	10101	△ △ △ △ △ △
	12	01	01010	10165	△ △ △ △ △ S
	13	67	25652	65434	U B S C R I
	14	52	66650	15131	P T S △ O F
	15	01	77777	77777	△ 77 77 77 77 77
	16	0	0	0	Sym.
	17	22	77777	77777	. 77 77 77 77 77
E12	20	40	EK21	13	
	21	31	34723	02701	F I X E D △
	22	52	51345	06601	P O I N T △
	23	70	24543	42425	V A R I A B
	24	46	30210	17777	L E , △ 77 77
	25	0	0	0	Var.
	26	01	21013	45001	△ , △ I N △
	27	31	46512	46634	F L O A T I
	30	50	32015	25134	N G △ P O I
	31	50	66010	10101	N T △ △ △ △
	32	01	01305	36724	△ △ E Q U A
	33	66	34515	02277	T I O N . 77
		CA	EK34		

		IA	EL		
E13	0	40	EL1	11	
	1	46	34255	42454	L I B R A R
	2	73	01545	16766	Y Δ R O U T
	3	34	50302	10177	I N E , Δ 77
	4	0	0	0	Sym.
	5	21	01345	00131	, Δ I N Δ F
	6	34	72302	70152	I X E D Δ P
	7	51	34506	60130	O I N T Δ E
	10	53	67246	63451	Q U A T I O
	11	50	22777	77777	N . 77 77 77 77
E14	12	40	EL13	13	
	13	31	46512	46634	F L O A T I
	14	50	32015	25134	N G Δ P O I
	15	50	66016	57347	N T Δ S Y M
	16	25	51462	10177	B O L , Δ 77
	17	0	0	0	Sym.
	20	01	21013	45001	Δ , Δ I N Δ
	21	31	34723	02701	F I X E D Δ
	22	52	51345	06601	P O I N T Δ
	23	01	01010	10101	Δ Δ Δ Δ Δ Δ
	24	01	30536	72466	Δ E Q U A T
	25	34	51502	27777	I O N . 77 77
		CA	EL26		

		IA	EM								
E15	0	40	EM1	10							
	1	31	67502	66634	F	U	N	C	T	I
	2	51	50210	17777	O	N	,	Δ	77	77
	3	0	0	0	Sym.					
	4	01	21013	45001	Δ	,	Δ	I	N	Δ
	5	31	34723	02701	F	I	X	E	D	Δ
	6	52	51345	06601	P	O	I	N	T	Δ
	7	30	53672	46634	E	Q	U	A	T	I
	10	51	50227	77777	O	N	.	77	77	77
E16	11	40	EM12	14						
	12	65	67256	52654	S	U	B	S	C	R
	13	34	52663	02701	I	P	T	E	D	Δ
	14	70	24543	42425	V	A	R	I	A	B
	15	46	30016	57347	L	E	Δ	S	Y	M
	16	25	51462	10177	B	O	L	,	Δ	77
	17	0	0	0	Sym.					
	20	01	21013	45001	Δ	,	Δ	I	N	Δ
	21	31	34723	02701	F	I	X	E	D	Δ
	22	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ
	23	01	52513	45066	Δ	P	O	I	N	T
	24	01	30536	72466	Δ	E	Q	U	A	T
	25	34	51502	27777	I	O	N	.	77	77
		CA	EM26							

		IA	EN		
E17	0	40	EN1	21	
	1	46	34255	42454	L I B R A R
	2	73	01545	16766	Y Δ R O U T
	3	34	50300	16573	I N E Δ S Y
	4	47	24514	62101	M B O L , Δ
	5	0	0	0	Sym.
	6	01	21017	13466	Δ , Δ W I T
	7	33	01475	15430	H Δ M O R E
	10	01	66332	45001	Δ T H A N Δ
	11	01	01010	10101	Δ Δ Δ Δ Δ Δ
	12	51	50300	12454	O N E Δ A R
	13	32	67473	05066	G U M E N T
	14	21	01505	16601	, Δ N O T Δ
	15	31	51464	65171	F O L L O W
	16	30	27012	57301	E D Δ B Y Δ
	17	51	52305	00152	O P E N Δ P
	20	24	54305	06633	A R E N T H
	21	30	65346	52277	E S I S . 77
E18	22	40	EN23	17	
	23	65	67256	52654	S U B S C R
	24	34	52663	02701	I P T E D Δ
	25	70	24543	42425	V A R I A B
	26	46	30016	57347	L E Δ S Y M
	27	25	51462	10177	B O L , Δ 77
	30	0	0	0	Sym.
	31	01	21015	05166	Δ , Δ N O T
	32	01	01010	10101	Δ Δ Δ Δ Δ Δ
	33	01	01010	10101	Δ Δ Δ Δ Δ Δ
	34	01	31514	64651	Δ F O L L O
	35	71	30270	12573	W E D Δ B Y
	36	01	24500	15152	Δ A N Δ O P
	37	30	50015	22454	E N Δ P A R
	40	30	50663	33065	E N T H E S
	41	34	65227	77777	I S . 77 77 77
		CA	EN42		

		IA	EP							
E19	0	40	EP1	21						
	1	65	67256	52654	S	U	B	S	C	R
	2	34	52663	02701	I	P	T	E	D	Δ
	3	70	24543	42425	V	A	R	I	A	B
	4	46	30016	57347	L	E	Δ	S	Y	M
	5	25	51462	10177	B	O	L	,	Δ	77
	6	0	0	0	Sym.					
	7	21	01176	56725	,	Δ	(	S	U	B
	10	01	52545	13254	Δ	P	R	O	G	R
	11	24	47010	10101	A	M	Δ	Δ	Δ	Δ
	12	01	27674	74773	Δ	D	U	M	M	Y
	13	43	01505	16601	)	Δ	N	O	T	Δ
	14	31	51464	65171	F	O	L	L	O	W
	15	30	27012	57301	E	D	Δ	B	Y	Δ
	16	24	50015	15230	A	N	Δ	O	P	E
	17	50	01522	45430	N	Δ	P	A	R	E
	20	50	66333	06534	N	T	H	E	S	I
	21	65	22777	77777	S	.	77	77	77	77
E20	22	40	EP23	20						
	23	65	67256	62654	S	U	B	S	C	R
	24	34	52663	02701	I	P	T	E	D	Δ
	25	70	24543	42425	V	A	R	I	A	B
	26	46	30016	57347	L	E	Δ	S	Y	M
	27	25	51462	10177	B	O	L	,	Δ	77
	30	0	0	0	Sym.					
	31	01	21011	73167	Δ	,	Δ	(	F	U
	32	50	26663	45150	N	C	T	I	O	N
	33	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ
	34	01	27674	74773	Δ	D	U	M	M	Y
	35	43	01244	75150	)	Δ	A	M	O	N
	36	32	01656	72565	G	Δ	S	U	B	S
	37	26	54345	26665	C	R	I	P	T	S
	40	01	51310	17777	Δ	O	F	Δ	77	77
	41	0	0	0	Sym.					
	42	22	77777	77777	.	77	77	77	77	77
		CA	EP43							

		IA	ER								
E21	0	40	ER1	21							
	1	31	46512	46634	F	L	O	A	T	I
	2	50	32015	25134	N	G	△	P	O	I
	3	50	66017	02454	N	T	△	V	A	R
	4	34	24254	63021	I	A	B	L	E	,
	5	01	77777	77777	△	77	77	77	77	77
	6	0	0	0	Sym.					
	7	01	21011	73167	△	,	△	(	F	U
	10	50	26663	45150	N	C	T	I	O	N
	11	01	01010	10101	△	△	△	△	△	△
	12	01	01010	10127	△	△	△	△	△	D
	13	67	47477	34301	U	M	M	Y	)	△
	14	24	47515	03201	A	M	O	N	G	△
	15	65	67256	52654	S	U	B	S	C	R
	16	34	52666	50151	I	P	T	S	△	O
	17	31	01777	77777	F	△	77	77	77	77
	20	0	0	0	Sym.					
	21	22	77777	77777	.	77	77	77	77	77
E22	22	40	ER23	16						
	23	31	34723	02701	F	I	X	E	D	△
	24	52	51345	06601	P	O	I	N	T	△
	25	70	24543	42425	V	A	R	I	A	B
	26	46	30210	17777	L	E	,	△	77	77
	27	0	0	0	Sym.					
	30	01	21011	73167	△	,	△	(	F	U
	31	50	26663	45150	N	C	T	I	O	N
	32	01	27674	74773	△	D	U	M	M	Y
	33	43	01010	10101	)	△	△	△	△	△
	34	01	01345	00131	△	△	I	N	△	F
	35	46	51246	63450	L	O	A	T	I	N
	36	32	01525	13450	G	△	P	O	I	N
	37	66	01305	36724	T	△	E	Q	U	A
	40	66	34515	02277	T	I	O	N	.	77
		CA	ER41								

		IA	EX		
E23	0	40	EX1	21	
	1	65	67256	52654	S U B S C R
	2	34	52663	02701	I P T E D △
	3	70	24543	42425	V A R I A B
	4	46	30016	57347	L E △ S Y M
	5	25	51462	10177	B O L , △ 77
	6	0	0	0	Sym.
	7	01	21011	73167	△ , △ (F U
	10	50	26663	45150	N C T I O N
	11	01	01010	10101	△ △ △ △ △ △
	12	01	27674	74773	△ D U M M Y
	13	43	01505	16601	) △ N O T △
	14	31	51464	65171	F O L L O W
	15	30	27012	57301	E D △ B Y △
	16	24	50015	15230	A N △ O P E
	17	30	01522	45430	N △ P A R E
	20	50	66333	06534	N T H E S I
	21	65	22777	77777	S . 77 77 77 77
E24	22	40	EX23	10	
	23	47	51543	00166	M O R E △ T
	24	33	24500	15150	H A N △ O N
	25	30	01653	05224	E △ S E P A
	26	54	24663	00130	R A T E △ E
	27	53	67246	63451	Q U A T I O
	30	50	01315	15401	N △ F O R △
	31	0	0	0	Sym.
	32	22	77777	77777	. 77 77 77 77 77
		CA	EX33		

		IA	GA							
E25	0	40	GA1	5						
	1	65	67523	05431	S	U	P	E	R	F
	2	46	67516	76501	L	U	O	U	S	△
	3	65	73472	55146	S	Y	M	B	O	L
	4	65	01515	00146	S	△	O	N	△	L
	5	30	31662	27777	E	F	T	.	77	77
E26	6	40	GA7	23						
	7	31	67502	66634	F	U	N	C	T	I
	10	51	50210	17777	O	N	,	△	77	77
	11	0	0	0	Sym.					
	12	01	21015	15001	△	,	△	O	N	△
	13	46	30316	62101	L	E	F	T	,	△
	14	50	51660	13151	N	O	T	△	F	O
	15	46	46517	13027	L	L	O	W	E	D
	16	01	25730	12450	△	B	Y	△	A	N
	17	01	01010	10101	△	△	△	△	△	△
	20	01	01515	23050	△	△	O	P	E	N
	21	01	52245	43050	△	P	A	R	E	N
	22	66	33306	53465	T	H	E	S	I	S
	23	22	01015	43065	.	△	△	R	E	S
	24	66	01513	10166	T	△	O	F	△	T
	25	33	34650	16530	H	I	S	△	S	E
	26	50	66305	02630	N	T	E	N	C	E
	27	01	50516	60126	△	N	O	T	△	C
	30	33	30264	53027	H	E	C	K	E	D
	31	22	77777	77777	.	77	77	77	77	77
		CA	GA32							

		IA	GB		
E27	0	40	GB1	21	
	1	46	34255	42454	L I B R A R
	2	73	01545	16766	Y △ R O U T
	3	34	50300	16573	I N E △ S Y
	4	47	25514	62101	M B O L , △
	5	0	0	0	Sym.
	6	01	21013	46501	△ , △ I S △
	7	31	34546	56601	F I R S T △
	10	65	73472	55146	S Y M B O L
	11	01	01010	10101	△ △ △ △ △ △
	12	51	31016	53050	O F △ S E N
	13	66	30502	63022	T E N C E .
	14	01	01543	06566	△ △ R E S T
	15	01	51310	16633	△ O F △ T H
	16	34	65016	53050	I S △ S E N
	17	66	30502	63001	T E N C E △
	20	50	51660	12633	N O T △ C H
	21	30	26453	02722	E C K E D .
E28	22	40	GB23	20	
	23	24	50013	05367	A N △ E Q U
	24	24	66345	15001	A T I O N △
	25	31	51540	17777	F O R △ 77 77
	26	0	0	0	Sym.
	27	01	34500	16633	△ I N △ T H
	30	30	01542	45032	E △ R A N G
	31	30	01513	10124	E △ O F △ A
	32	01	70245	47301	△ V A R Y △
	33	01	01010	10101	△ △ △ △ △ △
	34	01	01653	05066	△ △ S E N T
	35	30	50263	00134	E N C E △ I
	36	50	01713	33426	N △ W H I C
	37	33	01777	77777	H △ 77 77 77 77
	40	0	0	0	Symbol
	41	01	24525	23024	△ A P P E A
	42	54	65227	77777	R S . 77 77 77
		CA	GB43		

		IA	GC		
E29	0	40	GC1	11	
	1	34	46463	03224	I L L E G A
	2	46	01657	34725	L △ S Y M B
	3	51	46011	70101	0 L △ (△ △
	4	0	0	0	Sym.
	5	01	01170	13151	△ △) △ F 0
	6	54	01463	03166	R △ L E F T
	7	01	51310	13053	△ 0 F △ E Q
	10	67	24663	45150	U A T I 0 N
	11	22	77777	77777	. 77 77 77 77 77
E30	12	40	GC13	16	
	13	47	51543	00166	M 0 R E △ T
	14	33	24500	15150	H A N △ 0 N
	15	30	01656	72565	E △ S U B S
	16	26	54345	26601	C R I P T △
	17	51	50017	77777	0 N △ 77 77 77
	20	0	0	0	Sym.
	21	21	01245	00124	, △ A N △ A
	22	54	32674	73050	R G U M E N
	23	66	01513	10101	T △ 0 F △ △
	24	01	01016	63330	△ △ △ T H E
	25	01	31675	02666	△ F U N C T
	26	34	51500	17777	I 0 N △ 77 77
	27	0	0	0	Sym.
	30	22	77777	77777	. 77 77 77 77 77
		CA	GC31		

		IA	GD		
E31	0	40	GD1	20	
	1	46	34255	42454	L I B R A R
	2	73	01545	16766	Y △ R O U T
	3	34	50300	16573	I N E △ S Y
	4	47	25514	62101	M B O L , △
	5	0	0	0	Sym.
	6	01	21015	15001	△ , △ O N △
	7	46	30316	62101	L E F T , △
	10	24	47515	03201	A M O N G △
	11	01	01010	10101	△ △ △ △ △ △
	12	24	54326	74730	A R G U M E
	13	50	66650	15131	N T S △ O F
	14	01	66333	00131	△ T H E △ F
	15	67	50266	63451	U N C T I O
	16	50	01777	77777	N △ 77 77 77 77
	17	0	0	0	Sym.
	20	22	77777	77777	. 77 77 77 77 77
E32	21	40	GD22	17	
	22	65	67523	05465	S U P E R S
	23	26	54345	26601	C R I P T △
	24	65	73472	55146	S Y M B O L
	25	21	01777	77777	, △ 77 77 77 77
	26	0	0	0	Sym.
	27	0	0	0	
	30	01	21012	44751	△ , △ A M O
	31	50	32010	10101	N G △ △ △ △
	32	01	01010	10101	△ △ △ △ △ △
	33	01	01010	10101	△ △ △ △ △ △
	34	01	01010	16567	△ △ △ △ S U
	35	25	65265	43452	B S C R I P
	36	66	65015	13101	T S △ O F △
	37	0	0	0	Sym.
	40	22	77777	77777	. 77 77 77 77 77
		CA	GD41		

		IA	GE		
E33	0	40	GE1	15	
	1	65	67523	05465	S U P E R S
	2	26	54345	26601	C R I P T △
	3	65	73472	55146	S Y M B O L
	4	21	01777	77777	, △ 77 77 77 77
	5	0	0	0	Sym.
	6	0	0	0	
	7	01	21013	45001	△ △ △ I N △
	10	31	34723	02701	F I X E D △
	11	52	51345	06601	P O I N T △
	12	01	01010	10101	△ △ △ △ △ △
	13	01	01010	13053	△ △ △ △ E Q
	14	67	24663	45150	U A T I O N
	15	22	77777	77777	. 77 77 77 77 77
E34	16	40	GE17	10	
	17	47	51543	00166	M O R E △ T
	20	33	24500	10701	H A N △ 4 △
	21	65	67523	05465	S U P E R S
	22	26	54345	26601	C R I P T △
	23	65	73472	55146	S Y M B O L
	24	65	01345	00165	S △ I N △ S
	25	30	53673	05026	E Q U E N C
	26	30	22777	77777	E . 77 77 77 77
		CA	GE27		

		IA	GF		
E35	0	40	GF1	11	
	1	52	51710	15152	P O W Δ O P
	2	30	54246	63451	E R A T I O
	3	50	01657	34725	N Δ S Y M B
	4	51	46012	44751	O L Δ A M O
	5	50	32016	56725	N G Δ S U B
	6	65	26543	45266	S C R I P T
	7	65	01513	10177	S Δ O F Δ 77
	10	0	0	0	Sym.
	11	22	77777	77777	. 77 77 77 77 77
E36	12	40	GF13	10	Δ Δ Δ Δ Δ Δ
	13	52	51710	15152	P O W Δ O P
	14	30	54246	63451	E R A T I O
	15	50	01657	34725	N Δ S Y M B
	16	51	46013	45001	O L Δ I N Δ
	17	31	34723	02701	F I X E D Δ
	20	52	51345	06601	P O I N T Δ
	21	30	53672	46634	E Q U A T I
	22	51	50227	77777	O N . 77 77 77
		CA	GF23		

		IA	GH								
E37	0	40	GH1	23							
	1	50	67472	53054	N	U	M	B	E	R
	2	01	51310	15152	Δ	O	F	Δ	O	P
	3	30	54245	02765	E	R	A	N	D	S
	4	01	17257	30126	Δ	(	B	Y	Δ	C
	5	51	47472	40126	O	M	M	A	Δ	C
	6	51	67506	64301	O	U	N	T	)	Δ
	7	31	51540	14634	F	O	R	Δ	L	I
	10	25	54245	47301	B	R	A	R	Y	Δ
	11	01	54516	76634	Δ	R	O	U	T	I
	12	50	30017	77777	N	E	Δ	77	77	77
	13	0	0	0	Sym.					
	14	01	34650	15051	Δ	I	S	Δ	N	O
	15	66	01305	36724	T	Δ	E	Q	U	A
	16	46	01665	10150	L	Δ	T	O	Δ	N
	17	67	47253	05401	U	M	B	E	R	Δ
	20	46	34656	63027	L	I	S	T	E	D
	21	01	31515	40166	Δ	F	O	R	Δ	T
	22	33	34650	15451	H	I	S	Δ	R	O
	23	67	66345	03022	U	T	I	N	E	.
E38	24	40	GH25	14						
	25	34	50663	05446	I	N	T	E	R	L
	26	51	26453	45032	O	C	K	I	N	G
	27	01	52245	43050	Δ	P	A	R	E	N
	30	66	33306	53065	T	H	E	S	E	S
	31	01	24502	70124	Δ	A	N	D	Δ	A
	32	25	65514	66766	B	S	O	L	U	T
	33	30	01702	44667	E	Δ	V	A	L	U
	34	30	01010	10101	E	Δ	Δ	Δ	Δ	Δ
	35	01	65343	25065	Δ	S	I	G	N	S
	36	22	01011	70101	.	Δ	Δ	(	Δ	Δ
	37	42	01014	30101	|	Δ	Δ	)	Δ	Δ
	40	42	77777	77777	|	77	77	77	77	77
		CA	GH41							

		IA	GI								
E39	0	40	GI1	11							
	1	26	46516	53027	C	L	O	S	E	D
	2	01	52245	43050	Δ	P	A	R	E	N
	3	66	33306	53465	T	H	E	S	I	S
	4	01	24525	23024	Δ	A	P	P	E	A
	5	54	65017	13466	R	S	Δ	W	I	T
	6	33	01505	10126	H	Δ	N	O	Δ	C
	7	51	54543	06552	O	R	R	E	S	P
	10	51	50273	45032	O	N	D	I	N	G
	11	01	51523	05022	Δ	O	P	E	N	.
E40	12	40	GI13	23						
	13	50	67472	53054	N	U	M	B	E	R
	14	01	51310	16567	Δ	O	F	Δ	S	U
	15	25	65265	43452	B	S	C	R	I	P
	16	66	65015	15001	T	S	Δ	O	N	Δ
	17	0	0	0	Sym.					
	20	01	17257	30126	Δ	(	B	Y	Δ	C
	21	51	47472	40126	O	M	M	A	Δ	C
	22	51	67506	64301	O	U	N	T	)	Δ
	23	01	01010	10101	Δ	Δ	Δ	Δ	Δ	Δ
	24	34	65015	05166	I	S	Δ	N	O	T
	25	01	30536	72446	Δ	E	Q	U	A	L
	26	01	66510	15067	Δ	T	O	Δ	N	U
	27	47	25305	40151	M	B	E	R	Δ	O
	30	25	66243	45030	B	T	A	I	N	E
	31	27	01315	45147	D	Δ	F	R	O	M
	32	01	27344	73050	Δ	D	I	M	E	N
	33	65	34515	00165	S	I	O	N	Δ	S
	34	30	50663	05026	E	N	T	E	N	C
	35	30	22777	77777	E	.	77	77	77	77
		CA	GI36							

		IA	GJ		
E41	0	40	GJ1	11	
	1	51	52305	00152	O P E N Δ P
	2	24	54305	06633	A R E N T H
	3	30	65346	50124	E S I S Δ A
	4	47	51503	20165	M O N G Δ S
	5	67	25652	65434	U B S C R I
	6	52	66650	15131	P T S Δ O F
	7	01	77777	77777	Δ 77 77 77 77 77
	10	0	0	0	Sym.
	11	22	77777	77777	. 77 77 77 77 77
E42	12	40	GJ13	11	
	13	34	46463	03224	I L L E G A
	14	46	01657	34725	L Δ S Y M B
	15	51	46210	17777	O L , Δ 77 77
	16	0	0	0	Sym.
	17	01	21013	15154	Δ , Δ F O R
	20	01	54343	23366	Δ R I G H T
	21	01	51310	13053	Δ O F Δ E Q
	22	67	24663	45150	U A T I O N
	23	22	77777	77777	. 77 77 77 77 77
E43	24	40	GJ25	4	
	25	34	50265	15454	I N C O R R
	26	30	26660	16765	E C T Δ U S
	27	30	01513	10126	E Δ O F Δ C
	30	51	47472	42277	O M M A . 77
		CA	GJ31		

		IA	GK		
E44	0	40	GK1	7	
	1	50	67472	53054	N U M B E R
	2	01	51310	13053	Δ O F Δ E Q
	3	67	24466	50165	U A L S Δ S
	4	34	32506	50150	I G N S Δ N
	5	51	66013	05367	O T Δ E Q U
	6	24	46016	65101	A L Δ T O Δ
	7	51	50302	27777	O N E . 77 77
E45	10	40	GK11	6	
	11	65	51473	00151	S O M E Δ O
	12	52	30500	15224	P E N Δ P A
	13	54	30506	63330	R E N T H E
	14	65	30650	15051	S E S Δ N O
	15	66	01264	65165	T Δ C L O S
	16	30	27227	77777	E D . 77 77 77
		CA	GK17		

		IA	GL							
E46	0	40	GL1	13						
	1	50	67472	53054	N	U	M	B	E	R
	2	01	51310	15152	△	0	F	△	0	P
	3	30	50012	42565	E	N	△	A	B	S
	4	51	46676	63001	0	L	U	T	E	△
	5	70	24466	73001	V	A	L	U	E	△
	6	65	34325	06501	S	I	G	N	S	△
	7	50	51660	13053	N	0	T	△	E	Q
	10	67	24460	16651	U	A	L	△	T	0
	11	01	50674	72530	△	N	U	M	B	E
	12	54	01513	10126	R	△	0	F	△	C
	13	46	51653	02722	L	0	S	E	D	.
E47	14	40	GL15	13						
	15	50	67472	53054	N	U	M	B	E	R
	16	01	51310	15152	△	0	F	△	0	P
	17	30	50015	22454	E	N	△	P	A	R
	20	30	50663	33065	E	N	T	H	E	S
	21	30	65210	15150	E	S	,	△	0	N
	22	01	46303	16621	△	L	E	F	T	,
	23	01	50516	60130	△	N	0	T	△	E
	24	53	67244	60166	Q	U	A	L	△	T
	25	51	50674	72530	0	N	U	M	B	E
	26	54	01513	10126	R	△	0	F	△	C
	27	46	51653	02722	L	0	S	E	D	.
		CA	GL30							

		IA	GM		
E48	0	40	GM1	10	
	1	65	67523	05431	S U P E R F
	2	46	67516	76501	L U O U S Δ
	3	24	54326	74730	A R G U M E
	4	50	66650	15150	N T S Δ O N
	5	01	31675	02666	Δ F U N C T
	6	34	51500	17777	I O N Δ 77 77
	7	0	0	0	Sym.
	10	22	77777	77777	. 77 77 77 77 77
E49	11	40	GM12	17	
	12	71	34663	33450	W I T H I N
	13	01	24543	26747	Δ A R G U M
	14	30	50666	50151	E N T S Δ O
	15	31	01475	15430	F Δ M O R E
	16	01	66332	45001	Δ T H A N Δ
	17	12	01463	42554	7 Δ L I B R
	20	24	54730	15451	A R Y Δ R O
	21	67	66345	03065	U T I N E S
	22	22	24543	26747	. A R G U M
	23	30	50666	50151	E N T S Δ O
	24	31	01777	77777	F Δ 77 77 77 77
	25	0	0	0	Sym.
	26	01	50516	60126	Δ N O T Δ C
	27	33	30264	53027	H E C K E D
	30	22	77777	77777	. 77 77 77 77 77
		CA	GM31		

"Args, Operands, Ss. Not Checked"

		IA	GP							
After	0	40	GP1	7	△	△	△	△	△	△
E10, E48,	1	01	01010	10101	△	△	△	△	△	△
E13, E15,	2	01	01010	10101	△	△	△	△	△	△
	3	01	01010	10101	△	△	△	△	△	△
	4	01	01245	43267	△	△	A	R	G	U
	5	47	30506	66501	M	E	N	T	S	△
	6	50	51660	12633	N	O	T	△	C	H
	7	30	26453	02722	E	C	K	E	D	.
After	10	40	GP11	6						
E2, E5	11	01	01656	72565	△	△	S	U	B	S
	12	26	54345	26665	C	R	I	P	T	S
	13	01	50516	60101	△	N	O	T	△	△
	14	01	01010	10101	△	△	△	△	△	△
	15	26	33302	64530	C	H	E	C	K	E
	16	27	22777	77777	D	.	77	77	77	77
After	17	40	GP20	5						
E20, E8,	20	01	01656	72565	△	△	S	U	B	S
E16	21	26	54345	26665	C	R	I	P	T	S
	22	01	50516	60126	△	N	O	T	△	C
	23	33	30264	53027	H	E	C	K	E	D
After	24	22	77777	77777	.	77	77	77	77	77
E9	25	40	GP4	4						
E51	26	40	GP27	6						
	27	01	01010	10101	△	△	△	△	△	△
	30	01	01010	10151	△	△	△	△	△	O
	31	52	30542	45027	P	E	R	A	N	D
	32	65	01505	16601	S	△	N	O	T	△
	33	26	33302	64430	C	H	E	C	K	E
	34	27	22777	77777	D	.	77	77	77	77
		CA	GP35							

		IA	GQ		
E50	0	40	GQ1	20	
	1	66	51510	14724	T O O Δ M A
	2	50	73012	76747	N Y Δ D U M
	3	47	73012	45432	M Y Δ A R G
	4	67	47305	06665	U M E N T S
	5	01	51500	13167	Δ O N Δ F U
	6	50	26663	45150	N C T I O N
	7	01	77777	77777	Δ 77 77 77 77 77
	10	0	0	0	Sym.
	11	22	01010	10101	. Δ Δ Δ Δ Δ
	12	01	01010	10154	Δ Δ Δ Δ Δ R
	13	30	65660	15131	E S T Δ O F
	14	01	66333	46501	Δ T H I S Δ
	15	65	30506	63050	S E N T E N
	16	26	30015	05166	C E Δ N O T
	17	01	26333	02645	Δ C H E C K
	20	30	27227	77777	E D . 77 77 77
E51	21	40	GQ22	10	
	22	52	65306	72751	P S E U D O
	23	01	51523	05424	Δ O P E R A
	24	66	34515	00165	T I O N Δ S
	25	73	47255	14621	Y M B O L ,
	26	01	77777	77777	Δ 77 77 77 77 77
	27	0	0	0	Sym.
	30	01	21015	15001	Δ , Δ O N Δ
	31	54	34323	36622	R I G H T .
		CA	GQ32		

		IA	FQ		
E52	0	40	FQ1	14	
	1	34	50265	15454	I N C O R R
	2	30	26660	16573	E C T Δ S Y
	3	47	25514	60165	M B O L Δ S
	4	30	53673	05026	E Q U E N C
	5	30	22010	10101	E . Δ Δ Δ Δ
	6	0	0	0	
	7	0	0	0	1st Sym.
	10	0	0	0	
	11	01	01777	77777	Δ Δ 77 77 77 77
	12	0	0	0	
	13	0	0	0	2nd Sym.
	14	0	0	0	
		CA	FQ15		

		IA	GV		
E53	0	40	GV1	14	
	1	26	46516	53027	C L O S E D
	2	01	24256	55146	Δ A B S O L
	3	67	66300	17024	U T E Δ V A
	4	46	67300	12452	L U E Δ A P
	5	52	30245	46501	P E A R S Δ
	6	71	34663	30150	W I T H Δ N
	7	51	01010	10101	O Δ Δ Δ Δ Δ
	10	01	01010	10101	Δ Δ Δ Δ Δ Δ
	11	01	01010	12651	Δ Δ Δ Δ C O
	12	54	54306	55251	R R E S P O
	13	50	27345	03201	N D I N G Δ
	14	51	52305	02277	O P E N . 77
E54	15	40	GV16	13	Δ Δ Δ Δ Δ Δ
	16	51	52305	00152	O P E N Δ P
	17	24	54305	06633	A R E N T H
	20	30	65346	52101	E S I S , Δ
	21	51	50014	63031	O N Δ L E F
	22	66	21012	44751	T , Δ A M O
	23	50	32016	56725	N G Δ S U B
	24	65	26543	45266	S C R I P T
	25	65	01513	10101	S Δ O F Δ Δ
	26	01	01777	77777	Δ Δ 77 77 77 77
	27	0	0	0	Sym.
	30	22	77777	77777	. 77 77 77 77 77
E55	31	40	GV32	15	
	32	34	50265	15454	I N C O R R
	33	30	26660	16765	E C T Δ U S
	34	30	01513	10151	E Δ O F Δ O
	35	52	30500	15224	P E N Δ P A
	36	54	30506	63330	R E N T H E
	37	65	34650	15150	S I S Δ O N
	40	01	46303	16601	Δ L E F T Δ
	41	24	47515	03201	A M O N G Δ
	42	01	01245	43267	Δ Δ A R G U
	43	47	30506	66501	M E N T S Δ
	44	51	31017	77777	O F Δ 77 77 77
	45	0	0	0	Sym.
	46	22	77777	77777	. 77 77 77 77 77
		CA	GV47		

		IA	GY		
E56	0	40	GY1	11	
	1	34	50265	15454	I N C O R R
	2	30	26660	16765	E C T △ U S
	3	30	01513	10126	E △ O F △ C
	4	51	47472	40124	O M M A △ A
	5	47	51503	20124	M O N G △ A
	6	54	32674	73050	R G U M E N
	7	66	65015	13101	T S △ O F △
	10	0	0	0	Sym.
	11	22	77777	77777	. 77 77 77 77 77
E57	12	40	GY13	14	
	13	47	51543	00166	M O R E △ T
	14	33	24500	10514	H A N △ 2 9
	15	01	67502	64651	△ U N C L O
	16	65	30270	15152	S E D △ O P
	17	30	50015	22454	E N △ P A R
	20	30	50663	33065	E N T H E S
	21	30	65012	45027	E S △ A N D
	22	64	51540	10101	/ O R △ △ △
	23	01	01242	56551	△ △ A B S O
	24	46	67663	00170	L U T E △ V
	25	24	46673	00165	A L U E △ S
	26	34	32506	52227	I G N S . 77
		CA	GY27		

		IA	GZ		
E58	0	40	GZ1	7	
	1	26	51506	56624	C O N S T A
	2	50	66013	44646	N T △ I L L
	3	30	32244	60151	E G A L △ O
	4	50	01463	03166	N △ L E F T
	5	21	01253	03151	, △ B E F O
	6	54	30016	56624	R E △ S T A
	7	54	66227	77777	R T . 77 77 77
		CA	GZ10		

Pseudo Operation Heading Translator

This routine provides the necessary input and output references required by the sentences of the sub program, and also furnishes to the Pseudo Operation Heading generator and to the Exit sentence the necessary linkage so that control is transferred properly during the Object Program.

The input and output references are set by building the DP List containing the dummy variables and their associated dummy call words. These dummy variables as used by the sentences of the sub program are assigned call words as follows:

76x-- subscripted variable (x = number of subscripts).

63--- single valued fixed or floating variable.

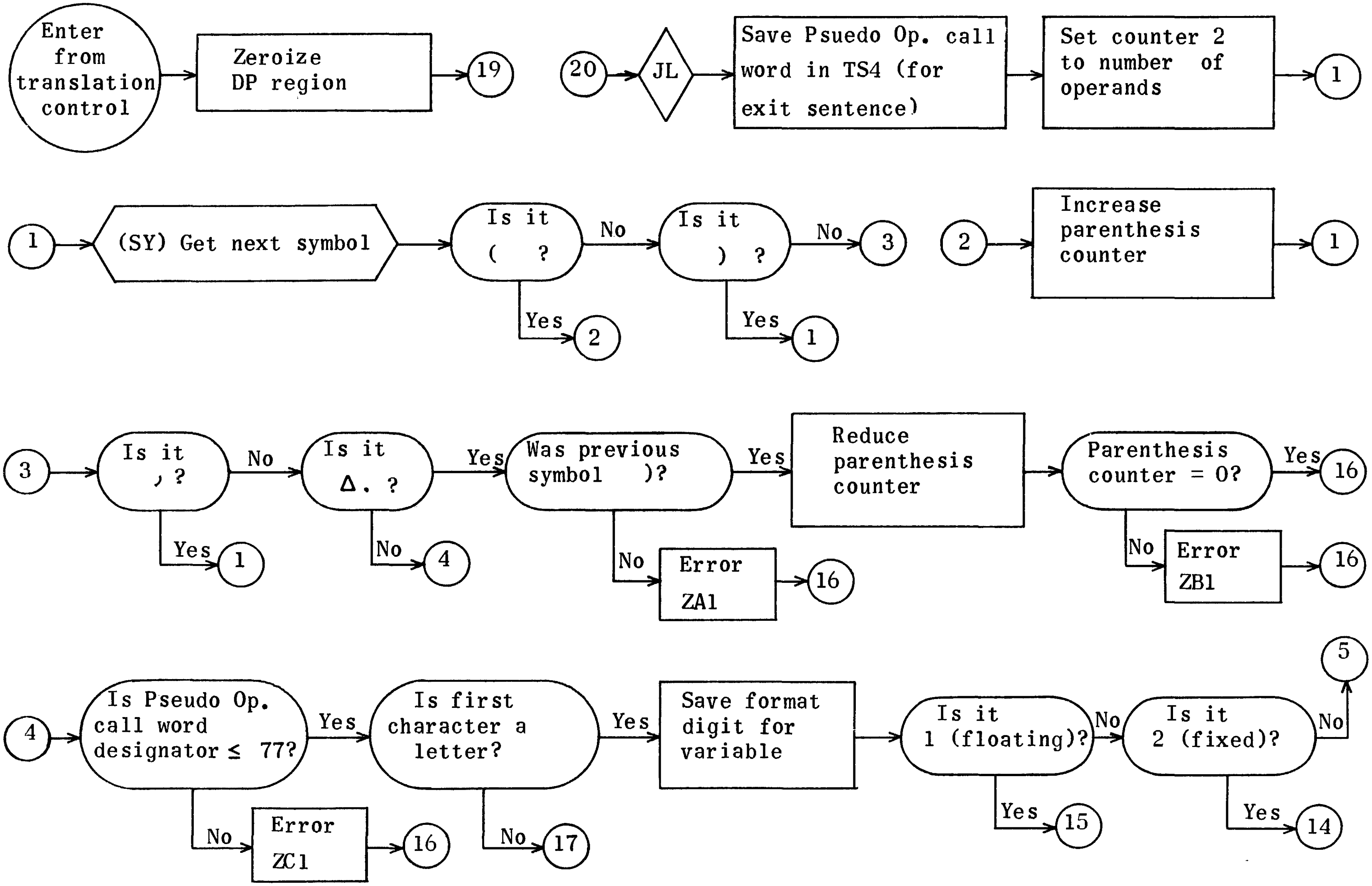
61--- functions.

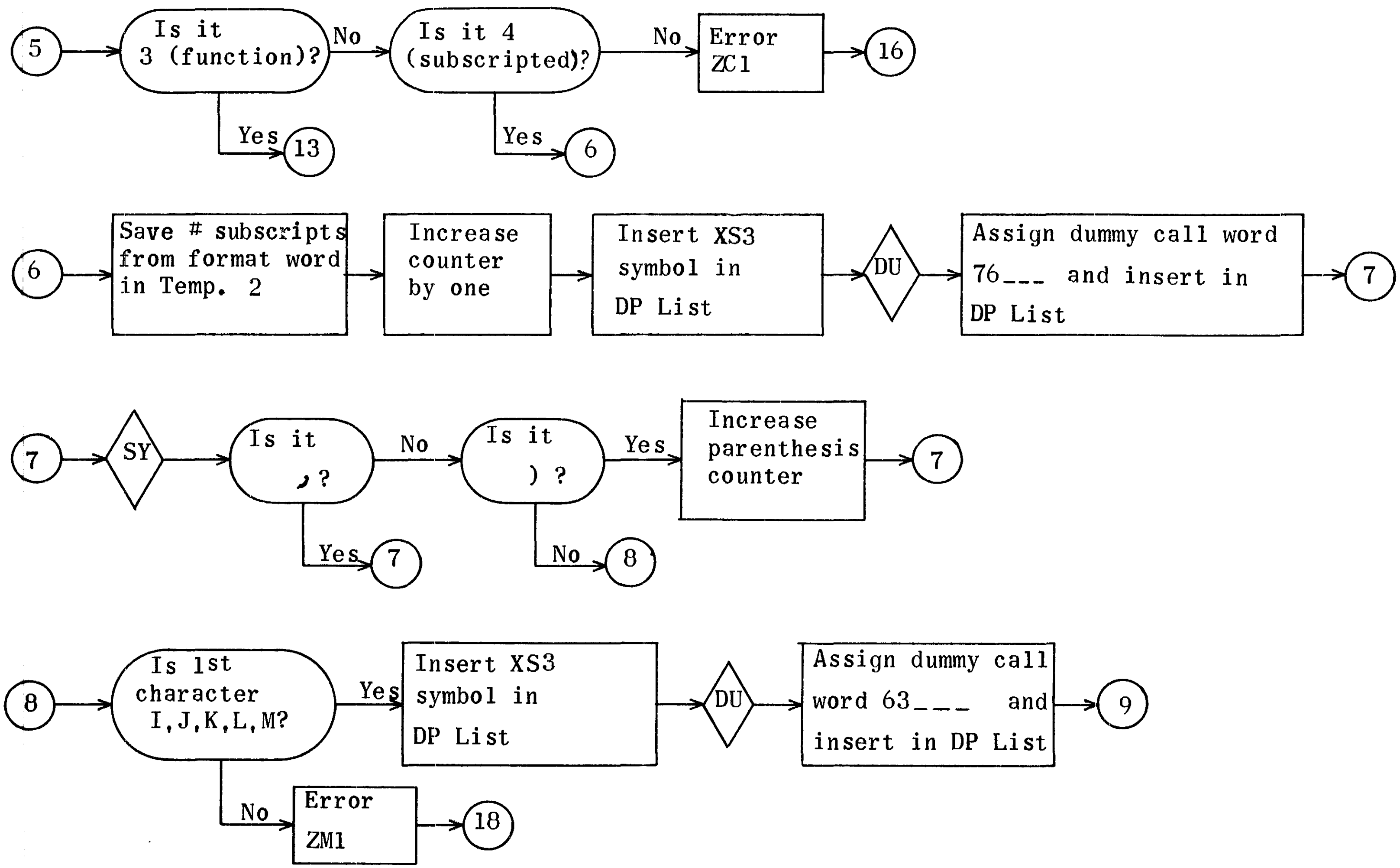
These call words represent the addresses from which input values or the locations of output values are to be obtained during the Object Program. The addresses represented by these call words lie in the Sub Program Input List, a part of the Termination Buffer.

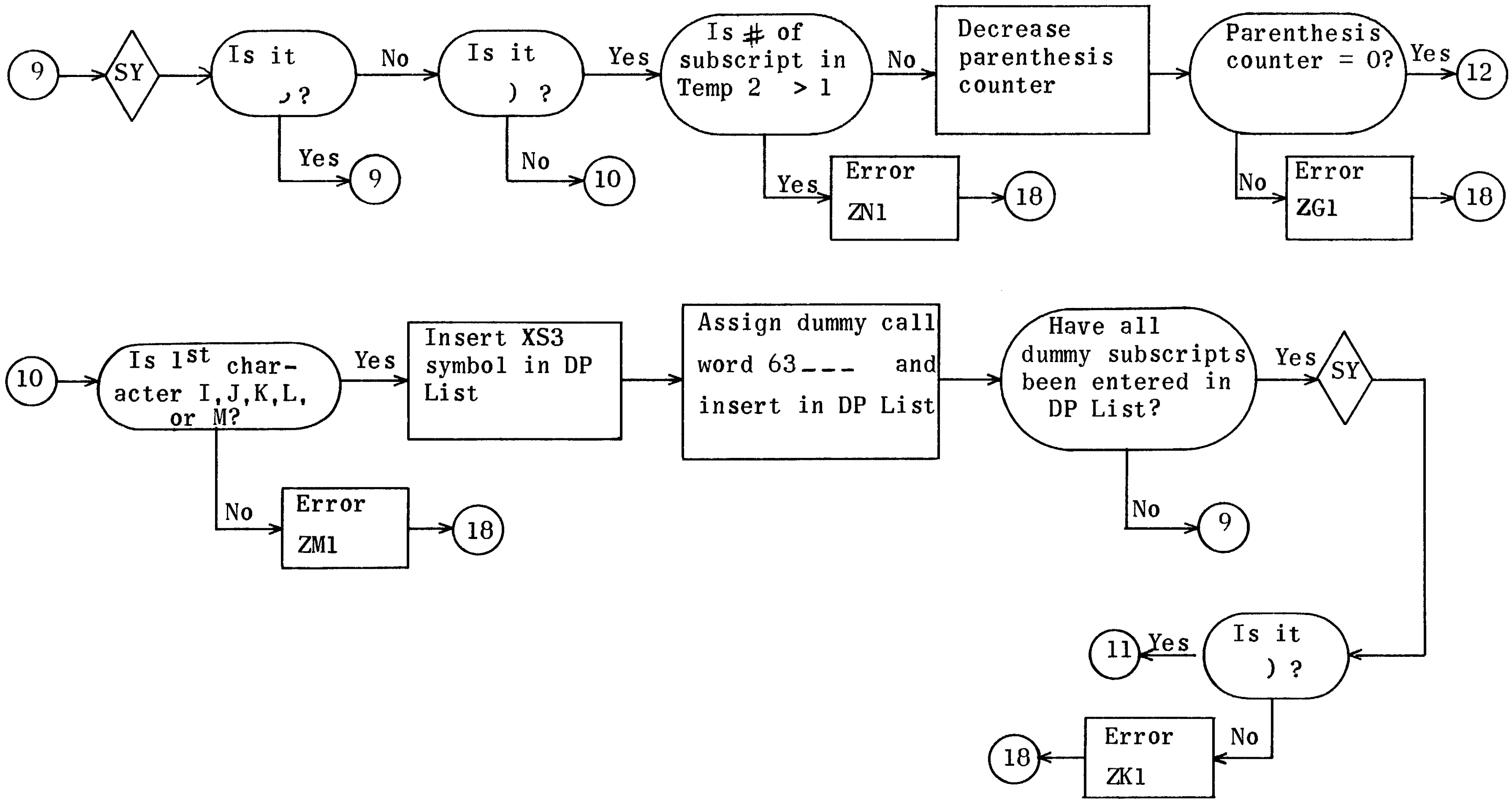
The 22--- type call word of the next sentence of the sub program will be used by the Heading Sentence generator to form the jump instruction which, during running, transfers control into the sub program after being referenced by the COMPUTE sentence.

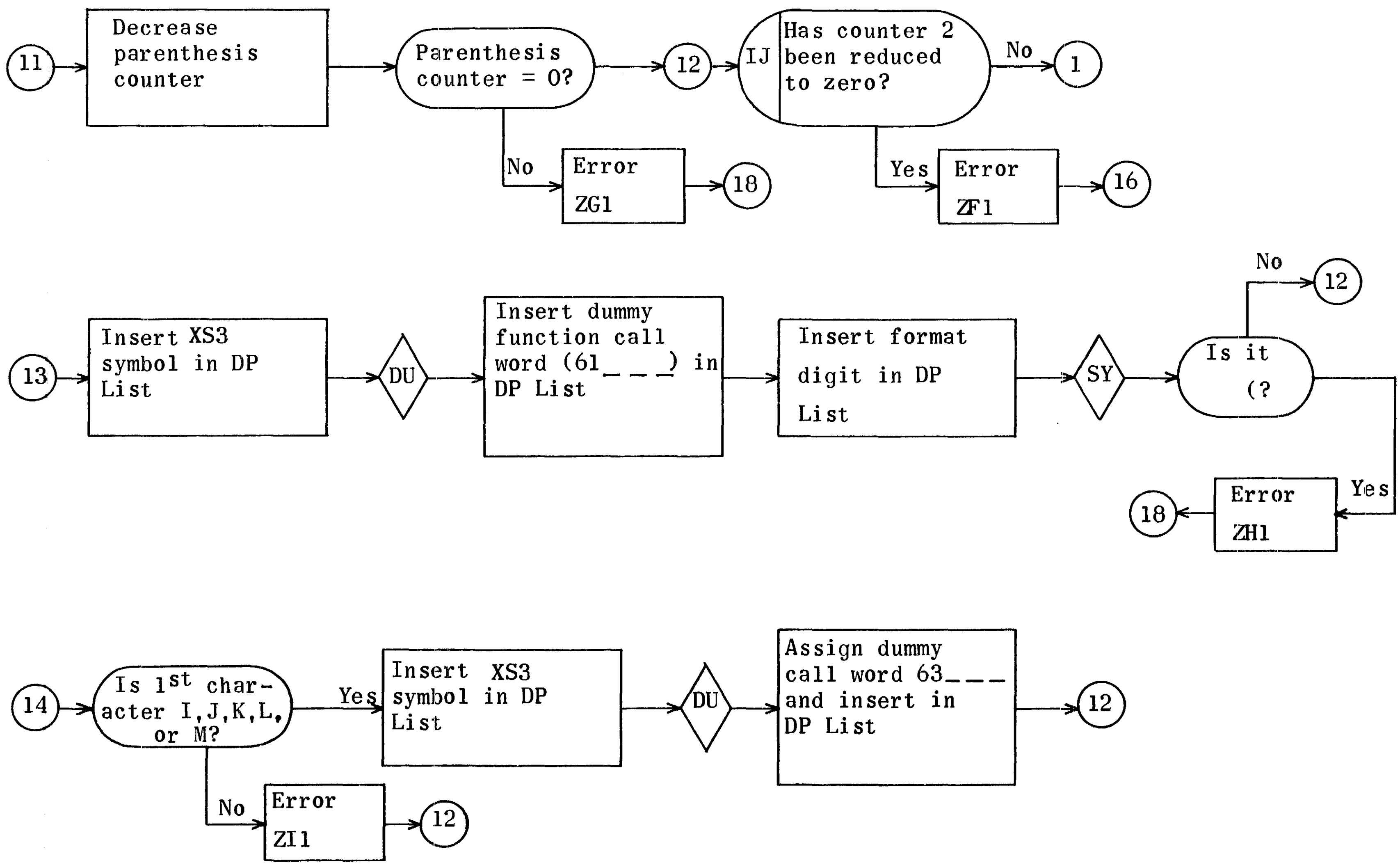
A check is also made by this routine to insure that any previous sub programs have EXIT sentences.

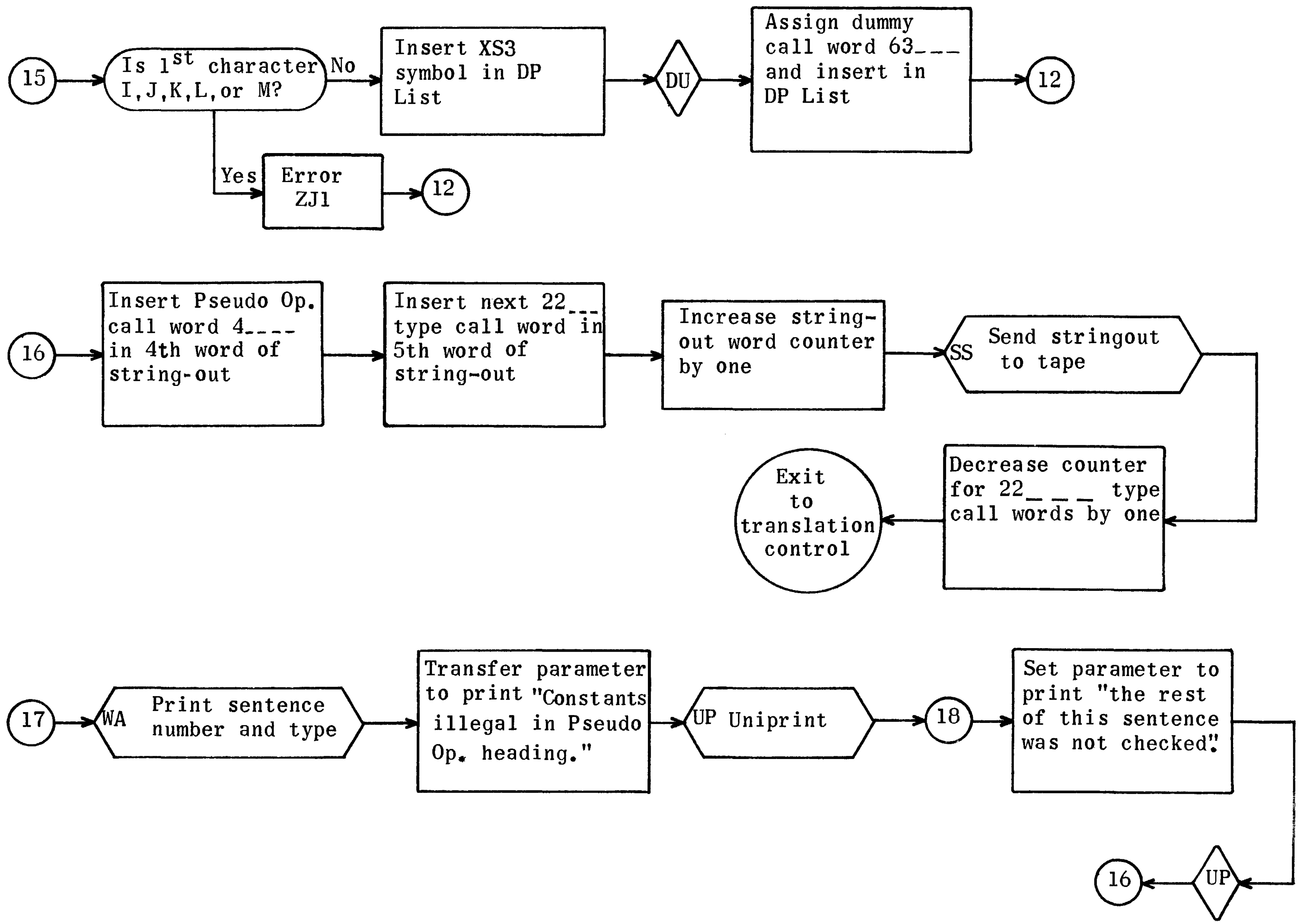
Pseudo Operation Heading Translator

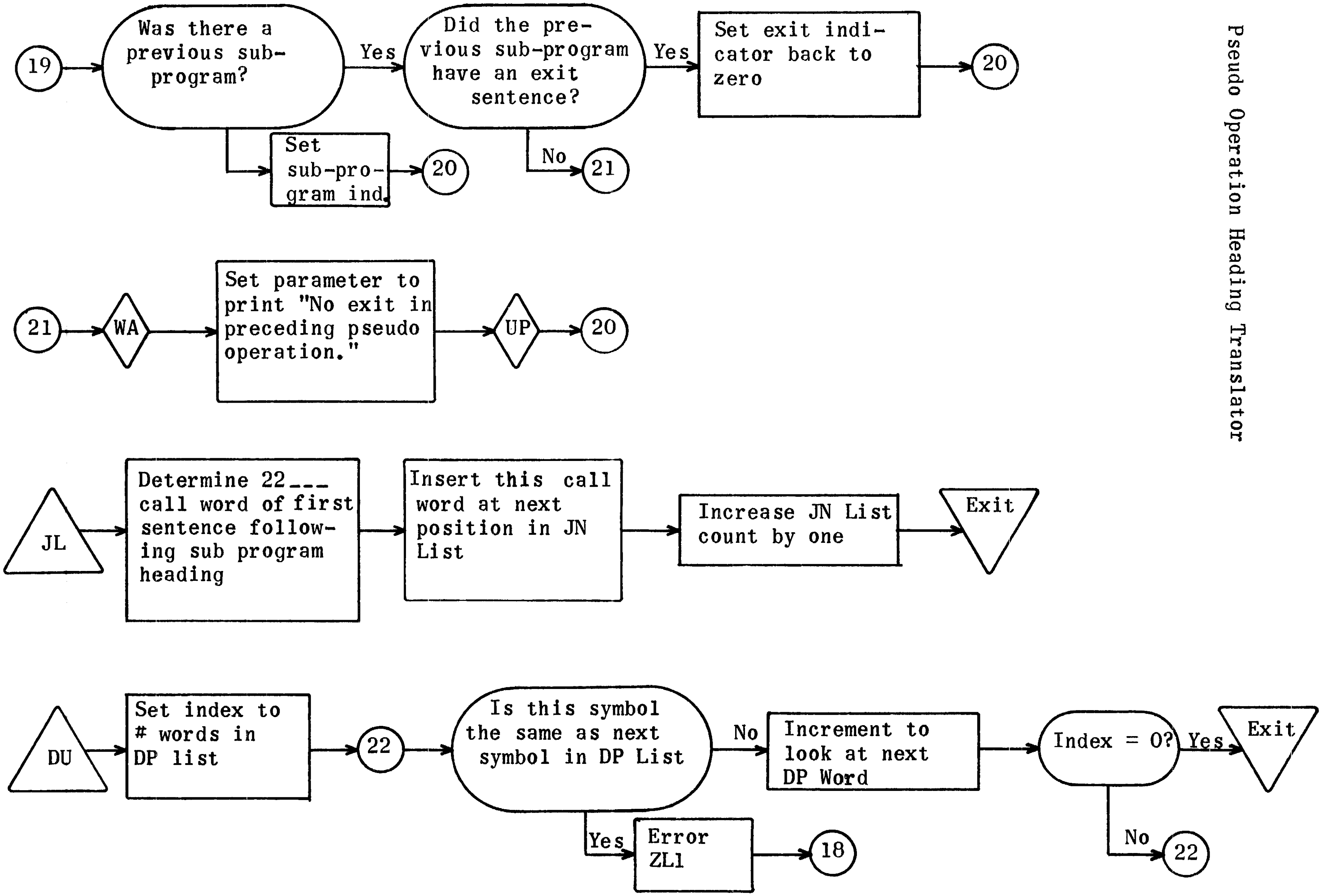



5
Is it 3 (function)?
No
Yes
13
Is it 4 (subscripted)?
No
Yes
6
Error ZC1
16
6
Save # subscripts from format word in Temp. 2
Increase counter by one
Insert XS3 symbol in DP List
DU
Assign dummy call word 76___ and insert in DP List
7
7
SY
Is it , ?
Yes
7
No
Is it) ?
Yes
No
8
Increase parenthesis counter
7
8
Is 1st character I,J,K,L,M?
Yes
No
Insert XS3 symbol in DP List
DU
Assign dummy call word 63___ and insert in DP List
9
Error ZM1
18


9
SY
Is it
, ?
No
Yes
9
Is it
) ?
Yes
No
10
Is # of
subscript in
Temp 2 > 1
No
Yes
Error
ZN1
18
Decrease
parenthesis
counter
Parenthesis
counter = 0?
Yes
12
No
Error
ZG1
18
10
Is 1st char-
acter I,J,K,L,
or M?
Yes
No
Error
ZM1
18
Insert XS3
symbol in DP
List
Assign dummy call
word 63___ and
insert in DP List
Have all
dummy subscripts
been entered in
DP List?
Yes
SY
No
9
Is it
) ?
Yes
11
No
Error
ZK1
18


11
Decrease parenthesis counter
Parenthesis counter = 0?
No
Error ZG1
18
12
IJ
Has counter 2 been reduced to zero?
No
1
Yes
Error ZF1
16
13
Insert XS3 symbol in DP List
DU
Insert dummy function call word (61_ _ _) in DP List
Insert format digit in DP List
SY
Is it (?
No
12
Yes
Error ZH1
18
14
Is 1st character I,J,K,L, or M?
Yes
No
Error ZI1
12
Insert XS3 symbol in DP List
DU
Assign dummy call word 63_ _ _ and insert in DP List
12


15
Is 1st character I,J,K,L,or M?
No
Yes
Insert XS3 symbol in DP List
DU
Assign dummy call word 63___ and insert in DP List
12
Error ZJ1
12
16
Insert Pseudo Op. call word 4____ in 4th word of string-out
Insert next 22___ type call word in 5th word of string-out
Increase string-out word counter by one
SS Send stringout to tape
Decrease counter for 22___ type call words by one
Exit to translation control
17
WA Print sentence number and type
Transfer parameter to print "Constants illegal in Pseudo Op. heading."
UP Uniprint
18
Set parameter to print "the rest of this sentence was not checked".
UP
16


19
Was there a previous sub-program?
Yes
Did the previous sub-program have an exit sentence?
Yes
Set exit indicator back to zero
20
Set sub-program ind.
20
No
21
21
WA
Set parameter to print "No exit in preceding pseudo operation."
UP
20
JL
Determine 22___ call word of first sentence following sub program heading
Insert this call word at next position in JN List
Increase JN List count by one
Exit
DU
Set index to # words in DP list
22
Is this symbol the same as next symbol in DP List
No
Increment to look at next DP Word
Index = 0?
Yes
Exit
Yes
Error ZL1
18
No
22

List of Error Print-Outs

Program Entrance	Print-Out "Sentence__________(SUB)" precedes all of these.
ZA1	No final closing parenthesis.
ZB1 and ZG1	The number of open parentheses is not equal to the number of close parentheses.
ZC1	Machine or internal error.
ZF1	Failed to exit. Probably no space period symbol.
ZH1	Parenthetical expression not allowed for the functional variable in the Pseudo Op Heading statement.
ZI1	Fixed point operands do not begin with legal characters i.e. (I, J, K, L or M) in the Pseudo Op Heading.
ZJ1	Floating point operands in the Pseudo Op Heading begin with illegal characters, i.e. (I, J, K, L or M).
ZK1	No closing parenthesis or too many subscripts.
ZL1	Duplicated symbols are not allowed in Pseudo Op Heading.
ZM1	Erroneous subscript found.
ZN1	At least one subscript missing on subscripted variable.
ZO1	The rest of this sentence was not checked.
XN32	No exit in preceding Pseudo Operation.
XN3	Constants illegal in Pseudo Op Heading.

Regions for Pseudo Operation Heading Translator

```
RE   PU4400
RE   PV4471
RE   PX4630
RE   PY4667
RE   PZ4714
RE   PW4741
RE   PE4747
RE   DU4761
RE   JL5006
RE   ZA5023
RE   ZB5036
RE   ZC5062
RE   ZF5075
RE   ZG5113
RE   ZH5122
RE   ZI5153
RE   ZJ5204
RE   ZK5234
RE   ZL5252
RE   ZM5273
RE   ZN5306
RE   ZO5327
RE   XN5355
```

There is one conflict between the string-out subroutine regions and the above regions (each uses region ZO). However, if the above regions are read in first and the string-out subroutine regions second, the Pseudo-Op Heading tape will assemble properly.

Master Control Region for Pseudo-OP Heading Translator.

		IA	PU		
	0	MJ	0	PW	
	1	RP	10132	XN17	Zeroize
	2	TP	PU44	DP	Region DP (90 slots)
20	3	RJ	JL	JL1	Reference routine for building Pseudo OP 2nd lines.
	4	TP	TA4	Q	(TA4) = no. of operands
	5	TV	TA4	TS4	Send 40--- CW to TS4
	6	QT	PU45	PU46	Mask off no. of operands and set CTR2
1	7	RJ	SY	SY1	
	10	EJ	PU47	PU12	Test "("
	11	MJ	0	XN	Jump to test ")"
2	12	RA	PU50	PU51	Parentheses Counter + 1 ⟶ Paren. Ctr.
	13	MJ	0	PU7	
3	14	EJ	PU52	PU7	Test ","
	15	EJ	PU53	PU17	Test "Δ. "
	16	MJ	0	PU26	
	17	TP	SZ2	A	
	20	EJ	PU54	PU22	Test previous symbol for ")".
	21	MJ	0	ZA1	Error! No close parenthesis
	22	RS	PU50	PU51	Parenthesis Counter - 1 ⟶ Paren. Ctr.
	23	ZJ	ZB1	PU	A ≠ 0 ; Indicates opening and closing parens not equal.
	24	MJ	0	PU65	
	25	ZJ	ZC1	PU	
4	26	TP	PU55	A	Test CTR1 (assigning CW
	27	TJ	PU63	PU65	sequence numbers) ≤ $(77)_8$
	30	MJ	0	ZC1	Error!
	31	TP	TA5	Q	Mask and save format digit
	32	QT	PU56	PU57	1, 2, 3, or 4
	33	RA	PU31	PU70	Modifies address for picking up next operand.
	34	TP	PU57	A	Format digit 1, 2, 3 or 4 ⟶ A
	35	EJ	PU51	PZ1	Test for '1'
	36	EJ	PU60	PY1	Test for '2'
	37	EJ	PU61	PX1	Test for '3' (Function)
	40	EJ	PU62	PV1	Test for '4' (subscripted variable)
	41	MJ	0	ZC1	Error! Format digit not 1, 2, 3 or 4.
12	42	IJ	PU46	PU7	Initial no. operands -1 ⟶ PU46
	43	MJ	0	ZF1	Error! Failed to exit.
	44	0	0	0	
	45	0	0	77	Mask
	46	0	0	0	
	47	17	77777	77777	(
	50	0	0	0	
	51	0	0	1	
	52	21	77777	77777	,
	53	01	22777	77777	Δ.
	54	43	77777	77777	)

Master Control Region for Pseudo-OP Heading Translator (continued)

55	0	0	0	
56	0	0	7	Mask
57	0	0	0	
60	0	0	2	
61	0	0	3	
62	0	0	4	
63	0	0	100	
64	77	77777	77776	-1
65	TP	SY7	Q	Test first character for letter.
66	QJ	PU31	XN3	
67	MJ	0	PU25	
70	0	1	0	
	CA	PU71		

Sub Region for Subscripted Variable

		IA	PV		
	0	MJ	0	PU42	Exit
6	1	TP	PU31	A	
	2	RS	A	PV110	Mask 'op' portion of
	3	TU	A	PV4	format word and save
	4	TP	[0]	Q	in Temp. 2 = PV112
	5	QT	PV111	PV112	
	6	RA	PU64	PV113	CTR + 1 ⟶ CTR)
	7	RA	PV10	PU64	(set up proper address)
	10	TP	SY2	[DP]	Insert XS-3 symbol in DP List
	11	TP	PV114	PV10	Reset PV10)
	12	RJ	DU	DU1	(Test duplication of symbol)
	13	TP	PV112	A	Previously saved 'op' ⟶ A
	14	LT	14	A	Shift op to v of A_R
	15	RA	A	PV115	A_R + 76 - 00 ⟶ A_R
	16	AT	PU55	PV116	76'N'00 + CTR1 ⟶ Temp. 5 = PV116
	17	TP	PV112	A	Previously saved 'op' ⟶ A
	20	LT	6	PV117	Shift 'op' to A 0-5
	21	MJ	0	PV130	Jump out for correction
	22	AT	PU55	PU55	Setting up index which
	23	TP	PV120	PV121	determines when to begin exit
	24	RA	PV121	PV117	
	25	RA	PU64	PV113	
	26	RA	PV27	PU64	Insert '76' N-- CW in DP
	27	TP	PV116	[DP]	
	30	TP	PV122	PV27	
7	31	RJ	SY	SY1	
	32	EJ	PV123	PV31	Test ','
	33	EJ	PV124	PV35	Test ')'
	34	MJ	0	PV102	Jump to correction 1
	35	RA	PV125	PV113	Parenthesis counter +1 ⟶ Paren. Ctr
	36	MJ	0	PV31	
	37	RA	PU64	PV113	
	40	RA	PV41	PU64	
	41	TP	SY2	[DP]	Insert XS-3 symbol in DP list
	42	TP	PV114	PV41	
	43	RJ	DU	DU1	
	44	TP	PV126	A	'63000' ⟶ A
	45	RA	A	PU55	'63000' + CTR1 ⟶ A
	46	TP	A	PV116	Save CW in Temp. 5 = PV116
	47	RA	PU55	PV113	CTR1 + 1 ⟶ CTR1
	50	RA	PU64	PV113	CTR + 1 ⟶ CTR
	51	RA	PV52	PU64	
	52	TP	PV116	[DP]	Send CW to DP List
	53	TP	PV122	PV52	
9	54	RJ	SY	SY1	
	55	EJ	PV123	PV54	Test ','
	56	EJ	PV127	PV104	Jump to correction 2
	57	MJ	0	PV133	Jump to correction 3
	60	RA	PV61	PU64	

Sub Region for Subscripted Variable (continued)

```
      61   TP   SY2     [DP]
      62   TP   PV114   PV61     Insert XS-3 symbol in DP list
      63   RJ   DU      DU1
      64   TP   PV126   A        '63000' —> A
      65   AT   PU55    PV116    '63000' + CTR1 —> A
      66   RA   PU55    PV113    CTR1+1 —> CTR1
      67   RA   PU64    PV113    CTR+1 —> CTR
      70   RA   PV71    PU64  }
      71   TP   PV116   [DP]  }  Send CW to DP List
      72   TP   PV122   PV71  }
      73   IJ   PV121   PV54
      74   RJ   SY      SY1
      75   EJ   PV127   PV77     Test ')'
      76   MJ   0       ZK1      Error. No closing parenthesis
(11)  77   RS   PV125   PV113    Parenthesis counter -1 —> Paren. Ctr.
      100  ZJ   ZG1     PV       Test for same no. of open and close
                                 parens.
      101  0    0       0
(8)   102  TP   SY10    Q    }   (1) Test for subscript
      103  QJ   PV37    ZM1  }
      104  TP   PV107   A    }   (2) If op > 01 then wrong
      105  TJ   PV112   ZN1  }   Exit was used and at least one
      106  MJ   0       PV77 }   subscript will be missing
      107  01   0       0        from DP List
      110  0    1       0
      111  77   0       0        Mask
      112  0    0       0        Temp. 2
      113  0    0       1
      114  TP   SY2     DP       Presetter for XS-3 —> DP
      115  0    0       76000    CW
      116  0    0       0        Temp. 5
      117  0    0       0        Temp. 3
      120  77   77777   77775    -2
      121  0    0       0        Index
      122  TP   PV116   DP       Presetter for CW —> DP
      123  21   77777   77777    ,
      124  17   77777   77777    (
      125  0    0       0        Parenthesis Counter
      126  0    0       63000    CW
      127  43   77777   77777    )
      130  TP   PV117   A     }
      131  RA   A       PV113 }  Setting up an index for
      132  MJ   0       PV22  }  the no. of passes thru last loop
(10)  133  TP   SY10    Q     }        Test for subscript
      134  QJ   PV135   ZM1   }  (3)
      135  RA   PU64    PV113 }        I, J, K, L or M
      136  MJ   0       PV60  }
           CA   PV137
```

Sub Region for Filing Functions in DP

		IA	PX		
	0	MJ	0	PU42	
13	1	RA	PU64	PX27	Increase CTR by 1
	2	RA	PX3	PU64	
	3	TP	SY2	[DP]	Send XS-3 symbol DP
	4	TP	PX32	PX3	Preset PX3
	5	RJ	DU	DU1	
	6	RA	PU64	PX27	Increase CTR by 1
	7	TP	PX36	A	C W ⟶ A
	10	AT	PU55	PX35	C W to Temp. 6 after being sequenced
	11	RA	PX12	PU64	
	12	TP	PX35	[DP]	Temp. 6 ⟶ DP_n
	13	TP	PX33	PX12	Preset PX12
	14	RA	PU55	PU60	CTR1+2 ⟶ CTR1 ⟶
	15	TP	PU31	A	
	16	RS	A	PX30	Set up address to obtain
	17	TU	A	PX22	correct format digit
	20	RA	PU64	PX27	CTR+1 ⟶ CTR
	21	RA	PX22	PU64	
	22	TP	[30000]	[DP]	Send format digit(1, 2, 3 or 4) to DP List
	23	TP	PX34	PX22	Preset PX22
	24	RJ	SY	SY1	
	25	EJ	PX31	ZH1	Test '('
	26	MJ	0	PX	
	27	0	0	1	
	30	0	1	0	
	31	17	77777	77777	(
	32	TP	SY2	DP	Preset PX3
	33	TP	PX35	DP	Preset PX12
	34	TP	30000	DP	Preset PX22
	35	0	0	0	Temp. 6
	36	0	0	61000	
		CA	PX37		

Sub Region for FIXED POINT OPERAND

		IA	PY		
	0	MJ	0	PU42	
14	1	TP	SY10	Q	Testing
	2	QJ	PY3	ZI1	for I, J, K, L or M
	3	RA	PU64	PY22	CTR+1 ⟶ CTR
	4	RA	PY5	PU64	
	5	TP	SY2	[DP]	Insert XS-3 symbol in DP
	6	TP	PY23	PY5	Preset PY5
	7	RJ	DU	DU1	
	10	TP	PY21	A	CW ⟶ A
	11	AT	PU55	PY20	Temp. 7 CW plus sequence no.
	12	RA	PU55	PY22	CTR1+1 ⟶ CTR1
	13	RA	PU64	PY22	CTR+1 ⟶ CTR
	14	RA	PY15	PU64	
	15	TP	PY20	[DP]	Insert 63---type call word in DP List
	16	TP	PY24	PY15	Preset PY15
	17	MJ	0	PY	
	20	0	0	0	Temp. 7
	21	0	0	63000	CW for FIXED POINT CONSTANT
	22	0	0	1	
	23	TP	SY2	DP	Presetter PY5
	24	TP	PY20	DP	Presetter PY15
		CA	PY25		

Sub Region for FLOATING POINT OPERAND

```
        IA   PZ
    0   MJ   0       PU42
15  1   TP   SY10    Q      }   Testing
    2   QJ   ZJ1     PZ3    }   for I, J, K, L or M
    3   RA   PU64    PZ22       CTR+1 ⟶ CTR
    4   RA   PZ5     PU64
    5   TP   SY2     [DP]       Insert XS-3 symbol
    6   TP   PZ23    PZ5        Preset PZ5
    7   RJ   DU      DU1
   10   TP   PZ21    A
   11   AT   PU55    PZ20       Temp.8 - CW  plus sequence no.
   12   RA   PU55    PZ22       CTR1+1 ⟶ CTR1
   13   RA   PU64    PZ22       CTR+1 ⟶ CTR
   14   RA   PZ15    PU64
   15   TP   PZ20    [DP]       Insert 63--- type call word in DP List
   16   TP   PZ24    PZ15       Preset PZ15
   17   MJ   0       PZ
   20   0    0       0          Temp.8
   21   0    0       63000      CW  for FLOATING POINT
   22   0    0       1
   23   TP   SY2     DP
   24   TP   PZ20    DP
        CA   PZ25
```

```
        IA   PW
    0   TP   PW4     PU46       CTR2 }
    1   TP   PW4     PU55       CTR1 }  Reset counters
    2   TP   PW5     PU64       CTR  }
    3   MJ   0       PE1
    4   0    0       0
    5   77   77777   77776
        CA   PW6
```

```
            IA    PE
       0    MJ    0       CT
(16)   1    TP    TA4     WL3       Pseudo Op CW ——> WL3
       2    RA    PE10    VB4       22000 + VB4 = CW  of 1st sentence
                                    after heading
       3    TP    A       WL4       CW——>WL4
       4    RA    WL      PE11      Word counter + 1——>Word ctr.
       5    RJ    SS      SS1       Send string out to tape
       6    RS    VB4     PE11
       7    MJ    0       PE
      10    0     0       22000
      11    0     0       1
            CA    PE12
```

```
            IA    ZO
       0    MJ    0       PU
(18)   1    MJ    0       ZO2
       2    TP    ZO25    UP3
       3    RJ    UP2     UP
       4    MJ    0       ZO
       5    01    01010   10101 )
       6    01    01010   10101 |
       7    01    01010   10101 |
      10    01    01010   10101 |
      11    01    01010   10101 }   Causes carriage return
      12    01    01010   10101 |   before print out
      13    01    01010   10101 |
      14    01    01010   10101 |
      15    01    01010   10101 )
      16    66    33300   15430     T  H  E  △  R  E
      17    65    66015   13101     S  T  △  O  F  △
      20    66    33346   50165     T  H  I  S  △  S
      21    30    50663   05026     E  N  T  E  N  C
      22    30    01712   46501     E  △  W  A  S  △
      23    50    51660   12633     N  O  T  △  C  H
      24    30    26453   02722     E  C  K  E  D  .
      25    40    ZO5     20
            CA    ZO26
```

Test Duplication of Symbol

```
         IA   DU
     0   MJ   0       [30000]
     1   RA   DU20    PU64       Index + Ctr. = CTR. -1
22   2   TP   [DP]    A
     3   EJ   SY2     DU5
     4   MJ   0       DU15
     5   TP   DU24    A          0 ⟶ A
     6   TJ   DU20    DU12       Index > 0  indicates error
     7   TP   DU23    DU2
    10   TP   DU22    DU20       Exit routine
    11   MJ   0       DU
    12   TP   DU23    DU2
    13   TP   DU22    DU20       Error routine
    14   MJ   0       ZL1
    15   RA   DU2     DU21       Modifty DP address
    16   IJ   DU20    DU2
    17   MJ   0       DU7        Jump to Exit routine
    20   77   77777   77776      Index
    21   0    1       0
    22   77   77777   77776      Presetter for Index
    23   TP   DP      A
    24   0    0       0
         CA   DU25
```

Routine to Make Up List JN of 2nd Lines of Pseudo Op's

```
         IA   JL
     0   MJ   0       30000      Exit
     1   TP   JL12    Q          Mask to Q
     2   QT   JN      A          JN = 0 20000 0 initially
     3   LQ   A       25         Shift to V position number of
                                 pseudo ops.
     4   AT   JL14    A          Set-up to get proper loading
     5   TV   A       JL7        position for next call word in list.
     6   SP   VB4     17         Securing and loading call
     7   AT   JL13    [30000]    word in list.
    10   RA   JN      PU70       Increasing list length count
    11   MJ   0       JL         Exit
    12   0    07777   0          Mask
    13   0    22000   0          Base call word of pseudo ops
    14   0    0       JN1        Base address of 1st call word
         CA   JL15               in list.
```

Error Print-Outs

	IA	ZA		
0	MJ	0	PU	
1	RJ	WA	WA1	Prints: SENTENCE ____ (SUB)
2	TP	ZA12	UP3	Gives print-out indicated
3	RJ	UP2	UP	by parameter.
4	MJ	0	ZA	
5	50	51013	13450	N O Δ F I N
6	24	46012	64651	A L Δ C L O
7	65	34503	20152	S I N G Δ P
10	24	54305	06633	A R E N T H
11	30	65346	52277	E S I S . Δ
12	40	ZA5	5	
	CA	ZA13		

	IA	ZB		
0	MJ	0	PU	
1	RJ	WA	WA1	
2	TP	ZB23	UP3	
3	RJ	UP2	UP	
4	MJ	0	ZB	
5	66	33300	15067	T H E Δ N U
6	47	25305	40151	M B E R Δ O
7	31	01515	23050	F Δ O P E N
10	01	52245	43050	Δ P A R E N
11	66	33306	53065	T H E S E S
12	01	34650	15051	Δ I S Δ N O
13	66	01305	36724	T Δ E Q U A
14	46	01665	10166	L Δ T O Δ T
15	33	30010	10101	H E Δ Δ Δ Δ
16	01	01506	74725	Δ Δ N U M B
17	30	54015	13101	E R Δ O F Δ
20	26	46516	53001	C L O S E Δ
21	52	24543	05066	P A R E N T
22	33	30653	06522	H E S E S .
23	40	ZB5	16	
	CA	ZB24		

```
      IA    ZC
 0    MJ    0       PU
 1    RJ    WA      WA1
 2    TP    ZC12    UP3
 3    RJ    UP2     UP
 4    MJ    0       ZC
 5    47    24263   33450        M  A  C  H  I  N
 6    30    01515   40134        E  Δ  O  R  Δ  I
 7    50    66305   45024        N  T  E  R  N  A
10    46    01305   45451        L  Δ  E  R  R  O
11    54    22777   77777        R  .  77 77 77 77
12    40    ZC5     5
      CA    ZC13
```

```
      IA    ZF
 0    MJ    0       PU
 1    RJ    WA      WA1
 2    TP    ZF15    UP3
 3    RJ    UP2     UP
 4    MJ    0       ZF
 5    31    24344   63027        F  A  I  L  E  D
 6    01    66510   13072        Δ  T  O  Δ  E  X
 7    34    66220   15254        I  T  .  Δ  P  R
10    51    25242   54673        O  B  A  B  L  Y
11    01    50510   16552        Δ  N  O  Δ  S  P
12    24    26300   15230        A  C  E  Δ  P  E
13    54    34512   60165        R  I  O  D  Δ  S
14    73    47255   14622        Y  M  B  O  L  .
15    40    ZF5     10
      CA    ZF16
```

```
        IA    ZG
 0      MJ    0       ZØ1
 1      RJ    WA      WA1
 2      TP    ZB23    UP3
 3      RJ    UP2     UP
 4      TP    ZG6     PV102
 5      MJ    0       ZG
 6      0     0       0
        CA    ZG7
```

```
        IA    ZH
 0      MJ    0       Z01
 1      RJ    WA      WA1
 2      TP    ZH30    UP3
 3      RJ    UP2     UP
 4      MJ    0       ZH
 5      52    24543   05066        P  A  R  E  N  T
 6      33    30663   42624        H  E  T  I  C  A
 7      46    01307   25254        L  △  E  X  P  R
10      30    65653   45150        E  S  S  I  O  N
11      65    01505   16601        S  △  N  O  T  △
12      24    46465   17130        A  L  L  O  W  E
13      27    01315   15401        D  △  F  O  R  △
14      66    33300   10101        T  H  E  △  △  △
15      01    01010   10101        △  △  △  △  △  △
16      01    01316   75026        △  △  F  U  N  C
17      66    34515   02446        T  I  O  N  A  L
20      01    70245   43424        △  V  A  R  I  A
21      25    46300   13450        B  L  E  △  I  N
22      01    66333   00152        △  T  H  E  △  P
23      65    30672   75101        S  E  U  D  O  △
24      51    52013   33024        O  P  △  H  E  A
25      27    34503   20165        D  I  N  G  △  S
26      66    24663   04730        T  A  T  E  M  E
27      50    66227   77777        N  T  .  77 77 77
30      40    ZH5     23
        CA    ZH31
```

```
        IA    ZI
 0      MJ    0       PU42
 1      RJ    WA      WA1
 2      TP    ZI30    UP3
 3      RJ    UP2     UP
 4      MJ    0       ZI
 5      31    34723   02701      F  I  X  E  D  Δ
 6      52    51345   06601      P  O  I  N  T  Δ
 7      51    52305   42450      O  P  E  R  A  N
10      27    65012   75101      D  S  Δ  D  O  Δ
11      50    51660   12530      N  O  T  Δ  B  E
12      32    34500   17134      G  I  N  Δ  W  I
13      66    33014   63032      T  H  Δ  L  E  G
14      24    46010   10101      A  L  Δ  Δ  Δ  Δ
15      01    01010   10101      Δ  Δ  Δ  Δ  Δ  Δ
16      01    01263   32454      Δ  Δ  C  H  A  R
17      24    26663   05465      A  C  T  E  R  S
20      01    34223   02201      Δ  I  .  E  .  Δ
21      17    34214   42145      (  I  ,  J  ,  K
22      21    46015   15401      ,  L  Δ  O  R  Δ
23      47    43013   45001      M  )  Δ  I  N  Δ
24      66    33300   15265      T  H  E  Δ  P  S
25      30    67275   10151      E  U  D  O  Δ  O
26      52    01333   02427      P  Δ  H  E  A  D
27      34    50322   27777      I  N  G  .  77 77
30      40    ZI5     23
        CA    ZI31
```

```
        IA   ZJ
 0      MJ   0       PU42
 1      RJ   WA      WA1
 2      TP   ZJ37    UP3
 3      RJ   UP2     UP
 4      MJ   0       ZJ
 5      31   46512   46634      F  L  O  A  T  I
 6      50   32015   25134      N  G  Δ  P  O  I
 7      50   66015   15230      N  T  Δ  O  P  E
10      54   24502   76501      R  A  N  D  S  Δ
11      34   50016   63330      I  N  Δ  T  H  E
12      01   52653   06727      Δ  P  S  E  U  D
13      51   02515   20133      O  -  O  P  Δ  H
14      30   24273   45032      E  A  D  I  N  G
15      01   01010   10101      Δ  Δ  Δ  Δ  Δ  Δ
16      01   01253   03234      Δ  Δ  B  E  G  I
17      54   01713   46633      N  Δ  W  I  T  H
20      01   34464   63032      Δ  I  L  L  E  G
21      24   46012   63324      A  L  Δ  C  H  A
22      54   24266   63054      R  A  C  T  E  R
23      65   01342   23022      S  Δ  I  .  E  .
24      01   17342   14421      Δ  (  I  ,  J  ,
25      45   21460   15154      K  ,  L  Δ  O  R
26      21   47432   27777      ,  M  )  .  77 77
27      40   ZJ5     22
        CA   ZJ30
```

```
        IA   ZK
 0      MJ   0       Z01
 1      RJ   WA      WA1
 2      TP   ZK15    UP3
 3      RJ   UP2     UP
 4      MJ   0       ZK
 5      50   51012   64651        N  O  Δ  C  L  O
 6      65   34503   20152        S  I  N  G  Δ  P
 7      24   54305   06633        A  R  E  N  T  H
10      30   65346   50151        E  S  I  S  Δ  O
11      54   01665   15101        R  Δ  T  O  O  Δ
12      47   24507   30165        M  A  N  Y  Δ  S
13      67   25652   65434        U  B  S  C  R  I
14      52   66652   27777        P  T  S  .  77 77
15      40   ZK5     10
        CA   ZK16
```

```
        IA   ZL
 0      MJ   0       Z01
 1      RJ   WA      WA1
 2      TP   ZL20    UP3
 3      RJ   UP2     UP
 4      MJ   0       ZL
 5      27   67524   63426        D  U  P  L  I  C
 6      24   66302   70165        A  T  E  D  Δ  S
 7      73   47255   14665        Y  M  B  O  L  S
10      01   24543   00150        Δ  A  R  E  Δ  N
11      51   66012   44646        O  T     A  L  L
12      51   71302   70134        O  W  E  D  Δ  I
13      50   01526   53067        N  Δ  P  S  E  U
14      27   51015   15201        D  O  Δ  O  P  Δ
15      01   01010   10101        Δ  Δ  Δ  Δ  Δ  Δ
16      01   01333   02427        Δ  Δ  H  E  A  D
17      34   50322   27777        I  N  G  .  77 77
20      40   ZL5     13
        CA   ZL21
```

```
        IA    ZM
  0     MJ    0        Z01
  1     RJ    WA       WA1
  2     TP    ZM12     UP3
  3     RJ    UP2      UP
  4     MJ    0        ZM
  5     30    54545    15030        E  R  R  O  N  E
  6     51    67650    16567        O  U  S  Δ  S  U
  7     25    65265    43452        B  S  C  R  I  P
 10     66    01315    16750        T  Δ  F  O  U  N
 11     27    22777    77777        D  .  77 77 77 77
 12     40    ZM5      5
        CA    ZM13
```

```
        IA    ZN
  0     MJ    0        Z01
  1     RJ    WA       WA1
  2     TP    ZN20     UP3
  3     RJ    UP2      UP
  4     MJ    0        ZN
  5     24    66014    63024        A  T  Δ  L  E  A
  6     65    66015    15030        S  T  Δ  O  N  E
  7     01    65672    56526        Δ  S  U  B  S  C
 10     54    34526    60147        R  I  P  T  Δ  M
 11     34    65653    45032        I  S  S  I  N  G
 12     01    51500    16567        Δ  O  N  Δ  S  U
 13     25    65265    43452        B  S  C  R  I  P
 14     66    30270    10101        T  E  D  Δ  Δ  Δ
 15     01    01010    10101        Δ  Δ  Δ  Δ  Δ  Δ
 16     01    01702    45434        Δ  Δ  V  A  R  I
 17     24    25463    02277        A  B  L  E  .  77
 20     40    ZN5      13
        CA    ZN21
```

```
          IA   XN
     0    EJ   PU54    PU7      Test closing parenthesis
     1    MJ   0       PU14
     2    MJ   0       Z01
(17) 3    RJ   WA      WA1
     4    TP   XN7     UP3      Print region
     5    RJ   UP2     UP
     6    MJ   0       XN2
     7    40   XN10    7
    10    26   51506   56624    C O N S T A
    11    50   66650   13446    N T S Δ I L
    12    46   30322   44601    L E G A L Δ
    13    34   50015   26530    I N Δ P S E
    14    67   27510   15152    U D O Δ O P
    15    01   33302   42734    Δ H E A D I
    16    50   32227   77777    N G .
(19)17    TP   TS4     Q        Test for heading bit
    20    QJ   XN21    XN25
    21    TP   VD1     Q        Test for Exit Bit
    22    QJ   XN23    XN32
    23    TP   XN30    VD1      Zeroize VD1
    24    MJ   0       PU3
    25    RA   TS4     XN27     Set heading bit
    26    MJ   0       PU3
    27    40   0       0
    30    0    0       0
    31    MJ   0       PU3
(21)32    RJ   WA      WA1
    33    TP   XN45    UP3      Error Print region
    34    RJ   UP2     UP
    35    MJ   0       XN31
    36    50   51013   07234    N O Δ E X I
    37    66   01345   00152    T Δ I N Δ P
    40    54   30263   02734    R E C E D I
    41    50   32015   26530    N G Δ P S E
    42    67   27510   15152    U D O Δ O P
    43    30   54246   63451    E R A T I O
    44    50   22777   77777    N .
    45    40   75543   7
          CA   XN46
```

IV. GENERATION PHASE

IV. GENERATION PHASE

1. Generation Setup and Drum Loader

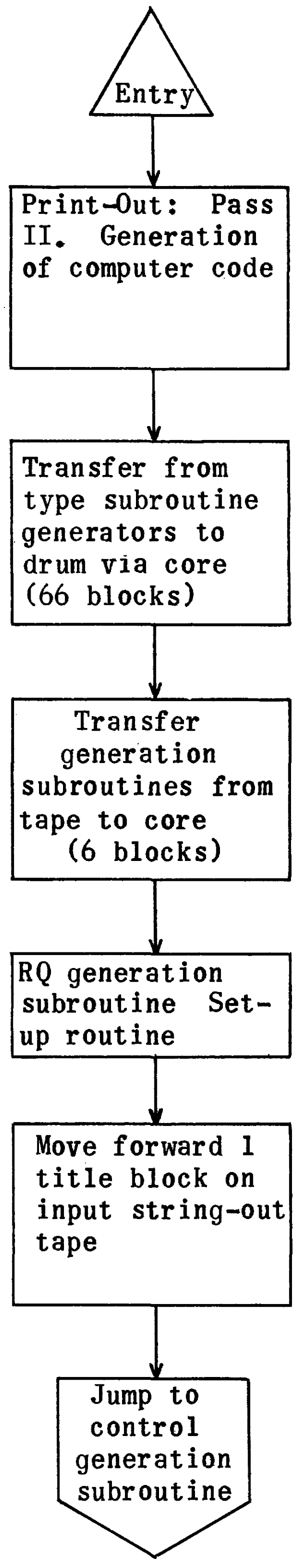
After the initial print-out: Pass II. Generation of Computer Code, this routine transfers from tape to core to drum the two 27-block sections of the Subroutine Generators. Next, it transfers from tape to core the 6 blocks of Generation Subroutines.

RQ routine is then referenced to set up some block and line counters, put the proper parameter for 5 or 7 Uniservos into Op Control routine, and put two title blocks on both tape 5 holding Op File I and the tape that is to hold the generated coding. This tape will be either on Uniservo 4 or 7, depending on whether 5 or 7 Uniservos are used. In addition, on the 22nd line of the title block for the generated coding, the RQ routine puts the contents of 13, which is a count of the number of blocks of the corrected problem on tape 5.

The tape holding the string-out input, either on Uniservo 3 or 6, is now moved forward one block to bypass the title. Then an exit jump is made to the beginning address of CG, the Control Generation subroutine.

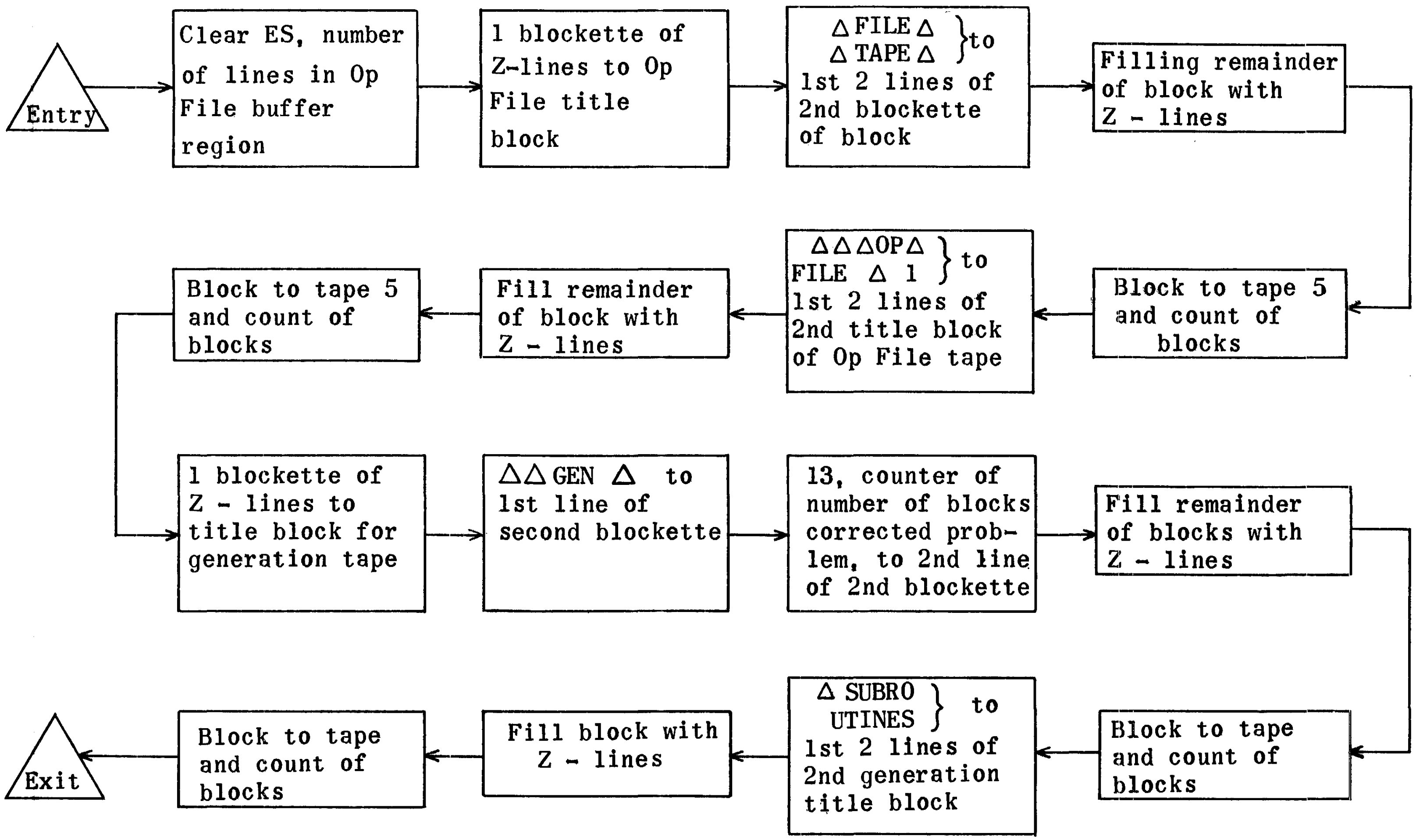
Also included in the same block as the Generation Set-Up is a Drum Loader routine which can be used to help update or correct the UNICODE Master Tape. First a flex or bioctal copy of a revised Generator is loaded into the core. A look at the annotated coding of this Drum Loader will show the numerical PAK setting to the left of a section of coding labeled for the specific Generator. A start at this address will transfer the Generator to its proper place in the drum. In this connection, the separate write-up on the System Tape Package should be consulted to ensure that the other necessary steps are taken to update the Master Tape correctly.

Generation Set-Up Routines - Flow Charts



Generation Set-Up Routines- Flow Charts

RQ Routine To Set Up Op Control Routines and Write Title Blocks For Op File I and Generated Routines on Tapes



Generation Setup and Drum Loader Regions

```
RE  DA7230
RE  RQ7256
RE  BF7325
RE  BG6250
RE  BH6250
RE  CJ50212
RE  CK56462
RE  CD3300
RE  CE3300
RE  CN600
RE  EX7350
```

Generation Subroutine regions are also needed to assemble this tape.

Generation Setup and Drum Loader

Print-Out:					
Pass II. Gener-		IA	DA		
ation of Computer	0	RJ	BF	BF1	
Code	1	TP	DA21	GT3	
	2	RJ	GT2	GT	
To get subroutine	3	RP	BG30000	DA5	
generators on	4	TP	BR	CJ	
drum via core	5	TP	DA22	GT3	
from tape	6	RJ	GT2	GT	
	7	RP	BH30000	DA11	
	10	TP	BR	CK	
	11	TP	DA23	GT3	To get generation subroutines from
	12	RJ	GT2	GT	tape to core
	13	RJ	RQ	RQ1	To operate generation Op-Control
					set up routine
	14	TP	TN	A	Move forward tape $\begin{Bmatrix}3\\6\end{Bmatrix}$ 1 block. This
	15	AT	DA24	GT3	servo holds the string-outs plus
	16	RJ	GT2	GT	1-block title
	17	MJ	0	DA20	Dummy jump instruction (replaces
					discarded "12" clearing instruction)
	20	MJ	0	CG	Jump to exit
	21	50	CD1	BR	
	22	50	CE1	BR	Parameters for generators in 2 sect.
	23	50	CN1	BR	Parameter for generation subroutines
	24	30	103	0	Parameter for moving forward tape 3
					1 block
	25	0	0	0	Excess storage of a zero formerly
					used in instruction 17
		CA	DA26		
Routine to Set		IA	RQ		
Up Op Control	0	MJ	0	30000	Exit
Tape Write	1	TP	GP7	ES	Clears 2 storage locations, es = no.
Routine and	2	TP	GP7	ES5	lines in Op File buffer region, np
Write Title					es 5 = no. of blocks of Op Files
Blocks for Op	3	RP	10024	RQ5	
File and Gen.	4	TP	GP2	NP	Puts 20_8 lines of Z's into np
Routines on	5	TP	GP13	NP24	# File # into np
Tapes	6	TP	GP14	NP25	# Tape #
	7	RP	10142	RQ11	
Op File	10	TP	GP2	NP26	Filling remainder of np with Z's
Setup	11	TP	RC	GT3	Parameter → generalized tape handler
	12	RJ	GT2	GT	Writing block on tape via tape hdlr.
	13	RA	ES5	GP10	Count of blocks
	14	TP	GP	NP	Δ Δ Δ O P Δ to np
	15	TP	GP1	NP1	F I L E Δ 1
	16	RP	10166	RQ20	
	17	TP	GP2	NP2	Filling rest of np with Z's
	20	TP	RC	GT3	
	21	RJ	GT2	GT	Using tape handler

```
                22  RA  ES5     GP10   Count of blocks
Gen.Routines    23  TP  RC2     A      Putting proper parameter in RC4 de-
Setup           24  AT  TN      RC4      pending on whether TN = 0 or 0 3 0.
                                         The latter is for 7 servos.
                25  TP  GP7     ES6    Clearing counter for no. blocks of
                                         generated subroutines
                26  RP  10024   RQ30   20 lines of Z's to GN, buffer region
                27  TP  GP2     GN       of subroutines used in writing on
                                         tape
                30  TP  GP15    GN24   ΔΔGenΔto GN
                31  TP  13      GN25   Count of no. blocks of corrected
                                         problem on tape 5
                32  RP  10142   RQ34
                33  TP  GP2     GN26   Filling GN with lines of Z's
                34  TP  RC4     GT3
                35  RJ  GT2     GT     Writing block on tape
                36  RA  ES6     GP10   Count of blocks
                37  TP  GP11    GN     ΔSUBRO
                40  TP  GP12    GN1    UTINES   to GN
                41  RP  10166   RQ43
                42  TP  GP2     GN2    Filling GN with lines of Z's
                43  TP  RC4     GT3
                44  RJ  GT2     GT     Writing block on tape and counting
                45  RA  ES6     GP10     blocks
                46  MJ  0       RQ     Jump to exit
                    CA  RQ47


                    IA  BF
                 0  MJ  0       30000
                 1  TP  BF4     UP3    Gives print-out:ΔΔΔΔΔΔ Pass II.
                 2  RJ  UP2     UP       Generation of Computer Code
                 3  MJ  0       BF
                 4  0   BF5     10     Parameter
                 5  01  01010   10101  Δ ――――― Δ
                 6  52  24656   50134  P A S S   I
                 7  34  22010   10101  I . Δ Δ Δ Δ
                10  01  32305   03054  Δ G E N E R
                11  24  66345   15001  A T I O N Δ
                12  51  31012   65147  O F Δ C O M
                13  52  67663   05401  P U T E R Δ
                14  26  51273   07777  C O D E
                    CA  BF15
```

Routine used to load Generators from Core to Drum (used only in assembling initially the UNICODE generators; operated by console manipulation). A changed generator is first read into the core. Then a start with PAK set to the numbered address shown at left will transfer the generator to its place in the drum.

```
        IA   EX
7350    RP   DR30000    EX44     Start
        TP   KB         CJ
7352    RP   DM30000    EX44     Jump
        TP   KB         EA
7354    RP   DK30000    EX44     If
        TP   KB         EB
7356    RP   DO30000    EX44     Print
        TP   KB         EC
7360    RP   DY30000    EX44     Compute
        TP   KB         ED
7362    RP   DU30000    EX44     Vary
        TP   KB         EF
7364    RP   DQ30000    EX44     Resume
        TP   KB         EY
7366    RP   DW30000    EX44     Exit
        TP   KB         EH
7370    RP   DT30000    EX44     Type
        TP   KB         EI
7372    RP   DN30000    EX44     List
        TP   KB         EJ
7374    RP   DP30000    EX44     Read
        TP   KB         EK
7376    RP   DS30000    EX44     Stop
        TP   KB         EL
7400    RP   DZ30000    EX44     Dimens.
        TP   KB         EM
7402    RP   DX30000    EX44     Pseudo-Op Heading
        TP   KB         EN
7404    RP   DV30000    EX44     End of Tape
        TP   KB         EO
7406    RP   DH30000    EX44     Eq. 1 Listing
        TP   KB         ET
7410    RP   DI30000    EX44     Eq. 2 Redundancy
        TP   KB         EU
7412    RP   DJ30000    EX44     Eq. 3 Generator
        TP   KB         EV
        MS   0          EX2
        CA   EX45
```

2. GENERATION SUBROUTINES

2. Generation Subroutine Regions

	RE	TN20	Temporary to indicate whether 5 or 7 servos (set in string-out)
	RE	GT21	Tape handler
	RE	TH21	
	RE	UP421	Line-number processing routine
	RE	UQ443	
	RE	US453	
	RE	UW513	
	RE	EP537	Machine Error Routine
	RE	BR537	
	RE	BP564	
	RE	BQ632	
	RE	WA653	Sentence number print-out during an error print-out
	RE	WB677	
	RE	GP717	Op routine to write output on tape and RG routine used as adjunct to VARY
	RE	RC735	
	RE	ES742	
	RE	RG755	
	RE	OP1047	
	RE	XP1126	
	RE	CW1211	Call word routine
	RE	LW1250	Routine to get call word of referenced line number from list
	RE	HI1306	Routine to put call word in referenced line-number list
	RE	KI1336	Illegal line jump check routine
	RE	LS1465	Library list routine
	RE	CG1530	Control generation routine
	RE	CH1642	
	RE	VX1670	Excess three to Flex code
	RE	VE2044	
	RE	NP2052	Op File buffer
	RE	WL2242	Input buffer (250_8 lines maximum)
	RE	BK2242	
	RE	KB2512	Region where any generator operates
	RE	GN5360	Generated routines output buffer
	RE	CI144	Library List Threshold (keeps max. of library routines referenced at 99)
Size of Generators on Drum	RE	DH612	Eq. 1, Generation
	RE	DI2604	Eq. 2, Redundancy
	RE	DJ2615	Eq. 3, Generator
	RE	DK763	If
	RE	DM33	Jump
	RE	DN461	List
	RE	DO107	Print
	RE	DP430	Read
	RE	DQ174	Resume
	RE	DR30	Start
	RE	DS425	Stop
	RE	DT560	Type
	RE	DU766	Vary

	RE	DV502	End of tape
	RE	DW34	Exit
	RE	DX24	Pseudo-Op Heading
	RE	DY551	Compute
	RE	DZ53	Dimension
	RE	ZZ7230	Generation Set-Up Block
	RE	DA7230	
	RE	ZA77000	Region of UNICODE Service Routines
	RE	FC40001	Excess Three to Flex-Code List
	RE	CB40101	Combination List
	RE	DL40102	Dimension List
	RE	CL46101	Constant List
	RE	VF47101	Vary File List
	RE	IZ47246	Referenced Line-number List
	RE	JN47722	List of call words of 2nd-line numbers of sub-programs
	RE	RW50023	Rewind List of call words of tape numbers referenced
	RE	LN50046	Library List of call words of library routines referenced
Initial addresses of generators stored on drum	RE	CJ50212	Start
	RE	EA50242	Jump
	RE	EB50275	If
	RE	EC51260	Print
	RE	ED51367	Compute
	RE	EF52140	Vary
	RE	EY53126	Resume
	RE	EH53322	Exit
	RE	EI53356	Type
	RE	EJ54136	List
	RE	EK54617	Read
	RE	EL55247	Stop
	RE	EM55674	Dimension
	RE	EN55747	Pseudo-Op Heading
	RE	EO55773	End of Tape
	RE	ET56475	Equation 1, Generation Sorting
	RE	EU57307	Equation 2, Redundancy Check
	RE	EV62113	Equation 3, Generator
These routines are part of End of Tape and are referenced from Control Generation	RE	IG2675	Routine to put Constant List on tape 5
	RE	UG2713	Routine to put Dimension List on tape 5
	RE	EG2732	Rewind tape routine
	RE	BE2750	Gives generation termination print-out
	RE	BU2774	Sends excess-three symbol list to tape 5

Unless otherwise stated in the coding, the above regions are sufficient for all the Generation Subroutines included in this section.

Control Generation Routine

As with the Generation Set-Up Routine, the indicator TN is used to determine on which Uniservo the string-out input to generation has been written. It may either be on Uniservo 3 or 6 depending on whether 5 or 7 Uniservos have been used.

The title block having been passed by, the first line of any block on this tape beginning a new sentence string-out contains the number of lines in the string-out. If this number is greater than 170_8, two blocks of input for that sentence are read into the input buffer. The buffer can only preserve a maximum of 250_8 significant words. Any excess lines above 250_8 are later overlayed by the transfer of a generator into the core. Alarms in the Translation or String-Out Phase have already given adequate protection against possible exceeding of this string-out buffer maximum so there is no further check made against this contingency in generation.

The line number of the sentence being analyzed is compared with the numbers in the referenced line-number list IZ by means of routine HI and, if found, its call word added to the list as needed.

The content of BK2, which holds the name of the sentence under analysis, is compared with a list of sentence titles to determine what type of sentence is being analyzed. Depending on which equality is found, a jump is made to a corresponding section of the routine which brings in the proper generator from the drum, makes a referencing return jump to it, and then jumps back to the beginning entry of Control Generation to get the next sentence input. The return jump to the generator causes the generation of the desired sentence coding, followed by the writing of it on tape and the storing of its Op File in a buffer for later writing on tape.

If none of a list of 13 sentence types is recognized, a comparison is made to see if End of Tape instruction has been encountered. If yes, the End of Tape Generator is brought into the core from the drum. Control of the End of Tape generation is retained in the Control Generation from CG77-CG110 where a succession of return jumps does a variety of things explained more thoroughly in the write-up on the End of Tape Generator. The exit from this succession is a jump to ZA10, the address of an overall UNICODE control service routine in the drum.

If the End of Tape sentence is not recognized as suggested in the preceding paragraph, the call word of the sentence is checked to see if it is greater than 40000. If yes, the sentence is recognized as a Pseudo-Op Heading and the generator for this type is brought into the core. Before referencing this generator, the line number of the sentence is put in the proper place in the prelude of the routine which is to be generated. Following this extra remedial step, the generator is referenced similarly as with other generators.

If the call word of the sentence proposed above is not greater than 40000, the sentence is determined by this system of elimination to be the only remaining type not considered - namely, an equation.

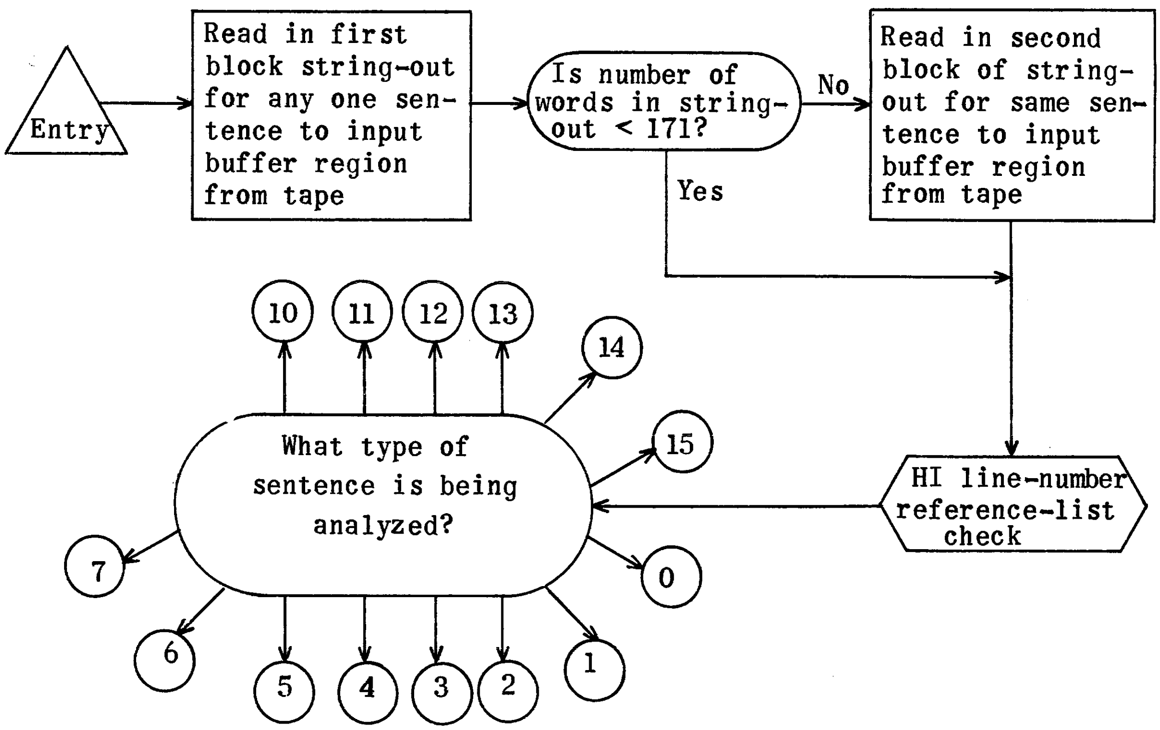
This type of sentence requires special handling which is explained at greater length in another write-up. Briefly an equation sorting routine is transferred from drum to core and then referenced by Control; next, an equation redundancy routine is transferred from drum to core and similarly referenced; finally, the last equation generator is brought into the core and referenced to complete the handling of the sentence. Termination is as usual by getting the next sentence input.

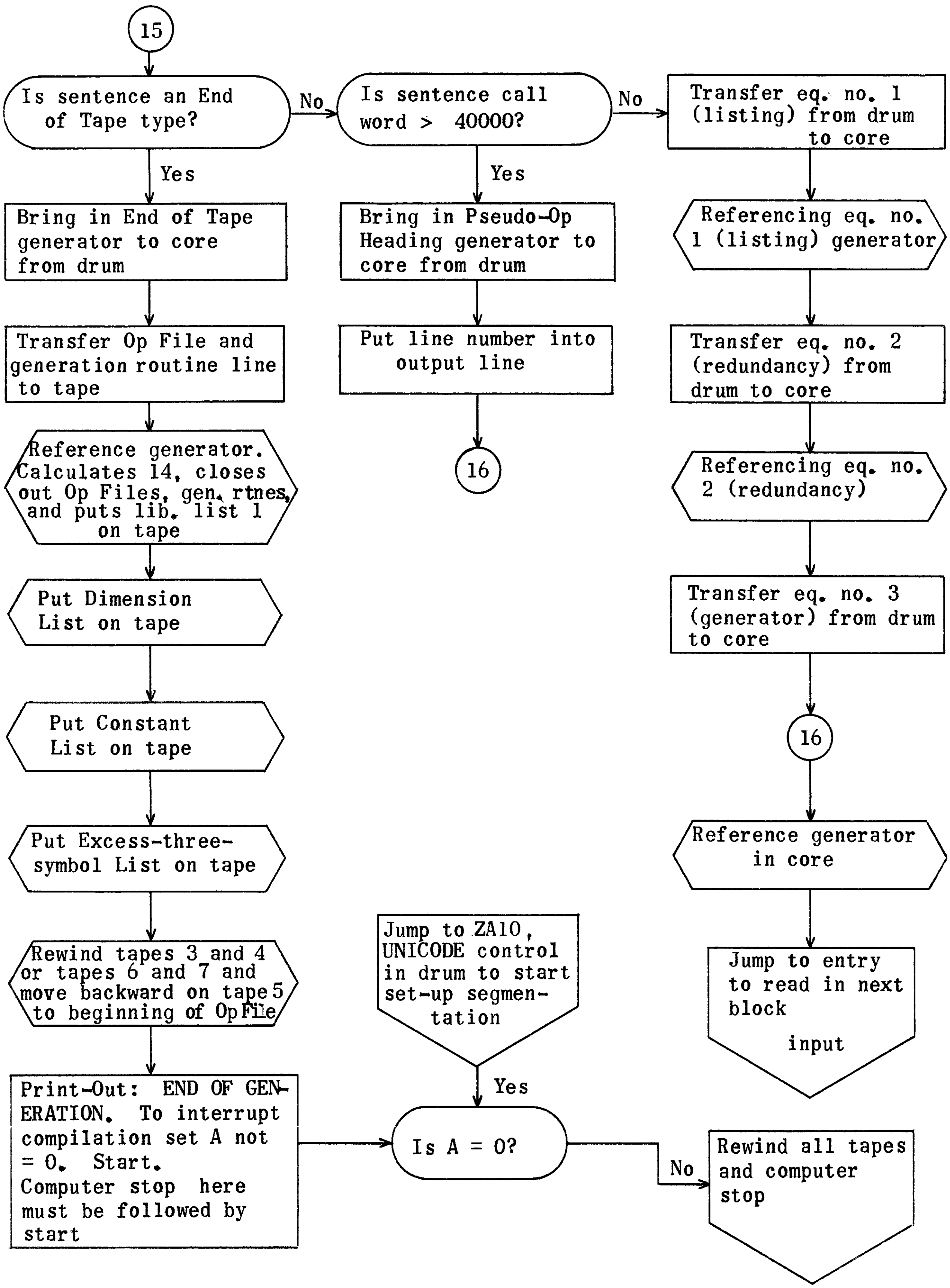
The only final termination to generation lies in the recognition and handling of an End of Tape sentence.

All generators or portions of generators are transferred to the core at the same starting address, 2512. This first line is an exit line, the entry line for the main referencing of a generator being the Reco equivalent of 2513.

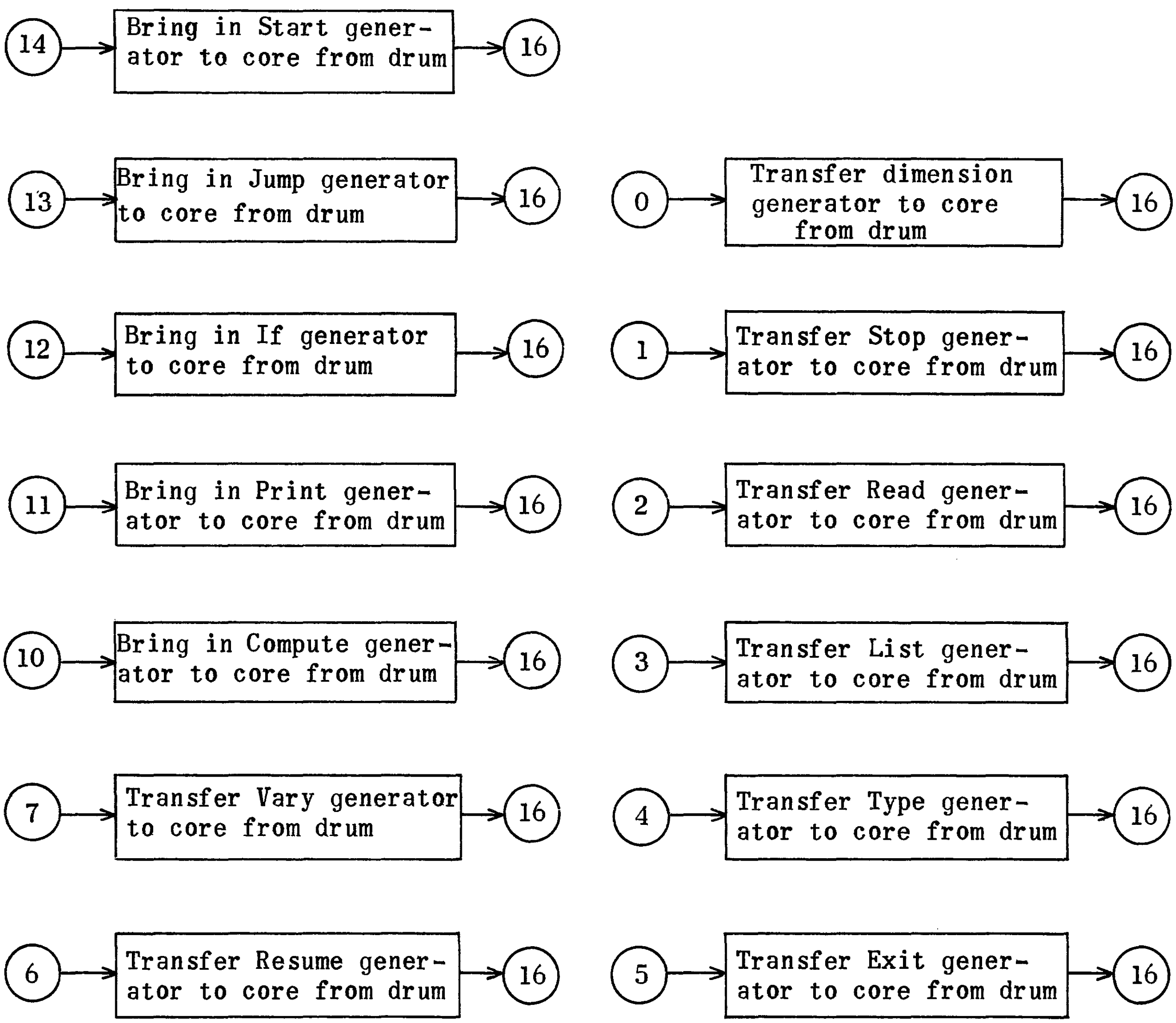
The generators are packed on the drum starting at 50212. Information concerning their assumed length on the drum and their initial addresses there is obtained by examination of the annotated copy of Generation Subroutine regions preceding the Reco coding of the Generation Phase.

Flow Chart for Control Generation Routine




15
Is sentence an End of Tape type?
No
Is sentence call word > 40000?
No
Transfer eq. no. 1 (listing) from drum to core
Yes
Bring in End of Tape generator to core from drum
Yes
Bring in Pseudo-Op Heading generator to core from drum
Referencing eq. no. 1 (listing) generator
Transfer Op File and generation routine line to tape
Put line number into output line
Transfer eq. no. 2 (redundancy) from drum to core
Reference generator. Calculates 14, closes out Op Files, gen. rtnes, and puts lib. list 1 on tape
16
Referencing eq. no. 2 (redundancy)
Put Dimension List on tape
Transfer eq. no. 3 (generator) from drum to core
Put Constant List on tape
16
Put Excess-three-symbol List on tape
Reference generator in core
Rewind tapes 3 and 4 or tapes 6 and 7 and move backward on tape 5 to beginning of Op File
Jump to ZA10, UNICODE control in drum to start set-up segmentation
Jump to entry to read in next block
input
Yes
Print-Out: END OF GENERATION. To interrupt compilation set A not = 0. Start. Computer stop here must be followed by start
Is A = 0?
No
Rewind all tapes and computer stop

Flow Chart for Control Generation Routine (cont.)



CONTROL GENERATION ROUTINE

```
         IA   CG
         0    TP   TN        A       Bringing in 1st block (for any one sentence)
         1    AT   CH2       GT3       from tape {3} to bk, buffer input region
         2    RJ   GT2       GT                   {6}
         3    TP   BK        A
         4    TJ   CH        CG10    Is input < 171?
         5    TP   TN        A       Bringing in 2nd block for same sentence to
         6    AT   CH3       GT3     input region from tape {3
         7    RJ   GT2       GT                             {6
        10    RJ   HI        HI1     Check if line no. is in ref. list and, if so,
                                       giving it a call word
        11    TP   BK2       A       Name of sentence to A
                                                            20014    13    12
        12    RP   20015     CG21    Determining if sentence is start, jump, if
                                       11       10        7      6      5     4
        13    EJ   CH4       CG14    print, compute, vary, resume, exit, type,
                                      3      2     1        0
        14    SN   Q         0       list, read, stop, or dimens. and going to
        15    SA   CG34      1       proper transfer command accordingly.
        16    AT   CG35      A
        17    TV   A         CG20
        20    MJ   0         30000

        21    EJ   CH21      CG77    Is sentence an End of Tape?
        22    TP   CH1       A       Is call word >40000? If so, it is a Pseudo-Op
        23    TJ   BK3       CG75      Heading
Sentence 24   RP   DH30000   CG26
is an    25   TP   ET        KB      Translation for equation
equation 26   RJ   KB        KB1
         27   RP   DI30000   CG31
         30   TP   EU        KB      Redundancy check for equation
         31   RJ   KB        KB1
         32   RP   DJ30000   CG41    Transferring equation generator to core
         33   TP   EV        KB
        34    0    0         20015
        35    0    0         CG41
        36    0    0         0       Unused words
        37    0    0         0
        40    TP   BK1       2531    Putting line number into proper output line
                                       for Pseudo-Op Heading Routine to correct
                                       oversight in that routine
        41    RJ   KB        KB1     Standard return jump to any generator
        42    MJ   0         CG      Return to get next sentence
        43    RP   DR30000   CG41    Transfers Start generator from drum to core
        44    TP   CJ        KB        and then jumps to reference the generator
        45    RP   DM30000   CG41    Same with Jump
        46    TP   EA        KB
        47    RP   DK30000   CG41    Same with If
        50    TP   EB        KB
        51    RP   DO30000   CG41    Same with Print
        52    TP   EC        KB
```

```
 53  RP   DY30000  CG41   Same with Compute
 54  TP   ED       KB
 55  RP   DU30000  CG41   Same with Vary
 56  TP   EF       KB
 57  RP   DQ30000  CG41   Same with Resume
 60  TP   EY       KB
 61  RP   DW30000  CG41   Same with Exit
 62  TP   EH       KB
 63  RP   DT30000  CG41   Same with Type
 64  TP   EI       KB
 65  RP   DN30000  CG41   Same with List
 66  TP   EJ       KB
 67  RP   DP30000  CG41   Same with Read
 70  TP   EK       KB
 71  RP   DS30000  CG41   Same with Stop
 72  TP   EL       KB
 73  RP   DZ30000  CG41   Same with Dimension
 74  TP   EM       KB
 75  RP   DX30000  CG40   Brings in Pseudo-Op Heading Routine, jumps
 76  TP   EN       KB       to CG40 to perform 1st function of routine
                            before referencing the generator proper
 77  RP   DV30000  CG101  Brings in End of Tape generator
100  TP   EO       KB
101  TP   CH25     OP1    Sends End of Tape data to tape
102  RJ   OP       OP2
103  RJ   KB       KB1    Ref. generator: Calculates 14, closes out
                          Op File, gen. rtnes, and puts list 1 on tape
104  RJ   UG       UG1    Puts Dimension List on tape
105  RJ   IG       IG1    Puts Constant List on tape
106  RJ   BU       BU1    Getting Excess-three symbol List
107  RJ   EG       EG1    Rewind 3 and 4 or 6 and 7 and move backward
                            on 5 to beginning of Op File
110  RJ   BE       BE1    Termination of gen. print-out
111  MJ   0        ZA10   Exit to UNICODE control in drum
     CA   CG112

     IA   CH
  0  0    0        171
  1  0    0        40000
  2  50   103      BK     Parameter to read 1st block of any sentence
                            string-out to input
  3  50   103      BK170  Parameter to read 2nd block of same sentence
                            string-out to input
  4  65   66245    46677  START
  5  44   67475    27777  JUMP
  6  34   31777    77777  IF
  7  52   54345    6677   PRINT
 10  26   51475    26766  COMPUT
 11  70   24547    37777  VARY
 12  54   30656    74730  RESUME
 13  30   72346    67777  EXIT
 14  66   73523    7777   TYPE
 15  46   34656    67777  LIST
```

16	54	30242	77777	READ
17	65	66515	27777	STOP
20	27	34473	5065	DIMENS
21	30	50277	77777	END
22	0	23000	2	Op File setup for End of Tape
23	0	0	0	
24	0	23000	0	Gen. setup for End of Tape
25	0	CH24	CH22	Parameter for referencing op routine for End of Tape
	CA	CH26		

COMPUTER ERROR ROUTINE

This routine is used when a compilation inconsistency occurs in the Generation Phase or later. It prints the following:

ALARM△XX.△△Compilation△Inconsistency△(Possible Computer Error). Recompile.

where XX, a decimal number from 1 - 20, is determined by where the routine is entered. The regular entrances to the routine are BR1 to BR24. If the entrance is BR1, XX = 1; if the entrance is BR10, XX = 8; if the entrance is BR24, XX = 20; etc. The routine should <u>not</u> be entered with a return jump.

After the print-out, all tapes are rewound, and the computer stops with PAK set at the UNICODE service entrance of compilation.

A rewind of all tapes with a computer stop is secured without a print-out by entering the routine at BQ6.

Eleven alarms (entries BR1-BR13) have been assigned at different portions of the UNICODE coding. Explanations of these alarms follow:

COMPILER INCONSISTENCY OR COMPUTER ERROR ALARMS

Print-out	Entry	Description
ALARM 1	BR 1	Subscripted variable symbol or call word is not found in the Dimension List.
ALARM 2	BR 2	Referenced sentence number is not found in the Reference (IZ) List.
ALARM 3	BR 3	Sentence number of last sentence in the range of a VARY is not found in the VARY File (VARY generator).
ALARM 4	BR 4	Initial address of Operand List > Current address (Equation Generator).
ALARM 5	BR 5	Call word is not found in Directory I (Segmentation Phase).
ALARM 6	BR 6	Op File III and Directory 4 are inconsistent. Flagged call word is not found in Op File III (Allocation Phase).
ALARM 7	BR 7	Tape on Servo 2 positioned incorrectly.
ALARM 8	BR 10	Tape on Servo 3 (or 6) positioned incorrectly.
ALARM 9	BR 11	Tape on Servo 4 (or 7) positioned incorrectly.
ALARM 10	BR 12	Tape on Servo 5 positioned incorrectly.
ALARM 11	BR 13	Call word within routine is not found in Op File III (Processor).

Machine Error Print

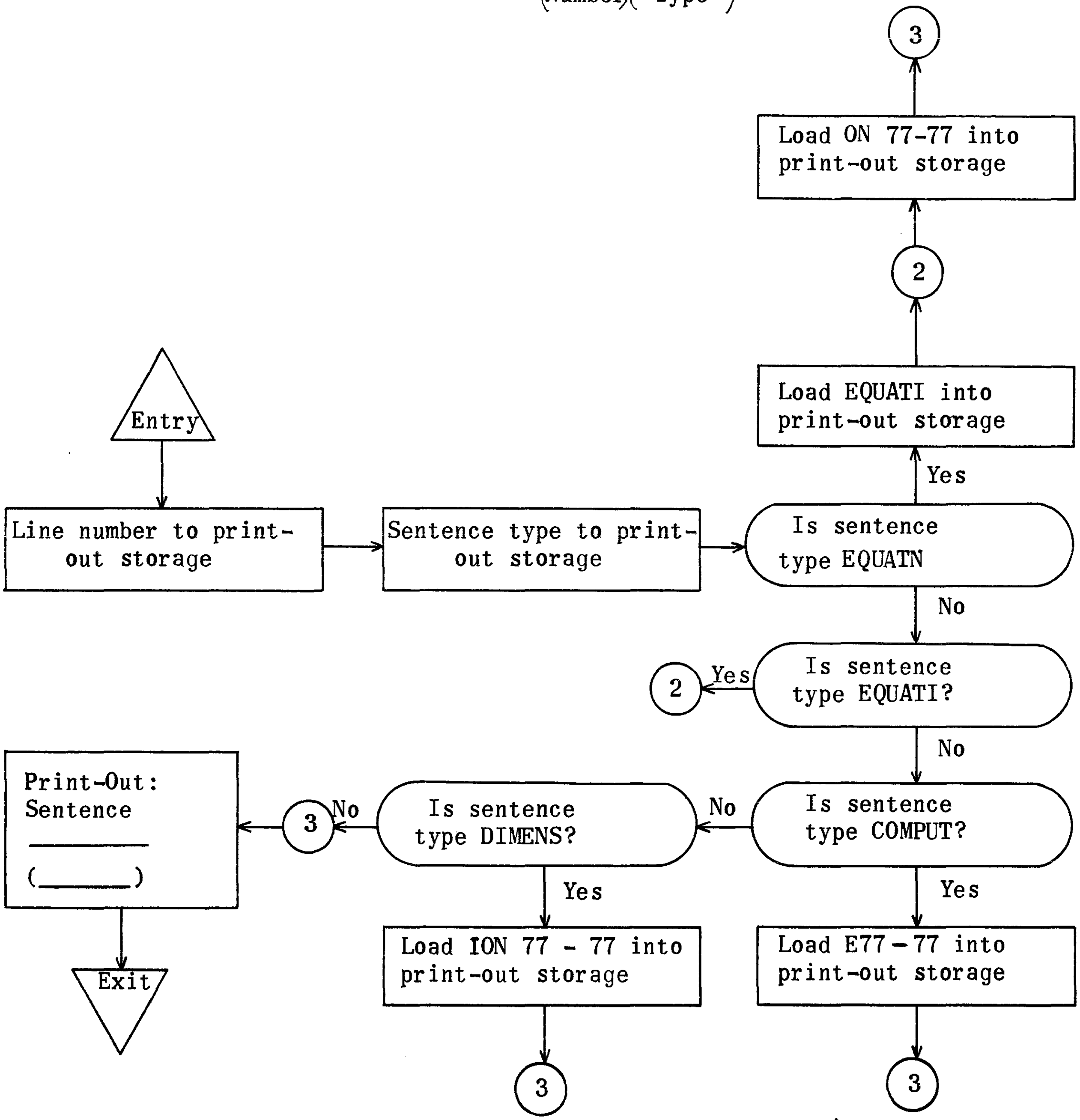
	IA	BR		
0	0	0	BR1	
1	RJ	BP	BQ	
2	RJ	BP	BQ	
3	RJ	BP	BQ	
4	RJ	BP	BQ	
5	RJ	BP	BQ	
6	RJ	BP	BQ	Used entries
7	RJ	BP	BQ	
10	RJ	BP	BQ	
11	RJ	BP	BQ	
12	RJ	BP	BQ	
13	RJ	BP	BQ	
14	RJ	BP	BQ	
15	RJ	BP	BQ	
16	RJ	BP	BQ	
17	RJ	BP	BQ	
20	RJ	BP	BQ	Unused entries
21	RJ	BP	BQ	
22	RJ	BP	BQ	
23	RJ	BP	BQ	
24	RJ	BP	BQ	
	CA	BR25		

	IA	BQ		
0	TP	BP	A	Manipulation to get proper alarm number
1	SS	BR	17	into print-out coding
2	AT	BP1	BQ3	
3	0	30000	30000	
4	TP	BP26	UP3	Print-out
5	RJ	UP2	UP	
6	TP	BQ17	BQ20	Entry for rewind and stop only. Sets index for 7 Uniservos
7	MJ	10000	BQ11	Bypasses next instruction if MJ1 is set
10	TP	BQ16	BQ20	Sets index of rewinding tapes for 5 Uniservos
11	TP	BP44	GT3	"Rewind parameter" to tape handler
12	RJ	GT2	GT	Rewind Uniservo via tape handler subroutine
13	RA	GT3	BP45	Increasing tape handler parameter to rewind next tape
14	IJ	BQ20	BQ12	Jump back to rewind remaining tapes
15	MS	0	ZA	Exit and stop
16	0	0	4	Index Constant (Used by Read Generator also)
17	0	0	6	Index Constant for 7 Uniservos
20	0	0	0	Holds index for rewinding Uniservos
	CA	BQ21		

	IA	BP		
0	0	0	30000	Set by entry "return jump" lines and used to compute alarm no.
1	TP	BP1	BP30	Dummy instruction used to make up instruction BQ3
2	04	77220	10126	1. Δ Δ C
3	05	77220	10126	2. Δ Δ C
4	06	77220	10126	3. Δ Δ C
5	07	77220	10126	4. Δ Δ C
6	10	77220	10126	5. Δ Δ C
7	11	77220	10126	6. Δ Δ C
10	12	77220	10126	7. Δ Δ C
11	13	77220	10126	8. Δ Δ C
12	14	77220	10126	9. Δ Δ C
13	04	03220	10126	10.Δ Δ C
14	04	04220	10126	11.Δ Δ C
15	04	05220	10126	12.Δ Δ C
16	04	06220	10126	13.Δ Δ C
17	04	07220	10126	14.Δ Δ C
20	04	10220	10126	15.Δ Δ C
21	04	11220	10126	16.Δ Δ C
22	04	12220	10126	17.Δ Δ C
23	04	13220	10126	18.Δ Δ C
24	04	14220	10126	19.Δ Δ C
25	05	03220	10126	20.Δ Δ C
26	0	BP27	15	Parameter for print-out
27	24	46245	44701	ALARM Δ
30	0	0	0	Filled in by alarm number computation coding
31	51	47523	44624	O M P I L A
32	66	34515	00134	T I O N Δ I
33	50	26515	06534	N C O N S I
34	65	66305	02673	S T E N C Y
35	01	17525	16565	Δ (P O S S
36	34	25463	00126	I B L E C
37	51	47526	76630	O M P U T E
40	54	01305	45451	R Δ E R R O
41	54	43220	10154	R) . Δ Δ R
42	30	26514	75234	E C O M P I
43	46	30227	77777	L E .
44	10	1	0	Rewind parameter to tape handler
45	0	1	0	Constant (Used in Read Generator also)
	CA	BP46		

Flow Chart for WA, WB "Sentence____(____)" Print-Out - Generation

(Line Number) (Sentence Type)



WA Subroutine to Print-Out "Sentence (Line Number) (Sentence Type)"
without Error Referencing

	IA	WA		
0	MJ	0	30000	Exit
1	MJ	0	WA2	Start
2	TP	WL1	WB3	Line number to print-out storage
3	TP	WL2	A	Sentence type to print-out storage and A
4	TP	A	WB5	
5	TP	WB10	WB6	
6	EJ	WB15	WA15	Is type EQUATN?
7	EJ	WB11	WA16	Is type EQUATI?
10	EJ	WB16	WA20	Is type COMPUT?
11	EJ	WB17	WA22	Is type DIMENS?
12	TP	WB	UP3	Print-Out: Sentence ______(______)
13	RJ	UP2	UP	
14	MJ	0	WA	
15	TP	WB11	WB5	Load EQUATI / ON77—77 into print-out storage
16	TP	WB12	WB6	
17	MJ	0	WA12	
20	TP	WB13	WB6	Load E77____77 into print-out storage
21	MJ	0	WA12	
22	TP	WB14	WB6	Load ION77777 into print-out storage
23	MJ	0	WA12	
	CA	WA24		

	IA	WB		
0	0	WB1	7	Parameter for print-out
1	65	30506	63050	S E N T E N
2	26	30010	17777	C E Δ Δ 77 77
3	0	0	0	Line number
4	01	01011	77777	Δ Δ Δ (77 77
5	0	0	0	Sentence name
6	0	0	0	
7	43	01017	77777	) Δ Δ 77 77 77
10	77	77777	77777	Filler
11	30	53672	46634	EQUATI
12	51	50777	77777	ON 77____77
13	30	77777	77777	E 77____77
14	34	51507	77777	ION 77 - 77
15	30	53672	46650	EQUATN
16	26	51475	26766	COMPUT
17	27	34473	05065	DIMENS
	CA	WB20		

ROUTINE TO CONTROL TRANSFER OF OP FILE 1 ITEMS
AND GENERATED SUBROUTINES TO TAPE

To use Op Control Routine, a parameter word must be sent to Op1 prior to the entry instruction RJ Op Op2. u of Op1 must contain the address of the first line of the generated subroutine; v, the address of the first line of the Op File 1 entry for the subroutine. The function of the routine is to transfer the generated subroutines and Op File 1 items to Uniservos. Z lines are added to fill up the last block of each generated subroutine. 170_8 lines constitute a block.

The actual writing on tape units is done by means of the generalized tape handler routine. The proper parameter words and entries to the tape handler routine are supplied in this Op Control Routine.

The entry instruction of this routine is a return jump to RG subroutine which adds a call word to the Op File and alters the exit line of the generated routine if the sentence generated is the last sentence in a VARY loop.

Op File 1 items are stored in a buffer region, NP, and accumulated until they fill a block, whence they are transferred to tape. Not taken care of in this routine is the final unfilled block of Op File 1 items. The coding necessary to fill this final Op File 1 block with Z's and transfer it to tape is contained in the End of Tape instruction.

The routine handles data stored either in the core or drum. If subroutine data is in the drum and it exceeds a block, it is transferred a block at a time into region GN in the core and thence onto tape. Subroutine data groups less than a block are transferred from drum to core in one set of repeat instructions. Op File 1 data groups in the drum are transferred to NP in the core just as if they were located in the core.

Subroutine data groups in the core are handled somewhat faster. All complete blocks of a subroutine are handled as a single unit in their referral to the generalized tape handler. The last partial block of a subroutine is then transferred to region GN, where the proper number of Z lines is added to make a complete block. This region GN of 170_8 lines is needed only during Op Control operation. Between referrals to the routine it may be used for other temporary purposes. In this respect it differs from region NP which is reserved exclusively for Op File 1 item storage during generation.

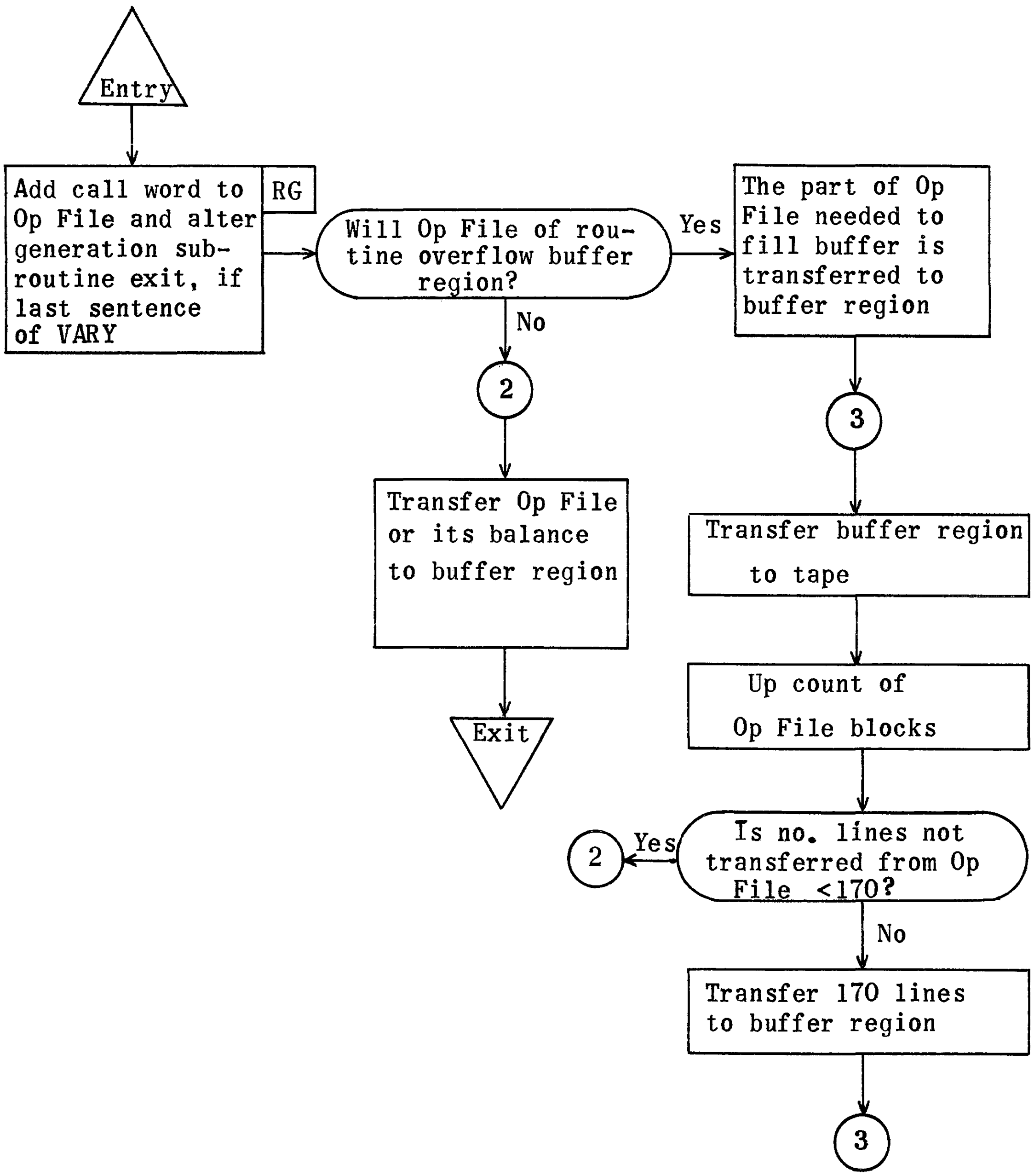
At the beginning of generation instruction RJ RQ RQ1 causes the proper starting blocks to be written on tape, and sets up the proper parameters for the generalized tape handler, depending upon whether 5 or 7 Uniservos are used. On Uniservo for generated subroutines, GEN TAPE is written on the 21st and 22nd lines of the first block, SUBROUTINES on the 1st and 2nd lines of the 2nd block. On Uniservo for Op File items, FILE TAPE and OP FILE 1 are similarly put on the first two blocks, with Z - fillers on the balance of the block lines. The counts of blocks of subroutines and Op File 1 items include these starting blocks.

The v portion of the first line of a subroutine program must contain the number of lines of prelude and routine. Similarly, the v portion of the first line of an Op File 1 item should contain the number of lines in the item. These figures are used in this routine.

ES, the counter for the number of lines in NP, is used in the End of Tape routine to transfer the final Op File 1 block to tape. ES5, the number of blocks of Op File 1 written on tape, and ES6, the number of blocks of subroutines written on tape, are also used in subsequent routines.

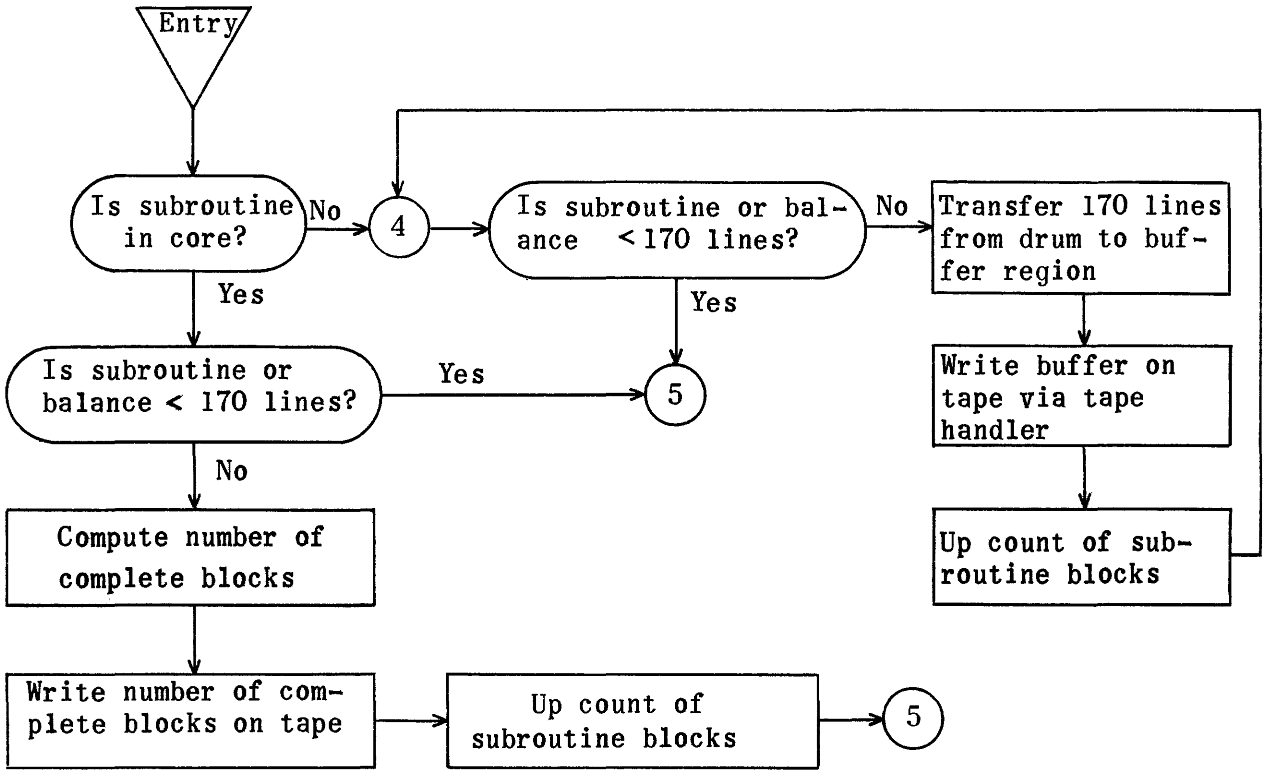
Flow Charts for Op Control Routines - Generation

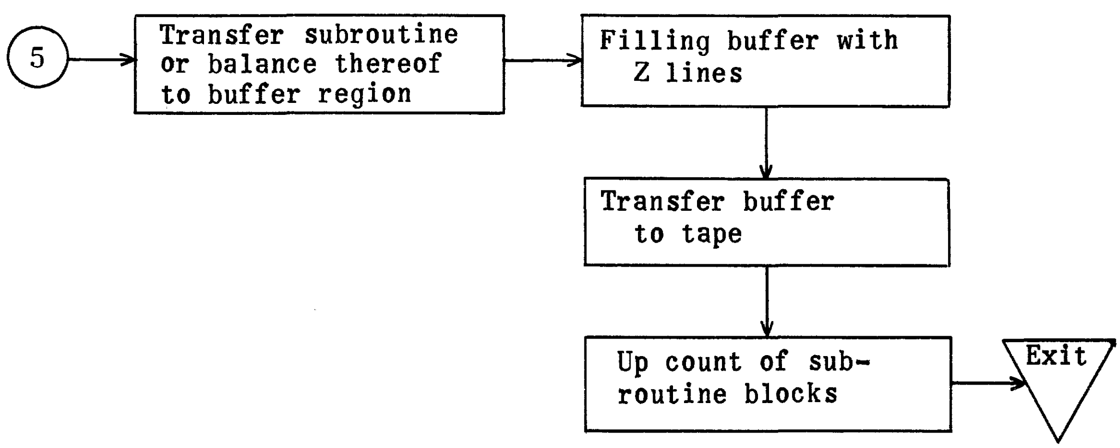
Op Routine To Store Op Files and Write Buffer Loads on Tape



Flow Charts For Op Control Routines - Generation - (Cont.)

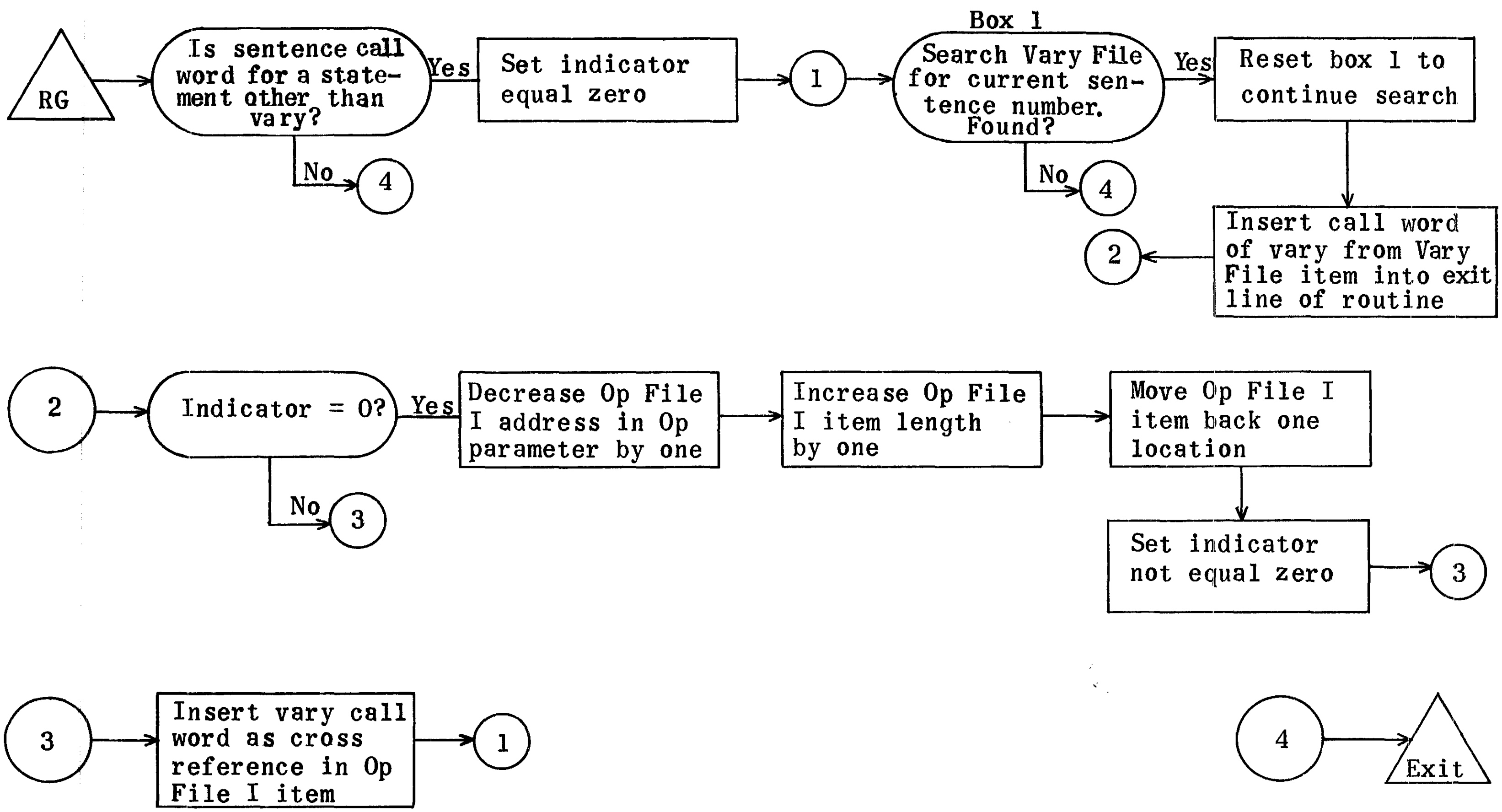
XP Routine To Write Generated Routines on Tape





Flow Charts for Op Control Routines - Cont.

RG Routine to Insert Vary Call Word in Exit Line and in Op File I Item of Last Statement in a Vary Range



OP CONTROL SUBROUTINE

Routine to		IA	OP		
Store Op	0	MJ	0	30000	Exit
Files and	1	0	30000	30000	u = address of 1st line of generated sub-
Write Op					routine. v = address of 1st line of Op File
Files on	2	RJ	RG	RG1	VARY subroutine alters exit lines of routine
Tape					being written on tape
	3	TP	OP1	Q	Address of 1st line of Op File → ES11
	4	QT	GP3	ES11	
	5	SP	OP1	17	
	6	TU	A	OP10	Number of lines in Op File → ES1
	7	TP	GP3	Q	
	10	QT	30000	ES1	
	11	TP	ES	ES2	ES + ES1 → ES2
	12	RA	ES2	ES1	
	13	TJ	GP5	OP44	Does ES2 exceed 170?
	14	TP	GP5	A	Number of lines left to fill NP → ES4
	15	ST	ES	ES4	
	16	SA	GP6	17	Sets up u of repeat command Op 25 so that
	17	TU	A	OP25	proper number of lines needed to fill NP
					are transferred to it
	20	TP	ES	ES3	Sets up v of Op 26 such that Op File items are
	21	RA	ES3	RC1	transferred to correct part of NP
	22	TV	ES3	OP26	
	23	SP	ES11	17	
	24	TU	A	OP26	Sets up u of Op 26 to correct beginning add.
	25	RP	30000	OP27	Transfers Op File items to fill up NP
	26	TP	30000	30000	
	27	TP	RC	GT3	Writes completed NP onto a block of tape
	30	RJ	GT2	GT	
	31	RA	ES5	GP10	Count of Op File blocks
	32	TP	GP7	ES	Clears ES storage
	33	RA	ES11	ES4	ES11 + ES4 → ES11, the next address of Op
					File item to be transferred
	34	RS	ES1	ES4	ES1 - ES4 → ES1, number of lines left in
					Op File item to be transferred
	35	TJ	GP5	OP44	Is 170 > no. of lines left in Op File item?
	36	SP	ES11	17	Setting up u of Op 64 to proper address
1 block of	37	TU	A	OP41	
170 lines	40	RP	30170	OP42	Transferring 170 Op File items to NP
to buffer	41	TP	30000	NP	
region NP	42	TP	GP5	ES4	170 → ES4
for trans-	43	MJ	0	OP27	
fer to	44	TP	ES	ES3	Number lines in NP → ES3
tape	45	TP	A	ES	Number of lines due to be in NP → ES
	46	TP	ES1	A	
Last	47	SA	GP6	17	Sets up u of repeat to proper value
partial	50	TU	A	OP55	
block to	51	RA	ES3	RC1	Sets up v of Op 56 to correct address
NP	52	TV	ES3	OP56	

```
               53  SP  ES11    17      Sets up u of Op 56 to correct address
               54  TU  A       OP56
               55  RP  30000   XP      Transfers last quantity of Op File items to
               56  TP  30000   30000     NP, leaving NP as an unfilled partial
                                         buffer region block.
                   CA  OP57

Routine to         IA  XP
Write Gen-      0  TU  OP1     XP2
erated          1  TP  GP3     Q       Number of lines of subroutine -> ES12
Routines        2  QT  30000   ES12
on Tape         3  LQ  OP1     25      Address of 1st line of subroutines -> ES10
                4  QT  GP3     ES10
                5  TJ  GP6     XP22    If 30000> address, subroutine is in core.
                                         Otherwise, assumed to be in drum
                6  TP  ES12    A       Test to see if subroutine has fewer than
                7  TJ  GP5     XP40      170 lines left
               10  SP  ES10    17      Set-up u of XP13 to right address
               11  TU  A       XP13
Drum           12  RP  30170   XP14    Transfer 170 lines of subroutines to GN
               13  TP  30000   GN
               14  TP  RC4     GT3     Write block on tape
               15  RJ  GT2     GT
               16  RA  ES6     GP10    Count of blocks
               17  RS  ES12    GP5     Reduce ES12 to no. of lines left in subrtne.
               20  RA  ES10    GP5     Increase ES10 to address of next line of sub-
                                         routine to be transferred
               21  MJ  0       XP6
               22  TP  ES12    A       Test for less than 170 lines in subroutine
               23  TJ  GP5     XP40
               24  DV  GP5     ES7     Number of blocks in subroutine -> ES7
               25  TP  A       ES12    Remainder or number lines in last partial
                                         block to ES12
               26  TP  ES7     A       Setting up parameter with correct number of
               27  ST  GP10    A         blocks to be written on tape
Core           30  LA  A       25
               31  AT  RC4     GT3
               32  TV  ES10    GT3     Setting up correct referencing address of
                                         parameter
               33  RJ  GT2     GT      Writing blocks on tape
               34  RA  ES6     ES7     Count of blocks
               35  MP  ES7     GP5     Calculating number of lines written on tape
               36  AT  ES10    ES10    Correcting ES10 address to that of next
                                         line to be transferred
               37  TP  ES12    A       Test to see if any lines left to be written
               40  ZJ  XP41    OP        of subroutine
Partial        41  SA  GP6     17      Setting up u of repeat to proper value
Block          42  TU  A       XP45
               43  SP  ES10    17      Setting up correct referencing address of
               44  TU  A       XP46      next line of subroutine in XP46
               45  RP  30000   XP47    Putting remaining lines of subroutine in GN
               46  TP  30000   GN
```

```
47  TP   GP5     A       Setting up u of XP55 such that remainder of
50  SS   ES12    17        GN is filled with right number of lines of
51  TU   A       XP55      Z's
52  RA   XP55    GP4
53  TV   ES12    XP56    Setting up v of XP56 so that Z lines start
54  RA   XP56    RC3       at right place in GN
55  RP   10000   XP57    Filling up GN with Z's
56  TP   GP2     30000
57  TP   RC4     GT3     Parameter word -> generalized tape handler
60  RJ   GT2     GT      To tape handler
61  RA   ES6     GP10    Count of blocks
62  MJ   0       OP      Exit
    CA   XP63

    IA   RC
 0  71   00105   NP      Parameter word to write 1 block on tape 5
                           from NP
 1  0    0       NP      Address of 1st line of Op File storage
 2  71   00104   GN      Tape 4 parameter write from GN
 3  0    0       GN      Address of 1st line of storage used for a
                           partial block of a gen. routine
 4  0    0       0       Parameter temporary used for writing from GN
                           to either tape 4 or tape 7
    CA   RC5

    IA   GP
 0  01   01015   15201   ΔΔΔ0PΔ
 1  31   34463   00104   FILEΔ1
 2  74   74747   47474   Line of Z's
 3  0    0       77777   Mask
 4  0    10000   0
 5  0    0       170
 6  0    0       30000
 7  0    0       0
10  0    0       1
11  01   65672   55451   ΔSUBRO
12  67   66345   03065   UTINES
13  01   31344   63001   ΔFILEΔ
14  01   66245   23001   ΔTAPEΔ
15  01   01323   05001   ΔΔGENΔ
    CA   GP16
```

Op Control Subroutine-Sequential Uses
of Temporary Storage (ES)

0	Number of lines in NP, buffer region in which Op Files are accumulated for writing on tape.
1	Number of lines in current Op File being stored. Number of lines remaining to be stored from current Op File.
2	Used to accumulate ES + ES1.
3	ES $\rightarrow$ ES3 (ES3 + NP) $\longrightarrow$ ES3, giving the address in NP to which next line is to be transferred.
4	Number of lines put in NP from current Op File the last time a group of lines was transferred.
5	Number of blocks of Op File 1 written on tape.
6	Number of blocks of subroutines written on tape.
7	Number of whole blocks of subroutines to be written on tape.
10	Address of next line of subroutine to be written on tape.
11	Address of next line of Op File to be transferred to NP.
12	Number of lines of subroutines. Number of lines of subroutine in last block.

OP CONTROL SUBROUTINE - RG ROUTINE

To Insert Vary Call Word in Exit Line of Last Statement of Range and in the Op File I Item

		IA	RG		
4	0	MJ	0	30000	Exit
	1	TU	OP1	RG3	Set address of routine into RG3
	2	TP	RG62	Q	u-mask $\rightarrow$ Q
	3	QT	30000	A	Routine CW $\rightarrow$ A
	4	TJ	RG63	RG7	27000 > CW?
	5	TJ	RG64	RG12	No; 30000 > CW?
	6	MJ	0	RG	No; so out
	7	TJ	RG65	RG	22000 > CW? If so, out
	10	TJ	RG66	RG12	No; 23000 > CW?
	11	MJ	0	RG	No; so out
	12	TP	RG62	RG71	Set QJ indicator bit = 0
1	13	TU	VF	RG16	CW = 22 --- or 27 ---
	14	TU	RG70	RG17	Set EJ initially
	15	TP	BK1	A	Sentence number $\rightarrow$ A
	16	RP	30000	RG	Check for matching sentence number in
	17	EJ	30000	RG20	Vary File
	20	SP	RG16	0	jn $\rightarrow$ AR_u
	21	LQ	Q	17	jn — r $\rightarrow$ Q_u
	22	TU	Q	RG16	Set RP for Continuing Search
	23	SS	Q	0	r $\rightarrow$ AR_u
	24	SA	RG17	0	Add r to Starting Point of Previous Search
	25	TU	A	RG17	Reset EJ to continue search at next word
	26	TU	A	RG33	Set address of Vary CW in transfer command
	27	TU	A	RG56	Set Vary CW address in shift command
	30	LQ	OP1	Q25	Address of routine $\rightarrow$ Q_V
	31	TV	Q	RG33	Set routine address in transfer command
	32	RA	RG33	RG67	Set to address of exit line
	33	TV	30000	30000	Transfer Vary CW to exit line of routine
2	34	TP	RG71	Q	Determine if this Op File I item has been
	35	QJ	RG56	RG36	changed before
	36	SP	OP1	17	No, so enter Op File address in A_u
	37	TU	A	RG43	
	40	TU	A	RG50	
	41	TU	A	RG52	Enter Op File I address in commands
	42	TU	A	RG54	
	43	SP	30000	17	Enter # words of item in A_u
	44	SA	RG64	0	Add j = 3
	45	TU	A	RG53	Set into RP
	46	RS	OP1	GP10	Decrease Op File I address in parameter
	47	TV	A	RG54	Set transfer instruction to new address of Op File I item
	50	SA	30000	0	Set address for insertion of new cross
	51	TV	A	RG60	reference
	52	RA	30000	GP10	Increase # words in Op File I item by one

	53	RP	30000	RG55	Move Op File I item up one location
	54	TP	30000	30000	
	55	TP	RG	RG71	Set QJ indicator bit = 1
3	56	SP	30000	17	Vary CW $\rightarrow A_{R_u}$
	57	TP	RG62	Q	u-mask $\rightarrow$ Q
	60	QT	A	30000	Enter Vary CW as Cross Reference in Op File I
	61	MJ	0	RG15	Back to continue search
	62	0	77777	0	
	63	0	27000	0	
	64	0	30000	0	
	65	0	22000	0	
	66	0	23000	0	
	67	0	0	6	
	70	0	VF1	0	
	71	0	0	0	
	72	CA	RG72		

CONSTANT CALL WORD ROUTINE FOR GENERATION

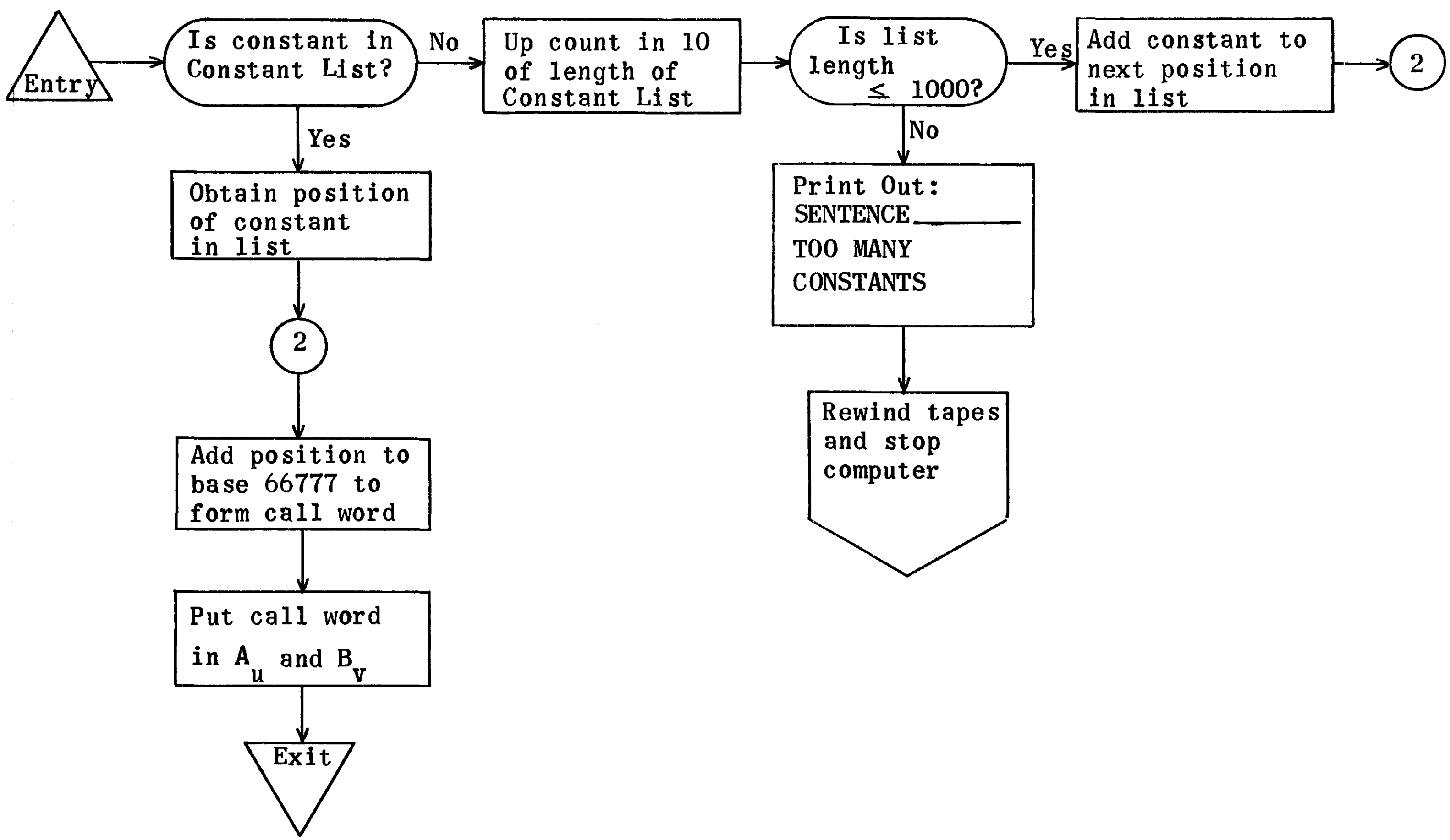
At the start of string-out 00 20000 00000 is put in fixed address 10, which is a counter register for the number of constants. Both u and v of 10 increase with each added constant. If n of 0 2,n n in 10 exceeds 1000_8, the computer stops with the alarm print-out -- (Sentence _______(_______) Too Many Constants.

Input constant goes to A and the instruction RJ CW CW1 activates the routine. The call word output goes to Q_v and A_u.

The routine occupies 36_8 lines in region CW. Region C1, the list of constants, may occupy up to 1000_8 lines in the maximum-size problem. Needed for the alarm print-out is the UP print-out subroutine.

If a constant is already in list CL, entry to the routine gives the call word by determination of its position. If a constant is not in the list, it is added to it and given the next call-word-number assignment.

Flow Chart - CW Call Word Routine of Constants - Generation



Call Word-Generation

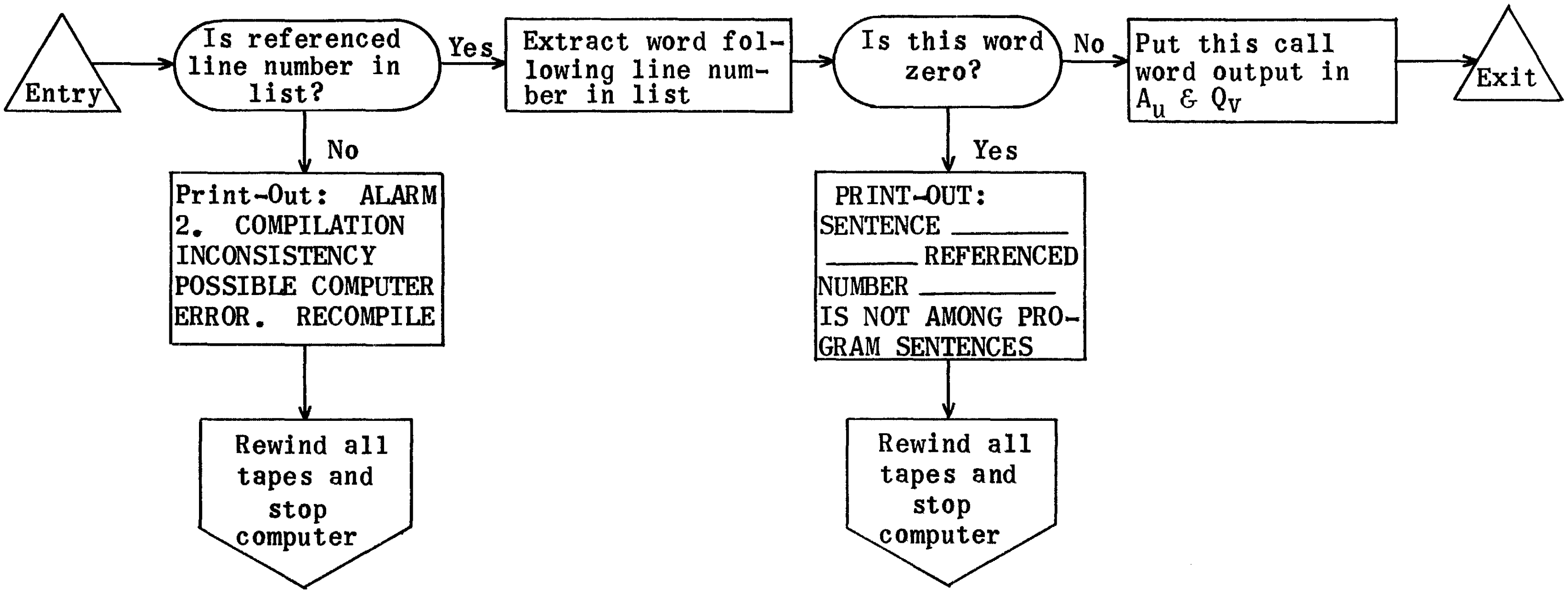
```
                    IA   CW
                0   MJ   0       30000     Exit
                1   TU   10      CW2       Sets up u of repeat by using Constant List
                                             count in 10
                2   RP   30000   CW7  }    Checks to see if constant is in CL, Con. List
                3   EJ   CL      CW4  }
                4   SN   Q       17        [-j, -(n-r)]    (A_R)_u
                5   SA   10      0         [-j, r-n] + [j,n]^u = r -> (A_R)_u
                6   MJ   0       CW22
When con-       7   TP   A       Q         Constant -> q
stant is       10   TV   10      CW20      n -> v of CW17
not in         11   RA   10      CW27      Counter 10 increased by 1
list           12   TJ   CW30    CW17      Is Call List ≤ 1000?
               13   RJ   WA      WA2       Gets sentence number print-out
               14   TP   CW26    UP3  }    Sends parameter to error print-out routine
               15   RJ   UP2     UP   }      and gets print-out:  Too Many Constants
               16   MJ   0       BQ6       Jump to rewind tapes and computer stop rtne.
Adding         17   RA   CW20    CW36      (n + CL) -> v of CW20
Constant       20   TP   Q       30000     Constant added to next position in list
to list        21   SP   10      17        n -> (A_R)u
               22   AT   CW31    Q         (r + 66777)-> q_u.  Call word in q_u
               23   QT   CW35    Q         Extraneous material in q destroyed via mask
                                             and QT. Call word formed in A_u
               24   LQ   Q       25        Call word put in Q_v
               25   MJ   0       CW        Jump to exit
               26   40   CW32    3         Parameter word used in print-out
               27   0    1       1         Used also as a constant in LS routine and in
                                             read generator
               30   0    21001   1001      Threshold check on size of CL
               31   0    66777   0         Base number from which call words are de-
                                             termined by adding to position in list CL
               32   66   51510   14724     T O O △ M A
               33   50   73012   65150     N Y △ C O N
               34   65   66245   6665      S T A N T S
               35   0    77777   0         Mask
               36   0    0       CL        Address of 1st line of Constant List
                    CA   CW37
```

Routine D to Get Call Word of Referenced Line
Number from List IZ - Generation

To use this routine, the referenced line number is put in A. Then instruction RJ LW LW1 will put the call-word output in A_u and Q_v. If a line number is not found in list IZ, the computer will stop with the error print-out: ALARM 2. COMPILATION INCONSISTENCY (POSSIBLE COMPUTER ERROR). RECOMPILE.

If the call word of a line number is not found, the computer will stop with the error print-out: SENTENCE_______(_______) REFERENCED NUMBER _______ IS NOT A PROGRAM SENTENCE.

Flow Chart - LW Generator Subroutine to Get Call Word of Referenced Line Number From Referenced-Line-Number List IZ



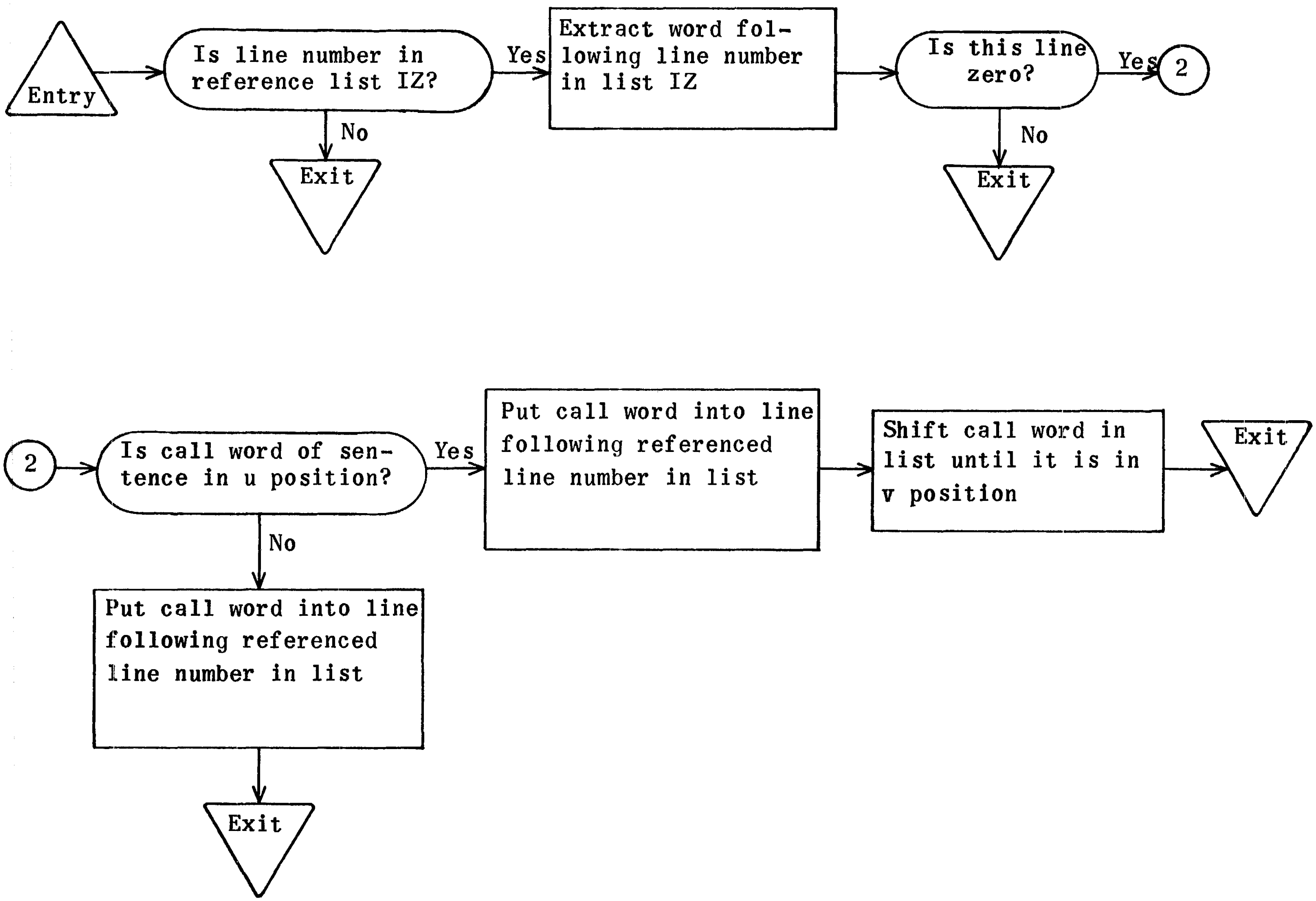
Generation--LW Routine to Get Call Word of Referenced
Line No. from List IZ--Routine D

	IA	LW		
0	MJ	0	30000	Exit
1	TP	A	LW27	Entry. Storing line no. for possible print-out
2	TU	11	LW3	Setting up repeat via Reference List Counter
3	RP	30000	BR2	Search for line number in Line No. Call
4	EJ	IZ	LW5	Word List
5	SN	Q	17	$-[j, (n-r)] = -j, (r-n)$
6	SA	11	0	$[-j, (r-n)] + [j, n] = r$
7	SA	LW23	0	$r + IZ \rightarrow A_u$
10	TU	A	LW11	Setting up u of next instruction
11	TP	30000	A	Call word of line no. $\longrightarrow A_v$
12	ZJ	LW13	LW16	Test if call word is there
13	TP	A	Q	Call word $\longrightarrow Q_v$
14	LA	A	17	Call word $\longrightarrow A_u$
15	MJ	0	LW	
16	RJ	WA	WA2	Sentence no. Print-Out
17	TP	LW22	UP3	Referenced No. -- Is not a Program Sentence.
20	MJ	0	CW15	Jumps to computer stop after rewind tapes via CW routine portion
21	07	77777	77777	Used as a mask in LS routine
22	40	LW24	11	Parameter for Print-Out
23	0	IZ	0	Address of 1st line of line no. list
24	54	30313	05430	R E F E R E
25	50	26302	70150	N C E D △ N
26	67	47253	05401	U M B E R △
27	0	0	0	
30	01	34650	15051	△ I S △ N O
31	66	01240	15254	T △ A △ P R
32	51	32542	44701	O G R A M △
33	65	30506	63050	S E N T E N
34	26	30227	77777	C E .
35	65	77777	77777	Unused
	CA	LW36		

Line Number Check Routine C -- Generation

Instruction RJ HI HI1 activates this routine without input. The routine picks out the line number of the sentence under surveillance from buffer region BK and checks to see if this number has previously been put in Line Number Reference List IZ. If an equality is found, a check is made to see if the call word of the line number has been put in the address following the line number in IZ. If not, the call word of the line number is obtained from the buffer region and inserted in the v part of this location.

Flow Chart for Routine C Generation - HI Reference-List Line-Number Checking Routine



Reference-List Line-Number Checking Routine C-- Generation

		IA	HI		
	0	MJ	0	30000	Exit
	1	TU	11	HI3	Sets up u of repeat by counter 11
	2	TP	BK1	A	Line no. to A
	3	RP	30000	HI	Is line no. in reference list IZ?
	4	EJ	IZ	HI5	
	5	SN	Q	17	$-j,\ (r-n)$
	6	SA	11	0	$j,\ n+[-j,\ (r-n)] = r$
	7	SA	HI26	0	$r + IZ \rightarrow A_u$
	10	TU	A	HI12	Sets up instruction to get call word of line number to A
	11	LQ	HI12	Q25	Puts address in Q_v of line that should have call word
	12	TP	30000	A	
	13	ZJ	HI	HI14	Exit if a call word is there
	14	TP	BK3	A	Call word of sentence to A
	15	TJ	HI27	HI23	Is $[0\ \ 1\ \ 0] >$ (BK3). If so, call word is in v
	16	TV	Q	HI17	Sets up right ref.-list address in v of next
Call word					instruction
of sentence	17	TU	BK3	30000	Call word to line following line no. in ref.
is in u po-					list
sition	20	TU	HI12	HI21	Sets up same ref.-list address in next instruction
	21	LQ	30000	25	Transfers call word to v position
	22	MJ	0	HI	
	23	TV	Q	HI24	Puts address into v of next instruction
Call word	24	TP	BK3	30000	Call word to right line in ref. list
in BK3 is	25	MJ	0	HI	
in v po-	26	0	IZ	0	
sition	27	0	1	0	
		CA	HI30		

KI Illegal Line Jump Check Routine -- Generation

After a call word has been obtained for a line number, it should be put in A_u (the rest of A must be cleared) for this test. (The regular call word output of LW gives the call word as desired in A_u.) In Q should be a pseudo-operation indicator. 40 0 0 indicates that a sentence is within a pseudo op. Zero indicates being outside a pseudo Op. Now instruction RJ KI KI1 will activate this routine.

Four error print-outs occur for attempted illegal jumps. All are prefixed by SENTENCE______

1) JUMP TO SENTENCE OUTSIDE PSEUDO OP FROM WITHIN PSEUDO OP IS NOT PERMITTED.

2) JUMP TO PSEUDO OP LINE FROM OUTSIDE PSEUDO OP IS NOT PERMITTED.

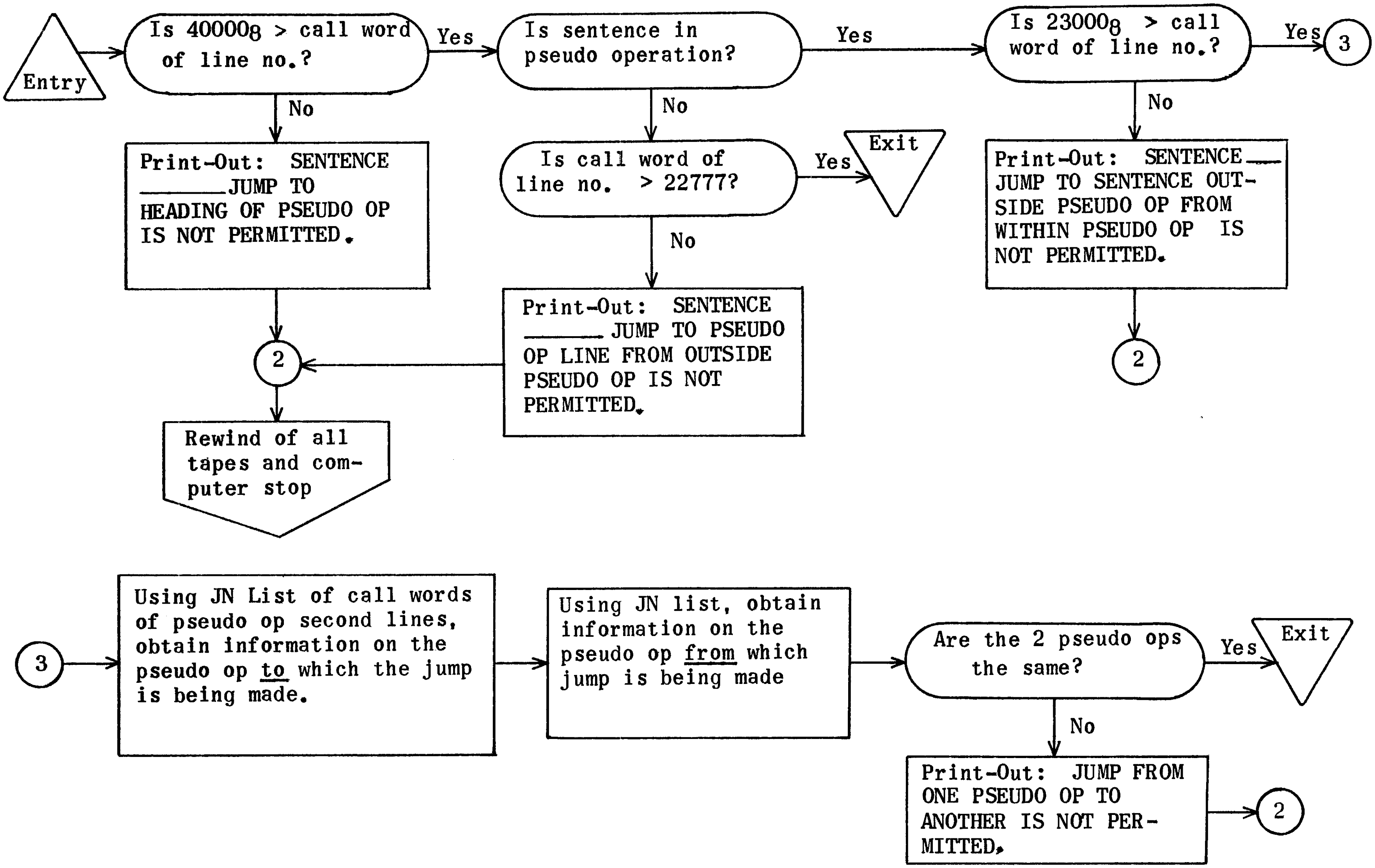
3) JUMP FROM ONE PSEUDO OP TO ANOTHER IS NOT PERMITTED.

4) JUMP TO HEADING OF PSEUDO OP IS NOT PERMITTED.

The computer stops after each of these print-outs and all tapes are rewound.

The call word comparisons within the routine are based on the convention that all sentences within a pseudo op, except the first, have a call word less than 23000 and all sentences outside a pseudo op have a call word greater than 22777. The call word of the first line or heading of a pseudo op is 40000 plus. Only the compute instruction may reference this line. A list JN of 2nd line pseudo-op call words is used to check illegal jumps from one pseudo op to another.

KI Illegal Line Jump Check Routine - Flow Chart
Line No. Call Word Input in A_u — Pseudo-Op Indicator in Q



KI Illegal Line Jump Check Routine--Generation

Line No. Call Word Input in A_u
Pseudo-Op Indicator in Q

		IA	KI		
	0	MJ	0	30000	Exit
	1	TP	BK1	KI57	Line No. to Print-Out Storage
	2	TJ	KI54	KI10	Is 40000 > call word of line no.?
	3	TP	KI46	UP3	Sentence ______ΔJumpΔ
	4	RJ	UP2	UP	
	5	TP	KI51	UP3	To heading of pseudo-op is not permitted
	6	RJ	UP2	UP	
	7	MJ	0	BQ6	Jump to rewind of servos and computer stop
Call word	10	QJ	KI11	KI14	Is sentence within pseudo-op?
< 40000	11	TJ	KI52	KI23	Is 23000 > call word of line no.?
within	12	TP	KI45	UP3	Sentence______Jump to sentence outside
pseudo-op	13	MJ	0	KI6	pseudo op from within pseudo op is not permitted
Outside	14	TP	A	Q	Line no. call word Q_u
pseudo-op	15	TP	KI53	A	Is line no. call word > 22777?
	16	TJ	Q	KI	
	17	TP	KI46	UP3	Sentence______Jump
	20	RJ	UP2	UP	
	21	TP	KI47	UP3	To pseudo op sentence from outside pseudo op
Within	22	MJ	0	KI6	is not permitted
pseudo-op	23	TU	JN	KI24	Setting up u of next instruction for comparison of line no. call word with list JN of pseudo op 2nd lines
	24	RP	20000	KI41	Purpose of comparison is to find via Q to
	25	TJ	JN1	KI26	which pseudo op jump is being made
	26	TP	Q	KI126	
	27	TU	JN	KI31	Setting up u of instruction to number within JN list plus 20000
	30	SP	BK3	17	Getting call word of sentence to u of A
	31	RP	20000	KI43	Determining via Q in which pseudo op we
	32	TJ	JN1	KI33	are operating
	33	TP	KI126	A	If pseudo op in which we are operating is
	34	EJ	Q	KI	the same as pseudo op to which we are jumping, Q and KI126 will be equal
	35	TP	KI46	UP3	Sentence______Jump
	36	RJ	UP2	UP	
	37	TP	KI50	UP3	From 1 pseudo op to another is not permitted
	40	MJ	0	KI6	
	41	TP	JN	KI126	
	42	MJ	0	KI27	
	43	TP	JN	Q	
	~~44~~	~~MJ~~	~~0~~	~~KI33~~	
	45	0	KI55	20	Parameter for Sentence______Jump to Sentence outside pseudo op from within pseudo op is not permitted

46	0	KI55	4	Parameter for Sentence_______Jump
47	40	KI75	12	Parameter for __ to pseudo op sentence from outside pseudo op is not permitted
50	40	KI107	10	Parameter for __ from one pseudo op to another is not permitted
51	40	KI117	7	Parameter for __ to heading of pseudo op is not permitted
52	0	23000	0	
53	0	22777	0	
54	0	40000	0	
55	65	30506	63050	S E N T E N
56	26	30017	77777	C E △
57	0	0	0	
60	01	44674	75201	△ J U M P △
61	66	51016	53050	T O △ S E N
62	66	30502	63001	T E N C E △
63	51	67666	53427	O U T S I D
64	30	01526	53067	E △ P S E U
65	27	51015	15201	D O △ O P △
66	31	54514	70171	F R O M △ W
67	34	66333	45001	I T H I N △
70	52	65306	72751	P S E U D O
71	01	51520	13465	△ O P △ I S
72	01	50516	60101	△ N O T △ △
73	52	30544	73466	P E R M I T
74	66	30272	27777	T E D .
75	66	51015	26530	T O △ P S E
76	67	27510	15152	U D O △ O P
77	01	46345	03001	△ L I N E △
100	31	54514	70151	F R O M △ O
101	67	66653	42730	U T S I D E
102	01	52653	06727	△ P S E U D
103	51	01515	20134	O △ O P △ I
104	65	01505	16601	S △ N O T △
105	52	30544	73466	P E R M I T
106	66	30272	27777	T E D .
107	01	31545	14701	△ F R O M △
110	51	50300	15265	O N E △ P S
111	30	67275	10151	E U D O △ O
112	52	01665	10124	P △ T O △ A
113	50	51663	33054	N O T H E R
114	01	34650	15051	△ I S △ N O
115	66	01523	05447	T △ P E R M
116	34	66663	02722	I T T E D .
117	66	51013	33024	T O △ H E A
120	27	34503	20151	D I N G △ O
121	31	01526	53067	F △ P S E U
122	27	51015	15201	D O △ O P △
123	34	65015	05166	I S △ N O T
124	01	52305	44734	△ P E R M I
125	66	66302	72277	T T E D .
126	0	0	0	
	CA	KI127		

LS Library List Routine - Generation

The list LN built up on the drum starting at 50046 during Generation is a list of call words of library routines referenced.

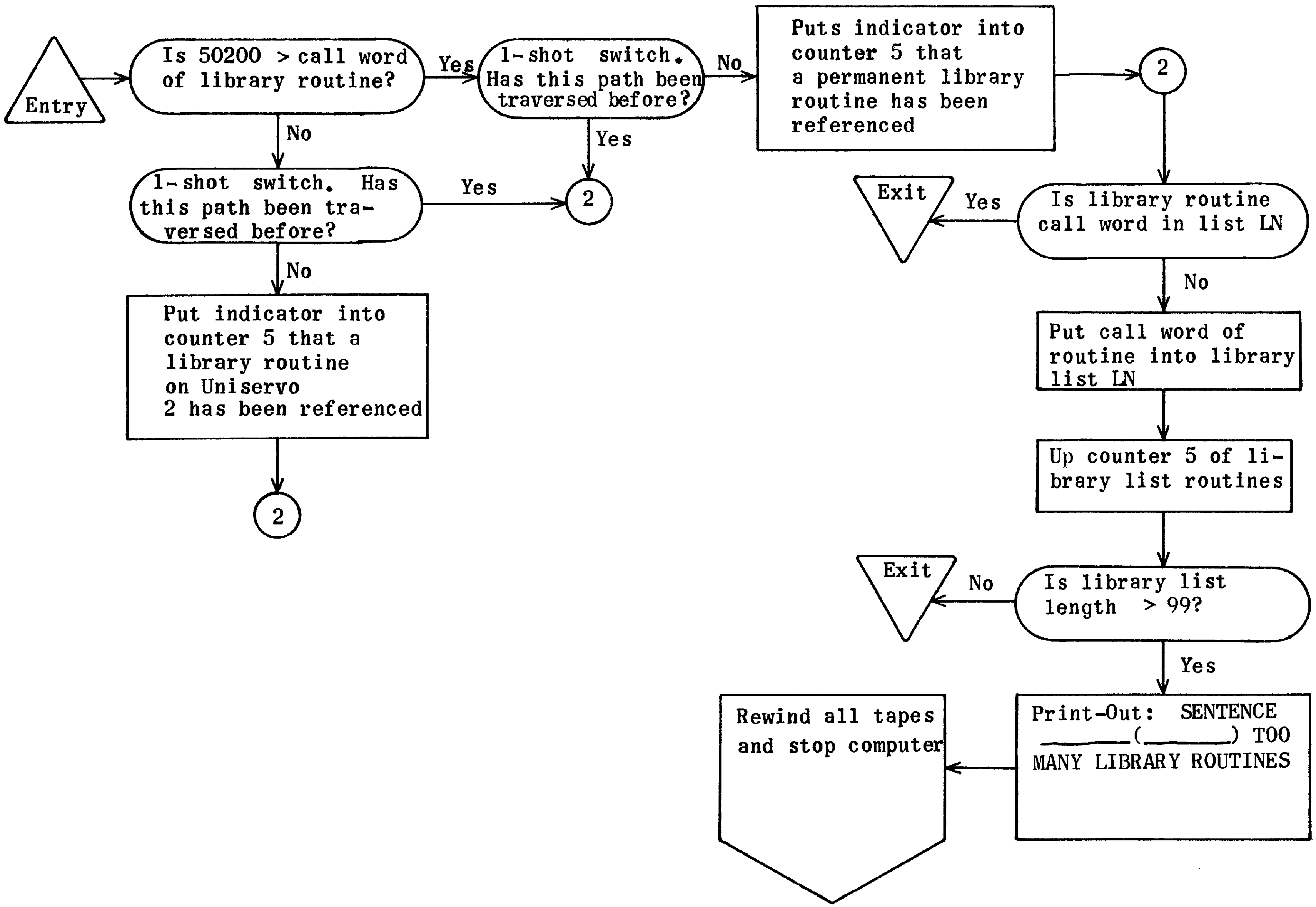
Each call word is stored in the u position. Call words less than 50200 designate Permanent Library Routines. Call words ≥ 50200 designate library routines which have been put on the library tape on Uniservo 2 by the Librarian.

LS Library List Routine distinguishes between the two types of library routines referenced and by means of two one-shot switches puts an indicator into counter 5 the first time each of the types is used. If a Permanent Library Routine has been referenced, 40 is put into the operation portion of counter 5. If a library routine from Uniservo 2 has been referenced, 20 is put into the operation portion of counter 5. Of course, when both types have been referenced, 60 is in the operation portion of 5.

The input to the routine is the call word of the library routine in A_u. A search is made of the list to see if that call word has previously been put in. If it is already there, a quick exit occurs. If it is not there, it is put in the list at the next empty space and counter 5 is increased by 00 00001 00001 to w0 2000n n where w is the indicator mentioned above and n is the cumulative number of call words in the list. Before the exit, a check is made to see if n is less than 100. If it is not, the following print-out occurs: SENTENCE_______(_______) TOO MANY LIBRARY ROUTINES.

The blanks in this print-out are filled in, respectively, by a line number and the sentence type. Of course, if this improbable print-out occurs, all the tapes are rewound and the computer stops.

Flow Chart for Generation LS Library List Routine



Library List Routine--Generation

Input Call Word in A_u

	IA	LS		
0	MJ	0	30000	Exit
1	TP	A	Q	Call Word → q
2	TJ	LS40	LS7	Is 50200 > call word? If so, a Permanent Library Routine is being referenced
3	RJ	LS3	LS5	Call word is ≥ 50200
4	MJ	0	LS12	
5	CC	5	LS42	Puts indicator that library routine from Uniservo 2 is being referenced into 5
6	MJ	0	LS12	
7	RJ	LS7	LS11	
10	MJ	0	LS12	
11	CC	5	LS41	Puts indicator that a Permanent Library Routine has been referenced into 5
12	TP	Q	A	Call Word → A
13	TU	5	LS14	Sets up u of repeat so that library list may be compared
14	RP	20000	LS16	If library routine is already in list, go to exit
15	EJ	LN	LS	
16	TV	5	LS20	Putting library routine call word in list LN when it has not been found there
17	RA	LS20	LS37	
20	TP	Q	30000	
21	RA	5	CW27	Adding 0 1 1 to counter 5
22	TP	LW21	Q	Putting mask 07 77777 77777 into q
23	QT	5	A	Masking indicator bits out of 5 for transfer to A as 0 2000n n
24	TJ	LS36	LS	Is 00 20100 00100 > A. Thus n, number of routines, must be < 100_{10}
25	RJ	WA	WA2	Print-Out: SENTENCE_____(_____) TOO MANY LIBRARY ROUTINES. Rewinds tapes and stops computer
26	TP	LS30	UP3	
27	MJ	0	CW15	
30	40	LS31	5	Parameter for print-out
31	66	51510	14724	T O O Δ M A
32	50	73014	63425	N Y Δ L I B
33	54	24547	30154	R A R Y Δ R
34	51	67663	45030	O U T I N E
35	65	77777	77777	S
36	0	CI20000	CI	Threshold for number of library routines. CI = 100_{10}
37	0	0	LN	Address of 1st line of library list
40	0	50200	0	Call word of 1st non-permanent library routine
41	40	0	0	Indicator that a Permanent Library Routine has been referenced
42	20	0	0	Indicator that Uniservo 2 Library Routine has been referenced
	CA	LS43		

Routine for Conversion of Excess-Three to Flex Code

Three regions -- VX (154_8 addresses), FC (100_8 addresses), and VE (6 addresses) -- comprise the total 262_8 needed for this routine.

The parameter input line, VX4, holds the address of the first line of input in the u portion. In the v portion is given the number of words of input. If every other line starting with the first address is to be selected as input, 40 is put in the operation code of VX4. If every line following the first address is to be used, 00 is put in the operation code.

In the u portion of VX3, the desired address of the first line of output should be supplied. V of VX3 must be zero before entering routine. The routine when operated by instruction RJ VX2 VX will supply in the v portion of VX3 the number of words of output. The Flex code output is packed from the left with the necessary added shift-up or shift-down Flex codes.

Every excess-three character from 00 to 76 has a corresponding Flex code or set of Flex codes assigned to it as shown on the accompanying table. 77, though assigned Flex code 77, is not stored in the output.

Because of the addition of shift-up and shift-down Flex codes and the fact that some excess-three characters are represented by more than one Flex code, greater storage space must be allowed for the output than is needed for the input.

In the table the first digit of each Flex code representation is not stored in the output. It is used only to distinguish between lower-case and capital letters. A 4 in the first position indicates lower-case; 0 indicates capital.

A basic assumption in this routine is that the characters on the Flexowriter are in the standardized form shown in Table I on page 15 of PX38 (Input and Output Systems - Univac Scientific). Any changes made on the Flexowriter keyboard from this standard will cause erroneous results in the print and type instructions of UNICODE.

The keyboard of the Unityper is assumed to be in accordance with the changes proposed on the two pages following the code table. See Chapter 8, Tape Preparation, of the UNICODE Manual for an explanation of a system of bypassing this requirement of an altered keyboard.

Excess Three to Flex Code Table

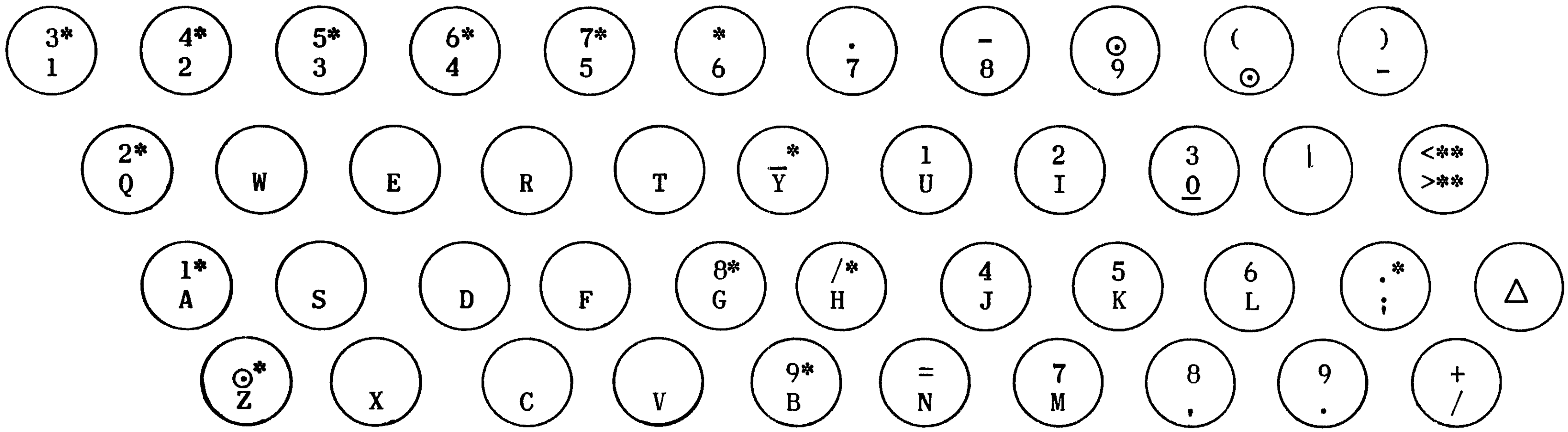
Excess Three Character Where Different	Excess Three Code	Flex Code	Character
	0	056	-
	1	004	Space
	2	456	———
	3	437	0
	4	452	1
	5	474	2
	6	470	3
	7	464	4
	10	462	5
	11	466	6
	12	472	7
	13	460	8
	14	433	9
/	15	054	/
>	16	413 01 12	gtr
	17	046	(
	20	070	\3/
	21	446	,
	22	442	.
;	23	446	,
	24	030	A
	25	023	B
	26	016	C
	27	022	D
	30	020	E
	31	026	F
	32	013	G
	33	005	H
	34	014	I
	35	062	\5/
	36	060	\8/
<	37	411 24 12	lsr

Excess Three to Flex Code Table (Cont.)

Excess Three Character Where Different	Excess Three Code	Flex Code	Character
	40	074	\2/
	41	064	\4/
	42	450	|
	43	042	)
	44	032	J
	45	036	K
	46	011	L
	47	007	M
	50	006	N
	51	003	O
	52	015	P
	53	035	Q
	54	012	R
	55	066	\6/
*	56	427 61 54	*
	57	033	\9/
	60	037	\0/
	61	052	\1/
	62	044	\./
	63	454	+
	64	054	/
	65	024	S
	66	001	T
	67	034	U
	70	017	V
	71	031	W
	72	027	X
	73	025	Y
	74	021	Z
	75	072	\7/
	76	444	=
	77	077	Ignore

Proposed Unityper Changes

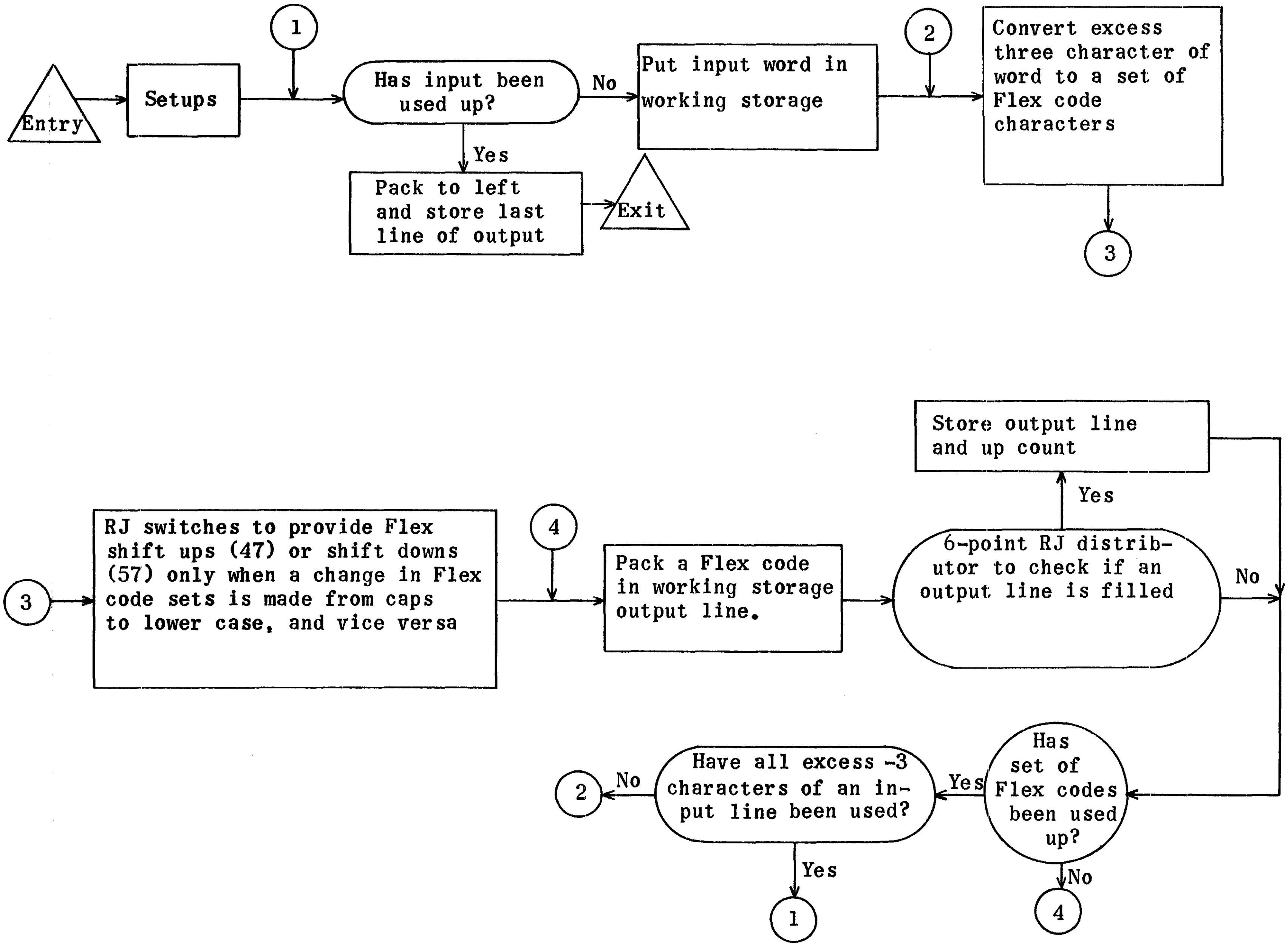
PRESENT			PROPOSED ADDITIONS	
PULSE CODE	NAME	SYMBOL	NAME	SYMBOL
00 0000	Ignore	$\not{i}$	Superscript minus	-
00 1101	Apostrophe	'	Superscript slash	/
00 1110	Ampersand	&	Greater than	>
01 0000	Carriage return	$\not{r}$	Superscript three	3
01 1101	Number	#	Superscript five	5
01 1110	Cent	¢	Superscript eight	8
01 1111	At one	@	Less than	<
10 0000	Tab	$\not{t}$	Superscript two	2
10 0001	Quotation	"	Superscript four	4
10 1101	Dollar	$	Superscript six	6
10 1111	Question	?	Superscript nine	9
11 0000	Sigma	Σ	Superscript zero	⊙
11 0001	Beta	β	Superscript one	1
11 0010	Colon	:	Superscript decimal point	.
11 1101	Per cent	%	Superscript Seven	7



	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
00	−* ~~l~~	△	−	⊙	1	2	3	4	5	6	7	8	9	/* '	>** Ɛ	(
01	3* ~~r~~	,	.	;	A	B	C	D	E	F	G	H	I	5* #	8* ¢	<**
10	2* ~~t~~	4* "	|	)	·J	K	L	M	N	<u>O</u>	P	Q	R	6* $	*	9* ?
11	0* Σ	1* β	·* :	+	/	S	T	U	V	W	X	Y	Z	7* %	=	

* Superscript symbols
** New symbols

Excess Three To Flex Code Subroutine Flow Chart



Excess-Three to Flex Code Subroutine

			Must be set at zero before using subroutine
VX3 =		Address of 1st line of output	No. of words of output
VX4 =	00 if every line. 40 if every other line	Address of 1st line of input	No. of words of input

```
    IA  VX
 0  MJ  0       VX5      Entry
 1  RJ  0       0
 2  MJ  0       30000    Exit
 3  0   0       0
 4  0   0       0
 5  TP  VX152   VE5      Set up input line character index
 6  RP  10005   VX10  }  Set up n-point distributor
 7  TV  VX141   VX65  }    to beginning values
10  TV  VX140   VX72  }
11  TV  VX136   VX47  }  Set up to insure that the output will start
12  TV  VX137   VX54  }    with either a shift up or shift down
                                                  47          57
13  TP  VX150   VE    }  Clear 2 addresses of working storage
14  TP  VX150   VE1   }
15  TP  VX4     Q        Parameter VX4 -> q
16  QJ  VX17    VX21     Test to see if 40 is in operation code of q
17  TP  VX153   VE2      [0 2 0] ->VE2 to enable input address to be
                           incremented so every other line is taken
20  MJ  0       VX22
21  TP  VX147   VE2      [0 1 0] -> VE2
22  TV  VX4     VE       Number of words of input -> VE
23  TU  VX4     VX31     Address of 1st input line-> u of VX31
24  TU  VX3     VE3   }  Address of 1st output line-> v of VE3
25  LQ  VE3     25    }
26  TV  VE3     VX102    Address of 1st output line-> v of VX102
27  IJ  VE      VX31     Index jump for number words of input
30  MJ  0       VX121
31  TP  30000   VE4      Line of input -> VE4
32  LQ  VE4     17       Initial shift of input line so 1st character
                           will be in proper position
33  LQ  VE4     6        Puts character XY to be masked out in right
                           side of u of VE4
34  TP  VX142   A     }  [SP  fc  0] + [0  xy  0]->[SP  fc + xy 0]
35  QA  VX143   VX36  }  ->VX36
36  0   0       0     }
37  EJ  VX151   VX115    If Flex code picked up is a 77, storing part
                           of routine is bypassed
40  LA  A       44       A_R --> A_L
```

41	SJ	VX42	VX45	Test if character is lower case. Negative means lower case
42	LA	A	3	Left shift and split subtract to eliminate 4 from Flex code representation
43	SS	A	0	
44	MJ	0	VX47	Jump to switch
45	LA	A	3	Left shift to properly position Flex code at far left of A_L
46	MJ	0	VX54	Jump to switch
47	RJ	VX54	VX55	Entry↓Switch to provide shift ups and shift downs in output only when a change is made from lower case to caps or vice versa
50	RJ	VX54	VX52	
51	MJ	0	VX73	↑ Exit. No action.
52	SA	VX145	0	
53	MJ	0	VX60	↑ Exit.
54	RJ	VX47	VX50	Entry ↑
55	RJ	VX47	VX57	
56	MJ	0	VX73	↓ Exit - no action.
57	SA	VX144	0	↓ Exit.
60	LQ	VE1	6	When Switch has provided a 47 or 57 to be inserted in VE1, these three steps pack the Flex code into the output line
61	SA	VE1	0	
62	TP	A	VE1	
63	SS	A	0	Clears A_R
64	RJ	VX64	VX65	N-Point Distributor used to determine when each output line has received its six Flex code characters
65	RJ	VX64	VX101	
66	RJ	VX64	VX101	
67	RJ	VX64	VX101	
70	RJ	VX64	VX101	
71	RJ	VX64	VX101	
72	MJ	0	VX102	
73	LA	A	6	A no-action exit from the Switch causes subroutine to transfer the Flex code character to the output, following which A_R is cleared, and a jump is made to the n-point distributor
74	LQ	VE1	6	
75	SA	VE1	0	
76	TP	A	VE1	
77	SS	A	0	
100	MJ	0	VX64	
101	ZJ	VX73	VX115	When a = 0?, an excess-three character has had its Flex code set used up
102	TP	VE1	30000	Completed output line is stored
103	SA	VX102	0	v of instruction VX102 is increased by 1
104	SA	VX146	0	
105	TP	A	VX102	
106	SS	A	0	Clears A_R
107	TP	VX150	VE1	Output line is cleared
110	SA	VX3	0	Number of words of output is increased by 1
111	SA	VX146	0	
112	TP	A	VX3	
113	SS	A	0	
114	MJ	0	VX101	
115	IJ	VE5	VX33	Index jump to determine when a line of input has been exhausted
116	TP	VX152	VE5	Index is set up for next input line

117	RA	VX31	VE2	VX31 is increased to take next line of input
120	MJ	0	VX27	Jump back to input-word index
121	TP	VE1	A	Test to see if output line is empty
122	ZJ	VX123	VX2	
123	TV	VX134	VX72	Setting up n-point distributor to handle last line of output
124	RP	10005	VX126	
125	TV	VX135	VX65	
126	LQ	VE1	6	Loop of left shifting until elements in VE1 are in leftmost position
127	MJ	0	VX64	
130	TP	VX102	VX131	Putting last line into output
131	0	0	0	
132	RA	VX3	VX146	Completing count of output lines
133	MJ	0	VX2	Handling final line of output
134	0	0	VX130	
135	0	0	VX126	
136	0	0	VX55	
137	0	0	VX50	
140	0	0	VX102	
141	0	0	VX101	
142	SP	FC	0	
143	0	77	0	
144	0	0	57	
145	0	0	47	
146	0	0	1	
147	0	1	0	
150	0	0	0	
151	07	70000	0	
152	0	0	5	
153	0	2	0	Constant (used also by Read Generator)
	CA	VX154		

Region FC of Flex codes is not shown here because it has previously been given in the section explaining the tables used in the translation phase.

EXCESS-THREE TO FLEX CODE
USES OF WORKING STORAGE VE

0 Index for number of words in input.

1 For assembling output characters.

2 To increment address from which input lines are taken.

3 To assemble first address of output.

4 To store line of excess-three characters while working on it.

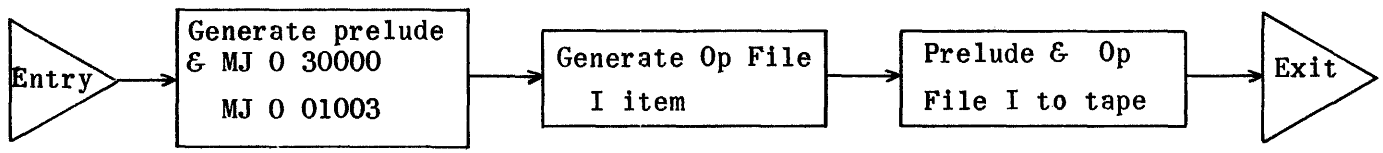
5 Character index per line of input.

3. GENERATORS

3. GENERATORS

The generators are described in the order in which they are loaded on the drum. See Generation Subroutine Regions in the preceding section for this order.

Start Generator Flow Chart



START GENERATOR SUBROUTINE

```
        RE    PT2512
        RE    PL5360
        RE    FL2542

        RE    OP1047            Generation subroutine
        RE    WL2242            Input to generator

        IA    PT
    0   MJ    0        30000    Exit
    1   RP    30010    PT3    } Generate Prelude format
    2   TP    PT16     PL     }
    3   SP    WL3      17     } Sentence call word to prelude
    4   TU    A        PL     }
    5   TP    WL1      PL5      Standard line no.
    6   RP    30002    PT10   } Generate Op File I format
    7   TP    PT26     FL     }
   10   SP    WL3      17     } Sentence call word to Op File I
   11   TU    A        FL     }
   12   TP    PT15     OP1    } Parameters to Op (--> tape)
   13   RJ    OP       OP2    }
   14   MJ    0        PT       Exit
   15   0     PL       FL       Parameters
   16   0     0        10     }
   17   0     0        2      }
   20   0     0        0      }
   21   0     0        0      } Prelude format
   22   0     0        0      }
   23   0     0        0      }
   24   MJ    0        30000  }
   25   MJ    0        01003  }
   26   0     [0]      2      } Op File I format
   27   0     0        2      }
        CA    PT30
```

Jump Generation Routine

The string-out input to the Jump Generator consists of 6 lines. The first four conform to the standard format: number of words in string-out in v part of first line, line number in second line, title in third line, and call word of sentence in v part of fourth line. The fifth line contains the line number of the line to which the jump is to be executed. The sixth line contains 40 0 0 if the sentence is within a pseudo op; if not, it is cleared.

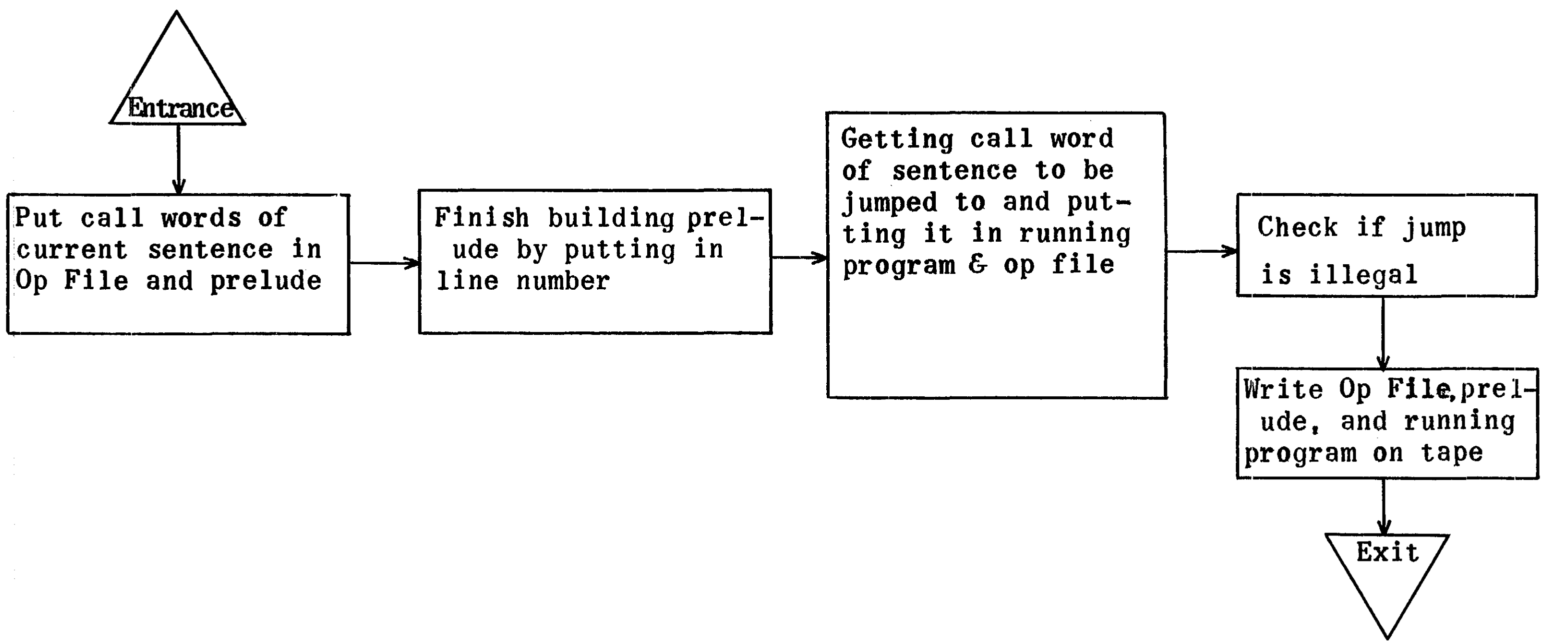
The Jump Generator builds up the Op File, prelude, and running program from this data. The first line of the generated running program is a dummy line, MJ 0 30000, put in to conform to the standard format of all generated running programs. In the v part of the second running program line is put the call word of the sentence to which the jump is to be made. Following this line is the ten line, 10 0 1, put in to ensure that the jump will be made to the second line of running program generated for the sentence. The first line of any running program has been standardized as the exit line of that segment of coding.

Also put in the Op File is the call word of the line number to which the jump is to be made.

A separate routine, KI, is used to determine if the jump is permitted. Jumps may be made within a pseudo operation <u>only</u> to other sentences that are also within the same pseudo op. Jumps may not be made from outside a pseudo op to sentences within a pseudo op. Jumps may not be made to the first line or initial heading of a pseudo op.

As with other generation routines, the final instruction is the reference to the op routine which stores the Op File and writes the generated routine on tape.

Jump Generation Flow Chart



Jump Generation

```
    RE    JU2512
```

Generation Subroutine regions are also needed to assemble this tape

```
    IA    JU
 0  MJ    0       30000
 1  SP    BK3     17       Call word of sentence to 1st line of Op
 2  TU    A       JU17       File in u position
 3  TU    A       JU22     Call word of sentence to 1st line of
                             prelude in u position
 4  TP    BK1     JU27     Line no. to prelude
 5  TP    BK4     A        Getting call word of line number to be
 6  RJ    LW      LW1        jumped to from ref. list
 7  TV    Q       JU31     Call word to v of running prog. jump line
10  TU    A       JU21     Call word to Op  File cross reference
11  TP    BK5     Q        Puts pseudo op  indicator into Q
12  RJ    KI      KI1      Check to see if jump is permitted
13  TP    JU16    OP1      Writes Op File & prelude & running program
                             on tape
14  RJ    OP      OP2
15  MJ    0       JU       Exit
16  0     JU22    JU17     Parameter for writing Op File & generated
                             routine on tape
17  0     30000   3
20  0     0       2        Op File "dummy" lines
21  0     30000   0
22  0     30000   11
23  0     0       3
24  0     0       0
25  0     0       0        Prelude "dummy" lines
26  0     0       0
27  0     0       0
30  MJ    0       30000
31  MJ    0       30000    Running program "dummy" lines
32  10    0       1
    CA    JU33
```

If Generation

The "if" string-out output VN - VN33, as described in the write-up for same, becomes the input BK - BK33 of this routine. KB, the control routine, generates the coding needed for obtaining the variables or constants to be compared. If X or Y is a subscripted variable, a relative constant call word (10000 or 10001) is assigned to it in the coding. The regular call word of X or Y is stored following the generated routine. The processor later replaces the 10000 call word with the address of this stored call word. The stored call word in turn is replaced by the address of the first line of the array of the variable. This obviates the necessity of the routine keeping track of where the call word of the variable has been put and putting this address relative to 1000 in wherever a reference is made to the variable.

When X or Y is a pseudo op subscripted variable, this indirect method is no longer necessary. Because the pseudo op call word is a call word of a call word, the address is obtained by using it directly.

KB uses KC routine to generate the coding needed for getting the right address of an item in an array of values of a subscripted variable. The number of subscripts of a subscripted variable must never be zero. The call word of the first line of an array is obtained by using the subscripts but giving them zero value. Operation of KC is based upon the following formula:

$$1\ [X(I,J,K,L)] = 1\ [X(0,0,0,0)] + [I \cdot M_I + J \cdot M_J + K \cdot M_K + L] \text{ Modulus } Z$$

Z, the modulus, is the product of the number of values assignable to each subscript in the dimension statement. The subscripts vary from right to left. $M_K = L_D$ where L_D means the number of values retained for L as shown in dimension statement, viz: DIM $X(I_D,J_D,K_D,L_D)$. $M_J = K_D \cdot L_D$. $M_I = J_D \cdot K_D \cdot L_D$. $Z = I_D \cdot J_D \cdot K_D \cdot L_D$. $1\ [X(0,0,0,0)]$ means the address of the variable whose subscripts are zero. Thus, it is the address of the first line in an array. It is located by use of the relative constants 10000 and 10001, as explained above.

Thus the program divides the sum of the products and the value of L by the modulus Z. The remainder in A is added to the address represented by

1 [X(0,0,0,0)] to give the final address of 1 [X(I,J,K,L)]. This address is transferred to A_u where it is used in a TU instruction to set up a TP instruction that will put the variable into a temporary storage location, 60000 for X and 60001 for Y. Following instructions give X and Y absolute or negative values, if desired. The processor changes 60000 and 60001 to assigned addresses.

Coding for the tests needed is now generated. The threshold jumps that make the tests go to manual jumps within the coding. This is done to facilitate segmentation. In the v addresses of these manual jumps is put the call word of the line number to which the main jump is to be made. Following the manual jumps, "10 lines" are put to ensure that the jump to coding of a sentence goes to the second line of the coding, the first line being an exit.

Subroutine KD generates the test coding for the situation in which three line numbers of possible jumps have been supplied in the string-out input. Subroutine KF takes care of the case in which there are two line numbers and one test which divides X and Y into two exhaustive categories. Also taken care of in this routine is the situation in which two tests are requested but no third line number is given for a final jump in case both fail. In the latter instance, of course, the jump is made back to the beginning address, 1000, of the coding. From here, a jump is made to the second line of the coding for the subsequent sentence.

Subroutine KK takes care of the case when just one test is made in an "if" sentence. In addition, a segment of it handles the details of termination and references the op routine to get the Op File and generated routine written on tape.

KH consists of a group of subroutines which assist in all the functions described above. The Op File is stored and built up here. In its initial form KH57 holds 0 30000 2 in the first line of Op File. This line is not preset at the start of a use of the Generation Routine. Hence, it becomes necessary to transfer the generation coding afresh either from drum or tape prior to each use of it. The v of this instruction is added to as lines are filled in the Op File. One subroutine of KH keeps a count of the line of the running program relative to 1000 as it loads output region GL. This count, called

100x on "if" generation annotated coding, is used to compute jump addresses and to calculate total lines at end of "if" generation.

Print-outs that may occur during "if" generation are those which accompany use of KI, the illegal line number check routine. (See separate write-up on KI.) In a KH subroutine, the call word of the line number is obtained from LW, sent to KI for checking, and then put in the generated routine. (See reference list write-up for print-out that may occur in LW.)

KA holds constants used and KE holds dummy instructions that are modified and assembled to make up the generated routine.

Attached is an explanation of the use of temporary storage (addresses GL100 - 112), a descriptive format of first eight lines of GL output, and samples of generated coding.

Initial Lines of Output

	GL				
Prelude	0	0	u	v	Call word of sentence to u of GL. v = 100x - 1000 + 6. Thus v is no. lines generated routine incl. "10 lines" and prelude.
	1	0	0	v	v = 100x - 1000, number of lines subject to address modification.
	2	0	20000	0	The 2 in 3rd digit from left is a count of temporaries used. Count of relative constants is in 4th digit from right.
	3	0	0	0	Number of inputs is zero.
	4	0	0	0	Number of outputs is zero
	5	Line	Number		Line number of sentence
Exit line of running program	6	MJ	0	v	v = 100x - number of "10" lines + 3. This gives a jump to 2nd line of coding of subsequent sent.
	7				Entry line of running program.

Temporary Storage for If Generation

GL				
100				Where each new line of running program is assembled before insertion in output GL.
101	0	0	100x	Ordinal number of running program line relative to 1000 ("10 lines" are included.) Always has next line to be used.
102	0	0	v	Used in computing jump lines.
103	0	0	v	Number of relative constants used. (10000 and/or 10001)
104	0	0	v	Call word of subscripted variable equated to 10000.
105	0	0	v	Call word of subscripted variable equated to 10001.
106	0	0	v	Number of "10 lines"
107	0	u	v	(BK15)
110	0	u	v	(BK16) Holds, alternatively, the values in BK15 - 20 on X and BK25 - 30 on Y when these are subscripted variables.
111	0	u	v	(BK17)
112	0	0	v	(BK20)

IF GENERATION - SAMPLE CODING

*Example 1

NOT in Pseudo-Op List
 $<$ First test
 $>$ Second test
For both X and Y: Sign complement desired
                   Absolute value desired
X and Y subscripted variables with 4 subscripts each

	GL				
	0	0	u	50	u = Call word of "IF" sentence line no.
	1	0	0	42	
	2	0	20000	02000	
	3	0	0	0	
	4	0	0	0	
	5	Line Number			
1000	6	MJ	0	1042	
1001	7	SP	u	0	u = Call word of L subscript
1002	10	MA	u	v	u = Call word of M_K = K multiplier
					v = Call word of K subscript
1003	11	MA	u	v	u = Call word of M_J
					v = Call word of J
1004	12	MA	u	v	u = Call word of M_I
					v = Call word of I
1005	13	TJ	u	1007	u = Call word of Z, modulus
1006	14	DV	u	Q	u = Call word of Z, modulus
1007	15	SA	10000	17	
1010	16	TU	A	1011	Braced portion is coding to obtain X in
1011	17	TP	30000	60000	proper form in 60000.
1012	20	TM	60000	60000	
1013	21	TN	60000	60000	
1014	22	SP	u	0	
1015	23	MA	u	v	
1016	24	MA	u	v	
1017	25	MA	u	v	Coding to put Y in proper form in 60001.
1020	26	TJ	u	1022	Explanations of u and v are same as for
1021	27	DV	u	Q	X above.
1022	30	SA	10001	17	
1023	31	TU	A	1024	
1024	32	TP	30000	60001	
1025	33	TM	60001	60001	
1026	34	TN	60001	60001	
1027	35	TP	60000	A	X $\rightarrow$ A
1030	36	TJ	60001	1033	Is X $<$ Y?
1031	37	EJ	60001	1034	Is X $\ngtr$ Y?

*The sentence from which this program was developed read as follows: If $-|X(i,j,k,l)| < -|Y(i,j,k,l)|$ jump to sentence 42, if $-|X(i,j,k,l)| > -|Y(i,j,k,l)|$ jump to sentence 54, if $-|X(i,j,k,l)| = -|Y(i,j,k,l)|$ jump to sentence 4Δ.

1032	40	MJ	0	v	v = Call word of line number of 2nd test. X > Y.
	41	10	0	1	
1033	42	MJ	0	v	v = Call word of line number of 1st test. X < Y.
	43	10	0	1	
1034	44	MJ	0	v	v = Call word of 3rd line number. X = Y.
	45	10	0	1	
1035	46	0	0	v	10000 equated to 1035 by processor. v = Call word of 1st line of X array.
1036	47	0	0	v	10001 equated to 1036 by processor. v = Call word of 1st line of Y array.
1037					Temporary storage. 60000 equated to this address by processor.
1040					Temporary storage. 60001 equated to this address by processor.
1041					1st line of program of next sentence (exit).
1042					2nd line of program of next sentence (entrance).

Op File

KH

57	0	u	7	u is call word of "if" line number.
60	0	0	41	100x - 1000 - "10 lines" + 2 temporaries.
61	0	u	0	u is call word of X.
62	0	u	0	u is call word of Y
63	0	u	0	u is call word of 2nd test line number.
64	0	u	0	u is call word of 1st test line number.
65	0	u	0	u is call word of 3rd line number.

The count kept in GL101 of the ordinal program number line relative to 1000 is not the same as that shown above since it includes "10 lines". Proper deductions are made for this inclusion in computing the totals near the end of the program.

*Example 2

In Pseudo Op List with a Pseudo Op subscripted variable of 3 subscripts for X & 2 for Y
< = Single test
Only one line number (one for above test)
Sign Complement of X desired

	GL				
	0	0	u	33	u = Call word of "If" sentence line number
	1	0	0	25	
	2	0	20000	0	
	3	0	0	0	
	4	0	0	0	
	5	Line Number			
1000	6	MJ	0	1027	X > Y
1001	7	SP	u	0	u = Call word of K subscript
1002	10	MA	u	v	u = Call word of M_J v = Call word of J
1003	11	MA	u	v	u = Call word of M_I v = Call word of I
1004	12	TJ	u	1006	u = Call word of Z, modulus
1005	13	DV	u	Q	u = Call word of Z, modulus
1006	14	SA	u	17	u = Pseudo op call word of call word of X
1007	15	TU	A	1010	
1010	16	TP	30000	60000	This puts X into 60000
1011	17	TN	60000	60000	
1012	20	SP	u	0	u = Call word of J subscript
1013	21	MA	u	v	u = Call word of M_I v = Call word of I
1014	22	TJ	u	1016	u = Call word of Z, modulus
1015	23	DV	u	Q	
1016	24	SA	u	17	u = Pseudo op call word of call word of Y
1017	25	TU	A	1020	This puts Y into 60001
1020	26	TP	30000	60001	
1021	27	TP	60001	A	
1022	30	TJ	60000	1000	Is X > Y?
1023	31	MJ	0	v	v = Call word of line no. of 1st test. X ≤ Y.
	32	10	0	1	
1024					Temp storage 60000 equated to this address by processor.
1025					Temp storage 60001 equated to this address by processor.

Op File

	KH				
	57	0	u	3	u = Call word of "If" sentence line number.
	60	0	0	26	Running prog. length including 2 temporaries
	61	0	u	0	u = Call word of line number of test

*If - X(i,j,k) < = Y(i,j) jump to sentence 37Δ.

*Example 3

< First test
> Second test
No 3rd line number
X and Y are not subscripted variables.

GL

	0	0	u	20	u = Call word of "if" sentence line number
	1			12	
	2	0	20000	0	
	3	0	0	0	
	4	0	0	0	
	5	Line Number			
1000	6	MJ	0	1013	X = Y
1001	7	TP	u	60000	u = Call word of X
1002	10	TP	u	60001	u = Call word of Y
1003	11	TP	60000	A	
1004	12	TJ	60001	1007	Is X < Y?
1005	13	EJ	60001	1000	Is X ≯ Y?
1006	14	MJ	0	v	v = Call word of line number of 2nd test. X > Y.
	15	10	0	1	
1007	16	MJ	0	v	v = Call word of line number of 1st test. X < Y.
	17	10	0	1	
1010					Temporary (60000)
1011					Temporary (60001)
1012					1st line of next sentence coding
1013					2nd line of generated program of next sentence

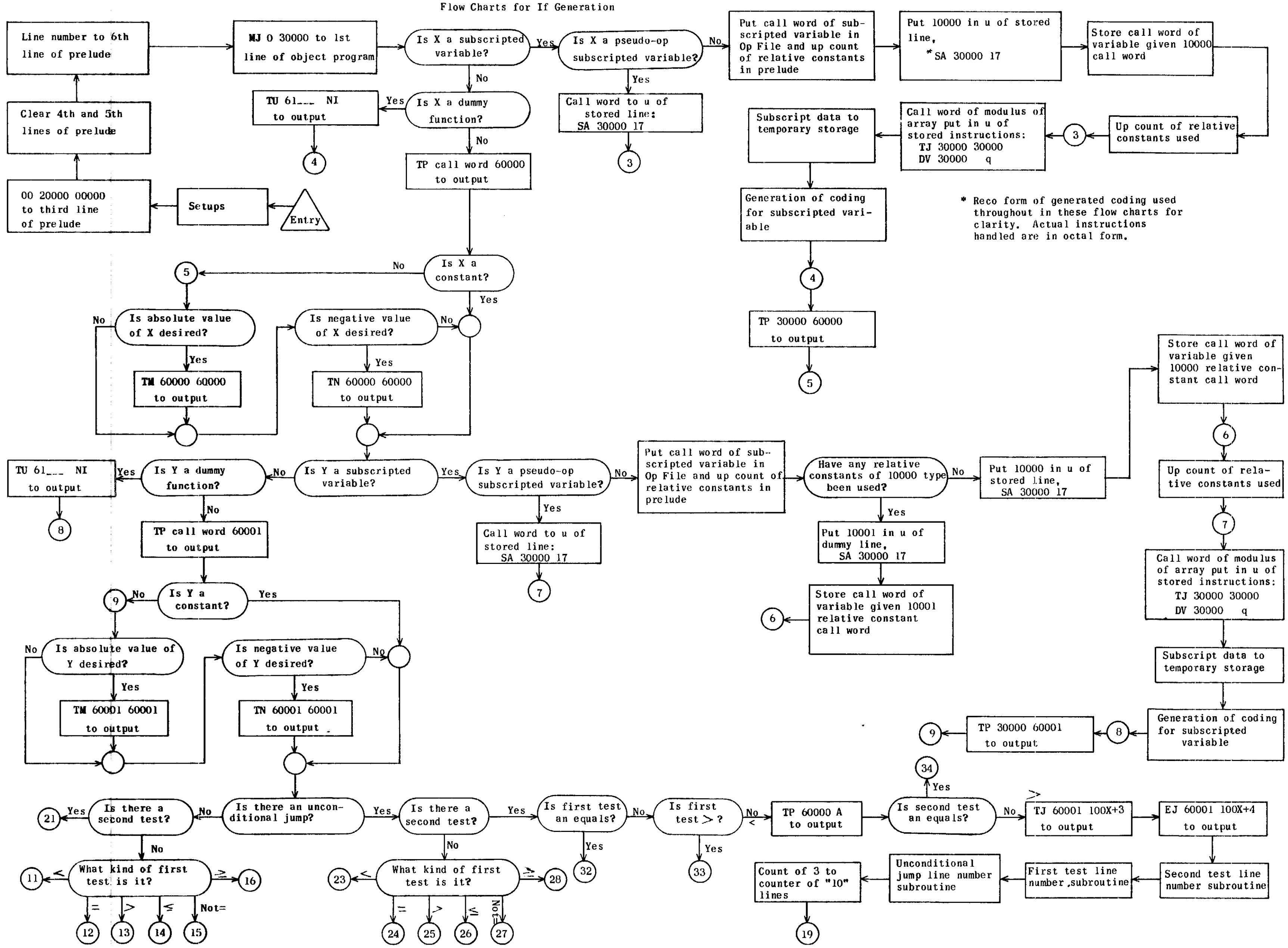
Op File

KH

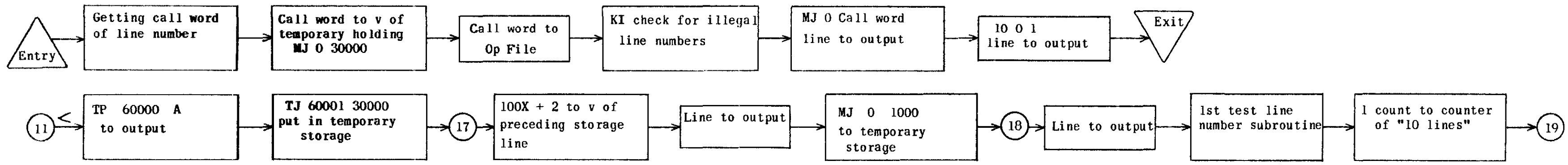
57	0	u	4	u = Call word of "if" sentence line number
60	0	0	12	
61	0	u	0	u = Call word of 2nd test line number
62	0	u	0	u = Call word of 1st test line number

*If X < Y jump to sentence 67, if X > Y jump to sentence 33Δ.

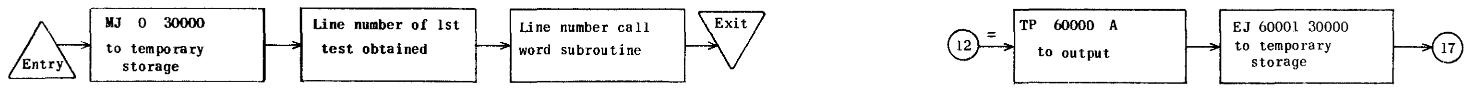
Flow Charts for If Generation



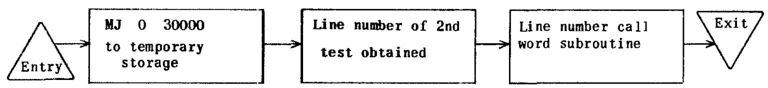
Line Number Call Word **Subroutine**



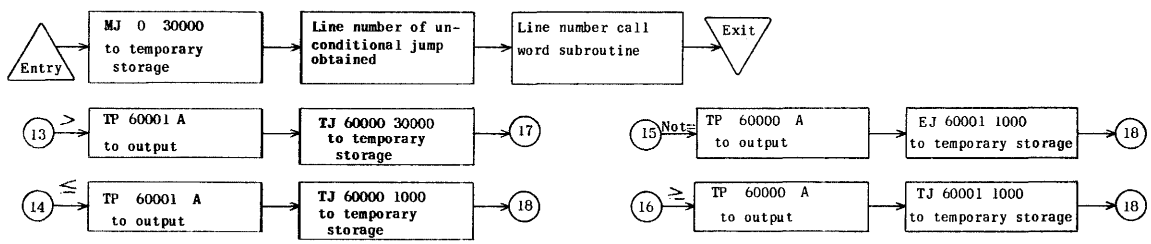
First Test Line Number **Subroutine**



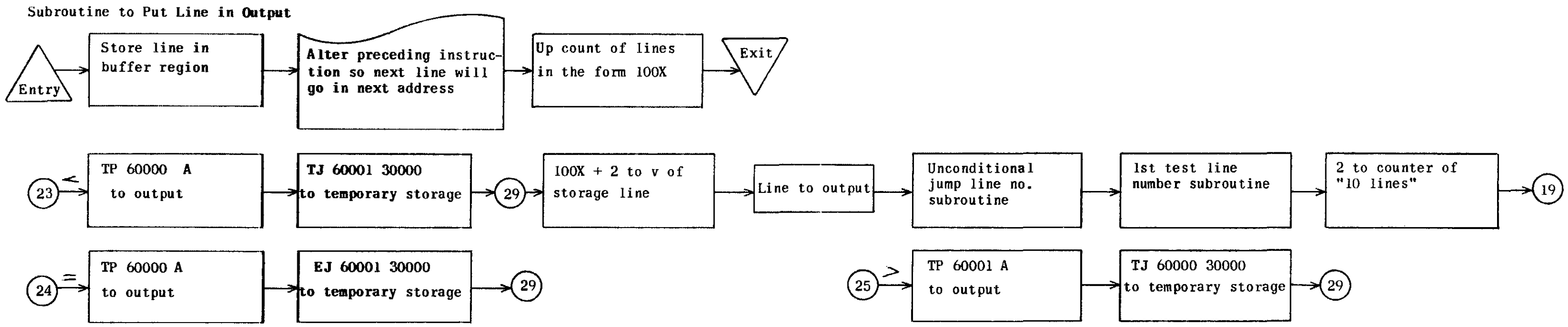
Second Test Line **Number Subroutine**



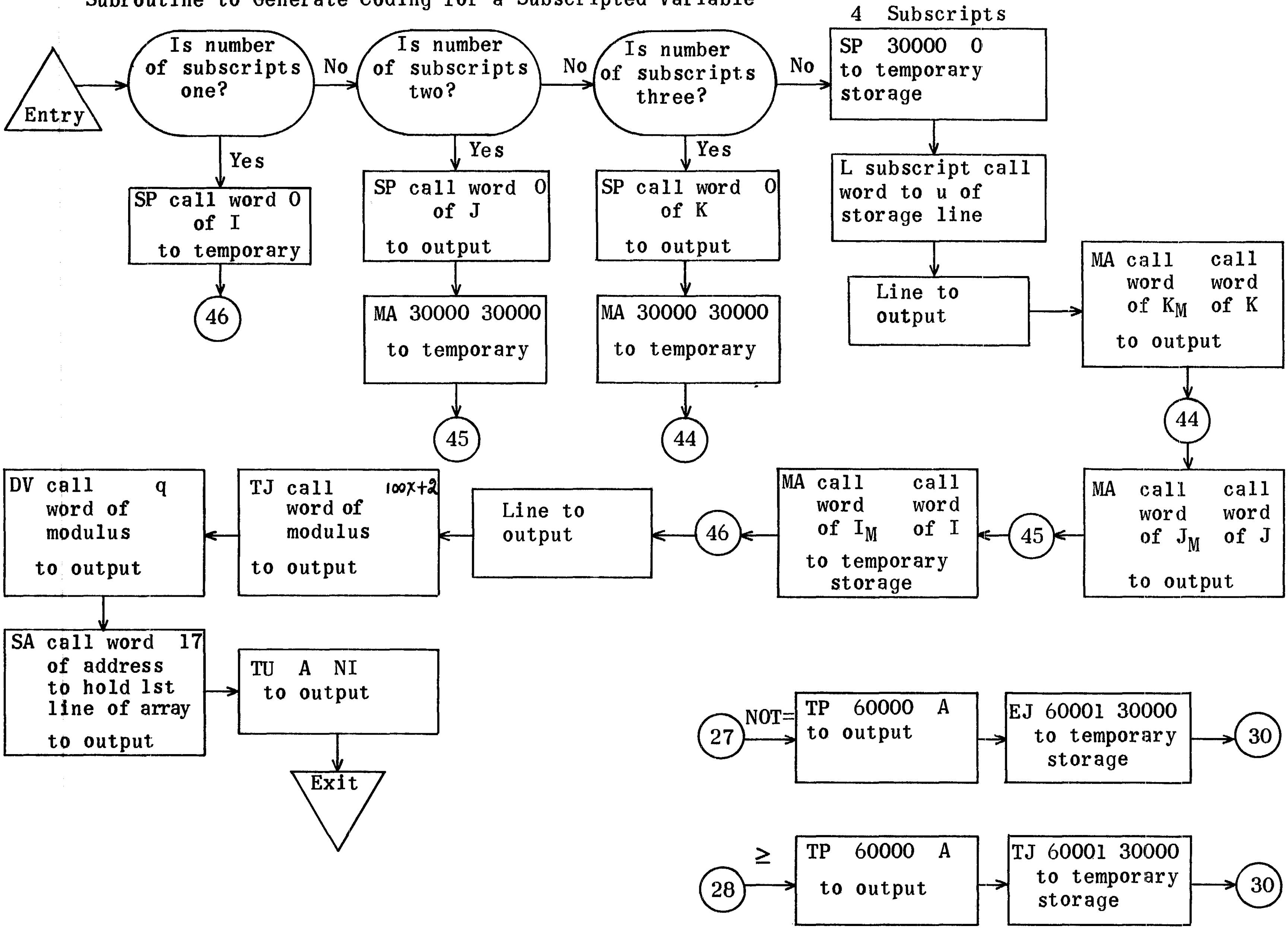
Unconditional Jump Line **Number Subroutine**



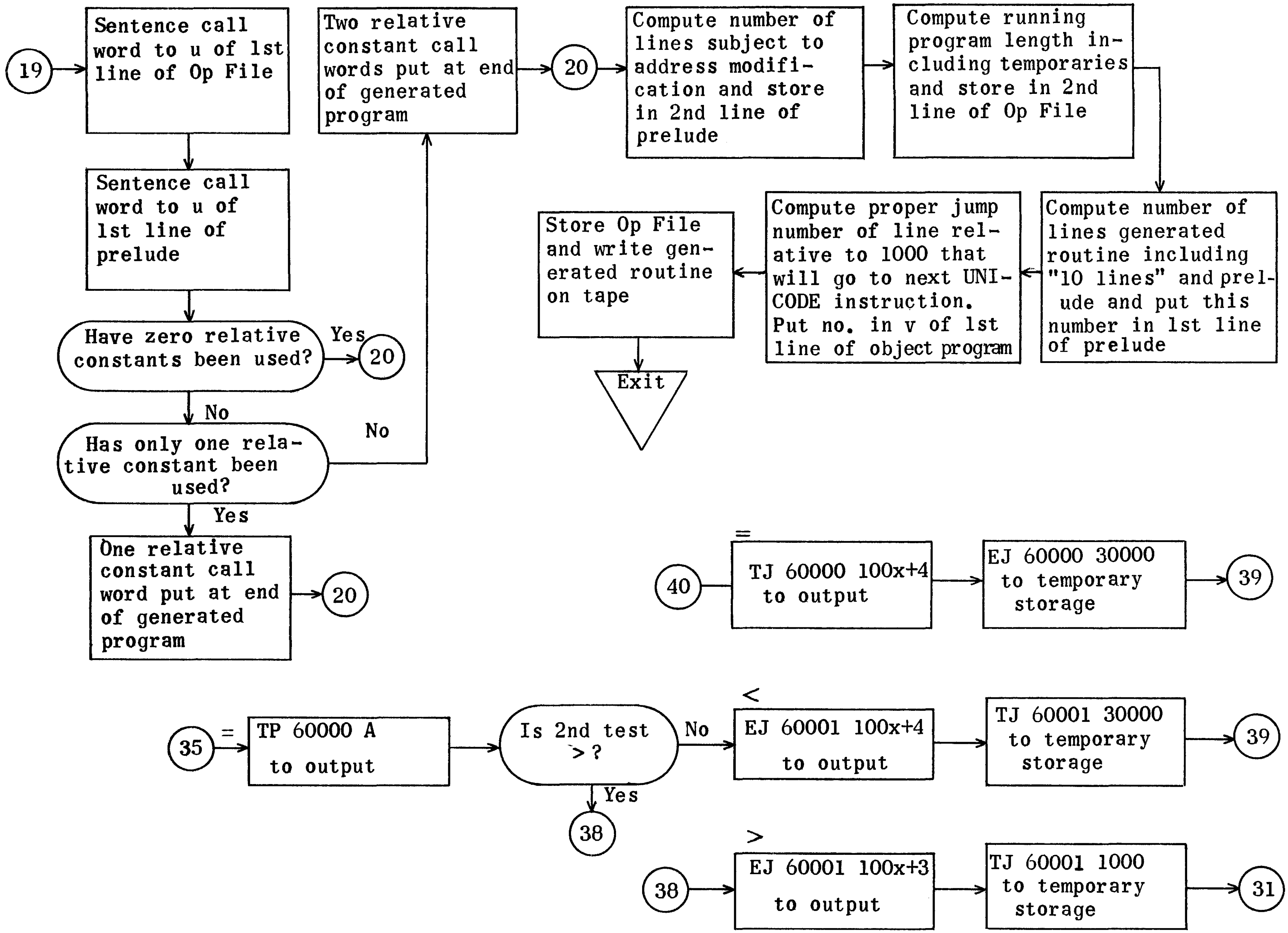
Subroutine to Put Line in **Output**

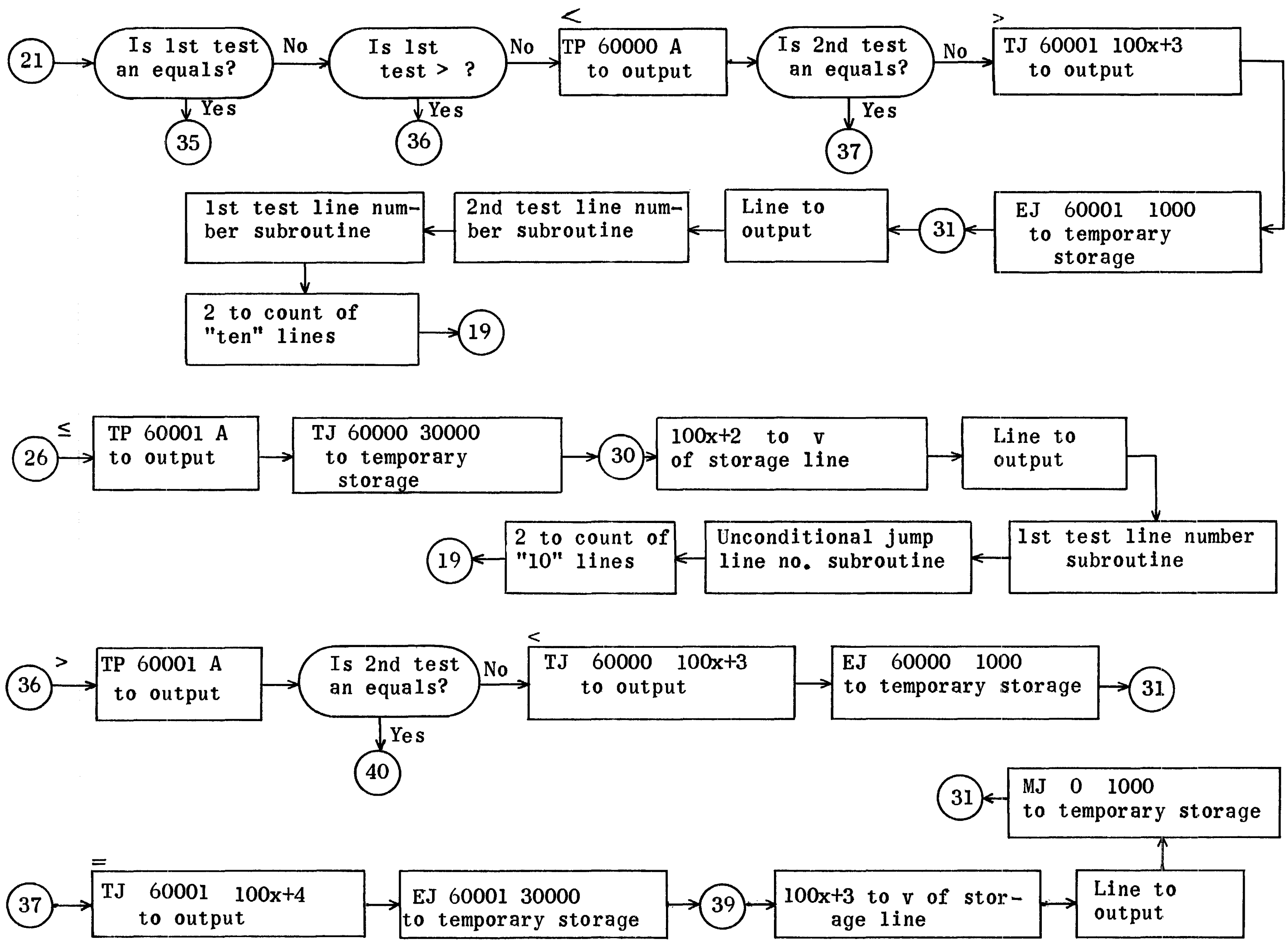


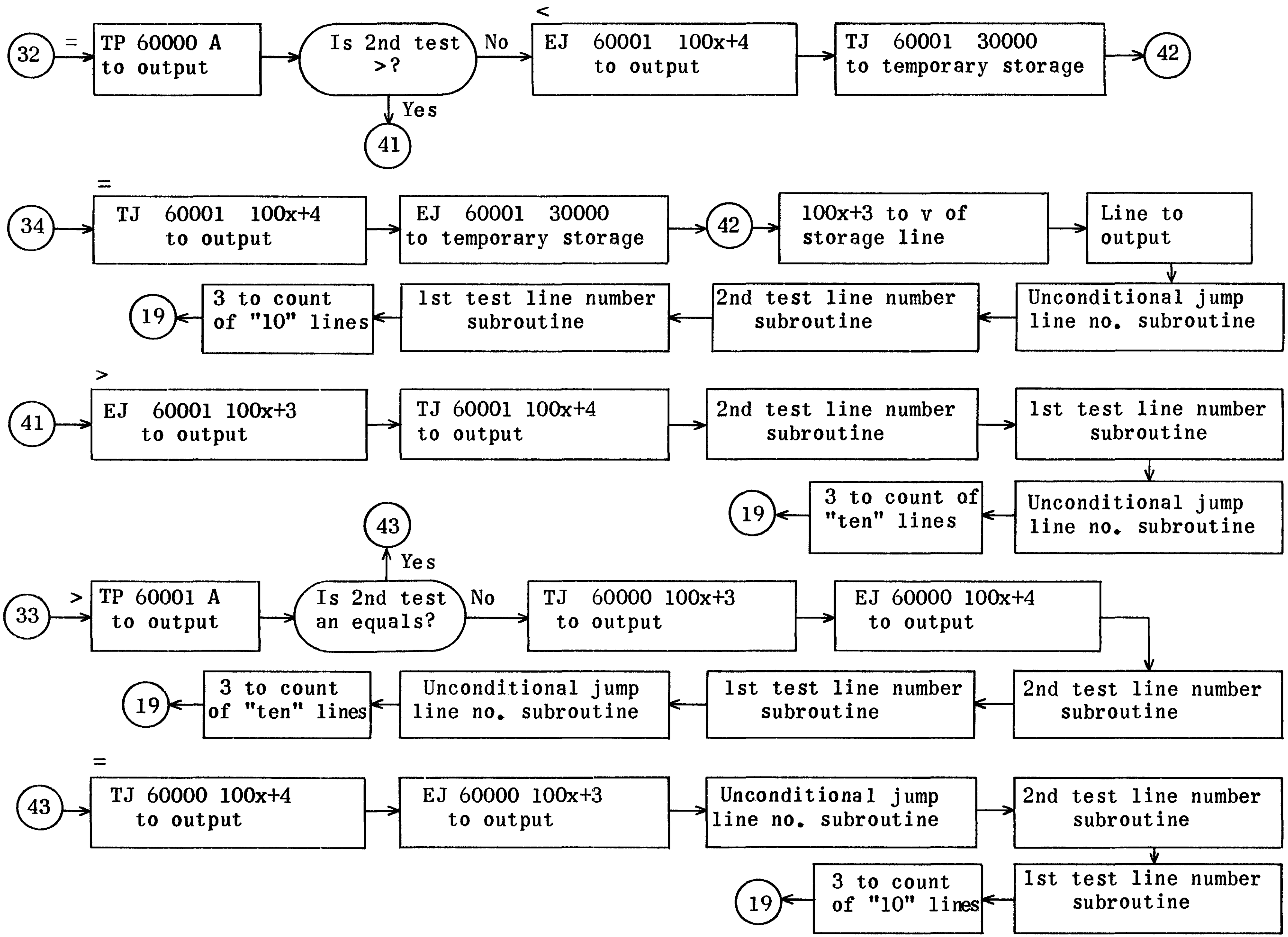
Subroutine to Generate Coding for a Subscripted Variable



Termination Subroutine




21
Is 1st test an equals?
No
Yes
35
Is 1st test > ?
No
Yes
36
<
TP 60000 A to output
Is 2nd test an equals?
No
Yes
37
>
TJ 60001 100x+3 to output
EJ 60001 1000 to temporary storage
31
Line to output
2nd test line number subroutine
1st test line number subroutine
2 to count of "ten" lines
19
26
≤
TP 60001 A to output
TJ 60000 30000 to temporary storage
30
100x+2 to v of storage line
Line to output
1st test line number subroutine
Unconditional jump line no. subroutine
2 to count of "10" lines
19
36
>
TP 60001 A to output
Is 2nd test an equals?
No
Yes
40
<
TJ 60000 100x+3 to output
EJ 60000 1000 to temporary storage
31
37
=
TJ 60001 100x+4 to output
EJ 60001 30000 to temporary storage
39
100x+3 to v of storage line
Line to output
MJ 0 1000 to temporary storage
31


32
=
TP 60000 A
to output
Is 2nd test
>?
No
Yes
41
<
EJ 60001 100x+4
to output
TJ 60001 30000
to temporary storage
42
34
=
TJ 60001 100x+4
to output
EJ 60001 30000
to temporary storage
42
100x+3 to v of
storage line
Line to
output
Unconditional jump
line no. subroutine
2nd test line number
subroutine
1st test line number
subroutine
3 to count
of "10" lines
19
41
>
EJ 60001 100x+3
to output
TJ 60001 100x+4
to output
2nd test line number
subroutine
1st test line number
subroutine
Unconditional jump
line no. subroutine
3 to count of
"ten" lines
19
33
>
TP 60001 A
to output
Is 2nd test
an equals?
Yes
43
No
TJ 60000 100x+3
to output
EJ 60000 100x+4
to output
2nd test line number
subroutine
1st test line number
subroutine
Unconditional jump
line no. subroutine
3 to count
of "ten" lines
19
43
=
TJ 60000 100x+4
to output
EJ 60000 100x+3
to output
Unconditional jump
line no. subroutine
2nd test line number
subroutine
1st test line number
subroutine
3 to count
of "10" lines
19

IF Generation Regions

RE	KB2512
RE	KA2644
RE	KC2660
RE	KD2737
RE	KE3070
RE	KF3123
RE	KH3265
RE	KK3353
RE	SA3457
RE	KR3462

Generation Subroutine regions are also needed to assemble this tape.

If Generation

KD - Unconditional jump with second test
KB - Start- Control
KF - Unconditional Jump and no second test. KF53 - no unconditional jump and a second test.
KK - No unconditional jump and no second test. KK47-Termination loop.
KC - Subscripted variable coding
KH and KR - Subsidiary routines
KA - Constants
KE - Dummy instructions

```
Unconditional   IA   KD
jump with    0  TP   BK7     A       Is there a second test?
second       1  ZJ   KD2     KF
test         2  TP   BK4     A       Is first test an =?
             3  EJ   KA4     KD41
<1st test    4  EJ   KA5     KD75    Is first test > ?
             5  TP   KE10    GL100   TP 60000 A to output
             6  RJ   KH40    KH35
             7  TP   BK6     A       Is 2nd test an =?
>2nd test   10  EJ   KA4     KD25
            11  TP   KE11    GL100   TJ 60001 30000
            12  RJ   KH24    KH21    To put proper jump (+3) in v of above
            13  RJ   KH40    KH35    Line to output
            14  RA   GL102   KA      Adding 1 to jump storage line in GL102
            15  TP   KE14    GL100   EJ 60001 30000
            16  TV   GL102   GL100   Jump (100X + 4) to v of above
            17  RJ   KH40    KH35    Line to output
            20  RJ   KH3     KH      Line no. of 2nd test to output plus "10" line
            21  RJ   KH7     KH4     1st test line no. + "10" line to output
            22  RJ   KH13    KH10    Unconditional jump line number + 10 line to
                                       output
            23  TP   KA4     GL106   3 to GL106 as count of number of 10 lines
= 2nd test  24  MJ   0       KK47    Jump to termination loop
            25  TP   KE11    GL100   TJ 60001 30000
            26  RJ   KH30    KH25    100X + 4 to v of above instruction
            27  RJ   KH40    KH35    Line to output
            30  RS   GL102   KA      100X + 3 now in GL102
            31  TP   KE14    GL100   EJ 60001 30000
            32  TV   GL102   GL100   100X + 3 to v of above
            33  RJ   KH40    KH35    Line to output
            34  RJ   KH13    KH10    MJ 0 v followed by 10 line to output.
                                       v = unconditional jump line no.
            35  RJ   KH3     KH      MJ 0 v followed by 10 0 1. 2nd test
                                       line no. = v
            36  RJ   KH7     KH4     MJ 0 v (first test) with 10 0 1 to output
            37  TP   KA4     GL106   Number of 10 lines (3) to storage
= 1st test  40  MJ   0       KK47    Jump to termination loop
            41  TP   KE10    GL100   TP 60000 A to output
            42  RJ   KH40    KH35
            43  TP   BK6     A       Is 2nd test >
            44  EJ   KA5     KD61
```

```
<2nd test      45  TP  KE14   GL100   EJ  60001  30000
               46  RJ  KH30   KH25    100X + 4 to v of above
               47  RJ  KH40   KH35    Line to output
               50  RS  GL102  KA      100X + 4 - 1
               51  TP  KE11   GL100   TJ  60001  30000
               52  MJ  0      KD32
               53  TP  KE32   GL100   TU  A  30000
               54  TU  A      GL100   Puts 61 --- Call word into u of above
                                        instruction
               55  RJ  KR4    KR1     Puts address of next instruction into v of
                                        above instruction and sends line to output.
                                        [TU 61---NI]
               56  MJ  0      30000
               57  0   0      0
>2nd test      60  0   0      0
               61  TP  KE14   GL100   EJ  60001  30000
               62  RJ  KH24   KH21    100X + 3 to v of above instruction
               63  RJ  KH40   KH35    Line to output
               64  RA  GL102  KA      100X + 3 + 1
               65  TP  KE11   GL100   TJ  60001  30000
               66  TV  GL102  GL100   100X + 4 to v of above
               67  RJ  KH40   KH35    Line to output
               70  RJ  KH3    KH      2nd test
               71  RJ  KH7    KH4     1st test
               72  RJ  KH13   KH10    Unconditional test
               73  TP  KA4    GL106   3 to count of ten lines
>1st test      74  MJ  0      KK47    To termination loop
               75  TP  KE15   GL100 }
               76  RJ  KH40   KH35  } TP  60001  A  to output
               77  TP  BK6    A     }
<2nd test     100  EJ  KA4    KD115 } Is 2nd test =?
              101  TP  KE16   GL100   TJ  60000  30000
              102  RJ  KH24   KH21    100X + 3 to v of above
              103  RJ  KH40   KH35    Line to output
              104  RA  GL102  KA      100X + 3 + 1
              105  TP  KE24   GL100   EJ  60000  30000
              106  TV  GL102  GL100   100X + 4 to v of above
              107  RJ  KH40   KH35    Line to output
              110  RJ  KH3    KH      2nd test
              111  RJ  KH7    KH4     1st test
              112  RJ  KH13   KH10    Unconditional test
              113  TP  KA4    GL106   3 to count of "10" lines
 = 2nd test   114  MJ  0      KK47    To termination loop
              115  TP  KE16   GL100   TJ  60000  30000
              116  RJ  KH30   KH25    100X + 4 to v of above
              117  RJ  KH40   KH35    Line to output
              120  RS  GL102  KA      100X + 4 - 1
              121  TP  KE24   GL100   EJ  60000  30000
              122  TV  GL102  GL100   100X + 3 to v of above
              123  RJ  KH40   KH35    Line to output
              124  RJ  KH13   KH10    Unconditional test
              125  RJ  KH3    KH      2nd test
              126  RJ  KH7    KH4     1st test
```

```
             127  TP   KA4      GL106    3 to count of "10" lines
             130  MJ   0        KK47     To termination loop
                  CA   KD131

Start-            IA   KB
Control        0  MJ   0        30000    Exit
               1  TV   KK101    KH35     GL6 to v of KH35
               2  TV   KK102    KH41     KH6 to v of KH41
               3  TP   KA1      GL103    Clearing GL103, the counter of relative
                                           constants used
               4  TP   KE12     GL2      0  20000  0  to output
               5  TP   KA1      GL3      Clear GL3, GL4
               6  TP   KA1      GL4
               7  TP   BK1      GL5      Line no. to GL5
              10  TP   KA2      GL101    0  0  1000  to GL101
              11  TP   KE       GL100    MJ  0  30000  to GL6, first line of Object
              12  RJ   KH40     KH35       Program
Generation    13  TP   BK11     A        If BK11 isn't zero, X is a subscripted
coding for    14  ZJ   KB15     KR5      variable
X             15  SP   BK14     17       If 77000> call word, it is a pseudo-op sub-
              16  TJ   KA10     KB37       scripted variable
              17  RJ   KH16     KH14     Puts call word of sub. var. in Op File & ups
                                           count of relative cons. used
              20  TU   KA11     KE31     10000  to u of SA  30000  17
              21  TP   BK14     GL104    Storing call word of variable given 10000
                                           call word
              22  RA   GL103    KA       Count of relative const. used increased by 1
              23  TP   KA7      Q        0  77777  0  mask to q
              24  QT   BK11     A        Call word of modulus to A_u
              25  TU   A        KE27     Modulus call word to u of  TJ 30000 30000
              26  TU   A        KE30                                DV 30000 q
              27  RP   30004    KB31     Subscript data to GL107-12
              30  TP   BK15     GL107
              31  TP   KA6      Q        Mask of 0  0  77777  to q
              32  QT   BK11     A        Number of subscripts to A
              33  RJ   KC       KC1      Generation of coding for subscripted variable
              34  TP   KE1      GL100    TP  30000  60000 to GL100 and to generated
              35  RJ   KH40     KH35       output coding
              36  MJ   0        KB47
              37  TU   A        KE31     Call word to u of instruction (SA 30000 17)
                                           for pseudo op
              40  MJ   0        KB23
Non-          41  TP   KE1      GL100    TP  30000  60000  to GL100
subscrip-     42  SP   BK14     17       Call word to u of above
ted X         43  TU   A        GL100
              44  RJ   KH40     KH35     Line to generated coding output
              45  TP   BK31     Q        Is X a constant?
              46  QJ   KB57     KB47
              47  TP   BK13     Q        Is absolute value desired?
              50  QJ   KB51     KB53
              51  TP   KE3      GL100    TM  60000  60000 to output
              52  RJ   KH40     KH35
              53  TP   BK12     Q        Is negative value desired?
              54  QJ   KB55     KB57
```

```
             55   TP   KE4     GL100   TN  60000  60000 to output
             56   RJ   KH40    KH35
Generation   57   TP   BK21    A       Is Y a subscripted variable?
coding for   60   ZJ   KB61    KR10
Y            61   SP   BK24    17      If 77000 > call word, it is a pseudo op sub.
             62   TJ   KA10    KB110     variable
             63   RJ   KH16    KH14    Puts call word of sub. var. in Op File and
                                         ups count of rel. cons. used
             64   TP   GL103   A       Have any relative constants of 10000 type
             65   ZJ   KB66    KB71      been used?
             66   TU   KA12    KE31    10001 to u of SA  30000  17
             67   TP   BK24    GL105   Storing call word of variable given 10001
                                         call word
             70   MJ   0       KB73
             71   TU   KA11    KE31    10000 to u of SA  30000  17
             72   TP   BK24    GL104   Storing call word of variable given 10000
                                         call word
             73   RA   GL103   KA      Count of relative constants increased
             74   TP   KA7     Q       0  77777  0  to q
             75   QT   BK21    A                                  TJ  30000  30000
             76   TU   A       KE27    Modulus call word to u of
             77   TU   A       KE30                                 DV  30000  q
            100   RP   30004   KB102    Subscript data of Y to temporary storage
            101   TP   BK25    GL107
            102   TP   KA6     Q        0  0  77777  to q
            103   QT   BK21    A        Number of subscripts to A
            104   RJ   KC      KC1      Gen. of coding for subscripted variable
            105   TP   KE2     GL100    TP  30000  60001  to output
            106   RJ   KH40    KH35
            107   MJ   0       KB120
            110   TU   A       KE31     Call word to u of SA 30000 17 for pseudo op
            111   MJ   0       KB74
Non-sub-    112   TP   KE2     GL100    TP  30000  60001  to output line
scripted    113   SP   BK24    17       Call word to u of above line
Y           114   TU   A       GL100
            115   RJ   KH40    KH35     Line to output
            116   TP   BK32    Q        Is Y a constant?
            117   QJ   KB130   KB120
            120   TP   BK23    Q        Is absolute value desired?
            121   QJ   KB122   KB124
            122   TP   KE5     GL100    TM  60001  60001 to output
            123   RJ   KH40    KH35
            124   TP   BK22    Q        Is negative value desired?
            125   QJ   KB126   KB130
            126   TP   KE6     GL100    TN  60001  60001  to output
            127   RJ   KH40    KH35
            130   TP   BK10    A        Is there an unconditional jump?
            131   ZJ   KD      KF53
                  CA   KB132
```

Uncon-		IA	KF		
ditional	0	RJ	SA2	SA	Puts MJ Z 0 in A where Z is code number
Jump and	1	TP	KE7	A	for relation test
no 2nd	2	RP	30005	KF47 ≥ ?	
Test	3	TJ	KF4	KF4	
	4	MJ	2	KF11 < ?	
	5	MJ	3	KF22 = ?	
	6	MJ	4	KF26 > ?	Determining what first test is
	7	MJ	5	KF32 ≤ ?	
	10	MJ	6	KF43	
				NOT = ?	
< 1st test	11	TP	KE10	GL100	TP 60000 A to output
	12	RJ	KH40	KH35	
	13	TP	KE11	GL100	TJ 60001 30000
	14	RJ	KH34	KH31	100X + 2 to v of above
	15	RJ	KH40	KH35	Line to output
	16	RJ	KH13	KH10	Unconditional test
	17	RJ	KH7	KH4	1st test
	20	TP	KA3	GL106	2 to count of "10" lines
	21	MJ	0	KK47	To termination loop
=(1st)	22	TP	KE10	GL100	TP 60000 A to output
	23	RJ	KH40	KH35	
	24	TP	KE14	GL100	EJ 60001 30000
	25	MJ	0	KF14	
> 1st	26	TP	KE15	GL100	TP 60001 A to output
	27	RJ	KH40	KH35	
	30	TP	KE16	GL100	TJ 60000 30000
≤ 1st	31	MJ	0	KF14	
	32	TP	KE15	GL100	TP 60001 A to output
	33	RJ	KH40	KH35	
	34	TP	KE16	GL100	TJ 60000 30000
	35	RJ	KH34	KH31	100X + 2 to v of above
	36	RJ	KH40	KH35	Line to output
	37	RJ	KH	KH4	1st test
	40	RJ	KH13	KH10	Unconditional jump
	41	TP	KA3	GL106	2 to count of "10" lines
	42	MJ	0	KK47	To termination loop
NOT =	43	TP	KE10	GL100	TP 60000 A to output
(1st)	44	RJ	KH40	KH35	
	45	TP	KE14	GL100	EJ 60001 30000
≥1st	46	MJ	0	KF35	
	47	TP	KE10	GL100	TP 60000 A to output
	50	RJ	KH40	KH35	
	51	TP	KE11	GL100	TJ 60001 30000
	52	MJ	0	KF35	
No uncon-	53	TP	BK7	A	Is there a second test?
ditional	54	ZJ	KF55	KK	
jump and	55	TP	BK4	A	Is 1st test =?
a second	56	EJ	KA4	KF106	
test	57	EJ	KA5	KF124	Is 1st test > ?
<(1st test)	60	TP	KE10	GL100	TP 60000 A to output
	61	RJ	KH40	KH35	
	62	TP	BK6	A	Is 2nd test =?
	63	EJ	KA4	KF75	

```
2nd test >  64  TP  KE11    GL100     TJ  60001  30000
            65  RJ  KH24    KH21      100X + 3 to v of above
            66  RJ  KH40    KH35      Line to output
            67  TP  KE21    GL100 }
            70  RJ  KH40    KH35  }   EJ  60001  1000   to output
            71  RJ  KH3     KH        2nd test setup
            72  RJ  KH7     KH4       1st test setup
            73  TP  KA3     GL106     2 to count of "ten" lines
            74  MJ  0       KK47      To termination
2nd test =  75  TP  KE11    GL100     TJ  60001  30000
            76  RJ  KH30    KH25      100X + 4 to v of above
            77  RJ  KH40    KH35      Line to output
           100  TP  KE14    GL100     EJ  60001  30000
           101  RS  GL102   KA        100X + 4 - 1
           102  TV  GL102   GL100     100X + 3 to v of above instruction
           103  RJ  KH40    KH35      Line to output
           104  TP  KE20    GL100     MJ  0  1000
= (1st     105  MJ  0       KF70
test)      106  TP  KE10    GL100 }
           107  RJ  KH40    KH35  }   TP  60000  A  to output
           110  TP  BK6     A     }
           111  EJ  KA5     KF117 }   Is 2nd test > ?
< 2nd      112  TP  KE14    GL100     EJ  60001  30000
test       113  RJ  KH30    KH25      100X + 4 to v of above
           114  RJ  KH40    KH35      Line to output
           115  TP  KE11    GL100     TJ  60001  30000
>2nd test  116  MJ  0       KF101
           117  TP  KE14    GL100     EJ  60001  30000
           120  RJ  KH24    KH21      100X + 3 to v of above
           121  RJ  KH40    KH35      Line to output
           122  TP  KE22    GL100     TJ  60001  1000
> 1st      123  MJ  0       KF70
test       124  TP  KE15    GL100 }
           125  RJ  KH40    KH35  }   TP  60001  A to output
           126  TP  BK6     A     }
< 2nd      127  EJ  KA4     KF135 }   Is 2nd test =?
test       130  TP  KE16    GL100     TJ  60000  30000
           131  RJ  KH24    KH21      100X + 3 to v of above
           132  RJ  KH40    KH35      Line to output
           133  TP  KE23    GL100     EJ  60000  1000
           134  MJ  0       KF70
= 2nd      135  TP  KE16    GL100     TJ  60000  30000
test       136  RJ  KH30    KH25      100X + 4 to v of above
           137  RJ  KH40    KH35      Line to output
           140  TP  KE24    GL100     EJ  60000  30000
           141  MJ  0       KF101
                CA  KF142

                IA  KK
No Uncon-    0  RJ  SA2     SA    }   Puts MJ  Z  0  in A where Z is code number
ditional     1  TP  KE7     A     }     for relation test
Jump &       2  RP  30005   KK43 ≥ ?
no Second    3  TJ  KK4     KK44
Test
```

```
              4  MJ   2      KK11 < ?
              5  MJ   3      KK23 = ?     Determination of type of 1st test
              6  MJ   4      KK27 > ?
              7  MJ   5      KK33 ≤ ?
<1st test    10  MJ   6      KK37 NOT =?
             11  TP   KE10   GL100  } TP 60000 A to output
             12  RJ   KH40   KH35   }
             13  TP   KE11   GL100    TJ  60001  30000
             14  RJ   KH34   KH31     100X + 2 to v of above
             15  RJ   KH40   KH35     Line to output
             16  TP   KE20   GL100  } MJ  0  1000  to output
             17  RJ   KH40   KH35   }
             20  RJ   KH7    KH4      1st test set-up
             21  TP   KA     GL106    1 to count of "10" lines
= 1st        22  MJ   0      KK47     To termination loop
test         23  TP   KE10   GL100  } TP 60000 A to output
             24  RJ   KH40   KH35   }
             25  TP   KE14   GL100    EJ  60001  30000
             26  MJ   0      KK14
>            27  TP   KE15   GL100  } TP  60001  A  to output
             30  RJ   KH40   KH35   }
             31  TP   KE16   GL100    TJ  60000  30000
             32  MJ   0      KK14
≤            33  TP   KE15   GL100  } TP  60001  A  to output
             34  RJ   KH40   KH35   }
             35  TP   KE13   GL100    TJ  60000  1000
NOT =        36  MJ   0      KK17
             37  TP   KE10   GL100  } TP  60000  A  to output
             40  RJ   KH40   KH35   }
             41  TP   KE21   GL100    EJ  60001  1000
             42  MJ   0      KK17
≥            43  TP   KE10   GL100  } TP  60000  A  to output
             44  RJ   KH40   KH35   }
             45  TP   KE22   GL100    TJ  60001  1000
             46  MJ   0      KK17
Termi-       47  SP   BK3    17     } Sentence call word to u of 1st line of Op
nation       50  TU   A      KH57   }   File
Loop         51  TP   A      GL       Call word to u of 1st line of prelude
             52  TP   GL103  A      } Is number of relative const. equal to zero?
             53  ZJ   KK54   KK64   }
             54  EJ   KA     KK62     Is number of rel. cons. equal to 1?
No. of       55  TP   GL104  GL100  } Relative constant call words put at end of
rel. cons.   56  RJ   KH40   KH35   }   generated program.  Numbers were equated
= 2          57  TP   GL105  GL100  }   to 10000 and 10001 in coding
             60  RJ   KH40   KH35   }
             61  MJ   0      KK64
             62  TP   GL104  GL100  } Call word of no.equated to 10000 put at end
             63  RJ   KH40   KH35   }
             64  TP   GL101  A        Ordinal 100X program line to A
             65  ST   KA2    GL1      Subtracting 1000 and putting in GL1
             66  TV   A      GL       100X-1000 to GLv
             67  ST   GL106  A      } 100X-1000-number of "ten" lines + 2 to 2nd
             70  AT   KA3    KH60   }   line of Op File
```

```
            71  RA  GL      KA13    100X - 1000 + 6 to v of prelude 1st line
            72  TP  GL101   A     }
            73  ST  GL106   A     } 100X - number of "ten" lines + 3 to v of
            74  AT  KA4     A     }   1st line of running program
            75  TV  A       GL6   }
            76  TP  KK103   OP1   } Writing Op File and gen. routines on tape
            77  RJ  OP      OP2   }
           100  MJ  0       KB
           101  0   0       GL6
           102  0   0       KH61
           103  0   GL      KH57
                CA  KK104

                IA  KC
Sub-         0  MJ  0       30000
scripted     1  EJ  KA      KC53    Are no. of subscripts 1?
Variable     2  EJ  KA3     KC45    Are no. of subscripts 2?
Coding       3  EJ  KA4     KC37    Are no. of subscripts 3?
Number of    4  TP  KE25    GL100   SP  30000  0
subscripts   5  SP  GL112   17    } Call word of L subscript to above line. Sub-
are 4        6  TU  A       GL100 }   scripts assumed to be I,J,K,L
             7  RJ  KH40    KH35    Line to output
            10  TP  KE26    GL100   MA  30000  30000
            11  TU  GL111   GL100   KM → u of above line
            12  TV  GL111   GL100   K → v of above
            13  RJ  KH40    KH35    Line to output
            14  TU  GL110   GL100   JM to u of MA  30000  30000
            15  TV  GL110   GL100   J to v of above
            16  RJ  KH40    KH35    Line to output
            17  TU  GL107   GL100   IM to u of MA  30000  30000
            20  TV  GL107   GL100   I to v of above
            21  RJ  KH40    KH35    Line to output
            22  TP  KE27    GL100   TJ  Mod.  30000
            23  TV  GL101   GL100 } 100X + 2 to v of above
            24  RA  GL100   KA3   }
            25  RJ  KH40    KH35    Line to output
            26  TP  KE30    GL100 } DV Mod. q to output
            27  RJ  KH40    KH35  }
            30  TP  KE31    GL100 } SA CW 17 to output.  CW is call word of
            31  RJ  KH40    KH35  }   address of line that will hold address of
                                      1st line of array
            32  RJ  KR4     KR      TU A NI to output.  NI means Next Instr.
            33  MJ  0       KC
            34  0   62000   0       Stored constant used to identify dummy
                                      pseudo op functions
            35  RJ  KD56    KD53    TU 61--- NI to output
3 sub-      36  MJ  0       KB105   Return to finish handling variable Y
scripts     37  TP  KE25    GL100   SP  30000  0
            40  SP  GL111   17    } K subscript call word to u of above
            41  TU  A       GL100 }
            42  RJ  KH40    KH35    Line to output
```

```
               43  TP   KE26    GL100    MA  30000  30000  to output line
 2 sub-        44  MJ   0       KC14
 scripts       45  TP   KE25    GL100    SP  30000  0
               46  SP   GL110   17
               47  TU   A       GL100    J subscript call word to u of above
               50  RJ   KH40    KH35     Line to output
               51  TP   KE26    GL100    MA  30000  30000  to output line
 1 sub-        52  MJ   0       KC17
 script        53  TP   KE25    GL100    SP  30000  0
               54  SP   GL107   17
               55  TU   A       GL100    I call word to u of above
               56  MJ   0       KC21
                   CA   KC57

                         Subsidiary Subroutines

 2nd test          TA   KH
 line no.       0  TP   KE      GL100    MJ  0  30000  to output line
 subroutine     1  TP   BK7     A        Line number of 2nd test to A
                2  RJ   KH56    KH45     Getting call word for line number, putting
                                           it in Op File, putting it in output
                                           and putting 10 line in output
                3  MJ   0       30000
 1st test       4  TP   KE      GL100    MJ  0  30000
 line no.       5  TP   BK5     A        Line number 1st test to A
 subroutine     6  RJ   KH56    KH45     Line number call word subroutine
 Uncon-         7  MJ   0       30000
 ditional      10  TP   KE      GL100    MJ  0  30000
 jump line     11  TP   BK10    A        Line no. of unconditional jump to A
 no. sub-      12  RJ   KH56    KH45     Line number call word subroutine
 routine       13  MJ   0       30000
 Subscripted   14  RJ   KH44    KH41     Call word sent to Op File
 var. call     15  RA   GL2     KA2      Ups  count of relative constants used in
 word to                                   prelude
 Op. File      16  MJ   0       30000
               17  RJ   KD56    KD53     TU  61 ---  NI  to output
               20  MJ   0       KB34     Return to finish handling variable X
               21  TP   GL101   GL102    (1000 + count of lines) to GL102
 +3 Jump       22  RA   GL102   KA4      + 3
 setter        23  TV   GL102   GL100    v of GL100 set to 100X + 3
               24  MJ   0       30000
 +4 Jump       25  TP   GL101   GL102
 setter        26  RA   GL102   KA5      100X + 4 to v of output line
               27  TV   GL102   GL100
               30  MJ   0       30000
 + 2 Jump      31  TP   GL101   GL102
 setter        32  RA   GL102   KA3      100X + 2 to v of output line
               33  TV   GL102   GL100
               34  MJ   0       30000
 Subroutine    35  TP   GL100   [GL6]    Inserting output line in proper place in
 to put                                    generated coding
 line in       36  RA   KH35    KA       Upping v of KH35 by 1
 output        37  RA   GL101   KA       Count of 1000 plus number of lines
               40  MJ   0       30000
```

```
Loads Op     41  TP   A      KH61     Loads Op File with call word
File         42  RA   KH41   KA       Ups v of above by 1
for call     43  RA   KH57   KA       Increases count of Op File lines by 1
word         44  MJ   0      30000
Line         45  RJ   LW     LW1      Getting call word of line number
number       46  TV   Q      GL100    Call word to v of output line
call word    47  RJ   KH44   KH41     Call word to Op File
subroutine   50  SP   Q      17       Call word of line no. to Au
             51  TP   BK33   Q        Puts Pseudo-Op indicator in Q
             52  RJ   KI     KI1      Check for illegal line numbers
             53  RJ   KH40   KH35     Line to output
             54  TP   KE17   GL100    10  0  1  to output
             55  RJ   KH40   KH35
 Op File     56  MJ   0      30000
 build-up    57  0    30000  2
 space       60  0    0      0
             61  0    0      0
             62  0    0      0
             63  0    0      0
             64  0    0      0
             65  0    0      0
                 CA   KH66

                 IA   KA
Constants     0  0    0      1
              1  0    0      0
              2  0    0      1000
              3  0    0      2
              4  0    0      3
              5  0    0      4
              6  0    0      77777
              7  0    77777  0
             10  0    77000  0
             11  0    10000  0
             12  0    10001  0
             13  0    0      6
                 CA   KA14

                 IA   KE
Dummy         0  MJ   0      30000
Instruc-      1  TP   30000  60000
tions for     2  TP   30000  60001
Use in        3  TM   60000  60000
Building      4  TN   60000  60000
Generated     5  TM   60001  60001
Routine       6  TN   60001  60001
              7  MJ   0      0
             10  TP   60000  A
             11  TJ   60001  30000
             12  0    20000  0
             13  TJ   60000  1000
             14  EJ   60001  30000
             15  TP   60001  A
```

```
            16  TJ   60000   30000
            17  10   0       1
            20  MJ   0       1000
            21  EJ   60001   1000
            22  TJ   60001   1000
            23  EJ   60000   1000
            24  EJ   60000   30000
            25  SP   30000   0
            26  MA   30000   30000
            27  TJ   30000   30000
            30  DV   30000   Q
            31  SA   30000   17
            32  TU   A       30000
                CA   KE33

                IA   SA
             0  SP   BK4     17       Puts 1st test code relation number in A_u
             1  TU   A       KE7        and then in KE7_u.
             2  MJ   0       30000
                CA   SA3

                IA   KR
             0  TP   KE32    GL100    TU  A  30000
Subroutine   1  TV   GL101   GL100    100X + 1 to v of above
to put       2  RA   GL100   KA
TU-A-NI      3  RJ   KH40    KH35     Line to output
in output    4  MJ   0       30000
             5  SP   BK14    17       Is call word of variable X a dummy function
             6  TJ   KC34    KH17       of pseudo op?
             7  MJ   0       KB41
            10  SP   BK24    17       Is call word of variable Y a dummy function
            11  TJ   KC34    KC35       of pseudo op?
            12  MJ   0       KB112
                CA   KR13
```

Print Generation Routine

It is assumed that everything following PRINT# in this instruction is to be printed. Thus, parentheses are included in the print-out. Since the printed data is generally self-explanatory comments following a print instruction are assumed redundant. If they are included, the routine will include them in the printed output.

It is further assumed that any one Print instruction is no longer than 6 Unityper lines. Material that would fill more space than this should be divided into as many instructions as needed to bring each within the proper limit.

The first line of the string-out contains the number of lines in the string-out. In the second line is the line number of the instruction. The third contains the title, PRINT. The v portion of the fourth line holds the call word assigned to the instruction. The fifth and succeeding lines contain the excess-three characters which will be converted to Flex code during generation.

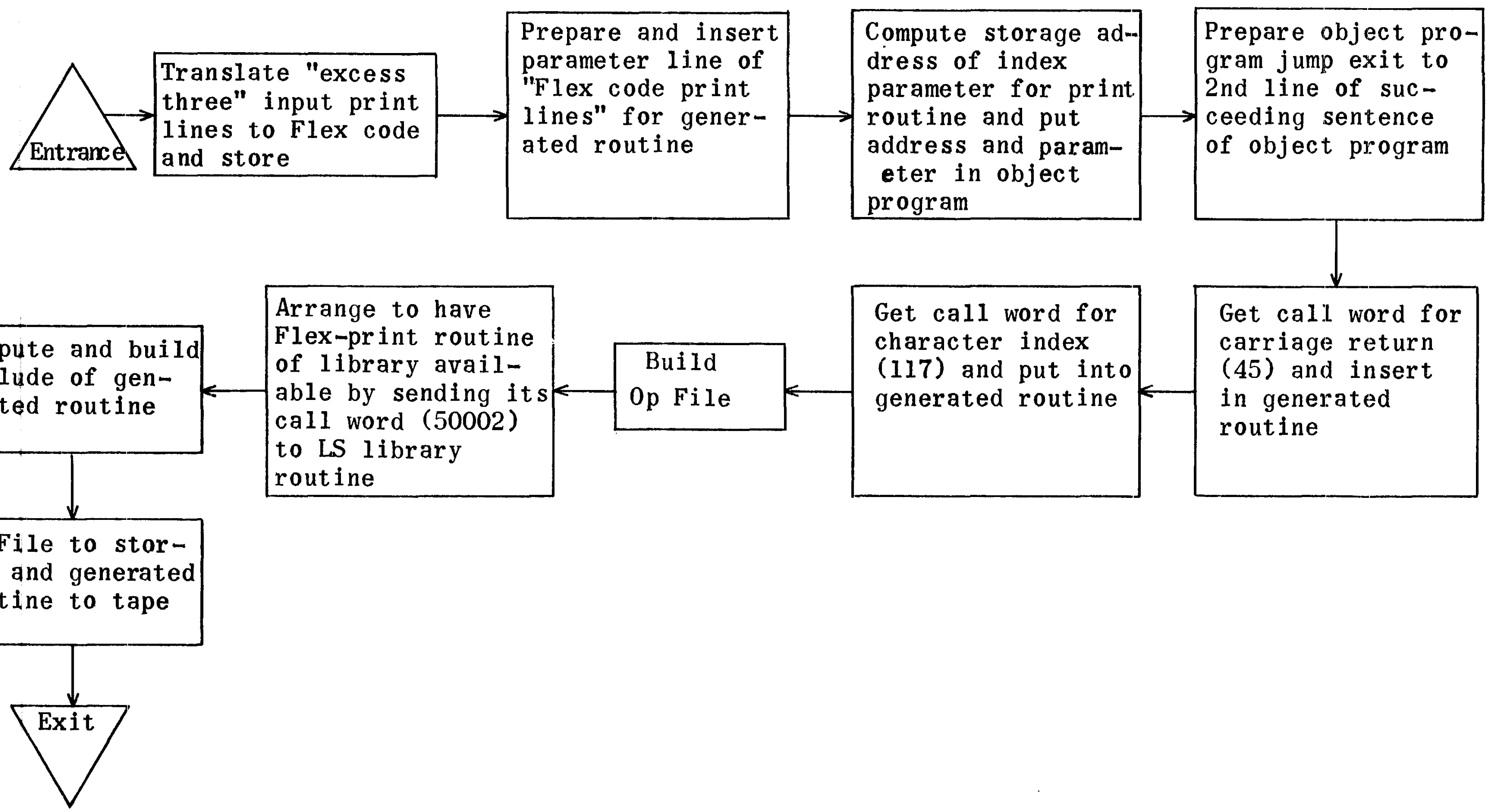
Excess-three codes are converted by the routine to Flex codes which are stored for later printing during the Object Program run. A library routine is referenced during this run to effect the printing. Because the library routine to print Flex code directly is much shorter than a library routine that could print directly from excess three, this procedure of converting from excess-three to Flex code during generation was adopted. Space saving during the Object Program run was considered of paramount importance.

GL, the region in which the print subroutine is stored before writing on tape, has to have at its disposal a variable address length that will hold the 22_8-address print subroutine and prelude plus the indeterminate group of Flex codes. The Flex codes, because of the addition of shift-up and shift-down codes and substitution of more than one Flex code for a corresponding excess-three character, will likely take up more space than the group of excess-three lines in BK. GL cannot exceed 520_8 lines and in most cases will be far less.

The size of the Op File 1 item for PRINT is 3 addresses. The generated subroutine is 22_8 + number of words of Flex code. The number of words in the running program is 12_8 + number of words of Flex code.

After the instruction in BK, the buffer region, has been identified during generation as PRINT, the control generation routine by instruction RJ UR UR1 activates the print generator. The print routine generates the coding needed for the print subroutine and gets it written on the proper tape. Also stored in NP for later writing on tape is the Op File 1 item.

Flow Chart of Print Generation Routine



Print Generation

Regions

RE	UR2512	Print generator
RE	GL5360	Storage for generated subroutine plus prelude

Generation Subroutine Regions are also needed to assemble this tape.

		IA	UR		
	0	MJ	0	30000	Exit
	1	TP	BK	A	Entry. No. of lines of input → a
	2	RS	A	UR75	No. of words of excess 3 to parameter line
	3	TV	A	UR50	
	4	TP	UR50	VX4	Parameter words to X3 to Flex code routine
	5	TP	UR51	VX3	
	6	RJ	VX2	VX	Jump to X3 to Flex code routine
	7	TP	VX3	GL20	Output parameter line from X3 to Flex code
	10	TU	UR76	GL20	Changing u to address relative to 1000
	11	TV	GL20	UR106	Computing and putting temporary storage address in running program where needed
	12	RA	UR106	UR77	
	13	TV	UR106	UR65	
	14	TV	UR106	UR63	Preparing jump exit of running program to 2nd line of succeeding subroutine
	15	RA	UR63	UR100	
	16	SP	UR106	17	Temp storage address in u and v sent to region accumulating subroutine, later to be used as a parameter in print tag rtne.
	17	AT	UR106	GL21	
	20	TP	UR101	A	Getting call word for carriage return Flex code
	21	RJ	CW	CW1	
	22	TV	Q	UR64	Inserting call word for carriage return in program
	23	TP	UR102	A	Getting call word for index 117
	24	RJ	CW	CW1	
	25	TU	A	UR65	Call word to running program
	26	SP	BK3	17	
	27	TU	A	UR52	Call word of statement to 1st line of Op File
	30	TU	A	UR55	
	31	TV	GL20	UR53	Computing & putting no. of lines in running program, including temporaries, into Op File
	32	RA	UR53	UR103	
	33	TP	UR54	A	Putting call word for print tag rtne. into LN, so this routine will be available in the library
	34	RJ	LS	LS1	
	35	TP	UR104	UR56	No. address modification lines to prelude
	36	TV	GL20	UR57	Number unmodifiable constants to prelude
	37	TP	BK1	UR62	Line no. to prelude
	40	TV	GL20	UR55	Computing & putting proper number in v of prelude 1st line
	41	RA	UR55	UR105	
	42	RP	30020	UR44	Prelude & 1st line of running program to assembly region
	43	TP	UR55	GL	
	44	TP	UR47	OP1	Transferring Op File & subroutine to Op File from where it will go on tape later
	45	RJ	OP	OP2	
	46	MJ	0	UR	Exit to 1st line
	47	0	GL	UR52	Parameter line for Op control routine
	50	0	BK4	0	Parameter lines for X3 to Flex code
	51	0	GL22	0	
Op File 1 Item	52	0	30000	3	u = call word of print statement
	53	0	0	30000	v = no. lines, running program, including temporaries
	54	0	50002	0	Call word for print tag routine

```
GL  0      55   0    30000   30000   u = Call word of print statement. v = #
                                       lines prelude & routine
    1      56   0    0       30000   v = number lines subject to address modi-
                                       fication
Pre- 2     57   0    0       0       v = number of unmodifiable constants
lude 3     60   0    0       0
     4     61   0    0       0
     5     62   0    0       0       Line number
     6     63   MJ   0       30000   Exit - 1st line of running program
     7     64   PR   0       30000   v = 1 (45)
Run- 10    65   TP   30000   30000   u = 1 (117)  v = temp. storage address
ning 11    66   TP   01007   50002
     12    67   10   0       3       Parameter lines to Print Tag Routine
Pro- 13    70   TP   01010   50002
gram 14    71   10   0       4
     15    72   RJ   50002   50002   Jump to print tag routine
     16    73   10   2       0
     17    74   MJ   0       1000    Jump back to first line of running program
     20    75   0    0       4
     21    76   0    1011    0
           77   0    0       1011
           100  0    0       2
           101  0    0       45
           102  0    0       117
           103  0    0       12
           104  0    0       14
           105  0    0       22
           106  0    0       30000
                CA   UR107
```

Compute Generation Routine

This routine forms a code that sets up data in the proper location for the equation coding, followed by a return jump to this part. All the actual computational coding is done by the equation generation routine.

The string-out input to the Compute Generator contains the call words of the variables or constants in the same sequence in which they appear in the input sentences. Subscripted variables have multipliers and moduli saved in addition to their call words. Thus one subscripted variable occupies 2, 3 or 4 locations, depending on how many subscripts it has, and the subscript call words follow thereafter. Functions within pseudo operations have only the call word of the function in the string-out and no argument call words, even though the arguments may be stated in the input sentence. At the end of every string-out is a line of zeros followed by 01 227-7 (the XS3 representation of $\triangle$.). When a compute sentence contains several terms separated by "and's" in the input sentence, the string-out has a zero line inserted between the last call word of one term and the first call word of the following term.

The Compute Generator builds up Operation File I, prelude, running program and file of relative constants from this data. The first line of the generated coding - the exit line - is an MJ to the line that follows second after the last generated line. The last line of the running code is an MJ to the exit line. After this follows a list of generated relative constants.

For terms that are not inside parentheses in the input sentence (that is, for the first string-out call word and those following zero lines) the routine generates:

1) In most cases (call-word types 66,65,64,4)

RJ	25---	25---	or	RJ	4---	4----
10	00000	00001		10	00000	00001

2) For subscripted variables (call-word type 77)

TP	64---	62000	1,2,3 or 4 of those lines depending on how many subscripts the subscripted variable has.
TP	64---	62001	
TP	64---	62002	
TP	64---	62003	
RJ	24---	24---	
10	00000	0001	

3) And for dummy functions (call-word type 61)

	TU	Call word + 1	α
	TV	Call word + 1	α
	RA	α	Call word of constant 1
α	RJ	$\boxed{30000}$	$\boxed{30000}$

The terms that are inside parentheses in the input sentence precede the code of the RJ line and ten line of their respective symbol. Their handling splits into two groups: those that are within or are input parameters to a pseudo operation, and those that are not.

To set up input parameters for reference to a pseudo operation the routine generates:

4) For functions (call-word type 66)

β	00	Call word	Call word	in the location for relative constants
$\beta + 1$	00	25---	25---	
	TP	β	61---	in the running code
	TP	$\beta + 1$	61---	
	00	25---	00000	in Operation File I

5) For subscripted variables (call-word type 77)

γ	00	Call word	Call word		relative constant
	TP	γ	76X---		running code
	00	77---	00000		OP File I
	TP	Call word of 1st multiplier	63---	(1)	with 1,2,3 or 4 subscripts No. (4), (1) & (4), (1) & (2) & (4) or (1) & (2) & (3) & (4) of these rows appear in running code.
	TP	Call word of 2nd multiplier	63---	(2)	
	TP	Call word of 3rd multiplier	63---	(3)	
	TP	Call word of modulus	63---	(4)	

6) For all others (call-word types 64, 65 or 67)

TP	Call word	63---	running code

For terms within parentheses of a function or a subscripted variable but not within a pseudo operation the routine generates:

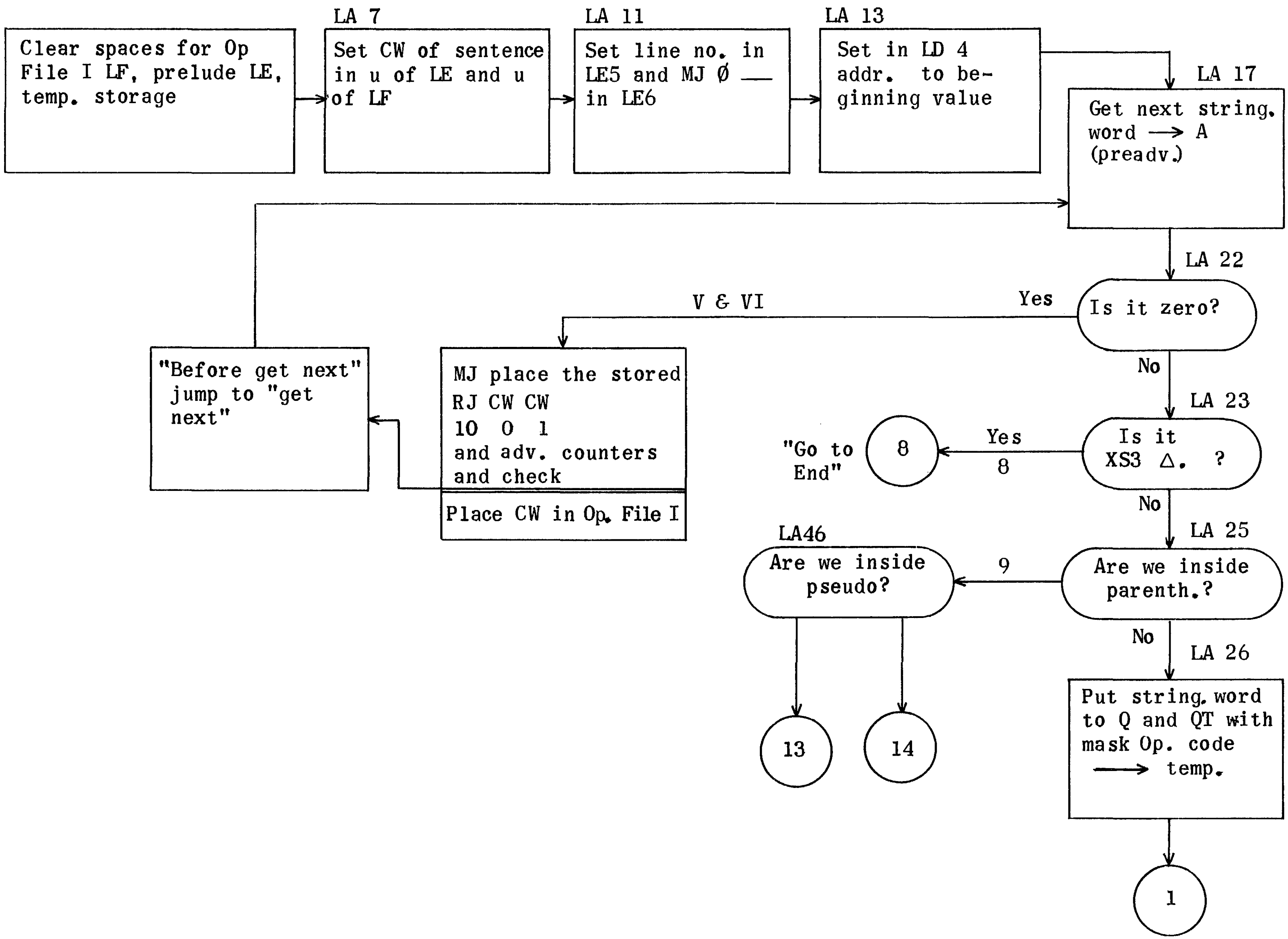
7) For subscripted variables (call-word types 76 or 77)

δ	00	Call word	Call word	relative constants
	TP	δ	75---	running code
	TP	modulus	62---	
(for 77 only)	00	Call word	00000	OP File I (this does not apply for Call-word type 76)

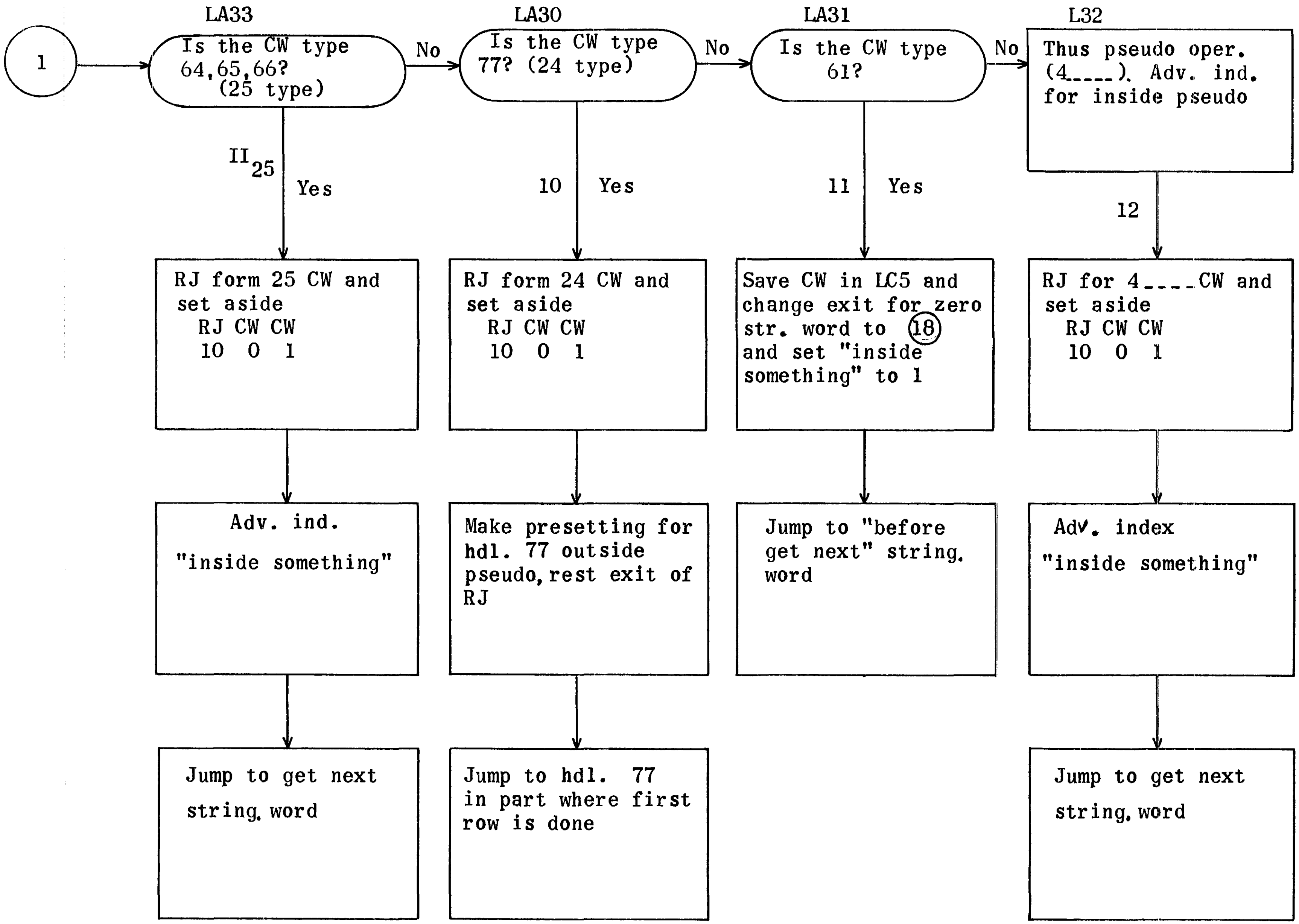
8) For all others (Call-word types 63,64,65 or 67)

	TP	Call word	62---	running code

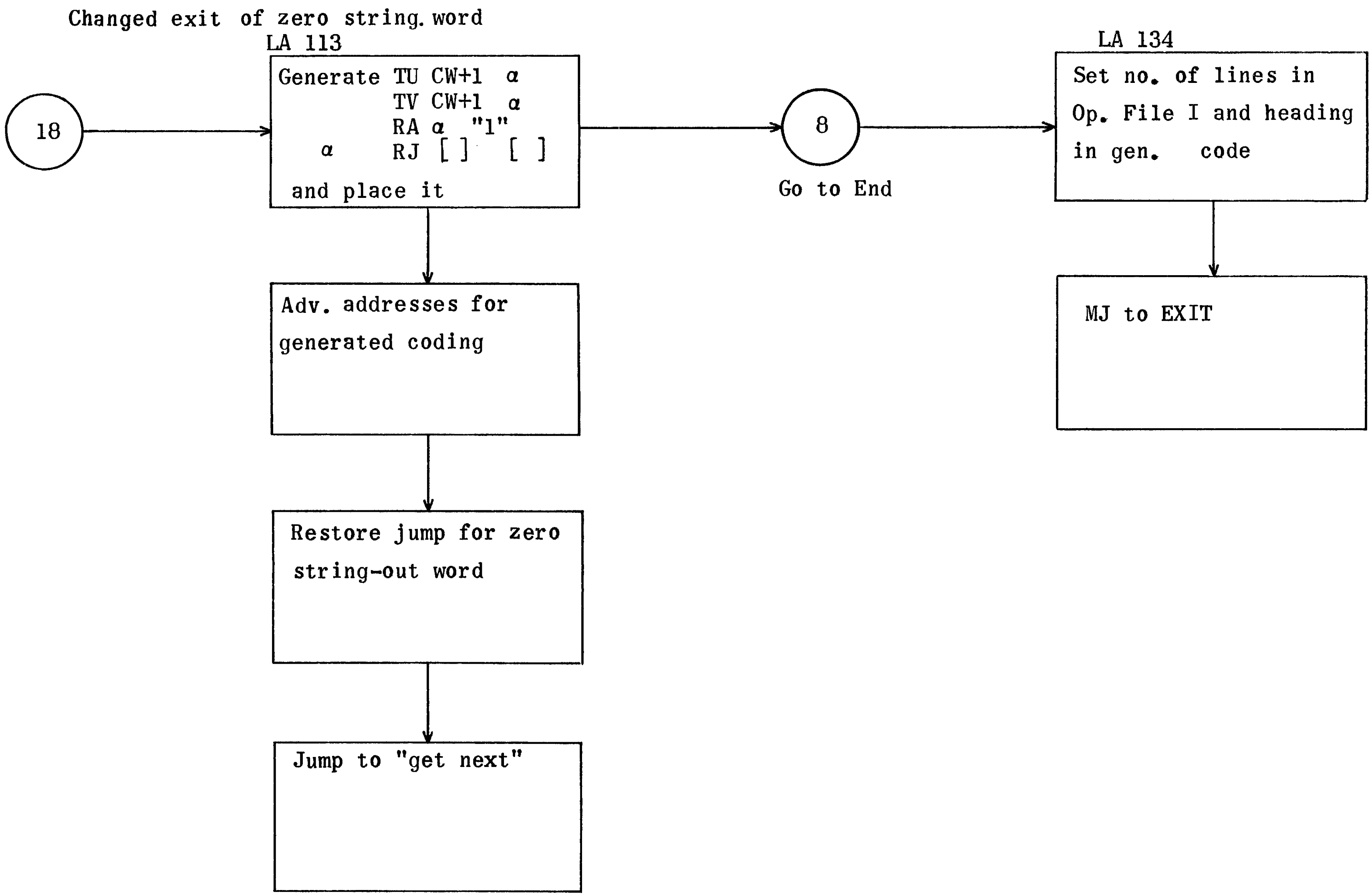
Flow Chart of Compute Generation Routine

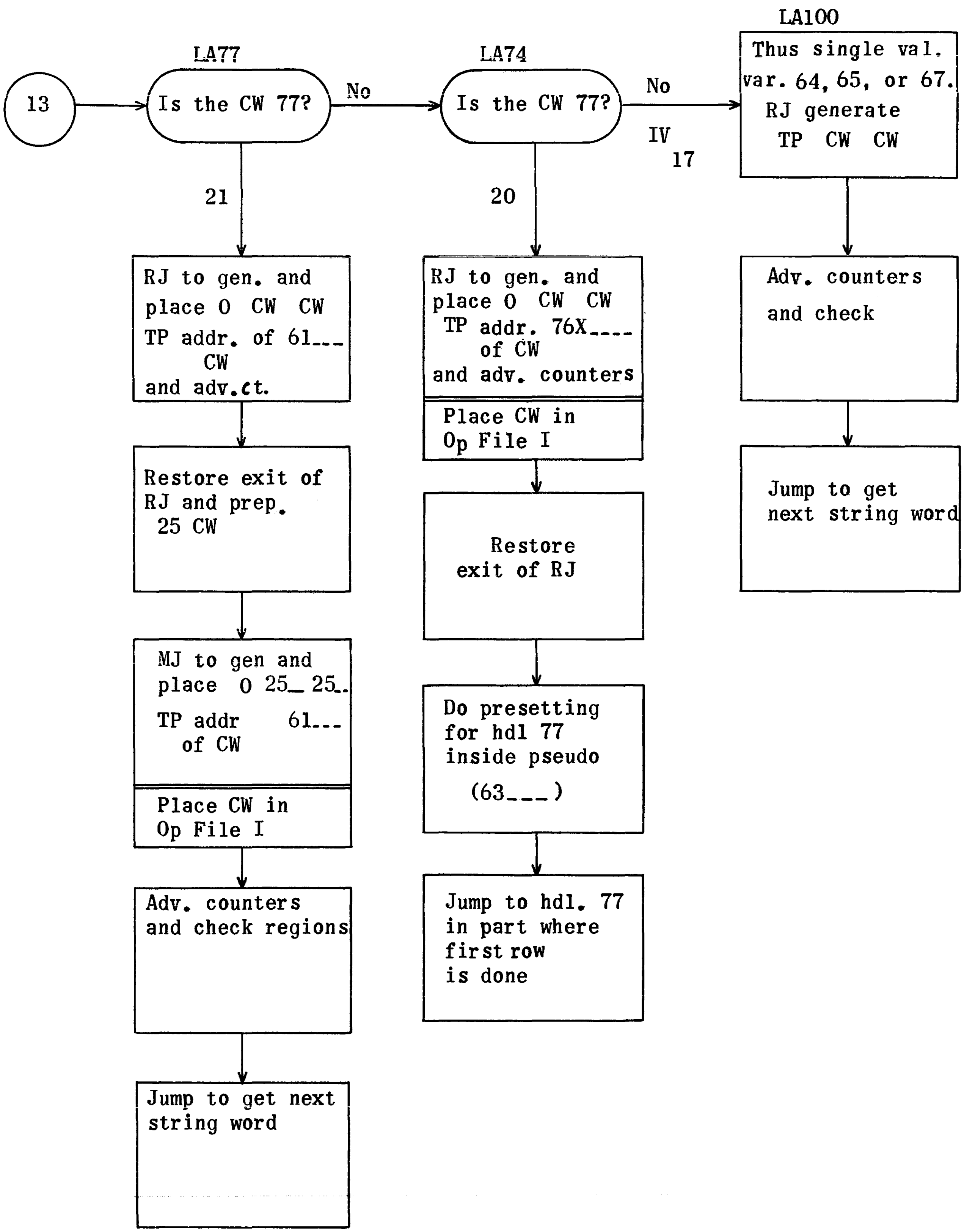


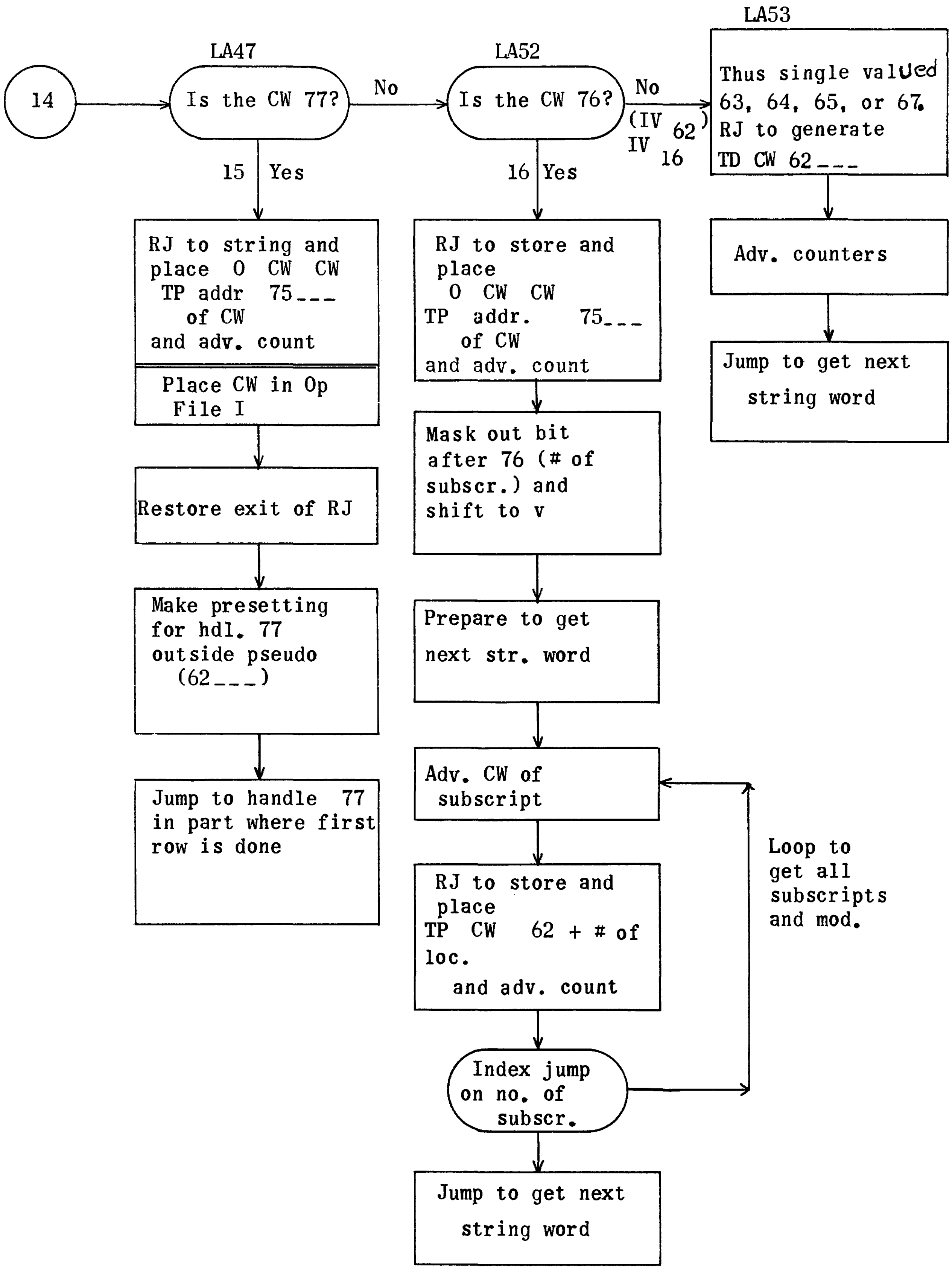
1054



1
LA33
Is the CW type 64,65,66? (25 type)
No
II25
Yes
RJ form 25 CW and set aside
RJ CW CW
10 0 1
Adv. ind.
"inside something"
Jump to get next string. word
LA30
Is the CW type 77? (24 type)
No
10
Yes
RJ form 24 CW and set aside
RJ CW CW
10 0 1
Make presetting for hdl. 77 outside pseudo, rest exit of RJ
Jump to hdl. 77 in part where first row is done
LA31
Is the CW type 61?
No
11
Yes
Save CW in LC5 and change exit for zero str. word to 18 and set "inside something" to 1
Jump to "before get next" string. word
L32
Thus pseudo oper. (4____). Adv. ind. for inside pseudo
12
RJ for 4____CW and set aside
RJ CW CW
10 0 1
Adv. index
"inside something"
Jump to get next string. word


Changed exit of zero string. word
LA 113
18
Generate TU CW+1 α
TV CW+1 α
RA α "1"
α RJ [ ] [ ]
and place it
8
Go to End
LA 134
Set no. of lines in Op. File I and heading in gen. code
MJ to EXIT
Adv. addresses for generated coding
Restore jump for zero string-out word
Jump to "get next"


13
LA77
Is the CW 77?
No
21
RJ to gen. and place 0 CW CW TP addr. of 61___ CW and adv.ct.
Restore exit of RJ and prep. 25 CW
MJ to gen and place 0 25_ 25_ TP addr 61___ of CW
Place CW in Op File I
Adv. counters and check regions
Jump to get next string word
LA74
Is the CW 77?
No
IV
17
20
RJ to gen. and place 0 CW CW TP addr. 76X____ of CW and adv. counters
Place CW in Op File I
Restore exit of RJ
Do presetting for hdl 77 inside pseudo (63___)
Jump to hdl. 77 in part where first row is done
LA100
Thus single val. var. 64, 65, or 67. RJ generate TP CW CW
Adv. counters and check
Jump to get next string word


14
LA47
Is the CW 77?
No
15
Yes
RJ to string and place 0 CW CW TP addr 75___ of CW and adv. count
Place CW in Op File I
Restore exit of RJ
Make presetting for hdl. 77 outside pseudo (62___)
Jump to handle 77 in part where first row is done
LA52
Is the CW 76?
No
(IV 62)
IV 16
16
Yes
RJ to store and place 0 CW CW TP addr. 75___ of CW and adv. count
Mask out bit after 76 (# of subscr.) and shift to v
Prepare to get next str. word
Adv. CW of subscript
RJ to store and place TP CW 62 + # of loc. and adv. count
Index jump on no. of subscr.
Jump to get next string word
Loop to get all subscripts and mod.
LA53
Thus single valued 63, 64, 65, or 67. RJ to generate TD CW 62___
Adv. counters
Jump to get next string word

Subroutines

I

Generate and place
0 CW CW
TP addr. [00000 + no. of locat.]
of CW first 2 or 3 bits
filled by the different entries
adv. addresses, check
exceeded regions and jump
to get next stringout word

II

Generate and put aside
RJ CW CW
10 0 1
Advance index "inside something" and jump to get next string. word

III

Handle 77 CW cases with different entries for inside and outside pseudo operation, and jump to get next stringout word

IV

Generate and place TP CW
62___ + no. of location
Restore subrout. and advance counters with exceeded reg. check. Only used in RJ by III and 16

V

When zero stringout word,
place RJ CW CW
10 0 1 (was put aside by II) and clear both "insides" and adv. resp. clear counters and go to get next stringout word

VI

Check whether CW is already in OP File I. When not, place it there and adv. with exceed. region check
Only used in RJ by V

Compute Generator
Regions

RE	LA2512	Main program
RE	LB2710	Subroutines
RE	LC3117	Constants
RE	LJ3172	Checks for exceeded regions
RE	LK3213	Alarm print
RE	LO3217	Alarm (> region LF)
RE	LS3230	Alarm (> 1777)
RE	LT3241	Alarm (> region LE)
RE	LV3251	Alarm (> region LI)
RE	LP2000	Constant for last addr. + 1 of exit
RE	LQ5360	Constant for last addr. + 1 of region LF
RE	LR6777	Constant for last addr. + 1 of region LE
RE	LU7777	Constant for last addr. + 1 of region
RE	LD3263	Temporaries
RE	LE5360	Generated coding
RE	LI7000	Storage for constants
RE	LF3300	Op File I

LI should always follow LE so that in the end when adding the generated constants to LE the region never can be exceeded

RE	CW1211	
RE	BK2242	
RE	OP1047	
RE	WA653	Generation subroutines used
RE	UP421	
RE	BQ632	
RE	WB677	

```
         IA   LA
     0   MJ   0       30000    Exit
     1   RP   10014   LA3   }  Clear temporaries
     2   TP   LC      LD    }
     3   RP   10005   LA6   }  Clear space for prelude
     4   TP   LC      LE    }
     5   10   0       1        Const. used by LA14
     6   SP   BK3     17    }
(3)  7   TP   A       LE    }  Place sent. CW in prelude and Op File I
    10   TP   A       LF    }
    11   TP   BK1     LE5      Place XS3 code of line number in Op File I
(4) 12   TP   LC20    LE6      Prepare exit line in prelude
    13   TV   LC6     LD3   }
    14   TP   LA5     LD14  }  Set starting value in temporaries
    15   TP   LC2     LD5   }
    16   TP   LC22    LD4   }
(5) 17   RA   LA20    LC1   }  (Pre-advanced) bring next string-out word
(6) 20   TP   BK3     LD6   }    in storage LD6 and to A
    21   TP   LD6     A
(7) 22   EJ   LC      LB144    Is it zero?
    23   EJ   LC7     LB173    Is it Δ.?
    24   TP   LC      A     }  Are we inside something?
    25   TJ   LD      LA46  }
    26   TP   LD6     Q        Put string-out word ⟶Q
    27   QT   LC23    LD7      Mask out operation code into LD7 and A
    30   EJ   LC23    LA40     CW type 77?
    31   EJ   LC17    LA42     CW type 61?
    32   TJ   LC15    LA35     CW type 4?
    33   RJ   LB36    LB42     Left only CW type 64, 65, 66; jump to set
                                 aside RJ CW CW
                                        10 0  1
    34   MJ   0       LA17     Go to get next string-out word
(12)35   TP   LC2     LD1      Set index "inside pseudo operation"  }
    36   RJ   LB36    LB32     Jump to set aside  RJ  CW  CW        } CW4
                                                  10  0   1         }
    37   MJ   0       LA17     Go to get next string-out word
(10)40   RJ   LB36    LB37     Jump to set aside  RJ  CW  CW   CW77
                                                  10  0   1
    41   MJ   0       LB176    Jump to handle 77 CW
(11)42   TP   LD6     LD13     Save CW 61---in LD13 v address        }
    43   TV   LC34    LA22     Change exit for zero string-out word to }
                                 LA113                                } CW61
    44   TP   LC2     LD       Set "inside something" to 1            }
    45   MJ   0       LA17     Jump to get next string-out word       }
(9) 46   TJ   LD1     LA74     Are we inside pseudo? Yes ⟶ LA74     } inside
(14)47   TP   LD6     Q     }  In parent. but not inside pseudo:     } some-
    50   QT   LC23    LD7   }    mask out Operation Code             } thing
    51   EJ   LC23    LA55     CW type 77?                           }
    52   EJ   LC10    LA60     CW type 76?                           }
    53   RJ   LB133   LB116    Left only type 63, 64, 65 or 67:go to }
                                 generating with 62...               }
    54   MJ   0       LA17
```

```
(15)  55  RJ  LB14    LB21    RJ to gener. and placing       ┐
                                 0   CW    CW                 │
                                 TP  Addr.75---               │
                                     of CW                    ├ CW Type 77
      56  RJ  LB143   LB134   RJ to taking care of Op        │ (not inside
                                 File I                       │ pseudo)
      57  MJ  0       LB112   Jump to handle subscr.         │
                                 var. case                    ┘
(16)  60  RJ  LB133   LB167   RJ to gener. and placing       ┐
                                 0   CW    CW                 │
                                 TP  Addr. 75---              │
                                     of CW                    │
      61  TP  LC21    Q    }  Mask out bit # of subscripts   │
      62  QT  LD6     LD10 }                                  │
      63  LQ  LD10    36      # of subscr. in v of LD 10      │
      64  TP  LC46    Q    }  Prepare to get next string-     ├ CW type 76
      65  QT  LD6     A    }     out word                     │ (no - never! -
(17)  66  AT  LC15    LD6     Bring CW-1 of first sub-        │ inside Pseudo-
                                 script in storage LD6        │ Op)
      67  MJ  0       LA70    Space filling jump (free)       │
(19)  70  RA  LD6     LC2     Up date CW                      │
      71  RJ  LB133   LB116   Jump to generate and place      │
                                 TP [CW] 62...+ # of locat.   │
      72  IJ  LD10    LA73    IJ on # of subscr.             }  Subscr. -1
      73  ZJ  LA70    LA17    Jump to get next string.       }  (zero jump
                                 word                         ┘ needed since
                                                                index by 1 too
                                                                high)
(13)  74  TP  LD6     Q    }  Operat. code → A and LD7       ┐
      75  QT  LC23    LD7  }                                  │
      76  EJ  LC23    LA102   CW type 77?                     │ In parenthe-
      77  EJ  LC12    LA105   CW type 66?                     ├ ses inside
     100  RJ  LB133   LB160   Left only CW type 64, 65,       │ pseudo op.
                                 or 67                        │
     101  MJ  0       LA17    Go to get next string. word     ┘
(20) 102  RJ  LB14    LB23    RJ to gener. and place          ┐
                                 0   CW    CW                 │
                                 TP  Addr. 76X...             ├ CW type 77 in-
                                     of CW                    │ side pseudo
     103  RJ  LB143   LB134   RJ to take care of Op File 1    │
     104  MJ  0       LB114   Jump to handle subscr.          │
                                 var. case                    ┘
(21) 105  RJ  LB14    LB15    RJ to gener. and place          ┐
                                 0   CW    CW                 │
                                 TP  Addr. 61...              │
                                     of CW                    │
     106  TP  LC23    Q    }  Put mask for CW code — Q        │
                           }  Change CW in LD6 to sent.       │
                           }     CW25...                      │
     107  QS  LC14    LD6  }                                  ├ CW type 66
     110  RJ  LB14    LB15    RJ to gener. and place          │ inside pseudo
                                 0   CW    CW                 │
                                 TP  Addr. 61...              │
                                     of CW                    ┘
```

```
      111 RJ LB143  LB134   RJ to take care of Op
                              File I
      112 MJ 0      LA17    Jump to get reset string-
                              out word
(18)  113 RA LD13   LC2     Adv. CW by 1
      114 SP LD13   17      Move CW + 1 to u addr.
      115 TU A      LC30  }                   TU [ ] [ ]
      116 TU A      LC31  } Place CW in u of  TV [ ] [ ]
      117 TP LC24   A       Put "1003" in v of A } form excl. 10 lines
                                                 } "next addr.+ 2"
      120 AT LD5    A       Add # of addr. in gener. coding          Case
                              excl. 10 lines
      121 TV A      LC30  } Place "next addr. + 2" (excl. 10 TU [ ][ ]   CW
      122 TV A      LC31  }   lines) in v of TV [ ][ ]                61...
      123 MJ 0      LA167   Place "next addr." (incl.
                              10 lines) in RP command
(22)  124 RP 30004  LA126 }
      125 TP LC30   30000 } Place 4 rows of generated coding
(23)  126 TV LC36   LA22    Restore exit of case zero
                              string. word
      127 RA LD5    LC5   }
      130 RJ LJ12   LJ7   } Adv. counters resp. clear
      131 RP 10003  LA133 }   # of locat. rel. 100 and
      132 TP LC     LD    }   both insides
(24)  133 MJ 0      LA17  }
(8)   134 TV LD3    LE    } Fill v of LE (LE7 +...)-LE
      135 RS LE     LC37  }
      136 TV LE     LE1   } Fill v of LE1
      137 RS LE1    LC43  }   (LE7 +...) - LE - 6 (6 is prelude
                              coding)
      140 RS LD4    LC22  }
      141 TV LD4    LE2   } Fill v of LE2
      142 LQ LE2    11    }
      143 RS LB140  LC42  }
      144 TV A      LF    } Fill v of LF
      145 RA LE6    LD5   } Fill v of LE6
      146 RA LE6    LC2   } (second addr. of next routine)
      147 ST LC20   LF1   } Fill v of LF1                          Go to
      150 RS LF1    LC2   } (LE6-LC20)                             end
      151 SP LE2    6     }
      152 AT LA162  LA162 }
      153 TV LE     LA163 } Prepare moving of generated
      154 RA LA163  LC37  }   constants
      155 LQ LE2    Q33   }
      156 RA LE     Q     }
      157 RA LE1    Q     } Add constants to # of generated
      160 RA LF1    Q     }   addresses
      161 RA LE6    Q     }
      162 RP 30000  LJ    } Move constants to end of coding
      163 TP LI     30000 }
      164 TP LC44   OP1   }
      165 RJ OP     OP2   } Bring generated coding to tape
      166 MJ 0      LA    }
```

```
           167  SP  LC30   17      Come from LA123          Patch for generating
           170  TU  A      LC32                             RA addr. 1
           171  TP  LC2    A       Get a CW for const. 1
           172  RJ  CW     CW1
           173  TV  Q      LC32
           174  TV  LD3    LA125
           175  MJ  0      LA124   Jump back to coding
                CA  LA176


                IA  LB
I            0  SP  LD6    17
             1  AT  LD6    LI      Form Ø  CW  CW in next storage addr.
             2  TU  A      LC36      save CW in u in LC36 (used by LB135 in VI)
             3  MJ  0      LJ15
             4  TU  LD4    LC26    Generate
             5  RA  LC26   LD2     TP 01... CW + # of locat. and place it
             6  TV  LD3    LB7       for gener. const.  0   CW   CW
             7  TP  LC26   30000     for gener. code   TP   01...CW + #loc.
            10  RA  LD2    LC2
            11  RJ  LJ12   LJ11
            12  RA  LD4    LC27    Advance counters
            13  RA  LD5    LC2
I exit      14  MJ  0      30000
I_61        15  TV  LC17   LC26    Put 61000 in v of LC26
            16  MJ  0      LB
I_62        17  TV  LC16   LC26    Put 62000 in v of LC26
            20  MJ  0      LB
I_75        21  TV  LC11   LC26    Put 75000 in v of LC26
            22  MJ  0      LB
I 76_x      23  TU  LA20   LB25
            24  RA  LB25   LC1     Get next string-out word (in advance,
            25  TP  30000  LD7       not yet officially) into LD7
            26  SP  LD7    6       Shift # of subscripts 9_10 bits to the left
            27  TV  A      LC26
            30  RA  LC26   LC10    Put 76X000 in v of LC26
            31  MJ  0      LB
II          32  SP  LD6    17      Form RJ   CW   CW    and set it aside
            33  AT  LD6    A            10   Ø    1
            34  AT  LC35   LD13
            35  TP  LC2    LD      Set index "inside something" to 1
II exit     36  MJ  0      30000   Only used in RJ
II_24       37  TP  LC23   Q
            40  QS  LC13   LD6     Make 24...CW before going to II
            41  MJ  0      LB32
II_25       42  TP  LC23   Q
            43  QS  LC14   LD6     Make 25...CW before going to II
            44  MJ  0      LB32
III         45  RP  10004  LB47
            46  TP  LC     LD7     Clear temp. storage   Handl. of subscr. var.
            47  RJ  LB111  LB106   Get next string-out word → A
            50  TU  A      LD10    Modulus → u of LD10
```

	51	TV	A	LD7	# of subscr. -1 ⟶ v of LD7
	52	RS	LD7	LC2	
	53	SP	LD10	71	Get const. CW for mod.
	54	RJ	CW	CW1	
	55	TP	A	LD10	CW for mod. ⟶ u of LD10
	56	IJ	LD7	LB60	First IJ on # of subscripts
	57	MJ	0	LB103	
	60	RJ	LB111	LB106	Get next string-out word ⟶ A
	61	TU	A	LD12	Store multiplier 2 in LD12(u)
	62	TV	A	LD11	Store multiplier 1 in LD11(v)
	63	TP	LD11	A	Get CW for multiplier 1
	64	RJ	CW	CW1	
	65	TU	A	LC26	Generate and place TP [CW mult. 1] 62... 63... #of locat. for multipl. 1
	66	RJ	LB133	LB121	
	67	IJ	LD7	LB71	Second IJ on # of subscr.
	70	MJ	0	LB103	
	71	SP	LD12	71	Get const. CW for mult. 2
	72	RJ	CW	CW1	
	73	TU	A	LC26	Generate and place TP [CW mult. 2] 62... 63... # of locat.
	74	RJ	LB133	LB121	
	75	IJ	LD7	LB77	Third IJ on # of subscr.
	76	MJ	0	LB103	
	77	RJ	LB111	LB106	Get next string-out word ⟶ A
	100	RJ	CW	CW1	Get const. CW for mult. 3 (this string word has data only in v)
	101	TU	A	LC26	Generate and place TP [CW mult. 3] 62... 63... # of locat. for multipl. 1
	102	RJ	LB133	LB121	
	103	TU	LD10	LC26	Generate and place TP [CW modulus] 62... 63... # of locat.
	104	RJ	LB133	LB121	
	105	MJ	0	LA17	Go to get next string-out word
	106	RA	LA20	LC1	Get next string-out word to A (used as subrout. in III)
	107	TU	LA20	LB110	
	110	TP	30000	A	
	111	MJ	0	30000	
III_{62}	112	TV	LC40	LB121	Set jump to IV_{62} in IV
	113	MJ	0	LB45	
III_{63}	114	TV	LC41	LB121	Set jump to IV_{63} in IV
	115	MJ	0	LB45	
IV_{16}	116	SP	LD6	17	Prepare IV_{16}
	117	TU	A	LC26	
	120	MJ	0	LB122	Generate and place TP CW
IV	121	MJ	0	30000	Jump to right entry
IV_{62}	122	TV	LC16	LC26	Place 62...in LC26
	123	MJ	0	LB125	
IV_{63}	124	TV	LC15	LC26	Place 63...in LC26
	125	RA	LC26	LD2	Add # of locat. to 62/63... in LC26 v address
	126	TV	LD3	LB127	Place "next addr. for gen. coding" in NI
	127	TP	LC26	30000	Place one line of generated coding
	130	RA	LD2	LC2	Adv. counters and check exceeded region
	131	RJ	LJ12	LJ11	
	~~132~~	~~RA~~	~~LD5~~	~~LC2~~	
IV exit	133	MJ	0	30000	
VI	134	TP	LC25	Q	Mask CW at hand ⟶ A in u address

```
           135  QT   LC36    A      ]
           136  RP   20000   LB140  }  Compare whether already in Op File 1
           137  EJ   LF2     LB143  ]
           140  TP   A       LF2       When not yet in Op File 1, put CW in it
                                         (TP because space is not cleared before!)
           141  MJ   0       LJ3    }  Advance addresses  (1 in v)
           142  RA   LB136   LC1    ]                     (1 in u)
VI exit    143  MJ   0       30000     Used only in RJ
V          144  TV   LD3     LB146
           145  RP   30002   LB147  }  Place the 2 rows that have { RJ  CW  CW
           146  TP   LD13    30000  ]    been set away            { 10  Ø   1
           147  RA   LD5     LC2    }
           150  RJ   LJ12    LJ10   ]  Adv. counters
           151  RP   10003   LB153  }  Clear all "inside's" and counter for
           152  TP   LC      LD     ]    number of addr. in array
           153  TU   LD13    LC36      Put CW in u of LC36
           154  RJ   LB143   LB134     RJ to take care of Op File 1
           155  MJ   0       LA17      Jump to get next string-out word
I63        156  TV   LC15    LC26   }
           157  MJ   0       LB     ]  Prepare I63
IV17       160  SP   LD6     17     ]
           161  TU   A       LC26   }  Prepare IV17
           162  MJ   0       LB124  ]
           163  TP   LA34    LA23   ]  Shortcut  (skip everything up to
           164  RJ   LA22    LA17   |    next zero word)
           165  TP   LC45    LA23   {  Restore LA23
           166  MJ   0       LB144  ]  Jump to handle zero word situation
           167  SP   LD6     17     ]
           170  TU   A       LC26   |
           171  TV   LC11    LC26   |  Place MJ in end
           172  MJ   0       LB125  }
           173  TP   LC20    LC26   |
           174  RJ   LB133   LB126  |
           175  MJ   0       LA134  ]
           176  TP   LC46    Q         Mask for last 3 bits, come from LA41
           177  RA   LA20    LC1       Advance to next string-out word
           200  TU   LA20    LB201  }
           201  QT   30000   A      ]  Mask out # of subscripts
           202  EJ   LC2     LB206     Is it 1?
           203  TJ   LC5     LB205     Is it < 4?
           204  RA   LA20    LC1       It is 4     : advance once more
           205  RA   LA20    LC1       It is 2 or 3: advance once more
           206  MJ   0       LA17      It is 1     : go to get next string-out
                CA   LB207                            word
```

Constants

	IA	LC		
0	0	0	0	
1	0	1	0	
2	0	0	1	
3	0	0	2	
4	0	0	3	
5	0	0	4	
6	0	0	LE7	
7	01	22777	77777	XS3 "$\triangle$."
10	0	0	76000	
11	0	0	75000	
12	0	0	66000	
13	0	0	24000	
14	0	0	25000	
15	0	0	63000	
16	0	0	62000	
17	0	0	61000	
20	MJ	0	01000	
21	0	0	00700	
22	0	10000	10000	
23	0	0	77000	
24	0	0	1003	
25	0	77777	0	
26	TP	30000	30000	
27	0	1	1	
30	TU	30000	30000	These four rows belong together (the 30000 must not be messed up)
31	TV	30000	30000	
32	RA	30000	30000	
33	RJ	30000	30000	
34	0	0	LA113	
35	RJ	0	0	This instr.-const. must have zero's !!!
36	0	30000	LB144	
37	0	0	LE	
40	TU	0	LB122	
41	TV	0	LB124	
42	TP	A	LF	
43	0	0	6	
44	0	LE	LF	
45	EJ	LC7	LB173	
46	0	0	7	
47	TP	A	LQ	For exceeded region checks
50	0	0	LR	
51	MJ	0	LP	
52	AT	LD6	LU	
	CA	LC53		

Exceeded Region Tests

	IA	LJ		
0	TJ	LC51	LA164	Gen. constants
1	TU	LS	LK1	
2	MJ	0	LK	Alarm
3	RA	LB140	LC2	
4	TJ	LC47	LB142	Region LE
5	TU	LT	LK1	
6	MJ	0	LK	Alarm
7	RA	LD3	LC3	
10	RA	LD3	LC2	
11	RA	LD3	LC2	Region LF
12	TJ	LC50	30000	
13	TU	LO	LK1	
14	MJ	0	LK	Alarm
15	RA	LB1	LC2	
16	TJ	LC52	LB4	Region LI
17	TU	LV	LK1	
20	MJ	0	LK	Alarm
	CA	LJ21		

Alarm Entrance

	IA	LK	
0	RJ	WA	WA2
1	TP	30000	UP3
2	RJ	UP2	UP
3	MJ	0	BQ6
	CA	LK4	

Alarm 1

	IA	LS		
0	0	LS1	0	
1	40	LS2	7	
2	32	30503	05424	Generated code
3	66	30270	12651	exceeds 1777
4	27	30013	07226	addresses.
5	30	30276	50104	
6	12	12120	12427	
7	27	54306	56530	
10	65	22777	77777	
	CA	LS11		

Alarm 2

	IA	LT		
0	0	LT1	0	
1	40	LT2	6	
2	54	30323	45150	Region for Op File 1
3	01	31515	40151	is exceeded.
4	52	01313	44630	
5	01	04013	46501	
6	30	72263	03027	
7	30	27227	77777	
	CA	LT10		

Alarm 3

	IA	LO		
0	0	LO1	0	
1	40	LO2	7	Region for generated
2	54	30323	45150	coding is exceeded.
3	01	31515	40132	
4	30	50305	42466	
5	30	27012	65127	
6	34	50320	13465	
7	01	30722	63030	
10	27	30272	27777	
	CA	LO11		

Alarm 4

	IA	LV	
0	0	LV1	0
1	40	LV2	10
2	54	30323	45150
3	01	31515	40132
4	30	50305	42466
5	30	27012	65150
6	65	66245	06665
7	01	34650	13072
10	26	30302	73027
11	22	77777	77777
	CA	LV12	

Region for generated constants is exceeded.

		Temporaries			Compute Generate	
LD	0				Index "inside something"	
	1				Index " pseudo oper.	
	2			[ ]	Running # adv. by IV(+ 1), 18(= 0), I(+ 1)	
	3			[ ]	Addr. of gen. code adv. by V(+ 2), IV(+ 1), 18(+ 4), I(+ 1)	
	4	Ø	10000	10000	CW of gener. const. adv. by I(+ 1 in u and v)	cleared in beginning
	5	Ø	Ø	1	adv. by V(+ 1) IV(+ 1), 18(+ 4), I(+ 1)	
	6				Next string-out word	
	7				Working space	cleared later again
	10				Working space	
	11				Working space	
	12				Working space	
	13				Storage space for {RJ CW CW / 10 Ø 1}	
	14	10	Ø	1		

Generated Code:

LE	0	Ø	sent.CW	Ø		cleared in beginning
	1					
	2					
	3					
	4					
	5	Line # XS3 code				
	6	MJ	Ø	01000	Set by LA12 and LA160	
	:					

OP File I

LF	0	Ø	sent.CW	Ø	not cleared in beginning
	1				
	2				
	3				
	4				

Generated Constants

LI	0
	1
	.
	.
	.

Vary Generation Routine

The Vary generator uses the string-out and the Vary File as built during the Translation Phase to prepare the relative coding necessary to perform the functions of the input Vary sentence. This generator also provides an Op File I item to be used by the Segmentation Phase. The relative coding is later modified by the Processor according to the information furnished by the Allocator.

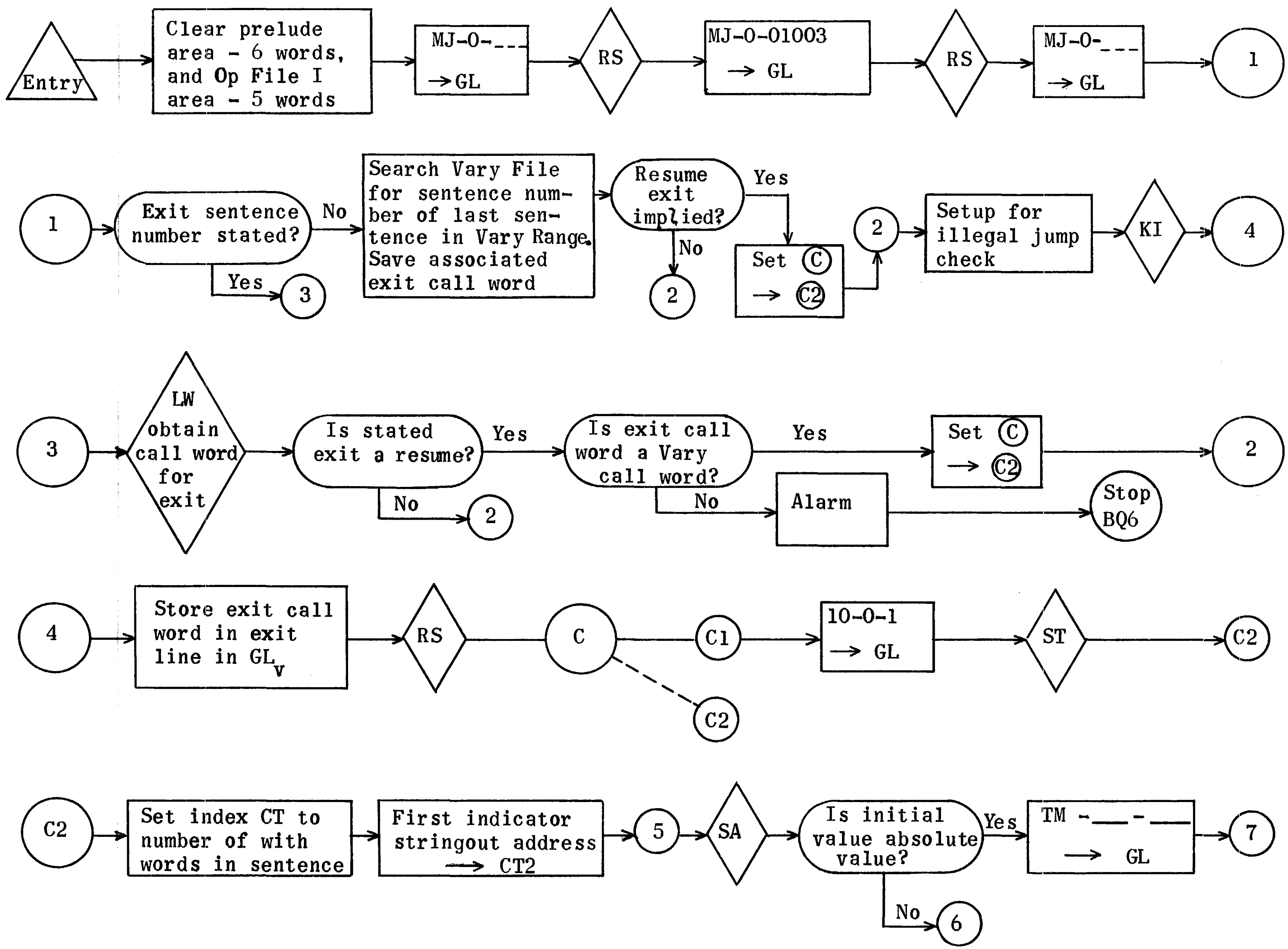
The generated Vary coding may be broken down into the sequence of functions performed by the Vary sentence.

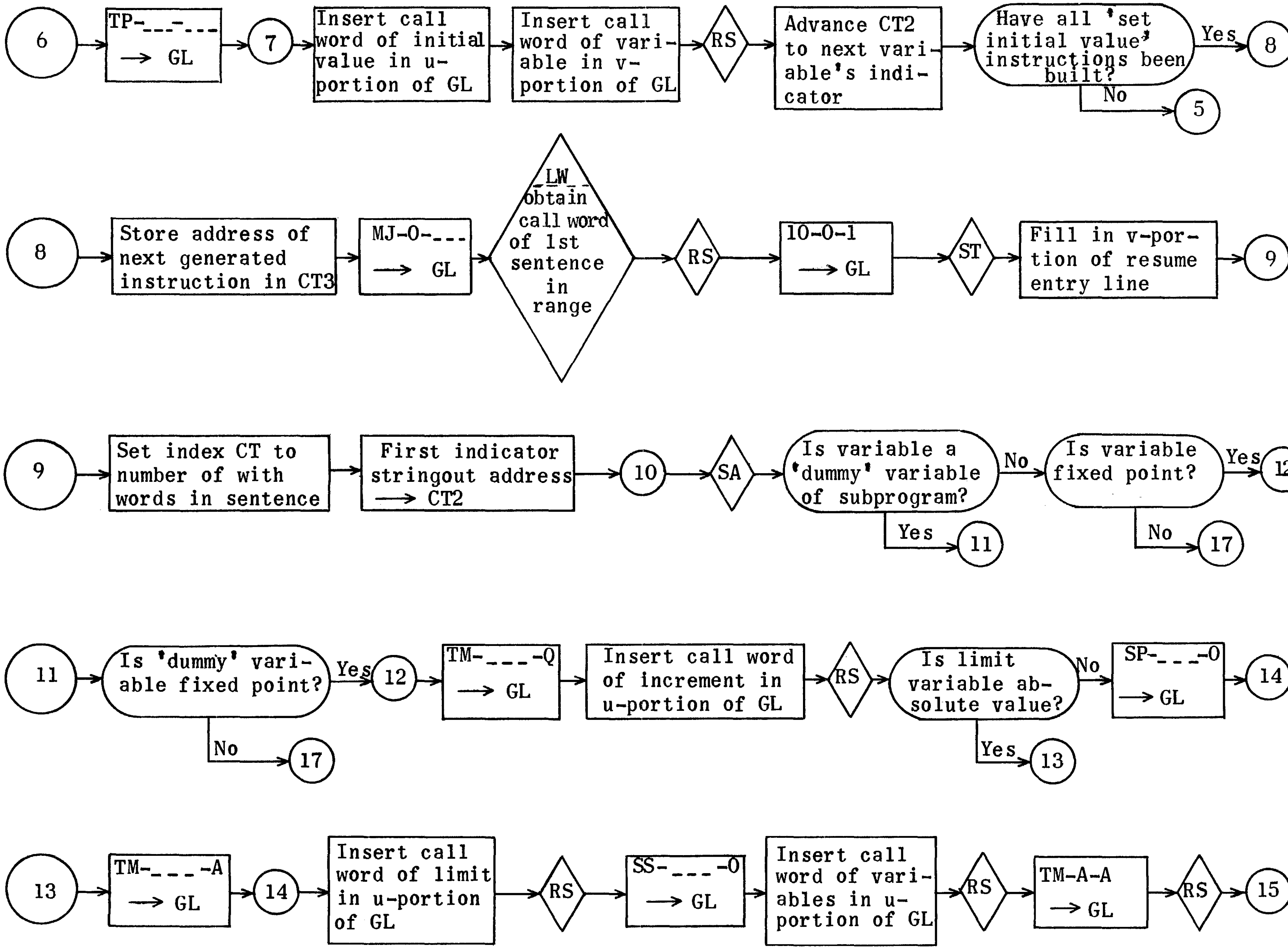
	MJ - 00000 -[4]	Resume entry
	MJ - 00000 -[2 or 5]	Normal entry
1	MJ - 00000 -[ ]	Exit as specified in string-out or Vary File
2	{Set initial value(s)}	
3	{Jump to first statement in range}	
4	{Tests for completion of Vary. If finished, to 1}	
	{Modify variable(s)}	
	{Back to 3}	
5	{Tests for indefinite loop, if required}	
	{Back to 2}	

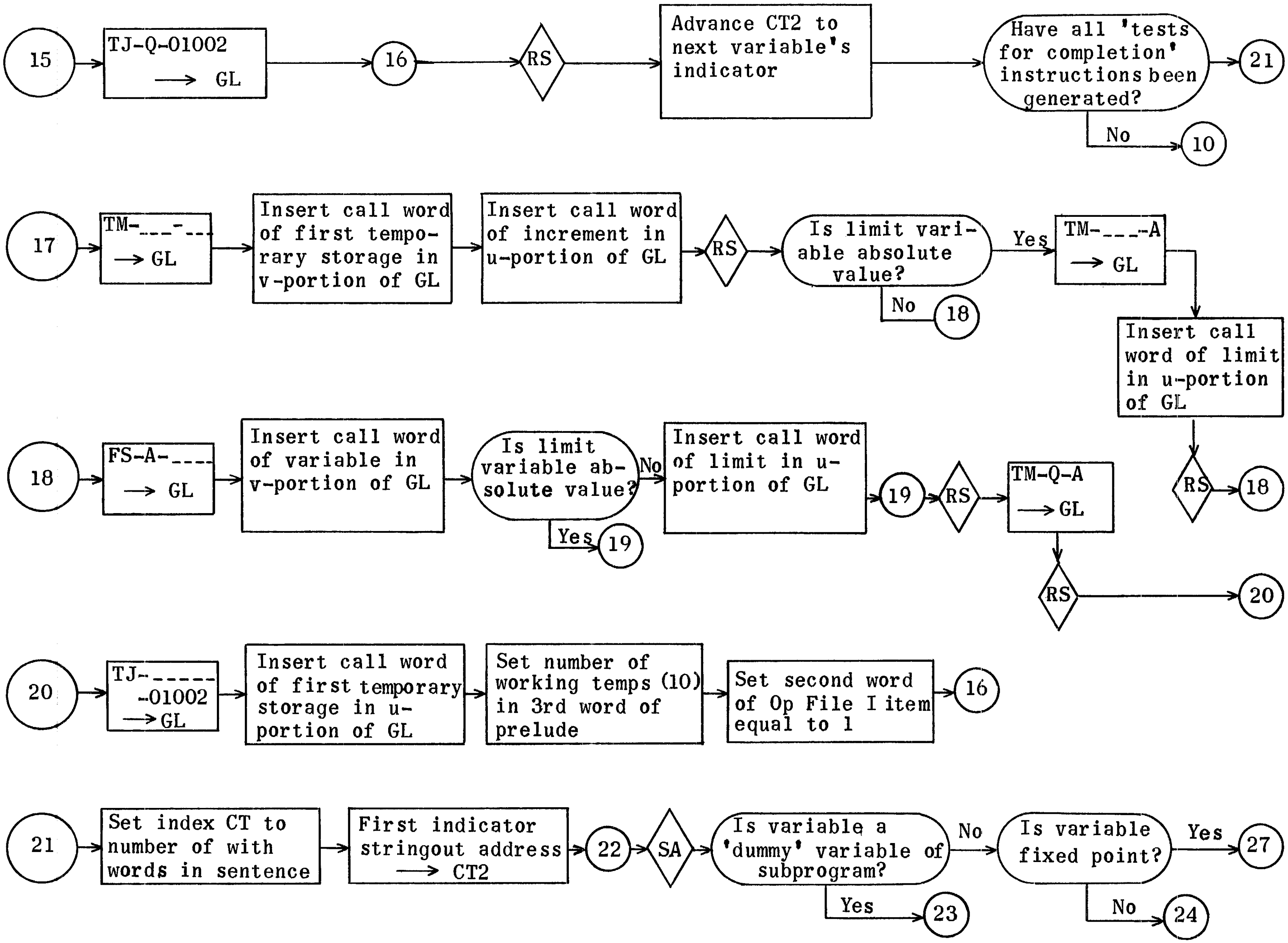
The call word from the u-portion of the Vary File item is filled into the Exit instruction by the Vary generator when the transfer component is implied rather than stated.

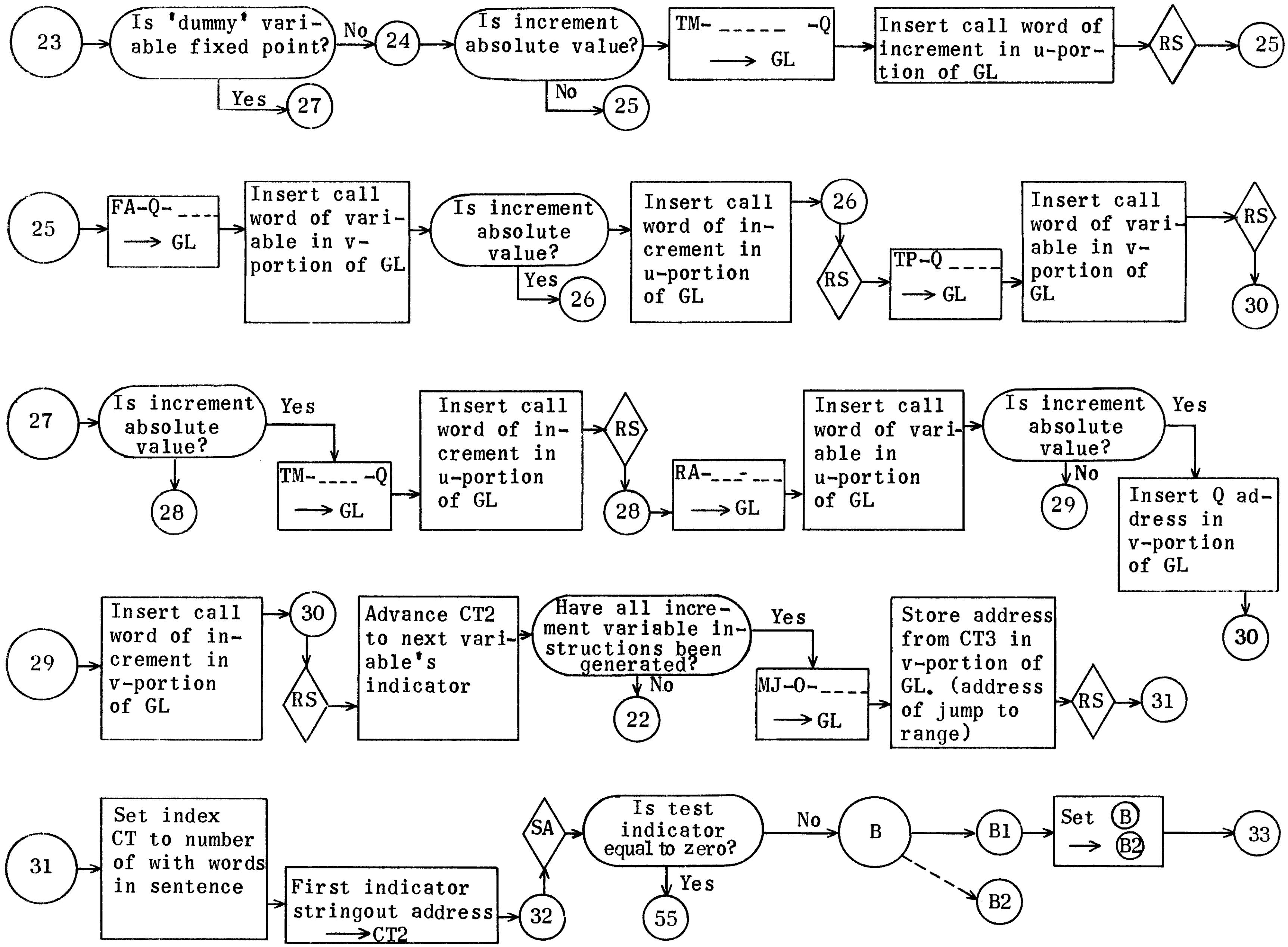
The return to the Vary coding from the last sentence in the Vary's range is accomplished by the insertion of the Vary call word (from the v-portion of the Vary File item) into the Exit line of the generated coding for the last sentence in the range. This insertion is effected by the RG routine of the Generation subroutines. The Exit line of the last sentence in the Vary range will return to the Vary coding at the Resume Entry line.

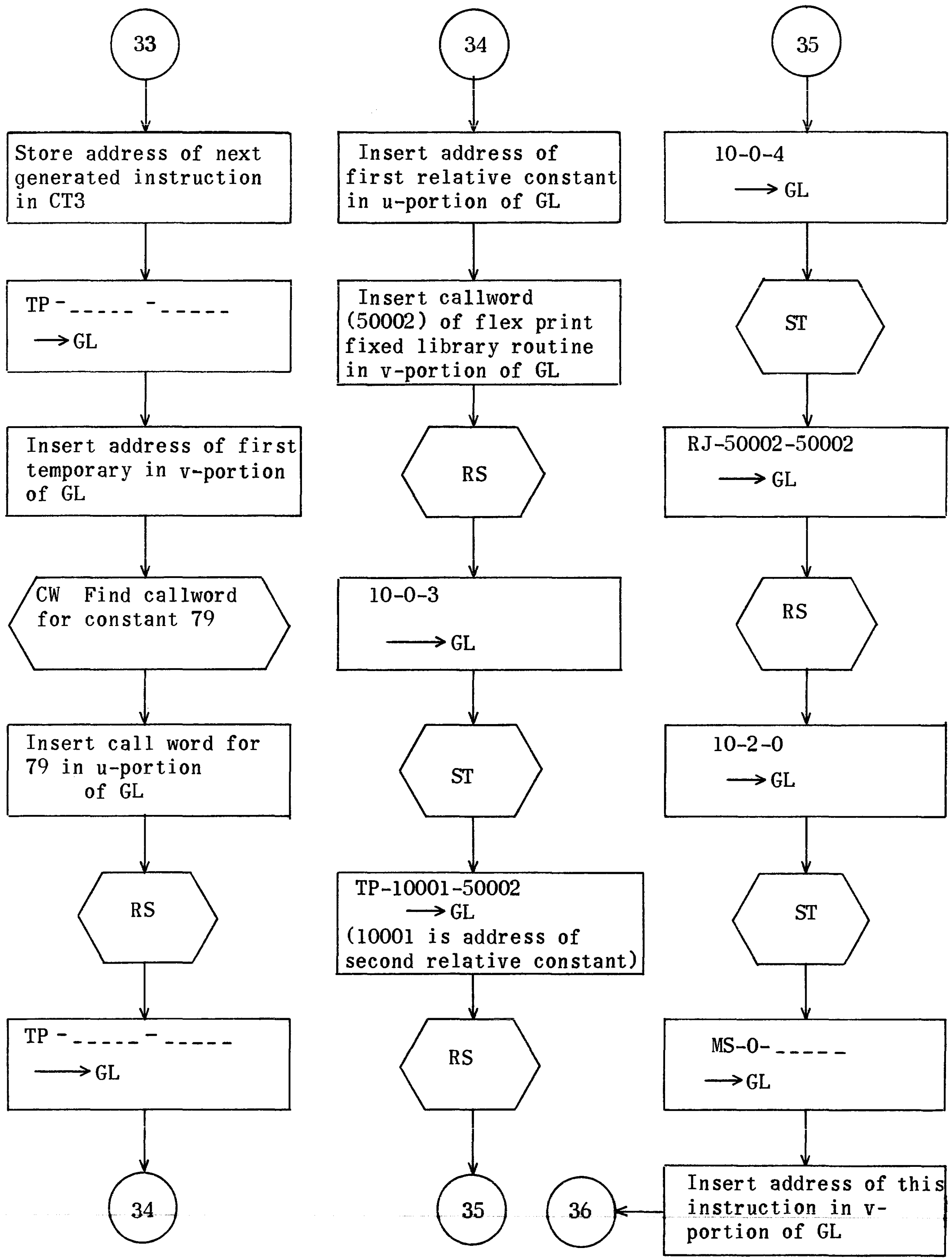
Vary Generator Flow Charts

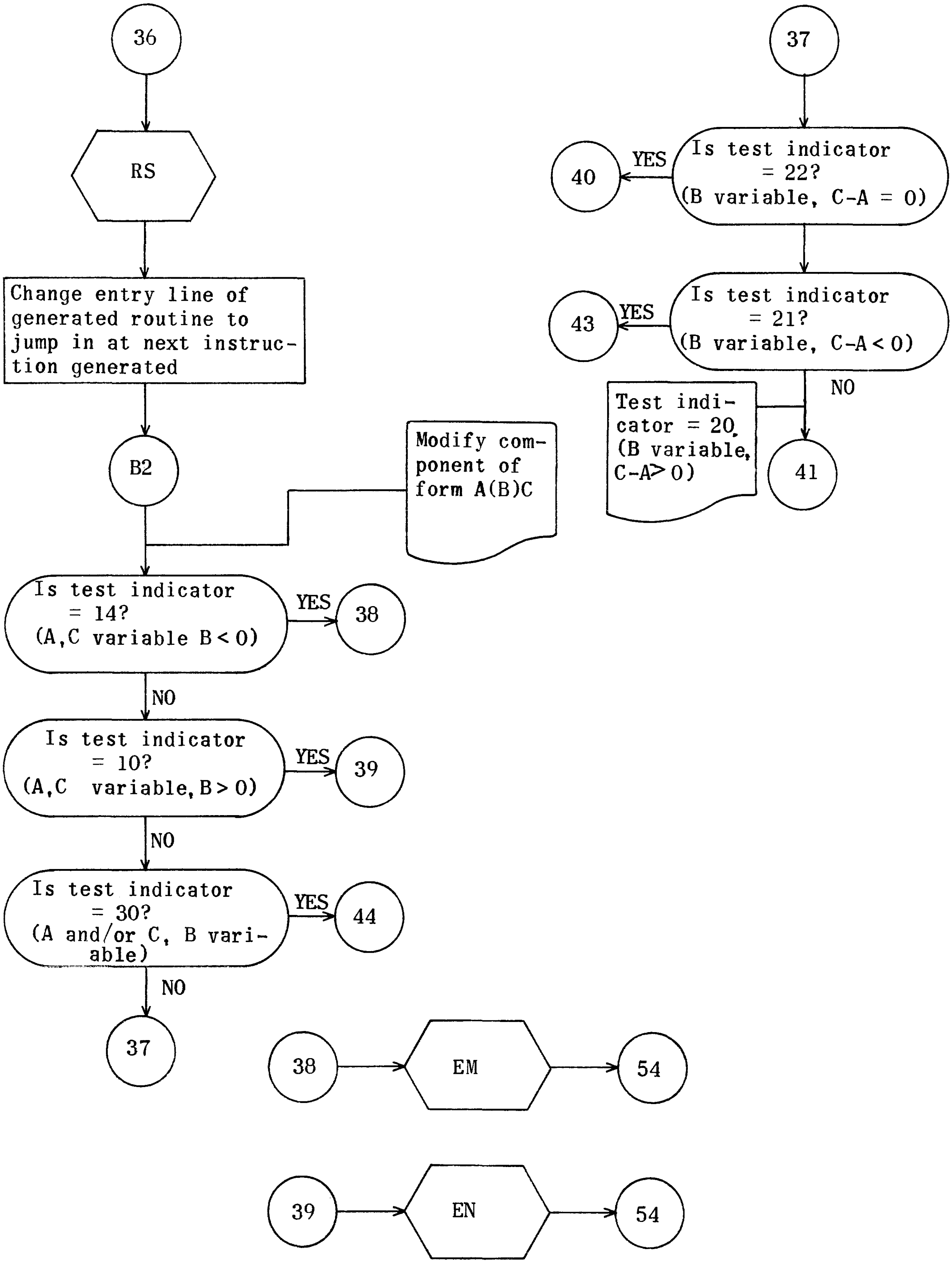


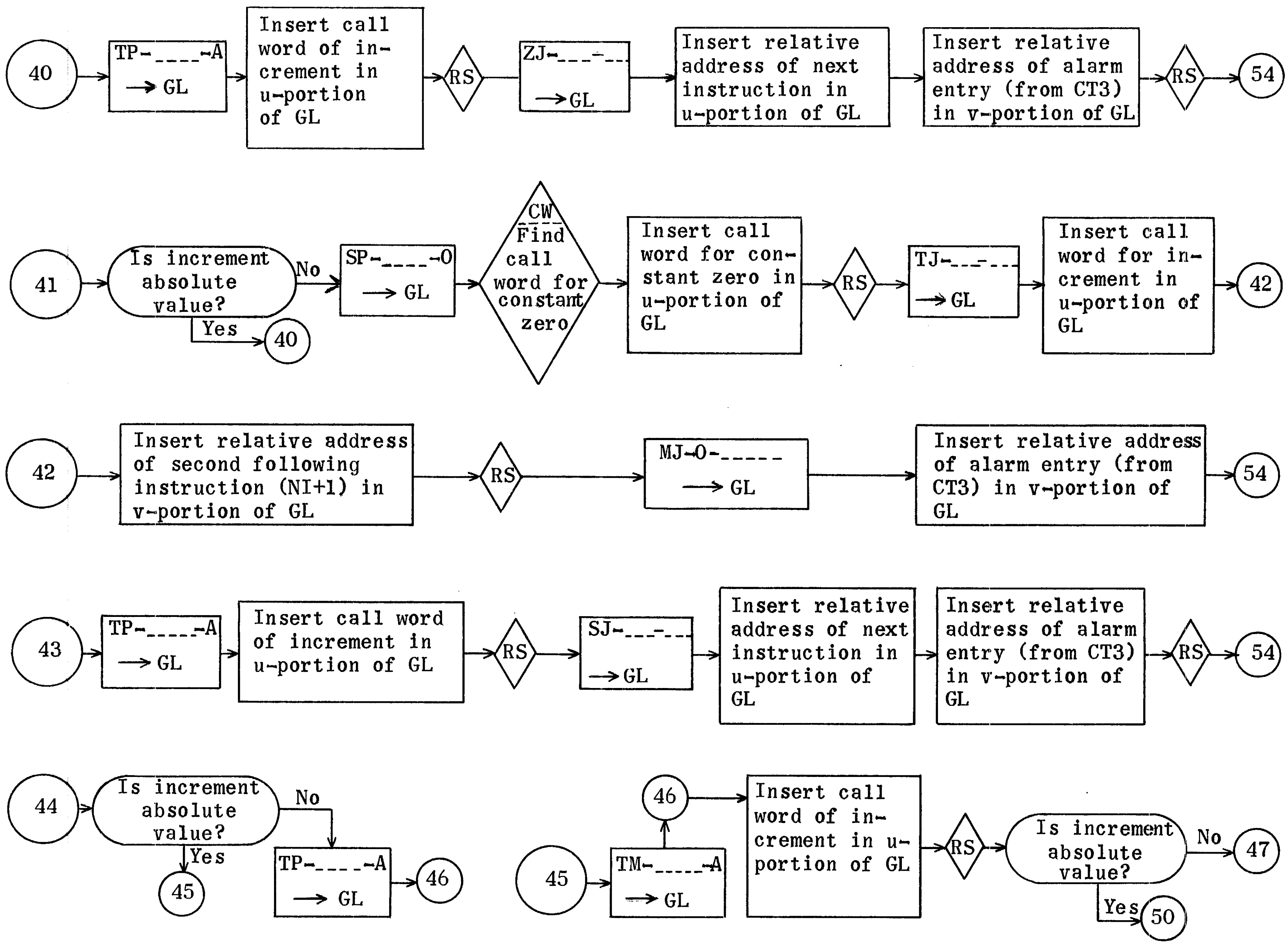

6
TP-__-___ → GL
7
Insert call word of initial value in u-portion of GL
Insert call word of variable in v-portion of GL
RS
Advance CT2 to next variable's indicator
Have all 'set initial value' instructions been built?
Yes
8
No
5
8
Store address of next generated instruction in CT3
MJ-0-___ → GL
_LW_ obtain call word of 1st sentence in range
RS
10-0-1 → GL
ST
Fill in v-portion of resume entry line
9
9
Set index CT to number of with words in sentence
First indicator stringout address → CT2
10
SA
Is variable a 'dummy' variable of subprogram?
No
Yes
11
Is variable fixed point?
Yes
12
No
17
11
Is 'dummy' variable fixed point?
Yes
12
No
17
TM-___-Q → GL
Insert call word of increment in u-portion of GL
RS
Is limit variable absolute value?
No
Yes
13
SP-___-0 → GL
14
13
TM-___-A → GL
14
Insert call word of limit in u-portion of GL
RS
SS-___-0 → GL
Insert call word of variables in u-portion of GL
RS
TM-A-A → GL
RS
15

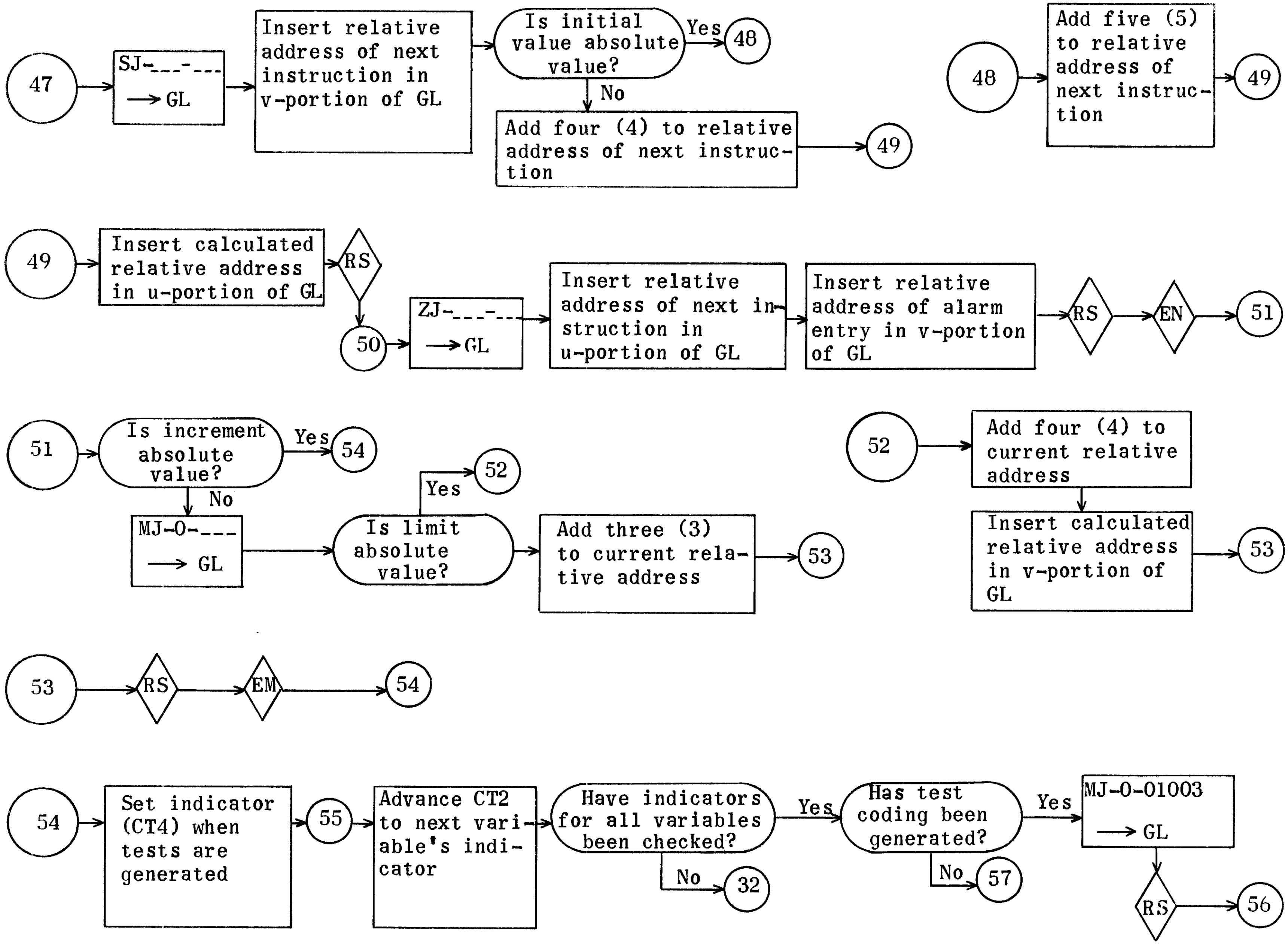

15
TJ-Q-01002 → GL
16
RS
Advance CT2 to next variable's indicator
Have all 'tests for completion' instructions been generated?
21
No
10
17
TM-___-___ → GL
Insert call word of first temporary storage in v-portion of GL
Insert call word of increment in u-portion of GL
RS
Is limit variable absolute value?
Yes
TM-___-A → GL
No
18
Insert call word of limit in u-portion of GL
RS
18
18
FS-A-____ → GL
Insert call word of variable in v-portion of GL
Is limit variable absolute value?
No
Yes
19
Insert call word of limit in u-portion of GL
19
RS
TM-Q-A → GL
RS
20
20
TJ-_____ -01002 → GL
Insert call word of first temporary storage in u-portion of GL
Set number of working temps (10) in 3rd word of prelude
Set second word of Op File I item equal to 1
16
21
Set index CT to number of with words in sentence
First indicator stringout address → CT2
22
SA
Is variable a 'dummy' variable of subprogram?
No
Is variable fixed point?
Yes
27
Yes
23
No
24

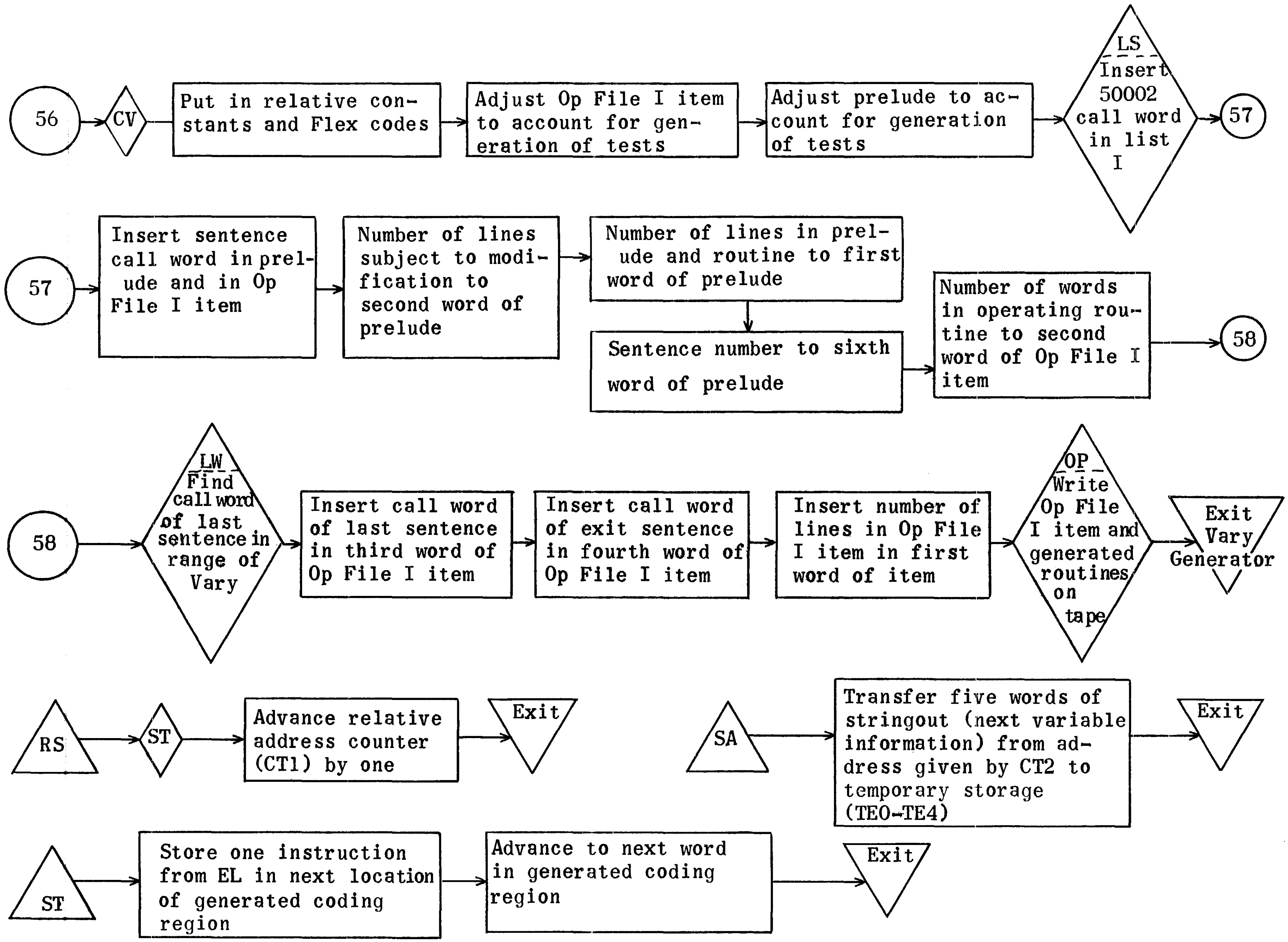

23
Is 'dummy' variable fixed point?
No
Yes
27
24
Is increment absolute value?
No
25
TM- _____ -Q
→ GL
Insert call word of increment in u-portion of GL
RS
25
25
FA-Q- ____
→ GL
Insert call word of variable in v-portion of GL
Is increment absolute value?
Yes
26
Insert call word of increment in u-portion of GL
26
RS
TP-Q ____
→ GL
Insert call word of variable in v-portion of GL
RS
30
27
Is increment absolute value?
Yes
28
TM-____ -Q
→ GL
Insert call word of increment in u-portion of GL
RS
28
RA-___-___
→ GL
Insert call word of variable in u-portion of GL
Is increment absolute value?
Yes
No
29
Insert Q address in v-portion of GL
30
29
Insert call word of increment in v-portion of GL
30
RS
Advance CT2 to next variable's indicator
Have all increment variable instructions been generated?
Yes
No
22
MJ-0-____
→ GL
Store address from CT3 in v-portion of GL. (address of jump to range)
RS
31
31
Set index CT to number of with words in sentence
First indicator stringout address
→ CT2
32
SA
Is test indicator equal to zero?
No
Yes
55
B
B1
B2
Set B
→ B2
33

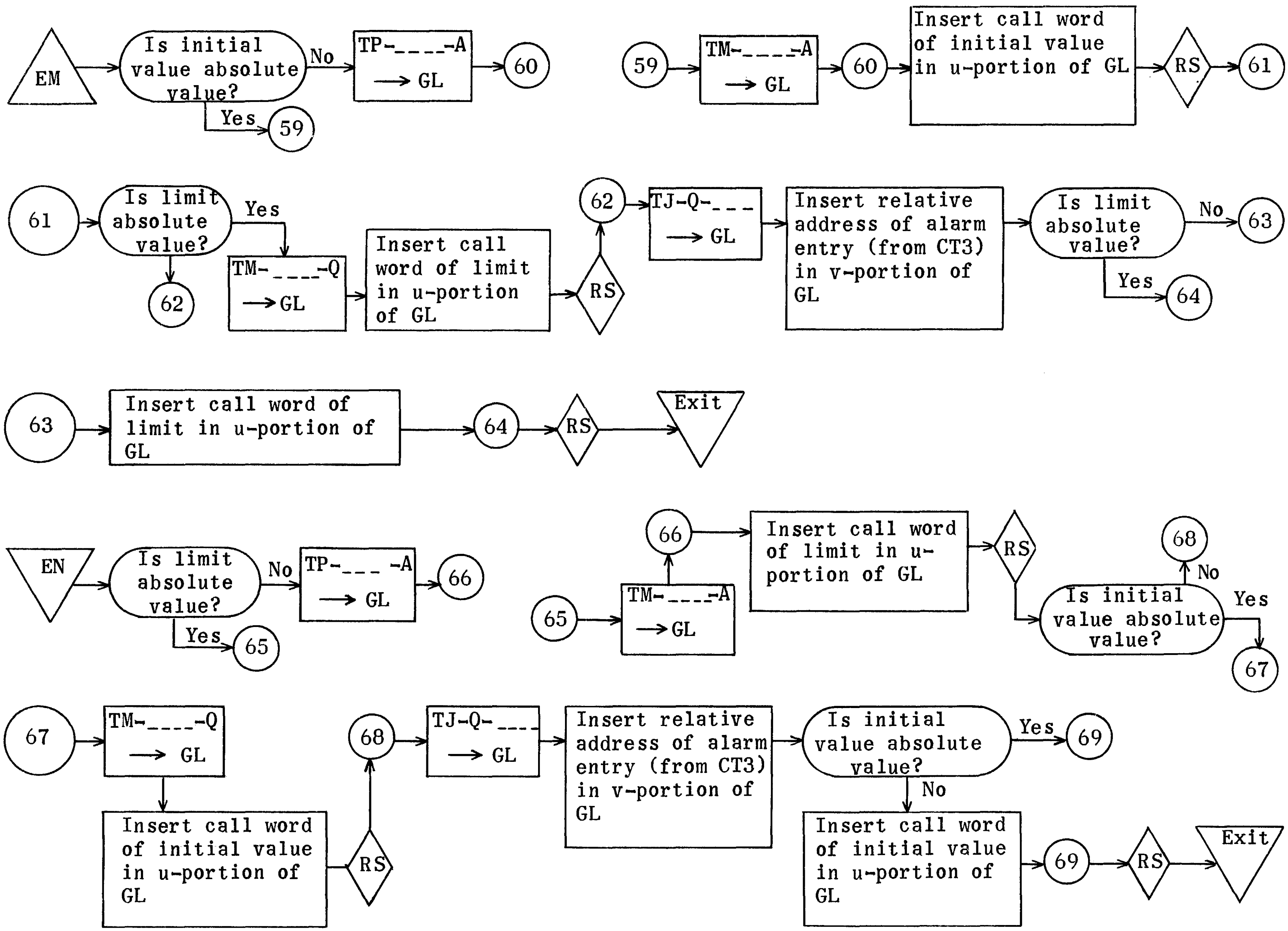

33
Store address of next generated instruction in CT3
TP-_____ -_____
→GL
Insert address of first temporary in v-portion of GL
CW Find callword for constant 79
Insert call word for 79 in u-portion of GL
RS
TP-_____-_____
→GL
34
34
Insert address of first relative constant in u-portion of GL
Insert callword (50002) of flex print fixed library routine in v-portion of GL
RS
10-0-3
→GL
ST
TP-10001-50002
→GL
(10001 is address of second relative constant)
RS
35
35
10-0-4
→GL
ST
RJ-50002-50002
→GL
RS
10-2-0
→GL
ST
MS-0-_____
→GL
Insert address of this instruction in v-portion of GL
36

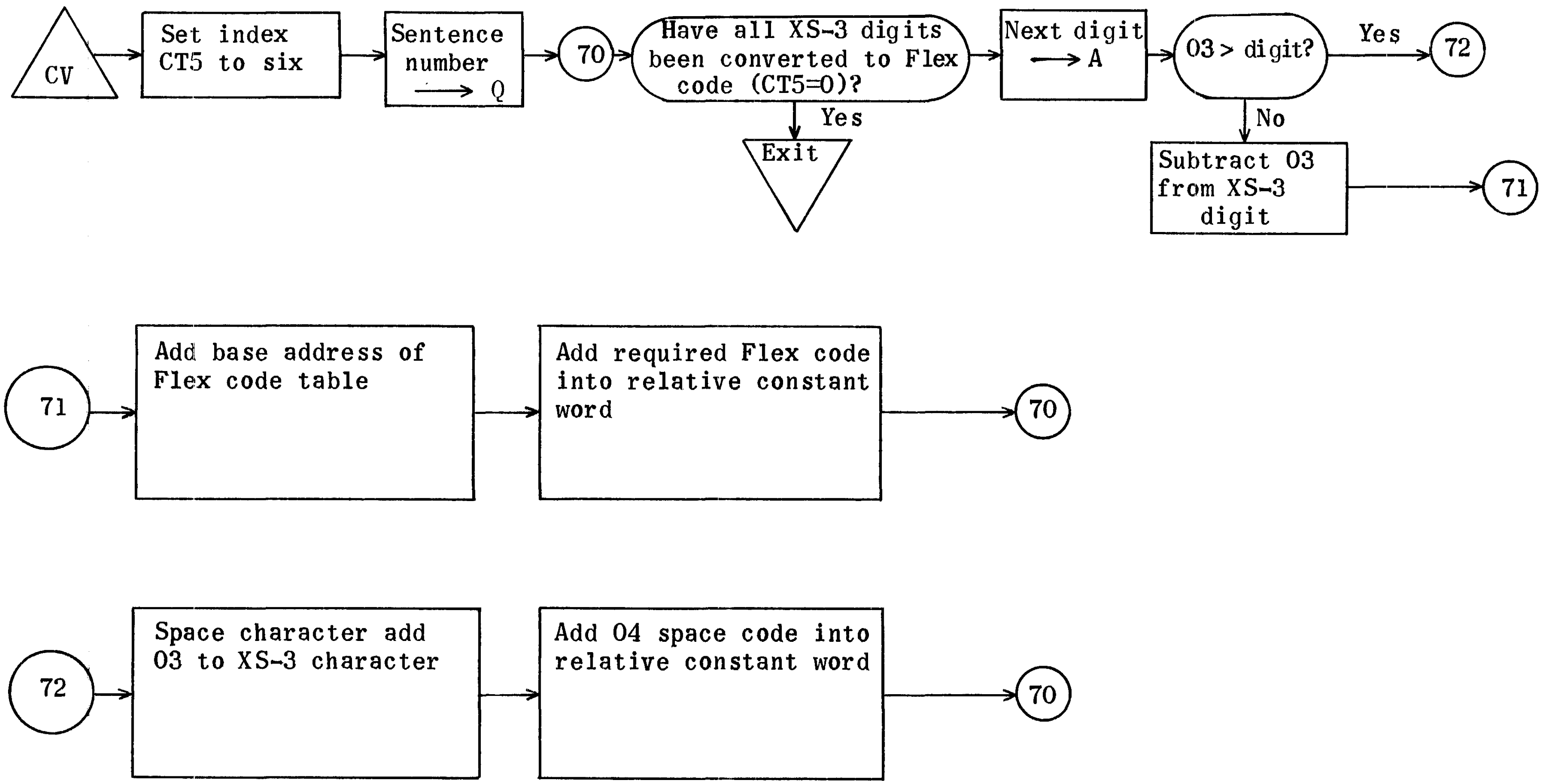

36
RS
Change entry line of generated routine to jump in at next instruction generated
B2
Modify component of form A(B)C
Is test indicator = 14? (A,C variable B < 0)
YES
38
NO
Is test indicator = 10? (A,C variable, B > 0)
YES
39
NO
Is test indicator = 30? (A and/or C, B variable)
YES
44
NO
37
37
Is test indicator = 22? (B variable, C-A = 0)
YES
40
Is test indicator = 21? (B variable, C-A < 0)
YES
43
NO
Test indicator = 20 (B variable, C-A > 0)
41
38
EM
54
39
EN
54


40
TP-_____-A
→ GL
Insert call word of increment in u-portion of GL
RS
ZJ-___-___
→ GL
Insert relative address of next instruction in u-portion of GL
Insert relative address of alarm entry (from CT3) in v-portion of GL
RS
54
41
Is increment absolute value?
No
Yes
40
SP-_____-0
→ GL
CW
Find call word for constant zero
Insert call word for constant zero in u-portion of GL
RS
TJ-___-___
→ GL
Insert call word for increment in u-portion of GL
42
42
Insert relative address of second following instruction (NI+1) in v-portion of GL
RS
MJ-0-_____
→ GL
Insert relative address of alarm entry (from CT3) in v-portion of GL
54
43
TP-_____-A
→ GL
Insert call word of increment in u-portion of GL
RS
SJ-___-___
→ GL
Insert relative address of next instruction in u-portion of GL
Insert relative address of alarm entry (from CT3) in v-portion of GL
RS
54
44
Is increment absolute value?
No
Yes
45
TP-_____-A
→ GL
46
45
TM-_____-A
→ GL
46
Insert call word of increment in u-portion of GL
RS
Is increment absolute value?
No
47
Yes
50


47
SJ-___-___ → GL
Insert relative address of next instruction in v-portion of GL
Is initial value absolute value?
Yes
48
No
Add four (4) to relative address of next instruction
49
48
Add five (5) to relative address of next instruction
49
49
Insert calculated relative address in u-portion of GL
RS
50
ZJ-___-___ → GL
Insert relative address of next instruction in u-portion of GL
Insert relative address of alarm entry in v-portion of GL
RS
EN
51
51
Is increment absolute value?
Yes
54
No
MJ-0-___ → GL
Is limit absolute value?
Yes
52
Add three (3) to current relative address
53
52
Add four (4) to current relative address
Insert calculated relative address in v-portion of GL
53
53
RS
EM
54
54
Set indicator (CT4) when tests are generated
55
Advance CT2 to next variable's indicator
Have indicators for all variables been checked?
No
32
Yes
Has test coding been generated?
No
57
Yes
MJ-0-01003 → GL
RS
56


56
CV
Put in relative constants and Flex codes
Adjust Op File I item to account for generation of tests
Adjust prelude to account for generation of tests
LS
Insert 50002 call word in list I
57
57
Insert sentence call word in prelude and in Op File I item
Number of lines subject to modification to second word of prelude
Number of lines in prelude and routine to first word of prelude
Sentence number to sixth word of prelude
Number of words in operating routine to second word of Op File I item
58
58
LW
Find call word of last sentence in range of Vary
Insert call word of last sentence in third word of Op File I item
Insert call word of exit sentence in fourth word of Op File I item
Insert number of lines in Op File I item in first word of item
OP
Write Op File I item and generated routines on tape
Exit Vary Generator
RS
ST
Advance relative address counter (CT1) by one
Exit
SA
Transfer five words of stringout (next variable information) from address given by CT2 to temporary storage (TE0-TE4)
Exit
ST
Store one instruction from EL in next location of generated coding region
Advance to next word in generated coding region
Exit


EM
Is initial value absolute value?
No
Yes
59
TP-____-A → GL
60
59
TM-____-A → GL
60
Insert call word of initial value in u-portion of GL
RS
61
61
Is limit absolute value?
Yes
62
TM-____-Q → GL
Insert call word of limit in u-portion of GL
RS
62
TJ-Q-____ → GL
Insert relative address of alarm entry (from CT3) in v-portion of GL
Is limit absolute value?
No
63
Yes
64
63
Insert call word of limit in u-portion of GL
64
RS
Exit
EN
Is limit absolute value?
No
Yes
65
TP-___ -A → GL
66
65
TM-____-A → GL
66
Insert call word of limit in u-portion of GL
RS
Is initial value absolute value?
No
68
Yes
67
67
TM-____-Q → GL
Insert call word of initial value in u-portion of GL
RS
68
TJ-Q-____ → GL
Insert relative address of alarm entry (from CT3) in v-portion of GL
Is initial value absolute value?
Yes
69
No
Insert call word of initial value in u-portion of GL
69
RS
Exit



To convert XS-3 sentence number to Flex code, insert in relative constants

Vary Generator Regions

RE	VY2512	(1)
RE	IN2513	(4)
RE	VA2517	(50)
RE	VE2567	(40)
RE	CE2627	(21)
RE	VB2650	(23)
RE	FX2673	(24)
RE	FL2717	(27)
RE	VC2746	(12)
RE	FG2760	(16)
RE	FD2776	(22)
RE	VT3020	(51)
RE	DJ3071	(37)
RE	DK3130	(12)
RE	DL3142	(35)
RE	DM3177	(13)
RE	EM3212	(23)
RE	EN3235	(23)
RE	VS3260	(24)
RE	BP3304	(27)
RE	CV3333	(20)
RE	RS3353	(3)
RE	ST3356	(3)
RE	SA3361	(4)
RE	CN3365	(73)
RE	RC3460	(13)
RE	CT3473	(6)
RE	GL3501	(1)
RE	TE3502	(5)
RE	PF3507	(5)

```
RE   CW1211       Obtain CW for constant
RE   LS1465       Insert Library CW in List I
RE   OP1047       Write Generated routine and Op File I
                    on tape
RE   BR537        Compiler of computer error routine
RE   KI1336       Illegal jump check routine
RE   LW1250       Sentence CW locating routine
RE   UP421        On line print routine
RE   WA653        Print heading routine
RE   BQ632        To rewind tapes
RE   BK2242       Sentence string-out
RE   PL5360       Op File I
RE   GC5366       Generated coding
RE   VF47101      Vary File
```

```
   IA  VY
0  MJ  0      30000     Exit line
   CA  VY1

   IA  IN
0  RP  10006  IN2 }     Zeroize Prelude area
1  TP  CN     PL  }
2  RP  10005  IN4 }     Zeroize Op File I area
3  TP  CN     PF  }
4  MJ  0      VA        {VA0 = IN4}
   CA  IN5
```

```
              IA   VA
①  VA 0      TP   CN34    GL          MJ  0 - --> GL
      1      RJ   RS2     RS          Store
      2      TP   CN34    GL          MJ  0  1003 --> GL
      3      RJ   RS2     RS          Store
      4      TP   CN34    GL          MJ  0  -  --> GL
①     5      SP   BK7     0      }
      6      ZJ   VE      VA7    }    Is exit sentence number stated?
      7      TU   VF      VA11   }
     10      SP   BK6     0      }    No, so search Vary file for sentence
     11      RP   30000   BR3    }      number of last sentence in range
     12      EJ   [VF1]   VA13   }
     13      SP   VA11    0      }
     14      LQ   Q       17     }    Add r to VF1 to find Exit call word
     15      TU   Q       VA11   }
     16      SS   Q       0      }
     17      SA   VA12    0      }
     20      TU   A       VA12        Set to continue search
     21      TU   A       VA25   }
     22      TU   A       VA30   }    Set up
     23      TU   A       VA31   }
     24      TP   CN15    Q      }    Vary call word for this Vary File
     25      QT   30000   A      }      item --> A
     26      EJ   BK3     VA30        Has the cor. Vary File item been found ?
     27      MJ   0       VA10        No, back to continue search
     30      TU   30000   CT          Save Exit call word
     31      SP   30000   45     }    Is there an implied resume?
     32      SJ   VA33    VA34   }
     33      TV   CN31    CE1         Yes, so set (C) to (C2)
     34      LT   10024   Q      }
     35      TV   Q       CT     }    Save Exit call word in CTv
②    36      TP   CN55    Q           0 --> Q35
     37      SP   BK3     0           Sentence CW --> Ace
     40      TJ   CN54    VA43        Is 26000 > Sentence CW? If yes, then 22—
     41      QT   CT      A           Exit CW --> Au
     42      MJ   0       VA45
     43      QT   CT      A           Exit CW --> Au
     44      TP   CN34    Q           1 --> Q35 indicates within Pseudo-Op.
     45      RJ   KI      KI1        Illegal sentence number check
④    46      TV   CT      GL          Fill v of Exit line
     47      MJ   0       CE
             CA   VA50
```

```
          IA   VE
(3)  VE  0  RJ   LW      LW1       Obtain call word for Exit
         1  TU   A       CT    }   Save call word
         2  TV   Q       CT    }
         3  TP   BK10    Q     }   Is stated Exit a Resume?
         4  QJ   VE5     VA36  }
         5  TP   CN15    Q     }   Yes, so Exit CW to CT2v and Acc
         6  QT   CT      CT2   }
         7  TJ   CN54    VE12      26000 > CW?
        10  TJ   CN60    VE32      No, so is 27000 > CW?  If so OK
        11  MJ   0       VE34      No, so to alarm
        12  SP   VF      17    }   m + VF2 --> Au              VF   0   jn     m
        13  SA   CN24    0     }                                        SN
        14  TU   A       VE26      Set beginning of search      m       SN   CW26
        15  LT   6       A         jn --> Av                                 CW26
        16  TP   CN61    Q     }   n --> CT3                                 :
        17  QT   A       CT3   }                                             :
        20  QT   VF      Q         m --> Q                                  SN
        21  RS   CT3     Q         n-m --> CT3                      n       SN   CW26
        22  LT   43      CT3       ÷ 2                                           CW22
        23  IJ   CT3     VE25      Checked all items?                       SN
        24  MJ   0       VE34      Yes, and not found, so                        CW22
                                     error                                   :
        25  TP   CN15    Q     }   Does exit CW agree                       SN   CW22
        26  QT   30000   A     }     with next Vary CW
        27  EJ   CT2     VE32  }     in Vary File?
        30  RA   VE26    CN53      No, so advance to next item
        31  MJ   0       VE23        and back
        32  TV   CN31    CE1       Set (C) to (C2) to avoid gen. 10--line
        33  MJ   0       VA36
        34  RJ   WA      WA2   }
        35  TP   CN62    UP3   }   Print alarm
        36  RJ   UP2     UP    }
        37  MJ   0       BQ6       Rewind tapes and stop
            CA   VE40
```

```
             IA   CE
     CE  0   RJ   RS2      RS          Store Exit line
C        1   MJ   0       [CE2]
C1       2   TP   CN17     GL          10  0  1 --> GL
         3   RJ   ST2      ST          Store
C2       4   TP   BK4      CT          Set index to # of WITH words
         5   TP   CN23     CT2         String-out address of 1st indicator-> CT2
5        6   RJ   SA3      SA          Store next variable info in TE-TE4
         7   TP   TE2      Q      }
        10   QJ   CE11     CE13   }    Is initial value absolute value?
        11   TP   CN27     GL          Yes, so TM - - --> GL
        12   MJ   0        CE14
6       13   TP   CN26     GL          No, so TP - - --> GL
7       14   TU   TE2      GL          TP
                                       TM   CW_init  - -
                                       TP
        15   TV   TE1      GL          TM   CW_init  CW_var
        16   RJ   RS2      RS          Store
        17   RA   CT2      CN5         Advance to next variable's indicator
        20   IJ   CT       CE6         Have we built all 'set initial value'
                                         instructions?
        21   MJ   0        VB          Yes  {VB0 = CE21
             CA   CE22

             IA   VB
8    VB  0   TP   CT1      CT3         Save address of JUMP TO RANGE
         1   TP   CN34     GL          MJ  0 -    GL
         2   SP   BK5      0
         3   RJ   LW       LW1         To find CW of first sentence of range
         4   TV   Q        GL          Insert CW in MJ instruction
         5   RJ   RS2      RS          Store
         6   TP   CN17     GL          10   0   1 --> GL
         7   RJ   ST2      ST          Store
        10   TV   CT1      GC          Fill in RESUME entry line
9       11   TP   BK4      CT          Set index to # of WITH words
        12   TP   CN23     CT2         Set address of first variable
10      13   RJ   SA3      SA          Transfer variable to temporary area
        14   TP   CN15     Q      }    CW of variable --> A.
        15   QT   TE1      A      }
        16   TJ   CN12     VB21        64000  > CW?
        17   TJ   CN13     FX          No, 65000 > CW?
        20   MJ   0        FL          No, so floating variable
11      21   TP   TE1      Q      }    CW is 63..., so determine if fixed or
        22   QJ   FL       FX     }       floating
             CA   VB23
```

```
                 IA   FX      Fixed Variable (Build test for completion)
(12)  FX     0   TP   CN27    GL    TM —— Q ——> GL
             1   TU   TE3     GL    TM  CW     Q ——> GL
                                          inc
             2   RJ   RS2     RS    Store
             3   TP   TE4     Q    }
             4   QJ   FX22    FX5  }  Is limit variable absolute value?
             5   TP   VB2     GL    No, so  SP  ——   0 ——> GL
                                            SP       0
                                            TM   CW  A ——> GL
                                                   L
(14)         6   TU   TE4     GL
             7   RJ   RS2     RS    Store
            10   TP   BP4     GL            SS  ——   0 ——> GL
            11   TU   TE1     GL            SS  CW   0 ——> GL
                                                  var
            12   RJ   RS2     RS    Store
            13   TP   CN30    GL            TM   A   A ——> GL
            14   RJ   RS2     RS    Store
(15)        15   TP   CN33    GL            TJ   Q   1002 —> GL
(16)        16   RJ   RS2     RS    Store
            17   RA   CT2     CN5   Advance to next indicator address
            20   IJ   CT      VB13  Back if all tests for completion not
                                      generated
            21   MJ   0       VC
(13)        22   TP   CN30    GL            TM   -   A ——> GL
            23   MJ   0       FX6
                 CA   FX24


                 IA   FL      Floating Variable.  (Build for completion)
(17)  FL     0   TP   CN27    GL    TM  —  —    ——> GL
             1   TV   RC1     GL    TM ——70000
             2   TU   TE3     GL    TM  CW  70000         (CW of increment.)
             3   RJ   RS2     RS    Store
             4   TP   TE4     Q    }
             5   QJ   FL6     FL11 }  Is limit variable absolute value?
             6   TP   CN30    GL    Yes, so  TM  ——  A ——> GL
             7   TU   TE4     GL             TM  CW  A   (CW of limit)
            10   RJ   RS2     RS
(18)        11   TP   CN32    GL             FS  A ——  ——> GL
            12   TV   TE1     GL             FS  A   CW  (CW of variable)
            13   TP   TE4     Q    }  Is limit variable absolute value?
            14   QJ   FL16    FL15 }
            15   TU   TE4     GL    No, so FS CW CW (CW  of limit.)
                                                       u
(19)        16   RJ   RS2     RS    Store
            17   TP   CN30    GL             TM ——  A ——> GL
            20   TU   CN27    GL             TM  Q   A
            21   RJ   RS2     RS    Store
(20)        22   TP   CN33    GL    TJ ——  01002 —> GL
            23   TU   RC1     GL    TJ 70000 01002
            24   TU   CN16    PL2   Set # working temps into 3rd word of Prelude
            25   TV   CN1     PF1   Set word 2 of Op File 1 item = 1
            26   MJ   0       FX16  To store
                 CA   FL27
```

```
            IA   VC     (Increment Variable Control)
(21)  VC  0  TP   BK4    CT          Set index to # of WITH words
          1  TP   CN23   CT2         Set address of first variable indicator
(22)      2  RJ   SA3    SA          To store group of CW's in TE
          3  TP   CN15   Q     }     Send CW of variable to A
          4  QT   TE1    A     }
          5  TJ   CN12   VC10        64000 > CW?
          6  TJ   CN13   FD          65000 > CW?
(23)      7  MJ   0      FG          No, so floating variable
         10  TP   TE1    Q     }     CW is 63---; determine if fixed or
         11  QJ   FG     FD    }       floating
             CA   VC12

             IA   FG    (Build Floating increment variable instructions)
(24)  FG  0  TP   TE3    Q           Increment CW --> Q
          1  QJ   FG2    FG5         Absolute value?
          2  TP   CN27   GL          Yes   TM   ----         Q --> GL
          3  TU   TE3    GL                TM   CW_inc       Q
          4  RJ   RS2    RS          Store
(25)      5  TP   CN31   GL                FA   Q       --  --> GL
          6  TV   TE1    GL                FA   Q       CW_var.
          7  TP   TE3    Q     }
         10  QJ   FG12   FG11  }     Is increment absolute value?
         11  TU   TE3    GL          No; so FA CW_inc   CW_var. ---> GL
(26)     12  RJ   RS2    RS          Store
         13  TP   CN26   GL                TP   Q     --   ---> GL
         14  TV   TE1    GL                TP   Q     CW_var.
         15  MJ   0      FD14        To store
             CA   FG16
```

```
              IA   FD    (Build fixed increment variable instrs. and Jump Back)
27   FD  0    TP   TE3    Q          Increment to Q
         1    QJ   FD2    FD5        Absolute value?
         2    TP   CN27   GL         Yes, so  TM   ——      Q   ——>  GL
         3    TU   TE3    GL                  TM   CW_inc  Q   ——>  GL
         4    RJ   RS2    RS         Store
28       5    TP   FD15   GL                  RA   ——     ——   ——>  GL
         6    TU   TE1    GL                  RA   CW_var ——   ——>  GL
         7    TP   TE3    Q     }
        10    QJ   FD11   FD13  }    Is increment abs. value?
        11    TV   CN27   GL         Yes,     RA   CW_var  Q   ——>  GL
        12    MJ   0      FD14
29      13    TV   TE3    GL         No,      RA   CW_var  CW_inc. ——> GL
30      14    RJ   RS2    RS         Store
        15    RA   CT2    CN5        Advance to next indicator
        16    IJ   CT     VC2        Back if all increment instructions not
                                       generated
        17    TP   CN34   GL                  MJ   0      ——   ——>  GL
        20    TV   CT3    GL                  MJ   0      01--- (Back to Jump to
        21    RJ   RS2    RS         Store                        Range)
        22    MJ   0      VT           {VT0 = FD22}
              CA   FD23
```

```
              IA    VT
31   VT  0    TP    BK4     CT        Set index to # of WITH words
         1    TP    CN23    CT2       Set address of 1st indicator
32       2    RJ    SA3     SA        Transfer 5 words to temporary
         3    SP    TE      0
         4    ZJ    VT5     VS1       Is indicator zero?
B        5    MJ    0       [VT6]
B1       6    TV    CN36    VT5       Set B to B2
33       7    TP    CT1     CT3       (CT1)->CT3.  Save alarm print address
        10    TP    CN26    GL        TP  ---   ---   --> GL
        11    TV    RC1     GL        TP  ---   70000
        12    SP    CN3     0         Find CW for 79_10
        13    RJ    CW      CW1
        14    TU    A       GL        TP   67...   70000-> GL
        15    RJ    RS2     RS        Store
        16    TP    CN26    GL        TP   ---    ---  --> GL
34      17    TU    CN35    GL        TP  10000   ---
        20    TV    CN25    GL        TP  10000  50002
        21    RJ    RS2     RS        Store
        22    TP    CN20    GL        10  0  3    --> GL
        23    RJ    ST2     ST        Store
        24    TP    CN25    GL        TP  10001  50002  --> GL
        25    RJ    RS2     RS        Store
35      26    TP    CN21    GL        10  0  4  --> GL
        27    RJ    ST2     ST        Store
        30    TP    CN36    GL        RJ  50002  ---   --> GL
        31    TV    CN25    GL        RJ 50002  50002 --> GL
        32    RJ    RS2     RS        Store
        33    TP    CN22    GL        10  2  0 --> GL
        34    RJ    ST2     ST        Store
        35    TP    CN7     GL        MS   0 ---->GL
        36    TV    CT1     GL        MS   0   01000+...
36      37    RJ    RS2     RS        Store
        40    TV    CT1     GC1       Change entry to jump into first test
B2      41    LQ    TE      Q20
        42    QJ    VT45    VT43
        43    LQ    Q       1
        44    QJ    DJ      DJ2       DJ, indicator = 14  DJ2, indicator = 10
        45    QJ    DL      VT46      DL, indicator = 30
37      46    LQ    Q       1
        47    QJ    DJ4     VT50      DJ4, indicator = 22
43      50    QJ    DK      DJ16      DK12, indicator = 21. DJ16, indicator = 20
              CA    VT51
```

```
                      IA   DJ     Indicators:  10, 14, 20(part 1)
(38) Indic.=    DJ 0  RJ   EM22   EM    Build and store test instr. for case 2
     14            1  MJ   0      VS
(39) Indic.= 10    2  RJ   EN22   EN    Build and store test instr. for case 1
                   3  MJ   0      VS
(40) Indic.= 22    4  TP   CN26   GL    TP   ——      A ——> GL
                   5  TU   TE3    GL    TP   CW_inc  A ——> GL
                   6  RJ   RS2    RS    Store
                   7  TP   VA6    GL    ZJ  ——   ——  ——> GL
                  10  SP   CT1    0
                  11  SA   CN1    17
                  12  TU   A      GL    ZJ   NI   ——   ——> GL
                  13  TV   CT3    GL    ZJ   NI   alarm
                                                  entry ——> GL
                  14  RJ   RS2    RS    Store
                  15  MJ   0      VS
(41) Indic.= 20   16  TP   TE3    Q    } Is increment absolute value?
                  17  QJ   DJ4    DJ20 }
                  20  TP   VA5    GL    SP   ———    0 ——> GL
                  21  SP   CN     0    } Find CW for zero
                  22  RJ   CW     CW1  }
                                              67...
                  23  TU   A      GL    SP  CW zero  0 ——> GL
                  24  RJ   RS2    RS    Store
                  25  TP   CN33   GL    TJ  — — —> GL
                  26  TU   TE3    GL    TJ   CW_inc  — —> GL
(42)              27  SP   CN2    0
                  30  SA   CT1    0
                  31  TV   A      GL    TJ   CW_inc    NI + 1 ——> GL
                  32  RJ   RS2    RS    Store
                  33  TP   CN34   GL    MJ     0     ——  ——> GL
                  34  TV   CT3    GL    MJ     0     alarm
                                                     entry ——> GL
                  35  RJ   RS2    RS    Store
                  36  MJ   0      VS
                      CA   DJ37

                      IA   DK
(43) Indic.=    DK 0  TP   CN26   GL    TP   ——   A ——> GL
     21            1  TU   TE3    GL    TP   CW_inc  A —> GL
                   2  RJ   RS2    RS    Store
                   3  TP   CN35   GL    SJ ———> GL
                   4  SP   CT1    0
                   5  SA   CN1    17
                   6  TU   A      GL    SJ   NI ——> GL
                   7  TV   CT3    GL    SJ   NI alarm
                                               entry
                  10  RJ   RS2    RS    Store
                  11  MJ   0      VS
                      CA   DK12
```

```
                     IA   DL    (b variable, a and/or c variable  Indicator = 30)
(44) Indic.= 30DL 0  TP   TE3   Q     } Is increment absolute value?
                  1  QJ   DL4   DL2   }
                  2  TP   CN26  GL      No, TP ---- A ----> GL
                  3  MJ   0     DL5
(45)              4  TP   CN30  GL      Yes, TM ---- A ----> GL
(46)              5  TU   TE3   GL      T(P/M)      CW inc       A
                  6  RJ   RS2   RS      Store
                  7  TP   TE3   Q     } Is increment absolute value?
                 10  QJ   DL24  DL11  }
(47)             11  TP   CN35  GL      SJ -- -- --> GL
                 12  SP   CT1   0
                 13  SA   CN1   0
                 14  TV   A     GL      SJ ---- NI --> GL
                 15  TP   TE2   Q     }
                 16  QJ   DL21  DL17  } Is initial value absolute value?
                 17  SA   CN4   17      No, so add 4 to (A)
                 20  MJ   0     DL22
(48)             21  SA   CN5   17      Yes, so add 5 to (A)
(49)             22  TU   A     GL      SJ  b < 0    NI --> GL
                 23  RJ   RS2   RS      Store
(50)             24  TP   VA6   GL      ZJ ----  --> GL
                 25  SP   CT1   0
                 26  SA   CN1   17
                 27  TU   A     GL      ZJ    NI --> GL
                 30  TV   CT3   GL      ZJ    NI   alarm
                 31  RJ   RS2   RS      Store      entry       GL
                 32  RJ   EN22  EN
(51)             33  TP   TE3   Q     } Is increment absolute value?
                 34  QJ   VS    DM    }
                     CA   DL35


                     IA   DM
              DM  0  TP   CN34   GL     MJ      0 ---> GL
                  1  SP   CT1    0
                  2  TP   TE4    Q    } Is limit absolute value?
                  3  QJ   DM6    DM4  }
                  4  SA   CN52   0      No, so add 3 to current address in GC
                                          region
                  5  MJ   0      DM7
                  6  SA   CN4    0      Yes, so add 4 to current address in
                                          GC region
                  7  TV   A      GL     MJ      0    NI +{2/3}
                 10  RJ   RS2    RS     Store
                 11  RJ   EM22   EM     Now build and store tests for b < 0 case
                 12  MJ   0      VS
                     CA   DM13
```

```
              IA   EM
       0      TP   TE2     Q      }  Is initial value absolute value?
       1      QJ   EM4     EM2    }
       2      TP   CN26    GL        TP —— A ——> GL
       3      MJ   0       EM5
(59)   4      TP   CN30    GL        TM —— A ——> GL
(60)   5      TU   TE2     GL        TP/M  CWinit   A ——> GL
       6      RJ   RS2     RS        Store
(61)   7      TP   TE4     Q      }
      10      QJ   EM11    EM14   }  Is limit absolute value?
      11      TP   CN27    GL        Yes, TM —— Q ——> GL
      12      TU   TE4     GL             TM  CW1 Q ——> GL
      13      RJ   RS2     RS        Store
(62)  14      TP   CN33    GL        TJ      Q ——> GL
      15      TV   CT3     GL        TJ      Q alarm
                                               entry  ——> GL
      16      TP   TE4     Q      }  Is limit value absolute value?
      17      QJ   EM21    EM20   }
(63)  20      TU   TE4     GL        No, so change u of TJ to CW of limit
(64)  21      RJ   RS2     RS        Store
      22      MJ   0       30000     Out
              CA   EM23

              IA   EN
  EN   0      TP   TE4     Q      }  Is limit absolute value?
       1      QJ   EN4     EN2    }
       2      TP   CN26    GL        TP —— A ——> GL
       3      MJ   0       EN5
(65)   4      TP   CN30    GL        TM —— A ——> GL
(66)   5      TU   TE4     GL        TP/M  CW1 A ——> GL
       6      RJ   RS2     RS
       7      TP   TE2     Q      }  Is initial value absolute value?
      10      QJ   EN11    EN14   }
(67)  11      TP   CN27    GL        TM —— Q ——> GL
      12      TU   TE2     GL        TM  CWinit  Q ——> GL
      13      RJ   RS2     RS        Store
(68)  14      TP   CN33    GL        TJ      Q — —> GL
      15      TV   CT3     GL        TJ      Q  alarm
                                                entry
      16      TP   TE2     Q      }  Is initial value absolute value?
      17      QJ   EN21    EN20   }
      20      TU   TE2     GL        No, so change u of TJ to initial value CW
(69)  21      RJ   RS2     RS
      22      MJ   0       30000
              CA   EN23
```

```
                IA   VS
(54)   VS  0    TP   CN34    CT4       Set indicator when tests are generated
(55)       1    RA   CT2     CN5       Advance to next indicator's address
           2    IJ   CT      VT2       Have all variables been checked?
           3    TP   CT4     Q       } Yes, so have we put in tests?
           4    QJ   VS5     BP      }
           5    TP   CN34    GL        Yes, so MJ  0  1003 --> GL
           6    RJ   RS2     RS        Store
(56)       7    RJ   CV3     CV        Convert sentence # to Flex code
          10    TV   ST      VS12
          11    RP   30013   VS13    } Put in relative constants and Flex codes
          12    TP   RC      30000   }
          13    TP   CN1     PF        Set word 1 of Op File I = 1
          14    TV   CN7     PF1       Set word 2 of Op File I = 14_8
          15    TU   CN36    PF4       Insert 50002 CW into 5th word of Op. File I
          16    TV   RC      PL        Set V of 1st word of Prelude = 11_8
          17    TP   CN2     PL1       Set 2nd word of Prelude = 2
          20    TP   CN16    PL2       Build 3rd word of Prelude
          21    TP   CN55    Q       } 50002 call word --> A_u
          22    QT   CN36    A       }
          23    RJ   LS      LS1       Insert call word in List I
          24    MJ   0       BP        To build Prelude and Op File I {BP0 = VS24}
                CA   VS25

                IA   BP
(57)   BP  0    LQ   BK3     Q17
           1    TU   Q       PL        Sentence CW to Prelude to Op File I
           2    TU   Q       PF
           3    SP   ST      0       }
           4    SS   CN24    0       } # lines subject to address modification
           5    SA   PL1     0       } 1 to word 2 of Prelude
           6    TV   A       PL1     }
           7    SA   PL      0       } # lines in Prelude + Rtne to 1st word
          10    SA   CN6     0       }   of Prelude
          11    TV   A       PL      }
          12    TP   BK1     PL5       Store sentence number in word 6 of Prelude
          13    SP   CT1     0       }
          14    SS   CN10    0       } # words in running rtne. to 2nd word of
          15    AT   PF1     PF1     }   Op File I item
(58)      16    SP   BK6     0       }
          17    RJ   LW      LW1     } CW of last sentence to word 3 of Op File I
          20    TU   A       PF2     }
          21    SP   GC2     17      } CW of Exit sentence to word 4 of Op File I
          22    TU   A       PF3     }
          23    RA   PF      CN4       Add 4 to # lines in Op File I item
          24    TP   CN57    OP1     } To write Op File I and generated routines
          25    RJ   OP      OP2     }   on tape
Exit      26    MJ   0       VY        To Exit
                CA   BP27
```

```
          IA   CV
CV    0   TP   CN6     CT5      Set index
      1   TP   BK1     Q        Sentence # —>Q
70    2   IJ   CT5     CV4      Finished?
      3   MJ   0       30000    Yes, so out
      4   LA   RC5     6
      5   LQ   Q       6
      6   QT   CN51    A        Next digit —>A
      7   TJ   CN52    CV15     3 > digit?
     10   SS   CN52    0        No, so subtract 3
     11   SA   CN32    0        Add Base Flex code address
     12   TV   A       CV13     Set address of Flex code
     13   RA   RC5     30000    Add into Flex word
     14   MJ   0       CV2
     15   SA   CN52    0        Add 3
     16   AT   RC5     RC5      Add into Flex word
     17   MJ   0       CV2
          CA   CV20

          IA   RS
RS    0   RJ   ST2     ST
      1   RA   CT1     CN1
      2   MJ   0       [30000]
          CA   RS3

          IA   ST
ST    0   TP   GL      [GC]     Store generated coding
      1   RA   ST      CN1
      2   MJ   0       [30000]
          CA   ST3

          IA   SA
SA    0   TU   CT2     SA2
      1   RP   30005   SA3
      2   TP   [30000] TE
      3   MJ   0       [30000]
          CA   SA4
```

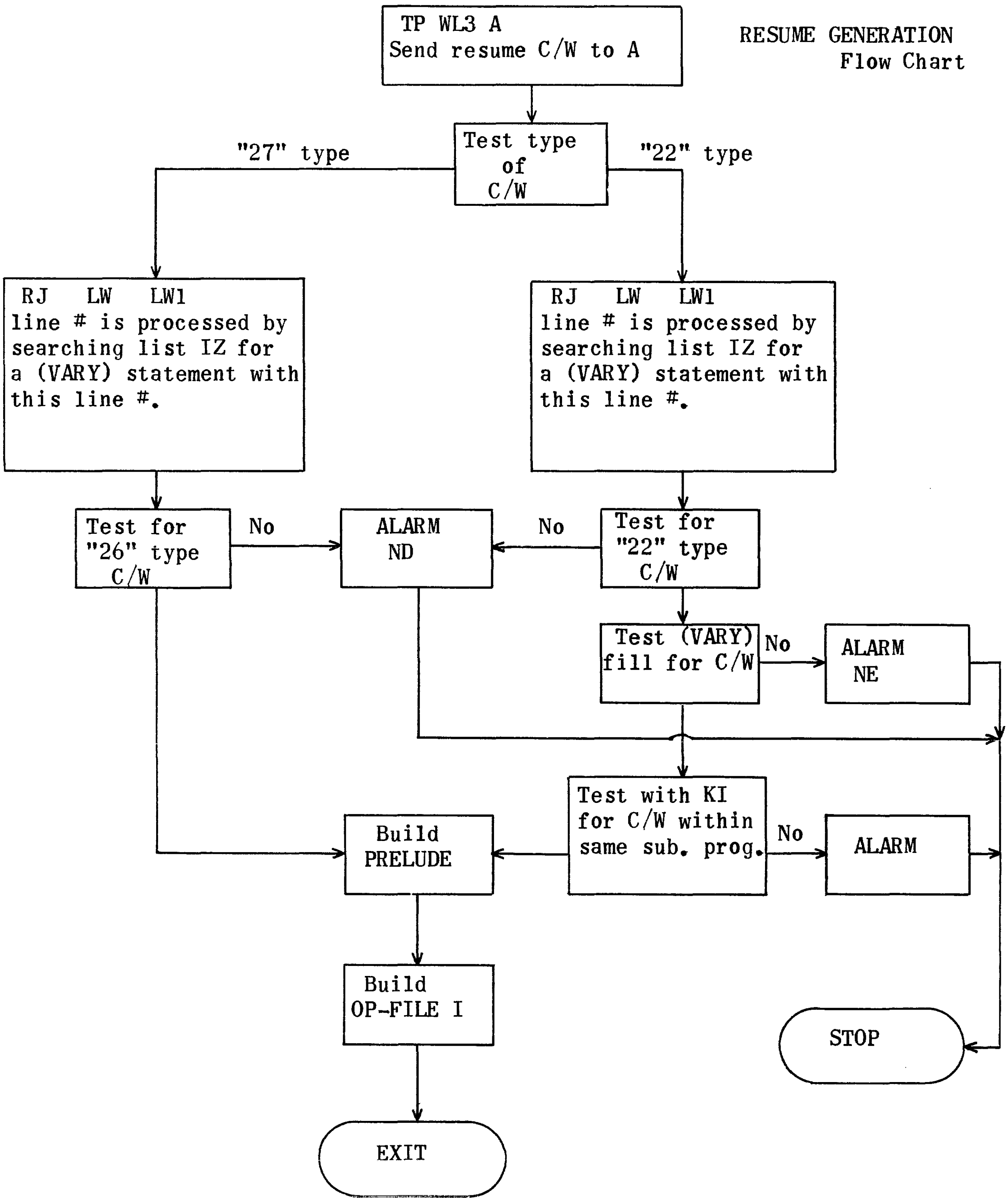
	IA	CN	
0	0	0	0
1	0	0	1
2	0	0	2
3	0	0	117
4	0	0	4
5	0	5	5
6	0	0	6
7	MS	0	14
10	0	0	1000
11	0	0	63000
12	0	0	64000
13	0	0	65000
14	0	0	67000
15	0	0	77777
16	0	10	2011
17	10	0	1
20	10	0	3
21	10	0	4
22	10	2	0
23	0	BK11	BK11
24	0	VF2	GC
25	TP	10001	50002
26	TP	Q	A
27	TM	Q	Q
30	TM	A	A
31	FA	Q	CE4
32	FS	A	CN37
33	TJ	Q	1002
34	MJ	0	1003
35	SJ	10000	0
36	RJ	50002	VT41
37	0	0	37
40	0	0	52
41	0	0	74
42	0	0	70
43	0	0	64
44	0	0	62
45	0	0	66
46	0	0	72
47	0	0	60
50	0	0	33
51	0	0	77
52	0	0	3
53	0	2	0
54	0	0	26000
55	0	77777	0
56	0	0	42
57	0	PL	PF
60	0	0	27000
61	0	0	07777
62	40	CN63	10

63	54	30656	74730	R E S U M E
64	01	30723	46601	△ E X I T △
65	47	67656	60154	M U S T △ R
66	30	31305	40166	E F E R △ T
67	51	01240	17024	O △ A △ V A
70	54	73016	53050	R Y △ S E N
71	66	30502	63001	T E N C E △
72	22	77777	77777	
	CA	CN73		

	IA	RC		
RC 0	0	20000	11	
1	0	70000	70000	
2	45	47173	01225	CR ↑ V A R Y
3	04	24200	60120	△ S E N T E
4	06	16200	45700	N C E △ ↓
5	0	0	0	
6	47	04053	02404	↑ △ H A S △
7	30	06041	40622	A N △ I N D
10	20	26140	61401	E F I N I T
11	20	04110	30315	E △ L O O P
12	57	42454	50000	↓ . CR CR
	CA	RC13		

	IA	CT		
CT 0	0	0	0	Holds CW for Exit line; then Index for # WITH words
1	0	0	01000	# lines running routine + 1000 (exclude 10 lines)
2	0	0	0	Holds string-out address of next test indicator
3	0	0	0	Address of instruction to jump to Range; then, address of Alarm Print instruction
4	0	0	0	Indicator that test coding already appears
5	0	0	0	Index for Sentence number conversion (not stored on MD)
	CA	CT6		

RESUME GENERATION
Flow Chart



RESUME GENERATION

REGIONS

RE	NC2512
RE	ND2651
RE	NE2667
RE	WL2242
RE	LW1250
RE	VF47101
RE	GL5360
RE	TF2706
RE	OP1047
RE	KI1336
RE	UP421
RE	BQ632
RE	WA653

RESUME GENERATOR

		IA	NC		
	0	MJ	0	30000	
	1	TP	WL3	Q	Send CW to Q from Resume String-Out
	2	QT	NC61	A	Mask i_{14-9}
	3	SS	NC62	0	Test for 27___ (subtract 27000_v)
	4	ZJ	NC13	NC5	
	5	TP	WL4	A	Send line no. k (referring to Vary sent.)
27___	6	RJ	LW	LW1	Routine D finds CW for vary sent, in IZ
Branch	7	TP	Q	NC66	Save CW in NC66
	10	QT	NC61	A	Mask i_{14-9} $(xx000)_v$
	11	SS	NC63	0	Test for 26___ (subtract 26000_v)
	12	ZJ	ND1	NC41	To prelude generation or error
	13	TP	WL4	A	Send line no. k (referring to Vary sent.)
Test	14	RJ	LW	LW1	Routine D finds CW for Vary sent, in IZ
for 22	15	TP	Q	NC66	Save CW in NC66
	16	QT	NC61	A	Mask i_{14-9} $(xx000)_v$
	17	SS	NC64	0	Test for 22___ (subtract $22000)_v$
	20	ZJ	ND1	NC21	To test Vary file or error
	21	TP	VF	Q	Code word of Vary file (no. of words)
22___	22	QT	NC57	NC56	Mask "n" & store in Index = NC56
Branch	23	QT	NC60	NC107	Mask "m" & save in NC107
	24	MJ	0	NC120	Jump to correction (1)
	25	0	0	0	
Test	26	RS	NC56	NC110	Subtract 1 from Index
Vary	27	RA	NC107	NC111	Add 2 to m
File	30	MJ	0	NC130	Jump to correction (2)
for	31	0	0	0	
CW	32	TP	VF	Q	Changed to VF_{m+2}
	33	QT	NC60	A	Mask CW

```
34   EJ   NC66    NC37     Test with CW in NC66 for equality
35   RA   NC32    NC106    Increment VFm + 2 by 2
36   MJ   0       NC112    Jump to correction (3)
37   TP   NC66    A        Vary CW in A
40   MJ   0       NC103    Jump to correction (4)
41   RP   30010   NC43     Generate Prelude Format
42   TP   NC70    GL
43   LQ   WL3     17       Move CW of Resume to "u" portion
44   TU   Q       GL       (0, CW, 0)Q→(0, 0, 0)gl
45   TP   WL1     GL5      Line no.
46   TV   NC66    GL7      CW
47   RP   30003   NC51     Generate Op File I format
50   TP   NC100   TF
51   TU   GL      TF       CW Resume
52   MJ   0       NC125    Jump to correction (5)
53   TP   NC114   OP1      (0 GL TF)
54   RJ   OP      OP2
55   MJ   0       NC
56   0    0       0        Index
57   0    7777    0
60   0    0       77777
61   0    0       77000
62   0    0       27000
63   0    0       26000
64   0    0       22000
65   0    1       0
66   0    0       0        L(Vary CW)
67   40   0       0
70   0    0       10       CW Resume in u
71   0    0       2
72   0    0       0
73   0    0       0        Prelude format
74   0    0       0
75   0    0       0        Line number
76   MJ   0       30000
77   MJ   0       0        CW Vary in v
100  0    0       3        CW Resume in u
101  0    0       2        Op File I format
102  0    0       0        CW Vary in u
103  TP   NC67    Q        Send parameter to Q
104  RJ   KI      KI1      (4)
105  MJ   0       NC41
106  0    2       0
107  0    0       0
110  0    0       1
111  0    0       2
112  IJ   NC56    NC32     (3)
113  MJ   0       NE1
114  0    GL      TF       Parameter for Op routine
115  0    0       0
116  0    0       0
117  0    0       0
```

```
120   TP   NC56    A          n -> A
121   LT   25      NC56       Shift n to A0
122   RS   NC56    NC107      (1)  n-m -> NC56 = Index
123   LT   43      NC56       Index shifted right 1 or NC56/2
124   MJ   0       NC26
125   TP   NC66    A          Move CW of Vary sent. to u address,
126   LT   10017   TF2          jump to correction (6)
127   MJ   0       NC134      (5)
130   LT   63      NC133      Shift to u position
131   RA   NC32    NC133      (2)  Add to (VF), i.e., VFm + 2
132   MJ   0       NC32
133   0    0       0
134   TP   NC136   NC32       Preset NC32
135   MJ   0       NC53       (6)
136   TP   VF      Q          Presetter for NC32
      CA   NC137
```

ERROR ROUTINE

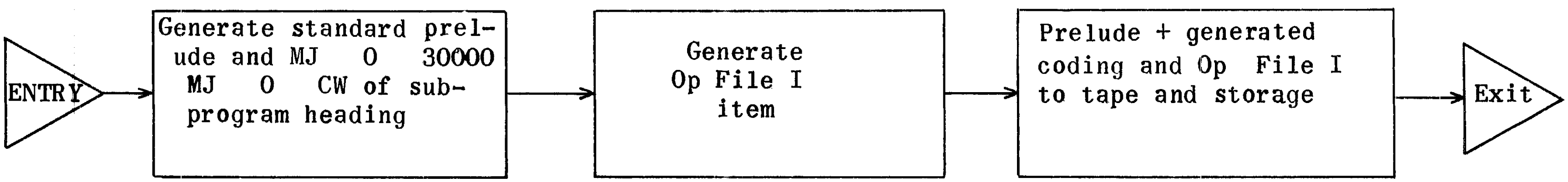
```
      IA   ND
 0    MJ   0       BQ6
 1    RJ   WA      WA1
 2    TP   ND15    UP3
 3    RJ   UP2     UP
 4    MJ   0       ND
 5    66   33305   43001      THEREΔ
 6    34   65015   05101      ISΔNOΔ
 7    54   30313   05430      REFERE
10    50   26300   16651      NCEΔTO
11    01   24011   77024      ΔAΔ(VA
12    54   73430   16566      RY)ΔST
13    24   66304   73050      ATEMEN
14    66   22777   77777      T.
15    40   ND5     10
      CA   ND16
```

ERROR ROUTINE

```
      IA   NE
 0    MJ   0       BQ6
 1    RJ   WA      WA1
 2    TP   NE16    UP3
 3    RJ   UP2     UP
 4    MJ   0       NE
 5    65   66246   63047      STATEM
 6    30   50660   15430      ENTΔRE
 7    31   30543   05026      FERENC
10    30   65012   40150      ESΔAΔN
11    51   50023   07234      ON-EXI
12    65   66305   06601      STENTΔ
```

13	17	70245	47343	(VARY)
14	01	65305	06630	ΔSENTE
15	50	26302	27777	NCE.
16	40	NE5	11	
	CA	NE17		

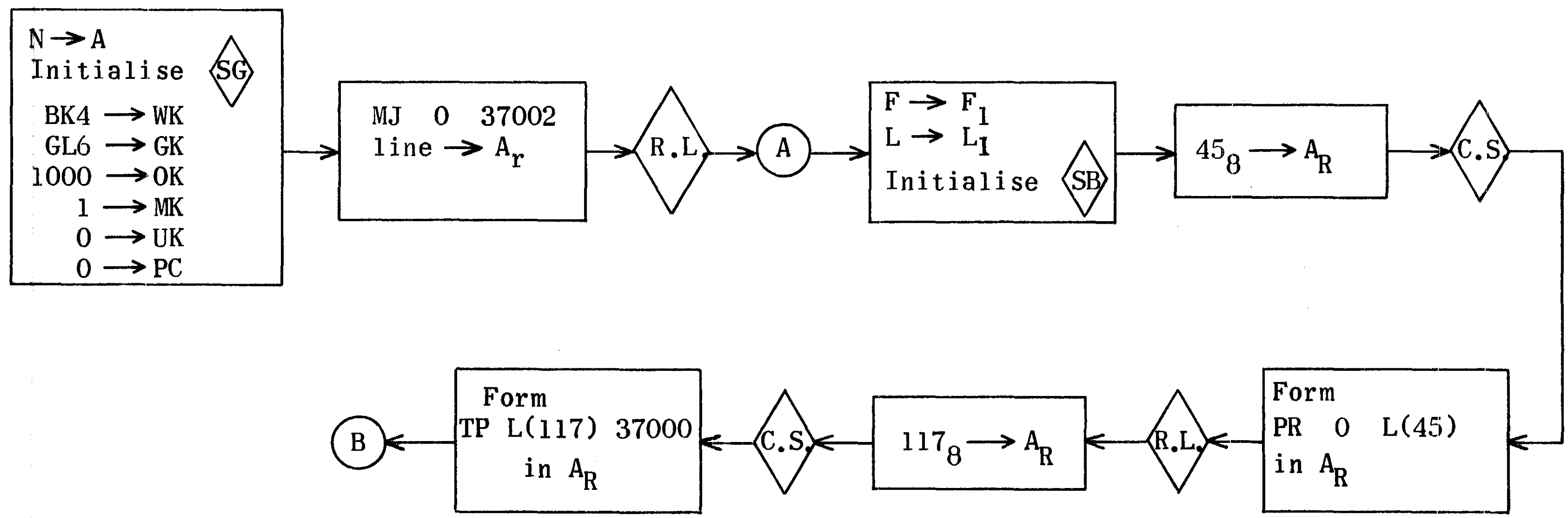
Flow Chart for Exit Generator

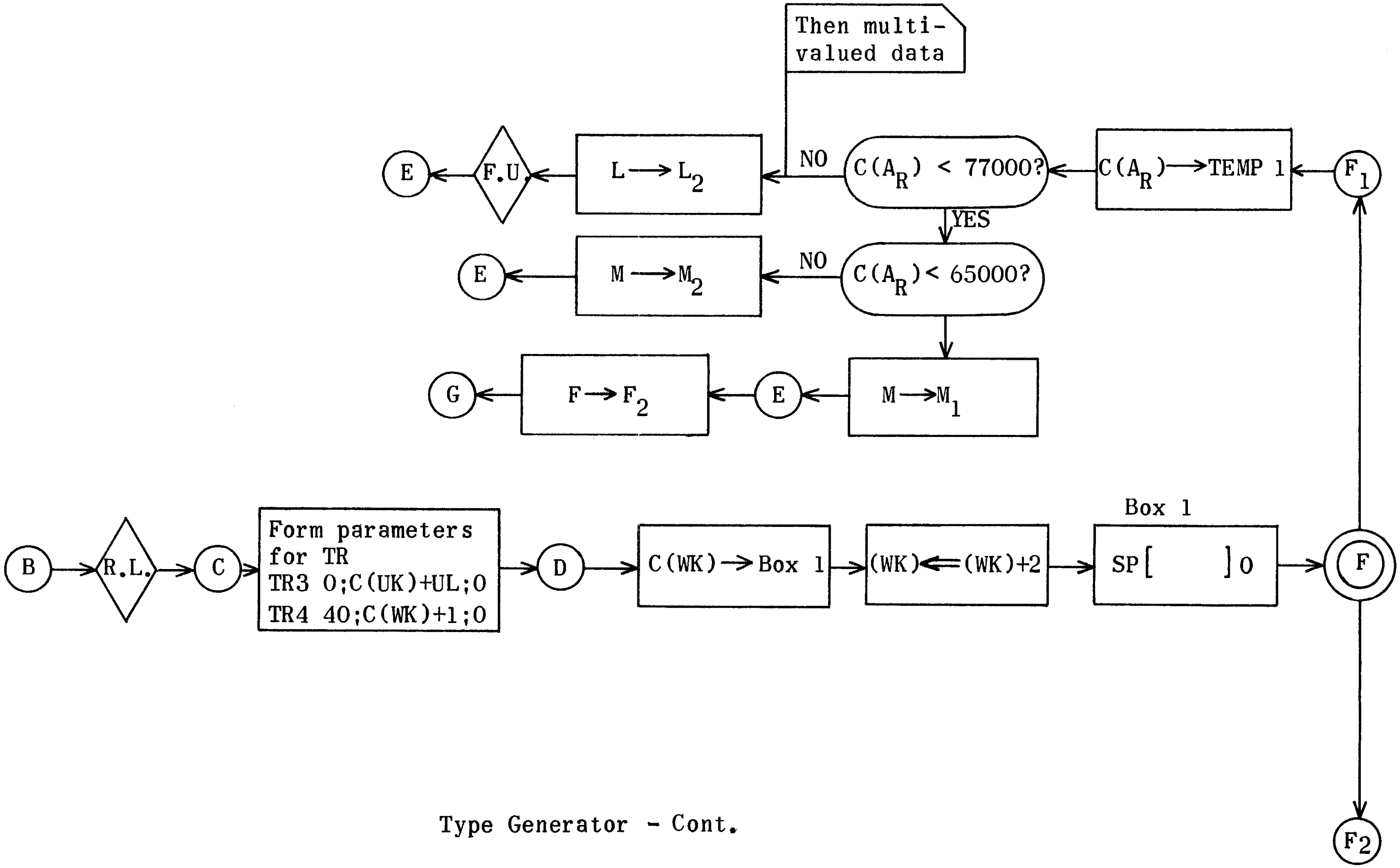


EXIT GENERATOR

```
      RE   PX2512
      RE   PL5360
      RE   FL2546
      RE   OP1047
      RE   WL2242


      IA   PX
  0   MJ   0       30000
  1   RP   30010   PX3       Generate Prelude Format
  2   TP   PX20    PL
  3   SP   WL3     17        Sentence call word to prelude
  4   TU   A       PL
  5   TP   WL1     PL5       Standard line no.
  6   TV   WL4     PL7       CW  Sub-routine heading→2nd line of
                               coding for sentence
  7   RP   30003   PX11      Generate Op File I Format
 10   TP   PX30    FL
 11   SP   WL3     17        Sentence call word to Op. File I
 12   TU   A       FL
 13   SP   WL4     17        CW  subroutine heading to Op File I
 14   TU   A       FL2
 15   TP   PX33    OP1       Prelude + Generated Coding and Op File I
 16   RJ   OP      OP2         to tape and storage
 17   MJ   0       PX        Exit
 20   0    0       10
 21   0    0       2
 22   0    0       0         Prelude Format
 23   0    0       0
 24   0    0       0
 25   0    0       0
 26   MJ   0       30000     Object Program Coding
 27   MJ   0       30000
 30   0    0       3         Op File I Format
 31   0    0       2
 32   0    [0]     0         CW  of Subroutine heading
 33   0    PL      FL        Parameters
      CA   PX34
```

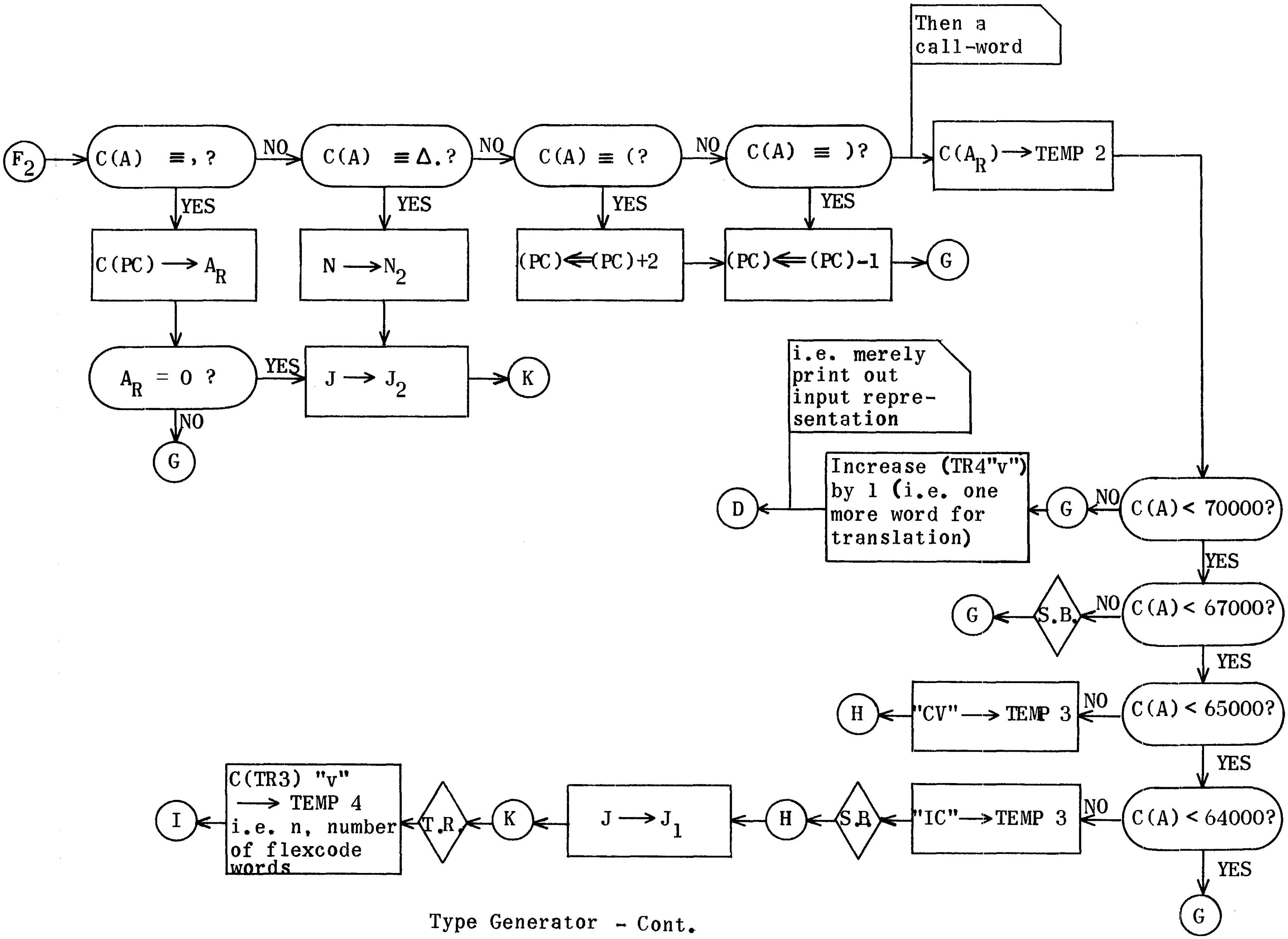
Type Generator



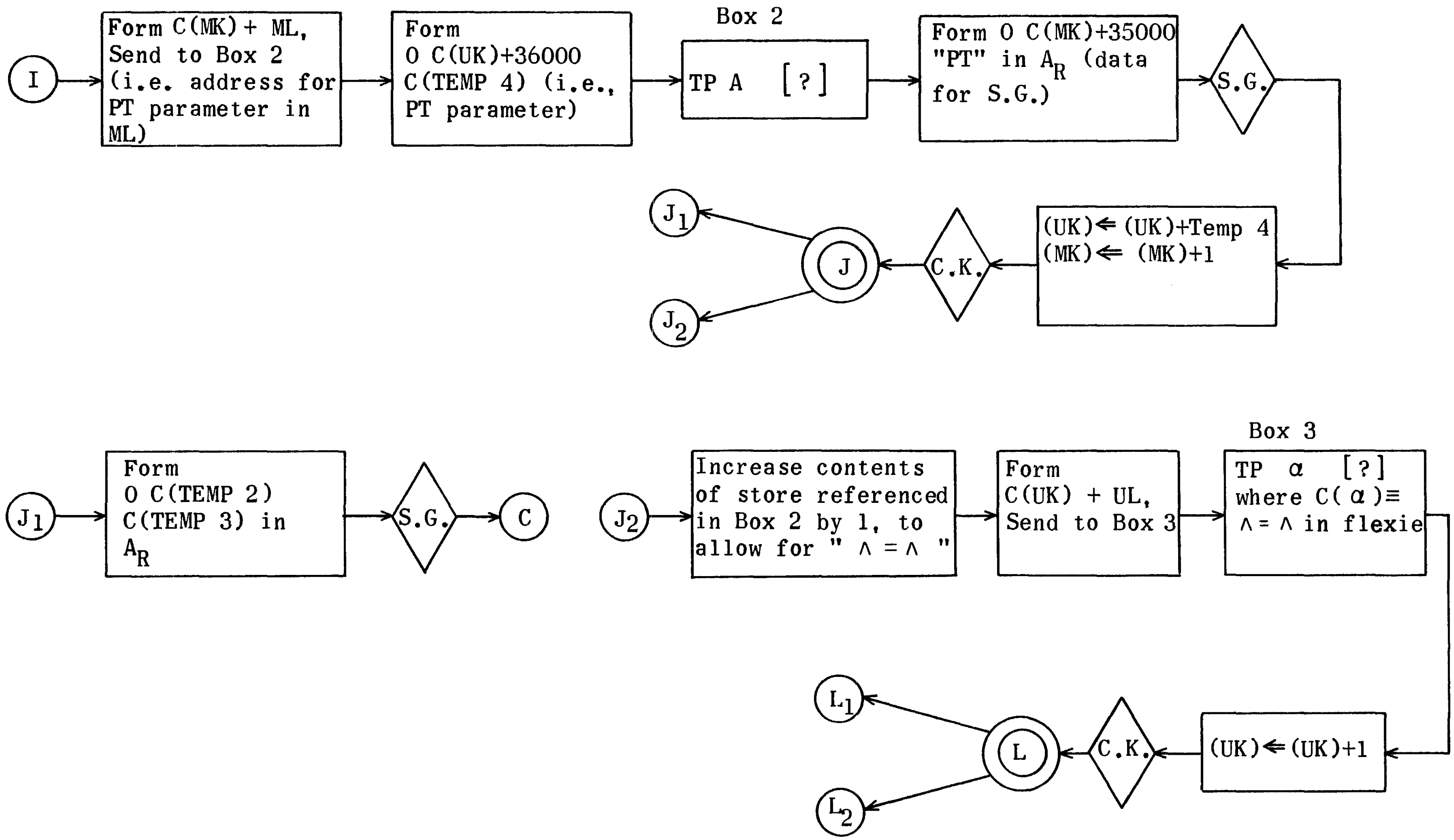


Type Generator - Cont.

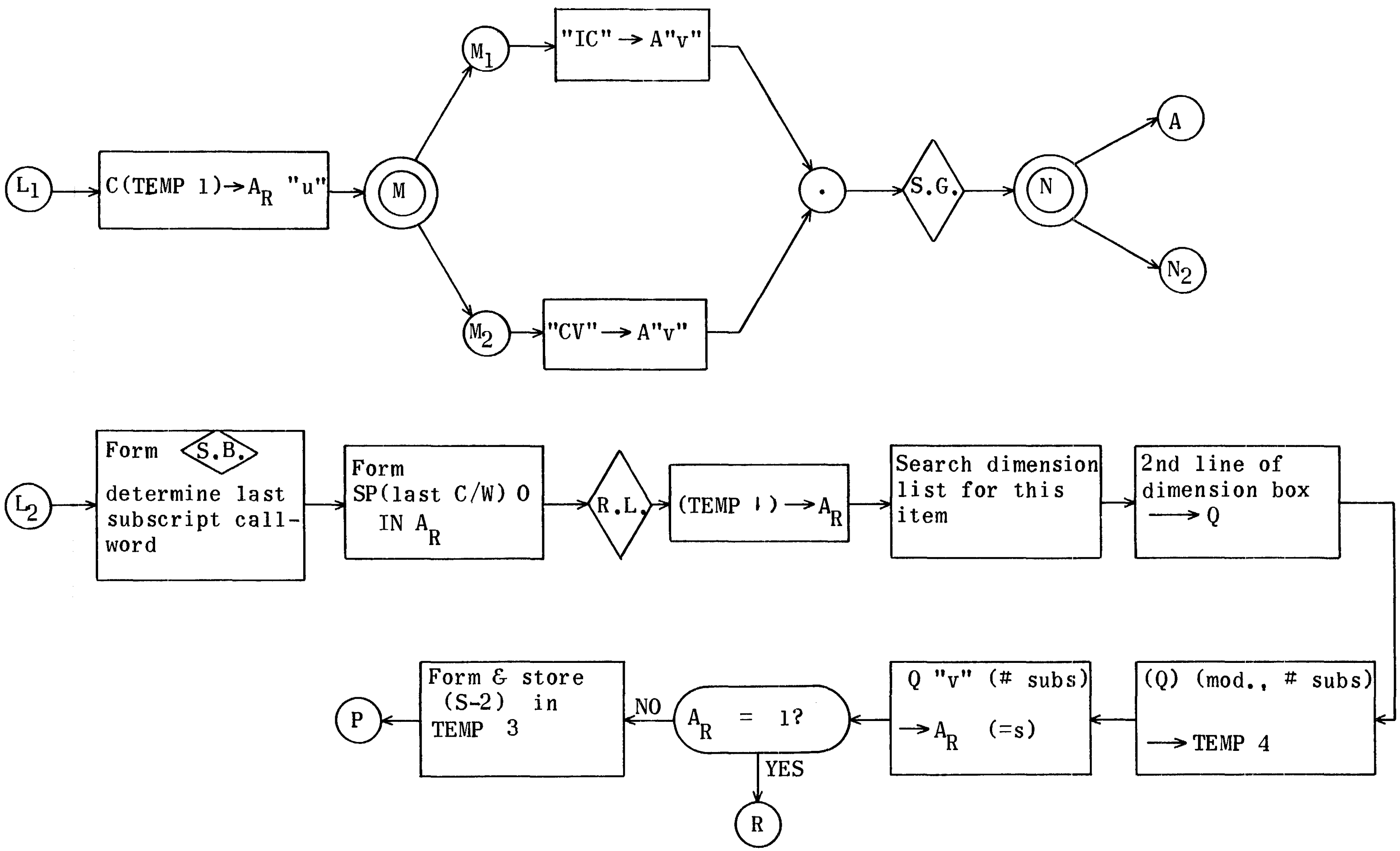
1109



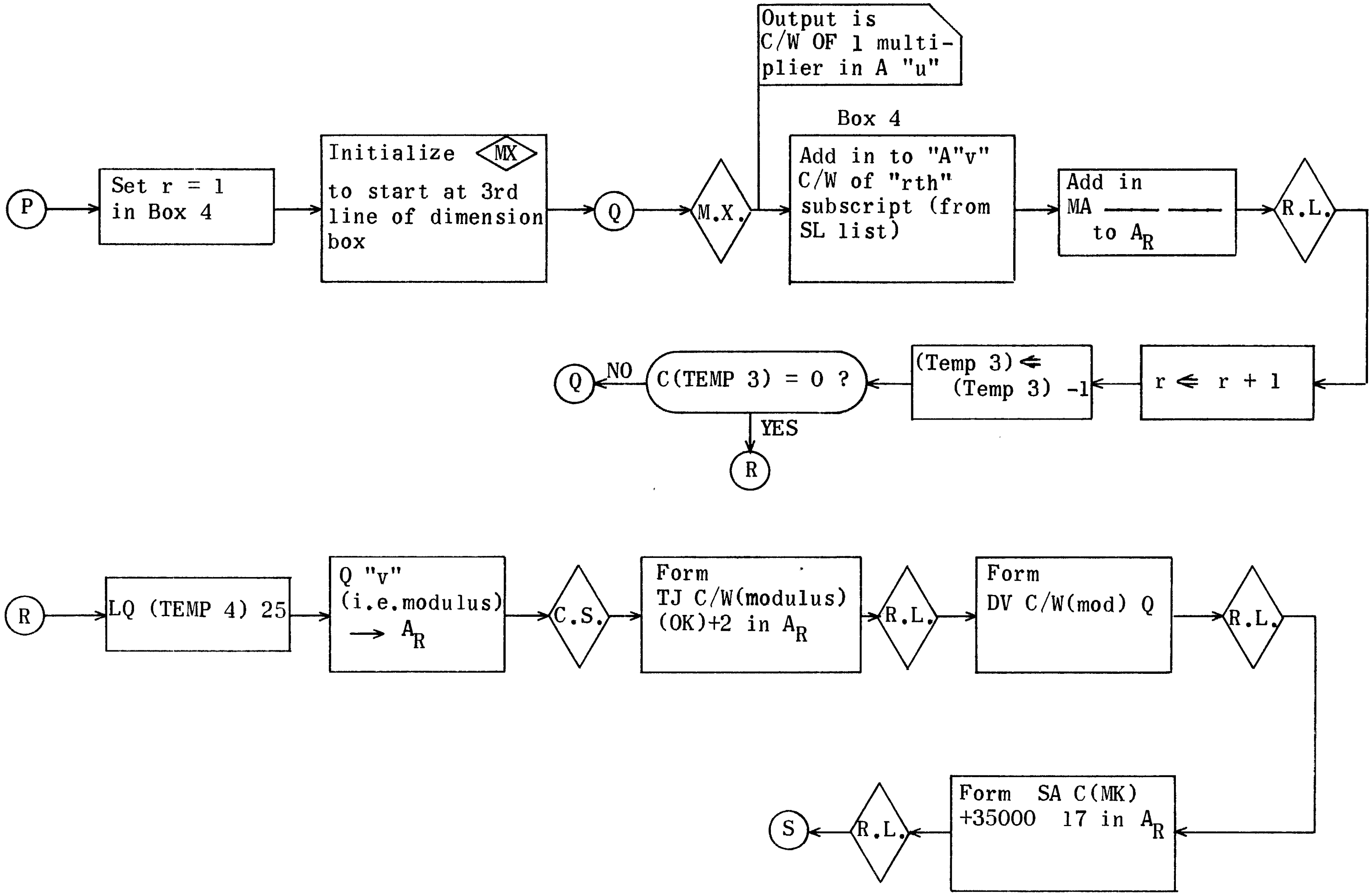
Type Generator - Cont.



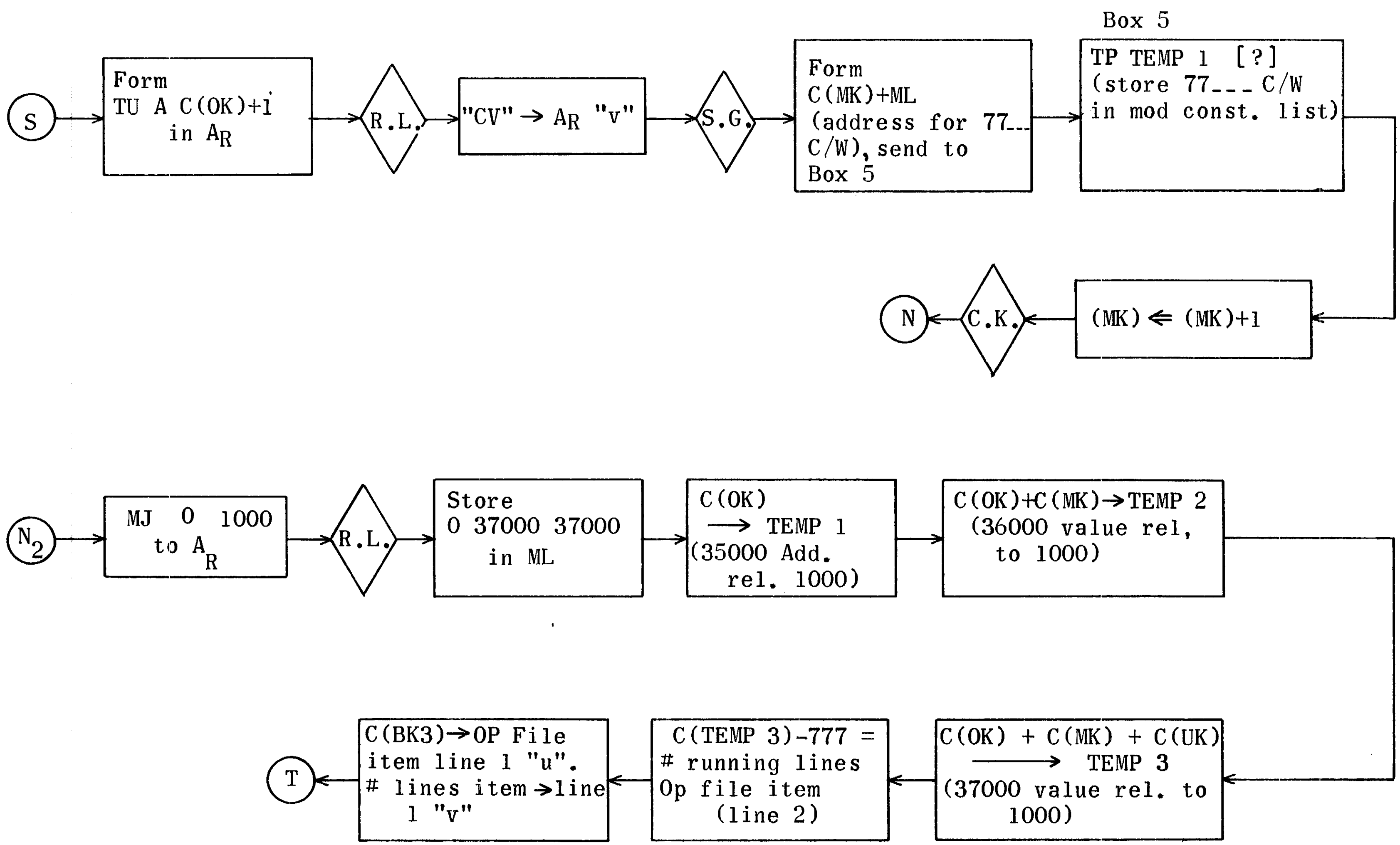
Type Generator - Cont.



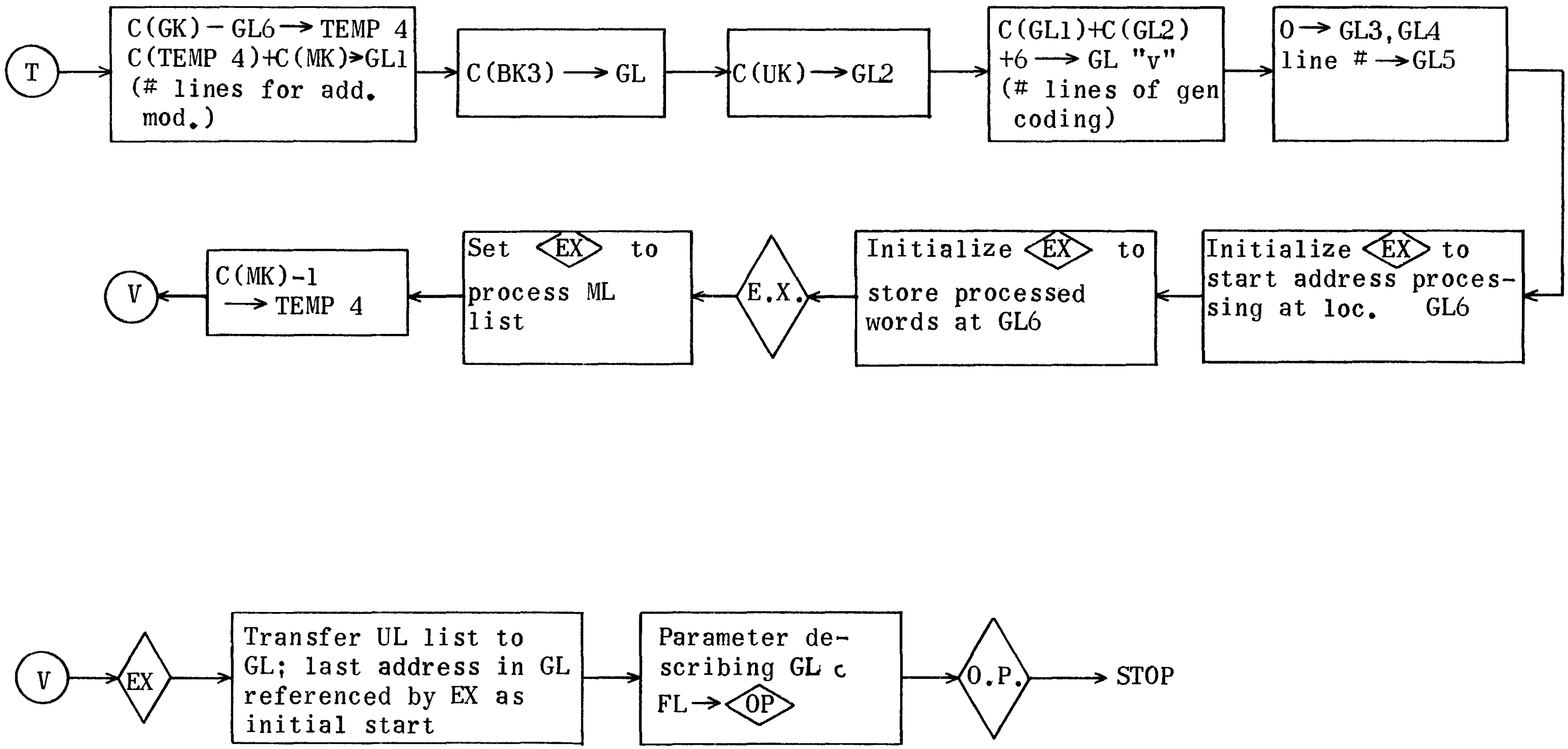
Type Generator - Cont.



Type Generator - Cont.



Type Generator - Cont.



Type Generator - Cont.

TYPE GENERATOR

REGIONS

Generation Subroutines	RE	LS1465	Library List Routine
	RE	CS1211	CS = CW Constant Call Word Routine
	RE	BR537	Machine Error Routine
	RE	UP421	Excess Three Print-Out Routine
	RE	OP1047	Loads Generators and Op Files on Tape
	RE	WA653	Routine to Print: Sentence — (Type)
	RE	BQ632	Rtne.to rewind all tapes & stop computer
	RE	TR1670	TR = VX Excess Three to Flex Code Routine
	RE	DL40102	Dimension List
	RE	BK2242	String-Out Buffer Input
	RE	GL5360	Buffer Output Region for Generated Rtne.
	RE	TY2512	Generator proper
	RE	IN2513	
	RE	TG2530	
	RE	MV2672	
	RE	PR2760	
	RE	MX3030	
	RE	EX3044	
	RE	SG3076	
	RE	RL3137	
	RE	ST3143	
	RE	CK3147	
	RE	FU3165	
	RE	SB3173	
	RE	CN3176	
	RE	PC3272	Working Space
	RE	OK3273	
	RE	GK3274	
	RE	UK3275	
	RE	MK3276	
	RE	WK3277	
	RE	TM3300	
	RE	SL3306	
	RE	VE3312	
	RE	FL3320	← Region used to build up Op File
	RE	ML3730	
	RE	UL4340	

Type Generator

	IA	TY		
	MJ	0	30000	Exit
	CA	TY1		

Initialization

	IA	IN		
0	TV	TG141	TG131	$N \longrightarrow A$
1	RP	10003	IN3	Initialize sub-generator
2	TV	SG36	SG10	
3	TV	CN73	FU5	Initialize Op File routine to FL2
4	TP	CN	PC	Clear PC
5	TP	CN	UK	$UK \rightarrow 0$
6	TP	CN1	MK	$MK \rightarrow 1$
7	TP	CN31	OK	$OK \longrightarrow 1000$
10	TP	CN70	GK	$GK \longrightarrow GL6$
11	TP	CN	WK	$WK \longrightarrow BK4$
12	TU	CN73	WK	
13	SP	CN56	0	MJ 0 37002 Generated
14	RJ	RL3	RL	
	CA	IN15		

Main Routine

	IA	TG		
0	TP	TG132	TG23	$F \rightarrow F_1$
1	TP	TG133	TG126	$L \rightarrow L_1$
2	TV	CN67	SB	Initialize subscript storing routine
3	SP	CN4	0	$45_8 \longrightarrow A_R$
4	RJ	CS	CS1	Place in constant pool
5	SP	CN57	0	PR 0 L (carriage return flex) formed and put in output
6	SA	Q	0	
7	RJ	RL3	RL	
10	SP	CN5	0	$79 \longrightarrow A$
11	RJ	CS	CS1	Find CW
12	SA	CN47	0	TP L(79) 37000 formed and put in output
13	RJ	RL3	RL	
14	SP	CN41	0	$40 \;\; 1 \;\; 0 \longrightarrow A$
15	AT	WK	TR4	Start to form entry line for TR and inform TR of location for output
16	SP	UK	17	
17	AT	CN63	TR3	
20	TU	WK	TG22	$r \longrightarrow$ BOX 1
21	RA	WK	CN45	$r + 2 \longrightarrow r$
22	SP	[30000]	0	Examine rth word
23	[0	30000	30000]	$F_1 \equiv$ TP A TM; $F_2 \equiv$ MJ 0 TG36

```
24  TJ   CN23    TG30       < 77000?
25  TP   TG134   TG126      No - i.e., 77--- type variable. L -> L2
26  RJ   FU4     FU         Insert in Op File item
27  MJ   0       TG34       Jump to E

30  TJ   CN17    TG33       < 65000?
31  TU   CN71    TG127      No - i.e., 65,66 -- so "CV" wanted M -> M2
32  MJ   0       TG34       Jump to E
33  TU   CN72    TG127      Must be 64---i.e., "IC" wanted M -> M1
34  TP   TG135   TG23       F -> F2
35  MJ   0       TG55       Jump to G
36  RP   30004   TG53   }
37  EJ   CN25    TG40   }   Test for, Δ⊙ ( ) or none
    CA   TG40

    IA   TG40
40  MJ   0       TG47       ∧  Jump to test PC
41  MJ   0       TG45       Δ ⊙  Jump to set N
42  RA   PC      CN2        (  PC + 2 -> PC
43  RS   PC      CN1        )  PC - 1 -> PC
44  MJ   0       TG55       Jump to G
45  TV   TG136   TG131      N -> N2
46  MJ   0       TG51       Jump to set J
47  SP   PC      0

50  ZJ   TG55    TG51       If zero, continue; non-zero, jump to G
51  TP   TG137   TG111      J -> J2
52  MJ   0       TG71       Jump to K
53  TP   A       TM1        Not any of above,.·. CW.   Save in TEMP 2
54  TJ   CN21    TG57       C(A) < 70000?
55  RA   TR4     CN1        No,.·. a dummy variable-count 1 more word
56  MJ   0       TG20         for TR and jump to C
57  TJ   CN20    TG62       C(A) < 67000?

60  RJ   SB2     SB         No - a numerical subscript - so note
61  MJ   0       TG55         and jump to G
62  TJ   CN17    TG65       C(A) <  65000?
63  TP   CN14    TM2        No; a floating variable, so "CV" -> TEMP 3
64  MJ   0       TG70         and jump to H
65  TJ   CN16    TG55       C(A) < 64000?  If so DUMMY
66  TP   CN15    TM2        No - so subscript, so "IC" -> TEMP 3
67  RJ   SB2     SB         Store in subscript list

70  TP   TG140   TG111      J -> J1
71  RJ   TR2     TR         Go translate
72  TP   CN24    Q          V mask -> Q
73  QT   TR3     TM3        Save n (number flex words) in TEMP 4
74  SP   MK      0          Current number modifiable constants
75  SA   CN65    0          Plus ML, is address at which to store
76  TV   A       TG101      Parameter about to be formed
77  SP   UK      0          C(UK)
    CA   TG100
```

```
     IA   TG100
100  SA   CN11    17         + 36000 = "u" of parameter
101  AT   TM3     [30000]
102  SP   MK      0          C(MK)
103  SA   CN10    17         + 35000 = CW for parameter location
104  SA   CN13    0          And PT is routine used
105  RJ   SG34    SG         Subgen to produce coding
106  RA   UK      TM3        UK + C (TEMP 4) --> UK
107  RA   MK      CN1        MK + 1 --> MK

110  RJ   CK3     CK
111  [0   30000   30000]     J1 ≡ SP  TM1  17; J2 ≡ MJ  0  TG115
112  SA   TM2     0          Form "CW required"  "IC or CV"
113  RJ   SG34    SG         Subgenerator
114  MJ   0       TG14       Jump to (B)
115  SP   TG101   17     }
116  TU   A       TG117  }   Increase last parameter by 1 to allow
117  RA   [30000] CN1    }     for " ↓ ∧ = ∧ "
120  SP   UK      0      }
121  SA   CN64    0      }
122  TV   A       TG123  }   Store "↓∧=∧" in UL
123  TP   CN42    [30000]}
124  RA   UK      CN1        UK + 1 --> UK
125  RJ   CK3     CK
126  [0   30000   30000]     L1 ≡ SP TM  17; L2 ≡ MJ  0  MV
127  SA   [30000] 0          M1 ⇛add in "IC ; M2 ⇛add in "CV"

130  RJ   SG34    SG         Subgenerator
131  MJ   0       [30000]    Either back, or out to processor
132  TP   A       TM         F1  }
133  SP   TM      17         L1  }
134  MJ   0       MV         L2  }
135  MJ   0       TG36       F2  }
136  0    0       PR         N2  }         Constants
137  MJ   0       TG115      J2  }
                                 }
140  SP   TM1     17         J1  }
141  0    0       TG         N1 (i.e., A)
     CA   TG142

     IA   MV
  0  RS   SB      CN1    }
  1  LA   A       17     }   Obtain last stored subscript CW
  2  TU   A       MV3    }
  3  SP   [30000] 17     }
  4  SA   CN52    0          Add in SP ___ ___
  5  RJ   RL3     RL     }
  6  SP   TM      0      }   Find appropriate dimension box
  7  TU   6       MV10   }
                         }
 10  RP   20000   BR1    }
 11  EJ   DL      MV12   }
 12  SN   Q       17         - jn + r
```

```
13  SA   MV10     0
14  SA   MV11     0           -->Address of 2nd line of box
15  TU   A        MV16
16  TP   [30000]  Q             2nd line --> Q
17  TP   Q        TM3           # subs, modulus --> TEMP 4

20  QT   CN24     A             # subs --> A
21  EJ   CN1      MV35          = 1?
22  ST   CN2      TM2           No, form &store S-2
23  TU   CN67     MV30          Prepare to extract CW in order
24  RA   MV16     CN33          Form address of 3rd line of dim. box
25  TU   A        MX
                                  and initialize m-extractor
26  TV   MX12     MX1
27  RJ   MX11     MX            Upon return, CW for 1 mult in A "u"

30  SA   [30000]  0             Add in CW of 1 subscript
31  SA   CN60     0               and MA ___ ___
32  RJ   RL3      RL            Store
33  RA   MV30     CN33
                                Prepare to pick up next subscript, then
34  IJ   TM2      MV27            back
35  LQ   TM3      25            Modulus --> Q "v"
36  QT   CN24     A             --> A
37  RJ   CS       CS1           Place in constant pool
    CA   MV40

    IA   MV40
40  SA   CN55     0             TJ  L(Mod)  2
41  SA   OK       0             TJ  L(Mod)  C  (OK) + 2
42  RJ   RL3      RL            Store
43  SP   Q        17            CW (Mod) --> A "u"
44  SA   CN61     0             DV Mod Q
45  RJ   RL3      RL            Store
46  SP   MK       0             Form 35---type pseudo CW of base 77---
47  SA   CN10     17              in A "u"

50  SA   CN53     0             --> SA  L(CW)  17
51  RJ   RL3      RL            Store
52  SP   CN51     0             TU  A  1
53  SA   OK       0             TU  A  "N.I."
54  RJ   RL3      RL            Store
55  SP   CN14     0             And "CV" is routine used
56  RJ   SG34     SG            Subgenerator
57  SP   MK       0
                                C(MK) + ML is address in mod. list for
                                  77---CW
60  SA   CN65     0
61  TV   A        MV62
62  TP   TM       [30000]       Store base CW
63  RA   MK       CN1           MK + 1 --> MK
64  RJ   CK3      CK            Check length
65  MJ   0        TG131         Jump back to (N) (Main Routine)
    CA   MV66
```

Sub-Processor

```
    IA   PR
 0  SP   CN6     0           MJ  0  1000
 1  RJ   RL3     RL          Stored
 2  TP   CN34    ML          Set up index address line
 3  SP   OK      0
 4  TP   A       TM          35000 (i.e., ML) Val. rel. 1000
 5  AT   MK      TM1         36000 (i.e., UL) val. rel. 1000
 6  AT   UK      TM2         37000 (i.e., temp) val. rel. 1000
 7  ST   CN7     FL1         Total # lines in running prog.(incl.temps)

10  SP   BK3     17          CW this routine
11  TP   A       GL          CW this routine to u of output line
12  SA   FU5     0           CW and number of lines complete Op File I
13  ST   CN66    FL            item
14  SP   GK      0           C(GK) - GL6 = # lines for modification by
15  ST   CN70    TM3           this routine
16  AT   MK      GL1
17  TP   UK      GL2
                             Complete prelude
20  TP   CN      GL3
21  TP   CN      GL4
22  TP   BK1     GL5
23  RS   TM3     CN1         Set up index for GL mod.
24  SP   CN70    17
25  TU   A       EX          Extract words from GL6
26  TV   CN70    EX7         Store words at GL6
27  RJ   EX13    EX          Exchange 35, 36, 37's in GL

30  TU   CN65    EX
31  SP   MK      0
32  ST   CN1     TM3         Now process mod. consts.
33  RJ   EX13    EX
34  TV   EX7     PR40        Set in address in GL for UL consts.
35  SP   UK      17
36  AT   CN62    PR37        Form RP order
37 [0    30000   30000]

40  TP   UL     [30000]      Repeated transfer from UL ⟶ GL
41  SP   GL1     0
42  SA   GL2     0           Total # output lines
43  SA   CN3     0
44  TV   A       GL
45  TP   CN43    OP1         Parameter ⟶ OP
46  RJ   OP      OP2         Output
47  MJ   0       TY          EXIT
    CA   PR50
```

Subroutine to Extract Multipliers and Obtain Appropriate CW's

```
    IA  MX
 0  TP  [30000] Q            1 line ——>Q
 1  MJ  0       [30000]      Switch (initially MX2)
 2  TV  MX13    MX1          FLIP
 3  MJ  0       MX7
 4  LQ  Q       25           Reverse "u" and "v"
 5  RA  MX      CN33         Modify entry for next application
 6  TV  MX12    MX1          FLOP
 7  QT  CN24    A            Extract n

10  RJ  CS      CS1          Place in constant pool
11  MJ  0       [30000]      Exit
12  0   0       MX2
13  0   0       MX4
    CA  MX14
```

Replacing 35---, 36---, 37--- Addresses with Values Relative 1000

```
    IA  EX
 0  TP  [30000] Q            1 line to Q
 1  QT  CN44    A            Inspect "Op. code"
 2  EJ  CN35    EX7          If a 10 line, O.K.
 3  RJ  EX31    EX14         Process "v"
 4  LQ  Q       25           Shift "u"——>"v"
 5  RJ  EX31    EX14         Process "u"
 6  LQ  Q       17           Restore Q
 7  TP  Q       [30000]      And output it in GL

10  RA  EX      CN33
11  RA  EX7     CN1
12  IJ  TM3     EX           Back for next line
13  MJ  0       [30000]      EXIT
14  TP  Q       TM4          Save Q
15  QT  CN23    TM5          Mask off 1st two digits
16  RP  30003   EX31
17  EJ  CN10    EX20

20  MJ  0       EX26         35
21  MJ  0       EX24         36
22  RA  TM4     TM2          37  Add in val (37)
23  MJ  0       EX27
24  RA  TM4     TM1          36 Add in val (36)
25  MJ  0       EX27
26  RA  TM4     TM           35  Add in val. (35)
27  SS  TM5     0            Subtract original 1st two digits

30  TP  A       Q            Set result back in Q
31  MJ  0       [30000]      Exit back to main level
    CA  EX32
```

Subgenerator, to Produce Coding Handling Parameters

```
    IA   SG
 0  TP   A       Q          "u" & "v" —>Q for PT, IC, CV
 1  SA   CN46    0          Add in TP ___ ___
 2  RJ   RL3     RL         Store
 3  SP   CN36    0          10  0  3
 4  RJ   ST3     ST         Store
 5  QT   CN24    SG37       Name of routine ("V") to temp.
 6  EJ   CN14    SG11       Is it CV?
 7  EJ   CN15    SG12       Is it IC?

10  RJ   SG40    [30000]    PT
11  RJ   SG40    [30000]    CV  Used before?   Initialized to SG13
12  RJ   SG40    [30000]    IC
13  RJ   FU4     FU         No, insert in Op File 1, List 1, then
14  SP   SG37    17           ensure this path not taken again
15  RJ   LS      LS1
16  RS   SG40    CN1        Find address to be changed
17  TV   A       SG20

20  TV   SG35    [30000]
21  SP   SG37    0          Name to A "v"
22  SA   CN50    0          Add in TP  35000 ___
23  RJ   RL3     RL         Store
24  SP   CN37    0          10  0  4
25  RJ   ST3     ST         Store
26  SP   SG37    17
27  SA   SG37    0

30  SA   CN54    0          Add in RJ ___ ___
31  RJ   RL3     RL         Store
32  SP   CN40    0          10  2  0
33  RJ   ST3     ST
34  MJ   0       [30000]    EXIT
35  0    0       SG26
36  0    0       SG13
37  0    30000   30000
40  0    30000   30000      Erasable
    CA   SG41

    IA   RL
 0  RJ   ST3     ST         Store
 1  RA   OK      CN1        Increment OK
 2  RJ   CK3     CK1        Check size of routine
 3  MJ   0       [30000]    Exit
    CA   RL4
```

```
   IA  ST
0  TV  GK     ST1
1  TP  A     [30000]       Store
2  RA  GK     CN1          Increment GK
3  MJ  0     [30000]       Exit
   CA  ST4
```

Error Print-Out Routine

```
    IA  CK
0   SP  OK     0      }
1   SA  MK     0      }    Sum 3 counters
2   SA  UK     0      }
3   TJ  CN32  [30000]
4   RJ  WA     WA1         Print-Out:  Sentence ___(Type)
5   TP  CK10   UP3    }
6   RJ  UP2    UP     }    Print-Out: Generated Sentence Too Long
7   MJ  0      BQ6         Jump to rewind tapes and computer stop
10  40  CK11   5           Parameter for print-out routine
11  32  30503  05424       GENERA
12  66  30270  16530       TEDΔSE
13  50  66305  02630       NTENCE
14  01  66515  10146       ΔTOOΔL
15  51  50322  27777       ONG.
    CA  CK16
```

Updating Op File 1 Item

```
   IA  FU
0  LA  A      17           Shift CW to "u" field
1  TV  FU5    FU2          Where?
2  TP  A     [30000]       Store in item
3  RA  FU5    CN1          Increment counter
4  MJ  0     [30000]       Exit
5  0   0     [30000]       Counter
   CA  FU6
```

Storing SS in Subscript List (SL)

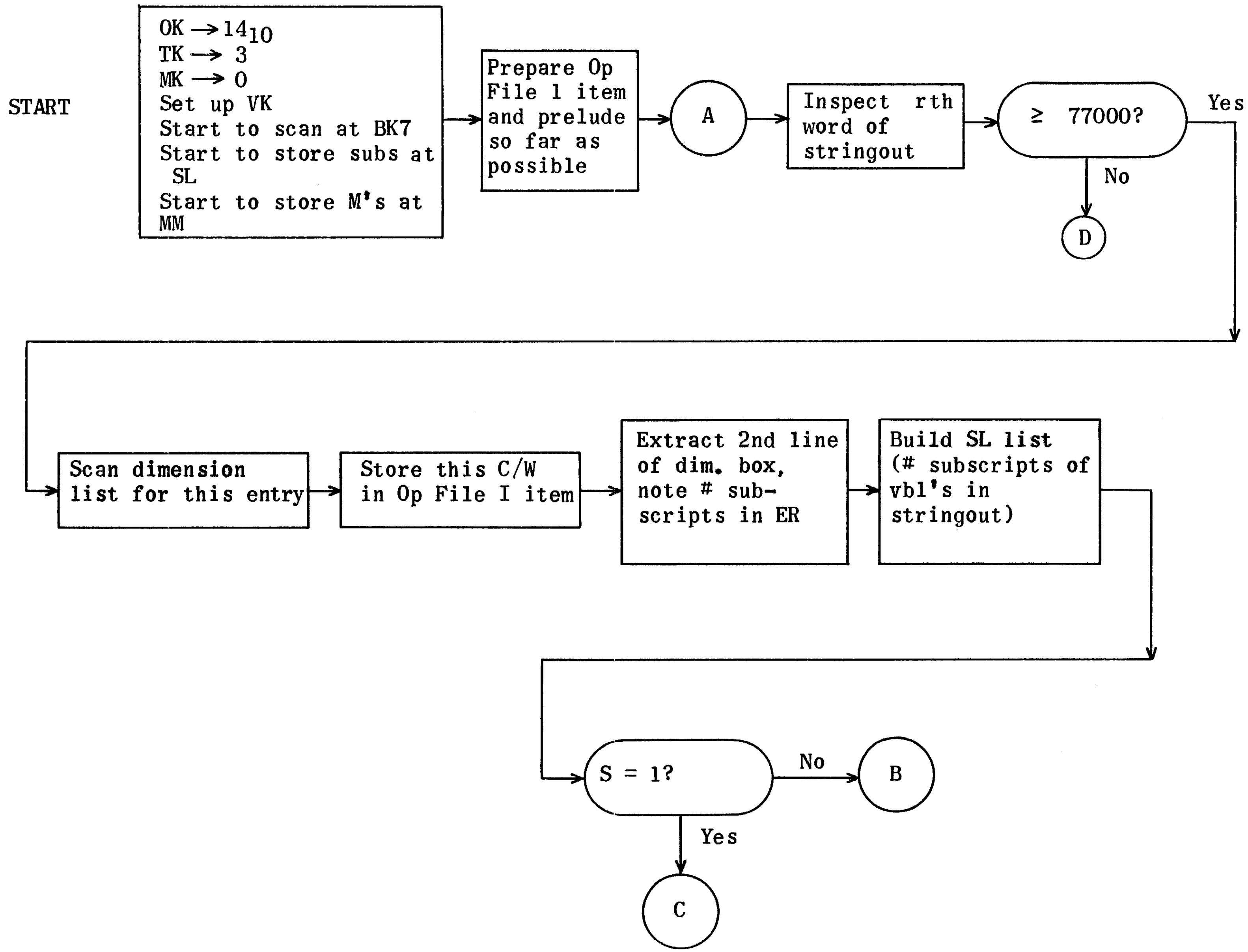
```
   IA  SB
0  TP  A      30000        Store subscript CW
1  RA  SB     CN1          Increment "v" address
2  MJ  0      30000          and exit
   CA  SB3
```

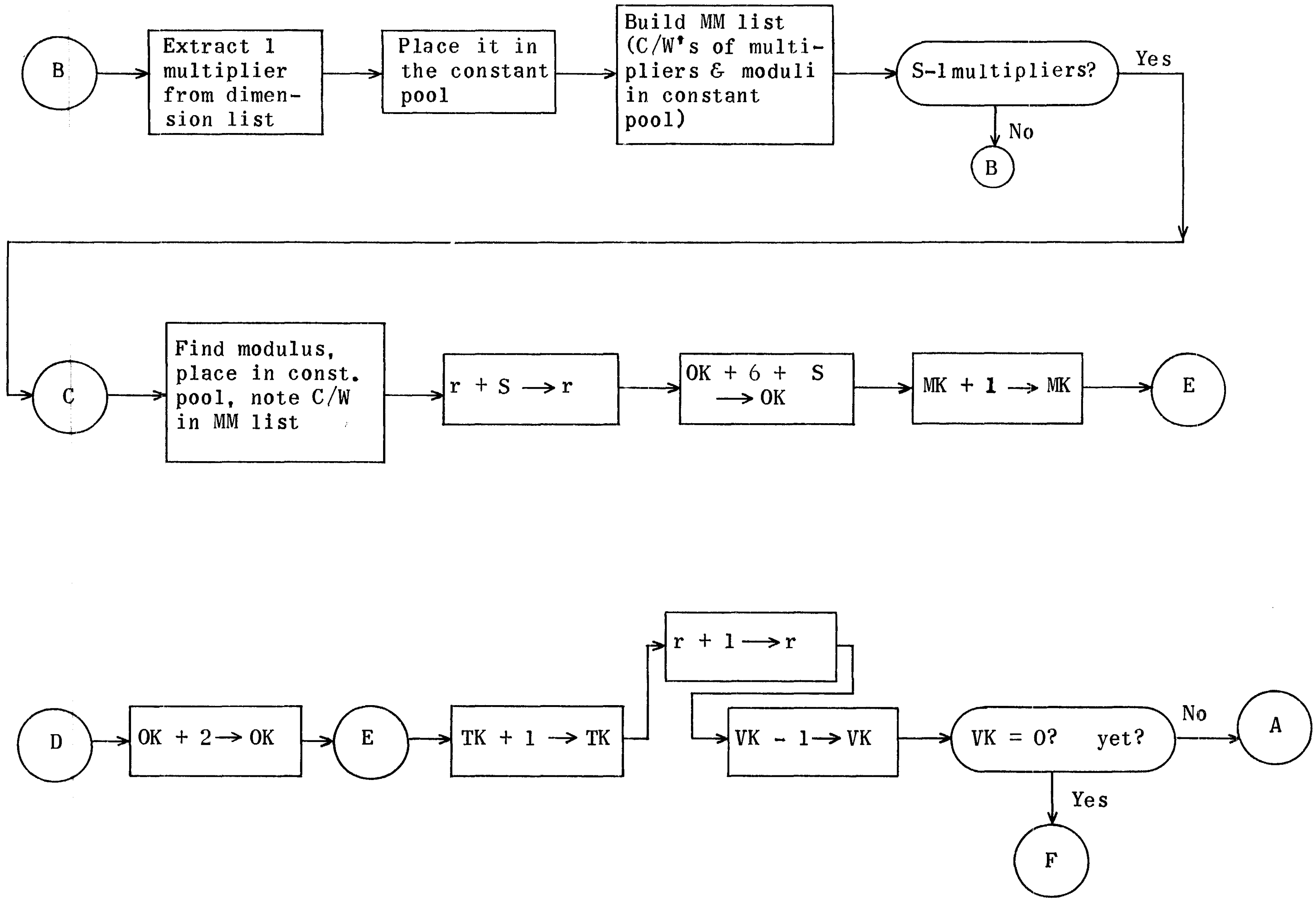
Constants

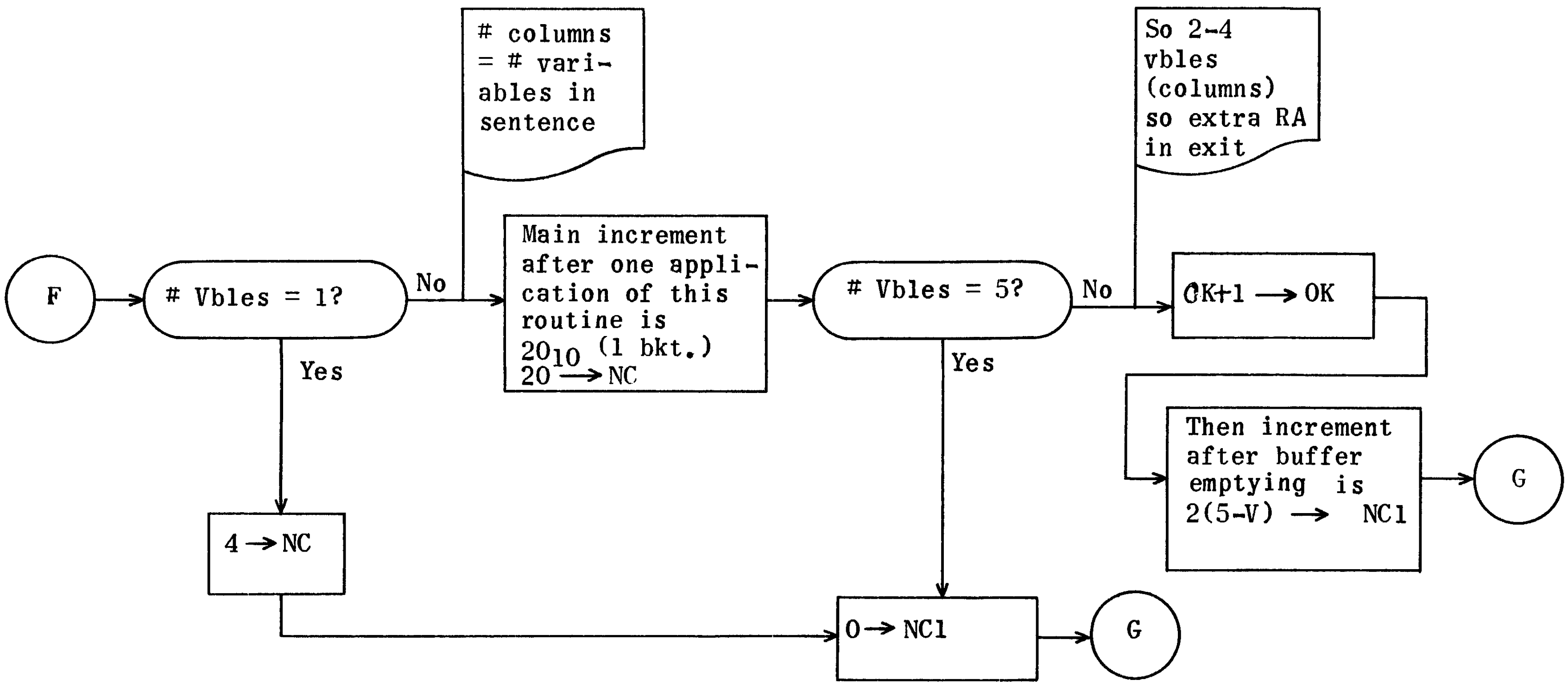
```
   IA  CN
0  0   0      0
1  0   0      1
2  0   0      2
3  0   0      6
4  0   0      45
```

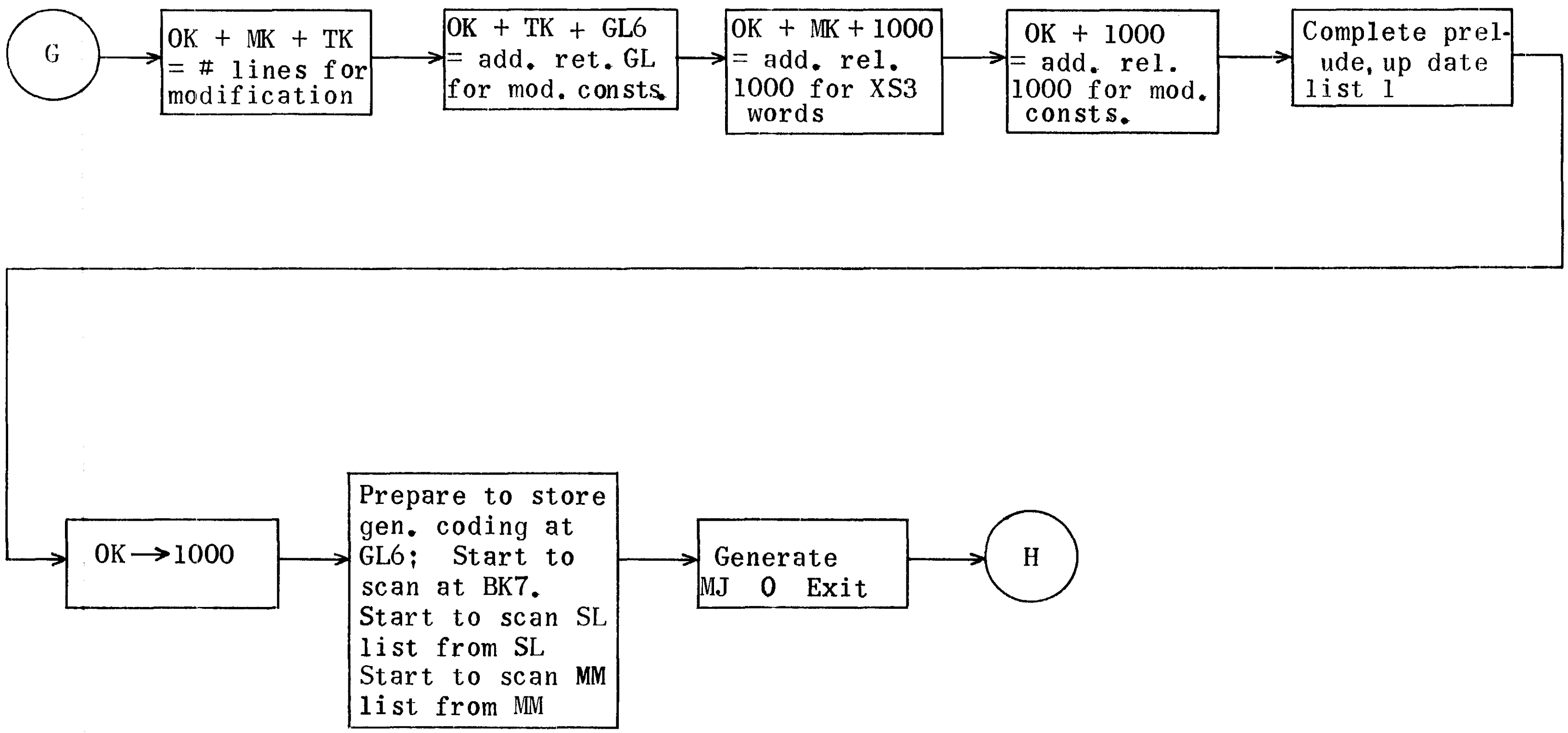
```
 5  0    0      117
 6  MJ   0      1000
 7  0    0      777

10  0    0      35000
11  0    0      36000       Pseudo-address codes
12  0    0      37000
13  0    0      50002       PT
14  0    0      50062       CV    Library call words
15  0    0      50112       IC
16  0    0      64000
17  0    0      65000

20  0    0      67000
21  0    0      70000
22  0    0      76000
23  0    0      77000
24  0    0      77777       v-mask
25  0    0      40          Λ
26  0    0      120         Δ ⊙       Various string-out symbols
27  0    1      0           (

30  0    2      0           )
31  0    0      1000
32  0    0      1776        Check on length of gen. coding
33  0    1      0
34  0    37000  37000
35  10   0      0
36  10   0      3
37  10   0      4
    CA   CN40

    IA   CN40
40  10   2      0
41  40   1      0
42  57   04440  40000
43  0    GL     FL
44  77   0      0
45  0    2      0
46  TP   0      0
47  TP   0      37000

50  TP   35000  0
51  TU   32000  1
52  SP   0      0
53  SA   0      17
54  RJ   0      0
55  TJ   0      2
56  MJ   0      37002
57  PR   0      0
```

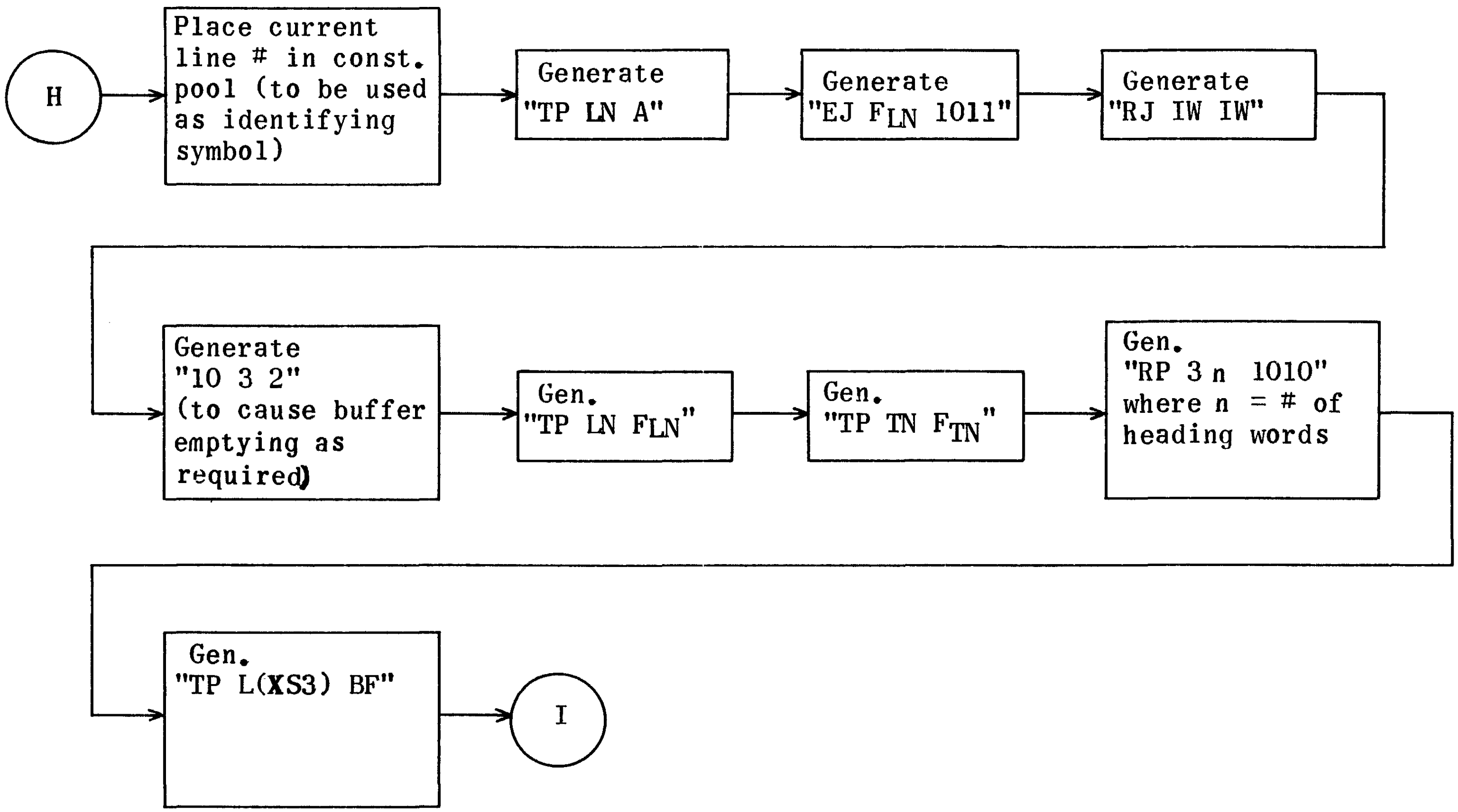
60	MA	0	0
61	DV	0	31000
62	RP	30000	PR41
63	0	UL	0
64	0	0	UL
65	0	ML	ML
66	0	0	FL
67	0	SL	SL
70	0	0	GL6
71	0	CN14	0
72	0	CN15	0
73	0	BK4	FL2
	CA	CN74	


START
OK → 14_{10}
TK → 3
MK → 0
Set up VK
Start to scan at BK7
Start to store subs at SL
Start to store M's at MM
Prepare Op File 1 item and prelude so far as possible
A
Inspect rth word of stringout
≥ 77000?
Yes
No
D
Scan dimension list for this entry
Store this C/W in Op File I item
Extract 2nd line of dim. box, note # sub-scripts in ER
Build SL list (# subscripts of vbl's in stringout)
S = 1?
No
B
Yes
C

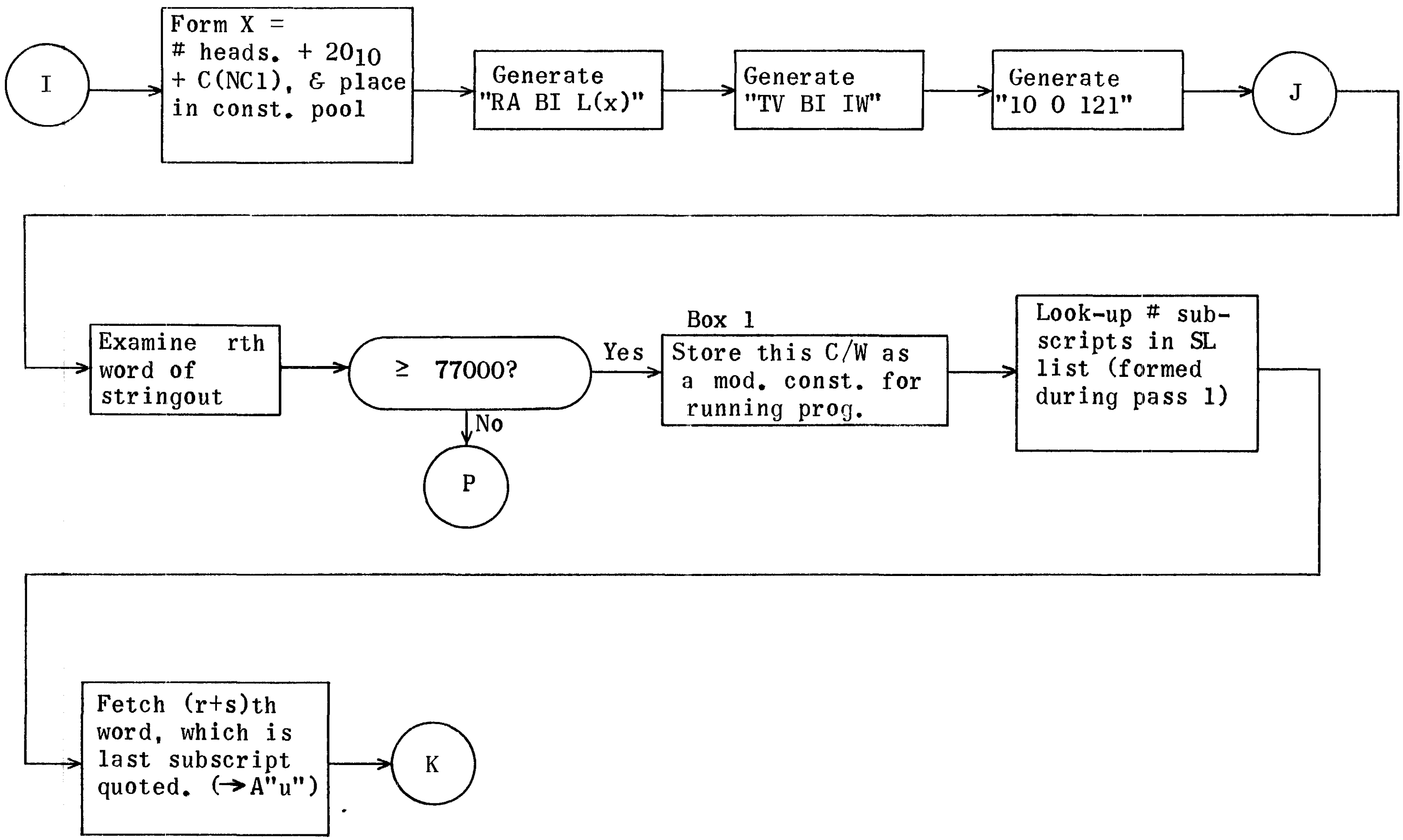

B
Extract 1 multiplier from dimension list
Place it in the constant pool
Build MM list (C/W's of multipliers & moduli in constant pool)
S-1 multipliers?
Yes
No
B
C
Find modulus, place in const. pool, note C/W in MM list
r + S → r
OK + 6 + S → OK
MK + 1 → MK
E
D
OK + 2 → OK
E
TK + 1 → TK
r + 1 → r
VK - 1 → VK
VK = 0? yet?
No
A
Yes
F


F
Vbles = 1?
No
Yes
columns = # variables in sentence
Main increment after one application of this routine is
20_{10} (1 bkt.)
20 → NC
4 → NC
Vbles = 5?
No
Yes
So 2-4 vbles (columns) so extra RA in exit
OK+1 → OK
Then increment after buffer emptying is
2(5-V) → NC1
G
0 → NC1
G

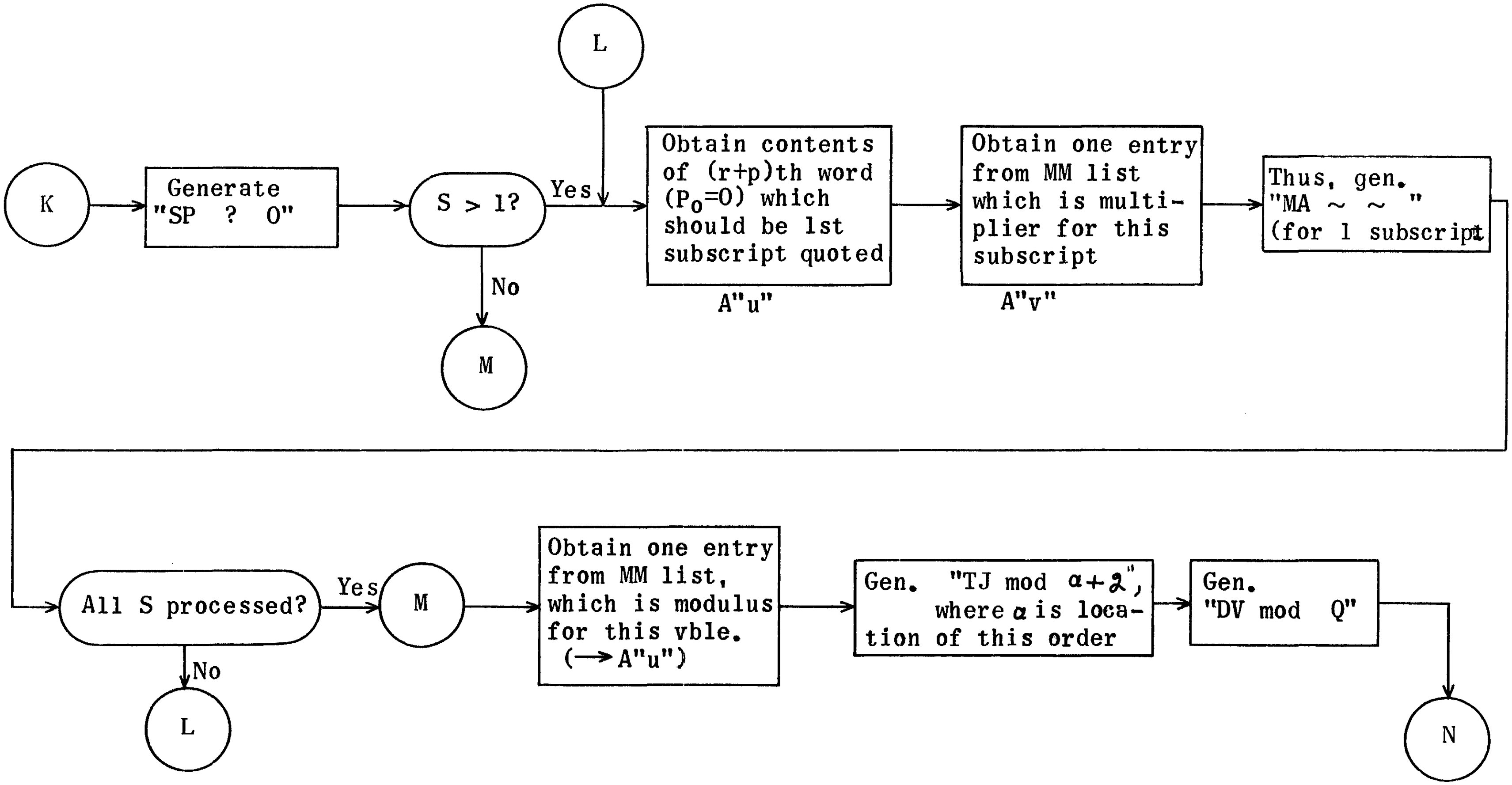

G
OK + MK + TK = # lines for modification
OK + TK + GL6 = add. ret. GL for mod. consts.
OK + MK + 1000 = add. rel. 1000 for XS3 words
OK + 1000 = add. rel. 1000 for mod. consts.
Complete prelude, up date list 1
OK → 1000
Prepare to store gen. coding at GL6; Start to scan at BK7. Start to scan SL list from SL Start to scan MM list from MM
Generate MJ 0 Exit
H

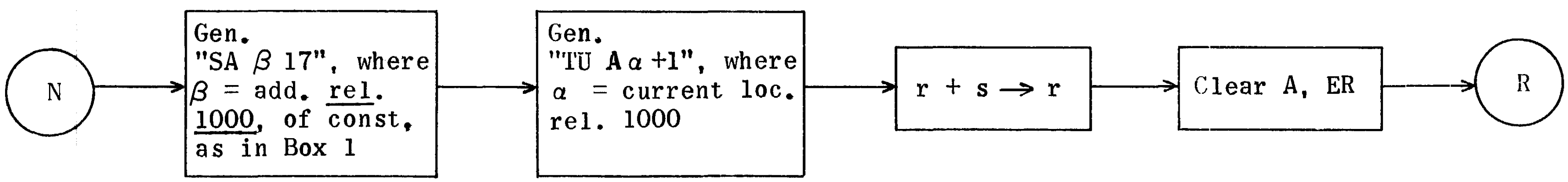

H
Place current line # in const. pool (to be used as identifying symbol)
Generate "TP LN A"
Generate "EJ FLN 1011"
Generate "RJ IW IW"
Generate "10 3 2" (to cause buffer emptying as required)
Gen. "TP LN FLN"
Gen. "TP TN FTN"
Gen. "RP 3 n 1010" where n = # of heading words
Gen. "TP L(XS3) BF"
I

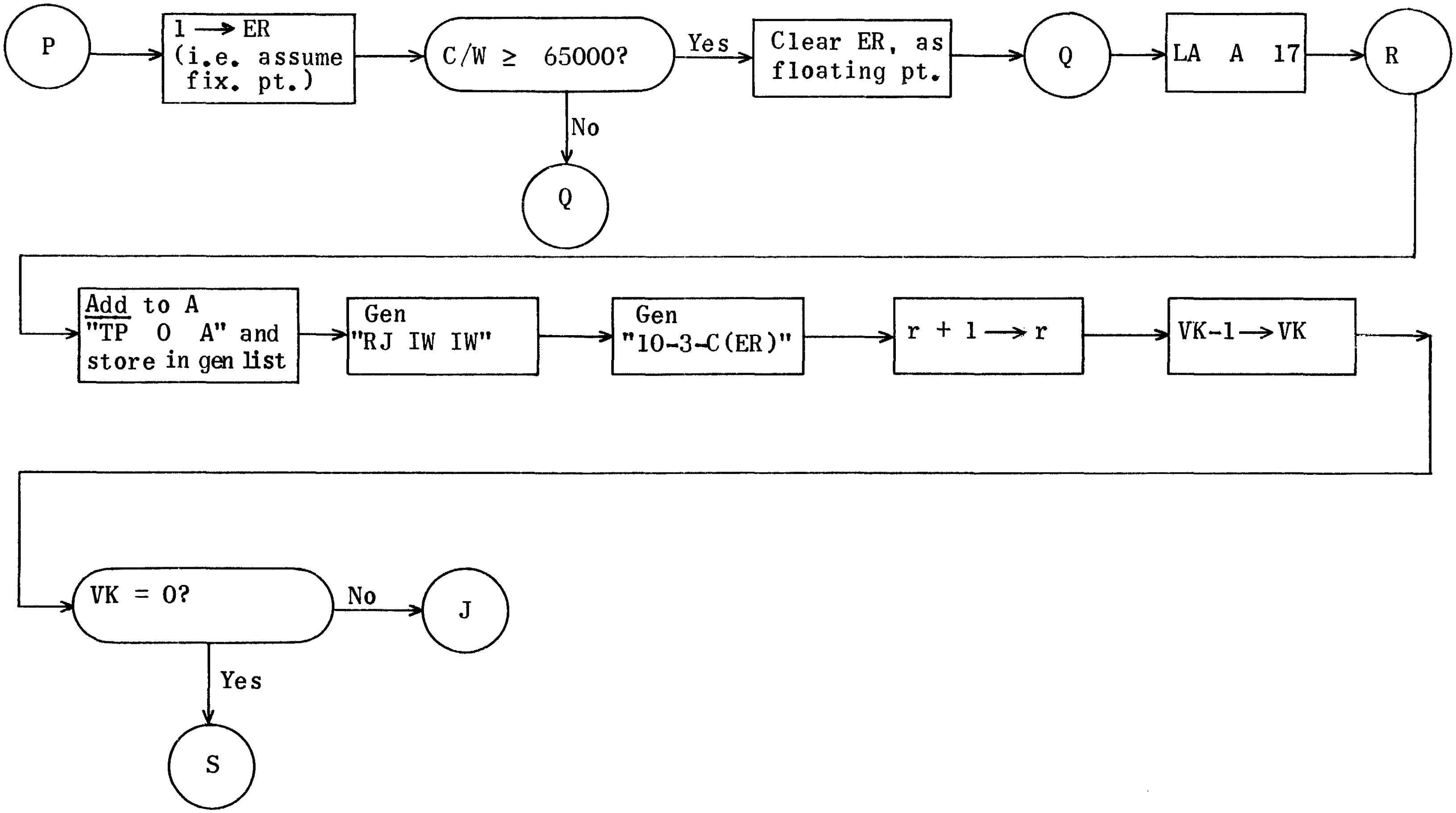
1131

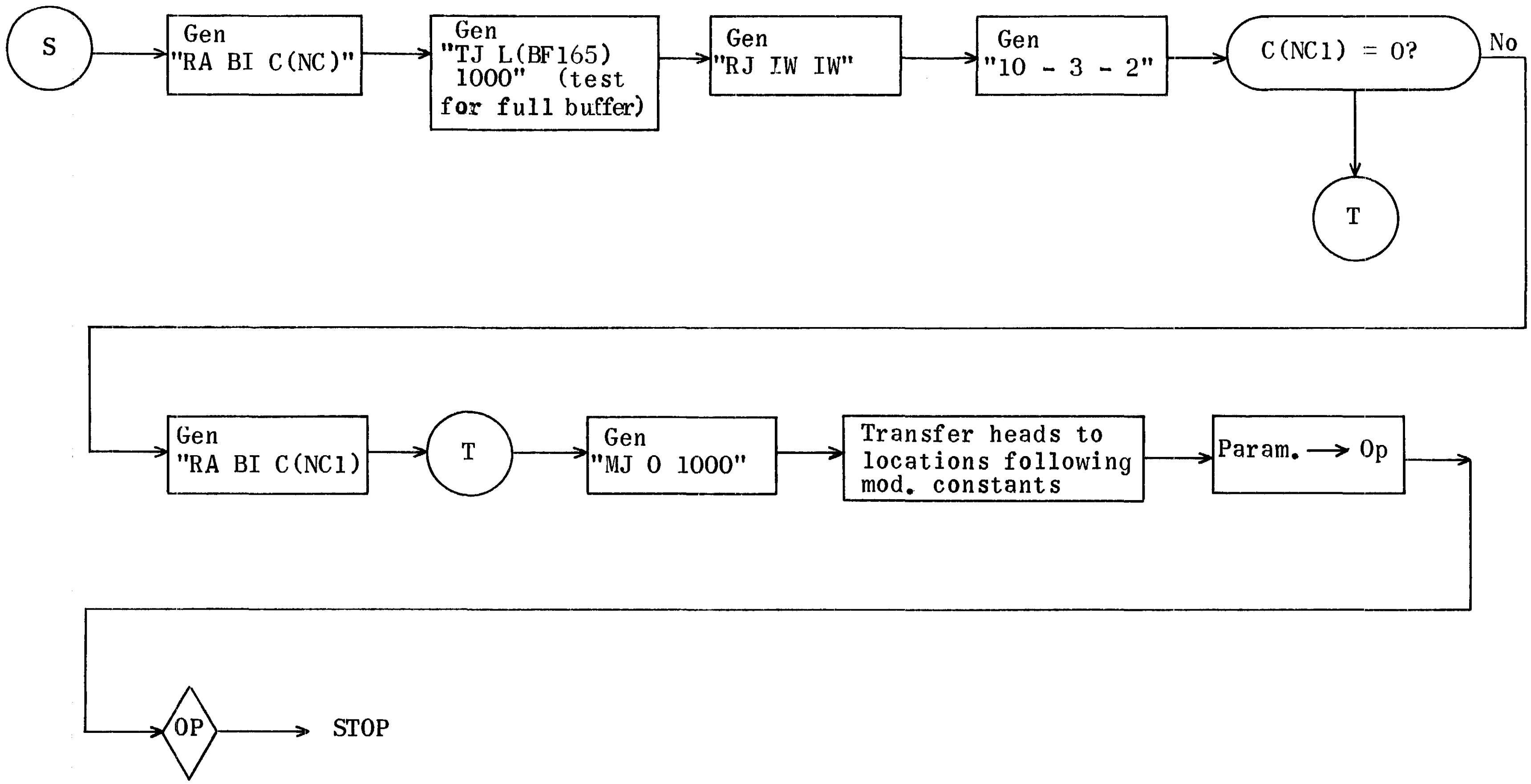


I
Form X = # heads. + 20_{10} + C(NC1), & place in const. pool
Generate "RA BI L(x)"
Generate "TV BI IW"
Generate "10 0 121"
J
Examine rth word of stringout
≥ 77000?
Yes
No
P
Box 1
Store this C/W as a mod. const. for running prog.
Look-up # subscripts in SL list (formed during pass 1)
Fetch (r+s)th word, which is last subscript quoted. (→A"u")
K


K
Generate "SP ? 0"
S > 1?
Yes
No
M
L
Obtain contents of (r+p)th word (P_0=0) which should be 1st subscript quoted
A"u"
Obtain one entry from MM list which is multiplier for this subscript
A"v"
Thus, gen. "MA ~ ~ " (for 1 subscript)
All S processed?
Yes
No
L
M
Obtain one entry from MM list, which is modulus for this vble. (→ A"u")
Gen. "TJ mod α+2", where α is location of this order
Gen. "DV mod Q"
N


N
Gen.
"SA β 17", where
β = add. rel.
1000, of const,
as in Box 1
Gen.
"TU A α +1", where
α = current loc.
rel. 1000
r + s → r
Clear A, ER
R


P
1 ⟶ ER (i.e. assume fix. pt.)
C/W ≥ 65000?
Yes
No
Q
Clear ER, as floating pt.
Q
LA A 17
R
Add to A "TP 0 A" and store in gen list
Gen "RJ IW IW"
Gen "10-3-C(ER)"
r + 1 ⟶ r
VK-1 ⟶ VK
VK = 0?
No
J
Yes
S


S
Gen "RA BI C(NC)"
Gen "TJ L(BF165) 1000" (test for full buffer)
Gen "RJ IW IW"
Gen "10 - 3 - 2"
C(NC1) = 0?
No
T
Gen "RA BI C(NC1)
T
Gen "MJ 0 1000"
Transfer heads to locations following mod. constants
Param. → Op
OP
STOP

LIST GENERATOR

REGIONS

Generation Subroutines	RE	LS1465	Library List Routine	
	RE	CS1211	CS = CW Constant Call Word Routine	
	RE	BR537	Machine Error Routine	
	RE	OP1047	Routine to Transfer Generated Routine and Op File to Tape	
	RE	RW50023	List of call words of tape numbers referenced for use of STOP instruction	
	RE	DL40102	Dimension List	
	RE	BK2242	Buffer input region for string-out	
	RE	GL5360	Buffer output region for generated routine	
	RE	WW12	Fixed location where READ and LIST indicators are stored	
	RE	LI2512		
	RE	IN2513		
	RE	PA2532		
	RE	PB2632		
	RE	PC2666		
	RE	RL3113		
	RE	ST3116		
	RE	OR3121		
	RE	CN3136	Generator proper	
	RE	OK3173		
	RE	TK3174		
	RE	MK3175		
	RE	VK3176		
	RE	NC3177		
	RE	ER3201		
	RE	TC3204		
	RE	SL3205		
	RE	MM3212		
	RE	FL3236	Used to store Op File for LIST	
	RE	NL71002		7 in these addresses is a code figure to keep processor from modifying addresses
	RE	TN71003	Fixed output locations	
	RE	BI71004		
	RE	BF71005	LIST Buffer location	

```
      IA   LI
      MJ   0       30000          Exit
      CA   LI1
```

Preliminary Initialization

```
      IA   IN
 0    TP   CN7     OK             14_10 running lines at least
 1    TP   CN3     TK             3 "10 lines"
 2    TP   CN      MK             0 modifiable constants
 3    TP   BK5     VK             Set up variable counter
 4    TU   CN24    PA             Start scanning string-out at BK7
 5    TV   CN25    PA15           Build subscript List from SL
 6    TV   CN26    PA34           Build mult. & mod. List from MM
 7    SP   BK3     17             Routine CW to Prelude
10    TP   A       GL
11    TP   CN27    FL2            Note CW of IW routine
12    TV   CN24    PA5            Future cross-refs. to be stored at FL3
13    AT   CN3     FL             Call word and at least no. 3 of lines to
                                    1st line of Op File
14    TP   CN      GL3            0 inputs
15    TP   CN      GL4            0 outputs
16    TP   BK1     GL5            Line number to Prelude
      CA   IN17
```

"LIST" Generator - First Pass

```
      IA   PA
 0    SP   [30000] 0              Inspect rth word of string-out
 1    TJ   CN14    PA55           Multivalued?
 2    TU   6       PA3            Yes, scan Dimension List
 3    RP   [30000] BR1
 4    EJ   DL      PA5
 5    LT   10017   [30000]        Build Op File 1 item
 6    RA   FL      CN1
 7    SN   Q       17             -jn + r

10    SA   PA3     0              +r
11    SA   PA4     0              +DL => add. of 2nd line (modulus; S)
12    TU   A       PA13
13    TP   [30000] Q
14    QT   CN20    ER             Using v-mask, note # subscripts (s)
15    TP   A       [30000]        Build subscript list
16    EJ   CN1     PA40           Is s = 1?
17    ST   CN2     ER1            No, form & store (S-2)

20    TU   PA13    PA37           Note address of 2nd line
21    RA   PA13    CN15           Form address of 3rd line
22    TU   A       PA24
23    TP   PA76    PA25           Set flip-flop of m-extractor
24    TP   [30000] Q              1 line of dim. box --> Q
25    [0   30000   30000]         1 TP 2 PA25; 2 MJ 0 PA27
```

26	MJ	0	PA32	Jump to extract v-field
27	LQ	Q	25	Q "u" → Q "v"
30	RA	PA24	CN15	Modify for next line
31	TP	PA76	PA25	Reset flip-flop to 1
32	QT	CN20	A	Extract v field
33	RJ	CS	CS1	Insert in constant pool, and find CW
34	TP	A	[30000]	Build MM list (A "u")
35	RA	PA34	CN1	
36	IJ	ER1	PA24	Back for more multipliers
37	TP	[30000]	Q	2nd line again to Q
	CA	PA40		
	IA	PA40		
40	LQ	Q	25	Shift modulus to "v" and extract it
41	QT	CN20	A	
42	RJ	CS	CS1	Place in pool
43	TV	PA34	PA44	and place in MM list
44	TP	A	[30000]	
45	RA	PA34	CN1	
46	SP	ER	17	S → A "u"
47	AT	PA	PA	Bring r count up to date
50	RA	PA5	CN1	Op File Item building op. updated
51	RA	PA15	CN1	SL list building op. updated
52	RA	OK	CN4	OK + 4 → OK
53	AT	ER	OK	OK + 5 → OK
54	RA	MK	CN1	1 mod constant
55	RA	OK	CN2	OK + 2 → OK (S.V. variable entry)
56	RA	TK	CN1	One "10 line"
57	RA	PA	CN15	r + 1 → r
60	RS	VK	CN1	vk - 1 → vk
61	ZJ	PA	PA62	If zero, wrap up this pass.
62	SP	BK5	0	Number variables → A
63	EJ	CN1	PA73	= 1?
64	TP	CN10	NC	No, > 1. 20_{10} → INC
65	EJ	CN5	PA74	= 5?
66	RA	OK	CN1	No, OK + 1 → OK
67	SP	CN5	0	5 → A
70	SS	BK5	1	2(5 - v) = SUBINC
71	TP	A	NC1	
72	MJ	0	PB	Jump to initialization, Pass 2
73	TP	CN4	NC	1 vble, INC = 4
74	TP	CN	NC1	1 or 5 vbles., SUBINC = 0
75	MJ	0	PB	Jump to init., Pass 2
76	TP	PA77	PA25	Constants for m flip-flop
77	MJ	0	PA27	
	CA	PA100		

Initialization, Pass 2

```
     IA   PB
 0   SP   OK     0
 1   AT   MK     ER
 2   AT   TK     GL1          C(OK)+C(MK)+C(TK) = # lines for add. mod.
 3   SS   MK     0
 4   SA   CN23   0            C(OK)+C(TK)+GL6 = add. rel. GL for mods.
 5   TV   A      PC53
 6   SP   ER     0            C(OK)+C(MK)+1000
 7   AT   CN12   TC                  = XS3 add. rel. 1000

10   ST   MK     MK           C(OK)+1000 = mod. const. add. rel. 1000
11   TP   BK6    GL2          # unmods.
12   SP   BK6    0
13   AT   ER     FL1          Total number of running lines
14   TP   BK5    VK           Set variable counter
15   TU   CN24   PC51         Set to scan at BK7
16   TU   CN25   PC55         Start obtaining # subs from SL list
17   TU   CN26   PC74         Start obtaining mults. and mods. from MM
                                list
20   TP   CN12   OK           Set OK to 1000
21   TV   CN23   ST           Start storing output at GL6
22   SP   CN27   0            "50077" to A
23   RJ   LS     LS1          Update list 1
24   SP   GL1    0
25   SA   GL2    0
26   SA   CN6    0            + 6 = # lines for prelude
27   TV   A      GL

30   SP   TC     0            XS3 add. rel. 1000
31   SA   BK6    0            + # heads
32   SA   OR14   0
33   RJ   RL2    RL           Store MJ 0 Exit
     CA   PB34
```

Second Pass

```
     IA   PC
 0   SP   BK1    0            This line number
 1   RJ   CS     CS1          Insert in constant pool (CW ⟶ A "u")
 2   SA   OR     0            Add in TP ⟶ A
 3   RJ   RL2    RL
 4   SP   OR1    0            EJ  NL  1011
 5   RJ   RL2    RL
 6   SP   OR2    0            RJ  IW  IW
 7   RJ   RL2    RL

10   SP   CN16   0            Basic "ten line"
11   SA   CN2    0            + 2 in "v"
12   RJ   ST2    ST           Store it
13   TP   GL7    ER           "TP CW (LN) A
```

```
14   TV   CN21     ER            ->"TP  CW(LN)  F LN
15   SP   ER       0
16   RJ   RL2      RL
17   TP   OR       ER     }
                          }   TP  CW(TN)  F TN
20   TU   BK4      ER     }
21   TV   CN22     ER     }
22   SP   ER       0
23   RJ   RL2      RL         Store this line
24   SP   GL2      17         # heads -> A "u"
25   SA   OR3      0          ->RP  3n  1010
26   RJ   RL2      RL         Store
27   SP   TC       17         XS3 add. rel. 1000
30   TP   OR       ER     }
31   TU   A        ER     }   TP  L(XS3)  BF
32   TV   CN17     ER     }
33   SP   ER       0
34   RJ   RL2      RL         Store this line
35   SP   GL2      0          # heads
36   SA   CN10     0          + 20_10
37   SA   NC1      0          + SUBINC = total RA const.
     CA   PC40

     IA   PC40
40   RJ   CS       CS1        Insert in constant pool
41   SP   OR4      0      }
42   SA   Q        0      }   RA  BI  L (INC 1) to output
43   RJ   RL2      RL     }
44   SP   OR5      0      }   TV  BI  IW  to output
45   RJ   RL2      RL     }
46   SP   CN32     0          Basic 10 line
47   SA   CN11     0          + appropriate value to reach IW "store"
                                line
50   RJ   ST2      ST
51   SP   [30000]  0          Examine rth word
52   TJ   CN14     PC130      Multivalued
53   TP   A        [30000]    Yes, store this CW as a running mod.const.
54   RA   PC53     CN1        Set for next time
55   TP   [30000]  ER         # SS -> ER
56   RA   PC55     CN15       Modify
57   SP   ER       17         # SS -> A "u"

60   SA   PC51     0          Find location of
61   TU   A        PC62       Last subscript for "SP ___ 0" order
62   SP   [30000]  17         Last CW -> A "u"
63   SA   OR6      0          Add in SP ____ 0
64   RJ   RL2      RL         Store this line
65   SP   ER       0          More than 1 subscript?
66   EJ   CN1      PC102
67   ST   CN2      ER1        Yes, form and store (S-2)

70   SP   PC51     0
71   SA   CN15     0          Add 1 u to find first subscript
```

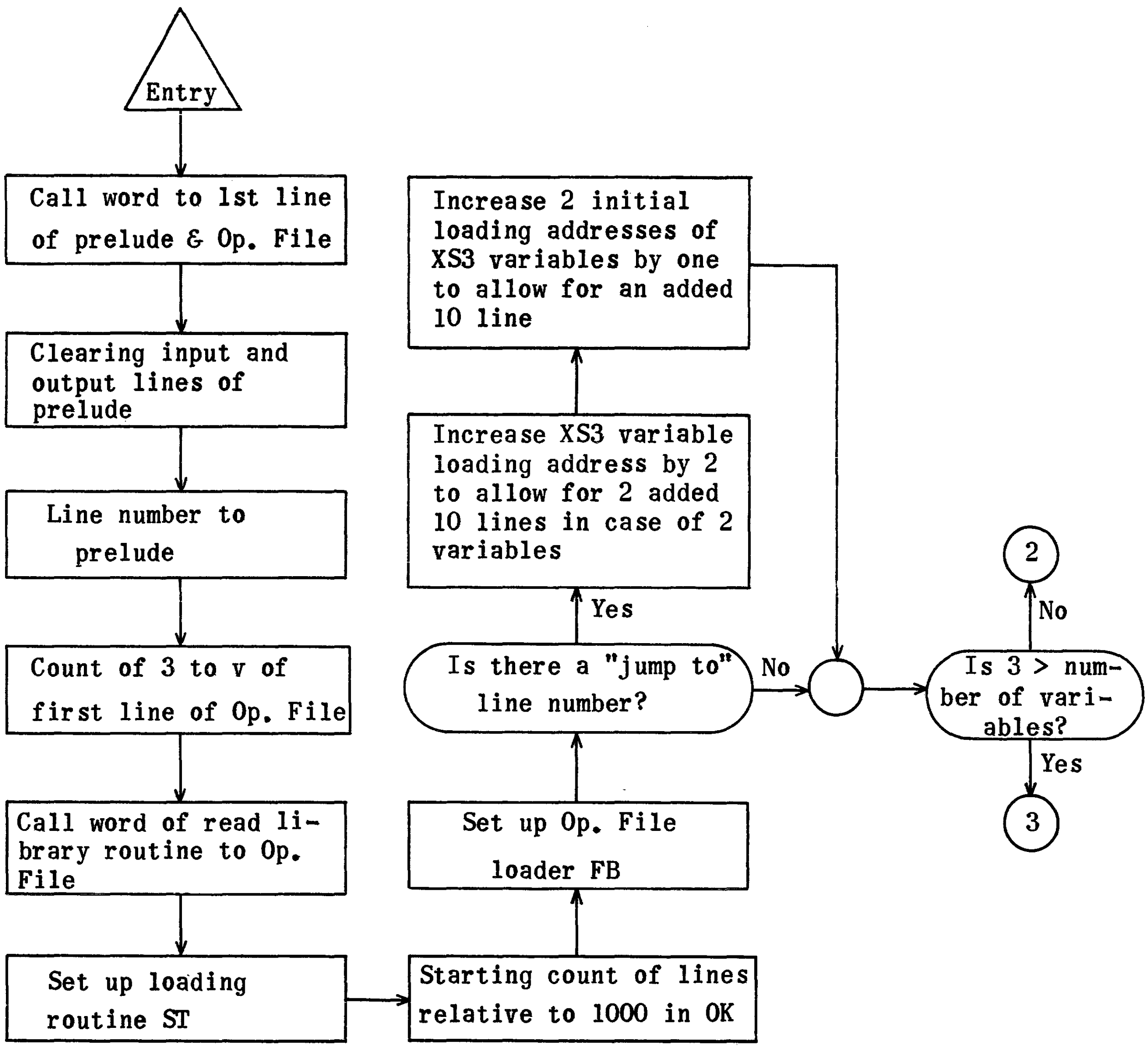
```
 72   TU   A        PC73
 73   SP   [30000]  0          Subscript ——> v field
 74   SA   [30000]  0          Multiplier——>u field
 75   SA   OR7      0          MA ——>Op field
 76   RJ   RL2      RL         Store
 77   RA   PC73     CN15       Modify to pick up next subscript
      CA   PC100

      IA   PC100
100   RA   PC74     CN15       To pick up next multiplier
101   IJ   ER1      PC73
102   TU   PC74     PC105      To pick up modulus
103   RA   PC74     CN15       Set for next time
104   SP   OR10     0          TJ —— 2
105   TP   [30000]  ER1        Save CW (Mod)
106   SA   ER1      0          TJ  CW (Mod)  2
107   SA   OK       0          Complete TJ line

110   RJ   RL2      RL         Store
111   SP   ER1      0          —— CW (Mod) ——
112   SA   OR11     0          DV —— Q
113   RJ   RL2      RL         Store
114   SP   MK       17         Add. rel. 1000 of mod. consts.
115   SA   OR12     0          "SA  CW (Base) 17"
116   RJ   RL2      RL
117   RA   MK       CN1        Modify MK for next time

120   SP   OR13     0          TU  A  1
121   SA   OK       0          Complete line
122   RJ   RL2      RL
123   SP   ER       17         S ——> A "u"
124   AT   PC51     PC51       r + s ——> r
125   TP   CN       A          Clear A and ER
126   TP   A        ER           then jump to form
127   MJ   0        PC134        TP [    ]  A

130   TP   CN1      ER         Single valued. 1 ——> ER "v" (i.e., assume
                                 fixed)
131   TJ   CN13     PC133      Text v, 65000
132   TP   CN       ER         Floating, clear ER "v"
133   LA   A        17         CW ——> A "u"
134   SA   OR       0          TP ——A
135   RJ   RL2      RL         Store
136   SP   OR2      0          RJ  IW  IW
137   RJ   RL2      RL         Store this line
      CA   PC140
```

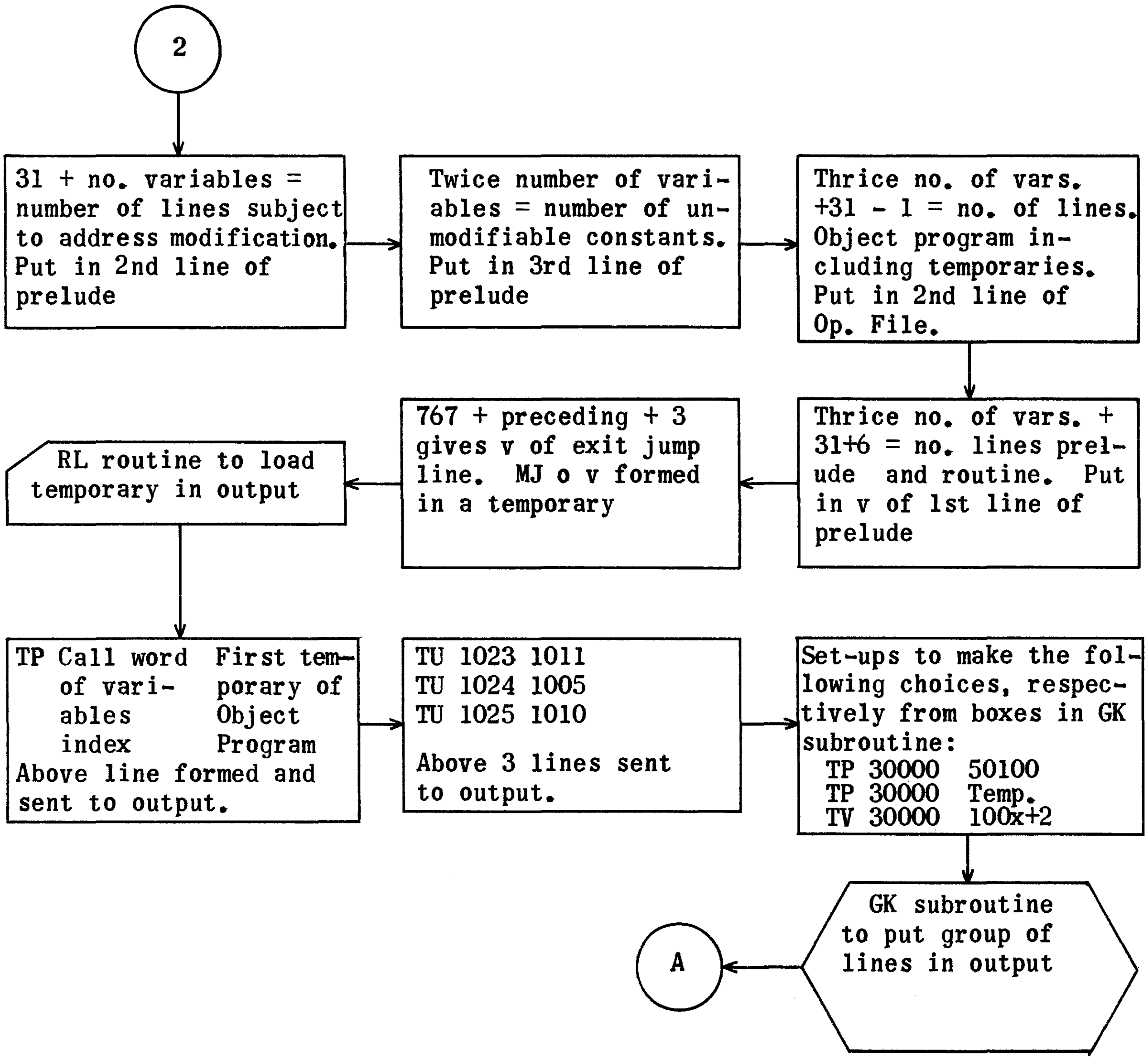
```
     IA   PC140
140  SP   CN16    0          Basic 10-line (10  3  0)
141  SA   ER      0          Plus 0 or 1
142  RJ   ST2     ST
143  RA   PC51    CN15       r + 1 ⟶ r
144  RS   VK      CN1        Vble count decreased by 1
145  ZJ   PC51    PC146
146  SP   NC      0          INC ⟶ A
147  RJ   CS      CS1        Place in const. pool

150  SP   OR4     0          RA  BI  —
151  SA   Q       0          Complete line
152  RJ   RL2     RL         Store
153  SP   CN30    0          BF165 ⟶ A
154  RJ   CS      CS1        Insert in pool
155  TP   OR10    ER
156  TU   A       ER
157  TV   CN12    ER         TJ L(BF165) 1000 formed and put in output

160  SP   ER      0
161  RJ   RL2     RL
162  SP   OR2     0
163  RJ   RL2     RL         RJ  IW  IW to output
164  SP   CN16    0          Basic 10-line
165  SA   CN2     0          Add 2 to complete it
166  RJ   ST2     ST
167  SP   NC1     0          Subinc ⟶ A

170  ZJ   PC171   PC175      Zero?
171  RJ   CS      CS1        No, insert in pool
172  SP   OR4     0
173  SA   Q       0          RA  BI Subinc formed & put in output
174  RJ   RL2     RL
175  TP   OR14    ER
176  TV   CN12    ER         MJ  0  1000  formed in A
177  SP   ER      0
     CA   PC200

     IA   PC200
200  RJ   RL2     RL         Store
201  SP   GL2     17         # heads ⟶ A "u"
202  SA   CN17    0          + 30000
203  TU   A       PC206
204  TU   PC51    PC207
205  TV   PC53    PC207      Transfer heading codes
206  RP   [0]     PC210
207  TP   [30000] [30000]

210  TP   CN31    OP1        Parameter to output handler
211  RJ   OP      OP2        Go output
212  TP   CN15    Q          1 ⟶ Q
213  QS   CN15    WW         Inform processor of "LIST"
```

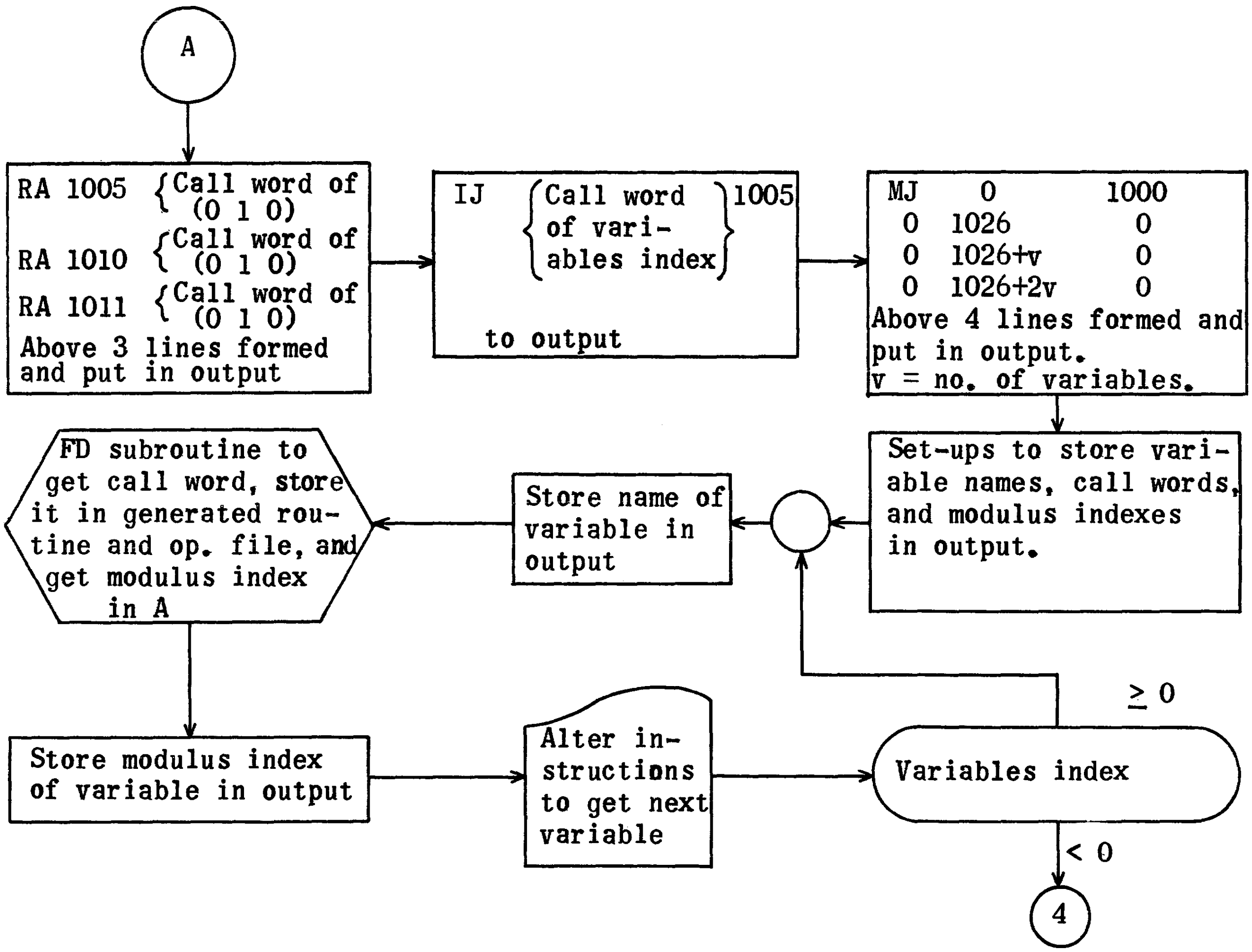
```
214  SP   BK4     0          Tape # CW ---> A
215  TU   RW      PC216
216  RP   [0]     PC220
217  EJ   RW1     PC224      Already in list of CW's?

220  RA   RW      CN33       No, increment index by 1
221  SA   CN34    0          Add [RW]
222  TV   A       PC223
223  TP   BK4     [30000]    And insert in list
224  MJ   0       LI         Exit
     CA   PC225

     IA   RL
  0  RJ   ST2     ST
  1  RA   OK      CN1
  2  MJ   0       [30000]
     CA   RL3

     IA   ST
  0  TP   A       [30000]
  1  RA   ST      CN1
  2  MJ   0       [30000]
     CA   ST3

     IA   OR
  0  TP   0       32000
  1  EJ   NL      1011
  2  RJ   50077   50077
  3  RP   [30000] 1010
  4  RA   BI      0
  5  TV   BI      50077
  6  SP   0       0
  7  MA   0       0

 10  TJ   0       2
 11  DV   0       31000
 12  SA   0       17
 13  TU   32000   1
 14  MJ   0       1
     CA   OR15

     IA   CN
  0  0    0       0
  1  0    0       1
  2  0    0       2
  3  0    0       3
  4  0    0       4
  5  0    0       5
  6  0    0       6
  7  0    0       16

 10  0    0       24
 11  0    0       121
```

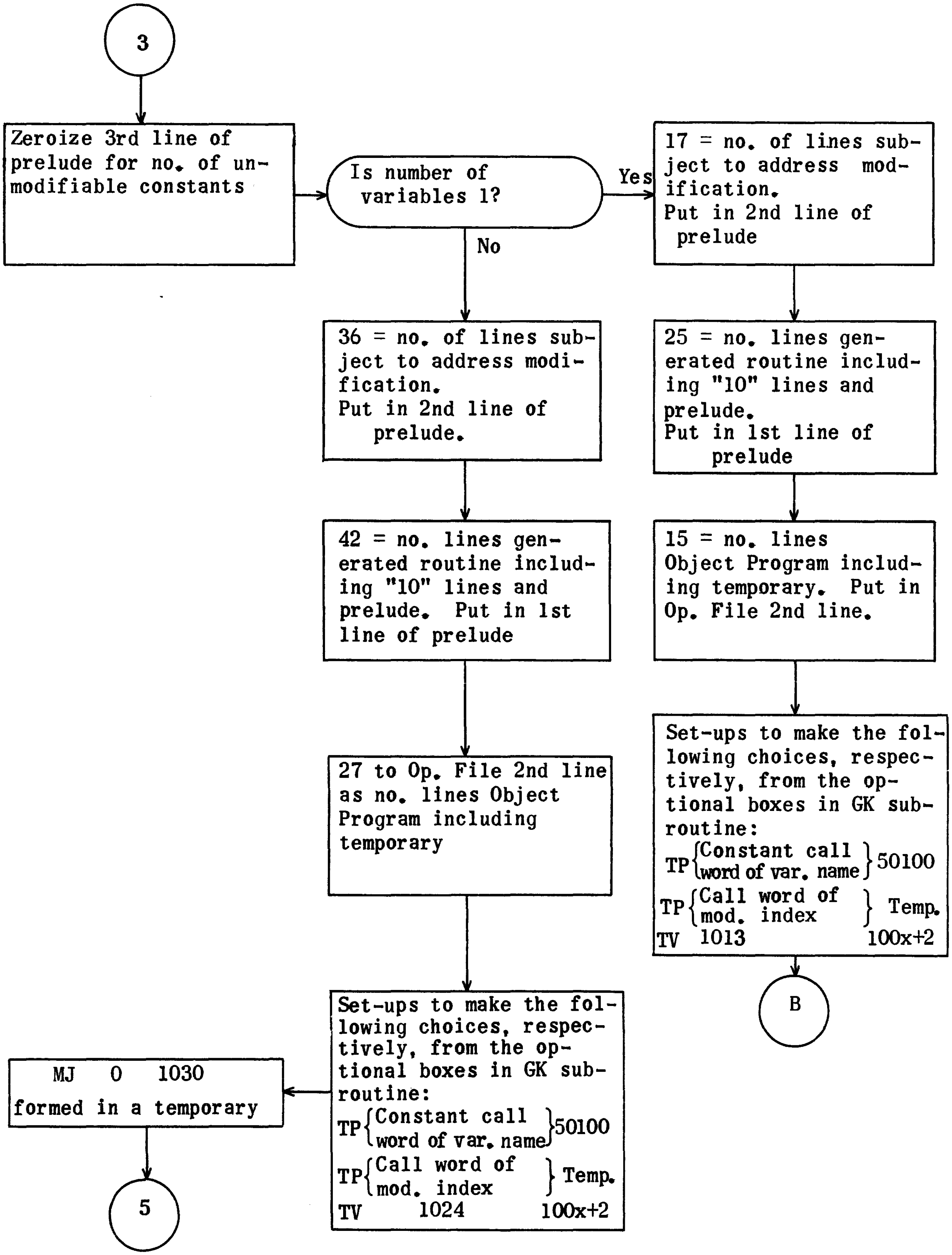
12	0	0	1000
13	0	0	65000
14	0	0	77000
15	0	1	0
16	10	3	0
17	0	30000	BF
20	0	0	77777
21	0	0	NL
22	0	0	TN
23	0	0	GL6
24	0	BK7	FL3
25	0	SL	SL
26	0	MM	MM
27	0	50077	0
30	0	0	1172
31	0	GL	FL
32	10	0	0
33	0	1	1
34	0	0	RW
	CA	CN35	

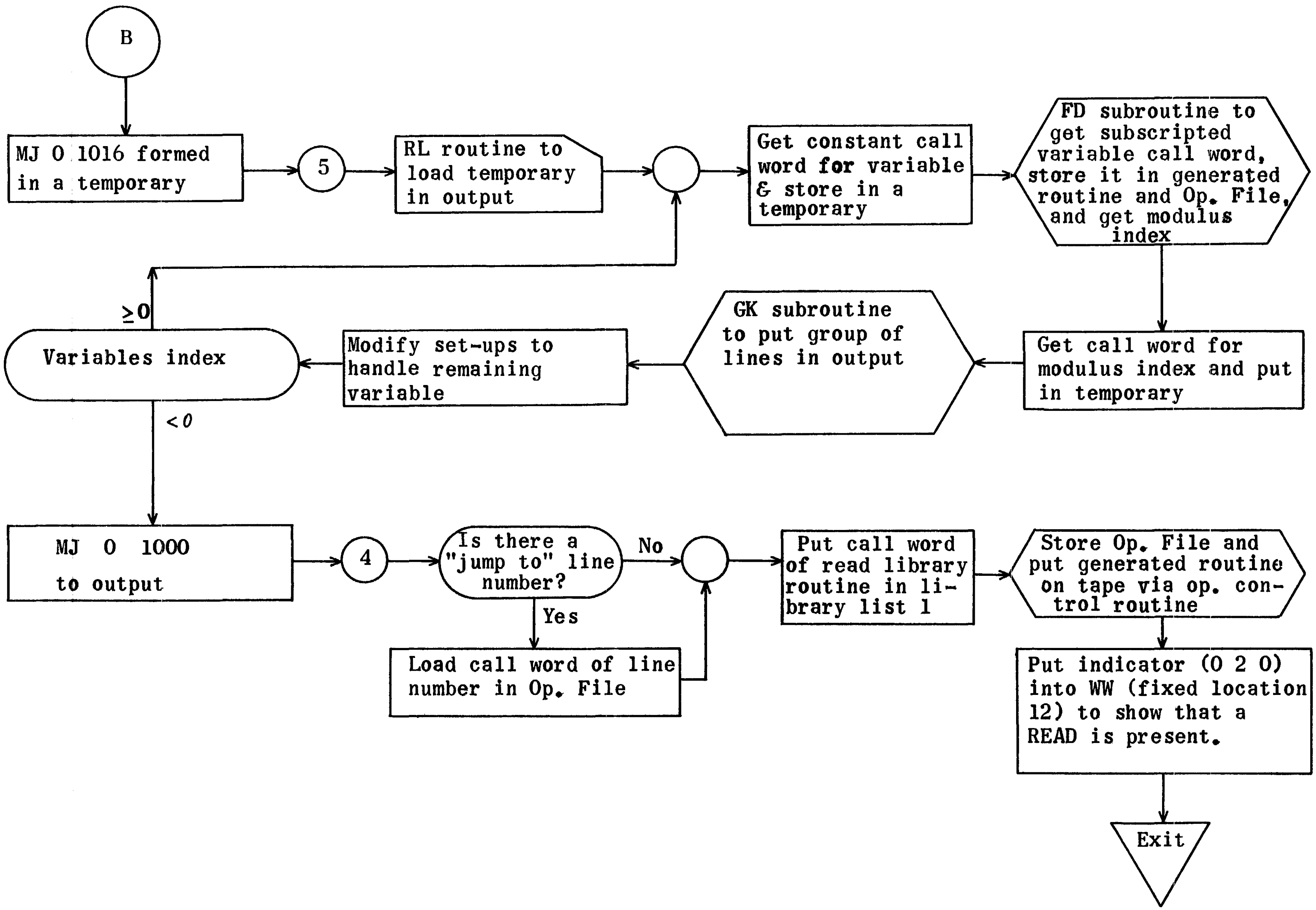
Flow Charts of Read Generator



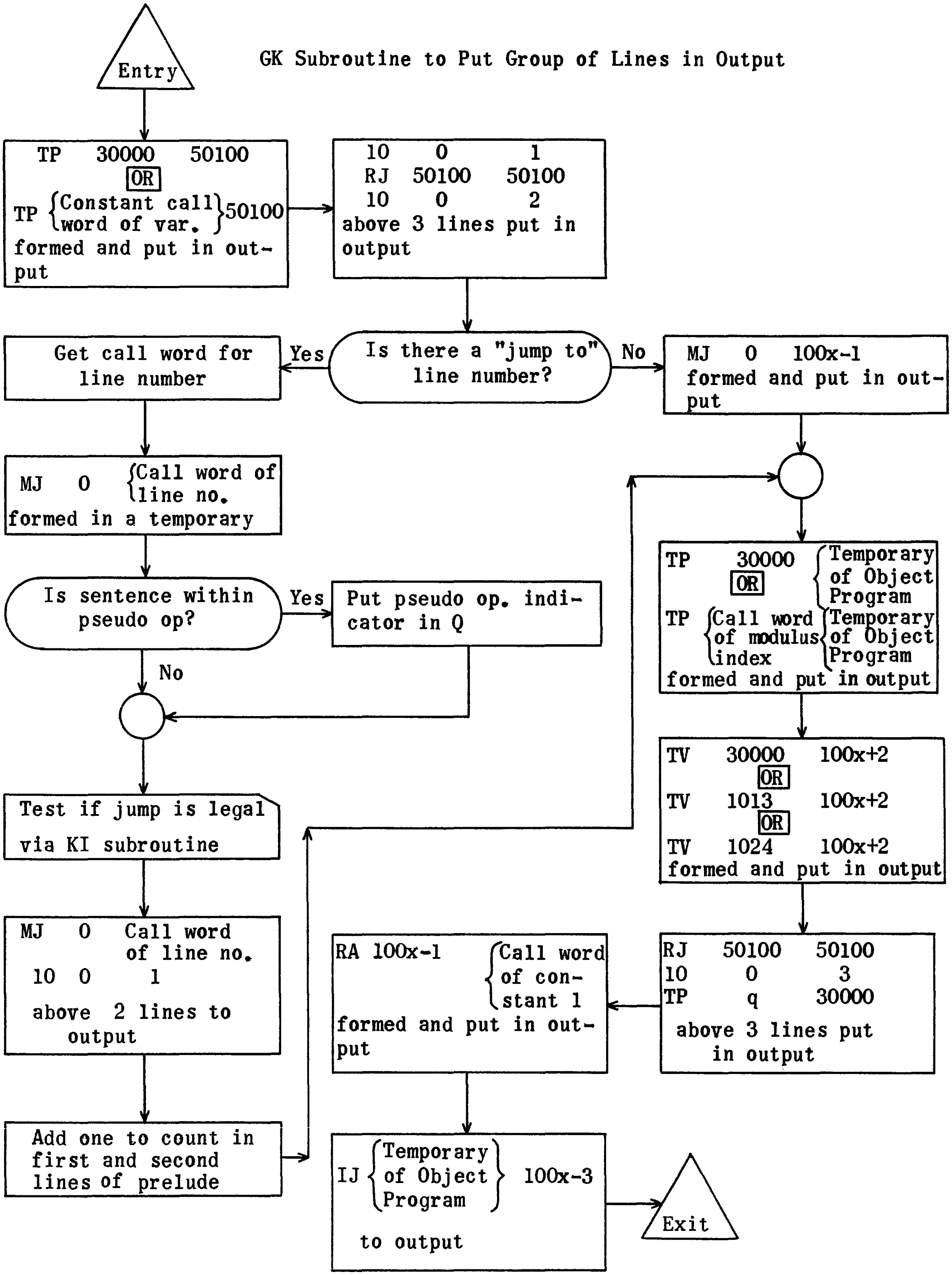

2
31 + no. variables = number of lines subject to address modification. Put in 2nd line of prelude
Twice number of variables = number of unmodifiable constants. Put in 3rd line of prelude
Thrice no. of vars. +31 - 1 = no. of lines. Object program including temporaries. Put in 2nd line of Op. File.
Thrice no. of vars. + 31+6 = no. lines prelude and routine. Put in v of 1st line of prelude
767 + preceding + 3 gives v of exit jump line. MJ o v formed in a temporary
RL routine to load temporary in output
TP Call word of variables index First temporary of Object Program
Above line formed and sent to output.
TU 1023 1011
TU 1024 1005
TU 1025 1010
Above 3 lines sent to output.
Set-ups to make the following choices, respectively from boxes in GK subroutine:
TP 30000 50100
TP 30000 Temp.
TV 30000 100x+2
GK subroutine to put group of lines in output
A


A
RA 1005 {Call word of (0 1 0)
RA 1010 {Call word of (0 1 0)
RA 1011 {Call word of (0 1 0)
Above 3 lines formed and put in output
IJ {Call word of variables index} 1005
to output
MJ 0 1000
0 1026 0
0 1026+v 0
0 1026+2v 0
Above 4 lines formed and put in output.
v = no. of variables.
Set-ups to store variable names, call words, and modulus indexes in output.
Store name of variable in output
FD subroutine to get call word, store it in generated routine and op. file, and get modulus index in A
Store modulus index of variable in output
Alter instructions to get next variable
Variables index
≥ 0
< 0
4

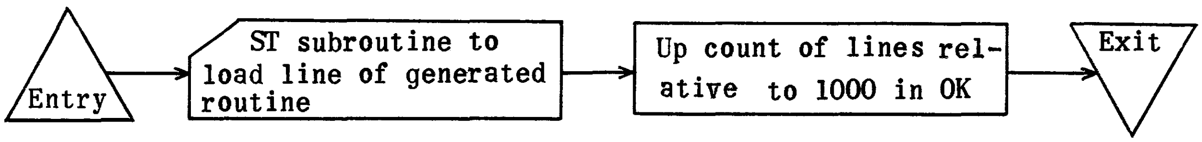

3
Zeroize 3rd line of prelude for no. of unmodifiable constants
Is number of variables 1?
Yes
No
17 = no. of lines subject to address modification.
Put in 2nd line of prelude
36 = no. of lines subject to address modification.
Put in 2nd line of prelude.
25 = no. lines generated routine including "10" lines and prelude.
Put in 1st line of prelude
42 = no. lines generated routine including "10" lines and prelude. Put in 1st line of prelude
15 = no. lines Object Program including temporary. Put in Op. File 2nd line.
Set-ups to make the following choices, respectively, from the optional boxes in GK subroutine:
TP Constant call word of var. name 50100
TP Call word of mod. index Temp.
TV 1013 100x+2
B
27 to Op. File 2nd line as no. lines Object Program including temporary
Set-ups to make the following choices, respectively, from the optional boxes in GK subroutine:
TP Constant call word of var. name 50100
TP Call word of mod. index Temp.
TV 1024 100x+2
MJ 0 1030
formed in a temporary
5


B
MJ 0 1016 formed in a temporary
5
RL routine to load temporary in output
Get constant call word for variable & store in a temporary
FD subroutine to get subscripted variable call word, store it in generated routine and Op. File, and get modulus index
Get call word for modulus index and put in temporary
GK subroutine to put group of lines in output
Modify set-ups to handle remaining variable
Variables index
≥0
<0
MJ 0 1000 to output
4
Is there a "jump to" line number?
No
Yes
Load call word of line number in Op. File
Put call word of read library routine in library list 1
Store Op. File and put generated routine on tape via op. control routine
Put indicator (0 2 0) into WW (fixed location 12) to show that a READ is present.
Exit

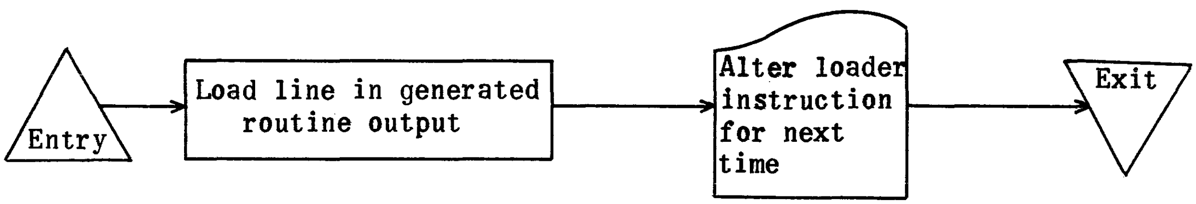
GK Subroutine to Put Group of Lines in Output



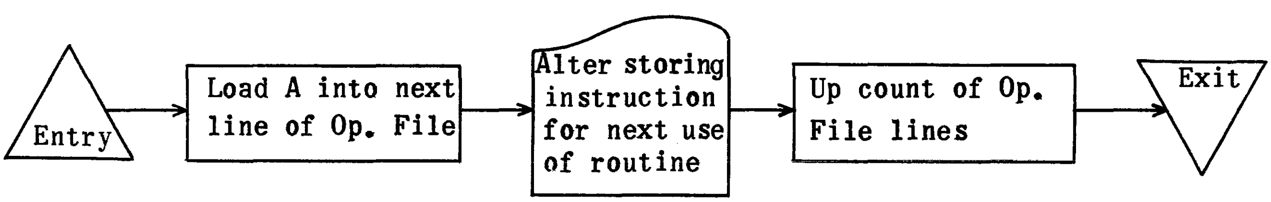
RL Routine to Load Temporary in Output



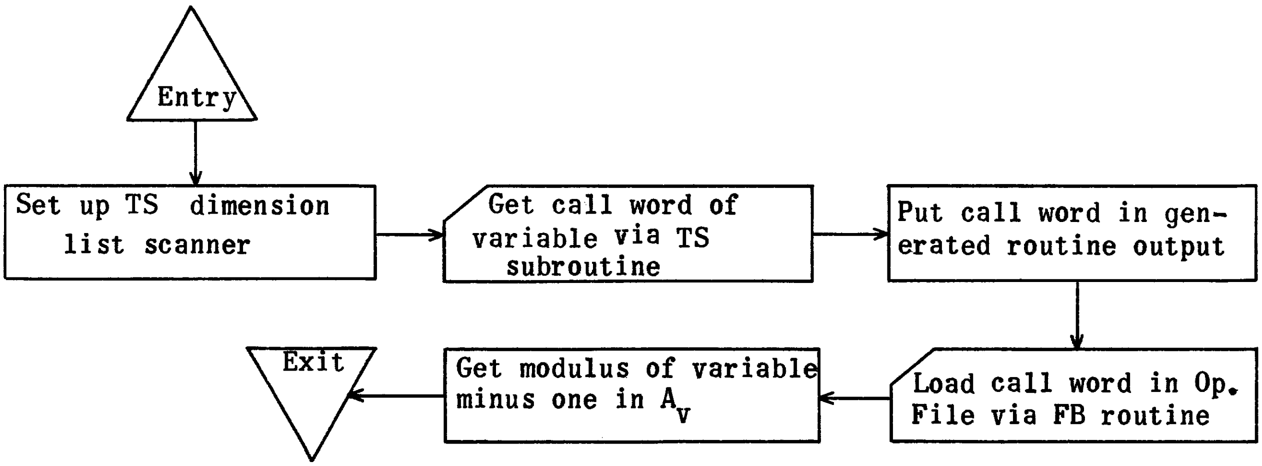
ST Subroutine to Load Lines of Generated Routine



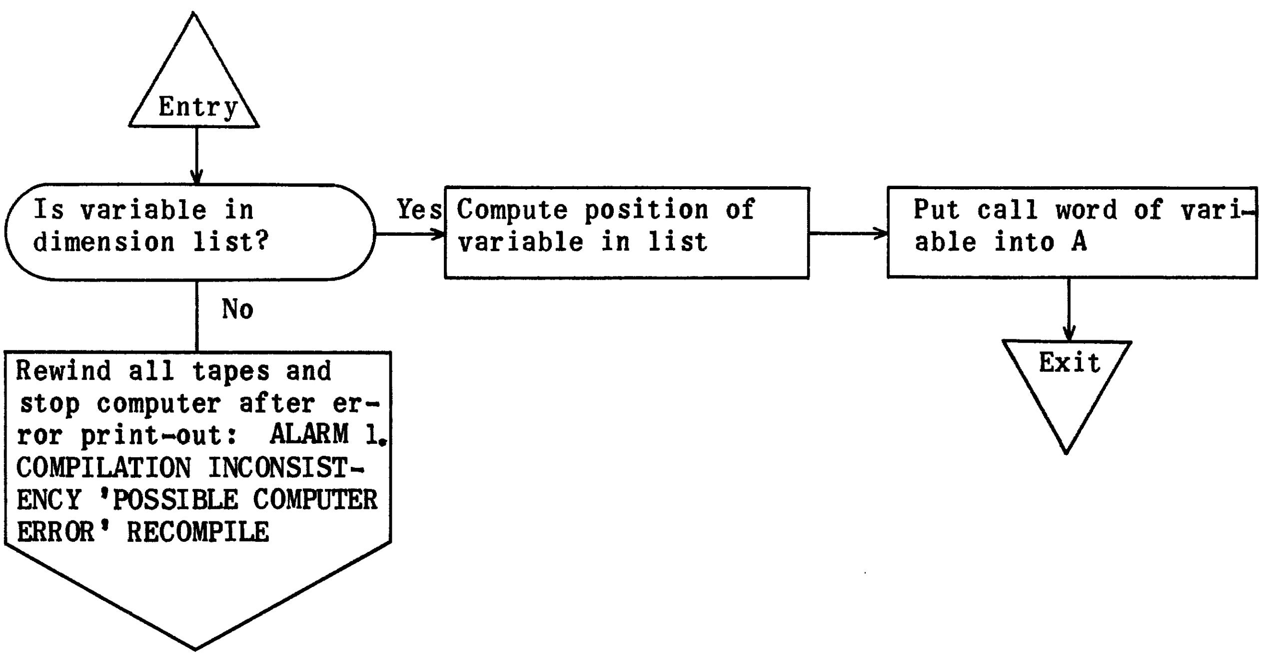
FB Subroutine to Load Op. File



FD Subroutine to Get Call Word of Variable, Store It in Output, Put it in Op. File and Get Modulus Index in A



TS Subroutine to Get Call Word of Subscripted Variable From Dimension List



READ GENERATOR REGIONS

	RE	CS1211	= CW, Call-word subroutine
	RE	LS1465	
	RE	OP1047	
	RE	BR537	
	RE	LW1250	Generation subroutines
	RE	KI1336	
	RE	VX1670	
	RE	BP564	
	RE	BQ632	
	RE	DL40102	Dimension List
	RE	LL47246	= IZ, Referenced-line-number List
	RE	BK2242	Input buffer
	RE	GL5360	Generated routines output buffer
	RE	WW12	Fixed location holding read indicator
Generator + temporaries	RE	RE2512	
	RE	IN2513	
	RE	FW2647	
	RE	GK2726	
	RE	RL3041	
	RE	ST3044	
	RE	FD3047	
	RE	TS3063	
	RE	FB3073	
	RE	CN3077	
	RE	OK3142	
	RE	ER3143	
	RE	FL3150	Where Op File I is built up

READ GENERATOR

```
              IA   RE
              MJ   0       30000        Exit
              CA   RE1

              IA   IN
Entry    0    SP   BK3     17           Call word to 1st line of prelude, GLu
         1    TP   A       GL
         2    TP   A       FL           Call word to 1st line of Op File 1 item
         3    TP   CN      GL3          Clearing input and output lines of prelude
         4    TP   CN      GL4
         5    TP   BK1     GL5          Line number to prelude
         6    TV   CN3     FL           Number (3) to v of 1st line of Op File
         7    TP   CN40    FL2          Call word (50100) to 3rd line of Op File.
                                          Library call word reference
        10    TV   CN31    ST           Initializing ST (load routine) to GL6
        11    TP   CN13    OK           Initializing OK to read  0  0  1000
        12    TV   CN32    FB           Sets up v of FB to FL3
        13    SP   BK4     0            Is there a "jump to" line number in the
        14    ZJ   GK110   IN15           sentence?
        15    SP   BK5     0            Is 3 > number of variables?
        16    TJ   CN3     FW
        17    AT   CN10    GL1          31 + number variables = no. lines subject
                                          to address modification
        20    SP   BK5     1            Number of unmodifiable constants = twice
        21    TP   A       GL2            number of variables
        22    SA   GL1     0            Thrice no. of variables + 31  - 1 = no. of
        23    ST   CN1     FL1            lines of running program including
                                          temporaries
        24    SA   CN4     0            Thrice no. of variables + 31 + 6 = no. of
        25    TV   A       GL             lines prelude and routine
        26    AT   CN12    ER1          767 + above enumeration gives address of
                                          1st temporary of running program
        27    SA   CN3     0             MJ  0  above  formed to make 1st line a
        30    TP   RE      ER                   +3
        31    TV   A       ER              jump to 2nd line of next sentence
        32    RJ   RL2     RL           Line to generated routine output
        33    SP   BK5     0            Getting constant call word for no.
        34    SS   CN1     0              variables minus one
        35    RJ   CS      CS1
        36    TP   CN33    ER           TP  Call Word of      First temp of
        37    TU   A       ER                Variables Index   Object Program
        40    TV   ER1     ER             formed and sent to output
        41    RJ   RL2     RL
        42    TP   CN41    ER           TU  1023  1011  to output
        43    RJ   RL2     RL
        44    RA   ER      BP45
        45    ST   BQ16    ER           TU  1024  1005  to output
        46    RJ   RL2     RL
        47    RA   ER      CN15         TU  1025  1010  to output
        50    RJ   RL2     RL
```

Setups for a sub-routine	51	RP	10003	IN53	00 30000 30000 to 3 temporaries
	52	TP	CN26	GK73	
	53	RA	ER1	CN1	Puts in u and v of ER1 the address of 2nd temporary of Object Program
	54	SP	ER1	17	
	55	AT	ER1	ER1	
	56	RJ	GK72	GK	Puts a succession of lines in output
	57	SP	BP45	0	Gets constant call word for 0 1 0
	60	RJ	CS	CS1	
	61	TP	CN32	ER	RA 1005 Call word of (0 1 0) to output
	62	TU	CN27	ER	
	63	TV	Q	ER	
	64	RJ	RL2	RL	
	65	RA	ER	CN16	RA 1010 Call word of (0 1 0) to output
	66	RJ	RL2	RL	
	67	RA	ER	BP45	RA 1011 Call Word of (0 1 0) to output
	70	RJ	RL2	RL	
	71	TP	CN34	ER	IJ Call word of Variables Index 1005 to output
	72	SP	GL7	17	
	73	TU	A	ER	
	74	TV	GL11	ER	
	75	RJ	RL2	RL	
	76	TP	RE	ER	MJ 0 1000 to output
	77	TV	CN13	ER	
	100	RJ	RL2	RL	
	101	TP	CN1	ER1	1 ⟶ ER1
	102	SP	CN14	17	0 1026 0 to output
	103	TP	A	ER	
	104	RJ	RL2	RL	
	105	SP	BK5	17	0 (1026 + v) 0 to output
	106	AT	ER	ER	
	107	RJ	RL2	RL	
	110	IJ	ER1	IN105	0 (1026 + 2 v) 0 to output
	111	TU	CN31	IN122	Setup to get variables from string-out at BK6
	112	TV	CN33	FD3	Setup to store call words in output at certain location
	113	SP	CN33	0	Setup to store call words at above locat. + v. v = no. variables
	114	SA	BK5	0	
	115	TV	A	IN123	
	116	SA	BK5	0	Setup to store modulus indexes at 1st location + 2 v
	117	TV	A	IN125	
	120	SP	BK5	0	Variables index (v - 1) formed in ER1
	121	ST	CN1	ER1	
	122	TP	30000	ER	Get variable from string-out input.
	123	TP	ER	30000	Store variable as fixed const. in output.
	124	RJ	FD13	FD	Get Dimension List call word of subscripted variable, store in output and Op File, & get modulus - 1 and store in output
	125	TP	A	30000	
	126	RA	IN122	BP45	Modifying instr. to get next variable
	127	RA	IN123	CN1	
	130	RA	IN125	CN1	
	131	RA	FD3	CN1	
	132	IJ	ER1	IN122	Index jump to get remaining variables

	133	MJ	0	FW44	Jump to termination of generation
		CA	IN134		
		IA	FW		
	0	TP	CN	GL2	Zeroize number of unmodifiable constants
	1	TU	CN31	FW25	Setup to scan string-out at BK6, beginning of X3 variable list
	2	TP	RE	ER	MJ 0 ___ to temporary ER
	3	ST	CN1	ER2	Variables index set up in ER2
1 vari-	4	ZJ	FW15	FW5	Is number of variables one?
able	5	TP	CN6	GL1	17 = number of lines subject to address modification
	6	TV	CN27	GL	25 = number of lines generated routine, including "10" lines & prelude
	7	TP	CN5	FL1	15 = Op File count of running program including temporaries
	10	TP	CN17	GK75	0 1013 0 to temporary as address holding call word of variable
	11	TP	CN23	ER1	0 1014 1014 to temporary as address of temporary in Object Program
	12	TV	CN34	FD3	Sets up FD routine to store call word in output
	13	TV	CN30	ER	MJ 0 1016 formed in ER
2 vari-	14	MJ	0	FW24	
ables	15	TP	CN11	GL1	36 = no. of lines subject to address modification
	16	TV	CN36	GL	42 = no. of lines gen. routine incl. 10 lines and prelude
	17	TP	CN7	FL1	27 = Op File count of Object Program lines, incl. temps
	20	TP	CN20	GK75	0 1024 0 to temp. as address holding call word of variable
	21	TP	CN24	ER1	0 1026 1026 to temp. as address of temporary of Object Program
	22	TV	CN35	FD3	Setup FD rtne.to store call word in output
	23	TV	CN37	ER	MJ 0 1030 formed in ER
	24	RJ	RL2	RL	Line to output
	25	TP	30000	ER	Get constant call word for name of subscripted variable and store name in constant pool
	26	TP	ER	A	
	27	RJ	CS	CS1	
	30	TP	A	GK73	Store constant call word in temporary
	31	RJ	FD13	FD	Get Dimension List call word of subscripted variable, store in output & Op. File, and get modulus minus one in A
	32	RJ	CS	CS1	Get call word of modulus - 1 and store in temporary
	33	TP	A	GK74	
	34	RJ	GK72	GK	Put a succession of lines into output
	35	RA	GK75	BP45	Altering instructions to get a remaining variable
	36	RA	FW25	BP45	
	37	RA	FD3	CN1	
	40	IJ	ER2	FW25	Jump back to get a remaining variable
	41	TP	RE	ER	MJ 0 1000 to output
	42	TV	CN13	ER	
	43	RJ	RL2	RL	

Termi- nation	44	SP	BK4	0	Is there a "jump to" line number?
	45	ZJ	FW46	FW50	
	46	SP	ER3	0	Store call word of "jump to" line no. as cross reference in Op. File
	47	RJ	FB3	FB	
	50	SP	CN40	0	Call word referencing read routine in Library put into Library List
	51	RJ	LS	LS1	
	52	TP	CN42	OP1	Op File to storage and generated routine to tape
	53	RJ	OP	OP2	
	54	TP	VX153	Q	Indicator bit (0 2 0) put in WW (fixed location 12) to show a "READ" is present
	55	QS	VX153	WW	
	56	MJ	0	RE	
		CA	FW57		
		IA	GK		
	0	TP	CN33	ER	TP 30000 50100 or TP Constant Call Word of Variable 50100 — formed and put in output. If more than 2 variables, the first; otherwise, the second
	1	TV	CN21	ER	
	2	TU	GK73	ER	
	3	RJ	RL2	RL	
	4	TP	CN25	ER	10 0 1 formed in ER
	5	TV	CN1	ER	
	6	RJ	ST2	ST	Line to output without upping count in OK of lines relative to 1000
	7	TP	CN21	ER	RJ 50100 50100 to output
	10	RJ	RL2	RL	
	11	TP	CN25	ER	10 0 2 to output
	12	TV	CN2	ER	
	13	RJ	ST2	ST	
	14	TP	RE	ER	MJ 0 0 to ER
	15	TP	BK4	A	Is there a "jump to" line no. in sentence?
	16	ZJ	GK76	GK17	
	17	SP	OK	0	MJ 0 100X - 1 to output
	20	SS	CN1	0	
	21	TV	A	ER	
	22	RJ	RL2	RL	
	23	MJ	0	GK32	
	24	RJ	RL2	RL	MJ 0 Call Word of Line No. to output
	25	TP	CN25	ER	10 0 1 to output
	26	TV	CN1	ER	
	27	RJ	ST2	ST	
	30	RA	GL	CN1	Adding one to prelude counts
	31	RA	GL1	CN1	
	32	TP	CN33	ER	TP 30000 or Call Word of Modulus Index — Temporary of Object Program — to output
	33	TU	GK74	ER	
	34	TV	ER1	ER	
	35	RJ	RL2	RL	
	36	TP	CN35	ER	TV {30000 or 1013 or 1024} 100X + 2 to output. More than 2 var., 1 var., or 2 var. setups determine u of generated coding
	37	TU	GK75	ER	
	40	TV	OK	ER	
	~~41~~	~~RA~~	~~ER~~	~~CN2~~	
	42	RJ	RL2	RL	

```
          43   TP   CN21   ER       RJ  50100  50100  to output
          44   RJ   RL2    RL
          45   TP   CN25   ER
          46   TV   CN3    ER       10  0  3  to output
          47   RJ   ST2    ST
          50   TP   CN33   ER
          51   TV   CN26   ER       TP  q  30000  to output
          52   TU   CN30   ER
          53   RJ   RL2    RL
          54   SP   CN1    0        Putting 1 into constant pool and getting
          55   RJ   CS     CS1        its call word into Qv
          56   TP   CN32   ER
          57   SP   OK     0                    Call Word
          60   SS   CN1    17       RA  100X-1   of 1     to output
          61   TU   A      ER
          62   TV   Q      ER
          63   RJ   RL2    RL
          64   TP   CN34   ER
          65   TU   ER1    ER
          66   SP   OK     0        IJ  Temporary of     100X-3  to output
          67   SS   CN3    0            Object Program
          70   TV   A      ER
          71   RJ   RL2    RL
          72   MJ   0      30000    Subroutine exit
          73   0    30000  30000
          74   0    30000  30000    Temporaries used in generation
          75   0    30000  30000
          76   RJ   LW     LW1      Getting call word for line number
          77   TV   Q      ER       MJ  0  Call word of  to ER
                                           Line No.
         100   TP   A      ER3
         101   TP   A      ER4      Storing call word of line no. in 2 temps.
         102   TP   CN22   A
         103   TJ   BK3    GK105    Is call word of sentence > 22777?
         104   TP   GK107  Q        Put a word with U35 filled into Q to show
                                      Pseudo-Op. condition
         105   TP   ER4    A        Call word of line no. to Au
         106   RJ   KI     KI1      Test if jump is legal
         107   MJ   0      GK24
         110   RA   CN35   CN2      Increase excess-3 variable loading address
                                      by 2 to allow for 2 added "ten" lines
         111   RP   20002  IN15     Increase initial loading address of excess-
         112   RA   CN33   CN1        three variables to allow for added "10"
                                      line following jump to line number
               CA   GK113

               IA   RL
Generated 0    RJ   ST2    ST       Loads line into output of generated routine.
 Routine  1    RA   OK     CN1      Ups count of 100X. Ordinal count of number
 Loader                              of generated routine line relative to 1000.
 Plus     2    MJ   0      30000    Does not include "10" lines.
100X           CA   RL3
 Counter
```

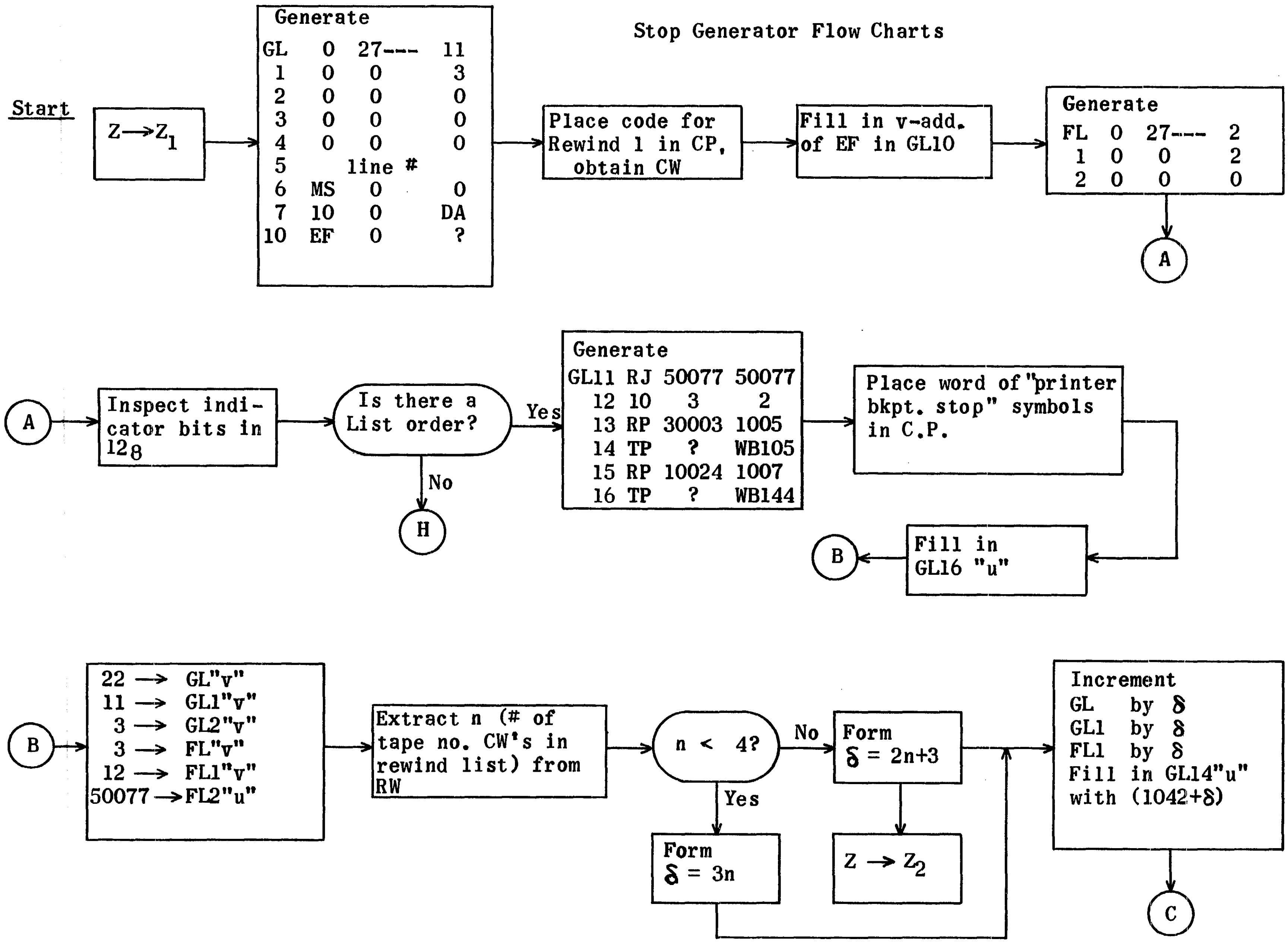
```
                IA   ST
Generated 0     TP   ER      30000     Loads line into output
Routine   1     RA   ST      CN1       Alters loading line for next line of
Line                                   output
Loader    2     MJ   0       30000
                CA   ST3
```

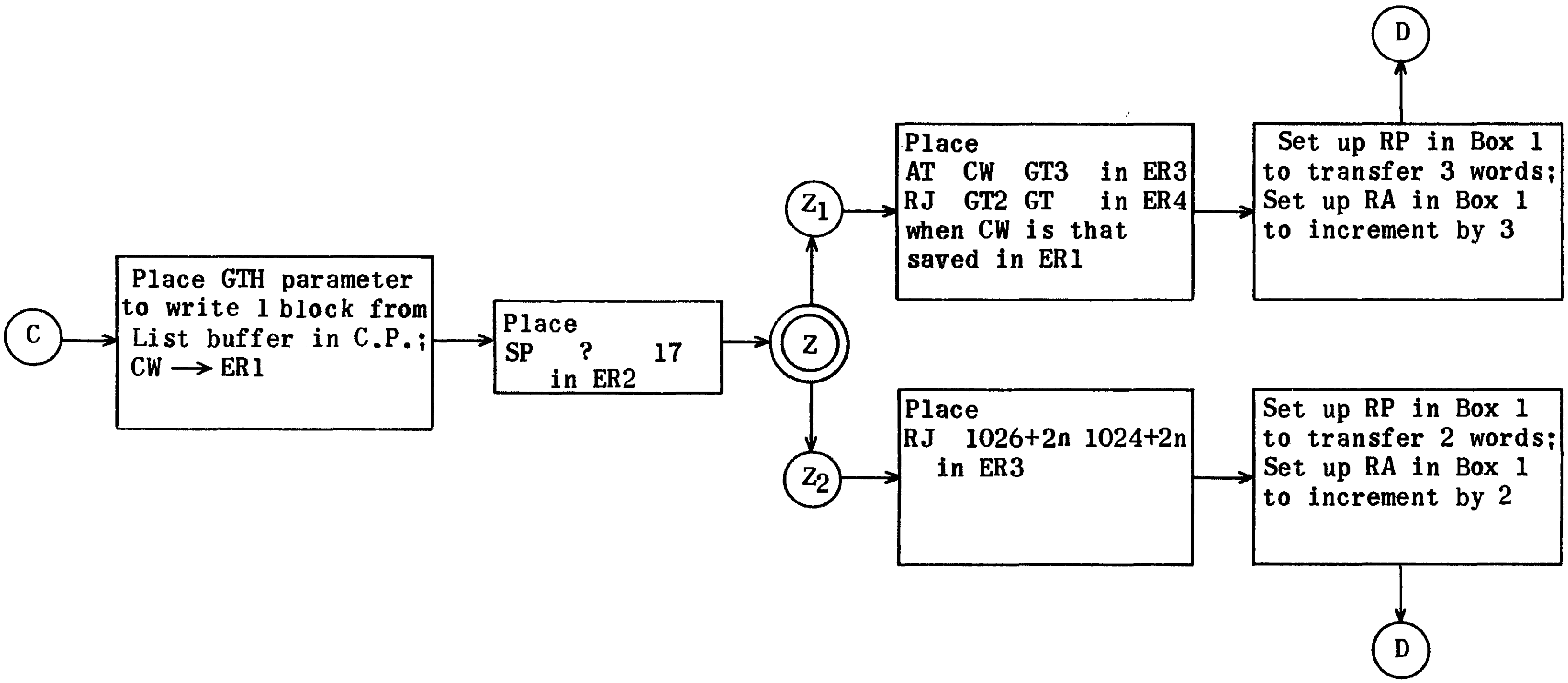
Control Subroutine to get call word of a variable from Dimension List, store it in output and Op File, and get modulus - 1 in A_v

```
                IA   FD
          0     TP   ER      A      }  Get call word of variable from Di-
          1     TU   6       TS     }    mension List
          2     RJ   TS7     TS     }
          3     TP   A       30000     Put call word in output
          4     LA   A       17     }  Put call word in Op File 1
          5     RJ   FB3     FB     }
          6     RA   TS6     BP45   }
          7     TU   A       FD10   }  Extract modulus from Dimension List,
         10     TP   30000   Q      }    subtract one from it, and put into Av
         11     QT   CS35    A      }
         12     SS   BP45    71     }
         13     MJ   0       30000
                CA   FD14

Get Call        IA   TS
Word of   0     RP   0       BR1    }  If variable is not in list, computer
a vari-   1     EJ   DL      TS2    }    stops after a rewind of tapes and
able in                                  print-out:  ALARM 1 COMILATION
Dimen-                                   INCONSISTENCY'POSSIBLE COMPUTER ERROR'
sion List 2     SN   Q       17     }    RECOMPILE
          3     SA   TS      0      }
          4     SA   TS1     0      }  Computing position of variable in list
          5     TU   A       TS6    }    and getting call word of it into A
          6     TP   30000   A      }
          7     MJ   0       30000
                CA   TS10

Load            IA   FB
Op        0     TP   A       30000     Storing line in Op File
File 1    1     RA   FB      CN1       Increase storing order
          2     RA   FL      CN1       Up count of number of lines
          3     MJ   0       30000
                CA   FB4

Constants       IA   CN
and       0     0    0       0
Dummy     1     0    0       1
Commands  2     0    0       2
Used to   3     0    0       3
Make up   4     0    0       7
Generated 5     0    0       15
Routine   6     0    0       17
          7     0    0       27
```

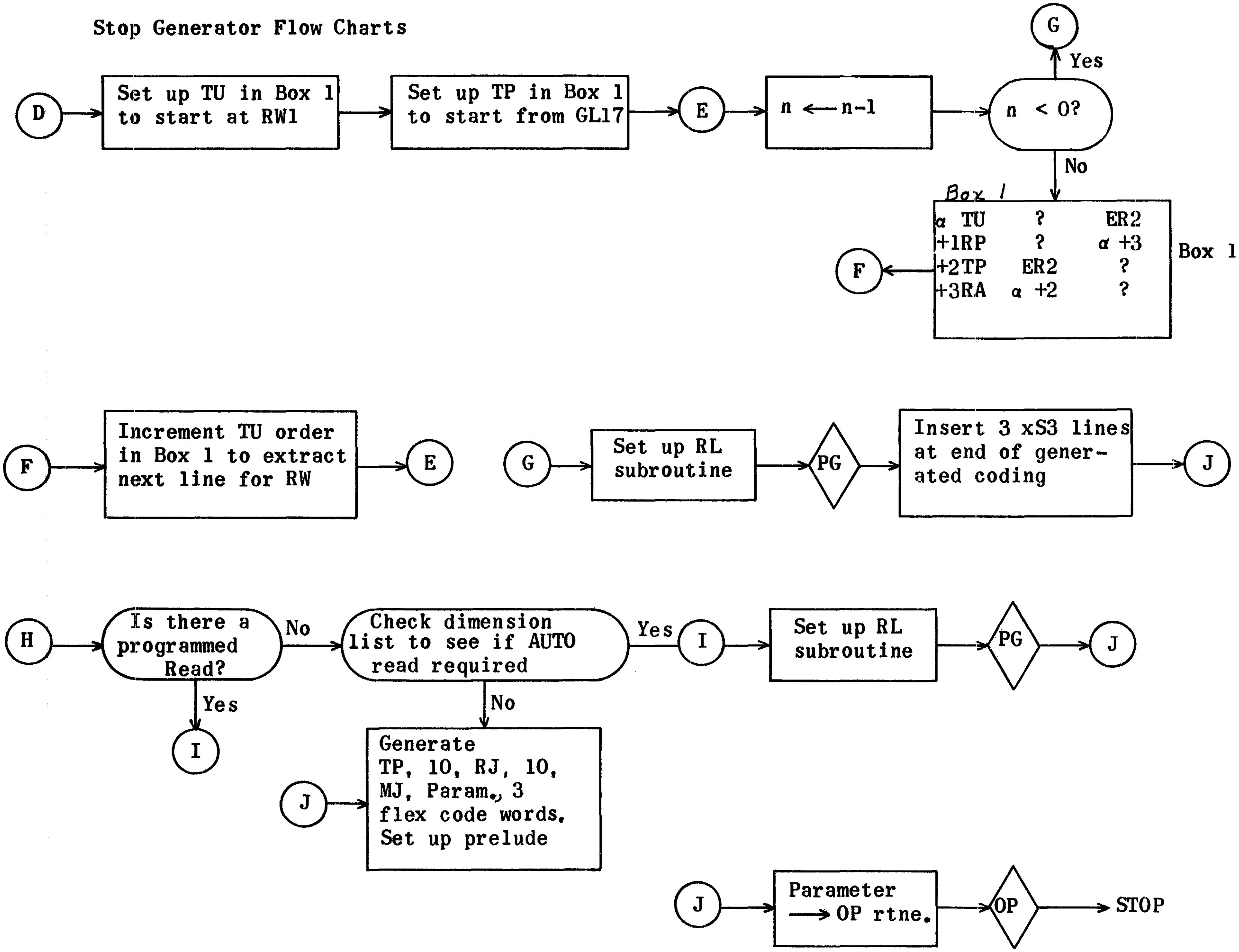
	10	0	0	31	
	11	0	0	34	
	12	0	0	767	
	13	0	0	1000	
	14	0	0	1026	Address holding call word of 1st variable for more-than-2-variable case
	15	0	1	3	
	16	0	3	0	
	17	0	1013	0	Address holding call word of variable for 1-variable case
	20	0	1024	0	Address holding call word of 1st variable for 2-variable case
	21	RJ	50100	50100	
	22	0	0	22777	
	23	0	1014	1014	Address of temporary of Object Program for 1-variable case
	24	0	1026	1026	Address of temporary of Object Program for 2-variable case
	25	10	0	0	
	26	0	30000	30000	
	27	0	1005	25	
	30	0	Q	1016	
	31	0	BK6	GL6	
	32	RA	DL	FL3	DL is initial location of Dimension List
When more	33	TP	LL	GL37	
than 2	34	IJ	0	GL24	GL24 is loading address of variable when only one
vars.,					
GL37 is	35	TV	0	GL40	GL40 is initial loading addr. of variables when there are two
initial					
loading	36	0	0	42	
address	37	0	0	1030	
of X3	40	0	50100	0	Call word of Read permanent library routine
names	41	TU	1023	1011	
	42	0	GL	FL	
		CA	CN43		

Stop Generator Flow Charts

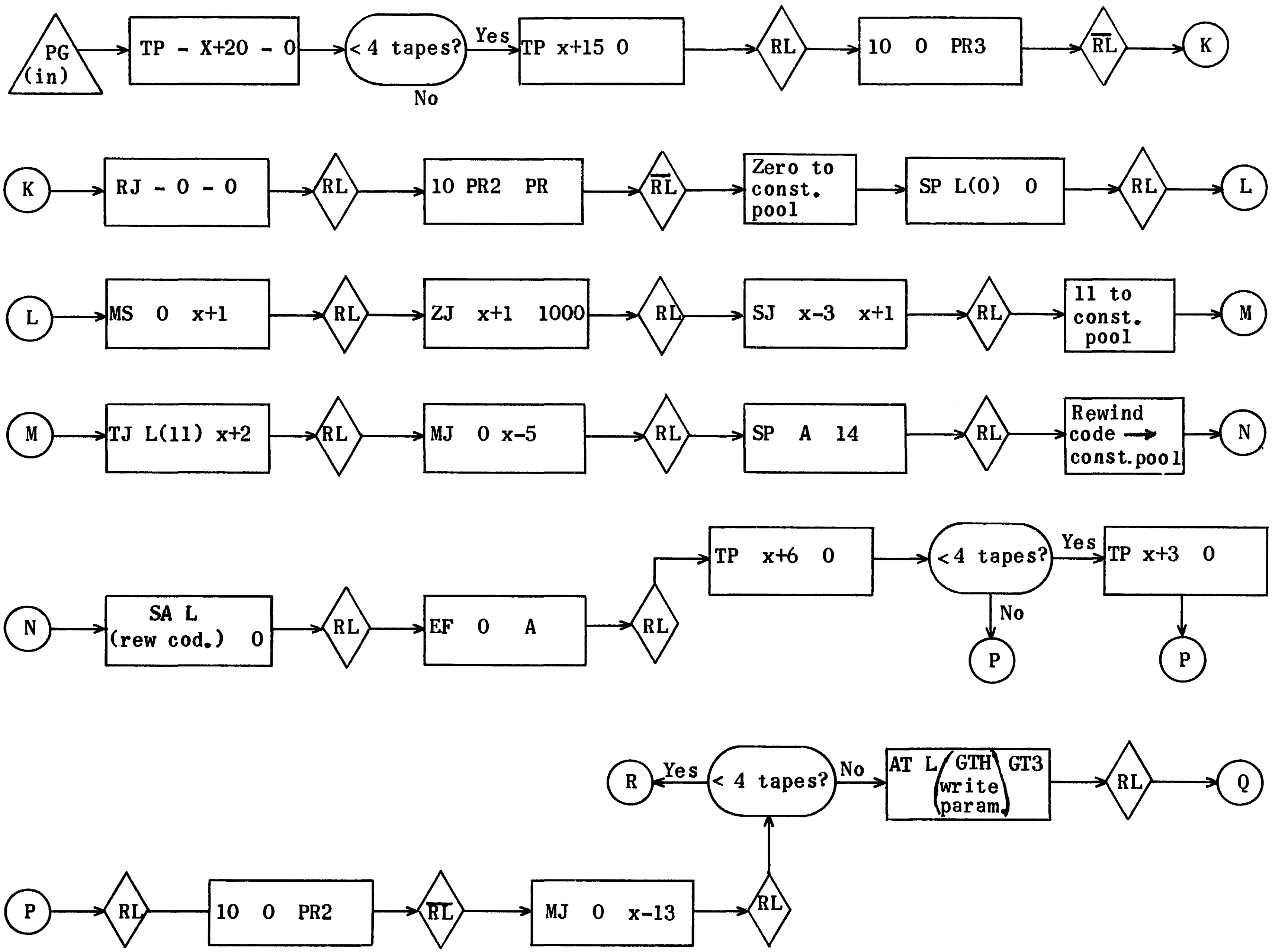



C
Place GTH parameter to write 1 block from List buffer in C.P.; CW → ER1
Place SP ? 17 in ER2
Z
Z1
Place AT CW GT3 in ER3 RJ GT2 GT in ER4 when CW is that saved in ER1
Set up RP in Box 1 to transfer 3 words; Set up RA in Box 1 to increment by 3
D
Z2
Place RJ 1026+2n 1024+2n in ER3
Set up RP in Box 1 to transfer 2 words; Set up RA in Box 1 to increment by 2
D

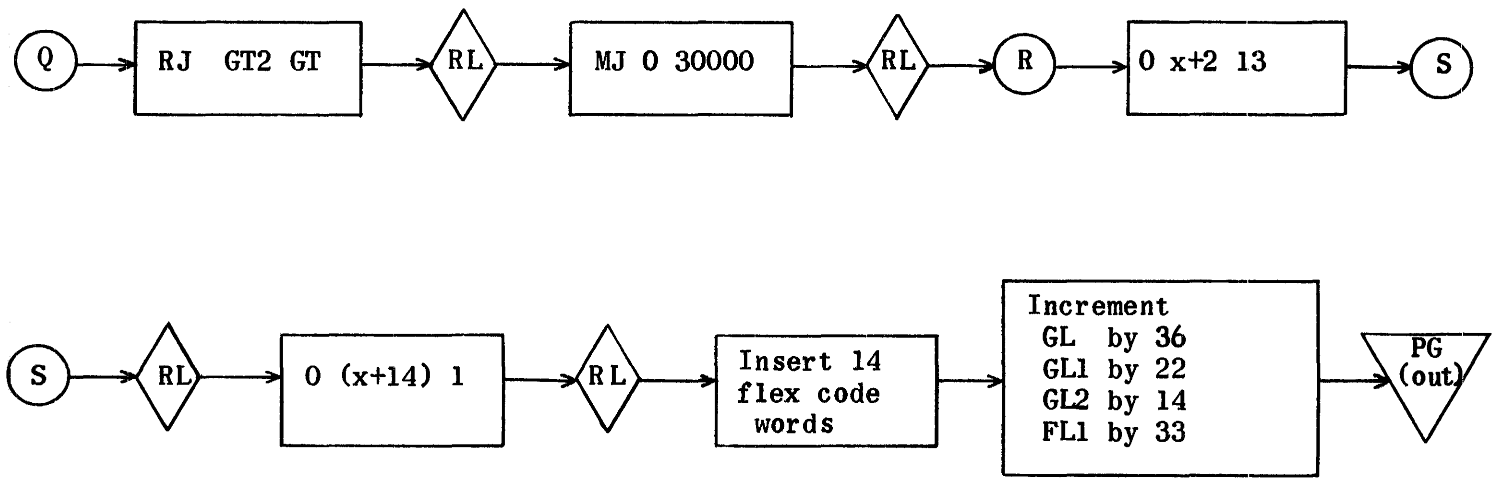
Stop Generator Flow Charts



Stop Generator Flow Charts



Stop Generator Flow Charts



In above routine X = address rel. 1000 of order currently being generated

STOP GENERATOR REGIONS

Generation Subroutines	RE	CS1211	Call word routine (= CW)
	RE	BR537	Machine error print-out routine
	RE	OP1047	Op control routine
	RE	DL40102	Dimension List
	RE	BK2242	Buffer input region
	RE	GL5360	Buffer output region for generated routine
	RE	RW50023	Rewind list of call words of tape no.'s referenced by read and list instructions
	RE	WW12	Fixed location of read, list indicator
	RE	ST2512	Stop Generator
	RE	SG2513	
	RE	HT2513	
	RE	PG2702	
	RE	RL3017	
	RE	CN3024	
	RE	ER3137	Temporaries
	RE	FL3144	Where Op File I is built
	RE	DA77300	Object Program service routine
	RE	PR77250	UNICODE print-out routine
	RE	GT210	Object program tape handler
	RE	WB71005	List buffer (170)
	RE	IW50077	Call word for LIST permanent library routine

STOP GENERATOR

```
       IA   ST
       MJ   0       30000     Exit
       CA   ST1

       IA   SG
HT 0   TP   CN      HT166     Set indicator to zero
   1   RP   10005   HT3       Zeroize 5 lines of GL
   2   TP   CN      GL
   3   SP   BK3     0
   4   LA   A       17        Call word
   5   TU   A       GL
   6   TV   CN4     GL        11 --> GL "v"
   7   TV   CN2     GL1       3 --> GL1 "v"
  10   TP   BK1     GL5       Line number
  11   RP   30003   HT13      MS, "10" line, EF
  12   TP   CN32    GL6
  13   SP   CN27    0         Rew. 1 code
  14   RJ   CS      CS1
  15   TV   Q       GL10      Fill in EF "v"
  16   RP   10003   HT20      Zeroize 3 lines for Op File item
  17   TP   CN      FL
  20   TV   CN24    FL        2 --> FL "v"
  21   TV   CN24    FL1       2 --> FL1 "v"
  22   SP   BK3     0         Call word
  23   LA   A       17
  24   TU   A       FL
  25   TP   WW      Q         I/O indicator word
  26   QT   CN17    A         Is there a list?
  27   ZJ   HT30    HT125
  30   RP   30006   HT32      RJ, 10, RP, TP, RP, TP
  31   TP   CN35    GL11
  32   SP   CN30    0         Stop word to constant pool
  33   RJ   CS      CS1
  34   TU   A       GL16      Fill in TP2 "u"
  35   TV   CN7     GL        22 --> GL "v"
  36   TV   CN4     GL1       11 --> GL1 "v"
  37   TV   CN2     GL2       3 --> GL2 "v"
       CA   SG40

       IA   SG40
  40   TV   CN2     FL        3 --> FL "v"
  41   TV   CN5     FL1       12 --> FL1 "v"
  42   TU   CN35    FL2       IW  CW --> FL2 "u"
  43   TP   CN12    Q         Mask for n from RW list
  44   QT   RW      ER        Extract # tape call words (n)
  45   TP   A       ER1       n --> ER1
  46   TJ   CN3     HT51      Test v < 4
  47   TP   CN25    HT166     4 or more, set indicator to large no.
  50   TP   CN2     ER1       3 --> ER1
```

```
 51   SP   A        1         2n
 52   AT   ER1      ER1       Form inc. for prelude (3n or 2n + 3)
 53   SA   CN15     17        Add 1042, form (1042 + 3n, 1045 + 2n)
 54   TU   A        GL14      Fill in TP2 "u"
 55   RA   GL       ER1     }
 56   RA   GL1      ER1     } Increment prelude counters
 57   RA   FL1      ER1     }
 60   SP   CN31     0         General GTH parameter to write 1 block
 61   RJ   CS       CS1       to C.P.
 62   TP   A        ER1       Save it
 63   TP   PG       ER2       SP——17——>ER2
 64   IJ   HT166    HT73      How many tapes?
 65   TP   CN100    ER3       < 4;  AT —— GT3 ——> ER3
 66   TU   ER1      ER3             AT   L(GTHp)   GT3 —— ER3
 67   TP   CN101    ER4             RJ   GT2   GT ——> ER4
 70   TU   CN37     HT106     Set up RP to write 3 words
 71   TV   CN112    HT110     Set up RA to inc. by 3
 72   MJ   0        HT101     Jump
 73   SP   ER       1         4 or more tapes; 2n ——>A
 74   AT   CN14     ER3       Add 1024 ——> 1024 + 2n in ER3 "v"
 75   SA   CN24     17        Add  0  37  2 ——> RJ  1026 + 2n   ?  in A
 76   AT   ER3      ER3       Complete order
 77   TU   CN40     HT106     Set up RP to write 2 words
      CA   SG100

      IA   SG100
100   TV   CN105    HT110     Set up RA to inc. by 2
101   TU   CN42     HT105     Set up TU order to start at RW1
102   TV   CN103    HT107     Start at GL17
103   IJ   ER       HT105     Count down on n index
104   MJ   0        HT113     Exit
105   TU   [30000]  ER2       Complete SP order
106   RP   [0]      HT110
107   TP   ER2      [30000]
110   RA   HT107    [30000]
111   RA   HT105    CN17      Increase by 1 "u"
112   MJ   0        HT103
113   TV   HT107    RL1       Now HT 103 "v" holds next address in GL
114   RS   HT107    CN103     Subtract GL17
115   SA   CN41     0         Add 1007
116   TP   CN       RL4       Zeroize RL4
117   TV   A        RL4       And set it up (add. rel. 1000)
120   RJ   PG114    PG        Execute PG coding
121   TV   RL1      HT124
122   RA   HT124    CN6       Increment by 14
123   RP   30003    HT163   } Insert XS3 - "END OF OUTPUT"
124   TP   CN106    30000   }   then go to conclusion
125   QT   CN20     A       } No list - how about a programmed Read?
126   ZJ   HT151    HT127   }
127   TP   CN       ER        No. prog. Read - investigate auto-read
130   TV   6        ER        Set up ER with #77 CW's
131   TP   CN16     ER1       77000 is 1st CW
```

```
132   TU   6        HT136    Set up RP
133   IJ   ER       HT135    Count down on index
134   MJ   0        HT155    Exit - no auto-read
135   SP   ER1      0
136   RP   [0]      BR1
137   EJ   DL       HT140
      CA   SG140

      IA   SG140
140   SN   Q        17
141   SA   HT136    0
142   SA   HT137    0
143   TU   A        HT144
144   TP   [30000]  Q
145   QT   CN25     A        Inspect X
146   ZJ   HT147    HT151    If zero, auto-read
147   RA   ER1      CN1      No - prepare to search for next CW
150   MJ   0        HT133
151   TV   CN102    RL1      Read coding - prepare to gen. coding
152   TP   CN13     RL4      Gen from GL11, add entr --> 1002
153   RJ   PG114    PG       Execute PG coding
154   MJ   0        HT163    Go to conclusion
155   RP   30011    HT157    NO READ, NO LIST
156   TP   CN55     GL11
157   TV   CN7      GL       22 --> GL "v"
160   TV   CN4      GL1      11 --> GL1 "v"
161   TV   CN2      GL2      3  --> GL2 "v"
162   TV   CN4      FL1      11 --> FL1 "v"
163   TP   CN77     OP1      Conclusion - parameter to Op
164   RJ   OP       OP2
165   MJ   0        ST       Exit
166   0    0        0        Indicator word
      CA   SG167
```

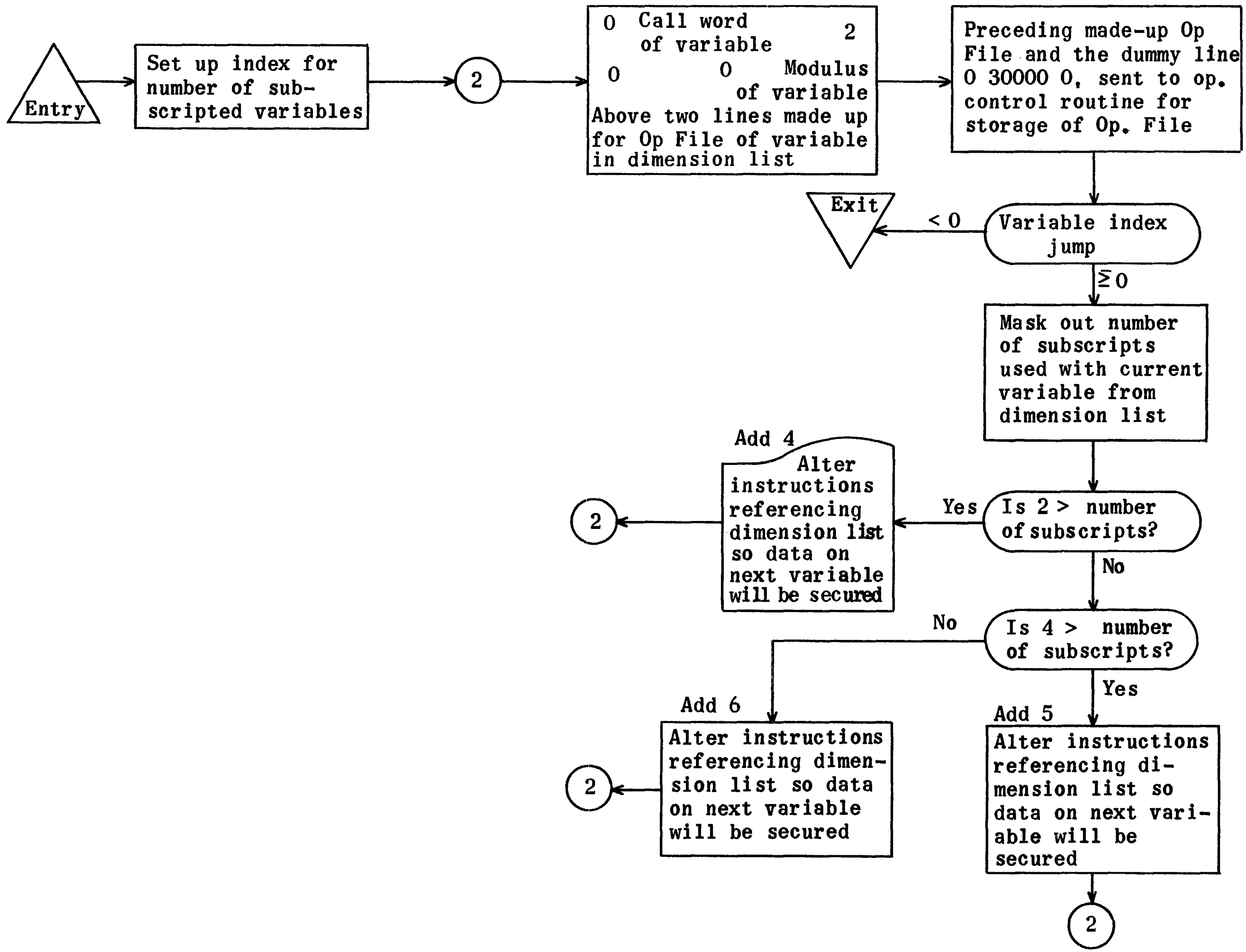
```
        IA   SG167
PG  0   SP   RL4     17      Add. entr. → A "u"
    1   AT   CN43    ER      Add  TP  20  0
    2   IJ   HT166   PG4     Or  <  4 tapes?
    3   RS   ER      CN22    Yes, subtract 3 "u"
    4   RJ   RL3     RL      Store this running line
    5   TP   CN56    ER      10  0  PR3
    6   RJ   RL3     RL1     Store this 10 line
    7   TP   CN57    ER      RJ  0  0

   10   RJ   RL3     RL      Store this running line
   11   TP   CN60    ER      10  PR2  PR
   12   RJ   RL3     RL1       to output
   13   SP   CN      0       Clear A
   14   RJ   CS      CS1     → Constant Pool
   15   TP   HT13    ER
   16   TU   A       ER      SP  1(0)  0 to output
   17   RJ   RL3     RL

   20   SP   RL4     0       Add entr. → A "v"
   21   AT   CN44    ER      Add  MS  0  1
   22   RJ   RL3     RL      Store this running line
   23   SP   RL4     17      Add entr. → A "u"
   24   AT   CN45    ER      Add  ZJ  1  1000
   25   RJ   RL3     RL      Store it
   26   SP   RL4     17      Entr. → A "u"
   27   SA   RL4     0       and A "v"

   30   AT   CN46    ER      Add  45  77775  00001
   31   RJ   RL3     RL      Store this (SJ line)
   32   SP   RL4     0       Entr. → A "v"
   33   AT   CN47    ER      Add TJ — 2
   34   SP   CN111   0       11_10 → A
   35   RJ   CS      CS1     → Constant Pool
   36   TU   A       ER      TJ  L(11)  X + 2
   37   RJ   RL3     RL      Store this
        CA   SG227

        IA   SG227
   40   SP   RL4     0       Entr. → A "v"
   41   AT   CN50    ER      Add  44  77777  77773 → MJ line
   42   RJ   RL3     RL      Store it
   43   TP   CN51    ER      SP  A  14
   44   RJ   RL3     RL      Store it
   45   SP   CN26    0       Rewind code → A
   46   RJ   CS      CS1     → C.P. (Constant Pool)
   47   TP   HT115   ER      SA — 0

   50   TU   A       ER
   51   RJ   RL3     RL      Store it
   52   TP   CN34    ER      EF  0  A
   53   RJ   RL3     RL      Store it
   54   SP   RL4     17      Add entr. → A "u"
```

```
 55   AT   CN52    ER         Add TP  6  0
 56   IJ   HT166   PG60       or less than 4?
 57   RS   ER      CN22       Yes - subtract 3 "u"

 60   RJ   RL3     RL         Store it
 61   TP   CN56    ER         10  0  PR3
 62   RJ   RL3     RL1        Store this 10 line
 63   SP   RL4     0          Add entr. —> A "v"
 64   AT   CN53    ER         Add  44  77777  77765 ( ⇒ MJ)
 65   RJ   RL3     RL         Store it
 66   IJ   HT166   PG70       How many tapes?
 67   MJ   0       PG77        < 4 - jump

 70   TP   CN100   ER         AT —— GT3
 71   TU   ER1     ER         AT  CW(Write param.) GT3
 72   RJ   RL3     RL         Store it
 73   TP   CN101   ER         RJ  GT2  GT
 74   RJ   RL3     RL         Store it
 75   TP   CN54    ER         MJ  0  30000
 76   RJ   RL3     RL         Store it
 77   SP   RL4     17         Add entr. —> A "u"
      CA   SG267

      IA   SG267
100   AT   CN21    ER         Add  0  2  13
101   RJ   RL3     RL         Store it
102   SP   RL4     17         Entr. —> A "u"
103   AT   CN23    ER         Add  0  14  1
104   RJ   RL3     RL         Store it
105   TV   RL1     PG107      Extract address in GL list
106   RP   30014   PG110   }
107   TP   CN63    [30000] }  Insert Flex codes

110   RA   GL      CN11       Inc. GL "v" by 36_8
111   RA   GL1     CN7        Inc. GL1 "v" by 22_8
112   RA   GL2     CN6        Inc. GL2 "v" by 14_8
113   RA   FL1     CN10       Inc. FL1 "v" by 33_8
114   MJ   0       [30000]    Exit
      CA   SG304

      IA   SG304
RL 0  RA   RL4     CN1
   1  TP   ER      [30000]
   2  RA   RL1     CN1
   3  MJ   0       [30000]
   4  [0   0       0]
      CA   SG311
```

```
        IA   SG311
CN 0    0    0        0
   1    0    0        1
   2    0    0        3
   3    0    0        4
   4    0    0        11
   5    0    0        12
   6    0    0        14
   7    0    0        22

  10    0    0        33
  11    0    0        36
  12    0    0        77
  13    0    0        1002
  14    0    0        1024
  15    0    0        1042
  16    0    0        77000
  17    0    1        0
  20    0    2        0
  21    0    2        13
  22    0    3        0
  23    0    14       1
  24    0    37       2         RJ in "u"
  25    7    0        0
  26    2    200      0         General rewind
  27    2    200      10000     Rewind #1

  30    0    61616    16161     Breakpoint stop word
  31    74   20100    1005      Parameter to write 1 block from list buffer
  32    MS   0        0
  33    10   0        DA
  34    EF   0        A
  35    RJ   IW       IW
  36    10   3        2
  37    RP   30003    1005
        CA   SG351

        IA   SG351
  40    TP   30002    WB105
  41    RP   10024    1007
  42    TP   RW1      WB144
  43    TP   20       0
  44    MS   0        1
  45    ZJ   1        1000
  46    45   77775    00001
  47    TJ   0        2
  50    44   77777    77773
  51    SP   A        14
  52    TP   6        0
  53    44   77777    77765
  54    MJ   0        30000
  55    TP   1005     0
  56    10   0        PR3
  57    RJ   0        0
```

```
60    10    PR2      PR
61    MJ    0        1000
62    0     1006     3
63    45    47200    62204     cr ↑ ENDΔ
64    03    26041    23406     OFΔ RUN
65    45    45000    00000     cr cr ______
66    01    03041    22031     TO Δ REW
67    14    06220    41454     IND Δ I/

70    03    04013    01520     0 Δ TAPE
71    24    04242    00104     SΔ SETΔ
72    24    20121    70304     SERVO Δ
73    06    03041    40604     NO Δ IN Δ
74    30    04051    40104     A Δ HIT Δ
75    24    01301    20157     START ↓
76    45    22140    10103     cr ditto
77    0     GL       FL
      CA    SG411

      IA    SG411
100   AT    0        GT3
101   RJ    GT2      GT
102   0     0        GL11
103   0     0        GL17
104   0     0        2
105   0     0        CN104     L(2)
106   30    50270    15131     ENDΔOF
107   01    51676    65267     ΔOUTPU
110   66    22010    10101     T. ∧‾‾∧
111   0     0        13
112   0     0        CN2       L(3)
      CA    SG424
```

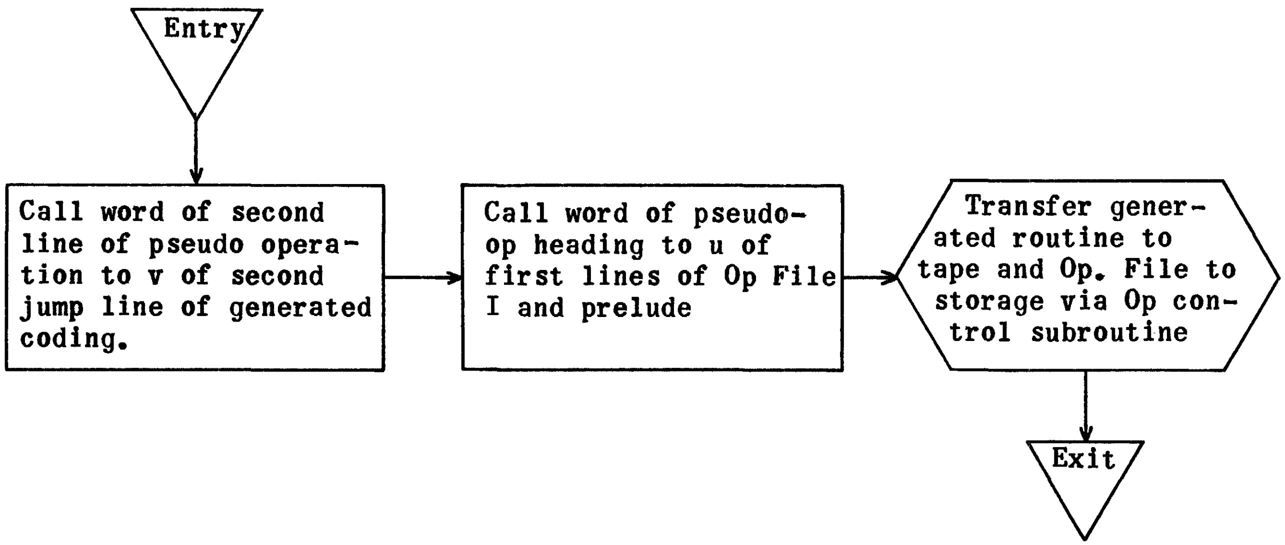
Flow Chart for Dimension Generator



DIMENSION GENERATOR

```
      RE   CQ2512
      RE   C02547
      RE   OP1047
      RE   DL40102

      IA   CQ
 0    MJ   0       30000     Exit
 1    TP   6       Q         Mask # of arrays to establish
 2    QT   C011    A           index
 3    TP   A       C010      Set index
 4    IJ   C010    CQ5
 5    SP   DL2     17        Call word → Op File 1
 6    TU   A       C013
 7    SP   DL3     71        Modulus → Op File 1
10    TV   A       C014
11    TP   C012    OP1       Parameters to Op.
12    RJ   OP      OP2
13    IJ   C010    CQ15
14    MJ   0       CQ        Exit
15    TP   DL3     Q         Mask # of subscripts
16    QT   C011    A
17    TJ   C02     CQ31      2 >(A)?  No-add 4 (it must be 0,1)
20    TJ   C04     CQ25      4 >(A)?
21    RA   CQ5     C07
22    RA   CQ7     C07       Add 6
23    RA   CQ15    C07
24    MJ   0       CQ5
25    RA   CQ5     C06
26    RA   CQ7     C06       Add 5
27    RA   CQ15    C06
30    MJ   0       CQ5
31    RA   CQ5     C05
32    RA   CQ7     C05       Add 4
33    RA   CQ15    C05
34    MJ   0       CQ5
      CA   CQ35

      IA   CO
 0    0    0       0
 1    0    0       1
 2    0    0       2         No. of subscripts
 3    0    0       3
 4    0    0       4
 5    0    4       0
 6    0    5       0         Modifiers
 7    0    6       0
10    0    0       [0]       Index
11    0    0       77777     Mask
12    0    C015    C013      Parameters
13    0    0       2
14    0    0       0         Op File 1
15    0    30000   0
      CA   C016
```

Pseudo-Operation Heading (Generation) - Flow Chart



PSEUDO-OP HEADING-GENERATION

```
        RE    BK2242
        RE    OP1047
        RE    PS2512

        IA    PS
   0    MJ    0        30000        Exit
   1    TV    BK4      PS21         Call word of second line of subprogram to v
                                      of output line
   2    LQ    BK3      Q17     }    Call word of Pseudo-Op heading to u of 1st
   3    TU    Q        PS10    }      line of Op File 1.
   4    TU    Q        PS12         Same to u of 1st line of prelude
   5    TP    PS23     OP1     }    Transfer generated routine to tape and Op
   6    RJ    OP       OP2     }      File to storage
   7    MJ    0        PS           Exit
  10    0     [0]      2       }    Op File 1
  11    0     0        2       }
  12    0     [0]      11      }
  13    0     0        3       }
  14    0     0        0       }    Prelude of generated routine
  15    0     0        0       }
  16    0     0        0       }
  17    0     0        0       }
  20    MJ    0        30000   }    Generated routine plus "10" line
  21    MJ    0        [0]     }
  22    10    0        1       }
  23    0     PS12     PS10         Parameter word for transfer of generator
                                      to tape and Op File to storage
        CA    PS24
```

The line number in input buffer line bkl is inserted in PS17 by generation control prior to operation of this routine in the core.

End of Tape--Generation

Control of the End of Tape Generator is in the last part of the Control Generation subroutine. First the Op File is transferred to the proper storage area. Then RJ KB KB1 does the following things:

It closes out the Op File block, sending it to tape, and adds on an "End of Entry" block. In the "End of Entry" block following the first two lines, the contents of locations 5-17 are reproduced. Prior to this, the value of 14 is computed and a warning print-out given if the number of blocks scheduled to be put on tape 5 will exceed 2500.

Two blocks of Z's are added to the tape holding the generation subroutines following an "End of Entry" block.

List I of the library routines referenced is sent to tape 5 with an initial block having in its second line the contents of counter 5. An "End of Entry" block is added at the end.

Next, RJ UG UG1 puts the Dimension List on tape 5 with opening and closing blocks. RJ IG IG1 puts the Constant List on tape 5. RJ BU BU1 references a BX subroutine to build an excess-three symbol list of single-valued variables. Then the BU subroutine sends this list to tape 5 with the appropriate beginning and ending block.

RJ EG EG1 rewinds the string-out input tape and the generation-routine tapes and moves backward on tape 5 until the reader head is positioned just before the entry blocks of the Op File I data.

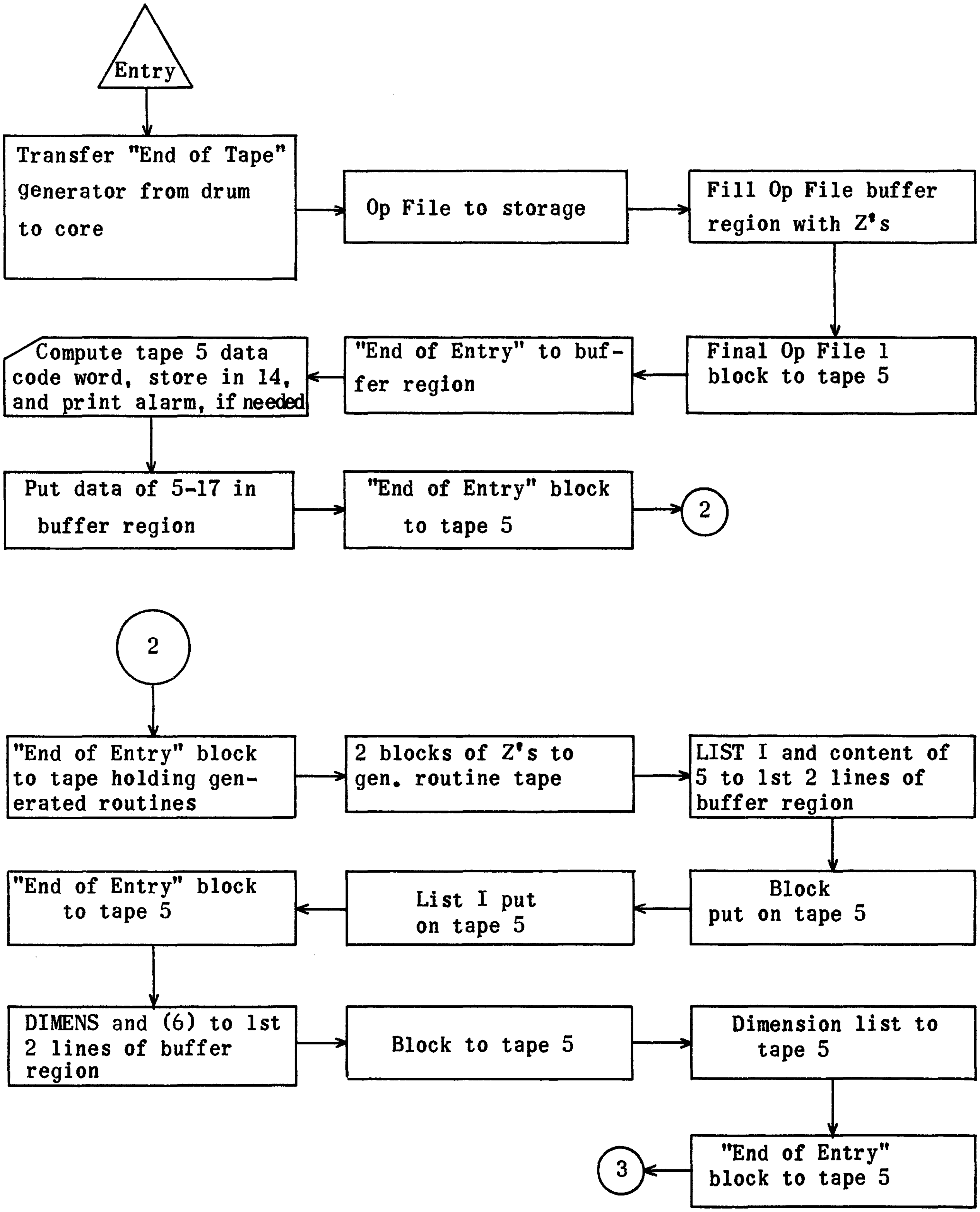
RJ BE BE1 gives the termination print-out for generation and provides the option of interruption or continuation of the UNICODE program.

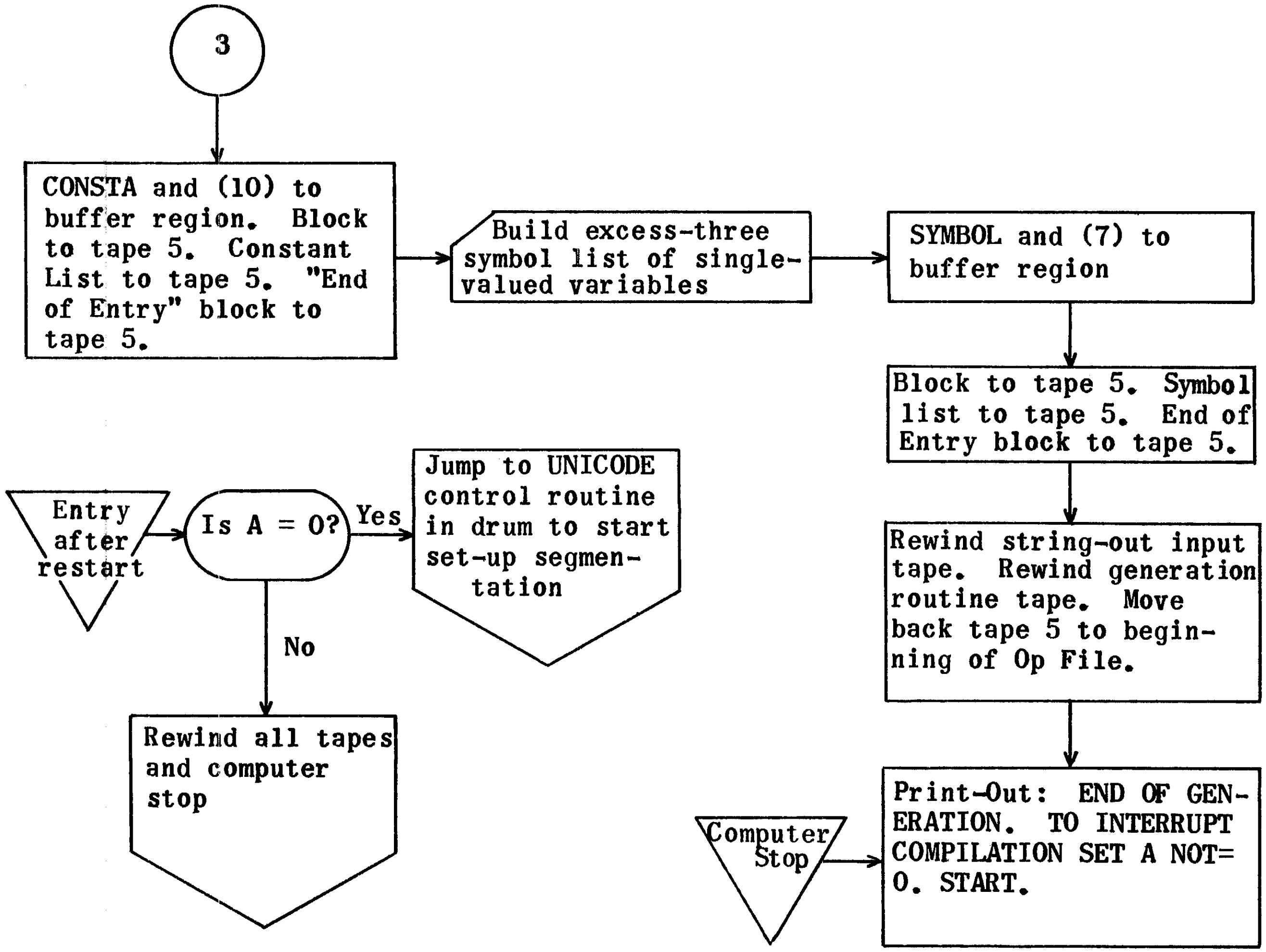
Subsidiary subroutine TE is another name for KB during the "End of Tape" operation. TF is a list of labels and a mask. EW is a subroutine which adds Z's to a title block and transfers it to tape and contains a portion which puts List I on tape. IW is a subroutine which takes any length list and adds it to tape, computing the number of blocks and adding at the end an "End of Entry" block.

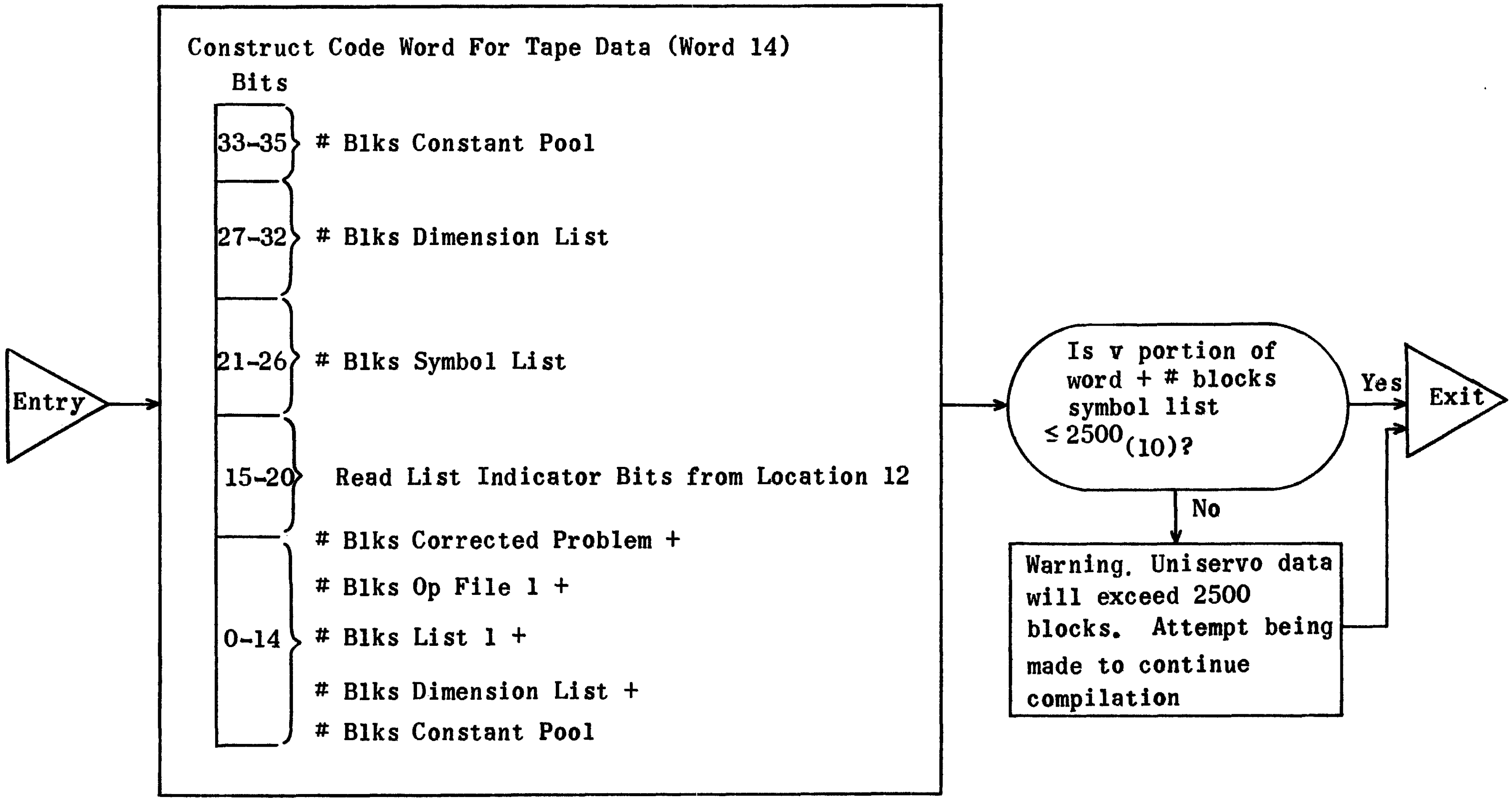
RJ BV BV1 is an instruction within TE which in turn references regions BM, BN, and BO and computes the value of 14.

Explanation of FS, a region of 7 temporaries used during operation of IW, is given in annotated form following the print-out of the Reco coding.

End of Tape - Generation - Flow Chart




3
CONSTA and (10) to buffer region. Block to tape 5. Constant List to tape 5. "End of Entry" block to tape 5.
Build excess-three symbol list of single-valued variables
SYMBOL and (7) to buffer region
Block to tape 5. Symbol list to tape 5. End of Entry block to tape 5.
Rewind string-out input tape. Rewind generation routine tape. Move back tape 5 to beginning of Op File.
Computer Stop
Print-Out: END OF GENERATION. TO INTERRUPT COMPILATION SET A NOT= 0. START.
Entry after restart
Is A = 0?
Yes
Jump to UNICODE control routine in drum to start set-up segmentation
No
Rewind all tapes and computer stop


Entry
Construct Code Word For Tape Data (Word 14)
Bits
33-35
Blks Constant Pool
27-32
Blks Dimension List
21-26
Blks Symbol List
15-20
Read List Indicator Bits from Location 12
0-14
Blks Corrected Problem +
Blks Op File 1 +
Blks List 1 +
Blks Dimension List +
Blks Constant Pool
Is v portion of word + # blocks symbol list ≤ 2500(10)?
Yes
No
Exit
Warning. Uniservo data will exceed 2500 blocks. Attempt being made to continue compilation

End of Tape--Generation
Regions

Generation Subroutine regions are also needed for assembly of this tape.

RE	TE2512
RE	TF2565
RE	EW2573
RE	IW2610
RE	IG2675
RE	UG2713
RE	EG2732
RE	BE2750
RE	BU2774
RE	BX3012
RE	BV3052
RE	BM3104
RE	BN3123
RE	BO3154
RE	FS3214
RE	BZ3223
RE	BW4223
RE	BY2777

End of Tape — Generation

(See Control Generation Routine (CG77-111) for control portion of these End-of-Tape Subroutines.)

```
        IA    TE
 0      MJ    0        30000      Exit
 1      TP    ES       A          Entry
 2      ZJ    TE3      TE16
 3      AT    RC1      A
 4      TV    A        TE12
 5      TP    GP5      A
 6      SS    ES       17         Last block of Op File 1 filled with
 7      AT    GP4      A            Z's and transferred to tape 5
10      TU    A        TE11
11      RP    10000    TE13
12      TP    GP2      30000
13      TP    RC       GT3
14      RJ    GT2      GT
15      RA    ES5      GP10
16      RJ    BV       BV1        To set up code tape data word 14 and test
                                    length of data to go  on Uniservo 5
17      TP    TF       NP
20      TP    TF1      NP1
21      RP    30013    TE23       End of entry block of Op File 1 with data
22      TP    5        NP2          on 5-17 goes to Uniservo 5
23      RP    10153    TE25
24      TP    GP2      NP15
25      RJ    GT2      GT
26      RA    ES5      GP10
27      TP    TF       GN
30      TP    TF1      GN1
31      RP    10166    TE33       End of entry block of subroutines for
32      TP    GP2      GN2          Uniservo 4 or 7
33      TP    RC4      GT3
34      RJ    GT2      GT
35      RA    ES6      GP10
36      TP    GP2      GN
37      TP    GP2      GN1
40      RJ    GT2      GT         2 blocks of Z's following subroutines
41      RA    ES6      GP10         on tape 4 or 7
42      RJ    GT2      GT
43      RA    ES6      GP10
44      TP    ES5      FS5        Setting up counter of blocks from beginning
                                    of Op File on in tape 5
45      TP    TF2      NP
46      TP    TF5      Q
47      QT    5        NP1        Start of transfer of List I to tape 5
50      ZJ    TE51     TE
51      RJ    EW4      EW
52      MJ    0        EW5
        CA    TE53
```

```
     IA   TF
 0   30   50270   15131     ENDΔOF
 1   01   30506   65473     ΔENTRY
 2   46   34656   60104     LISTΔ1
 3   26   51506   56624     CONSTA
 4   27   34473   05065     DIMENS
 5   0    7777    0         Mask
     CA   TF6

     IA   EW
 0   RP   10166   EW2
 1   TP   GP2     NP2       Subroutine to fill a block containing 2
 2   TP   RC      GT3         title lines with lines of Z's and transfer
 3   RJ   GT2     GT          to tape 5
 4   MJ   0       30000
 5   TP   EW14    IW64
 6   TP   GP3     Q         To finish transferring List I of library
 7   QT   5       FS2         routine call words to tape 5
10   RJ   IW      IW1
11   TP   FS      FS4       No. of blocks of library list goes to FS4

12   RA   FS5     FS4       Adding in no. blocks of Library List I to
13   MJ   0       TE          accumulative block counter
14   0    0       LN
     CA   EW15
```

Subroutine Used to Transfer a List
to Tape

```
          IA   IW
      0   MJ   0       30000     Exit
      1   TP   GP10    FS        Entry. Starting count of number of blocks
                                   with 1
      2   TP   IW64    A         Is list located in drum or core?
      3   TJ   GP6     IW20
      4   TP   FS2     A         Is 170>no. lines left in list? If so, go to
      5   TJ   GP5     IW35        partial-block portion
      6   SP   IW64    17        Setting up transfer line for block transfer
List in   7   TU   A       IW11
Drum     10   RP   30170   IW12      Transferring block lines to buffer in core
     11   TP   30000   NP
     12   TP   RC      GT3       Writing 1 block on tape
     13   RJ   GT2     GT
     14   RA   FS      GP10      Counting number of blocks
     15   RS   FS2     GP5       Subtracting no. lines transferred from FS2
     16   RA   IW64    GP5       Increasing address to next line to be
                                   transferred
     17   MJ   0       IW4       Jump back to continue transferring data,
                                   block by block, to tape
     20   TP   FS2     A         Is 170>no. lines left in list? If so, go to
     21   TJ   GP5     IW35        partial block portion
```

```
List in     22  DV  GP5    FS1     No. of whole blocks to be transferred -> FS1
Core        23  TP  A      FS2     Remainder -> FS2
            24  TP  FS1    A       Setting up parameter and transferring
            25  SS  GP10   25        no. whole blocks of list to tape
            26  AT  RC     GT3       in one reference to tape handler
            27  TV  IW64   GT3
            30  RJ  GT2    GT
            31  RA  FS     FS1     Upping block count
            32  MP  FS1    GP5     Updating address for next line to be
            33  AT  IW64   IW64      transferred
            34  TP  FS2    A       No. lines left in list -> A
Partial     35  ZJ  IW36   IW57
Block       36  SA  GP6    17      Setting up repeat lines to transfer re-
to          37  TU  A      IW42      mainder of data to NP
Tape 5      40  SP  IW64   17
after       41  TU  A      IW43
Filling     42  RP  30000  IW44    Transferring data to NP
With Zs     43  TP  30000  NP
            44  TP  GP5    A       Calculating number of Z lines needed and
            45  SS  FS2    17        setting up repeat lines accordingly
            46  TU  A      IW52
            47  RA  IW52   GP4
            50  TV  FS2    IW53
            51  RA  IW53   RC1
            52  RP  10000  IW54    Transferring Z lines to buffer region to
            53  TP  GP2    30000     fill up block
            54  TP  RC     GT3     Transferring final block to tape
            55  RJ  GT2    GT
            56  RA  FS     GP10    Upping block count
End of      57  TP  TF     NP      END∆OF  } to terminating block
Entry       60  TP  TF1    NP1     ∆ENTRY  }
Block       61  RJ  EW4    EW      Block to tape
            62  RA  FS     GP10    Upping block count of list
            63  MJ  0      IW
            64  0   0      0       Input line holds address of 1st line of
                                     list in v
                CA  IW65
```

Routine to Put List of Constants on Tape 5

```
                IA  IG
             0  MJ  0      30000   Exit
             1  TP  B03    A       Entry
             2  ZJ  IG3    IG      If B03 is zero, the list of constants is
                                     nonexistent
             3  TP  TF3    NP      CONSTA to title line of block
             4  TP  10     NP1     Counter to 2nd line of 1st blockette of block
             5  RJ  EW4    EW      Sends 1st block to tape (title block)
             6  TP  IG15   IW64    Sends input line to subroutine
             7  TP  GP3    Q       Masks out no. of words of constants to FS2
            10  QT  10     FS2
```

```
11  RJ   IW     IW1      Sends list to tape via subroutine
12  TP   FS     FS3      Count of blocks to FS3
13  RA   FS5    FS3      Accumulative block counter updated
14  MJ   0      IG
15  0    0      CL
    CA   IG16
```

Routine to Put Dimension List on Tape 5

```
    IA   UG
    MJ   0      30000    Exit
    TP   B04    A        If B04 is zero, the dimension list is
    ZJ   UG3    UG         nonexistent
    TP   TF4    NP       DIMENS      to title block
    tp   6      NP1      Counter 6
    RJ   EW4    EW       Title block to tape
    TP   UG16   IW64     Input line to subroutine IW
    TP   TF5    Q        Length of List masked out to FS2
    QT   6      FS2
    LQ   FS2    25
    RJ   IW     IW1      Send list to tape
    TP   FS     FS6      Count of blocks to FS6
    RA   FS5    FS6      Updating accumulative block counter
    MJ   0      UG
    0    0      DL
    CA   UG17
```

Routine to Rewind Tapes 3 and 4 (or Tapes 6 and 7) and Move To Front of Op File 1 on Tape 5

```
                IA   EG
             0  MJ   0      30000    Exit
             1  SP   EG13   0
             2  AT   TN     GT3      Rewind Uniservo 3 or 6
             3  RJ   GT2    GT
             4  SP   EG14   0
             5  AT   TN     GT3      Rewind Uniservo 4 or 7
             6  RJ   GT2    GT
Moves to     7  SP   FS5    25       Accumulative block counter (FS5) to right
Front of    10  AT   EG15   GT3        position to add to parameter for
Op File 1   11  RJ   GT2    GT         generalized tape handler
on Tape     12  MJ   0      EG
on Servo    13  10   3      0        Parameter to rewind 3
5           14  10   4      0        Parameter to rewind 4
            15  40   5      0        Parameter to move backward 5
                CA   EG16
```

End of Generation Print-Out Routine

```
    IA   BE
 0  MJ   0       30000     Exit
 1  TP   BE10    UP3       Print-Out: END OF GENERATION.  TO INTERRUPT
 2  RJ   UP2     UP          COMPILATION SET A NOT = 0.  START.
 3  SP   BE7     0         Clears A
 4  MS   0       BE5       Stop with Next Instruction in PAK
 5  ZJ   BE6     BE        If A ≠ 0, jump to rewind tapes and stop
 6  MJ   0       BQ6
 7  0    0       0
10  0    BE11    13        Parameter for Print-Out
11  30   50270   15131     ENDΔOF
12  01   32305   03054     ΔGENER
13  24   66345   15022     ATION.
14  01   01665   10134     ΔΔTOΔI
15  50   66305   45467     NTERRU
16  52   66012   65147     PTΔCOM
17  52   34462   46634     PILATI
20  51   50016   53066     ONΔSET
21  01   24015   05166     ΔAΔNOT
22  01   76032   20101     Δ = 0.ΔΔ
23  65   66245   46622     START.
    CA   BE24
```

Routine to Write Excess-Three Symbol List on Tape (Uniservo 5)

```
    IA   BU
 0  MJ   0       30000     Exit
 1  TP   7       A         Is 7 is zero, there are no single-valued
 2  ZJ   BU3     BU          variables
 3  TP   A       FS2       Length of List to FS2
 4  TP   BU14    NP        SYMBOL
                                       To title block
 5  TP   7       NP1       Counter 7
 6  RJ   EW4     EW        Title block to tape
 7  RJ   BX      BX1       Builds excess-three symbol list
10  TP   BU15    IW64      Input line to subroutine IW
11  RJ   IW      IW1       List to tape with end of entry block
12  RA   FS5     FS        Cumulative count of blocks updated
13  MJ   0       BU
14  65   73472   55146     SYMBOL
15  0    0       BZ        Initial address of excess-three symbol list
    CA   BU16
```

Routine to Build Excess-Three Symbol List

```
      IA   BX
  0   MJ   0         30000      Exit
  1   TP   7         BX1        One less than number of words in final
  2   IJ   BX1       BX4          list→working storage BX1. If number of
  3   MJ   0         BX           words is zero, bypass the routine
  4   TP   BX30      Q
  5   QT   6         A          Adjust to start first tnf after the
  6   AT   BX11      BX11         Dimension List
  7   TN   BX31      Q          Mask → Q for search
 10   RP   BY30001   BX12
 11   TP   CB1       BW         One segment → core
 12   RA   BX11      BX36
 13   TU   BX37      BX15       Set up to get next block and start this one
 14   TP   BX33      BX2
 15   QT   30000     A          Mask all but last 4 digits → A
 16   EJ   BX34      BX22       If =  0  0  60000 → BX22
 17   RA   BX15      BX32       Advance address
 20   IJ   BX2       BX15       Recycle to continue search
 21   MJ   0         BX10       Recycle to load a second segment
 22   TU   BX15      BX24
 23   RS   BX24      BX32       Assemble the final list
 24   TP   30000     BZ
 25   RA   BX24      BX35
 26   IJ   BX1       BX17       Check for completion
 27   MJ   0         BX         Exit
 30   0    7777      0          Four-digit extractor
 31   0    0         7777       Negative of mask used for search
 32   0    1         0          u advance
 33   0    0         BY         Length of segment - 1
 34   0    0         60000      Used for EJ test
 35   0    0         1          v advance
 36   0    BY1       0          Length of segment
 37   0    BW        0          Segment location
      CA   BX40
```

Code Word for Tape Data Subroutines

```
      IA   BV
  0   MJ   0         30000      Exit
  1   RP   10005     BV3
  2   TP   B0        B03        Clear temporaries
  3   TP   B0        14         Clear 14
  4   TP   10        Q
  5   QT   B01       A          Constant pool
  6   ZJ   BV7       BV16       (A) = 0 = No  constant pool
  7   DV   B02       B03        (A) ≠ 0 - Divide and store q
 10   ZJ   BV13      BV11       (A) = 0 = No remainder
 11   RA   B03       B011       Quotient + label + end
 12   MJ   0         BV14
```

```
         13  RA   B03    B014      (A) ≠ 0 = remainder - add 1 + label + end
         14  SP   B03    41
Constant 15  TP   A      14         → 1436,35,34
Pool     16  TP   6      Q     }
         17  QT   B012   A     }   Dimension List
         20  ZJ   BV21   BM        (A) = 0 = No Dimension List
         21  LQ   A      25        (A) ≠ 0 shift to v position for divide
         22  DV   B02    [B04]     Divide and store Q
         23  ZJ   BV26   BV24      (A) = 0 = No remainder
         24  RA   B04    B011      Add quotient + label + end
         25  MJ   0      BV27
         26  RA   B04    B014      (A) ≠ 0 = remainder add quotient + 1 + label
                                     + end
         27  SP   B04    33
         30  AT   14     14
         31  MJ   0      BM
             CA   BV32

             IA   BM     + Symbol List + Read List indicators
          0  TP   7      Q     }
          1  QT   B01    A     }   Symbol List
          2  ZJ   BM3    BM12      (A) = 0 = No  symbol List. Go to next step
          3  DV   B02    B05       (A) ≠ 0 divide by 170
          4  ZJ   BM7    BM5       (A) = 0 = no remainder
          5  RA   B05    B011      Add quotient + label + end
          6  MJ   0      BM10                          add quotient + 1
          7  RA   B05    B014      (A) ≠ 0 = remainder + label + end
         10  SP   B05    25        Shift
         11  AT   14     14        Symbol List blks →14
         12  TP   12     Q     }
         13  QT   B013   A     }   Read List indicator
         14  ZJ   BM15   BN        (A) = 0 = No Read List indicators
         15  AT   14     14        (A) ≠ 0 add → 14
         16  MJ   0      BN
             CA   BM17

             IA   BN     14v
          0  TP   13     Q     }
          1  QT   B01    A     }   Number blocks corrected problem
          2  AT   ES5    [B06]     Corr. prob. + (ES5)→ temp.       }
          3  RA   B06    B010       "      "        " + 1→ temp.   } Op File 1
          4  TP   5      Q     }
          5  QT   B01    A     }   List 1
          6  ZJ   BN7    BN15      (A) = 0 = No List 1
          7  DV   B02    [B07]     No. blks List 1 → temp.
         10  ZJ   BN14   BN11                            Add quotient + label
         11  RA   B07    B011      (A) = 0 = No remainder       + end
         12  RA   B07    B06       Subtotal
         13  MJ   0      BN16
         14  RA   B07    B014      (A) ≠ 0 = remainder   add quotient + 1 +label
                                                                + end
         15  RA   B07    B06       Subtotal
         16  RA   B07    B03       Add constant pool
```

```
17  RA  B07    B04     Add Dimension List
20  SP  B07    0
21  AT  14     14      Totals thru constant pool ⟶ 14v
22  TP  14     Q
23  QT  B01    A
24  AT  B05    A       (A) = 14v + Symbol List
25  TJ  B015   BV      (u) > (A) its o.k. exit
26  TP  B016   UP3     (u) not > (A) print warning: WARNING.
27  RJ  UP2    UP        UNISERVO 5 DATA WILL EXCEED 2500 BLOCKS.
                         ATTEMPT BEING MADE TO CONTINUE COMPILATION.
30  MJ  0      BV      Exit
    CA  BN31

    IA  B0
 0  0   0      0
 1  0   0      77777   Mask
 2  0   0      170     Words8 1 blk
 3  0   0      0       Constant pool
 4  0   0      0       Dimension List
 5  0   0      0       Symbol List
 6  0   0      0       Corr. prob. + (ES5) + 1
 7  0   0      0       Temp.
10  0   0      1
11  0   0      2       Label + end
12  0   7777   0       Mask
13  0   3      0       Mask
14  0   0      3       Remainder + label + end
15  0   0      4705    2500(10) + 1
16  00  B017   21      Parameter for print
17  71  24545  03450   WARNIN
20  32  22010  16750   G.ΔΔUN
21  34  65305  47051   ISERVO
22  01  10012  72466   Δ5ΔDAT
23  24  01713  44646   AΔWILL
24  01  30722  63030   ΔEXCEE
25  27  01051  00303   DΔ2500
26  01  25465  12645   ΔBLOCK
27  65  22010  12466   S.ΔΔAT
30  66  30475  26601   TEMPTΔ
31  25  30345  03201   BEINGΔ
32  47  24273  00166   MADEΔT
33  51  01010  10101   OΔΔΔΔΔ
34  01  01265  15066   ΔΔCONT
35  34  50673  00126   INUEΔC
36  51  47523  44624   OMPILA
37  66  34515  02277   TION.
    CA  B040
```

Temporary Region FS

0	Number of blocks of any List transferred to tape
1	Number of full blocks of a List transferred
2	Number of lines in partial block or first-number of lines in List
3	Number of blocks of constants on tape
4	Number of blocks of Library List on tape
5	Number of blocks accumulative back to beginning of Op File 1
6	Number of blocks of Dimension List