DR. JOHN MANOTES
COMPUTER TECHNOLOGY DEPT.
PURDUE UNIVERSITY
CALUMET CAMPUS
HAMMOND, IN 46323

1620 USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter or pencil, do not use ink)

Program No._____ Date_____

Program Name:_____

1. Does the abstract adequately describe what the program is and what it does? Yes___ No___
   Comment_____

2. Does the program do what the abstract says? Yes___ No___
   Comment_____

3. Is the Description clear, understandable, and adequate? Yes___ No___
   Comment_____

4. Are the Operating Instructions understandable and in sufficient detail? Yes___ No___
   Comment_____
   Are the Sense Switch options adequately described (if applicable)? Yes___ No___
   Are the mnemonic labels identified or sufficiently understandable? Yes___ No___
   Comment_____

5. Does the source program compile satisfactorily (if applicable)? Yes___ No___
   Comment_____

6. Does the object program run satisfactorily? Yes___ No___
   Comment_____

7. Number of test cases run_____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes___ No___
   Comment_____

8. Does the Program Meet the minimal standards of the 1620 Users Group? Yes___ No___
   Comment_____

9. Were all necessary parts of the program received? Yes___ No___
   Comment_____

10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

Mr. Richard L. Pratt
Data Corporation
7500 Old Xenia Pike
Dayton, Ohio 45432

Your Name _____

Company _____

Address _____

User Group Code_____

THIS REVIEW FORM IS PART OF THE 1620 USER GROUP ORGANIZATION'S PROGRAM REVIEW AND EVALUATION PROCEDURE. NONMEMBERS ARE CORDIALLY INVITED TO PARTICIPATE IN THIS EVALUATION.

11/09/64

SIMULTANEOUS EQUATION SOLUTION

Author: D. N. Leeson
World Trade Europe Corporation
3-5, Cité du Retiro
Paris 8e, France

Modifications or revisions to this program, as they occur, will be announced in the appropriate Catalog of Programs for the IBM Data Processing Systems. If such announcement indicates a change to the program decks or tapes, a complete new program, if needed, should be requested from the Program Distribution Center.

DECK KEY

1. Program Deck
2. Sample Problem Deck
   (5 Cards)

SIMULTANEOUS EQUATION SOLUTION (Card)

Author: D. N. Leeson
World Trade Europe Corporation
3-5, Cité du Retiro
Paris 8e, France

Direct Inquiries to: Author

A. Purpose/Description: This program generates the solutions to a linear system of maximum rank 39 x 39. One may have 99 constant vectors per matrix of coefficients.

B. Method: Calculation of the product matrix. Arithmetic; floating.

C. Restrictions and Range: 39 x 39

D. Accuracy: Rounding error for very large systems noticeable.

E. Machine Configuration: 1620 with 1622 attachment. Division feature not required.

F. Program Requirements: All of core is required for the maximum problem.

G. Source Language: This program uses SPS Language, and is non-relocatable.

H. Program Execution Time: Variable dependent upon problem size.

I. Check-Out Status: N/A

J. Sample Problem Running Time: N/A

K. Comments: This program and its documentation were written by an IBM employee. It was developed for a specific purpose and submitted for general distribution to interested parties in the hope that it might prove helpful to other members of the data processing community. The program and its documentation are essentially in the author's original form. IBM serves as the distribution agency in supplying this program. Questions concerning the use of the program should be directed to the author's attention.

DESCRIPTION

This program generates solutions to a linear system of maximum matrix 39 X 39 with from 1 to 99 constant vectors. Division feature and indirect addressing are not necessary. The solution is accomplished without matrix inversion by the product matrix method. This method requires only $\frac{m^3}{2}$ multiplications and divisions as opposed to inversion which requires m^3 multiplications and divisions. The typed output of this program is the constant vectors and associated solution vectors. All input and output is in excess 50 floating point notation.

CARD PREPARATION

Data input consists of 1 header card,1 or more matrix cards and 1 or more constant vector cards per constant vector set.

HEADER CARD

Cols. 1-2: $\bar{xx}$ = number if rows = number of columns in the matrix of coefficients.

Cols. 3-4: $\bar{xx}$ - number of constant vectors

MATRIX CARDS: The matrix of coefficients by rows in floating point form with high order digits flagged. Utilize as many columns and as many cards as needed with eight elements per card . A matrix of 6 X 6 will use 4 full cards and 40 columns of a 5th. A matrix of 2 X 2 uses only 1/2 of one card. A maximum matrix uses 190 full cards and 10 columns of the 191st. (39 X 39)

CONSTANT VECTOR CARD(S): The constant vector in floating point form with high order digits flagged. Utilize as many columns and as many cards as needed with eight elements per card. A matrix of 16 X 16 with 1 constant vector of 6 elements requires 2 cards for constant vector description.

If more than 1 constant vector exists begin a new set of constant vector card(s) for each constant vector

EX $\begin{matrix} 2X + 3Y \\ 9X - 2Y \end{matrix} = \begin{pmatrix} 7 \\ 4 \end{pmatrix} \begin{pmatrix} 6 \\ 12 \end{pmatrix} \begin{pmatrix} 3 \\ -8 \end{pmatrix}$

CARD 1 $\bar{0}2\bar{0}3$

2 $\bar{5}12000000\bar{5}13000000\bar{5}19000000\bar{5}120000000$

3 $\bar{5}17000000\bar{5}140000000$

4 $\bar{5}16000000\bar{5}212000000$

5 $\bar{5}13000000\bar{5}180000000$

OPERATION:

1. Clear memory
2. Load program deck
3. Program halts after loading.
4. Ready data in card-read hopper
5. Press start.
6. Program solves for all constant vectors and halts. If further systems are to be solved, ready reader with data and press start.

CONSTANT VECTOR
5170000000
5140000000
SOLUTION OF SYSTEM FOR ABOVE LISTED VECTOR
5083870970
5117741935

CONSTANT VECTOR
5160000000
5212000000
SOLUTION OF SYSTEM FOR ABOVE LISTED VECTOR
5115483872
5096774193

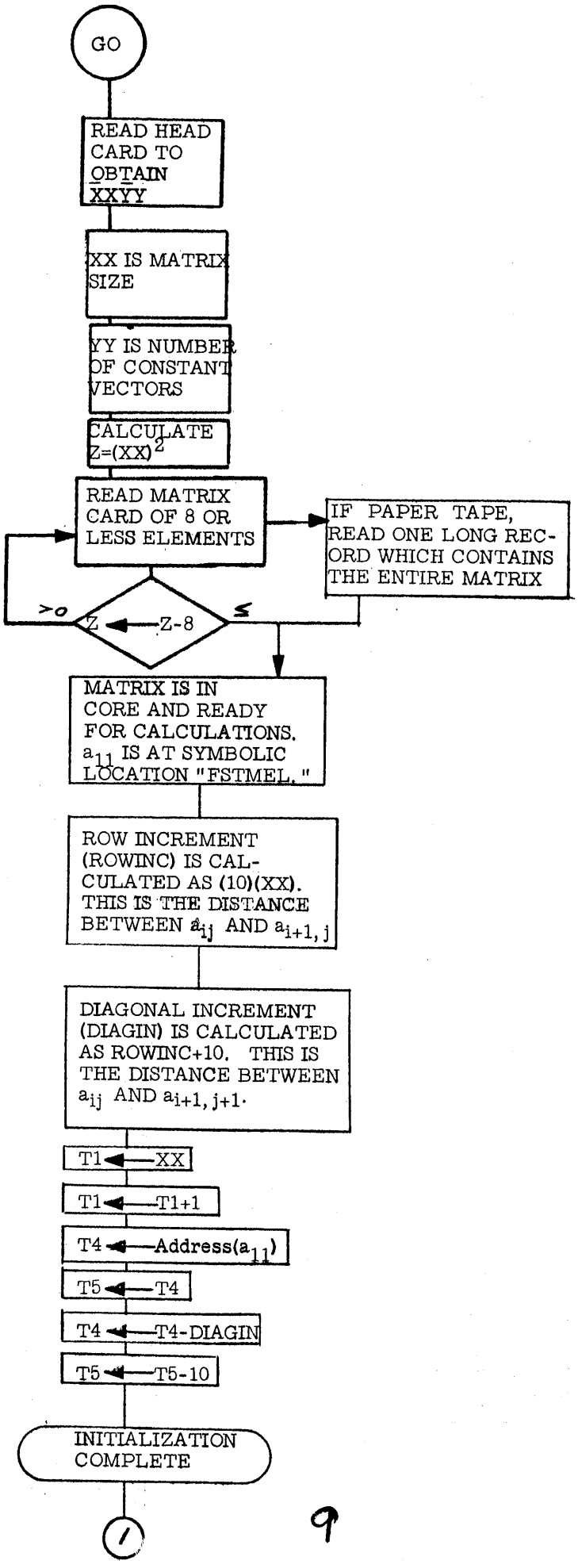
CONSTANT VECTOR
5130000000
5180000000
SOLUTION OF SYSTEM FOR ABOVE LISTED VECTOR
5058064510
5113870967

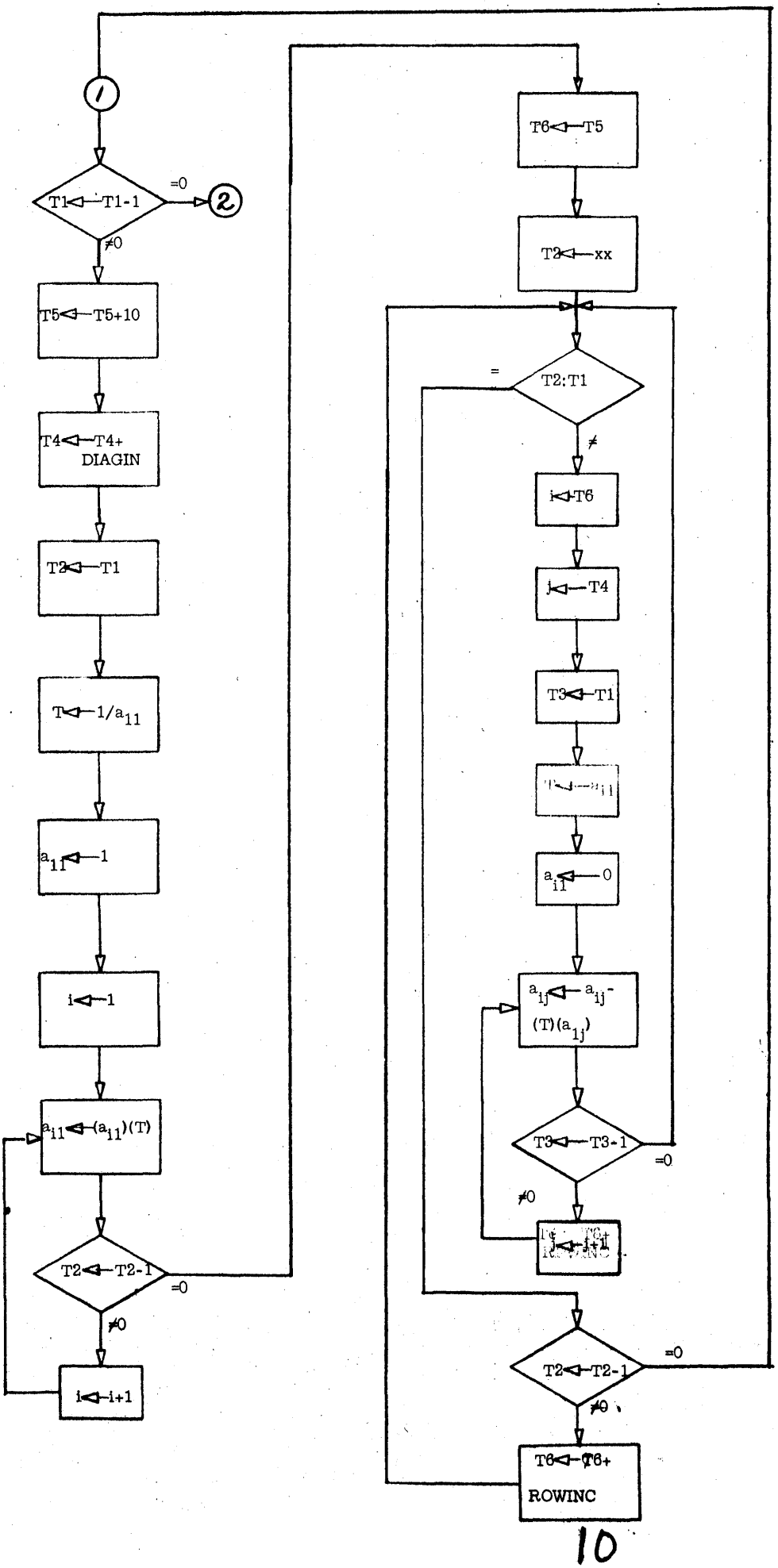
```
                                99999 *                    **********************************************Z
                                99999 *                    * THIS PROGRAM CALCULATES ROOTS TO A         *Z
                                99999 *                    * SYSTEM OF SIMULTANEOUS  EQUATIONS          *Z
                                99999 *                    * WHOSE SIZE MAY NOT EXCEED 39X39.           *Z
                                99999 *                    * FOR EACH MATRIX OF COEFFICIENTS YOU        *Z
                                99999 *                    * MAY HAVE A MAXIMUM OF 99 SOLUTION          *Z
                                99999 *                    * VECTORS.  THIS PROGRAM COMPUTES THE        *Z
                                99999 *                    * SOLUTIONS WITHOUT INVERSION OF THE         *Z
                                99999 *                    * MATRIX.  THE METHOD EMPLOYED               *Z
                                99999 *                    * IS TERMED THE METHOD OF THE PRODUCT        *Z
                                99999 *                    * MATRIX.                                    *Z
                                99999 *                    **********************************************Z
02179          16 00000          10 CMNT1    DAC     16,CONSTANT VECTOR-Z
02211          43 00000          20 CMNT2    DAC     43,SOLUTION OF SYSTEM FOR ABOVE LISTED VECTOR-Z
02300           5 00000          30 HEAD     DS      5Z
02380          80 00000          35          DS      80Z
02385           5 00000          40 ROWINC   DS      5Z
02390           5 00000          50 DIAGIN   DS      5Z
02392           2 00000          60 TEMP1    DS      2Z
02394           2 00000          70 TEMP2    DS      2Z
02396           2 00000          80 TEMP3    DS      2Z
02401           5 00000          90 TEMP4    DS      5Z
02406           5 00000         100 TEMP5    DS      5Z
02411           5 00000         110 TEMP6    DS      5Z
02421          10 00000         120 TEMP     DS      10Z
02431          10 00000         130 ONE      DC      10,5110000000Z
02441          10 00000         140 ZERO     DC      10,0Z
02452          11 00000         150 OUTPUT   DC      11,-Z
02462          10 00000         160 FSTMEL   DS      10Z
17662       15200 00000         170          DS      15200Z
17742          80 00000         175          DS      80Z
17752          10 00000         180 SOLVE    DS      10Z
18132         380 00000         190          DS      380Z
18212          80 00000         195          DS      80Z
                                99999 *                    **********************************************Z
                                99999 *                    * READ HEADER CARDS AND DATA                 *Z
                                99999 *                    **********************************************Z
18214 36 02296 00500    1020 GO     RNCD    HEAD-4Z
18226 23 02297 02297    1021        M       HEAD-3,HEAD-3Z
18238 16 18256 -2453    1022        TFM     A01023+6,FSTMEL-9Z
18250 36 00000 00500    1023 A01023 RNCD    Z
18262 12 00099 0-008    1024        SM      99,8,8Z
18274 47 18306 01100    1025        BNP     A01040Z
18286 11 18256 -0080    1026        AM      A01023+6,80Z
18298 49 18250 00000    1027        B       A01023Z
18306                   1028        DORG    *-3Z
18306 13 02297 00-10    1040 A01040 MM      HEAD-3,10,9Z
18318 26 02385 00099    1050        TF      ROWINC,99Z
18330 11 00099 -0010    1060        AM      99,10Z
18342 26 02390 00099    1070        TF      DIAGIN,99Z
18354 26 02392 02297    1080        TF      TEMP1,HEAD-3Z
18366 11 02392 000-1    1090        AM      TEMP1,1,10Z
18378 16 02401 -2462    1100        TFM     TEMP4,FSTMELZ
18390 16 02406 -2462    1110        TFM     TEMP5,FSTMELZ
18402 22 02401 02390    1120        S       TEMP4,DIAGINZ
18414 12 02406 -0010    1130        SM      TEMP5,10Z
```

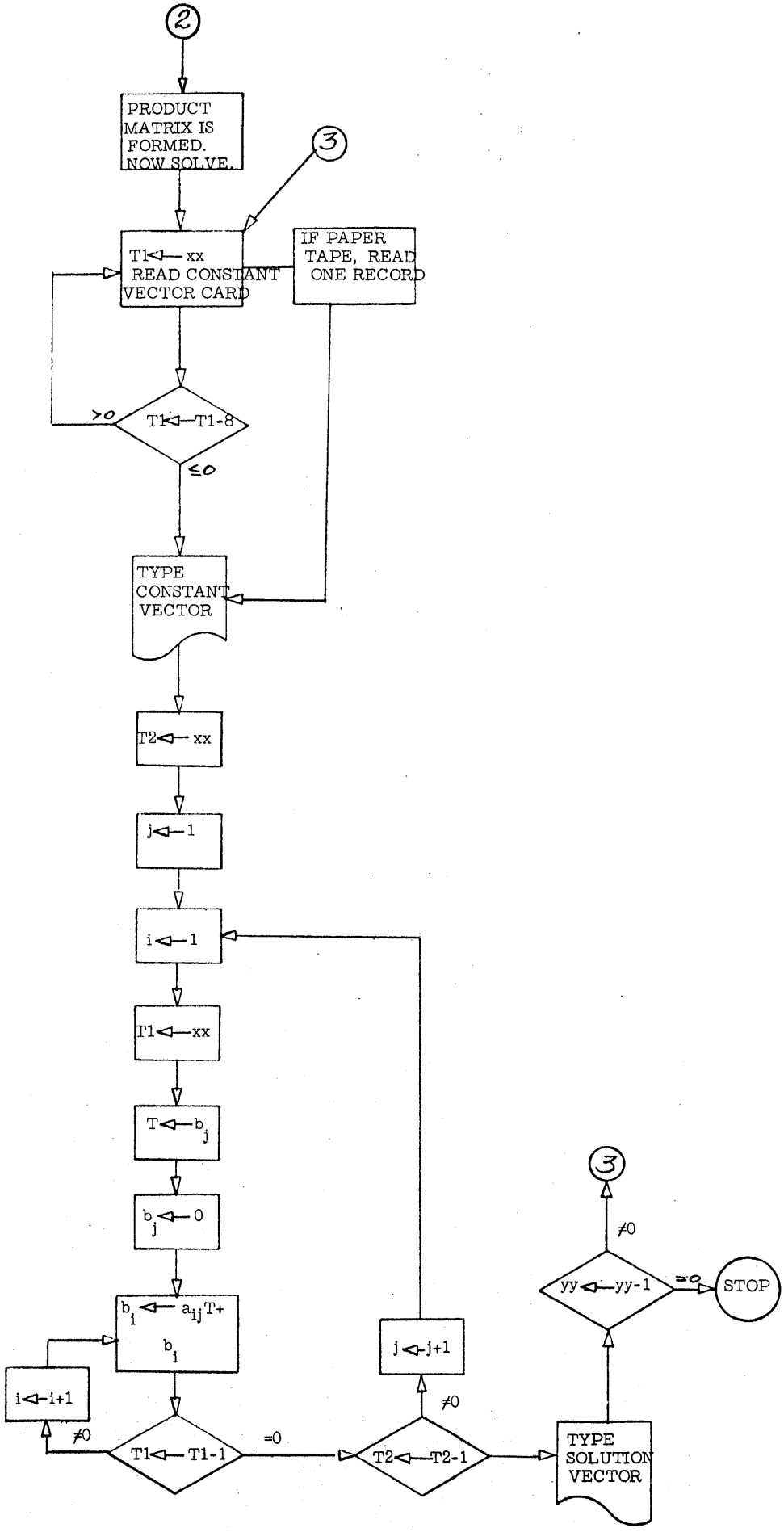
```
                        99999 *                 **********************************
                        99999 *                 * ALL INITIALIZATION IS COMPLETE *Z
                        99999 *                 **********************************Z
18426 12 02392 000-1  1150 A01150 SM    TEMP1,1,10Z
18438 46 19002 01200  1160        BZ    A03190Z
18450 11 02406 -0010  1170        AM    TEMP5,10Z
18462 21 02401 02390  1180        A     TEMP4,DIAGINZ
18474 26 02394 02392  1190        TF    TEMP2,TEMP1Z
18486 26 18569 02401  1200        TF    A02040+35,TEMP4Z
18498 26 18588 02401  2010        TF    A02060+6,TEMP4Z
18510 26 18617 02401  2020        TF    A02070+23,TEMP4Z
18522 26 18636 02401  2030        TF    A02080+6,TEMP4Z
18534 16 00469 J8569  2040 A02040 FD    ONE,0Z
18546 26 01260 02431
18558 49 01422 -0000
18570 26 02421 00099  2050        TF    TEMP,99Z
18582 26 00000 02431  2060 A02060 TF    0,ONEZ
18594 16 00469 J8629  2070 A02070 FM    0,TEMPZ
18606 26 01260 00000
18618 49 01262 -2421
18630 26 00000 00099  2080 A02080 TF    0,99Z
18642 12 02394 000-1  2090        SM    TEMP2,1,10Z
18654 46 18698 01200  2100        BZ    A02150Z
18666 11 18617 -0010  2110        AM    A02070+23,10Z
18678 11 18636 -0010  2120        AM    A02080+6,10Z
18690 49 18594 00000  2130        B     A02070Z
18698                 2140        DORG  *-3Z
18698 26 02411 02406  2150 A02150 TF    TEMP6,TEMP5Z
18710 26 02394 02297  2160        TF    TEMP2,HEAD-3Z
18722 24 02394 02392  2170 A02170 C     TEMP2,TEMP1Z
18734 46 18958 01200  2180        BE    A03140Z
18746 26 18817 02411  2190        TF    A03040+11,TEMP6Z
18758 26 18824 02411  2200        TF    A03050+6,TEMP6Z
18770 26 18865 02401  3010        TF    A03060+35,TEMP4Z
18782 26 18869 02411  3020        TF    A03070+23,TEMP6Z
18794 26 02396 02392  3030        TF    TEMP3,TEMP1Z
18806 26 02421 00000  3040 A03040 TF    TEMP,0Z
18818 26 00000 02441  3050 A03050 TF    0,ZEROZ
18830 16 00469 J8865  3060 A03060 FM    TEMP,0Z
18842 26 01260 02421
18854 49 01262 -0000
18866 16 00469 J8901  3070 A03070 FS    0,99Z
18878 16 00445 -0000
18890 49 00402 -0099
18902 12 02396 000-1  3080        SM    TEMP3,1,10Z
18914 46 18958 01200  3090        BZ    A03140Z
18926 11 18865 -0010  3100        AM    A03060+35,10Z
18938 11 18889 -0010  3110        AM    A03070+23,10Z
18950 49 18830 00000  3120        B     A03060Z
18958                 3130        DORG  *-3Z
18958 12 02394 000-1  3140 A03140 SM    TEMP2,1,10Z
18970 46 18426 01200  3150        BZ    A01150Z
18982 21 02411 02385  3160        A     TEMP6,ROWINCZ
18994 49 18722 00000  3170        B     A02170Z
19002                 3180        DORG  *-3Z
```

```
                                99999 *                    **********************************************Z
                                99999 *                    * THE PRODUCT MATRIX IS FORMED                *Z
                                99999 *                    * READ ONE SOLUTION VECTOR AND SOLVE          *Z
                                99999 *                    **********************************************Z
19002 26 02392 02297  3190 A03190 TF   TEMP1,HEAD-3Z
19014 16 19032 J7743  3191        TFM  A03192+6,SOLVE-9Z
19026 36 00000 00500  3192 A03192 RNCD  Z
19038 12 02392 000-8  3193        SM   TEMP1,8,10Z
19050 47 19082 01100  3194        BNP  A03200Z
19062 11 19032 -0080  3195        AM   A03192+6,80Z
19074 49 19026 00000  3196        B    A03192Z
19082                 3197        DORG *-3Z
19082 16 19165 J7752  3200 A03200 TFM  A04050+11,SOLVEZ
19094 16 19196 J9222  3210        TFM  A04080+6,A04120Z
19106 34 00000 00102  4020        RCTY Z
19118 39 02179 00100  4030        WATY CMNT1Z
19130 26 02392 02297  4035 A04035 TF   TEMP1,HEAD-3Z
19142 34 00000 00102  4040        RCTY Z
19154 26 02451 00000  4050 A04050 TF   OUTPUT-1,0Z
19166 38 02442 00100  4060        WNTY OUTPUT-10Z
19178 12 02392 000-1  4070        SM   TEMP1,1,10Z
19190 46 00000 01200  4080 A04080 BZ   0Z
19202 11 19165 -0010  4090        AM   A04050+11,10Z
19214 49 19142 00000  4100        B    A04050-12Z
19222                 4110        DORG *-3Z
19222 16 02406 J7752  4120 A04120 TFM  TEMP5,SOLVEZ
19234 16 02401 -2462  4130        TFM  TEMP4,FSTMELZ
19246 26 02394 02297  4140        TF   TEMP2,HEAD-3Z
19258 26 19329 02406  4150 A04150 TF   A04200+11,TEMP5Z
19270 26 19336 02406  4160        TF   A05010+6,TEMP5Z
19282 26 19365 02401  4170        TF   A05020+23,TEMP4Z
19294 16 19401 J7752  4180        TFM  A05030+23,SOLVEZ
19306 26 02392 02297  4190        TF   TEMP1,HEAD-3Z
19318 26 02421 00000  4200 A04200 TF   TEMP,0Z
19330 26 00000 02441  5010 A05010 TF   0,ZEROZ
19342 16 00469 J9377  5020 A05020 FM   0,TEMPZ
19354 26 01260 00000
19366 49 01262 -2421
19378 16 00469 J9413  5030 A05030 FA   0,99Z
19390 16 00445 -0000
19402 49 00422 -0099
19414 12 02392 000-1  5040        SM   TEMP1,1,10Z
19426 46 19470 01200  5050        BZ   A05100Z
19438 21 19365 02385  5060        A    A05020+23,ROWINCZ
19450 11 19401 -0010  5070        AM   A05030+23,10Z
19462 49 19342 00000  5080        B    A05020Z
19470                 5090        DORG *-3Z
19470 12 02394 000-1  5100 A05100 SM   TEMP2,1,10Z
19482 46 19526 01200  5110        BZ   A05160Z
19494 11 02401 -0010  5120        AM   TEMP4,10Z
19506 11 02406 -0010  5130        AM   TEMP5,10Z
19518 49 19258 00000  5140        B    A04150Z
19526                 5150        DORG *-3Z
19526 34 00000 00102  5160 A05160 RCTY Z
19538 39 02211 00100  5170        WATY CMNT2Z
19550 16 19196 J9582  5180        TFM  A04080+6,A05210Z
19562 16 19165 J7752  5185        TFM  A04050+11,SOLVEZ
```

```
19574 49 19130 00000  5190          B      A04035Z
19582                 5200          DORG   *-3Z
                      99999 *                *********************************Z
                      99999 *                *CHECK THE NUMBER OF SOLUTION VECTORS  *Z
                      99999 *                *********************************Z
19582 12 02299 000-1  5210 A05210   SM     HLAD-1,1,10Z
19594 47 19626 01200  6010          BNZ    A06050Z
19606 48 00000 00000  6020          H      Z
19618 49 18214 00000  6030          B      GOZ
19626                 6040          DORG   *-3Z
19626 34 00000 00102  6050 A06050   RCTY   Z
19638 34 00000 00102  6060          RCTY   Z
19650 49 19002 00000  6070          B      A03190Z
18214                 6080          DEND   GOZ
```


GO
READ HEAD CARD TO OBTAIN XXYY
XX IS MATRIX SIZE
YY IS NUMBER OF CONSTANT VECTORS
CALCULATE Z=(XX)2
READ MATRIX CARD OF 8 OR LESS ELEMENTS
IF PAPER TAPE, READ ONE LONG RECORD WHICH CONTAINS THE ENTIRE MATRIX
>0
Z ← Z-8
≤
MATRIX IS IN CORE AND READY FOR CALCULATIONS. a11 IS AT SYMBOLIC LOCATION "FSTMEL."
ROW INCREMENT (ROWINC) IS CALCULATED AS (10)(XX). THIS IS THE DISTANCE BETWEEN aij AND ai+1, j
DIAGONAL INCREMENT (DIAGIN) IS CALCULATED AS ROWINC+10. THIS IS THE DISTANCE BETWEEN aij AND ai+1, j+1.
T1 ← XX
T1 ← T1+1
T4 ← Address(a11)
T5 ← T4
T4 ← T4-DIAGIN
T5 ← T5-10
INITIALIZATION COMPLETE
1


1
T1←T1-1
=0
2
≠0
T5←T5+10
T4←T4+ DIAGIN
T2←T1
T←1/a11
a11←1
i←1
a11←(a11)(T)
T2←T2-1
=0
≠0
i←i+1
T6←T5
T2←xx
=
T2:T1
≠
i←T6
j←T4
T3←T1
T←aij
aij←0
aij←aij-(T)(a1j)
T3←T3-1
=0
≠0
j←j+1
T2←T2-1
=0
≠0
T6←T6+ ROWINC


2
PRODUCT MATRIX IS FORMED. NOW SOLVE.
3
T1 ← xx
READ CONSTANT VECTOR CARD
IF PAPER TAPE, READ ONE RECORD
>0
T1 ← T1-8
≤0
TYPE CONSTANT VECTOR
T2 ← xx
j ← 1
i ← 1
T1 ← xx
T ← b_j
b_j ← 0
b_i ← a_ij T+ b_i
i ← i+1
≠0
T1 ← T1-1
=0
T2 ← T2-1
j ← j+1
≠0
TYPE SOLUTION VECTOR
3
≠0
yy ← yy-1
=0
STOP