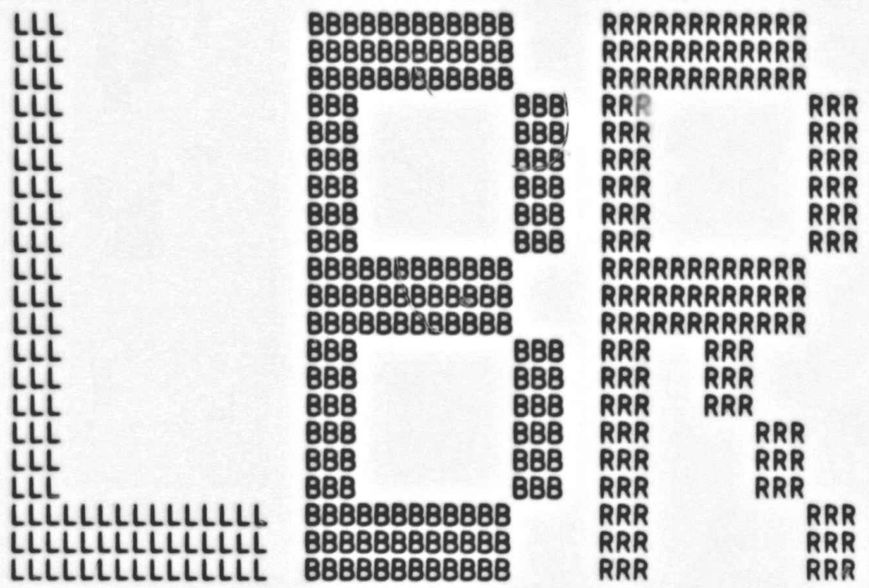

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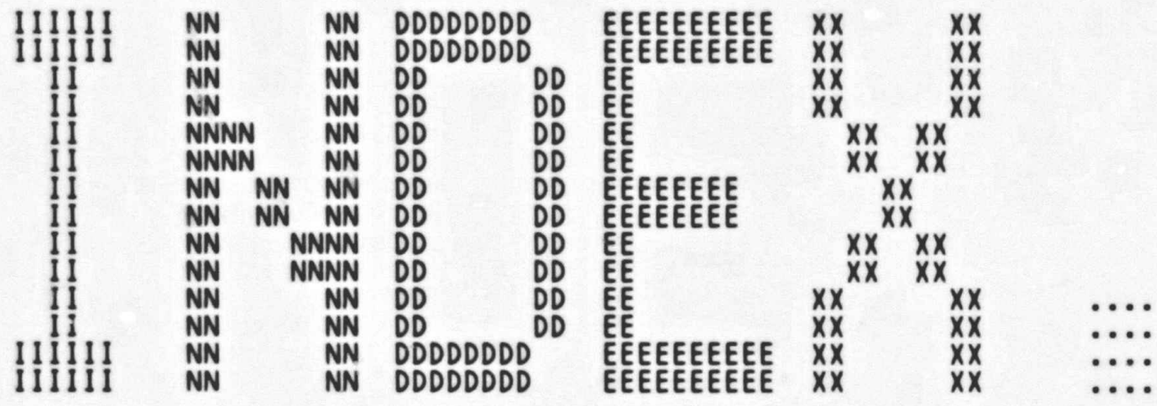

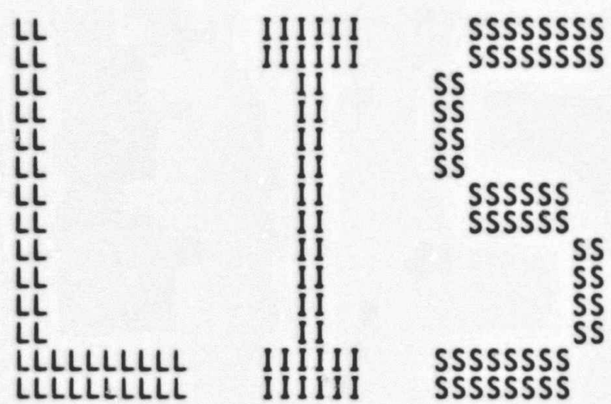

```
;     1          0001  0 MODULE LBR_INDEX
;     2          0002  0                 (IDENT = 'V04-000') =   ! Index manipulation routines
;     3          0003  1 BEGIN
;     4          0004  1
;     5          0005  1 !
;     6          0006  1 !**************************************************************************
;     7          0007  1 !*                                                                        *
;     8          0008  1 !*  COPYRIGHT (c) 1978, 1980, 1982, 1984 BY                              *
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;    25          0025  1 !*                                                                        *
;    26          0026  1 !*                                                                        *
;    27          0027  1 !**************************************************************************
;    28          0028  1
;    29          0029  1 !++
;    30          0030  1 !
;    31          0031  1 ! FACILITY:  Library access procedures
;    32          0032  1 !
;    33          0033  1 ! ABSTRACT:
;    34          0034  1 !
;    35          0035  1 !       The VAX/VMS librarian procedures implement a standard access method
;    36          0036  1 !       to libraries through a shared, common procedure set.
;    37          0037  1 !
;    38          0038  1 ! ENVIRONMENT:
;    39          0039  1 !
;    40          0040  1 !       VAX native, user mode.
;    41          0041  1 !
;    42          0042  1 !--
;    43          0043  1 !
;    44          0044  1 !
;    45          0045  1 ! AUTHOR: Tim Halvorsen, Benn Schreiber         11-Jun-1979
;    46          0046  1 !
;    47          0047  1 ! MODIFIED BY:
;    48          0048  1 !
;    49          0049  1 !       V03-004 GJA0078         Greg Awdziewicz         22-Mar-1984
;    50          0050  1 !               Put traverse_keys fix back in.
;    51          0051  1 !
;    52          0052  1 !       V03-003 JWT0093         Jim Teague              01-Feb-1983
;    53          0053  1 !               Undo last fix.
;    54          0054  1 !
;    55          0055  1 !       V03-002 JWT0091         Jim Teague              20-Jan-1983
;    56          0056  1 !               Propagate status returned from traverse or traverse2.
;    57          0057  1 !
```

```
;   58          0058  1 !       V03-001 JWT0058         Jim Teague                19-Oct-1982
;   59          0059  1 !               Fix variable-length index module deletion bug.
;   60          0060  1 !
;   61          0061  1 !--
```

```
;    63          0062  1 %SBTTL 'Declarations';
;    64          0063  1 LIBRARY 'SYS$LIBRARY:STARLET.L32';      ! VAX/VMS common definitions
;    65          0064  1
;    66          0065  1 REQUIRE 'PREFIX';                  ! Librarian general definitions
;    67          0204  1
;    68          0205  1 REQUIRE 'LBRDEF';                  ! Librarian structure definitions
;    69          0796  1
;    70          0797  1 REQUIRE 'OLDFMTDEF';               ! Old library format definitions
;    71          0893  1
;    72          0894  1 LINKAGE
;    73          0895  1     fmg_match = JSB (REGISTER = 2, REGISTER = 3,
;    74          0896  1                      REGISTER = 4, REGISTER = 5) : NOTUSED (10, 11); ! Linkage for FMG$MATCH_NAME
;    75          0897  1
;    76          0898  1 FORWARD ROUTINE
;    77          0899  1     lbr$set_index,                 ! Set current index number
;    78          0900  1     lbr$lookup_key,                ! Lookup a key and return RFA
;    79          0901  1     lbr$insert_key,                ! Insert a key
;    80          0902  1     lbr$replace_key,               ! Replace rfa for key and modify module header ref. counts
;    81          0903  1     lbr$delete_key,                ! Delete a key
;    82          0904  1     lbr$get_index,                 ! Return all entries of an index
;    83          0905  1     lbr$search,                    ! Search for all keys assoc. with RFA
;    84          0906  1     check_wild,                    ! Check wildcard name against entry
;    85          0907  1     call_user,                     ! Call user action routine
;    86          0908  1     add_key,                       ! Add a key to a specified index
;    87          0909  1     delete_key,                    ! Delete key from current primary index
;    88          0910  1     remove_key,                    ! Remove a key from a specified index
;    89          0911  1     lookup_key,                    ! Lookup a key and return an RFA
;    90          0912  1     traverse_keys,                 ! Traverse an index one key at a time
;    91          0913  1     create_index,                  ! Create an index block
;    92          0914  1     delete_index,                  ! Deallocate an index block
;    93          0915  1     find_key,                      ! Find key in index structure
;    94          0916  1     key_search,                    ! Binary key search
;    95          0917  1     key_search2,                   ! Variable length keyword search
;    96          0918  1     find_index : JSB_2,            ! Locate index block
;    97          0919  1     add_index,                     ! Add index pointer to parent block
;    98          0920  1     add_index2,                    ! Add index pointer to parent block of variable index
;    99          0921  1     reset_highest,                 ! Reset highest keys in parent blocks
;   100          0922  1     reset_highest2,                ! Reset highest keys in variable len index
;   101          0923  1                                    !   parent blocks
;   102          0924  1     check_lock : JSB_0,            ! Check if index is locked from modification
;   103          0925  1     mark_dirty : JSB_1;            ! Mark index block modified
;   104          0926  1
;   105          0927  1 EXTERNAL ROUTINE
;   106          0928  1     fmg$match_name : fmg_match,    ! Perform embedded wild-card matching
;   107          0929  1     make_upper_case : JSB_3,       ! Convert name to upper case, check length
;   108          0930  1     moveto_upper_case : JSB_3,     ! Convert
;   109          0931  1     incr_refcnt,                   ! Increment module reference count
;   110          0932  1     decr_refcnt,                   ! Decrement module reference count
;   111          0933  1     lbr_old_lkp_key,               ! Lookup key in old library
;   112          0934  1     lbr_old_get_idx,               ! Return contents of old library index
;   113          0935  1     lbr_old_src_idx,               ! Search old library index for RFA
;   114          0936  1     read_old_record : JSB_2,       ! Read record from old format library
;   115          0937  1     get_mem : JSB_2,               ! Allocate dynamic memory
;   116          0938  1     get_zmem : JSB_2,              ! Allocate zeroed dynamic memory
;   117          0939  1     dealloc_mem : JSB_2,           ! Deallocate dynamic memory
;   118          0940  1     alloc_block : JSB_2,           ! Allocate disk block
;   119          0941  1     dealloc_block : JSB_1,         ! Deallocate disk block
```

```
;  120     0942  1      read_block : JSB_2,                ! Read disk block
;  121     0943  1      read_n_block : JSB_2,              ! Read and cache multiple disk blocks
;  122     0944  1      find_block : JSB_3,                ! Locate disk block and cache it
;  123     0945  1      read_record : JSB_2,               ! Read data record
;  124     0946  1      write_record,                      ! Write data record
;  125     0947  1      add_cache : JSB_2,                 ! Add cache entry
;  126     0948  1      lookup_cache : JSB_2,              ! Lookup cache entry
;  127     0949  1      empty_cache,                       ! Empty cache - write all dirty blocks
;  128     0950  1      set_module,                        ! Read module header
;  129     0951  1      incr_rfa : JSB_2,                  ! Increment an RFA
;  130     0952  1      validate_ctl : JSB_1;              ! Validate control table index
;  131     0953  1
;  132     0954  1  EXTERNAL
;  133     0955  1      lbr$gl_maxread,                    ! Max number of blocks to read at once
;  134     0956  1      lbr$gl_maxidxrd,                   ! Max number of blocks in one index read
;  135     0957  1      lbr$gl_control: REF BBLOCK;        ! Address of control block
;  136     0958  1
;  137     0959  1  EXTERNAL LITERAL
;  138     0960  1      lbr$_dupkey,
;  139     0961  1      lbr$_illctl,
;  140     0962  1      lbr$_illidxnum,
;  141     0963  1      lbr$_illop,
;  142     0964  1      lbr$_intrnlerr,
;  143     0965  1      lbr$_invkey,
;  144     0966  1      lbr$_invrfa,
;  145     0967  1      lbr$_keynotfnd,
;  146     0968  1      lbr$_libnotopn,
;  147     0969  1      lbr$_nomtchfou,
;  148     0970  1      lbr$_nulidx,
;  149     0971  1      lbr$_updurtrav;
;  150     0972  1
;  151     0973  1
```

```
;  153          0974  1 %SBTTL  'LBR$SET_INDEX';
;  154          0975  1 GLOBAL ROUTINE lbr$set_index (ctl_index, index) =
;  155          0976  1
;  156          0977  1 !---
;  157          0978  1 !
;  158          0979  1 !       Set the current primary index for later operations.
;  159          0980  1 !
;  160          0981  1 ! Inputs:
;  161          0982  1 !
;  162          0983  1 !       ctl_index = Address of longword containing control table index.
;  163          0984  1 !       index = Primary index number
;  164          0985  1 !
;  165          0986  1 ! Outputs:
;  166          0987  1 !
;  167          0988  1 !       lbr$_illidxnum - illegal index number
;  168          0989  1 !       lbr$_libnotopn - library file not open
;  169          0990  1 !       lbr$_insvirmem - insufficent virtual memory
;  170          0991  1 !       lbr$_illctl - illegal control table index
;  171          0992  1 !---
;  172          0993  1
;  173          0994  2 BEGIN
;  174          0995  2
;  175          0996  2 BUILTIN
;  176          0997  2     NULLPARAMETER;              ! True if argument unspecified
;  177          0998  2
;  178          0999  2
;  179          1000  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  180          1001  2
;  181          1002  3 BEGIN
;  182          1003  3     BIND
;  183          1004  3         header = .lbr$gl_control [lbr$l_hdrptr]: BBLOCK; ! Get address of library header
;  184          1005  3
;  185          1006  3     IF NULLPARAMETER(2)                         ! If index number not supplied
;  186          1007  3     OR ..index GTRU .header [lhd$b_nindex]      ! If greater than maximum,
;  187          1008  3     OR ..index EQL 0
;  188          1009  3     THEN
;  189          1010  3         RETURN lbr$_illidxnum;          ! return with error
;  190          1011  3
;  191          1012  3     lbr$gl_control [lbr$l_curidx] = ..index; ! Save current index number
;  192          1013  2     END;
;  193          1014  2
;  194          1015  2 RETURN true;
;  195          1016  2
;  196          1017  1 END;
```

```
                                .TITLE  LBR_INDEX
                                .IDENT  \V04-000\

                                .EXTRN  FMG$MATCH_NAME, MAKE_UPPER_CASE
                                .EXTRN  MOVETO_UPPER_CASE
                                .EXTRN  INCR_REFCNT, DECR_REFCNT
                                .EXTRN  LBR_OLD_LKP_KEY
                                .EXTRN  LBR_OLD_GET_IDX
                                .EXTRN  LBR_OLD_SRC_IDX
                                .EXTRN  READ_OLD_RECORD
                                .EXTRN  GET_MEM, GET_ZMEM
```

```
                                                        .EXTRN  DEALLOC_MEM, ALLOC_BLOCK
                                                        .EXTRN  DEALLOC_BLOCK, READ_BLOCK
                                                        .EXTRN  READ_N_BLOCK, FIND_BLOCK
                                                        .EXTRN  READ_RECORD, WRITE_RECORD
                                                        .EXTRN  ADD_CACHE, LOOKUP_CACHE
                                                        .EXTRN  EMPTY_CACHE, SET_MODULE
                                                        .EXTRN  INCR_RFA, VALIDATE_CTL
                                                        .EXTRN  LBR$GL_MAXREAD, LBR$GL_MAXIDXRD
                                                        .EXTRN  LBR$GL_CONTROL, LBR$_DUPKEY
                                                        .EXTRN  LBR$_ILLCTL, LBR$_ILLIDXNUM
                                                        .EXTRN  LBR$_ILLOP, LBR$_INTRNLERR
                                                        .EXTRN  LBR$_INVKEY, LBR$_INVRFA
                                                        .EXTRN  LBR$_KEYNOTFND, LBR$_LIBNOTOPN
                                                        .EXTRN  LBR$_NOMTCHFOU, LBR$_NULIDX
                                                        .EXTRN  LBR$_UPDURTRAV

                                                        .PSECT  $CODE$,NOWRT,2

                                        0FFC 00000      .ENTRY  LBR$SET_INDEX, Save R2,R3,R4,R5,R6,R7,R8,-      ; 0975
                                                                R9,R10,R11
                                50      04   BC  D0 00002      MOVL    @CTL_INDEX, R0                          ; 1000
                                          0000G 30 00006      BSBW    VALIDATE_CTL
                                31          50  E9 00009      BLBC    STATUS, 3$
                                51    0000G CF  D0 0000C      MOVL    LBR$GL_CONTROL, R1                      ; 1004
                                50      0A  A1  D0 00011      MOVL    10(R1), R0
                                02          6C  91 00015      CMPB    (AP), #2                                ; 1006
                                            13  1F 00018      BLSSU   1$
                                          08  AC  D5 0001A      TSTL    8(AP)
                                            0E  13 0001D      BEQL    1$
    08  BC      01  A0                    08      00  ED 0001F      CMPZV   #0, #8, 1(R0), @INDEX               ; 1007
                                                    05  1F 00026      BLSSU   1$
                                                08  BC  D5 00028      TSTL    @INDEX                          ; 1008
                                                    08  12 0002B      BNEQ    2$
                                50 00000000G    8F  D0 0002D 1$:    MOVL    #LBR$_ILLIDXNUM, R0             ; 1010
                                                    04  00034      RET
                                12  A1       08  BC  D0 00035 2$:    MOVL    @INDEX, 18(R1)                  ; 1012
                                50                  01  D0 0003A      MOVL    #1, R0                          ; 1015
                                                    04  0003D 3$:    RET                                     ; 1017

; Routine Size:  62 bytes,    Routine Base:  $CODE$ + 0000
```

```
;  198          1018  1 %SBTTL  'LBR$LOOKUP_KEY';
;  199          1019  1 GLOBAL ROUTINE lbr$lookup_key (ctl_index, key_name, retrfa) =
;  200          1020  1
;  201          1021  1 !---
;  202          1022  1 !
;  203          1023  1 !       Lookup a specified key and return the RFA associated
;  204          1024  1 !       with the key.
;  205          1025  1 !
;  206          1026  1 ! Inputs:
;  207          1027  1 !
;  208          1028  1 !       ctl_index = Address of a longword containing control table index.
;  209          1029  1 !       key_name = Address of descriptor if ASCII keys,
;  210          1030  1 !                  or actual binary key.
;  211          1031  1 !       retrfa = Address of 6-byte buffer to receive RFA.
;  212          1032  1 !
;  213          1033  1 ! Outputs:
;  214          1034  1 !
;  215          1035  1 !       retrfa = RFA associated with key, if found.
;  216          1036  1 !
;  217          1037  1 !       lbr$_libnotopn - library not open
;  218          1038  1 !       lbr$_keynotfnd - key not found
;  219          1039  1 !       lbr$_illctl - illegal control table index
;  220          1040  1 !
;  221          1041  1 !---
;  222          1042  1
;  223          1043  2 BEGIN
;  224          1044  2
;  225          1045  2 MAP
;  226          1046  2     key_name : REF BBLOCK,                  ! Pointer to string descriptor
;  227          1047  2     retrfa: REF BBLOCK;                     ! Pointer to RFA
;  2[illegible] 1048  2
;  2[illegible] 1049  2 LOCAL
;  230          1050  2     keydesc : BBLOCK [dsc$c_s_bln],
;  231          1051  2     keynambuf : BBLOCK [lbr$c_maxkeylen],
;  232          1052  2     recdesc : BBLOCK [dsc$c_s_bln];
;  233          1053  2
;  234          1054  2 BIND
;  235          1055  2     length = recdesc [dsc$w_length] : WORD,
;  236          1056  2     addr = recdesc [dsc$a_pointer] : REF BBLOCK;
;  237          1057  2
;  238          1058  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  239          1059  2 keydesc [dsc$w_length] = .key_name [dsc$w_length];! Set length of name
;  240          1060  2 keydesc [dsc$a_pointer] = keynambuf;
;  241          1061  2 CH$MOVE (.key_name [dsc$w_length],
;  242          1062  2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
;  243          1063  2
;  244          1064  3 BEGIN
;  245          1065  3     BIND
;  246          1066  3         header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK, ! Pointer to header
;  247          1067  3         context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK, ! Pointer to context block
;  248          1068  3         eomodrfa = context[ctx$b_eomodrfa] : BBLOCK,    ! End of module RFA
;  249          1069  3         readrfa = context[ctx$b_readrfa] : BBLOCK;      ! Next RFA for read
;  250          1070  3
;  251          1071  3     IF .context[ctx$v_oldlib]                           ! If old format library
;  252          1072  3     THEN
;  253          1073  4         BEGIN
;  254          1074  4             perform(lbr_old_lkp_key (keydesc, .retrfa));! Then process elsewhere
```

```
;    255      1075 4             CH$MOVE(rfa$c_length, .retrfa, readrfa);     ! Set RFA for reading
;    256      1076 4             CH$FILL(0, rfa$c_length, eomodrfa);          ! Disable end of module
;    257      1077 4             perform(read_old_record(readrfa, recdesc)); ! Read and skip header
;    258      1078 4             IF .length NEQ omh$c_size
;    259      1079 4                 THEN RETURN lbr$_invrfa
;    260      1080 4                 ELSE
;    261      1081 5                     BEGIN
;    262      1082 5                         BIND
;    263      1083 5                             modsizwords = addr[omh$l_modsiz] : VECTOR[,WORD];
;    264      1084 5
;    265      1085 5                         CH$MOVE(rfa$c_length, .retrfa, eomodrfa);
;    266      1086 5                         incr_rfa(.modsizwords[1] + .modsizwords[0]*%X'10000', eomodrfa);
;    267      1087 5                         END
;    268      1088 4             END
;    269      1089 3     ELSE
;    270      1090 4         BEGIN
;    271    P 1091 4             perform (lookup_key (.lbr$gl_control [lbr$l_curidx],
;    272      1092 4                          keydesc, .retrfa));
;    273      1093 4
;    274      1094 4             CH$MOVE(rfa$c_length, .retrfa, readrfa);     ! Set for lbr$get_record
;    275      1095 4             perform(read_record(readrfa, recdesc));      ! Read module header to skip it
;    276      1096 4             IF .length NEQ mhd$c_mhdlen+.header[lhd$b_mhdusz] ! If module header not correct length
;    277      1097 4             OR .addr[mhd$l_refcnt] EQL 0                       !  or ref count is 0
;    278      1098 4             THEN RETURN lbr$_invrfa;                          !  then RFA is bad
;    279      1099 3             END;
;    280      1100 3     context[ctx$v_lkpdon] = true;                 ! Indicate lookup_key done
;    281      1101 2     END;
;    282      1102 2
;    283      1103 2 RETURN true;
;    284      1104 2
;    285      1105 1 END;


                                  0FFC 00000      .ENTRY  LBR$LOOKUP_KEY, Save R2,R3,R4,R5,R6,R7,R8,- ; 1019
                                                          R9,R10,R11                                   ;
                     5E   FF70  CE 9E 00002       MOVAB   -144(SP), SP                                 ;
                     50     04  BC D0 00007       MOVL    @CTL_INDEX, R0                               ; 1058
                         0000G  30 0000B          BSBW    VALIDATE_CTL                                 ;
                     4C         50 E9 0000E       BLBC    STATUS, 1$                                   ;
                     50     08  AC D0 00011       MOVL    KEY_NAME, R0                                 ; 1059
                F8   AD         60 B0 00015       MOVW    (R0), KEYDESC                                ;
                FC   AD     08  AE 9E 00019       MOVAB   KEYNAMBUF, KEYDESC+4                         ; 1060
       FC   BD   04  B0         60 28 0001E       MOVC3   (R0), @4(R0), @KEYDESC+4                     ; 1062
                     52  0000G  CF D0 00024       MOVL    LBR$GL_CONTROL, R2                           ; 1066
                     57     0A  A2 D0 00029       MOVL    10(R2), R7                                   ;
                     56     0E  A2 D0 0002D       MOVL    14(R2), R6                                   ; 1067
                     58     0C  AC D0 00031       MOVL    RETRFA, R8                                   ; 1074
       4C        04  A6         05 E1 00035       BBC     #5, 4(R6), 2$                                ; 1071
                                58 DD 0003A       PUSHL   R8                                           ; 1074
                     F8         AD 9F 0003C       PUSHAB  KEYDESC                                      ;
            0000G    CF         02 FB 0003F       CALLS   #2, LBR_OLD_LKP_KEY                          ;
                     5E         50 E9 00044       BLBC    STATUS, 3$                                   ;
       28   A6       68         06 28 00047       MOVC3   #6, (R8), 40(R6)                             ; 1075
  06        00       6E         00 2C 0004C       MOVC5   #0, (SP), #0, #6, 34(R6)                     ; 1076
```

```
                                                22   A6        00051
                                          51    6E   9E 00053          MOVAB   RECDESC, R1                             ; 1077
                                          50    28   A6   9E 00056     MOVAB   40(R6), R0
                                                0000G 30   0005A     BSBW    READ_OLD_RECORD
                                          6E         50   E9 0005D 1$: BLBC    STATUS, 6$
                                          1C         6E   B1 00060     CMPW    LENGTH, #28                            ; 1078
                                                     5A   12 00063     BNEQ    4$
                                    57         04   AE        02   C1 00065     ADDL3   #2, ADDR, R7                   ; 1083
                                22  A6         68             06   28 0006A     MOVC3   #6, (R8), 34(R6)               ; 1085
                                          51    22   A6   9E 0006F     MOVAB   34(R6), R1                             ; 1086
                                          50    02   A7   3C 00073     MOVZWL  2(R7), R0
                                          57         67   3C 00077     MOVZWL  (R7), R7
                                    57    57         10   78 0007A     ASHL    #16, R7, R7
                                          50         57   C0 0007E     ADDL2   R7, R0
                                                0000G 30   00081     BSBW    INCR_RFA
                                                     41   11 00084     BRB     5$                                     ; 1078
                                                     58   DD 00086 2$: PUSHL   R8                                     ; 1092
                                                F8   AD   9F 00088     PUSHAB  KEYDESC
                                                12   A2   DD 0008B     PUSHL   18(R2)
                                          0000V CF         03   FB 0008E     CALLS   #3, LOOKUP_KEY
                                                38         50   E9 00093     BLBC    STATUS, 6$
                                22  A6         68             06   28 00096     MOVC3   #6, (R8), 40(R6)               ; 1094
                                          51    6E   9E 0009B     MOVAB   RECDESC, R1                            ; 1095
                                          50    28   A6   9E 0009E     MOVAB   40(R6), R0
                                                0000G 30   000A2     BSBW    READ_RECORD
                                          26         50   E9 000A5 3$: BLBC    STATUS, 6$
                                          50    3C   A7   9A 000A8     MOVZBL  60(R7), R0                             ; 1096
                                          50         10   C0 000AC     ADDL2   #16, R0
                              50          6E         10             00   ED 000AF     CMPZV   #0, #16, LENGTH, R0
                                                     09   12 000B4     BNEQ    4$
                                          50    04   AE   D0 000B6     MOVL    ADDR, R0                               ; 1097
                                                04   A0   D5 000BA     TSTL    4(R0)
                                                     08   12 000BD     BNEQ    5$
                                          50 00000000G   8F   D0 000BF 4$:  MOVL    #LBR$_INVRFA, R0                   ; 1098
                                                               04 000C6     RET
                                    04    A6               02   88 000C7 5$:  BISB2   #2, 4(R6)                      ; 1100
                                          50               01   D0 000CB     MOVL    #1, R0                         ; 1103
                                                               04 000CE 6$:  RET                                    ; 1105

; Routine Size:  207 bytes,    Routine Base:  $CODE$ + 003E
```

```
;  287          1106  1 %SBTTL  'LBR$INSERT_KEY';
;  288          1107  1 GLOBAL ROUTINE lbr$insert_key (ctl_index, key_name, rfa) =
;  289          1108  1
;  290          1109  1 !---
;  291          1110  1 !
;  292          1111  1 !       Insert a key into the current primary index.
;  293          1112  1 !
;  294          1113  1 ! Inputs:
;  295          1114  1 !
;  296          1115  1 !       ctl_index = Address of control table index.
;  297          1116  1 !       key_name = Address of descriptor if ASCII keys,
;  298          1117  1 !                  actual key if binary key.
;  299          1118  1 !       rfa = Address of RFA to be associated with the key.
;  300          1119  1 !
;  301          1120  1 ! Outputs:
;  302          1121  1 !
;  303          1122  1 !       lbr$_libnotopn - library not open
;  304          1123  1 !       lbr$_illctl - illegal control table index
;  305          1124  1 !       lbr$_dupkey - duplicate key
;  306          1125  1 !       lbr$_invrfa - rfa does not point at valid data
;  307          1126  1 !---
;  308          1127  1
;  309          1128  2 BEGIN
;  310          1129  2
;  311          1130  2 MAP
;  312          1131  2     key_name : REF BBLOCK[dsc$c_s_bln],
;  313          1132  2     rfa : REF BBLOCK[rfa$c_length];
;  314          1133  2
;  315          1134  2 LOCAL
;  316          1135  2     keydesc : BBLOCK [dsc$c_s_bln],
;  317          1136  2     keynambuf : BBLOCK [lbr$c_maxkeylen],
;  318          1137  2     cachentry : REF BBLOCK;
;  319          1138  2
;  320          1139  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  321          1140  2 perform (check_lock ());                ! Verify ability to modify index
;  322          1141  2 keydesc [dsc$w_length] = .key_name [dsc$w_length];
;  323          1142  2 keydesc [dsc$a_pointer] = keynambuf;
;  324          1143  2 CH$MOVE (.key_name [dsc$w_length],
;  325          1144  2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
;  326          1145  2
;  327          1146  3 BEGIN
;  328          1147  3     BIND
;  329          1148  3         index_desc = .lbr$gl_control[lbr$l_hdrptr] + lhd$c_idxdesc
;  330          1149  3                 + (.lbr$gl_control[lbr$l_curidx]-1)*idd$c_length : BBLOCK,
;  331          1150  3         context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK; ! Context block
;  332          1151  3
;  333          1152  3     IF .context[ctx$v_oldlib]                          ! Cannot insert into old library
;  334          1153  3         OR .context [ctx$v_ronly]                      !  or one that is read only
;  335          1154  3     THEN
;  336          1155  3         RETURN lbr$_illop;
;  337          1156  3
;  338          1157  3     perform (add_key (.lbr$gl_control [lbr$l_curidx], keydesc, .rfa));
;  339          1158  3     perform(incr_refcnt(.rfa));                                    ! Increment module refernce count
;  340          1159  3                                                                    !  updated reference count
;  341          1160  3     context[ctx$v_hdrdirty] = true;                                ! Flag header is dirty
;  342          1161  2     END;
;  343          1162  2
```

```
;  344          1163  2 RETURN true;
;  345          1164  2
;  346          1165  1 END;


                                                  0FFC 00000          .ENTRY  LBR$INSERT_KEY, Save R2,R3,R4,R5,R6,R7,R8,- ; 1107
                                                                              R9,R10,R11
                                5E      FF78    CE  9E 00002          MOVAB   -136(SP), SP                                ;
                                50        04    BC  D0 00007          MOVL    @CTL_INDEX, R0                              ; 1139
                                                0000G 30 0000B          BSBW    VALIDATE_CTL                                ;
                                56                50  E9 0000E          BLBC    STATUS, 3$                                  ;
                                                0000V 30 00011          BSBW    CHECK_LOCK                                  ; 1140
                                50                50  E9 00014          BLBC    STATUS, 3$                                  ;
                                50        08    AC  D0 00017          MOVL    KEY_NAME, R0                                ; 1141
                             F8 AD                60  B0 0001B          MOVW    (R0), KEYDESC                               ;
                             FC AD                6E  9E 0001F          MOVAB   KEYNAMBUF, KEYDESC+4                        ; 1142
                          FC BD        04 B0      60  28 00023          MOVC3   (R0), @4(R0), @KEYDESC+4                    ; 1144
                                50      0000G CF    D0 00029          MOVL    LBR$GL_CONTROL, R0                          ; 1148
                                52        0E  A0    D0 0002E          MOVL    14(R0), R2                                  ; 1150
                             05        04 A2      05  E0 00032          BBS     #5, 4(R2), 1$                               ; 1152
                                         04 A2    95  00037          TSTB    4(R2)                                       ; 1153
                                                  08  18 0003A          BGEQ    2$                                          ;
                                50 00000000G 8F   D0  0003C 1$:       MOVL    #LBR$_ILLOP, R0                             ; 1155
                                                  04  00043          RET                                                 ;
                                         0C AC    DD  00044 2$:       PUSHL   RFA                                         ; 1157
                                         F8 AD    9F  00047          PUSHAB  KEYDESC                                     ;
                                         12 A0    DD  0004A          PUSHL   18(R0)                                      ;
                          0000V CF                03  FB 0004D          CALLS   #3, ADD_KEY                                 ;
                                12                50  E9 00052          BLBC    STATUS, 3$                                  ;
                                         0C AC    DD  00055          PUSHL   RFA                                         ; 1158
                          0000G CF                01  FB 00058          CALLS   #1, INCR_REFCNT                             ;
                                07                50  E9 0005D          BLBC    STATUS, 3$                                  ;
                             04 A2                08  88 00060          BISB2   #8, 4(R2)                                   ; 1160
                                50                01  D0 00064          MOVL    #1, R0                                      ; 1163
                                                  04  00067 3$:       RET                                                 ; 1165

; Routine Size:  104 bytes,    Routine Base:  $CODE$ + 010D
```

```
;  348          1166  1 %SBTTL  'LBR$REPLACE_KEY';
;  349          1167  1 GLOBAL ROUTINE lbr$replace_key (ctl_index, key_name, oldrfa, newrfa) =
;  350          1168  1
;  351          1169  1 !---
;  352          1170  1 !
;  353          1171  1 !       Replace the RFA associated with a key with a new rfa.  Update
;  354          1172  1 !       the reference counts in both the old and new module headers
;  355          1173  1 !
;  356          1174  1 ! Inputs:
;  357          1175  1 !
;  358          1176  1 !       ctl_index = Address of control table index
;  359          1177  1 !       key_name = Address of descriptor if ASCII, key if binary
;  360          1178  1 !       oldrfa = Address of old rfa
;  361          1179  1 !       newrfa = Address of new rfa
;  362          1180  1 !
;  363          1181  1 ! Outputs:
;  364          1182  1 !
;  365          1183  1 !       lbr$_libnotopn - library not open
;  366          1184  1 !       lbr$_illctl - illegal control table index
;  367          1185  1 !       lbr$_invrfa - invalid rfa
;  368          1186  1 !
;  369          1187  1 !---
;  370          1188  1
;  371          1189  2 BEGIN
;  372          1190  2
;  373          1191  2 MAP
;  374          1192  2     key_name : REF BBLOCK,
;  375          1193  2     oldrfa : REF BBLOCK,
;  376          1194  2     newrfa : REF BBLOCK;
;  377          1195  2
;  378          1196  2 LOCAL
;  379          1197  2     keydesc : BBLOCK [dsc$c_s_bln],
;  380          1198  2     keynambuf : BBLOCK [lbr$c_maxkeylen];
;  381          1199  2
;  382          1200  2 perform (validate_ctl (..ctl_index));          ! Validate control table index
;  383          1201  2 keydesc [dsc$w_length] = .key_name [dsc$w_length];
;  384          1202  2 keydesc [dsc$a_pointer] = keynambuf;
;  385          1203  2 CH$MOVE (.key_name [dsc$w_length],
;  386          1204  2         .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
;  387          1205  2
;  388          1206  3 BEGIN
;  389          1207  3     LOCAL
;  390          1208  3         vbn,
;  391          1209  3         index_block,
;  392          1210  3         offset,
;  393          1211  3         addpos,
;  394          1212  3         entry : REF BBLOCK;
;  395          1213  3
;  396          1214  3     BIND
;  397          1215  3         context = .lbr$gl_control [lbr$l_ctxptr] : BBLOCK;
;  398          1216  3
;  399          1217  3     IF .context [ctx$v_oldlib]
;  400          1218  3         OR .context [ctx$v_ronly]
;  401          1219  3         THEN RETURN lbr$_illop;
;  402          1220  3 !
;  403          1221  3 ! First make sure its a real key.  If not found, treat as an insert
;  404          1222  3 !
```

```
;  405       1223  3      IF NOT find_key (.lbr$gl_control [lbr$l_curidx], keydesc, 0,
;  406       1224  3                      vbn, index_block, offset, addpos)
;  407       1225  3          THEN RETURN lbr$insert_key (.ctl_index, .key_name, .newrfa);
;  408       1226  3      entry = .index_block + index$c_entries + .offset;    ! Point to entry
;  409       1227  3      IF NOT CH$EQL (rfa$c_length, entry [idx$b_rfa], rfa$c_length, .oldrfa)
;  410       1228  3          THEN RETURN lbr$_invrfa;
;  411       1229  3  !
;  412       1230  3  ! Decrement ref. count in old module header
;  413       1231  3  !
;  414       1232  3      perform (decr_refcnt (.oldrfa));
;  415       1233  3  !
;  416       1234  3  ! Increment ref. count in new module header
;  417       1235  3  !
;  418       1236  3      perform (incr_refcnt (.newrfa));
;  419       1237  3  !
;  420       1238  3  ! Update index entry
;  421       1239  3  !
;  422       1240  3      CH$MOVE (rfa$c_length, .newrfa, entry [idx$b_rfa]);
;  423       1241  3      mark_dirty (.vbn);                                   ! Mark index block dirty
;  424       1242  2      END;
;  425       1243  2  RETURN true
;  426       1244  1  END;                                                     ! Of lbr$replace_key


                                    0FFC 00000          .ENTRY  LBR$REPLACE_KEY, Save R2,R3,R4,R5,R6,R7,R8,-; 1167
                                                                R9,R10,R11                                   ;
                  5E      FF68  CE   9E 00002           MOVAB   -152(SP), SP                                 ;
                  50        04  BC   D0 00007           MOVL    @CTL_INDEX, R0                               ; 1200
                            0000G    30 0000B           BSBW    VALIDATE_CTL                                 ;
                  77             50  E9 0000E           BLBC    STATUS, 5$                                   ;
                  56        08  AC   D0 00011           MOVL    KEY_NAME, R6                                 ; 1201
             F8   AD             66  B0 00015           MOVW    (R6), KEYDESC                                ;
             FC   AD        10  AE   9E 00019           MOVAB   KEYNAMBUF, KEYDESC+4                         ; 1202
   FC    BD   04  B6             66  28 0001E           MOVC3   (R6), @4(R6), @KEYDESC+4                     ; 1204
                  51     0000G  CF   D0 00024           MOVL    LBR$GL_CONTROL, R1                           ; 1215
                  50        0E  A1   D0 00029           MOVL    14(R1), R0                                   ;
         05       04  A0             05  E0 0002D           BBS     #5, 4(R0), 1$                                ; 1217
                            04  A0   95 00032           TSTB    4(R0)                                        ; 1218
                                 08  18 00035           BGEQ    2$                                           ;
                  50 00000000G  8F   D0 00037 1$:       MOVL    #LBR$_ILLOP, R0                              ; 1219
                                     04 0003E           RET                                                  ;
                                 5E  DD 0003F 2$:       PUSHL   SP                                           ; 1223
                            08  AE   9F 00041           PUSHAB  OFFSET                                       ;
                            10  AE   9F 00044           PUSHAB  INDEX_BLOCK                                  ;
                            18  AE   9F 00047           PUSHAB  VBN                                          ;
                                 7E  D4 0004A           CLRL    -(SP)                                        ;
                            F8  AD   9F 0004C           PUSHAB  KEYDESC                                      ;
                            12  A1   DD 0004F           PUSHL   18(R1)                                       ;
             0000V   CF          07  FB 00052           CALLS   #7, FIND_KEY                                 ;
                     0E          50  E8 00057           BLBS    R0, 3$                                       ;
                            10  AC   DD 0005A           PUSHL   NEWRFA                                       ; 1225
                                 56  DD 0005D           PUSHL   R6                                           ;
                            04  AC   DD 0005F           PUSHL   CTL_INDEX                                    ;
             FF31    CF          03  FB 00062           CALLS   #3, LBR$INSERT_KEY                           ;
```

```
                                              04 00067      RET                                              ;
               54      08  AE      04  AE  C1 00068 3$:    ADDL3   OFFSET, INDEX_BLOCK, R4                 ; 1226
                               54      0C  C0 0006E         ADDL2   #12, ENTRY                               ;
          0C   BC              64      06  29 00071         CMPC3   #6, (ENTRY), @OLDRFA                     ; 1227
                                       08  13 00076         BEQL    4$                                       ;
                           50 00000000G 8F  D0 00078         MOVL    #LBR$_INVRFA, R0                         ; 1228
                                       04 0007F             RET                                              ;
                                   0C  AC  DD 00080 4$:     PUSHL   OLDRFA                                   ; 1232
                      0000G   CF      01  FB 00083          CALLS   #1, DECR_REFCNT                          ;
                              1A      50  E9 00088 5$:      BLBC    STATUS, 6$                               ;
                                   10  AC  DD 0008B         PUSHL   NEWRFA                                   ; 1236
                      0000G   CF      01  FB 0008E          CALLS   #1, INCR_REFCNT                          ;
                              0F      50  E9 00093          BLBC    STATUS, 6$                               ;
               64      10  BC      06  28 00096             MOVC3   #6, @NEWRFA, (ENTRY)                     ; 1240
                           50      0C  AE  D0 0009B         MOVL    VBN, R0                                  ; 1241
                                  0000V  30 0009F           BSBW    MARK_DIRTY                               ;
                           50      01  D0 000A2             MOVL    #1, R0                                   ; 1243
                                   04 000A5 6$:             RET                                              ; 1244

; Routine Size:  166 bytes,     Routine Base:  $CODE$ + 0175
```

```
;  428     1245  1 %SBTTL  'LBR$DELETE_KEY';
;  429     1246  1 GLOBAL ROUTINE lbr$delete_key (ctl_index, key_name) =
;  430     1247  1
;  431     1248  1 !---
;  432     1249  1 !
;  433     1250  1 !       Delete a specified key from the current primary index.
;  434     1251  1 !
;  435     1252  1 ! Inputs:
;  436     1253  1 !
;  437     1254  1 !       ctl_index = Address of control table index.
;  438     1255  1 !       key_name = Address of string desciptor or binary key.
;  439     1256  1 !
;  440     1257  1 ! Outputs:
;  441     1258  1 !
;  442     1259  1 !       lbr$_libnotopn - library not open
;  443     1260  1 !       lbr$_illctl - illegal control table index
;  444     1261  1 !       lbr$_keynotfnd - key not found
;  445     1262  1 !---
;  446     1263  1
;  447     1264  2 BEGIN
;  448     1265  2
;  449     1266  2 MAP
;  450     1267  2     key_name : REF BBLOCK;
;  451     1268  2
;  452     1269  2 LOCAL
;  453     1270  2     keydesc : BBLOCK [dsc$c_s_bln],
;  454     1271  2     keynambuf : BBLOCK [lbr$c_maxkeylen];
;  455     1272  2
;  456     1273  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  457     1274  2 perform (check_lock ());                ! Verify ability to modify index
;  458     1275  2 keydesc [dsc$w_length] = .key_name [dsc$w_length];
;  459     1276  2 keydesc [dsc$a_pointer] = keynambuf;
;  460     1277  2 CH$MOVE (.key_name [dsc$w_length],
;  461     1278  2          .key_name [dsc$a_pointer], .keydesc [dsc$a_pointer]);
;  462     1279  2
;  463     1280  2
;  464     1281  2 perform (delete_key (keydesc));         ! Delete the key
;  465     1282  2 RETURN true
;  466     1283  1 END;


                                        0FFC 00000          .ENTRY  LBR$DELETE_KEY, Save R2,R3,R4,R5,R6,R7,R8,- ; 1246
                                                                    R9,R10,R11
                                5E  FF78   CE  9E 00002     MOVAB   -136(SP), SP
                                50    04   BC  D0 00007     MOVL    @CTL_INDEX, R0                              ; 1273
                                          0000G 30 0000B    BSBW    VALIDATE_CTL
                                26          50  E9 0000E    BLBC    STATUS, 1$
                                          0000V 30 00011    BSBW    CHECK_LOCK                                  ; 1274
                                20          50  E9 00014    BLBC    STATUS, 1$
                                50    08   AC  D0 00017     MOVL    KEY_NAME, R0                                ; 1275
                             F8 AD          60  B0 0001B     MOVW    (R0), KEYDESC
                             FC AD          6E  9E 0001F     MOVAB   KEYNAMBUF, KEYDESC+4                        ; 1276
                          FC BD    04 B0     60  28 00023     MOVC3   (R0), @4(R0), @KEYDESC+4                    ; 1278
                                         F8   AD  9F 00029     PUSHAB  KEYDESC                                     ; 1281
```

```
                          0000V  CF            01  FB 0002C          CALLS   #1, DELETE_KEY                                  ;
                                 03            50  E9 00031          BLBC    STATUS, 1$                                      ;
                                 50            01  D0 00034          MOVL    #1, R0                                          ; 1282
                                                   04 00037 1$:       RET                                                     ; 1283

; Routine Size:  56 bytes,    Routine Base:  $CODE$ + 021B
```

```
;  468          1284  1 %SBTTL  'delete_key';
;  469          1285  1 GLOBAL ROUTINE delete_key (key_name) =
;  470          1286  1
;  471          1287  1 !---
;  472          1288  1 !
;  473          1289  1 !                   Delete a key from the current primary index
;  474          1290  1 !
;  475          1291  1 ! Inputs:
;  476          1292  1 !
;  477          1293  1 !       key_name = Address of string descriptor or binary key
;  478          1294  1 !
;  479          1295  1 ! Outputs:
;  480          1296  1 !
;  481          1297  1 !---
;  482          1298  1
;  483          1299  2 BEGIN
;  484          1300  2
;  485          1301  2 LOCAL
;  486          1302  2     localrfa : BBLOCK[rfa$c_length];
;  487          1303  2
;  488          1304  2 BIND
;  489          1305  2     context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK;
;  490          1306  2
;  491          1307  2 IF .context[ctx$v_oldlib]                        ! Cannot modify old libraries
;  492          1308  2     OR .context [ctx$v_ronly]                     !  or read only libraries
;  493          1309  2 THEN
;  494          1310  2     RETURN lbr$_illop;
;  495          1311  2
;  496        P 1312  2 perform(lookup_key(.lbr$gl_control[lbr$l_curidx],
;  497          1313  2                  .key_name, localrfa));
;  498          1314  2
;  499          1315  2 perform (remove_key (.lbr$gl_control [lbr$l_curidx], .key_name));
;  500          1316  2
;  501          1317  2 perform(decr_refcnt(localrfa));                  !Decrement reference count
;  502          1318  2
;  503          1319  2 context[ctx$v_hdrdirty] = true;                  !Flag header is dirty
;  504          1320  2
;  505          1321  2 RETURN true;
;  506          1322  2
;  507          1323  1 END;


                                    0004 00000          .ENTRY  DELETE_KEY, Save R2                                 ; 1285
                              5E    08   C2 00002          SUBL2   #8, SP                                              ;
                              50  0000G  CF   D0 00005          MOVL    LBR$GL_CONTROL, R0                          ; 1305
                              52    0E   A0   D0 0000A          MOVL    14(R0), R2                                  ;
                        05    04   A2   05   E0 0000E          BBS     #5, 4(R2), 1$                               ; 1307
                                   04   A2   95 00013          TSTB    4(R2)                                       ; 1308
                                        08   18 00016          BGEQ    2$                                          ;
                              50 00000000G   8F   D0 00018 1$:     MOVL    #LBR$_ILLOP, R0                         ; 1310
                                             04 0001F          RET                                                 ;
                                        5E   DD 00020 2$:     PUSHL   SP                                          ; 1313
                                   04   AC   DD 00022          PUSHL   KEY_NAME                                    ;
                                   12   A0   DD 00025          PUSHL   18(R0)                                      ;
```

```
                 0000V  CF             03  FB  00028          CALLS   #3, LOOKUP_KEY                          ;
                        24             50  E9  0002D          BLBC    STATUS, 3$                             ;
                           04          AC  DD  00030          PUSHL   KEY_NAME                               ; 1315
                        50       0000G  CF  D0  00033          MOVL    LBR$GL_CONTROL, R0                     ;
                           12          A0  DD  00038          PUSHL   18(R0)                                 ;
                 0000V  CF             02  FB  0003B          CALLS   #2, REMOVE_KEY                         ;
                        11             50  E9  00040          BLBC    STATUS, 3$                             ;
                                       5E  DD  00043          PUSHL   SP                                     ; 1317
                 0000G  CF             01  FB  00045          CALLS   #1, DECR_REFCNT                        ;
                        07             50  E9  0004A          BLBC    STATUS, 3$                             ;
                   04   A2             08  88  0004D          BISB2   #8, 4(R2)                              ; 1319
                        50             01  D0  00051          MOVL    #1, R0                                 ; 1321
                                           04  00054  3$:      RET                                            ; 1323

; Routine Size:  85 bytes,    Routine Base:  $CODE$ + 0253
```

```
;  509          1324  1 %SBTTL  'LBR$GET_INDEX';
;  510          1325  1 GLOBAL ROUTINE lbr$get_index (ctl_index, index, user_routine, match_desc) =
;  511          1326  1
;  512          1327  1 !---
;  513          1328  1 !
;  514          1329  1 !       Call a user-supplied routine for each key in the specified
;  515          1330  1 !       primary index.
;  516          1331  1 !
;  517          1332  1 ! Inputs:
;  518          1333  1 !
;  519          1334  1 !       ctl_index = Address of the control table index
;  520          1335  1 !       index = Address of the primary index number
;  521          1336  1 !       user_routine = Address of user action routine
;  522          1337  1 !       match_desc = Address (optional) of string descriptor for matching
;  523          1338  1 !
;  524          1339  1 ! Outputs:
;  525          1340  1 !
;  526          1341  1 !       The action routine is called once for each key in the index.
;  527          1342  1 !
;  528          1343  1 !       lbr$_libnotopn - library not open
;  529          1344  1 !       lbr$_illctl - illegal control table index
;  530          1345  1 !       lbr$_illidxnum - illegal index number
;  531          1346  1 !---
;  532          1347  1
;  533          1348  2 BEGIN
;  534          1349  2
;  535          1350  2 MAP
;  536          1351  2     match_desc : REF BBLOCK;
;  537          1352  2
;  538          1353  2 LOCAL
;  539          1354  2     keydesc : BBLOCK [dsc$c_s_bln],
;  540          1355  2     keynambuf : BBLOCK [lbr$c_maxkeylen],
;  541          1356  2     wildcard;
;  542          1357  2
;  543          1358  2 BUILTIN
;  544          1359  2     NULLPARAMETER;                ! True if argument unspecified
;  545          1360  2
;  546          1361  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  547          1362  2
;  548          1363  3 BEGIN
;  549          1364  3     BIND
;  550          1365  3         header = .lbr$gl_control [lbr$l_hdrptr] : BBLOCK, ! Address the library header
;  551          1366  3         context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK,
;  552          1367  3         index_desc = .lbr$gl_control[lbr$l_hdrptr] + lhd$c_idxdesc
;  553          1368  3                 + (.lbr$gl_control[lbr$l_curidx]-1)*idd$c_length : BBLOCK;
;  554          1369  3
;  555          1370  3     IF ..index GTRU .header [lhd$b_nindex]      ! If illegal index number,
;  556          1371  3     OR ..index EQL 0
;  557          1372  3     THEN
;  558          1373  3         RETURN lbr$_illidxnum;          ! return with error
;  559          1374  3
;  560          1375  3     wildcard = false;                           ! Assume no wildcards
;  561          1376  3     IF NOT NULLPARAMETER(4)                     ! If argument is present
;  562          1377  3         AND .match_desc [dsc$w_length] NEQ 0    !  and non-null
;  563          1378  3         AND .match_desc [dsc$a_pointer] NEQ 0   !  ...
;  564          1379  4         THEN BEGIN                              ! Then do wild card matching
;  565          1380  4             wildcard = true;                    ! then there is a match descriptor
```

```
;  566          1381  4              keydesc [dsc$w_length] = .match_desc [dsc$w_length];
;  567          1382  4              keydesc [dsc$a_pointer] = keynambuf;
;  568          1383  4              IF .index_desc [idd$v_nocasecmp]
;  569          1384  4              THEN
;  570          1385  4                  CH$MOVE (.match_desc [dsc$w_length],
;  571          1386  4                           .match_desc [dsc$a_pointer], .keydesc [dsc$a_pointer])
;  572          1387  4              ELSE
;  573          1388  4                  perform (make_upper_case (.match_desc, keydesc, true));
;  574          1389  3              END;
;  575          1390  3
;  576          1391  3      context [ctx$v_found1] = false;              !Flag no matches found
;  577          1392  3      IF .context[ctx$v_oldlib]                    ! If old format library
;  578        P 1393  3      THEN perform (lbr_old_get_idx (..index, .user_routine, (IF .wildcard
;  579        P 1394  3                                                              THEN .match_desc
;  580          1395  4                                                              ELSE 0)))
;  581          1396  4
;  582        P 1397  3      ELSE perform (traverse_keys (..index, (IF .wildcard          ! Traverse the index
;  583        P 1398  3                                              THEN check_wild      ! looking for matches
;  584        P 1399  3                                              ELSE call_user), .user_routine, ! or just calling user
;  585        P 1400  3                                         (IF .wildcard
;  586        P 1401  3                                              THEN .match_desc
;  587          1402  3                                              ELSE 0)));
;  588          1403  3      IF NOT .context [ctx$v_found1]                                !If no matches found
;  589          1404  4          THEN RETURN (IF .wildcard
;  590          1405  4                          THEN lbr$_nomtchfou
;  591          1406  4                          ELSE lbr$_nulidx
;  592          1407  4                          )
;  593          1408  3          ELSE RETURN true;
;  594          1409  3
;  595          1410  2      END;
;  596          1411  2
;  597          1412  1 END;                                                          !Of lbr$get_index


                                        0FFC 00000          .ENTRY  LBR$GET_INDEX, Save R2,R3,R4,R5,R6,R7,R8,-      ; 1325
                                                                    R9,R10,R11                                          ;
                                5E      FF78    CE  9E 00002        MOVAB   -136(SP), SP                            ;
                                50        04    BC  D0 00007        MOVL    @CTL_INDEX, R0                          ; 1361
                                        0000G   30  0000B           BSBW    VALIDATE_CTL                            ;
                                70              50  E9 0000E        BLBC    STATUS, 4$                              ;
                                50      0000G   CF  D0 00011        MOVL    LBR$GL_CONTROL, R0                      ; 1365
                                52        0A    A0  D0 00016        MOVL    10(R0), R2                              ;
                                56        0E    A0  D0 0001A        MOVL    14(R0), R6                              ; 1366
                                51        12    A0  D0 0001E        MOVL    18(R0), R1                              ; 1368
                                51        0A B041   7E 00022        MOVAQ   @10(R0)[R1], R1                         ;
                                51      00BC    C1  9E 00027        MOVAB   188(R1), R1                             ;
    08  BC         01  A2       08                 ED 0002C        CMPZV   #0, #8, 1(R2), @INDEX                   ; 1370
                                                05  1F 00033        BLSSU   1$                                      ;
                                          08    BC  D5 00035        TSTL    @INDEX                                  ; 1371
                                                08  12 00038        BNEQ    2$                                      ;
                                50 00000000G    8F  D0 0003A 1$:    MOVL    #LBR$_ILLIDXNUM, R0                     ; 1373
                                                    04 00041        RET                                             ;
                                                57  D4 00042 2$:    CLRL    WILDCARD                                ; 1375
                                04              6C  91 00044        CMPB    (AP), #4                                ; 1376
```

```
                                  3B  1F 00047        BLSSU   5$                                    ;
                         10       AC  D5 00049        TSTL    16(AP)                                ;
                                  36  13 0004C        BEQL    5$                                    ;
                         10       BC  B5 0004E        TSTW    @MATCH_DESC                           ; 1377
                                  31  13 00051        BEQL    5$                                    ;
                 50      10       AC  D0 00053        MOVL    MATCH_DESC, R0                        ; 1378
                         04       A0  D5 00057        TSTL    4(R0)                                 ;
                                  28  13 0005A        BEQL    5$                                    ;
                 57               01  D0 0005C        MOVL    #1, WILDCARD                          ; 1380
                 50      10       AC  D0 0005F        MOVL    MATCH_DESC, R0                        ; 1381
             F8  AD               60  B0 00063        MOVW    (R0), KEYDESC                         ;
             FC  AD               6E  9E 00067        MOVAB   KEYNAMBUF, KEYDESC+4                  ; 1382
      08         61               03  E1 0006B        BBC     #3, (R1), 3$                          ; 1383
 FC   BD     04  B0               60  28 0006F        MOVC3   (R0), @4(R0), @KEYDESC+4              ; 1386
                                  0D  11 00075        BRB     5$                                    ; 1385
                 51      F8       AD  9E 00077 3$:    MOVAB   KEYDESC, R1                           ; 1388
                 52               01  D0 0007B        MOVL    #1, R2                                ;
                               0000G  30 0007E        BSBW    MAKE_UPPER_CASE                       ;
                 65               50  E9 00081 4$:    BLBC    STATUS, 16$                           ;
             04  A6      40       8F  8A 00084 5$:    BICB2   #64, 4(R6)                            ; 1391
      17     04  A6               05  E1 00089        BBC     #5, 4(R6), 8$                         ; 1392
                 05               57  E9 0008E        BLBC    WILDCARD, 6$                          ; 1395
                         10       AC  DD 00091        PUSHL   MATCH_DESC                            ;
                                  02  11 00094        BRB     7$                                    ;
                                  7E  D4 00096 6$:    CLRL    -(SP)                                 ;
                         0C       AC  DD 00098 7$:    PUSHL   USER_ROUTINE                          ;
                         08       BC  DD 0009B        PUSHL   @INDEX                                ;
          0000G  CF               03  FB 0009E        CALLS   #3, LBR_OLD_GET_IDX                   ;
                                  26  11 000A3        BRB     13$                                   ;
                 05               57  E9 000A5 8$:    BLBC    WILDCARD, 9$                          ; 1402
                         10       AC  DD 000A8        PUSHL   MATCH_DESC                            ;
                                  02  11 000AB        BRB     10$                                   ;
                                  7E  D4 000AD 9$:    CLRL    -(SP)                                 ;
                         0C       AC  DD 000AF 10$:   PUSHL   USER_ROUTINE                          ;
                 07               57  E9 000B2        BLBC    WILDCARD, 11$                         ;
                 50   0000V       CF  9E 000B5        MOVAB   CHECK_WILD, R0                        ;
                                  05  11 000BA        BRB     12$                                   ;
                 50   0000V       CF  9E 000BC 11$:   MOVAB   CALL_USER, R0                         ;
                                  50  DD 000C1 12$:   PUSHL   R0                                    ;
                         08       BC  DD 000C3        PUSHL   @INDEX                                ;
          0000V  CF               04  FB 000C6        CALLS   #4, TRAVERSE_KEYS                     ;
                 1B               50  E9 000CB 13$:   BLBC    STATUS, 16$                           ;
      13     04  A6               06  E0 000CE        BBS     #6, 4(R6), 15$                        ; 1403
                 08               57  E9 000D3        BLBC    WILDCARD, 14$                         ; 1404
                 50 00000000G     8F  D0 000D6        MOVL    #LBR$_NOMTCHFOU, R0                   ;
                                      04 000DD        RET                                           ;
                 50 00000000G     8F  D0 000DE 14$:   MOVL    #LBR$_NULIDX, R0                      ;
                                      04 000E5        RET                                           ; 1408
                 50               01  D0 000E6 15$:   MOVL    #1, R0                                ;
                                      04 000E9 16$:   RET                                           ; 1412

; Routine Size:  234 bytes,    Routine Base:  $CODE$ + 02A8
```

```
;  599          1413  1 %SBTTL  'LBR$SEARCH';
;  600          1414  1 GLOBAL ROUTINE lbr$search (ctl_index, index, rfa, user_routine) =
;  601          1415  1
;  602          1416  1 !---
;  603          1417  1 !
;  604          1418  1 !       Search a specified primary index for all keys associated
;  605          1419  1 !       with a given RFA.  The user supplied action routine will
;  606          1420  1 !       be called for each key associated with the RFA.
;  607          1421  1 !
;  608          1422  1 ! Inputs:
;  609          1423  1 !
;  610          1424  1 !       ctl_index = Address of the control table index
;  611          1425  1 !       index = Address of the primary index number
;  612          1426  1 !       rfa = Address of the RFA to be searched for
;  613          1427  1 !       user_routine = Address of user supplied action routine.
;  614          1428  1 !
;  615          1429  1 ! Outputs:
;  616          1430  1 !
;  617          1431  1 !       The action routine will be called for each key found.
;  618          1432  1 !
;  619          1433  1 !---
;  620          1434  1
;  621          1435  2 BEGIN
;  622          1436  2
;  623          1437  2 MAP
;  624          1438  2     rfa: REF BBLOCK;              ! Access as RFA structure
;  625          1439  2
;  626          1440  2 ROUTINE check_rfa (entry, user_routine, index_desc, test_rfa) =
;  627          1441  3 BEGIN
;  628          1442  3 MAP
;  629          1443  3     test_rfa : REF BBLOCK[rfa$c_length],
;  630          1444  3     index_desc: REF BBLOCK,
;  631          1445  3     entry: REF BBLOCK;
;  632          1446  3 IF .entry [idx$l_vbn] EQL .test_rfa [rfa$l_vbn]
;  633          1447  3     AND .entry [idx$w_offset] EQL .test_rfa [rfa$w_offset]
;  634          1448  3 THEN
;  635          1449  3     perform (call_user (.entry, .user_routine, .index_desc));
;  636          1450  3 RETURN true;
;  637          1451  2 END;


                                0000 00000 CHECK_RFA:
                                                .WORD   Save nothing                                    ; 1440
                        50      04   AC  D0 00002      MOVL    ENTRY, R0                                  ; 1446
                        51      10   AC  D0 00006      MOVL    TEST_RFA, R1                               ;
                        61           60  D1 0000A      CMPL    (R0), (R1)                                 ;
                                     15  12 0000D      BNEQ    1$                                         ;
                    04  A1      04   A0  B1 0000F      CMPW    4(R0), 4(R1)                               ; 1447
                                     0E  12 00014      BNEQ    1$                                         ;
                        7E      08   AC  7D 00016      MOVQ    USER_ROUTINE, -(SP)                        ; 1449
                                     50  DD 0001A      PUSHL   R0                                         ;
                0000V   CF           03  FB 0001C      CALLS   #3, CALL_USER                              ;
                        03           50  E9 00021      BLBC    STATUS, 2$                                 ;
                        50           01  D0 00024 1$:  MOVL    #1, R0                                     ; 1450
```

```
                                                04 00027 2$:     RET                                                ; 1451

; Routine Size:  40 bytes,    Routine Base:  $CODE$ + 0392

;  638          1452  2
;  639          1453  2
;  640          1454  2 perform (validate_ctl (..ctl_index));   ! Validate control table index
;  641          1455  2
;  642          1456  3 BEGIN
;  643          1457  3     BIND
;  644          1458  3         context = .lbr$gl_control [lbr$l_ctxptr] : BBLOCK, ! Address the context block
;  645          1459  3         header = .lbr$gl_control [lbr$l_hdrptr] : BBLOCK; ! Address the library header
;  646          1460  3
;  647          1461  3     IF ..index GTRU .header [lhd$b_nindex]      ! If illegal index number,
;  648          1462  3     OR ..index EQL 0
;  649          1463  3     THEN
;  650          1464  3         RETURN lbr$_illidxnum;          ! return with error
;  651          1465  3
;  652          1466  3     IF .context[ctx$v_oldlib]           ! If old format library
;  653          1467  3     THEN RETURN lbr_old_src_idx (..index, .rfa, .user_routine);
;  654          1468  3
;  655          1469  3     perform (traverse_keys (..index, check_rfa, .user_routine, .rfa));
;  656          1470  3     END;
;  657          1471  2
;  658          1472  2 RETURN true;
;  659          1473  2
;  660          1474  1 END;


                                                    0FFC 00000          .ENTRY  LBR$SEARCH, Save R2,R3,R4,R5,R6,R7,R8,R9,-   ; 1414
                                                                                R10,R11
                                        50      04  BC   D0 00002       MOVL    @CTL_INDEX, R0                               ; 1454
                                                0000G 30 00006          BSBW    VALIDATE_CTL                                 ;
                                        48          50   E9 00009       BLBC    STATUS, 4$                                   ;
                                        50      0000G CF   D0 0000C     MOVL    LBR$GL_CONTROL, R0                           ; 1458
                                        50        0A  A0   7D 00011     MOVQ    10(R0), R0                                   ; 1459
    08  BC      01  A0                  08            00   ED 00015     CMPZV   #0, #8, 1(R0), @INDEX                        ; 1461
                                                      05   1F 0001C     BLSSU   1$                                           ;
                                                  08  BC   D5 0001E     TSTL    @INDEX                                       ; 1462
                                                      08   12 00021     BNEQ    2$                                           ;
                                        50 00000000G  8F   D0 00023 1$:  MOVL    #LBR$_ILLIDXNUM, R0                          ; 1464
                                                      04   0002A         RET                                                  ;
                                    0D      04  A1       05   E1 0002B 2$:  BBC     #5, 4(R1), 3$                            ; 1466
                                                7E    0C  AC   7D 00030     MOVQ    RFA, -(SP)                               ; 1467
                                                  08  BC   DD 00034     PUSHL   @INDEX                                       ;
                                            0000G CF          03   FB 00037 CALLS   #3, LBR_OLD_SRC_IDX                      ;
                                                              04   0003C     RET                                              ;
                                                  0C  AC   DD 0003D 3$:  PUSHL   RFA                                          ; 1469
                                                  10  AC   DD 00040     PUSHL   USER_ROUTINE                                 ;
                                                  92  AF   9F 00043     PUSHAB  CHECK_RFA                                    ;
                                                  08  BC   DD 00046     PUSHL   @INDEX                                       ;
                                            0000V CF          04   FB 0u049 CALLS   #4, TRAVERSE_KEYS                        ;
                                                03            50   E9 0004E BLBC    STATUS, 4$                               ;
```

```
                                50          01  D0 00051          MOVL    #1, R0                          ; 1472
                                                04 00054 4$:       RET                                     ; 1474

; Routine Size:  85 bytes,    Routine Base:  $CODE$ + 03BA
```

```
;  662          1475  1 %SBTTL  'check_wild';
;  663          1476  1 ROUTINE check_wild (entry, user_routine, index_desc, match_desc) =
;  664          1477  2 BEGIN
;  665          1478  2 !---
;  666          1479  2 !       Called by traverse for each entry in the index.  Check to
;  667          1480  2 !       see if current entry matches the match_desc.  Call user if so.
;  668          1481  2 !
;  669          1482  2 ! Inputs:
;  670          1483  2 !
;  671          1484  2 !       entry = Address of key entry
;  672          1485  2 !       user_routine = Address of user action routine
;  673          1486  2 !       index_desc = Address of index descriptor for index
;  674          1487  2 !       match_desc = string descriptor for match string
;  675          1488  2 !
;  676          1489  2 !---
;  677          1490  2 MAP
;  678          1491  2     entry : REF BBLOCK,
;  679          1492  2     index_desc : REF BBLOCK,
;  680          1493  2     match_desc : REF BBLOCK;
;  681          1494  2 LOCAL
;  682          1495  2     entrykey : BBLOCK [lbr$c_maxkeylen];
;  683          1496  2
;  684          1497  2 IF .index_desc [idd$v_upcasntry]
;  685          1498  2 THEN
;  686          1499  3     BEGIN
;  687          1500  3     moveto_upper_case (.entry [idx$b_keylen], entry [idx$t_keyname], entrykey)
;  688          1501  3     END
;  689          1502  2 ELSE
;  690          1503  2     CH$MOVE (.entry [idx$b_keylen], entry [idx$t_keyname], entrykey);
;  691          1504  2
;  692          1505  3 IF (NOT .index_desc [idd$v_ascii]                ! If not ASCII keys
;  693          1506  4  OR (fmg$match_name (.entry [idx$b_keylen], entrykey,
;  694          1507  4                       .match_desc [dsc$w_length],
;  695          1508  4                       .match_desc [dsc$a_pointer])
;  696          1509  4          OR CH$EQL (.match_desc [dsc$w_length], entrykey,
;  697          1510  4                       .match_desc [dsc$w_length],
;  698          1511  3                       .match_desc [dsc$a_pointer])))
;  699          1512  2     THEN perform (call_user (.entry, .user_routine, .index_desc, .match_desc));
;  700          1513  2 RETURN true
;  701          1514  1 END;                                            !Of check_wild


                                OFFC 00000 CHECK_WILD:
                                           .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 1476
                          5E    80   AE  9E 00002          MOVAB   -128(SP), SP                  ;
                          50    04   AC  D0 00006          MOVL    ENTRY, R0                     ; 1500
                          57    04   AC  D0 0000A          MOVL    ENTRY, R7                     ;
                    10    0C    BC       05  E1 0000E      BBC     #5, @INDEX_DESC, 1$           ; 1497
                          52         6E  9E 00013          MOVAB   ENTRYKEY, R2                  ; 1500
                          51    07   A0  9E 00016          MOVAB   7(R0), R1                     ;
                          50    06   A7  9A 0001A          MOVZBL  6(R7), R0                     ;
                                0000G 30  0001E           BSBW    MOVETO_UPPER_CASE             ;
                                   09 11  00021           BRB     2$                            ; 1499
                          51    06   A7  9A 00023 1$:      MOVZBL  6(R7), R1                     ; 1503
```

```
                 6E     07  A0          51  28 00027          MOVC3   R1, 7(R0), ENTRYKEY                          ;
                        1F  A0          BC  E9 0002C 2$:      BLBC    @INDEX_DESC, 3$                             ; 1505
                        56  10          AC  D0 00030          MOVL    MATCH_DESC, R6                              ; 1508
                        53              6E  9E 00034          MOVAB   ENTRYKEY, R3                                ; 1506
                        55  04          A6  D0 00037          MOVL    4(R6), R5                                   ;
                        54              66  3C 0003B          MOVZWL  (R6), R4                                    ;
                        52  06          A7  9A 0003E          MOVZBL  6(R7), R2                                   ;
                                  0000G 30  00042             BSBW    FMG$MATCH_NAME                              ;
                        07              50  E8 00045          BLBS    R0, 3$                                      ;
              04   B6                   6E  66 29 00048      CMPC3   (R6), ENTRYKEY, @4(R6)                      ; 1509
                                        10  12 0004D          BNEQ    4$                                          ;
                        7E  0C          AC  7D 0004F 3$:      MOVQ    INDEX_DESC, -(SP)                           ; 1512
                        7E  04          AC  7D 00053          MOVQ    ENTRY, -(SP)                                ;
                 0000V  CF              04  FB 00057          CALLS   #4, CALL_USER                               ;
                        03              50  E9 0005C          BLBC    STATUS, 5$                                  ;
                        50              01  D0 0005F 4$:      MOVL    #1, R0                                      ; 1513
                                        04  00062 5$:         RET                                                 ; 1514

; Routine Size:  99 bytes,    Routine Base:  $CODE$ + 040F
```

```
;   703          1515  1 %SBTTL  'call_user';
;   704          1516  1 ROUTINE call_user (entry, user_routine, index_desc, rfa) =
;   705          1517  1
;   706          1518  1 !---
;   707          1519  1 !
;   708          1520  1 !       This routine is used as an action routine by GET_INDEX
;   709          1521  1 !       and SEARCH to call the user with a standard argument
;   710          1522  1 !       list for a given key entry.
;   711          1523  1 !
;   712          1524  1 ! Inputs:
;   713          1525  1 !
;   714          1526  1 !       entry = Address of key entry
;   715          1527  1 !       user_routine = Address of user action routine
;   716          1528  1 !       index = Primary index number
;   717          1529  1 !
;   718          1530  1 ! Outputs:
;   719          1531  1 !
;   720          1532  1 !       The user routine is called with the following arguments:
;   721          1533  1 !               1) If ascii keys, address of key descriptor
;   722          1534  1 !                  If binary keys, address of longword key
;   723          1535  1 !               2) Address of RFA associated with the key
;   724          1536  1 !---
;   725          1537  1
;   726          1538  2 BEGIN
;   727          1539  2
;   728          1540  2 MAP
;   729          1541  2     index_desc: REF BBLOCK,                ! Address of index descriptor
;   730          1542  2     entry: REF BBLOCK;                     ! Address of key entry
;   731          1543  2
;   732          1544  2 BIND
;   733          1545  2     context = .lbr$gl_control [lbr$l_ctxptr] : BBLOCK;
;   734          1546  2
;   735          1547  2 context [ctx$v_found1] = true;            ! Flag match found
;   736          1548  2 IF .index_desc [idd$v_ascii]              ! If ASCII keys,
;   737          1549  2 THEN
;   738          1550  3     BEGIN
;   739          1551  3     LOCAL desc: BBLOCK [dsc$c_s_bln];     ! String descriptor
;   740          1552  3     desc [dsc$w_length] = .entry [idx$b_keylen];
;   741          1553  3     desc [dsc$a_pointer] = entry [idx$t_keyname];
;   742          1554  3     perform ((.user_routine) (desc, entry [idx$l_vbn])); ! Call user back
;   743          1555  3     END
;   744          1556  2 ELSE
;   745          1557  2     perform ((.user_routine) (entry [idx$l_keyid], entry [idx$l_vbn]));
;   746          1558  2
;   747          1559  2 RETURN true;
;   748          1560  2
;   749          1561  1 END;


                                0000 00000 CALL_USER:
                                                .WORD   Save nothing                            ; 1516
                            5E          08  C2 00002        SUBL2   #8, SP                      ;
                            50  0000G   CF  D0 00005        MOVL    LBR$GL_CONTROL, R0          ; 1545
                            50    0E    A0  D0 0000A        MOVL    14(R0), R0                  ;
```

```
                         04   A0      40   8F   88 0000E          BISB2   #64, 4(R0)                          ; 1547
                              50      04   AC   D0 00013          MOVL    ENTRY, R0                           ; 1552
                              12      0C   BC   E9 00017          BLBC    @INDEX_DESC, 1$                     ; 1548
                              6E      06   A0   9B 0001B          MOVZBW  6(R0), DESC                         ; 1552
                    04   AE        04   AC        07   C1 0001F  ADDL3   #7, ENTRY, DESC+4                  ; 1553
                                             04   AC   DD 00025  PUSHL   ENTRY                              ; 1554
                                             04   AE   9F 00028  PUSHAB  DESC                               ;
                                             06   11   0002B     BRB     2$                                  ;
                                             04   AC   DD 0002D  1$:     PUSHL   ENTRY                       ; 1557
                                             06   A0   9F 00030          PUSHAB  6(R0)                       ;
                         08   BC             02   FB   00033  2$:     CALLS   #2, @USER_ROUTINE           ;
                              03             50   E9   00037          BLBC    STATUS, 3$                  ;
                              50             01   D0   0003A          MOVL    #1, R0                      ; 1559
                                                  04   0003D  3$:     RET                                 ; 1561

; Routine Size:  62 bytes,    Routine Base:  $CODE$ + 0472
```

```
;  751          1562  1 %SBTTL  'add_key';
;  752          1563  1 GLOBAL ROUTINE add_key (index, key_desc, key_rfa, stop_vbn) =
;  753          1564  1 !---
;  754          1565  1 !
;  755          1566  1 !       This routine adds a key to a specified index.  If the index
;  756          1567  1 !       block is full, the block is split and a parent index block
;  757          1568  1 !       is created and is made to point to the 2 split index blocks.
;  758          1569  1 !
;  759          1570  1 ! Inputs:
;  760          1571  1 !
;  761          1572  1 !       index = Primary index number in which key is to be added.
;  762          1573  1 !       key_desc = Descriptor of key (ascii or binary) to be added.
;  763          1574  1 !       key_rfa = RFA to be associated with key.
;  764          1575  1 !       stop_vbn = (Optional) The VBN of an index block in the
;  765          1576  1 !                       index tree into which the key should be added.
;  766          1577  1 !                       If not specified, key added at bottom of tree.
;  767          1578  1 !
;  768          1579  1 ! Outputs:
;  769          1580  1 !
;  770          1581  1 !       Routine value = Success/failure status code
;  771          1582  1 !
;  772          1583  1 !---
;  773          1584  2 BEGIN
;  774          1585  2
;  775          1586  2 MAP
;  776          1587  2     key_desc: REF BBLOCK,                  ! Access as string descriptor
;  777          1588  2     key_rfa: REF BBLOCK;                   ! Access as RFA structure
;  778          1589  2
;  779          1590  2 LOCAL
;  780          1591  2     status,
;  781          1592  2     index_desc: REF BBLOCK,                ! Index descriptor
;  782          1593  2     entry_size,                            ! Size of each index entry
;  783          1594  2     index_block1: REF BBLOCK,              ! Address of index block
;  784          1595  2     vbn1,                                  ! VBN of current index block
;  785          1596  2     genpos,                                ! Offset to closest entry
;  786          1597  2     addpos;                                ! Offset where to add key
;  787          1598  2
;  788          1599  2 BUILTIN
;  789          1600  2     NULLPARAMETER;                 ! True if argument unspecified
;  790          1601  2
;  791          1602  2 MACRO
;  792        M 1603  2     entry (address,b) =
;  793        M 1604  2         (address+index$c_entries+b)
;  794          1605  2         %IF %LENGTH GTR 2 %THEN <%REMAINING> %ELSE <0,0,0> %FI%;
;  795          1606  2
;  796          1607  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
;  797          1608  2                   + (.index-1)*idd$c_length;
;  798          1609  2 !
;  799          1610  2 !   Use false option to check keyword and remove trailing blanks
;  800          1611  2 !
;  801          1612  2 perform (make_upper_case (.key_desc, .key_desc, false));
;  802          1613  2 !
;  803          1614  2 !       Check for illegal key length if ASCII keys
;  804          1615  2 !
;  805          1616  2 IF .index_desc [idd$v_ascii]
;  806          1617  2 THEN
;  807          1618  4     IF ((.key_desc [dsc$w_length] GTR .index_desc [idd$w_keylen]) ! If name too long
```

```
;  808     1619  3          OR (.key_desc [dsc$w_length] EQL 0))                    !  or zero length name
;  809     1620  2      THEN
;  810     1621  2          RETURN lbr$_invkey;                                     ! Then return with an error
;  811     1622  2  !
;  812     1623  2  !       If no primary index block exists yet, create the block.
;  813     1624  2  !
;  814     1625  2  IF .index_desc [idd$l_vbn] EQL 0        ! If no primary index block yet,
;  815     1626  2  THEN
;  816     1627  3      BEGIN
;  817     1628  3      perform(create_index(vbn1, index_block1));  ! Create index block
;  818     1629  3      index_desc [idd$l_vbn] = .vbn1;     ! Set as root of tree
;  819     1630  3      index_block1 [index$l_parent] = 0;  ! Set backward link
;  820     1631  2      END;
;  821     1632  2  !
;  822     1633  2  !       Find the key in the index tree.
;  823     1634  2  !
;  824     1635  2  status = find_key(.index, .key_desc,
;  825     1636  2          (IF NOT NULLPARAMETER(4) THEN .stop_vbn ELSE 0),
;  826     1637  2          vbn1, index_block1, genpos, addpos);
;  827     1638  2  !
;  828     1639  2  !       If key found, return duplicate key
;  829     1640  2  !
;  830     1641  2  IF .status                             ! If found,
;  831     1642  2  THEN
;  832     1643  2      RETURN lbr$_dupkey;                 ! Return duplicate key
;  833     1644  2  !
;  834     1645  2  !       If the current block is full, split the index block into
;  835     1646  2  !       2 blocks and create a parent index block if necessary.
;  836     1647  2  !
;  837     1648  2  IF .index_desc [idd$v_varlenidx]
;  838     1649  2  THEN
;  839     1650  2      entry_size = idx$c_rfaplsbyt + .key_desc[dsc$w_length]
;  840     1651  2  ELSE
;  841     1652  2      entry_size = idx$c_length + .index_desc [idd$w_keylen];
;  842     1653  2
;  843     1654  2  IF .index_block1 [index$w_used] + .entry_size GTRU index$c_blksiz
;  844     1655  2  THEN
;  845     1656  3      BEGIN
;  846     1657  3      LOCAL
;  847     1658  3          cur_entry : REF BBLOCK,         ! step through index entry at a time
;  848     1659  3          last_entry,
;  849     1660  3          last_used,                      ! location of last used byte in index block
;  850     1661  3          move_length,                    ! Length of half the block
;  851     1662  3          ptr,
;  852     1663  3          index_block2: REF BBLOCK,       ! Address of second block
;  853     1664  3          vbn2,                           ! VBN of second block
;  854     1665  3          rfa2: BBLOCK[rfa$c_length];     ! RFA used by add_key
;  855     1666  3
;  856     1667  3      !
;  857     1668  3      ! Create second index and copy about a quarter of the entries into it.
;  858     1669  3      !
;  859     1670  3
;  860     1671  3      perform(create_index(vbn2, index_block2)); ! Allocate index block
;  861     1672  3
;  862     1673  3      IF .index_desc [idd$v_varlenidx]
;  863     1674  3      THEN                    ! variable length keyword storage
;  864     1675  4          BEGIN
```

```
;  865          1676  4          cur_entry = .index_block1 + index$c_entries;
;  866          1677  4          last_used = .index_block1 + index$c_entries + .index_block1 [index$w_used];
;  867          1678  4          DO
;  868          1679  5              BEGIN
;  869          1680  5              LOCAL
;  870          1681  5                  entry_len;              ! length of variable index entry in index block
;  871          1682  5              last_entry = .cur_entry;
;  872          1683  5              entry_len = idx$c_rfaplsbyt + .cur_entry[idx$b_keylen];
;  873          1684  5              cur_entry = .cur_entry + .entry_len;
;  874          1685  5              END
;  875          1686  5          UNTIL (.cur_entry + lbr$c_maxkeylen )
;  876          1687  4                  GTR (.index_block1 + index$c_blksiz );
;  877          1688  4          move_length = .last_used - .last_entry;
;  878          1689  4
;  879          1690  4
;  880          1691  4          index_block1 [index$w_used] =
;  881          1692  4              .index_block1 [index$w_used] - .move_length;
;  882          1693  4          index_block2 [index$w_used] = .move_length;
;  883          1694  4          CH$MOVE(.move_length,           ! Copy half the block
;  884          1695  4              entry(.index_block1+.index_block1 [index$w_used],0),
;  885          1696  4              entry(.index_block2,0));
;  886          1697  4
;  887          1698  4          reset_highest2(.index,.index_desc,.vbn1,.index_block1); ! Reset highest key
;  888          1699  4          END
;  889          1700  3      ELSE                ! fixed length keyword storage
;  890          1701  4          BEGIN
;  891          1702  4          !
;  892          1703  4          !    Move the last fourth of the entries
;  893          1704  4          !
;  894          1705  5          move_length = (.index_block1 [index$w_used] / .entry_size / 4)  ! ***
;  895          1706  4                        * .entry_size;
;  896          1707  4          !
;  897          1708  4          !    If the keyword size is so large that fewer than four keywords fit
;  898          1709  4          !    in an index block, then only move out 1 entry.
;  899          1710  4          !
;  900          1711  4          IF .move_length EQL 0 THEN move_length = .entry_size;
;  901          1712  4          index_block1 [index$w_used] =
;  902          1713  4              .index_block1 [index$w_used] - .move_length;
;  903          1714  4          index_block2 [index$w_used] = .move_length;
;  904          1715  4          CH$MOVE(.move_length,           ! Copy 3/4 of the block
;  905          1716  4              entry(.index_block1+.index_block1 [index$w_used],0),
;  906          1717  4              entry(.index_block2,0));
;  907          1718  4
;  908          1719  4          reset_highest(.index_desc,.vbn1,.index_block1); ! Reset highest key
;  909          1720  3          END;
;  910          1721  3
;  911          1722  3      IF .index_block1 [index$l_parent] EQL 0 ! If at top of tree already,
;  912          1723  3      THEN
;  913          1724  4          BEGIN
;  914          1725  4          !
;  915          1726  4          ! Create a parent block for the 2 index blocks.
;  916          1727  4          !
;  917          1728  4          LOCAL
;  918          1729  4              index_block0: REF BBLOCK,   ! Address of parent block
;  919          1730  4              vbn0;                       ! VBN of parent block
;  920          1731  4
;  921          1732  4          perform(create_index(vbn0, index_block0)); ! Create parent
```

```
;   922     1733  4
;   923     1734  4          index_block0 [index$l_parent] = .index_block1 [index$l_parent];
;   924     1735  4          index_block1 [index$l_parent] = .vbn0;
;   925     1736  4          IF .index_block0 [index$l_parent] EQL 0 ! If root of tree
;   926     1737  4          THEN
;   927     1738  4              index_desc [idd$l_vbn] = .vbn0;     ! Reset root pointer
;   928     1739  4
;   929     1740  4          IF .index_desc [idd$v_varlenidx]
;   930     1741  4          THEN
;   931     1742  5              perform( add_index2(.index, .vbn1, .index_block1) )
;   932     1743  4          ELSE
;   933     1744  4              perform( add_index(.index, .vbn1, .index_block1) );
;   934     1745  4                                          ! Add highest key to parent
;   935     1746  3          END;
;   936     1747  3
;   937     1748  3      index_block2 [index$l_parent] = .index_block1 [index$l_parent];
;   938     1749  3
;   939     1750  3      IF .index_desc [idd$v_varlenidx]
;   940     1751  3      THEN
;   941     1752  4          BEGIN
;   942     1753  4          perform( add_index2(.index, .vbn2, .index_block2) );! Add key to parent
;   943     1754  4          !
;   944     1755  4          !       If any of the entries which were moved into the second
;   945     1756  4          !       block pointed to sub-indices, reset the parent backpointer
;   946     1757  4          !       in that sub-index to point to the second block (vbn2).
;   947     1758  4          !
;   948     1759  4          ptr = .index_block2 + index$c_entries;
;   949     1760  4          last_used = .index_block2+ index$c_entries +.index_block2[index$w_used];
;   950     1761  4          WHILE .ptr LSS .last_used DO
;   951     1762  5              BEGIN
;   952     1763  5              MAP
;   953     1764  5                  ptr: REF BBLOCK;                ! Address index entry
;   954     1765  5              IF .ptr [idx$w_offset] EQL rfa$c_index ! If points to index,
;   955     1766  5              THEN
;   956     1767  6                  BEGIN
;   957     1768  6                  LOCAL block: REF BBLOCK;
;   958     1769  6                  perform(find_index(.ptr [idx$l_vbn], block));
;   959     1770  6                  block [index$l_parent] = .vbn2; ! Reset parent block
;   960     1771  6                  mark_dirty(.ptr [idx$l_vbn]);   ! Mark block dirty
;   961     1772  5                  END;
;   962     1773  5              ptr = .ptr + idx$c_rfaplsbyt + .ptr[idx$b_keylen];
;   963     1774  4              END;
;   964     1775  4          END
;   965     1776  3      ELSE
;   966     1777  4          BEGIN
;   967     1778  4          perform( add_index(.index, .vbn2, .index_block2) );! Add key to parent
;   968     1779  4          !
;   969     1780  4          !       If any of the entries which were moved into the second
;   970     1781  4          !       block pointed to sub-indices, reset the parent backpointer
;   971     1782  4          !       in that sub-index to point to the second block (vbn2).
;   972     1783  4          !
;   973     1784  4          INCRU ptr FROM .index_block2+index$c_entries
;   974     1785  4              TO .index_block2+index$c_entries+.index_block2 [index$w_used]-1
;   975     1786  4              BY .entry_size
;   976     1787  4          DO
;   977     1788  5              BEGIN
;   978     1789  5              MAP
```

```
;  979          1790  5                ptr: REF BBLOCK;                    ! Address index entry
;  980          1791  5            IF .ptr [idx$w_offset] EQL rfa$c_index ! If points to index,
;  981          1792  5            THEN
;  982          1793  6                BEGIN
;  983          1794  6                LOCAL block: REF BBLOCK;
;  984          1795  6                perform(find_index(.ptr [idx$l_vbn], block));
;  985          1796  6                block [index$l_parent] = .vbn2; ! Reset parent block
;  986          1797  6                mark_dirty(.ptr [idx$l_vbn]);   ! Mark block dirty
;  987          1798  5                END;
;  988          1799  4            END;
;  989          1800  3        END;
;  990          1801  3    !
;  991          1802  3    !   If the add position was in the second half of the
;  992          1803  3    !   split block, then reset index_block1 and vbn1 so
;  993          1804  3    !   that the following code adds the key to the second
;  994          1805  3    !   block.  In addition, if we are adding a subindex key,
;  995          1806  3    !   then adjust the parent block of that subindex to point
;  996          1807  3    !   to this newly split second block rather than the original
;  997          1808  3    !   first block.  Adjust the add offset for the second block.
;  998          1809  3    !
;  999          1810  3        IF .addpos GTRU .index_block1 [index$w_used] ! If in 2nd half,
; 1000          1811  3        THEN
; 1001          1812  4            BEGIN
; 1002          1813  4            IF .key_rfa [rfa$w_offset] EQL rfa$c_index ! If index pointer,
; 1003          1814  4            THEN
; 1004          1815  5                BEGIN
; 1005          1816  5                LOCAL block: REF BBLOCK;
; 1006          1817  5                perform(find_index(.key_rfa [rfa$l_vbn], block));
; 1007          1818  5                block [index$l_parent] = .vbn2;     ! Reset parent block
; 1008          1819  5                mark_dirty(.key_rfa [rfa$l_vbn]);   ! Mark block modified
; 1009          1820  4                END;
; 1010          1821  4
; 1011          1822  4            mark_dirty(.vbn1);                  ! Mark block 1 modified now
; 1012          1823  4                                                ! since 2 will be marked below
; 1013          1824  4            addpos = .addpos - .index_block1 [index$w_used]; ! Adjust offset
; 1014          1825  4            index_block1 = .index_block2;   ! Add key to second block
; 1015          1826  4            vbn1 = .vbn2;
; 1016          1827  3            END;
; 1017          1828  3
; 1018          1829  2        END;
; 1019          1830  2    !
; 1020          1831  2    !       Make room for new entry by pushing all
; 1021          1832  2    !       the following entries in use down one.
; 1022          1833  2    !
; 1023          1834  2    CH$MOVE(.index_block1 [index$w_used] - .addpos,
; 1024          1835  2        entry(.index_block1+.addpos,0),
; 1025          1836  2        entry(.index_block1+.addpos+.entry_size,0));
; 1026          1837  2    index_block1 [index$w_used] = .index_block1 [index$w_used]+.entry_size;
; 1027          1838  2    !
; 1028          1839  2    !       Add the key to the index
; 1029          1840  2    !
; 1030          1841  2    entry(.index_block1+.addpos,idx$l_vbn) = .key_rfa [rfa$l_vbn];
; 1031          1842  2    entry(.index_block1+.addpos,idx$w_offset) = .key_rfa [rfa$w_offset];
; 1032          1843  2
; 1033          1844  2    IF .index_desc [idd$v_ascii]                ! If ASCII keys,
; 1034          1845  2    THEN
; 1035          1846  3        BEGIN
```

```
;1036     1847  3      !
;1037     1848  3      !   If keywords in this index are to be upper cased for
;1038     1849  3      !   entry then upcase.
;1039     1850  3      !
;1040     1851  3      IF NOT .index_desc [idd$v_nocasentr]
;1041     1852  3      THEN perform (make_upper_case (.key_desc, .key_desc, true));
;1042     1853  3
;1043     1854  3      CH$MOVE(.key_desc [dsc$w_length],   ! Copy ASCII key
;1044     1855  3          .key_desc [dsc$a_pointer],
;1045     1856  3          entry(.index_block1+.addpos,idx$t_keyname));
;1046     1857  3      entry(.index_block1+.addpos,idx$b_keylen) =
;1047     1858  3          .key_desc [dsc$w_length];
;1048     1859  3      END
;1049     1860  2  ELSE                                   ! If binary keys,
;1050     1861  2      entry(.index_block1+.addpos,idx$l_keyid) =
;1051     1862  2          ..key_desc;
;1052     1863  2  !
;1053     1864  2  !       Mark index block modified to be written back later.
;1054     1865  2  !
;1055     1866  2  mark_dirty(.vbn1);                ! Mark index block modified
;1056     1867  2  !
;1057     1868  2  !       Reset highest keys in parent index blocks.
;1058     1869  2  !
;1059     1870  2  IF .addpos+.entry_size EQL .index_block1 [index$w_used]
;1060     1871  2  THEN
;1061     1872  2      IF .index_desc[idd$v_varlenidx] !   If index block has variable length keys
;1062     1873  2      THEN
;1063     1874  3          perform( reset_highest2 (.index, .index_desc, .vbn1, .index_block1))
;1064     1875  2      ELSE
;1065     1876  2          perform( reset_highest (.index_desc, .vbn1, .index_block1) );
;1066     1877  2
;1067     1878  2  !
;1068     1879  2  ! Unless the entry points to an index, update the index entry total
;1069     1880  2  !
;1070     1881  3  BEGIN
;1071     1882  3      BIND
;1072     1883  3          header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
;1073     1884  3
;1074     1885  3      IF .key_rfa[rfa$w_offset] NEQ rfa$c_index
;1075     1886  4      THEN BEGIN
;1076     1887  4          header[lhd$l_idxcnt] = .header[lhd$l_idxcnt] + 1;
;1077     1888  4
;1078     1889  4          IF .index EQL 1                          ! If index 1
;1079     1890  4              THEN header[lhd$l_modcnt] = .header[lhd$l_modcnt] + 1;
;1080     1891  4          END
;1081     1892  3         ELSE header [lhd$l_idxovh] = .header [lhd$l_idxovh] + 1; ! Count overhead block
;1082     1893  2  END;
;1083     1894  2
;1084     1895  2  RETURN true;
;1085     1896  1  END;


                                  0FFC 00000          .ENTRY  ADD_KEY, Save R2,R3,R4,R5,R6,R7,R8,R9,R10,- ; 1563
                                                              R11
                                                              ;
```

```
               5E           3C  C2 00002          SUBL2   #60, SP                               ;
               50     0000G CF  D0 00005          MOVL    LBR$GL_CONTROL, R0                    ; 1607
               5B        04 AC  D0 0000A          MOVL    INDEX, R11                            ; 1608
               58   0A B04B 7E  0000E             MOVAQ   @10(R0)[R11], INDEX_DESC              ;
               58     00BC  C8  9E 00013          MOVAB   188(R8), INDEX_DESC                   ;
               5A        08 AC  D0 00018          MOVL    KEY_DESC, R10                         ; 1612
                            52  D4 0001C          CLRL    R2                                    ;
               51           5A  D0 0001E          MOVL    R10, R1                               ;
               50           5A  D0 00021          MOVL    R10, R0                               ;
                      0000G 30  00024             BSBW    MAKE_UPPER_CASE                       ;
               25           50  E9 00027          BLBC    STATUS, 3$                            ;
               12           68  E9 0002A          BLBC    (INDEX_DESC), 2$                      ; 1616
          02   A8           6A  B1 0002D          CMPW    (R10), 2(INDEX_DESC)                  ; 1618
                            04  1A 00031          BGTRU   1$                                    ;
                            6A  B5 00033          TSTW    (R10)                                 ; 1619
                            08  12 00035          BNEQ    2$                                    ;
               50 00000000G 8F  D0 00037 1$:      MOVL    #LBR$_INVKEY, R0                      ; 1621
                            04  0003E             RET                                           ;
                     04     A8  D5 0003F 2$:      TSTL    4(INDEX_DESC)                         ; 1625
                            1A  12 00042          BNEQ    4$                                    ;
                     10     AE  9F 00044          PUSHAB  INDEX_BLOCK1                          ; 1628
                     18     AE  9F 00047          PUSHAB  VBN1                                  ;
        0000V  CF           02  FB 0004A          CALLS   #2, CREATE_INDEX                      ;
               72           50  E9 0004F 3$:      BLBC    STATUS, 11$                           ;
           04  A8    14     AE  D0 00052          MOVL    VBN1, 4(INDEX_DESC)                   ; 1629
               50    10     AE  D0 00057          MOVL    INDEX_BLOCK1, R0                      ; 1630
                     02     A0  D4 0005B          CLRL    2(R0)                                 ;
                     08     AE  9F 0005E 4$:      PUSHAB  ADDPOS                                ; 1635
                     10     AE  9F 00061          PUSHAB  GENPOS                                ;
                     18     AE  9F 00064          PUSHAB  INDEX_BLOCK1                          ;
                     20     AE  9F 00067          PUSHAB  VBN1                                  ;
               04           6C  91 0006A          CMPB    (AP), #4                              ; 1636
                            0A  1F 0006D          BLSSU   5$                                    ;
                     10     AC  D5 0006F          TSTL    16(AP)                                ;
                            05  13 00072          BEQL    5$                                    ;
                     10     AC  DD 00074          PUSHL   STOP_VBN                              ;
                            02  11 00077          BRB     6$                                    ;
                            7E  D4 00079 5$:      CLRL    -(SP)                                 ;
                            5A  DD 0007B 6$:      PUSHL   R10                                   ; 1635
                            5B  DD 0007D          PUSHL   R11                                   ;
        0000V  CF           07  FB 0007F          CALLS   #7, FIND_KEY                          ;
               08           50  E9 00084          BLBC    STATUS, 7$                            ; 1641
               50 00000000G 8F  D0 00087          MOVL    #LBR$_DUPKEY, R0                      ; 1643
                            04  0008E             RET                                           ;
     08        68           02  E1 0008F 7$:      BBC     #2, (INDEX_DESC), 8$                  ; 1648
               6E           6A  3C 00093          MOVZWL  (R10), ENTRY_SIZE                     ; 1650
               6E           07  C0 00096          ADDL2   #7, ENTRY_SIZE                        ;
                            07  11 00099          BRB     9$                                    ;
               6E    02     A8  3C 0009B 8$:      MOVZWL  2(INDEX_DESC), ENTRY_SIZE             ; 1652
               6E           06  C0 0009F          ADDL2   #6, ENTRY_SIZE                        ;
               56    10     AE  D0 000A2 9$:      MOVL    INDEX_BLOCK1, R6                      ; 1654
               52           66  3C 000A6          MOVZWL  (R6), R2                              ;
     50        52           6E  C1 000A9          ADDL3   ENTRY_SIZE, R2, R0                    ;
     000001F4  8F           50  D1 000AD          CMPL    R0, #500                              ;
                            03  1A 000B4          BGTRU   10$                                   ;
                     01BE   31  000B6             BRW     33$                                   ;
                     18     AE  9F 000B9 10$:     PUSHAB  INDEX_BLOCK2                          ; 1671
```

```
                          20    AE  9F 000BC        PUSHAB  VBN2                                      :
               0000V  CF        02  FB 000BF        CALLS   #2, CREATE_INDEX                          :
                      01        50  E8 000C4 11$:   BLBS    STATUS, 12$                               :
                                    04 000C7        RET                                               :
                      57    18  AE  D0 000C8 12$:   MOVL    INDEX_BLOCK2, R7                          : 1693
                      59    14  AE  D0 000CC        MOVL    VBN1, R9                                  : 1698
         49           68        02  E1 000D0        BBC     #2, (INDEX_DESC), 14$                     :
                      50    0C  A6  9E 000D4        MOVAB   12(R6), CUR_ENTRY                         : 1676
               04     AE  0C A246  9E 000D8         MOVAB   12(R2)[R6], LAST_USED                     : 1677
                      52  01F4  C6  9E 000DE        MOVAB   500(R6), R2                               : 1687
                      53        50  D0 000E3 13$:   MOVL    CUR_ENTRY, LAST_ENTRY                     : 1682
                      51    06  A0  9A 000E6        MOVZBL  6(CUR_ENTRY), ENTRY_LEN                   : 1683
                      51        07  C0 000EA        ADDL2   #7, ENTRY_LEN                             :
                      50        51  C0 000ED        ADDL2   ENTRY_LEN, CUR_ENTRY                      : 1684
                      51  0080  C0  9E 000F0        MOVAB   128(R0), R1                               : 1686
                      52        51  D1 000F5        CMPL    R1, R2                                    : 1687
                                E9  15 000F8        BLEQ    13$                                       :
         51    04     AE        53  C3 000FA        SUBL3   LAST_ENTRY, LAST_USED, MOVE_LENGTH        : 1688
                      66        51  A2 000FF        SUBW2   MOVE_LENGTH, (R6)                         : 1692
                      67        51  B0 00102        MOVW    MOVE_LENGTH, (R7)                         : 1693
                      50        66  3C 00105        MOVZWL  (R6), R0                                  : 1695
   0C    A7    0C A046          51  28 00108        MOVC3   MOVE_LENGTH, 12(R0)[R6], 12(R7)           : 1696
                                56  DD 0010F        PUSHL   R6                                        : 1698
                      7E        58  7D 00111        MOVQ    INDEX_DESC, -(SP)                         :
                                5B  DD 00114        PUSHL   R11                                       :
               0000V  CF        04  FB 00116        CALLS   #4, RESET_HIGHEST2                        :
                                29  11 0011B        BRB     16$                                       : 1673
                      52        6E  C6 0011D 14$:   DIVL2   ENTRY_SIZE, R2                            : 1705
                      52        04  C6 00120        DIVL2   #4, R2                                    :
         51           52        6E  C5 00123        MULL3   ENTRY_SIZE, R2, MOVE_LENGTH               : 1706
                                03  12 00127        BNEQ    15$                                       : 1711
                      51        6E  D0 00129        MOVL    ENTRY_SIZE, MOVE_LENGTH                   :
                      66        51  A2 0012C 15$:   SUBW2   MOVE_LENGTH, (R6)                         : 1713
                      67        51  B0 0012F        MOVW    MOVE_LENGTH, (R7)                         : 1714
                      50        66  3C 00132        MOVZWL  (R6), R0                                  : 1716
   0C    A7    0C A046          51  28 00135        MOVC3   MOVE_LENGTH, 12(R0)[R6], 12(R7)           : 1717
                                56  DD 0013C        PUSHL   R6                                        : 1719
                      7E        58  7D 0013E        MOVQ    INDEX_DESC, -(SP)                         :
               0000V  CF        03  FB 00141        CALLS   #3, RESET_HIGHEST                         :
                          02    A6  D5 00146 16$:   TSTL    2(R6)                                     : 1722
                                45  12 00149        BNEQ    20$                                       :
                          20    AE  9F 0014B        PUSHAB  INDEX_BLOCK0                              : 1732
                          28    AE  9F 0014E        PUSHAB  VBN0                                      :
               0000V  CF        02  FB 00151        CALLS   #2, CREATE_INDEX                          :
                      77        50  E9 00156        BLBC    STATUS, 22$                               :
                      50    20  AE  D0 00159        MOVL    INDEX_BLOCK0, R0                          : 1734
               02     A0    02  A6  D0 0015D        MOVL    2(R6), 2(R0)                              :
               02     A6    24  AE  D0 00162        MOVL    VBN0, 2(R6)                               : 1735
                          02    A0  D5 00167        TSTL    2(R0)                                     : 1736
                                05  12 0016A        BNEQ    17$                                       :
               04     A8    24  AE  D0 0016C        MOVL    VBN0, 4(INDEX_DESC)                       : 1738
         0D           68        02  E1 00171 17$:   BBC     #2, (INDEX_DESC), 18$                     : 1740
                                56  DD 00175        PUSHL   R6                                        : 1742
                                59  DD 00177        PUSHL   R9                                        :
                                5B  DD 00179        PUSHL   R11                                       :
               0000V  CF        03  FB 0017B        CALLS   #3, ADD_INDEX2                            :
                                0B  11 00180        BRB     19$                                       :
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```
                                                56  DD 00182 18$:    PUSHL   R6                                      ; 1744
                                                59  DD 00184          PUSHL   R9                                      ;
                                                5B  DD 00186          PUSHL   R11                                     ;
                                      0000V     CF  03 FB 00188       CALLS   #3, ADD_INDEX                           ;
                                                67  50 E9 0018D 19$:  BLBC    STATUS, 25$                           ;
                                          02    A7  02 A6 00190 20$:  MOVL    2(R6), 2(R7)                          ; 1748
                                                53  1C AE 00195       MOVL    VBN2, R3                              ; 1753
                                    4F          68  02 E1 00199       BBC     #2, (INDEX_DESC), 24$                 ; 1750
                                                    0088 8F BB 0019D  PUSHR   #^M<R3,R7>                            ; 1753
                                                5B  DD 001A1          PUSHL   R11                                     ;
                                      0000V     CF  03 FB 001A3       CALLS   #3, ADD_INDEX2                          ;
                                                6F  50 E9 001A8       BLBC    STATUS, 27$                           ;
                                                52  0C A7 9E 001AB     MOVAB   12(R7), PTR                           ; 1759
                                                50  67 3C 001AF       MOVZWL  (R7), R0                              ; 1760
                                          04    AE  0C A047 9E 001B2  MOVAB   12(R0)[R7], LAST_USED                   ;
                                          04    AE  52 D1 001B8 21$:  CMPL    PTR, LAST_USED                        ; 1761
                                                75  18 001BC        BGEQ    30$                                   ;
                                      FFFF    8F  04 A2 B1 001BE    CMPW    4(PTR), #65535                        ; 1765
                                                1B  12 001C4        BNEQ    23$                                   ;
                                                51  28 AE 9E 001C6  MOVAB   BLOCK, R1                             ; 1769
                                                50  62 D0 001CA      MOVL    (PTR), R0                             ;
                                                    0000V 30 001CD  BSBW    FIND_INDEX                            ;
                                                7E      50 E9 001D0 22$:  BLBC    STATUS, 31$                       ;
                                                50  28 AE D0 001D3     MOVL    BLOCK, R0                             ; 1770
                                          02    A0  53 D0 001D7       MOVL    R3, 2(R0)                             ;
                                                50  62 D0 001DB       MOVL    (PTR), R0                             ; 1771
                                                    0000V 30 001DE    BSBW    MARK_DIRTY                            ;
                                                50  06 A2 9A 001E1 23$:  MOVZBL  6(PTR), R0                        ; 1773
                                                52  07 A042 9E 001E5   MOVAB   7(R0)[PTR], PTR                     ;
                                                    CC 11 001EA       BRB     21$                                   ; 1761
                                                    0088 8F BB 001EC 24$:  PUSHR   #^M<R3,R7>                       ; 1778
                                                5B  DD 001F0          PUSHL   R11                                     ;
                                      0000V     CF  03 FB 001F2       CALLS   #3, ADD_INDEX                           ;
                                                57  50 E9 001F7 25$:  BLBC    STATUS, 31$                           ;
                                                52  0C A7 9E 001FA     MOVAB   12(R7), R2                            ; 1784
                                                50  67 3C 001FE       MOVZWL  (R7), R0                              ; 1785
                                                54  0B A047 9E 00201  MOVAB   11(R0)[R7], R4                        ;
                                                    26 11 00206       BRB     29$                                   ; 1786
                                      FFFF    8F  04 A2 B1 00208 26$:  CMPW    4(PTR), #65535                        ; 1791
                                                1B  12 0020E        BNEQ    28$                                   ;
                                                51  2C AE 9E 00210  MOVAB   BLOCK, R1                             ; 1795
                                                50  62 D0 00214      MOVL    (PTR), R0                             ;
                                                    0000V 30 00217  BSBW    FIND_INDEX                            ;
                                                34      50 E9 0021A 27$:  BLBC    STATUS, 31$                       ;
                                                50  2C AE D0 0021D     MOVL    BLOCK, R0                             ; 1796
                                          02    A0  53 D0 00221       MOVL    R3, 2(R0)                             ;
                                                50  62 D0 00225       MOVL    (PTR), R0                             ; 1797
                                                    0000V 30 00228    BSBW    MARK_DIRTY                            ;
                                                52  6E C0 0022B 28$:  ADDL2   ENTRY_SIZE, PTR                      ; 1784
                                                54  52 D1 0022E 29$:  CMPL    PTR, R4                               ;
                                                D5  1B 00231        BLEQU   26$                                   ;
08  AE                          66              10  00 ED 00233 30$:  CMPZV   #0, #16, (R6), ADDPOS                 ; 1810
                                                3C  1E 00239        BGEQU   33$                                   ;
                                                52  0C AC D0 0023B     MOVL    KEY_RFA, R2                           ; 1813
                                      FFFF    8F  04 A2 B1 0023F    CMPW    4(R2), #65535                         ;
                                                1B  12 00245        BNEQ    32$                                   ;
                                                51  30 AE 9E 00247  MOVAB   BLOCK, R1                             ; 1817
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                       50           62  D0 0024B          MOVL    (R2), R0                          ;
                                 0000V  30 0024E          BSBW    FIND_INDEX                        ;
                       60           50  E9 00251  31$:    BLBC    STATUS, 34$                       ;
                       50      30   AE  D0 00254          MOVL    BLOCK, R0                         ; 1818
                  02   A0           53  D0 00258          MOVL    R3, 2(R0)                         ;
                       50           62  D0 0025C          MOVL    (R2), R0                          ; 1819
                                 0000V  30 0025F          BSBW    MARK_DIRTY                        ;
                       50           59  D0 00262  32$:    MOVL    R9, R0                            ; 1822
                                 0000V  30 00265          BSBW    MARK_DIRTY                        ;
                       50           66  3C 00268          MOVZWL  (R6), R0                          ; 1824
                  08   AE           50  C2 0026B          SUBL2   R0, ADDPOS                        ;
                  10   AE           57  D0 0026F          MOVL    R7, INDEX_BLOCK1                  ; 1825
                  14   AE           53  D0 00273          MOVL    R3, VBN1                          ; 1826
                       59      10   AE  D0 00277  33$:    MOVL    INDEX_BLOCK1, R9                  ; 1834
                       50           69  3C 0027B          MOVZWL  (R9), R0                          ;
                       50      08   AE  C2 0027E          SUBL2   ADDPOS, R0                        ;
             57        59      08   AE  C1 00282          ADDL3   ADDPOS, R9, R7                    ; 1835
             56        6E           0C  C1 00287          ADDL3   #12, ENTRY_SIZE, R6               ; 1836
           6647   0C   A7           50  28 0028B          MOVC3   R0, 12(R7), (R6)[R7]              ;
                       69           6E  A0 00291          ADDW2   ENTRY_SIZE, (R9)                  ; 1837
                       56      0C   AC  D0 00294          MOVL    KEY_RFA, R6                       ; 1841
                  0C   A7           66  D0 00298          MOVL    (R6), 12(R7)                      ;
                  10   A7      04   A6  B0 0029C          MOVW    4(R6), 16(R7)                     ; 1842
                       1F           68  E9 002A1          BLBC    (INDEX_DESC), 36$                 ; 1844
             0F        68           04  E0 002A4          BBS     #4, (INDEX_DESC), 35$             ; 1851
                       52           01  D0 002A8          MOVL    #1, R2                            ; 1852
                       51           5A  D0 002AB          MOVL    R10, R1                           ;
                       50           5A  D0 002AE          MOVL    R10, R0                           ;
                                 0000G  30 002B1          BSBW    MAKE_UPPER_CASE                   ;
                       6A           50  E9 002B4  34$:    BLBC    STATUS, 43$                       ;
        13   A7   04   BA           6A  28 002B7  35$:    MOVC3   (R10), @4(R10), 19(R7)            ; 1856
                  12   A7           6A  90 002BD          MOVB    (R10), 18(R7)                     ; 1858
                                    04  11 002C1          BRB     37$                               ; 1844
                  12   A7           6A  D0 002C3  36$:    MOVL    (R10), 18(R7)                     ; 1862
                       50      14   AE  D0 002C7  37$:    MOVL    VBN1, R0                          ; 1866
                                 0000V  30 002CB          BSBW    MARK_DIRTY                        ;
             50   08   AE           6E  C1 002CE          ADDL3   ENTRY_SIZE, ADDPOS, R0            ; 1870
   50        69        10           00  ED 002D3          CMPZV   #0, #16, (R9), R0                 ;
                                    23  12 002D8          BNEQ    40$                               ;
             10        68           02  E1 002DA          BBC     #2, (INDEX_DESC), 38$             ; 1872
                                    59  DD 002DE          PUSHL   R9                                ; 1874
                               18   AE  DD 002E0          PUSHL   VBN1                              ;
                                    58  DD 002E3          PUSHL   INDEX_DESC                        ;
                                    5B  DD 002E5          PUSHL   R11                               ;
               0000V   CF           04  FB 002E7          CALLS   #4, RESET_HIGHEST2                ;
                                    0C  11 002EC          BRB     39$                               ;
                                    59  DD 002EE  38$:    PUSHL   R9                                ; 1876
                               18   AE  DD 002F0          PUSHL   VBN1                              ;
                                    58  DD 002F3          PUSHL   INDEX_DESC                        ;
               0000V   CF           03  FB 002F5          CALLS   #3, RESET_HIGHEST                 ;
                       24           50  E9 002FA  39$:    BLBC    STATUS, 43$                       ;
                       50   0000G   CF  D0 002FD  40$:    MOVL    LBR$GL_CONTROL, R0                ; 1883
                       50      0A   A0  D0 00302          MOVL    10(R0), R0                        ;
                FFFF   8F      04   A6  B1 00306          CMPW    4(R6), #65535                     ; 1885
                                    0D  13 0030C          BEQL    41$                               ;
                               6A   A0  D6 0030E          INCL    106(R0)                           ; 1887
                       01           5B  D1 00311          CMPL    R11, #1                           ; 1889
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                                08  12 00314          BNEQ    42$                                     ;
                             6E A0  D6 00316          INCL    110(R0)                                 ; 1890
                                03  11 00319          BRB     42$                                     ; 1885
                             78 A0  D6 0031B 41$:     INCL    120(R0)                                 ; 1892
                          50    01  D0 0031E 42$:     MOVL    #1, R0                                  ; 1895
                                04 00321 43$:     RET                                                ; 1896

; Routine Size:  802 bytes,    Routine Base:  $CODE$ + 04B0
```

```
;  1087          1897  1 %SBTTL  'remove_key';
;  1088          1898  1 GLOBAL ROUTINE remove_key (index, key_desc, stop_vbn) =
;  1089          1899  1
;  1090          1900  1 !---
;  1091          1901  1 !
;  1092          1902  1 !       Delete a key from a specified primary index.
;  1093          1903  1 !
;  1094          1904  1 ! Inputs:
;  1095          1905  1 !
;  1096          1906  1 !       index = Primary index number
;  1097          1907  1 !       key_desc = Descriptor of key if ASCII, else binary key.
;  1098          1908  1 !       stop_vbn (optional) = VBN of index block containing key.
;  1099          1909  1 !
;  1100          1910  1 ! Outputs:
;  1101          1911  1 !
;  1102          1912  1 !       The key is deleted from the index if it exists.
;  1103          1913  1 !
;  1104          1914  1 !       true            key was found and deleted.
;  1105          1915  1 !       lbr$_keynotfnd  key was not found
;  1106          1916  1 !---
;  1107          1917  1
;  1108          1918  2 BEGIN
;  1109          1919  2
;  1110          1920  2 MAP
;  1111          1921  2     key_desc: REF BBLOCK;
;  1112          1922  2
;  1113          1923  2 LOCAL
;  1114          1924  2     index_desc: REF BBLOCK,             ! Index descriptor
;  1115          1925  2     vbn,                                ! VBN of index block
;  1116          1926  2     index_block: REF BBLOCK,            ! Address of index block
;  1117          1927  2     entry: REF BBLOCK,                  ! Address key entry
;  1118          1928  2     offset,                             ! Offset to key entry
;  1119          1929  2     addpos,                             ! Offset to add position
;  1120          1930  2     index_ptr,                          ! True if deleteing index pointer entry
;  1121          1931  2     entry_size;                         ! Size of each entry
;  1122          1932  2
;  1123          1933  2 BUILTIN
;  1124          1934  2     NULLPARAMETER;              ! True if argument unspecified
;  1125          1935  2
;  1126          1936  2 !
;  1127          1937  2 !       Find the entry describing the key.
;  1128          1938  2 !
;  1129        P 1939  2 perform (find_key (.index, .key_desc,
;  1130        P 1940  2         (IF NOT NULLPARAMETER(3) THEN .stop_vbn ELSE 0),
;  1131          1941  2                 vbn, index_block, offset, addpos));
;  1132          1942  2 !
;  1133          1943  2 !       Push down all following entries in the block.
;  1134          1944  2 !
;  1135          1945  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
;  1136          1946  2                 + (.index-1)*idd$c_length;
;  1137          1947  2
;  1138          1948  2 IF .index_desc[idd$v_varlenidx] !       If index block has variable length keys
;  1139          1949  2 THEN
;  1140          1950  2     entry_size = idx$c_rfaplsbyt + .key_desc [dsc$w_length]
;  1141          1951  2 ELSE
;  1142          1952  2     entry_size = idx$c_length + .index_desc [idd$w_keylen];
;  1143          1953  2
```

```
;  1144          1954  2 entry = .index_block + index$c_entries + .offset;
;  1145          1955  2 index_ptr = (.entry[rfa$w_offset] EQL rfa$c_index);
;  1146          1956  2
;  1147          1957  2 index_block [index$w_used] = .index_block [index$w_used] - .entry_size;
;  1148          1958  2 CH$MOVE(.index_block [index$w_used] - .offset,
;  1149          1959  2         .entry+.entry_size,
;  1150          1960  2         .entry);
;  1151          1961  2 !
;  1152          1962  2 !       If the block becomes empty, remove it from the tree.
;  1153          1963  2 !
;  1154          1964  2 IF .index_block [index$w_used] EQL 0
;  1155          1965  2 THEN
;  1156          1966  3     BEGIN
;  1157          1967  3     IF .index_block [index$l_parent] EQL 0      ! If root of tree,
;  1158          1968  3     THEN
;  1159          1969  3         index_desc [idd$l_vbn] = 0      ! Reset tree header
;  1160          1970  3     ELSE
;  1161          1971  3         remove_key(.index,              ! Else, remove parent pointer
;  1162          1972  3             .key_desc, .index_block [index$l_parent]);
;  1163          1973  3     delete_index(.vbn);         ! Deallocate index block
;  1164          1974  3     END
;  1165          1975  2 ELSE
;  1166          1976  3     BEGIN
;  1167          1977  3     mark_dirty(.vbn);           ! Mark block modified
;  1168          1978  3     IF .index_desc[idd$v_varlenidx] !   If index block has variable length keys
;  1169          1979  3     THEN
;  1170          1980  3         reset_highest2(.index, .index_desc, .vbn, .index_block)
;  1171          1981  3     ELSE
;  1172          1982  3         reset_highest(.index_desc, .vbn, .index_block);
;  1173          1983  2     END;
;  1174          1984  2 !
;  1175          1985  2 ! Unless we just removed an index pointer, update index totals in header
;  1176          1986  2 !
;  1177          1987  3 BEGIN
;  1178          1988  3     BIND
;  1179          1989  3         header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
;  1180          1990  3
;  1181          1991  3     IF NOT .index_ptr
;  1182          1992  4     THEN BEGIN
;  1183          1993  4         IF .index EQL 1
;  1184          1994  4             THEN header[lhd$l_modcnt] = .header[lhd$l_modcnt] -1;
;  1185          1995  4         header[lhd$l_idxcnt] = .header[lhd$l_idxcnt] -1;
;  1186          1996  4         END
;  1187          1997  3     ELSE header [lhd$l_idxovh] = .header [lhd$l_idxovh] - 1;
;  1188          1998  2 END;
;  1189          1999  2
;  1190          2000  2 RETURN true;
;  1191          2001  2
;  1192          2002  1 END;


                                    0FFC 00000          .ENTRY  REMOVE_KEY, Save R2,R3,R4,R5,R6,R7,R8,R9,-  ; 1898
                                                                R10,R11                                         ;
                              5E    10  C2 00002          SUBL2   #16, SP                                     ;
```

```
                                 5E   DD 00005          PUSHL   SP                                                          ; 1941
                              08 AE   9F 00007          PUSHAB  OFFSET
                              10 AE   9F 0000A          PUSHAB  INDEX_BLOCK
                              18 AE   9F 0000D          PUSHAB  VBN
                        03            6C 91 00010       CMPB    (AP), #3
                                      0A 1F 00013       BLSSU   1$
                              0C AC   D5 00015          TSTL    12(AP)
                                      05 13 00018       BEQL    1$
                              0C AC   DD 0001A          PUSHL   STOP_VBN
                                      02 11 0001D       BRB     2$
                                 7E   D4 0001F 1$:      CLRL    -(SP)
                              08 AC   DD 00021 2$:      PUSHL   KEY_DESC
                        58    04 AC   D0 00024          MOVL    INDEX, R8
                                 58   DD 00028          PUSHL   R8
                  0000V CF              07 FB 0002A       CALLS   #7, FIND_KEY
                        01              50 E8 0002F       BLBS    STATUS, 3$
                                        04 00032          RET
                        50  0000G   CF  D0 00033 3$:      MOVL    LBR$GL_CONTROL, R0                                          ; 1945
                        57    0A B048   7E 00038          MOVAQ   @10(R0)[R8], INDEX_DESC                                     ; 1946
                        57    00BC      C7 9E 0003D       MOVAB   188(R7), INDEX_DESC
                     09 67              02 E1 00042       BBC     #2, (INDEX_DESC), 4$                                        ; 1948
                        52    08 BC     3C 00046          MOVZWL  @KEY_DESC, ENTRY_SIZE                                       ; 1950
                        52              07 C0 0004A       ADDL2   #7, ENTRY_SIZE
                                        07 11 0004D       BRB     5$
                        52    02 A7     3C 0004F 4$:      MOVZWL  2(INDEX_DESC), ENTRY_SIZE                                   ; 1952
                        52              06 C0 00053       ADDL2   #6, ENTRY_SIZE
                        56    08 AE     D0 00056 5$:      MOVL    INDEX_BLOCK, R6                                             ; 1954
                     50 56    04 AE     C1 0005A          ADDL3   OFFSET, R6, R0
                        50              0C C0 0005F       ADDL2   #12, ENTRY
                                        51 D4 00062       CLRL    R1                                                          ; 1955
                  FFFF  8F      04 A0     B1 00064          CMPW    4(ENTRY), #65535
                                        02 12 0006A       BNEQ    6$
                                        51 D6 0006C       INCL    R1
                        59              51 D0 0006E 6$:   MOVL    R1, INDEX_PTR
                        66              52 A2 00071       SUBW2   ENTRY_SIZE, (R6)                                            ; 1957
                        51              66 3C 00074       MOVZWL  (R6), R1                                                    ; 1958
                        51        04 AE C2 00077          SUBL2   OFFSET, R1
                  60          6240      51 28 0007B       MOVC3   R1, (ENTRY_SIZE)[ENTRY], (ENTRY)                            ; 1960
                                        66 B5 00080       TSTW    (R6)                                                        ; 1964
                                        21 12 00082       BNEQ    9$
                              02 A6     D5 00084          TSTL    2(R6)                                                       ; 1967
                                        05 12 00087       BNEQ    7$
                              04 A7     D4 00089          CLRL    4(INDEX_DESC)                                               ; 1969
                                        0D 11 0008C       BRB     8$
                              02 A6     DD 0008E 7$:      PUSHL   2(R6)                                                       ; 1972
                              08 AC     DD 00091          PUSHL   KEY_DESC                                                    ; 1971
                                 58     DD 00094          PUSHL   R8
                  FF65 CF               03 FB 00096       CALLS   #3, REMOVE_KEY
                              0C AE     DD 0009B 8$:      PUSHL   VBN                                                         ; 1973
                  0000V CF              01 FB 0009E       CALLS   #1, DELETE_INDEX
                                        27 11 000A3       BRB     11$                                                         ; 1964
                        50    0C AE     D0 000A5 9$:      MOVL    VBN, R0                                                     ; 1977
                                  0000V 30 000A9          BSBW    MARK_DIRTY
                     10 67              02 E1 000AC       BBC     #2, (INDEX_DESC), 10$                                       ; 1978
                                        56 DD 000B0       PUSHL   R6                                                          ; 1980
                              10 AE     DD 000B2          PUSHL   VBN
                                 57     DD 000B5          PUSHL   INDEX_DESC
```

```
                                        58  DD 000B7          PUSHL   R8                                                      ;
                                0000V   CF  04  FB 000B9          CALLS   #4, RESET_HIGHEST2                                      ;
                                        0C  11 000BE              BRB     11$                                                     ;
                                        56  DD 000C0 10$:        PUSHL   R6                                                      ; 1982
                                    10  AE  DD 000C2              PUSHL   VBN                                                     ;
                                        57  DD 000C5              PUSHL   INDEX_DESC                                              ;
                                0000V   CF  03  FB 000C7          CALLS   #3, RESET_HIGHEST                                       ;
                                50      0000G   CF  D0 000CC 11$: MOVL    LBR$GL_CONTROL, R0                                      ; 1989
                                50      0A  A0  D0 000D1          MOVL    10(R0), R0                                              ;
                                0D          59  E8 000D5          BLBS    INDEX_PTR, 13$                                          ; 1991
                                01          58  D1 000D8          CMPL    R8, #1                                                  ; 1993
                                            03  12 000DB          BNEQ    12$                                                     ;
                                    6E  A0  D7 000DD              DECL    110(R0)                                                 ; 1994
                                    6A  A0  D7 000E0 12$:         DECL    106(R0)                                                 ; 1995
                                            03  11 000E3          BRB     14$                                                     ; 1991
                                    78  A0  D7 000E5 13$:         DECL    120(R0)                                                 ; 1997
                                50          01  D0 000E8 14$:     MOVL    #1, R0                                                  ; 2000
                                            04  000EB              RET                                                             ; 2002

; Routine Size:  236 bytes,    Routine Base:  $CODE$ + 07D2
```

```
;  1194          2003  1 %SBTTL  'lookup_key';
;  1195          2004  1 GLOBAL ROUTINE lookup_key (index, key_desc, retrfa) =
;  1196          2005  1
;  1197          2006  1 !---
;  1198          2007  1 !
;  1199          2008  1 !       Look up a given key and return the RFA associated with
;  1200          2009  1 !       the key, if found.
;  1201          2010  1 !
;  1202          2011  1 ! Inputs:
;  1203          2012  1 !
;  1204          2013  1 !       index = Primary index number
;  1205          2014  1 !       key_desc = Descriptor of key if ASCII, else binary key.
;  1206          2015  1 !       retadr = Longword to receive key entry address.
;  1207          2016  1 !       retvbn (optional) = Longword to receive VBN of index block.
;  1208          2017  1 !
;  1209          2018  1 ! Outputs:
;  1210          2019  1 !
;  1211          2020  1 !       retadr = Address of key entry if found.
;  1212          2021  1 !
;  1213          2022  1 !       true            if key found
;  1214          2023  1 !       lbr$_keynotfnd  if key not found
;  1215          2024  1 !
;  1216          2025  1 !---
;  1217          2026  1
;  1218          2027  2 BEGIN
;  1219          2028  2
;  1220          2029  2 MAP
;  1221          2030  2     retrfa: REF BBLOCK;          ! Address as RFA structure
;  1222          2031  2
;  1223          2032  2 LOCAL
;  1224          2033  2     vbn,                         ! VBN of index block
;  1225          2034  2     index_block: REF BBLOCK,     ! Address of index block
;  1226          2035  2     offset,                      ! Offset to key entry
;  1227          2036  2     addpos,                      ! Offset to add position
;  1228          2037  2     entry: REF BBLOCK;           ! Address of key entry
;  1229          2038  2
;  1230          2039  2 BUILTIN
;  1231          2040  2     NULLPARAMETER;               ! True if argument unspecified
;  1232          2041  2
;  1233        P 2042  2 perform (find_key (.index, .key_desc, 0,
;  1234          2043  2                  vbn, index_block, offset, addpos));
;  1235          2044  2
;  1236          2045  2 entry = .index_block + index$c_entries + .offset;
;  1237          2046  2
;  1238          2047  2 IF NOT NULLPARAMETER(3)
;  1239          2048  3 THEN BEGIN
;  1240          2049  3     retrfa [rfa$l_vbn] = .entry [idx$l_vbn];
;  1241          2050  3     retrfa [rfa$w_offset] = .entry [idx$w_offset];
;  1242          2051  2     END;
;  1243          2052  2
;  1244          2053  2 RETURN true;
;  1245          2054  2
;  1246          2055  1 END;
```

```
                                                0000 00000          .ENTRY  LOOKUP_KEY, Save nothing                ; 2004
                                          5E       10  C2 00002          SUBL2   #16, SP                         ;
                                                   5E  DD 00005          PUSHL   SP                              ; 2043
                                             08    AE  9F 00007          PUSHAB  OFFSET                          ;
                                             10    AE  9F 0000A          PUSHAB  INDEX_BLOCK                     ;
                                             18    AE  9F 0000D          PUSHAB  VBN                             ;
                                                   7E  D4 00010          CLRL    -(SP)                           ;
                                          7E       04  AC 7D 00012          MOVQ    INDEX, -(SP)                    ;
                                    0000V CF             07 FB 00016          CALLS   #7, FIND_KEY                    ;
                                          22             50 E9 0001B          BLBC    STATUS, 2$                      ;
                                50        08  AE       04  AE C1 0001E          ADDL3   OFFSET, INDEX_BLOCK, R0         ; 2045
                                          50             0C C0 00024          ADDL2   #12, ENTRY                      ;
                                          03             6C 91 00027          CMPB    (AP), #3                        ; 2047
                                                         11 1F 0002A          BLSSU   1$                              ;
                                                   0C    AC D5 0002C          TSTL    12(AP)                          ;
                                                   0C    13 0002F             BEQL    1$                              ;
                                          51       0C    AC D0 00031          MOVL    RETRFA, R1                      ; 2049
                                          61             60 D0 00035          MOVL    (ENTRY), (R1)                   ;
                                    04    A1       04    A0 B0 00038          MOVW    4(ENTRY), 4(R1)                 ; 2050
                                          50             01 D0 0003D 1$:      MOVL    #1, R0                          ; 2053
                                                         04 00040 2$:         RET                                     ; 2055

; Routine Size:  65 bytes,    Routine Base:  $CODE$ + 08BE
```

```
;  1248          2056  1 %SBTTL  'traverse_keys';
;  1249          2057  1 GLOBAL ROUTINE traverse_keys (index, action_routine, user_routine, rfa) =
;  1250          2058  1
;  1251          2059  1 !---
;  1252          2060  1 !
;  1253          2061  1 !       Traverse a specified primary index in key order
;  1254          2062  1 !       calling a user action routine for each key.
;  1255          2063  1 !
;  1256          2064  1 ! Inputs:
;  1257          2065  1 !
;  1258          2066  1 !       index = Primary index numebr
;  1259          2067  1 !       action_routine = Address of internal action routine
;  1260          2068  1 !       user_routine = Address of user action routine
;  1261          2069  1 !       rfa = RFA to pass to action routine
;  1262          2070  1 !
;  1263          2071  1 ! Outputs:
;  1264          2072  1 !
;  1265          2073  1 !       The user routine is called with the following arguments:
;  1266          2074  1 !               1) Address of key entry
;  1267          2075  1 !
;  1268          2076  1 !---
;  1269          2077  1
;  1270          2078  2 BEGIN
;  1271          2079  2
;  1272          2080  2 ROUTINE traverse (index_desc, vbn, action_routine, user_routine, txtrfa) =
;  1273          2081  3 BEGIN
;  1274          2082  3 !
;  1275          2083  3 !       Scan all entries in the given index block.
;  1276          2084  3 !
;  1277          2085  3 MAP
;  1278          2086  3     index_desc: REF BBLOCK;     ! Index descriptor
;  1279          2087  3
;  1280          2088  3 LOCAL
;  1281          2089  3     index_block: REF BBLOCK;    ! Index block address
;  1282          2090  3
;  1283          2091  3 perform (find_index (.vbn, index_block));
;  1284          2092  3
;  1285          2093  3 INCRU entry FROM .index_block+index$c_entries
;  1286          2094  3         TO .index_block+index$c_entries+.index_block[index$w_used]-1
;  1287          2095  3         BY idx$c_length + .index_desc [idd$w_keylen]
;  1288          2096  3 DO
;  1289          2097  4     BEGIN
;  1290          2098  4     MAP entry: REF BBLOCK;
;  1291          2099  4     IF .entry [idx$w_offset] EQL rfa$c_index    ! If subindex,
;  1292          2100  4     THEN
;  1293        P 2101  4         perform (traverse (.index_desc, .entry [idx$l_vbn],
;  1294          2102  5                 .action_routine, .user_routine, .txtrfa))
;  1295          2103  4     ELSE
;  1296          2104  4         perform((.action_routine)(.entry, .user_routine, .index_desc, .txtrfa));
;  1297          2105  3     END;
;  1298          2106  3
;  1299          2107  3 RETURN true;
;  1300          2108  2 END;
```

```
                                 0FFC 00000 TRAVERSE:
                                            .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11                    ; 2080
                          5E        04  C2 00002     SUBL2   #4, SP                                          ;
                          51        6E  9E 00005     MOVAB   INDEX_BLOCK, R1                                 ; 2091
                          50  08    AC  D0 00008     MOVL    VBN, R0                                         ;
                              0000V 30  0000C     BSBW    FIND_INDEX                                      ;
                          51        50  E9 0000F     BLBC    STATUS, 5$                                      ;
                          50  00    BE  3C 00012     MOVZWL  @INDEX_BLOCK, R0                                ; 2094
                          50        6E  C0 00016     ADDL2   INDEX_BLOCK, R0                                 ;
                          55  0B    A0  9E 00019     MOVAB   11(R0), R5                                      ;
                          53  04    AC  D0 0001D     MOVL    INDEX_DESC, R3                                  ; 2095
                          54  02    A3  3C 00021     MOVZWL  2(R3), R4                                       ;
                          54        06  C0 00025     ADDL2   #6, R4                                          ;
                    52    6E        0C  C1 00028     ADDL3   #12, INDEX_BLOCK, ENTRY                         ; 2102
                                    2D  11 0002C     BRB     4$                                              ;
                  FFFF    8F  04    A2  B1 0002E 1$: CMPW    4(ENTRY), #65535                                ; 2099
                                    11  12 00034     BNEQ    2$                                              ;
                          7E  10    AC  7D 00036     MOVQ    USER_ROUTINE, -(SP)                             ; 2102
                              0C    AC  DD 0003A     PUSHL   ACTION_ROUTINE                                  ;
                                        62  DD 0003D     PUSHL   (ENTRY)                                         ;
                                        53  DD 0003F     PUSHL   R3                                              ;
                        BB    AF        05  FB 00041     CALLS   #5, TRAVERSE                                    ;
                                        0E  11 00045     BRB     3$                                              ;
                                  14    AC  DD 00047 2$: PUSHL   TXTRFA                                          ; 2104
                                        53  DD 0004A     PUSHL   R3                                              ;
                                  10    AC  DD 0004C     PUSHL   USER_ROUTINE                                    ;
                                        52  DD 0004F     PUSHL   ENTRY                                           ;
                      0C  BC            04  FB 00051     CALLS   #4, @ACTION_ROUTINE                             ;
                          0B            50  E9 00055 3$: BLBC    STATUS, 5$                                      ;
                          52            54  C0 00058     ADDL2   R4, ENTRY                                       ; 2093
                          55            52  D1 0005B 4$: CMPL    ENTRY, R5                                       ;
                                        CE  1B 0005E     BLEQU   1$                                              ;
                          50            01  D0 00060     MOVL    #1, R0                                          ; 2107
                                            04 00063 5$  RET                                                     ; 2108

; Routine Size:  100 bytes,    Routine Base:  $CODE$ + 08FF


;  1301          2109  2
;  1302          2110  2 ROUTINE traverse2 (index_desc, vbn, action_routine, user_routine, txtrfa) =
;  1303          2111  3 BEGIN
;  1304          2112  3 !
;  1305          2113  3 !       Traverse2 handles indices with variable length keywords.
;  1306          2114  3 !       Scan all entries in the given index block.
;  1307          2115  3 !
;  1308          2116  3 MAP
;  1309          2117  3     index_desc: REF BBLOCK;     ! Index descriptor
;  1310          2118  3
;  1311          2119  3 LOCAL
;  1312          2120  3     entry,                      ! Traverse each entry in index block
;  1313          2121  3     index_block: REF BBLOCK;    ! Index block address
;  1314          2122  3
;  1315          2123  3 perform (find_index (.vbn, index_block));
;  1316          2124  3
;  1317          2125  3 entry = .index_block+index$c_entries;
;  1318          2126  3 WHILE .entry LSS .index_block+index$c_entries+.index_block[index$w_used]-1 DO
```

```
; 1319          2127  4         BEGIN
; 1320          2128  4         MAP entry: REF BBLOCK;
; 1321          2129  4         IF .entry [idx$w_offset] EQL rfa$c_index      ! If subindex,
; 1322          2130  4         THEN
; 1323        P 2131  4             perform (traverse2 (.index_desc, .entry [idx$l_vbn],
; 1324          2132  5                     .action_routine, .user_routine, .txtrfa))
; 1325          2133  4         ELSE
; 1326          2134  4             perform((.action_routine)(.entry, .user_routine, .index_desc, .txtrfa));
; 1327          2135  4         entry = .entry + idx$c_rfaplsbyt + .entry [idx$b_keylen];
; 1328          2136  3         END;
; 1329          2137  3
; 1330          2138  3 RETURN true;
; 1331          2139  2 END;



                                                  OFFC 00000 TRAVERSE2:
                                                                    .WORD    Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11                    ; 2110
                          5E             04  C2 00002              SUBL2    #4, SP
                          51             6E  9E 00005              MOVAB    INDEX_BLOCK, R1                                         ; 2123
                          50        08   AC  D0 00008              MOVL     VBN, R0
                                    0000V 30 0000C                 BSBW     FIND_INDEX
                          4D             50  E9 0000F              BLBC     STATUS, 5$
                 52       6E             0C  C1 00012              ADDL3    #12, INDEX_BLOCK, ENTRY                                 ; 2125
                          50        00   BE  3C 00016 1$:          MOVZWL   @INDEX_BLOCK, R0                                        ; 2126
                          50             6E  C0 0001A              ADDL2    INDEX_BLOCK, R0
                          50             0B  C0 0001D              ADDL2    #11, R0
                          50             52  D1 00020              CMPL     ENTRY, R0
                                         37  18 00023              BGEQ     4$
               FFFF       8F        04   A2  B1 00025              CMPW     4(ENTRY), #65535                                        ; 2129
                                         12  12 0002B              BNEQ     2$
                          7E        10   AC  7D 0002D              MOVQ     USER_ROUTINE, -(SP)                                     ; 2132
                                    0C   AC  DD 00031              PUSHL    ACTION_ROUTINE
                                         62  DD 00034              PUSHL    (ENTRY)
                                    04   AC  DD 00036              PUSHL    INDEX_DESC
                   C3     AF             05  FB 00039              CALLS    #5, TRAVERSE2
                                         0F  11 0003D              BRB      3$
                                    14   AC  DD 0003F 2$:          PUSHL    TXTRFA                                                  ; 2134
                                    04   AC  DD 00042              PUSHL    INDEX_DESC
                                    10   AC  DD 00045              PUSHL    USER_ROUTINE
                                         52  DD 00048              PUSHL    ENTRY
                   0C     BC             04  FB 0004A              CALLS    #4, @ACTION_ROUTINE
                          0E             50  E9 0004E 3$:          BLBC     STATUS, 5$
                          50        06   A2  9A 00051              MOVZBL   6(ENTRY), R0                                            ; 2135
                          52      07 A042    9E 00055              MOVAB    7(R0)[ENTRY], ENTRY
                                         BA  11 0005A              BRB      1$                                                      ; 2126
                          50             01  D0 0005C 4$:          MOVL     #1, R0                                                  ; 2138
                                             04 0005F 5$:          RET                                                              ; 2139

; Routine Size:  96 bytes,    Routine Base:  $CODE$ + 0963


; 1332          2140  2 !
; 1333          2141  2 !       Main body of traverse_keys procedure
; 1334          2142  2 !
```

```
;  1335          2143  2 LOCAL
;  1336          2144  2     index_desc: REF BBLOCK;                 ! Index descriptor
;  1337          2145  2
;  1338          2146  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
;  1339          2147  2                 + (.index-1)*idd$c_length;
;  1340          2148  2
;  1341          2149  2 IF .index_desc [idd$l_vbn] EQL 0              ! If empty index,
;  1342          2150  2 THEN
;  1343          2151  2     RETURN true;                              ! return immediately
;  1344          2152  2
;  1345          2153  2 !
;  1346          2154  2 ! Set the lock for the index
;  1347          2155  2 !
;  1348          2156  2 index_desc [idd$v_locked] = true;
;  1349          2157  2
;  1350          2158  2 IF .index_desc[idd$v_varlenidx] !             If index block has variable length keys
;  1351          2159  2 THEN
;  1352        P 2160  2     perform(traverse2(.index_desc, .index_desc [idd$l_vbn],
;  1353          2161  3                 .action_routine,.user_routine, .rfa))
;  1354          2162  2 ELSE
;  1355        P 2163  2     perform(traverse(.index_desc, .index_desc [idd$l_vbn],
;  1356          2164  2                 .action_routine,.user_routine, .rfa));
;  1357          2165  2 !
;  1358          2166  2 ! Clear the lock
;  1359          2167  2 !
;  1360          2168  2 index_desc [idd$v_locked] = false;
;  1361          2169  2
;  1362          2170  2 RETURN true;
;  1363          2171  2
;  1364          2172  1 END;


                                0004 00000          .ENTRY  TRAVERSE_KEYS, Save R2                  ; 2057
                      51  0000G  CF   D0 00002       MOVL    LBR$GL_CONTROL, R1                      ; 2146
                      50    04  AC   D0 00007       MOVL    INDEX, R0                               ; 2147
                      52    0A B140  7E 0000B       MOVAQ   @10(R1)[R0], INDEX_DESC                 ;
                      52  00BC  C2   9E 00010       MOVAB   188(R2), INDEX_DESC                     ;
                          04  A2   D5 00015         TSTL    4(INDEX_DESC)                           ; 2149
                              31   13 00018         BEQL    3$                                      ;
                      62          02   88 0001A     BISB2   #2, (INDEX_DESC)                        ; 2156
                13    62          02   E1 0001D     BBC     #2, (INDEX_DESC), 1$                    ; 2158
                      7E    0C    AC   7D 00021     MOVQ    USER_ROUTINE, -(SP)                     ; 2161
                            08    AC   DD 00025     PUSHL   ACTION_ROUTINE                          ;
                            04    A2   DD 00028     PUSHL   4(INDEX_DESC)                           ;
                                  52   DD 0002B     PUSHL   INDEX_DESC                              ;
                FF6E  CF                05   FB 0002D     CALLS   #5, TRAVERSE2                   ;
                                        11   11 00032     BRB     2$                              ;
                      7E    0C    AC   7D 00034 1$:     MOVQ    USER_ROUTINE, -(SP)             ; 2164
                            08    AC   DD 00038         PUSHL   ACTION_ROUTINE                  ;
                            04    A2   DD 0003B         PUSHL   4(INDEX_DESC)                   ;
                                  52   DD 0003E         PUSHL   INDEX_DESC                      ;
                FEF7  CF                05   FB 00040     CALLS   #5, TRAVERSE                    ;
                      06                50   E9 00045 2$:     BLBC    STATUS, 4$                      ;
                      62                02   8A 00048         BICB2   #2, (INDEX_DESC)            ; 2168
```

```
                                50          01  D0 0004B 3$:    MOVL    #1, R0                          ; 2170
                                                04 0004E 4$:    RET                                     ; 2172

; Routine Size:  79 bytes,    Routine Base:  $CODE$ + 09C3
```

```
;1366     2173  1 %SBTTL  'find_key';
;1367     2174  1 GLOBAL ROUTINE find_key (index, key_desc, stop_vbn,
;1368     2175  1                  retvbn, retblkadr, retgenpos, retaddpos) =
;1369     2176  1 !---
;1370     2177  1 !
;1371     2178  1 !       Find a given key and return all information concerning
;1372     2179  1 !       its position within the index tree.  This routine is
;1373     2180  1 !       used solely by routines such as add_key, remove_key,
;1374     2181  1 !       etc. for the common key search processing.
;1375     2182  1 !
;1376     2183  1 ! Inputs:
;1377     2184  1 !
;1378     2185  1 !       index = Primary index number
;1379     2186  1 !       key_desc = Descriptor of key if ASCII, else binary key.
;1380     2187  1 !       stop_vbn = VBN of specific index block, 0 if bottom of tree.
;1381     2188  1 !       retvbn = Longword to receive VBN of index block.
;1382     2189  1 !       retblkadr = Longword to receive address of index block.
;1383     2190  1 !       retgenpos = Longword to receive offset to generic entry.
;1384     2191  1 !       retaddpos = Longword to receive offset to add position.
;1385     2192  1 !
;1386     2193  1 ! Outputs:
;1387     2194  1 !
;1388     2195  1 !       retvbn = VBN of index block.
;1389     2196  1 !       retblkadr = Address of index block.
;1390     2197  1 !       retgenpos = Offset to generically closest key entry.
;1391     2198  1 !       retaddpos = Offset to position to add key.
;1392     2199  1 !
;1393     2200  1 !       true            if key found
;1394     2201  1 !       false           if key not found
;1395     2202  1 !---
;1396     2203  1
;1397     2204  2 BEGIN
;1398     2205  2
;1399     2206  2 MAP
;1400     2207  2     key_desc: REF BBLOCK;               ! Access as string descriptor
;1401     2208  2
;1402     2209  2 LOCAL
;1403     2210  2     status,
;1404     2211  2     keydesc : BBLOCK [dsc$c_s_bln],
;1405     2212  2     keynambuf : BBLOCK [lbr$c_maxkeylen],
;1406     2213  2     index_desc: REF BBLOCK,             ! Index descriptor
;1407     2214  2     index_block: REF BBLOCK,            ! Address of index block
;1408     2215  2     vbn,                                ! VBN of current index block
;1409     2216  2     offset,                             ! Offset to closest entry
;1410     2217  2     addpos;                             ! Offset to add position
;1411     2218  2
;1412     2219  2 MACRO
;1413   M 2220  2     entry (address,b) =
;1414   M 2221  2         (address+index$c_entries+b)
;1415     2222  2         %IF %LENGTH GTR 2 %THEN <%REMAINING> %ELSE <0,0,0> %FI%;
;1416     2223  2
;1417     2224  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
;1418     2225  2                 + (.index-1)*idd$c_length;
;1419     2226  2 !
;1420     2227  2 !       Get address of primary index block
;1421     2228  2 !
;1422     2229  2 vbn = .index_desc [idd$l_vbn];                  ! Top of tree
```

```
;  1423          2230  2 !
;  1424          2231  2 !       If no primary index block exists yet, key not found.
;  1425          2232  2 !
;  1426          2233  2 IF .vbn EQL 0                    ! If no primary index block yet,
;  1427          2234  2 THEN
;  1428          2235  2     RETURN lbr$_keynotfnd;       ! Return key not found
;  1429          2236  2
;  1430          2237  2 keydesc = 0;
;  1431          2238  2 keydesc [dsc$w_length] = .key_desc [dsc$w_length];
;  1432          2239  2 keydesc [dsc$a_pointer] = keynambuf;
;  1433          2240  2 !
;  1434          2241  2 !   If keywords in this index are to be upper cased for comparison then upcase
;  1435          2242  2 !
;  1436          2243  2 IF NOT .index_desc [idd$v_nocasecmp]
;  1437          2244  3 THEN perform (make_upper_case (.key_desc, keydesc, true))
;  1438          2245  2 ELSE
;  1439          2246  3     BEGIN
;  1440          2247  3     CH$MOVE (.key_desc [dsc$w_length], .key_desc [dsc$a_pointer],
;  1441          2248  3              .keydesc [dsc$a_pointer]);
;  1442          2249  2     END;
;  1443          2250  2
;  1444          2251  2 !
;  1445          2252  2 !       If a specific index VBN was specified, start there
;  1446          2253  2 !
;  1447          2254  2 IF .stop_vbn NEQ 0               ! If specified,
;  1448          2255  2 THEN
;  1449          2256  2     vbn = .stop_vbn;             ! then use it
;  1450          2257  2 !
;  1451          2258  2 !       Search down the subtree until either the bottom is
;  1452          2259  2 !       reached or an error is detected.
;  1453          2260  2 !
;  1454          2261  3 DO BEGIN
;  1455          2262  3     !
;  1456          2263  3     !   Locate the index block to be searched.  It will either
;  1457          2264  3     !   find the block in the index cache or it will be read
;  1458          2265  3     !   from disk and cached.
;  1459          2266  3     !
;  1460          2267  3     perform(find_index(.vbn, index_block));
;  1461          2268  3     !
;  1462          2269  3     !   Search for position of key within index block.
;  1463          2270  3     !
;  1464          2271  3     IF .index_desc[idd$v_varlenidx] !   If index block has variable length keys
;  1465          2272  3     THEN
;  1466          2273  3         status = key_search2(.index_desc,.index_block,keydesc,
;  1467          2274  3                              offset, addpos)
;  1468          2275  3     ELSE
;  1469          2276  3         status = key_search(.index_desc,.index_block,keydesc,
;  1470          2277  3                             offset, addpos);
;  1471          2278  3     !
;  1472          2279  3     !   If a specific index block was specified, then stop the search.
;  1473          2280  3     !
;  1474          2281  3     IF .stop_vbn EQL .vbn                ! If at specified block,
;  1475          2282  3     THEN
;  1476          2283  3         EXITLOOP;                        ! then stop search
;  1477          2284  3     !
;  1478          2285  3     !   If the entry found by the binary search points to another
;  1479          2286  3     !   index, then continue searching using that index.  If it
```

```
;  1480          2287  3      !   points to an actual data record, then we have reached the
;  1481          2288  3      !   bottom of the tree and the search is stopped.
;  1482          2289  3      !
;  1483          2290  3      IF .offset LSS 0                        ! If no closest entry,
;  1484          2291  3          OR .entry(.index_block+.offset,idx$w_offset) NEQ rfa$c_index
;  1485          2292  3      THEN
;  1486          2293  3          EXITLOOP;                           ! Then stop search
;  1487          2294  3
;  1488          2295  3      vbn = .entry(.index_block+.offset,idx$l_vbn); ! Next index
;  1489          2296  3      END
;  1490          2297  3
;  1491          2298  2      UNTIL false;                            ! Loop until EXITLOOP
;  1492          2299  2
;  1493          2300  2  !
;  1494          2301  2  !       Return index block VBN, address and entry offsets.
;  1495          2302  2  !
;  1496          2303  2  .retvbn = .vbn;
;  1497          2304  2  .retblkadr = .index_block;                  ! Return block address
;  1498          2305  2  .retgenpos = .offset;                      ! Return offset to entry
;  1499          2306  2  .retaddpos = .addpos;                      ! Return offset to add position
;  1500          2307  2
;  1501          2308  2  IF NOT .status                              ! If key not found,
;  1502          2309  2  THEN
;  1503          2310  2      RETURN lbr$_keynotfnd;                  ! Return key not found
;  1504          2311  2
;  1505          2312  2  !
;  1506          2313  2  ! Propagate actual length of actual index string back to caller
;  1507          2314  2  !
;  1508          2315  2  key_desc[dsc$w_length] = .keydesc[dsc$w_length];
;  1509          2316  2  RETURN true;                               ! Return successful
;  1510          2317  2
;  1511          2318  1  END;


                                    0FFC 00000          .ENTRY  FIND_KEY, Save R2,R3,R4,R5,R6,R7,R8,R9,R10,-; 2174
                                                                R11                                          ;
                              5E    FF6C    CE  9E 00002          MOVAB   -148(SP), SP                         ;
                              51  0000G     CF  D0 00007          MOVL    LBR$GL_CONTROL, R1                   ; 2224
                              50      04    AC  D0 0000C          MOVL    INDEX, R0                            ; 2225
                              57      0A  B140  7E 00010          MOVAQ   @10(R1)[R0], INDEX_DESC              ;
                              57    00BC    C7  9E 00015          MOVAB   188(R7), INDEX_DESC                  ;
                              58      04    A7  D0 0001A          MOVL    4(INDEX_DESC), VBN                   ; 2229
                                            03  12 0001E          BNEQ    1$                                   ; 2233
                                          00A5  31 00020          BRW     8$                                   ;
                                        F8  AD  D4 00023 1$:      CLRL    KEYDESC                              ; 2237
                              56        08  AC  D0 00026          MOVL    KEY_DESC, R6                         ; 2238
                          F8  AD            66  B0 0002A          MOVW    (R6), KEYDESC                        ;
                          FC  AD            0C  AE  9E 0002E      MOVAB   KEYNAMBUF, KEYDESC+4                 ; 2239
                    11    67                03  E0 00033          BBS     #3, (INDEX_DESC), 2$                 ; 2243
                              51        F8  AD  9E 00037          MOVAB   KEYDESC, R1                          ; 2244
                              52            01  D0 0003B          MOVL    #1, R2                               ;
                              50            56  D0 0003E          MOVL    R6, R0                               ;
                                          0000G 30 00041          BSBW    MAKE_UPPER_CASE                      ;
                              07            50  E8 00044          BLBS    STATUS, 3$                           ;
```

```
                                             04 00047       RET                                          ;
          FC   BD      04   B6          66   28 00048 2$:   MOVC3    (R6), @4(R6), @KEYDESC+4            ; 2248
                            52     0C   AC   D0 0004E 3$:   MOVL     STOP_VBN, R2                        ; 2254
                                        03   13 00052       BEQL     4$                                  ;
                            58          52   D0 00054       MOVL     R2, VBN                             ; 2256
                            51          6E   9E 00057 4$:   MOVAB    INDEX_BLOCK, R1                     ; 2267
                            50          58   D0 0005A       MOVL     VBN, R0                             ;
                                     0000V   30 0005D       BSBW     FIND_INDEX                          ;
                            74          50   E9 00060       BLBC     STATUS, 10$                         ;
               15           67          02   E1 00063       BBC      #2, (INDEX_DESC), 5$                ; 2271
                                   04   AE   9F 00067       PUSHAB   ADDPOS                              ; 2273
                                   0C   AE   9F 0006A       PUSHAB   OFFSET                              ;
                                   F8   AD   9F 0006D       PUSHAB   KEYDESC                             ;
                                   0C   AE   DD 00070       PUSHL    INDEX_BLOCK                         ;
                                        57   DD 00073       PUSHL    INDEX_DESC                          ;
                    0000V   CF          05   FB 00075       CALLS    #5, KEY_SEARCH2                     ;
                                        13   11 0007A       BRB      6$                                  ;
                                   04   AE   9F 0007C 5$:   PUSHAB   ADDPOS                              ; 2276
                                   0C   AE   9F 0007F       PUSHAB   OFFSET                              ;
                                   F8   AD   9F 00082       PUSHAB   KEYDESC                             ;
                                   0C   AE   DD 00085       PUSHL    INDEX_BLOCK                         ;
                                        57   DD 00088       PUSHL    INDEX_DESC                          ;
                    0000V   CF          05   FB 0008A       CALLS    #5, KEY_SEARCH                      ;
                            53          50   D0 0008F 6$:   MOVL     R0, STATUS                          ;
                            58          52   D1 00092       CMPL     R2, VBN                             ; 2281
                                        1C   13 00095       BEQL     7$                                  ;
                            51     08   AE   D0 00097       MOVL     OFFSET, R1                          ; 2290
                                        16   19 0009B       BLSS     7$                                  ;
               50           6E          51   C1 0009D       ADDL3    R1, INDEX_BLOCK, R0                 ; 2291
                     FFFF   8F     10   A0   B1 000A1       CMPW     16(R0), #65535                      ;
                                        0A   12 000A7       BNEQ     7$                                  ;
               50           6E          51   C1 000A9       ADDL3    R1, INDEX_BLOCK, R0                 ; 2295
                            58     0C   A0   D0 000AD       MOVL     12(R0), VBN                         ;
                                        A4   11 000B1       BRB      4$                                  ; 2261
                       10   BC          58   D0 000B3 7$:   MOVL     VBN, @RETVBN                        ; 2303
                       14   BC          6E   D0 000B7       MOVL     INDEX_BLOCK, @RETBLKADR             ; 2304
                       18   BC     08   AE   D0 000BB       MOVL     OFFSET, @RETGENPOS                  ; 2305
                       1C   BC     04   AE   D0 000C0       MOVL     ADDPOS, @RETADDPOS                  ; 2306
                            08          53   E8 000C5       BLBS     STATUS, 9$                          ; 2308
                            50 00000000G 8F   D0 000C8 8$:   MOVL     #LBR$_KEYNOTFND, R0                 ; 2310
                                             04 000CF       RET                                          ;
                            66     F8   AD   B0 000D0 9$:   MOVW     KEYDESC, (R6)                       ; 2315
                            50          01   D0 000D4       MOVL     #1, R0                              ; 2316
                                             04 000D7 10$:  RET                                          ; 2318

; Routine Size:  216 bytes,    Routine Base:  $CODE$ + 0A12
```

```
;  1513          2319  1 %SBTTL  'key_search';
;  1514          2320  1 ROUTINE key_search (index_desc, index_block, key_desc, genpos, addpos) =
;  1515          2321  1
;  1516          2322  1 !---
;  1517          2323  1 !
;  1518          2324  1 !       This routine searches a specified index block using a binary
;  1519          2325  1 !       search and returns the position (offset) within the block
;  1520          2326  1 !       where the key should be added (if not found) or its exact
;  1521          2327  1 !       position (if found).
;  1522          2328  1 !
;  1523          2329  1 !       It is also used to run down the index tree to find a given
;  1524          2330  1 !       key by searching each index block and using the key found
;  1525          2331  1 !       generically using this routine to get to the next index block
;  1526          2332  1 !       to be searched (the child).
;  1527          2333  1 !
;  1528          2334  1 ! Inputs:
;  1529          2335  1 !
;  1530          2336  1 !       index_desc = Primary index descriptor
;  1531          2337  1 !       index_block = Address of the index block
;  1532          2338  1 !       key_desc = String descriptor of the key
;  1533          2339  1 !       genpos = Longword to receieve offset to the entry which is
;  1534          2340  1 !                       most generically close to the key.
;  1535          2341  1 !       addpos (optional) = Longword to receieve offset to position
;  1536          2342  1 !                       where the key should be added in the block.
;  1537          2343  1 !
;  1538          2344  1 ! Outputs:
;  1539          2345  1 !
;  1540          2346  1 !       genpos = Offset to generically closest entry.
;  1541          2347  1 !       addpos (if specified) = Offset to position to add key.
;  1542          2348  1 !
;  1543          2349  1 !       Routine value = true if key found, else false.
;  1544          2350  1 !---
;  1545          2351  1
;  1546          2352  2 BEGIN
;  1547          2353  2
;  1548          2354  2 MAP
;  1549          2355  2     index_desc: REF BBLOCK,                ! Index descriptor
;  1550          2356  2     index_block:        REF BBLOCK,        ! Address of index block
;  1551          2357  2     key_desc:           REF BBLOCK;        ! String descriptor
;  1552          2358  2
;  1553          2359  2 LOCAL
;  1554          2360  2     entry_size,                            ! Size of each index entry
;  1555          2361  2     test,                                  ! -1 (LSS), 0 (EQL), 1 (GTR)
;  1556          2362  2     min,                                   ! Lower search limit
;  1557          2363  2     max,                                   ! Upper search limit
;  1558          2364  2     i;                                     ! Current entry being searched
;  1559          2365  2
;  1560          2366  2 BUILTIN
;  1561          2367  2     NULLPARAMETER;              ! True if argument unspecified
;  1562          2368  2
;  1563          2369  2 MACRO
;  1564        M 2370  2     entry (i,b,p,s,e) =
;  1565          2371  2         index_block [index$c_entries+(i-1)*.entry_size+b,p,s,e]%;
;  1566          2372  2
;  1567          2373  2 entry_size = idx$c_length + .index_desc [idd$w_keylen];
;  1568          2374  2 min = 1;                                   ! Set min and max limits
;  1569          2375  2 max = .index_block [index$w_used]/.entry_size;
```

```
;  1570     2376  2
;  1571     2377  2 IF .max EQL 0                                ! If null index block,
;  1572     2378  2 THEN
;  1573     2379  3     BEGIN
;  1574     2380  3     i = 1;                                    ! Add at 1st slot
;  1575     2381  3     test = -1;                                ! No adjustment, key not found
;  1576     2382  3     END
;  1577     2383  2 ELSE
;  1578     2384  2 DO
;  1579     2385  3     BEGIN
;  1580     2386  3     i = (.min+.max) / 2;                      ! Calculate middle entry
;  1581     2387  3     IF .index_desc [idd$v_ascii]              ! If ASCII keys,
;  1582     2388  3     THEN
;  1583     2389  4         BEGIN
;  1584     2390  4         IF .index_desc [idd$v_upcasntry]
;  1585     2391  4         THEN
;  1586     2392  5             BEGIN
;  1587     2393  5             LOCAL
;  1588     2394  5                 entrynambuf : BBLOCK [lbr$c_maxkeylen];
;  1589     2395  5
;  1590     2396  5             moveto_upper_case ( .entry [.i,idx$b_keylen],
;  1591     2397  5                                 entry [.i,idx$t_keyname], entrynambuf);
;  1592     2398  5             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
;  1593     2399  5                 .key_desc [dsc$a_pointer],
;  1594     2400  5                 .entry [.i,idx$b_keylen],
;  1595     2401  5                 entrynambuf, 0);
;  1596     2402  5             END
;  1597     2403  4         ELSE
;  1598     2404  4             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
;  1599     2405  4                 .key_desc [dsc$a_pointer],
;  1600     2406  4                 .entry [.i,idx$b_keylen],
;  1601     2407  4                 entry [.i,idx$t_keyname],0);
;  1602     2408  4         END
;  1603     2409  3     ELSE
;  1604     2410  3         test = ..key_desc - .entry [.i, idx$l_keyid];
;  1605     2411  3     IF .test GTR 0
;  1606     2412  3     THEN
;  1607     2413  3         min = .i+1                            ! Set to upper half
;  1608     2414  3     ELSE
;  1609     2415  3         max = .i-1;                           ! Set to lower half
;  1610     2416  3     END
;  1611     2417  3
;  1612     2418  2     UNTIL (.test EQL 0) OR (.min GTR .max);
;  1613     2419  2
;  1614     2420  2 IF .test GTR 0                                ! If greater than last key
;  1615     2421  2 THEN
;  1616     2422  2     i = .i+1;                                 ! then point after last key
;  1617     2423  2
;  1618     2424  2 IF NOT NULLPARAMETER(5)                       ! If add position specified,
;  1619     2425  2 THEN
;  1620     2426  2     .addpos = (.i-1) * .entry_size;           ! Return offset where to add key
;  1621     2427  2 !
;  1622     2428  2 !       If the add position points past the end of the block,
;  1623     2429  2 !       then adjust the closest entry to point to the last entry
;  1624     2430  2 !       in the block so that add_key has a block to insert the
;  1625     2431  2 !       key into.  Note that if the block is empty, return -1.
;  1626     2432  2 !
```

```
;  1627          2433  2 .genpos = (.i-1) * .entry_size;          ! Return offset to closest entry
;  1628          2434  2 IF ..genpos GEQU .index_block [index$w_used] ! If over block,
;  1629          2435  2 THEN
;  1630          2436  2     .genpos = ..genpos - .entry_size;    ! Set to last entry in block
;  1631          2437  2
;  1632          2438  2 RETURN .test EQL 0;                      ! True if key found
;  1633          2439  2
;  1634          2440  1 END;


                                    0FFC 00000 KEY_SEARCH:
                                                .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2320
                          5E      FF7C    CE  9E 00002        MOVAB   -132(SP), SP                      ;
                          5B        04    AC  D0 00007        MOVL    INDEX_DESC, R11                   ; 2373
                          7E        02    AB  3C 0000B        MOVZWL  2(R11), ENTRY_SIZE                ;
                          6E              06  C0 0000F        ADDL2   #6, ENTRY_SIZE                    ;
                          54              01  D0 00012        MOVL    #1, MIN                           ; 2374
                          59        08    BC  3C 00015        MOVZWL  @INDEX_BLOCK, MAX                 ; 2375
                          59              6E  C6 00019        DIVL2   ENTRY_SIZE, MAX                   ;
                                          09  12 0001C        BNEQ    1$                                ; 2377
                          55              01  D0 0001E        MOVL    #1, I                             ; 2380
                          5A              01  CE 00021        MNEGL   #1, TEST                          ; 2381
                                        0088  31 00024        BRW     9$                                ; 2377
                    50    54              59  C1 00027 1$:    ADDL3   MAX, MIN, R0                      ; 2386
                    55    50              02  C7 0002B        DIVL3   #2, R0, I                         ;
                                04    AE    FF  A5 9E 0002F   MOVAB   -1(R5), 4(SP)                    ; 2397
                    50          04    AE      6E C5 00034     MULL3   ENTRY_SIZE, 4(SP), R0             ;
                    56          50    08      AC C1 00039     ADDL3   INDEX_BLOCK, R0, R6               ; 2396
                                50    6B      E9 0003E        BLBC    (R11), 5$                         ; 2387
                    57          50    08      AC C1 00041     ADDL3   INDEX_BLOCK, R0, R7               ; 2397
                                53    0C      AC D0 00046     MOVL    KEY_DESC, R3                      ; 2399
                    29          6B            05 E1 0004A     BBC     #5, (R11), 3$                     ; 2390
                                52    08      AE 9E 0004E     MOVAB   ENTRYNAMBUF, R2                   ; 2397
                                51    13      A7 9E 00052     MOVAB   19(R7), R1                        ;
                                50    12      A6 9A 00056     MOVZBL  18(R6), R0                        ;
                                      0000G   30 0005A        BSBW    MOVETO_UPPER_CASE                 ;
                                50    12      A6 9A 0005D     MOVZBL  18(R6), R0                        ; 2400
                                56            01 D0 00061     MOVL    #1, R6                            ; 2398
              50    00    04    B3      0C BC 2D 00064        CMPC5   @KEY_DESC, @4(R3), #0, R0, ENTRYNAMBUF    ;
                                      08    AE 0006B          
                                            03 1A 0006D     BGTRU   2$                                ;
                                56          01 D9 0006F     SBWC    #1, R6                            ;
                                5A          56 D0 00072 2$: MOVL    R6, TEST                          ;
                                            20 11 00075     BRB     6$                                ; 2390
                                50    12      A6 9A 00077 3$: MOVZBL  18(R6), R0                        ; 2406
                                58          01 D0 0007B     MOVL    #1, R8                            ; 2407
              50    00    04    B3      0C BC 2D 0007E        CMPC5   @KEY_DESC, @4(R3), #0, R0, 19(R7)     ;
                                      13    A7 00085          
                                            03 1A 00087     BGTRU   4$                                ;
                                58          01 D9 00089     SBWC    #1, R8                            ;
                                5A          58 D0 0008C 4$: MOVL    R8, TEST                          ;
                                            06 11 0008F     BRB     6$                                ; 2387
                    5A    0C    BC      12  A6 C3 00091 5$: SUBL3   18(R6), @KEY_DESC, TEST           ; 2410
                                            06 15 00097 6$: BLEQ    7$                                ; 2411
```

```
                                54       01    A5  9E 00099          MOVAB   1(R5), MIN                                    ; 2413
                                                04  11 0009D          BRB     8$
                                59       04    AE  D0 0009F 7$:     MOVL    4(SP), MAX                                  ; 2415
                                                5A  D5 000A3 8$:     TSTL    TEST                                        ; 2418
                                                08  13 000A5          BEQL    9$
                                59              54  D1 000A7          CMPL    MIN, MAX
                                                03  14 000AA          BGTR    9$
                                                FF78 31 000AC         BRW     1$
                                                5A  D5 000AF 9$:      TSTL    TEST                                        ; 2420
                                                02  15 000B1          BLEQ    10$
                                                55  D6 000B3          INCL    I                                           ; 2422
                                05              6C  91 000B5 10$:     CMPB    (AP), #5                                    ; 2424
                                                0E  1F 000B8          BLSSU   11$
                                            14  AC  D5 000BA          TSTL    20(AP)
                                                09  13 000BD          BEQL    11$
                                50          FF  A5  9E 000BF          MOVAB   -1(R5), R0                                  ; 2426
                    14  BC      50              6E  C5 000C3          MULL3   ENTRY_SIZE, R0, @ADDPOS
                                                55  D7 000C8 11$:     DECL    R5                                          ; 2433
                    10  BC      55              6E  C5 000CA          MULL3   ENTRY_SIZE, R5, @GENPOS
        10  BC      08  BC      10              00  ED 000CF          CMPZV   #0, #16, @INDEX_BLOCK, @GENPOS              ; 2434
                                                04  1A 000D6          BGTRU   12$
                        10  BC                  6E  C2 000D8          SUBL2   ENTRY_SIZE, @GENPOS                         ; 2436
                                                50  D4 000DC 12$:     CLRL    R0                                          ; 2438
                                                5A  D5 000DE          TSTL    TEST
                                                02  12 000E0          BNEQ    13$
                                                50  D6 000E2          INCL    R0
                                                    04 000E4 13$:     RET                                                 ; 2440

; Routine Size:  229 bytes,    Routine Base:  $CODE$ + 0AEA
```

```
;1636     2441  1 %SBTTL  'key_search2';
;1637     2442  1 ROUTINE key_search2 (index_desc, index_block, key_desc, genpos, addpos) =
;1638     2443  1
;1639     2444  1 !---
;1640     2445  1 !
;1641     2446  1 !       Key_search2 is a modified key_search to handle indices with
;1642     2447  1 !       variable length keywords.
;1643     2448  1 !       This routine searches a specified index block using a sequential
;1644     2449  1 !       search and returns the position (offset) within the block
;1645     2450  1 !       where the key should be added (if not found) or its exact
;1646     2451  1 !       position (if found).
;1647     2452  1 !
;1648     2453  1 !       It is also used to run down the index tree to find a given
;1649     2454  1 !       key by searching each index block and using the key found
;1650     2455  1 !       generically using this routine to get to the next index block
;1651     2456  1 !       to be searched (the child).
;1652     2457  1 !
;1653     2458  1 ! Inputs:
;1654     2459  1 !
;1655     2460  1 !       index_desc = Primary index descriptor
;1656     2461  1 !       index_block = Address of the index block
;1657     2462  1 !       key_desc = String descriptor of the key
;1658     2463  1 !       genpos = Longword to receieve offset to the entry which is
;1659     2464  1 !                       most generically close to the key.
;1660     2465  1 !       addpos (optional) = Longword to receieve offset to position
;1661     2466  1 !                       where the key should be added in the block.
;1662     2467  1 !
;1663     2468  1 ! Outputs:
;1664     2469  1 !
;1665     2470  1 !       genpos = Offset to generically closest entry.
;1666     2471  1 !       addpos (if specified) = Offset to position to add key.
;1667     2472  1 !
;1668     2473  1 !       Routine value = true if key found, else false.
;1669     2474  1 !---
;1670     2475  1
;1671     2476  2 BEGIN
;1672     2477  2
;1673     2478  2 MAP
;1674     2479  2     index_desc: REF BBLOCK,                 ! Index descriptor
;1675     2480  2     index_block:        REF BBLOCK,         ! Address of index block
;1676     2481  2     key_desc:           REF BBLOCK;         ! String descriptor
;1677     2482  2
;1678     2483  2 LOCAL
;1679     2484  2     entry_size,                             ! Size of each index entry
;1680     2485  2     test,                                   ! -1 (LSS), 0 (EQL), 1 (GTR)
;1681     2486  2     max,                                    ! offset to end of used index
;1682     2487  2     last_entry,                             ! offset to last entry examined
;1683     2488  2     cur_entry;                              ! offset to current entry examined
;1684     2489  2
;1685     2490  2 BUILTIN
;1686     2491  2     NULLPARAMETER;              ! True if argument unspecified
;1687     2492  2
;1688     2493  2 MACRO
;1689   M 2494  2     entry (i,b,p,s,e) =
;1690     2495  2         index_block [index$c_entries+i+b,p,s,e]%;
;1691     2496  2
;1692     2497  2 IF NOT .index_desc [idd$v_ascii]          ! If not ASCII keys,
```

```
;  1693     2498  2 THEN
;  1694     2499  2     RETURN lbr$_intrnlerr;                ! key_search2 only for ASCII keys
;  1695     2500  2
;  1696     2501  2 max = .index_block [index$w_used];
;  1697     2502  2 test = 1;                                 ! Pre set to key not found
;  1698     2503  2 last_entry = 0;                           ! pre_set to first entry
;  1699     2504  2 cur_entry = 0;                            ! pre_set to first entry
;  1700     2505  2
;  1701     2506  2 IF .max EQL 0                             ! If null index block,
;  1702     2507  2 THEN
;  1703     2508  3     BEGIN
;  1704     2509  3     test = -1;
;  1705     2510  3     END
;  1706     2511  2 ELSE
;  1707     2512  3     BEGIN
;  1708     2513  3     WHILE (.test GTR 0) AND (.cur_entry LSS .max) DO
;  1709     2514  4         BEGIN
;  1710     2515  4         IF .index_desc [idd$v_upcasntry]
;  1711     2516  4         THEN
;  1712     2517  5             BEGIN
;  1713     2518  5             LOCAL
;  1714     2519  5                 entrynambuf : BBLOCK [lbr$c_maxkeylen];
;  1715     2520  5
;  1716     2521  5             moveto_upper_case (.entry [.cur_entry,idx$b_keylen],
;  1717     2522  5                                entry [.cur_entry,idx$t_keyname], entrynambuf);
;  1718     2523  5
;  1719     2524  5             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
;  1720     2525  5                 .key_desc [dsc$a_pointer],
;  1721     2526  5                 .entry [.cur_entry,idx$b_keylen],
;  1722     2527  5                 entrynambuf, 0)
;  1723     2528  5             END
;  1724     2529  4         ELSE
;  1725     2530  4             test = CH$COMPARE(.key_desc [dsc$w_length], ! Compare ASCII keys
;  1726     2531  4                 .key_desc [dsc$a_pointer],
;  1727     2532  4                 .entry [.cur_entry,idx$b_keylen],
;  1728     2533  4                 entry [.cur_entry,idx$t_keyname],0);
;  1729     2534  5         IF (.test GTR  0)
;  1730     2535  4         THEN
;  1731     2536  5             BEGIN
;  1732     2537  5             last_entry = .cur_entry;
;  1733     2538  5             cur_entry = .cur_entry + idx$c_rfaplsbyt + .entry[.cur_entry,idx$b_keylen];
;  1734     2539  4             END;
;  1735     2540  3         END;                ! While
;  1736     2541  2     END;
;  1737     2542  2
;  1738     2543  2 IF NOT NULLPARAMETER(5)                   ! If add position specified,
;  1739     2544  2 THEN
;  1740     2545  2     .addpos = .cur_entry;       ! Return offset where to add key
;  1741     2546  2 !
;  1742     2547  2 !       If the add position points past the end of the block,
;  1743     2548  2 !       then adjust the closest entry to point to the last entry
;  1744     2549  2 !       in the block so that add_key has a block to insert the
;  1745     2550  2 !       key into.  Note that if the block is empty, return -1.
;  1746     2551  2 !
;  1747     2552  2 .genpos = .cur_entry;               ! Return offset to closest entry
;  1748     2553  2 IF ..genpos GEQU .index_block [index$w_used] ! If over block,
;  1749     2554  2 THEN
```

```
;  1750          2555  2      .genpos = .last_entry;      ! Set to last entry in block
;  1751          2556  2
;  1752          2557  2  !
;  1753          2558  2  ! Must propagate actual length of actual index entry string
;  1754          2559  2  !       back to caller
;  1755          2560  2  !
;  1756          2561  2  IF .test EQL 0
;  1757          2562  2  THEN
;  1758          2563  3      BEGIN
;  1759          2564  3      key_desc[dsc$w_length] = .entry[.cur_entry,idx$b_keylen];
;  1760          2565  3      RETURN true;
;  1761          2566  3      END
;  1762          2567  2  ELSE
;  1763          2568  2      RETURN false;
;  1764          2569  2
;  1765          2570  1  END;


                                    0FFC 00000 KEY_SEARCH2:
                                                       .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2442
                                5E        80    AE   9E 00002          MOVAB   -128(SP), SP                  ;
                                08        04    BC   E8 00006          BLBS    @INDEX_DESC, 1$               ; 2497
                                50 00000000G    8F   D0 0000A          MOVL    #LBR$_INTRNLERR, R0           ; 2499
                                                04   00011          RET                                   ;
                                5A        08    BC   3C 00012 1$:      MOVZWL  @INDEX_BLOCK, MAX             ; 2501
                                59              01   D0 00016          MOVL    #1, TEST                      ; 2502
                                                5B   D4 00019          CLRL    LAST_ENTRY                    ; 2503
                                                57   D4 0001B          CLRL    CUR_ENTRY                     ; 2504
                                                5A   D5 0001D          TSTL    MAX                           ; 2506
                                                05   12 0001F          BNEQ    2$                            ;
                                59              01   CE 00021          MNEGL   #1, TEST                      ; 2509
                                                66   11 00024          BRB     8$                            ; 2506
                                56        0C    AC   D0 00026 2$:      MOVL    KEY_DESC, R6                  ; 2525
                                                59   D5 0002A 3$:      TSTL    TEST                          ; 2513
                                                5E   15 0002C          BLEQ    8$                            ;
                                5A              57   D1 0002E          CMPL    CUR_ENTRY, MAX                ;
                                                59   18 00031          BGEQ    8$                            ;
                          54              57    08   AC   C1 00033          ADDL3   INDEX_BLOCK, CUR_ENTRY, R4    ; 2522
                          53              57    08   AC   C1 00038          ADDL3   INDEX_BLOCK, CUR_ENTRY, R3    ; 2521
                          26        04    BC         05   E1 0003D          BBC     #5, @INDEX_DESC, 5$           ; 2515
                                          52         6E   9E 00042          MOVAB   ENTRYNAMBUF, R2               ; 2522
                                          51    13   A4   9E 00045          MOVAB   19(R4), R1                    ;
                                          55    12   A3   9A 00049          MOVZBL  18(R3), R5                    ; 2521
                                          50         55   D0 0004D          MOVL    R5, R0                        ; 2522
                                                0000G 30   00050          BSBW    MOVETO_UPPER_CASE             ;
                                          54         01   D0 00053          MOVL    #1, R4                        ; 2524
55                        00        04    B6         0C   BC   2D 00056          CMPC5   @KEY_DESC, @4(R6), #0, R5, ENTRYNAMBUF
                                                      6E   0005D          ;
                                                      03   1A 0005E          BGTRU   4$                            ;
                                          54         01   D9 00060          SBWC    #1, R4                        ;
                                          59         54   D0 00063 4$:      MOVL    R4, TEST                      ;
                                                      18   11 00066          BRB     7$                            ;
                                          55    12   A3   9A 00068 5$:      MOVZBL  18(R3), R5                    ; 2532
                                          58         01   D0 0006C          MOVL    #1, R8                        ; 2533
```

```
        55          00     04   B6     0C  BC  2D 0006F        CMPC5   @KEY_DESC, @4(R6), #0, R5, 19(R4)        ;
                                       13  A4     00076                                                           ;
                                           03  1A 00078        BGTRU   6$                                         ;
                                58         01  D9 0007A        SBWC    #1, R8                                     ;
                                59         58  D0 0007D 6$:    MOVL    R8, TEST                                   ;
                                           A8  15 00080 7$:    BLEQ    3$                                         ; 2534
                                5B         57  D0 00082        MOVL    CUR_ENTRY, LAST_ENTRY                      ; 2537
                                57    07 A547  9E 00085        MOVAB   7(R5)[CUR_ENTRY], CUR_ENTRY                ; 2538
                                           9E  11 0008A        BRB     3$                                         ; 2513
                                05         6C  91 0008C 8$:    CMPB    (AP), #5                                   ; 2543
                                           09  1F 0008F        BLSSU   9$                                         ;
                                      14   AC  D5 00091        TSTL    20(AP)                                     ;
                                           04  13 00094        BEQL    9$                                         ;
                         14     BC         57  D0 00096        MOVL    CUR_ENTRY, @ADDPOS                         ; 2545
                         10     BC         57  D0 0009A 9$:    MOVL    CUR_ENTRY, @GENPOS                         ; 2552
    10   BC        08    BC            10  00  ED 0009E        CMPZV   #0, #16, @INDEX_BLOCK, @GENPOS             ; 2553
                                           04  1A 000A5        BGTRU   10$                                        ;
                         10     BC         5B  D0 000A7        MOVL    LAST_ENTRY, @GENPOS                        ; 2555
                                           59  D5 000AB 10$:   TSTL    TEST                                       ; 2561
                                           0E  12 000AD        BNEQ    11$                                        ;
                    50          57    08   AC  C1 000AF        ADDL3   INDEX_BLOCK, CUR_ENTRY, R0                 ; 2564
                         0C     BC    12   A0  9B 000B4        MOVZBW  18(R0), @KEY_DESC                          ;
                                50         01  D0 000B9        MOVL    #1, R0                                     ; 2568
                                               04 000BC        RET                                                ;
                                           50  D4 000BD 11$:   CLRL    R0                                         ;
                                               04 000BF        RET                                                ; 2570

; Routine Size:  192 bytes,    Routine Base:  $CODE$ + 0BCF
```

```
;  1767          2571  1 %SBTTL  'find_index';
;  1768          2572  1 GLOBAL ROUTINE find_index (vbn, address) : JSB_2 =
;  1769          2573  1
;  1770          2574  1 !---
;  1771          2575  1 !       This routine locates a specific block in the library
;  1772          2576  1 !       file and returns the address of the block in memory
;  1773          2577  1 !       If the block is not currently cached in memory, it
;  1774          2578  1 !       will be automatically read from disk and added to the
;  1775          2579  1 !       cache.
;  1776          2580  1 !
;  1777          2581  1 ! Inputs:
;  1778          2582  1 !
;  1779          2583  1 !       vbn = requested block number in file
;  1780          2584  1 !       address = Longword to receive address of block
;  1781          2585  1 !
;  1782          2586  1 ! Outputs:
;  1783          2587  1 !
;  1784          2588  1 !       address = Address of block in memory
;  1785          2589  1 !---
;  1786          2590  1
;  1787          2591  2 BEGIN
;  1788          2592  2
;  1789          2593  2 BIND
;  1790          2594  2     header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
;  1791          2595  2
;  1792          2596  2 LOCAL
;  1793          2597  2     status,
;  1794          2598  2     cache_entry: REF BBLOCK;            ! Current cache entry address
;  1795          2599  2
;  1796          2600  2 status = lookup_cache(.vbn, cache_entry); ! Lookup block in cache
;  1797          2601  2
;  1798          2602  2 IF .status                               ! If found,
;  1799          2603  2 THEN
;  1800          2604  3     BEGIN
;  1801          2605  3     .address = .cache_entry [cache$l_address];  ! Return address
;  1802          2606  3     RETURN true;
;  1803          2607  2     END;
;  1804          2608  2
;  1805          2609  2 !
;  1806          2610  2 ! Attempt to read in multiple blocks if vbn is in the pre-allocated index
;  1807          2611  2 !
;  1808          2612  2 IF .vbn LEQU .header[lhd$l_hiprusd]
;  1809          2613  3 THEN BEGIN
;  1810        P 2614  3     perform (read_n_block (.vbn, MIN (.lbr$gl_maxidxrd, !Read in some index blocks
;  1811          2615  3                           (.header [lhd$l_hiprusd] - .vbn + 1))));
;  1812          2616  3     perform(find_index(.vbn, .address));        !Recurse to lookup in cache
;  1813          2617  3     END
;  1814          2618  3 ELSE BEGIN
;  1815          2619  3     perform(read_block(.vbn,.address)); ! Read from disk
;  1816          2620  3
;  1817          2621  3     perform (add_cache (.vbn, cache_entry));! Add cache list entry
;  1818          2622  3     cache_entry [cache$l_address] = ..address;
;  1819          2623  3
;  1820          2624  2     END;
;  1821          2625  2
;  1822          2626  2 RETURN true;
;  1823          2627  2
```

```
; 1824          2628  1 END;


                                1C  BB 00000 FIND_INDEX::
                                                 PUSHR   #^M<R2,R3,R4>                           ; 2572
                             5E                  04  C2 00002         SUBL2   #4, SP                          ;
                             53                  50  7D 00005         MOVQ    R0, R3                          ;
                             50          0000G   CF  D0 00008         MOVL    LBR$GL_CONTROL, R0              ; 2594
                             52            0A    A0  D0 0000D         MOVL    10(R0), R2                      ;
                             51                  6E  9E 00011         MOVAB   CACHE_ENTRY, R1                 ; 2600
                             50                  53  D0 00014         MOVL    VBN, R0                         ;
                                             0000G 30  00017         BSBW    LOOKUP_CACHE                    ;
                                09               50  E9 0001A         BLBC    STATUS, 1$                      ; 2602
                                50               6E  D0 0001D         MOVL    CACHE_ENTRY, R0                 ; 2605
                                64         08    A0  D0 00020         MOVL    8(R0), (ADDRESS)                ;
                                                 4B  11 00024         BRB     4$                              ; 2606
                          62    A2               53  D1 00026 1$:     CMPL    VBN, 98(R2)                     ; 2612
                                                 29  1A 0002A         BGTRU   3$                              ;
                       52 62    A2               53  C3 0002C         SUBL3   VBN, 98(R2), R2                 ; 2615
                                50           01  A2  9E 00031         MOVAB   1(R2), R0                       ;
                                51      0000G    CF  D0 00035         MOVL    LBR$GL_MAXIDXRD, R1             ;
                                50               51  D1 0003A         CMPL    R1, R0                          ;
                                                 03  15 0003D         BLEQ    2$                              ;
                                51               50  D0 0003F         MOVL    R0, R1                          ;
                                50               53  D0 00042 2$:     MOVL    VBN, R0                         ;
                                             0000G 30  00045         BSBW    READ_N_BLOCK                    ;
                                29               50  E9 00048         BLBC    STATUS, 5$                      ;
                                50               53  7D 0004B         MOVQ    VBN, R0                         ; 2616
                                                 B0  10 0004E         BSBB    FIND_INDEX                      ;
                                1E               50  E8 00050         BLBS    STATUS, 4$                      ;
                                                 1F  11 00053         BRB     5$                              ;
                                50               53  7D 00055 3$:     MOVQ    VBN, R0                         ; 2619
                                             0000G 30  00058         BSBW    READ_BLOCK                      ;
                                16               50  E9 0005B         BLBC    STATUS, 5$                      ;
                                51               6E  9E 0005E         MOVAB   CACHE_ENTRY, R1                 ; 2621
                                50               53  D0 00061         MOVL    VBN, R0                         ;
                                             0000G 30  00064         BSBW    ADD_CACHE                       ;
                                0A               50  E9 00067         BLBC    STATUS, 5$                      ;
                                50               6E  D0 0006A         MOVL    CACHE_ENTRY, R0                 ; 2622
                             08 A0               64  D0 0006D         MOVL    (ADDRESS), 8(R0)                ;
                                50               01  D0 00071 4$:     MOVL    #1, R0                          ; 2626
                                5E               04  C0 00074 5$:     ADDL2   #4, SP                          ; 2628
                                                 1C  BA 00077         POPR    #^M<R2,R3,R4>                   ;
                                                     05 00079         RSB                                     ;

; Routine Size:  122 bytes,    Routine Base:  $CODE$ + 0C8F
```

```
;  1826          2629  1 %SBTTL  'create_index';
;  1827          2630  1 ROUTINE create_index (vbn, address) =
;  1828          2631  1 !---
;  1829          2632  1 !
;  1830          2633  1 !       This routine allocates a new index block in the file,
;  1831          2634  1 !       initializes it, and returns the rfa and address.
;  1832          2635  1 !
;  1833          2636  1 ! Inputs:
;  1834          2637  1 !
;  1835          2638  1 !       None
;  1836          2639  1 !
;  1837          2640  1 ! Outputs:
;  1838          2641  1 !
;  1839          2642  1 !       vbn = VBN of newly allocated index block
;  1840          2643  1 !       address = Address of index block in memory
;  1841          2644  1 !---
;  1842          2645  1
;  1843          2646  2 BEGIN
;  1844          2647  2
;  1845          2648  2 BIND
;  1846          2649  2     context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK,
;  1847          2650  2     header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
;  1848          2651  2
;  1849          2652  2 LOCAL
;  1850          2653  2     cache_entry: REF BBLOCK;    ! New cache entry address
;  1851          2654  2
;  1852          2655  2 !
;  1853          2656  2 ! Allocate block from index cache if possible
;  1854          2657  2 !
;  1855          2658  2 IF .header[lhd$l_freeidx] NEQ 0
;  1856          2659  3 THEN BEGIN
;  1857          2660  3     LOCAL
;  1858          2661  3         buffer : REF VECTOR[,LONG];
;  1859          2662  3
;  1860          2663  3     perform(find_block(.header[lhd$l_freeidx], .address, cache_entry));
;  1861          2664  3     buffer = ..address;
;  1862          2665  3     .vbn = .header[lhd$l_freeidx];
;  1863          2666  3     header[lhd$l_freeidx] = .buffer[0];
;  1864          2667  3     CH$FILL(0, idx$c_length, .buffer);
;  1865          2668  3     header[lhd$l_freidxblk] = .header[lhd$l_freidxblk] - 1;
;  1866          2669  3     IF ..vbn GTRU .header[lhd$l_hiprusd]
;  1867          2670  3         THEN header[lhd$l_hiprusd] = ..vbn;
;  1868          2671  3     END
;  1869          2672  3 ELSE BEGIN
;  1870          2673  3     perform(alloc_block(.vbn, .address));       ! Allocate a disk block
;  1871          2674  3 !
;  1872          2675  3 !       Add the allocated block to the index cache
;  1873          2676  3 !
;  1874          2677  3     perform (add_cache (..vbn, cache_entry));! Add block to cache list
;  1875          2678  3     cache_entry [cache$l_address] = ..address;
;  1876          2679  3 !
;  1877          2680  3 !       Initialize the index block
;  1878          2681  3 !
;  1879          2682  4     BEGIN
;  1880          2683  4         BIND
;  1881          2684  4             index_block = ..address: BBLOCK;    ! Address index block
;  1882          2685  4
```

```
;  1883          2686  4          index_block [index$w_used] = 0;          ! No space used initially
;  1884          2687  3      END;
;  1885          2688  2  END;
;  1886          2689  2  mark_dirty(..vbn);                          ! Mark index block modified
;  1887          2690  2
;  1888          2691  2  header[lhd$l_idxblks] = .header[lhd$l_idxblks] + 1;      ! Count another index block
;  1889          2692  2
;  1890          2693  2  context [ctx$v_hdrdirty] = true;                  ! Mark header dirty
;  1891          2694  2
;  1892          2695  2  RETURN true;
;  1893          2696  2
;  1894          2697  1  END;


                                 0FFC 00000 CREATE_INDEX:
                                            .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2630
                              5E        04  C2 00002          SUBL2   #4, SP                       ;
                              50  0000G   CF  D0 00005          MOVL    LBR$GL_CONTROL, R0           ; 2649
                              58    0E    A0  D0 0000A          MOVL    14(R0), R8                   ;
                              56    0A    A0  D0 0000E          MOVL    10(R0), R6                   ; 2650
                              57    04    AC  D0 00012          MOVL    VBN, R7                      ; 2665
                              53    5A    A6  D0 00016          MOVL    90(R6), R3                   ; 2658
                                          33  13 0001A          BEQL    1$                           ;
                              52          6E  9E 0001C          MOVAB   CACHE_ENTRY, R2              ; 2663
                              51    08    AC  D0 0001F          MOVL    ADDRESS, R1                  ;
                              50          53  D0 00023          MOVL    R3, R0                       ;
                                    0000G 30  00026          BSBW    FIND_BLOCK                   ;
                              5D          50  E9 00029          BLBC    STATUS, 3$                   ;
                              50    08    BC  D0 0002C          MOVL    @ADDRESS, BUFFER             ; 2664
                              67          53  D0 00030          MOVL    R3, (R7)                     ; 2665
                           5A     A6          60  D0 00033          MOVL    (BUFFER), 90(R6)             ; 2666
06                   00     6E              00  2C 00037          MOVC5   #0, (SP), #0, #6, (BUFFER)   ; 2667
                                            60      0003C                                            ;
                              56    A6  D7 0003D          DECL    86(R6)                       ; 2668
                              52        67  D0 00040          MOVL    (R7), R2                     ; 2669
                           62     A6        52  D1 00043          CMPL    R2, 98(R6)                   ;
                                            30  1B 00047          BLEQU   2$                           ;
                           62     A6        52  D0 00049          MOVL    R2, 98(R6)                   ; 2670
                                            2A  11 0004D          BRB     2$                           ; 2658
                              51    08    AC  D0 0004F  1$:       MOVL    ADDRESS, R1                  ; 2673
                              50          57  D0 00053          MOVL    R7, R0                       ;
                                    0000G 30  00056          BSBW    ALLOC_BLOCK                  ;
                              2D          50  E9 00059          BLBC    STATUS, 3$                   ;
                              51          6E  9E 0005C          MOVAB   CACHE_ENTRY, R1              ; 2677
                              52          67  D0 0005F          MOVL    (R7), R2                     ;
                              50          52  D0 00062          MOVL    R2, R0                       ;
                                    0000G 30  00065          BSBW    ADD_CACHE                    ;
                              1E          50  E9 00068          BLBC    STATUS, 3$                   ;
                              50          6E  D0 0006B          MOVL    CACHE_ENTRY, R0              ; 2678
                           08     A0    08  BC D0 0006E          MOVL    @ADDRESS, 8(R0)              ;
                              50    08    BC  D0 00073          MOVL    @ADDRESS, R0                 ; 2684
                                          60  B4 00077          CLRW    (R0)                         ; 2686
                              50          52  D0 00079  2$:       MOVL    R2, R0                       ; 2689
                                    0000V 30  0007C          BSBW    MARK_DIRTY                   ;
```

```
                          66   A6  D6 0007F          INCL    102(R6)                          ; 2691
                    04    A8     08  88 00082       BISB2   #8, 4(R8)                       ; 2693
                          50     01  D0 00086       MOVL    #1, R0                           ; 2695
                                 04 00089 3$:      RET                                      ; 2697

; Routine Size:  138 bytes,    Routine Base:  $CODE$ + 0D09
```

```
;  1896          2698  1 %SBTTL  'delete_index';
;  1897          2699  1 ROUTINE delete_index (vbn) =
;  1898          2700  1
;  1899          2701  1 !---
;  1900          2702  1 !
;  1901          2703  1 !       Deallocate the memory used by an index block and
;  1902          2704  1 !       remove the cache entry.
;  1903          2705  1 !
;  1904          2706  1 ! Inputs:
;  1905          2707  1 !
;  1906          2708  1 !       vbn = VBN of index block to delete.
;  1907          2709  1 !
;  1908          2710  1 ! Outputs:
;  1909          2711  1 !
;  1910          2712  1 !       None
;  1911          2713  1 !---
;  1912          2714  1
;  1913          2715  2 BEGIN
;  1914          2716  2
;  1915          2717  2 BIND
;  1916          2718  2     context = .lbr$gl_control[lbr$l_ctxptr] : BBLOCK,
;  1917          2719  2     header = .lbr$gl_control[lbr$l_hdrptr] : BBLOCK;
;  1918          2720  2
;  1919          2721  2 LOCAL
;  1920          2722  2     blockaddr : REF VECTOR[,LONG],
;  1921          2723  2     status,
;  1922          2724  2     cache_entry : REF BBLOCK;
;  1923          2725  2
;  1924          2726  2 perform(find_block(.vbn, blockaddr, cache_entry));      !Get block in memory
;  1925          2727  2 IF .vbn LEQU .header[lhd$l_hipreal]
;  1926          2728  3 THEN BEGIN
;  1927          2729  3     blockaddr[0] = .header[lhd$l_freeidx];
;  1928          2730  3     header[lhd$l_freeidx] = .vbn;
;  1929          2731  3     header[lhd$l_freidxblk] = .header[lhd$l_freidxblk] + 1;
;  1930          2732  3     cache_entry[cache$v_dirty] = true;
;  1931          2733  3     END
;  1932          2734  2 ELSE perform (dealloc_block (.vbn));             ! Just deallocate block
;  1933          2735  2
;  1934          2736  2 header[lhd$l_idxblks] = .header[lhd$l_idxblks] - 1;
;  1935          2737  2
;  1936          2738  2 context [ctx$v_hdrdirty] = true;                 ! Mark header dirty
;  1937          2739  2 RETURN true;
;  1938          2740  2
;  1939          2741  1 END;


                                OFFC 00000 DELETE_INDEX:
                                           .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2699
5E                        08    C2 00002         SUBL2   #8, SP                                ;
50          0000G         CF    D0 00005         MOVL    LBR$GL_CONTROL, R0                    ; 2718
53            0A          A0    7D 0000A         MOVQ    10(R0), R3                            ; 2719
52                        6E    9E 0000E         MOVAB   CACHE_ENTRY, R2                       ; 2726
51            04          AE    9E 00011         MOVAB   BLOCKADDR, R1                         ;
50            04          AC    D0 00015         MOVL    VBN, R0                               ;
```

```
                                    0000G 30 00019          BSBW    FIND_BLOCK                                      ;
                                 31   50 E9 0001C          BLBC    STATUS, 3$                                      ;
                              5E A3   04 AC D1 0001F          CMPL    VBN, 94(R3)                                     ; 2727
                                      16 1A 00024          BGTRU   1$                                              ;
                              04 BE   5A A3 D0 00026          MOVL    90(R3), @BLOCKADDR                              ; 2729
                              5A A3   04 AC D0 0002B          MOVL    VBN, 90(R3)                                     ; 2730
                                      56 A3 D6 00030          INCL    86(R3)                                          ; 2731
                                 50   6E D0 00033          MOVL    CACHE_ENTRY, R0                                 ; 2732
                              0C A0      01 88 00036          BISB2   #1, 12(R0)                                      ;
                                         0A 11 0003A          BRB     2$                                              ; 2727
                                 50   04 AC D0 0003C 1$:     MOVL    VBN, R0                                         ; 2734
                                    0000G 30 00040          BSBW    DEALLOC_BLOCK                                   ;
                                 0A   50 E9 00043          BLBC    STATUS, 3$                                      ;
                                      66 A3 D7 00046 2$:     DECL    102(R3)                                         ; 2736
                              04 A4      08 88 00049          BISB2   #8, 4(R4)                                       ; 2738
                                 50      01 D0 0004D          MOVL    #1, R0                                          ; 2739
                                         04 00050 3$:        RET                                                     ; 2741

; Routine Size:  81 bytes,    Routine Base:  $CODE$ + 0D93
```

```
;  1941          2742  1 %SBTTL  'add_index';
;  1942          2743  1 ROUTINE add_index (index, vbn, index_block) =
;  1943          2744  1
;  1944          2745  1 !---
;  1945          2746  1 !
;  1946          2747  1 !       Create a key which points to the specified index block
;  1947          2748  1 !       in the parent index block.  The highest key in the
;  1948          2749  1 !       current block is used as the key value.
;  1949          2750  1 !
;  1950          2751  1 ! Inputs:
;  1951          2752  1 !
;  1952          2753  1 !       vbn = VBN of the index block
;  1953          2754  1 !       index = Primary index number
;  1954          2755  1 !
;  1955          2756  1 ! Outputs:
;  1956          2757  1 !
;  1957          2758  1 !       None
;  1958          2759  1 !---
;  1959          2760  1
;  1960          2761  2 BEGIN
;  1961          2762  2
;  1962          2763  2 MAP
;  1963          2764  2     index_block: REF BBLOCK;              ! Address of index block
;  1964          2765  2
;  1965          2766  2 LOCAL
;  1966          2767  2     entry_size,                           ! Size of each entry
;  1967          2768  2     last_entry: REF BBLOCK,               ! Last index entry in block
;  1968          2769  2     index_desc: REF BBLOCK,               ! Address of index descriptor
;  1969          2770  2     rfa: BBLOCK [rfa$c_length];           ! RFA to be associated with key
;  1970          2771  2
;  1971          2772  2
;  1972          2773  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
;  1973          2774  2                 + (.index-1)*idd$c_length;
;  1974          2775  2 !
;  1975          2776  2 !       Find the last entry in the index block.
;  1976          2777  2 !
;  1977          2778  2 entry_size = idx$c_length + .index_desc [idd$w_keylen];
;  1978          2779  2 last_entry = .index_block + index$c_entries
;  1979          2780  2         + .index_block [index$w_used] - .entry_size;
;  1980          2781  2 !
;  1981          2782  2 !       Setup special RFA which points to this index block.
;  1982          2783  2 !
;  1983          2784  2 rfa [rfa$l_vbn] = .vbn;                  ! Point to this block
;  1984          2785  2 rfa [rfa$w_offset] = rfa$c_index;        ! Mark as index pointer
;  1985          2786  2 !
;  1986          2787  2 !       Add the key to the parent index.
;  1987          2788  2 !
;  1988          2789  2 IF .index_desc [idd$v_ascii]            ! If ASCII string keys,
;  1989          2790  2 THEN
;  1990          2791  3     BEGIN
;  1991          2792  3     LOCAL
;  1992          2793  3         desc: BBLOCK [dsc$c_s_bln];     ! String descriptor
;  1993          2794  3
;  1994          2795  3     desc [dsc$w_length] = .last_entry [idx$b_keylen];
;  1995          2796  3     desc [dsc$a_pointer] = last_entry [idx$t_keyname];
;  1996        P 2797  3     perform( add_key (.index, desc, rfa,
;  1997          2798  3                 .index_block [index$l_parent]) );
```

```
;  1998          2799  3     END
;  1999          2800  2 ELSE
;  2000        P 2801  2     perform( add_key (.index,last_entry[idx$l_keyid],rfa,
;  2001          2802  2                      .index_block [index$l_parent]) );
;  2002          2803  2
;  2003          2804  2 RETURN true;
;  2004          2805  2
;  2005          2806  1 END;


                                0004 00000 ADD_INDEX:
                                           .WORD   Save R2                                          ; 2743
                              5E      10   C2 00002          SUBL2   #16, SP                         ;
                              51  0000G   CF D0 00005          MOVL    LBR$GL_CONTROL, R1              ; 2773
                              50    04    AC D0 0000A          MOVL    INDEX, R0                       ; 2774
                              52    0A B140 7E 0000E          MOVAQ   @10(R1)[R0], INDEX_DESC         ;
                              52  00BC    C2 9E 00013          MOVAB   188(R2), INDEX_DESC             ;
                              51    02    A2 3C 00018          MOVZWL  2(INDEX_DESC), ENTRY_SIZE       ; 2778
                              51          06 C0 0001C          ADDL2   #6, ENTRY_SIZE                  ;
                              50    0C    BC 3C 0001F          MOVZWL  @INDEX_BLOCK, R0                ; 2780
                              50    0C    AC C0 00023          ADDL2   INDEX_BLOCK, R0                 ;
                              50          51 C2 00027          SUBL2   ENTRY_SIZE, R0                  ;
                              50          0C C0 0002A          ADDL2   #12, LAST_ENTRY                 ;
                        08    AE    08    AC D0 0002D          MOVL    VBN, RFA                        ; 2784
                        0C    AE          01 AE 00032          MNEGW   #1, RFA+4                       ; 2785
                              51    0C    AC D0 00036          MOVL    INDEX_BLOCK, R1                 ; 2798
                              14          62 E9 0003A          BLBC    (INDEX_DESC), 1$                ; 2789
                              6E    06    A0 9B 0003D          MOVZBW  6(LAST_ENTRY), DESC             ; 2795
                        04    AE    07    A0 9E 00041          MOVAB   7(R0), DESC+4                   ; 2796
                              02    A1    DD 00046             PUSHL   2(R1)                           ; 2798
                              0C    AE    9F 00049             PUSHAB  RFA                             ;
                              08    AE    9F 0004C             PUSHAB  DESC                            ;
                                    09    11 0004F             BRB     2$                              ;
                              02    A1    DD 00051 1$:         PUSHL   2(R1)                           ; 2802
                              0C    AE    9F 00054             PUSHAB  RFA                             ;
                              06    A0    9F 00057             PUSHAB  6(LAST_ENTRY)                   ;
                              04    AC    DD 0005A 2$:         PUSHL   INDEX                           ;
                        F66A  CF          04 FB 0005D          CALLS   #4, ADD_KEY                     ;
                              03          50 E9 00062          BLBC    STATUS, 3$                      ;
                              50          01 D0 00065          MOVL    #1, R0                          ; 2804
                                          04 00068 3$:         RET                                     ; 2806

; Routine Size:  105 bytes,    Routine Base:  $CODE$ + 0DE4
```

```
;  2007     2807  1 %SBTTL  'add_index2';
;  2008     2808  1 ROUTINE add_index2 (index, vbn, index_block) =
;  2009     2809  1
;  2010     2810  1 !---
;  2011     2811  1 !
;  2012     2812  1 !       Add_index2 is a modified add_index to handle indices
;  2013     2813  1 !       with variable length keywords.
;  2014     2814  1 !       Create a key which points to the specified index block
;  2015     2815  1 !       in the parent index block.  The highest key in the
;  2016     2816  1 !       current block is used as the key value.
;  2017     2817  1 !
;  2018     2818  1 ! Inputs:
;  2019     2819  1 !
;  2020     2820  1 !       vbn = VBN of the index block
;  2021     2821  1 !       index = Primary index number
;  2022     2822  1 !
;  2023     2823  1 ! Outputs:
;  2024     2824  1 !
;  2025     2825  1 !       None
;  2026     2826  1 !---
;  2027     2827  1
;  2028     2828  2 BEGIN
;  2029     2829  2
;  2030     2830  2 MAP
;  2031     2831  2     index_block: REF BBLOCK;            ! Address of index block
;  2032     2832  2
;  2033     2833  2 LOCAL
;  2034     2834  2     entry_size,                         ! Size of each entry
;  2035     2835  2     last_entry: REF BBLOCK,             ! Last index entry in block
;  2036     2836  2     next_entry : REF BBLOCK,            ! search for last index entry in block.
;  2037     2837  2     index_desc: REF BBLOCK,             ! Address of index descriptor
;  2038     2838  2     rfa: BBLOCK [rfa$c_length];         ! RFA to be associated with key
;  2039     2839  2
;  2040     2840  2
;  2041     2841  2 index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc
;  2042     2842  2                 + (.index-1)*idd$c_length;
;  2043     2843  2 !
;  2044     2844  2 !       Find the last entry in the index block.
;  2045     2845  2 !
;  2046     2846  2 last_entry = .index_block + index$c_entries;
;  2047     2847  2 next_entry = .last_entry;
;  2048     2848  2 WHILE .next_entry [SS .index_block+index$c_entries+.index_block[index$w_used] DO
;  2049     2849  3     BEGIN
;  2050     2850  3     last_entry = .next_entry;
;  2051     2851  3     next_entry = .next_entry + idx$c_rfaplsbyt + .next_entry[idx$b_keylen];
;  2052     2852  2     END;
;  2053     2853  2 !
;  2054     2854  2 !       Setup special RFA which points to this index block.
;  2055     2855  2 !
;  2056     2856  2 rfa [rfa$l_vbn] = .vbn;                  ! Point to this block
;  2057     2857  2 rfa [rfa$w_offset] = rfa$c_index;        ! Mark as index pointer
;  2058     2858  2 !
;  2059     2859  2 !       Add the key to the parent index.
;  2060     2860  2 !
;  2061     2861  2 IF .index_desc [idd$v_ascii]            ! If ASCII string keys,
;  2062     2862  2 THEN
;  2063     2863  3     BEGIN
```

```
;  2064          2864  3      LOCAL
;  2065          2865  3          desc: BBLOCK [dsc$c_s_bln];     ! String descriptor
;  2066          2866  3
;  2067          2867  3      desc [dsc$w_length] = .last_entry [idx$b_keylen];
;  2068          2868  3      desc [dsc$a_pointer] = last_entry [idx$t_keyname];
;  2069        P 2869  3      perform( add_key (.index, desc, rfa,
;  2070          2870  3                       .index_block [index$l_parent]) );
;  2071          2871  3      END
;  2072          2872  2  ELSE
;  2073          2873  2      RETURN lbr$_intrnlerr;              ! add_index2 only for ASCII keys
;  2074          2874  2
;  2075          2875  2  RETURN true;
;  2076          2876  2
;  2077          2877  1  END;


                                001C 00000 ADD_INDEX2:
                                           .WORD   Save R2,R3,R4                                    ; 2808
                             5E       10  C2 00002           SUBL2   #16, SP                          ;
                             51 0000G  CF  D0 00005           MOVL    LBR$GL_CONTROL, R1               ; 2841
                             50   04   AC  D0 0000A           MOVL    INDEX, R0                        ; 2842
                             54   0A B140  7E 0000E           MOVAQ   @10(R1)[R0], INDEX_DESC          ;
                             54 00BC   C4  9E 00013           MOVAB   188(R4), INDEX_DESC              ;
                             53   0C   AC  D0 00018           MOVL    INDEX_BLOCK, R3                  ; 2846
                             50   0C   A3  9E 0001C           MOVAB   12(R3), LAST_ENTRY               ;
                             52        50  D0 00020           MOVL    LAST_ENTRY, NEXT_ENTRY           ; 2847
                             51        63  3C 00023 1$:       MOVZWL  (R3), R1                         ; 2848
                             51   0C A341  9E 00026           MOVAB   12(R3)[R1], R1                   ;
                             51        52  D1 0002B           CMPL    NEXT_ENTRY, R1                   ;
                                       0E  18 0002E           BGEQ    2$                               ;
                             50        52  D0 00030           MOVL    NEXT_ENTRY, LAST_ENTRY           ; 2850
                             51   06   A2  9A 00033           MOVZBL  6(NEXT_ENTRY), R1                ; 2851
                             52   07 A142  9E 00037           MOVAB   7(R1)[NEXT_ENTRY], NEXT_ENTRY    ;
                                       E5  11 0003C           BRB     1$                               ; 2848
                          08 AE       08   AC  D0 0003E 2$:    MOVL    VBN, RFA                         ; 2856
                          0C AE            01  AE 00043        MNEGW   #1, RFA+4                        ; 2857
                                           64  E9 00047        BLBC    (INDEX_DESC), 3$                 ; 2861
                             6E        06  A0 9B 0004A        MOVZBW  6(LAST_ENTRY), DESC              ; 2867
                          04 AE       07   A0 9E 0004E        MOVAB   7(R0), DESC+4                    ; 2868
                                      02   A3 DD 00053        PUSHL   2(R3)                            ; 2870
                                      0C   AE 9F 00056        PUSHAB  RFA                              ;
                                      08   AE 9F 00059        PUSHAB  DESC                             ;
                                      04   AC DD 0005C        PUSHL   INDEX                            ;
                       F5FF CF                04  FB 0005F    CALLS   #4, ADD_KEY                      ;
                             09                50  E8 00064    BLBS    STATUS, 4$                       ;
                                                04  00067    RET                                      ;
                             50 00000000G      8F  D0 00068 3$:    MOVL    #LBR$_INTRNLERR, R0      ; 2873
                                                04  0006F    RET                                      ;
                             50                01  D0 00070 4$:    MOVL    #1, R0                   ; 2875
                                                04  00073    RET                                      ; 2877

; Routine Size:  116 bytes,    Routine Base:  $CODE$ + 0E4D
```

```
;  2079     2878  1 %SBTTL 'reset_highest';
;  2080     2879  1 ROUTINE reset_highest (index_desc, vbn, index_block) =
;  2081     2880  1
;  2082     2881  1 !---
;  2083     2882  1 !
;  2084     2883  1 !       Reset the index pointers in the parent blocks
;  2085     2884  1 !       pointing to the specified index block.  Each
;  2086     2885  1 !       index pointer in a parent block contains the
;  2087     2886  1 !       highest key in the subindex block in order for
;  2088     2887  1 !       binary searches to work.  This routine is called
;  2089     2888  1 !       when the index block has changed in order to
;  2090     2889  1 !       reset the parents highest keys to the proper value.
;  2091     2890  1 !
;  2092     2891  1 ! Inputs:
;  2093     2892  1 !
;  2094     2893  1 !       index_desc = Address of primary index descriptor
;  2095     2894  1 !       vbn = VBN of index block
;  2096     2895  1 !       index_block = Address of index block
;  2097     2896  1 !
;  2098     2897  1 ! Outputs:
;  2099     2898  1 !
;  2100     2899  1 !       The highest keys in the parents are reset.
;  2101     2900  1 !
;  2102     2901  1 !---
;  2103     2902  1
;  2104     2903  2 BEGIN
;  2105     2904  2
;  2106     2905  2 MAP
;  2107     2906  2     index_desc: REF BBLOCK,             ! Address of index descriptor
;  2108     2907  2     index_block: REF BBLOCK;            ! Address of index block
;  2109     2908  2
;  2110     2909  2 LOCAL
;  2111     2910  2     entry_size,                         ! Size of each entry
;  2112     2911  2     last_entry: REF BBLOCK,             ! Last index entry in block
;  2113     2912  2     parent_block: REF BBLOCK,           ! Address of parent block
;  2114     2913  2     parent_entry: REF BBLOCK;           ! Address of parent entry
;  2115     2914  2
;  2116     2915  2
;  2117     2916  2 IF .index_block [index$l_parent] EQL 0  ! If no parent
;  2118     2917  2 THEN
;  2119     2918  2     RETURN true;                        ! then return done
;  2120     2919  2 !
;  2121     2920  2 !       Find the last entry in the index block.
;  2122     2921  2 !
;  2123     2922  2 entry_size = idx$c_length + .index_desc [idd$w_keylen];
;  2124     2923  2 last_entry = .index_block + index$c_entries
;  2125     2924  2         + .index_block [index$w_used] - .entry_size;
;  2126     2925  2 !
;  2127     2926  2 !       Find the parent index block.
;  2128     2927  2 !
;  2129     2928  2 perform (find_index (.index_block [index$l_parent], parent_block));
;  2130     2929  2 !
;  2131     2930  2 !       Locate the pointer to the subindex block.
;  2132     2931  2 !
;  2133     2932  2 INCRU entry FROM .parent_block+index$c_entries BY .entry_size
;  2134     2933  2 DO
;  2135     2934  3     BEGIN
```

```
;  2136      2935  3      MAP
;  2137      2936  3          entry: REF BBLOCK;                  ! Address index entry
;  2138      2937  3
;  2139      2938  3      IF .entry [idx$l_vbn] EQL .vbn          ! If points to subindex,
;  2140      2939  3      THEN
;  2141      2940  4          BEGIN
;  2142      2941  4          parent_entry = .entry;              ! Set address of parent entry
;  2143      2942  4          EXITLOOP;                           ! then exit the scan
;  2144      2943  3          END;
;  2145      2944  2      END;
;  2146      2945  2  !
;  2147      2946  2  !       Update the key in the parent index.
;  2148      2947  2  !
;  2149      2948  2  IF .index_desc [idd$v_ascii]               ! If ASCII string keys,
;  2150      2949  2  THEN
;  2151      2950  3      BEGIN
;  2152      2951  3      parent_entry [idx$b_keylen] = .last_entry [idx$b_keylen];
;  2153      2952  3      CH$MOVE(.last_entry [idx$b_keylen], ! Copy ASCII key
;  2154      2953  3                  last_entry [idx$t_keyname],
;  2155      2954  3                  parent_entry [idx$t_keyname]);
;  2156      2955  3      END
;  2157      2956  2  ELSE
;  2158      2957  2      parent_entry [idx$l_keyid] = .last_entry [idx$l_keyid];
;  2159      2958  2  !
;  2160      2959  2  !       Mark the parent index block modified.
;  2161      2960  2  !
;  2162      2961  2  mark_dirty(.index_block [index$l_parent]);
;  2163      2962  2  !
;  2164      2963  2  !       Reset the highest key in the parents parent.
;  2165      2964  2  !
;  2166      2965  2  reset_highest(.index_desc,.index_block [index$l_parent],.parent_block);
;  2167      2966  2
;  2168      2967  2  RETURN true;
;  2169      2968  2
;  2170      2969  1  END;


                                OFFC 00000 RESET_HIGHEST:
                                           .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11        ; 2879
                          5E        04  C2 00002   SUBL2   #4, SP                              ;
                          51  0C    AC  D0 00005   MOVL    INDEX_BLOCK, R1                     ; 2916
                          57  02    A1  D0 00009   MOVL    2(R1), R7                           ;
                                    60  13 0000D   BEQL    6$                                  ;
                          56  04    AC  D0 0000F   MOVL    INDEX_DESC, R6                      ; 2922
                          53  02    A6  3C 00013   MOVZWL  2(R6), ENTRY_SIZE                   ;
                          53        06  C0 00017   ADDL2   #6, ENTRY_SIZE                     ;
                          50        61  3C 0001A   MOVZWL  (R1), R0                           ; 2924
                    52    50        51  C1 0001D   ADDL3   R1, R0, R2                         ;
                          52        53  C2 00021   SUBL2   ENTRY_SIZE, R2                     ;
                          52        0C  C0 00024   ADDL2   #12, LAST_ENTRY                    ;
                          51        6E  9E 00027   MOVAB   PARENT_BLOCK, R1                   ; 2928
                          50        57  D0 0002A   MOVL    R7, R0                              ;
                                  FD9E  30 0002D   BSBW    FIND_INDEX                          ;
                          3F        50  E9 00030   BLBC    STATUS, 7$                          ;
```

```
                 51          6E          0C  C1 00033          ADDL3   #12, PARENT_BLOCK, ENTRY                ; 2938
                       08    AC          61  D1 00037 1$:      CMPL    (ENTRY), VBN                            ;
                             05          05  12 0003B          BNEQ    2$                                      ;
                             50          51  D0 0003D          MOVL    ENTRY, PARENT_ENTRY                     ; 2941
                             05          05  11 00040          BRB     3$                                      ; 2940
                             51          53  C0 00042 2$:      ADDL2   ENTRY_SIZE, ENTRY                       ; 2932
                             F0          F0  11 00045          BRB     1$                                      ;
                             11          66  E9 00047 3$:      BLBC    (R6), 4$                                ; 2948
                       06    A0    06    A2  90 0004A          MOVB    6(LAST_ENTRY), 6(PARENT_ENTRY)          ; 2951
                             51    06    A2  9A 0004F          MOVZBL  6(LAST_ENTRY), R1                       ; 2952
                 07    A0    07    A2          51  28 00053    MOVC3   R1, 7(LAST_ENTRY), 7(PARENT_ENTRY)      ; 2954
                             05          05  11 00059          BRB     5$                                      ; 2948
                       06    A0    06    A2  D0 0005B 4$:      MOVL    6(LAST_ENTRY), 6(PARENT_ENTRY)          ; 2957
                             50          57  D0 00060 5$:      MOVL    R7, R0                                  ; 2961
                                   0000V 30  00063             BSBW    MARK_DIRTY                              ;
                                         6E  DD 00066          PUSHL   PARENT_BLOCK                            ; 2965
                             7E          56  7D 00068          MOVQ    R6, -(SP)                               ;
                       91    AF          03  FB 0006B          CALLS   #3, RESET_HIGHEST                       ;
                             50          01  D0 0006F 6$:      MOVL    #1, R0                                  ; 2967
                                         04  00072 7$:         RET                                             ; 2969

; Routine Size:  115 bytes,    Routine Base:  $CODE$ + 0EC1
```

```
;  2172          2970  1 %SBTTL  'reset_highest2';
;  2173          2971  1 ROUTINE reset_highest2 (index, index_desc, vbn, index_block) =
;  2174          2972  1
;  2175          2973  1 !---
;  2176          2974  1 !
;  2177          2975  1 !       Reset_highest2 is a modified reset_highest
;  2178          2976  1 !       to handle variable length keyword indices.
;  2179          2977  1 !       Reset the index pointers in the parent blocks
;  2180          2978  1 !       pointing to the specified index block.  Each
;  2181          2979  1 !       index pointer in a parent block contains the
;  2182          2980  1 !       highest key in the subindex block in order for
;  2183          2981  1 !       binary searches to work.  This routine is called
;  2184          2982  1 !       when the index block has changed in order to
;  2185          2983  1 !       reset the parents highest keys to the proper value.
;  2186          2984  1 !
;  2187          2985  1 ! Inputs:
;  2188          2986  1 !
;  2189          2987  1 !       index_desc = Address of primary index descriptor
;  2190          2988  1 !       vbn = VBN of index block
;  2191          2989  1 !       index_block = Address of index block
;  2192          2990  1 !
;  2193          2991  1 ! Outputs:
;  2194          2992  1 !
;  2195          2993  1 !       The highest keys in the parents are reset.
;  2196          2994  1 !
;  2197          2995  1 !---
;  2198          2996  1
;  2199          2997  2 BEGIN
;  2200          2998  2
;  2201          2999  2 MAP
;  2202          3000  2     index_desc: REF BBLOCK,                 ! Address of index descriptor
;  2203          3001  2     index_block: REF BBLOCK;                ! Address of index block
;  2204          3002  2
;  2205          3003  2 LOCAL
;  2206          3004  2     entry,                                  ! index block entry
;  2207          3005  2     entry_size,                             ! Size of each entry
;  2208          3006  2     last_entry: REF BBLOCK,                 ! Last index entry in block
;  2209          3007  2     next_entry : REF BBLOCK,                ! search for last index entry in block.
;  2210          3008  2     parent_block: REF BBLOCK,               ! Address of parent block
;  2211          3009  2     parent_entry: REF BBLOCK;               ! Address of parent entry
;  2212          3010  2
;  2213          3011  2
;  2214          3012  2 IF .index_block [index$l_parent] EQL 0  ! If no parent
;  2215          3013  2 THEN
;  2216          3014  2     RETURN true;                            ! then return done
;  2217          3015  2 !
;  2218          3016  2 !       Find the last entry in the index block.
;  2219          3017  2 !
;  2220          3018  2 next_entry = .index_block + index$c_entries;
;  2221          3019  2 WHILE .next_entry LSS .index_block+index$c_entries+.index_block[index$w_used] DO
;  2222          3020  3     BEGIN
;  2223          3021  3     last_entry = .next_entry;
;  2224          3022  3     next_entry = .next_entry + idx$c_rfaplsbyt + .next_entry[idx$b_keylen];
;  2225          3023  2     END;
;  2226          3024  2 !
;  2227          3025  2 !       Find the parent index block.
;  2228          3026  2 !
```

```
;  2229     3027  2 perform (find_index (.index_block [index$l_parent], parent_block));
;  2230     3028  2 !
;  2231     3029  2 !       Locate the pointer to the subindex block.
;  2232     3030  2 !
;  2233     3031  2 entry = .parent_block+index$c_entries;
;  2234     3032  2 WHILE true DO
;  2235     3033  3     BEGIN
;  2236     3034  3     MAP
;  2237     3035  3         entry: REF BBLOCK;              ! Address index entry
;  2238     3036  3
;  2239     3037  3     IF .entry [idx$l_vbn] EQL .vbn      ! If points to subindex.
;  2240     3038  3     THEN
;  2241     3039  4         BEGIN
;  2242     3040  4         parent_entry = .entry;          ! Set address of parent entry
;  2243     3041  4         EXITLOOP;                       ! then exit the scan
;  2244     3042  4         END
;  2245     3043  3     ELSE
;  2246     3044  3         entry = .entry + idx$c_rfaplsbyt + .entry [idx$b_keylen];
;  2247     3045  3         IF .entry GTR .parent_block + lbr$c_pagesize    ! Don't loop forever if not found
;  2248     3046  3         THEN RETURN lbr$_intrnlerr;
;  2249     3047  2     END;
;  2250     3048  2 !
;  2251     3049  2 !       Update the key in the parent index.
;  2252     3050  2 !
;  2253     3051  2 IF .index_desc [idd$v_ascii]            ! If ASCII string keys,
;  2254     3052  2 THEN
;  2255     3053  3     BEGIN
;  2256     3054  3     IF .parent_entry [idx$b_keylen] EQL .last_entry [idx$b_keylen]
;  2257     3055  3     THEN        ! We're in luck, they are the same size
;  2258     3056  4         BEGIN
;  2259     3057  4         parent_entry [idx$b_keylen] = .last_entry [idx$b_keylen];
;  2260     3058  4         CH$MOVE(.last_entry [idx$b_keylen],     ! Copy ASCII key
;  2261     3059  4                 last_entry [idx$t_keyname],
;  2262     3060  4                 parent_entry [idx$t_keyname]);
;  2263     3061  4         END
;  2264     3062  3     ELSE        ! Remove old entry, compress, and enter new one.
;  2265     3063  4         BEGIN
;  2266     3064  4         LOCAL
;  2267     3065  4             parent_entry_siz;
;  2268     3066  4
;  2269     3067  4         parent_entry_siz = idx$c_rfaplsbyt + .parent_entry [ idx$b_keylen];
;  2270     3068  4         CH$MOVE( .parent_block + index$c_entries + .parent_block[index$w_used]
;  2271     3069  4                 - (.parent_entry + .parent_entry_siz),
;  2272     3070  4                 .parent_entry + .parent_entry_siz,
;  2273     3071  4                 .parent_entry );                !compress to cover old entry
;  2274     3072  4         parent_block[index$w_used] = .parent_block[index$w_used] - .parent_entry_siz;
;  2275     3073  4         perform (add_index2 (.index, .vbn, .index_block) );
;  2276     3074  3         END;
;  2277     3075  3     END
;  2278     3076  2 ELSE
;  2279     3077  2     RETURN lbr$_intrnlerr;              ! reset_highest2 only for ASCII keys
;  2280     3078  2 !
;  2281     3079  2 !       Mark the parent index block modified.
;  2282     3080  2 !
;  2283     3081  2 mark_dirty(.index_block [index$l_parent]);
;  2284     3082  2 !
;  2285     3083  2 !       Reset the highest key in the parent's parent.
```

```
;  2286          3084  2 !       Must check that .parent_block is the address of block .index_block [index$l_parent]
;  2287          3085  2 !       since the last call to add_index2 may have resulted in a new parent.
;  2288          3086  2 !       If there is a new parent then it has already been reset.
;  2289          3087  2 !
;  2290          3088  3 BEGIN
;  2291          3089  3 LOCAL
;  2292          3090  3     blk_adr,
;  2293          3091  3     status;
;  2294          3092  3
;  2295          3093  3 perform ( find_index ( .index_block [index$l_parent], blk_adr) );
;  2296          3094  3 IF .blk_adr EQL .parent_block
;  2297          3095  3 THEN
;  2298          3096  4     BEGIN
;  2299          3097  4     status = reset_highest2(.index,.index_desc, .index_block [index$l_parent],.parent_block);
;  2300          3098  4     IF NOT .status THEN RETURN lbr$_intrnlerr;
;  2301          3099  3     END;
;  2302          3100  2 END;
;  2303          3101  2
;  2304          3102  2 RETURN true;
;  2305          3103  2
;  2306          3104  1 END;


                                OFFC 00000 RESET_HIGHEST2:
                                           .WORD   Save R2,R3,R4,R5,R6,R7,R8,R9,R10,R11          ; 2971
                             5E      08  C2 00002          SUBL2   #8, SP                        ;
                             57  10  AC  D0 00005          MOVL    INDEX_BLOCK, R7               ; 3012
                                 02  A7  D5 00009          TSTL    2(R7)                         ;
                                     03  12 0000C          BNEQ    1$                            ;
                                   00D2  31 0000E          BRW     11$                           ;
                             50      0C  A7  9E 00011 1$:  MOVAB   12(R7), NEXT_ENTRY            ; 3018
                             51          67  3C 00015 2$:  MOVZWL  (R7), R1                      ; 3019
                             51      0C A147  9E 00018     MOVAB   12(R1)[R7], R1                ;
                             51          50  D1 0001D      CMPL    NEXT_ENTRY, R1                ;
                                         0E  18 00020      BGEQ    3$                            ;
                             52          50  D0 00022      MOVL    NEXT_ENTRY, LAST_ENTRY        ; 3021
                             51      06  A0  9A 00025      MOVZBL  6(NEXT_ENTRY), R1             ; 3022
                             50      07 A140 9E 00029      MOVAB   7(R1)[NEXT_ENTRY], NEXT_ENTRY ;
                                         E5  11 0002E      BRB     2$                            ; 3019
                             51          6E  9E 00030 3$:  MOVAB   PARENT_BLOCK, R1              ; 3027
                             50      02  A7  D0 00033      MOVL    2(R7), R0                     ;
                                       FD21  30 00037      BSBW    FIND_INDEX                    ;
                             6F          50  E9 0003A      BLBC    STATUS, 8$                    ;
                             58          6E  D0 0003D      MOVL    PARENT_BLOCK, R8              ; 3031
                             50      0C  A8  9E 00040      MOVAB   12(R8), ENTRY                 ;
                             53    0200  C8  9E 00044      MOVAB   512(R8), R3                   ; 3045
                         0C  AC          60  D1 00049 4$:  CMPL    (ENTRY), VBN                  ; 3037
                                         05  12 0004D      BNEQ    5$                            ;
                             56          50  D0 0004F      MOVL    ENTRY, PARENT_ENTRY           ; 3040
                                         10  11 00052      BRB     6$                            ; 3039
                             51      06  A0  9A 00054 5$:  MOVZBL  6(ENTRY), R1                  ; 3044
                             50      07 A140 9E 00058      MOVAB   7(R1)[ENTRY], ENTRY           ;
                             53          50  D1 0005D      CMPL    ENTRY, R3                     ; 3045
                                         E7  15 00060      BLEQ    4$                            ;
```

```
                                                77  11  00062          BRB     10$                                             ; 3046
                                            73  08  BC  E9  00064 6$:  BLBC    @INDEX_DESC, 10$                                ; 3051
                                        06  A2  06  A6  91  00068      CMPB    6(PARENT_ENTRY), 6(LAST_ENTRY)                  ; 3054
                                                11  12  0006D          BNEQ    7$
                                        06  A6  06  A2  90  0006F      MOVB    6(LAST_ENTRY), 6(PARENT_ENTRY)                  ; 3057
                                        50  06  A2  9A  00074          MOVZBL  6(LAST_ENTRY), R0                               ; 3058
                                07  A6      07  A2      50  28  00078  MOVC3   R0, 7(LAST_ENTRY), 7(PARENT_ENTRY)             ; 3060
                                                2F  11  0007E          BRB     9$                                              ; 3054
                                            59  06  A6  9A  00080 7$:  MOVZBL  6(PARENT_ENTRY), PARENT_ENTRY_SIZ             ; 3067
                                            59      07  C0  00084      ADDL2   #7, PARENT_ENTRY_SIZ
                                            50          68  3C  00087  MOVZWL  (R8), R0                                       ; 3068
                                    51      58          50  C1  0008A  ADDL3   R0, R8, R1
                                    50      56          59  C1  0008E  ADDL3   PARENT_ENTRY_SIZ, PARENT_ENTRY, R0             ; 3069
                                            51          50  C2  00092  SUBL2   R0, R1
                                            51          0C  C0  00095  ADDL2   #12, R1
                                    66      60          51  28  00098  MOVC3   R1, (R0), (PARENT_ENTRY)                       ; 3071
                                            68          59  A2  0009C  SUBW2   PARENT_ENTRY_SIZ, (R8)                         ; 3072
                                                        57  DD  0009F  PUSHL   R7                                              ; 3073
                                                    0C  AC  DD  000A1  PUSHL   VBN
                                                    04  AC  DD  000A4  PUSHL   INDEX
                                        FE6D        CF      03  FB  000A7  CALLS   #3, ADD_INDEX2
                                                37          50  E9  000AC 8$:  BLBC    STATUS, 12$
                                                50      02  A7  D0  000AF 9$:  MOVL    2(R7), R0                               ; 3081
                                                    0000V   30  000B3      BSBW    MARK_DIRTY
                                                51      04  AE  9E  000B6  MOVAB   BLK_ADR, R1                              ; 3093
                                                50      02  A7  D0  000BA  MOVL    2(R7), R0
                                                    FC9A    30  000BE      BSBW    FIND_INDEX
                                                22          50  E9  000C1  BLBC    STATUS, 12$
                                                58      04  AE  D1  000C4  CMPL    BLK_ADR, R8                             ; 3094
                                                            19  12  000C8  BNEQ    11$
                                                            58  DD  000CA  PUSHL   R8                                      ; 3097
                                                        02  A7  DD  000CC  PUSHL   2(R7)
                                                7E      04  AC  7D  000CF  MOVQ    INDEX, -(SP)
                                        FF28    CF          04  FB  000D3  CALLS   #4, RESET_HIGHEST2
                                                08          50  E8  000D8  BLBS    STATUS, 1T$                             ; 3098
                                                50  00000000G  8F  D0  000DB 10$:  MOVL    #LBR$_INTRNLERR, R0
                                                                04  000E2  RET
                                                50          01  D0  000E3 11$:  MOVL    #1, R0                                  ; 3102
                                                                04  000E6 12$:  RET                                             ; 3104

; Routine Size:  231 bytes,    Routine Base:  $CODE$ + 0F34
```

```
;  2308          3105  1 %SBTTL  'check_lock';
;  2309          3106  1 GLOBAL ROUTINE check_lock : JSB_0 =
;  2310          3107  2 BEGIN
;  2311          3108  2
;  2312          3109  2 !---
;  2313          3110  2 !
;  2314          3111  2 !       Check if the index is locked from modification.
;  2315          3112  2 !
;  2316          3113  2 ! Inputs:
;  2317          3114  2 !
;  2318          3115  2 !       None
;  2319          3116  2 !
;  2320          3117  2 ! Outputs:
;  2321          3118  2 !
;  2322          3119  2 !       None
;  2323          3120  2 !
;  2324          3121  2 ! Routine value:
;  2325          3122  2 !
;  2326          3123  2 !       true            Ok to modify index
;  2327          3124  2 !       lbr$_updurtrav  Index is locked
;  2328          3125  2 !
;  2329          3126  2 !---
;  2330          3127  2
;  2331          3128  2 BIND
;  2332          3129  2     index_desc = .lbr$gl_control [lbr$l_hdrptr] + lhd$c_idxdesc         ! Name index descriptor for current
;  2333          3130  2                + (.lbr$gl_control [lbr$l_curidx] - 1) * idd$c_length
;  2334          3131  2                                  : BBLOCK;
;  2335          3132  2
;  2336          3133  2 IF .index_desc [idd$v_locked]
;  2337          3134  2     THEN RETURN lbr$_updurtrav
;  2338          3135  2     ELSE RETURN true
;  2339          3136  2
;  2340          3137  1 END;                                                  ! Of check_lock


                                51     0000G   CF   DO 00000 CHECK_LOCK::
                                                          MOVL    LBR$GL_CONTROL, R1                      ; 3129
                                50       12    A1   DO 00005                                            ; 3130
                                50       0A B140   7E 00009          MOVAQ   @10(R1)[R0], R0
                                50     00BC    C0   9E 0000E          MOVAB   188(R0), R0
                          08    60             01   E1 00013          BBC     #1, (R0), 1$                    ; 3133
                                50 00000000G   8F   DO 00017          MOVL    #LBR$_UPDURTRAV, R0             ; 3135
                                                   05 0001E          RSB
                                50             01   DO 0001F 1$:     MOVL    #1, R0
                                                   05 00022          RSB                                     ; 3137

; Routine Size:  35 bytes,    Routine Base:  $CODE$ + 101B
```

```
;  2342          3138  1 %SBTTL  'mark_dirty';
;  2343          3139  1 GLOBAL ROUTINE mark_dirty (vbn) : JSB_1 =
;  2344          3140  1
;  2345          3141  1 !---
;  2346          3142  1 !
;  2347          3143  1 !       Mark an index block modified in memory so that
;  2348          3144  1 !       it gets written back to disk when the file is closed.
;  2349          3145  1 !
;  2350          3146  1 ! Inputs:
;  2351          3147  1 !
;  2352          3148  1 !       vbn = disk block number
;  2353          3149  1 !
;  2354          3150  1 ! Outputs:
;  2355          3151  1 !
;  2356          3152  1 !       None
;  2357          3153  1 !---
;  2358          3154  1
;  2359          3155  2 BEGIN
;  2360          3156  2
;  2361          3157  2 LOCAL
;  2362          3158  2     cache_entry: REF BBLOCK;
;  2363          3159  2
;  2364          3160  2 perform (lookup_cache (.vbn, cache_entry)); ! Lookup entry in cache
;  2365          3161  2
;  2366          3162  2 cache_entry [cache$v_dirty] = true;      ! Mark modified
;  2367          3163  2
;  2368          3164  2 RETURN true;
;  2369          3165  2
;  2370          3166  1 END;


                                5E              04  C2 00000 MARK_DIRTY::
                                                            SUBL2   #4, SP                                  ;  3139
                                51              6E  9E 00003        MOVAB   CACHE_ENTRY, R1                 ;  3160
                                              0000G 30 00006        BSBW    LOOKUP_CACHE                    ;
                                0A              50  E9 00009        BLBC    STATUS, 1$                      ;
                                50              6E  D0 0000C        MOVL    CACHE_ENTRY, R0                 ;  3162
                             0C A0              01  88 0000F        BISB2   #1, 12(R0)                      ;
                                50              01  D0 00013        MOVL    #1, R0                          ;  3164
                                5E              04  C0 00016 1$:    ADDL2   #4, SP                          ;  3166
                                                05 00019            RSB                                     ;

; Routine Size:  26 bytes,    Routine Base:  $CODE$ + 103E

;  2371          3167  1
;  2372          3168  1 END
;  2373          3169  0 ELUDOM
```

```
;                                PSECT SUMMARY
;
;       Name                    Bytes                   Attributes
;
;  $CODE$                         4184  NOVEC,NOWRT,  RD ,  EXE,NOSHR,  LCL,  REL,  CON,NOPIC,ALIGN(2)



;                             Library Statistics
;
;                                        -------- Symbols --------      Pages       Processing
;       File                             Total    Loaded   Percent      Mapped      Time
;
;  _$255$DUA28:[SYSLIB]STARLET.L32;1      9776        14         0       581          00:01.0




;                                   COMMAND QUALIFIERS

;       BLISS/CHECK=(FIELD,INITIAL,OPTIMIZE)/LIS=LIS$:INDEX/OBJ=OBJ$:INDEX MSRC$:INDEX/UPDATE=(ENH$:INDEX)

; Size:         4184 code + 0 data bytes
; Run Time:       01:25.6
; Elapsed Time:   02:52.4
; Lines/CPU Min:   2220
; Lexemes/CPU-Min: 22428
; Memory Used:  377 pages
; Compilation Complete
```

GETHELP
LIS

INDEX
LIS

GETPUT
LIS

GETMEM
LIS

OLDLIB
LIS

OPENCLOSE
LIS

OUTPUTHLP
LIS

LBRMSG
LIS