BELLCOMM, INC.
955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D. C. 20024

869 04059

SUBJECT: BGRAPH - A Plotting Routine for DEEDIX - Case 610

DATE: April 16, 1969

FROM: D. P. Nash

ABSTRACT

BGRAPH is a printer plotting routine developed to graphically display the values of expendable consumption determined in program DEEDIX as a function of mission time. To implement BGRAPH, several modifications have been made to DEEDIX, and a flag has been added to indicate the variable to be plotted.

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MEMORANDUM FOR FILE

I. Introduction

The DEEDIX program automates many of the calculations required for a consumables analysis of a mission activity timeline.* Subroutine BGRAPH has been written to plot the values of expendable consumption determined in DEEDIX as a function of mission time. This memorandum describes BGRAPH as well as several modifications to DEEDIX made to implement BGRAPH.

II. Subroutine BGRAPH

A. Output

Figure 1 contains a sample graph obtained as output from BGRAPH. The graph is drawn on the printer, with periods representing the axes, and stars (*) indicating the plotted values. The maximum (VIMAX) and minimum (VIMIN) values on the ordinate are determined in the main program and are entered into BGRAPH in COMMON. The time scale on the abscissa is non-uniform. The minimum value is the first time instant in the time series, A(K), and each successive printed time value represents a change in the magnitude of the plotted variable. The abscissa extends vertically to accommodate all of the time values to be printed.

B. Input

Input to BGRAPH is through a COMMON block containing the following variables:

1. A(300) - The series of instants at which timeline activities change.**
2. DATA(2,300) - The values to be plotted.
3. J - The parameter of the loop which calls BGRAPH.
4. JUMP1 - The number of values to be plotted.

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*D. P. Nash, "DEEDIX - A Program for Timeline Activities Analysis" - Case 610, B6901042, January 17, 1969.

**In the original version of DEEDIX, A(300) was included in the DIMENSION statement.

5. VIMAX - The maximum value of the variable to be plotted.

6. VIMIN - The minimum value of the variable to be plotted.

7. IFLAG - The flag that designates a plotting option as described below.

IFLAG is an integer variable which may be assigned a value one through four, each value designating the option shown:

Value of IFLAG	Option
1	No plot
2	Plot TRATE per interval of mission time
3	Plot TSUM per interval of mission time
4	Plot ACUCØN vs mission time

IFLAG is read from a data card (FORMAT: I1) which immediately precedes the regular data deck for DEEDIX.

C. Structure of BGRAPH

Figure 2 contains a flow diagram of BGRAPH. Initial entries in BGRAPH are type and dimension statements followed by a DATA statement which names the characters that will be used for plotting. Next, the arguments for FPMARG* are computed, and that subroutine is called.

The graph is labeled, and the scale of the ordinate is computed and written. The ordinate is represented by a row of 101 periods across the page; the abscissa is represented by a column of periods down the page. A one-dimensional array, LINE, is set up containing 101 alphameric elements. Each element contains one character: a period, a star, or a blank. A DO loop is used to fill all 101 elements with characters. The ordinate, for example, is created by a loop of the form

```
      DO 1210 I = 1,101
 1210 LINE (I) = PERIOD.
```

The ordinate is subsequently written.

---

*FPMARG is a subroutine developed by R. T. Kleiner and O. R. Pardo in assembly language. FPMARG permits continuous printing of output without the normal skipping of lines at the top and bottom of each page.

In similar fashion, the values of the dependent variables are plotted. The location of the variable is determined by INOW:

INOW = ((DATA(J,K)-VIMIN)/DELY)+1.5

where: DATA(J,K) is the value to be plotted; VIMIN is the smallest value to be plotted; and the "scale factor," DELY, is (VIMAX-VIMIN)/100, VIMAX being the largest value of the variable to be plotted. LINE is loaded with: periods in the first and last elements; stars in the elements from LINE(INOW) through LINE(IBFOR) (IBFOR is the preceding value of INOW); and blanks in the remaining elements. All 101 elements of LINE are then written, the row being preceded by the printed value of the corresponding independent variable, A(K). Next, LINE is loaded with periods in positions 1 and 101, a star in position INOW, and blanks in the remaining elements and is written again. The entire printing procedure is ignored, however, if INOW equals IBFOR. INOW now becomes IBFOR and the entire process is repeated for every subsequent value of the independent variable. When the sequence of independent variables is exhausted, the ordinate is reprinted, and control returns to the calling subroutine.

The BGRAPH subroutine is shown in Appendix A; a dictionary of FORTRAN variables used is contained in Appendix B.

D. Modifications to DEEDIX

A large block of additional material is inserted at the end of DEEDIX to call BGRAPH. This is shown in the flow diagram in Figure 3. The program compiles data for the plot routine after TØTALR(M), TØTALS(M), and ACUCØN(M) have been determined for interval J. IFLAG indicates which variable is to be entered into array DATA(MM,J) where MM is the characteristic number, which designates a particular consumable, and J is the position of the interval in sequence A. Therefore, array DATA contains the values to be plotted. If IFLAG = 1, however, this whole procedure is skipped, and there is no plot. By a process of comparison of sequential values, the maximum (VIMAX) and minimum (VIMIN) values to be plotted are found. The program then calls Subroutine BGRAPH.

Dixie Nash

1025-DPN-dcs D. P. Nash

Attachments

APPENDIX A

SUBROUTINE BGRAPH

```
      SUBROUTINE BGRAPH
C
C
C     THIS SUBROUTINE PLOTS TOTAL RATE OF CONSUMPTION, TOTAL
C     CONSUMPTION, OR CUMULATIVE CONSUMPTION OF AN
C     EXPENDABLE PER INTERVAL OF MISSION TIME.
C
      COMMON A(300),DATA(2,300),J,JUMP1,VIMAX,VIMIN,IFLAG
      DIMENSION LINE(101),YSCALE(11)
      REAL LINE
      DATA PERIOD/'.'/,STAR/'*'/,BLANK/' '/
      IBFOR=1
      NLT=(2*JUMP1)+15
      N1=NLT/66
      N1=N1*66
      IF(N1.LT.NLT) N1=N1+66
      N2=5
      N3=N1
C
C
C     SUBROUTINE FPMARG SUPPRESSES THE SKIPPING OF LINES AT THE
C     TOP AND BOTTOM OF EACH PAGE OF THE PLOT.  IT THEREFORE
C     PERMITS CONTINUOUS PRINTING.
C
      CALL FPMARG(N1,N2,N3)
C
C
C     WRITE TITLE OF GRAPH.
C
      IFLAG1=IFLAG-1
      GO TO (40,50,60),IFLAG1
   40 IF(J.EQ.2) GO TO 45
      WRITE(6,3000)
      GO TO 30
   45 WRITE(6,3010)
     GO TO 30
   50 IF(J.EQ.2) GO TO 55
      WRITE(6,3020)
      GO TO 30
   55 WRITE(6,3030)
      GO TO 30
   60 IF(J.EQ.2) GO TO 65
      WRITE(6,3040)
      GO TO 30
  65  WRITE(6,3050)
   30 WRITE(6,3060)
 3000 FORMAT(19X,'TOTAL RATE OF CONSUMPTION OF ELECTRICAL POWER ',
     1 '(KW) PER INTERVAL OF MISSION TIME (HOURS AND MINUTES)'//)
 3010 FORMAT(22X,'TOTAL RATE OF CONSUMPTION OF OXYGEN (LBS/HR) ',
     1 'PER INTERVAL OF MISSION TIME (HOURS AND MINUTES)'//)
 3020 FORMAT(23X,'TOTAL CONSUMPTION OF ELECTRICAL POWER (KWH) PER',
     1 ' INTERVAL OF MISSION TIME (HOURS AND MINUTES)'//)
 3030 FORMAT(28X,'TOTAL CONSUMPTION OF OXYGEN (LBS) PER ',
     1 'INTERVAL OF MISSION TIME (HOURS AND MINUTES)'//)
 3040 FORMAT(28X,'TOTAL CONSUMPTION OF ELECTRICAL POWER (KWH) '
     1 'VS MISSION TIME (HOURS AND MINUTES)'//)
 3050 FORMAT(32X,'TOTAL CONSUMPTION OF OXYGEN (LBS) VS '
     1 'MISSION TIME (HOURS AND MINUTES)'//)
```

SUBROUTINE BGRAPH

```
 3060  FORMAT(43X,'(AN INTERVAL IS DEFINED BY SUCCESSIVE ',
     1 'TIME INSTANTS)'//)
C
C
C   OBTAIN SCALE ON Y (CONSUMPTION) AXIS.  Y AXIS IS HORIZONTAL.
C   X (TIME) AXIS IS VERTICAL IN PRINTOUT.
C
       DELY=(VIMAX-VIMIN)/100.
       YSCALE(1)=VIMIN
       YSCALE(11)=VIMAX
       DO 1 I=2,10
    1  YSCALE(I)=YSCALE(I-1)+10.0*DELY
       WRITE(6,1200) (YSCALE(I),I=1,11,2)
       WRITE(6,1201) (YSCALE(I),I=2,10,2)
 1200  FORMAT(15X,E9.3,5(11X,E9.3))
 1201  FORMAT(19X,'.',5(5X,E9.3,5X,'.'))
       DO 1204 I=1,3
 1204  WRITE(6,1205)
 1205  FORMAT(19X,'.',10(9X,'.'))
C
C
C   PRINT OUT THE Y AXIS.
C
       DO 1210 I=1,101
 1210  LINE(I)=PERIOD
       WRITE(6,1025) (LINE(I),I=1,101)
C
C
C   PLOT VALUES OF DEPENDENT VARIABLE.
C
       DO 500 K=1,JUMP1
  190  DO 200 I=1,101
  200  LINE(I)=BLANK
       INOW=((DATA(J,K)-VIMIN)/DELY)+1.5
       IF(K.EQ.1) GO TO 280
       IF(IBFOR-INOW)300,320,321
  280  DO 290 I=1,INOW
       LINE(1)=PERIOD
       LINE(101)=PERIOD
  290  LINE(I)=STAR
       GO TO 328
  300  LINE(1)=PERIOD
       LINE(101)=PERIOD
       DO 310 I=IBFOR,INOW
  310  LINE(I)=STAR
       GO TO 328
  321  LINE(1)=PERIOD
       LINE(101)=PERIOD
       DO 315 I=INOW,IBFOR
  315  LINE(I)=STAR
       GO TO 328
  320  GO TO 500
  328  LL=A(K)
       XX=LL
       YY=(A(K)-XX)*100.
       JJ=YY
C
C
```

SUBROUTINE BGRAPH

```
C       THE FOLLOWING LOOP INSURES THE PRINTING OF THE
C       CORRECT TIME INSTANT.
C
        DO 2051 I=1,3
        X=XX+FLOAT(JJ)/100.
        IF(X-A(K)) 2000,2050,2025
 2000   JJ=JJ+1
        GO TO 2050
 2025   JJ=JJ-1
 2050   CONTINUE
 2051   CONTINUE
        WRITE(6,1050) LL,JJ,(LINE(I),I=1,101)
  327   DO 330 I=1,101
  330   LINE(I)=BLANK
        LINE(1)=PERIOD
        LINE(101)=PERIOD
        LINE(INOW)=STAR
        WRITE(6,1025) (LINE(I),I=1,101)
  500   IBFOR=INOW
C
C
C  PRINT TIME INSTANT AT END OF SEQUENCE AND Y AXIS.
C  ALSO PRINT SCALE AT END OF GRAPH.
C
        K=K+1
        LL=A(K)
        XX=LL
        YY=(A(K)-XX)*100.
        JJ=YY
        DO 4000 I=1,3
        X=XX+FLOAT(JJ)/100.
        IF(X-A(K))3070,3090,3080
 3070   JJ=JJ+1
        GO TO 3090
 3080   JJ=JJ-1
 3090   CONTINUE
 4000   CONTINUE
        DO 510  I=1,101
  510   LINE(I)=PERIOD
  600   WRITE(6,1050) LL,JJ,(LINE(I),I=1,101)
 1025   FORMAT(19X,101A1)
 1050   FORMAT(2X,I5,' HR  ',I2,' MIN ',101A1)
        DO 1060 I=1,3
 1060   WRITE(6,1205)
        WRITE(6,1201) (YSCALE(I),I=2,10,2)
        WRITE(6,1200) (YSCALE(I),I=1,11,2)
        CALL FPMARG(66,5,63)
        RETURN
        END
```

APPENDIX B

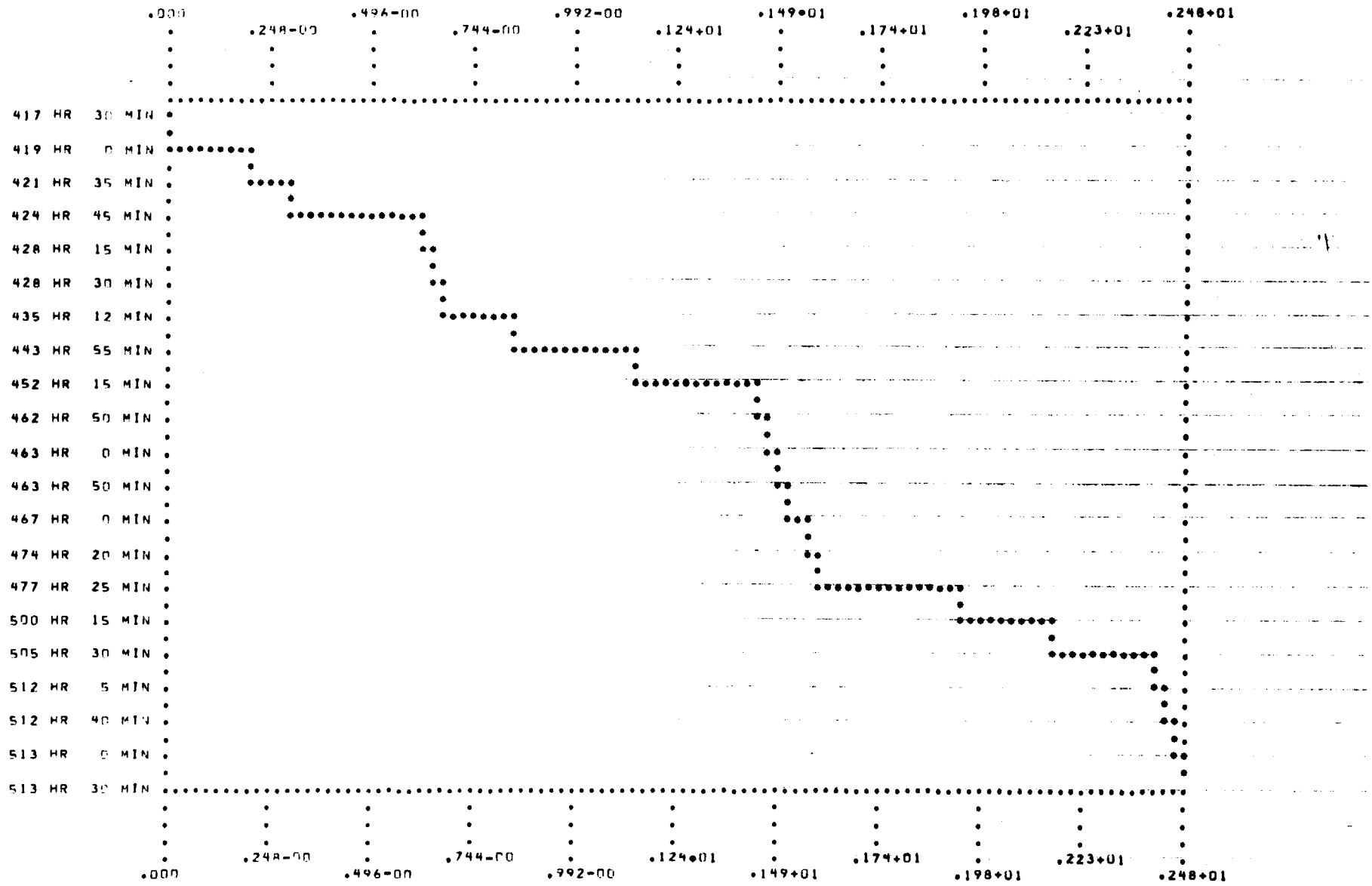
FORTRAN Dictionary

Variable	Description
A(K)	Time sequence which incorporates time series of all processors; the independent variable. Each element of the series is expressed in hours and minutes in the form M.N where M is the number of hours into the mission, and N is the number of minutes.
BLANK	A character used in plotting.
DATA(J,K)	The dependent variable; contains the consumption values of consumable J to be plotted against the time instants in array A(K).
DELY	The scale factor on the ordinate.
IBFOR	The preceding value of INOW.
IFLAG	Flag indicating the variable to be graphed.
IFLAG1	IFLAG - 1
INOW	Indicates in which of 101 positions the value of the variable is to be plotted.
J	Indicates which characteristic's consumption is being plotted.
JUMP1	The total number of values to be plotted.
LINE(K)	The array containing the characters used for plotting.
NLT	Total number of lines required for the graph.
N2	Number of lines to be skipped from top of page before printing graph.
PERIOD	A character used in plotting; '.'.
STAR	A character used in plotting; '*'.

Variable	Description
VIMAX	Largest value of variable to be plotted.
VIMIN	Smallest value of variable to be plotted.
YSCALE	Array containing values printed along the ordinate.

FIGURE 1

CUMULATIVE CONSUMPTION OF ELECTRICAL POWER (KWH) VS MISSION TIME



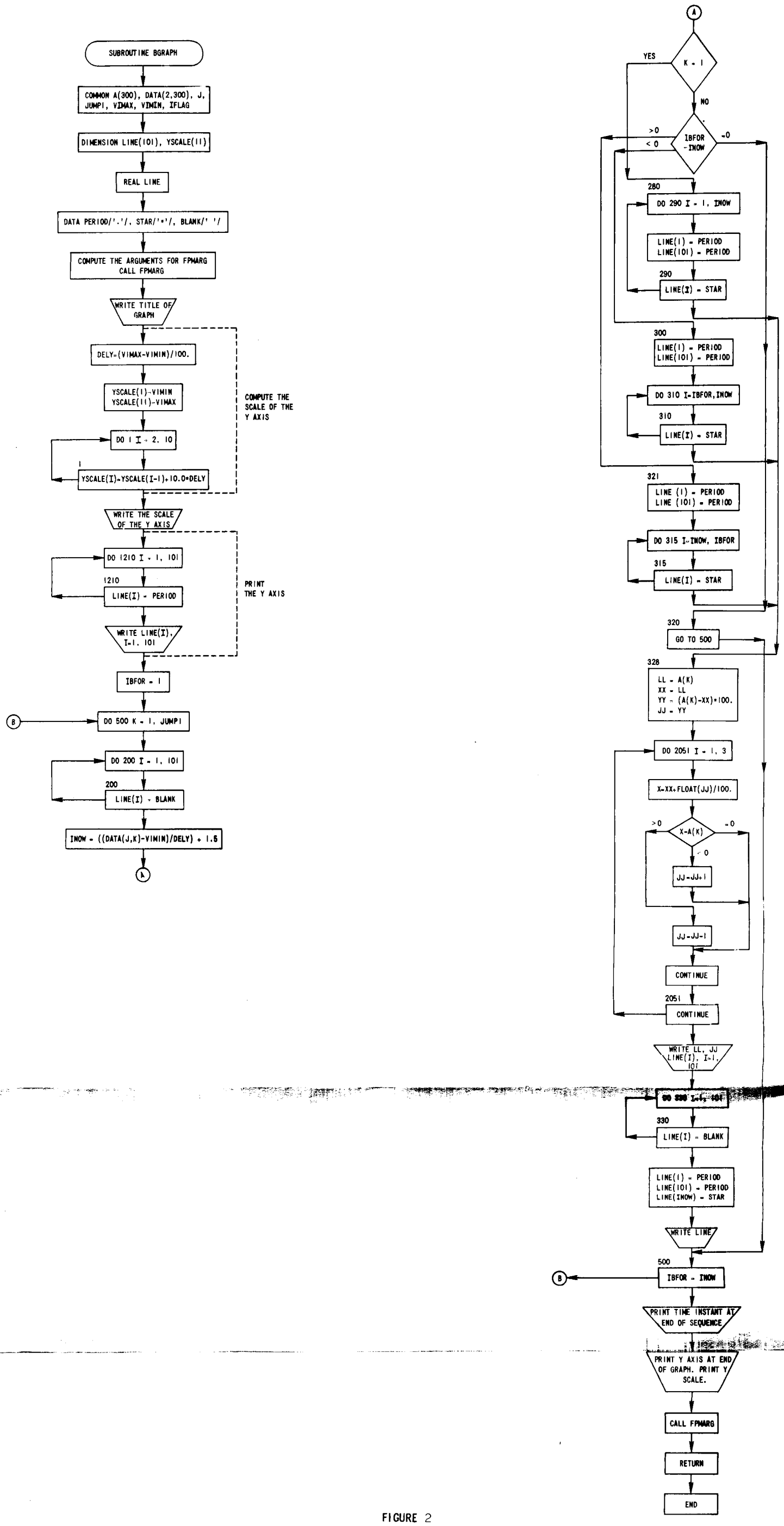


FIGURE 2
SUBROUTINE BGRAPH

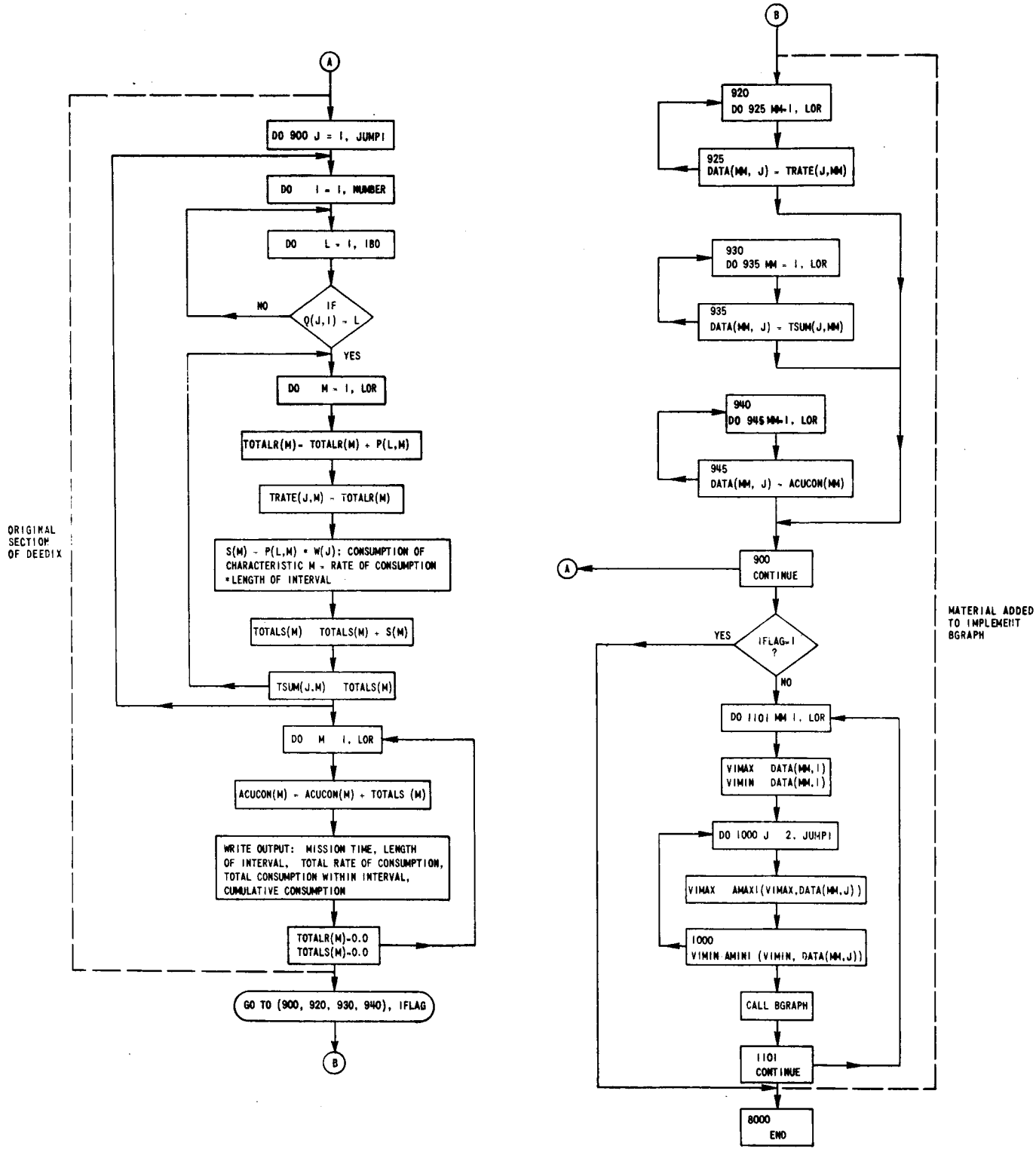


FIGURE 3
FLOW DIAGRAM OF THE CALLING ROUTINE

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From: D. P. Nash

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