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DECUS NO.	5/8-83 A&B
TITLE	OCTAL DEBUGGING PROGRAM (With and without Floating Point)
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DATE	June 1967
SOURCE LANGUAGE	

OCTAL DEBUGGING PROGRAM WITHOUT FLOATING POINT

Program Library Write-up DECUS No. 8/8S-83 A

ABSTRACT

This program is an on-line debugger which will communicate with the operator through the ASR-33 Teletype. It allows register examination and modification, octal dumping, binary punching, multiple simultaneous breakpoints, starting a program, and running at a particular location with preset AC and link. ODP is completely relocatable at the beginning of all pages except page zero, and is compatible with the PDP-5, the PDP-8, and the PDP-8/S.

REQUIREMENTS

1. Storage

   The high version of ODP requires from location 7000 to 7577. The low version requires from 0200 to 0777. All versions will require three pages. Also, location 0002 is used for a breakpoint pointer to ODP.

2. Equipment

   The standard PDP-8 package with ASR-33 Teletype are required. In addition, a high-speed punch is optional.

LOADING

1. Be sure the binary loader is properly in core. If not, examine the RIM loader, and read in the binary loader.

2. Load in program that needs attention via this loader.

3. Load ODP via binary loader.

USAGE

1. Set SR toggles to the value of starting address (7000 in high version, 0200 in low). Press load address. Then push start.

2. ODP will execute a CR/LF and is prepared to execute user commands.

RESTRICTIONS

1. Breakpointer register

   On page zero register 0002 is used as a pointer to ODP. It should be avoided.

2. Overlap

The user must not use any of the three pages of core in use by ODP.

3. Status core

ODP will operate only within the memory field in which it resides.

OPERATION

1. Description

ODP is essentially a unified collection of short routines for handling various user commands. The user types a letter representing a particular command, and an octal number if that is appropriate. For example, to insert a breakpoint (an effective JMS ODP which will trap an instruction at a desired location) one need only type B, followed by the octal absolute value of the address where the trapped instruction lies. A special feature of ODP is that many breakpoints (up to 7) may be simultaneously in core with the trapped instruction preserved. For instructions that require an octal number to be typed, ODP will type a space immediately after it identifies the command. After most instructions, a CR/LF combination will be executed to signal completion of that command. All octal numbers are automatically terminated after four digits, but may be terminated earlier by ALTMODE. ODP ignores all irrelevant characters.

2. Summary of commands

O XXXX	Open register XXXX. ODP types out contents.
I XXXX	Insert in most recently opened register the number XXXX.
N	Type out the location followed by the contents of the next register. May be followed by I command.
B XXXX	Put a breakpoint at location XXXX.
A	Examine AC register. May be modified by I instruction.
L	Examine link register. May be modified by I instruction. A 0001 is a set link; a 0000 is an off link.
D XXXX XXXX	Dump in octal the contents of XXX to XXXX inclusive. Four words are placed per TTY line.

S XXXX Start (or go) at XXXX with AC and link equal to zero.

R XXXX Go from XXXX, the same as S, but with AC equal to the value of A register, and link equal to the value of L register.

C Continue from most recently encountered breakpoint. Trapped instruction is replaced and C program is continued from the location of the trapped instruction. The initial contents of the link and AC are that of the L and A registers respectively.

J This must be carefully watched! It causes program control to jump to location 6000 where single-stepper, written by the author for an interpretive language, usually resides.

P Binary punch requested. Computer halts. Further information is via the SR.

3. Notes on various commands

1. Open (O)

After the register is examined it is automatically closed. Hence the user cannot accidentally modify the contents, as with DDT, by typing a new command string while the register is still open.

2. Insert (I)

Sequential insertion is possible with ODP. That is, after one I instruction, say at location XXXX, typing another I will cause insertion at location XXXX+1, and so on.

3. Breakpoints (B)

Up to seven breakpoints may be placed in core at once. If the user attempts to place more than seven in core, then the computer will halt. The same result will occur if, upon encountering a breakpoint, ODP cannot find it listed in its internal table. When the trapped instruction is re-installed (by the C instruction) that breakpoint is eliminated from the table. Upon encountering a breakpoint, the contents of the AC link are preserved in the A and L registers for user examination, and ODP will execute a CR/LF combination to signal return to its control.

4. Go instructions (S, C, and R)

   After recognizing an S, C, or R command, the computer will set the AC and link appropriately, then halt. This is in case the user should want to place the computer in the single-step mode after one of these instructions. If this should not be the case, merely depress the continue switch.

5. Binary Punch (P)

   After the user typed a P, the computer will halt. There are several functions that the user must now handle through the SR.

   a. Put up bit 11 for high-speed punch, leave off for ASR-33 punch. Push continue to indicate the output mode.

   b. Set the SR to the octal value of the number of individual blocks that are to be punched with a single checksum. Push continue. Leader is punched.

   c. Set the SR to the initial address of the first block. Push continue. Set the SR to the final address in the first block. Push continue. That block, with an origin setting, is punched out in binary loader format. Punch is inclusive from initial to final location.

   d. For the next block, go through the same steps as outlined in (c) except with the new initial and final addresses, and continue in this way. When the last block has been punched, the checksum and trailer will be punched. A CR/LF will be executed and ODP will await further instructions.

   e. RIM format

      To punch in RIM format, put the number of blocks equal to (octal), and use the address of one register as both the initial and final addresses for each block. When done punching, set SR to 7264, load address, and push continue. (Make sure the AC is clear). Trailer will be punched. For the low version, set SR to 0464 and proceed as above.

LISTING ATTACHED

COMBINED DEBUGGING PACKAGE with FLOATING POINT

DECUS No. 8/8S-83 B

ABSTRACT

The Combined Debugging Package (CDP) consists of the Octal Debugging Program (ODP) by this author plus certain additions which will enable the user to debug in floating point interpretive mode. Additional instructions provided include the insertion of interpretive breakpoints and single-stepping. At present the package is located directly below the floating point package to leave the lower portion of the memory to the user. It may easily be relocated to any desired position. Two versions are available: one for the three word package and a second for the four word package.

REQUIREMENTS

The standard version of CDP requires cells 3600-4614, and is compatible with floating point packages A, B, C. It must be relocated to 3400 to accommodate package D, due to the presence of the output controller. The four word version occupies memory locations 4200-5221, and is compatible with two additional versions of the four word package: that with output controller and that with extended functions, both written by this author. All versions of CDP require in addition, cell 2 for breakpoints, and cells 5, 6, 7 as pointers to the input, output, and arithmetic packages respectively.

OPERATION

CDP is an on-line debugger with two modes: floating and machine. Transfer to floating mode is accomplished by typing F. Machine mode is entered by the instruction M. When CDP is initially started, it is in machine mode. While in M mode it behaves exactly as ODP, with the minor exception that the J instruction has been liquidated in favor of the F command.

When transfer to F mode has been accomplished, a new set of instructions are enabled. The command B YYYY will insert an interpretive breakpoint (code 0017) at location YYYY. The original instruction is preserved and can be replaced with the C or S command. There may be up to seven interpretive breakpoints in core. Interpretive breakpoints and machine breakpoints are stored on separate tables. Hence there will be no interference between them, and seven of each type may be in core simultaneously. Upon encountering a breakpoint, the contents of the floating accumulator (FAC) will be typed out in decimal, floating point format, and control is returned to CDP.

The user then has several alternatives. He may choose to single-step, interpretively. To do this he merely types S, and the trapped instruction is replaced and executed. After its completion of that one interpretive command the FAC is typed out. Another S will cause another step to be executed after which the FAC is typed out. This process may continue indefinitely, until the user attempts to single-step over a FEXT. In this case CDP will type an up-arrow " " and transfer automatically to M mode. Because the single-stepping process is accomplished by continually moving the breakpoint one ahead, after the last S instruction one breakpoint will remain. To eliminate that breakpoint and restore the lost instruction, one must use the C command as described below. If one single-steps over a FEXT, the instruction past the FEXT is lost, replaced by an 0017. That is the penalty for carelessness. Also, there must be at least two locations on the breakpoint table free (or no more than five breakpoints in core at one time) for the S instruction to operate properly.

Another alternative after encountering a breakpoint is to continue full speed. This is accomplished by the C instruction. The breakpoint is replaced with the original instruction and processing continues from that point. If the user placed a breakpoint on a FEXT, and then wants to C, an up-arrow will be typed and automatic transfer to M mode will take place. Unlike the S instruction, however, there is no residue breakpoint in this case.

A third alternative might be to transfer back to M mode. This is done by typing M. If for some reason the user is not sure of what mode he is currently in, he may type the letter of the mode he thinks he is in. If there is no CR/LF response by CDP, it means that he typed a character that was not recognized, and hence is in the mode typed. If a CR/LF occurs, it means the user guessed wrong, but a transfer has occurred placing him in the mode he thought he was in before. Automatic transfer takes place upon encountering a breakpoint. If CDP is in M mode, and a floating breakpoint is encountered, automatic transfer to F mode is effected, and vice-versa.

The following instructions are also available in F mode and retain the same meaning as in M mode: O, I, N, A, L, D, R, and P.

ADDITIONS TO COMBINED DEBUGGING PACKAGES
for
FLOATING EXAMINATION and MODIFICATION

An addition has been written for CDP which will enable the user to examine and modify floating point numbers in core. Versions are available for both three and four word packages.

Old commands that were deleted from F mode include O, N, and I. The O was changed to E, for examination. The meanings of the commands N and I have been changed, although the mnemonics remain the same. Below is a summary of new commands.

E XXXX — Output in decimal the contents of the floating point number whose exponent is held in XXXX and whose mantissa follows in sequential registers.

I XXXX — Insert a floating point number exponent of which will be placed at XXXX and whose mantissa will follow in sequential registers. The user types the decimal number following the command. Also, note that sequential insertion is possible.

N — Examine the next sequential floating point number. If working with the four word package, this would be the location of the last exponent plus four.

For all the above commands, the FAC is saved and replaced after execution. To examine the FAC, the user need only type E 44 followed by an ALT-MODE to terminate the number before four digits.

The additions require 50 (octal) locations and are located directly under CDP. Thus, new core requirements are the following:

3 WORD VERSION: 3530-4614
4 WORD VERSION: 4130-5221

Starting addresses remain unchanged. Also, the program assumes that location 5 contains 7400. Check on this before using the additional instructions. Listings follow.

```
                /OCTAL DEBUGGING PROGRAM -JAMES ROTHMAN 6/15/67

                *7000
7000  6046              TLS
7001  4752  END,        JMS I CRLF
7002  4753              JMS I READ        /READ A NUMBER
7003  4754              JMS I TYPE
7004  1355              TAD N14 /RESET CONSTANTS
7005  3357              DCA CNT
7006  1360              TAD RTABA
7007  3361              DCA TABA
7010  1362              TAD RTABB
7011  3363              DCA TABB
7012  1763  LOOP1,      TAD I TABB
7013  3337              DCA CHECK
7014  6034              KRS
7015  1761              TAD I TABA        /IDENTIFY REQUEST
7016  7650              SNA CLA
7017  5737              JMP I CHECK       /ENTER REQUESTED ROUTINE
7020  2361              ISZ TABA
7021  2363              ISZ TABB
7022  2357              ISZ CNT
7023  5212              JMP LOOP1
7024  5202              JMP END+1         /CAN'T IDENTIFY-READ AGAIN
7025  4764  O,          JMS I OCTRD       /OPEN INSTRUCTION
7026  3365              DCA CURLOC
7027  1765              TAD I CURLOC
7030  4304              JMS OCTPNT        /TYPE CONTENTS
7031  5201              JMP END
7032  4764  II,         JMS I OCTRD       /INSERT INSTRUCTION
7033  3765              DCA I CURLOC
7034  2365              ISZ CURLOC
7035  5201              JMP END
7036  2365  N,          ISZ CURLOC        /NEXT REGISTER REQUESTED
7037  1365              TAD CURLOC
7040  4304              JMS OCTPNT
7041  5227              JMP II-3

7042  4764  D,          JMS I OCTRD       /OCTAL DUMP REQUESTED
7043  3361              DCA INIT          /RECORD FIRST AND LAST
7044  4764              JMS I OCTRD       /OF REQUESTED REGISTERS
7045  7041              CIA
7046  3363              DCA FIN
7047  4752  LOOP2,      JMS I CRLF
7050  1361              TAD INIT
7051  4304              JMS OCTPNT
7052  1366              TAD HYPH
7053  4754              JMS I TYPE
7054  1367              TAD N4
7055  3357              DCA CNT
7056  1761  LOOP3,      TAD I INIT        /OUTPUT 4 SEQUENTIAL REGISTER
7057  4304              JMS OCTPNT
7060  1361              TAD INIT          /FINISHED?
7061  1363              TAD FIN
7062  7650              SNA CLA
7063  5201              JMP END
7064  2361              ISZ INIT
7065  2357              ISZ CNT
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7066  5256          JMP LOOP3
7067  5247          JMP LOOP2
7070  4764  S,      JMS I OCTRD     /START REQUESTED
7071  3361          DCA LOCJMP
7072  4752          JMS I CRLF
7073  7402  GO,     HLT
7074  5761          JMP I LOCJMP
7075  4764  R,      JMS I OCTRD     /RUN WITH PRESET AC
7076  3361          DCA LOCJMP      /AND LINK REQUESTED
7077  4752          JMS I CRLF
7100  1370          TAD LINK
7101  7110          CLL RAR
7102  1371          TAD AC
7103  5273          JMP GO
7104  0000  OCTPNT, 0       /OCTAL PRINT SUB-ROUTINE
7105  3373          DCA TEMP4
7106  1374          TAD R240
7107  4754          JMS I TYPE
7110  1367          TAD N4
7111  3372          DCA TEMP3
7112  1373  LOOP6,  TAD TEMP4
7113  7104          CLL RAL
7114  7006          RTL
7115  3373          DCA TEMP4
7116  1373          TAD TEMP4
7117  7004          RAL
7120  0356          AND M7
7121  1375          TAD R260
7122  4754          JMS I TYPE

7123  2372          ISZ TEMP3
7124  5312          JMP LOOP6
7125  5704          JMP I OCTPNT
7126  5776  J,      JMP I M6000     /JUMP TO SINGLE-STEPPER
7127  1371  A,      TAD AC  /AC REFERENCED
7130  4337          JMS CHECK
7131  3371          DCA AC  /RE-INSERT AC
7132  5201          JMP END
7133  1370  L,      TAD LINK        /LINK REFERENCED
7134  4337          JMS CHECK
7135  3370          DCA LINK        /RE-INSERT LINK
7136  5201          JMP END
7137  0000  CHECK,  0       /CHECK FOR INSERT REQUEST
7140  4304          JMS OCTPNT
7141  4752          JMS I CRLF
7142  4753          JMS I READ
7143  4754          JMS I TYPE
7144  6034          KRS
7145  1377          TAD N311
7146  7640          SZA CLA
7147  5204          JMP END+3       /CONTINUE AS USUAL
7150  4764          JMS I OCTRD
7151  5737          JMP I CHECK
7152  7466  CRLF,   LF      /CONSTANTS AND VARIABLES
7153  7474  READ,   RD
7154  7501  TYPE,   TYS
7155  7764  N14,    -14
7156  0007  M7,     7
7157  0000  CNT,    0
7160  7177  RTABA,  LETTER
```

```
7161  7177  TABA,   LETTER
7162  7551  RTABB,  LOCS
7163  7551  TABB,   LOCS
7164  7313  OCTRD,  RDOCT
7165  0000  CURLOC, 0
7166  0255  HYPH,   255
7167  7774  N4,     -4
7170  0000  LINK,   0
7171  0000  AC,     0
7172  0000  TEMP3,  0
7173  0000  TEMP4,  0
7174  0240  R240,   240
7175  0260  R260,   260
7176  6000  M6000,  6000
7177  7467
7200  7461
7201  7462
7202  7476
7203  7477
7204  7464
7205  7474  LETTER, -311,-317,-316,-302,-301,-314,-304
7206  7455
7207  7456
7210  7475
7211  7466
7212  7460          -323,-322,-303,-312,-320
7213  3350  P,      DCA CHK /MEMORY PUNCH REQUESTED
7214  7402          HLT
7215  7604          LAS
7216  0375          AND M1
7217  7640          SZA CLA
7220  1360          TAD HTYPE
7221  1365          TAD TYPE2
7222  3373          DCA LOCPNT
7223  1373          TAD LOCPNT
7224  3774          DCA I LORCAL
7225  7402          HLT
7226  7604          LAS
7227  7041          CIA
7230  3351          DCA CNT2
7231  4752          JMS I LEADER

7232  7402  LOOP4,  HLT     /RECORD FIRST AND LAST REGISTERS
7233  7604          LAS
7234  3353          DCA INIT2
7235  7402          HLT
7236  7604          LAS
7237  3354          DCA FIN2
7240  1355          TAD M177
7241  3356          DCA M77
7242  7120          STL
7243  1353          TAD INIT2
7244  4266          JMS PRINT
7245  1357          TAD R77
7246  3356          DCA M77
7247  1753  LOOP5,  TAD I INIT2
7250  4266          JMS PRINT
7251  1353          TAD INIT2
7252  7041          CIA
```

```
7253  1354          TAD FIN2
7254  7650          SNA CLA
7255  5260          JMP DONE
7256  2353          ISZ INIT2
7257  5247          JMP LOOP5
7260  2351  DONE,   ISZ CNT2
7261  5232          JMP LOOP4
7262  1350          TAD CHK
7263  4266          JMS PRINT
7264  4752          JMS I LEADER
7265  5761          JMP I ENDIT
7266  0000  PRINT,  0        /BINARY FORMAT PRINT
7267  3362          DCA TEMP1
7270  1362          TAD TEMP1
7271  7012
7272  7012
7273  7012          RTR;RTR;RTR
7274  0356          AND M77
7275  4304          JMS SUM
7276  4773          JMS I LOCPNT
7277  1362          TAD TEMP1
7300  0357          AND R77
7301  4304          JMS SUM
7302  4773          JMS I LOCPNT
7303  5666          JMP I PRINT
7304  0000  SUM,    0
7305  3363          DCA TEMP2
7306  1363          TAD TEMP2
7307  1350          TAD CHK
7310  3350          DCA CHK
7311  1363          TAD TEMP2
7312  5704          JMP I SUM

7313  0000  RDOCT,  0        /OCTAL READ SUB-ROUTINE
7314  1364          TAD M240
7315  4765          JMS I TYPE2
7316  3363          DCA TEMP2
7317  1366          TAD MN4
7320  3362          DCA TEMP1
7321  4767  BACK,   JMS I READ2
7322  4765          JMS I TYPE2
7323  6034          KRS
7324  1370          TAD N375
7325  7650          SNA CLA
7326  5346          JMP TERM
7327  6034          KRS
7330  0371          AND M270
7331  1372          TAD N260
7332  7640          SZA CLA
7333  5321          JMP BACK
7334  1363          TAD TEMP2
7335  7104          CLL RAL
7336  7006          RTL
7337  3363          DCA TEMP2
7340  6034          KRS
7341  1372          TAD N260
7342  1363          TAD TEMP2
7343  3363          DCA TEMP2
7344  2362          ISZ TEMP1
7345  5321          JMP BACK
```

```
7346  1363  TERM,    TAD TEMP2
7347  5713           JMP I RDOCT
7350  0000  CHK,     0          /CONSTANTS AND VARIABLES
7351  0000  CNT2,    0
7352  7515  LEADER,  LDR
7353  0000  INIT2,   0
7354  0000  FIN2,    0
7355  0177  M177,    177
7356  0077  M77,     77
7357  0077  R77,     77
7360  0006  HTYPE,   HITYPE-TYP
7361  7001  ENDIT,   END
7362  0000  TEMP1,   0
7363  0000  TEMP2,   0
7364  0240  M240,    240
7365  7501  TYPE2,   TYP
7366  7774  MN4,     -4
7367  7474  READ2,   RD
7370  7403  N375,    -375
7371  0270  M270,    270
7372  7520  N260,    -260
7373  0000  LOCPNT,  0
7374  7546  LDRCAL,  JMSLOC
7375  0001  M1,      1
7376  0000
7377  0000
7400  0000
7401  0000
7402  0000
7403  0000
7404  0000  ADDR,    0,0,0,0,0,0,0
7405  4243  B,       JMS RESET
7406  1350           TAD BRPNTR
7407  3002           DCA 2
7410  4253           JMS FIND
7411  4731           JMS I RDOCT2
7412  3726           DCA I TABC
7413  1726           TAD I TABC
7414  3333           DCA TEMP5
7415  1733           TAD I TEMP5
7416  3730           DCA I TABD
7417  1334           TAD BRINST
7420  3733           DCA I TEMP5
7421  5735           JMP I END2
7422  0000  PNTHIT,  0          /FOUND BREAK-POINT
7423  3736           DCA I ACC
7424  7004           RAL
7425  3737           DCA I LINK2
7426  7240           STA
7427  1222           TAD PNTHIT
7430  3222           DCA PNTHIT
7431  5735           JMP I END2
7432  4243  C,       JMS RESET
7433  1222           TAD PNTHIT
7434  7041           CIA
7435  4253           JMS FIND
7436  1730           TAD I TABD
7437  3622           DCA I PNTHIT
7440  3726           DCA I TABC
```

```
7441  1222           TAD PNTHIT
7442  5740           JMP I RPLUS1
7443  0000  RESET,   0
7444  1325           TAD RTABC
7445  3326           DCA TABC
7446  1327           TAD RTABD
7447  3330           DCA TABD
7450  1341           TAD RN4
7451  3332           DCA CNT4
7452  5643           JMP I RESET
7453  0000  FIND,    0
7454  3243           DCA RESET
7455  1243           TAD RESET
7456  1726           TAD I TABC
7457  7650           SNA CLA
7460  5653           JMP I FIND

7461  2326           ISZ TABC
7462  2330           ISZ TABD
7463  2332           ISZ CNT4
7464  5255           JMP .-7
7465  7402           HLT
7466  0000  LF,      0
7467  1342           TAD M215
7470  4301           JMS TYP
7471  1343           TAD M212
7472  4301           JMS TYP
7473  5666           JMP I LF
7474  0000  RD,      0
7475  6031           KSF
7476  5275           JMP .-1
7477  6036           KRB
7500  5674           JMP I RD
7501  0000  TYP,     0
7502  6041           TSF
7503  5302           JMP .-1
7504  6046           TLS
7505  7300           CLA CLL
7506  5701           JMP I TYP
7507  0000  HITYPE,  0
7510  6021           PSF
7511  5310           JMP .-1
7512  6026           PLS
7513  7300           CLA CLL
7514  5707           JMP I HITYPE
7515  0000  LDR,     0
7516  1344           TAD N75
7517  3347           DCA LEADCT
7520  1345           TAD M200
7521  4746           JMS I JMSLOC
7522  2347           ISZ LEADCT
7523  5320           JMP .-3
7524  5715           JMP I LDR
7525  7376  RTABC,   ADDR
7526  7376  TABC,    ADDR
7527  7565  RTABD,   INST
7530  7565  TABD,    INST
7531  7313  RDOCT2,  RDOCT
7532  0000  CNT4,    0
7533  0000  TEMP5,   0
```

```
7534  4402  BRINST, JMS I 2
7535  7001  END2,   END
7536  7171  ACC,    AC
7537  7170  LINK2,  LINK
7540  7076  RPLUS1, R+1
7541  7771  RN4,    -7
7542  0215  M215,   215
7543  0212  M212,   212
7544  7634  N75,    -144
7545  0200  M200,   200
7546  0000  JMSLOC,    0
7547  0000  LEADCT,    0
7550  7422  BRPNTR,    PNTHIT
7551  7032
7552  7025
7553  7036
7554  7405
7555  7127
7556  7133
7557  7042
7560  7070
7561  7075
7562  7432
7563  7126
7564  7213  LOCS,   II,G,N,B,A,L,D,S,R,C,J,P
7565  0000
7566  0000
7567  0000
7570  0000
7571  0000
7572  0000
7573  0000  INST,   0,0,0,0,0,0,0
              FIN=TABB
              INIT=TABA
              LOCJMP=TABA
              N311=LETTER
```

```
A        7127
AC       7171
ACC      7536
ADDR     7376
B        7405
BACK     7321
BRINST   7534
BRPNTR   7550
C        7432
CHECK    7137
CHK      7350
CNT      7157
CNT2     7351
CNT4     7532
CRLF     7152
CURLOC   7165
D        7042
DONE     7260
END      7001
ENDIT    7361
END2     7535
FIN      7163
```

```
FIND     7453
FIN2     7354
GO       7073
HITYPE   7507
HTYPE    7360
HYPH     7160
II       7032
INIT     7161
INIT2    7353
INST     7565
J        7126
JMSLOC   7546
L        7133
LDR      7515
LDRCAL   7374
LEADCT   7547
LEADER   7352
LETTER   7177
LF       7460
LINK     7170
LINK2    7537
LOCJMP   7161
LOCPNT   7373
LOCS     7551
LOOP1    7012
LOOP2    7047
LOOP3    7056
LOOP4    7232
LOOP5    7247
LOOP6    7112
MN4      7366
M1       7375
M177     7355
M200     7545
M212     7543
M215     7542
M240     7364
M270     7371
M6000    7176
M7       7156
M77      7356
N        7036
N14      7155
N260     7372
N311     7177
N375     7370
N4       7167
N75      7544
O        7025
OCTPNT   7104
OCTRD    7164
P        7213
PNTHIT   7422
PRINT    7266
R        7075
RD       7474
RDOCT    7313
RDOCT2   7531
READ     7153
READ2    7367
```

```
RESET    7443
RN4      7541
RPLUS1   7540
RTABA    7160
RTABB    7162
RTABC    7525
RTABD    7527
R240     7174
R260     7175
R77      7357
S        7070
SUM      7304
TABA     7161
TABB     7163
TABC     7526
TABD     7530
TEMP1    7362
TEMP2    7363
TEMP3    7172
TEMP4    7173
TEMP5    7533
TERM     7346
TYP      7501
TYPE     7154
TYPE2    7365
D
```

```
                /3 WORK PACKAGE
                /JAMES NOLAN ... JULY 6,1967

                /ADDITIONS TO ODP TO HANDLE FLOATING
                /POINT DEBUGGING.       THIS PORTION IS
                /PLACED BELOW THE FLOATING POINT
                /PACKAGE. A FLOATING BREAKPOINT IS
                /INTERPRETIVE 9017. COMMANDS IN THIS
                /MODE ARE: B XXXX -BREAKPOINT,C -
                /CONTINUE AFTER BREAKPOINT,REINSTATING
                /TRAPPED INSTRUCTION,S-SINGLE STEP (OR
                /EFFECTIVELY MOVE BREAKPOINT ONE AHEAD)
                /AND M - JUMP BACK TO MACHINE MODE.
                /ENTRY INTO FLOATING MODE IS EFFECTED BY
                /THE COMMAND F IN NORMAL, MACHINE LANGUAGE
                /DEBUGGING MODE.        THE F COMMAND REPLACES THE
                /FORMER J COMMAND IN ODP. IN F MODE, THE
                /COMMANDS T,O,P,A,L,D,R, AND P HAVE THE SAME
                /EFFECT AS IN M MODE.
                /NOTE: TO BE COMPATABLE WITH PACKAGE D,
                /THIS PROGRAM MUST BE RELOCATED TO 4200.
                *4400
4400    7300    BEGZ,   CLA CLL
4401    1303            TAD NEWA        /RESET POINTERS TO OPERATIONS T BL S
4402    3707            DCA I LOCA      /IN ODP TO POINT TO FLOATING DE UG E
4403    1304            TAD NEWB
4404    3710            DCA I LOCB
4405    1305            TAD NEWC
4406    3711            DCA I LOCC      /RESET POINTERS IN ODP FOR A FL AT N
4407    1306            TAD NEWD        /BREAKPOINT TABLE
4410    3712            DCA I LOCD
4411    1315            TAD NEWJMP
4412    3716            DCA I RESM2     /MODIFICATION IN C INSTRUCTION  N  D
4413    1313            TAD NEWBIN      /CHANGE BREAKPOINT INSTRUCTION  0  0
4414    3714            DCA I LOCBIN
4415    5725            JMP I ODP
                /M INSTRUCTION - SWITCH TO MACHINE MODE.
                /THEREFORE ALL OLD POINTERS AND TABLES MUST
                /BE REPLACED.
4416    1317    M,      TAD FLDA
4417    3707            DCA I LOCA
4420    1320            TAD FLDB
4421    3710            DCA I LOCB
4422    1321            TAD FLDC
4423    3711            DCA I LOCC
4424    1322            TAD FLDD
4425    3712            DCA I LOCD
4426    1323            TAD FLDBIN
4427    3714            DCA I LOCBIN
4430    1324            TAD FLDJAD
4431    3716            DCA I RESM2
4432    5725            JMP I ODP
4433    0000    BRKPNT, 0               /LOCATION OF RETURN FROM AN
4434    1727            TAD I PPNT      /INTERPRETIVE BREAK POINT
4435    3326            DCA STORE
4436    1044            TAD 44
4437    3352            DCA EXP
4440    1045            TAD 45
```

```
4441  3333          DCA HORD
4442  1046          TAD 46
4443  3334          DCA LORD
4444  4735          JMS I CRLF2
4445  4406          JMS I 6
4446  1332          TAD EXP
4447  3044          DCA 44
4450  1333          TAD HORD
4451  3045          DCA 45
4452  1334          TAD LORD
4453  3046          DCA 46
4454  7240          STA
4455  1326          TAD STORE
4456  3731          DCA I GO2
4457  1731          TAD I GO2
4460  3730          DCA I PNTHT
4461  5200          JMP HERE
4462  1740  HERE,   TAD I CIABD      /RETURN FROM C ROUTINE IN ODP
4463  3334          DCA LORD
4464  1734          TAD I LORD
4465  7640          SZA CLA /FETCH INSTRUCTION,WAS IT FEXT?
4466  5633          JMP I RRKPNT      /NO-RE-ENTER INTERPRETER
4467  1336          TAD OPAR          /YES-ENTER M MODES.TYPE UP ARRO
4470  4737          JMS I TYPIT
4471  5216          JMP M    /ENTER M MODE
4472  4741  SS,     JMS I RSET        /SINGLE STEP ROUTINE.RESET POIN FR
4473  4742          JMS I FINDII      /FIND INSTRUCTION FROM GIVEN AD RE S
4474  1343          TAD RETLOC        /CHANGE POINTER IN BREAKPOINT R UT NE
4475  3744          DCA I LEND2
4476  1326          TAD STORE         /INSERT BREAKPOINT AT NEXT REGI TE
4477  5745          JMP I RPLUS5      /ENTER B ROUTINE
4500  1325  RETPNT, TAD OBP /RETURN FROM B, RESET POINTER TO END
4501  3744          DCA I LEND2
4502  5746          JMP I CI          /ENTER CONTINUE ROUTINE
                /CONSTANTS AND POINTERS
4503  4547  NEWA,   LETR2
4504  4563  NEWB,   LOMS2
4505  4577  NEWC,   ADDR2
4506  4606  NEWD,   INS12
4507  3762  LOCA,   RTAB2
4510  3762  LOCB,   RTAB2
4511  4325  LOCC,   RTAB2
4512  4327  LOCD,   RTAB2
4513  0017  NEWBIN, 17
4514  4334  LOCBIN, BRTEST
4515  5774  NEWJMP, 5774
4516  4241  RESM2,  RESET-2
4517  3777  OLDA,   LETTER
4520  4351  OLDB,   LOMS
4521  4176  OLDC,   ADDR
4522  4305  OLDD,   INS1
4523  4402  OLDBIN, JMS I 2
4524  1222  OLDJMP, 1222
4525  3602  ODP,    ENT
4526  0000  STORE,  0
4527  5600  FPC1,   5600
4530  4222  PNTHT,  PUTHI1
4531  5655  GO2,    5655
4532  0000  EXP,    0
```

```
4533  0000  HORD,    0
4534  0000  LORD,    0
4535  4206  CRLF2,   LF
4536  4336  UPAR,    33A
4537  4301  TYBIT,   TYB
4540  4330  CTABD,   TABD
4541  4243  RSFI,    RESET
4542  4253  FINDIT,  FIND
4543  4500  RETLOC,  RETRN1
4544  4335  LEND2,   END2
4545  4212  BPLUS5,  B+5
4546  4232  C1,      C
4547  7467
4550  7461
4551  7462
4552  7476
4553  7477
4554  7464
4555  7474
4556  7455  LETR2,   -311,-317,-316,-302,-301,-314,-304,-323
4557  7456
4560  7475
4561  7463
4562  7460
                    -322,-303,-315,-320,
4563  3633
4564  3626
4565  3637
4566  4205
4567  3727
4570  3753
4571  3643
4572  4472
4573  3676
4574  4232
4575  4416
4576  4013  LOWS2,   II,U,,,,A,L,B,SS,R,C,M,P
4577  0000
4600  0000
4601  0000
4602  0000
4603  0000
4604  0000
4605  0000  ADWR2,   0,,,,,,,0,0,0
4606  0000
4607  0000
4610  0000
4611  0000
4612  0000
4613  0000
4614  0000  INST2,   0,,,,,,,,,0,0
                    X6
4616  7200              72          /POINTER TO OUTPUT PACKAGE
                    X6563
6563  4433              PRINT       /INTERPRETATION TABLE OF PACKAGE
```

```
/OCTAL DEBUGGING PROGRAM -JAMES RUTHMAN 6/15/67

                    x3600
  3600   6046              TLR
  3601   6026              PLS
  3602   4752   END,       JMS I CRLF
  3603   4753              JMS I READ          /READ A NUMBER
  3604   4754              JMS I TYPE
  3605   1355              TAD N14 /RESET CONSTANTS
  3606   3357              DCA CNT
  3607   1360              TAD RTABA
  3610   3361              DCA TABA
  3611   1362              TAD RTABB
  3612   3363              DCA TABB
  3613   1763   LOOP1,     TAD I TABB
  3614   3337              DCA CHECK
  3615   6034              KRS
  3616   1761              TAD I TABA          /IDENTIFY REQUEST
  3617   7650              SNA CLA
  3620   5737              JMP I CHECK         /ENTER REQUESTED ROUTINE
  3621   2361              ISZ TABA
  3622   2363              ISZ TABB
  3623   2357              ISZ CNT
  3624   5213              JMP LOOP1
  3625   5203              JMP END+1           /CAN'T IDENTIFY-READ AGAIN
  3626   4765   O,         JMS I OCTRD         /OPEN INSTRUCTION
  3627   3366              DCA CURLOC
  3630   1766              TAD I CURLOC
  3631   4305              JMS OCTPNT          /TYPE CONTENTS
  3632   5202              JMP END
  3633   4765   II,        JMS I OCTRD         /INSERT INSTRUCTION
  3634   3766              DCA I CURLOC
  3635   2366              ISZ CURLOC
  3636   5202              JMP END
  3637   2366   N,         ISZ CURLOC          /NEXT REGISTER REQUESTED
  3640   1366              TAD CURLOC
  3641   4305              JMS OCTPNT
  3642   5230              JMP II-5

  3643   4765   D,         JMS I OCTRD         /OCTAL DUMP REQUESTED
  3644   3361              DCA INIT            /RECORD FIRST AND LAST
  3645   4765              JMS I OCTRD         /OF REQUESTED REGISTERS
  3646   7041              CIA
  3647   3363              DCA FIN
  3650   4752   LOOP2,     JMS I CRLF
  3651   1361              TAD INIT
  3652   4305              JMS OCTPNT
  3653   1367              TAD HYPH
  3654   4754              JMS I TYPE
  3655   1370              TAD N4
  3656   3357              DCA CNT
  3657   1761   LOOP3,     TAD I INIT          /OUTPUT 4 SEQUENTIAL REGISTER
  3660   4305              JMS OCTPNT
  3661   1361              TAD INIT            /FINISHED?
  3662   1363              TAD FIN
  3663   7650              SNA CLA
  3664   5202              JMP END
  3665   2361              ISZ INIT
  3666   2357              ISZ CNT
```

B (5)

```
3667  5257          JMP LOOP3
3670  5250          JMP LOOP2
3671  4765  S,      JMS I OCTRD      /START REQUESTED
3672  3361          DCA LOCJMP
3673  4752          JMS I CRLF
3674  7402  GO,     HLT
3675  5761          JMP I LOCJMP
3676  4765  R,      JMS I OCTRD      /RUN WITH PRESET AC
3677  3361          DCA LOCJMP       /AND LINK REQUESTED
3700  4752          JMS I CRLF
3701  1371          TAD LINK
3702  7110          CLL RAR
3703  1372          TAD AC
3704  5274          JMP GO
3705  0000  OCTPNT, 0        /OCTAL PRINT SUB-ROUTINE
3706  3374          DCA TEMP4
3707  1375          TAD S240
3710  4754          JMS I TYPE
3711  1370          TAD M4
3712  3373          DCA TEMP3
3713  1374  LOOP6,  TAD TEMP4
3714  7104          CLL RAL
3715  7006          RTL
3716  3374          DCA TEMP4
3717  1374          TAD TEMP4
3720  7004          RAL
3721  0356          AND M7
3722  1376          TAD M260
3723  4754          JMS I TYPE

3724  2373          ISZ TEMP3
3725  5313          JMP LOOP6
3726  5705          JMP I OCTPNT
3727  1372  A,      TAD AC   /AC REFERENCED
3730  4337          JMS CHECK
3731  3372          DCA AC   /RE-INSERT AC
3732  5202          JMP END
3733  1371  L,      TAD LINK         /LINK REFERENCED
3734  4337          JMS CHECK
3735  3371          DCA LINK         /RE-INSERT LINK
3736  5202          JMP END
3737  0000  CHECK,  0        /CHECK FOR INSERT REQUEST
3740  4305          JMS OCTPNT
3741  4752          JMS I CRLF
3742  4753          JMS I READ
3743  4754          JMS I TYPE
3744  6034          KRS
3745  1364          TAD M311
3746  7640          SZA CLA
3747  5205          JMP END+3        /CONTINUE AS USUAL
3750  4765          JMS I OCTRD
3751  5737          JMP I CHECK
3752  4266  CRLF,   LF       /CONSTANTS AND VARIABLES
3753  4274  READ,   RD
3754  4301  TYPE,   TYS
3755  7764  M14,    -14
3756  0007  M7,     7
3757  0000  CNT,    0
3760  3777  RIABA,  LETTER
3761  3777  TABA,   LETTER
```

```
3762  4351  RTABB,  LOPS                                              B
3763  4351  TABB,   LOPS
3764  7467  N311,   -311
3765  4113  OCTRD,  RDOCT
3766  0000  CURLOC, 0
3767  0255  HYPH,   255
3770  7774  N4,     -4
3771  0000  LINK,   0
3772  0000  AC,     0
3773  0000  TEMP3,  0
3774  0000  TEMP4,  0
3775  0240  R240,   240
3776  0260  R260,   260
3777  7467
4000  7461
4001  7462
4002  7476
4003  7477
4004  7464
4005  7474  LETTER, -311,-317,-316,-302,-301,-314,-304
4006  7455
4007  7456
4010  7475
4011  7472
4012  7460          -323,-322,-303,-306,-320
4013  3350  P,      DCA CHK /MEMORY PUNCH REQUESTED
4014  7402          HLT
4015  7604          LAS
4016  0375          AND M1
4017  7640          SZA CLA
4020  1360          TAD HTYPE
4021  1365          TAD TYPE2
4022  3373          DCA LOCPNT
4023  1373          TAD LOCPNT
4024  3774          DCA I LURCAL
4025  7402          HLT
4026  7604          LAS
4027  7041          CIA
4030  3351          DCA CNT2
4031  4752          JMS I LEADER

4032  7402  LOOP4,  HLT      /RECORD FIRST AND LAST REGISTERS
4033  7604          LAS
4034  3353          DCA INIT2
4035  7402          HLT
4036  7604          LAS
4037  3354          DCA FIN2
4040  1355          TAD M177
4041  3356          DCA R77
4042  7120          STL
4043  1353          TAD INIT2
4044  4266          JMS PRINT
4045  1357          TAD R77
4046  3356          DCA R77
4047  1753  LOOP5,  TAD I INIT2
4050  4266          JMS PRINT
4051  1353          TAD INIT2
4052  7041          CIA
4053  1354          TAD FIN2
```

```
4054  7650          SNA CLA
4055  5260          JMP DONE
4056  2353          IS7 INI12
4057  5247          JMP LOOP5
4060  2351  DONE,   IS7 CNT2
4061  5232          JMP LOOP4
4062  1350          TAD CHK
4063  4266          JMS PRINT
4064  4752          JMS I LEADER
4065  5761          JMP I ENDIT
4066  0000  PRINT,  0        /BINARY FORMAT PRINT
4067  3362          DCA TEMP1
4070  1362          TAD TEMP1
4071  7012
4072  7012
4073  7012          RTR,RTR,RTR
4074  0356          AND M77
4075  4304          JMS SUM
4076  4773          JMS I LOCPNT
4077  1362          TAD TEMP1
4100  0357          AND R77
4101  4304          JMS SUM
4102  4773          JMS I LOCPNT
4103  5666          JMP I PRINT
4104  0000  SUM,    0
4105  3363          DCA TEMP2
4106  1363          TAD TEMP2
4107  1350          TAD CHK
4110  3350          DCA CHK
4111  1363          TAD TEMP2
4112  5704          JMP I SUM

4113  0000  RDOCT,  0        /OCTAL READ SUB-ROUTINE
4114  1364          TAD M240
4115  4765          JMS I TYPE2
4116  3363          DCA TEMP2
4117  1366          TAD MN4
4120  3362          DCA TEMP1
4121  4767  BACK,   JMS I READ2
4122  4765          JMS I TYPE2
4123  6034          KRS
4124  1370          TAD N375
4125  7650          SNA CLA
4126  5346          JMP TERM
4127  6034          KRS
4130  0371          AND M270
4131  1372          TAD M260
4132  7640          SZA CLA
4133  5321          JMP BACK
4134  1363          TAD TEMP2
4135  7104          CLL RAL
4136  7006          RTL
4137  3363          DCA TEMP2
4140  6034          KRS
4141  1372          TAD M260
4142  1363          TAD TEMP2
4143  3363          DCA TEMP2
4144  2362          IS7 TEMP1
4145  5321          JMP BACK
4146  1363  TERM,   TAD TEMP2
```

```
4147  5713            JMP I RDOCT
4150  0000  CHK,      0          /CONSTANTS AND VARIABLES
4151  0000  CNT2,     0
4152  4315  LEADER,   LDR
4153  0000  INIT2,    0
4154  0000  FIN2,     0
4155  0177  M177,     177
4156  0077  M77,      77
4157  0077  R77,      77
4160  0006  HITYPE,   HITYPE-TYP
4161  3602  ENDIT,    END
4162  0000  TEMP1,    0
4163  0000  TEMP2,    0
4164  0240  M240,     240
4165  4301  TYPE2,    TYP
4166  7774  MN4,      -4
4167  4274  READ2,    RD
4170  7403  N375,     -375
4171  0270  M270,     270
4172  7520  N260,     -260
4173  0000  LOCPNT,   0
4174  4346  LDRCAL,   JMSLOC
4175  0001  M1,       1
4176  0000
4177  0000
4200  0000
4201  0000
4202  0000
4203  0000
4204  0000  ADDR,     0,0,0,0,0,0,0
4205  4243  B,        JMS RESET
4206  1350            TAD BRPNTR
4207  3002            DCA 2
4210  4253            JMS FIND
4211  4731            JMS I RDOCT2
4212  3726            DCA I TABC
4213  1726            TAD I TABC
4214  3333            DCA TEMP5
4215  1733            TAD I TEMP5
4216  3730            DCA I TABD
4217  1334            TAD BRINST
4220  3733            DCA I TEMP5
4221  5735            JMP I END2
4222  0000  PNTHIT,   0          /FOUND BREAK-POINT
4223  3736            DCA I ACC
4224  7004            RAL
4225  3737            DCA I LINK2
4226  7240            STA
4227  1222            TAD PNTHIT
4230  3222            DCA PNTHIT
4231  5775            JMP I LOCM
4232  4243  C,        JMS RESET
4233  1222            TAD PNTHIT
4234  7041            CIA
4235  4253            JMS FIND
4236  1730            TAD I TABD
4237  3622            DCA I PNTHIT
4240  3726            DCA I TABC
4241  1222            TAD PNTHIT
```

```
4242  5740          JMP I RPLUS1
4243  0000  RESET, 0
4244  1325          TAD RTABC
4245  3326          DCA TABC
4246  1327          TAD RTABD
4247  3330          DCA TABD
4250  1341          TAD RN4
4251  3332          DCA CNT4
4252  5643          JMP I RESET
4253  0000  FIND,   0
4254  3243          DCA RESET
4255  1243          TAD RESET
4256  1726          TAD I TABC
4257  7650          SNA CLA
4260  5653          JMP I FIND

4261  2326          ISZ TABC
4262  2330          ISZ TABD
4263  2332          ISZ CNT4
4264  5255          JMP .-7
4265  7402          HLT
4266  0000  LF,     0
4267  1342          TAD M215
4270  4301          JMS TYP
4271  1343          TAD M212
4272  4301          JMS TYP
4273  5666          JMP I LF
4274  0000  RD,     0
4275  6031          KSF
4276  5275          JMP .-1
4277  6036          KRB
4300  5674          JMP I RD
4301  0000  TYP,    0
4302  6041          TSF
4303  5302          JMP .-1
4304  6046          TLS
4305  7300          CLA CLL
4306  5701          JMP I TYP
4307  0000  HITYPE, 0
4310  6021          PSF
4311  5310          JMP .-1
4312  6026          PLS
4313  7300          CLA CLL
4314  5707          JMP I HITYPE
4315  0000  LDR,    0
4316  1344          TAD M75
4317  3347          DCA LEADCT
4320  1345          TAD M200
4321  4746          JMS I JMSLOC
4322  2347          ISZ LEADCT
4323  5320          JMP .-3
4324  5715          JMP I LDR
4325  4176  RTABC,  ADDR
4326  4176  TABC,   ADDR
4327  4365  RTABD,  INST
4330  4365  TABD,   INST
4331  4113  RDUCT2, RDUCT
4332  0000  CNT4,   0
4333  0000  TEMP5,  0
4334  4402  BRINST, JMS I 2
```

B

B (10)

```
4335  3602  END2,    END
4336  3772  ACC,     AC
4337  3771  LINK2,   LINK
4340  3677  RPLUS1,  -1+1
4341  7771  RN4,     -7
4342  0215  M215,    215
4343  0212  M212,    212
4344  7634  N75,     -144
4345  0200  M200,    200
4346  0000  JMSLOC,  0
4347  0000  LEADCT,  0
4350  4222  BRPNTR,  PNTHIT
4351  3633
4352  3626
4353  3637
4354  4205
4355  3727
4356  3733
4357  3643
4360  3671
4361  3676
4362  4232
4363  4376
4364  4013  LOCS,    11,U,C,W,A,L,D,S,R,C,F,P
4365  0000
4366  0000
4367  0000
4370  0000
4371  0000
4372  0000
4373  0000  INSI,    0,0,0,0,0,0,0,0
4374  4462  NEWK,    HERE     /POINTER TO CI ROUTINE
4375  4416  LOCM,    M
4376  5777  F,       JMP I FTRANS
4377  4400  FTRANS,  BEG2
                    FINETABB
                    INTI=TABA
                    LOCJMP=TABA
```

```
A         3727
AC        3772
ACC       4336
ADDR      4176
ADDR2     4577
B         4205
BACK      4121
BEG2      4400
BPLUS5    4545
BRINST    4334
BRKPNT    4433
BRPNTR    4350
C         4232
CHECK     3737
CHK       4150
CNT       3757
CNT2      4151
CNT4      4332
CRLF      3752
CRLF2     4535
```

B

```
CIABD    4540
CURLOC   3766
C1       4546
D        3643
DONE     4060
END      3602
ENDIT    4161
END2     4335
EXP      4532
F        4376
FIN      3763
FIND     4253
FINDIT   4542
FIN2     4154
FPNT     4527
FTRANS   4377
GO       3674
GO2      4531
HERE     4462
HITYPE   4307
HORD     4533
HTYPE    4160
HYPH     3767
II       3633
INIT     3761
INIT2    4153
INST     4365
INST2    4606
JMSLOC   4346
L        3733
LDR      4315
LDRCAL   4174
LEADCT   4347
LEADER   4152
LEND2    4544
LETR2    4547
LETTER   3777
LF       4266
LINK     3771
LINK2    4337
LOCA     4507
LOCB     4510
LOCBIN   4514
LOCC     4511
LOCD     4512
LOCJMP   3761
LOCM     4375
LOCPNT   4173
LOCS     4351
LOCS2    4563
LOOP1    3613
LOOP2    3650
LOOP3    3657
LOOP4    4032
LOOP5    4047
LOOP6    3713
LORD     4534
M        4416
MN4      4166
M1       4175
```

B (12)

M177	4155
M200	4345
M212	4343
M215	4342
M240	4164
M270	4171
M7	3756
M77	4156
N	3637
NEWA	4503
NEWB	4504
NEWBIN	4513
NEWC	4505
NEWD	4506
NEWJMP	4515
NEWR	4374
N14	3755
N260	4172
N311	3764
N375	4170
N4	3770
N75	4344
O	3626
OCTPNT	3705
OCTRD	3765
ODP	4525
OLDA	4517
OLDB	4520
OLDBIN	4523
OLDC	4521
OLDD	4522
OLDTAD	4524
P	4013
PNTHIT	4222
PNTHT	4530
PRINT	4066
R	3676
RD	4274
RDOCT	4113
RDOCT2	4331
READ	3753
READ2	4167
RESET	4243
RESM2	4516
RETLOC	4543
RETPNT	4500
RN4	4341
RPLUS1	4340
RSET	4541
RTABA	3760
RTABB	3762
RTABC	4325
RTABD	4327
R240	3775
R260	3776
R77	4157
S	3671
SS	4472
STORE	4526

SUM	4104
TABA	3761
TABB	3763
TABC	4326
TABD	4330
TEMP1	4162
TEMP2	4163
TEMP3	3773
TEMP4	3774
TEMP5	4335
TERM	4146
TYP	4301
TYPE	3754
TYPE2	4165
TYPIT	4537
UPAR	4536

```
                BEG2=5000
                /JAMES ROTHMAN  ... JULY 6,1967

                /4 WORD PACKAGE
                /ADDITIONS TO ODP TO HANDLE FLOATING
                /POINT DEBUGGING.       THIS PORTION IS
                /PLACED BELOW THE FLOATING POINT
                /PACKAGE. A FLOATING BREAKPOINT IS
                /INTERPRETIVE 0017. COMMANDS IN THIS
                /MODE ARE: B XXXX -BREAKPOINT,C -
                /CONTINUE AFTER BREAKPOINT,REINSTATING
                /TRAPPED INSTRUCTION,S-SINGLE STEP (OR
                /EFFECTIVELY MOVE BREAKPOINT ONE AHEAD)
                /AND M - JUMP BACK TO MACHINE MODE.
                /ENTRY INTO FLOATING MODE IS EFFECTED BY
                /THE COMMAND F IN NORMAL, MACHINE LANGUAGE
                /DEBUGGING MODE.        THE F COMMAND REPLACES THE
                /FORMER J COMMAND IN ODP. IN F MODE, THE
                /COMMANDS T,O,N,A,L,D,R, AND P HAVE THE SAME
                /EFFECT AS IN M MODE.
                *BEG2
5000    7300            CLA CLL
5001    1307            TAD NEWA        /RESET POINTERS TO OPERATIONS T BL S
5002    3713            DCA I LOCA      /IN ODP TO POINT TO FLOATING DE UG ER
5003    1310            TAD NEWB
5004    3714            DCA I LOCB
5005    1311            TAD NEWC
5006    3715            DCA I LOCC      /RESET POINTERS IN ODP FOR A FL AT NG
5007    1312            TAD NEWD        /BREAKPOINT TABLE
5010    3716            DCA I LOCD
5011    1321            TAD NEWJMP
5012    3722            DCA I RESM2     /MODIFICATION IN C INSTRUCTION IN ODP
5013    1317            TAD NEWBIN      /CHANGE BREAKPOINT INSTRUCTION TO  017
5014    3720            DCA I LOCBIN
5015    5731            JMP I ODP
                /M INSTRUCTION - SWITCH TO MACHINE MODE.
                /THEREFORE ALL OLD POINTERS AND TABLES MUST
                /BE REPLACED.
5016    1323    M,      TAD OLDA
5017    3713            DCA I LOCA
5020    1324            TAD OLDB
5021    3714            DCA I LOCB
5022    1325            TAD OLDC
5023    3715            DCA I LOCC
5024    1326            TAD OLDD
5025    3716            DCA I LOCD
5026    1327            TAD OLDBIN
5027    3720            DCA I LOCBIN
5030    1330            TAD OLDTAD
5031    3722            DCA I RESM2
5032    5731            JMP I ODP
5033    0000    BRKPNT, 0       /LOCATION OF RETURN FROM AN
5034    1732            TAD I FPNT      /INTERPRETIVE BREAK POINT
5035    3347            DCA STORE
5036    1044            TAD 44
5037    3335            DCA EXP
5040    1045            TAD 45
```

```
5041  3336          DCA HORD
5042  1046          TAD 46
5043  3340          DCA MIDDL
5044  1047          TAD 47
5045  3337          DCA LORD
5046  4741          JMS I CRLF2
5047  4406          JMS I 6
5050  1335          TAD EXP
5051  3044          DCA 44
5052  1336          TAD HORD
5053  3045          DCA 45
5054  1340          TAD MIDDL
5055  3046          DCA 46
5056  1337          TAD LORD
5057  3047          DCA 47
5060  7240          STA
5061  1347          TAD STORE
5062  3734          DCA I GO2
5063  1734          TAD I GO2
5064  3733          DCA I PNTHT
5065  5200          JMP BEG2
5066  1744  HERE,   TAD I CTABD      /RETURN FROM C ROUTINE IN ODP
5067  3337          DCA LORD
5070  1737          TAD I LORD
5071  7640          SZA CLA /FETCH INSTRUCTION.WAS IT FEXT?
5072  5633          JMP I BRKPNT     /NO-RE-ENTER INTERPRETER
5073  1342          TAD UPAR         /YES-ENTER M MODES.TYPE UP ARRO
5074  4743          JMS I TYPIT
5075  5216          JMP M   /ENTER M MODE
5076  4745  SS,     JMS I RSET       /SINGLE STEP ROUTINE.RESET POIN ER
5077  4746          JMS I FINDIT     /FIND INSTRUCTION FROM GIVEN AD RE S
5100  1350          TAD RETLOC       /CHANGE POINTER IN BREAKPOINT R UT NE
5101  3751          DCA I LEND2
5102  1347          TAD STORE        /INSERT BREAKPOINT AT NEXT REGI TE
5103  5752          JMP I BPLUS5     /ENTER B ROUTINE
5104  1331  RETPNT, TAD ODP /RETURN FROM B. RESET POINTER TO END
5105  3751          DCA I LEND2
5106  5753          JMP I C1         /ENTER CONTINUE ROUTINE
                /CONSTANTS AND POINTERS
5107  5154  NEWA,   LETR2
5110  5170  NEWB,   LOCS2
5111  5204  NEWC,   ADDR2
5112  5213  NEWD,   INST2
5113  4360  LOCA,   RTABA
5114  4362  LOCB,   RTABB
5115  4725  LOCC,   RTABC
5116  4727  LOCD,   RTABD
5117  0017  NEWBIN, 17
5120  4734  LOCBIN, BRINST
5121  5774  NEWJMP, 5774
5122  4641  RESM2,  RESET-2
5123  4377  OLDA,   LETTER
5124  4751  OLDB,   LOCS
5125  4576  OLDC,   ADDR
5126  4765  OLDD,   INST
5127  4402  OLDBIN, JMS I 2
5130  1222  OLDTAD, 1222
5131  4202  ODP,    END
5132  5600  FPNT,   5600
5133  4622  PNTHT,  PNTHIT
```

(2) C

```
5134  5661  GO2,     5661
5135  0000  EXP,     0
5136  0000  HORD,    0
5137  0000  LORD,    0
5140  0000  MIDDL,   0
5141  4666  CRLF2,   LF
5142  0336  UPAR,    336
5143  4701  TYPIT,   TYP
5144  4730  CTABD,   TABD
5145  4643  RSET,    RESET
5146  4653  FINDIT,  FIND
5147  0000  STORE,   0
5150  5104  RETLOC,  RETPNT
5151  4735  LEND2,   END2
5152  4612  BPLUS5,  B+5
5153  4632  C1,      C
5154  7467
5155  7461
5156  7462
5157  7476
5160  7477
5161  7464
5162  7474
5163  7455  LETR2,   -311,-317,-316,-302,-301,-310,-304,-323
5164  7456
5165  7475
5166  7463
5167  7460
                    -322,-303,-315,-320,
5170  4233
5171  4226
5172  4237
5173  4605
5174  4327
5175  4333
5176  4243
5177  5076
5200  4276
5201  4632
5202  5016
5203  4413  LOCS2,   II,U,N,B,A,L,D,SS,R,C,M,P
5204  0000
5205  0000
5206  0000
5207  0000
5210  0000
5211  0000
5212  0000  ADDR2,   0,0,0,0,0,0,0
5213  0000
5214  0000
5215  0000
5216  0000
5217  0000
5220  0000
5221  0000  INSL2,   0,0,0,0,0,0,0
                    ×6
0006  7200          7200      /POINTER TO OUTPUT PACKAGE
0007  5600          5600
                    ×5767

5767  5033          BRKPNT    /INTERPRETATION TABLE OF PACKAGE
```

```
/OCTAL DEBUGGING PROGRAM -JAMES ROTHMAN 6/15/67

                *4200
4200  6046      ENn,    TLS
4201  6026              PLS
4202  4752              JMS I CRLF
4203  4753              JMS I READ        /READ A NUMBER
4204  4754              JMS I TYPE
4205  1355              TAD N14 /RESET CONSTANTS
4206  3357              DCA CNT
4207  1360              TAD RTABA
4210  3361              DCA TABA
4211  1362              TAD RTABB
4212  3363              DCA TABB
4213  1763      LOOP1,  TAD I TABB
4214  3337              DCA CHECK
4215  6034              KRS
4216  1761              TAD I TABA        /IDENTIFY REQUEST
4217  7650              SNA CLA
4220  5737              JMP I CHECK       /ENTER REQUESTED ROUTINE
4221  2361              ISZ TABA
4222  2363              ISZ TABB
4223  2357              ISZ CNT
4224  5213              JMP LOOP1
4225  5203              JMP END+1         /CAN'T IDENTIFY-READ AGAIN
4226  4765      O,      JMS I OCTRD       /OPEN INSTRUCTION
4227  3366              DCA CURLOC
4230  1766              TAD I CURLOC
4231  4305              JMS OCTPNT        /TYPE CONTENTS
4232  5202              JMP END
4233  4765      II,     JMS I OCTRD       /INSERT INSTRUCTION
4234  3766              DCA I CURLOC
4235  2366              ISZ CURLOC
4236  5202              JMP END
4237  2366      N,      ISZ CURLOC        /NEXT REGISTER REQUESTED
4240  1366              TAD CURLOC
4241  4305              JMS OCTPNT
4242  5230              JMP II-3

4243  4765      D,      JMS I OCTRD       /OCTAL DUMP REQUESTED
4244  3361              DCA INII          /RECORD FIRST AND LAST
4245  4765              JMS I OCTRD       /OF REQUESTED REGISTERS
4246  7041              CIA
4247  3363              DCA FIN
4250  4752      LOOP2,  JMS I CRLF
4251  1361              TAD INII
4252  4305              JMS OCTPNT
4253  1367              TAD HYPH
4254  4754              JMS I TYPE
4255  1370              TAD N4
4256  3357              DCA CNT
4257  1761      LOOP3,  TAD I INIT        /OUTPUT 4 SEQUENTIAL REGISTER
4260  4305              JMS OCTPNT
4261  1361              TAD INII          /FINISHED?
4262  1363              TAD FIN
4263  7650              SNA CLA
4264  5202              JMP END
4265  2361              ISZ INII
4266  2357              ISZ CNT
```

```
4267  5257          JMP LOOP3
4270  5250          JMP LOOP2
4271  4765  S,      JMS I OCTRD      /START REQUESTED
4272  3361          DCA LOCJMP
4273  4752          JMS I CRLF
4274  7402  GO,     HLT
4275  5761          JMP I LOCJMP
4276  4765  R,      JMS I OCTRD      /RUN WITH PRESET AC
4277  3361          DCA LOCJMP       /AND LINK REQUESTED
4300  4752          JMS I CRLF
4301  1371          TAD LINK
4302  7110          CLL RAR
4303  1372          TAD AC
4304  5274          JMP GO
4305  0000  OCTPNT, 0        /OCTAL PRINT SUB-ROUTINE
4306  3374          DCA TEMP4
4307  1375          TAD R240
4310  4754          JMS I TYPE
4311  1370          TAD N4
4312  3373          DCA TEMP3
4313  1374  LOOP6,  TAD TEMP4
4314  7104          CLL RAL
4315  7006          RTL
4316  3374          DCA TEMP4
4317  1374          TAD TEMP4
4320  7004          RAL
4321  0356          AND M7
4322  1376          TAD R260
4323  4754          JMS I TYPE

4324  2373          ISZ TEMP3
4325  5313          JMP LOOP6
4326  5705          JMP I OCTPNT
4327  1372  A,      TAD AC  /AC REFERENCED
4330  4337          JMS CHECK
4331  3372          DCA AC  /RE-INSERT AC
4332  5202          JMP END
4333  1371  L,      TAD LINK         /LINK REFERENCED
4334  4337          JMS CHECK
4335  3371          DCA LINK         /RE-INSERT LINK
4336  5202          JMP END
4337  0000  CHECK,  0        /CHECK FOR INSERT REQUEST
4340  4305          JMS OCTPNT
4341  4752          JMS I CRLF
4342  4753          JMS I READ
4343  4754          JMS I TYPE
4344  6034          KRS
4345  1364          TAD N311
4346  7640          SZA CLA
4347  5205          JMP END+3        /CONTINUE AS USUAL
4350  4765          JMS I OCTRD
4351  5737          JMP I CHECK
4352  4666  CRLF,   LF       /CONSTANTS AND VARIABLES
4353  4674  READ,   RD
4354  4701  TYPE,   TYP
4355  7764  N14,    -14
4356  0007  M7,     7
4357  0000  CNT,    0
4360  4377  RTABA,  LETTER
4361  4377  TABA,   LETTER
```

(6) C

```
4362  4751  RTABB,   LOCS
4363  4751  TARB,    LOCS
4364  7467  N311,    -311
4365  4513  OCTRD,   RDOCT
4366  0000  CURLOC,  0
4367  0255  HYPH,    255
4370  7774  N4,      -4
4371  0000  LINK,    0
4372  0000  AC,      0
4373  0000  TEMP3,   0
4374  0000  TEMP4,   0
4375  0240  R240,    240
4376  0260  R260,    260
4377  7467
4400  7461
4401  7462
4402  7476
4403  7477
4404  7464
4405  7474  LETTER,  -311,-317,-316,-302,-301,-314,-304
4406  7455
4407  7456
4410  7475
4411  7472
4412  7460            -323,-322,-303,-306,-320
4413  3350  P,       DCA CHK /MEMORY PUNCH REQUESTED
4414  7402            HLT
4415  7604            LAS
4416  0375            AND M1
4417  7640            SZA CLA
4420  1360            TAD HTYPE
4421  1365            TAD TYPE2
4422  3373            DCA LOCPNT
4423  1373            TAD LOCPNT
4424  3774            DCA I LURCAL
4425  7402            HLT
4426  7604            LAS
4427  7041            CIA
4430  3351            DCA CNT2
4431  4752            JMS I LEADER

4432  7402  LOOP4,   HLT      /RECORD FIRST AND LAST REGISTERS
4433  7604            LAS
4434  3353            DCA INIT2
4435  7402            HLT
4436  7604            LAS
4437  3354            DCA FIN2
4440  1355            TAD M177
4441  3356            DCA M77
4442  7120            STL
4443  1353            TAD INIT2
4444  4266            JMS PRINT
4445  1357            TAD R77
4446  3356            DCA M77
4447  1753  LOOP5,   TAD I INIT2
4450  4266            JMS PRINT
4451  1353            TAD INIT2
4452  7041            CIA
4453  1354            TAD FIN2
```

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4454  7650          SNA CLA
4455  5260          JMP DONE
4456  2353          ISZ INIT2
4457  5247          JMP LOOP5
4460  2351  DONE,   ISZ CNT2
4461  5232          JMP LOOP4
4462  1350          TAD CHK
4463  4266          JMS PRINT
4464  4752          JMS I LEADER
4465  5761          JMP I ENDIT
4466  0000  PRINT,  0        /BINARY FORMAT PRINT
4467  3362          DCA TEMP1
4470  1362          TAD TEMP1
4471  7012
4472  7012
4473  7012          RTR;RTR;RTR
4474  0356          AND M77
4475  4304          JMS SUM
4476  4773          JMS I LOCPNT
4477  1362          TAD TEMP1
4500  0357          AND R77
4501  4304          JMS SUM
4502  4773          JMS I LOCPNT
4503  5666          JMP I PRINT
4504  0000  SUM,    0
4505  3363          DCA TEMP2
4506  1363          TAD TEMP2
4507  1350          TAD CHK
4510  3350          DCA CHK
4511  1363          TAD TEMP2
4512  5704          JMP I SUM

4513  0000  RDOCT,  0        /OCTAL READ SUB-ROUTINE
4514  1364          TAD M240
4515  4765          JMS I TYPE2
4516  3363          DCA TEMP2
4517  1366          TAD MN4
4520  3362          DCA TEMP1
4521  4767  BACK,   JMS I READ2
4522  4765          JMS I TYPE2
4523  6034          KRS
4524  1370          TAD N375
4525  7650          SNA CLA
4526  5346          JMP TERM
4527  6034          KRS
4530  0371          AND M270
4531  1372          TAD N260
4532  7640          SZA CLA
4533  5321          JMP BACK
4534  1363          TAD TEMP2
4535  7104          CLL RAL
4536  7006          RTL
4537  3363          DCA TEMP2
4540  6034          KRS
4541  1372          TAD N260
4542  1363          TAD TEMP2
4543  3363          DCA TEMP2
4544  2362          ISZ TEMP1
4545  5321          JMP BACK
4546  1363  TERM,   TAD TEMP2
```

```
4547  5713            JMP I RDOCT
4550  0000  CHK,     0          /CONSTANTS AND VARIABLES
4551  0000  CNT2,    0
4552  4715  LEADER,  LDR
4553  0000  INIT2,   0
4554  0000  FIN2,    0
4555  0177  M177,    177
4556  0077  M77,     77
4557  0077  R77,     77
4560  0006  HTYPE,   HITYPE-TYP
4561  4202  ENDIT,   END
4562  0000  TEMP1,   0
4563  0000  TEMP2,   0
4564  0240  M240,    240
4565  4701  TYPE2,   TYP
4566  7774  MN4,     -4
4567  4674  READ2,   RD
4570  7403  N375,    -375
4571  0270  M270,    270
4572  7520  N260,    -260
4573  0000  LOCPNT,  0
4574  4746  LDRCAL,  JMS LOC
4575  0001  M1,      1
4576  0000
4577  0000
4600  0000
4601  0000
4602  0000
4603  0000
4604  0000  ADDR,    0,0,0,0,0,0,0
4605  4243  B,       JMS RESET
4606  1350            TAD BRPNTR
4607  3002            DCA 2
4610  4253            JMS FIND
4611  4731            JMS I RDOCT2
4612  3726            DCA I TABC
4613  1726            TAD I TABC
4614  3333            DCA TEMP5
4615  1733            TAD I TEMP5
4616  3730            DCA I TABD
4617  1334            TAD BRINST
4620  3733            DCA I TEMP5
4621  5735            JMP I END2
4622  0000  PNTHIT,  0          /FOUND BREAK-POINT
4623  3736            DCA I ACC
4624  7004            RAL
4625  3737            DCA I LINK2
4626  7240            STA
4627  1222            TAD PNTHIT
4630  3222            DCA PNTHIT
4631  5775            JMP I LOCM
4632  4243  C,        JMS RESET
4633  1222            TAD PNTHIT
4634  7041            CIA
4635  4253            JMS FIND
4636  1750            TAD I TABD
4637  3622            DCA I PNTHIT
4640  3726            DCA I TABC
4641  1222            TAD PNTHIT
```

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```
4642  5740          JMP I RPLUS1
4643  0000  RESET, 0
4644  1325          TAD RTABC
4645  3326          DCA TABC
4646  1327          TAD RTABD
4647  3330          DCA TABD
4650  1341          TAD RN4
4651  3332          DCA CNT4
4652  5643          JMP I RESET
4653  0000  FIND,   0
4654  3243          DCA RESET
4655  1243          TAD RESET
4656  1726          TAD I TABC
4657  7650          SNA CLA
4660  5653          JMP I FIND

4661  2326          ISZ TABC
4662  2330          ISZ TABD
4663  2332          ISZ CNT4
4664  5255          JMP .-7
4665  7402          HLT
4666  0000  LF,     0
4667  1342          TAD M215
4670  4301          JMS TYP
4671  1343          TAD M212
4672  4301          JMS TYP
4673  5666          JMP I LF
4674  0000  RD,     0
4675  6031          KSF
4676  5275          JMP .-1
4677  6036          KRB
4700  5674          JMP I RD
4701  0000  TYP,    0
4702  6041          TSF
4703  5302          JMP .-1
4704  6046          TLS
4705  7300          CLA CLL
4706  5701          JMP I TYP
4707  0000  HITYPE, 0
4710  6021          PSF
4711  5310          JMP .-1
4712  6026          PLS
4713  7300          CLA CLL
4714  5707          JMP I HITYPE
4715  0000  LDR,    0
4716  1344          TAD N75
4717  3347          DCA LEADCT
4720  1345          TAD M200
4721  4746          JMS I JMSLOC
4722  2347          ISZ LEADCT
4723  5320          JMP .-3
4724  5715          JMP I LDR
4725  4576  RTABC,  ADDR
4726  4576  TABC,   ADDR
4727  4765  RTABD,  INST
4730  4765  TABD,   INST
4731  4513  RDDCT2, RDDCT
4732  0000  CNT4,   0
4733  0000  TEMP5,  0
4734  4402  BRINST, JMS I 2
```

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```
4735  4202  END2,   END
4736  4372  ACC,    AC
4737  4371  LINK2,  LINK
4740  4277  RPLUS1, R+1
4741  7771  RN4,    -7
4742  0215  M215,   215
4743  0212  M212,   212
4744  7634  N75,    -144
4745  0200  M200,   200
4746  0000  JMSLOC, 0
4747  0000  LEADCT, 0
4750  4622  BRPNTR, PNTHIT
4751  4233
4752  4226
4753  4237
4754  4605
4755  4327
4756  4333
4757  4243
4760  4271
4761  4276
4762  4632
4763  4776
4764  4413  LOCS,   II;O,N,B,A,L,D,S,R,C,F,P
4765  0000
4766  0000
4767  0000
4770  0000
4771  0000
4772  0000
4773  0000  INST,   0,0,0,0,0,0,0
4774  5066  NEWR,   HERE    /POINTER TO C1 ROUTINE
4775  5016  LOCM,   M
4776  5777  F,      JMP I FTRANS
4777  5000  FTRANS, BEG2
              FIN=TABB
              INIT=TABA
              LOCJMP=TABA
```

```
A         4327
AC        4372
ACC       4736
ADDR      4576
ADDR2     5204
B         4605
BACK      4521
BEG2      5000
BPLUS5    5152
BRINST    4734
BRKPNT    5033
BRPNTR    4750
C         4632
CHECK     4337
CHK       4550
CNT       4357
CNT2      4551
CNT4      4732
CRLF      4352
CRLF2     5141
```

```
CTABD    5144
CURLOC   4366
C1       5153
D        4243
DONE     4460
END      4202
ENDIT    4561
END2     4735
EXP      5135
F        4776
FIN      4363
FIND     4653
FINDIT   5146
FIN2     4554
FPNT     5132
FTRANS   4777
GO       4274
GO2      5134
HERE     5066
HITYPE   4707
HORD     5136
HTYPE    4560
HYPH     4367
II       4233
INIT     4361
INIT2    4553
INST     4765
INST2    5213
JMSLOC   4746
L        4333
LDR      4715
LDRCAL   4574
LEADCT   4747
LEADER   4552
LEND2    5151
LETR2    5154
LETTER   4377
LF       4666
LINK     4371
LINK2    4737
LOCA     5113
LOCB     5114
LOCBIN   5120
LOCC     5115
LOCD     5116
LOCJMP   4361
LOCM     4775
LOCPNT   4573
LOCS     4751
LOCS2    5170
LOOP1    4213
LOOP2    4250
LOOP3    4257
LOOP4    4432
LOOP5    4447
LOOP6    4313
LORD     5137
M        5016
MIDDL    5140
MN4      4566
```

C (11)

C (12)

M1	4575
M177	4555
M200	4745
M212	4743
M215	4742
M240	4564
M270	4571
M7	4356
M77	4556
N	4237
NEWA	5107
NEWB	5110
NEWBIN	5117
NEWC	5111
NEWD	5112
NEWJMP	5121
NEWR	4774
N14	4355
N260	4572
N311	4364
N375	4570
N4	4370
N75	4744
O	4226
OCTPNT	4305
OCTRD	4365
ODP	5131
OLDA	5123
OLDB	5124
OLDBIN	5127
OLDC	5125
OLDD	5126
OLDTAD	5130
P	4413
PNTHIT	4622
PNTHT	5133
PRINT	4466
R	4276
RD	4674
RDOCT	4513
RDOCT2	4731
READ	4353
READ2	4567
RESET	4643
RESM2	5122
RETLOC	5150
RETPNT	5104
RN4	4741
RPLUS1	4740
RSET	5145
RTABA	4360
RTABB	4362
RTABC	4725
RTABD	4727
R240	4375
R260	4376
R7	4557
S	4271
SS	5076

```
STORE    5147
SUM      4504
TABA     4361
TABB     4363
TABC     4726
TABD     4730
TEMP1    4562
TEMP2    4563
TEMP3    4373
TEMP4    4374
TEMP5    4733
TERM     4546
TYP      4701
TYPE     4354
TYPE2    4565
TYPIT    5143
UPAR     5142
D
```

C (13)

```
                /ADDITIONS TO CDP FOR FLOATING EXAMINAYTION AND
                /MODIFICATION. 3 WORD PACKAGE.
                /JAMES ROTHMAN  JULY 27,1967
                *3530                   /ADDITIONS TO ODP FOR EXAMINING AND
                        OUTPUT=11       /MODIFYING FLOATING POINT NUMBERS
                        INPUT=12
3530  4774      EX,     JMS I OCTRD     /EXAMINE INSTRUCTION
3531  3370              DCA TEMP
3532  4407              JMS I 7
3533  6371              FPUT TEMP2      /SAVE FAC
3534  5770              FGET I TEMP
3535  0011              OUTPUT
3536  5371              FGET TEMP2
3537  0000              FEXT
3540  5776              JMP I BEG
3541  4407      IN,     JMS I 7 /INSERT INSTRUCTION
3542  6371              FPUT TEMP2
3543  0012              INPUT
3544  6770              FPUT I TEMP
3545  5371              FGET TEMP2
3546  0000              FEXT
3547  1367              TAD P4
3550  1370              TAD TEMP        /NEXT FLOATING NUMBER
3551  3370              DCA TEMP
3552  5776              JMP I BEG
3553  1367      NEXT,   TAD P4  /EXAMINE NEXT
3554  1370              TAD TEMP
3555  3370              DCA TEMP
3556  1370              TAD TEMP
3557  4775              JMS I OCTPNT    /PRINT ADDRESS
3560  5332              JMP EX+2
3561  0000      IPUT,   0       /CHECK AND CALL INPUT
3562  4405              JMS I 5
3563  1060              TAD 60          /VALID INPUT?
3564  7650              SNA CLA
3565  5362              JMP .-3 /NO. TRY AGAIN.
3566  5761              JMP I IPUT      /YES. EXIT.
```

```
                /CONSTANTS AND POINTERS FOR ADDITIONS.
3567    0003    P4,     3
3570    0000    TEMP,   0
3571    0000
3572    0000
3573    0000    TEMP2,  0;0;0           /TEMP. FAC STORAGE
3574    4113    OCTRD,  4113
3575    3705    OCTPNT, 3705
3576    3602    BEG,    3602
                *4563   /MODIFICATIONS TO ADDRESS TABLE IN ODP
4563    3541            IN
4564    3530            EX
4565    3553            NEXT
                *4550   /COMMAND TABLE IN ODP
4550    7473            -305    /CHANGE O TO E
                *6555   /INTERPRETATION TABLE IN PACKAGE
6555    7200            7200    /FLOATING OUTPUT
6556    3561            IPUT    /FLOATING INPUT

BEG     3576
EX      3530
IN      3541
INPUT   0012
IPUT    3561
NEXT    3553
OCTPNT  3575
OCTRD   3574
OUTPUT  0011
P4      3567
TEMP    3570
TEMP2   3571
```

```
                /ADDITIONS TO CDP FOR FLOATING EXAMINATION AND
                /MODIFICATION. 4 WORD PACKAGE.
                /JAMES ROTHMAN  JULY 27,1967
                *4130   /ADDITIONS TO ODP FOR EXAMINING AND
                        OUTPUT=11       /MODIFYING FLOATING POINT NUMBERS
                        INPUT=12
4130    4775    EX,     JMS I OCTRD     /EXAMINE INSTRUCTION
4131    3370            DCA TEMP
4132    4407            JMS I 7
4133    6371            FPUT TEMP2      /SAVE FAC
4134    5770            FGET I TEMP
4135    0011            OUTPUT
4136    5371            FGET TEMP2
4137    0000            FEXT
4140    5777            JMP I BEG
4141    4407    IN,     JMS I 7 /INSERT INSTRUCTION
4142    6371            FPUT TEMP2
4143    0012            INPUT
4144    6770            FPUT I TEMP
4145    5371            FGET TEMP2
4146    0000            FEXT
4147    1367            TAD P4
4150    1370            TAD TEMP        /NEXT FLOATING NUMBER
4151    3370            DCA TEMP
4152    5777            JMP I BEG
4153    1367    NEXT,   TAD P4  /EXAMINE NEXT
4154    1370            TAD TEMP
4155    3370            DCA TEMP
4156    1370            TAD TEMP
4157    4776            JMS I OCTPNT    /PRINT ADDRESS
4160    5332            JMP EX+2
4161    0000    IPUT,   0       /CHECK AND CALL INPUT
4162    4405            JMS I 5
4163    1061            TAD 61  /VALID INPUT?
4164    7650            SNA CLA
4165    5362            JMP .-3 /NO. TRY AGAIN.
4166    5761            JMP I IPUT      /YES. EXIT.
                /CONSTANTS AND POINTERS FOR ADDITIONS.
4167    0004    P4,     4
```

```
4170  0000  TEMP,    0
4171  0000
4172  0000
4173  0000
4174  0000  TEMP2,   0;0;0;0 /TEMP. FAC STORAGE
4175  4513  OCTRD,   4513
4176  4305  OCTPNT,  4305
4177  4202  BEG,     4202
            *5170    /MODIFICATIONS TO ADDRESS TABLE IN ODP
5170  4141            IN
5171  4130            EX
5172  4153            NEXT
            *5155    /COMMAND TABLE IN ODP
5155  7473            -305     /CHANGE O TO E
            *5761    /INTERPRETATION TABLE IN PACKAGE
5761  7200            7200     /FLOATING OUTPUT
5762  4161            IPUT     /FLOATING INPUT

BEG      4177
EX       4130
IN       4141
INPUT    0012
IPUT     4161
NEXT     4153
OCTPNT   4176
OCTRD    4175
OUTPUT   0011
P4       4167
TEMP     4170
TEMP2    4171
```