Identification

Specific POPS
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Chapter 2

POPS

A.   WORK STACK POPS

Pops

POP: CLOAD   Load into current work

FORMAT: cload(Y)

FUNCTION: Set C(WO) = C(Y)

EXAMPLE: See CEAW

POP: CEAW   Effective address to current work

FORMAT: ceaw(Y)

FUNCTION: Set C(WO) 0-17 = Y

Set C(WO) 18-35 = 0

EXAMPLE:

Assume C(VARSIZ) =

000007	000000
0	18 35

The following two pops are equivalent: cload(varsiz)
and ceaw(7)

WO - W5 Before			WO - W5 After		
W5	000105	000000	W5	000105	000000
W4	000104	000000	W4	000104	000000
W3	000103	000000	W3	000103	000000
W2	000102	000000	W2	000102	000000
W1	000101	000000	W1	000101	000000
WO	000100	000000	WO	000007	000000
	0 18 35			0 18 35	

POP: LOAD   Load

FORMAT: load(Y)

FUNCTION: 1. Add 1 to work counter

2. Set C(WO) = C(Y)

EXAMPLE: See EAW

POP: EAW Effective address to work

FORMAT: eaw(Y)

FUNCTION: 1. Add 1 to work counter

2. Set C(WO) 0-17 = Y

Set C(WO) 18-35 = 0

EXAMPLE:

Assume C(VARSIZ) = | 000007 | 000000 |
                     0   18   35

The following two pops are equivalent: load(varsiz) and eaw(7)

WO - W5 Before		
W5	000105	000000
W4	000104	000000
W3	000103	000000
W2	000102	000000
W1	000101	000000
WO	000100	000000
	0	18 35

WO - W5 After		
W5	000104	000000
W4	000103	000000
W3	000102	000000
W2	000101	000000
W1	000100	000000
WO	000007	000000
	0	18 35

POP: STOR   Store

FORMAT: stor(Y)

FUNCTION: Set C(Y) = C(WO)

POP: STORP   Store and prune

FORMAT: storp(Y)

FUNCTION: 1. Set C(Y) = C(WO)

2. Prune WO

POP: STU   Store upper

FORMAT: stu(Y)

FUNCTION: Set C(Y) 0-17 = C(WO) 0-17

Do not change C(Y) 18-35

POP: STUP Store upper, and prune

FORMAT: stup(Y)

FUNCTION: 1. Set C(Y) 0-17 = C(WO) 0-17
Do not change C(Y) 18-35

2. Prune WO

POP: PRW   Prune work

FORMAT: prw(Y)

FUNCTION: Subtract C(Y) 0-17 from work counter; i.e.,
prune work stack by C(Y) 0-17 words

EXAMPLE: See PWCT

POP: PWCT Prune work to count

FORMAT: pwct(Y)

FUNCTION: Prune work to size C(Y) 0-17

EXAMPLE:

Assume   C(c2) =
000002	000000
0	18 35

C(c3) =
000003	000000
0	18 35

The following pops are equivalent: prw(c2) and
pwct (c3)

Work Stack Before

W5	0	0
W4	100	0
W3	200	0
W2	300	0
W1	400	0
WO	500	0
	0	18 35

Work Stack After

W3	0	0
W2	100	0
W1	200	0
WO	300	0
	0	18 35

POP: PRWX   Prune work for exit

FORMAT: prwx( )

FUNCTION: Prune work to its size prior to the last
           executed JSB pop

COMMENT: The function of this pop is to prune work, not
          to extend it

B. MISCELLANEOUS POPS

<u>Pops</u>

POP: POPNOP No operation

FORMAT: popnop( )

FUNCTION: Go to the next pop

POP: ORKEY Or symbol key

FORMAT: orkey(Y)

FUNCTION: Set C(SYMKEY) 18-35 = C(SYMKEY) 18-35 .or. C(Y) 18-35

SYMKEY is a one-word register in the data segment.
(The interpreter ignores C(SYMKEY) 0-17)

POP: MRK Set MRKER

FORMAT: mrk(Y)

FUNCTION: Set C(MRKER) 0-17 = Y

MRKER is a one-word register in the data segment.
(The interpreter ignores C(MRKER) 18-35)

POP: FACT Fact

FORMAT: fact(Y)

Y may be an even or odd location

FUNCTION: 1. Bump bottom of roll 3 (fact roll) by two words

2. Set C(word 1) = C(Y)

3. Set C(word 2) = C(Y+1)

COMMENT: fact(Y) is equivalent to load(Y)
                                    pob(3)
                                    cload(Y+1)
                                    pobp(3)

C. ARITHMETIC AND LOGICAL POPS

Most of the arithmetic and logical pops are in one of eight categories, as shown in Figure 1. The pops that are not in one of these categories are NGT and NOT.

1. Arithmetic Pops

Arithmetic pops perform the following types of operations: addition, subtraction, multiplication, division, and negation. These pops work on full words. However, they are frequently used to perform simple operations in which only the upper half of each word is of interest to the user. In these cases, the user should make sure that the lower halves of the words are cleared before the pops are executed. Otherwise, the results might be incorrect.

EXAMPLE:

The pop add(Y) sets C(WO) = C(WO) + C(Y)

        Before   After

Y | 000003 | 777777 | Y | 000003 | 777777 |
     0   18   35   0   18   35

WO | 000002 | 777777 | WO | 000006 | 777776 |
     0   18   35   0   18   35

The upper half of the result is 6, not 5, becuase of carry from the lower half.

Pops

POP: ADD Add

FORMAT: add(Y)

FUNCTION: Set C(WO) = C(WO) + C(Y)

Category	Interpreter Action	+	-	*	/	.and.	.or.	.ext.	.eor.	.ins.
						Operation and Corresponding Pops				
1.	Set C(WO) = C(WO) operation C(Y)	ADD	SUB	MLT	DVD	AND	OR	EXT	EOR	INS
2.	Set C(Y) = C(Y) operation C(WO)	ADS	SBS	MLTS		ANS	ORS		ERS	
3.	Set C(Y) = C(Y) operation C(WO) and prune WO	ADSP	SBSP	MLTSP		ANSP	ORSP		ERSP	
4.	Set C(RP(WO)) = C(RP(WO))operation C(Y)	ADDI				ANDI		EXTI		INSI
5.	Set C(RP(WO)) = C(RP(WO))operation C(Y) and prune WO	ADDIP				ANDIP		EXTIP		INSIP
6.	Set C(B) = C(B) operation C(Y) B is a location on roll N (See ERB for further explanation)								ERB	INSB
7.	Set C(W1) = C(W1) operation C(Y)									INS1
8.	Set C(W2) = C(W2) operation C(Y)									INS2

Notes: a. The operations are described in the text

   b.   For representative examples of the categories, see EXT(categories 1,7, and 8),
        ORS (categories 2 and 3), ADDI (categories 4 and 5), and ERB (category 6).

Figure 1.   Categories of Arithmetic and Logical Pops

POP: ADS Add to storage

FORMAT: ads(Y)

FUNCTION: Set C(Y) = C(Y) + C(WO)

POP: ADSP Add to storage, and prune

FORMAT: adsp(Y)

FUNCTION: 1. Set C(Y) = C(Y) + C(WO)

           2. Prune WO

POP: ADDI Add indirect

FORMAT: addi(Y)

FUNCTION: Set C(RP(WO)) = C(RP(WO)) + C(Y)

EXAMPLE:

    addi(alpha)

ALPHA | 000002 | 000000 | C(TOP+6) 0-17 = 100000
         0   18   35

    WO | 5 | 0 | 6 | RP(WO) = 100005
         0   18 30 35

100005 before | 000004 | 000000 |
                  0   18   35

100005 after | 000006 | 000000 |
                  0   18   35

POP: ADDIP Add indirect, and prune

FORMAT: addip(Y)

FUNCTION: 1. Set C(RP(WO)) = C(RP(WO)) + C(Y)

           2. Prune WO

POP: SUB Subtract

FORMAT: sub(Y)

FUNCTION: Set C(WO) = C(WO) - C(Y)

POP: SBS   Subtract from storage

FORMAT: sbs(Y)

FUNCTION: Set C(Y) = C(Y) - C(WO)

EXAMPLE:

sbs(alpha)

ALPHA before	$\underline{000005}$	$\underline{000000}$
	0 18	35

WO	000002	000000
	0 18	35

ALPHA after	000003	000000
	0 18	35

POP: SBSP   Subtract from storage, and prune

FORMAT: sbsp(Y)

FUNCTION: 1. Set C(Y) = C(Y) - C(WO)

2. Prune WO

POP: MLT   Multiply

FORMAT: mlt(Y)

FUNCTION: Set C(WO) 0-17 = C(WO) 0-17* C(Y) 0-17, assuming
that C(WO) 18-35 = 0 and C(Y) 18-35 = 0

COMMENT: The operands and the product are 18-bit upper-
half integers. If necessary, the product is
truncated on the left to 18 bits.

POP: MLTS   Multiply to storage

FORMAT: mlts(Y)

FUNCTION: Set C(Y) 0-17 = C(Y) 0-17* C(WO) 0-17, assuming
that C(Y) 18-35 = 0 and C(WO) 18-35 = 0

EXAMPLE:

mlts(alpha)

WO

000003	000000
0	18 35

ALPHA before

000002	000000
0	18 35

ALPHA after

000006	000000
0	18 35

COMMENT: The operands and the product are 18-bit upper-half
           integers. If necessary, the product is truncated
           on the left to 18 bits.

POP: MLTSP Multiply to storage, and prune

FORMAT: mltsp(Y)

FUNCTION: 1. Set C(Y) 0-17 = C(Y) 0-17* C(WO) 0-17 assuming
               that C(Y) 18-35 = 0 and C(WO) 18-35 = 0

            2. Prune WO

COMMENT: The operands and the product are 18-bit upper-half
           integers. If necessary, the product is truncated
           on the left to 18 bits.

POP: DVD   Divide

FORMAT: dvd(Y)

FUNCTION: Set C(WO) 0-17 = C(WO) 0-17/C(Y) 0-17, assuming that
            C(WO) 18-35 = 0, C(Y) 18-35 = 0, and C(Y) 0-17 $\neq$ 0

EXAMPLE:

dvd(alpha)

WO before

000007	000000
0	18 35

ALPHA

000003	000000
0	18 35

WO

000002	000000
0	18 35

COMMENT: The operands and the quotient are 18-bit upper-half
           integers. The remainder is ignored.

POP: NGT   Negate   (two's complement)

FORMAT: ngt( )

FUNCTION: Set $C(WO) = -C(WO)$

COMMENT: 1. Two negates will always return the original state
of a number

2. Negation means taking the two's complement of a
number. It does not mean changing bit 0 (the
sign bit). The following code changes C(ALPHA) 0:

```
eaw(octal(400000))
ersp(alpha)
```

This code does not negate ALPHA, unless
C(ALPHA) = 200000000000 or 600000000000.

POP: NGTS Negate storage (two's complement)

FORMAT: ngts(Y)

FUNCTION: Set $C(Y) = -C(Y)$

EXAMPLES:

In each of the following examples, the pop is ngts(alpha)

ALPHA before | 000001 | 000000 | +1   ALPHA after | 777777 | 000000 | -1
             0   18   35   0   18   35

ALPHA before | 000000 | 000000 | 0   ALPHA after | 000000 | 000000 | 0
             0   18   35   0   18   35
                                                  (There is no
                                                  such thing
                                                  as -0)

2. Logical Pops

    a. Simple Operations

    The following truth table summarizes the simple logical
    operations:

xk	yk	zk			
		.and.	.ext.	.or.	.eor.
0	0	0	0	0	0
0	1	0	0	1	1
1	0	0	1	1	1
1	1	1	0	1	0

.and. = and
.ext. = extract
.or. = or
.eor. = exclusive or

The general format of pops performing these operations is:

Set zk = xk .logical. yk   (for k = 0,1,..., and 35)

where .logical. represents the operation; and x,y,and z are 36-bit quantities whose k'th bits are xk, yk, and zk, respectively.   The pops work on all bits of x,y, and z in parallel.

<u>Pops</u>

POP: AND And

FORMAT: and(Y)

FUNCTION: Set C(WO) = C(WO) .and. C(Y)

POP: ANS And to storage

FORMAT: ans(Y)

FUNCTION: Set C(Y) = C(Y) .and. C(WO)

EXAMPLE:

ans(alpha)

WO	000006	000000
	0	18 35

ALPHA before	000003	000000
	0	18 35

ALPHA after	000002	000000
	0	18 35

POP: ANSP And to storage, and prune

FORMAT: ansp(Y)

FUNCTION: 1. Set C(Y) = C(Y) .and. C(WO)

2. Prune WO

POP: ANDI And indirect

FORMAT: andi(Y)

FUNCTION: Set C(RP(WO)) = C(RP(WO)) .and. C(Y)

POP: ANDIP And indirect, and prune

FORMAT: andip(Y)

FUNCTION: 1. Set C(RP(WO)) = C(RP(WO)) .and. C(Y)

         2. Prune WO

POP: OR Or

FORMAT: or(Y)

FUNCTION: Set C(WO) = C(WO) .or. C(Y)

POP: ORS Or to storage

FORMAT: ors(Y)

FUNCTION: Set C(Y) = C(Y) .or. C(WO)

EXAMPLE:

    ors(alpha)

    WO

000006	000000
0	18 35

    ALPHA before

000003	000000
0	18 35

    ALPHA after

000007	000000
0	18 35

POP: ORSP Or to storage, and prune

FORMAT: orsp(Y)

FUNCTION: 1. Set C(Y) = C(Y) .or. C(WO)

         2. Prune WO

POP: EXT Extract

FORMAT: ext(Y)

FUNCTION: Set C(WO) = C(WO) .ext. C(Y)

EXAMPLE: ext(alpha)

WO before

000006	000000

0   18   35

ALPHA

000003	000000

0   18   35

WO after

000004	000000

0   18   35

POP: EXTI Extract indirect

FORMAT: exti(Y)

FUNCTION: Set C(RP(WO)) = C(RP(WO)) .ext. C(Y)

POP: EXTIP Extract indirect, and prune

FORMAT: extip(Y)

FUNCTION: 1. Set C(RP(WO)) = C(RP(WO)) .ext. C(Y)

2. Prune WO

POP: EOR Exclusive or

FORMAT: eor(Y)

FUNCTION: Set C(WO) = C(WO) .eor. C(Y)

POP: ERS Exclusive or to storage

FORMAT: ers(Y)

FUNCTION: Set C(Y) = C(Y) .eor. C(WO)

POP: ERSP Exclusive or to storage, and prune

FORMAT: ersp(Y)

FUNCTION: 1. Set C(Y) = C(Y) .eor. C(WO)

2. Prune WO

POP: ERB   Exclusive or to bottom

FORMAT: erb(Y)

FUNCTION: Set $C(B) = C(B)$ .eor. $C(Y)$

B is a location on roll N, where $N = C(MRKER)$ 0-17

For fixed-size groups, $B = C(BOTTOM+N)$ 0-17
$- C(GRPSIZ+N)$ 0-17

For variable-size groups, $B = C(BOTTOM+N)$ 0-17
$- C(VARSIZ)$ 0-17

EXAMPLE:

erb(alpha)

ALPHA

000001	000000
0 18	35

$C(BOTTOM+6)$ 0-17 = 100100
B = 100100 - 100 = 100000

MRKER

000006	000000
0 18	35

$C(GRPSIZ+6)$ 0-17 = 100

100000 before

000007	000000
0 18	35

100000 after

000006	000000
0 18	35

COMMENT: If N consists of fixed-size groups, B is the first word of the last group before the bottom. However, the user may set VARSIZ to any number; thus, if N consists of variable-size groups, B may be any word in (or even above) the last group.

b.   Insert Operation

The following truth table summarizes the insert operation:

xk	yk	zk before	zk after
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

Pops in this category insert x_k into z_k when $y_k = 0$. These pops work on all bits of x, y, and z in parallel. The operand Y is always an even location, with $C(Y) = x$ and $C(Y+1) = y$. The location of z is different for each insert pop.

Pops

POP: INS   Insert

FORMAT: ins(Y)
        Y is an even address

FUNCTION: Set C(WO) = C(WO) .ins. C(Y)

EXAMPLE:

ins(2000)

	Q	X	Q	Y
2000 2001	777	000	777	000

0   9   18   27 35

WO before

A	B	C	D

0   9   18   27 35

WO after

A	X	C	Y

0   9   18   27 35

POP: INSI   Insert indirect

FORMAT: insi(Y)
        Y is an even address

FUNCTION: Set C(RP(WO)) = C(RP(WO)) .ins. C(Y)

POP: INSIP   Insert indirect, and prune

FORMAT: insip(Y)
        Y is an even address

FUNCTION: 1. Set C(RP(WO)) = C(RP(WO)) .ins. C(Y)

        2. Prune WO

POP: INSB   Insert into bottom
      (See ERB.)

FORMAT: insb(Y)
         Y is an even address

FUNCTION: Set C(B) = C(B) .ins. C(Y)

POP: INS1   Insert into W1

FORMAT: ins1(Y)
         Y is an even address

FUNCTION: Set C(W1) = C(W1) .ins. C(Y)

POP: INS2   Insert into W2

FORMAT: ins2(Y)
         Y is an even address

FUNCTION: Set C(W2) = C(W2) .ins. C(Y)

C. Not Operation

Pop

POP: NOT Not

FORMAT: not(Y)

FUNCTION: If C(Y) = 0, set C(Y) 0-17 = 1
           If C(Y) ≠ 0, set C(Y) = 0

EXAMPLES:

not(alpha)

ALPHA before | 000000 | 000000 | ALPHA before | 000100 | 000000 |
              0   18   35   0   18   35

ALPHA after | 000001 | 000000 | ALPHA after | 000000 | 000000 |
              0   18   35   0   18   35

COMMENT: The purpose of this pop is to invert | 000000 | 000000 |
                                               0   18   35
         and | 000001 | 000000 |. The interpreter treats any
             0   18   35
         operand that is non-zero as if it were | 000001 | 000000 |.
                                                 0   18   35

D. ROLL MANIPULATION POPS

1. Normal Roll Manipulation

Pops

POP: POB Put on bottom

FORMAT: pob(N)

FUNCTION: 1. Bump bottom of roll N by 1 word

            2. Set C(word 1) = C(WO)

POP: POBP Put on bottom, and prune

FORMAT: pobp(N)

FUNCTION: 1. Bump bottom of roll N by 1 word

            2. Set C(word 1) = C(WO)

            3. Prune WO

POP: POBS Put on bottom from storage

FORMAT: pobs(Y)

FUNCTION: 1. Bump bottom of roll M by 1 word, where
                M=C(MRKER) 0-17

            2. Set C(word 1) = C(Y)

POP: GOB Get off bottom

FORMAT: gob(N)

FUNCTION: 1. Set false, and go to next pop if C(TOP+N) 0-17 =
                C(BOTTOM+N) 0-17. Otherwise, set true and perform
                steps 2-3.

            2. Add 1 to work counter

            3. Set C(WO) = C(C(BOTTOM+N) 0-17 - 1); i.e., load
                the word immediately above the bottom of roll N

POP: GOBP Get off bottom, and prune

FORMAT: gobp(N)

FUNCTION: 1. Set false, and go to next pop if
               C(TOP+N) 0-17 = C(BOTTOM+N) 0-17. Otherwise,
               set true and perform steps 2-4.

           2. Add 1 to work counter

           3. Set C(WO) = C(C(BOTTOM+N) 0-17 - 1); i.e., load
               the word immediately above the bottom of roll N

           4. Set C(BOTTOM+N) 0-17 = C(BOTTOM+N) 0-17 - 1;
               i.e., prune one word from the bottom of roll N

POP: CNT Count roll

FORMAT: cnt(N)

FUNCTION: 1. Add 1 to work counter

           2. Set C(WO) = C(BOTTOM+N) - C(TOP+N)
               This calculation gives the number of words
               between the top and the bottom of the roll;
               i.e., the number of unreserved words in use.

POP: CNTG Count group

FORMAT: cntg(N)

FUNCTION: Count the last variable size group on roll N.

           1. Assume that RP(ROLPTR+N) is the location of
               the VSW of the last group on roll N. Count
               the group (w words)
                   w = C(BOTTOM+N) 0-17 -RP(ROLPTR+N)-1

           2. Set C(VSW) 0-17 = w

EXAMPLE:

cntg(6)

TOP+6 | 100000 | 000000 | BOTTOM+6 | 100107 | 000000 |
       0   18   35   0   18   35

ROLPTR+6 | 100 | x | 6 | RP(ROLPTR+6) = 100100
          0   18 30 35

VSW after | 000006 | unchanged | (100107-100100-1 = 6)
           0   18   35

Illustration

Roll 6

100000		
100100	000006	000000	Variable size word
100101	first word	
100107			Bottom

0   18   35

COMMENT: In executing this pop, the interpreter ignores
C(ROLPTR+N) 30-35.

POP: PRU Prune roll

FORMAT: pru(N)

FUNCTION: Set C(BOTTOM+N) 0-17 = C(TOP+N) 0-17

POP: PTP Prune to pointer

FORMAT: ptp(Y)

FUNCTION: Set C(BOTTOM+C(Y) 30-35) 0-17 = RP(Y)

POP: PTPP Prune to pointer in work and prune

FORMAT: ptpp( )

FUNCTION: 1. Set C(BOTTOM+C(WO) 30-35) 0-17 = RP(WO)

        2. Prune WO

COMMENT: Assume C(C1) =   000001   000000
                         0   18   35

      In this case, ptpp( ) is equivalent to ptp(w0)
                                         prw(c1)

POP: PBCT   Prune by count

FORMAT: pbct(N)

FUNCTION: Set C(BOTTOM+N) 0-17 = C(BOTTOM+N) 0-17 - C(W0) 0-17;
           i.e., prune C(W0) 0-17 words from the bottom of
           roll N

POP: PBCTP   Prune by count, and prune

FORMAT: pbctp(N)

FUNCTION: 1. Set C(BOTTOM+N) 0-17 =
              C(BOTTOM+N) 0-17 - C(W0) 0-17

          2. Prune W0

POP: PTCT   Prune to count

FORMAT: ptct(N)

FUNCTION: Set C(BOTTOM+N) 0-17 = C(TOP+N) 0-17 + C(W0) 0-17;
           i.e., prune roll N, so that there are C(W0) 0-17
           words from top to bottom

POP: PTCTP   Prune to count, and prune

FORMAT: ptctp(N)

FUNCTION: 1. Set C(BOTTOM+N) 0-17 = C(TOP+N) 0-17 + C(W0) 0-17

          2. Prune W0

POP: PLG   Prune last group

FORMAT: plg(N)

FUNCTION: Set C(BOTTOM+N) 0-17 = C(BOTTOM+N) 0-17 -K, if the
            difference $\geq$ C(TOP+N) 0-17. Otherwise, do not
            prune group.

            K = C(GRPSIZ+N) 0-17, if C(GRPSIZ+N) 0-17 is non-zero

            K = C(VARSIZ) 0-17 + 1 if C(GRPSIZ+N) 0-17 is zero.

POP: REMOV Remove

FORMAT: remov(N)

FUNCTION: Make all but one of the words from anchor to floor of
            roll N available to other rolls, and put roll N on
            the list of removed rolls.

            Set C(BOTTOM+N) = 0, and set C(TOP+N) = information
            to be used by the interpreter.

POP: OPN Open

FORMAT: opn(N)

FUNCTION: Case 1: C(BOTTOM+N) $\neq$ 0; i.e., the roll is already
                     open

              Go to next pop

            Case 2: C(BOTTOM+N) = 0

              1. Take roll N off the list of removed rolls

              2. Set C(BOTTOM+N) and C(TOP+N) both equal to
                  C(ANCHOR+N)

   NOTE: If all of the available words on the
                         removed roll were used, C(ANCHOR+N)
                         points to the remaining word on roll N.
                         Otherwise, C(ANCHOR+N) points to the
                         first unused word on roll N.

POP: RSV Reserve

FORMAT: rsv(N)

FUNCTION: 1. Compute the number of words currently reserved (w words) $w = C(TOP+N)$ 0-17 - $C(ANCHOR+N)$ 0-17

2. Bump the bottom of roll N by 1 word

3. Set $C(word\ 1)$ 0-17 $= w$. Ignore the lower half of word 1.

4. Set $C(TOP+N)$ 0-17 $= C(BOTTOM+N)$ 0-17

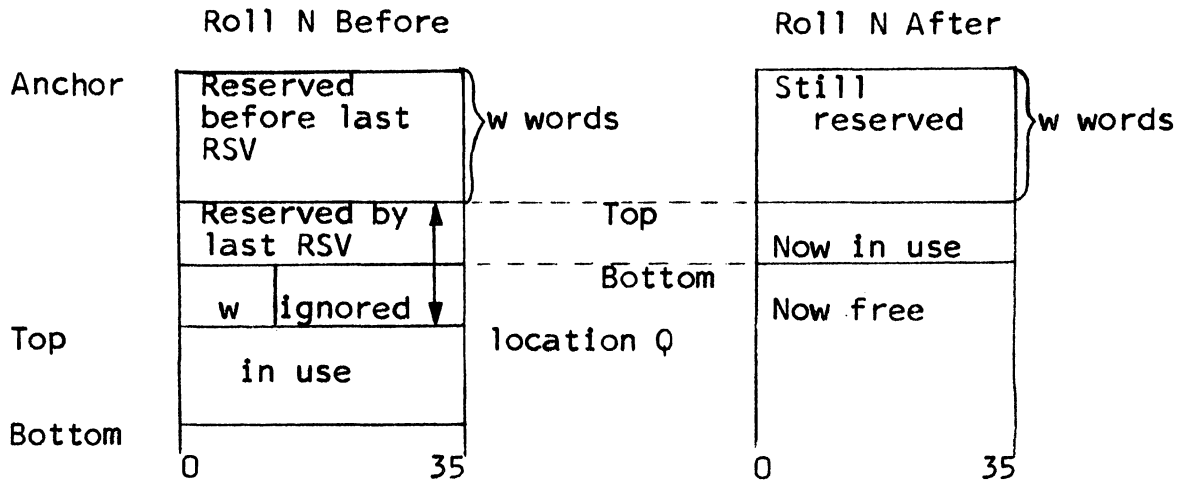This is illustrated below:
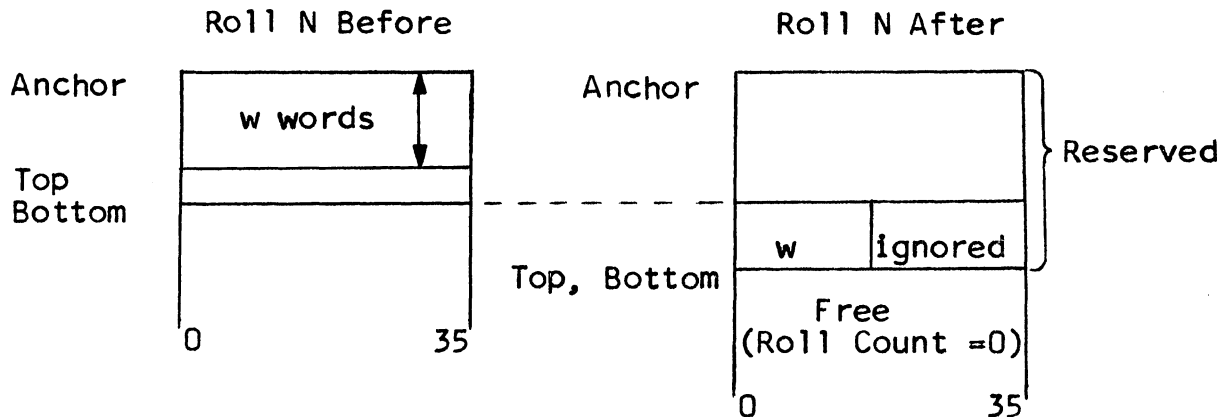
POP: REL Release

FORMAT: rel(N)

FUNCTION: Case 1: $C(TOP+N)$ 0-17 $= C(ANCHOR+N)$ 0-17; nothing is reserved

Set $C(BOTTOM+N)$ 0-17 $= C(TOP+N)$ 0-17

Case 2: Roll N contains one or more reserved words

1. Set $C(BOTTOM+N)$ 0-17 $= Q-1$, where $Q = C(TOP+N)$ 0-17

2. Recover w, $C(Q-1)$ 0-17 (See RSV pop.)

3. Set $C(TOP+N)$ 0-17 $= C(ANCHOR+N)$ 0-17 $+ w$

This is illustrated below:

Roll N Before   Roll N After

POP: RSVM Reserve and mark

FORMAT: rsvm(N)

FUNCTION: 1. Execute mrk(N)

           2. Execute rsv(N)

POP: DNX Down next word

FORMAT: dnx(N)

FUNCTION: 1. Case 1: C(ROLPTR+N) = 0; i.e., C(ROLPTR+N) =

$$\boxed{\begin{array}{c|c|c} 0 & 0 & 0 \end{array}}$$
0   18 30 35   (Points to bottom.)

Set C(ROLPTR+N) = $\boxed{\begin{array}{c|c|c} 0 & 0 & M \end{array}}$, where M = N.
                  0   18 30 35   (Points to top.)

Case 2: C(ROLPTR+N) ≠ 0; i.e., C(ROLPTR+N) =
$\boxed{\begin{array}{c|c|c} P & x & M \end{array}}$, where M is usually N.
0   18 30 35

Set C(ROLPTR+N) = $\boxed{\begin{array}{c|c|c} P+1 & 0 & M \end{array}}$
                  0   18 30 35

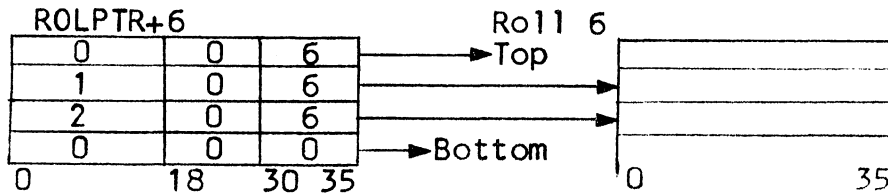   (Points one word
                                         down.)

2. If roll M is removed, set C(ROLPTR+N) = 0,
    and set false

    If RP(ROLPTR+N) $\geq$ C(BOTTOM+M) 0-17, set
    C(ROLPTR+N) = 0, and set false*

    If RP(ROLPTR+N) < C(BOTTOM+M) 0-17, set true

EXAMPLE: Assume initial C(ROLPTR+6) = 0

ROLPTR+6 Before dnx(6)	ROLPTR+6 After Step 1 Case 1	ROLPTR+6 After Step 2	
0 0 0	0 0 6	0 0 6	Set true
0 0 6	1 0 6	1 0 6	Set true
1 0 6	2 0 6	2 0 6	Set true
2 0 6	3 0 6	0 0 0	Set false

(positions: 0 18 30 35)

*If roll M is the current read-spill roll (see Paragraph D.2.a),
the interpreter does the following:

1. Determine whether there are more groups in the current
    read-spill segment

2. If there are no more groups, set C(ROLPTR+N) = 0, and
    set false

    If there are more groups, set
    C(ROLPTR+N) 0-17 = C(BOTTOM+M) 0-17 - C(TOP+M) 0-17,
    append next section of groups to bottom of roll M, and
    set true

POP: UNX   Up next word

FORMAT: unx(N)

FUNCTION: Let Q = C(BOTTOM+N) 0-17 - C(TOP+N) 0-17

1. Case 1: C(ROLPTR+N) = 0; i.e.,

   C(ROLPTR+N) =

0	0	0
0	18	30 35

   Set C(ROLPTR+N) =

P	0	N
0	18	30 35

   , where P = Q

   Case 2: C(ROLPTR+N) ≠ 0; i.e.,

   C(ROLPTR+N) =

P	ignored
0	18 35

   Do not change C(ROLPTR+N)

2. If P = 0, then set C(ROLPTR+N) =

0	0	0
0	18	30 35

   , and set false

   If P ≠ 0, then set C(ROLPTR+N) =

P-1	unchanged
0	18 35

   , and set true

EXAMPLE: Assume initial C(ROLPTR+6) = 0

ROLPTR+6

0	0	6	→ Top
1	0	6	→
2	0	6	→
0	0	0	→ Bottom
0	18	30 35	

Roll 6

0	35
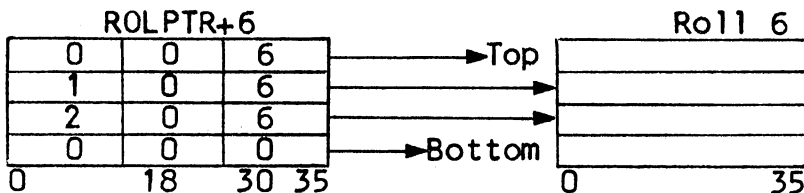
ROLPTR+6 Before unx(6)	ROLPTR+6 After step 1	ROLPTR+6 After step 2	
Case 1			
0 | 0 | 0	3 | 0 | 6	2 | 0 | 6	Set true
Case 2			
2 | 0 | 6	2 | 0 | 6	1 | 0 | 6	Set true
Case 2			
1 | 0 | 6	1 | 0 | 6	0 | 0 | 6	Set true
Case 2			
0 | 0 | 6	0 | 0 | 6	0 | 0 | 0	Set false
0 18 30 35	0 18 30 35	0 18 30 35	

COMMENTS: 1. The interpreter assumes that roll N is not removed

2. N overrides C(ROLPTR+N) 30-35

3. No special action is taken for the read-spill roll.

POP: DLOAD Down and Load

FORMAT: dload(N)

FUNCTION: 1. Execute the pop dnx(N)

2. If true condition was set, add 1 to work
    counter; and set $C(WO) = C(RP(ROLPTR+N))$ --
    i.e., load the word pointed to
    If false condition was set, do not change work

POP: DNG Down next group

FORMAT: dng(N)

FUNCTION: Let $G = C(GRPSIZ+N)$ 0-17 and let
            $V = C(RP(ROLPTR+N))$ 0-17

Execute the pop dnx(N), with the following
exceptions:

In step 1, case 2; i.e., $C(ROLPTR+N) =$

P	x	M
0	18	30 35

If roll N consists of fixed-size groups, set
$C(ROLPTR+N) =$

P+G	0	M
0	18	30 35

If roll N consists of variable-size groups, set
$C(ROLPTR+N) =$

P+V+1	0	M
0	18	30 35

POP: ULOAD Up and load

FORMAT: uload(N)

FUNCTION: 1. Execute the pop unx(N)

2. If true condition was set, add 1 to work
    counter; and set $C(WO) = C(RP(ROLPTR+N))$ --
    load the word pointed to

    If false condition was set, do not change work

POP: UNG   Up next group

FORMAT: ung(N)

FUNCTION: Let G = C(GRPSIZ+N) 0-17. (Here, G must be non-zero)
            Execute the pop unx(N) with the following exception:

            In step 2, if $P \neq 0$, set
            C(ROLPTR+N) = | P - G | unchanged |
                          0   18   35

COMMENT: This pop required fixed-size groups.

POP: CPY   Copy

FORMAT: cpy(N)
          M = C(MRKER) 0-17

FUNCTION: 1.   Count roll N, to determine the number of words
                 between the top and bottom of the roll.
                 w = number of words counted

            2.   If w = 0, take no further action.

                 If $w \neq 0$, bump the bottom of roll M by w words;
                 and copy w words (top to bottom) from roll N into
                 this w-word area of roll M. (Words are copied
                 sequentially.)

EXAMPLE: mrk(5)
           cpy(6)
              TOP+5 | 100000 | 000000 | BOTTOM+6 | 101002 | 000000 |
              TOP+6 | 101000 | 000000 | 0   18   35
                     0   18   35

        BOTTOM+5 before | 100003 | 000000 |
                        0   18   35
                               BOTTOM+5 after | 100005 | 000000 |
                                              0   18   35

Illustration

Before pop

100000	2	0	Top roll 5
	100	0
	200	0
			Bottom
101000	1	0	Top roll 6
	1000	0
			Bottom
0   18   35

After pop

100000	2	0	Top roll 5
	100	0
	200	0
	1	0
	1000	0
			Bottom
101000	1	0	Top roll 6
	1000	0
			Bottom
0   18 35

POP: CPYR   Copy and release

FORMAT: cpyr(N)

FUNCTION: 1. Execute cpy(N)

  2. Execute rel(N)

POP: CPYP   Copy and prune

FORMAT: cpyp(N)

FUNCTION: 1. Execute cpy(N)

  2. Set C(BOTTOM+N) 0-17 = C(TOP+N) 0-17

POP: CPYG   Copy group

FORMAT: cpyg(Y)
  X and Y are locations of roll pointers
  X = C(MRKER) 0-17

FUNCTION: Copy the group starting at location RP(Y) (group A)
  to the group starting at location RP(X) (group B).
  Either group may be fixed-size or variable-size.
  (If variable-size, the roll pointer points to the
  VSW.) Group sizes need not be the same.

  1. Determine group size of each group, as follows:
  G = C(GRPSIZ+M) 0-17 , where M = roll number

  If G ≠ 0, group size equals G

  If G = 0, group size equals C(VSW) 0-17

  2. Copy group A into group B, according to the
  following rules:

  a. If group A is a variable size group, do not
  copy the VSW. Begin by copying the word
  following the VSW.

  b. If group B is a variable size group, do not
  change the VSW. Copy the first word from
  group A into the location following the VSW.

  c. Copy words sequentially

d. If the group size of group A = N words, and
    the group size of group B > N words, then copy
    group A into the first N words of group B and
    set the remaining words of group B to zero.

e. If the group size of group B = N words, and
    the group size of group A ≥ N words, then copy
    the first N words of group A into group B.

EXAMPLE: mrk(rolptr+6)
          cpyg(rolptr+5)

Assume RP(ROLPTR+5) is the location of the first word of the
following fixed-size group on roll 5:

word 1
word 2
word 3
word 4

The following illustrations show how this group would be copied
into different types of groups on roll 6:

3-word Fixed size	5-word Fixed size	4-word Fixed size	3-word Variable size	
word 1	word 1	word 1	VSW	unchanged
word 2	word 2	word 2	word 1	
word 3	word 3	word 3	word 2	
	word 4	word 4	word 3	
	zeros			

POP: CPYGB Copy variable-size group from Y pointer to bottom
             of marked roll

FORMAT: cpygb(Y)
         Y is the location of a roll pointer
         M = C(MRKER) 0-17

FUNCTION: In the following discussion, RP(Y) is the location
           of the VSW of the group to be copied, and
           C(VSW) 0-17 = V

    1. Set C(VARSIZ) 0-17 = V

    2. Bump bottom of roll M by V+1 words

    3. Set C(word 1) 0-17 = V
        Set C(word 1) 18-35 = 0

    4. Copy remaining words (if any) into words 2
        through V+1

EXAMPLE: cpygb(rolptr+5)

GRPSIZ+5	000000	000000
GRPSIZ+6	000000	000000

0   18   35

TOP+5	100000	000000
TOP+6	101000	000000

0   18   35

ROLPTR+5 | 10 | 0 | 5 |

0   18 30 35

BOTTOM+6 | 102000 | 000000 |

0   18   35

MRKER | 000006 | 000000 |

0   18   35

VARSIZ after | 000002 | unchanged |

0   18   35

BOTTOM+6 after | 102003 | 000000 |

0   18   35

Illustration

Roll 5

Anchor		
100000		
100010	000002	ignored
	000100	000000
	000200	000000
Bottom	0 18 35	

Roll 6

Anchor			
101000			
102000	000002	000000	Old bottom
	000100	000000	
	000200	000000	
	0 18 35		New bottom

POP: CPYX Copy expression

FORMAT: cpyx(N)
         M = C(MRKER) 0-17

FUNCTION: Case 1: Roll N is empty
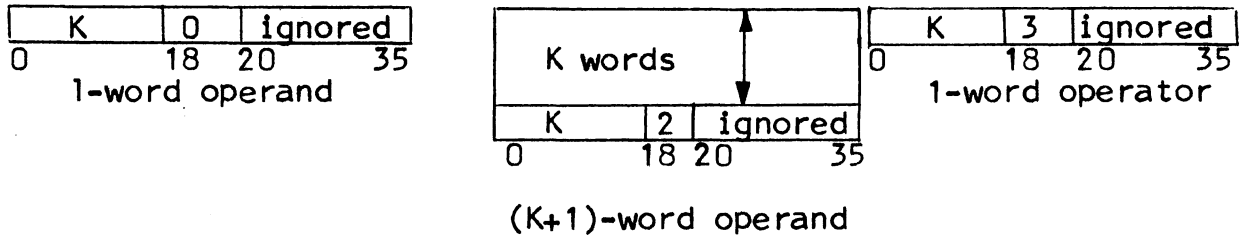
          Set false

          Case 2: Roll N is not empty

          1. Set true

          2. Determine the length of the expression to be
              copied, using the following rules:

a. The elements of the expression are either operands or operators:

K	0	ignored
0	18 20	35

1-word operand

```
┌──────────────────────┐
│                    ↑ │
│  K words           │ │
│                    ↓ │
├──────────────────────┤
│   K   │ 2 │ ignored  │
└──────────────────────┘
0      18  20        35
```

(K+1)-word operand

K	3	ignored
0	18 20	35

1-word operator

where: $K \geq 1$

b. Unless the expression consists only of one operand, its first element is an operator

c. Elements are stored backward (from bottom to top). The first element appears immediately above the bottom, but the last element does not necessarily end at the top.

d. The interpreter scans the elements from bottom to top. It initially sets a counter to 1. Each operand subtracts 1 from the counter. Each operator adds K-1 to the counter. When the count reaches 0, the expression ends.

3. Bump bottom of marked roll by number of words to copy

4. Copy expression onto the marked roll.

EXAMPLE:

Z = A + B   FORTRAN expression   Value f counter, after
= Z + A B   Polish expression   scanning of each element

Location	Representation on Roll			
B 100000	Offset of B in roll 0	0	anything	0
A 100001	Offset of A in roll 0	0	anything	1
+ 100002	2	3	code for +	2
Z 100002	Offset of Z in roll 0	0	anything	1
= 100004	2	3	code for =	2
	0	18 20	35	1 (initial value)

B, A, and Z are on links in roll 0. Here, the offsets are the locations of the VSW's for these links.

POP: CPYXP Copy expression, and prune

FORMAT: cpyxp(N)

FUNCTION: 1. Execute cpyx(N)

2. If true, set C(BOTTOM+N) 0-17 = location of last word in the expression; i.e., the word nearest the top of the roll.

POP: ZBG Zero bottom group

FUNCTION: Let G = C(GRPSIZ+N) 0-17 and V = C(VARSIZ) 0-17

Case 1: G ≠ 0

1. Make ROLPTR+N point to the bottom of roll N

2. Bump bottom of roll N by G words

3. Set C(word 1) = 0, ..., C(word G) = 0

Case 2: G = 0

1. Make ROLPTR+N point to the bottom of roll N

2. Bump bottom of roll N by V+1 words

3. Set C(word 1) 0-17 = V

Set C(word 1) 18-35 = 0

4. Set C(word 2) = 0,..., C(word V+1) = 0, if V>0

POP: SORTR   Sort roll

FORMAT: sortr(N)
          Roll N consists of 2-word groups; the first word of each
          group is the key.

FUNCTION: sort the groups of roll N (from top to bottom) so that
            the keys are in ascending logical order; i.e., the
            keys are interpreted as signless 36-bit numbers.

EXAMPLE:

sortr(5)

	Roll 5 Before	
top	12	0
	4	0
	1	0
	5	0
	1003	0
bottom	6	0
	0 18 35	

	Roll 5 After	
top	1	0
	5	0
	12	0
	4	0
	1003	0
bottom	6	0
	0 18 35	

COMMENT: This pop is used to sort addresses or one-word symbols.
           It is not used for sorting signed numbers; in this
           case, the positive numbers would precede the negative
           numbers.

2. Manipulation of Spill Rolls

a. Spill Rolls

The following discussion covers the use of spill rolls by a

two-pass compiler or assembler. These rolls cannot be used

by a one-pass procedure.

Assume N-1 is the last roll used, where N = C(OPNERS) 0-17.

Rolls N-1 and N-2 are used as read or write spill rolls, as

described below:

Pass 1:

    N-1 -- Write-spill roll
          The interpreter writes data on this roll

    N-2 -- Not used

Pass 2:

    N-1 -- Read spill roll
          The interpreter reads data from this roll

    N-2 -- Write-spill roll (binary roll)
          The interpreter writes data on this roll

Pass 3: WBIN (See WBIN pop)

    N-1 -- Not used

    N-2 -- Read spill (binary roll)
          The interpreter reads data from this roll, to
          produce text, linkage, and symbol segments
          during the execution of WBIN

RSPTR and WSPTR are data segment registers denoting offsets

on the current read- and write-spill rolls, respectively:

RSPTR
offset	ignored	N R
0	18	30 35

N R - Number of current
      read-spill roll

    NOTE: If C(RSPTR) = 0, there is no current
        read-spill roll

WSPTR
offset	ignored	N W
0	18	30 35

N W - Number of current
      write-spill roll

    NOTE: If C(WSPTR) = 0, there is no current
        write-spill roll

Words above the location denoted by RSPTR may be discarded.

Words above the location denoted by WSPTR may be written on

an auxiliary data segment, called a write-spill segment.

During pass 1, the write-spill segment is spill segment 1;

any data written on spill segment 1 is read during pass 2.

During pass 2, the write-spill segment is spill segment 2;

any data written on spill segment 2 is read during pass 3.

The first section of data from the appropriate spill segment

is read via a RWND pop; remaining sections are read via DNG

pops (see the discussions of these pops for details).

The read- and write-spill rolls consist of variable-size groups.

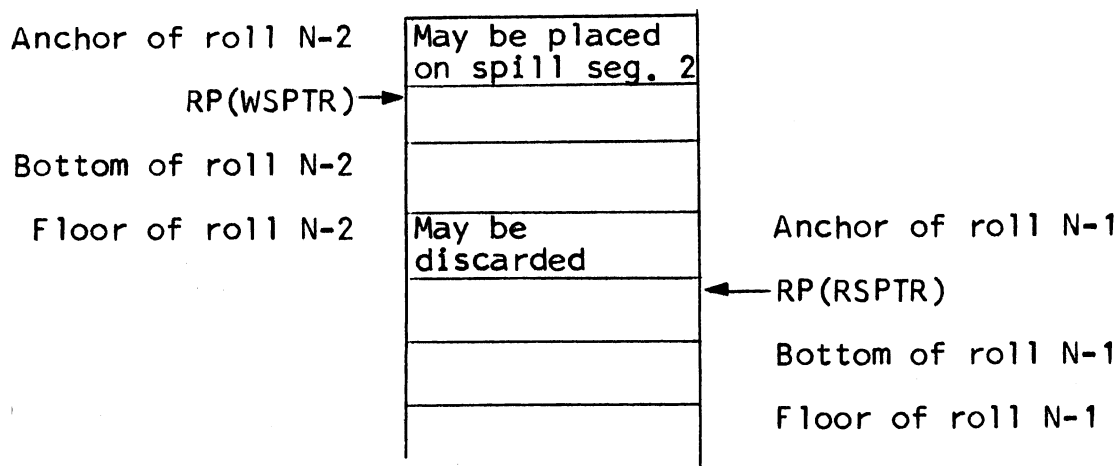Figure 2 illustrates the setup of these rolls during pass 2:

Anchor of roll N-2
RP(WSPTR)→

Bottom of roll N-2

Floor of roll N-2

```
┌──────────────────┐
│May be placed     │
│on spill seg. 2   │
├──────────────────┤
│                  │
│                  │
├──────────────────┤
│                  │
│                  │
├──────────────────┤
│May be            │
│discarded         │
├──────────────────┤        Anchor of roll N-1
│                  │
├──────────────────┤ ◄── RP(RSPTR)
│                  │
│                  │        Bottom of roll N-1
├──────────────────┤
│                  │        Floor of roll N-1
└──────────────────┘
```

Figure 2.   Setup of Read-Spill and Write-Spill Rolls During Pass 2

The following information is true for both the read-spill and the

write-spill rolls:

1.   Initially, anchor, top, and bottom are at the same location.

2.   Thereafter, anchor is the location of the first word in use;
     bottom is one word after the last word in use, and the
     distance between top and anchor = total number of words
     released.

3.   The only significance of top is for roll pointer addressing;
     i.e., the offset of any word on either of these rolls is
     fixed, even if information has been released above it.

b.   Manipulation of Space

Manipulation of spill rolls is summarized below:

Pass 1 -- N W = N-1

Assume: 1.   Interpreter tried to bump bottom of some roll,
               but there was insufficient space in the data
               segment.

          2.   C(WSPTR) ≠ 0

          3.   RP(WSPTR) > C(ANCHOR+N W) 0-17; i.e., there
               is available space to release, starting with
               the anchor and ending with RP(WSPTR) -1.

Action: 1.   Copy words from available space to spill segment 1
               (starting with next free location in spill
               segment 1).

          2.   Release the space on roll N W

          3.   Set C(ANCHOR+N W) 0-17 = RP(WSPTR)

          4.   Perform any necessary roll movements

Result: C(ANCHOR+N W) 0-17 - C(TOP+N W) 0-17 = cumulative
          number of words written on spill segment 1

Example:

     zbg(N W)   Here, the write-spill roll is the expanding roll

                    Before   After
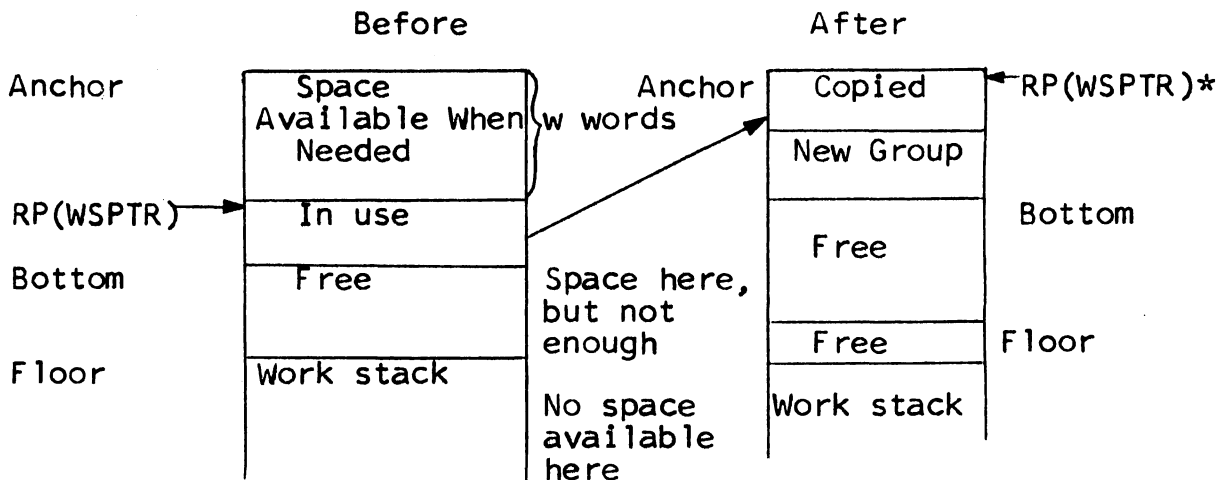
Anchor | Space |)   Anchor | Copied |◄─RP(WSPTR)*
            | Available When |w words | |
            | Needed |} | New Group |
                                                                      Bottom
RP(WSPTR)─► | In use | | |
                                                     | Free |
Bottom | Free | Space here,
                                    but not | Free | Floor
                                    enough
Floor | Work stack | | Work stack |
                                    No space
                                    available   *Top was adjusted by
                                    here   subtracting w words

Pass 2 -- N R = N-1

Assume: 1. Interpreter tried to bump bottom of some roll,
             but there was insufficient space in the data segment.

         2. C(RSPTR) $\neq$ 0

         3. RP(RSPTR) > C(ANCHOR+N R) 0-17; i.e., there is
             available space to release, starting with the
             anchor and ending with RP(RSPTR) -1.

Action: 1. Release space

         2. Set C(ANCHOR+N R) 0-17 = RP(RSPTR)

         3. Perform any necessary roll movements

Result: C(ANCHOR+N R) 0-17 - C(TOP+N R) 0-17 = Cumulative
         number of words released

Comment: In pass 2, roll N-2 may obtain space from roll N-1,

          without moving any words. The interpreter merely

          adjusts the floor of roll N-2, which is always the

          anchor or roll N-1. The interpreter releases only

          the required number of words from roll N-1, and saves

          the remaining releasable words for future allocation.

          During pass 2, usually more words are read than

          written. Therefore, the read-spill roll (N-1) should

          make space available to the write-spill roll (N-2)

          fast enough to eliminate the need for moving any words.

          In pass 2, the write-spill roll is manipulated in the

          manner described for pass 1. In this case, however,

          the write-spill roll is N-2, and released words are

          copied into spill segment 2.

RWND Pop

POP: RWND Rewind

FORMAT: rwnd(N)
N is the number of the current read-spill or
write-spill roll

FUNCTION: Case 1: If C(RSPTR) 30-35 = N, then rewind the
read-spill roll

1. Set C(TOP+N) = C(ANCHOR+N)
Set C(BOTTOM+N) = C(ANCHOR+N)

2. Set C(RSPTR) = 0

Case 2: If C(RSPTR) 30-35 ≠ N, then rewind the
write-spill roll

1. Set C(RSPTR) =

0	0	N
0	18 30	35

Set C(WSPTR) = 0

2. If current write-spill segment is
empty, go to next pop
Otherwise, perform steps a, b, and c

a. Copy remaining words from roll N
(anchor to bottom) to write-spill
segment. (This segment now becomes
the read-spill segment.)

b. Set C(TOP+N) = C(ANCHOR+N)

Set C(BOTTOM+N) = C(ANCHOR+N)

c. Get first section of groups
(implementation dependent) from new
read-spill segment and put them on the
bottom of roll N; i.e., bump the bottom
of roll N by the appropriate number of
words, and copy the words from the
read-spill segment to roll N.

COMMENT: The RWND pop should be used as follows:

At end of pass 1 -- rwnd(N-1)

At end of pass 2 -- {rwnd(N-1)
{rwnd(N-2)

E.   CONTROL POPS

Pops

POP: JMP   Jump

FORMAT: jmp(Y)
         Y is a location in the procedure segment

FUNCTION: 1. Set pop counter equal to Y

           2. Execute the pop at location Y

POP: JMPP Prune and jump

FORMAT: jmpp(Y)
         Y is a location in the procedure segment

FUNCTION: 1. Prune WO

           2. Set pop counter equal to Y

           3. Execute the pop at location Y

POP: JNX   Jump on no index

FORMAT: jnx(Y)
         Y is a location in the procedure segment

FUNCTION: If C(WO) 7-17 = 0, then execute jmpp(Y)

           If C(WO) 7-17 $\neq$ 0, then set C(WO) 7-17 = C(WO) 7-17 - 1

           NOTE: C(WO) 7-17 is called the count field.

EXAMPLE:

In this example, control passes to jmp(loop) three times; then,

WO is pruned, and control passes to done.

```
        eaw(3)
    loop:pop
        .
        .
        .
    jnx(done)
    jmp(loop)
```

POP: DOML Do machine language

FORMAT: doml(Y)

Y is a location in the procedure segment. It is
the location of the first word of a machine language
program

FUNCTION: Execute the GE-645 instruction tra(Y)

COMMENT: Assume that ALPHA is the current C(X1), and that
BETA is the location of the next pop to be
interpreted after leaving the machine language
program. At any location GAMMA, the machine
language program may return to the interpreter
as follows:

Case	Instruction(s)
BETA = ALPHA	gamma: tra(popset,ri)
BETA = ALPHA+1	gamma: tra(next,ri)
BETA = GAMMA+1	gamma: trx(x1,popset,ri)
Otherwise	gamma: 1dx(x1,beta,du)
	tra(popset,ri)

POPSET and NEXT are locations of ITS pairs in the data segment.

Each ITS pair points to a location in the interpreter segment.

POP: EXEC Execute

FORMAT: exec(Y)
Y is a location in the procedure segment

FUNCTION: Execute the pop at location Y, using the current
value of the pop counter; i.e., do not set the
pop counter to location Y.

EXAMPLE:

The following is part of a conversion routine to handle

principal part, decimal scale, and binary scale.

Assume C(W0) 0-17 = 0 if principal part is to be converted

                       1 if decimal scale is to be converted

                       2 if binary scale is to be converted

The following code appears in the procedure segment:

```
table: cona(char)
       conda(char)
       conba(char)
```

The code below could be used to convert a character

```
xntv(w0)
exec(table)     "execute one of the above three instructions"
jmp(endn)       "go here if end-of-line"
next pop        "go here otherwise"
```

COMMENT: If the executed pop is a JSB pop (see Paragraph F),

          then the exit stack records the location following

          the EXEC pop (not the location following the JSB pop).

F. SUBROUTINE POPS

Pops

POP: JSB Jump to subroutine

FORMAT: jsb(Y)
         Y is a location in the procedure segment. It is
         the location of an entry word in a subroutine

FUNCTION: 1. Add 2 to exit counter

            2. Set C(word 1) 0-17 = L + 1, where L is the
                location of the current JSB pop

                Set C(word 1) 18-35 = current work size

                Set C(word 2) = 0 (i.e., set false)

            3. Execute jmp(Y)

POP: EXIT Exit

FORMAT: exit(N)
         N is usually 0.

FUNCTION: 1. Prune two words from the exit buffer

            2. Jump to location L + N + 1, where L is the
                location of the last executed JSB pop.

            3. Restore true/false status that existed before
                the last JSB was executed.

POP: EXITP Prune and exit

FORMAT: exitp(N)

FUNCTION: 1. Execute PRWX pop

            2. Execute exit(N) pop

COMMENT: exitp(N) is equivalent to prwx( )
                                     exit(N)

POP: PRE   Prune exit

FORMAT: pre(Y)

FUNCTION: Subtract 2 * C(Y) 0-17 from exit counter; i.e., prune
            exit stack by C(Y) 0-17 pairs of words

EXAMPLE:

Assume a program contains the following subroutine calls:

```
        ┌─────────────────┐
        │  subroutine 1   │
        └─────────────────┘
                 │ calls
                 ▼
        ┌─────────────────┐
        │  subroutine 2   │
        └─────────────────┘
                 │ calls
                 ▼
        ┌─────────────────┐
        │  subroutine 3   │
        └─────────────────┘
```
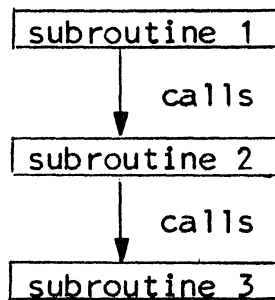
Assume C(C2) = | 000002 | 000000 |
                0   18   35

To return directly from a location in subroutine 3 to location

ALPHA in subroutine 1, the user would write:

```
pre(c2)
jmp(alpha)
```

G. ADDRESS SUBSTITUTION POPS

The locations W0 through W5, and D0 through D5 are treated as pops when they appear as operands with other pops; e.g., add(w0). Another group of pops, A0 through A5, are also in this category (see Argument Pops below).

Pops

POP: The work pops: W0, W1, W2, W3, W4, and W5

FORMAT: pop(Wn)

   n = 0, 1, 2, 3, 4, or 5

FUNCTION: 1. Form a new pop whose left half is the location of Wn and whose right half is "pop"

   2. Execute this new pop

EXAMPLE:

Assume that the work counter is set at 777005.

add(w3) look like this:

6	335
0	18 35

The interpreter converts this to:

777002	6
0	18 35

   This means: Set C(W0) = C(W0) + C(777002)

COMMENT: If a work pop has a true or false tag, the tag is added to Wn, and the test is made before step 1.

POP: The dummy pops: D0, D1, D2, D3, D4, and D5

FORMAT: pop(Dn)

   n = 0, 1, 2, 3, 4, or 5

FUNCTION: 1. Form a new pop whose left half is C(Dn) 0-17 and whose right half is "pop"

   2. Execute this new pop

EXAMPLE:

Assume that the dummy counter is set at 777405

777404 | 3000 | 0 |
　　　　0　　　18　35

add(d1) looks like this: | 6 | 42 |
　　　　　　　　　　　　　0　　18　35

The interpreter converts this to: | 3000 | 6 |
　　　　　　　　　　　　　　　　　0　　　18　35

This means: Set $C(W0) = C(W0) + C(3000)$

COMMENT: If a dummy pop has a true or false tag, the tag is added to Dn, and the test is made before step 1.

POP: The argument pops: A0, A1, A2, A3, A4, and A5

FORMAT: pop(An)

n = 0, 1, 2, 3, 4, or 5

FUNCTION: Get the argument of "pop" from the argument list of the last executed JSB pop.

Assume the last executed JSB pop is at location L.

Location	Pop
L+0	jsb(Y0)
L+1	bort(Y1)
L+2	bort(Y2)
L+3	bort(Y3)
L+4	bort(Y4)
L+5	bort(Y5)

NOTE: The subroutine should be terminated by the pop exit(5), so that none of the BORT pops will be executed.

1. Form a new pop whose left half is Yn and whose right half is "pop"

2. Execute this new pop

EXAMPLE:

Assume that the last JSB pop is at location L and that

locations L through L+2 contain the following data:

	j	jsb
L	j	jsb
L+1	a	bort
L+2	b	bort

0   18 35

add(a1) looks like this: | 6 | 366 |

0   18 35

The interpreter converts this to: | a | 6 |

0   18 35

This means: Set $C(WO) = C(WO) + C(a)$

COMMENTS: 1.   If an argument pop has a true or false tag,
the tag is added to An, and the test is made
before step 1.

2.   The use of BORT pops in forming the argument
list insures against a possible bug in the pops
procedure. If control accidentally reaches
one of these pops, the interpreter will abort
the procedure.

3.   The number of BORT pops depends on the number
of arguments. If there are more than 5 arguments,
then an XNDW pop must precede any reference to
the sixth (or succeeding) argument.

4.   The argument indices and the exit indices are
off by one; e.g., termination of a subroutine
by exit(0) would set the pop counter to
location L+1.

H. INDEX POPS

Each index pop is followed by another pop, and it modifies the operand of this following pop. This modification affects only the execution of the modified pop; it does not change the representation of the pop in the procedure segment.

<u>Pops</u>

POP: XNTF   Index next table by fixed

FORMAT: xntf(Y)
         pop(Z)

FUNCTION: Use Y + Z instead of Z

EXAMPLE: See Figure 3

COMMENT: The following coding illustrates the use of the
          XNTF pop:

```
        l:  xntf(3)
        m:  stor(table)
              .
              .
              .
            jmp(1) "To store in TABLE+3"
            jmp(m) "To store in TABLE"
```

POP: XNTV   Index next table by variable

FORMAT: xntv(Y)
         pop(Z)

FUNCTION: Use C(Y) 0-17 + Z instead of Z

EXAMPLE: See Figure 3

POP: XNIF Index next indirect by fixed

FORMAT: xnif(Y)
         pop(Z)

FUNCTION: Use Y + C(Z) 0-17 instead of Z

EXAMPLE: See Figure 3

POP: XNIV   Index next indirect by variable

FORMAT: xniv(Y)
         pop(Z)

FUNCTION: Use C(Y) 0-17 + C(Z) 0-17 instead of Z

EXAMPLE: See Figure 3

POP: XNPF   Index next pointer by fixed

FORMAT: xnpf(Y)
         pop(Z)

FUNCTION: Use Y + RP(Z) instead of Z

EXAMPLE: See Figure 3

POP: XNFP   Index next fixed by pointer

FORMAT: xnfp(Y)
         pop(Z)

FUNCTION: Use RP(Y) + Z instead of Z

EXAMPLE: See Figure 3

POP: XNPV   Index next pointer by variable

FORMAT: xnpv(Y)
         pop(Z)

FUNCTION: Use C(Y) 0-17 + RP(Z) instead of Z

EXAMPLE: See Figure 3

POP: XNVP   Index next variable by pointer

FORMAT: xnvp(Y)
         pop(Z)

FUNCTION: Use RP(Y) + C(Z) 0-17 instead of Z

EXAMPLE: See Figure 3

POP: XNDW   Index next work, dummy, or argument

FORMAT: xndw(Y)
         pop(Z)

FUNCTION: Add C(Y) 0-17 to work, dummy, or argument address

EXAMPLE: See Figure 3

Data Segment Setup   Some characteristics of roll 5

Location

100	5	ignored
200	700	ignored
300	2	ignored

0   18   35

C(TOP+5) 0-17 = 120000
ROLPTR+5 =

1	x	5

0   18   30 35

RP(ROLPTR+5) = 120001

EXAMPLES:

xntf(3)
            = stor(403)
stor(400)

xntv(100)
                   = stor(405)
stor(400)

xnif(3)
            = stor(703)
stor(200)

xniv(100)
                   = stor(705)
stor(200)

xnpf(3)
            = stor(120004)
stor(rolptr+5)

xnfp(rolptr+5)
                   = stor(120004)
stor(3)

xnpv(100)
            = stor(120006)
stor(rolptr+5)

xnvp(rolptr+5)
                   = stor(120006)
stor(100)

xndw(300)
            = stor(w1)
stor(w3)

xndw(300)
            = stor(d1)
stor(d3)

xndw(300)
            = stor(a5)
stor(a3)

Figure 3. Examples of the Index Pops

General Comments

1. XNDW is the only indexing pop that can be followed by
    an address substitution pop.

2. XNFP and XNVP are faster than XNPF and XNPV, respectively.

3. The following example illustrates a complex use of the
    XNTV pop:

            xntv(w0)
            stor(400)

    Assume W0 is at location 777000 in the data segment,

    and that it has the following format:

    W0 | 000007 | 000000 |
       0   18   35

    xntv(w0) looks like this: | 354 | 332 |
                                     0   18   35

    The interpreter converts this to: | 777000 | 354 |
                                        0   18   35

    Thus, the modified pop is: stor(407)

I. MOVE POPS

Pops

POP: MOV Move

FORMAT: mov(Y)
         to(Z)

FUNCTION: Set C(Z) = C(Y) and skip the pop to (Z)

        NOTE: The interpreter ignores the number of the pop
               following the MOV pop

EXAMPLE:

mov(c3)
to(varsiz)

    C3 | 000003 | 000000 |
            0   18   35

    VARSIZ after | 000003 | 000000 |
                      0   18   35

COMMENTS: See TO

POP: TO

FORMAT: mov(Y)
         to(Z)

FUNCTION: See MOV

COMMENTS: 1. The TO pop should not be executed alone. However,
               the user may allow a certain number of illegal
               executions of the TO pop to occur before an abort,
               by setting TOCNT, a one-word register in the data
               segment.

               When a TO pop is executed alone, the interpreter
               adds 1 to C(TOCNT). If C(TOCNT) is 0 or positive,
               an abort occurs. If C(TOCNT) is negative, an error
               message is printed (e.g., EXECUTED TO POP AT
               015610); and the interpreter executes the next pop.

2. The following rules apply to the MOV and TO pops:

    a. The TO pop must have the same tag (true, false, or none) as the MOV pop has

    b. The TO pop cannot be indexed

    c. The operand of the TO pop cannot be an address substitution pop

NOTE: The following code is permitted:

Indexed Move	Move with Address Substitution Pop
xnpf(5) mov(rolptr+6) to(alpha)	mov(w3) to(alpha)

3. The following comparative code shows the advantage of the MOV pop:

Fast	Slower	Even Slower
mov(Y) to(Z)	cload(Y) stor(Z)	load(Y) storp(Z)
2 pops in one		Pushes down and pops up work

POP: MOVF Move from

FORMAT: movf(Y)

FUNCTION: Set C(FROM) 0-17 = Y

    FROM is a one-word register in the data segment. (The interpreter ignores C(FROM) 18-35)

EXAMPLE: See MOVT

COMMENTS: See MOVT

POP: MOVT   Move to

FORMAT: movt(Y)

FUNCTION: Move n consecutive words from starting location
C(FROM) 0-17 to starting location Y.
n = C(WO) 0-17
FROM is a one-word register in the data segment.
(The interpreter ignores C(FROM) 18-35.)

EXAMPLE: In this example, the words at locations ALPHA -- ALPHA+7
are moved to locations BETA -- BETA+7.

```
ceaw(7)
movf(alpha)
movt(beta)
```

COMMENTS: 1.   Each MOVF overrides the preceding MOVF

2.   Any number of MOVT pops may follow a MOVF pop

3.   Any number of pops may be executed between a
MOVF pop and a MOVT pop

4.   There are no restrictions concerning true/false
tags, or the use of address substitution pops

5.   Words are moved in a forward sequence; thus, the
upward move on the left works and the downward
move on the right does not work:

Upward Move

Position	Before	After
Position 1	x	1
Position 2	x	2
Position 3	x	3
Position 4	1	4
Position 5	2	5
Position 6	3	6
Position 7	4	7
Position 8	5	5
Position 9	6	6
Position 10	7	7
Position 11		
Position 12		

Downward Move

Before   After
x
x
x
1   1
2   2
3   1
4   2
5   1
6   2
7   1
x   2
x   1
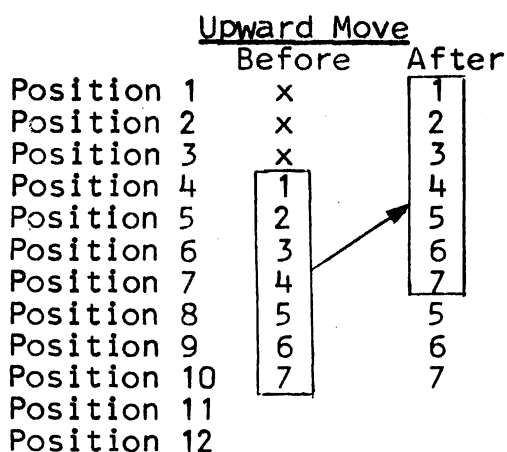
Here, the numbers in the left
column were moved up 3 positions
to form the right column. The
boxed numbers were moved.
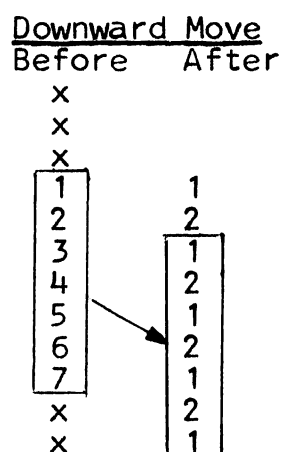
Here, the numbers in the left
column were moved down 2 to
form the right column. The
boxed numbers were moved.

J. INPUT POPS

1. Character Input

The source of character input is an input stream. There
are two types of input streams: the source procedure, and
strings. The source procedure is the ASCII text in the
input segment; e.g., FORTRAN source procedure. String
input consists of portions of type-1, type-2, or type-3
strings, as summarized below:

string	Input Stream
Type-1	Excludes count-character and characters not included in the count
Type-2	Excludes end-of-file character and any characters that follow it
Type-3	Excludes the two control words at the beginning of each group of the string

Characters excluded from a string direct the interpreter in
delimiting the string.

The source procedure comes from a file that was previously
created on the console. Type-1 and type-2 strings come from
SYMBUF or rolls. Type-3 strings come from rolls.

There is only one input stream at a time; this is called the
current input stream. Initially, the current input stream
is the source procedure.

The input stream can be changed by a SWIP or a SWAP pop.
The SWIP pop nests input streams; this is similar to the
nesting of subroutines by JSB and EXIT: swip(0) corresponds
to the EXIT pop; and swip(Y), where $Y \neq 0$, corresponds to
the JSB pop. On the other hand, the SWAP pop is similar to
the JMP pop, in that it changes input streams without
changing nesting.

2. Input Registers

The input registers reflect the status of the current input

stream.   The status may be one of the following:

        Initial -- Signifies beginning of line (applicable only to
                the source procedure)

        Normal -- Signifies middle of line or string

        End-of-file -- Signifies no more lines, if current input
                  stream is the source procedure
                  Signifies no more characters, if current
                  input stream is a string

The input registers are one-word registers in the data segment:

TLYIN -- GE-645 tally word. Points to next available character
       in the current input stream.

          NOTE: TLYIN points to a location in the data segment.
               If the current input stream is the source
               procedure, this location is in a buffer containing
               information which the interpreter copies from
               the input segment.

MODES -- C(MODES) 0-17 = -1 if current input stream is the
                    source procedure
                    Location of NXST file, if current input
                    stream is a string (See NXST.)

          C(MODES) 18-35 = 0 if current status is normal
                       -2 if current status in initial
                       -6 if current status is end-of-file

CHARC -- C(CHARC) 0-17 = Column number of current input
                    character. (On a source procedure line,
                    the leftmost character occupies
                    column 1.)

CHAR -- Representation of current character in the input stream,
       as it appears in the TRANS table (See Chapter 1,
       Paragraph G.2.b.)

Keys	ASCII or spec. char	Keys	
0	9	18	35

CRDNUM -- C(CRDNUM) 0-17 - Must be zero

> C(CRDNUM) 18-26 = Number of last group processed
> in current type-3 string

> C(CRDNUM) 27-35 - Must be zero

CRDNUM+1 -- C(CRDNUM+1) 0-17 - Must be zero

> C(CRDNUM+1) 18-26 = Number of groups in current
> type-3 string

> C(CRDNUM+1) 27-35 - Must be zero

SWIP and SWAP initialize all necessary input registers
for a new current input stream. The character input
subroutine shared by the next character and next *string*
pops updates the input registers each time it fetches a
character from the current input stream.

3. Character Input Pops

Pops

POP: NXCH Get next character

FORMAT: a: nxch( )

FUNCTION: 1. If status is end-of-file, execute the pop
in location 2 in the procedure segment. This
will usually be a JMP or a JSB pop.

If status is initial, then change it to normal;
and get next character, if any.

If status is normal, then get next character,
if any.

2. Case 1: If successful in getting another
character

a. Add 1 to column number

b. If this character is to be skipped, get
next character, if any, and go back to
beginning of step 2.

      c. If this character is octal 201, then set status to end-of-file and jump to location a+1 in the procedure segment.

         If this character is octal 000, octal 001, . . ., or octal 177, then store the character and its keys in CHAR, and jump to location a+2.

Case 2: If unsuccessful in getting another character, and input is from the console

Try to get the next line:

    If unsuccessful, set status to end-of-file, and jump to location a+1

    If successful, set status to initial, set column number to 0, add 1 to alter number, and jump to location a+1

Case 3: If unsuccessful in getting another character, and input is from a roll

    If this is the end of a type-1 or type-3 string, set end-of-file condition, and jump to location a+1

    If this is a type-2 string, the unsuccessful condition cannot occur, since these strings are terminated with an end-of-file character (octal 201).

EXAMPLE: See PAKA, Paragraph K

POP: NXST   Next string

FORMAT: a: nxst(Y)

Y is the location of a 3-word file:

	location of key word	roll # if non-0 SYMBUF if 0
Y		
Y+1	type of string 1, 2, or 3	Pack-from option 0 = off non-0 = on
Y+2	Used only by NXSTCS, SWIP, and SWAP	
	0	18 35

C(Y) 0-17 -- Location of word with keys in bits
0-8 and 18-35

C(Y) 18-35 -- Roll into which string is to be
packed (or SYMBUF if 0)

C(Y+1) 0-17 -- Type of string to be formed

C(Y+1) 18-35 -- Option determining whether
C(CHAR) 9-17 is to be packed into
the string

FUNCTION: Pack the characters from the current input
stream into SYMBUF or on a roll, forming a type-1,
type-2, or type-3 string. Pack characters from
left to right. If the string is being formed
on a roll, start forming the string at the bottom
of the roll. If the string is being formed in
SYMBUF, assume that an RSYM pop was executed, and
start forming the string in the first location
in SYMBUF.

1.   Initialize string according to its type

2.   If the pack-from option is on, then pack
C(CHAR) 9-17 into the string

3.   Simulate NXCH pop, with exceptions noted below

4.   Case 1:   If successful, compare keys in CHAR
with keys specified in key word.
If one or more bits match, terminate
the string according to type, and jump
to location a+2 in the procedure
segment. (Also perform Case 2.c)
Otherwise, pack C(CHAR) 9-17 into the
string, and go back to step 3.

Case 2:   If unsuccessful, perform the following
steps:

a. Terminate string according to type

b. Set C(CHAR) =

000000	777777
0	18 35

c. If the string was formed on a roll,
then make the corresponding roll
pointer point to the location of the
first word in string

d. Jump to location a+1 in the procedure
segment

COMMENT: On end-of-line, the interpreter goes to the next
pop (same as NXCH).

POP: NXSTC Next string continued

FORMAT: a: nxstc(Y)

FUNCTION: Continue forming a string (with an option to pack the
current character).
Execute NXST pop, eliminating step 1.

EXAMPLE: In this example, the interpreter forms a string in
SYMBUF, beginning with a left parenthesis and ending
with a right parenthesis.

FILE1	KEY1	0
	1	1
	not used	

0   18   35

KEY1	000000	000003

0   18   35

Assume the keys have the following meaning:

Bit 34 -- 1 if ∿ (escape character)
Bit 35 -- 1 if)

Assume that the current character is a left parenthesis.

Code:
```
      rsym( )
      nxst(file1)                "pack initial left parenthesis and
                                  string up to break"
      jmp(error)                 "special case if end of line"
more:scha(trans+octal(176))      "advance if escape"
      jmp(error)                 "special case if end of line"
      jmp(done,f)                "right parenthesis encountered
                                  instead"
      nxstc(file1)               "continue string with escaped
                                  character"
      jmp(error)                 "special case if end of line"
      jmp(more)                  "test break character"
        .
        .
        .
done:pak(char)                   "pack terminal right parenthesis"
      cnts( )                    "count the string"
```

COMMENT: On end-of-line, the interpreter goes to the next
pop (same as NXCH).

POP: NXSTCS   Next string continued and save

FORMAT: a: nxstcs(Y)
          Y is the location of a file with the same format
          as the file for NXST.   (See NXST.)

FUNCTION: Save next available position in type-3 string,
           and then continue forming string.

     1.   Set $C(Y+2)$ = coded information describing
          current input character and next available
          position in string being formed

     2.   Execute nxstc(Y)

COMMENTS: 1.   NXSTCS may not be used to form type-1 or
                type-2 strings

           2.   The pops swip(Y) and swap(Y) use the information
                in Y+2 to determine whether to switch to the
                beginning of an input stream or to a saved
                position in the stream.
                If $C(Y+2) = 0$, swip(Y) or swap(Y) switches
                to the beginning of the stream. The pops
                procedure is responsible for clearing $C(Y+2)$,
                whenever necessary.

           3.   On end-of-line the interpreter goes to the
                next pop (same as NXCH).

POP: NXICH   Get next initial character

FORMAT: nxich( )

FUNCTION: If the current status is normal, get the first
           character of the next line
           If the current status is end-of-file, execute the
           pop in location 2 of the procedure segment
           If the current status in initial, get the first
           character of the current line

COMMENT: 1.   This pop can only be used with the source
                procedure. It cannot be used with string
                input.

           2.   On end-of-line, the interpreter goes to the
                next pop (same as NXCH).

4. Changing Input Streams

Pops

POP: SWAP   Swap input streams

FORMAT: swap(Y)

> Y is the location of a file with the same format as the file for NXST. (See NXST.)
>
> If C(Y) 18-35 = 0, the new input stream is in SYMBUF
>
> If C(Y) 18-35 = N, the new input stream is on roll N and RP(ROLPTR+N) is the location of the first word

FUNCTION: Change current input stream, as directed by the file at location Y.

> If C(Y+2) = 0, set C(CHARC) = 0
>
> Otherwise, set CHAR and CHARC according to coded information in C(Y+2)   (See NXSTCS.)

COMMENTS: 1.   If Y = 0, then the interpreter aborts the pops procedure

2.   SWAP can only change the input stream to SYMBUF or a roll

POP: SWIP   Switch input streams recursively

FORMAT: swip(Y), where Y ≠ 0   (Here, Y is the location of a
             or   file with the same format as
          swip(0)   the file for NXST.)

FUNCTION: Case 1:   The operand is Y; Y≠0

1.   Bump bottom of roll 4 (swip roll) by three words

2.   Use these three words to record current position in current input stream for later use by a swip(0)

3.   Execute swap(Y); i.e., change input streams as directed by the file at location Y

Case 2:   The operand is O

    1.   Get three words off the bottom of roll 4

    2.   Use these words to recover current position
       in a previous input stream

    3.   Change to previous input stream, as directed
       by these words

    4.   Prune roll 4 by three words

COMMENT: 1.   It is illegal to change the input stream to
        a type-3 string using a swip(Y) pop, if a
        type-3 string is already nested

       2.   The swip(Y) pop can only change the input stream
        to SYMBUF or a roll

       3.   The input stream can be changed to the source
        procedure only by the appropriate number of swip(O)
        pops.

5.   Changing Mode

Pops

POP: MODB   Mode blank

FORMAT: modb( )

FUNCTION: Cause NXCH to accept any character; i.e., after this
        pop, NXCH will accept any character, until the
        next MODNB pop says otherwise.

POP: MODNB   Mode non-blank

FORMAT: modnb(Y)
        Y is usually a location the the TRANS table.
        C(Y) 9-17 = character to be skipped
        modnb( ) is equivalent to modnb(trans+octal (40)) --
        blank is 040

FUNCTION: Cause NXCH to skip the character whose code matches
        C(Y) 9-17
        If Y = O, then NXCH will skip blanks.

EXAMPLE: In this example, NXCH gets the next non-blank
        character
```
                modnb( )
                   .
                   .
                   .
                nxch( )
                jmp(end1n)
```

K. STRING MANIPULATION POPS

Pops

POP: CNTS   Count symbol

FORMAT: cnts(Y)

FUNCTION: Assume SYMBUF contains a type-1 string

1. Count the number of characters and the number of words in type-1 string in SYMBUF.

2. Set C(SYMBUF) 0-8 = number of characters in string. Set C(SYMCNT) 0-17 = number of words in string.

3. If Y is a non-zero, then set C(Y) 0-17 = number of words in string. Otherwise, do not change C(Y) 0-17.

This is illustrated below:

SYMCNT	W	
SYMCNT+1		
SYMBUF	C		

0   9   18   27 35
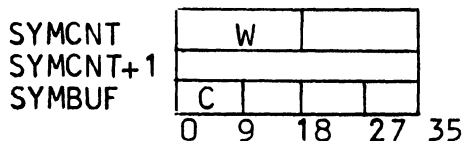
The interpreter would change W and C. If Y ≠ 0, C(Y) 0-17 would be set to W. NOTE: W = C/4 + 1 (ignoring remainder)

POP: RSYM   Reset symbol buffer

FORMAT: rsym( )

FUNCTION: Assume SYMBUF contains a type-1 string

1. Count the type-1 string currently in SYMBUF (i.e., count the number of words and the number of characters in SYMBUF).

2. Change the count field of the string to zero.

3. Change the remaining characters in the string to blanks

4. Set C(SYMCNT) = 0 Set C(SYMCNT+1) = 0

POP: PAK Pack

FORMAT: pak(Y)

FUNCTION: Insert C(Y) 9-17 immediately to the right of the
            last character inserted into SYMBUF
            C(Y) 9-17 is a 9-bit ASCII character

EXAMPLE: pak(char)

The character 1 would look like this in CHAR:

keys	061	keys
0	9	18 35

If SYMBUF contains the null string, the interpreter sets
C(SYMBUF) as follows:

0	1	₿	₿
0	9	18	27 35

POP: PAKR Reset and pack

FORMAT: pakr(Y)

FUNCTION: 1. Execute RSYM pop
            2. Execute pak(Y) pop

POP: PAKA Pack and advance

FORMAT: paka(Y)

FUNCTION: 1. Execute pak(Y) pop
            2. Execute NXCH pop

EXAMPLE: The following coding causes the interpreter to keep
           packing characters into SYMBUF, until it receives
           a blank:

```
          modb( )              "accept blanks"
          rsym( )              "reset symbol to blanks"
loop;     nxch( )              "get next character"
          jmp(endln)           "special case if end of line"
          sch(trans+octal(40)) "octal 40 is blank"
          jmp(blk,t)           "jump if blank"
          paka(char)           "otherwise, pack in symbol,
                                and advance"
          jmp(endln)           "special case if end of line"
          jmp(loop+2)          "continue"
              .
              .
              .
blk:      cnts( )              "count the symbol"
```

COMMENT: On end-of-line, the interpreter goes to the next
           pop (same as NXCH).

POP: PAKAR Reset, pack, and advance

FORMAT: pakar(Y)

FUNCTION: 1. Execute RSYM pop

2. Execute pak(Y) pop

3. Execute NXCH pop

COMMENT: On end-of-line, the interpreter goes to the next pop
(same as NXCH).

POP: PLXP Plex put

FORMAT: plxp(N)

FUNCTION: Given a type-1 string in SYMBUF, put a plex on the
bottom of roll N. The string need not have been
counted.

1. Count the string in SYMBUF (i.e., count the number
of words and the number of characters)
w = number of words

2. Bump bottom of roll N by $w+1$ words

3. Move type-1 string from SYMBUF to word 1 -- word w
(inclusive)

4. Set C(word $w+1$) 0-17 = w (the lower half of this
word is used by the interpreter.)

EXAMPLE:

plxp(5)

Assume the type-1 string "continue" is in SYMBUF.

Roll 5 after

8	c	o	n	Old bottom
t	i	n	u	
e	ø	ø	ø	
3	special			

0   9   18 27 35 New bottom

POP: PLXG   Plex get

FORMAT: plxg(N)

FUNCTION: Given a plex on the bottom of roll N, form a type-1
            string in SYMBUF.

    1.   Recover number of words in string (w words)
        from the last word of the plex (word w+1)
        w = C(word w+1) 0-17 (See PLXP)

    2.   Move word 1 -- word w (inclusive) to SYMBUF --
        SYMBUF + w - 1 (inclusive)

    3.   Set C(SYMCNT) 0-17 = w

    4.   Set C(SYMCNT) 18-35 = 0

    5.   Set C(SYMCNT+1) = C(word w+1)

    6.   If the previous string in SYMBUF had more than
        w words, then fill these words with ASCII
        blanks.

EXAMPLE:

plxg(5)

Assume roll 5 contains the plex shown in the example for PLXP.

plxg(5)

SYMBUF after

SYMCNT	3	0	
SYMCNT+1	3	special	
SYMBUF	8	c	o	n
	t	i	n	u
	e	b̸	b̸	b̸

0   9   18 27 35

POP: PLXM   Plex make

FORMAT: plxm(N)

FUNCTION: Convert a type-1 string into a plex. Assume the
following:

RP(ROLPTR+N) is the location of the VSW of the last
group on roll N. This group contains a type-1 string.
The bottom of roll N follows the last word of the
string
The string has been counted (i.e., the number of
words and the number of characters have been counted)

NOTE: The group need not have been counted

Let w = number of words in the string

1. Bump bottom of roll N by 1 word

2. Set C(word 1) 0-17 = w (The lower half of
this word is used by
the interpreter)

3. Set C(VSW) 0-17 = w+1

Set C(VSW) 18-35 = 0

EXAMPLE:

plxm(5)

Assume the last group on roll 5 is the string, "continue".

Roll 5 after

4		0	
8	c	o	n
t	i	n	u
e	⌀	⌀	⌀
3		special	

Old bottom
New bottom

0   9   18   27 35

POP: CCAT Concatenate

FORMAT: ccat(N)

FUNCTION: Concatenate a type-1 string in SYMBUF to a type-1
string in roll N.

Assume the following:

RP(ROLPTR+N) is the location of the first word
of the second type-1 string

The bottom of roll N immediately follows the
last word of the second type-1 string

Both type-1 strings have been counted (i.e.,
the number of words and the number of characters
have been counted)

1. Bump bottom of roll N if the concatenated string
requires more words.

2. Add the character count of the first string
to the character count of the second string.

3. Concatenate the first string to the second
string.

4. Insert trailing blanks into the last word,
if necessary.

EXAMPLE:

ccat(5)

Assume SYMBUF contains the string, "to", and RP(ROLPTR+5)
is the location of the string, "go".

Resulting string in roll 5:

4	g	o	t
o	b̸	b̸	b̸

0   9   18 27 35   new bottom

old bottom

L. SYNTAX POPS

<u>Pops</u>

POP: FEX   Set FEXIT

FORMAT: fex(Y)

FUNCTION: Set C(FEXIT) 0-17 = Y

   FEXIT is a one-word register in the data segment.
   (The interpreter ignores C(FEXIT) 18-35)

POP: PSAV   Position save

FORMAT: psav( )

FUNCTION: 1. Bump bottom of roll 2 (save roll) by four words

   2. In these four words, record the current status
       of the input stream.

EXAMPLE: See PRES

POP: PRES   Position restore

FORMAT: pres( )

FUNCTION: If C(BOTTOM+2) 0-17 ≠ C(TOP+2) 0-17, go back to last
           saved position; and remove four words from roll 2.

   Otherwise, take no action

EXAMPLE:

Input stream: ABCDEF

<u>Pop</u>	<u>Character read</u>
nxch( )	A
popnop( )	
psav( )	
nxch( )	B
popnop( )	
nxch( )	C
popnop( )	
pres( )	
nxch( )	B
popnop( )	

POP: PDES   Position destroy

FORMAT: pdes( )

FUNCTION: If $C(BOTTOM+2)$ 0-17 $\neq$ $C(TOP+2)$ 0-17, prune four
words from the bottom of roll 2

M. COUNTING POPS

Pops

POP: ZER   Zero

FORMAT: zer(Y)

FUNCTION: Set C(Y) = 0

POP: ZERD   Zero double

FORMAT: zerd(Y)   Y is an even address

FUNCTION: Set DP(Y) = 0

POP: ONE   One

FORMAT: one(Y)

FUNCTION: Set C(Y) 0-17 = 1
           Set C(Y) 18-35 = 0

POP: INC   Increment

FORMAT: inc(Y)

FUNCTION: Set C(Y) 0-17 = C(Y) 0-17 +1

POP: DCR   Decrement

FORMAT: dcr(Y)

FUNCTION: 1. If C(Y) 0-17 = 0, set false
               If C(Y) 0-17 ≠ 0, set true

           2. If true, set C(Y) 0-17 = C(Y) 0-17 -1

EXAMPLE:

In this example, control passes to loop three times; then control
passes to the pop after jmp(loop,t).

```
                ceaw(3)
                stor(alpha)
        loop:   pop
                  .
                  .
                  .
                dcr(alpha)
                jmp(loop,t)
```

N. CONVERSION POPS

The following number will be used to demonstrate the use of
the conversion pops:

$$1.5e2b17$$

This number is equivalent to the fraction:

$$\frac{1.5 * 10**2}{2**17}$$

It is represented in octal as follows:

| 000226 | 000000 | (226 octal = 150 decimal)
|--------|--------|
0   18   35

The number consists of three parts:

  1.5 -- Principal part. If a sign preceded this number,
         the interpreter would not consider the sign to
         be included in the principal part.

  e2 -- Decimal scale. The decimal scale may be positive
         or negative.

  b17 -- Binary scale. The binary scale may be positive
         or negative.

1. Setting Mode

The interpreter uses the data-segment register CONMOD, to

determine whether a number to be converted to binary format

is to be treated as a decimal number or an octal number.

It has the following format:

CONMOD | 0 = dec. 1 = oct. | ignored |
       0   18   35

Pops That Set CONMOD

POP: MODD   Decimal mode

FORMAT: modd( )

FUNCTION: Set C(CONMOD) 0-17 = 0; i.e., cause decimal conversions

POP: MODO   Octal mode

FORMAT: modo( )

FUNCTION: Set C(CONMOD) 0-17 = 1; i.e., cause octal conversions

2. The Number Buffer

Number conversions occur in the following group of contiguous
data-segment registers, the number buffer:

	0	7 8	18	35
CONBUF CONBUF+1	Principal part (ignoring the decimal point) changed to binary. A two-word signless integer.			
FCNT	# of digits to right of dec. pt.		Set to 0 and ignored	
SIGN	Sign of number. 0 = + non-zero = -			
DSCALE	# after e Pos. or neg.		Set to 0 and ignored	
BSCALE	# after b Pos. or neg.		Set to 0 and ignored	
DSIGN	Sign of dec. scale 0=+, nonzero = -		Set to 0 and ignored	
BSIGN	Sign of bin. scale 0 = +, nonzero = -		0=no bin. scale # 1=bin. scale #	

The user sets the following registers in the number buffer:
FCNT, SIGN, DSIGN, and the upper half of BSIGN. The following
coding is recommended for this purpose:

> To signify a negative number -- one(sign)
>
> To signify a negative decimal or binary scale -- one(dsign)
>   or one(bsign)
>
> To count each digit to the right of the decimal point --
>   inc(fcnt)

The interpreter sets all the other registers (including the lower
half of BSIGN) as directed by the conversion pops.

EXAMPLE:

The number buffer would be set as follows for the number 1.5e2b17.
Assume decimal conversion throughout.

	0	8	18	35
CONBUF	0		0	
CONBUF+1	0		15	
FCNT	1		0	
SIGN	0			
DSCALE	2		0	
BSCALE	17	0		
DSIGN	0		0	
BSIGN	0		1	

Pops That Set Registers in the Number Buffer

POP: RNUM   Reset number

FORMAT: rnum( )

FUNCTION: Set the 8 words in the number buffer to zero

POP: CON   Convert principal part

FORMAT: con(Y)
          Y is usually CHAR

FUNCTION: Let integer = DP(CONBUF), and digit = C(Y) 14-17.
            (Digit is a number from 0 through 9.)

            Octal conversion - Set integer = 8*integer + digit

            Decimal conversion - Set integer = 10*integer + digit

            These formulas convert the principal part from
            left to right, digit by digit.

            Following conversion, the entire principal part =
            DP(CONBUF), ignoring any decimal point or sign.

POP: CONA   Convert and advance

FORMAT: cona(Y)
          Y is usually CHAR

FUNCTION: 1. Execute con(Y) pop

            2. Execute NXCH pop

COMMENT: On end-of-line, the interpreter goes to the next pop
           (same as NXCH)

POP: CONR   Reset and convert

FORMAT: conr(Y)

FUNCTION: 1. Execute RNUM pop

            2. Execute con(Y) pop

POP: CONAR Reset, convert, and advance

FORMAT: conar(Y)

FUNCTION: 1. Execute RNUM pop

2. Execute con(Y) pop

3. Execute NXCH pop

COMMENT: On end-of-line, the interpreter goes to the next pop
(same as NXCH).

POP: CONBA Convert binary scale, and advance

FORMAT: conba(char)
CHAR is always assumed to be the operand for this pop,
regardless of the operand.

FUNCTION: 1. Let integer = C(BSCALE) 0-7,
and digit = C(CHAR) 14-17.
(Digit is a number from 0 - 9)

Octal conversion - Replace integer by 8* integer
± digit
Decimal conversion - Replaces integer by 10*
integer ± digit

NOTE: This pop is normally preceded by a MODD pop.

The formula converts the binary scale from left
to right, digit by digit.

Following conversion, the entire signed binary
scale = C(BSCALE) 0-7.

2. Set C(BSIGN) 18-35 = 1.

3. Execute NXCH pop

COMMENT: On end-of-line, the interpreter goes to the next pop
(same as NXCH).

POP: CONDA Convert decimal scale, and advance

FORMAT: conda(char)
CHAR is always assumed to be the operand for this pop,
regardless of the operand

FUNCTION: 1. Let integer = C(DSCALE) 0-17,
               and digit = C(CHAR) 14-17.
               (Digit is a number from 0 - 9)

               Octal conversion - Replace integer by 8*
                          integer ± digit.

               Decimal conversion - Replace integer by 10*
                          integer ± digit.

               NOTE: This pop is normally preceded by a MODD
                      pop.

               The formula converts the decimal scale from
               left to right, digit by digit.

               Following conversion, the entire signed decimal
               scale = C(DSCALE) 0-17.

           2. Execute NXCH pop.

COMMENT: On end-of-line, the interpreter goes to the next
          pop (same as NXCH).

3. Conversion and Storage of Binary Numbers

The following pops convert binary numbers in the number buffer
to fixed-point or floating-point numbers of single or double
precision.

Pops

POP: FXDS Convert to fixed-point, single-precision

FORMAT: fxds(Y)
         Y is the location of a single word in the data segment

FUNCTION: Convert the number in the number buffer to a
           fixed-point, single-precision number, and store
           the number in Y.

EXAMPLE: See FLTD

POP: FXDD Convert to fixed-point, double-precision

FORMAT: fxdd(Y)
         Y and Y+1 are the locations of a pair of words in
         the data segment. Y is an even location.

FUNCTION: Convert the number in the number buffer to a fixed-
           point, double-precision number, and store the
           number in Y and Y+1. The high-order bits are in Y,
           and the low-order bits are in Y+1.

EXAMPLE: See FLTD

POP: FLTS Convert to floating-point, single-precision

FORMAT: flts(Y)
       Y is a location of a single word in the data segment

FUNCTION: Convert the number in the number buffer to a floating-point, single-precision number, and store the number in Y.

EXAMPLE: See FLTD

POP: FLTD Convert to floating-point, double-precision

FORMAT: fltd(Y)
       Y and Y+1 are the locations of a pair of words in the data segment
       Y is an even location.

FUNCTION: Convert the number in the number buffer to a floating-point, double-precision number, and store the number in Y and Y+1. The high-order bits are in Y, and the low-order bits are in Y+1.

EXAMPLES:

Assume that ALPHA is an even location in the data segment, and that the number buffer is set as shown in the example on page 74.

Pop	ALPHA after		ALPHA+1 after	
fxds(alpha)	000226	000000	unchanged	
fxdd(alpha)	000226	000000	000000	000000
flts(alpha)	020454	000000	unchanged	
fltd(alpha)	020454	000000	000000	000000
	0	18 35	0	18 35

0.   PRECISION ARITHMETIC POPS

The precision arithmetic pops use a two-word register,

located in the data segment:

           MPAC   MPAC+1

36 bits	36 bits
Even	Odd
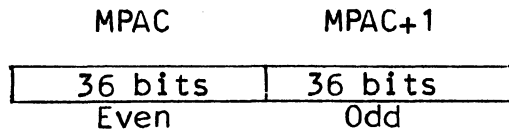
1.   Fixed-Point Operations

Double-precision fixed-point numbers are integers ranging

from $-2**71$ through $2**71 - 1$.

EXAMPLES:

400000	000000	000000	000000	$-2**71$
0	18 35	0	18 35	

777777	777777	777777	777777	-1
0	18 35	0	18 35	

000000	000000	000000	000000	0
0	18 35	0	18 35	

000000	000000	000000	000001	1
0	18 35	0	18 35	

377777	777777	777777	777777	$2**71 - 1$
0	18 35	0	18 35	

Pops

Each of the following pops requires a single-precision operand.

However, several of the pops require extension of C(Y). Here,

extension means that the interpreter prefixes C(Y) with 36

bits, each of which is a copy of C(Y) 0. (See -1 and 1 in

the examples above.)

POP: PADD   Precision add

FORMAT: padd(Y)

FUNCTION: Set DP(MPAC) = DP(MPAC) + C(Y) where C(Y) is
            extended to double precision

EXAMPLES:

padd(alpha)

MPAC before

000000	000001	000000	000000
0	18 35	0	18 35

2**36

ALPHA extended

000000	000000	000001	000000
0	18 35	0	18 35

2**18
(extended)

MPAC after

000000	000001	000001	000000
0	18 35	0	18 35

padd(alpha)

MPAC before

000000	000001	000000	000000
0	18 35	0	18 35

2**36

ALPHA extended

777777	777777	777777	000000
0	18 35	0	18 35

-2**18
(extended)

MPAC after

000000	000000	777777	000000
0	18 35	0	18 35

POP: PSUB   Precision subtract

FORMAT: psub(Y)

FUNCTION: Set DP(MPAC) = DP(MPAC) - C(Y) where C(Y) is extended to double precision

EXAMPLES:

psub(alpha)

MPAC before

000000	000001	000000	000000
0	18 35	0	18 35

2**36

ALPHA extended

000000	000000	000001	000000
0	18 35	0	18 35

2**18
(extended)

MPAC after

000000	000000	777777	000000
0	18 35	0	18 35

psub(alpha)

MPAC before

000000	000001	000000	000000
0	18 35	0	18 35

2**36

ALPHA extended

777777	777777	777777	000000
0	18 35	0	18 35

-2**18
(extended)

MPAC after

000000	000001	000001	000000
0	18 35	0	18 35

POP: PMLT Precision multiply

FORMAT: pmlt(Y)

FUNCTION: Set DP(MPAC) = C(MPAC+1) * C(Y)

POP: PMLTD Precision multiply double

FORMAT: pmltd(Y)

FUNCTION: 1. Set DP(MPAC) = DP(MPAC) * C(Y)
           2. Truncate product to 72 bits, if necessary.
               If truncation is necessary, set false
               If no truncation is necessary, set true

EXAMPLE:

pmltd(alpha)

MPAC before
| 000000 | 000002 | 000000 | 000001 | $2**37 + 1$
0   18   35 0   18   35

ALPHA
                            | 000000 | 000003 | 3
                            0   18   35

MPAC after
(Set true)
| 000000 | 000006 | 000000 | 000003 |
0   18   35 0   18   35

POP: PDVD Precision divide

FORMAT: pdvd(Y)

FUNCTION: 1. Set DP(MPAC) = DP(MPAC) / C(Y)
               Extend the quotient to double precision
               Note: If the quotient falls outside the range
                      from $-2**35$ to $2**35 - 1$, a divide
                      check error occurs.
           2. Set C(RMD) = remainder
               RMD is a one-word register in the data segment

EXAMPLE:

pdvd(alpha)

MPAC before
| 000000 | 000000 | 000000 | 000007 | 7
0   18   35 0   18   35

ALPHA
                            | 000000 | 000003 | 3
                            0   18   35

MPAC after
| 000000 | 000000 | 000000 | 000002 | 2
0   18   35 0   18   35

RMD
                            | 000000 | 000001 | 1
                            0   18   35

2. Floating-Point Operations

Double-precision floating-point numbers consist of an exponent, e, which is an integer ranging from -128 to +127 in steps of 1; and a mantissa, m, which is a fraction ranging from -1 to 1 -2**-63 in steps of 2**-63. (For further information, see the GE-635 Programmers' Reference Manual.) These numbers are subject to the following restrictions:

For negative numbers, $-1 \leq m < -1/2$

For zero, $m = 0$ and $e = -128$

For positive numbers, $1/2 \leq m < 1$

Both m and e are in two's complement form

The floating-point number $m * 2^{**e}$ is represented in the MPAC register as follows:
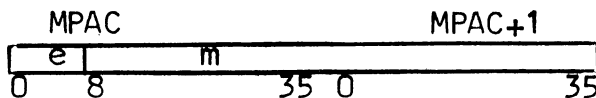
Pops

Each of the following pops requires a double-precision operand. The user can extend a single-precision number to double precision, by moving it to an even location and setting the following odd location to zero:
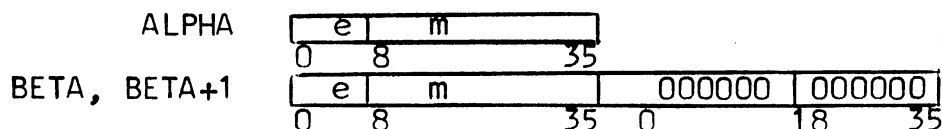
where C(ALPHA) is extended via the following pops:

```
mov(alpha)
to(beta)      "BETA must be an even location"
zer(beta+1)
```

CAUTION: Overflow may occur in each of the following operations!

POP: PADDF   Precision add floating

FORMAT: paddf(Y)

FUNCTION: Set DP(MPAC) = DP(MPAC) + DP(Y)

EXAMPLE:

paddf(alpha)

MPAC before

006700	000000	000000	000000
0	18 35	0	18 35

7.00 = 7/8 * 2**3

ALPHA

002700	000000	000000	000000
0	18 35	0	18 35

1.75 = 7/8 * 2**1

MPAC after

010430	000000	000000	000000
0	18 35	0	18 35

8.75=35/64 * 2**4

POP: PSUBF Precision subtract floating

FORMAT: psubf(Y)

FUNCTION: Set DP(MPAC) = DP(MPAC) - DP(Y)

POP: PMLTF   Precision multiply floating

FORMAT: pmltf(Y)

FUNCTION: Set DP(MPAC) = DP(MPAC) * DP(Y)

POP: PDVDF   Precision divide floating

FORMAT: pdvdf(Y)

FUNCTION: Set DP(MPAC) = DP(MPAC) / DP(Y)

3.   Conversion Operations

Pops

POP: FLT   Float

FORMAT: flt(Y)
          C(Y) is a single-precision integer

FUNCTION: Set DP(MPAC) = C(Y) converted to a double-precision
            floating-point number

EXAMPLE:

flt(alpha)

ALPHA

| 000000 | 000001 | 1 (fixed point)
0   18   35

MPAC after

| 002400 | 000000 | 000000 | 000000 | 1 (floating point)
0   18   35   0   18   35

POP: FIXS Fix Single

FORMAT: fixs(Y)
         C(Y) is a single-precision floating-point number
         Y may be an even or odd address

FUNCTION: Set DP(CONBUF) = C(Y) converted to a double-precision
           fixed-point integer.

POP: FIXD Fix Double

FORMAT: fixd(Y)
         DP(Y) is a double-precision floating-point number
         Y must be an even address

FUNCTION: Set DP(CONBUF) = DP(Y) converted to a double-precision
           fixed-point integer

EXAMPLE:

fixd(mpac)

MPAC

| 002400 | 000000 | 000000 | 000000 | 1 (floating point)
0   18   35   0   18   35

CONBUF after

| 000000 | 000000 | 000000 | 000001 | 1 (fixed point)
0   18   35   0   18   35

P.   SET POPS

The set pops compare two items to determine whether a certain
condition is met. If the condition is met, they set the true
indicator. If the condition is not met, they set the false
indicator.

1.   Algebraic Comparisons

Algebraic comparisons involve 36-bit signed integers. The
largest number is octal 377777777777 ($2**35 - 1$). The
smallest number is octal 400000000000 ($-2**35$).

Pops

POP: SGT   Set on greater than

FORMAT: sgt(Y)

FUNCTION: Set true if C(WO) > C(Y) algebraically
            Otherwise, set false

POP: SGTP   Set on greater than, and prune

FORMAT: sgtp(Y)

FUNCTION: 1.   Set true if C(WO) > C(Y) algebraically
                 Otherwise, set false

            2.   Prune WO

POP: SEQ   Set on equal

FORMAT: seq(Y)

FUNCTION: Set true if C(WO) = C(Y)
            Otherwise, set false

POP: SEQP   Set on equal, and prune

FORMAT: seqp(Y)

FUNCTION: 1.   Set true if C(WO) = C(Y)
                 Otherwise, set false
            2.   Prune WO

POP: SLT Set on less than

FORMAT: slt(Y)

FUNCTION: Set true if C(WO) < C(Y) algebraically
           Otherwise, set false

POP: SLTP Set on less than, and prune

FORMAT: sltp(Y)

FUNCTION: 1. Set true if C(WO) < C(Y) algebraically
               Otherwise, set false

           2. Prune WO

2. Masked Comparisons

Pops

POP: SME Set on masked equality

FORMAT: sme(Y)
        Y is an even address

FUNCTION: Set true if C(WO) k = C(Y) k, whenever C(Y+1) k = 0
           (ignoring all other bits)
           Otherwise, set false.

EXAMPLE:

sme(alpha)

WO	112233	445566
ALPHA	716253	443526
ALPHA+1	707070	707070

In this case, set true

0   18   35

POP: SMEP Set on masked equality, and prune

FORMAT: smep(Y)
        Y is an even address

FUNCTION: 1. Set true if C(WO) k = C(Y) k, whenever C(Y+1) k = 0
               (ignoring all other bits)
               Otherwise, set false

           2. Prune WO

POP: SME1   Set on masked equality in W1

FORMAT: sme1(Y)
          Y is an even address

FUNCTION: Set true if C(W1) k = C(Y) k , whenever C(Y+1) k = 0
            (ignoring all other bits)
            Otherwise, set false

POP: SME2   Set on masked equality in W2

FORMAT: sme2(Y)
          Y is an even address

FUNCTION: Set true if C(W2) k = C(Y) k, whenever C(Y+1) k = 0
            (ignoring all other bits)
            Otherwise, set false

POP: SMEI   Set on masked equality indirect

FORMAT: smei(Y)
          Y is an even address

FUNCTION: Set true if C(RP(W0)) k = C(Y) k , whenever
            C(Y+1) k = 0 (ignoring all other bits)
            Otherwise, set false

POP: SMEIP   Set on masked equality indirect, and prune

FORMAT: smeip(Y)
          Y is an even address

FUNCTION: 1.   Set true if C(RP(W0)) k = C(Y) k , whenever
                 C(Y+1) k = 0 (ignoring all other bits)
                 Otherwise, set false
            2.   Prune W0

POP: SMEB   Set on masked equality on bottom
             (See ERB.)

FORMAT: smeb(Y)
          Y is an even address.

FUNCTION: Set true if C(B) k = C(Y) k , whenever
            C(Y+1) k = 0 (ignoring all other bits)

            Otherwise, set false

3. Bit Comparisons

Pops

POP: SEV   Set on even

FORMAT: sev( )

FUNCTION: Set true if C(WO) 17 = 0
       Otherwise, set false

POP: SEVS   Set on even in storage

FORMAT: sevs(Y)

FUNCTION: Set true if C(Y) 17 = 0
       Otherwise, set false

POP: SCA   Set on comparative and

FORMAT: sca(Y)

FUNCTION: Set true if C(WO) .and. C(Y) $\neq$ 0
       Otherwise, set false

EXAMPLE:

The following is a test to determine whether bit 7 or bit 8 of

CHAR is 1:

```
        ceaw(octal(3000))
        sca(char)
        jmp(bothoff,f)
```

The CEAW pop puts 1 in bits 7 and 8 of WO, and 0 in each of

the other 34 bits.

POP: SCAP Set on comparative and, and prune

FORMAT: scap(Y)

FUNCTION: 1. Set true if C(WO) .and. C(Y) $\neq$ 0
          Otherwise, set false

          2. Prune WO

POP: SNZ Set on non-zero

FORMAT: snz( )

FUNCTION: Set true if $C(WO) \neq 0$
           Otherwise, set false

POP: SNZS Set on non-zero in storage

FORMAT: snzs(Y)

FUNCTION: Set true if $C(Y) \neq 0$
           Otherwise, set false

POP: SCNT Set on roll count

FORMAT: scnt(N)

FUNCTION: Set true if $C(TOP+N)$ 0-17 $\neq C(BOTTOM+N)$ 0-17
           Otherwise, set false

4. Character Comparisons

Pops

POP: SCH Set on character equal

FORMAT: sch(Y)

FUNCTION: Set true if $C(CHAR)$ 0-17 $= C(Y)$ 0-17
           Otherwise, set false

POP: SCHA Set on character equal, and advance

FORMAT: scha(Y)

FUNCTION: 1. Set true if $C(CHAR)$ 0-17 $= C(Y)$ 0-17
              Otherwise, set false
           2. If true, execute NXCH pop
              If false, skip a pop

EXAMPLE: The following two pops would cause a blank to be suppressed:
```
                    a: scha(trans+octal(40))
                       jmp(endln)
```

The following pops would suppress all leading blanks:
```
                    a: scha(trans+octal(40))
                       jmp(endln)
                       jmp(a,t)
```

COMMENT: On end-of-line, the interpreter goes to the next pop (same as NXCH)

POP: SCKY   Set on character keys

FORMAT: scky(Y)

FUNCTION: Set true if C(CHAR) 18-35 .and. C(Y) 18-35 ≠ 0
           Otherwise, set false

POP: SCKYA   Set on character keys, and advance

FORMAT: sckya(Y)

FUNCTION: 1.   Set true if C(CHAR) 18-35 .and. C(Y) 18-35 ≠ 0
                Otherwise, set false
           2.   If true, execute NXCH pop
                If false, skip a pop

EXAMPLE:

sckya(alpha)

Assume the TRANS table entries for comma and semicolon are:

TRANS+ octal 54 | 000054 | 002000 | -- comma
                  0   9   18   35

TRANS+ octal 73 | 000073 | 010000 | -- semicolon
                  0   9   18   35

In this example, a 1 in bit 23 signifies a semicolon, and a 1

in bit 25 signifies a comma.

	C(ALPHA)	Result
Case 1:	| 0 | 2000 |	Set true and execute NXCH pop if ,
Case 2:	| 0 | 10000 |	Set true and execute NXCH pop if ;
Case 3:	| 0 | 12000 |	Set true and execute NXCH pop if , or ;
	0 18 35	

COMMENT: On end-of-line, the interpreter goes to the next pop
          (same as NXCH)

5. Null Comparisons

The following pops make no comparisons, but simply set true or false.

Pops

POP: STRU   Set true

FORMAT: stru( )

FUNCTION: Set true

POP: SFAL   Set false

FORMAT: sfal( )

FUNCTION: Set false

6. Symbol Comparisons

Pops

POP: SSKY   Set on symbol key

FORMAT: ssky(Y)

FUNCTION: Set true if C(Y) .and. C(SYMKEY) $\neq$ 0
           Otherwise, set false

COMMENT: The user must be sure that C(Y) 0-17 = 0, since
          this is a full-word comparison. (See ORKEY.)

POP: SSKYA   Set on symbol key, and advance

FORMAT: sskya(Y)

FUNCTION: 1. Set true if C(Y) .and. C(SYMKEY) $\neq$ 0
              Otherwise, set false
           2. If true, execute the pop at location 1 of the
              procedure segment
              If false, go to the next pop

POP: SSY   Set on symbol

FORMAT: ssy(Y)

> Y is the location of the first word of a type-1 string

FUNCTION: Assume SYMBUF contains a type-1 string

1. Count the type-1 string in SYMBUF.

2. Compare the string in SYMBUF with the string starting at location Y. This is a word-by-word comparison.

3. If all words match, set true
Otherwise, set false

POP: SSYA   Set on symbol, and advance to next symbol if equal

FORMAT: ssya(Y)

> Y is the location of the first word of a type-1 string

FUNCTION: Assume SYMBUF contains a type-1 string

1. Count the type-1 string in SYMBUF.

2. Compare the string in SYMBUF with the string starting at location Y. This is a word-by-word comparison.

3. If all words match, set true
Otherwise, set false

4. If true, execute the pop at location 1 in the procedure segment
If false, go to the next pop

COMMENTS: 1. The pop at location 1 is usually a JMP or a JSB

2. ssya(symbol) is equivalent to ssy(symbol)
exec(1,t)

Q. REQUIRE POPS

The require pops compare two items to determine whether a
certain condition is met. If the condition is met, the
interpreter goes to the next pop (or advances). If the
condition is not met, the interpreter executes the syntax
fail routine. The syntax fail routine executes a PRES pop
and jumps to the location specified by FEXIT (see FEX).

1. Symbol Comparisons

Pops

POP: RSY   Require on symbol

FORMAT: rsy(Y)

FUNCTION: Assume SYMBUF contains a type-1 string

        1. Count the type-1 string in SYMBUF

        2. Compare the string in SYMBUF with the string
            starting at location Y. This is a word-by-word
            comparison.

        3. If all words match, go to next pop.

            Otherwise, execute syntax fail routine.

POP: RSYA   Require on symbol, and advance.

FORMAT: rsya(Y)

FUNCTION: Assume SYMBUF contains a type-1 string

        1. Count the type-1 string in SYMBUF.

        2. Compare the string in SYMBUF with the string
            starting at location Y. This is a word-by-word
            comparison.

        3. If all words match, execute the pop at location
            1 of the procedure segment.

            Otherwise, execute syntax fail routine.

POP: RSKY   Require on symbol key

FORMAT: rsky(Y)

FUNCTION: Go to next pop if C(Y) .and. C(SYMKEY) $\neq$ 0

   Otherwise, execute syntax fail routine.

POP: RSKYA   Require on symbol key, and advance

FORMAT: rskya(Y)

FUNCTION: If C(Y) .and. C(SYMKEY) $\neq$ 0, execute the pop at

   location 1 of the procedure segment.

   Otherwise, execute syntax fail routine.

2.   Character Comparisons

Pops

POP: RCH   Require on character equal

FORMAT: rch(Y)

FUNCTION: Go to next pop if C(CHAR) 0-17 = C(Y) 0-17

   Otherwise, execute syntax fail routine

POP: RCHA   Require on character equal, and advance

FORMAT: rcha(Y)

FUNCTION: Execute NXCH pop if C(CHAR) 0-17 = C(Y) 0-17

   Otherwise, execute syntax fail routine

COMMENT: On end-of-line, the interpreter goes to the next

   pop (same as NXCH)

POP: RCKY   Require on character keys

FORMAT: rcky(Y)

FUNCTION: Go to next pop if C(CHAR) 18-35 .and. C(Y) 18-35 $\neq$ 0

   Otherwise, execute syntax fail routine

POP: RCKYA   Require on character keys, and advance

FORMAT: rckya(Y)

FUNCTION: Execute NXCH pop if C(CHAR) 18-35 .and. C(Y) 18-35 $\neq$ 0

  Otherwise, execute syntax fail routine.

COMMENT: On end-of-line, the interpreter goes to the next
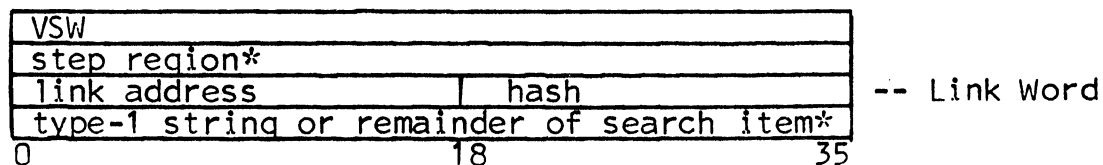
  pop (same as NXCH)

R.   SEARCH POPS

1. General

The search pops search a roll for a search item matching a given item called a clue.

Two types of rolls may be searched: linked and non-linked.

A linked roll consists of variable-size groups that are linked on threads via link words. Each link word contains the address of the next logical link word on the thread. A linked group is set up as follows:

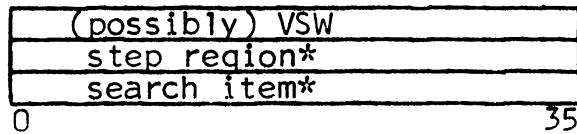| VSW		
step region*		
link address		hash	-- Link Word
type-1 string or remainder of search item*		

0   18   35

* May be any number of words

The link address is 0 if no more links follow; otherwise, it is the location of the next link word. For roll 0 it is an absolute location; for rolls 1-63 it is relative to the top.

If the clue is a type-1 string, then the interpreter computes the hash; in this case, the hash is not included in the clue or in the search item. If the clue is not a type-1 string, the interpreter uses the right half of the first word of the clue as the hash; in this case, the hash is included in the clue and in the search item.

The step region contains any pertinent information describing the search item.

A non-linked roll may consist of fixed or variable-size groups. It is set up as follows:

```
┌─────────────────────────────────┐
│    (possibly) VSW               │
├─────────────────────────────────┤
│     step region*                │
├─────────────────────────────────┤
│     search item*                │
└─────────────────────────────────┘
0                               35
```

* May be any number of words

Roll 0 must be set up as a linked roll. Rolls 1-63 may be linked or non-linked.

2. Types of Threads

Two types of threads are used for linked groups, depending on the roll number and on the type of clue to be matched:
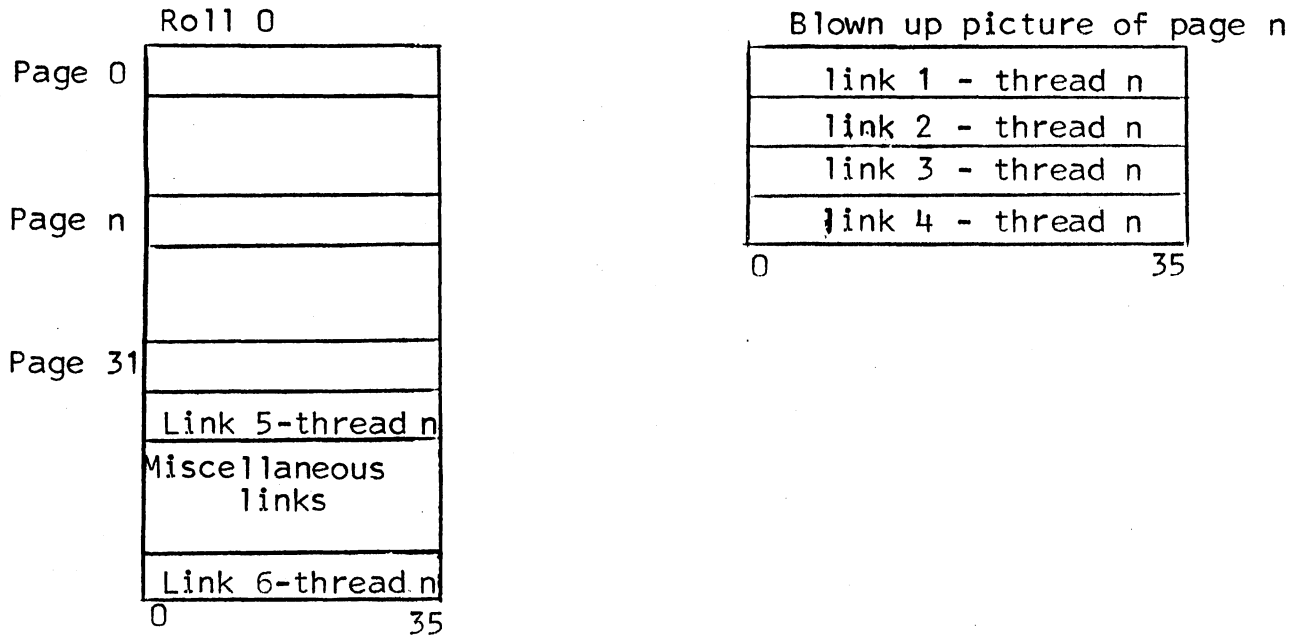
Thread Type	Clue	Roll Number
1	Type-1 string	0
2	{ Type-1 string	1-63
	{ Anything else	0-63

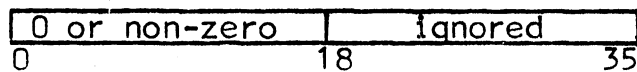There are 32 type-1 threads. There may be any number of type-2 threads.

The first 32K of roll 0 (after the first eight words) consists of one page for each type-1 thread. The links in this area are contiguous. If the total requirement for a type-1 thread exceeds 1024 words, the excess words are stored somewhere in the 32K area after page 31.

EXAMPLE:

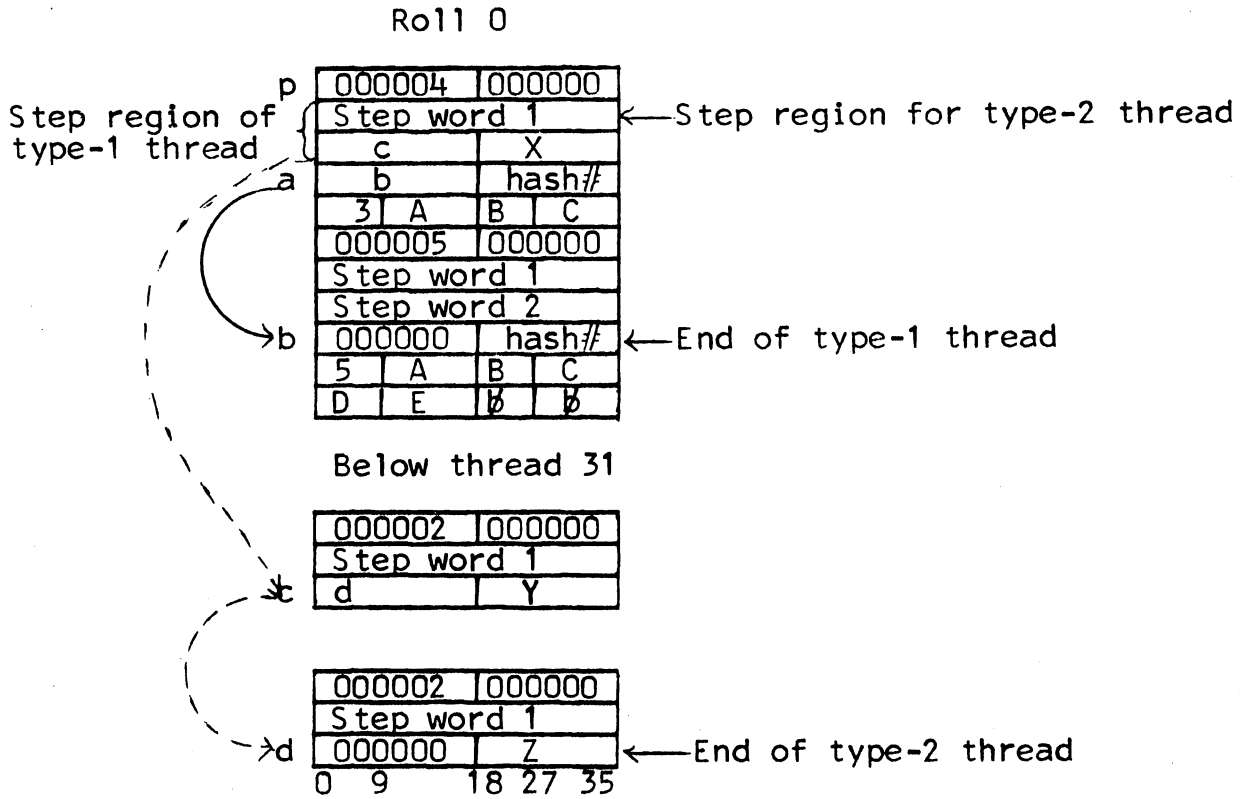Assume that the first four links for thread n (a type-1 thread) take up 1024 words:

Roll 0

Page 0	
Page n	
Page 31	
	Link 5-thread n
	Miscellaneous links
	Link 6-thread n

0   35

Blown up picture of page n

link 1 - thread n
link 2 - thread n
link 3 - thread n
link 4 - thread n

0   35

The thread table for roll 0 contains an entry for each type-1 thread:

0 or non-zero	Ignored

0   18   35

Here 0 means that the thread is empty. A non-zero value gives the absolute location of the first link word on the thread. The thread table THREAD is located in the data segment.

Links for type-2 threads in roll 0 are placed after page 31 by the interpreter. The user may start such a thread in the first 7-word group on roll 0, provided that the step size is 0-6 and C(ROLPTR) = 0. Otherwise, these type-2 threads must emanate from the step region of a type-1 thread. In each case, all subsequent links are placed after page 31.

EXAMPLE:

Roll 0

Step region of type-1 thread

p → 000004 | 000000
Step word 1 ← Step region for type-2 thread
c | X
a → b | hash#
3 | A | B | C
000005 | 000000
Step word 1
Step word 2
b → 000000 | hash# ← End of type-1 thread
5 | A | B | C
D | E | 0̸ | 0̸

Below thread 31

000002 | 000000
Step word 1
c → d | Y

000002 | 000000
Step word 1
d → 000000 | Z ← End of type-2 thread
0   9   18 27 35

NOTE: If the type-1 thread is thread T, C(THREAD+T) 0-17 = a

The type-1 thread is connected by a solid arrow. The type-2 thread is connected by dashed arrows. X, Y and Z are 18-bit constants, most likely offsets on some other roll (pointing to other information).

3. The Search File

The search file for srch(Y), srchp(Y), linkn(Y), and linkp(Y) has the following format:

Y	roll number (N)	0 - not rel.links non-0 - rel.links
Y+1	step size	0 - non-masked non-zero - masked
Y+2	# of words in clue	ignored
Y+3	Tells whether clue is type-1 string	location of clue
Y+4	mask (if any) -# of bits in mask must match # of bits in clue *	
	0 18 35	

* May be any number of words

The items in the search file have the following functions:

C(Y) 0-17 - Number of the roll to be searched

C(Y) 18-35 - In a search file for roll 0, C(Y) 18-35 is ignored

In a search file for another roll containing links, C(Y) 18-35 = non-zero

In a search file for another roll not containing links, C(Y) 18-35 = 0

C(Y+1) 0-17 - Number of words in step region

C(Y+2) 0-17 - Number of words in clue (computed by interpreter for type-1 strings).

C(Y+3) 0 - If 0, the clue is not a type-1 string

If 1, the clue is a type-1 string

Bits 1-17 are ignored.

C(Y+3) 18-35 - A location in the data segment, usually SYMBUF

If this field contains -1, C(MRKER) 0-17 is the location of a roll pointer which points to clue.

If this field contains -2, C(MRKER) 0-17 specifies the location of the clue.

This permits the clue to be in the work stack.

Mask - The mask is used, only if selected portions of the clue
are to be compared. In the mask, a 1-bit means ignore
and a 0-bit means compare. The number of words in the
mask matches the number of words in the clue: if there
is no mask, the search file is 4-words; if there is a
mask, the search file is 4-words plus the number of
words in the clue.

Masks may be used only for non-linked searches.

The following search file is for step size 2 and
type-1 strings in roll 0:

0	0
2	0
0	0
-1	SYMBUF

0   18   35

4.   Linked Searches

If there are no links on the roll to be searched, the search
is unsuccessful. Otherwise, the interpreter begins a linked
search by determining the proper thread to search and the
location of the first link on that thread. It uses one of
the following methods:

Type-1 thread -- The interpreter computes the thread number
                 and looks in the thread table to obtain the
                 location of the first link word in the thread.

Type-2 thread -- In this case, the user must make ROLPTR+N point
to the VSW of the first link on the thread. The
interpreter computes the absolute location of
the VSW, and adds the number of words in the
step region plus one to determine the location
of the link word.

Next, the interpreter computes the hash number of the clue.
(See Paragraph R.1.)

The interpreter then starts the search by comparing the hash in
the first link word with the hash of the clue. If they match,
and the clue is not a type-1 string, the search is successful.
If they match, and the clue is a type-1 string, the interpreter
compares the clue words with the search item words; if they do
not match (very rare), it looks for another occurrence of the
same hash. If the two hashes do not match, the interpreter
uses the link word to determine the address of the next link
word. The interpreter continues this process, until it finds
a match or reaches the end of the thread.

5. Non-Linked Searches

If there are no groups on the roll to be searched, then the
search is unsuccessful. Otherwise, the interpreter assumes that
RP(ROLPTR+N) = location of the first word (or VSW) of a group;
it locates the first item according to one of the following
equations:

For fixed-size groups -- Search item location =
                        RP(ROLPTR+N) + step size

For variable-size groups -- Search item location =
                        RP(ROLPTR+N) + step size +1

Next, the interpreter compares the search item with the

clue. If the comparison is unsuccessful, the interpreter

simulates the pop dng(N) to find the first word of the

next group.

The interpreter continues its search, until it is successful,

or until it reaches the bottom of the roll.

Pops

POP: SRCH Search

FORMAT: srch(Y)

        Y is the location of a search file (See Paragraph R.3.)

FUNCTION: 1. Perform the search as directed by the search file

           2. If successful, make CURPTR and ROLPTR+N point to
              the location of the first word of the group
              containing the clue, and set true.

              CURPTR is a one-word register in the data segment
              with the following format:

P - (offset rela- tive to top of N)	ignored	N
0	18 30	35
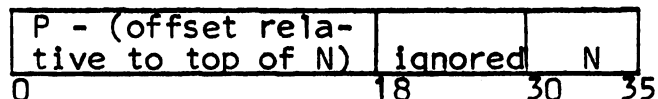
              CURPTR is a roll pointer; it points to
              P + C(TOP+N) 0-17

              If unsuccessful, set C(ROLPTR+N) = 0, and set
              false

EXAMPLE:

In this example, the user scans for a left parenthesis and then searches for a symbol.

modnb( )	"ignore blanks"
rsym( )	"reset symbol to blanks"
loop: nxch( )	"get next character"
jmp(endln)	"special case if end of line"
sch(trans+octal(50))	"octal 50 is left parenthesis"
jmp(loctr+3,t)	"jump if left parenthesis"
pak(char)	"otherwise, pack in symbol"
jmp(loop)	"...and continue"
cnts( )	"count the symbol"
srch(sfile)	"search for it"
jmp(absent,f)	"jump if unsuccessful"

POP: SRCHP   Search Put

FORMAT: srchp(Y)

Y is the location of a search file (See Paragraph R.3.)

FUNCTION: 1. Perform the search as directed by the search file

2. If successful, perform actions indicated for SRCH pop. If unsuccessful, perform steps 3-10.

3. Set false

4. Determine number of words to create (n words)

5. Allocate space for group, as follows:

Roll 0, type-1 thread - If there is room on the page corresponding to the thread, allocate space at the bottom of the page

If there is no room on the page, allocate space on the bottom of the roll

NOTE: The first time the interpreter determines
       that there is no space available on a
       page, it closes the page; even if a
       subsequent link will fit on the page,
       it is not put there.

Roll 0, type-2 thread -- Allocate next available
       space on the bottom of the roll

Roll 1-63 -- Allocate next available space at
       the bottom of the roll

6. If this is a variable size group, create VSW,
   as follows:

```
 ┌───────┬──────┐
 │  n-1  │  0   │
 └───────┴──────┘
 0       18    35
```
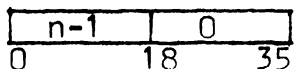
7. Fill the step region with zeros.

8. Create link word, if necessary. (The link
   address of this word is 0.)

   Set the link address of the previous link word
   (if any) in the thread to the absolute or
   relative location of the newly created link
   word.

9. Copy the clue.

10. Make CURPTR and ROLPTR+N point to the location
    of the first word of the newly created group.

EXAMPLES:

Assume that the user wants to form a type-2 thread on roll 6.
This is the only thread on roll 6. To accomplish this, he
writes the following code:

```
pru(6)
srchp(file1) "The search will fail, and the clue
             will be put on roll 6."
```

To put a new link on the same thread, the user writes:

```
zer(rolptr+6)
srchp(file1)
```

POP: LINKN   Link next

FORMAT: linkn(Y)

Y is the location of a search file (see Paragraph R.3.).
Here, only the first two words are applicable:

Y	roll number(N)	Ignored
Y+1	search step	Ignored

0   18   35

FUNCTION: Assume RP(ROLPTR+N) is the location of the VSW of a
linked group on roll N.

If C(link word) 0-17 = 0, set false

Otherwise, make ROLPTR+N point to the VSW of the next
link in the thread; and set true.

EXAMPLE:

linkn(alpha)

ALPHA	000005	000000
ALPHA+1	000002	000000

0   18   35

TOP+5	100000	000000

0   18   35

ROLPTR+5 before	100	0	5

0   18   30 35

ROLPTR+5 after	200	0	5

0   18   30 35

The true condition would be set.

Illustration

Roll 5

100100	3	0
		} step region
203	hash#
100200	3	0
		} step region
0	hash#

0   18   35
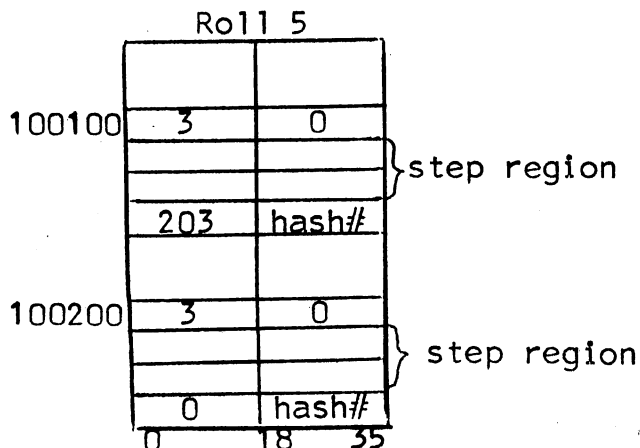
Comments: 1. This pop can use a search file set up for
               a search pop. In this case, it simply
               ignores all information except C(Y) 0-17
               and C(Y+1) 0-17.

            2. The interpreter gets N from the search
               file. It assumes C(ROLPTR+N) 30-35 = N.

POP: LINKP   Link put

FORMAT: linkp(Y)

        Y is the location of a search file (see Paragraph R.3.).

FUNCTION: Assume RP(ROLPTR+N) is the location of the VSW
            of the last link on roll N. Also assume that the
            first word of the clue is special: the left half
            is ignored, and the right half is to be used as
            hash

            Place a link on the bottom of roll N, according
            to the specifications of the search file:

            1. Determine number of words to create

            2. Allocate space for link

            3. Create VSW

            4. Fill the step region with zeros

            5. Create link word: zero in left half, followed
                by right half of first word of clue

            6. Make the link word in the previous link point
                to the newly created link word.

            7. Copy the remainder of the clue (if any)

            8. Make CURPTR and ROLPTR+N point to the location
                of the first word of the newly created link

EXAMPLE:

linkp (alpha)

	0	18	35
ALPHA	5	1
ALPHA+1	2	0
ALPHA+2	1	0
ALPHA+3	0	20000

20000   [ignored | 767]   ROLPTR+5   [100 | x | 5]
                                             0   18 30 35

TOP+5   [100000 | 000000]   BOTTOM+5   [101000 | 000000]
                                             0   18   35

```
         Roll 5
        ┌──────┬──────┐
        │      │      │
100100  │  3   │  0   │
        ├──────┼──────┤   ┐ step region
        │      │      │   │
        ├──────┼──────┤   } Upper half set by pop (rest of group unchanged)
        │ 1003 │ 676  │   ┘
        ├──────┼──────┤
        │      │      │
101000  │  3   │  0   │   Old bottom
        ├──────┴──────┤   ┐
        │      0      │   │ step region
        ├─────────────┤   ┘
        │      0      │
        ├──────┬──────┤
        │  0   │ 767  │
        └──────┴──────┘
```
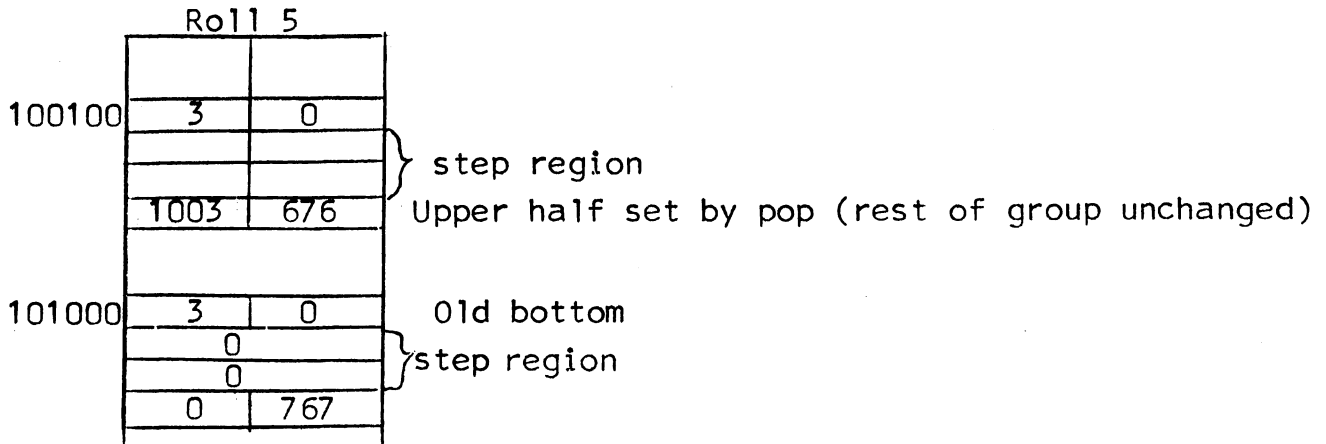
POP: TSRCH   Table search

FORMAT: tsrch(Y)

      If $Y \neq 0$, then Y is the even location of a 2-word search
          file

      Otherwise, FTAB, a two-word register in the data segment,
          is the location of the search file

Search File

	table location	0
word1	table location	0
word2	0	# of table entries
	0 17	18 35
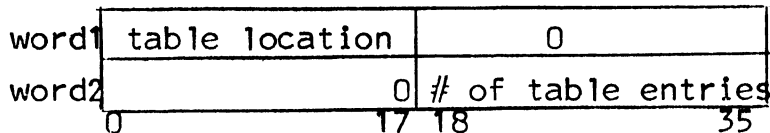
C(word 1) 0-17 -- Location of table consisting of 4-word entries.
              The first two words of each entry are the key,
              and the keys are in ascending logical order.

The following illustration shows how the keys are sorted:

2	d	o	∅	∅	∅	∅	∅
2	i	f	∅	∅	∅	∅	∅
3	e	n	d	∅	∅	∅	∅
7	e	n	d	f	i	l	e

```
0   9  18  27 35  0   9  18  27 35
          word 1
```

C(SYMBUF,SYMBUF+1) = clue. A typical clue is shown below:

```
SYMBUF    | 7 | e | n | d |
SYMBUF+1  | f | i | l | e |
          0   9   18  27  35
```

FUNCTION: 1. Search the table for a key that matches the clue

2. If there is no match, set false

Otherwise, set true, and C(MRKER) 0-17 = location immediately following the matching key; i.e., word 3 of the entry satisfying the test.

EXAMPLE:

In this example, if the search is successful, the interpreter will load words 3 and 4 of the entry satisfying the test.

```
cnts( )

tsrch( )

jmp(absent,f)

xntv(mrker)

load(1)          "load word 4"

xntv(mrker)

load(0)          "load word 3"
```

POP: SRCHK   Search keys

FORMAT: srchk(Y)

>   Y is the location of a 6-word search file

Search File

	0 (roll 0)	search option
Y		
Y+1	step size	0
Y+2	ignored	
Y+3	ignored	
Y+4	mask	
Y+5	-n	octal 12

0   18   35

C(Y+5) 0-17 -- Offset relative to link word in any link on
               roll 0. This is the offset of a selected word
               in the step region. Therefore, n must be $\leq$ step
               size.

C(Y+4) -- 36-bit mask. The 1's in this mask define bits to be
          tested in the selected word. These bits are called
          the keys.

C(Y) 18-35 -- 0 if a test is to be made for all keys off

            1 if a test is to be made for any keys on

FUNCTION: 1. Test keys in each link on roll 0, according to the
              search option, until successful or until there are
              no more links.

           2. If successful, set true; and make ROLPTR+0 point
              to the VSW of the link satisfying the test.

              If unsuccessful, set false; and set C(ROLPTR+0) = 0.

EXAMPLE:

srchk(alpha)

ALPHA	000000	000001
ALPHA+1	000005	000000
ALPHA+2	ignored	
ALPHA+3	ignored	
ALPHA+4	777000	000777
ALPHA+5	777775	000012
	0 18	35

NOTE: 777775 is -3

Typical Link

000007	000000
step word -5	
step word -4	
▨	▨
step word -2	
step word -1	
link word	
3	a	b	c
0 9 18 27 35			

3 { step word -3

Here, the interpreter tests each link for any 1 bits in the shaded areas in step word -3.

COMMENT: The interpreter performs the search as follows: It first searches thread 31, then thread 30, then thread 29, etc. However, it performs a forward search on each thread.

POP: SRCHKC   Search keys continued

FORMAT: srchkc(Y)

Y is the location of the 6-word search file used by the last executed SRCHK or SRCHKC pop. (See SRCHK for format.)

FUNCTION: 1. Determine whether the last executed SRCHK or SRCHKC pop was successful

2. If the pop was not successful, then set false and set C(ROLPTR+0) = 0.

If the pop was successful, execute SRCHK pop with the following modification: RP(ROLPTR+0) is pointing to the VSW of the link satisfying the test. If this link is the last on thread N, then start search at the first link of thread N-1. If this link is not the last link on thread N, then start search at the next link of thread N.

S. SHIFT POPS

Pops

POP: WRKL Shift work left

FORMAT: wrkl(Y)

FUNCTION: Shift work left by C(Y) 0-17 bit positions. Fill
           with zeros on the right of WO.

EXAMPLES:

    wrkl (C3)

C3 | 000003 | 000000 |
          0   18   35

              Case 1   Case 2

WO before | 007777 | 000000 | WO before | 777777 | 000000 |
          0   18   35   0   18   35

WO after | 077770 | 000000 | WO after | 777770 | 000000 |
          0   18   35   0   18   35

COMMENT: WRKL is equivalent to multiplication by a power of 2.

POP: WRKR Shift work right

FORMAT: wrkr(Y)

FUNCTION: Shift work right by C(Y) 0-17 bit positions. Fill with
           zeros on the left of WO.

EXAMPLES:

    wrkr (C3)

    C3 | 000003 | 000000 |
              0   18   35

Case 1   Case 2

WO Before | 007777 | 000000 | WO Before | 777777 | 000000 |
            0   18   35   0   18   35

WO After | 000777 | 700000 | WO After | 077777 | 700000 |
            0   18   35   0   18   35

COMMENT: WRKR is a logical shift, not an arithmetic shift.
It should not be used to divide a negative number by a
power of 2.

T.   EXCHANGE POPS

<u>Pops</u>

POP: XCH   Exchange work and storage

FORMAT: xch(Y)

FUNCTION: Exchange C(W0) and C(Y)

EXAMPLE:

xch(w1)

```
            Before                      After

    W0  | 000003 | 000000 |    W0  | 000005 | 000000 |
        0       18      35        0       18      35

    W1  | 000005 | 000000 |    W1  | 000003 | 000000 |
        0       18      35        0       18      35
```

POP: XLR   Exchange left and right halves of work

FORMAT: xlr( )

FUNCTION: Exchange C(W0) 0-17 and C(W0) 18-35

POP: XLRS   Exchange left and right halves of storage

FORMAT: xlrs(Y)

FUNCTION: Exchange C(Y) 0-17 and C(Y) 18-35

EXAMPLE:

xlrs(alpha)

```
    ALPHA before   | 000005 | 000000 |
                   0       18      35

    ALPHA after    | 000000 | 000005 |
                   0       18      35
```

COMMENT: xlr( ) is equivalent to xlrs(w0)

U. DUMMY POPS

Pops

POP: DMY   Load Dummy

FORMAT: dmy(Y)

FUNCTION: 1. Add 1 to dummy counter

        2. Set $C(DO)$ 0-17 = Y

           Set $C(DO)$ 18-35 = 0

EXAMPLE:

dmy(7) appends the following word to the dummy stack:

000007	000000
0 18	35

POP: PRD   Prune Dummy

FORMAT: prd(Y)

FUNCTION: Subtract $C(Y)$ 0-17 from dummy counter;

        i.e., prune dummy stack by $C(Y)$ 0-17 words

V. USER POPS

There are five user pops. Each corresponds to a GE-645 machine
language subroutine in the procedure segment. The starting
locations of these subroutines are stored in the upper halves
of locations 3-7 in the procedure segment. For example:

	Loc. of subroutine for user1	Ignored
3		
	0	18 35

Each of these starting locations is somewhere after the reserved
locations (octal 0-12).

In writing the subroutines constituting the user pops, the user
must observe the following conventions:

1. The base pairs are all reserved:

    <u>Used by Pops Interpreter</u>   <u>Used by Multics</u>

    AP - Procedure segment   SP - Stack segment
    BP - Data segment   LP - Linkage segment

2. The following registers are reserved:

    X1 - Pop counter   - Relative to AP
    X3 - Work)
    X4 - Exit }   - Relative to BP
    X5 - Dummy)

3. The other registers may be changed.

4. The user routines return to the interpreter in the
    manner described for DOML (see DOML).

Pops

POP: USER1, USER2, USER3, USER4, and USER5

FORMAT: userN(Y)

        N = 1,2,3,4, or 5
        Y is a location in the data segment

FUNCTION: Execute the corresponding user routine

EXAMPLE:

user3(w2)

Assume user3 is a store lower pop: The operand is Y, a

location in the data segment.

The routine sets $C(Y)$ 18-35 = $C(W0)$ 18-35.

```
WO      | 001750 | 000625 |
          0        18      35

W2 before| 000764 | 000235 |
          0        18      35

W2 after | 000764 | 000625 |
          0        18      35
```

COMMENTS: 1.   True/false tags and address modification pops
                   may be used with the user pops; i.e., the pop
                   user4(w2,f) is permitted.

           2.   The user pops are similar to DOML; however,
                   they are more versatile, since the operand of
                   a user pop may specify data. The operand of
                   the DOML pop simply specifies the location
                   of the machine language subroutine. (See DOML.)

W. TIMING POPS

Pops

POP: TYMF   Time from

FORMAT: tymf(N)
N is normally roll 3 (fact roll)

FUNCTION: Record time by setting TYMER and TYMER+1. These are
contiguous one-word registers in the data segment,
with the following formats:

TYMER (even address)	Location of current TYMF	0
TYMER+1	Current time (in 64ths of a millisecond)	

0   18   35
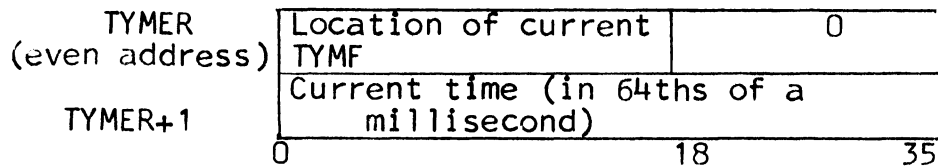
POP: TYMT   Time to

FORMAT: tymt(N)
N is normally roll 3

FUNCTION: 1. Compute elapsed time between last time recorded
(TYMF) and current time (TYMT)

2. Bump bottom of roll N by two words, and put the
following information in these words:

word 1	time difference - recorded in 64ths of a millisecond	
word 2	location of last TYMF pop	location of current TYMT pop

0   18   35
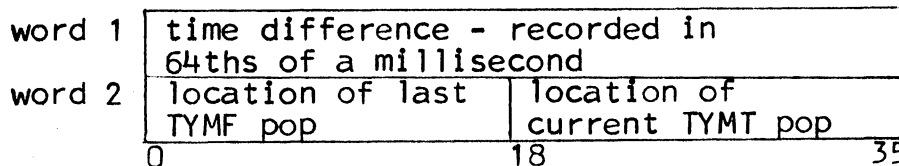
Time difference = current time - C(TYMER+1) - C(TYMASK)

TYMASK is a 36-bit cell in the data segment, with the
following format:

k bits	36-k bits
1	Fudge factor

0   k   35
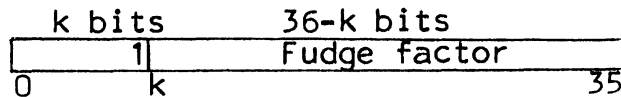
The k-bit field may be used to set a flag in word 1,
indicating that timing information follows. If the
k-bit field contains 1, then the first k-bits of
word 1 are set to 1's. The user should choose k small
enough, so that 36-k bits are sufficient for recording
the time difference. If k=0, then there will be no
flag in word 1.

The fudge factor is set equal to the time spent
in executing the TYMF and TYMT pops, so that this
may be omitted from a critical time calculation.
This time may be determined by executing a pair
of successive TYMF and TYMT pops and using the
elapsed time. The current estimate is
25 (milliseconds/64).

General Comments

1. Any number of pops may appear between a TYMF pop and
    a TYMT pop.

2. If there are several TYMF pops, each TYMF overrides
    the preceding TYMF.

CAUTION: The current implementation of the interpreter does
          not include a Multics timer interface. Therefore,
          until further notice, all times will be 0. The
          timer feature was originally provided for a GECOS
          environment, where the timings would be more
          meaningful than in a Multics environment.

X. ERROR POPS

Each of the error pops bumps the bottom of roll 1 (error roll) by one word and sets C(word 1) as follows:

Card Number	Column Number	P i p	Y
0 8	9 18	19	35

Card number -- C(CRDNUM) 18-26.

Column number -- The number of the column in which the error
                 occurred. This is either C(WO) 0-17 or
                 C(CHARC) 0-17, depending on the pop. The
                 first 9 bits in this number must be zero.

Pip -- A character printed as part of the error list (see Printing
       the Error List, paragraph Y.1.c). If C(word 1) 18 = 0,
       the pip is a ^. This appears under the erroneous
       character. If C(word 1) 18 = 1, the pop is a `. This
       appears under a character after the erroneous character.

Y -- The operand of the pop. This is the location of the first
     word of the error message. This location must be in the
     lower half of the data segment; i.e., Y must be < 2**17
     The error message is a type-1 string

EXAMPLE:

Y	17	I	L	L
Y+1	E	G	A	L
Y+2	ß	C	H	A
Y+3	R	A	C	T
Y+4	E	R	ß	ß

0   9   18   27 35

Pops

POP: EROR   Error on work

FORMAT: eror(Y)
         Y is the location of the error message. (See description
         above).

FUNCTION: 1. Bump bottom of roll 1 by one word

           2. Set C(word 1) as follows:

               C(word 1) 0-8 = C(CRDNUM) 18-26
               C(word 1) 9-17 = C(WO) 9-17. (Here, C(WO) 0-8 must
                                                   be zero.)

               C(word 1) 18 = 0
               C(word 1) 19-35 = Y

POP: ERRP Error on work, and prune

FORMAT: errp(Y)
        Y is the location of the error message.
        (See description above.)

FUNCTION: 1. Execute eror(Y)

          2. Prune WO

POP: ERRCC Error on current column

FORMAT: errcc(Y)
        Y is the location of the error message.
        (See description above.)

FUNCTION: 1. Bump bottom of roll 1 by one word

          2. Set C(word 1) as follows:

              C(word 1) 0-8 = C(CRDNUM) 18-26
              C(word 1) 9-17 = C(CHARC) 9-17. (Here, C(CHARC)
                                      0-8 must be zero.)

              C(word 1) 18 = 0
              C(word 1) 19-35 = Y

COMMENT: errcc(Y) is equivalent to load(charc)
                                  errp(Y)

POP: ERRLC Error on last column

FORMAT: errlc(Y)
        Y is the location of the error message.
        (See description above.)

FUNCTION: 1. Bump bottom of roll 1 by one word

          2. Set C(word 1) as follows:

              C(word 1) 0-8 = C(CRDNUM) 18-26
              C(word 1) 9-17 = C(CHARC) 9-17. (Here, C(CHARC)
                                      0-8 must be zero.)

              C(word 1) 18 = 1
              C(word 1) 19-35 = Y

Y.   OUTPUT POPS

1.   Print Pops

The print pops (PRNT and PRNTC) prepare data for printing.

They specify the format of the data and the order in which it

is to be printed.

Each print line may contain up to 132 ASCII characters.

The characters constituting the print line are first placed in

PLINE, a 37-word buffer in the data segment. PLINE has the

following format:

```
        PLINE+0 -- Print positions 1-4
        PLINE+1 -- Print positions 5-8
        PLINE+2 -- Print positions 9-12
                    .
                    .
                    .
        PLINE+32 -- Print positions 129-132
        PLINE+33
        PLINE+34    Extra words, which may be needed for control
        PLINE+35                characters.
        PLINE+36
```

(The locations PLINE-3, PLINE-2, and PLINE-1 provide a backstop

in case any integer extends to the left of print position 1.)

When a line is terminated, the interpreter moves the line to

the list segment or the error segment.

a.   The Parameter File

The operand of a print pop is the location of the parameter

file in the data segment.* Six types of words may be used in

this file:

* This is true if $Y \neq 0$. (See Printing the Error List,
                paragraph Y.1.c.)

ATH - ASCII to ASCII conversion

HTH - Hollerith to ASCII conversion

FID, LID, RID, FIO, LIO, and RIO - Numeric to ASCII conversion

Skip - Skip a certain number of words in the parameter file

Leave - Go to the next pop, without terminating the print line

PRT - Terminate the print line, and go to the next pop.

Each file word consists of five fields:

Field 1 (bits 0-2) - Code - This field identifies the type of file word, as follows:

        0 - SKIP
        1 - ATH
        3 - HTH
        4 - FID, LID, RID, FIO, LIO, and RIO
        5 - PRT
        2,6, and 7 - not used

The code field is not applicable to the leave file word.

Field 2 (bits 3-7) - Word Count (W) - This field tells the number of words to be moved to PLINE (ATH, HTH) or the type of integer conversion (FID, LID, RID, FIO, LIO, RIO). Otherwise, it is ignored.

Field 3 (bits 8-14) - Print Position (P) - The meaning of this field depends on the type of file word.

Field 4 (bits 15-17) and Field 5 (bits 18-35) - Index (I) and Address (A) - These fields give an effective address, which is computed as follows:

Index	Effective Address
I = 0	A
I = 1	A+C(X1)
I = 2	A+C(X2)
I = 3	A+C(X3)
I = 4	A+C(OUTAG4) 0-17
I = 5	A+C(OUTAG5) 0-17
I = 6	A+C(OUTAG6) 0-17
I = 7	(See LEAVE, page 126)

Each index corresponds to a GE-645 index register. Therefore, this feature can be used only by the interpreter.

OUTAG4, OUTAG5, and OUTAG6 are cells in the data segment.

The meaning of the effective address depends on the type of file word.

b. Description of File Words

1. ATH - ASCII to ASCII

FORMAT: ath(A,I,P,W)

REPRESENTATION IN DATA SEGMENT:

1	W	P	I	A
0	3	8	15 18	35
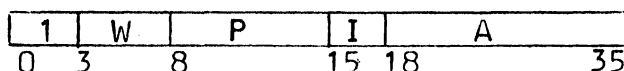
MEANING OF OPERANDS:

A and I -- Effective address is location of first word in string

P -- Print position for first ASCII character (1-127) ASCII characters are moved into PLINE left to right

W -- Word count. If W = 0, a type-1 string is to be moved to PLINE
If W = 1,2,..., or 31, 4W characters are to be moved to PLINE

NOTE: The first character in a type-1 string tells how many characters are to be moved to PLINE, but this character itself is never moved.

2. HTH - Hollerith to ASCII

FORMAT: hth(A,I,P,W)

REPRESENTATION IN DATA SEGMENT:

3	W	P	I	A
0	3	8	15 18	35
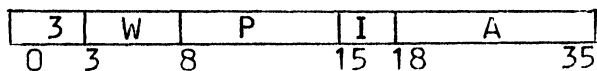
MEANING OF OPERANDS:

A, I, and P -- Same as for ATH

The ASCII equivalents of the Hollerith characters are moved into PLINE left to right.

W -- Word count. If W = 0, a type-1 Hollerith string is to be moved to PLINE

If W = 1,2,..., or 31, 6W characters are to be moved to PLINE.

COMMENT: The difference between an ASCII type-1 string and a Hollerith type-1 string is illustrated below:

```
ASCII     3   A   B   C      Hollerith   5   A   B   C   D   E
         003 101 102 103                05  21  22  23  24  25
```

3.   Integer to ASCII (macros shown below)

FORMAT: macro(A,I,P)

REPRESENTATION IN DATA SEGMENT:

```
 ┌───┬─────┬─────┬───┬──────────────┐
 │ 4 │ W*  │  P  │ I │      A       │
 └───┴─────┴─────┴───┴──────────────┘
 0   3     8     15  18             35
```
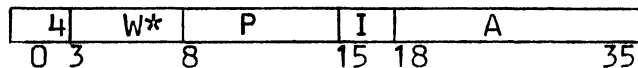
*The macro determines W. (See MEANING OF OPERANDS.)

MEANING OF OPERANDS:

A and I -- Effective address is location of integer

P -- Print position for least significant digit (1-127) Numeric data is moved into PLINE right to left.

W -- Conversion type - The value of W for each of the macros is shown in the chart below:

Macro	Meaning	Value of W	Number of characters
FID	Full integer decimal	0	Number of significant
LID	Left integer decimal	1	digits (Plus one, if
RID	Right integer decimal	2	the sign is negative)
FIO	Full integer octal	8	12
LIO	Left integer octal	9	6
RIO	Right integer octal	10	6

EXAMPLE:

C(ALPHA) = | 777777 | 000001 |
0   18   35

Print Positions

-262143	fid(alpha,0,20)
-1	lid(alpha,0,20)
1	rid(alpha,0,20)
777777000001	fio(alpha,0,20)
777777	lio(alpha,0,20)
000001	rio(alpha,0,20)

9   20

COMMENTS: 1. For negative decimal numbers, the leftmost
                character is the sign. Otherwise, the leftmost
                character is the most significant digit.

            2. Leading zeros are printed with octal numbers.
                No leading zeros are printed with decimal numbers.

            3. Zero is represented as shown below:

                FID, LID, RID   0
                     LIO, RIO   000000
                     FIO 000000000000

4) LEAVE - Leave

    FORMAT: leave( )

    REPRESENTATION IN DATA SEGMENT

    | 7 7 7 7 7 | 7 | 7 7 7 7 7 7 |
    0   15 18   35

        The macro determines the entire word

        The 7 in bits 15-17 indicates that the file word is
        LEAVE
        All other bits are ignored

5) SKIP - Skip

    FORMAT: skip(A,I) or skip(A)

    REPRESENTATION IN DATA SEGMENT:

    | 0 | 0 | 0 | I | A |
    0   3   8   15 18 35

MEANING OF OPERANDS:

A and I -- Effective address is location of
next parameter word relative to
current parameter word.

COMMENT:

The user may specify a backward skip, but may
not specify a skip of 0 words:

skip(0) is illegal (terminates line, with
error message)
skip(1) goes to next word, as usual
skip(2) skips one word
skip(-3) goes back three words

6)   PRT - Print

FORMAT: prt(P,I,A)

REPRESENTATION IN DATA SEGMENT:

5	0	P	I	A
0	3	8	15 18	35
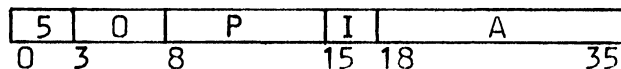
MEANING OF OPERANDS:

A and I -- An effective address of 1-15 decimal
specifies the number of lines to space
after printing: 1 means single space,
2 means double space, etc.

An effective address of 20 decimal
specifies that a new page should begin
after the line is printed.

P -- The report code:

2, if the line should be included in the list
segment

Any other number, if the line should be included
in the error segment

Pops

POP: PRNT   Print

FORMAT: prnt(Y)
         If Y ≠ 0, it is the first word of the parameter file
         (See Printing the Error List, paragraph Y.I.c, for a
         description of what happens when Y = 0.)

FUNCTION: 1.   Clear PLINE -- PLINE+36 to ASCII blanks

            2.   Proceed as directed by parameter file

EXAMPLE:

        Procedure Segment   Data Segment

        prnt(list)   list: hth (string1,0,1,2)
                                                  ath (string2,0,20,0)
                                                  fio(number,0,60)
                                                  prt(1,0,3)

        STRING1 | H O L | L E R | I T H | ␣ ␣ ␣ |

        STRING2 | 5 A | S C | I I | ␣ ␣ |

        NUMBER | 000007 | 000000 |
                  0   18   35

        PLINE | HOLLERITH   ASCII   000007000000 |
                  1   20   60 Print
                                                                      Position

COMMENTS: 1.   The interpreter will truncate an ASCII or Hollerith
                 string on the right, if necessary, so that it will
                 not exceed to the right of print position 132.

            2.   Data may be placed in PLINE in any order; e.g.,
                 positions 22-35 may be filled before positions
                 3-10. Data may also be superimposed on other data

            3.   CAUTION: Always use a PRNT or PRNTC pop to place
                 data in PLINE -- do not move any strings directly
                 into the buffer.

POP: PRNTC   Print continue

FORMAT: prntc(Y)

FUNCTION: Proceed as directed by parameter file
           NOTE: This pop does not clear PLINE buffer

COMMENTS: See PRNT

c.   Printing the Error List

POP: PRNT   Print

FORMAT: prnt(0)

FUNCTION: Case 1:   Input Stream on Cards -- Roll 1 (error roll)
                      empty
                      Go to next pop

            Case 2:   Input Stream on Cards -- Roll 1 non-empty

                1.   Scan each word on error roll, and print
                     each error message
                2.   Prune error roll

            Case 3:   Input Stream on Roll N -- Roll 1 empty

                Set C(BOTTOM+N) 0-17 = RP(ROLPTR+N)

            Case 4:   Input Stream on Roll N -- Roll 1 non-empty

                1.   Sort error roll in ascending order

                2.   Place the following information in the
                     error segment: each message on
                     the error roll, with the corresponding
                     FORTRAN statement (including pips).
                     (See Error Pops, Paragraph X.)
                     (The input stream must be a type-3 string).

                3.   Prune error roll

                4.   Set C(BOTTOM+N) 0-17 = RP(ROLPTR+N)

EXAMPLE:

The following messages are part of a FORTRAN error list:

    38   IF(L(J)-MC(K)) 299,50,299

* * *   OPERAND IN WRONG MODE.

    67   999 FORMAT (15H1 ***SUB-LATINS)

* * *   MULTIPLY DEFINED EFN.

2. WBIN Pop

WBIN uses information on the binary and relbit rolls to produce text, linkage, and symbol segments.

a. Binary Roll Format

Each group on the binary roll defines a section of consecutive words in the text, linkage, or symbol segment. The binary roll contains variable-size groups with the following format:

```
+-----------------+
|       VSW       |
+-----------------+
|      VSW+1      |
+-----------------+
|     k words     |
+-----------------+
0               35
```
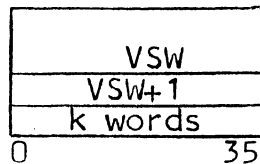
C(VSW) 0-17 - Size of group

C(VSW) 18-35 - 0 if not labeled COMMON
               Otherwise, offset of word on SYMREF roll
               Note: This field is used only by FORTRAN IV, not
                      by the interpreter.

C(VSW+1) 0-7 - Number of words in section (k)

k = 0,1,2,...,or 255

C(VSW+1) 8-11 - Segment type (in octal)

        0-7 -- Illegal (does not apply here)
        10 -- Object procedure (text segment)
        11 -- Absolute (does not apply here)
        12 -- Linkage (linkage segment)
        13 -- Blank COMMON (does not apply here)
        14 -- Stack (does not apply here)
        15 -- Definitions section (in text or linkage
               segment)
        16 -- Symbol segment
        17 -- Illegal (does not apply here)

        Note: Groups with types labeled "does not apply
               here" are ignored by the interpreter.

C(VSW+1) 12-17 - Ignored by the interpreter

C(VSW+1) 18-35 - Loading origin

k words -- Section of code to be moved to specified segment

b. Setup of Text and Linkage Segments

The interpreter uses the following data segment registers to
determine the setup of the text and linkage segments:

TXTL

# of words in text for obj. proc.	Ignored	
0	18	35

LNKL

# of words in linkage for obj.proc.	Ignored	
0	18	35

PUTDEF

0 - Def. section follows text in text segment non-0 - Def. sec. follows linkage in linkage segment	Ignored	
0	18	35

DFSL

# of words in definitions sect.	Ignored	
0	18	35

c. Loading Origin

The loading origin is an offset in the text, linkage, or
symbol segment. It tells the interpreter where to begin
loading the k-word section. For the definitions section,
the loading origin is relative to the location of the first
definition word. Otherwise, it is relative to the first
word of the segment.

d. Relbit Roll Format

As each new group is being formed on the binary roll,
relocation codes (if any) for that group are stored on the
relbit roll. A 6-bit relocation code is stored for each
half-word in the k-word section. These codes are stored
contiguously, starting at the leftmost position in the relbit
roll. Figure 4 shows the setup of the relbit roll.

1U	1L
2U	2L
3U	3L

k-word section
U = Upper
L = Lower

0   18   35

Relbit Roll

Top

1U	1L	2U	2L	3U	3L
4U	4L	5U	5L	6U	6L

$(k+2)/3$ words (ignoring remainder)

Bottom 0   6   12 18 24 30 35
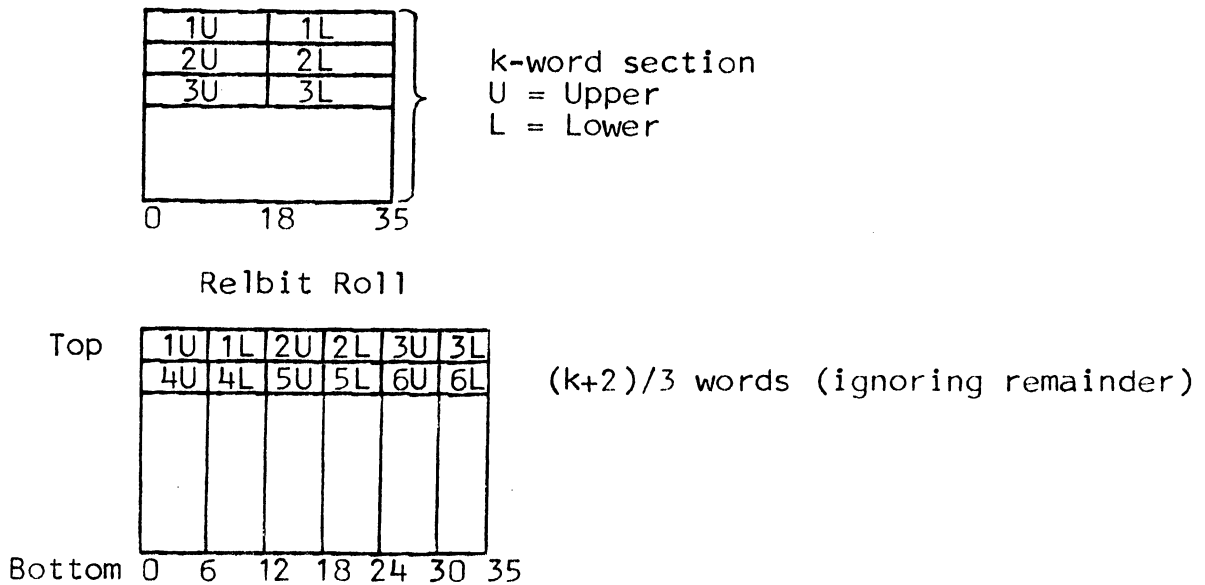
Figure 4. Setup of Relocation Information for k-word
          Section

The relocation codes have the following meanings:

```
   00 -- Multics code 0 (later squeezed to 1 bit)
01-17 -- Not used
20-37 -- Standard Multics codes (later squeezed to 5 bits)
40-77 -- Not used
```

e. Collection of Relbits

The interpreter uses the text and linkage segments to collect

relbits. After all relbits have been collected, the interpreter

squeezes the 6-bit relocation codes into 1-bit and 5-bit Multics

relocation codes, and places this information into the symbol

segment:

Before   After

000000   0   1-bit string
01xxxx   1xxxx   5-bit string

NOTE: These strings are concatenated; thus, 5-bit codes may

overlap words.

After all relbits have been moved to the symbol segment,
the interpreter moves text to the text segment, linkage
to the linkage segment, and symbols to the symbol segment.

The relbits are collected in the text and linkage segments
as follows: There are four classes of relbits: text, linkage,
definitions, and symbol. The text and linkage segments are each
. 'ed into sectors. Each sector is approximately 2**18/3 words.
The second sector of the text segment contains text relbits,
the third sector of the text segment contains definitions relbits,
the second sector of the linkage segment contains linkage relbits,
and the third sector of the linkage segment contains symbol
relbits. The first sector in each segment is not used in the
collection of relbits. Since Multics preclears each unused page
on first reference, the interpreter does not preclear the sectors
before collecting relbits.

The sectors containing relbits have the following setup: The
first four words of each sector are used by the interpreter to
store pointers. The remaining words in the sector contain
relocation codes in the same format as they would appear on
the relbit roll.

EXAMPLE:

TXTL | 7 | 0 |

Ultimate Contents of Text Segment:

0	OU	OL
1	1U	1L
2	2U	2L
3	3U	3L
4	4U	4L
5	5U	5L
6	6U	6L

Text Sector:

0	Used by					
1	Interpreter					
2						
3						
4	OU	OL	1U	1L	2U	2L
5	3U	3L	4U	4L	5U	5L
6	6U	6L				

0   6   12 18 24 30 35

f. Symbol Segment

The first portion of the symbol segment contains symbols which are moved from the binary roll. Following this are three sections of relbits for the text, linkage, and symbol segments, respectively.

The interpreter uses the contents of the SYML register in the data segment to determine the setup of the symbol segment:

SYML	# of words in symbol segment (excluding relbits)	Ignored
	0 18	35

Relbits for the definitions section are concatenated with those for the text segment or for the linkage segment, depending on the value of PUTDEF.

Relbits for the symbol segment pertain only to the symbol words stored in the first portion.

The setup of the symbol segment is shown below:

symbol words
Relbits for text (possibly incl. definitions)
Relbits for linkage (poss. incl. def.)
Relbits for symbols

0   35
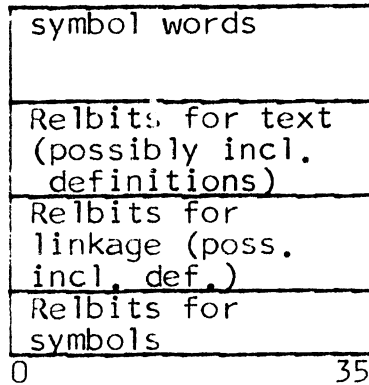
The following illustrates the format of a typical relbits section:

# of relbits in area below
packed relbits

0   35
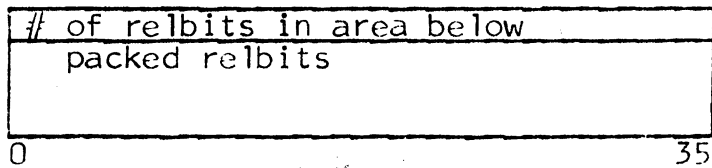
g. Definitions Section

The definitions section should begin with the following words:

	0	9	18	26	35
Group A 0	5		0		
	T		2		
	8	r	e	1	
	-	t	e	x	
	t	0	0	0	
Group B 5	10		0		
	L		2		
	8	r	e	1	
	-	l	i	n	
	k	0	0	0	
Group C 10	15		0		
	S		2		
	10	r	e	1	
	-	s	y	m	
	b	o	1	0	

Left half is offset of next group in definitions section
T = offset of text relbit sect. in symbol seg.,2=symbol seg.

Symbolic name for text relbits; identifies word above

Left half is offset of next group in definitions section
L = offset of linkage relbit section in symbol seg.,
        2 = symbol seg.
Symbolic name for link relbits; identifies word above

Left half is offset of next group in definitions section
S = offset of symbol relbit sect. in symbol seg., 2 = symbol seg.

Symbolic name for symbol relbits; identifies word above

The second word in each group is set by the interpreter. All other words are set by the user.

The offsets of these three groups in the definitions section are contained in three data segment registers set by the user:

RELTX

Offset of Group A	ignored
0	18 35

RELLK

Offset of Group B	ignored
0	18 35

RELSY

Offset of Group C	ignored
0	18 35
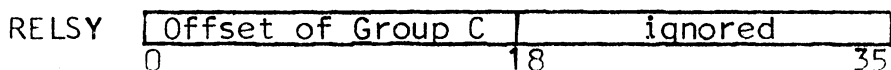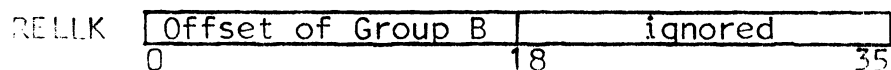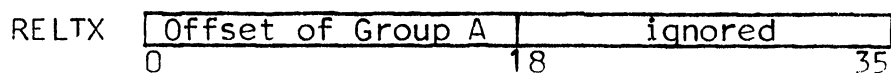
If the definitions section is set up as described above, C(RELTX) 0-17 = 0, C(RELLK) 0-17 = 5, and C(RELSY) 0-17 = 10. This feature allows the user to place these groups anywhere in the definitions section.

Pop

POP: WBIN Write Binary

FORMAT: wbin(0)
         or
         wbin(N) where N is the number of the binary roll

FUNCTION: Case 1:   The operand is 0

This pop determines the numbers of the binary and relbit rolls from two data segment registers:

(Even location)

BINREL

# of binary roll	Ignored
0	18 35

BINREL+1

# of relbit roll	Ignored
0	18 35
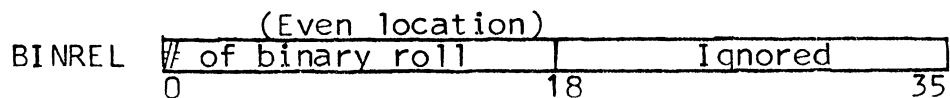
1. If relbit roll is empty, go to next pop.

   Otherwise, move 6-bit characters from relbit roll to proper sector in text or linkage segment.

2. Prune relbit roll

Case 2: The operand is N

1. If C(LNKL) 0-17 = 0, then set C(LNKL) 0-17 = 8, and create dummy 8-word linkage header:

0	0	0
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	8
7	0	8
	0 18	35

2. Squeeze relbits and move them to the symbol segment

3. Set the three relbit pointers in the definitions section.

4. Scan the binary roll and move the text, linkage, and symbol words to the proper segments.

COMMENTS: 1. The wbin(0) pop should be executed as each group is put on the binary roll (if the group contains relocatable information).

2. The wbin(N) pop should be executed only after the last group has been put on the binary roll.

3. If the operand of the WBIN pop is N, N overrides C(BINREL) 0-17

Z.   EXECUTIVE AND TERMINATION POPS

1. Snap Pops

There are two snap pops:

        SNAPC -- Snap core

        SNAP -- Snap panel, stacks, and rolls

The format of each of these pops is pop(Y), where Y is the
location of a file in the data segment.

All snap output appears in the error segment.

a. Core Dumps

1) File Format

Each word of the file for a SNAPC pop has the following
format:
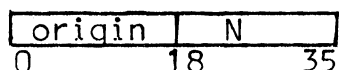
origin	N
0	18 35

If origin ≠ 777777, the file word directs the interpreter
to snap N words in the data segment, starting at origin.
The file may contain any number of words of this type.

EXAMPLE:

010000	000100
0	18 35
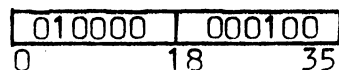
This word causes the interpreter to snap data segment
locations 10000 -- 10077.

If origin = 777777, the file word signifies the end of the
file. Every file must include a word of this type.

A typical file is:

010000	000100
034000	000040
777777	000000

0   18   35

2) Snap Format

SNAPC produces the following output:

1. The first line is:

        SNAP LOC nnnnnn

   where nnnnnn is the octal location of the SNAPC pop in the
   procedure segment.

2. Following this message, all snaps requested in the file
   appear in single-spaced format. Each line begins with the
   octal address of the first word snapped in the line. This
   is followed by eight octal words, in each line except the
   last. For example, 013100 indicates that the line snaps
   data segment locations 013100 -- 013107. The last line
   snaps one to eight words, depending on the number of words·
   remaining; i.e., $N = 8I + J$ (I lines of 8 words and 1 line
   of J words).

   A star appearing to the right of one of the octal addresses
   indicates that one or more lines were deleted. A deletion
   occurs whenever an 8-word pattern is repeated. Most
   deletions occur because of a block of zeros.

EXAMPLE:

        000600
        002020*

Here, the lines starting with the following addresses were

deleted: 000610 -- 002010;

i.e., C(600) = C(610) = . . . = C(2010)
       C(601) = C(611) = . . . = C(2011)
                              .
                              .
                              .
       C(607) = C(617) = . . . = C(2017)

The last line of a snap is never deleted.

b. Panel, Stack, and Roll Dumps

1) File Format

Each word of the file for a SNAP pop has the following format:

```
 _____
|  M  |  N  |
 -----------
0     18   35
```
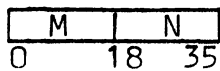
The significance of these fields is summarized in the

following chart:

Sign-bit of M	Sign-bit of N	Meaning in First Word	Meaning After First Word
0	0	Snap roll M. If N≠0, it is the location of a message to precede the snap; the message is a type-1 string (generally the name of the roll) in the data segment.	Same as in first word
0	1	N is a negative two's complement number. Snap $|N|$ rolls starting at roll M: i.e., snap rolls M through M+$|N|$ - 1 EXAMPLE: $\begin{array}{\|c\|c\|}\hline 000010 & 777774 \\ \hline\end{array}$ 0 18 35 says snap rolls 10, 11, 12, and 13 (octal). (777774=-4)	Same as in first word
1	0	Snap stacks.	End of file
1	1	Snap stacks and panel.	End of file

If the sign bit of the first word = 1, then the first word is
a special word; its interpretation is different from that of the
following words in the file. There are three possible types
of setups:

special word	special word	roll words
roll words	end word	end word
end word		

The sign bit of the end word = 1. A typical file is:

777777	777777	Snap stacks and panel
000006	000000	Snap roll 6 (no message)
777777	777777	End of file

0   18   35

2) Panel Snaps

A panel snap displays the following registers in the data
segment: SYMTLY, SYMCNT, SYMBUF-1, FEXIT, SYMKEY, CHAR, CHARC,
MODES, CONMOD, VARSIZ, MRKER, FCNT, DSCALE, BSCALE, DSIGN, BSIGN,
SYMBUF, CURPTR, RMD, MPAC, TLYIN, CONBUF, and ALTER. The
identification of the register appears above its contents.

3) Stack Snaps

A stack snap displays the currently used words in the work,
dummy, and exit stacks. A word in the left margin identifies
the stack: WORK, DMY, or EXIT. The format is similar to that
of a core snap. However, there is no suppression of lines;
and the addresses are relative to the beginning of each stack.
The appearance of addresses anywhere within the range
777000 -- 777770 indicates that the stack was over-pruned.
In this case, the snap displays the over-pruned area.

EXAMPLE:

```
(-100)  777700
(- 70)  777710
          .                    Indicates octal 100(i.e.,64) words
          .                    over-pruned
          .
        777770
```

The stack snap is single spaced.

4) Roll Snaps

A roll snap may be preceded by a message (see the chart on

page 140). The format of the snap depends on the characteristics

of the roll:

1. If the roll is empty or over-pruned, the following message

   appears: n EMPTY, where n is the roll number in decimal.

   There is nothing else in the snap.

2. If the roll is not open, the following message appears:

   n NOT OPEN, where n is the roll number in decimal. There

   is nothing else in the snap.

3. Otherwise, the snap displays the roll from the anchor

   up to (but not including) the bottom.

The first two items on each line are: the roll number

(in decimal), and the location in octal of the first word

in the line relative to the anchor. These are followed

by eight octal words in each line except the last. If

the number of words from anchor to bottom is a multiple

of eight, then the last octal line contains simply the roll

number and the offset of the bottom from the anchor. Otherwise,

the last octal line also displays one to seven words. These

octal lines are double spaced.

The following subtitles appear below the octal words to which

they apply:

```
            ^ANCHOR
            ^TOP
            ^ANCHOR,TOP
```

One of the following subtitles appears below the empty space

corresponding to the bottom:

```
            ^BOTTOM
            ^TOP,BOTTOM
```

EXAMPLE:

```
        003726000000
                      ^BOTTOM
```

If the last line of the roll dump contains no items of the

roll, then ^BOTTOM or ^TOP,BOTTOM appears below the first empty

space.

Suppression is possible. However, only the lines under which

no subtitles appear may be suppressed. The first and the last

lines are always printed.

The following information appears below the indication of the

bottom:

n1 TO FLOOR   VAR GRPSIZ(or n2 GRPSIZ) n3 GUESS   n4 ROLPTR

where: n1 = number of words from bottom to floor

          n2 = number of words in fixed-size groups
               (VAR indicates variable-size groups)

          n3 = number of words in the initial guess

          n4 = C(ROLPTR+N) 0-17. If no number appears here
                                  then C(ROLPTR+N) = 0.

          These are all decimal numbers.

For roll 0 only, the snap concludes with a table showing
the start of each of the 32 threads in the roll, the
number of links in each thread, and the number of references
made to each thread (by SRCH or SRCHP).

Pops

POP: SNAPC   Snap core

FORMAT: snapc(Y)

          Y is the location of the first word of a file
          (See Paragraph Z.1.a.)

FUNCTION: Produce a snap, as directed by the file

POP: SNAP   Snap panel, stacks and rolls

FORMAT: snap(Y)

          Y is the location of the first word of a file
          (See Paragraph Z.1.b.)

FUNCTION: Produce a snap, as directed by the file

2. Termination Pops

<u>Pops</u>

POP: BORT   Abort procedure

FORMAT: bort( )

FUNCTION: 1. Snap data segment locations 0 to location preceding
               top of roll 0

            2. Execute a snap(Y) pop, using C(ROLDMP) 0-17 as
               the file location. ROLDMP is a register in the
               data segment with the following format:

location of file for snap(Y)	ignored
0	18 35

            3. Terminate the procedure (See Chapter 1, Paragraph F)

POP: FIN   Finish procedure

FORMAT: fin( )

FUNCTION: Terminate the procedure (See Chapter 1, Paragraph F.)

Appendix A

Summary of Commonly
Used Areas in the Data Segment

Data Area	Illustration	Set By	Used By	Cleared By
Anchor table	ANCHOR+N — Location of anchor for roll N | 0 — (0, 18, 35)	Initialization routine Roll expansion routine and pops that put information on the bottom of a roll	Pops that refer to rolls Roll expansion routine OPN, REL, REMOV, RSV RSVM, RWND, SNAP	Lower half cleared by initialization routine
Bottom Table	BOTTOM+N — Location of bottom for roll N | 0 — (0, 18, 35)	Initialization routine Roll expansion routine CPYP, CPYR, GOBP, OPN, PBCT, PBCTP, PLG, PRNT(0), PRU, PTCT, PTCTP, PTP, PTPP, REL, REMOV, RSV, RSVM, RWND	Pops that refer to rolls Roll expansion routine CNT, CNTG, CPY, CPYP, CPYR, CPYX, CPYXP, DLOAD, DNG, DNX, ERB, GOB, GOBP, INSB, OPN, PBCT, PBCTP, PDES, PLG, PLXG, PRES, PSAV, RSV, RSVM, SCNT, SNAP, SMEB, SORTR, ULOAD, UNG, UNX	Lower half cleared by initialization routine
BSCALE	b=binary scale — # after b Pos. or neg. | Set to 0 and ignored — (0, 8, 35)	CONBA	FXDD, FXDS, SNAP	CONR, CONAR, RNUM
BSIGN	Sign of bin. scale 0 = +, non-zero = - | 0-no bin. scale # 1-bin. scale # — (0, 18, 35)	User (upper) CONBA(lower)	FXDD, FXDS, SNAP	CONR, CONAR, RNUM
CHAR	Keys | ASCII or spec. char | Keys — (0, 9, 18, 35)	Character input subrt. SWIP, SWAP	Character input subrt. CONBA, CONDA, RCH, RCHA, RCKY, RCKYA, SCH, SCHA, SCKY, SCKYA, SNAP	
CHARC	Col. # of current input character | 0 — (0, 18, 35)	Character input subrt. SWIP, SWAP	Character input subrt. ERRCC, ERRLC, SNAP	
CONBUF & CONBUF+1	Principal part (ignoring the decimal point) changed to binary. A two-word signless integer — (0, 18, 35)	CON, CONA, CONAR, CONR, FIXD, FIXS	FLTD, FLTS, FXDS, FXDD, SNAP	CONR, CONAR, RNUM
CONMOD	0 = dec. 1 = oct. | Ignored — (0, 18, 35)	MODD, MODO	CON, CONA, CONAR, CONBA, CONDA, CONR, SNAP	

Data Area	Illustration	Set By	Used By	Cleared By
CRDNUM	0 | n | 0 (0, 18, 27, 35) where n = # of last group processed in current type-3 string	Character input subrt. SWAP, SWIP	Character input subrt. EROR, ERRCC, ERRLC, ERRP, PRNT	
CRDNUM+1	0 | n | 0 (0, 18, 27, 35) where n = number of groups in current type-3 string	Character input subrt. SWAP, SWIP	Character input subrt. EROR, ERRCC, ERRLC, ERRP, PRNT	
CURPTR	P (offset relative to top of N) | ignored | N (0, 18, 30, 35)	LINKP, SRCH, SRCHP	SNAP	
DFSL	# of words in definitions sectn. | Ignored (0, 18, 35)	User	WBIN	
DMYSIZ	Size of dummy | 0 (0, 18, 35)	User	Initialization routine	
DSCALE	e=decimal scale # following e Pos. or neg. # | Set to 0 and ignored (0, 18, 35)	CONDA	FLTD, FLTS, FXDD, FXDS, SNAP	CONR, CONAR, RNUM
DSIGN	Sign of dec. scale 0=+, nonzero = − | Set to 0 and ignored (0, 18, 35)	User	FLTD, FLTS, FXDD, FXDS, SNAP	CONR, CONAR, RNUM
FCNT	# of digits to right of dec. pt. | Set to 0 and ignored (0, 18, 35)	User	FLTD, FLTS, FXDD, FXDS, SNAP	CONR, CONAR, RNUM
FEXIT	Specifies loc. for syntax fail routine | 0 (0, 18, 35)	FEX	RCH, RCHA, RCKY, RCKYA, RSKY, RSKYA, RSY, RSYA	
FUNBUF	FUNBUF+n where n = offset of word in FUNBUF 4 Character positions (0, 35)	Interpreter	User	

Data Area	Illustration	Set By	Used By	Cleared By
Floor Table	**Floor+N** — Location of floor for roll N ǀ 0 (0 · 18 · 35)	See Anchor Table	See Anchor Table	See Anchor Table
FROM	Starting location for data movement ǀ ignored (0 · 18 · 35)	MOVF	MOVT	
FTAB / FTAB+1	Table location ǀ 0 / 0 ǀ # of table entries (0 · 18 · 35)	User	TSRCH	
GRPSIZ	**GRPSIZ+N** — G ǀ ignored (0 · 18 · 35) G≠0 – Roll N contains G-word groups G=0 – Roll N contains var. size groups	User	CPYG, DNG, ERB, INSB, PLG, SMEB, SNAP, SRCH, SRCHP, UNG, ZBG	
GUESS	**GUESS+N** — Specifies space alloc. for roll N (0 · 35)	User	Initialization routine SNAP	
LAST	Starting loc. of rolls ǀ 0 (0 · 18 · 35)	User	Initialization routine	
LNKL	# of words in linkage for obj. proc ǀ Ignored (0 · 18 · 35)	User	WBIN	
MODES	Identifies current input stream ǀ Identifies current status (0 · 18 · 35)	Character input subrt. SWAP, SWIP	SNAP	

Data Area	illustration	Set By	Used By	Cleared
MPAC MPAC+1	Used for storage of fixed-point and floating-point numbers 0 35	FLT,PADD,PADDF PDVD, PDVDF,PMLT, PMLTD, PMLTF,PSUB, PSUBF	PADD,PADDF,PDVD,PDVDF PMLT,PMLTD,PMLTF,PSUB, PSUBF,SNAP	
MRKER	Roll number ignored 0 18 35	MRK,RSVM,TSRCH	CPY,CPYG,CPYGB,CPYP,CPYR, CPYX,CPYXP,ERB,INSB,LINKP,POBS SMEB,SNAP, SRCH,SRCHP	
MTEST	0-Roll movement statistics given if debug version non-0-Roll movement statistics never given 0 35	User	Roll expansion routine in debug version. Ignored in production version.	
OPNERS	# of rolls to be opened 0 0 18 35	User	Initialization routine Roll expansion routine	
OUTAG4	Address used to det. effective address for PRNT and PRNTC 0 0 18 35	User	PRNT(Y), PRNTC(Y)	
OUTAG5	Same as OUTAG4	Same as OUTAG4	Same as OUTAG4	
OUTAG6	Same as OUTAG4	Same as OUTAG4	Same as OUTAG4	
PLINE Buffer	PLINE+n where n = 0,1,...,35,or 36 Four print positions 0 35	PRNT(Y), PRNTC(Y)		PRNT(Y)
PUTDEF	0 - Def section follows text in text segment non-0 - Def. sec. follows linkage in linkage segment Ignored 0 18 35	User	WBIN	

Data Area	Illustration	Set By	Used By	Cleared By
RMD	Remainder from PDVD Operation 0 ... 35	PDVD	SNAP	
ROLDMP	Location of file for snap(Y) | Ignored 0 ... 18 ... 35	User	BORT	
ROLPTR	P | Offset rel. to top of N | Ignored | Roll # N 0 ... 18 ... 30 ... 35	DLOAD, DNG, DNX, LINKN, LINKP, SRCH, SRCHK, SRCHKC, SRCHP, ULOAD, UNG, UNX, ZBG	CCAT, CNTG, CPYG, DLOAD, DNG, DNX, LINKN, LINKP, PLXM, PRNT(U), SRCH, SRCHKC, SRCHP, SWAP, SWIP, SNAP, ULOAD, UNG, UNX	DLOAD, DNG, DNX, ULOAD, UNG, UNX (Also by user prior to one of above pops.)
RSIZE	Maximum count of roll | Ignored 0 ... 18 ... 35	Roll expansion routine (only in debug version)	Termination routine (only in debug version)	Initialization routine (only in debug version)
RSPTR	Offset in current read-spill roll | Ignored | N_R 0 ... 18 ... 30 ... 35 where N_R = Read Spill roll	User RWND	Spill routine	RWND
SIGN	Sign of number. 0 = + non-zero = - 0 ... 35	User	FLTD, FLTS, FXDD, FXDS	CONR, CONAR, RNUM
SYMBUF	SYMBUF+n where n = 0,1,...128 or 129 4 character positions 0 ... 35	CNTS, NXST, NXSTC, NXSTCS, PAK, PAKA, PAKAR, PAKR, PLXG, PLXP, RSY, RSYA, RSYM, SSY, SSYA	CCAT, CNTS, LINKP, PAK, PAKA, PAKAR, PAKR, PLXP, RSY, RSYA, RSYM, SNAP, SRCH, SRCHP, SSY, SSYA, SWAP, SWIP, TSRCH	PAKR, PAKAR, RSYM
SYMCNT	# of words in symbol | Data used by interpreter 0 ... 18 ... 35	CNTS, PAKAR, PAKR, PLXG, PLXP, RSY, RSYA, RSYM, SSY, SSYA	PLXG, PLXP, RSY, RSYA, SNAP, SSY, SSYA	PAKAR, PAKR, RSYM
SYMCNT+1	For Type-1 String Plex Word For Type-2 String # of char. in string | ignored 0 ... 18 ... 35	PLXG Character Input Subrt.	SNAP Character input subrt.	RSYM, PAKAR, PAKR

Data Area	Illustration	Set By	Used By	Cleared By
STAR1F	0 - Special function buffer not used non-0 - Special function buffer used `0` .... `35`	User	Character input subroutine	
STRMTY	| FUNBUF | 4n = 1 | 41(oct) | `0` .... `18` ..... `30` .. `35` FUNBUF - Location of first word in function buffer n - Number of words in function buffer	User	Character input subroutine	
ESCAPE	0 - Ignore NL character and its keys non-0 - Pack NL character into FUNBUF and examine keys `0` .... `35`	User	Character input subroutine	
TOGOOD	1- Funct. Buff. full | Ignore 2- Roll 0 thread table to be written `0` .... `18` ...... `35`	User	Executed to(-1) pop (Any other value means that to(-1) is illegal.)	
BINREL	| # of binary roll | Ignored | `0` .... `18` ...... `35`	User	WBIN	
BINREL+1	| # of rel bit roll | Ignored | `0` .... `18` ...... `35`	User	WBIN	
RELTX	|Offset of link word for **rel_text** in definitions section| Ignored | `0` .... `18` ...... `35`	User	WBIN	
RELLK	|Offset of link word for **rel_link** in def. section| Ignored | `0` .... `18` ...... `35`	User	WBIN	
RELSY	|Offset of link word for **rel_symbol** in definitions section| Ignored | `0` .... `18` ...... `35`	User	WBIN	

Data Area	Illustration	Set By	Used By	Cleared
SYMKEY	Ignored / Value used in symbol comparison 0 18 35	ORKEY	RSKY, RSKYA, SNAP, SSKY, SSKYA	User
SYML	Offset in symbol segment / Ignored 0 18 35	User	WBIN	
THREAD	C(THREAD+n) where n = 1,2,...31, or 32 0 - empty thread non-0 - abs. loc. of 1st link word on thread / Ignored 0 18 35	SRCHP	SRCH, SRCHK, SRCHKC, SRCHP	Initialization
TLYIN	GE-645 Tally Word - Points to next avail. char. in the current input strm 0 35	Character input subrt. SWAP, SWIP	SNAP	
TOCNT	# of illegal exect. of TO pop that may occur before an abort 0 35	User TO	TO	
TOP TABLE	TOP+N Location of top for roll N / 0 0 18 35	Any pop that puts info. on the bottom of a roll CPYR, OPN, REL, REMOV, RSV RSVM, RWND	All pops that refer to rolls	Lower half cleared by initialization routine
PKFRSW	Index / Ignored 0 18 35 Index Meaning 0 Get pack-from option from NXST file (as usual) 1 No pack-from this time; set C(PKFRSW) = 0 for next time 2 Pack-from this time; set C(PKFRSW) = 0 for next time 3 No pack from 4 Pack-from	User	Character Input subroutine	

Data Area	Illustration	Set By	Used By	Cleared by
TRANS	TRANS+n where n=1,2,...,200, or 201 octal Keys | ASCII rep. of char. | Keys 0 9 18 35	User	Character input subrt.	
TYMASK	k bits 36-k bits 1 | Fudge factor 0 k 35 k-bit field — flag set here, to indicate timing information follows fudge factor — equals time spent in execut. timing pops; this time may be omitted from time calculation	User	TYMT	
TYMER TYMER+1	Loc. of cur. TYMF | 0 Cur. Time (in 64ths of a msec) 0 18 35	TYMF	TYMT	
TXTL	# of words in text for obj. proc. | ignored 0 18 35	User	WBIN	
USCNT	USCNT+n where n = 0,1,...,(F-4), or (F-5) # of times pop n was executed 0 35 Note: F = current value of false tag	Execution of each pop (Debug version only)	Termination routine (Debug version only)	**Initialization routine (Debug version only)**
VARSIZ	# of words in var. size group | 0 0 18 35	User CPYGB	ERB,INSB,PLG,SMEB, PLG SNAP, ZBG	User
WRKSIZ	Size of work | 0 0 18 35	User	Initialization routine	
WSPTR	Offset in current write-spill roll | Ignored | N_W 0 18 35 where Nw=write-spill roll	User	Spill routine	
XITSIZ	Size of exit | ignored 0 18 35	User	Initialization routine	

Appendix B

SPECIAL FEATURES

Function Buffer

Characters from the current input stream may be packed in a
special function buffer, located in the data segment. This
feature is currently used only by FL/I.

The interpreter examines STAR1F, a register in the data
segment, to determine whether to pack characters into the
function buffer:

STAR1F

```
| 0(FORTRAN console input or any string    |
|    input stream) - buffer not used       |
| non-0 (FL/I console input stream only)-   |
|    buffer used                           |
0                                          35
```

If C(STAR1F) ≠ 0, then STRMTY, another data-segment register,
is interpreted as a GE-645 tally word. The pops procedure is
responsible for setting STRMTY to its initial value; FL/I
initializes this register as follows:

STRMTY
```
| FUNBUF      | 4n - 1 | 41(oct) |
0             18       30       35
```

    FUNBUF - Location of first word in function buffer.
        n - Number of words in function buffer

The interpreter packs all non-skipped characters into the
function buffer. On end-of-line, the interpreter continues
with the first character from the next line; if there are
no more lines, it goes to the next pop. Its treatment of
the (NL) character depends on the contents of the ESCAPE register:

ESCAPE
| 0 - Ignore (NL) character and its keys |
| non-0 - Pack (NL) character into FUNBUF |
| and examine keys |

0   35

If C(STAR1F) = 0, the interpreter ignores C(ESCAPE).

When the function buffer is full, the interpreter sets the data
segment register TOGOOD, as follows:

| 000001 | 000000 |
0   18   35

The interpreter then executes the pop at location 8 (decimal)
in the procedure segment. This pop may be a jump to a routine
that copies the contents of the function buffer onto a roll
and reinitializes the buffer. The last executed pop in the
routine should be to(-1):

| 777777 | 000020 |
0   18   35

Special Version of TO Pop -- to(-1)

POP: TO

FORMAT: to(-1)

FUNCTION: If C(TOGOOD) 0-17 = 1, return to point in character
           input routine at which function buffer overflow
           occurred, and proceed as if no overflow.

           If C(TOGOOD) 0-17 = 2, then call the symout entry in
           the FL/I command to write out roll 0 and the thread
           table. This feature allows the user to predefine
           symbols. FL/I uses this feature to save the symbol
           table for initialization on future assemblies.
           (See MSPM BX.7.01, The fl/1 Command.)

Otherwise, perform function of ordinary TO pop.

COMMENT: to(-1) clears C(TOGOOD) after testing it.

CCAT Pop -- Abnormal Case

If the total number of characters in a concatenated string
would be > 511, then the interpreter sets C(TOGOOD) 0-17 = 3, and
executes the pop at location 10(decimal) in the procedure
segment. This pop may be a jump to a routine that starts
a new string instead. This routine should not contain a
to(-1) pop.

Pack-From Switch

The pack-from switch, PKFRSW, regulates the use of the
pack-from option (see NXST). This register, located in the
data segment, has the following format:

```
PKFRSW    | Index    ignored |
          0         18    35
```

Value of Index	Meaning
0	Get pack-from option from NXST file (as usual)
1	No pack-from this time; set C(PKFRSW) = 0 for next time
2	Pack-from this time; set C(PKFRSW) = 0 for next time
3	No pack-from
4	Pack-from