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COLLOCATION FLUTTER ANALYSIS STUDY

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VOLUME IV.

CoFA - COMPUTER PROGRAM TO PERFORM FLUTTER ANALYSIS BY THE COLLOCATION METHOD

APRIL 1969

MISSILE SYSTEMS DIVISION
HUGHES
HUGHES AIRCRAFT COMPANY

COFA

COLLOCATION FLUTTER ANALYSIS STUDY

VOLUME IV

COFA - COMPUTER PROGRAM TO PERFORM FLUTTER ANALYSIS BY THE COLLOCATION METHOD

Prepared by Dynamics & Environments Section Personnel
Hughes Aircraft Company, Missile Systems Division
Contract No. 00019-68-C-0247

APRIL 1969

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ABSTRACT

A collocation solution of the flutter and vibration problems for a multiple component system is presented. The formulation utilizes structural, aerodynamic, and inertial characteristics in the form of matrices of structural and aerodynamic influence coefficients and a mass matrix, respectively, for each component. The use of a rigid-body modal matrix permits a general analysis for a system free in space with up to six rigid-body degrees of freedom.

The computer program provides the flutter or vibration solution for a system composed of as many as 20 flexible components with a maximum total of 49 collocation control points. An option is provided to vary the density as well as the reduced velocity. Another option is provided to yield the modes from a vibration analysis in a punched-card format for use in flutter analysis by modal methods.

SECTION 1

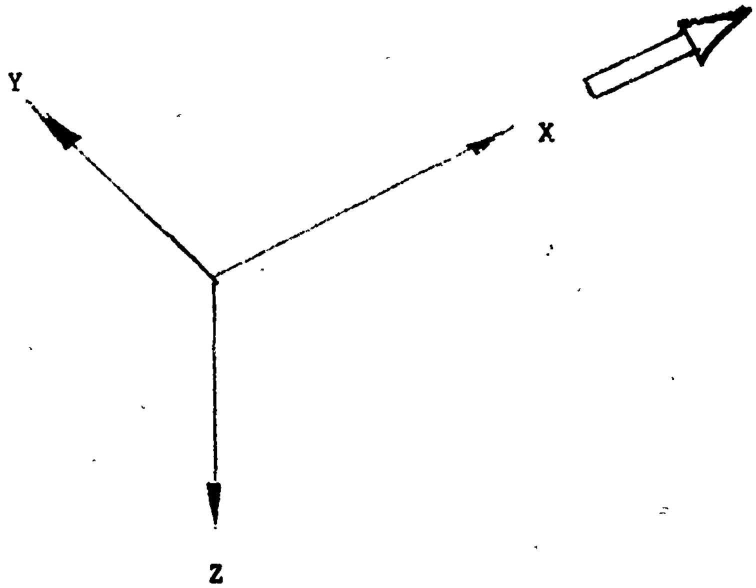
INTRODUCTION

The mathematical formulation of the flutter problem results in a set of integral equations whose closed form solution is impossible to obtain for most practical problems. One of the most useful approximate methods of solving these equations is by direct collocation. A solution by collocation is one in which the equations are satisfied at a finite number of selected points on the structure. These points, known as collocation points, are satisfied simultaneously. The collocation solution results in a matrix formulation which when cast in the canonical form will yield eigenvalues that are directly related to the flutter stability parameters. This manual presents a digital computer program that will perform collocation flutter analyses. The computer program, which is written in Fortran IV, was developed by Rodden, Farkas, and Malcom in Reference 1.

The collocation formulation of the flutter problem has been presented in Reference 2. The equations are presented for analysis of single component systems restrained (cantilevered) in space and for sysmmetrical systems free in space undergoing either symmetric or antisymmetric flutter. A method of generalizing the matrix equation for free-free flutter to include up to six rigid-body degrees of freedom has been given in Reference 3. The present program extends the formulation of Reference 2 to include an arbitrary combination of rigid-body degrees of freedom (Ref. 3), and to consider more than one flexible component. In addition, an option has been provided to vary the altitude (i.e. density) as well as the reduced velocity. Finally, options have been added to carry out a vibration analysis (which requires no aerodynamic data) and to provide vibration modes in punched-card format for use in a modal flutter or vibration analysis.

SECTION 2

The NASA body axis system with the x, y, and z axes directed forward, starboard, and downward, respectively, is recommended for consistency with the formulation of the static aeroelastic problems in Reference 4. However, the usual flutter convention with the x, y and z axes directed aft, starboard and downward, respectively, may be used instead. In either case, the vertical normal force and deflection are positive downward.



SECTION 3

DERIVATION OF EQUATIONS

The integral equations of aeroelasticity consist of two basic relationships: The first is the relation between the structural deformation, the structural influence function, and the inertial and aerodynamic loadings; the second is the relation between the aerodynamic disturbance (downwash), the aerodynamic influence (kernel) function, and the aerodynamic pressure. A collocation formulation of the deformation integral equation for a vehicle free in space may be written in matrix form by requiring that the integral equation be satisfied at a discrete set of control points. We choose a single type of coordinate, viz., the deflection h, as an adequate measure of both the deformation and the free-stream disturbance, not only for simplicity in the resulting equations but also because deflections have a more general meaning on a cambered vehicle and deflection influence coefficients are more readily obtained from a structural analysis than slope (or twist) influence coefficients. The resulting deformation matrix equation is

$$\{h_1\} - \{h_o\} = K[a] (\{F_i\} + \{F_a\}) \tag{1}$$

where $\{h_1\}$ is the set of components of the absolute deflections of the control points, $\{h_o\}$ is the set of components of the deflections of the control points due to the rigid-body motion of some reference points, $[a]$ is the set of structural influence coefficients (SICs, or flexibility matrix) for the system cantilevered from (or otherwise restrained at) the reference point, $\{F_i\}$ is the set of inertial force components integrated throughout the region adjacent to each control point, $\{F_a\}$ is the set of aerodynamic force components integrated over the vehicle surface adjacent to each control point, and the scaler K has been introduced as a factor to the SICs for convenience in investigating variations in stiffness levels. The inertial forces may be written in terms of a mass matrix $[M]$ and the control point accelerations.

$$\{F_i\} = -(1/386)[M]\{\ddot{h}_1\} \qquad (2)$$

where the diagonal elements of the mass matrix are found from integrating the structural mass density throughout the region adjacent to the control points. (N. B., the mass matrix need not be diagonal, and, in general, will not be so if the elements must be derived from a set of weight data previously lumped at a system of control points different from those required in the aeroelastic analysis. The use of a coupled mass matrix permits simulation of given inertial characteristics at a set of control points frequently dictated by more difficult aerodynamic considerations.)

A collocation formulation of the aerodynamic integral equation is more difficult than in the case of the deformation integral equation because of the singularities in the aerodynamic kernel function. The determination of three relationships is necessary to derive a set of aerodynamic influence coefficients (AICs) that relate the control point forces to the deflections. The most basic and difficult is the pressure-downwash relation that is derived from numerical analysis of the aerodynamic integral equation. The simpler relations are the numerical integration of the pressure to obtain the force, and the numerical substantial differentiation of the deflection to obtain the downwash. The effort involved in each step depends on the planform, Mach number regime, and frequency range; a survey of the status of unsteady AICs is given in Ref. 4. For present purposes, it is sufficient to state the definition of the AICs in the oscillatory case. We write the aerodynamic control point forces in terms of the control point deflections as

$$\{F_a\} = (4\pi^2/12)\rho f^2 b_r^2 s[W][C_h]\{h_1\} \qquad (3)$$

where $[C_h]$ is the theoretically derived dimensionless (complex) matrix of oscillatory AICs, f is the frequency of the assumed harmonic motion, ρ is the atmospheric density, b_r is the reference semichord, s is the reference span, and $[W]$ is an empirically derived weighting matrix for modification of the theoretical AICs. A method for obtaining the elements of the weighting matrix has been suggested in Ref. 4.

The sum of the force components may be written now from Eqs. (2) and (3) for the case of harmonic motion.

$$\{F_i\} + \{F_a\} = (4\pi^2 f^2/386)([M] + 32.174\ \rho b_r^2 s[W][C_h])\{h_1\} \tag{4a}$$

$$= (4\pi^2 f^2/386)[\overline{M}]\{h_1\} \tag{4b}$$

We next discuss the manner of inclusion of the rigid-body degrees of freedom in Eq. (1). The matrix $\{h_o\}$ has been defined as the set of components of the deflections of the control points due to the rigid-body motion of the reference point. Each component of the control point deflections h_o is linearly related to the rigid-body translations and rotations, provided the rotations are small. Therefore, we may define a rigid-body modal matrix $[h_R]$ as the transformation

$$\{h_o\} = [h_R]\,\{a_R\} \tag{5}$$

where $\{a_R\}$ is the set of amplitudes of rigid-body translations and rotations of the reference point. As an example, if we consider symmetrical vertical motion, $[h_R]$ is composed of two columns: the first is a unit column corresponding to the plunging mode, the second consists of the x-coordinate of each control point corresponding to the pitching mode; $\{a_R\}$ is composed of two elements: the first is the plunging displacement z_o, the second is the pitching angular displacement θ.

Before proceeding in the derivation, we should review the format of the various matrices in the case of a multiple flexible component system. As an example, we consider a symmetrical flutter analysis of an aircraft whose wing, aft fuselage, and tail are flexible, and whose forward fuselage may be assumed to be rigid. We assume that the reference point (cantilever point) can be located in the vehicle such that its various components are independent. If we choose a point at the intersection of the wing and fuselage, then the wing is independent of the aft fuselage-tail combination, but the tail and aft fuselage must be considered together. The motion of the rigid forward fuselage is determined by the motion of the reference point, and the forward fuselage will not enter into any flexible considerations but only into the free-free boundary conditions. From the foregoing, it is seen that the various matrices will appear in partitioned form. If we denote the wing and aft fuselage-tail system by the subscripts 1 and 2, respectively, then the flexibility matrix appears as

$$[a] = \left[\begin{array}{c|c} a_1 & 0 \\ \hline 0 & a_2 \end{array}\right] \tag{6}$$

the mass matrix as

$$[M] = \left[\begin{array}{c|c} M_1 & 0 \\ \hline 0 & M_2 \end{array}\right] \tag{7}$$

the weighting matrix as

$$[W] = \left[\begin{array}{c|c} W_1 & 0 \\ \hline 0 & W_2 \end{array}\right] \tag{8}$$

the AICs as

$$[C_h] = \left[\begin{array}{c|c} C_{h1} & 0 \\ \hline 0 & C_{h2} \end{array}\right] \tag{9}$$

and the rigid-body modal matrix as

$$[h_R] = \left[\begin{array}{c} h_{R1} \\ \hline h_{R2} \end{array}\right] \tag{10}$$

Two requirements should be emphasized with regard to the AICs. The first concerns the proper inclusion of the reference geometry associated with the nondimensional AICs. The dimensional form of Eq. (9) may be written.

$$b_r^2 s[C_h] = \left[\begin{array}{c|c} b_1^2 s_1 C_{h1} & 0 \\ \hline 0 & b_2^2 s_2 C_{h2} \end{array}\right] \tag{11}$$

where b_r and s are the reference semichord and span of the composite system, b_1 and s_1 are the reference geometry for the first component, and b_2 and s_2 are the reference geometry for the second component. The second requirement is that the AICs for each component must be determined for the same "dimensional" reduced velocity V/ω. If the reference reduced velocity is

$$1/k_r = V/b_r\omega \tag{12}$$

then the reduced velocity for the first component must be

$$1/k_1 = (1/k_r)(b_r/b_1) \qquad (13)$$

and, for the second component,

$$1/k_2 = (1/k_r)(b_r/b_2) \qquad (14)$$

Both of these requirements can be met in formulating the composite AICs by choosing the same reference geometry in determining the AICs for each component.

The rigid-body modal matrix provides the basis for a general statement of the boundary conditions for the free-free flutter of the composite system. The boundary conditions for harmonic motion may be written as

$$[h_R]^T[\overline{M}]\{h_1\} + [\Delta\overline{m}]\{a_R\} = \{0\} \qquad (15)$$

where $[\Delta\overline{m}]$ is an incremental generalized mass matrix, including aerodynamic effects, of any rigid component of the system attached to the reference point (e.g., the forward fuselage that was assumed to be rigid in the foregoing example),* and is not considered in the formulation of the flexible component mass and aerodynamic matrices. The form of the matrix $[\Delta\overline{m}]$ may be illustrated by the previous example with a rigid forward fuselage again in symmetrical motion. We may write

$$[\Delta\overline{m}] = [\Delta m] + [\Delta Q] \qquad (16)$$

---

*N. B.: It is assumed that no dynamic coupling exists between the rigid and flexible components. A suitable distinction can always be made between the rigid and flexible components such that this requirement can be met.

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where the generalized rigid component mass matrix of the forward fuselage is

$$[\Delta m] = \begin{bmatrix} M_o & S_o \\ S_o & I_{yo} \end{bmatrix} \qquad (17)$$

in which M_o, S_o, and I_{yo} are the mass, static unbalance about the reference point, and pitching moment of inertia about the reference point, respectively, of the forward fuselage, and the generalized aerodynamic forces on the forward fuselage (if not negligible) are found from

$$[\Delta Q] = 32.174\ \rho b_o^2 s_o [h_{Ro}]^T [C_{ho}] [h_{Ro}] \qquad (18)$$

where $[h_{Ro}]$ is the rigid-body modal matrix, $[C_{ho}]$ is the set of AICs, and b_o and s_o are the reference geometry for the forward fuselage. Again the AICs must be found for the reduced velocity of the composite system.

We are now in a position to eliminate the rigid-body degrees of freedom and to formulate the eigenvalue problem for the flutter of the flexible free-free system. Substituting Eqs. (4b) and (5) into Eq. (1), and adding the structural damping factor 1/(1 + ig) to the flexibility matrix to provide the artificial structural damping necessary to sustain the assumed harmonic motion of the flutter system, we obtain

$$\{h_1\} - [h_R]\{a_R\} = (4\pi^2 Kf^2/386(1 + ig))[a][\overline{M}]\{h_1\} \qquad (19)$$

or

$$\lambda(\{h_1\} - [h_R]\{a_R\}) = [a][\overline{M}]\{h_1\} \qquad (20a)$$

$$= [U]\{h_1\} \qquad (20b)$$

where λ denotes the eigenvalue

$$\lambda = \lambda_R + i\lambda_I \tag{21a}$$

$$= 386(1 + ig)/4\pi^2 K f^2 \tag{21b}$$

Premultiplying Eq. (20b) by $[h_R]^T[\overline{M}]$, and multiplying Eq. (15) by λ and subtracting, permits solution for the amplitudes of the rigid-body motion

$$\lambda\{a_R\} = -[\overline{m}]^{-1}[h_R]^T[\overline{M}]\,[U]\{h_1\} \tag{22}$$

where

$$[\overline{m}] = [h_R]^T[\overline{M}]\,[h_R] + [\Delta\overline{m}] \tag{23}$$

Finally, substituting Eq. (22) into Eq. (20b) yields the generalized matrix equation for free-free flutter

$$\lambda\{h_1\} = ([I] - [h_R]\,[\overline{m}]^{-1}[h_R]^T[\overline{M}])[U]\,\{h_1\} \tag{24}$$

The solution of Eq. (24) for the complex eigenvalues leads to the free-free frequency and the required structural damping. From Eq. (21), we obtain the frequency

$$f = (1/2\pi)\sqrt{386/K\lambda_R} \tag{25}$$

and the required structural damping

$$g = \lambda_I/\lambda_R \tag{26}$$

Since the formulation of the AICs requires the assumption of a reduced velocity $1/k_r$, the velocity follows from that and the frequency obtained in Eq. (25)

$$U = 0.5921\,(2\pi f b_r)(1/k_r) \qquad (27)$$

Equation (24) is seen to be completely general, being applicable from the cantilever case (in which we let $[h_R]$ vanish) to the case of six rigid body degrees of freedom, and for a vibration analysis for which the aerodynamic terms and required structural damping are deleted. We observe that Eq. (24) is a matrix formulation of the algebraic procedures for free-free vibration analysis described in Ref. 4 (Par. 11.2).

From a series of solutions of Eq. (24) for various reduced velocities, the conventional required damping versus velocity stability curve can be constructed for a specific altitude, and the flutter point is determined as the velocity for which the required damping and actual damping are equal. An alternative approach to the flutter analysis is based on a single representative reduced velocity and a series of solutions of Eq. (24), carried out for various densities. The density at which the required damping and actual damping are equal may be used to find a stiffness-altitude similarity parameter for flutter from which the flutter stability may be determined. However, at present, the validity of this latter approach requires further investigation, particularly the sensitivity of the results to the choice of representative reduced velocity.

The generalized mass corresponding to each free vibration mode is of interest in various modal analyses of flying qualities, stability and control characteristics, or transient response of flexible vehicles. If Eq. (24) is solved for the free vibration modes (by deleting the aerodynamic terms) then the n'th generalized mass is given by

$$m^{(n)} = \{h_1^{(n)}\}^T[M]\{h_1^{(n)}\} + \{a_R^{(n)}\}^T[\Delta m]\{a_R^{(n)}\} \qquad (28)$$

where $\{h_1^{(n)}\}$ is the n'th free vibration mode and the corresponding rigid component mode is found from Eq. (22)

$$\{a_R^{(n)}\} = -\frac{4\pi^2 K}{386} f_n^2 [M]^{-1} [h_R]^T [M][U]\{h_1^{(n)}\} \tag{29}$$

SECTION 4

REFERENCES

1. W. P. Rodden, E. F. Farkas and H. A. Malcom. "Flutter and Vibration Analysis by a Collocation Method: Analytical Development and Computation Procedure". Aerospace Corporation Report No. TDR-169(3230-11)TN-14, 31 July 1963.
2. W. P. Rodden, "Matrix Approach to Flutter Analysis" Institute of the Aerospace Sciences Fairchild Fund Paper No. FF-23, May 1958; based on North American Aviation, Inc., Report NA-56-1070, 1 May 1956.
3. W. P. Rodden, "On Vibration and Flutter Analysis with Free-Free Boundary Conditions". Journal of the Aerospace Sciences, 28 (1961) 65.
4. W. P. Rodden and J. D. Revell. "The Status of Unsteady Aerodynamic Influence Coefficients". Institute of Aerospace Sciences Fairchild Fund Paper No. FF-33, 23 January 1962; preprinted in Aerospace Corporation Report TDR-930(2230-09) TN-2, 22 November 1961.
5. R. L. Bisplinghoff, H. Ashley, and R. L. Halfman. Aeroelasticity. Reading: Addison-Wesley Publishing Company, Inc., 1955.
6. R. H. Scanlan and Robert Rosenbaum. Introduction to the Study of Aircraft Vibration and Flutter. New York: The MacMillan Company, 1951.

SECTION 5

DESCRIPTION OF PROGRAM INPUT

UNITS

The dimensional data required for each component consist of the mass matrix in pounds, the flexibility matrix in inches per pound, and the reference semichord and semispan in feet. The aerodynamic influence coefficients are dimensionless. In the case of free-free analysis, the rigid-body mass matrix, e.g., in a symmetrical analysis if S_o and I_{yo} are given in the foot-pound system, the x-coordinates which correspond to the rigid body pitching mode must be measured in feet, whereas if S_o and I_{yo} are given in the inch-pound system, the x-coordinate must be measured in inches. The density is required in slugs per cubic foot.

CLASSES OF DATA AND PROBLEMS

Five classes of data must be provided: mass, aerodynamic influence coefficients (AICs) and their weighting matrices, structural influence coefficients, the rigid-body motion modal matrix, and the rigid component generalized mass characteristics. The cantilever case does not require either the rigid body modal matrix or the generalized masses. (For a vibration analysis, the aerodynamic input is not required.)

Several classifications of problems may be analyzed using the collocation flutter analysis program. They are cantilever flutter analysis — the structure is restrained from plunging motion. Free-free flutter analysis the structure is free to pitch, plunge, and roll. The free-free cases may have rigid components and flexible components. However, when flexible components are coupled together, the structural attachment between component must be statically determinate. When rigid body components are used, any number up to six rigid body modes may be used. Also vibration analyses may be performed when zero aerodynamic forces are used.

PROGRAM RESTRICTIONS AND OPTIONS

1. The maximum number of control points that can be used for all flexible components of any system is 49. A maximum of 49 control points may also be used for the rigid component for the purpose of deriving the generalized aerodynamic force.

2. The maximum number of flexible components is 20.

3. The maximum number of values used in the reference reduced velocity $(1/K_R)$ series is 20.

4. The maximum number of values used in a density series is 20.

5. The program provides for varying the densities with each $(1/K_R)$ or for using the same densities with all $(1/K_R)$'s.

6. The maximum number of output modes is 25.

7. The maximum number of rigid-body motion modes is 6.

8. It is possible to reserve a partition in the upper left-hand corner of the flexible components AIC matrices for control points whose aerodynamic forces may be neglected or found from an alternate theory to that used for the primary control points. This partition is termed the external stores region since external stores are an example of a source of additional control points requiring such special consideration. The maximum number of control points that can be reserved on each flexible component for external stores is 48.

9. A weighting matrix is an optional input for each flexible component. The order of this matrix must be identical with the order of the AIC matrices for the particular component.

10. Any number of complete sets (decks) of input data may be stacked and run in one machine pass.

DATA DECK SETUP

Loading Order

The data decks are assembled using cards punched from keypunch forms and/or card that are punched-card output from appropriate computer programs. The data items in each deck have the following order, with the exception that some of the items may be omitted if indicators used in the control cards specify their absence.

1. Title card
2. Data deck general control card
3. K card (flexibility matrix scale factor)
4. Data card for change in matrix iteration tests
5. Control card(s) for external stores and weighting matrices
6. Reference semichord (b_r) and reference reduced velocities ($1/k_r$)'s
7. Reference semichord (b_{ri}) and reference semispan (S_i) for rigid and flexible components (surfaces)
8. Density series (if same densities are used for all ($1/k_r$)'s
9. Generalized mass matrix ($[\Delta m]$) for rigid components
10. Mass matrix ($[M]_i$) for each flexible surface
11. Rigid-body motion modal matrix ($[h_{R_0}]$) for rigid component
12. Rigid-body motion modal matrix ($[h_{R_i}]$) for each flexible surface
13. Flexibility matrix ($[a]_i$)
14. Weighting matrices ($[W]_i$)
15. Aerodynamic input repeated for each ($1/k_r$)
    a. Density series cards (if densities vary with each ($1/k_r$)
    b. AIC matrix ($[C_{h_0}]$) for rigid component (if present)
    c. AIC matrix ($[C_h]_i$) for each flexible surface

Input Data Description

1. The title card may contain any alphanumeric characters desired in Columns 2 through 72.

2. Data deck general control card (FORMAT 18I4):

Col	1-4	5-8	9-12	13-16	17-20	21-24	25-28	29-32	33-36
Name	NSUR	NAERO	NRIGID	NFUS	NDENS	MODES	NDELM	NPUNCH	NCOM
Field	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

NSUR: Number of flexible components (surfaces), ≤ 20.

NAERO: Number of reference reduced velocities, ≤ 20; NAERO = 0 is used for vibration analyses.

NRIGID: Number of rigid-body motion modes to be input (= number of columns in $([h_R])$; NRIGID = 0 for the cantilever case.

NFUS: NFUS must = 1 if AICs $([C_{ho}])_j$, j = 1, NAERO are input for the rigid components; NFUS = 0 if $[C_{ho}]$ is not input.

NDENS: If NDENS = 0 the densities are to vary with each $1/k_r$ and are input as part of Item 15; if NDENS>0 this number of densities must be input as Item 8, and each density value will be used for all $(1/k_r)$'s.

MODES: Number of output modes, ≤ 25.

NDELM: NDELM = 0 if no rigid component generalized mass matrix $([\Delta m])$is input; NDELM = 1 if $[\Delta m]$ is input.

NPUNCH: This indicator is used to obtain a printout of the dynamic matrix ([U]) and to obtain the frequencies and modes in punched-card format; NPUNCH = 0 if no printout of [U] or punched output is desired; NPUNCH = 1 if only punched-card output is desired and NPUNCH = -1 will provide the printout of [U] and the punched output. (The minus sign must be in Column 29 and the 1 (one) in Column 32.)

NCON: This indicator provides for changing five program test numbers used in the matrix iteration subroutine; NCON = 0 if no changes are desired and NCON $\neq$ 0 if any of the tests is to be changed.

3. K card (FORMAT 6E12.8)

Col	1-2
Name	K
Field	(1)

Field 1 contains K, the flexibility matrix normalizing constant; if the [a] matrix has not been normalized, enter K = 1.0. The flexibility matrix calculated by the program FLUENC has not been normalized.

4. Data card for changes in matrix iteration tests (FORMAT 3E12.8 and 2I4). Omit this card when NCON = 0. There are three test numbers and two control numbers that define the convergence criteria for the flutter eigenvalue solution. A suggested set of numbers are built into the program; these, however, may be changed by the program user. To alter any number, all five numbers must be reentered.

Col	1-12	13-24	25-36	37-40	41-44	
Name	EPSP	EPDP	AITKEN	NITRSP	NITRDP	
Field	(1)	(2)	(3)	(4)	(5)	

EPSP = 0.5×10^{-6} or input number; test for eigenvector convergence when the iteration procedure is approaching a single root.

EPDP = 0.5×10^{-7} or input number; test for convergence when the interation procedure is approaching a pair of close roots.

AITKEN = 0.9 or input number; if this test is met, the program uses a procedure (known as Aitken's δ^2 method) to accelerate convergence.

NITRSP = 40; a maximum of 40 single precision arithmetic iterations will be performed for each eigenvalue if its eigenvectors have not converged in a lesser number.

. ITRDP = 100; if the eigenvectors for any one eigenvalue have not converged in NITRSP single precisions iterations, the program will then use up to a maximum of 100 double arithmetic iterations.

5. Control card(s) for external stores and weighting matrices (FORMAT 18I4); omit this data when NAERO = 0.

Col	1-4	5-8	9-12	13-16	
Name	$ISXT_1$	ISW_1	$ISXT_2$	ISW_2	
Field	1	2	3	4	

Continue on successive cards to $ISW_i = ISW_{NSUR}$.

$ISXT_i$ = Number of control points reserved for the external stores on surface i.

ISW_i = 0, no weighting matrix is to be input for surface i.
= 1, weighting matrix is to be input for surface i.

Continue on next card, until i = NSUR.

6. Reference semichord, b_r and reduced velocity $(1/k_r)$ series (FORMAT 6E12.8): These reference parameters are used in computing the flutter velocities.

Col	1-12	13-24	25-36	37-48	49-60	61-72
Name	b_r	$(1/k_r)_1$	$(1/k_r)_2$	$(1/k_r)_3$	$(1/k_r)_4$	$(1/k_r)_5$
Field	(1)	(2)	(3)	(4)	(5)	(6)

Continue $(1/k_r)_i$'s on next card(s); $i \leq 20$. The b_r(feet) may be any value; but it is noted that the $(1/k_r)_i$ predetermines the $(1/k_i)$ used when computing the AIC matrices for each surface. The $1/k_i$ for surface i is found from the relationship $(1/k_i) = (1/k_r)(b_r/b_{ri})$ where b_{ri} is the reference semichord for surface i.

7. A reference semichord (b_{r_i}) and semispan (s_i) must be input for the rigid component if NFUS = 1, and for each flexible surface if NAERO>0.

When NFUS = 1 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	b_{r_0}	s_{r_0}	b_{r_1}	s_{r_1}	b_{r_2}	s_{r_2}
Field	(1)	(2)	(3)	(4)	(5)	(6)

Where b_{r_0} and s_{r_0} are the reference semichord and semispan for the rigid component. Continue on next card(s) until $b_{r_i} = b_{r_{NSUR}}$ and $s_{r_i} = s_{r_{NSUR}}$.

When NFUS = 0 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	b_{r_1}	s_{r_1}	b_{r_2}	s_{r_2}	b_{r_3}	s_{r_3}
Field	(1)	(2)	(3)	(4)	(5)	(6)

Continue on next card(s) until $b_{r_i} = b_{r_{NSUR}}$ and $s_{r_i} = s_{r_{NSUR}}$.

8. Density series (FORMAT 6E12.5): Omit this input if NDENS=0 in Item 2. If NDENS>0 begin in field 1 of this card and NDENS densities, ≤ 20. Continue on successive card(s).

Column	1-12	13-24	25-36	37-48
Name	ρ_1	ρ_2	ρ_3	ρ_4
Field	1	2	3	4

9. Rigid component generalized mass matrix $[\Delta m]$. The $[\Delta m]$ matrix for the rigid component(s) of the system must be compatible with the flexible surfaces product matrix given by $[h_R]^T[M][h_R]$, i.e., each element in $[\Delta m]$ is based upon the same rigid-body motion generalized coordinate as the respective element in the product matrix. Input by column beginning each column on a new card. Omit this data when NDELM = 0.

Col	1-12	13-24	25-36		
Name	$\Delta m_{1,1}$	$\Delta m_{2,1}$	$\Delta m_{3,1}$	$\Delta m_{(NRIGID-1),1}$	$\Delta m_{NRIGID,1}$
Field	(1)	(2)	(3)	(NRIGID-1)	(NRIGID)

Continue on successive card(s) until

10. Mass matrix [M]: The mass matrix is partitioned as shown on page A-10, only the nonzero partitions are input; i.e., a separate mass matrix ($[M_i]$) is input for each surface. The sequence for considering the surfaces is the same as that used in Item 5 and 7 if NAERO>0. Repeat the following input for each surface from i = 1 to NSUR.

Size Control Cards

Column	1-4	5-8	9-12	
Name	$NSIZE_i$			
Field	(1)	(2)	(3)	

$NSIZE_i$ = the order of $[M]_i$

Often many of the elements in a mass matrix are zero; the following format has been provided so that most of the zero elements will not need to be entered into the program as data.

Control Card(s) for Omitting Zeros (FORMAT 18I4)

Column	1-4	5-8	9-12	13-16	17-20	
Name	LOW_1	$LHIGH_1$	LOW_2	$LHIGH_2$	LOW_3	$LHIGH_i$
Field	(1)	(2)	(3)	(4)	(5)	(2_i)

LOW_i = The row number in which the first nonzero element appears in Column i.

$LHIGH_i$ = The row number in which the last nonzero element appears in Column i.

If only one nonzero element appears in Column i (i.e., a diagonal mass matrix) the row number in which it appears must be used for both LOW and LHIGH.

Mass Matrix Elements (FORMAT 6E12.8)

Col	1-12	13-24	25-36			
Name	$\Delta m_{1,LOW}$	$\Delta m_{1,LOW+1}$	$\Delta m_{1,LOW+2}$		$\Delta m_{1,\ LHIGH-1}$	$\Delta m_{1,\ LHIGH}$
Field	(1)	(2)	(3)			

The elements are entered by column; each column begins on a new card. Any zero elements in rows between LOW and LHIGH must be entered or their respective fields left blank. If external stores are present (ISXT>0) all store control points must be entered before the surface control points; i.e., the elements representing the external stores mass must occupy the upper left-hand corner of the mass matrix.

11. Rigid component inodal matrix, $[h_{R_0}]$ (see page 7). Omit this input when NFUS = 0. The number of rows in $[h_{R_0}]$ must be the same as the number of control points considered when computing the $[C_{h_c}]$ matrices; the number of columns must agree with NRIGID.

Size Control Card(s) (FORMAT 18I4)

Column	1-4	5-8	
Name	NROWS		
Field	(1)	(2)	

NROWS = The number of rows in $[h_{R_0}]$

Matrix $[h_{R_o}]$ Elements (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	$h_{R_{o1,1}}$	$h_{R_{o2,1}}$	$h_{R_{o3,1}}$	....	....	$h_{R_{oNROWS,1}}$
Field	(1)	(2)	(3)	(4)	(5)	(6)

The elements are entered by column, with each column beginning on a new card.

12. Rigid-body modal matrix, $[h_R]$ (see page 7). Omit this input if NRIGID = 0. $[h_R]$ is to be input by partitions $[h_R]_i$, each partition is of order (NSIZE x NRIGID) for each surface. The following data is to be repeated for i = 1, NSUR.

Size Control Card (FORMAT 18I4)

Column	1-4	5-8	
Name	NSIZE		
Field	(1)	(2)	

NSIZE = Number of control points on each surface

Matrix $[h_R]_i$ Elements (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	$h_{R_{1,1}}$	$h_{R_{2,1}}$	$h_{R_{3,1}}$	....	....	$h_{R_{NSIZE,1}}$
Field	(1)	(2)	(3)	(4)	(5)	(6)

The elements are entered by column, with each column beginning on a new card.

13. Flexibility matrices, [a] (see page 6). The flexibility matrix is partitioned, only the nonzero partitions $[a]_i$ corresponding to the

flexible surfaces are entered. The matrix may be formed by any of the well-known procedures using elementary beam theory, force or displacement methods. The program FLUENC will generate this matrix using the displacement method. The punched output from FLUENC may be used as direct input into this program. The following data is repeated for i = 1, NSUR.

Control Card (FORMAT 18I4):

Column	1-4	5-8	9-12	13-16
Name	m_i	(BLANK)	IFORM	IROW
Field	(1)	(2)	(3)	(4)

m_i = The number of rows in $[a]_i$

IFORM = 0 if the elements are to be input using column binary format.

= 1 if the elements are to be input using FORTRAN (FORMAT 6E12.8) or FLUENC output is to be used directly.

IROW = 0 if the matrix elements are to be entered by column.

= 1 if the matrix elements are to be entered by row.

Matrix $[a]_i$ elements (use format specified above):

For IFORM = 1 and IROW = 1 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48
Name	$a_{1,1}$	$a_{1,2}$	$a_{1,3}$	$a_{1,4}$
Field	(1)	(2)	(3)	(4)

Each row starts on a new card.

For IFORM = 1 and IROW = 0 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	
Name	$a_{1,1}$	$a_{2,1}$	$a_{3,1}$	$a_{4,1}$	
Field	(1)	(2)	(3)	(4)	

Each column starts on a new card.

If IFORM = 0, then IROW must = 0: The matrix elements are input using column binary format; Column 1 starts in Origin 1. Column 2 starts in location $(1 + m_i)$; Column 3 starts in location $(1 + 2m_i)$; etc. A TRA* card must end each $[a_i]$ deck. (The column binary format should be used only if the data are available as punched-card output from appropriate computer programs.) The only advantage of the C-B format is the minimum card storage space required.

14. Weighting matrix, [W] (see page 6). The weighting matrix is partitioned, only the nonzero partitions $[W]_i$ corresponding to the flexible surfaces are entered. No provisions have been made for entering a $[W_0]_i$ matrix for the rigid component; any adjustment to $[C_{h_0}]$ must be made before it is input as data. If $ISW_i = 0$ omit this data. Repeat the following data for i = 1, NSUR.

For $(ISW)_i = 0$ and $(ISXT)_i > 0$

Control card for external stores elements (FORMAT 18I4)

Column	1-4	5-8	9-12	13-16	
Name	$NXST_i$	(BLANK)	NFORM	NROW	
Field	(1)	(2)	(3)	(4)	

---

*The TRA card has a 7 and9 punch in Column 1, Column 2 through 72 are blank and Column 73 through 80 will contain the characters used for identification and sequencing in the punched card output deck.

NXST$_i$ = 0 if no $[W]_i$ matrix is input for the external stores area (the program will use a unit matrix, I)

= n the number of control points reserved for stores.

NFORM = 1 if the $[W]_i$ matrix elements will be input using FORTRAN (FORMAT 6E12.8)

- 0 if the elements are to be input using column binary format

NROW = 0 if the $[W_i]$ matrix elements are to be input by column

= 1 if the matrix elements are to be input by row

External stores elements $[W]_i$. Format given on control card above.

For NFORM = 1 NROW = 1

Column	1-12	13-24	25-36	37-48	
Name	$W_{1,1}$	$W_{1,2}$	$W_{1,3}$	$W_{1,4}$	
Field	(1)	(2)	(3)	(4)	

Each row starts on a new card.

For NFORM = 1 NROW = 0

Column	1-12	13-24	25-36	37-48	
Name	$W_{1,1}$	$W_{2,1}$	$W_{3,1}$	$W_{4,1}$	
Field	(1)	(2)	(3)	(4)	

Each column starts on a new card.

If NFORM = 0, then must NROW = 0: The matrix elements are input using column binary format; Column 1 starts in Origin 1. Column 2 starts in location $(1 + IXST_i)$; Column 3 starts in location $(1 + 2IXST_i)$; etc. A TRA card must end each $[a_i]$ deck. The column binary format should be used only if the data are available as punched-card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage space required.

Control card for flexible surface weighting matrix $[W]_i$

(FORMAT 18I4) The $[W_i]$ matrix is often sparse, sometimes diagonal and may be of large order, ≤49; for this reason we provide for partitioning of the matrix and entering only the nonzero partitions.

Column	1-4	5-8	9-12	13-16	
Name	$NSIZE_i$	NPART	NFORM	NROW	
Field	(1)	(2)	(3)	(4)	

NSIZE = The number of control points used on surface i. Do not include control points for external stores.

NPART = The number of partitions in the $[W_i]_j$ surface matrix

NFORM = 1 if the $[W]_i$ will be input using FORTRAN (FORMAT 6E12.8)

= 0 if the elements are to be input using column binary format

NROW = 0 if the $[W_i]$ matrix elements are to be input by column

= 1 if the matrix elements are to be input by row

Repeat the following two data item for each partition j = 1, NPART.

Control card for partition $[W_i]_j$ FORMAT (18I4)

Column	1-4	5-8	9-12	13-16	17-21	
Name	N_j					
Field	(1)	(2)	(3)	(4)	(5)	

N_j = The order of partition j of $[W_i]$

Elements in partition $[W_i]_j$. Format given on the control card for flexible surface weighting matrix.

NFORM = 1 NROW = 1

Column	1-12	13-24	25-36	37-48	
Name	$W_{1,1}$	$W_{1,2}$	$W_{1,3}$	$W_{1,4}$	
Field	(1)	(2)	(3)	(4)	

Each row starts on a new card.

NFORM = 1 NROW = 0

Column	1-12	13-24	25-36	37-48	
Name	$W_{1,2}$	$W_{2,1}$	$W_{3,1}$	$W_{4,1}$	
Field	(1)	(2)	(3)	(4)	

Each column starts on a new card.

If NFORM = 0, then must NROW = 0: The matrix elements are input using column binary format; Column 1 starts in Origin 1. Column 2 starts in location $(1 + IXST_i)$; Column 3 starts in location $(1 + 2IXST_i)$ etc. A TRA card must end each $[a_i]$ deck. The column binary format should be used only if the data are available as punched-card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage space required.

For $(ISW)_i = 0$ and $(ISXT)_i = 0$

Control card for flexible surface weighting matrix $[W]_i$ (FORMAT 18I4). The $[W_i]$ matrix is often sparse, sometimes diagonal and may be of large order, $\simeq 49$; for this reason we provide for partitioning of the matrix and entering only the nonzero partitions. Repeat the following data for i = 1, NSUR.

Column	1-4	5-8	9-12	13-16	17-20	
Name	NSIZE$_i$	NPART	NFORM	NROW		
Field	(1)	(2)	(3)	(4)	(5)	

NSIZE = The number of control points used on surface i

NPART = The number of partitions in the $[W_i]_j$ surface matrix

NFORM = 1 if the $[W]_i$ will be input using FORTRAN (FORMAT 6E12.8)

= 0 if the elements are to be input using column binary format

NROW = 0 if the elements are to be input by column

= 1 if the elements are to be input by row

Repeat the following two data items for each partition j = 1, NPART.

Control card for partition $[W_i]_j$ FORMAT (18I4)

Column	1-4	5-8	9-12	13-16
Name	N_j			
Field	(1)	(2)	(3)	(4)

N_j = The order of partition j of $[W_i]$

Elements in partition $[W_i]_j$ format given on the control card for flexible surface weighting matrix.

NFORM = 1 NROW = 1

Column	1-12	13-24	25-36	37-48
Name	$W_{1,1}$	$W_{1,2}$	$W_{1,3}$	$W_{1,4}$
Field	(1)	(2)	(3)	(4)

Each row starts on a new card.

NFORM = 1 NROW = 0

Column	1-12	13-24	25-36	37-48
Name	$W_{1,1}$	$W_{2,1}$	$W_{3,1}$	$W_{4,1}$
Field	(1)	(2)	(3)	(4)

Each column starts on a new card.

If NFORM = 0, then must NROW = 0: The matrix elements are input using column binary format; Column 1 starts in Origin 1. Column 2 starts in location $(1 + m_i)$; Column 3 starts in location $(1 + 2m_i)$; etc. A TRA card must end each $[a_i]$ deck. The column binary format should used only if the data are available as punched-card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage space required.

15. Aerodynamic data: The aerodynamic input consists of NAERO sets of AIC's. Each set of AIC's consists of the AIC's for each surface which have the same reference $1/k_r$ (see Item 6). If NDENS = 0 a density series will precede each set of AIC's. Input the density series (if Item 8 was omitted) and the AIC matrices for each surface with the following input order. Repeat the order for each $(1/k_r)_j$ j = 1, NAERO.

Control card for density series (FORMAT 18I4). Omit this input if NDENS>0.

Column	1-4	5-8	9-12	13-16
Name	NRHO			
Field	(1)	(2)	(3)	(4)

NRHO = The number of densities to be entered for $(1/k_r)_j \leq 20$

Density Series (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48
Name	ρ_1	ρ_2	ρ_3	ρ_4
Field	(1)	(2)	(3)	(4)

Rigid component AIC matrix $[C_{h_0}]_j$. Omit this input if NFUS = 0. The $[C_{h_0}]_j$ matrix may be sparse; thus, provision has been made to partition the matrix and enter only the nonzero partitions.

Reference 1/k for $[C_{h_o}]_j$ (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48
Name	1/k			
Field	(1)	(2)	(3)	(4)

1/k = The reduced velocity used in computing the rigid component $[C_{h_o}]_j$. The AIC's in $[C_{h_o}]$ must be computed for a 1/k which properly relates them to the j^{th} $1/k_r$.

Control card for $[C_{h_o}]_j$ matrix (FORMAT 18I4)

Column	1-4	5-8	9-12	13-16
Name	NSIZE	NPART	NFORM	NROW
Field	(1)	(2)	(3)	(4)

NSIZE = Number of control points on the rigid component

NPART = Number of nonzero partitions in $[C_{h_o}]_j$
= 1 for an unpartitioned matrix

NFORM = 1 if the $[C_{h_o}]_j$ matrix is to be input using FORTRAN (FORMAT 6E12.8)
= 0 if the $[C_{h_o}]_j$ matrix is to be input using column binary format

NROW = 1 if the $[C_{h_o}]_j$ matrix is to be input by row
= 0 if the $[C_{h_o}]_j$ matrix is to be input by column

Repeat the following data for each partition, K = 1, NPART.

Partition Size Card (FORMAT 18I4)

Column	1-4	5-8	9-12	13-16	
Name	N				
Field	(1)	(2)	(3)	(4)	

N = The order of partition k

Elements in partition K of $[C_{h_o}]_j$. Format is given on the control card for $[C_{h_o}]_j$ matrix. All the elements in the AIC matrices are complex numbers, but the complexity is considered in the program. Thus, each partition may be input as though it is a real matrix of size N x 2N. The real elements form the odd number columns and the imaginary elements in the even numbered columns.

For NFORM = 1 NROW = 1

Column	1-12	13-24	25-36	37-48	
Name	$a(Re)_{1,1}$	$a(I)_{1,1}$	$a(Re)_{1,2}$	$a(I)_{1,2}$	
Field	(1)	(2)	(3)	(4)	

Each row starts on a new card.

For NFORM = 1 and NROW = 0

Column	1-12	13-24	25-36	37-48	49-60	
Name	$a(Re)_{1,1}$	$a(I)_{1,1}$	$a(Re)_{2,1}$	$a(I)_{2,1}$		
Field	(1)	(2)	(3)	(4)	(5)	

Each column starts on a new card.

For NFORM = 0, NROW must = 0. Use column binary format. Column 1 starts in card Origin 1, Column 2 in location (1 + 2N), Column 3 in location (1 + 4N), etc. A TRA card must end each deck. The column binary format should be used only if the data are available as punched-card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage space required.

Flexible component AIC matrix $[C_h]_i$. The AIC matrices are often sparse; thus, a provision is made partitioning the matrix and entering only the nonzero partitions. The following data is repeated for i = 1, NSUR.

For $ISXT_i > 0$.

Control card for external stores partition of the surface i AIC matrix $[C_h]_{ij}$ (FORMAT 18I4)

Column	1-4	5-8	9-12	13-16	
Name	NXST	(BLANK)	NFORM	NROW	
Field	(1)	(2)	(3)	(4)	

$NXST_i$ = Number of control points reserved for external stores

NFORM = 1 of the matrix elements are to be input using FORTRAN (FORMAT 6E12.8)

= 0 if the matrix elements are to be entered using column binary format

NROW = 1 if the matrix elements are to be entered by row

= 0 if the matrix elements are to be entered by column

Elements for external stores partition of AIC matrix $[C_h]_{ij}$

For NFORM = 1 and NROW = 1

Column	1-12	13-24	25-36	37-48	
Name	$a(Re)_{1,1}$	$a(I)_{1,1}$	$a(Re)_{1,2}$	$a(I)_{1,2}$	
Field	(1)	(2)	(3)	(4)	

Each row begins on a new card.

For NFORM = 1 and NROW = 0

Column	1-12	13-24	25-36	37-48	
Name	a(Re)1, 1	a(I)1, 1	a(Re)2, 1	a(Re)2, 1	
Field	(1)	(2)	(3)	(4)	

If NFORM = 0 then NROW must = 0 use column binary format. Column 1 starts in card origin 1, Column 2 in Location $(1+2NXT_i)$, Column 3 in Location $(1+4NXST_i)$, etc. A TRA Card must end each deck. The column binary format should be used only if the data are available as punched-card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage space requirements.

Reference $1/k_i$ card for control point AIC matrix $\left[C_h\right]_{ij}$

FORMAT (6E12.8)

Column	1-12	13-24	25-36	
Name	1/k			
Field	(1)	(2)	(3)	

$1/k_i$ = The reduced velocity used in computing the flexible component $\left[C_h\right]_{ij}$. The AIC's must be computed for a $1/k_i$ which properly relates them to the jth $1/k_r$.

Control card for control point AIC matrix $\left[C_h\right]_{ij}$ (FORMAT (1814)

Column	1-4	5-8	9-12	13-16	
Name	NSIZE	NPART	NFORM	NROW	
Field	(1)	(2)	(3)	(4)	

NSIZE = Order of control point AIC matrix $\left[C_h\right]_{ij}$

NPART = Number of partitions in $\left[C_h\right]_{ij}$

NFORM = 1 matrix elements are to be input using FORTRAN (FORMAT 6E12.8)

= 0 matrix elements are to be input using column binary format

NROW = 1 elements input by row.

= 0 elements input by column.

Repeat the following data for j = 2, NPART. j = 1 corresponds to the external stores partition

Control card for partition size of partition j FORMAT (18J4)

Column	1-4	5-8	9-12	
Name	N			
Field	(1)	(2)	(3)	

N = Order of partition j

Elements of control point AIC matrix $\left[C_H\right]_{i,j}$ partition j

For NFORM = 1 and NROW = 1 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	
Name	a(RE)1, 1	a(I)1, 1	a(Re)1, 2	a(I)1, 2	
Field	(1)	(2)	(3)	(4)	

Each row starts on a new card

For NFORM = 1 and NROW = 0 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	
Name	a(Re)1, 1	a(I)1, 1	a(Re)2, 1	a(I)2, 1	
Field	(1)	(2)	(3)	(4)	

Each column starts on a new card

For NFORM = 0 then NROW must = 0 use column binary format. Column 1 starts in card origin 1, Column 2 in Location (1 + 2N), Column 3 in Location (1 + 4N), etc. A TRA card must end each deck. The column binary format should be used only if the data are available as punched card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage space requirements

For ISXT$_i$ = 0

Reference $1/k_i$ card for control point AIC matrix $\left[C_h\right]_{ij}$

FORMAT (6E12.8)

Column	1-12	13-24	25-36	
Name	$1/k_i$			
Field	(1)	(2)	(3)	

$1/k_i$ = The reduced velocity used in computing the flexible component $\left[C_h\right]_{ij}$. The AIC's must be computed for a $1/k_i$ which properly relates them to the jth $1/k_r$.

Control card for control point AIC matrix $\left[C_h\right]_{ij}$ FORMAT (18I4)

Column	1-4	5-8	9-12	13-16	
Name	NSIZE	NPART	NFORM	NROW	
Field	(1)	(2)	(3)	(4)	

NSIZE = Order of control point AIC matrix $\left[C_h\right]_{ij}$

NPART = Number of partitions in $\left[C_h\right]_{ij}$

NFORM = 1 matrix elements are to be input using FORTRAN (FORMAT 6E12.8)

= 0 matrix elements are to be input using column binary format.

NROW = 1 elements input by row

= 0 elements input by column

Repeat the following data for j = 1, NPART.

Control card for partition size of partition j FORMAT (18I4)

Column	1-4	5-8	9-12	
Name	N			
Field	(1)	(2)	(3)	

N = Order of partition

Elements of control point AIC matrix $\left[C_h\right]_{i,j}$ partition j

For NFORM = 1 and NROW = 1 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	
Name	a(Re)1, 1	a(I)1, 1	a(Re)1, 2	a(I)1, 2	
Field	(1)	(2)	(3)	(4)	

Each row starts on a new card

For NFORM = 1 and NROW = 0 (FORMAT 6E12.8)

Column	1-12	13-24	25-36	37-48	
Name	a(Re)1, 1	a(I)1, 1	a(Re)2, 1	a(I)2, 1	
Field	(1)	(2)	(3)	(4)	

For NFORM = 0 then NROW must = 0 use column binary format. Column 1 start in card origin 1, Column 2 in Location (1 + 2N), Column 3 in Location (1 + 4N), etc. A TRA card must end each deck. The column binary format should be used only if the data are available as punched card output from appropriate computer programs. The only advantage of C-B format is the minimum card storage requirements.

SECTION 6

DESCRIPTION OF PROGRAM OUTPUT

A. Printed Output

1. All input data.
2. The dynamic matrix or flutter determinant if NPUNCH = -1 is used in the general control card.
3. For the vibration analysis or for each $1/k_r$ in a flutter analysis
   a. The eigenvalue for each output mode followed by the number of single- and double-precision iterations and the number of Aitken accelerations.
   b. The normalized eigenvectors (modes) followed by the check eigenvalues and eigenvectors.
   c. The frequencies (omegas) in cycles per second followed (in a flutter analysis) by the structural damping coefficient and the velocity (knots) assoicated with each frequency.
   d. If NPUNCH = ±1, the sequencing numbers used for identifying the punched-card output (frequencies and modes); this will conclude the printout for each $1/k_r$ used in a flutter analysis.
4. In a vibration analysis, the generalized mass corresponding to each output (free vibration) mode will follow the above printed output [see Eq. (28), Section I].
5. A number of different statements may be printed which indicate machine or program detected errors in input data (wrong format or incompatibility in the number of rows input for a matrix and the number designated).
6. If the program or the machine fails in the iteration portion of the program, a note will be printed stating the type or cause of failure.

7. If convergence is not obtained in the allowable number of iterations, a note will be printed and the program will continue. (In this case the eigenvalues and eigenvectors should be compared with the check eigenvalues and eigenvectors to determine if the convergence is sufficiently accurate.)

8. The printed output for the example problem is shown on the following pages.

SECTION 7

EXAMPLE PROBLEMS

As example problems, we choose a cantilever flutter analysis and a free-free symmetric flutter analysis of the jet transport wing (and rigid fuselage) treated throughout Ref. 5 and shown in Figure A-1. The wing mass, flexibility and aerodynamic matrices and the fuselage aerodynamic matrix (symmetric case) can be seen in the example problem printed output (pages 41-62) and will not be repeated with the list of input data to follow. The flexibility matrix normalizing factor is $K = 10^{-7}$. The wing weighting matrix is taken as unity ($[I]$) and, in this case, requires no input. The symmetrical rigid component (one-half of the fuselage) generalized mass matrix is given below in the pound-inch system

$$[\Delta m] = \begin{bmatrix} M_o & S_o \\ S_o & I_{yo} \end{bmatrix} = \begin{bmatrix} 17,400 & 1,370,250 \\ 1,370,250 & 4,457,907,200 \end{bmatrix}$$

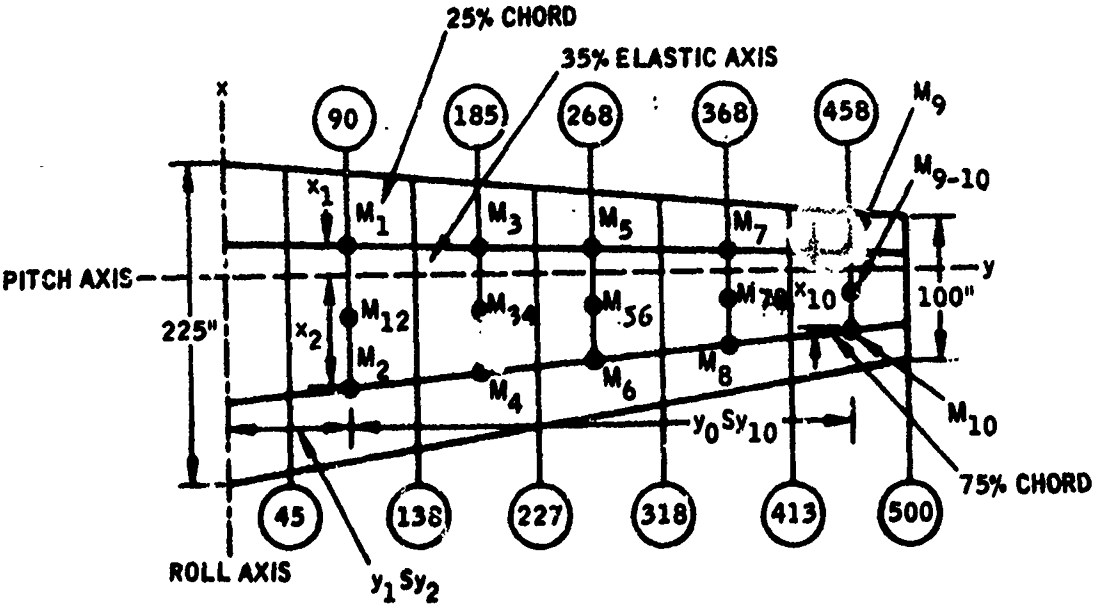

Figure A-1. Jet transport wing geometry.

In the antisymmetric case, the rigid component generalized mass matrix would be $[\Delta m] = [I_{xo}]$, and in the composite longitudinal-lateral case, the generalized mass matrix would be

$$[\Delta m] = \begin{bmatrix} M_o & S_o & 0 \\ S_o & I_{yo} & 0 \\ 0 & 0 & I_{xo} \end{bmatrix}$$

The symmetrical case requires the two rigid-body degrees of freedom of plunging and pitching. The rigid-body modal matrix, therefore, consists of two columns: a unit column, and a column of the x-coordinate of each control point. The rigid-body modal matrix for the wing is

$$[h_R] = [1 \;\; x] = \begin{bmatrix} 1 & 20.25 \\ 1 & -81.00 \\ 1 & 17.85 \\ 1 & -71.40 \\ 1 & 15.80 \\ 1 & -63.20 \\ 1 & 13.30 \\ 1 & -53.20 \\ 1 & 11.05 \\ 1 & -44.20 \end{bmatrix}$$

The rigid-body modal matrix for the fuselage is

$$[h_{Ro}] = [1 \;\; x] = \begin{bmatrix} 1 & -373.30 \\ 1 & -248.30 \\ 1 & -123.30 \\ 1 & +\;\;1.70 \\ 1 & +126.70 \end{bmatrix}$$

Note that the above matrix is used in computing the incremental generalized mass which results from the aerodynamic loads on one-half of the fuselage and, therefore, the x-coordinates must be given in the proper order for the control points used in computing the fuselage AICs. [In this problem the fuselage AICs are hypothetical, but the x-coordinates are given in the order necessary for the slender-body theory AICs.]

The reference geometry for the wing is $b_{rw} = 5.468$ ft and $s_w = 37.917$ ft. The reference geometry for the fuselage is $b_{ro} = 5.468$ ft and $s_o = 18.9585$ ft. [We assume that the wing reference geometry was used to nondimensionalize the fuselage AIC matrix, and, because we require only one-half of the fuselage aerodynamic force, it can be obtained by setting $s_o = (1/2)s_w$.] Both example problems are carried out for the single reduced velocity $1/k_r = 16.67$ with the reference semichord for the system $b_r = 5.468$ ft and with sea-level density $\rho = 0.002378$ slugs/ft^3.

The output modes, the flutter frequencies and velocities, and the required structural damping can be seen in the example problem printed output (pages A-55 through A-65).

The input keypunch sheets are given, followed by the computer output.

AIRCRAFT

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NAME ____ PHONE ____ DATE ____ LOG NO. ____ PROB. NO. ____ PROG. NO. ____

```
                                    Title Card
      JET TRANSPORT EXAMPLE PROBLEM - CANTILEVER CASE                   HM100000
                              General Control Card
   1   1   0   0   1   4   0   0                                        HM100001
                        Flexibility Matrix Normalising Constant, K (FORMAT 6E12.8)
 1.0     -07                                                            HM100002
        ISXTi and ISWi (Controls for Number of External Stores Control Points and [W]i, i = 1, NSUR)(FORMAT 16I4)
   0   0                                                                HM100003
                            Reference br and Reference 1/kr's (FORMAT 6E12.8)
 5.468       16.67                                                      HM100004
                     Reference bri and Reference si for Each Surface (FORMAT 6E12.8)
 5.468      37.917                                                      HM100005
                                 Density Series (FORMAT 6E12.8)
 0.002378                                                               HM100006
                            NSIZE for Mass Matrix, [M] (FORMAT 18I4)
  10                                                                    HM100007
              Row Location of First and Last (LOWr, HIGHr) Nonzero Element in Each Column of [M]
   1   2   1   2   3   4   3   4   5   6   5   6   7   8   7   8   9  10HM100008
```

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NAME ______ PHONE ______ DATE ______ LOG NO. ______ PROB. NO ______ PROG NO ______

```
         1         2         3         4         5         6         7      IDENTIFICATION
12345678901234567890123456789012345678901234567890123456789012345678901234567890
   9  10                                                                HM100009
                          [M] Matrix Elements (FORMAT 6E12.8)
 5383.6     -134.9                                                      HM100010
-  134.9      925.2                                                     HM100011
  20732.    - 11005.0                                                   HM100012
-11005.0     11478.                                                     HM100013
   3113.9    139.7                                                      HM100014
   139.7      806.6                                                     HM100015
 2638.8     - 21.                                                       HM100016
- 21.0        803.3                                                     HM100017
   487.5       7.3                                                      HM100018
 7.3          177.9                                                     HM100019
                     Control Card for Flexibility Matrix. [a] (FORMAT 18I4)
  10       1   0                                                        HM100020
                               [a] Matrix Elements
 The matrix elements can be seen in the printed output. The control card gives the size and specifies the format (FORTRAN 6E12.8,
 by columns). See Section II, Part B, Item 13 for other formats.
```

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NAME ______ PHONE ______ DATE ______ LOG NO. ______ PROB. NO. ______ PROG. NO. ______

IDENTIFICATION

```
                        Reference 1/k for [C4] Matrix (FORMAT 6E12.8)
 16 67                                                                  HM100041
                       Control Card for [C4] Matrix Input (FORMAT 18I4)
  10   5   1   1                                                        HM100042
            Partition k Size (FORMAT 18I4). Partition k Elements (FORMAT 6E12.8, by Row) k = 1, 5
   2                                                                    HM100043
 300997  +03-60092673+02-30579615+03 32278209+02                        HM100044
 19111816+00 16514119+02 57335448+00-16514119+02                        HM100045
   2                                                                    HM100046
 29334980+03-55152775+02-29728241+03+31246942+02                        HM100047
 14211353+00+13930788-02+42634058+00-13930788+02                        HM100048
   2                                                                    HM100049
 30483998+03-53866061+02-30827594+03+31871554+02                        HM100050
 11384775+00+12607991+02+34154829+00-12607991+02                        HM100051
   2                                                                    HM100052
 32483251+03-62278329+02-32767460+03+32541166+02                        HM100053
 84216232-01+11079562+02+25264870+00-11079562+02                        HM100054
   2                                                                    HM100055
```

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NAME PHONE DATE

```
 30321474+03-43827882+02-30521602+03+26517133+02                        HM100056
 53236897-01+84300262+01+15971068+00-84300262+01                        HM100057
 Other formats that can be used to input the [Ch] matrices are explained
 in Section III, Part B, Item 15.

      JET TRANSPORT EXAMPLE PROBLEM - SYMMETRIC CASE                    HM200000
   1   1   2   1   1   4   1   0                                        HM200001
 K                                  (same as used for cantilever case)  HM200002
 ISXT ISW                           (same as used for cantilever case)  HM200003
 br          1/kr                   (same as used for cantilever case)  HM200004
             Reference br, and Reference ai for Each Surface, i = O, 1, NSUR
 5.468       18.9585     6.468      37.917                              HM200005
 Density                            (same as used for cantilever case)  HM200006
              Rigid Component Generalized Mass Matrix, [Δm] (FORMAT 6E12.8, by Columns)
 17400.0     137025   +07                                               HM200007
 137025  +07 44579072+10                                                HM200008
 NSIZE for [M]                      (same as used for cantilever case)  HM200009
 LOW, HIGH                          (same as used for cantilever case)  HM200010
```

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NAME ____ PHONE ____ DATE ____ LOG NO. ____ PROB NO. ____ PROG NO. ____

	1–12	13–24	25–36	37–48	49–60	61–72	IDENTIFICATION 73–80
1	LOW$_{10}$ HIGH$_{10}$			(same as used in cantilever case)			HM200011
2	[M] Matrix Elements			(same as used in cantilever case)			
3		Number of Rows in Rigid Component Rigid-Body Modal Matrix, [h_{R_0}] (FORMAT 18I4)					
4	5						HM200022
5			[h_{R_0}] Matrix Elements (FORMAT 6E12.8, by Columns)				
6	1.0	1.0	1.0	1.0	1.0		HM200023
7	-373.30	-248.30	-123.30	+1.70	+126.70		HM200024
8		Number of Rows in Surface 1 Rigid-Body Modal Matrix, [h_R] (FORMAT 18I4)					
9	10						HM200025
10			[h_R]$_1$ Matrix Elements (FORMAT 6E12.8, by Columns)				
11	1.0	1.0	1.0	1.0	1.0	1.0	HM200026
12	1.0	1.0	1.0	1.0			HM200027
13	20.25	-31.0	17.85	-71.40	15.80	-63.20	HM200028
14	13.30	-53.20	11.05	-44.20			HM200029
15	Control Card for [A]			(same as used in cantilever case)			HM200030
16	[A] Matrix Elements			(same as used in cantilever case)			
17	1/k for Rigid Component [C_{h_0}] (FORMAT 6E12.8)						
18	16.67						
19							
20							
21							
22							
23							
24							
25							

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```
                  Control Card for [Chn] Matrix Input (FORMAT 1314)
   5   1   0   0                                                        HM200052
                  [Chn] Matrix Elements (Column Binary Format)
   5
 The above control card indicates a 5 x 5 (unpartitioned) matrix to be input using column
 binary format.  The matrix can be seen in the printed output and will not be tabulated.
 (Other input formats are explained in Section II, Part B, item 15.)
                  1/k for Surface [Ch] Matrix
 16.67                                                                  HM200064
                  Control Card for Surface [Ch] Matrix Input
  10   5   1   1                                                        HM200065
                  [Ch] Matrix by Partitions
 The partitions are identical to those used in the cantilever case.
```

```
 JET TRANSPORT EXAMPLE PROBLEM - CANTILEVER CASE                    HM051641
              FLUTTER ANALYSIS BY A COLLOCATION METHOD USING AERODYNAMIC INFLUENCE COEFFICIENTS

NSUR =    1  NAERO =    1  NRIGID =  0  NFUS =  0  NDENS =    1  MODES OUT =  4 NDELM =  0 NPUNCH =  0

                          B (REF) =       0.54680000E 01      K =       0.10000000E-06

                          SURFACE                B                    S            EXTERNAL STORES SIZE

                             1             0.54580000E 01        0.37917800E 02           0



                                                  MASS MATRIX
                                          SURFACE  1,     10 CONTROL POINTS
            COLUMN     1         COLUMN     2      COLUMN     3       COLUMN     4       COLUMN     5       COLUMN     6

     1   0.53835000E 04   -0.13490000E 03   0.                 0.                 0.                 0.
     2  -0.13490000E 03    0.92520000E 03   0.                 0.                 0.                 0.
     3   0.                0.               0.20732000E 05    -0.11005000E 05     0.                 0.
     4   0.                0.              -0.11005000E 05     0.11478000E 05     0.                 0.
     5   0.                0.               0.                 0.                 0.31139000E 04     0.13970000E 03
     6   0.                0.               0.                 0.                 0.13970000E 03     0.80660000E 03
     7   0.                0.               0.                 0.                 0.                 0.
     8   0.                0.               0.                 0.                 0.                 0.
     9   0.                0.               0.                 0.                 0.                 0.
    10   0.                0.               0.                 0.                 0.                 0.
            COLUMN     7         COLUMN     8      COLUMN     9       COLUMN    10       COLUMN
     1   0.                0.               0.                 0.
     2   0.                0.               0.                 0.
     3   0.                0.               0.                 0.
     4   0.                0.               0.                 0.
     5   0.                0.               0.                 0.
     6   0.                0.               0.                 0.
     7   0.26388000E 04   -0.21000000E 02   0.                 0.
     8  -0.21000000E 02    0.88330000E 03   0.                 0.
     9   0.                0.               0.48750000E 03     0.73000000E 01
    10   0.                0.               0.73000000E 01     0.17790000E 03
```

```
                                              FLEXIBILITY MATRIX
                                       SURFACE  1,      10 CONTROL POINTS
             COLUMN     1        COLUMN     2        COLUMN     3        COLUMN     4        COLUMN     5        COLUMN     6

     1   0.87172000E 02   0.13361000E 02   0.12778000E 03   0.62720000E 02   0.16251000E 03   0.10492200E 03
     2   0.13361000E 02   0.  3619000E 03   0.22722000E 02   0.32297000E 03   0.10492200E 03   0.33529000E 03
     3   0.12778000E 03   [illegible]       0.77732000E 03   0.15726000E 03   0.48255000E 03   0.37626000E 03
     4   0.62720000E 02   0.3229   E        0.15726000E 03   0.63749000E 03   0.37628000E 03   0.60135000E 03
     5   0.16251000E 03   0.10492  0E 03    0.48255000E 03   0.37628000E 03   0.12758000E 04   0.11344300E 04
     6   0.10492200E 03   0.335  000E 03    0.37626000E 03   0.88136000E 03   0.11344300E 04   0.16999000E 04
     7   0.20479000E 03   0.15630000E 03   0.73284000E 03   0.64338000E 03   0.19350000E 04   0.18169000E 04
     8   0.15639000E 03   0.35021000E 03   0.64338000E 03   0.10012100E 04   0.18160000E 04   0.22928000E 04
     9   0.24285000E 03   0.20257000E 03   0.95810000E 03   0.88378000E 03   0.25283000E 04   0.24294000E 04
    10   0.26403000E 03   0.35785000E 03   0.88378000E 03   0.11810600E 04   0.24294000E 04   0.28249000E 04
             COLUMN     7        COLUMN     8        COLUMN     9        COLUMN    10        COLUMN
     1   0.20478000E 03   0.15630000E 03   0.24285000E 03   0.26403000E 03
     2   0.15630000E 03   0.35021000E 03   0.20257000E 03   0.35785000E 03
     3   0.73284000E 03   0.64338000E 03   0.95810000E 03   0.88378000E 03
     4   0.64338000E 03   0.10012100E 04   0.88378000E 03   0.11810600E 04
     5   0.17350000E 04   0.18160000E 04   0.25283000E 04   0.    94000E 04
     6   0.18160000E 04   0.22926000E 04   0.24294000E 04   0.2 .49000E 04
     7   0.35862000E 04   0.35052000E 04   0.52675000E 04   0.51171000E 04
     8   0.35052000E 04   0.42290000E 04   0.51171000E 04   0.57187000E 04
     9   0.52675000E 04   0.51171000E 04   0.64840000E 04   0.82340000E 04
    10   0.51171000E 04   0.57187000E 04   0.82340000E 04   0.92310000E 04


                                              WEIGHTING MATRIX
                                       SURFACE  1,        NO WEIGHTING MATRIX
```

```
                                   AERODYNAMIC MATRIX          1./K R =        0.1667000E 02
                                       SURFACE  1.      10 CONTROL POINTS
         COLUMN     1      COLUMN     2      COLUMN     3      COLUMN     4      COLUMN     5      COLUMN     6

    1  0.36099700E 03  -0.60892673E 02  -0.30579615E 03   0.32278289E 02   0.               0.
    2  0.19111816E 00   0.16514119E 02   0.57335446E 00  -0.16514119E 02   0.               0.
    3  0.               0.               0.               0.               0.29334980E 03  -0.55152775E 02
    4  0.               0.               0.               0.               0.14211353E 00   0.13930788E 02
    5  0.               0.               0.               0.               0.               0.
    6  0.               0.               0.               0.               0.               0.
    7  0.               0.               0.               0.               0.               0.
    8  0.               0.               0.               0.               0.               0.
    9  0.               0.               0.               0.               0.               0.
   10  0.               0.               0.               0.               0.               0.
         COLUMN     7      COLUMN     8      COLUMN     9      COLUMN    10      COLUMN    11      COLUMN    12

    1  0.               0.               0.               0.               0.               0.
    2  0.               0.               0.               0.               0.               0.
    3 -0.29728243E 03   0.31246942E 02   0.               0.               0.               0.
    4  0.47634856E 00  -0.13934788E 02   0.               0.               0.               0.
    5  0.               0.               0.38483998E 03  -0.53868861E 02  -0.38827594E 03   0.31871554E 02
    6  0.               0.               0.11384775E 00   0.12687991E 02   0.34154329E 00  -0.12687991E 02
    7  0.               0.               0.               0.               0.               0.
    8  0.               0.               0.               0.               0.               0.
    9  0.               0.               0.               0.               0.               0.
   10  0.               0.               0.               0.               0.               0.
         COLUMN    13      COLUMN    14      COLUMN    15      COLUMN    16      COLUMN    17      COLUMN    18

    1  0.               0.               0.               0.               0.               0.
    2  0.               0.               0.               0.               0.               0.
    3  0.               0.               0.               0.               0.               0.
    4  0.               0.               0.               0.               0.               0.
    5  0.               0.               0.               0.               0.               0.
    6  0.               0.               0.               0.               0.               0.
    7  0.32483651E 03  -0.52278329E 02  -0.32767[illegible]E 03   0.32541166E 02   0.               0.
    8  0.84215[illegible]E-01   0.11079562E 02   0.25264070E 00  -0.11079562E 02   0.               0.
    9  0.               0.               0.               0.               0.30321474E 03  -0.43827862E 02
   10  0.               0.               0.               0.               0.53236897E-01   0.84380262E 01
         COLUMN    19      COLUMN    20      COLUMN
    1  0.               0.
    2  0.               0.
    3  0.               0.
    4  0.               0.
    5  0.               0.
    6  0.               0.
    7  0.               0.
    8  0.               0.
    9 -0.3[illegible]E 03   [illegible]E 02
   10  0.[illegible]E 0[illegible]  -0.[illegible]E 01
```

```
                                   OUTPUT DATA

          FLUTTER ANALYSIS BY A COLLOCATION METHOD, USING AERODYNAMIC INFLUENCE COEFFICIENTS

            DENSITY =         0.23780000E-02      REDUCED VELOCITY =        0.16670000E 02

                                . RIGID BODY DEGREES OF FREEDOM


   MODE                EIGENVALUE                          ITERATIONS  S.P.     D.P.        AITKENS S.P.   D.P.

            1   0.28514254E 08    -0.25182939E 08                       10       0                  2       0
            2   0.12153621E 08    -0.28573745E 06                       18       0                  4       0
            3   0.63295259E 07     0.11860000E 07                       16       0                  4       0
            4   0.20438861E 07    -0.12622640E 07                       20       0                  4       0


                                        EIGENVECTORS

          COLUMN    1       COLUMN    2       COLUMN    3       COLUMN    4       COLUMN    5       COLUMN    6

    1   0.41765569E-01   0.39935716E-02   0.52422154E-01   0.27973628E-01   0.11268764E 00  -0.38122170E-01
    2   0.33611821E-01   0.67522200E-02   0.60325000E-01  -0.27717133E-02   0.95814571E-01  -0.47620138E-01
    3   0.14070067E 00   0.81289036E-02   0.17858658E 00   0.50252555E-01   0.26814691E 00  -0.69573386E-01
    4   0.16427082E 00   0.13288503E-01   0.17790778E 00  -0.14084030E-02   0.24426274E 00  -0.50556956E-01
    5   0.36103484E 00   0.17490047E-01   0.42532389E 00   0.86469743E-01   0.58779018E 00  -0.14839706E 00
    6   0.34535172E 00   0.25502904E-01   0.44030061E 00   0.33060263E-01   0.59176531E 00  -0.17162145E 00
    7   0.67711089E 00   0.14759703E-01   0.71753938E 00   0.68293358E-01   0.82485572E 00  -0.81978349E-01
    8   0.65968200E 00   0.26878921E-01   0.74431901E 00   0.29982516E-01   0.86821067E 00  -0.13225259E 00
    9   0.10000000E 01   0.57693956E-08   0.96504349E 00   0.27935114E-01   0.93070006E 00   0.65759503E-01
   10   0.98173523E 00   0.14738217E-01   0.10000000E 01   0.71209527E-10   0.10000000E 01   0.14332015E-09
          COLUMN    7       COLUMN    8       COLUMN
    1  -0.85501720E-01  -0.12844954E 00
    2  -0.14422336E 00  -0.92387966E-01
    3  -0.15972082E 00  -0.17723985E 00
    4  -0.16794566E 00  -0.15760267E 00
    5  -0.46918808E 00  -0.17300963E 00
    6  -0.45836876E 00  -0.26935221E 00
    7  -0.13126945E-01  -0.66963119E-01
    8   0.97545000E-0[illegible]  -[illegible]31042[illegible]E 00
    9   0.10000000E 01   [illegible]
   10   0.95827440E 00  -[illegible]46321E-01
```

```
        CHECK EIGENVALUES AND EIGENVECTORS

 0.28514267E 08 -0.2518[illegible]E 05  0.12153636E 08 -0.28584727E 06  0.63295459E 07  0.11864946E 07
 0.20439634E 07 -0.12623659E 07
          COLUMN    1      COLUMN    2      COLUMN    3      COLUMN    4      COLUMN    5      COLUMN    6

   1   0.41765565E-01   0.59935390E-02   0.57421844E-01   0.27973633E-01   0.11260817E 00  -0.38121185E-01
   2   0.33611786E-01   0.67527255E-02   0.60324983E-01  -0.27713930E-02   0.95815558E-01  -0.47126920E-01
   3   0.14070066E 00   0.81288441E-02   0.17058602E 00   0.50252573E-01   0.26811789E 00  -0.69571621E-01
   4   0.12642694E 00   0.13288569E-01   0.17790768E 00  -0.13998269E-02   0.24426423E 00  -0.90548721E-01
   5   0.36103078E 00   0.17496553E-01   0.42532286E 00   0.88469934E-01   0.58779208E 00  -0.14039379E 00
   6   0.34535159E 00   0.25592861E-01   0.44039804E 00   0.33061094E-01   0.59176783E 00  -0.17164619E 00
   7   0.67711881E 00   0.14759617E-01   0.71753857E 00   0.68293261E-01   0.82485651E 00   0.81976559E-03
   8   0.65968186E 00   0.27870910E-01   0.74431851E 00   0.29903183E-01   0.86821284E 00  -0.13224914E 00
   9   0.10000000E 01   0.10363443E-08   0.96504330E 00   0.27934334E-01   0.93069882E 00   0.65757559E-01
  10   0.98173518E 00   0.14732088E-01   0.10000000E 01   0.19184554E-09   0.10000000E 01   0.48020418E-09
          COLUMN    7      COLUMN    8      COLUMN
   1  -0.85493178E-01  -0.11845119E 00
   2  -0.19421509E 00  -0.9738[illegible]6E-01
   3  -0.15970453E 00  -0.1[illegible]72768E 00
   4  -0.18188963E 00  -0.[illegible]716879E 00
   5  -0.46907590E 00  -0.[illegible]309738E 00
   6  -0.458335[illegible]E 00  -0.20537629E 00
   7  -0.18102238E-01  -0.66989833E-01
   8   0.97864460E-02  -0.12320435E 00
   9   0.10000000E 01   0.81157384E-09
  10   0.95823531E 00  -0.11462694E-01


          MODE        FRQCY  (CPS)          DAMPING       VELOCITY (KNOTS)

            1       0.18517534E 01     -0.88317019E 00     0.62794529E 03
            2       0.28363596E 01     -0.23510478E-01     0.96183365E 03
            3       0.39303258E 01      0.18747073E 00     0.13328069E 04
            4       0.69164967E 01     -0.61758042E 00     0.23454407E 04
```

```
 JET TRANSPORT EXAMPLE PROBLEM - SYMMETRIC  CASE                    HM051699
            FLUTTER ANALYSIS BY A COLLOCATION METHOD USING AERODYNAMIC INFLUENCE COEFFICIENTS

NSUR =    1  NAERO =    1  NRIGID =  2  NFUS =  1  NDENS =    1  MODES OUT =  4 NDELM =  1 NPUNCH =  0

          B RIGID COMPONENT =      0.54680000E 01      S RIGID COMPONENT =     0.16958500E 02

                         B (REF) =       0.54680000E 01      K =        0.10000000E-06

                          SURFACE                   B                   S            EXTERNAL STORES SIZE

                             1            0.54680000E 01        0.37917000E 02            0

                                   RIGID COMPONENT MASS MATRIX
          COLUMN    1      COLUMN    2      COLUMN
    1   0.17400000E 05   0.13702500E 07
    2   0.13702500E 07   0.44579072E 10



                                                  MASS MATRIX
                                        SURFACE  1,    10 CONTROL POINTS
          COLUMN    1      COLUMN    2      COLUMN    3      COLUMN    4      COLUMN    5      COLUMN    6

    1   0.53836000E 04  -0.13490000E 03   0.               0.               0.               0.
    2  -0.13490000E 03   0.92520000E 03   0.               0.               0.               0.
    3   0.               0.               0.20732000E 05  -0.11005000E 05   0.               0.
    4   0.               0.              -0.11005000E 05   0.11478000E 05   0.               0.
    5   0.               0.               0.               0.               0.31139000E 04   0.139[illegible]E 03
    6   0.               0.               0.               0.               0.13970000E 03   0.80[illegible]E 03
    7   0.               0.               0.               0.               0.               0.
    8   0.               0.               0.               0.               0.               0.
    9   0.               0.               0.               0.               0.               0.
   10   0.               0.               0.               0.               0.               0.
          COLUMN    7      COLUMN    8      COLUMN    9      COLUMN   10      COLUMN
    1   0.               0.               0.               0.
    2   0.               0.               0.               0.
    3   0.               0.               0.               0.
    4   0.               0.               0.               0.
    5   0.               0.               0.               0.
    6   0.               0.               0.               0.
    7   0.26388000E 04  -0.21000000E 02   0.               0.
    8  -0.21000000E 02   0.80330000E 03   0.               0.
    9   0.               0.               0.48750000E 03   0.73000000E 01
   10   0.               0.               0.73000000E 01   0.17790000E 03

                                   RIGID COMPONENT MODES,          5 CONTROL POINTS.
          COLUMN    1      COLUMN    2      COLUMN
    1   0.10000000E 01  -0.3733[illegible]E 03
    2   0.10000000E 01  -0.2483[illegible]E 03
    3   0.10000000E 01  -0.[illegible]E 03
    4   0.10000000E 01   0.1706[illegible]E 03
    5   0.10000000E 01   0.1267[illegible]E 03
```

```
                                   RIGID BODY MODAL MATRIX
                              SURFACE  1,     10 CONTROL POINTS
          COLUMN      1        COLUMN     2        COLUMN
   1   0.10000000E 01    0.20250000E 02
   2   0.10000000E 01   -0.81000000E 02
   3   0.10000000E 01    0.17850000E 02
   4   0.10000000E 01   -0.71420000E 02
   5   0.10000000E 01    0.15800000E 02
   6   0.10000000E 01   -0.63200000E 02
   7   0.10000000E 01    0.13360000E 02
   8   0.10000000E 01   -0.53200000E 02
   9   0.10000000E 01    0.11050000E 02
  10   0.10000000E 01   -0.44200000E 02


                                    FLEXIBILITY MATRIX
                              SURFACE  1,     10 CONTROL POINTS
          COLUMN      1        COLUMN     2        COLUMN     3        COLUMN     4        COLUMN     5        COLUMN     6

   1   0.87172000E 02   0.13361000E 02   0.12778000E 03   0.62720000E 02   0.16251000E 03   0.10492200E 03
   2   0.13361000E 02   0.30861000E 03   0.62720000E 02   0.32297000E 03   0.10492200E 03   0.33529000E 03
   3   0.12778000E 03   0.62721900E 02   0.27752000E 03   0.15726000E 03   0.48255000E 03   0.37628000E 03
   4   0.62720000E 02   0.32297000E 03   0.15726000E 03   0.63749000E 03   0.37628000E 03   0.80136000E 03
   5   0.16251000E 03   0.10492200E 03   0.48255000E 03   0.37628000E 03   0.12758000E 04   0.11344300E 04
   6   0.10492200E 03   0.33529000E 03   0.37628000E 03   0.80136000E 03   0.11344300E 04   0.16999000E 04
   7   0.20478000E 03   0.15633000E 03   0.73284000E 03   0.64338000E 03   0.19350000E 04   0.18160000E 04
   8   0.15633000E 03   0.35021000E 03   0.64338000E 03   0.10012100E 04   0.18160000E 04   0.22920000E 04
   9   0.24285000E 03   0.20257000E 03   0.95810000E 03   0.88378000E 03   0.25283000E 04   0.24294000E 04
  10   0.20403000E 03   0.35785000E 03   0.88378000E 03   0.11810600E 04   0.24294000E 04   0.28249000E 04
          COLUMN      7        COLUMN     8        COLUMN     9        COLUMN    10        COLUMN
   1   0.20478000E 03   0.15633000E 03   0.24285000E 03   0.20403000E 03
   2   0.15633000E 03   0.35021000E 03   0.20257000E 03   0.35785000E 03
   3   0.73284000E 03   0.64338000E 03   0.95810000E 03   0.88378000E 03
   4   0.54138000E 03   0.10012100E 04   0.88378000E 03   0.11810600E 04
   5   0.19350000E 04   0.18160000E 04   0.25283000E 04   0.24294000E 04
   6   0.18160000E 04   0.22920000E 04   0.24294000E 04   0.28249000E 04
   7   0.36862000E 04   0.35052000E 04   0.52675000E 04   0.51171000E 04
   8   0.35052000E 04   0.47292000E 04   0.51171000E 04   0.57187000E 04
   9   0.52675000E 04   0.51171000E 04   0.84840000E 04   0.82340000E 04
  10   0.51171000E 04   0.57187000E 04   0.82340000E 04   0.92340000E 04


                                     WEIGHTING MATRIX
                              SURFACE  1,      NO WEIGHTING MATRIX
```

```
                      RIGID COMPONENT AERO MATRIX,         5 CONTROL POINTS
        COLUMN    1       COLUMN    2      COLUMN    3      COLUMN    4      COLUMN    5      COLUMN    6

  1  -0.19883166E 01  -0.71028437E 01  -0.31782072E 01   0.99733821E 01   0.17128096E 01  -0.24681993E 01
  2   0.20447044E 01  -0.30575088E 01  -0.89710928E 01   0.67589525E 00   0.25888789E 01   0.32829072E 01
  3   0.               0.               0.25888789E 01  -0.32829072E 01  -0.89710928E 01  -0.67589525E 00
  4   0.               0.               0.               0.               0.18608618E 01  -0.23997266E 01
  5   0.               0.               0.               0.               0.19459838E 00   0.73566824E 00
        COLUMN    7       COLUMN           COLUMN    9      COLUMN   10      COLUMN
  1   0.               0.               0.               0.
  2   0.               0.               0.               0.
  3   0.20347044E 01   0.30575088E 01   0.               0.
  4  -0.59000403E 01  -0.47448669E 00   0.16709520E 01   0.17538263E 01
  5   0.45455274E 00  -0.31600294E 01  -0.19732837E 01   0.81508698E 00
```

```
                          AERODYNAMIC MATRIX         1./K R =        0.16670000E 02
                             SURFACE  1.      10 CONTROL POINTS
         COLUMN    1       COLUMN    2       COLUMN    3       COLUMN    4       COLUMN    5       COLUMN    6

    1   0.38099700E 03  -0.68092673E 02  -0.30579615E 03   0.32278209E 02   0.               0.
    2   0.19111816E 00   0.16514119E 02   0.57335448E 00  -0.16514119E 02   0.               0.
    3   0.               0.               0.               0.               0.29334980E 03  -0.55152775E 02
    4   0.               0.               0.               0.               0.14211353E 00   0.13930788E 02
    5   0.               0.               0.               0.               0.               0.
    6   0.               0.               0.               0.               0.               0.
    7   0.               0.               0.               0.               0.               0.
    8   0.               0.               0.               0.               0.               0.
    9   0.               0.               0.               0.               0.               0.
   10   0.               0.               0.               0.               0.               0.
         COLUMN    7       COLUMN    8       COLUMN    9       COLUMN   10       COLUMN   11       COLUMN   12

    1   0.               0.               0.               0.               0.               0.
    2   0.               0.               0.               0.               0.               0.
    3  -0.29728241E 03   0.31246942E 02   0.               0.               0.               0.
    4   0.42634056E 00  -0.13937298E 02   0.               0.               0.               0.
    5   0.               0.               0.30383998E 03  -0.53868861E 02  -0.30827594E 03   0.31871554E 02
    6   0.               0.               0.11384775E 00   0.12607991E 02   0.34154329E 00  -0.12607991E 02
    7   0.               0.               0.               0.               0.               0.
    8   0.               0.               0.               0.               0.               0.
    9   0.               0.               0.               0.               0.               0.
   10   0.               0.               0.               0.               0.               0.
         COLUMN   13       COLUMN   14       COLUMN   15       COLUMN   16       COLUMN   17       COLUMN   18

    1   0.               0.               0.               0.               0.               0.
    2   0.               0.               0.               0.               0.               0.
    3   0.               0.               0.               0.               0.               0.
    4   0.               0.               0.               0.               0.               0.
    5   0.               0.               0.               0.               0.               0.
    6   0.               0.               0.               0.               0.               0.
    7   0.32483251E 03  -0.52278129E 02  -0.32757460E 03   0.32541166E 02   0.               0.
    8   0.84216232E-01   0.11079562E 02   0.25204870E 00  -0.11079562E 02   0.               0.
    9   0.               0.               0.               0.               0.30321474E 03  -0.43827882E 02
   10   0.               0.               0.               0.               0.53236897E-01   0.64300282E 01
         COLUMN   19       COLUMN   20       COLUMN
    1   0.               0.
    2   0.               0.
    3   0.               0.
    4   0.               0.
    5   0.               0.
    6   0.               0.
    7   0.               0.
    8   0.               0.
    9  -0.30521062E 03   0.28517173E 02
   10   0.15971048E 00  -0.64300282E 01
```

```
                                        OUTPUT DATA

          FLUTTER ANALYSIS BY A COLLOCATION METHOD, USING AERODYNAMIC INFLUENCE COEFFICIENTS

          DENSITY =        0.23780000E-02        REDUCED VELOCITY =        0.16670000E 02

                                  RIGID BODY DEGREES OF FREEDOM


                                                   ITERATIONS  S.P.    D.P.       AITKENS S.P.    D.P.
   MODE                EIGENVALUE

      1     0.22933607E 08     -0.15925949E 08                 13       0                  3        0
      2     0.13014712E 08     -0.15691301E 06                 15       0                  4        0
      3     0.48985828E 07      0.13604431E 07                 13       0                  2        0
      4     0.19962581E 07     -0.12316837E 07                 18       0                  4        6


                                        EIGENVECTORS

         COLUMN     1         COLUMN     2        COLUMN     3        COLUMN     4        COLUMN     5        COLUMN     6

   1  -0.22672209E 00    0.92881241E-01   -0.10980617E 00   -0.10249931E 00   -0.11566342E 00    0.10828242E-02
   2  -0.24322614E 00    0.96231452E-01   -0.11257997E 00   -0.13723300E 00   -0.14202341E 00    0.42004159E-03
   3  -0.10896546E 00    0.96128553E-01    0.36834285E-02   -0.72438926E-01    0.39344759E-01   -0.37217868E-01
   4  -0.13140213E 00    0.95914406E-01    0.38691290E-02   -0.12866633E 00    0.62680741E-02   -0.41506400E-01
   5   0.16390737E 00    0.24669461E-01    0.27384991E 00   -0.15872387E-01    0.38962762E 00   -0.14034653E 00
   6   0.13893196E 00    0.93805569E-01    0.27711217E 00   -0.70519944E-01    0.38137447E 00   -0.15814607E 02
   7   0.57352658E 00    0.51462698E-01    0.63861424E 00    0.20940761E-01    0.72148682E 00   -0.93109597E-01
   8   0.54571533E 00    0.66242830E-01    0.64748616E 00   -0.26460319E-01    0.75147159E 00   -0.13747385E 00
   9   0.10000000E 01    0.39256811E-08    0.98694071E 00    0.36698160E-01    0.94384034E 00    0.67121342E-01
  10   0.97106495E 00    0.19206324E-03    0.10000000E 01    0.18260105E-09    0.10000000E 01    0.73126528E-09
         COLUMN     7         COLUMN     8        COLUMN
   1   0.55517594E-01   -0.28637167E-01
   2   0.37303378E-03   -0.33456806E-02
   3  -0.61298331E-01   -0.81922612E-01
   4  -0.72267180E-01   -0.58644277E-01
   5  -0.53630956E 00   -0.13743654E 00
   6  -0.51810123E 00   -0.16383449E 00
   7  -0.12079909E 00   -0.69967863E-01
   8  -0.82737129E-01   -0.1[illegible]E 00
   9   0.10000000E 01    0.
  10   0.94309171E 00   -0.89704716E-02
```

```
CHECK EIGENVALUES AND EIGENVECTORS

0.22933607E 08 -0.15925956E 06  0.13014710E 06 -0.15691698E 06  0.48905000E 07  0.13604393E 07
0.19962599E 07 -0.12316678E 07
        COLUMN    1      COLUMN    2      COLUMN    3      COLUMN    4      COLUMN    5      COLUMN    6

   1 -0.22672210E 00  0.97801248E-01 -0.16939607E 00 -0.10249928E 00 -0.11566328E 00  0.10829196E-02
   2 -0.24322616E 00  0.96231465E-01 -0.11252989E 00 -0.13723299E 00 -0.14202321E 00  0.42007173E-03
   3 -0.10896548E 00  0.90128561E-01  0.36834970E-02 -0.72438898E-01  0.39344858E-01 -0.37217773E-01
   4 -0.13140214E 00  0.95914421E-01  0.38692318E-02 -0.12866630E 00  0.62682456E-02 -0.41586375E-01
   5  0.16390735E 00  0.84669469E-01  0.27384996E 00 -0.15872351E-01  0.38962777E 00 -0.14034850E 00
   6  0.13893196E 00  0.93805592E-01  0.27711225E 00 -0.70519987E-01  0.38137463E 00 -0.15814662E 00
   7  0.57352658E 00  0.51462696E-01  0.63801430E 00  0.20940764E-01  0.72148695E 00 -0.93109646E-01
   8  0.54571332E 00  0.66242832E-01  0.64748619E 00 -0.26460305E-01  0.75147167E 00 -0.13747361E 00
   9  0.10000000E 01  0.18256829E-08  0.96694071E 00  0.36698161E-01  0.94384057E 00  0.67121243E-01
  10  0.97106489E 00  0.19260280E-01  0.10000000E 01  0.19268157E-10  0.10000000E 01  0.11595592E-06
        COLUMN    7      COLUMN    8      COLUMN
   1  0.55517193E-03 -0.28630435E-01
   2  0.37502715E-01 -0.33451963E-02
   3 -0.61298424E-01 -0.81924672E-01
   4 -0.72267375E-01 -0.58643527E-01
   5 -0.53630659E 00 -0.13743543E 00
   6 -0.51040836E 00 -0.16305335E 00
   7 -0.12070819E 00 -0.69967353E-01
   8 -0.82736019E-01 -0.11890159E 00
   9  0.10000000E 01  0.12743769E-08
  10  0.94399217E 00 -0.80786561E-02


        MODE        FRQCY (CPS)          DAMPING        VELOCITY (KNOTS)

          1       0.20647998E 01     -0.69443715E 00     0.70819116E 03
          2       0.27489231E 01     -0.12056587E-01     0.92947031E 03
          3       0.44713368E 01      0.27818062E 00     0.15162683E 04
          4       0.69985134E 01     -0.61699621E 00     0.23732553E 04
```

SECTION 8

PROGRAM LISTING

```
$      OPTION  FORTRAN
$      FORTRAN LSTOU,DECK
C MAIN        FLUTTER OVERLAY
C             JAN 13,1967
      COMMON IT(218)
C     CHANGE  BCD TAPES TO BINARY TAPES
   10 CALL LLINK (6HPAR1TT)
      CALL PART1
      CALL LLINK (6HPAR2TT)

      CALL PART2
      GO TO 10
      END
$      FORTRAN LSTOU,DECK
C MPRINT
      SUBROUTINE MPRINT (A,M,N,MD,NTAPE)                                    HM14007
      DIMENSION   A(1), IT(6), C(6)                                         HM14007
      EQUIVALENCE  (IT,C)                                                   HM14007
    2 FORMAT    (1H , 4X, 6( 6X, 7HCOLUMN   1I4  )   ///     )              HM14008
    3 FORMAT    (1H  1I4, X,   (6E 17.8)  )                                 HM14008
      N1=N                                                                  HM14008
      N2=6                                                                  HM14008
      N3=6                                                                  HM14008
      N4=1                                                                  HM14008
    4 IF (N3-N1)  6,6,5                                                     HM14008
    5 N2=N1-N3+6                                                            HM14008
      N3=N1                                                                 HM14009
    6 K=0                                                                   HM14009
      DO  7  I= N4,N3                                                       HM14009
        K=K+1                                                               HM14009
    7   IT(K)=I                                                             HM14009
       WRITE (NTAPE,2) (IT(I),I=1,N2)
      DO  9  I=1,M                                                          HM14009
        K=0                                                                 HM14009
        L=MD*(N4-1)+I                                                       HM14009
        DO  8  J=N4,N3                                                      HM14009
          K=K+1                                                             HM14010
          C(K)=A(L)                                                         HM14010
    8     L=L+MD                                                            HM14010
    9  WRITE (NTAPE,3) I,(C(K),K=1,N2)
       IF (N3-N1) 10,11,11                                                  HM14010
   10  N3=N3+6                                                              HM14010
       N4=N4+6                                                              HM14010
       GOTO  4                                                              HM14010
   11  RETURN                                                               HM14010
       END                                                                  HM14010
$      FORTRAN LSTOU,DECK
C MPUNCH
       SUBROUTINE MPUNCH(A,M,N,IOUT,ITRA,IORG,BCDZ,MAXM,NTAPE,NCARDS)           001
       DIMENSION A(1)                                                           002
       RETURN                                                                   003
       END                                                                      004
$      LINK    PAR1TT
$      FORTRAN LSTOU,DECK
C PART1
       SUBROUTINE PART1                                                         001
C      NSUR=TOTAL NUMBER OF SURFACES ALLOWED.                                   002
C      NDENS=TOTAL NUMBER OF DENSITIES ALLOWED.                                 003
C      NRIGID=TOTAL NUMBER OF RIGID BODIES ALLOWED                              004
C      NSIZE=TOTAL NUMBER CONTROL POINTS ON ANY ONE SURFACE ALLOWED             005
C      NMODES=TOTAL NUMBER MODES INPUT ON ANY ONE SURFACE.                      006
```

```
      DIMENSION  ISXST(20), ISH(20), BR(21), S(21), RHO(20), UM(6,6),
     1           DU(6,12), DMBAR(6,12), BARMRR(6,12), LOW(50), LHIGH(50)
     2           , IT(218), VELCTY(20), NSIZES(20),
     3           A(50,100), F(50,100), U(50,100), HR(50,6), HRT(6,100),
     4           HT(6,100), G(6,100)
C THE FOLLOWING STATEMENT(S) HAVE BEEN MANUFACTURED BY THE TRANSLATOR TO
C   COMPENSATE FOR THE FACT THAT EQUIVALENCE DOES NOT REORDER COMMON---
      COMMON  IT
      EQUIVALENCE  (IT(1),ISXST), (IT(21),ISH), (IT(41),RHO)
     1            ,(IT(61),NTAPE1), (IT(62),NTAPE2), (IT(63),NTAPE3),
     2             (IT(64),NTAPE4), (IT(65),NTAPE5), (IT(66),NTAPE6),
     3             (IT(67),NTAPE7), (IT(68),NTAPE8), (IT(69),NTAPE9),
     4             (IT(70),NSUR), (IT(71),NRIGID), (IT(72),BREF),
     5             (IT(73),NAERO), (IT(74),NFUS), (IT(75),NDENS),
     6             (IT(76),MODES), (IT(77),NPOINT), (IT(78),NPUNCH),
     7             (IT(79),MAXR), (IT(80),MAXQ), (IT(81),MAXS),
     8             (IT(82),NC), (IT(83),NSURFS), (IT(84),NR2),
     9             (IT(85),BR), (IT(106),S), (IT(127),VELCTY),
      EQUIVALENCE  (IT(147),NTAPEU), (IT(148),NRHO), (IT(149),NITRSP),
     1             (IT(150),NITRDP), (IT(151),EPSP), (IT(152),EPDP),
     2             (IT(153),PICON), (IT(154),NVEL), (IT(155),NCARDS),
     3             (IT(156),AITKEN), (IT(157),NGO), (F,G), (F(601,1),HT)
     4,              (U,LOW), (U(51,1),LHIGH), (IT(158),FK),(IT(159),SQR
     5CON)           , (IT(160),NSIZES), (IT(180),UM), (DMBAR,BARMRR)
     6               , (IT(216),NDELM),(IT(217),AITKED),(IT(218),KPART)
    1 FORMAT  (18I4)
    2 FORMAT  (6E12.8)
    3 FORMAT  (1H 16X, 41H FLUTTER ANALYSIS BY A COLLOCATION METHOD
     1        ,42H USING AERODYNAMIC INFLUENCE COEFFICIENTS ///10H NSUR =
     2         I12, 10H  NAERO =  I14, 11H  NRIGID = I12, 9H  NFUS =
     3         I12, 10H  NDENS =  I14, 14H  MODES OUT =  I12
     4        , 9H NDELM = I12,10H NPUNCH =  I12    )
    4 FORMAT (1H0 22X, 11H B (REF) = 1E20.8, 5X, 4HK = 1E20.8 /1H0 25X,
     1        7HSURFACE 18X, 1HB 19X, 1HS 10X,20HEXTERNAL STORES SIZE //)
    5 FORMAT  (1H0 10X, 21H B RIGID COMPONENT =  1E18.8, 5X, 8H S RIGID
     1         ,13H COMPONENT =  1E18.8  )
    6 FORMAT  (1H  1I29,  2(  5X,  1E20.8),  1I12 )
   10 FORMAT  (1H1  48X, 12H MASS MATRIX      )
   11 FORMAT  (41H0 NUMBER OF CONTROL POINTS THIS MATRIX, ( I14,
     1         48H) AND TOTAL NUMBER OF CONTROL POINTS EXPECTED, (  I14,
     2         37H) DO NOT AGREE. PROGRAM CONTINUED....    )
   12 FORMAT  (1H1 42X,24H RIGID BODY MODAL MATRIX    )
   13 FORMAT  (1H  38X,  8HSURFACE  I12,  1H,  I16, 15H CONTROL POINTS)
   14 FORMAT  (1H1 43X, 20H FLEXIBILITY MATRIX     )
   15 FORMAT  (1H1  46X, 18H WEIGHTING MATRIX    )
   16 FORMAT  (1H1 28X, 29H RIGID COMPONENT AERO MATRIX, I19, 8H CONTROL
     1         7H POINTS     )
   17 FORMAT  (1H1   33X,  20H AERODYNAMIC MATRIX  8X, 10H 1./K R =
     1          1E20.8   )
   18 FORMAT  (1H0 30X, 23H RIGID COMPONENT MODES,  I110,
     1         17H CONTROL POINTS.     )
   19 FORMAT  (1H0 30X, 29H RIGID COMPONENT MASS MATRIX     )
   20 FORMAT  (47H0 ERROR IN INVERSE ROUTINE. PROGRAM TERMINATED      )
   21 FORMAT  ( 1H   38X, 8HSURFACE  I12,  1H, 6X, 13H NO WEIGHTING
     1          7H MATRIX  )
   22 FORMAT  ( 3E12.8, 2I4 )
   23 FORMAT  ( 8H0EPSP =   1E16.8, 1X, 8H EPDP =  1E16.8, 1X,
     1         10H AITKEN =  1E16.8, 1X, 10H NITRSP = I14, 1X,
     2         10H NITRDP =    I14   )
   24 FORMAT  (1H0 43X, 20H GENERALIZED MASSES  ////    (1H  38X,
     1           5H MASS  I14,  3H =   1E16.8 )  )
```

```
   25 FORMAT   ( 1H0  30X, 23H RIGID COMPONENT MODES  ///     )                079
   26 FORMAT   ( 2I4, 62X, 1A6, 1I4 )                                          080
   27 FORMAT   ( 1H0  33X, 23H PUNCHED CARDS NUMBERS  1A6, 1I4, 6H THRU        081
     1               1A6, 1I4   )                                              082
   28 FORMAT (1H0  20X,  3H K= 1E16.8     )                                    083
      DATA Q000CT/0202030440005/
      BCDZ =Q000CT                                                             085


$        OPTION  FORTRAN
$        FORTRAN LSTOU.DECK
C MAIN         FLUTTER OVERLAY
C              JAN 13,1967
      COMMON IT(218)
C     CHANGE  BCD TAPES TO BINARY TAPES
   10 CALL LLINK (6HPAR1TT)
      CALL PART1
      CALL LLINK (6HPAR2TT)
```

```
$       OPTION  FORTRAN
$       FORTRAN LSTOU.DECK
C MAIN        FLUTTER OVERLAY
C             JAN 13,1967
      COMMON IT(218)
C     CHANGE  BCD TAPES TO BINARY TAPES
   10 CALL LLINK (6HPAR1TT)
      CALL PART1
      CALL LLINK (6HPAR2TT)

      CALL PART2
      GO TO 10
      END
$       FORTRAN LSTOU.DECK
C MPRINT
      SUBROUTINE MPRINT (A,M,N,MD,NTAPE)
      DIMENSION   A(1), IT(6), C(6)
      EQUIVALENCE  (IT,C)
    2 FORMAT   (1H , 4X, 6( 6X, 7HCOLUMN   I14  )   ///     )
    3 FORMAT   (1H  I14, X,   (6E 17.8)  )
      N1=N
      N2=6
      N3=6
      N4=1
    4 IF (N3-N1)  6,6,5
    5 N2=N1-N3+6
      N3=N1
    6 K=0
      DO  7  I= N4,N3
        K=K+1
    7   IT(K)=I
      WRITE (NTAPE,2) (IT(I),I=1,N2)
      DO  9  I=1,M
        K=0
        L=MD*(N4-1)+I
        DO  8  J=N4,N3
          K=K+1
          C(K)=A(L)
    8     L=L+MD
    9 WRITE (NTAPE,3) I,(C(K),K=1,N2)
      IF (N3-N1) 10,11,11
   10 N3=N3+6
      N4=N4+6
      GOTO  4
   11 RETURN
      END
$       FORTRAN LSTOU.DECK
C MPUNCH
      SUBROUTINE MPUNCH(A,M,N,IOUT,ITRA,IORG,BCDZ,MAXM,NTAPE,NCARDS)
      DIMENSION A(1)
      RETURN
      END
$       LINK    PAR1TT
$       FORTRAN LSTOU.DECK
C PART1
      SUBROUTINE PART1
C     NSUR=TOTAL NUMBER OF SURFACES ALLOWED.
C     NDENS=TOTAL NUMBER OF DENSITIES ALLOWED.
C     NRIGID=TOTAL NUMBER OF RIGID BODIES ALLOWED
C     NSIZE=TOTAL NUMBER CONTROL POINTS ON ANY ONE SURFACE ALLOWED
C     NMODES=TOTAL NUMBER MODES INPUT ON ANY ONE SURFACE.
```

```
      DIMENSION  ISXST(20), ISW(20), BR(21), S(21), RHO(20), DM(6,6),         0120
     1           DQ(6,12), DMBAR(6,12), BARMRR(6,12), LOW(50), LHIGH(50)      0130
     2           , IT(218), VELCTY(20), NSIZES(20),                           0140
     3           A(50,100), F(50,100), U(50,100), HR(50,6), RT(6,100),        0150
     4           HT(6,100), G(6,100)                                          0160
C THE FOLLOWING STATEMENT(S) HAVE BEEN MANUFACTURED BY THE TRANSLATOR TO       0170
C   COMPENSATE FOR THE FACT THAT EQUIVALENCE DOES NOT REORDER COMMON---       0180
      COMMON  IT                                                              0190
      EQUIVALENCE  (IT(1),ISXST), (IT(21),ISW), (IT(41),RHO)                  0250
     1            ,(IT(61),NTAPE1), (IT(62),NTAPE2), (IT(63),NTAPE3),         0260
     2             (IT(64),NTAPE4), (IT(65),NTAPE5), (IT(66),NTAPE6),         0270
     3             (IT(67),NTAPE7), (IT(68),NTAPE8), (IT(69),NTAPE9),         0280
     4             (IT(70),NSUR), (IT(71),NRIGID), (IT(72),BREF),             0290
     5             (IT(73),NAERO), (IT(74),NFUS), (IT(75),NDENS),             0300
     6             (IT(76),MODES), (IT(77),NPOINT), (IT(78),NPUNCH),          0310
     7             (IT(79),MAXR), (IT(80),MAXQ), (IT(81),MAXS),               0320
     8             (IT(82),NC), (IT(83),NSURFS), (IT(84),NP2),                0330
     9             (IT(85),BR), (IT(106),S), (IT(127),VELCTY)                 0340
      EQUIVALENCE  (IT(147),NTAPE0), (IT(148),NRHO), (IT(149),NITRSP),        0350
     1             (IT(150),NITRDP), (IT(151),EPSP), (IT(152),EPDP),          0360
     2             (IT(153),PICON), (IT(154),NVEL), (IT(155),NCARDS),         0370
     3             (IT(156),AITKEN), (IT(157),NGO), (F,G), (F(601,1),HT)      0380
     4,              (U,LOW), (U(51,1),LHIGH), (IT(158),FK),(IT(159),SQR      0390
     5CON)           , (IT(160),NSIZES), (IT(180),DM), (DMBAR,BARMRR)         0400
     6               , (IT(216),NDELM),(IT(217),AITKED),(IT(218),KPART)       0410
    1 FORMAT  (18I4)                                                          0430
    2 FORMAT  (6E12.8)                                                        0440
    3 FORMAT  (1H 16X, 41H FLUTTER ANALYSIS BY A COLLOCATION METHOD           0450
     1        42H USING AERODYNAMIC INFLUENCE COEFFICIENTS ///10H NSUR =      0460
     2        1I2, 10H  NAERO =  1I4, 11H  NRIGID = 1I2, 9H  NFUS =           0470
     3        1I2, 10H  NDENS =  1I4, 14H  MODES OUT =  1I2                   0480
     4        , 9H NDELM = 1I2,10H NPUNCH =  1I2   )                          0490
    4 FORMAT (1H0 22X, 11H B (REF) = 1E20.8, 5X, 4HK = 1E20.8 /1H0 25X,       0500
     1       7HSURFACE 18X, 1HB 19X, 1HS 10X,20HEXTERNAL STORES SIZE //)      0510
    5 FORMAT  (1H0 10X, 21H B RIGID COMPONENT =  1E18.8, 5X, 8H S RIGID       0520
     1         13H COMPONENT =  1E18.8  )                                     0530
    6 FORMAT  (1H  1I29,  2(  5X,  1E20.8),  1I12 )                           0540
   10 FORMAT  (1H1  48X, 12H MASS MATRIX    )                                 0550
   11 FORMAT  (41H0 NUMBER OF CONTROL POINTS THIS MATRIX, ( 1I4,              0560
     1         48H) AND TOTAL NUMBER OF CONTROL POINTS EXPECTED, (  1I4,      0570
     2         37H) DO NOT AGREE, PROGRAM CONTINUED....    )                  0580
   12 FORMAT  (1H1 42X,24H RIGID BODY MODAL MATRIX   )                        0590
   13 FORMAT  (1H  38X,  8HSURFACE  1I2,  1H,  1I6, 15H CONTROL POINTS)       0600
   14 FORMAT  (1H1 43X, 20H FLEXIBILITY MATRIX    )                           0610
   15 FORMAT  (1H1  46X, 18H WEIGHTING MATRIX   )                             0620
   16 FORMAT  (1H1 28X, 29H RIGID COMPONENT AERO MATRIX, 1I9, 8H CONTROL      0630
     1         7H POINTS     )                                                0640
   17 FORMAT  (1H1    33X,  20H AERODYNAMIC MATRIX  8X, 10H 1./K R =          0650
     1          1E20.8  )                                                     0660
   18 FORMAT  (1H0 30X, 23H RIGID COMPONENT MODES,  1I10,                     0670
     1        17H CONTROL POINTS.    )                                        0680
   19 FORMAT  (1H0 30X, 29H RIGID COMPONENT MASS MATRIX    )                  0690
   20 FORMAT  (47H1 ERROR IN INVERSE ROUTINE, PROGRAM TERMINATED      )       0700
   21 FORMAT  ( 1H    38X, 8HSURFACE  1I2,  1H, 6X, 13H NO WEIGHTING          0710
     1          7H MATRIX  )                                                  0720
   22 FORMAT  ( 3E12.8, 2I4 )                                                 0730
   23 FORMAT  ( 8H0EPSP =    1E16.8, 1X, 8H EPDP =  1E16.8, 1X,               0740
     1          10H AITKEN =  1E16.8, 1X, 10H NITRSP = 1I4, 1X,               0750
     2          10H NITRDP =    1I4   )                                       0760
   24 FORMAT  (1H0 40X, 20H GENERALIZED MASSES  ////    (1H  30X,             0770
     1            5H MASS  1I4,  3H =   1F16.8 )  )                           0780
```

```
   25 FORMAT   ( 1H0  34X, 23H RIGID COMPONENT MODES  ///     )
   26 FORMAT   ( 2I4, 62X, 1A6, 1I4 )
   27 FORMAT   ( 1H0  35X, 23H PUNCHED CARDS NUMBERS  1A6, 1I4, 6H THRU
     1               1A6, 1I4   )
   28 FORMAT (1H0  20X,  3H K= 1E16.8     )
      DATA Q000CT/0202030440005/
      BCDZ =Q000CT
C     NTAPE0 = PUNCH OUTPUT TAPE
C     NTAPE2 = INPUT TAPE
C     NTAPE3 = OUTPUT PRINT TAPE
C     NTAPE4 =     /
C     NTAPE5 =    /    ARE UTILITY TAPES
C     NTAPE6 =  /
C     NTAPE7 = /
C     NTAPE8 =/
C     NTAPE9=/
      IF   ( NGO-98765 )      99,97,99
   97 IF   ( NAERO )          98,320,98
   98 NAERO = NAERO-1
      IF   ( NAERO )          99,99,170
   99 NTAPE0 = 8
      NTAPE2=5
      NTAPE3=6
      NTAPE4 = 9
      NTAPE5 = 3
      NTAPE6 = 4
      NTAPE7=11
      NTAPE8=1
      NTAPE9 =10
      MAXR = 50
      MAXQ = 6
      NCON=0
      MAXS=50
  991 REWIND NTAPE4
      REWIND NTAPE5
      REWIND NTAPE6
      REWIND NTAPE9
      SQRCON =  SQRT( 386.0) / (2.0*3.14159 )
      EPSP = .5E-06
      EPDP = .5E-07
      AITKEN = .9
      AITKED = .9
      PICON = .5921*2.0*3.14159
      NCARDS = 0
      NVFI  = 0
      NC=1
      NITRSP=40
      NITRDP=100
      RHO(1) = 0.0
C*********************************************************************
C READ IN TITLE, CONTROLS AND CONSTANTS AND PRINT.
  100 CALL RDIN  (NTAPE2,NTAPE3,1)
      READ  (NTAPE2,1)NSUR, NAERO, NRIGID, NFUS, NDENS, MODES          ,
     1NDFIM, NPUNCH, NCON
      READ  (NTAPE2,2)FK
      WRITE (NTAPE3,3)NSUR,NAERO, NRIGID,NFUS, NDENS,MODES
     1          , NDFIM, NPUNCH
      NR2=NRIGID*NC
      NSURFS=NSUR+NFUS
      IF   ( NCON )          102,104,102
  102 READ  (NTAPE2,22)EPSP,EPDP,AITKEN, NITRSP,NITRDP
```

```
      READ  (NTAPE2,22)AITKEN
      WRITE (NTAPE3,23)EPSP, EPDP, AITKEN, NITRSP, NITRDP
  104 IF  ( NAERO )             105,103,105
  103 WRITE (NTAPE3,28)FK
      GOTO  111
  105 READ  (NTAPE2,1)(ISXST(I),ISW(I),I=1,NSUR)
      READ  (NTAPE2,2)BREF,  (VELCTY(I),I=1,NAERO)
      NC=2
      NR2=  NRIGID *NC
      READ  (NTAPE2,2)(BR(I),S(I),I=1,NSURFS)
      IF ( NDENS )             106,107,106
  106 READ  (NTAPE2,2)(RHO(I),I=1,NDENS)
  107 IF ( NFUS )              108,109,108
  108 WRITE (NTAPE3,5)BR(1), S(1)
  109 WRITE (NTAPE3,4)BREF   ,FK
      DO  110 I=1,NSUR
        J=I+NFUS
  110   WRITE (NTAPE3,6) I, BR(J), S(J) ,ISXST(I)
C*********************************************************************
C READ IN FUSE  OF MASS CHARACTERISTICS
  111 IF  ( NRIGID )           112,117,112
  112 IF  ( NDELM  )           115,113,115
  113 DO  114 I=1,NRIGID
        DO   114 J=1,NRIGID
  114     DM(I,J)=0.0
      GOTO  117
  115 DO  116  I=1,NRIGID
  116   READ  (NTAPE2,2)(DM(J,I),J=1,NRIGID)
      WRITE (NTAPE3,19)
      CALL MPRINT (DM,NRIGID,NRIGID,MAXQ,NTAPE3)
C*********************************************************************
C READ MASS MATRIX FOR EACH SURFACE, STORE SYSTEM MASS MATRIX ON NTAPE4
  117 K1=0
        WRITE (NTAPE3,10)
      DO  120 I=1,NSUR
        READ  (NTAPE2,1)NSIZE
        READ  (NTAPE2,1)(LOW(J),LHIGH(J),J=1,NSIZE)
        DO  119  J=1,NSIZE
          DO  118  K=1,NSIZE
  118       A(K,J)=0.0
      N1=LOW(J)
      N2=LHIGH(J)
  119     READ  (NTAPE2,2)(A(N,J),N=N1,N2)
      WRITE (NTAPE4)NSIZE, NSIZE,  ((A(N,J),N=1,NSIZE),J=1,NSIZE)
        WRITE (NTAPE3,11)I, NSIZE
        CALL MPRINT (A,NSIZE,NSIZE,MAXR,NTAPE3)
      NSIZES(I)=NSIZE
  120   K1=K1+NSIZE
C*********************************************************************
C NPOINT = TOTAL NUMBER OF CONTROL POINTS ON ALL SURFACES.
      NPOINT=K1
C READ IN RIGID BODY MODAL MATRIX FOR EACH SYSTEM.
      IF ( NFUS )              121,123,121
  121 READ  (NTAPE2,1)NSIZE
      DO  122  J=1,NRIGID
  122   READ  (NTAPE2,2)(HR(I,J),I=1,NSIZE)
      WRITE (NTAPE3,18)NSIZE
      CALL MPRINT (HR,NSIZE,NRIGID,MAXS,NTAPE3)
      WRITE (NTAPE6)NSIZE, NRIGID, ((HR(I,J),I=1,NSIZE),J=1,NRIGID)
  123 IF ( NRIGID )            124,128,124
  124 K1=1
```

```
      WRITE (NTAPE3,12)
      DO  126   ISUR=1,NSUR
        READ  (NTAPE2,1)NSIZE
        K2=K1+NSIZE-1
        DO  125  J=1,NRIGID
 125      READ  (NTAPE2,2)(HR(I,J),I=K1,K2)
        WRITE (NTAPE3,13)ISUR,NSIZE
          CALL MPRINT  (HR(K1,1),NSIZE,NRIGID,MAXS,NTAPE3)
 126      K1=K1+NSIZE
      WRITE (NTAPE5)NPOINT, NRIGID, ((HR(N,J),N=1,NPOINT), I=1,
    1                          NRIGID  )
      IF  ( K1-NPOINT-1)     127,128,127
 127 WRITE (NTAPE3,11)K1, NPOINT
*********************************************************************
 READ IN FLEXIBILITY MATRIX FOR EACH SURFACE,       STORE ON NTAPE5
 128 K1=0
        WRITE (NTAPE3,14)
      DO  153   I=1,NSUR
      READ  (NTAPE2,1)NSIZE, J, IFORM, IROWS
      CALL MREAD (A,NSIZE,NSIZE,IFORM,IROWS,0,1,F,MAXR,NTAPE2,NTAPE3)
        WRITE (NTAPE3,13)I,NSIZE
      CALL MPRINT (A,NSIZE,NSIZE,MAXR,NTAPE3)
      WRITE (NTAPE5)NSIZE, NSIZE, ((A(J,K),J=1,NSIZE),K=1,NSIZE)
 153 K1=K1+NSIZE
      IF ( K1-NPOINT )        158,164,158
 158 WRITE (NTAPE3,11)K1, NPOINT
 164 IF ( NAERO )             166,165,166
 165 NRHO=1
      DO  500  I=1,NRIGID
        DO  500  J=1,NR2
 500      DQ(I,J)=0.0
      WRITE (NTAPE5)((DM(I,J),I=1,NRIGID),J=1,NRIGID)
      NCX=NC
      GOTO  215
C*********************************************************************
C READ IN WEIGHTING MATRIX FOR EACH SURFACE.....STORE ON NTAPE6,
  166  WRITE (NTAPE3,15)
      DO  178  I=1,NSUR
        IF   ( ISW(I) )        167,177,167
  167   N1=ISYST(I)
        IF   ( N1 )            168,172,168
  168   DO  170  J=1,N1
          DO  169  L=1,MAXR
            A(J,L)=0.0
  169       A(L,J)=0.0
  170     A(J,J)=1.0
        READ  (NTAPE2,1)NXST, J, IFORM, IROW
        IF   ( NXST )          171,172,171
  171   CALL MREAD (A,NXST,NXST,IFORM,IROW,0,1,F,MAXR,NTAPE2,NTAPE3)
  172   K=N1+1
        READ  (NTAPE2,1)NSIZE, NPART, IFORM, IROW
        IF   ( IFORM )         174,173,174
  173   CALL MREAD  (A(K,K),NSIZE,NSIZE,0,0,0,1,F,MAXR,NTAPE2,NTAPE3)
        K=K+NSIZE
        GOTO  176
  174   DO  175  J=1,NPART
          READ  (NTAPE2,1)NSIZE
      N=K+NC
      DO  1741  L=K,N
        DO  1741  M=1,K
 1741     A(M,L)=0.0
```

```
      CALL MREAD (A(K,K),NSIZE,NSIZE,1,IROW,0,0,F,MAXR,NTAPE2,NTAPE3)
  175   K=K+NSIZE
  176 K=K-1
C**********************************************************************
      WRITE (NTAPE3,15)I, K
      CALL MPRINT (A,K,K,MAXR,NTAPE3)
      WRITE (NTAPE6)K, K, ((A(J,L),J=1,K),L=1,K)
     GOTO  178
  177 WRITE (NTAPE3,21)I
  178   CONTINUE
  179 REWIND NTAPE6
      REWIND NTAPE7
      NCX=NC
      NVEL = NVEL+1
**********************************************************************
  IF SERIES OF DENSITIES FOR EACH V/B OMEGA, READ IN THAT SERIES.
      IF   ( NDENS )          180,181,180
  180 NRHO=NDENS
      GOTO  182
  181 READ  (NTAPE2,1)NRHO
      READ  (NTAPE2,2)(RHO(I),I=1,NRHO)
**********************************************************************
  READ IN COMPLEX AERODYNAMIC MATRIX FOR EACH SURFACE
  182 DO  210  I=1,NSURFS
      K=1
      K2=1
      IF   ( NFUS )             183,184,183
  183 IF   ( I-1 )              184,188,184
  184 L=I-NFUS
      IF   ( ISXST(L) )         185,188,185
  185   K=ISXST(L)+1
        K2 = K+ISXST(L)
        DO  186  J=1,K
          DO  186  L=1,K2
  186       A(J,L)=0.0
        READ  (NTAPE2,1)NXST, J, IFORM, IROW
        IF   ( NXST )            187,188,187
  187   N=  NXST *NC
      CALL MREAD (A,NXST,N,IFORM,IROW,0,1,U,MAXR,NTAPE2,NTAPE3)
  188   READ  (NTAPE2,2)VELC
        READ  (NTAPE2,1)NSIZE, NPART, IFORM, IROW
        IF   ( IFORM )           190,189,190
  189   N=  NSIZE      *NC
      CALL MREAD (A(K,K2),NSIZE,N ,IFORM,IROW,0,1,U,MAXR,NTAPE2,NTAPE3)
      NSIZE=NSIZE+K-1
        GOTO  193
  190   DO  192  J=1,NPART
          READ  (NTAPE2,1)NSIZE
      N=K2+NC
      DO  191  M=K2,N
        DO  191  L=1,K
  191     A(L,M)=0.0
          N=  NSIZE      *NC
      CALL MREAD (A(K,K2),NSIZE,N,1,IROW,0,0,U,MAXR,NTAPE2,NTAPE3)
          K=K+NSIZE
  192     K2=K2+N
      NSIZE=K-1
          N=K2-1
  193 IF   ( I-1 )               199,194,199
  194 IF   ( NFUS )              195,197,195
  195   WRITE (NTAPE3,15)NSIZE
```

```
      CALL MPRINT (A,NSIZE,N,MAXR,NTAPE3)
C*********************************************************************
C  COMPUTE (DQ) = (HR)T * (CH) * (HR)
      K1=1
      K2=1
      M=NC-1
      READ  (NTAPE6)NSIZE, L, ((U(L,J),L=1,NSIZE),J=1,NRIGID)
      CALL MMULTD  (A,M,U,0,F,NSIZE,NSIZE,NRIGID,MAXR,MAXR,MAXR)
      DO  196  L=1,NSIZE
        DO  196  J=1,NRIGID
  196     A(J,L)=U(L,J)
      CALL MMULTD (A,0,F,M,DQ,NRIGID,NSIZE,NRIGID,MAXR,MAXQ,MAXQ)
      GOTO  210
  197 DO  198  L=1,NRIGID
        DO  198  J=1,NR2
  198     DQ(L,J)=0.0
  199 L=I-NFUS
      IF  ( ISW(L) )         202,200,202
  200 WRITE (NTAPE7)NSIZE, N,    ((A(J,M),J=1,NSIZE),M=1,N)
      GOTO  208
  202 READ  (NTAPE6)L, L, ((F(J,M),J=1,L),M=1,L)
      IF ( NSIZE-L )         204,206,204
  204 WRITE (NTAPE3,11)NSIZE,L
  206 CALL MMULTD (F,0,A,NC-1,U,L,L,L,MAXR,MAXR,MAXR)
      WRITE (NTAPE7)NSIZE, N, ((U(J,M),J=1,NSIZE),M=1,N)
  208 WRITE (NTAPE3,17)VELC
      L=I-NFUS
      WRITE (NTAPE3,13)L, NSIZE
      CALL MPRINT  (A,NSIZE,N,MAXR,NTAPE3)
  210 CONTINUE
C*********************************************************************
C CARRY ON FROM HERE TO END ONCE FOR EACH DENSITY.
  215 DO  300  IRHO=1,NRHO
      K=NC*NPOINT
      DO  216  I=1,NPOINT
        DO  216  J=1,K
  216     U(I,J)=0.0
      REWIND  NTAPE4
      REWIND NTAPE5
      REWIND NTAPE7
        CON=RHO(IRHO)*BR(1)**2*S(1)  *32.174
      IF  ( NRIGID)   218,222,218
  218   DO  220  I=1,NRIGID
          DO  220  J=1,NR2,NCX
            DMBAR(I,J+1)=CON*DQ(I,J+1)
            K=J/NC+NC-1
  220       DMBAR(I,J)=DM(I,K)+CON*DQ(I,J)
C*********************************************************************
C READ ENTIRE HR MATRIX.
      READ  (NTAPE5)I,I, ((HR(I,J),I=1,NPOINT),J=1,NRIGID)
  222  K1=0
      DO  246  ISUR=1,NSUR
          K=ISUR+NFUS
          CON=RHO(IRHO)*BR(K)**2*S(K) *32.174
C*********************************************************************
C                  READ  (M) I
          READ  (NTAPE4)NSIZE, NSIZE, ((F(I,J),I=1,NSIZE),J=1,NSIZE)
      IF ( NAERO )           221,221,223
  221 DO  226  I=1,NSIZE
        DO  226  J=1,NSIZE
  226     A(I,J)=F(I,J)
```

```
      L=NSIZE
      GOTO  231
C***********************************************************************
C               READ  (W)*(CH) I
  223     READ  (NTAPE7)NSIZE, L,  ((A(I,J),I=1,NSIZE),J=1,L)
C***********************************************************************
C         COMPUTE (M BAR) =((M)+RHO*RR**2*S*(W)*(CH) ) I
      DO  228  I=1,NSIZE
        DO  228  J=1,L,NCX
          K=J/2+1
          A(I,J)=CON*A(I,J)+F(I,K)
  228     A(I,J+1)=CON*A(I,J+1)
C***********************************************************************
C READ FLEXIBILITY MATRIX FOR SURFACE
  231 READ  (NTAPE5)NSIZE, NSIZE, ((F(I,J),I=1,NSIZE),J=1,NSIZE)
      K=NC*K1+1
      CALL MMULTD (F,0,A,NC-1,U(K1+1,K),NSIZE,NSIZE,NSIZE,MAXR,MAXR,
     1              MAXR)
      IF  ( NRIGID )          232,246,232
C***********************************************************************
C FIND ( LITTLE M BAR ) = (DELTA M ) + (H R)TRANSPOSED * (M BAR) * (H R)
  232   DO  240  I=1,NSIZE
            K=K1+I
          DO  240  J=1,NRIGID
  240       G(J,I)=HR(K,J)
      K=NC*K1+1
      CALL MMULTD (G,0,A,NC-1,HRT(1,K),NRIGID,NSIZE,NSIZE,MAXQ,MAXR,
     1              MAXQ)
      CALL MMULTD  (HRT(1,K),NC-1,HR(K1+1,1),0,A,NRIGID,NSIZE,NRIGID,
     1               MAXQ,MAXS,MAXR)
      DO  244  I=1,NRIGID
        DO  244  J=1,NR2
  244     BARMRR(I,J)=BARMRR(I,J)+A(I,J)
  246 K1=K1+NSIZE
      L=NC*NPOINT
      IF  ( NRIGID )          247,268,247
  247 GOTO  (252,248),NC
  248 DO  250  I=1,NRIGID
        DO  250  J=1,NR2,NCX
          K=J/2+1
          G(I,K)=BARMRR(I,J+1)
  250     BARMRR(I,K)=BARMRR(I,J)
C***********************************************************************
C THEN (LITTLE M BAR)INVERSE AND FINAL U MATRIX STORED ON NTAPE9.
  252 CALL MNVRSX (BARMRR,0,A(1,1), A(1,MAXQ),NRIGID,IR,NC-1)
      IF  ( IR )              310,254,310
  254 GOTO  (260,256),NCX
  256 DO  258  I=1,NRIGID
        DO  258  J=1,NR2,NCX
          K=NR2-J
          M=K/2+1
          BARMRR(I,K)=BARMRR(I,M)
  258     BARMRR(I,K+1)=G(I,M)
  260 CALL MMULTD  (BARMRR,NC-1,HRT,NC-1, F,NRIGID,NRIGID, POINT,
     1               MAXQ,MAXQ,MAXR)
      CALL MMULTD  (F,NC-1,U,NC-1,HRT,NRIGID,NPOINT,NPOINT.MAXR,MAXR.
     1               MAXQ)
      CALL MMULTD  (HR,0,F,NC-1,A,NPOINT,NRIGID,NPOINT,MAXS,MAXR,MAXR)
      DO  264  I=1,NPOINT
        DO  262  J=1,L
          F(I,J)=U(I,J)
```

```
262       A(I,J)=-A(I,J)
        K=I*NC-NC+1
264     A(I,K)=1.0+A(I,K)
      CALL MMULTD (A,NC-1,F,NC-1,U,NPOINT,NPOINT,NPOINT,MAXR,MAXR,MAXR)
      IF  ( NAERO )            268,266,268
266   READ  (NTAPE5)A(1,1)
      WRITE (NTAPE5)((HRT(I,J),I=1,NRIGID),J=1,NPOINT)
268   WRITE (NTAPE9)NPOINT, L, ((U(I,J),I=1,NPOINT),J=1,L)
300   CONTINUE
      REWIND  NTAPE5
      REWIND  NTAPE6
      REWIND  NTAPE7
      REWIND  NTAPE8
      REWIND  NTAPE9
      KPART = 2
      RETURN
310   WRITE (NTAPE3,20)
      GOTO  991
320   REWIND  NTAPE4
      REWIND  NTAPE5
      IF  ( NRIGID )            330,332,330
330   READ  (NTAPE5)I,I, A(1,1)
332   K1=1
      DO  334  I=1,NPOINT
        DO  334  J=1,NPOINT
334       F(I,J)=0.0
      DO  336  ISUR=1,NSUR
        K2=K1+NSIZES(ISUR)-1
        READ  (NTAPE5)I,I, A(1,1)
        READ  (NTAPE4)NSIZE, NSIZE, ((F(I,J),I=K1,K2),J=K1 K2)
336     K1=K1+NSIZE
      READ  (NTAPE4)NSIZE, MODE, ((A(I,J),I=1,NSIZE),J=1,MODE)
      M=MODE/NC
      CALL MMULTD  (F,0,A,NC-1,U,NPOINT,NPOINT,M,MAXR,MAXR,MAXR)
      IF  ( NDELM )            337,348,337
337   IF  ( NRIGID )            338,348,338
338   READ  (NTAPE5)((DM(I,J),I=1,NRIGID),J=1,NRIGID)
      READ  (NTAPE5)((G(I,J),I=1,NRIGID),J=1,NPOINT)
      DO  339  I=1,NRIGID
        DO  339  J=1,NPOINT
339       G(I,J)=-G(I,J)
      CALL MMULTD  (G,0,A,0,HRT,NRIGID,NPOINT,M,MAXQ,MAXR,MAXQ)
      READ (NTAPE4)  (HR(I,1),I=1,M)
      DO  340  I=1,M
        DO  340  J=1,NRIGID
340       G(J,I) = HRT(J,I)/HR(I,1)
      WRITE (NTAPE3,25)
      CALL MPRINT (G,NRIGID,M,MAXQ,NTAPE3)
      IF  ( NPUNCH )             343,345,343
343   WRITE (NTAPE0,26)NRIGID, M, BCDZ, NCARDS
      NCARD = NCARDS+1
      CALL MPUNCH  ( G,NRIGID,M,0,1,1,BCDZ,MAXQ,NTAPE0,NCARD)
      WRITE (NTAPE3,27)BCDZ, NCARDS, BCDZ, NCARD
      NCARDS=NCARD+1
345   CONTINUE
      CALL MMULTD  (DM,0,G,0,HRT,NRIGID,NRIGID,M,MAXQ,MAXQ,MAXQ)
      DO  346  I=1,NRIGID
        DO  346  J=1,MODE
346       HR(J,I) = G(I,J)
348   DO  350  I=1,NPOINT
        DO  350  J=1,MODE
```

```
350       F(J,I)=A(I,J)
      CALL MMULTD  (F,0,U,0,A,M,NPOINT,M,MAXR,MAXR,MAXR)
      IF  ( NDELM )              352,358,352
  352 IF  ( NRIGID )             354,358,354
  354 CALL MMULTD  (HR,0,HRT,0,F,M,NRIGID,M,MAXR,MAXQ,MAXR)
      DO  356  I=1,MODF
        DO  356  J=1,M
  356     A(J,I) = A(J,I) + F(J,I)
  358 WRITE (NTAPE3,24) ( I, A(I,I),I=1,M)
      GOTO  991
      END
       FORTRAN LSTOU,DECK
C MREAD
C   MREAD
C MATRIX READ SUBROUTINE
C     CALL MREAD   (A,M,N,IFORM,IROW,ITRA,IORG,T,MD,NTAPE2,NTAPE3      )
C
C           A = MATRIX TO READ IN        ITRA = 0, TRA CARD AFTER MATRIX
C           M = NUMBER OF ROWS                =+1, TRA CARD AFTER EACH ROW
C           N = NUMBER OF COLUMNS                       (OR COLUMN )
C           IFORM = -1, FORMAT(12A6)     IORG = ORIGIN OF FIRST C.B. CARD
C                 =  0, COLUMN BINARY    T =MDXN TEMPORARY CELLS
C                 = +1, FORMAT(6E12.8)   MD= DIMENSIONED NUMBER OF ROWS
C           IROW = .0, MATRIX BY COLUMNS                        IN A
C                = +1, MATRIX BY ROWS    NTAPE2 = INPUT TAPE
C                                        NTAPE3 = OUTPUT TAPE
      SUBROUTINE MREAD  (A,M,N,IFORM,IROW,ITRA,IORG,T,MD,NTAPE2,NTAPE3 )
      DIMENSION    A(1), T(1)
    1 FORMAT   (6E12.8)
    2 FORMAT   (12A6)
    3 FORMAT   ( // 26H THATS ALL YOUR DATA.               )
    4 FORMAT (4E16.8)
      MN=MD*N
      DO  5  I=1,MN
        T(I)=0.0
    5   A(I)=0.0
      IF ( IFORM )  39,15,6
    6 IF  ( IROW )   8,7,8
    7 K3=1
      K4=N
      K5=MD
      K6=M-1
       K2=1
      GOTO 9
    8 K2=MN
      K3=MD
      K4=M
      K5=1
      K6=0
    9 DO  11  I=1,K4
        K1=I*K5-K5+1
        IF  (K6)   10,111,10
   10   K2=K1+K6
  111 IF (IFORM - 1)  38,110,109
  109 READ (NTAPE2,4) (A(L) ,L = K1,K2,K3)
      GO TO 11
  110   READ  (NTAPE2,1)(A(L),L=K1,K2,K3)
   11 CONTINUE
        GOTO 36
   15 K1=N
      K2=M
```

```
      K3=1
      IF ( IORG-1 )  16,17,17
   16 K3=2
   17 IF  ( IROW )  18,19,18
   18 K2=N
      K1=M
   19 IF ( ITRA )     22,21,22
   21 K1=1
   22 K=0
      DO  23  I=1,K1
        K4=K+K3
        K5=1
      CALL  BINRD  (T(K4), K5, L, NTAPE2, NTAPE3 )
        GOTO  (23,38,23,23),I
   23 K=K+K2
      IF  ( IROW )  28,24,28
   24 L=0
      IF  ( IORG-1)  26,26,25
   25 L=IORG-1
   26 DO  27  I=1,N
        J=I*MD-MD
        DO  27  K=1,M
          J=J+1
      L=L+1
   27 A(J)=T(L)
      GOTO  36
   28 L=0
      IF  (IORG-1)  30,30,29
   29 L=IORG-1
   30 DO  31  K=1,N
        J= K*MD-MD
        DO  31  I=K,MN,N
          J=J+1
          K1=L+I
   31     A(J)=T(K1)
   36 RETURN
   38 WRITE (NTAPE3,3)
      STOP
   39 READ  (NTAPE2,2)(A(I),I=1,M)
      GOTO  36
      END
$      FORTRAN LSIOU.DECK
C BINRD
      SUBROUTINE BINRD (T,K,L,NTAPE1,NTAPE2)
      DIMENSION T(1)
      RETURN
      END
$      FORTRAN LSIOU.DECK
C RDLN
      SUBROUTINE  RDLN  (NTAPE2, NTAPE3, I )
    1 FORMAT(80H
     1                                         )
    2 FORMAT(1H1)
    3 FORMAT  ( 1H0 )
      READ  (NTAPE2,1)
      GOTO   (4,5),I
    4 WRITE (NTAPE3,2)
      GOTO  6
    5 WRITE (NTAPE3,3)
    6 WRITE (NTAPE3,1)
      RETURN
```

```
      END                                                           0130
      FORTRAN LSTOU.DECK
C MMULTD
      SUBROUTINE MMULTD  (A,N1,B,N2,C,M,N,K,MA,MB,MC)               0010
      DIMENSION  A(1), B(1), C(1)                                   0020
      IC=1                                                          0040
      IA=MC*K                                                       0050
      IB=MA*N                                                       0060
      ID=MA                                                         0070
      IH=MC                                                         0080
      IJ=MC                                                         0090
      IF ( N1 )  4,3,4                                              0100
    3 IF ( N2 )  7,8,7                                              0110
    4 IB=2*IB                                                       0120
      ID=2*ID                                                       0130
      IF ( N2 )  5,6,5                                              0140
    5 IC=2                                                          0150
      GOTO  7                                                       0160
    6 IH=2*IH                                                       0170
      IC=3                                                          0180
    7 IA=2*IA                                                       0190
      IJ=2*IJ                                                       0200
    8 DO  18  I=1,M                                                 0210
      INC=0                                                         0220
      DO  11  J=I,IA,IH                                             0230
        C(J)=0.0                                                    0240
        IN=INC                                                      0250
        DO  10  L=I,IB,ID                                           0260
          IN=IN+1                                                   0270
   10     C(J)=C(J)+A(L)*B(IN)                                      0280
   11   INC=INC+MB                                                  0290
      INC=0                                                         0300
      GOTO  (18,12,15),IC                                           0310
   12 DO  14  J=I,IA,IJ                                             0320
        IE=I+MA                                                     0330
        IF=J+MC                                                     0340
        IN=INC                                                      0350
        DO  13  L=IE,IB,ID                                          0360
          IN=IN+1                                                   0370
          IG=IN+MB                                                  0380
          C(IF)=C(IF)+A(L)*B(IN)                                    0390
   13     C(J)=C(J)-A(L)*B(IG)                                      0400
   14   INC=INC+MB *2                                               0410
        GOTO  18                                                    0420
   15 IE=I+MC                                                       0430
      IF=I+MA                                                       0440
      DO  17  J=IF,IA,IJ                                            0450
        IN=INC                                                      0460
        C(J)=0.0                                                    0470
        DO  16  L=IE,IB,ID                                          0480
          IN=IN+1                                                   0490
   16     C(J)=C(J)+A(L)*B(IN)                                      0500
   17   INC=INC+MB                                                  0510
   18 CONTINUE                                                      0520
      RETURN                                                        0530
      END                                                           0540
       FORTRAN LSTOU.DECK
C MNVRSX
      SUBROUTINE  MNVRSX (AR,AI,B,C,KSZ,IGOOFD,NOP)                 0010
      DIMENSION AR(6,6), AI(6,6), B(6,6), C(6,6)                    0020
      IGOOFD=0                                                      0040
```

```
      IF ( NOP )      102,101,102
 101  CALL  INVERS  (AR,KSZ,IGOOFD)
      GO TO 20
 102  CONTINUE
      DO 1 K=1,KSZ
      DO 1 L=1,KSZ
 1    B(K,L)=AR(K,L)
      NO=0
      CALL  INVERS(B,KSZ,NO)
      IF (NO) 2,3,2
C  REAL MATRIX NOT SINGULAR
C  MULT B*AI    STO. C
 3    DO 4 K=1,KSZ
      DO 4 L=1,KSZ
      C(K,L)=0.0
      DO 4 I=1,KSZ
 4    C(K,L)=C(K,L)+B(K,I)*AI(I,L)
C  MULT. AI*C + AR    STO. B
      DO 5 K=1,KSZ
      DO 5 L=1,KSZ
      B(K,L)=AR(K,L)
      DO 5 I=1,KSZ
 5    B(K,L)=B(K,L)+AI(K,I)*C(I,L)
      NO=0
      CALL  INVERS(B,KSZ,NO)
      IF (NO) 2,7,2
C  SECOND MATRIX  NOT SINGULAR
C  MULT. -C*B  STO. AI      ALSO SET AR=B
 7    DO 8 K=1,KSZ
      DO 8 L=1,KSZ
      AI(K,L)=0.0
      AR(K,L)=B(K,L)
      DO 8 I=1,KSZ
 8    AI(K,L)=AI(K,L)-C(K,I)*B(I,L)
      GO TO 20
C  REAL MATRIX OR SECOND MATRIX SINGULAR    TRY IMAG. ROUTE
 2    DO 9 K=1,KSZ
      DO 9 L=1,KSZ
 9    B(K,L)=AI(K,L)
      NO=0
      CALL  INVERS(B,KSZ,NO)
      IF (NO) 10,11,10
C   IMAG. NOT SINGULAR
C   MULT. B*AR    STO. C
 11   DO 12 K=1,KSZ
      DO 12 L=1,KSZ
      C(K,L)=0.0
      DO 12 I=1,KSZ
 12   C(K,L)=C(K,L)+B(K,I)*AR(I,L)
C  MULT. AR*C+AI    STO B
      DO 13 K=1,KSZ
      DO 13 L=1,KSZ
      B(K,L)=AI(K,L)
      DO 13 I=1,KSZ
 13   B(K,L)=B(K,L)+AR(K,I)*C(I,L)
      NO=0
      CALL  INVERS(B,KSZ,NO)
      IF  (NO) 10,15,10
C   THIRD MATRIX NOT SINGULAR
C   MULT -C*B    STO AR    ALSO SET AI=-B
 15   DO 16 K=1,KSZ
```

```
      DO 16 L=1,KSZ                                                     0660
      AR(K,L)=0                                                         0670
      AI(K,L)=-B(K,L)                                                   0680
      DO 16 I=1,KSZ                                                     0690
 16   AR(K,L)=AR(K,L)+C(K,I)*B(I,L)                                     0700
      GO TO 20                                                          0710
 10   I GOOF D=1                                                        0720
 20   RETURN                                                            0730
      END                                                               0740
$      FORTRAN LSTOU,DECK
  INVERS
      SUBROUTINE INVERS (A,N,I GOOF D)                                  0010
      DIMENSION A(6,6), L(6), M(6)                                      0020
      CALL OVERFL(K000FX)                                               0040
       GO TO(500,500),K000FX                                            0050
 500  CALL OVERFL(K000FX)                                               0060
       GO TO(501,501),K000FX                                            0070
 501  CALL DVCHK (K000FX)                                               0080
       GO TO(502,502),K000FX                                            0090
 502  IGOOFD=0                                                          0100
C     SEARCH FOR LARGEST ELEMENT                                        0110
      DO 80 K=1,N                                                       0120
      L(K)=K                                                            0130
      M(K)=K                                                            0140
      BIGA=A(K,K)                                                       0150
      DO 20 I=K,N                                                       0160
      DO 20 J=K,N                                                       0170
      IF(ABS(BIGA)-ABS(A(I,J)))10,20,20                                 0180
 10   BIGA=A(I,J)                                                       0190
      L(K)=I                                                            0200
      M(K)=J                                                            0210
 20   CONTINUE                                                          0220
C     INTERCHANGE ROWS                                                  0230
      JROW=L(K)                                                         0240
      IF(L(K)-K)35,35,25                                                0250
 25   DO 30 I=1,N                                                       0260
      HOLD=-A(K,I)                                                      0270
      A(K,I)=A(JROW,I)                                                  0280
 30   A(JROW,I)=HOLD                                                    0290
C     INTERCHANGE COLUMNS                                               0300
 35   ICOL=M(K)                                                         0310
      IF(M(K)-K)45,45,37                                                0320
 37   DO 40 J=1,N                                                       0330
      HOLD=-A(J,K)                                                      0340
      A(J,K)=A(J,ICOL)                                                  0350
 40   A(J,ICOL)=HOLD                                                    0360
C     DIVIDE COLUMN BY MINUS PIVOT                                      0370
 45   DO 55 IC=1,N                                                      0380
 46   IF(IC-K)50,55,50                                                  0390
 50   A(IC,K)=A(IC,K)/(-A(K,K))                                         0400
 55   CONTINUE                                                          0410
C     REDUCE MATRIX                                                     0420
      DO 65 I=1,N                                                       0430
      DO 65 J=1,N                                                       0440
 56   IF(I-K)57,65,57                                                   0450
 57   IF(J-K)60,65,60                                                   0460
 60   A(I,J)=A(I,K)*A(K,J)+A(I,J)                                       0470
 65   CONTINUE                                                          0480
C     DIVIDE ROW BY PIVOT                                               0490
      DO 75 JR=1,N                                                      0500
 68   IF(JR-K)70,75,70                                                  0510
```

```
 71    A(K,JR)=A(K,JR)/A(K,K)
 75    CONTINUE
C      CONTINUED PRODUCT OF PIVOTS
C      REPLACE PIVOT BY RECIPROCAL
       A(K,K)=1.0/A(K,K)
C      CONTINUE COMPLETE OPERATION
 80    CONTINUE
       CALL DVCHK (K000FX)
        GO TO(510,503),K000FX
 503   CALL OVERFL(K000FX)
        GO TO(510,504),K000FX
 504   CALL OVERFL(K000FX)
        GO TO(510,505),K000FX
C      FINAL ROW AND COLUMN INTERCHANGE
 505   K=N
 100   K=(K-1)
       IF(K)150,150,103
 103   I=L(K)
       IF(I-K)120,120,105
 105   DO 110 J=1,N
       HOLD=A(J,K)
       A(J,K)=-A(J,I)
 110   A(J,I)=HOLD
 120   J=M(K)
       IF(J-K)100,100,125
 125   DO 130 I=1,N
       HOLD=A(K,I)
       A(K,I)=-A(J,I)
 130   A(J,I)=HOLD
       GO TO 100
 150   RETURN
 510   I GOOF D=1
       GO TO 150
       END
$       LINK    PAR2TT,PAR1TT
$       FORTRAN LSTOU,DECK
C PART2
       SUBROUTINE PART2
C PART.....2 VIBRATION AND FLUTTR ANALYSIS BY A COLLOCATION METHOD.
       DIMENSION IT(219),VELCTY(20),NSIZES(20),DM(6,6),RHO(20)
       COMMON/1/         U(49,196),GUESS(49,2),H(49,50),EIG(50),
     1          TEMP(2734),              NAKSR(25), NAKDR(25), NITER(25),
     2          OMEGA(25), DAMP(25), VELC(25)
C THE FOLLOWING STATEMENT(S) HAVE BEEN MANUFACTURED BY THE TRANSLATOR TO
C   COMPENSATE FOR THE FACT THAT EQUIVALENCE DOES NOT REORDER COMMON---
       COMMON  IT
       EQUIVALENCE  (IT(1),ISXST), (IT(21),ISW), (IT(41),RHO),
     1              (IT(61),NTAPE1), (IT(62),NTAPE2), (IT(63),NTAPE3),
     2              (IT(64),NTAPE4), (IT(65),NTAPE5), (IT(66),NTAPE6),
     3              (IT(67),NTAPE7), (IT(68),NTAPE8), (IT(69),NTAPE9),
     4              (IT(70),NSUR), (IT(71),NRIGID), (IT(72),BREF),
     5              (IT(73),NAERO), (IT(74),NFUS), (IT(75),NDENS),
     6              (IT(76),MODES), (IT(77),NPOINT), (IT(78),NPUNCH),
     7              (IT(79),MAXR), (IT(80),MAXQ), (IT(81),MAXS),
     8              (IT(82),NC), (IT(83),NSURFS), (IT(84),NP2),
     9              (IT(85),BR), (IT(106),S)
       EQUIVALENCE  (IT(127),VELCTY), (IT(147),NTAPE0), (IT(148),NRHO),
     1              (IT(149),NITRSP), (IT(150),NITRDP), (IT(151),EPSP),
     2              (IT(152),EPDP), (IT(153),PICON), (IT(154),NVEL),
     3              (IT(155),NCARDS), (IT(156),AITKEN), (IT(157),NGO),
     4              (IT(158),FK), (IT(159),SQRCON), (IT(160),NSIZES),
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     6              (IT(180),DM),(IT(217),AITKED), (IT(218),KPART)
  200 FORMAT  (1H1  48X,  12H OUTPUT DATA  /// 1H  11X,   6H FLUTTER
     1          52H ANALYSIS BY A COLLOCATION METHOD, USING AERODYNAMIC
     2          24H INFLUENCE COEFFICIENTS  // 1H0  14X, 11H DENSITY =
     3          1E20.8,  5X,  20H REDUCED VELOCITY =  1E20.8, // 1H0 33X,
     4          1I6,  32H RIGID BODY DEGREES OF FREEDOM   ///// )

  201 FORMAT  (1H1 20X, 5H MODE  7X, 12H OMEGA (CPS)  10X, 8H DAMPING
     1           4X, 17H VELOCITY (KNOTS)  ///   (   1H   20X, 1I4,
     2           3F20.8)    )
  202 FORMAT  ( 2I4, 62X, 1A6, 1I4 )
  203 FORMAT  ( 1H0 33X, 23H PUNCHED CARDS NUMBERS  1A6, 1I4, 6H THRU
     1           1A6, 1I4  )
  204 FORMAT  (1H1  45X, 16H DYNAMIC MATRIX   )
  205 FORMAT  (31H FLEXIBLE MODE SHAPES, SURFACE    1I4  )
  206 FORMAT (5H MODE  1I6, 32H, GIVES AN IMAGINARY FREQUENCY.   )
      DATA Q000CT/0202030440005/
      BCDZ =Q000CT
      NVEL=NVEL
      MAXP=49
      K=NC*NPOINT
      DO  290  I=1,NPOINT
        DO  290  J=1,K
  290     U(I,J)=0.0
      REWIND NTAPE9
      DO  314  IRHO=1,NRHO
        MODE=MODES
      READ  (NTAPE9)NSIZE, NSIZE2, ((U(I,J),I=1,NSIZE),
     1                    J=1,NSIZE2)
      IF  ( NPUNCH )          302,304,304
  302 WRITE (NTAPE3,204)
      CALL MPRINT (U,NPOINT,K,MAXP,NTAPE3)
  304 WRITE (NTAPE3,200)RHO(IRHO), VELCTY(NVEL), NRIGID
      DO  305  I=1,MODE
        NAKDR(I)=0
  305   NAKSR(I)=0
      CALL MITERS (U,GUESS ,0     ,NPOINT,MODE  ,MAXP  ,NC    ,EPSP  ,
     1            EPDP  ,NAKSR ,NAKDR ,NITRSP,NITRDP,AITKES,AITKED,
     2            IR    ,TEMP  ,H     ,EIG   ,NITER ,NTAPE9,NTAPE3)
      IF  ( NAERO )           3055,3054,3055
 3054 WRITE (NTAPE4)  NPOINT, MODE, ((H(I,J),I=1,NPOINT),J=1,MODE)
      WRITE (NTAPE4)  (EIG(I),I=1,MODE),NPOINT,MODE,NPOINT,MODE,MODE
 3055 CONTINUE
      MODES2 = NC*MODE
      DO  310  I=1,MODES2,NC
        K=I/NC +NC -1
      IF   (EIG(I))           3051,3052,3052
 3051 WRITE (NTAPE3,206)K
      OMEGA(K)=0.0
      GOTO  3053
 3052 OMEGA(K)= SQRCON / ( SQRT( FK*EIG(I)) )
 3053 GOTO  (306,308),NC
  306   DAMP(K)=0.0
        VELC(K)=0.0
        GOTO  310
  308   DAMP(K)= EIG(I+1) / EIG(I)
        VELC(K)= PICON*OMEGA(K)*BREF* VELCTY(NVEL)
  310 CONTINUE
      WRITE (NTAPE3,201)(K, OMEGA(K), DAMP(K), VELC(K) ,
     1                  K=1,MODE )
      IF  ( NPUNCH )          312,314,312
```

```
  312 K1=1                                                                  0910
      WRITE (NTAPE9,202)NSIZES(1), MODES2, BCDZ, NCARDS                     0920
      NCRDS = NCARDS+1                                                      0930
      CALL MPUNCH (OMEGA,MODES2,1,0,1,1,BCDZ,MAXP,NTAPE9,NCRDS)             0940
      WRITE (NTAPE3,203)BCDZ, NCARDS, BCDZ, NCRDS                           0950
      NCARDS=NCRDS+1                                                        0960
      DO  313  ISUR =1,NSUR                                                 0970
      IF  ( ISUR-1 )            3121,3122,3121                              0980
 3121 WRITE (NTAPE9,202)NSIZES(ISUR), MODES2,BCDZ,NCARDS                    0990
      NCRDS=NCARDS+1                                                        1000
      GO TO  3123                                                           1010
 3122 NCRDS=NCARDS                                                          1020
 3123 CALL MPUNCH (H(K1,1),NSIZES(ISUR),MODES2,0,1,1,BCDZ,MAXP,NTAPE9,      1030
     1               NCRDS )                                                1040
      WRITE (NTAPE3,205)ISUR                                                1050
      WRITE (NTAPE3,203)BCDZ,NCARDS,BCDZ,NCRDS                              1060
      NCARDS=NCRDS+1                                                        1070
  313 K1=K1+NSIZES(ISUR)                                                    1080
  314 CONTINUE                                                              1090
      REWIND NTAPE9                                                         1100
      NGO = 98765                                                           1110
      KPART = 1                                                             1120
      RETURN                                                                1130
      END                                                                   1140
$      FORTRAN LSTOU.DECK
C NORM7
      SUBROUTINE  NORM  (A,B,N,C,INDEX,MAXR,NC,NP)                      MTR40002
      DIMENSION  A(1), B(1), C(1), T(2)                                 MTR40004
      IF  ( INDEX )                      100,200,200                    MTR40006
  100 GO TO  (110,140),NP                                               MTR40007
  110 GO TO  (500,120),NC                                               MTR40008
  120 BIG = C(1)**2+C(2)**2                                             MTR40009
      GO TO  600                                                        MTR40010
  140 CALL DNORM (A,B,N,C,MAXR,NC,T)                                    MTR40012
      GO TO 700                                                         MTR40013
  200 INDEX=1                                                           MTR40015
      NSTART=NP+1                                                       MTR40016
      NSTOP=N*NP                                                        MTR40017
      K=NP*MAXR                                                         MTR40018
      IF  ( NSTART-NSTOP )               205,205,400                    MTR40019
  205 GO TO  (210,300),NC                                               MTR40020
  210 BIG=ABS(A(1))                                                     MTR40022
      DO  230   I=NSTART,NSTOP,NP                                       MTR40023
      IF  ( BIG-ABS(A(I)) )              220,220,230                    MTR40025
  220   INDEX=I                                                         MTR40026
        BIG=ABS(A(I))                                                   MTR40027
  230   CONTINUE                                                        MTR40028
      GO TO  400                                                        MTR40029
  300 BIG = A(1)**2 + A(K+1)**2                                         MTR40031
      DO  330  I=NSTART,NSTOP,NP                                        MTR40032
        J=K+I                                                           MTR40033
      IF  ( BIG-(A(I)**2+A(J)**2) )                 320,320,330         MTR40034
  320   BIG = A(I)**2 + A(J)**2                                         MTR40035
        INDEX = I                                                       MTR40036
  330   CONTINUE                                                        MTR40038
  400 J=NP*NC                                                           MTR40040
      I=INDEX+(NC-1)*K+(NP-1)                                           MTR40041
      C(J)=A(I)                                                         MTR40042
      J=J-(NP-1)                                                        MTR40043
      I=I-(NP-1)                                                        MTR40044
      C(J)=A(I)
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      I=INDEX+(NP 1)                                                    MTR40046
      C(NP)=A(I)                                                        MTR40047
      C(1)=A(INDEX)                                                     MTR40048
      GO TO  (410,140),NP                                               MTR40050
  410 GO TO  (500,600),NC                                               MTR40051
  500 DO  510  I=1,N                                                    MTR40053
  510   B(I)=A(I)/C(1)                                                  MTR40054
      GO TO  700                                                        MTR40055
  600 BIG = C(1)**2+C(2)**2                                             MTR40057
      DO  610  I=1,N                                                    MTR40058
        J=I+MAXR                                                        MTR40060
        T= A(I)*C(1)+A(J)*C(2)                                          MTR40061
        B(J) = ( A(J)*C(1)-A(I)*C(2) )  / BIG                           MTR40062
  610   B(I)= T/BIG                                                     MTR40063
  700 INDEX = INDEX/NP +NP-1                                            MTR40064
      RETURN                                                            MTR40065
      END                                                               MTR40067
$      FORTRAN LSIOU,DECK
C DNORMZ
      SUBROUTINE DNORM  (A,B,N,C,MAXR,NC,T)                             MTR40069
      DOUBLE PRECISION  A(1), B(1),C(1),T(1)                            MTR40071
  410 GO TO  (500,600),NC                                               MTR40072
  500 DO  510  I=1,N                                                    MTR40074
  510   B(I)=A(I)/C(1)                                                  MTR40075
      GO TO  700                                                        MTR40076
  600 BIG=C(1)*C(1) + C(2)*C(2)                                         MTR40078
      DO  610  I=1,N                                                    MTR40079
        J=I+MAXR                                                        MTR40080
        T= A(I)*C(1)+A(J)*C(2)                                          MTR40081
        B(J) = ( A(J)*C(1)-A(I)*C(2) )  / BIG                           MTR40082
  610   B(I)= T/BIG                                                     MTR40083
  700 RETURN                                                            MTR40084
      END                                                               MTR40086
$      FORTRAN LSIOU,DECK
C POHS
      SUBROUTINE  POH  (LMBDN,LMBD1,LMBD2,HN,HN1,H1,H2,N,NC)            MTR40089
      DIMENSION  LMBDN(1), LMBD1(1), LMBD2(1), HN(1), HN1(1), H1(1),    MTR40091
     1              H2(1), A(2)                                         MTR40092
      DOUBLE PRECISION  LMBDN, LMBD1, LMBD2, HN, HN1, H1, H2, A         MTR40093
      GO TO  (200,100),NC                                               MTR40095
          110  I=1,N                                                    MTR40097
        K=I+N                                                           MTR40099
        A(1) = LMBDN(1)*HN(I)-LMBDN(2)*HN(K)                            MTR40101
        A(2) = LMBDN(1)*HN(K)+LMBDN(2)*HN(I)                            MTR40102
        H1(I) = LMBD2(1)*HN1(I)-LMBD2(2)*HN1(K)-A(1)                    MTR40104
        H1(K) = LMBD2(1)*HN1(K)+LMBD2(2)*HN1(I)-A(2)                    MTR40105
        H2(I) = A(1)-LMBD1(1)*HN1(I)+LMBD1(2)*HN1(K)                    MTR40107
  110   H2(K) = A(2)-LMBD1(1)*HN1(K)-LMBD1(2)*HN1(I)                    MTR40108
      RETURN                                                            MTR40110
  200 DO  210  I=1,N                                                    MTR40112
        A(1)= LMBDN(1)*HN(I)                                            MTR40114
        H1(I) = LMBD2(1)*HN1(I)-A(1)                                    MTR40116
  210   H2(I) = A(1)-LMBD1*HN1(I)                                       MTR40117
      RETURN                                                            MTR40119
      END                                                               MTR40121
$      FORTRAN LSIOU,DECK
C AITKNS
      SUBROUTINE AITKNS (HN,HN1,HN2,HNEW,R,N,MAXR,NC,NP,IR)             MTR40123
      DIMENSION  HN(1), HN1(1), HN2(1), HNEW(1), A(2), B(4), C(2), D(2) MTR40125
      IR=0                                                              MTR40127
      L=NP*N                                                            MTR40129
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      C(1) = R**2                                                      MTR40130
      DO  110  I=1,1,NP                                                MTR40131
        D(1) = 0                                                       MTR40133
        D(2) = 0                                                       MTR40134
        DO  100  J=1,NC                                                MTR40136
          K=(J-1)*MAXR+I                                               MTR40138
          D(1) = D(1) + (HN1(K)-HN2(K))**2                             MTR40140
  100     D(2) = D(2) + (HN(K)-HN1(K))**2                              MTR40141
        IF  ( D(1) )                         105,110,105               MTR40143
  105   CONTINUE                                                       MTR40144
        IF  (D(2)/D(1) - C(1))               110,110,800               MTR40145
  110   CONTINUE                                                       MTR40146
      GO TO  (300,200),NP                                              MTR40148
  200 CALL AITKND  (HN,HN1,HN2,HNEW,N,MAXR,NC,A,B,C,D)                 MTR40149
      GO TO  700                                                       MTR40150
  300 DO  600  I=1,N                                                   MTR40152
        GO  TO  (400,500),NC                                           MTR40154
  400   C(1) =  HN(I)-2.*HN1(I)+HN2(I)                                 MTR40155
        IF  ( C(1) )                         410,600,410               MTR40156
  410   HNEW(I) =  HN2(I) - ( (HN1(I)-HN2(I))**2 /C(1) )               MTR40158
        GO TO 600                                                      MTR40159
  500   A(1) = 0.                                                      MTR40161
        C(1) = 2.                                                      MTR40162
        D(1) = 0.                                                      MTR40163
        DO  510  J=1,2                                                 MTR40164
          K = I+(J-1)*MAXR                                             MTR40166
          B(J) = HN(K)-2.*HN1(K)+HN2(K)                                MTR40167
          C = C*(HN1(K)-HN2(K))                                        MTR40168
          A = -(HN1(K) - HN2(K))**2 -A                                 MTR40169
  510     D = B(J)**2 +D                                               MTR40170
        IF  ( D )                            520,600,520               MTR40172
  520   HNEW(I) = HN2(I) - (B(1)*A(1)+B(2)*C(1))/ D(1)                 MTR40173
        HNEW(K) = HN2(K) - (B(1)*C(1)-B(2)*A(1))/ D(1)                 MTR40174
  600   CONTINUE                                                       MTR40176
  700   IR = 1                                                         MTR40178
  800 RETURN                                                           MTR40180
      END                                                              MTR40182
$       FORTRAN LSTOU.DECK
C AITKND
      SUBROUTINE  AITKND  (HN,HN1,HN2,HNEW,N,MAXR,NC,A,B,C.D)          MTR40184
      DIMENSION  HN(1), HN1(1), HN2(1).HNEW(1), A(1), B(2)  C(1), D(1) MTR40186
      DOUBLE PRECISION  HN, HN1, HN2, HNEW, A, B, C, D                 MTR40187
  300 DO  600  I=1.N                                                   MTR40189
        GO  TO  (400,500).NC                                           MTR40191
  400   C(1) =  HN(I)-2.*HN1(I)+HN2(I)                                 MTR40192
      IF ( ABS(C(1)) -.00000100 )          600,600,410                 MTR40193
  410   HNEW(I)=HN2(I) - ( (HN1(I)-HN2(I))*(HN1(I)-HN2(I)) /C(1) )     MTR40195
        GO TO 600                                                      MTR40196
  500   A(1) = 0.                                                      MTR40198
        C(1) = 2.                                                      MTR40199
        D(1) = 0.                                                      MTR40200
        DO  510  J=1,2                                                 MTR40201
          K = I+(J-1)*MAXR                                             MTR40203
          B(J) = HN(K)-2.*HN1(K)+HN2(K)                                MTR40204
          C = C*(HN1(K)-HN2(K))                                        MTR40205
          A = -( (HN1(K)-HN2(K))*(HN1(K)-HN2(K)) ) - A                 MTR40206
  510     D = B(J)*B(J) + D                                            MTR40207
        IF  ( D )                            520,600,520               MTR40209
  520   HNEW(I) = HN2(I) - (B(1)*A(1)+B(2)*C(1))/ D(1)                 MTR40210
        HNEW(K) = HN2(K) - (B(1)*C(1)-B(2)*A(1))/ D(1)                 MTR40211
  600   CONTINUE                                                       MTR40
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 700    IR = 1                                                          MTR40215
 800 RETURN                                                             MTR40217
     END                                                                MTR40219
$      FORTRAN LSTOU.DECK
C LEGISS
     SUBROUTINE LEGIS (LAMBDA,POS,E1,E2,NC,IR)                          MTR40222
     DIMENSION  LAMBDA(1), POS(1)                                       MTR40224
     DOUBLE PRECISION  LAMBDA, POS, R1, R2A, R2B                        MTR40225
     IR=0                                                               MTR40227
     GO TO  (100,200),NC                                                MTR40229
 100 R1 = ( DABS( LAMBDA(1)-LAMBDA(2) ) )/E1                            MTR40231
     R2A =  DABS( DABS(POS(2)/POS(1))-1.) / E2                          MTR40232
     R2A =  DABS( DABS(POS(4)/POS(3))-1.) / E2                          MTR40233
     CALL MPRINT  (R1,2,1,2,6)                                          MTR40234
     CALL MPRINT  (R2A,2,1,2,6)                                         MTR40235
     CALL MPRINT  (R2B,2,1,2,6)                                         MTR40236
 110 IF   ( R1-R2A )                       120,140,140                  MTR40238
 120 IF   ( R1-R2B )                       130,140,140                  MTR40240
 130 IR=NC                                                              MTR40242
 140 RETURN                                                             MTR40244
 200 R1 = DSQRT( (LAMBDA(1)-LAMBDA(3))*(LAMBDA(1)-LAMBDA(3)) + (LAMBDA MTR40245
    1       (2)-LAMBDA(4))*(LAMBDA(2)-LAMBDA(4)) ) / E1                 MTR40247
     R2A = DABS( DSQRT( ((POS(3)*POS(1)+POS(2)*POS(4))*(POS(3)*POS(1) +MTR40248
    1        POS(2)*POS(4)) + (POS(3)*POS(2)-POS(4)*POS(1))*(POS(3)*    MTR40249
    2        POS(2)-POS(4)*POS(1)) ) / (POS(1)*POS(1)+POS(2)*POS(2)) ) MTR40250
    3        -1. ) / E2                                                 MTR40251
     R2B = DABS( DSQRT( ( (POS(7)*POS(5)+POS(6)*POS(8)) / (POS(5)*POS  MTR40253
    1       (5) + POS(6)*POS(6)) )*( (POS(7)*POS(5)+POS(6)*POS(8)) /    MTR40254
    2       (POS(5)*POS(5) + POS(6)*POS(6)) ) + ( (POS(7)*POS(6) - POS(MTR40255
    3       8)*POS(5)) / (POS(5)*POS(5) + POS(6)*POS(6)) ) * ( (POS(7) MTR40256
    4       *POS(6) - POS(8)*POS(5)) / (POS(5)*POS(5) + POS(6)*POS(6)) MTR40257
    5       ) ) -1.) / E2                                               MTR40258
     GO TO 110                                                          MTR40260
     END                                                                MTR40262
$      FORTRAN LSTOU.DECK
C MADZ
     SUBROUTINE  MADS (A,B,C,NSIZE,NC)                                  MTR40264
     DOUBLE PRECISION  A(1), B(1), C(1)                                 MTR40265
     K=NC*NSIZE                                                         MTR40267
     DO  100  I=1,K                                                     MTR40269
 100   C(I)=A(I)-B(I)                                                   MTR40271
     RETURN                                                             MTR40272
     END                                                                MTR40273
$      FORTRAN LSTOU.DECK
C MULTS
     SUBROUTINE MULT  (A,B,C,LIZ,NIZ,MIZ,MAXA,MAXB,MAXC,NC,NP )          MTR40275
     DIMENSION  A(1), B(1), C(1)                                         MTR40277
     KA=NC*MAXA                                                          MTR40279
     KB=NC*MAXB                                                          MTR40280
     KC=NC*MAXC                                                          MTR40281
     GO TO (200,100),NP                                                  MTR40283
 100 CALL   DMULT (A,B,C,LIZ,NIZ,MIZ,KA,KB,KC,NC)                        MTR40285
     GO TO 700                                                           MTR40286
 200 DO   600  L=1,LIZ                                                   MTR40288
       DO   500  M=1,MIZ                                                 MTR40290
         K= (M-1)*KB +1                                                  MTR40292
         I= (M-1)*KC +L                                                  MTR40293
         C(I)=0.                                                         MTR40295
         GO TO  (300,400),NC                                             MTR40297
 300       DO  310  N=1,NIZ                                              MTR40299
             J=(N-1)*KA+L                                                MTR40301
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               JB = (N-1)+K                                                  MTR40302
  310          C(I)=C(I)+A(J)*B(JB)                                          MTR40303
            GO TO 500                                                        MTR40304
  400       IC = I+MAXC                                                      MTR40306
            C(IC) =0.                                                        MTR40307
            DO  410  N=1,NIZ                                                 MTR40309
              J= (N-1)*KA+L                                                  MTR40311
              JB= (N-1) +K                                                   MTR40312
              JC= J+MAXA                                                     MTR40313
              JBC= JB+MAXB                                                   MTR40314
              C(I)=C(I)+A(J)*B(JB)-A(JC)*B(JBC)                              MTR40316
  410         C(IC)=C(IC)+A(J)*B(JBC)+A(JC)*B(JB)                            MTR40317
  500       CONTINUE                                                         MTR40319
  600     CONTINUE                                                           MTR40321
  700 RETURN                                                                 MTR40323
      END                                                                    MTR40325
$       FORTRAN LSTOU.DECK
C DMULTS
      SUBROUTINE  DMULT (A,B,C,LIZ,NIZ,MIZ,KA,KB,KC,NC)                      MTR40327
      DOUBLE PRECISION  A(1), B(1), C(1)                                     MTR40329
      MAXA=KA/2                                                              MTR40330
      MAXB=KB/2                                                              MTR40331
  200 DO  600  L=1,LIZ                                                       MTR40332
        DO  500  M=1,MIZ                                                     MTR40334
          K= (M-1)*KB +1                                                     MTR40336
          I= (M-1)*KC +L                                                     MTR40337
          C(I)=0.                                                            MTR40339
          GO TO  (300,400),NC                                                MTR40341
  300       DO  310  N=1,NIZ                                                 MTR40343
              J=(N-1)*KA+L                                                   MTR40345
              JB = (N-1)+K                                                   MTR40346
  310         C(I)=C(I)+A(J)*B(JB)                                           MTR40347
          GO TO 500                                                          MTR40348
  400     IC=I+KC/2                                                          MTR40350
          C(IC) =0.                                                          MTR40351
          DO  410  N=1,NIZ                                                   MTR40353
            J= (N-1)*KA+L                                                    MTR40355
            JB= (N-1) +K                                                     MTR40356
            JC= J+MAXA                                                       MTR40357
            JBC = JB+MAXB                                                    MTR40358
            C(I)=C(I)+A(J)*B(JB)-A(JC)*B(JBC)                                MTR40360
  410       C(IC)=C(IC)+A(J)*B(JBC)+A(JC)*B(JB)                              MTR40361
  500     CONTINUE                                                           MTR40363
  600   CONTINUE                                                             MTR40365
  700 RETURN                                                                 MTR40367
      END                                                                    MTR40369
$       FORTRAN LSTOU.DECK
C POLMS
      SUBROUTINE POLM (PN,PN1,QN,QN1,E2,LMBD1,LMBD2,NC,IR,IGO)              MTR40372
      DIMENSION  PN(1), PN1(1), QN(1), QN1(1), E2(1), LMBD1(1), LMBD2(1)MTR40374
      DOUBLE PRECISION  PN, PN1, QN, QN1,      LMBD1, LMBD2, A(2)           MTR40375
      IR=0                                                                   MTR40376
      GO TO  (100,100,180),IGO                                               MTR40377
  100 GO TO  (110,200),NC                                                    MTR40379
  110 IF ( DABS( (PN-PN1)/(DSQRT( DABS(QN) )) ) -E2 )    120,120,112       MTR40381
  112 IF ( DABS( PN-PN1 ) - E2**2 )                      120,120,170       MTR40382
  120 IF ( DABS( (QN/QN1)-1.) - E2 )                     130,130,170       MTR40384
  130 LMBD2 = (PN*PN -4.*QN)                                                 MTR40386
      LMBD2 = DSQRT (DABS(LMBD2) )                                           MTR40387
      LMBD1 =(-PN + LMBD2) /2.                                               MTR40388
      LMBD2 =(-PN - LMBD2) /2.                                               MTR40389
```

```
      IF  ( ABS(LMBD1) - ABS(LMBD2) )                 140,150,160          MTR40391
  140 A= LMBD1                                                              MTR40392
      LMBD1=LMBD2                                                           MTR40393
      LMBD2=A                                                               MTR40394
      GO TO 160                                                             MTR40395
  150 IF  ( LMBD1 )                                   140,160,160          MTR40396
  160 IR=NC                                                                 MTR40398
  170 RETURN                                                                MTR40400
  180 GO TO (130,220),NC                                                    MTR40401
  200 A=DSQRT( QN(1)*QN(1) + QN(2)*QN(2) )                                  MTR40403
      IF  ( DSQRT( ( (PN-PN1)*(PN-PN1) + (PN(2)-PN1(2))*(PN(2)-PN1(2)) )MTR40405
     1       / A ) -E2)                                 210,210,170         MTR40406
  210 A = QN1*QN1 + QN1(2)*QN1(2)                                           MTR40407
      IF  ( ( ( (QN*QN1-QN(2)*QN1(2))/A )*( (QN*QN1-QN(2)*QN1(2))/A ) + MTR40409
     1        ( (QN*QN1(2)+QN1*QN(2))/A )*( (QN*QN1(2)+QN1*QN(2))/A )     MTR40410
     2       -1. ) - E2)                                220,220,170         MTR40411
  220 A(1) = PN*PN - PN(2)*PN(2) -4.*QN                                     MTR40412
      A(2) = 2.*(PN*PN(2)-2.*QN(2))                                         MTR40413
      IF  ( A(1) )              230,250,250                                 MTR40415
  230 A(1) = DSQRT( (-A(1)+DSQRT( A(1)*A(1)+A(2)*A(2) ) )  /2. )            MTR40417
      A(2) = A(2) / (2.*A(1))                                               MTR40418
  232 LMBD1(1) = (-PN+A(2))/2.                                              MTR40420
      LMBD1(2) = (-PN(2)+A(1))/2.                                           MTR40421
      LMBD2(1) = (-PN-A(2))/2.                                              MTR40422
      LMBD2(2) = (-PN(2)-A(1))/2.                                           MTR40423
      IF ( DSQRT( LMBD1*LMBD1+LMBD1(2)*LMBD1(2) ) - DSQRT( LMBD2*LMBD2 +MTR40425
     1       LMBD2(2)*LMBD2(2)) )                       240,160,160         MTR40426
  240 A=LMBD1(2)                                                            MTR40427
      LMBD1(2)=LMBD2(2)                                                     MTR40428
      LMBD2(2)= A                                                           MTR40429
      GO TO 140                                                             MTR40430
  250 A(1) = DSQRT( (A(1)+DSQRT( A(1)*A(1)+A(2)*A(2) )) /2. )               MTR40432
      A(2) = A(2) / (2.*A(1))                                               MTR40433
      LMBD1=A(1)                                                            MTR40434
      A(1)=A(2)                                                             MTR40435
      A(2)=LMBD1                                                            MTR40436
      GO TO 232                                                             MTR40437
      END                                                                   MTR40439
       FORTRAN LSTOU.DECK
C POS
      SUBROUTINE  PQ  (FL, HN, HN1, HN2, HN3, P, Q, NC, MAXR )              MTR40441
      DIMENSION  FL(1), HN(1), HN1(1), HN2(1), HN3(1), P(1), Q(1),          MTR40442
     1            A(3), B(3)                                                MTR40443
      DOUBLE PRECISION  FL, HN, HN1, HN2, HN3, P, Q, A, B                   MTR40445
      MAXR = MAXR/2                                                         MTR40447
      GO TO  (200,100), NC                                                  MTR40448
  100 A(1) = FL(1)*HN  - FL(2)*HN(MAXR+1)                                   MTR40450
      A(2) = FL(3)*HN1 - FL(4)*HN1(MAXR+1)                                  MTR40451
      A(3) = FL(5)*HN2 - FL( 6)*HN2(MAXR+1)                                 MTR40452
      B(1) = FL(1)*HN(MAXR+1)+ FL(2)*HN                                     MTR40454
      B(2) = FL(3)*HN1(MAXR+1)+FL(4)*HN1                                    MTR40455
      B(3) = FL(5)*HN2(MAXR+1)+FL( 6)*HN2                                   MTR40456
      P(1) = A(3)*HN1 - B(3)*HN1(MAXR+1)-A(1)*HN3 + B(1)*HN3(MAXR+1)        MTR40458
      P(2) = A(3)*HN1(MAXR+1)+B(3)*HN1 - A(1)*HN3(MAXR+1)-B(1)*HN3          MTR40459
      Q(1) = A(1)*HN2 - B(1)*HN2(MAXR+1)-A(2)*HN1 + B(2)*HN1(MAXR+1)        MTR40461
      Q(2) = A(1)*HN2(MAXR+1)+B(1)*HN2 - A(2)*HN1(MAXR+1)-B(2)*HN1          MTR40462
      A(1) = A(2)*HN3 - B(2)*HN3(MAXR+1)-A(3)*HN2 + B(3)*HN2(MAXR+1)        MTR40464
      B(1) = A(2)*HN3(MAXR+1)+B(2)*HN3 - A(3)*HN2(MAXR+1)-B(3)*HN2          MTR40465
      A(2) = A(1)*P(1) + B(1)*P(2)                                          MTR40467
      B(2) = A(1)*P(2) - B(1)*P(1)                                          MTR40468
      A(3) = A(1)*Q(1) + B(1)*Q(2)                                          MTR40469
```

```
      B(3) = A(1)*Q(2) - B(1)*Q(1)
      A(1) = A(1)*A(1) + B(1,*B(1)
      A(2) = A(2)/A(1)
      B(2) = B(2)/A(1)
      A(3) = A(3)/A(1)
      B(3) = B(3)/A(1)
      P(1) = FL(3)*A(2) - FL(4)*B(2)
      P(2) = FL(3)*B(2) + FL(4)*A(2)
      A(2) = FL(3)*FL(5) - FL(4)*FL( 6)
      B(2) = FL(4)*FL(5) + FL(3)*FL( 6)
      Q(1) = A(2)*A(3)-B(2)*B(3)
      Q(2) = A(2)*B(3)+A(3)*B(2)
      MAXR = 2*MAXR
      RETURN
  200 A(1) = (FL(2)*HN1*HN3 - FL(3)*HN2*HN2)
      P(1) = (FL(3)*HN2(1)*HN1(1) - FL(1)*HN(1)*HN3(1)) / A(1)
      Q(1) = ( FL(1)*HN(1)*HN2(1) - FL(2)*HN1(1)*HN1(1) )  / A(1)
      P(1) =  P(1)*FL(2)
      Q(1) =  Q(1)*FL(2)*FL(3)
      MAXR = 2*MAXR
      RETURN
      END
$      FORTRAN LSTOU.DECK
C CLOSES
C  SUBROUTINE  CLOSE.       COMPUTES 2 CLOSE ROOTS.
C
C         U = MATRIX. DIMENSIONED  (MAXR,2*NC*MAXR)
C         H = STARTING GUESS. DIMENSIONED((MAXR,2*NC*4)+2*NC*N)
C         NSIZE = SIZE OF MATRIX
C         MAXR = DIMENSIONED NUMBER OF ROWS OF U AND H
C         MAXTRY = MAXIMUM NUMBER OF DOUBLE PRECISION ITERATIONS.
C         EPS1 = SINGLE ROOT CONVERGENCE CRITERIA
C         EPS2 = DOUBLE ROOT CONVERGENCE CRITERIA
C         R= AITKENS CONVERGENCE CRITERIA
C         IRR = ERROR RETURN INDICATER.    =1, OVERFLOW
C                                          =2, DIVIDE CHECK
C                                          =3, BOTH OVERFLOW AND DIVIDE
C                                                               CHECK.
C         ITERS= NUMBER OF ITERATIONS PERFORMED, - FOR DOUBLE ROOT
C                                                + FOR SINGLE ROOT
C         NC = 1, REAL       2, COMPLEX
      SUBROUTINE CLOSES (U,H,NSIZE,MAXR,R,EPS1,EPS2,NC,IRR,MAXTRY,ITERS,
     1                  NAITKN,INDEX1,INDEX2,VALUE,MSIZE)
      DIMENSION   U(1),  H(1),   VALUE(1)
      CALL  OVERFL ( IOVFLW )
      CALL  DVCHK ( IDVDCT )
      IRR=0
      NX=2*NSIZE
      N2C=2*NC
      CALL  CHANGE  (U,MSIZE,NC*MSIZE,MAXR,1)
      CALL  CHANGE  (H,NSIZE,NC,NSIZE,1)
      I6=N2C*NSIZE
      I1=1
      I2=I1+I6
      I3=I2+I6
      I4=I3+I6
      I5=I4+I6
      K1=I1
      K4=I2
      K3=I3
      K2=I4
```

```
      ITERS = 0                                                         MTR40545
  100 K=0                                                               MTR40547
      IGO = 1                                                           MTR40548
  120 ITERS=ITERS+1                                                     MTR40549
      IF  ( ITERS-MAXTRY )                          140,140,130         MTR40550
  130 IF  ( K-0 )                                   132,140,132         MTR40551
  132 ITERS = ITERS-1                                                   MTR40552
      GO TO 800                                                         MTR40553
  140 K=K+1                                                             MTR40555
      I=K1                                                              MTR40556
      K1=K4                                                             MTR40557
      K4=K3                                                             MTR40558
      K3=K2                                                             MTR40559
      K2=I                                                              MTR40560
      CALL MULT  (U      ,H(K2),H(K1),NSIZE,NSIZE,1,MAXR,NSIZE,NSIZE,   MTR40562
     1              NC,2)                                               MTR40563
      INDEX=0                                                           MTR40564
      IK=I5+(4-K)*N2C                                                   MTR40565
      CALL NORM  (H(K1),H(K1),NSIZE,H(IK),INDEX,NSIZE,NC,2)             MTR40566
      CALL  OVERFL ( IOVFLW )                                           MTR40568
      GOTO  (150,160) ,IOVFLW                                           MTR40569
  150 IRR=IRR+1                                                         MTR40570
  160 CALL  DVCHK ( IDVDCT )                                            MTR40571
      GOTO  (170,180) ,IDVDCT                                           MTR40572
  170 IRR=IRR+2                                                         MTR40573
  180 IF  ( IRR )                   200,200,640                         MTR40574
C   TEST FOR CONVERGENCE TO A SINGLE ROOT                               MTR40576
  200 DO  220  I=1,16,2                                                 MTR40578
         J2 = K2+I-1                                                    MTR40579
         J3 = K1+I-1                                                    MTR40580
           IF  ( ABS(H(J2)-H(J3))-EPS1)     220,220,300                 MTR40581
  220      CONTINUE                                                     MTR40582
      GOTO  750                                                         MTR40583
  300 GOTO  (120,120,120,320),K                                         MTR40585
  320 J1=I5+(IGO+3)*N2C                                                 MTR40587
      J2=I5+(IGO+5)*N2C                                                 MTR40588
      J=2*INDEX-2                                                       MTR40590
      J3=K1+J                                                           MTR40591
      J5=K2+J                                                           MTR40592
      J7=K3+J                                                           MTR40593
      J9=K4+J                                                           MTR40594
C     COMPUTE   P N  AND  Q N.                                          MTR40596
      CALL  PQ (H(I5), H(J3), H(J5), H(J7), H(J9), H(J1), H(J2), NC, NX)MTR40597
      GOTO (350,340),IGO                                                MTR40600
  340 J1= I5+4*N2C                                                      MTR40601
      J2= J1+N2C                                                        MTR40602
      J3= J2+N2C                                                        MTR40603
      J4= J3+N2C                                                        MTR40604
      J5= I5+N2C                                                        MTR40605
      J6= J5+N2C                                                        MTR40606
C TEST FOR DOUBLE ROOT CONVERGENCE AND IF SO, COMPUTE LAMBDA 1 AND 2.   MTR40608
      CALL POLM (H(J2),H(J1),H(J4),H(J3),EPS2,H(J5),H(J6),NC,IR,IGO)    MTR40610
      GOTO  (344,344,400),IGO                                           MTR40611
  344 IF  ( IR )                    346,346,400                         MTR40612
  346 IF  ( ITERS-MAXTRY )                     347,800,800              MTR40613
  347 DO  348  I=1,N2C                                                  MTR40614
        H(J1)=H(J2)                                                     MTR40615
        H(J3)=H(J4)                                                     MTR40616
        J1=J1+1                                                         MTR40617
        J2=J2+1                                                         MTR40618
        J3=J3+1                                                         MTR40619
```

```
348    J4=J4+1
350 K=3
    IGO=2
    DO  354  J=1,3
    L=I5+(3-J)*N2C
    L1=I5+(4-J)*N2C
      DO  354  I=1,NC
        L=L+(I-1)*NC
        L1=L1+(I-1)*NC
        H(L1)=H(L)
354     H(L1+1)=H(L+1)
    CALL  AITKNS (H(K1), H(K2), H(K3), H(K4), R,  [illegible]E, NSIZE, NC, 2,
   1                  IR    )
    IF  ( IR )                 360,120,360
360 I=K1
    K1=K4
    K4=K3
    K3=K2
    K2=I
    NAITKN = NAITKN+1
    GOTO  100
400 CALL  POH (H(I5), H(J5), H(J6), H(K1), H(K2), H(K3), H(K4), NSIZE,
   1                NC)
    GOTO  (404,402),NC
402 VALUE(2)=H(J5+2)
    VALUE(4)=H(J6+2)
404 INDEX=0
    VALUE(1)=H(J5)
    VALUE(NC+1)=H(J6)
    CALL  NORM  (H(K3),H(K3),NSIZE,H(J1),INDEX,NSIZE,NC,2)
    INDEX1 = INDEX
    ITERS = -ITERS
    I=K4+2*INDEX-2
    H(J1)=H(I)
    H(J1+1)=H(I+1)
    GOTO (420,410),NC
410 I = I+NX
    H(J1+2)=H(I)
    H(J1+3)=H(I+1)
420 INDEX=-INDEX
    CALL  NORM  (H(K4),H(K4),NSIZE,H(J1),INDEX,NSIZE,NC,[illegible])
    IF  ( K -12 )                            440,500,480
440 J3=13
442 J4=14
450 K=1
460 DO  462  J=1,16
      J1=J3+J-1
      J2=J4+J-1
462   H(J1)=H(J2)
    GOTO  (520,510,514,600),K
470 J3=11
    GOTO  442
480 IF  ( K3-13 )                        490,490,470
490 K=3
    J3=11
    J4=13
    GOTO  460
500 K=2
    J3=13
    J4=11
    GOTO 460
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 510 J3=I1                                                              MTR40688
 512 J4=I2                                                              MTR40689
     GOTO  450                                                          MTR40690
 514 J3=I3                                                              MTR40691
     GOTO  512                                                          MTR40692
 520 CALL MADS  (H(I1),H(I3),H(I2),NSIZE,NC)                            MTR40693
 600 CALL CHANGE (H(I1),NSIZE,2*NC,NSIZE,2)                             MTR40695
 604 J=NC*NSIZE+1                                                       MTR40697
     INDEX=0                                                            MTR40698
     CALL NORM  (H(J),H(J),NSIZE,H(I5),INDEX,NSIZE,NC,1)                MTR40700
     J=J+INDEX1-1                                                       MTR40701
     J1=J+(NC-1)*NSIZE                                                  MTR40702
     H(J)=0.                                                            MTR40703
     H(J1)=0.                                                           MTR40704
     INDEX2 = INDEX                                                     MTR40705
 606 CALL OVERFL  ( IOVFLW )                                            MTR40707
     GOTO  (610,620) ,IOVFLW                                            MTR40708
 610 IRR=IRR+1                                                          MTR40709
 620 CALL DVCHK ( IDVDCT )                                              MTR40711
     GOTO  (630,640) ,IDVDCT                                            MTR40712
 630 IRR=IRR+2                                                          MTR40713
 640 CALL CHANGE  (U,NSIZE,NC*NSIZE,MAXR,2)                             MTR40715
 700 RETURN                                                             MTR40717
 750 IK=I5+(4-K)*N2C                                                    MTR40719
     VALUE(1) = H(IK)                                                   MTR40720
     IK=IK+2*(NC-1)                                                     MTR40721
     VALUE(NC)=H(IK)                                                    MTR40722
     INDEX1=INDEX                                                       MTR40723
     K=4                                                                MTR40724
     J3=I1                                                              MTR40725
     J4=K1                                                              MTR40726
     IF  ( K1-I1 )             460,600,460                              MTR40727
 800 IGO=3                                                              MTR40729
     INDEX1=INDEX                                                       MTR40730
     J=I5                                                               MTR40731
     J1 = I5+4*N2C                                                      MTR40732
 806 CALL  LEGIS  ( H(J),H(J1),EPS1,EPS2,NC,IR )                        MTR40733
     IF  ( IR )                340,340,750                              MTR40734
     END                                                                MTR40736
$      FORTRAN LSTCO.DECK
C MITERS
C  A IS STORED IN CORE AT A.      (MAXR X NC*NP*NSIZE )                 MTR40738
C  NTAPUT IS A UTILITY TAPE, FOR CHECK VECTORS IF DESIRED.              MTR40739
C  EPSP = EPSILON ONE = SINGLE PRECISION CONVERGENCE TEST NUMBER        MTR40740
C  EPDP = EPSILON TWO = DOUBLE PRECISION     ..       ..   ..           MTR40741
C  NC = 1, IF REAL                       NP = 1, IF SINGLE PRECISION    MTR40742
C       2, IF COMPLEX                       = 2, IF DOUBLE     ..       MTR40743
C  NGUESS = 0, IF FIRST GUESS IS TO BE A COLUMN OF ONES.                MTR40744
C  MODOUT = NO. OF MODES TO BE COMPUTED.                                MTR40745
C  NAKSP - NO. TIMES AITKNS ACCELERATION WAS USED IN SINGLE PRECISION.  MTR40746
C  NAKDP = ..     ..     ..      ..         ..    ..  .. DOUBLE     ..  .  MTR40747
C  MAXSP = MAXIMUM ITERATIONS ALLOWED IN SINGLE PRECISION.              MTR40748
C  MAXDP =    ..      ..            ..   .. DOUBLE     ..    .          MTR40749
C  IRR = ERROR RETURN  = 1, FOR OVERFLOW                                MTR40750
C                        2, FOR DIVIDE CHECK                            MTR40751
C                        3, FOR BOTH OVERFLOW AND DIVIDE CHECK          MTR40752
C  NSIZE = NO. OF ROWS AND COLUMNS OF A                                 MTR40753
C RSP =  R, AITKENS ACCELERATION CONVERGENCE CONTROL FOR SINGLE PRECIS. MTR40754
C  RDP =  R  AITKENS ACCELERATION CONVERGENCE CONTROL FOR DOUBLE PRECIS.MTR40755
C  MAXR  =  DIMENSIONED NUMBER OF ROWS OF A AND GUESS                   MTR40756
      SUBROUTINE MITERS(A,GUESS,NGUESS,NSIZE,MODOUT,MAXR,NC,EPSP,EPDP,  MTR40758
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     1                  NAKSR,NAKDR,MAXSR,MAXDR,RSP,RDP,IRR,H,VECTOR,   MTR40759
     2                  VALUE,NITER,NTAPUT,NTAPOT)                      MTR40760
      DIMENSION   A(1), GUESS(1), H(1), NITER(1), NAKSR(1), NAKDR(1),   MTR40763
     1            ATITLE(9), VECTOR(1), VALUE(1)                        MTR40764
      DATA  (ATITLE(I),I=1,9)   / 10H OVERFLOW, , 10H          ,        MTR40766
     1            10H    DIVIDE ,  10H CHECK    , 10H        IN ,       MTR40767
     2            10H CLOSE     ,  10H SWEEP    , 10HSUBROUTINE ,       MTR40768
     3            10H           /                                       MTR40769
   10 FORMAT   (1H0  5X, 6H MODE   13X, 11H EIGENVALUE   10X,           MTR40771
     1          24HITERATIONS  S.P.    D.P.  6X, 20H AITKENS S.P.   D.P. MTR40772
     2           ///  )                                                 MTR40773
   12 FORMAT   (1H  1I11,  2F19.8,  1I22,  1I7,  1I19,  1I7 )           MTR40774
   14 FORMAT   (1H  1I11,  1F29.8,  1I31,  1I7,  1I19,  1I7 )           MTR40775
   16 FORMAT   (1H0 I16, 43H MODES ARE CORRECT, COMPUTATION TERMINATED.)MTR40776
   18 FORMAT   (15H0MODIFIED MODE   I16, 22H IS CORRECT, TRUE MODE      MTR40777
     1           20H CANNOT BE COMPUTED.      )                         MTR40778
   20 FORMAT   (1H0  /// 1H0  46X, 14H EIGENVECTORS        ///    )     MTR40779
   22 FORMAT   (1H1 10X, 36H CHECK EIGENVALUES AND EIGENVECTORS     //  MTR40780
     1          (6E16.8)    )                                           MTR40781
   24 FORMAT   (5H MODE   I14, 29H HAS NOT CONVERGED IN MAXIMUM         MTR40782
     1          12H ITERATIONS    )                                     MTR40783
   26 FORMAT   (37H1***** ERROR IN ITERATION SUBROUTINE       PA10 )    MTR40784
      CALL OVERFL ( IOVFLW )                                            MTR40785
      CALL DVCHK ( IDVDCT )                                             MTR40787
      MSIZE = NSIZE                                                     MTR40788
      ISIZE = NC*MAXR                                                   MTR40789
      IRR=0                                                             MTR40790
C FIND A AND STORE ON TAPE IF NECESSARY.                                MTR40792
      IF  ( NTAPUT )           102,102,100                              MTR40793
  100 REWIND NTAPUT                                                     MTR40794
      M=NSIZE*ISIZE                                                     MTR40795
        WRITE   ( NTAPUT )     (A(I),I=1,M)                             MTR40796
      REWIND NTAPUT                                                     MTR40797
  102 IF  ( EPSP )             106,104,106                              MTR40799
  104 EPSP = .5E-08                                                     MTR40800
  106 IF  ( EPDP )             110,108,110                              MTR40802
  108 EPDP = .5E-08                                                     MTR40803
  110 JSIZE=NSIZE*(NC-1)                                                MTR40805
C DEFINE FIRST GUESS,  IF NOT GIVEN.                                    MTR40807
      IF  ( NGUESS )           111,114,111                              MTR40809
  111 IF  ( MAX -NSIZE )       116,116,112                              MTR40810
  112 DO  113  I=1,NSIZE                                                MTR40811
        J= NSIZE+I                                                      MTR40812
        J1= MAXR+I                                                      MTR40813
  113   GUESS(J)=GUESS(J1)                                              MTR40814
      GOTO  116                                                         MTR40815
  114 DO  115  I=1,NSIZE                                                MTR40817
        J=JSIZE+I                                                       MTR40818
        GUESS(J) = 0.                                                   MTR40819
  115   GUESS(I)=1.                                                     MTR40820
C DEFINE PROGRAM CONSTANTS.                                             MTR40822
  116 MODE = 0                                                          MTR40824
      I1=1                                                              MTR40825
          I2 = I1+ISIZE                                                 MTR40826
          I3 = I2+ISIZE                                                 MTR40827
C SET FOR MODE COUNT                                                    MTR40829
  130 MODE=MODE+1                                                       MTR40831
      KSIZE = NC*MSIZE                                                  MTR40832
      IF  ( MODE- MODOUT )                    140,140,500               MTR40833
  140 NSRAK=0                                                           MTR40835
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      NDRAK=0                                                           MTR40836
      ITERSR=0                                                          MTR40837
      ITERDR=0                                                          MTR40838
      K1=I1                                                             MTR40840
      K2=I3                                                             MTR40841
      K3=I2                                                             MTR40842
      DO  150  K=1,NC                                                   MTR40844
        J1=(K-1)*NSIZE                                                  MTR40845
        J= (K-1)*MSIZE+K1-1                                             MTR40846
        DO  150  I=1,MSIZE                                              MTR40847
          J=J+1                                                         MTR40848
          J1=J1+1                                                       MTR40849
  150     H(J)=GUESS(J1)                                                MTR40850
  152 NAK=0                                                             MTR40852
  160 NAK=NAK+1                                                         MTR40853
  162 ITERSR=ITERSR+1                                                   MTR40855
      IF  ( ITERSR-MAXSR )                      170,170,250             MTR40857
  170 I=K1                                                              MTR40859
      K1=K3                                                             MTR40860
      K3=K2                                                             MTR40861
      K2=I                                                              MTR40862
C  SET .... NOW MAKE ONE ITERATION.                                     MTR40864
C                                                                       MTR40865
      CALL MULT (A,H(K2),H(K1),MSIZE,MSIZE,1,MAXR,MSIZE,MSIZE,NC,1)     MTR40866
      INDEX=0                                                           MTR40868
      IK= I3+KSIZE+NC*(3-NAK)                                           MTR40869
      CALL NORM (H(K1),H(K1),MSIZE,H(IK),INDEX,MSIZE,NC,1)              MTR40870
      CALL OVERFL  ( IOVFLW )                                           MTR40872
      CALL DVCHK  ( IDVDCT )                                            MTR40873
      GOTO  (180,182) ,IOVFLW                                           MTR40875
  180 IRR=IRR+1                                                         MTR40876
  182 GOTO  (184,186) ,IDVDCT                                           MTR40877
  184 IRR=IRR+2                                                         MTR40878
  186 IF  ( IRR )                      190,190,600                      MTR40880
  190 GOTO  (160,200,200),NAK                                           MTR40882
  200 DO  210  I=1,KSIZE                                                MTR40884
        J1=K1+I-1                                                       MTR40885
        J2=K2+I-1                                                       MTR40886
        IF  ( ABS(H(J1)-H(J2))-EPSP )                  210,210,220      MTR40887
  210   CONTINUE                                                        MTR40888
      GOTO  400                                                         MTR40889
  220 GOTO  (160,160,230),NAK                                           MTR40891
  230 CALL AITKNS ( H(K1), H(K2), H(K3), H(K3), RSP, MSIZE, MSIZE, NC,  MTR40893
     1                 1, IR )                                          MTR40894
      IF  ( IR )                       240,232,240                      MTR40895
  232 L=2*NC                                                            MTR40896
      J=IK+L                                                            MTR40897
      DO  234  I=1,L,NC                                                 MTR40898
        J1=J+NC-I                                                       MTR40899
        J2=J-I+1                                                        MTR40900
        J3=J1-NC                                                        MTR40901
        J4=J2-NC                                                        MTR40902
        H(J1)=H(J3)                                                     MTR40903
  234   H(J2)=H(J4)                                                     MTR40904
      GOTO  162                                                         MTR40905
  240 I=K1                                                              MTR40907
      K1=K3                                                             MTR40908
      K3=K2                                                             MTR40909
      K2=I                                                              MTR40910
      NSRAK=NSRAK+1                                                     MTR40911
      GOTO  152                                                         MTR40912
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 250 CALL   OVERFL   ( IOVFLW )                                     MTR40914
     CALL   DVCHK   ( IDVDCT )                                      MTR40915
     GOTO   (260,262) ,IOVFLW                                       MTR40916
 260 IRR=IRR+1                                                      MTR40917
 262 GOTO   (264,266) ,IDVDCT                                       MTR40918
 264 IRR=IRR+2                                                      MTR40919
 266 IF   ( IRR   )                270,270,600                      MTR40920
 270 IF (K1-I1 )                   272,280,272                      MTR40922
 272 DO   274   I=1,KSIZE                                           MTR40924
       J=KL+I-1                                                     MTR40925
       J1=I1+I-1                                                    MTR40926
 274   H(J1) = H(J)                                                 MTR40927
 280 J=(MODE-1)*NC+1                                                MTR40928
     ITERSR=ITERSR-1                                                MTR40929
     CALL   CLOSES(A,H(I1),MSIZE,MAXR,RDP,EPSP,EPDP,NC,IRR,MAXDR,ITERDR,MTR40930
    1                 NDRAK,INDEX1,INDEX2,VALUE(J), NSIZE )         MTR40931
     IF   ( IRR )                  282,282,610                      MTR40945
 282 IF   ( ITERDR )               283,288,288                      MTR40946
 283 IF   ( KSIZE-ISIZE )          284,288,288                      MTR40948
 284 J1  =  I1+2*KSIZE                                              MTR40950
     J2  =  I2+KSIZE                                                MTR40951
     DO   286   I=1,KSIZE                                           MTR40952
       J1= J1-1                                                     MTR40953
       J2= J2-1                                                     MTR40954
 286   H(J2)=H(J1)                                                  MTR40955
 288 INDEX = INDEX1                                                 MTR40957
     INDIX = INDEX                                                  MTR40958
 290 M1  = NSIZE-1                                                  MTR40959
     J1=INDEX                                                       MTR40960
     IF   ( J1-M1 )                          292,292,298            MTR40961
 292 DO   296   K=1,ISIZE                                           MTR40962
       L=(K-1)*MAXR                                                 MTR40963
       L1=L+INDEX                                                   MTR40964
       HOLD= A(L1)                                                  MTR40965
       DO   294   J=J1,M1                                           MTR40966
         I=L+J                                                      MTR40967
 294     A(I) = A(I+1)                                              MTR40968
 296   A(I+1)=HOLD                                                  MTR40969
 298   L=NSIZE-MODE+1                                               MTR40970
     J = (MODE-1) * NC * MAXR +1                                    MTR40972
     CALL   SWEEPX (VECTOR(J),A, H, A(L), VALUE, MODE, MSIZE, MAXR, NC, MTR40977
    1              INDIX, EPSP, NSIZE, NITER(MODOUT+1) , IRR)       MTR40978
     CALL   OVERFL   ( IOVFLW )                                     MTR40979
     CALL   DVCHK    ( IDVDCT )                                     MTR40980
     GOTO   ( 300,302) ,IOVFLW                                      MTR40982
 300 IRR=IRR+1                                                      MTR40983
 302 GOTO   ( 304,306) ,IDVDCT                                      MTR40984
 304 IRR=IRR+2                                                      MTR40985
 306 IF   ( IRR )                  310,310,620                      MTR40986
 310 I=(NC-1)*NSIZE                                                 MTR40988
     DO   312   J=INDEX,NSIZE                                       MTR40989
       I=I+J                                                        MTR40990
       GUESS(I)=GUESS(L+1)                                          MTR40991
 312   GUESS(J)=GUESS(J+1)                                          MTR40992
     MSIZE = MSIZE-1                                                MTR40994
     NITER(MODE) = ITERSR+ITERDR                                    MTR40995
     NAKSR(MODE)= NSRAK                                             MTR40996
     NAKDR(MODE)= NDRAK                                             MTR40997
     IF   ( ITERDR )               320,360,360                      MTR40998
 320 MODE=MODE+1                                                    MTR40999
     ITERDR=-ITERDR                                                 MTR41000
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      NITER(MODE-1)= 0.                                                 MTR41001
      INDEX=INDEX2                                                      MTR41002
      IF  ( INDEX-NSIZE )                    326,330,330                MTR41003
  326 IF  ( INDEX1-INDEX2 )                  330,330,340                MTR41004
  330 INDIX=-INDEX                                                      MTR41005
     -INDEX=INDEX-1                                                     MTR41006
      GOTO 342                                                          MTR41007
  340 INDIX=-INDEX                                                      MTR41008
  342 CONTINUE                                                          MTR41009
      I1=I1+ISIZE                                                       MTR41010
      I2=I2+ISIZE                                                       MTR41011
      I3=I3+ISIZE                                                       MTR41012
      NAKSR(MODE-1) = 0.                                                MTR41013
      NAKDR(MODE-1) = 0.                                                MTR41014
      GOTO  290                                                         MTR41015
  360 I1=I1+ISIZE                                                       MTR41017
      I2=I1+ISIZE                                                       MTR41018
      I3=I2+ISIZE                                                       MTR41019
      GOTO  130                                                         MTR41020
  400 IF  ( K1-I1 )              410,413,410                            MTR41022
  410 DO  412  I=1,KSIZE                                                MTR41023
        J=K1+I-1                                                        MTR41024
        J1=I1+I-1                                                       MTR41025
  412   H(J1)=H(J)                                                      MTR41026
  413 DO  414  J=1,NC                                                   MTR41027
        I= NC*(MODE-1)+1                                                MTR41028
        J1=IK+J-1                                                       MTR41029
  414   VALUE(I)= H(J1)                                                 MTR41030
      INDIX=INDEX                                                       MTR41031
      GOTO  290                                                         MTR41032
  500 MODE=MODE-1                                                       MTR41034
      IF  ( MODE )               530,530,502                            MTR41035
  502 IF  ( NTAPUT )             510,510,504                            MTR41036
  504 READ  ( NTAPUT )      (A(I),I=1,M)                                MTR41037
      CALL   MULT (A,VECTOR, H,NSIZE,NSIZE,MODE,MAXR,MAXR,MAXR ,NC,1)   MTR41039
      DO  506  I=1,MODE                                                 MTR41041
        J= (I-1)*ISIZE    + 1                                           MTR41043
        J1 = (I-1)*NC+1                                                 MTR41044
        INDEX=0                                                         MTR41045
  506   CALL  NORM (H(J),H(J),NSIZE,GUESS(J1),INDEX,MAXR ,NC,1)         MTR41046
  510 IF  ( NTAPOT )             530,530,512                            MTR41048
  512 WRITE  (NTAPOT,10 )                                               MTR41050
      DO  522  I=1,MODE                                                 MTR41051
        J1= MAXSR                                                       MTR41052
        J2= NITER(I)-MAXSR                                              MTR41053
        IF  ( J2 )                           514,515,515                MTR41054
  514   J1=NITER(I)                                                     MTR41055
        J2=0                                                            MTR41056
        GO TO  517                                                      MTR41057
  515   IF  ( J2-MAXDR )                     517,516,516                MTR41058
  516   WRITE (NTAPOT,24)       I                                       MTR41059
  517   GO TO  (518,520) ,NC                                            MTR41060
  518   WRITE (NTAPOT,11)          I, VALUE(I),  J1,J2, NAKSR(I),NAKDR(I) MTR41062
        GOTO  522                                                       MTR41063
  520   J= 2*I                                                          MTR41065
        WRITE (NTAPOT,12)  I, VALUE(J-1), VALUE(J), J1,J2, NAKSR(I),    MTR41066
     1                             NAKDR(I)                             MTR41067
  522   CONTINUE                                                        MTR41068
      J=NC*MODE                                                         MTR41069
      WRITE  (NTAPOT,20)                                                MTR41070
      CALL   MPRINT    (VECTOR,NSIZE,J,MAXR,NTAPOT)                     MTR41071
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      IF   ( NTAPOT )                          530,530,524
  524 WRITE  (NTAPOT,22)    ((GUESS(I),I=1,J))                           MTR41074
      CALL   MPRINT ( H,NSIZE,J,MAXR ,NTAPOT)                            MTR41075
  530 RETURN                                                             MTR41076
  600 NITER(MODE) = ITERSP+ITEROR                                        MTR41078
      NAKSR(MODE) = NSRAK                                                MTR41079
      NAKOR(MODE) = NORAK                                                MTR41080
      IF   ( NTAPOT )              500,500,601                           MTR41081
  601 J=1                                                                MTR41082
      J1=4                                                               MTR41083
      GOTO   (602,604,606),IRR                                           MTR41084
  602 J1=2                                                               MTR41085
      GOTO    606                                                        MTR41086
  604 J=3                                                                MTR41087
  606 WRITE   (NTAPOT,26)    (ATITLE(I),I=J,J1)                          MTR41088
      GOTO  630                                                          MTR41089
  610 J2=6                                                               MTR41090
  612 NITER(MODE) = ITERSP+ITEROR                                        MTR41091
      NAKSR(MODE) = NSRAK                                                MTR41092
      NAKOR(MODE) = NORAK                                                MTR41093
      IF   ( NTAPOT )              530,530,613                           MTR41094
  613 J=1                                                                MTR41095
      J1=4                                                               MTR41096
      GOTO   (614,616,618),IRR                                           MTR41097
  614 J1=2                                                               MTR41098
      GOTO   618                                                         MTR41099
  616 J=3                                                                MTR41100
  618 WRITE   (NTAPOT,26)    (ATITLE(I),I=J,J1),   (ATITLE(5)),          MTR41101
     1                 (ATITLE(J2)),   (ATITLE(I),I=8,9)                 MTR41102
      IF   ( J2-6 )                          630,630,622                 MTR41103
  620 J2=7                                                               MTR41104
      GOTO  612                                                          MTR41106
  622 WRITE   (NTAPOT,18)     MODE                                       MTR41107
      IRR=0                                                              MTR41110
      J= (MODE-1)*NC*MAXR                                                MTR41111
      DO   624   I=1,ISIZE                                               MTR41112
        J1=J+I                                                           MTR41113
        J2=J+(NC-1)*MAXR+I                                               MTR41114
        VECTOR(J2)=0.                                                    MTR41115
  624   VECTOR(J1)=0.                                                    MTR41116
      GOTO  310                                                          MTR41117
  630 I=MODE-1                                                           MTR41118
      WRITE   (NTAPOT,16)     I                                          MTR41120
      GOTO   500                                                         MTR41121
      END                                                                MTR41122
$       FORTRAN LSTOU,DECK                                               MTR41124
C SWEEPS
C          S W E E P X    S U B R O U T I N E
C                                                                        MTR41126
C COMPUTES TRUE MODE AND SWEEPS IT FROM THE MATRIX. (REAL  R COMPLEX)    MTR41127
C                                                                        MTR41128
C  HTRUE  =  TRUE MODAL COLUMNS, AS COMPUTED. U = DYNAMIC MATRIX.        MTR41129
C       H  :  SERIES OF MODIFIED MODAL COLUMNS.FL= COLUMN OF EIGENVALUES. MTR41130
C      US  :  SERIES OF MODIFIED MODAL ROWS OF U.                        MTR41131
C    MODE  =  MODE NOW BEING COMPUTED.          N = SIZE                 MTR41132
C      MD  :  DIMENSIONED NUMBER OF ROWS OF U,US,H,HTRUE                 MTR41133
C      NX  :  1 IF PROBLEM IS REAL.                                      MTR41134
C          :  2 IF PROBLEM IS COMPLEX.                                   MTR41135
      SUBROUTINE  SWEEPX  (HTRUE, U, H, US, FL, MODE, N, MD, NC, INDIX,  MTR41136
     1                      EP, MSIZE, INDIS, IRR)                       MTR41137
      DIMENSION   H(1), US(1), U(1), HTRUE(1), FL(1), G(4)  INDIS(1)     MTR41139
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      INDEX=IABS(INDIX)                                                  MTR41156
      INDIS(MODE) = INDEX                                                MTR41157
      M=MODE-1                                                           MTR41158
      K1=M*NC*MD                                                         MTR41159
      NN=NC*MD                                                           MTR41160
      K2=MSIZE-M                                                         MTR41161
      IF  ( M )                   70,70,80                               MTR41162
   70 GOTO  (140,72) ,NC                                                 MTR41163
   72 IF  ( MSIZE-MD )            74,140,140                             MTR41164
   74 L=K1+2*N+1                                                         MTR41165
      K=K1+MD+N+1                                                        MTR41166
      DO  76  I=1,N                                                      MTR41167
        K=K-1                                                            MTR41168
        L=L-1                                                            MTR41169
        H(K)=H(L)                                                        MTR41170
   76   H(L)=0.                                                          MTR41171
      GOTO  140                                                          MTR41172
   80 DO  90  I=1,M                                                      MTR41173
        J1=MODE+I                                                        MTR41174
   90   INDIS(J1)=INDIS(I)                                               MTR41175
  100 IF  ( INDIX )               102,104,104                            MTR41176
  102 K2=K2+1                                                            MTR41177
      M=M-1                                                              MTR41178
  104 J1=K1+K2*NC+1                                                      MTR41179
      J2=K1+MSIZE*NC                                                     MTR41180
      IF  ( J1-J2 )                            105,105,107               MTR41181
  105 DO  106  I=J1,J2                                                   MTR41182
  106   H(I)=0.                                                          MTR41183
  107 GO TO (114,108),NC                                                 MTR41184
  108 J1=K1+K2*MD+1                                                      MTR41185
      J2=K1+K2*NC+1                                                      MTR41186
      DO  110  I=1,K2                                                    MTR41187
        J1=J1-1                                                          MTR41188
        J2=J2-1                                                          MTR41189
  110   H(J1)=H(J2)                                                      MTR41190
      IF  ( M )                   118,116,111                            MTR41191
  111 DO  112  I=1,M                                                     MTR41192
        H(J2)=0.                                                         MTR41193
  112   J2=J2+1                                                          MTR41194
  114 IF  ( M )                                118,118,120               MTR41195
  120 II=1                                                               MTR41196
      DO  130  I=1,M                                                     MTR41197
  121   DO  122  J=1,M                                                   MTR41198
          J1=MODE+J                                                      MTR41199
          IF  ( II - INDIS(J1))                122,123,122               MTR41200
  122     CONTINUE                                                       MTR41201
        II=II+1                                                          MTR41202
        GOTO  121                                                        MTR41203
  123   INDIS(J1)=0                                                      MTR41204
        IF  ( INDIS(MODE)-II )                 125,124,124               MTR41205
  124   INDIS(MODE)=INDIS(MODE)+1                                        MTR41206
  125   L=MSIZE-II                                                       MTR41207
        IF  ( L )                 129,129,126                            MTR41208
  126   J1= K1+MSIZE                                                     MTR41209
        J2= K1    +MSIZE +(NC-1)*MD                                      MTR41210
        DO  128  J=1,L                                                   MTR41211
          J1=J1-1                                                        MTR41212
          J2=J2-1                                                        MTR41213
          H(J2+1) = H(J2)                                                MTR41214
  128     H(J1+1) = H(J1)                                                MTR41215
  129   J1=K1+II                                                         MTR41216
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         J2=J1+(NC-1)*MD                                                MTR41217
         H(J1)=0.                                                       MTR41218
         H(J2)=0.                                                       MTR41219
  130    CONTINUE                                                       MTR41220
       IF  ( INDIX )           118,131,131                              MTR41221
  118 M=M+1                                                             MTR41222
  131 DO  132  I=1,M                                                    MTR41223
         J1=MODE+I                                                      MTR41224
  132    INDIS(J1)=INDIS(I)                                             MTR41225
      II=1                                                              MTR41226
      DO  138  I=1,M                                                    MTR41227
  133    DO 1134  J=1,M                                                 MTR41228
            J1=MODE+J                                                   MTR41229
            IF  ( II-INDIS(J1) )             1134,1135,1134             MTR41230
 1134       CONTINUE                                                    MTR41231
         II=II+1                                                        MTR41232
         GOTO  133                                                      MTR41233
 1135    L1=(NC*MSIZE-1)*MD+MODE+1                                      MTR41234
         L3=(MSIZE-II)*NN                                               MTR41235
        INDIS(J1) = 0                                                   MTR41236
         DO  138  J=1,NC                                                MTR41237
            J2=L1-(J-1)*MD-1                                            MTR41238
            IF  ( L3-NN )                  138,134,134                  MTR41239
  134       DO  136  I=1,L3,NN                                          MTR41240
               J1=L1-I                                                  MTR41241
               J2=J1-NN                                                 MTR41242
  136          US(J1)=US(J2)                                            MTR41243
            L1=L1-MD                                                    MTR41244
  138       US(J2)=0.                                                   MTR41245
  140 DO  142  I=1,NN                                                   MTR41246
         J1=K1+I                                                        MTR41247
  142    HTRUE(I)=H(J1)                                                 MTR41248
      IF  ( M )                31,31,8                                  MTR41249
    8 DO  25  I=1,M                                                     MTR41250
         K=MODE-I                                                       MTR41251
         L1=NC*MD*(K-1)                                                 MTR41252
         CALL  MULT (US( K  ), HTRUE, G, 1, MSIZE, 1, MD, M1, 1, NC, 1 ) MTR41253
      IF  ( G(1) )                         12,9,12                      MTR41259
    9 GO TO (11,10),NC                                                  MTR41260
   10 IF  ( G(2) )                         12,11,12                     MTR41261
   11 IRR=IRR+2                                                         MTR41262
   12 CONTINUE                                                          MTR41263
      GOTO (14,19),NC                                                   MTR41264
   14 IF (ABS(FL(K)/FL(MODE)-1.0) - EP )             15,15,16           MTR41265
   15 G=1.0                                                             MTR41266
      GOTO  17                                                          MTR41267
   16 G=(FL(K)-FL(MODE)) / G                                            MTR41268
   17 DO  18  J=1,MSIZE                                                 MTR41269
         L=L1+J                                                         MTR41270
   18    HTRUE(J)=H(L)-G(1)*HTRUE(J)                                    MTR41271
        GOTO  25                                                        MTR41272
   19 K=2*K                                                             MTR41273
       J=2*MODE                                                         MTR41274
      IF ( ABS((FL(K-1)*FL(J-1)+FL(K)*FL(J))/(FL(J-1)**2+FL(J)**2)-1.0) MTR41275
     1             -EP)         20,20,22                                MTR41276
   20 IF ( ABS((FL(K)*FL(J-1)-FL(K-1)*FL(J)) / (FL(J-1)**2+FL(J)**2))   MTR41277
     1             -EP)         21,21,22                                MTR41278
   21 G(1)=1.0                                                          MTR41279
      G(2)=0.0                                                          MTR41280
      GOTO  23                                                          MTR41281
   22 G(3)=G(1)**2+G(2)**2                                              MTR41282
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```
      G(4)=(FL(K)-FL(J))*G(1)-(FL(K-1)-FL(J-1))*G(2)                     MTR41283
      G(1)=((FL(K-1)-FL(J-1))*G(1)+(FL(K)-FL(J))*G(2)) / G(3)            MTR41284
      G(2)= G(4) / G(3)                                                  MTR41285
 23   DO  24  J1=1,MSIZE                                                 MTR41286
        K2=J1+MD                                                         MTR41287
        L=L1+J1                                                          MTR41288
        L2=L+MD                                                          MTR41289
        G(3)=HTRUE(J1)                                                   MTR41290
        HTRUE(J1) = H(L) + G(2)*HTRUE(K2) -G(1)*HTRUE(J1)                MTR41291
        HTRUE(K2)= H(L2)- G(1)*HTRUE(K2)-G(2)*G(3)                       MTR41292
 24    CONTINUE                                                          MTR41293
 25 CONTINUE                                                             MTR41296
     I=0                                                                 MTR41297
       CALL  NORM ( HTRUE,HTRUE, MSIZE, G, I, MD, NC, 1)                 MTR41298
 31  J1  =  1                                                            MTR41299
     J2  =  1                                                            MTR41300
     L4  =  MODE                                                         MTR41301
     DO  43    I=1,MSIZE                                                 MTR41302
       L1=J1                                                             MTR41303
       L2=J2                                                             MTR41304
       L3=K1+1                                                           MTR41305
       DO  33   MM=1,MODE                                                MTR41306
         IF ( I -INDIS(MM) )                    33,39,33                 MTR41307
 33      CONTINUE                                                        MTR41308
       DO  37  J=1,MSIZE                                                 MTR41309
         DO  35    MM=1,MODE                                             MTR41310
           IF  ( J-INDIS(MM) )                  35,37,35                 MTR41311
 35        CONTINUE                                                      MTR41312
         U(L1) = U(L2) - H(L3)*US(L4)                                    MTR41313
         GOTO   (38,36),NC                                               MTR41314
 36      J3= L1+MD                                                       MTR41315
         J4= L2+MD                                                       MTR41316
         J5= L4+MD                                                       MTR41317
         J6= L3+MD                                                       MTR41318
         U(J3)=U(J4)-H(L3)*US(J5) - H(J6)*US(L4)                         MTR41319
         U(L1)= U(L1) + H(J6)*US(J5)                                     MTR41320
 38      CONTINUE                                                        MTR41321
         L1=L1+1                                                         MTR41322
         L2=L2+1                                                         MTR41323
 37      L3=L3+1                                                         MTR41324
       GOTO  41                                                          MTR41325
 39    IF   ( I-INDIS(MODE) )                   43,42,43                 MTR41326
 41    J1=J1+NN                                                          MTR41327
 42    J2=J2+NN                                                          MTR41328
 43    L4=L4+NN                                                          MTR41329
      L4=(MSIZE-MODE)*NN+1                                               MTR41331
      DO  52  J=1,NC                                                     MTR41332
        L4 = L4 + (J-1)*MD                                               MTR41333
      L1=L4+(MSIZE-MODE)-1                                               MTR41334
      DO  52  I=L4,L1                                                    MTR41335
 52    U(I)=0.                                                           MTR41336
      RETURN                                                             MTR41342
      END                                                                MTR41343
*      FORTRAN ISTOU.DECK
C CHANGES
      SUBROUTINE   CHANGE   (A,M,N,MAXR,ICHUZ)                           MTR41345
      DIMENSION  A(1)                                                    MTR41346
      MB=2*MAXR                                                          MTR41347
      GO TO  (10,20) ,ICHUZ                                              MTR41348
  10 DO   12  I=1,N                                                      MTR41349
        K=(N-I)*MAXR+M+1                                                 MTR41350
```

```
        KK=(N-1)*MB+2*M+1
        DO  12  J=1,M
          IGET=K-J
          IPUT=KK-2*J
          A(IPUT)=A(IGET)
   12     A(IPUT+1)=0.
      GO TO  100
   20 K=0
      KK=0
      DO  24  I=1,N
        DO  22  J=1,M
          IGET = KK+2*J-1
          IPUT=K+J
   22     A(IPUT) = A(IGET)
        K=K+MAXR
   24   KK=KK+MB
  100 RETURN
      END
```

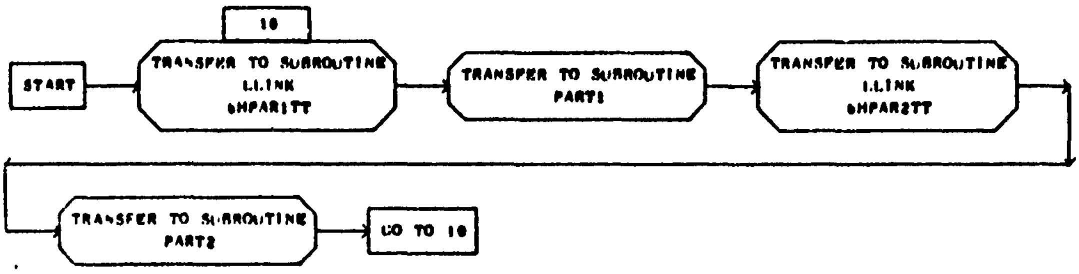
SECTION 9

FLOW DIAGRAMS

MAIN FLUTTER OVERLAY

JAN 11,1967

COMMON IT(218) PAGE 1

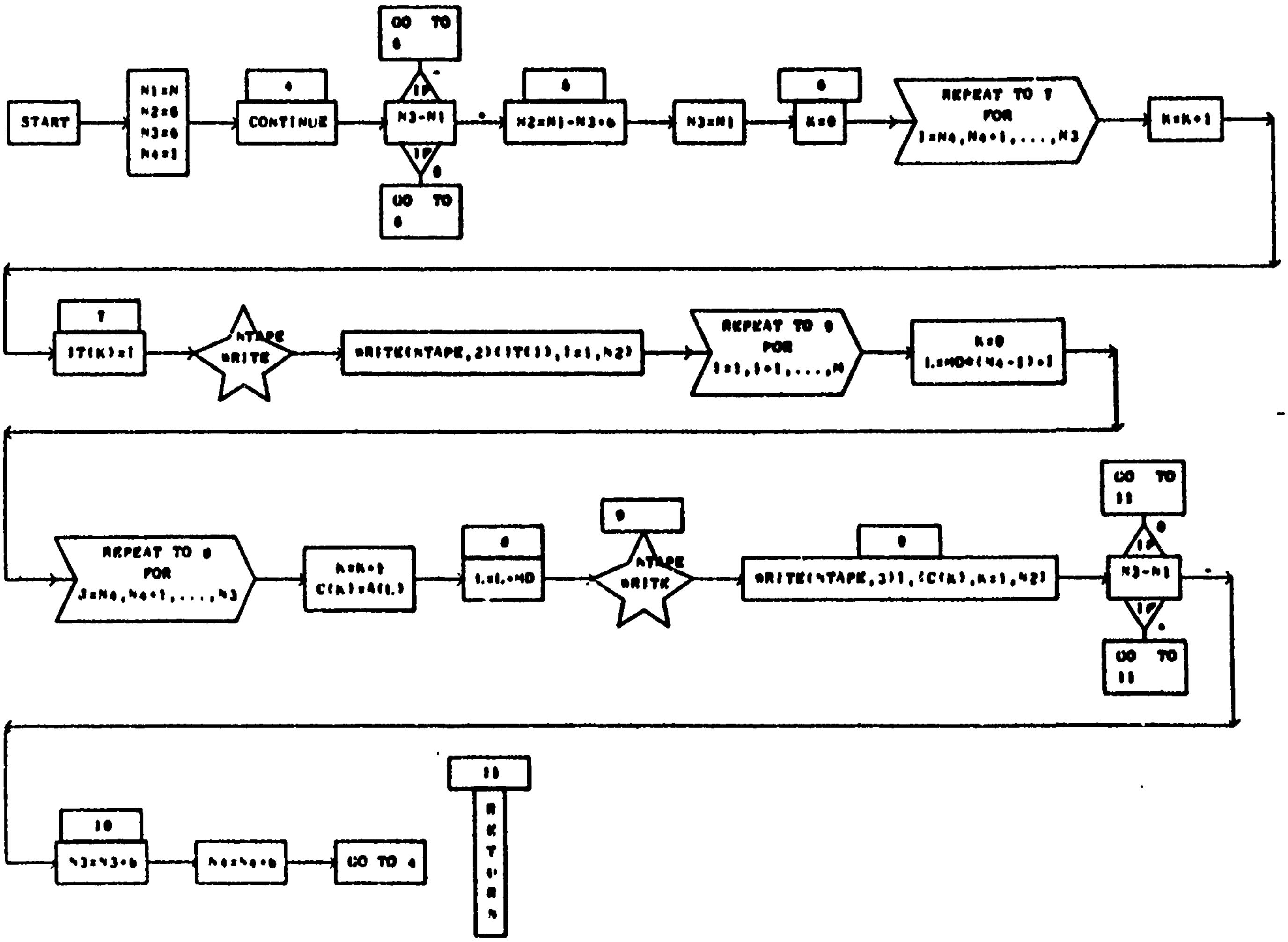


MPRINT

D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
A	1	IT	6	C	6				

SUBROUTINE MPRINT (A,M,N,MD,NTAPE)   PAGE 1



```
                                                  MPUNCH



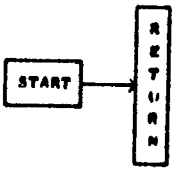
                                    D I M E N S I O N E D   V A R I A B L E S

SYMBOL    STORAGES    SYMBOL    STORAGES    SYMBOL    STORAGES    SYMBOL    STORAGES    SYMBOL    STORAGES

  A          1



                     SUBROUTINE MPUNCH(A,M,N,IOUT,ITRA,IORG,BCDZ,MAXM,NTAPE,NCARDS)                         PAGE  1
```



```
                                        PART1




                          D I M E N S I O N E D   V A R I A B L E S

SYMBOL     STORAGES     SYMBOL     STORAGES     SYMBOL     STORAGES     SYMBOL     STORAGES     SYMBOL     STORAGES

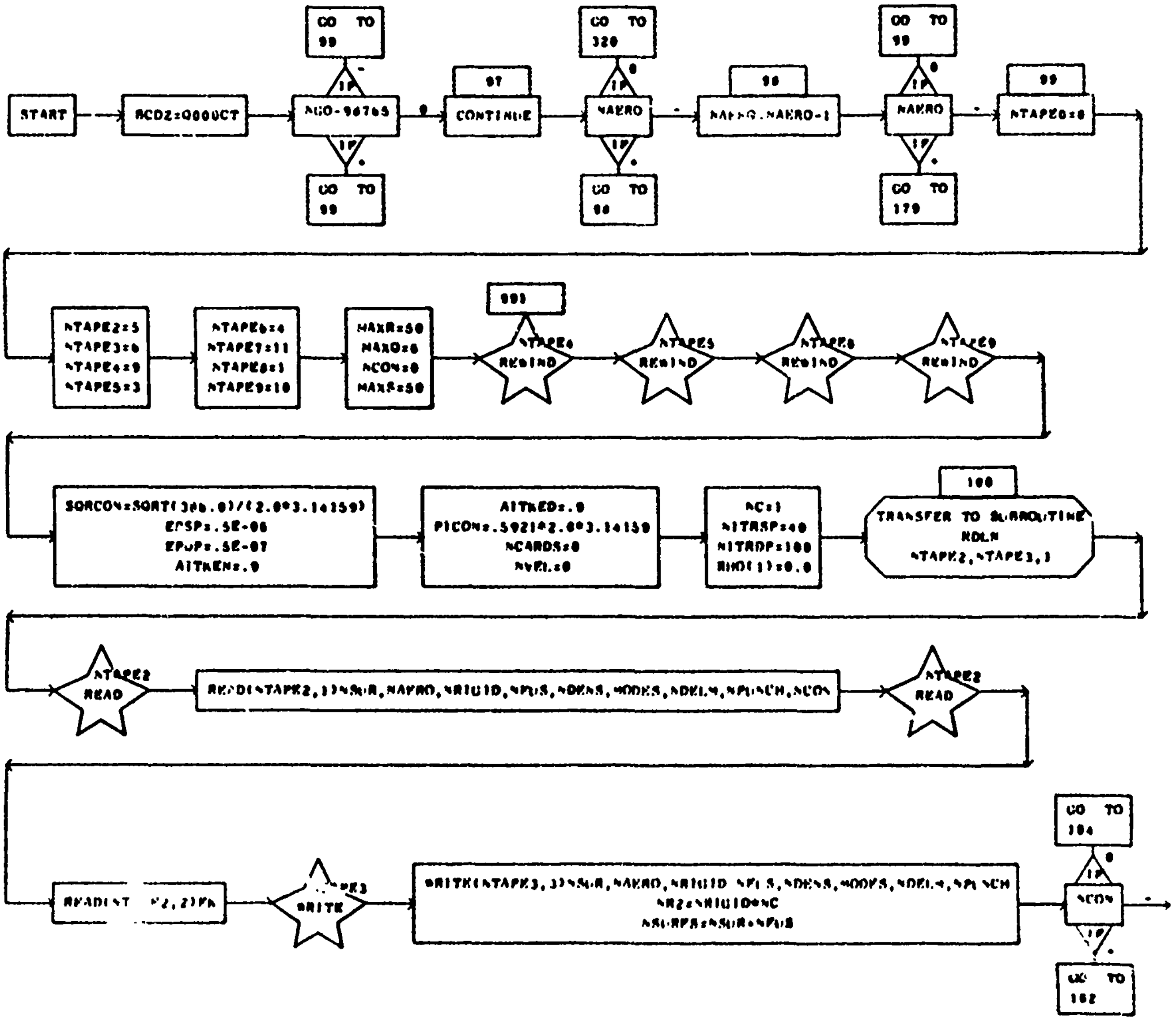
 ISXST      20           ISO        20           BR         21           S          21           RHO        20

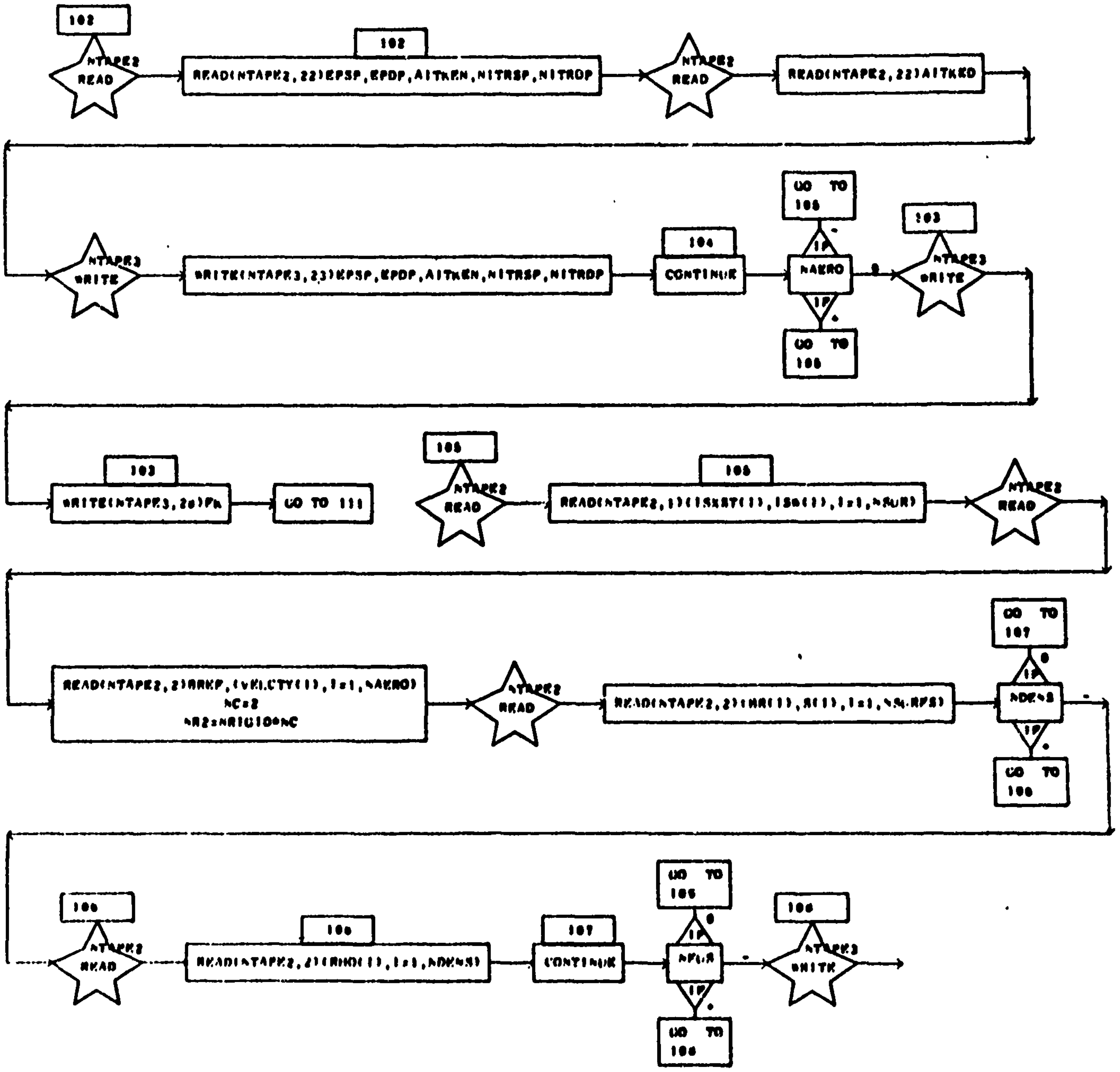
 DM         6,6          DG         6,12         DMBAR      6,12         BARMRR     6,12         LOW        50

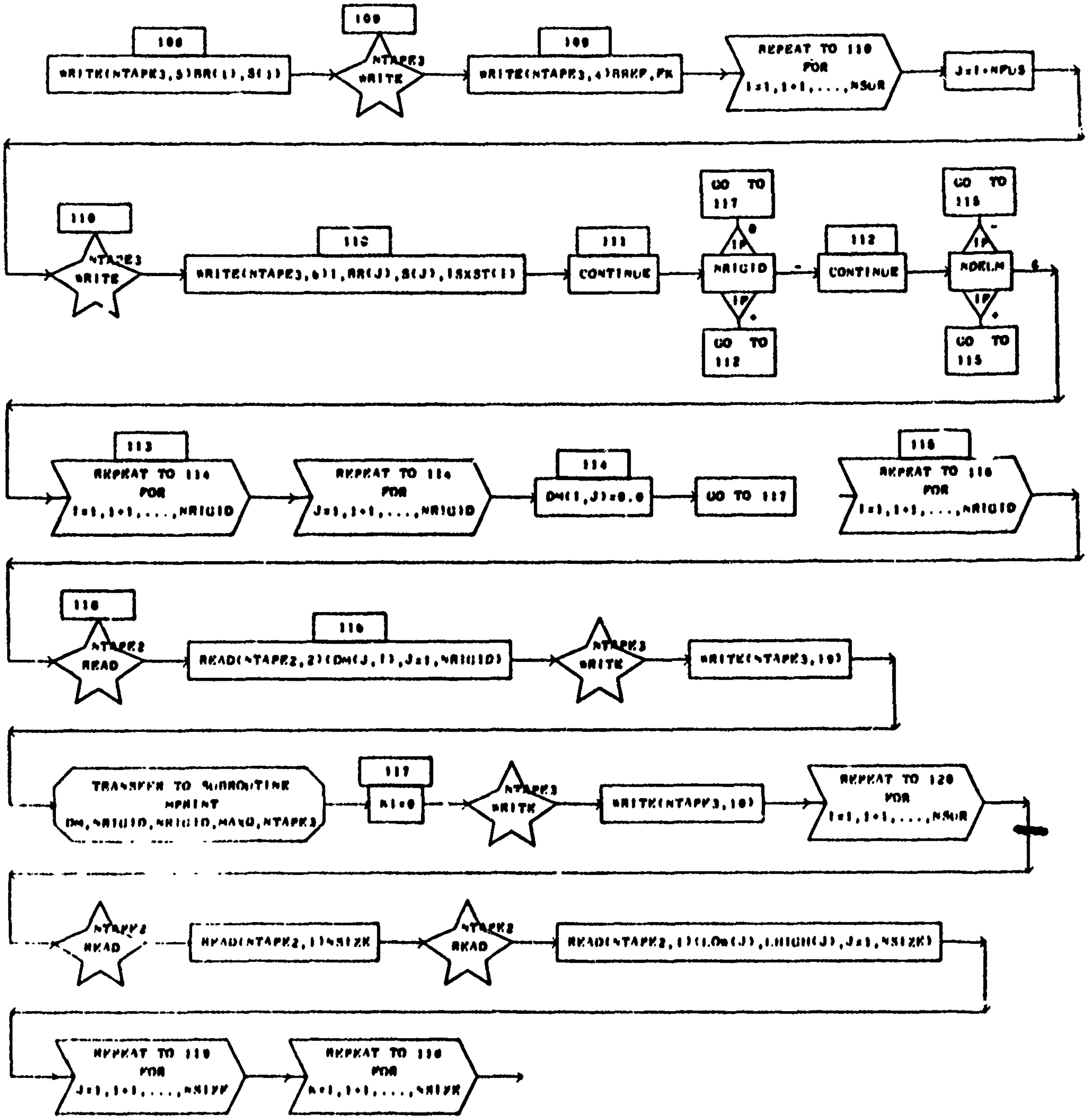
 LHIGH      50           IT         210          VELCTY     20           NSIZES     20           A          50,100

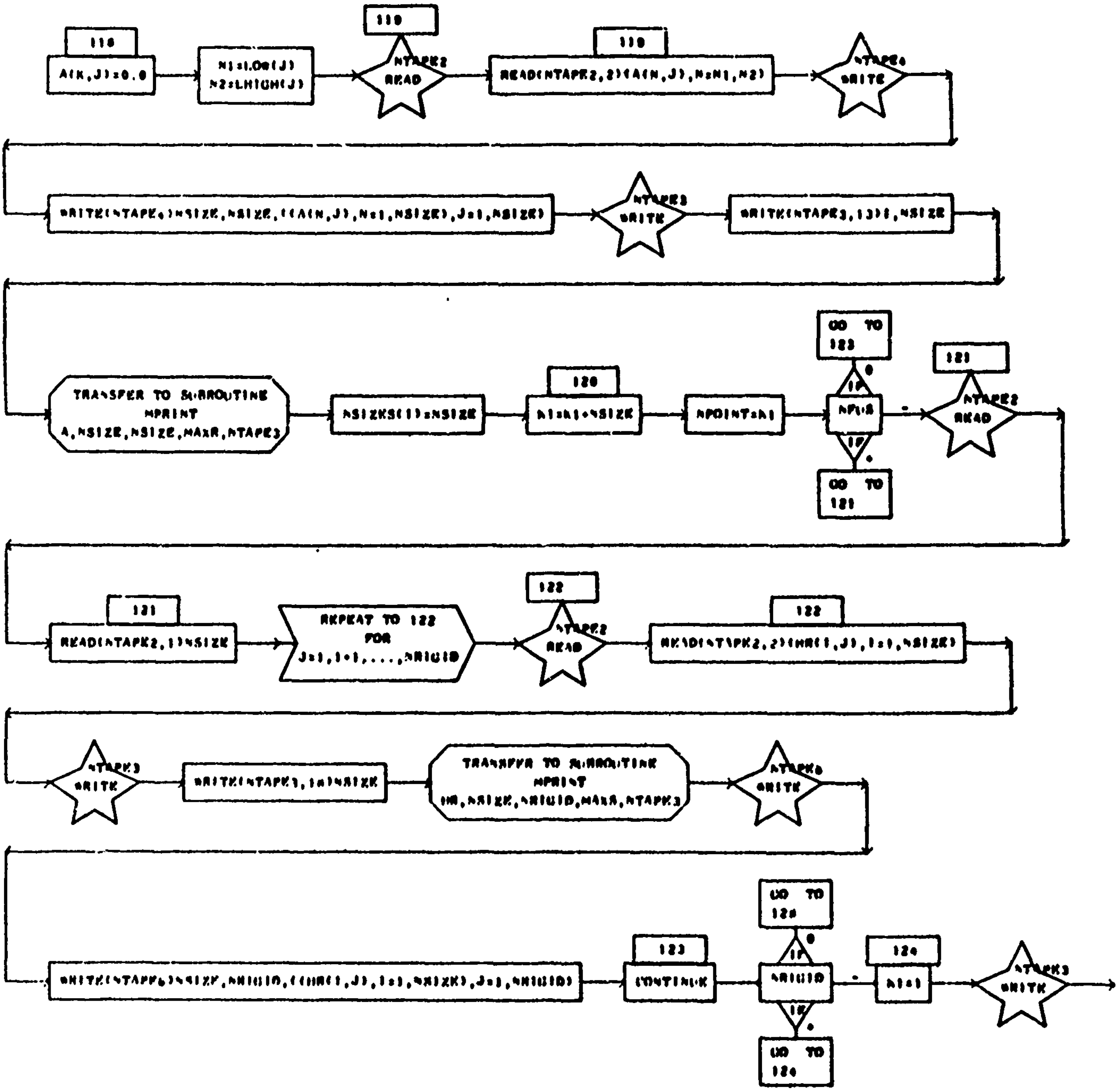
 P          50,100       U          6,100        MR         50,6         MRT        6,100        MY         6,100

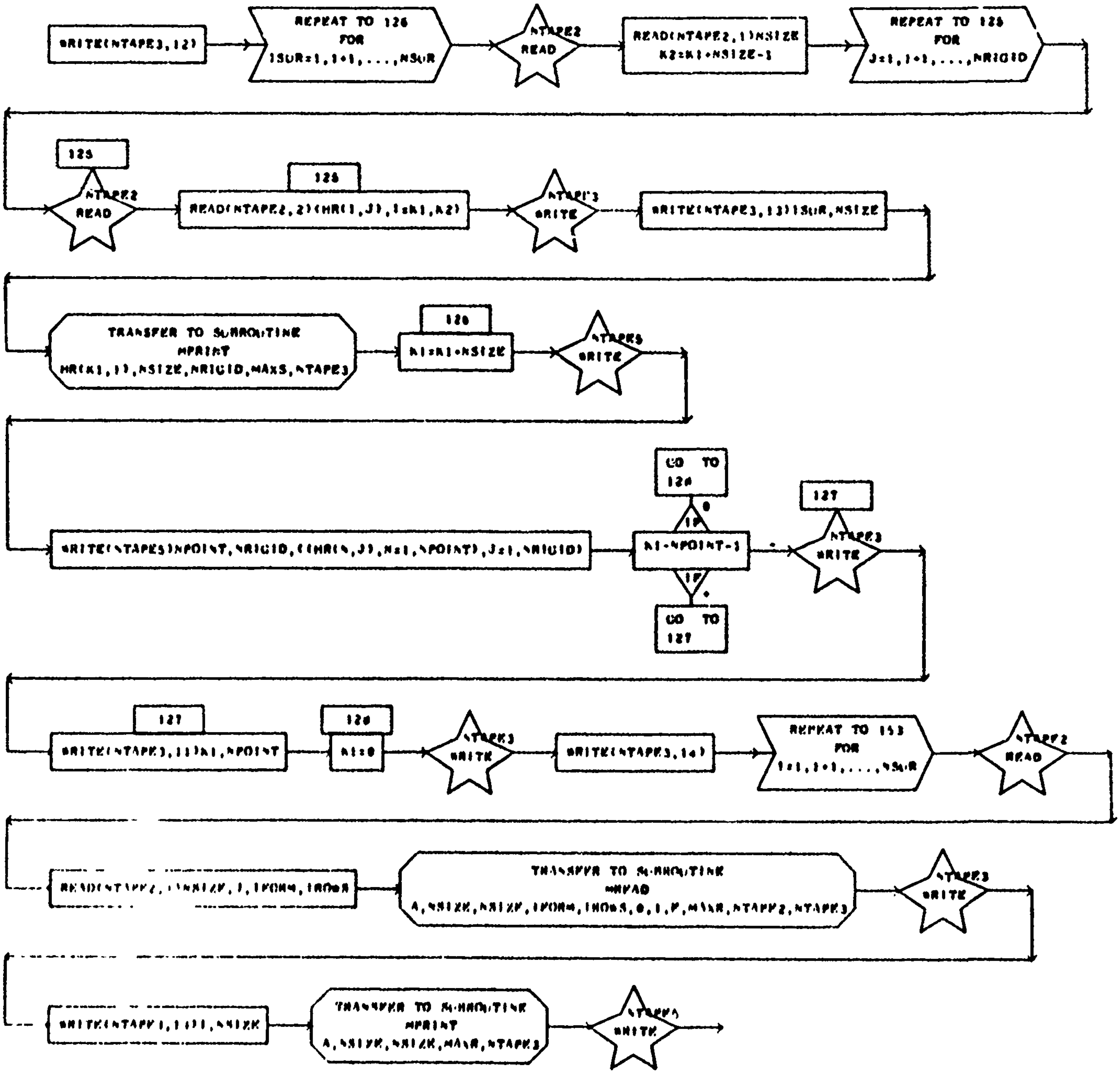
 Q          6,100
```

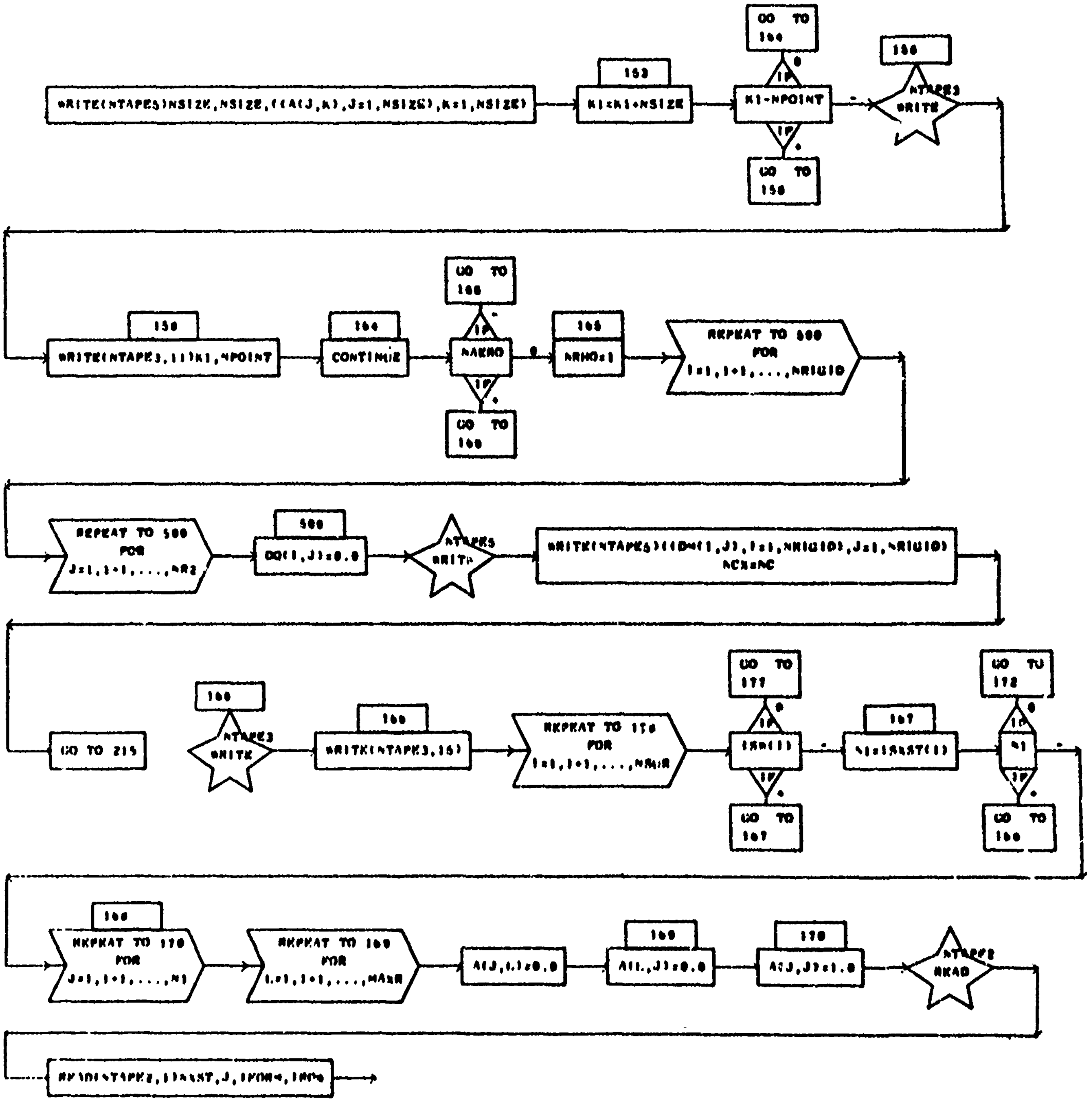

START
RCDZ=Q000CT
NGO-98765
IF
GO TO 99
GO TO 99
-
0
+
97
CONTINUE
NAERO
IF
GO TO 320
GO TO 98
98
NAERO=NAERO-1
NAERO
IF
GO TO 99
GO TO 179
99
NTAPE0=0
NTAPE2=5
NTAPE3=6
NTAPE4=9
NTAPE5=3
NTAPE6=4
NTAPE7=11
NTAPE8=1
NTAPE9=10
MAXR=50
MAXO=6
NCON=0
MAXS=50
991
NTAPE4 REWIND
NTAPE5 REWIND
NTAPE8 REWIND
NTAPE9 REWIND
SQRCON=SQRT(386.0)/(2.0*3.14159)
EPSP=.5E-06
EPUP=.5E-07
AITKEN=.9
AITKED=.9
PICON=.5921*2.0*3.14159
NCARDS=0
NVEL=0
NC=1
NITRSP=40
NITRDP=100
RHO(1)=0.0
100
TRANSFER TO SUBROUTINE RDLN NTAPE2,NTAPE3,1
NTAPE2 READ
READ(NTAPE2,1)NSUR,NAERO,NRIGID,NPUS,NDENS,NODES,NDELM,NPUNCH,NCON
NTAPE2 READ
READ(NT E2,2)FN
NTAPE3 WRITE
WRITE(NTAPE3,3)NSUR,NAERO,NRIGID NPUS,NDENS,NODES,NDELM,NPUNCH
NR2=NRIGID*NC
NSURFS=NSUR+NPUS
NCON
IF
GO TO 104
GO TO 102

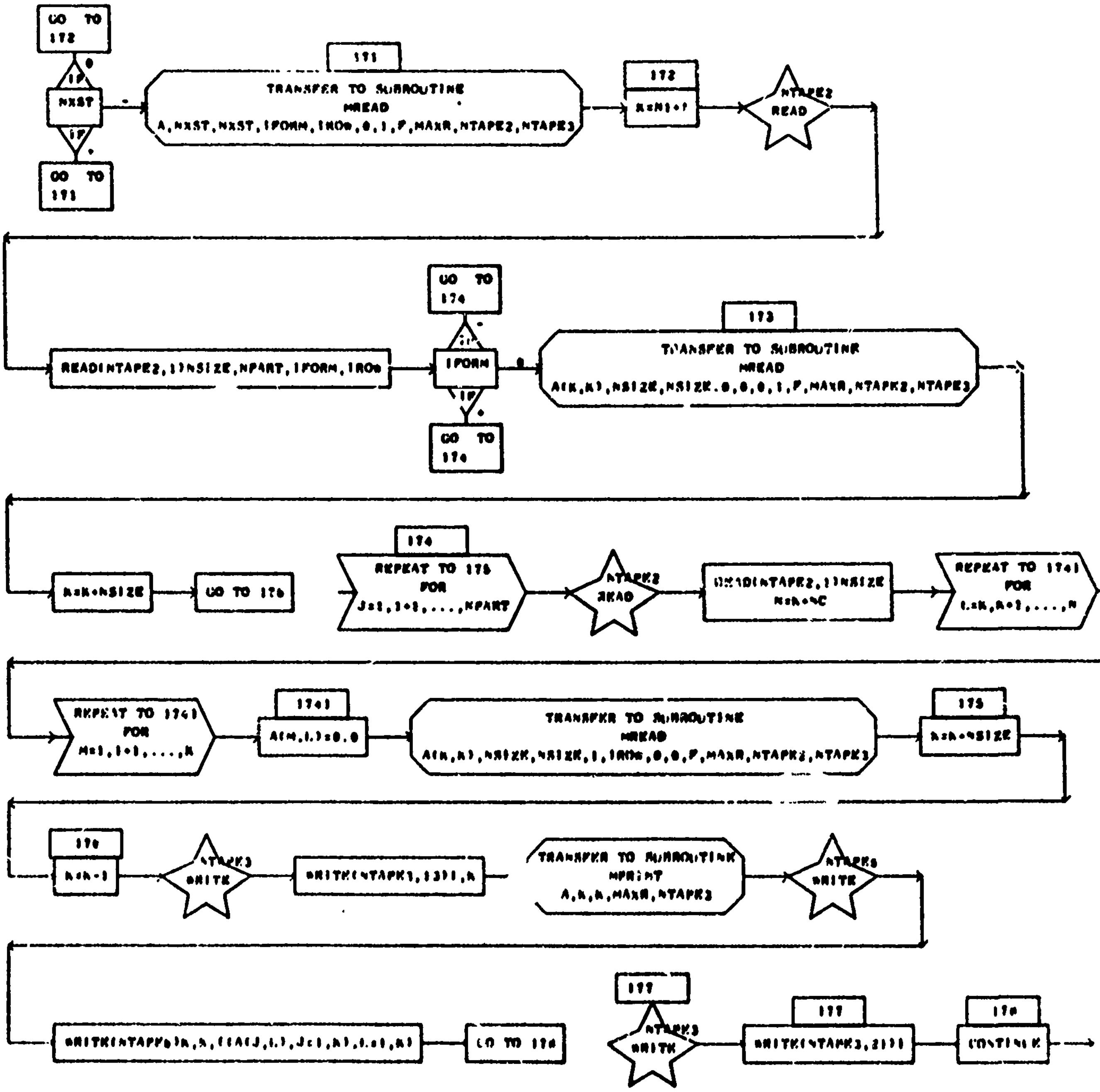

102
NTAPE2
READ
102
READ(NTAPE2,22)EPSP,EPDP,AITKEN,NITRSP,NITRDP
NTAPE2
READ
READ(NTAPE2,22)AITKED
NTAPE3
WRITE
WRITE(NTAPE3,23)EPSP,EPDP,AITKEN,NITRSP,NITRDP
104
CONTINUE
GO TO 105
-
IF
NAERO
0
IF
+
GO TO 105
103
NTAPE3
WRITE
103
WRITE(NTAPE3,24)FN
GO TO 111
105
NTAPE2
READ
105
READ(NTAPE2,1)(ISKST(I),ISN(I),I=1,NSUR)
NTAPE2
READ
READ(NTAPE2,2)RRKP,(VELCTY(I),I=1,NAERO)
NC=2
NR2=NRIGID*NC
NTAPE2
READ
READ(NTAPE2,2)(HR(I),R(I),I=1,NSURFS)
GO TO 107
0
IF
NDENS
-
IF
+
GO TO 106
106
NTAPE2
READ
106
READ(NTAPE2,2)(RHO(I),I=1,NDENS)
107
CONTINUE
GO TO 105
0
IF
NFUR
-
IF
+
GO TO 106
108
NTAPE3
WRITE

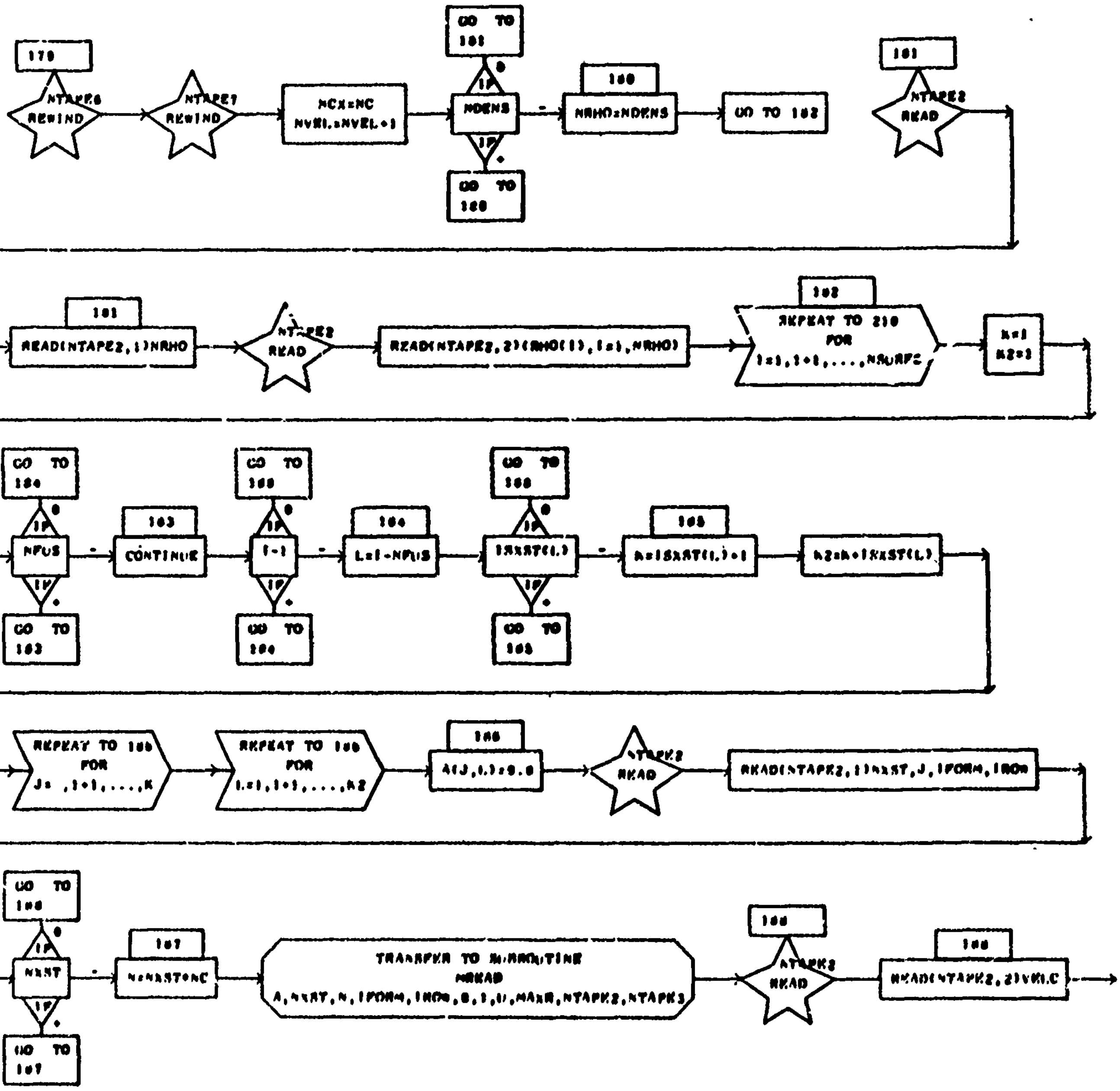

108
WRITE(NTAPE3,5)RR(I),S(I)
109
NTAPE3 WRITE
109
WRITE(NTAPE3,4)RRKP,FK
REPEAT TO 110 FOR I=1,1+1,...,NSUR
J=I+NPUS
110
NTAPE3 WRITE
110
WRITE(NTAPE3,6)I,RR(J),S(J),ISXST(I)
111
CONTINUE
GO TO 117
0
IF
NRIGID
IF
+
GO TO 112
-
112
CONTINUE
GO TO 115
-
IF
NDELM
IF
+
GO TO 115
6
113
REPEAT TO 114 FOR I=1,1+1,...,NRIGID
REPEAT TO 114 FOR J=1,1+1,...,NRIGID
114
DM(I,J)=0.0
GO TO 117
115
REPEAT TO 116 FOR I=1,1+1,...,NRIGID
116
NTAPE2 READ
116
READ(NTAPE2,2)(DM(J,I),J=1,NRIGID)
NTAPE3 WRITE
WRITE(NTAPE3,10)
TRANSFER TO SUBROUTINE MPRINT DM,NRIGID,NRIGID,MAXD,NTAPE3
117
KI=0
NTAPE3 WRITE
WRITE(NTAPE3,10)
REPEAT TO 120 FOR I=1,1+1,...,NSUR
NTAPE2 READ
READ(NTAPE2,1)NSIZE
NTAPE2 READ
READ(NTAPE2,1)(LOW(J),LHIGH(J),J=1,NSIZE)
REPEAT TO 119 FOR J=1,1+1,...,NSIZE
REPEAT TO 118 FOR K=1,1+1,...,NSIZE

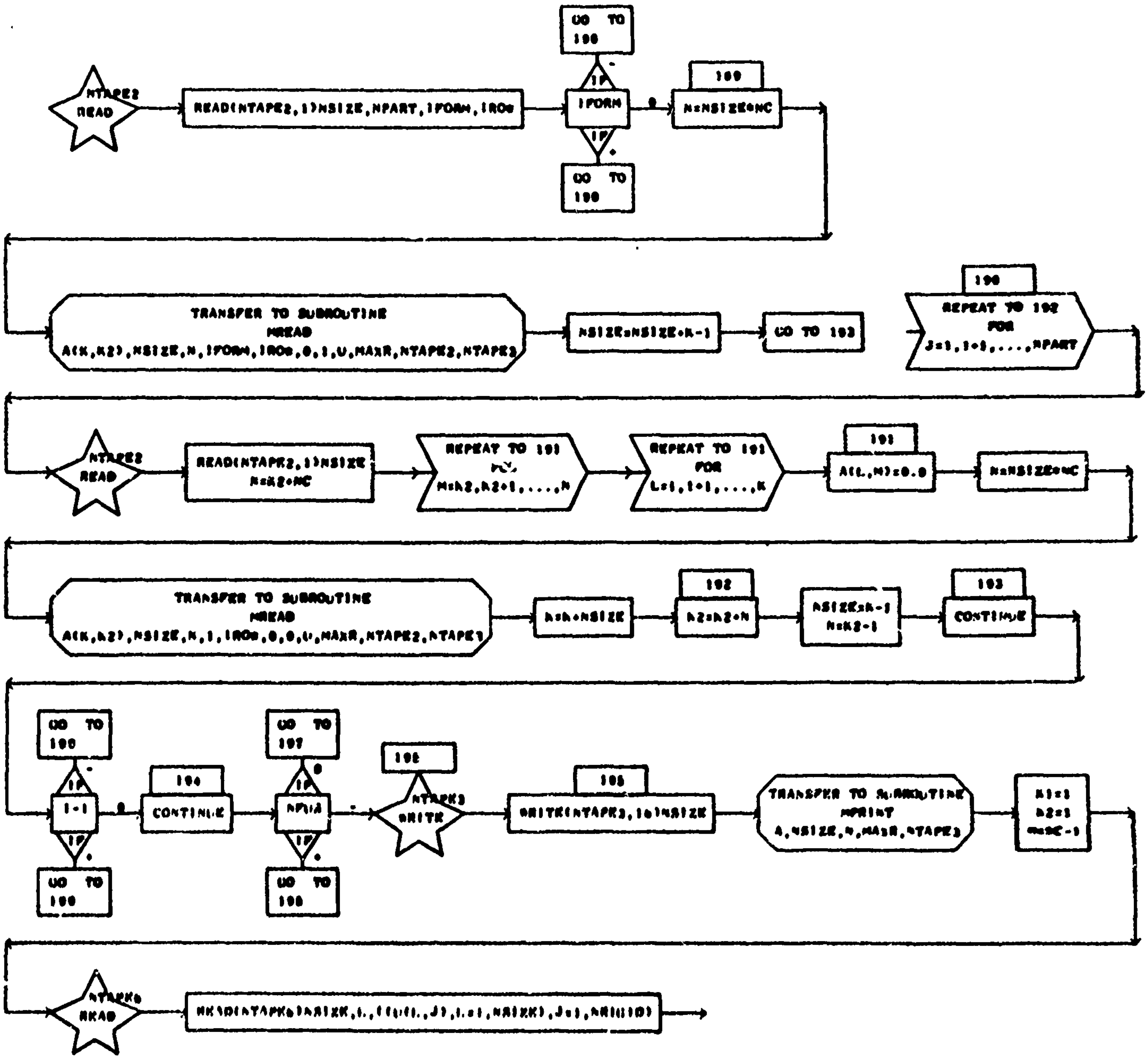

118
A(K,J)=0.0
N1=LOW(J)
N2=LHIGH(J)
119
NTAPE2
READ
119
READ(NTAPE2,2)(A(N,J),N=N1,N2)
NTAPE4
WRITE
WRITE(NTAPE4)NSIZE,NSIZE,((A(N,J),N=1,NSIZE),J=1,NSIZE)
NTAPE3
WRITE
WRITE(NTAPE3,13)I,NSIZE
TRANSFER TO SUBROUTINE
MPRINT
A,NSIZE,NSIZE,MAXR,NTAPE3
NSIZES(I)=NSIZE
120
N1=N1+NSIZE
NPOINT=N1
GO TO
123
0
IF
NFUS
IF
+
GO TO
121
-
121
NTAPE2
READ
121
READ(NTAPE2,1)NSIZE
REPEAT TO 122
FOR
J=1,1+1,...,NRIGID
122
NTAPE2
READ
122
READ(NTAPE2,2)(HR(I,J),I=1,NSIZE)
NTAPE3
WRITE
WRITE(NTAPE3,18)NSIZE
TRANSFER TO SUBROUTINE
MPRINT
HR,NSIZE,NRIGID,MAXR,NTAPE3
NTAPE6
WRITE
WRITE(NTAPE6)NSIZE,NRIGID,((HR(I,J),I=1,NSIZE),J=1,NRIGID)
123
CONTINUE
GO TO
128
0
IF
NRIGID
IF
+
GO TO
124
-
124
N1=1
NTAPE3
WRITE

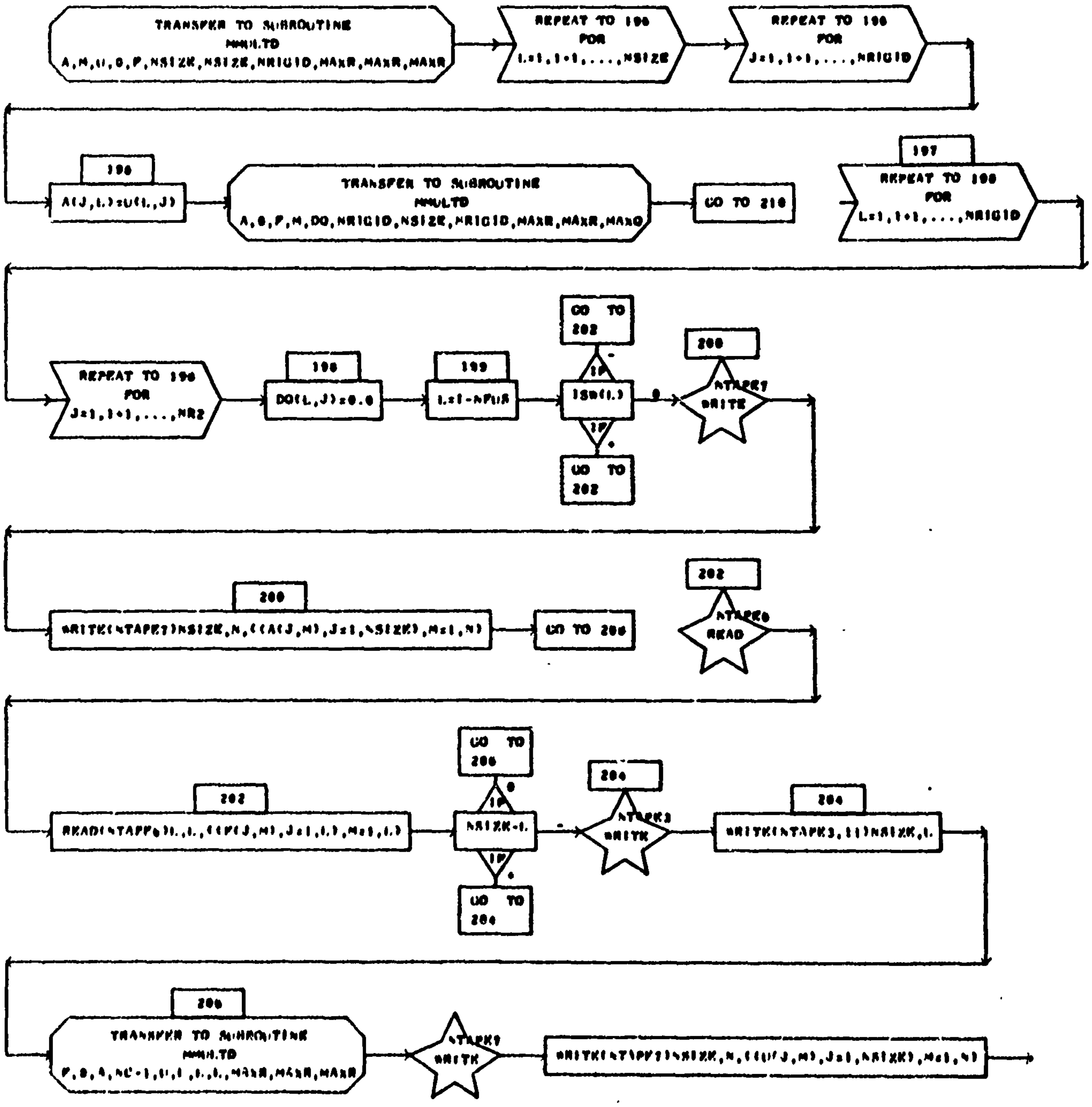

WRITE(NTAPE3,12)
REPEAT TO 126 FOR ISUR=1,1+1,...,NSUR
NTAPE2 READ
READ(NTAPE2,1)NSIZE
K2=K1+NSIZE-1
REPEAT TO 125 FOR J=1,1+1,...,NRIGID
125
NTAPE2 READ
125
READ(NTAPE2,2)(HR(I,J),I=K1,K2)
NTAPE3 WRITE
WRITE(NTAPE3,13)ISUR,NSIZE
TRANSFER TO SUBROUTINE HPRINT
HR(K1,1),NSIZE,NRIGID,MAXS,NTAPE3
126
K1=K1+NSIZE
NTAPE3 WRITE
WRITE(NTAPE5)NPOINT,NRIGID,((HR(N,J),N=1,NPOINT),J=1,NRIGID)
GO TO 128
0
IF
K1-NPOINT-1
-
IF
+
GO TO 127
127
NTAPE3 WRITE
127
WRITE(NTAPE3,11)K1,NPOINT
128
K1=0
NTAPE3 WRITE
WRITE(NTAPE3,14)
REPEAT TO 153 FOR I=1,1+1,...,NSUR
NTAPE2 READ
READ(NTAPE2,1)NSIZE,L,IFORM,IROWS
TRANSFER TO SUBROUTINE MREAD
A,NSIZE,NSIZE,IFORM,IROWS,0,1,P,MAXR,NTAPE2,NTAPE3
NTAPE3 WRITE
WRITE(NTAPE3,111)NSIZE
TRANSFER TO SUBROUTINE MPRINT
A,NSIZE,NSIZE,MAXR,NTAPE3
NTAPE3 WRITE

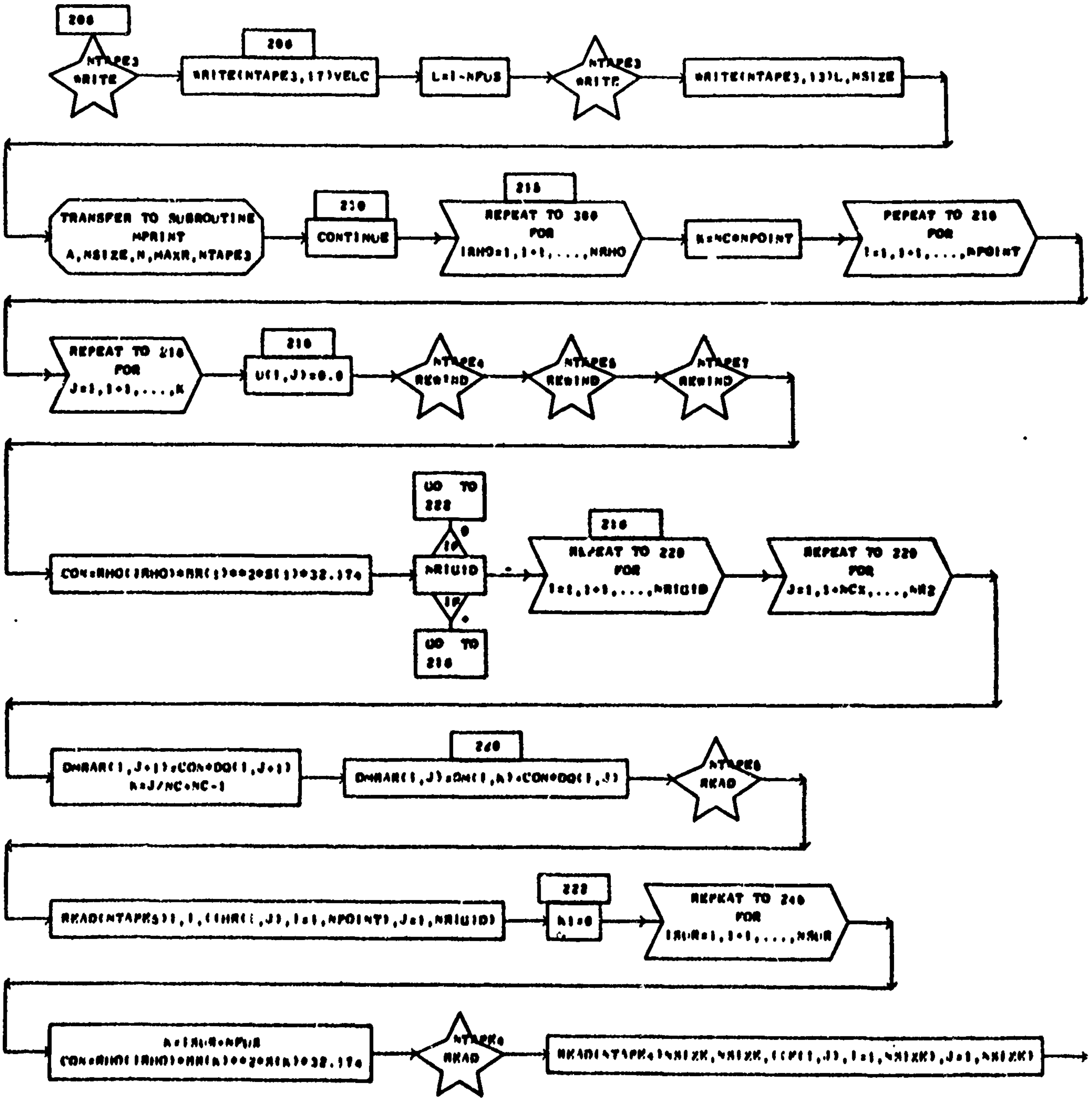

WRITE(NTAPE5)NSIZE,NSIZE,((A(J,K),J=1,NSIZE),K=1,NSIZE)
153
K1=K1+NSIZE
GO TO 164
IF
K1-NPOINT
0
+
-
GO TO 158
158
NTAPE3 WRITE
158
WRITE(NTAPE3,11)K1,NPOINT
164
CONTINUE
GO TO 166
IF
NAERO
0
+
GO TO 166
165
NRHO=1
REPEAT TO 500 FOR I=1,I+1,...,NRIGID
REPEAT TO 500 FOR J=1,J+1,...,NR2
500
DD(I,J)=0.0
NTAPE5 WRITE
WRITE(NTAPE5)((DD(I,J),I=1,NRIGID),J=1,NRIGID)
NCX=NC
GO TO 215
166
NTAPE3 WRITE
166
WRITE(NTAPE3,15)
REPEAT TO 170 FOR I=1,I+1,...,NBAR
GO TO 177
IF
IBN(I)
0
+
-
GO TO 167
167
N1=IBNST(I)
GO TO 172
IF
N1
0
+
-
GO TO 168
168
REPEAT TO 170 FOR J=1,J+1,...,N1
REPEAT TO 169 FOR L=1,L+1,...,MAXR
A(J,L)=0.0
169
A(L,J)=0.0
170
A(J,J)=1.0
NTAPE2 READ
READ(NTAPE2,1)NNST,J,IFORM,IROW

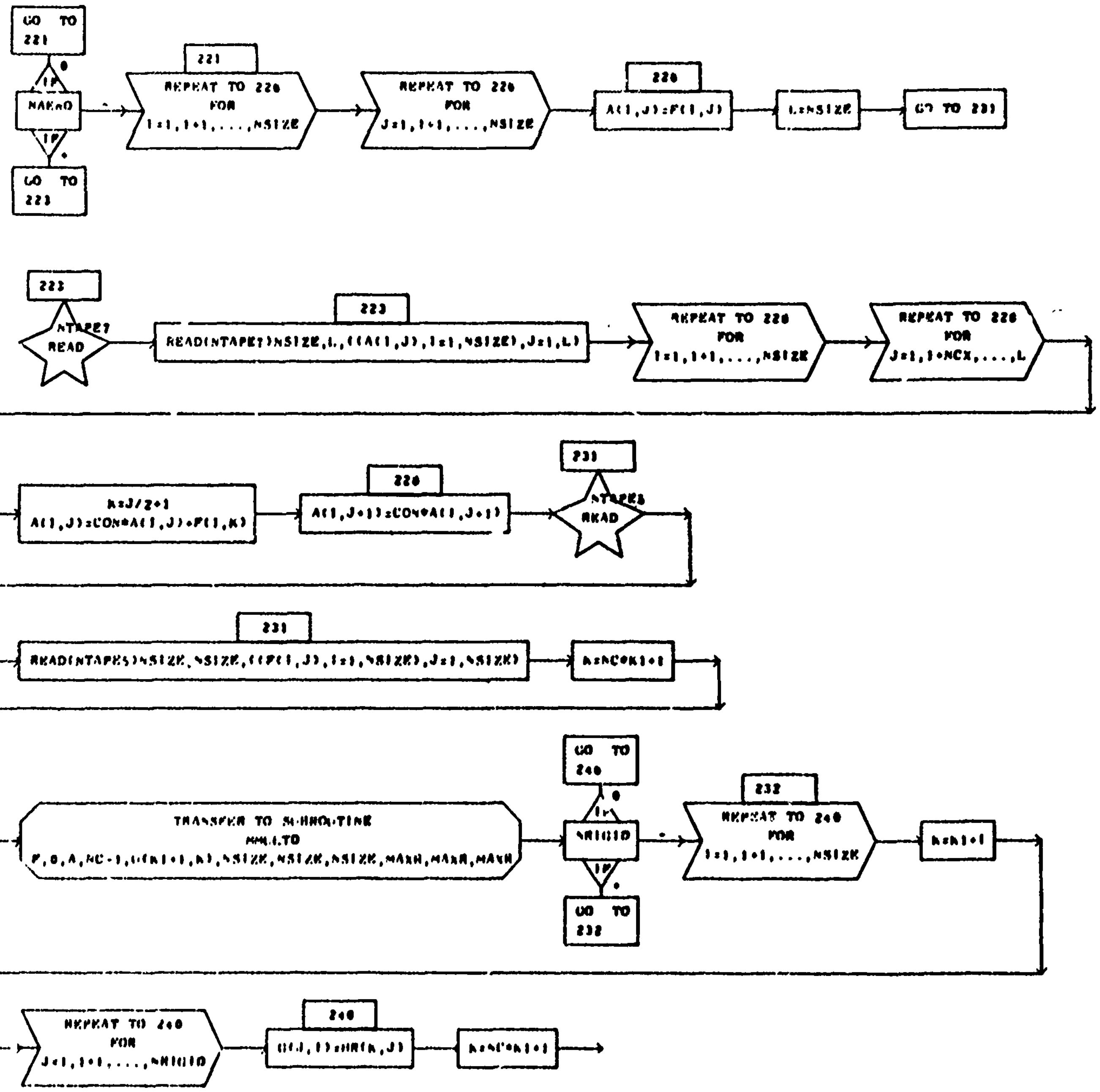

GO TO 172
IF
NXST
IF
GO TO 171
0
-
+
171
TRANSFER TO SUBROUTINE MREAD
A,NXST,NXST,IFORM,IROW,0,1,F,MAXR,NTAPE2,NTAPE3
172
K=N1+1
NTAPE2 READ
READ(NTAPE2,1)NSIZE,NPART,IFORM,IROW
GO TO 174
IF
IFORM
IF
GO TO 174
0
+
173
TRANSFER TO SUBROUTINE MREAD
A(K,K),NSIZE,NSIZE,0,0,0,1,F,MAXR,NTAPE2,NTAPE3
K=K+NSIZE
GO TO 176
174
REPEAT TO 175 FOR J=1,1+1,...,NPART
NTAPE2 READ
READ(NTAPE2,1)NSIZE
N=K+NC
REPEAT TO 1741 FOR L=K,K+1,...,N
REPEAT TO 1741 FOR M=1,1+1,...,K
1741
A(M,L)=0.0
TRANSFER TO SUBROUTINE MREAD
A(K,K),NSIZE,NSIZE,1,IROW,0,0,F,MAXR,NTAPE2,NTAPE3
175
K=K+NSIZE
176
K=K-1
NTAPE3 WRITE
WRITE(NTAPE3,13)I,K
TRANSFER TO SUBROUTINE MPRINT
A,K,K,MAXR,NTAPE3
NTAPE3 WRITE
WRITE(NTAPE3)K,K,((A(J,L),J=1,K),L=1,K)
GO TO 178
177
NTAPE3 WRITE
177
WRITE(NTAPE3,21)
178
CONTINUE

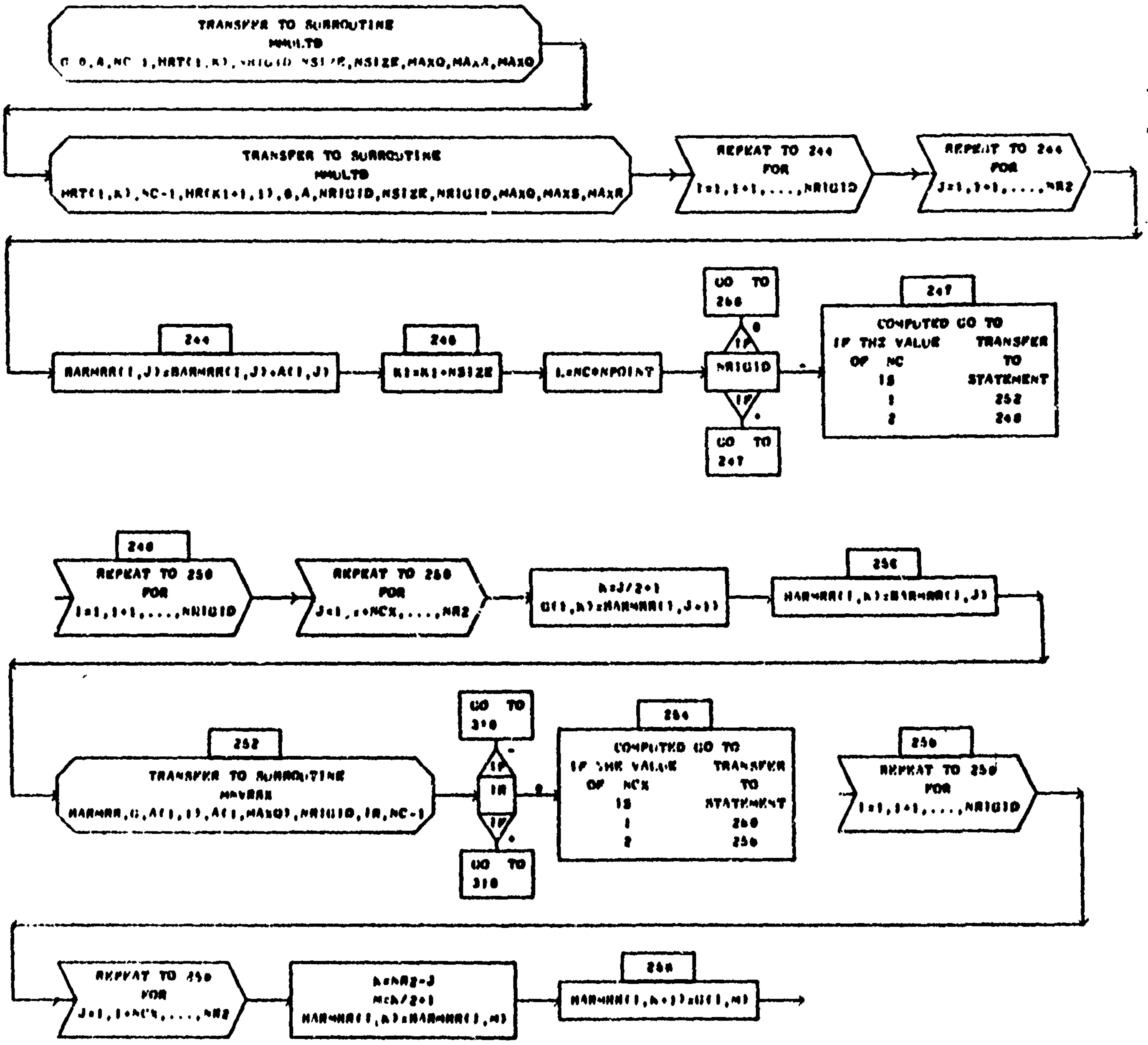

179
NTAPE6
REWIND
NTAPE7
REWIND
NCX=NC
NVEL=NVEL+1
GO TO
181
0
IF
NDENS
IF
+
GO TO
180
-
180
NRHO=NDENS
GO TO 182
181
NTAPE2
READ
181
READ(NTAPE2,1)NRHO
NTAPE2
READ
READ(NTAPE2,2)(RHO(I),I=1,NRHO)
182
REPEAT TO 210
FOR
I=1,1+1,...,NSURFC
K=1
K2=1
GO TO
184
0
IF
NFUS
IF
+
GO TO
183
-
183
CONTINUE
GO TO
188
0
IF
I-1
IF
+
GO TO
184
-
184
L=I-NFUS
GO TO
188
0
IF
IXXST(L)
IF
+
GO TO
185
-
185
K=IXXST(L)+1
K2=K+IXXST(L)
REPEAT TO 186
FOR
J= ,1+1,...,K
REPEAT TO 186
FOR
L=1,1+1,...,K2
186
A(J,L)=0.0
NTAPE2
READ
READ(NTAPE2,1)NXST,J,IFORM,IROW
GO TO
188
0
IF
NXST
IF
+
GO TO
187
-
187
N=NXST+NC
TRANSFER TO SUBROUTINE
MREAD
A,NXST,N,IFORM,IROW,0,1,U,MAXR,NTAPE2,NTAPE3
188
NTAPE2
READ
189
READ(NTAPE2,2)VKL,C

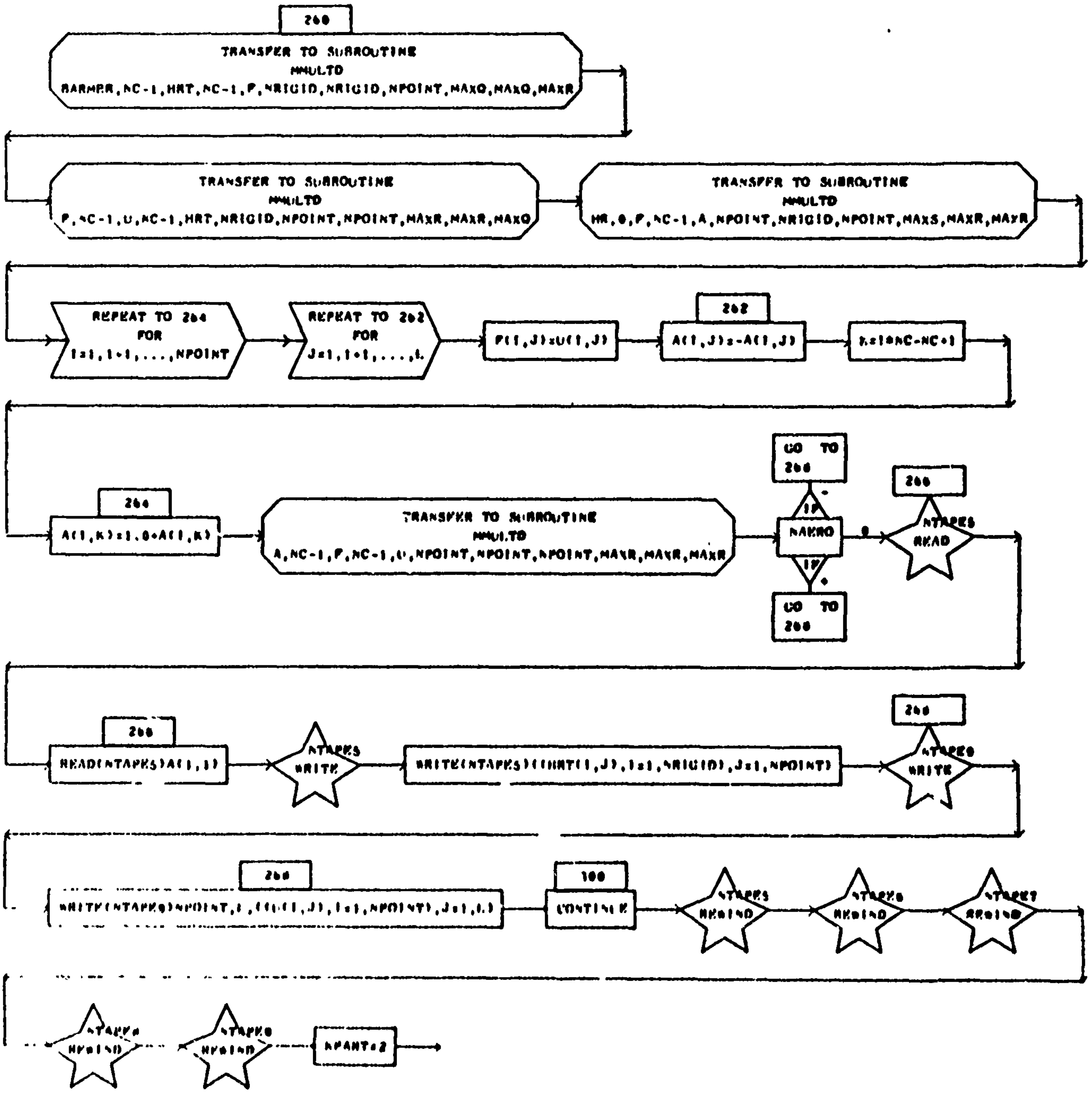

NTAPE2
READ
READ(NTAPE2,1)NSIZE,NPART,IFORM,IROW
GO TO 190
IF
IFORM
0
IF
GO TO 190
189
N=NSIZE*NC
TRANSFER TO SUBROUTINE
MREAD
A(K,K2),NSIZE,N,IFORM,IROW,0,1,U,MAXR,NTAPE2,NTAPE3
NSIZE=NSIZE+K-1
GO TO 193
190
REPEAT TO 192
FOR
J=1,1+1,....,NPART
NTAPE2
READ
READ(NTAPE2,1)NSIZE
N=K2+NC
REPEAT TO 191
FOR
M=K2,K2+1,....,N
REPEAT TO 191
FOR
L=1,1+1,....,K
191
A(L,M)=0.0
N=NSIZE*NC
TRANSFER TO SUBROUTINE
MREAD
A(K,K2),NSIZE,N,1,IROW,0,0,U,MAXR,NTAPE2,NTAPE1
K=K+NSIZE
192
K2=K2+N
NSIZE=K-1
N=K2-1
193
CONTINUE
GO TO 190
IF
I-1
0
IF
GO TO 190
194
CONTINUE
GO TO 197
IF
NPUA
0
IF
GO TO 198
195
NTAPE3
WRITE
196
WRITE(NTAPE3,1)NSIZE
TRANSFER TO SUBROUTINE
MPRINT
A,NSIZE,N,MAXR,NTAPE3
K1=1
K2=1
M=NC-1
NTAPE6
READ
READ(NTAPE6)NSIZE,L,((U(L,J),L=1,NSIZE),J=1,NRHS)

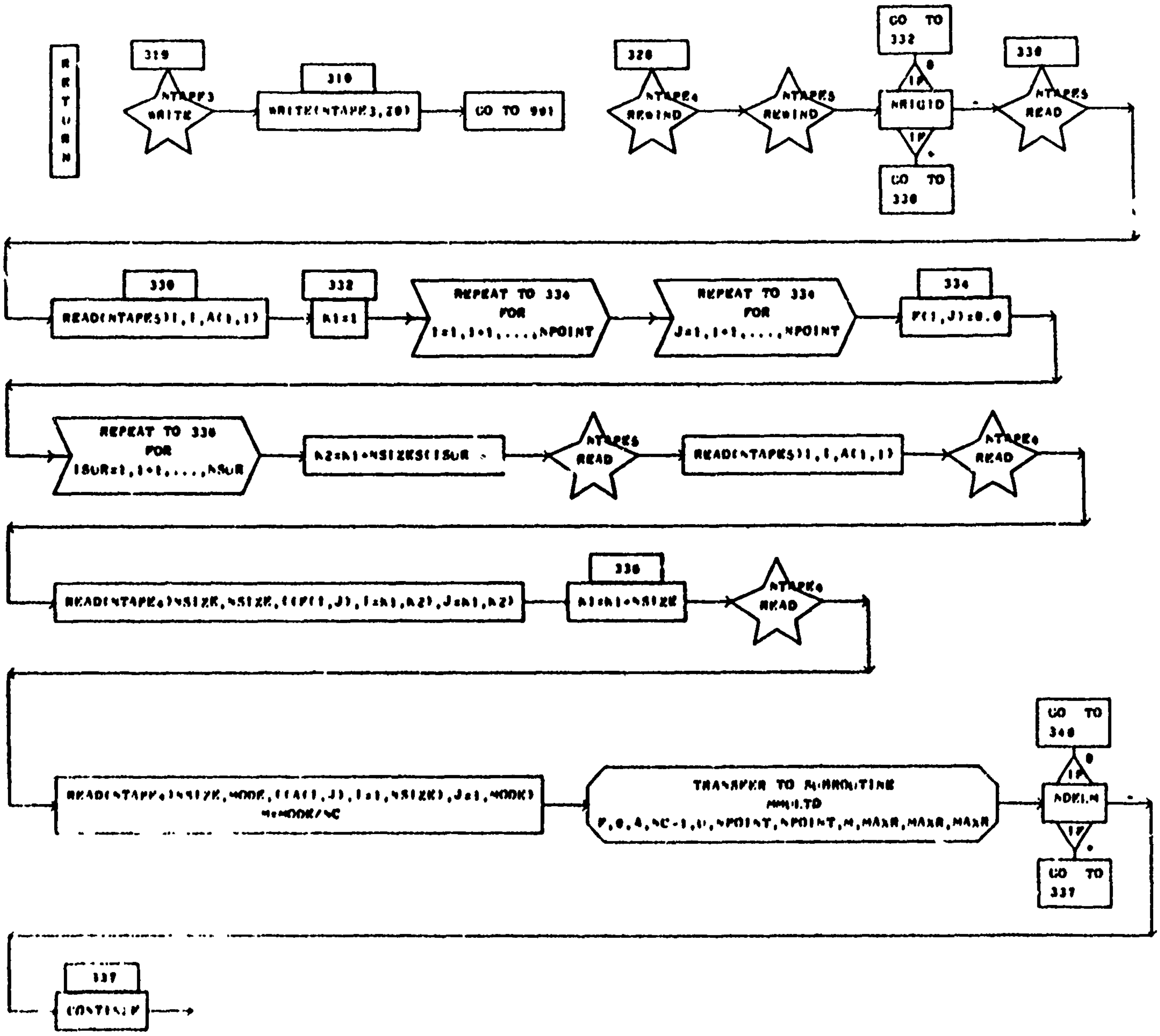

TRANSFER TO SUBROUTINE
MMULTD
A,M,U,G,F,NSIZE,NSIZE,NRIGID,MAXR,MAXR,MAXR
REPEAT TO 196
FOR
L=1,1+1,...,NSIZE
REPEAT TO 196
FOR
J=1,1+1,...,NRIGID
196
A(J,L)=U(L,J)
TRANSFER TO SUBROUTINE
MMULTD
A,G,F,M,DO,NRIGID,NSIZE,NRIGID,MAXR,MAXR,MAXO
GO TO 210
197
REPEAT TO 198
FOR
L=1,1+1,...,NRIGID
REPEAT TO 198
FOR
J=1,1+1,...,NR2
198
DO(L,J)=0.0
199
L=I-NFUR
GO TO
202
IF
ISW(L)
IF
0
GO TO
202
200
NTAPE7
WRITE
200
WRITE(NTAPE7)NSIZE,N,((A(J,M),J=1,NSIZE),M=1,N)
GO TO 206
202
NTAPE6
READ
202
READ(NTAPE6)L,L,((F(J,M),J=1,L),M=1,L)
GO TO
206
0
IF
NSIZE-L
IF
GO TO
204
-
204
NTAPE3
WRITE
204
WRITE(NTAPE3,11)NSIZE,L
206
TRANSFER TO SUBROUTINE
MMULTD
F,G,A,NC-1,U,I,L,L,MAXR,MAXR,MAXR
NTAPE7
WRITE
WRITE(NTAPE7)NSIZE,N,((U(J,M),J=1,NSIZE),M=1,N)

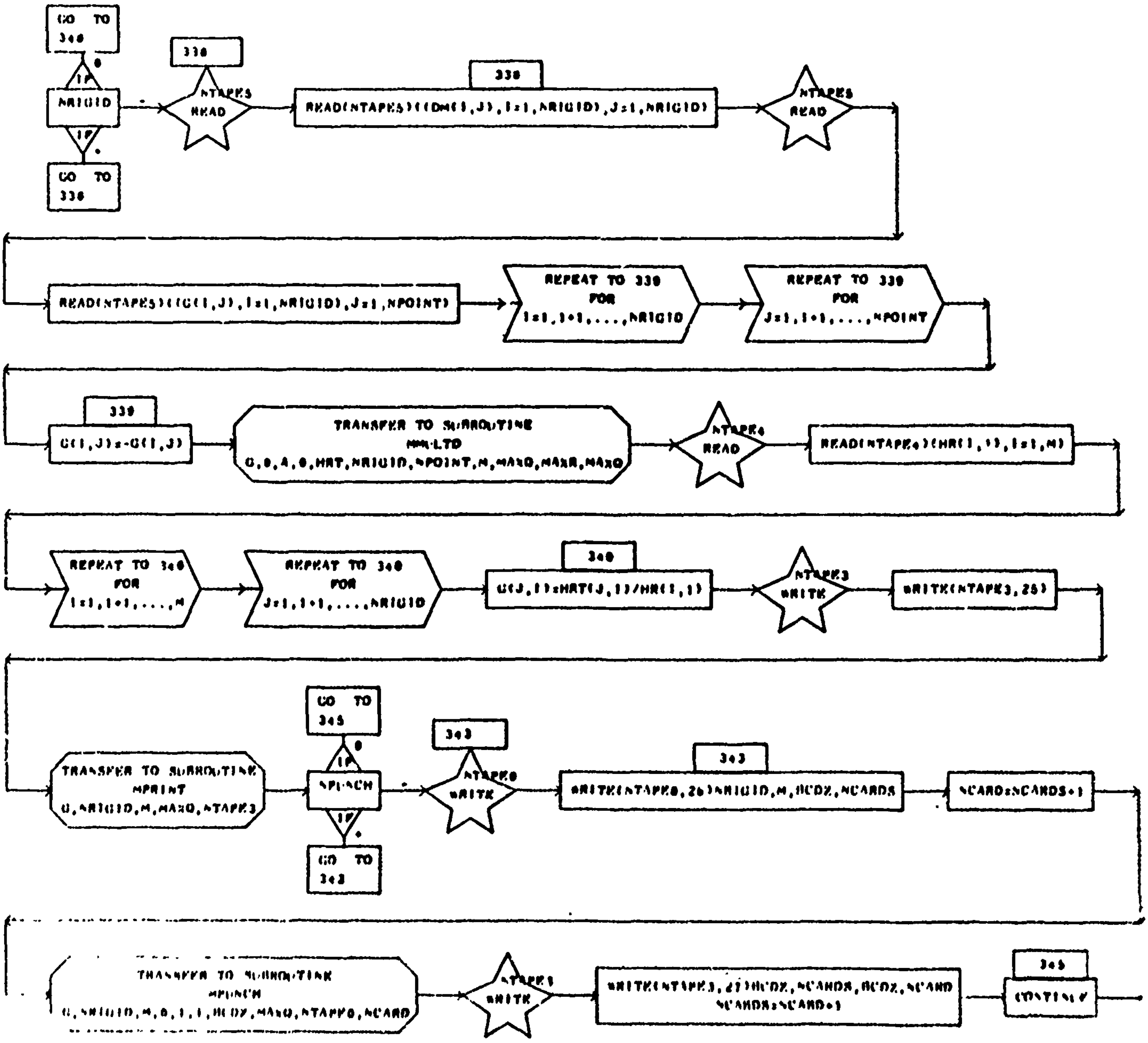

206
NTAPE3
WRITE
206
WRITE(NTAPE3,17)VELC
L=1-NPUS
NTAPE3
WRITE
WRITE(NTAPE3,13)L,NSIZE
TRANSFER TO SUBROUTINE
MPRINT
A,NSIZE,N,MAXR,NTAPE3
210
CONTINUE
215
REPEAT TO 300
FOR
IRHO=1,1+1,...,NRHO
K=NC*NPOINT
REPEAT TO 210
FOR
I=1,1+1,...,NPOINT
REPEAT TO 210
FOR
J=1,1+1,...,K
210
U(I,J)=0.0
NTAPE4
REWIND
NTAPE6
REWIND
NTAPE7
REWIND
CON=RHO(IRHO)*RR(I)**2*S(I)*32.174
GO TO
222
0
IF
NRIGID
-
IF
+
GO TO
216
216
REPEAT TO 220
FOR
I=1,1+1,...,NRIGID
REPEAT TO 220
FOR
J=1,1+NC,...,NN2
DMRAR(I,J+1)=CON*DO(I,J+1)
K=J/NC+NC-1
240
DMRAR(I,J)=DM(I,K)+CON*DO(I,J)
NTAPE5
READ
READ(NTAPE5)I,I,((HR(I,J),I=1,NPOINT),J=1,NRIGID)
222
K1=0
REPEAT TO 240
FOR
IRUR=1,1+1,...,NRUR
K=IRUR+NPUR
CON=RHO(IRHO)*RR(K)**2*R(K)*32.174
NTAPE4
READ
READ(NTAPE4)NSIZK,NSIZK,((P(I,J),I=1,NSIZK),J=1,NSIZK)

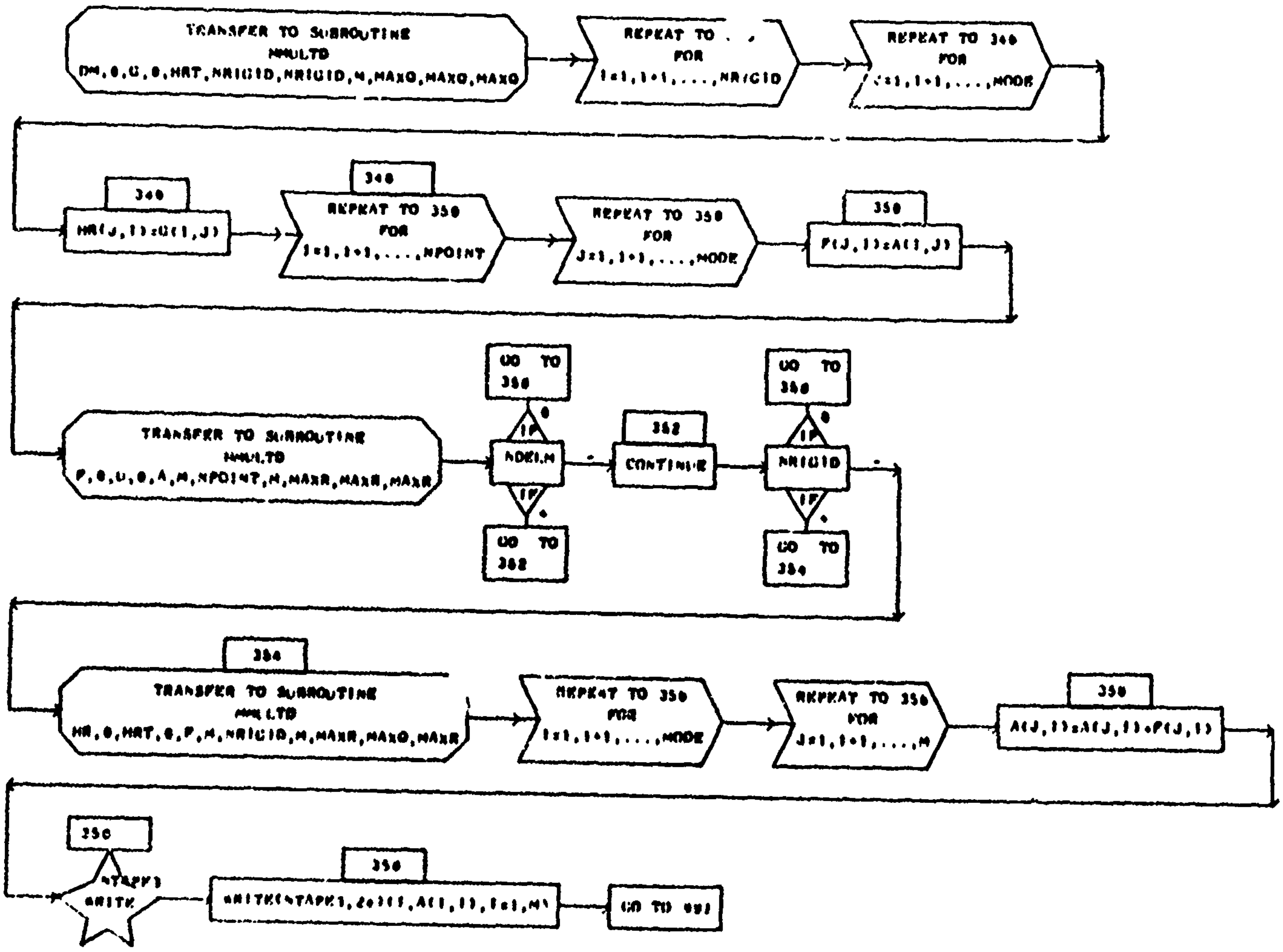

GO TO 221
0
IF
NAK=0
IF
+
GO TO 223
221
REPEAT TO 226 FOR I=1,I+1,...,NSIZE
REPEAT TO 226 FOR J=1,I+1,...,NSIZE
226
A(I,J)=F(I,J)
L=NSIZE
GO TO 231
223
NTAPE7 READ
223
READ(NTAPE7)NSIZE,L,((A(I,J),I=1,NSIZE),J=1,L)
REPEAT TO 226 FOR I=1,I+1,...,NSIZE
REPEAT TO 226 FOR J=1,1+NCX,...,L
K=J/2+1
A(I,J)=CON*A(I,J)+F(I,K)
226
A(I,J+1)=CON*A(I,J+1)
231
NTAPE5 READ
231
READ(NTAPE5)NSIZE,NSIZE,((F(I,J),I=1,NSIZE),J=1,NSIZE)
K=NC*K1+1
GO TO 240
0
IF
NRIGID
IF
+
GO TO 232
TRANSFER TO SUBROUTINE MMULTD
F,0,A,NC-1,G(K1+1,K),NSIZE,NSIZE,NSIZE,MAXN,MAXN,MAXN
232
REPEAT TO 240 FOR I=1,I+1,...,NSIZE
K=K1+1
REPEAT TO 240 FOR J=1,I+1,...,NRIGID
240
G(J,I)=HR(K,J)
K=NC*K1+1


TRANSFER TO SUBROUTINE
MMULTB
G,0,A,NC-1,HRT(1,K),NRIGID,NSIZE,NSIZE,MAXQ,MAXA,MAXQ
TRANSFER TO SUBROUTINE
MMULTB
HRT(1,K),NC-1,HR(K1+1,1),0,A,NRIGID,NSIZE,NRIGID,MAXQ,MAXS,MAXR
REPEAT TO 244
FOR
I=1,1+1,...,NRIGID
REPEAT TO 244
FOR
J=1,1+1,...,NR2
244
BARMNR(I,J)=BARMNR(I,J)+A(I,J)
246
K1=K1+NSIZE
L=NC+NPOINT
GO TO
266
0
IF
NRIGID
IF
+
GO TO
247
-
247
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1
252
2
248
248
REPEAT TO 250
FOR
I=1,1+1,...,NRIGID
REPEAT TO 250
FOR
J=1,1+NCX,...,NR2
K=J/2+1
U(I,K)=HARMNR(I,J+1)
250
HARMNR(I,K)=BARMNR(I,J)
252
TRANSFER TO SUBROUTINE
MAVERX
HARMNR,U,A(1,1),A(1,MAXQ),NRIGID,IR,NC-1
GO TO
310
-
IF
IR
IF
+
GO TO
310
0
254
COMPUTED GO TO
IF THE VALUE OF NCX IS
TRANSFER TO STATEMENT
1
260
2
256
256
REPEAT TO 258
FOR
I=1,1+1,...,NRIGID
REPEAT TO 258
FOR
J=1,1+NCX,...,NR2
K=NR2-J
M=K/2+1
HARMNR(I,K)=HARMNR(I,M)
258
HARMNR(I,K+1)=U(I,M)


260
TRANSFER TO SUBROUTINE
MMULTD
BARMPR,NC-1,HRT,NC-1,P,NRIGID,NRIGID,NPOINT,MAXQ,MAXQ,MAXR
TRANSFER TO SUBROUTINE
MMULTD
P,NC-1,U,NC-1,HRT,NRIGID,NPOINT,NPOINT,MAXR,MAXR,MAXQ
TRANSFER TO SUBROUTINE
MMULTD
HR,0,P,NC-1,A,NPOINT,NRIGID,NPOINT,MAXS,MAXR,MAXR
REPEAT TO 264
FOR
I=1,1+1,...,NPOINT
REPEAT TO 262
FOR
J=1,1+1,...,L
P(I,J)=U(I,J)
262
A(I,J)=-A(I,J)
K=I+NC-NC+1
264
A(I,K)=1.0+A(I,K)
TRANSFER TO SUBROUTINE
MMULTD
A,NC-1,P,NC-1,U,NPOINT,NPOINT,NPOINT,MAXR,MAXR,MAXR
GO TO
266
IF
-
NAERO
0
IF
+
GO TO
268
266
NTAPE5
READ
266
READ(NTAPE5)A(I,1)
NTAPE5
WRITE
WRITE(NTAPE5)((HRT(I,J),I=1,NRIGID),J=1,NPOINT)
268
NTAPE6
WRITE
268
WRITE(NTAPE6)NPOINT,L,((U(I,J),I=1,NPOINT),J=1,L)
100
CONTINUE
NTAPE5
REWIND
NTAPE6
REWIND
NTAPE7
REWIND
NTAPE8
REWIND
NTAPE9
REWIND
NPART=2


RETURN
319
NTAPE3 WRITE
310
WRITE(NTAPE3,20)
GO TO 901
328
NTAPE4 REWIND
NTAPE5 REWIND
GO TO 332
0
IF
NRIGID
-
IF
+
GO TO 330
330
NTAPE5 READ
330
READ(NTAPE5)I,J,A(I,J)
332
K1=1
REPEAT TO 334 FOR I=1,1+1,...,NPOINT
REPEAT TO 334 FOR J=1,1+1,...,NPOINT
334
F(I,J)=0.0
REPEAT TO 336 FOR ISUR=1,1+1,...,NSUR
K2=K1+NSIZES(ISUR -
NTAPE5 READ
READ(NTAPE5)I,J,A(I,J)
NTAPE4 READ
READ(NTAPE4)NSIZE,NSIZE,((F(I,J),I=K1,K2),J=K1,K2)
336
K1=K1+NSIZE
NTAPE4 READ
READ(NTAPE4)NSIZE,MODE,((A(I,J),I=1,NSIZE),J=1,MODE)
M=MODE/NC
TRANSFER TO SUBROUTINE MMULTD
F,B,A,NC-1,U,NPOINT,NPOINT,M,MAXR,MAXR,MAXR
GO TO 340
0
IF
NDKLM
-
IF
+
GO TO 337
337
CONTINUE


GO TO 340
0
IF
NRIGID
IF
+
GO TO 338
-
338
NTAPE5
READ
338
READ(NTAPE5)((DM(I,J),I=1,NRIGID),J=1,NRIGID)
NTAPE5
READ
READ(NTAPE5)((G(I,J),I=1,NRIGID),J=1,NPOINT)
REPEAT TO 339
FOR
I=1,1+1,...,NRIGID
REPEAT TO 339
FOR
J=1,1+1,...,NPOINT
339
G(I,J)=-G(I,J)
TRANSFER TO SUBROUTINE
MMLTD
G,0,A,0,HRT,NRIGID,NPOINT,M,MAXD,MAXR,MAXQ
NTAPE4
READ
READ(NTAPE4)(HR(I,1),I=1,M)
REPEAT TO 340
FOR
I=1,1+1,...,M
REPEAT TO 340
FOR
J=1,1+1,...,NRIGID
340
G(J,I)=HRT(J,I)/HR(I,1)
NTAPE3
WRITE
WRITE(NTAPE3,25)
TRANSFER TO SUBROUTINE
MPRINT
G,NRIGID,M,MAXQ,NTAPE3
GO TO 345
0
IF
NPUNCH
IF
+
GO TO 343
-
343
NTAPE8
WRITE
343
WRITE(NTAPE8,26)NRIGID,M,BCDZ,NCARDS
NCARD=NCARDS+1
TRANSFER TO SUBROUTINE
MPUNCH
G,NRIGID,M,0,1,1,BCDZ,MAXQ,NTAPE8,NCARD
NTAPE3
WRITE
WRITE(NTAPE3,27)BCDZ,NCARDS,BCDZ,NCARD
NCARDS=NCARD+1
345
CONTINUE


TRANSFER TO SUBROUTINE
MMULTD
DM,0,G,0,HRT,NRIGID,NRIGID,M,MAXQ,MAXQ,MAXQ
REPEAT TO . .
FOR
I=1,I+1,...,NRIGID
REPEAT TO 340
FOR
J=1,I+1,...,MODE
340
HR(J,I)=G(I,J)
340
REPEAT TO 350
FOR
I=1,I+1,...,NPOINT
REPEAT TO 350
FOR
J=1,I+1,...,MODE
350
F(J,I)=A(I,J)
TRANSFER TO SUBROUTINE
MMULTD
F,0,U,0,A,M,NPOINT,M,MAXR,MAXR,MAXR
GO TO
356
IF
0
NDELM
-
IF
+
GO TO
352
352
CONTINUE
GO TO
356
IF
0
NRIGID
-
IF
+
GO TO
354
354
TRANSFER TO SUBROUTINE
MMULTD
HR,0,HRT,0,F,M,NRIGID,M,MAXR,MAXQ,MAXR
REPEAT TO 356
FOR
I=1,I+1,...,MODE
REPEAT TO 356
FOR
J=1,I+1,...,M
356
A(J,I)=A(J,I)+F(J,I)
356
NTAPE3
WRITE
356
WRITE(NTAPE3,20)(I,A(I,I),I=1,M)
GO TO 991

```
                              MREAD

                               MREAD

                       MATRIX READ SUBROUTINE

      CALL MREAD   (A,M,N,IFORM,IROW,ITRA,IORG,T,MD,NTAPE2,NTAPE3      )


         A = MATRIX TO READ IN        ITRA = 0, TRA CARD AFTER MATRIX

        M = NUMBER OF ROWS                  =+1, TRA CARD AFTER EACH ROW

         N = NUMBER OF COLUMNS                            (OR COLUMN )

         IFORM = -1, FORMAT(12A6)    IORG = ORIGIN OF FIRST C.B. CARD

                 = 0, COLUMN BINARY   T =MDXN TEMPORARY CELLS

               = +1, FORMAT(5E12.8)  MD= DIMENSIONED NUMBER OF ROWS

         IROW = .0, MATRIX BY COLUMNS                            IN A

                 = +1, MATRIX BY ROWS   NTAPE2 = INPUT TAPE

                                         NTAPE3 = OUTPUT TAPE

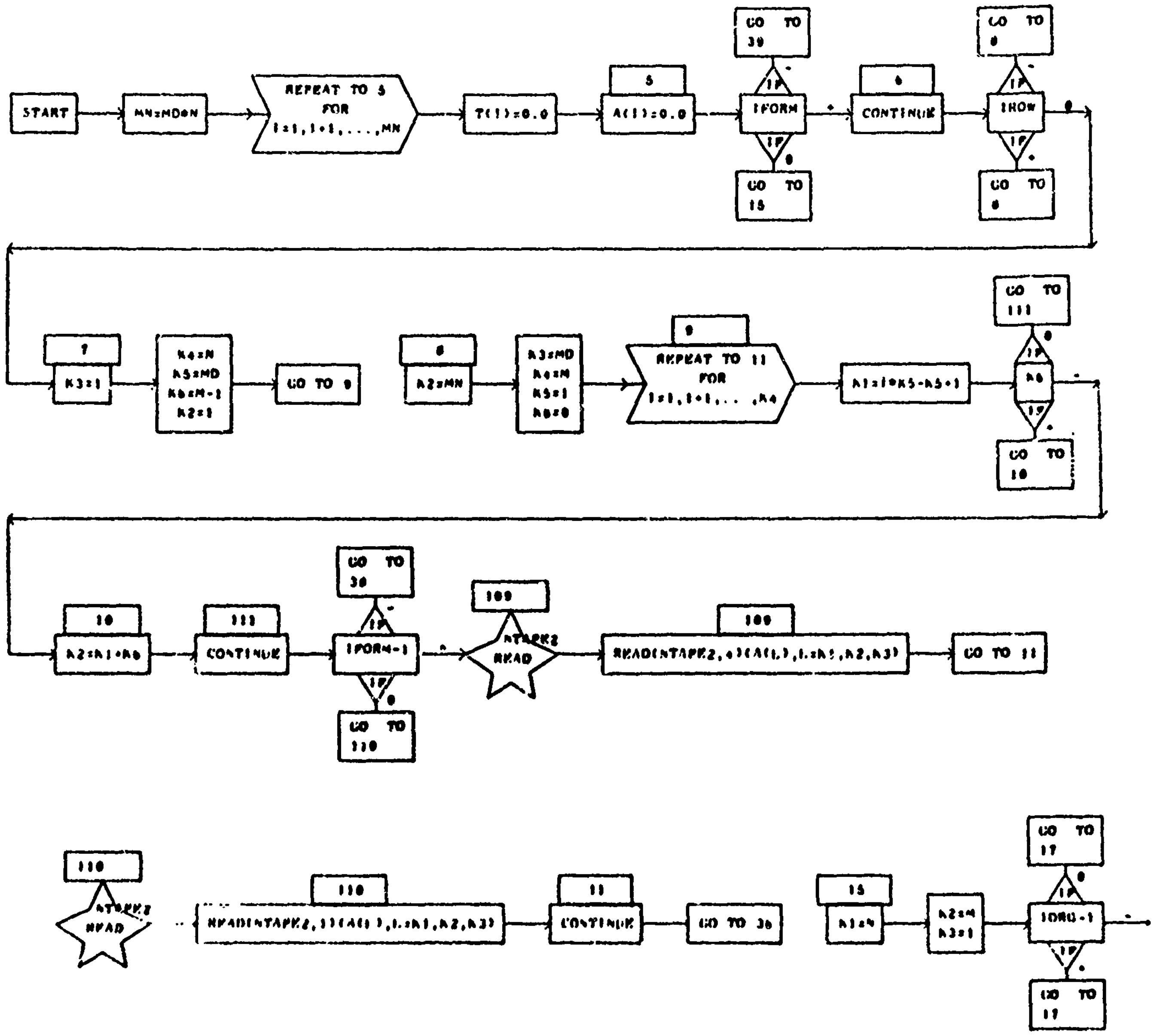



                  D I M E N S I O N E D   V A R I A B L E S

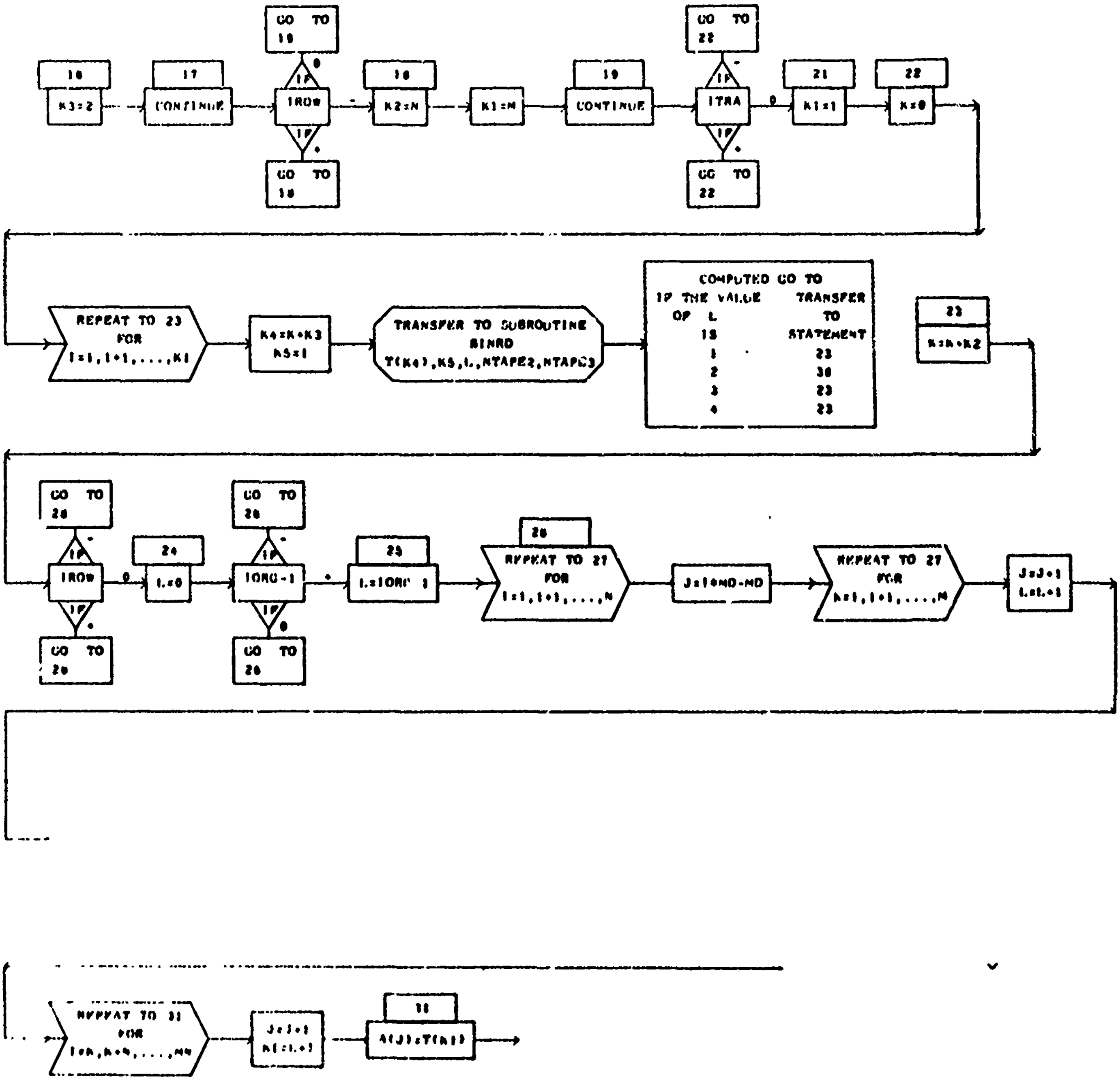
SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES

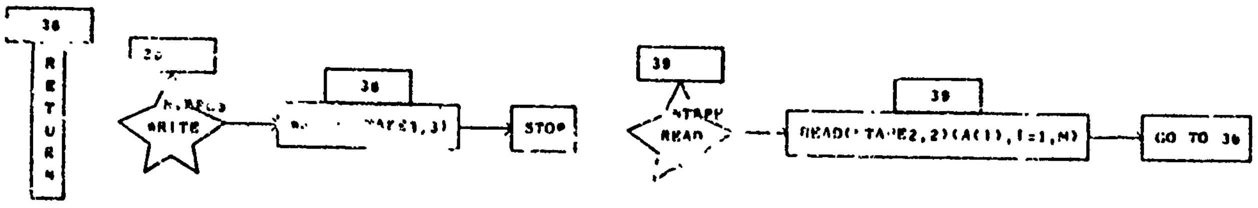
 A             1         T             1
```

SUBROUTINE MREAD (A,M,N,IFORM,IROW,ITRA,IORU,T,MD,NTAPE2,NTAPE3)



SUBROUTINE MREAD (A,M,N,IFORM,IROW,ITRA,IORG,T,MD,NTAPE2,NTAPE3)




36
RETURN
26
N,REC3
WRITE
36
YAPE1,3)
STOP
39
NTAPE
READ
39
READ(NTAPE2,2)(A(I),I=1,M)
GO TO 36

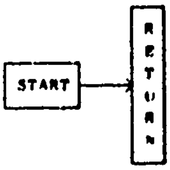
```
                                   BINRD

                         D I M E N S I O N E D   V A R I A B L E S

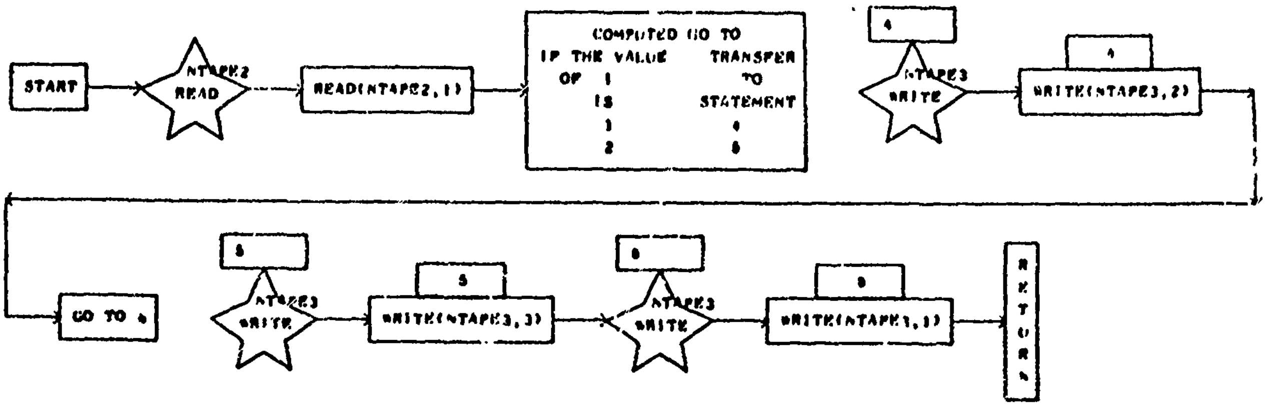
SYMBOL   STORAGES  SYMBOL   STORAGES  SYMBOL   STORAGES  SYMBOL   STORAGES  SYMBOL   STORAGES

  T         1
```

```
                         SUBROUTINE BINRD (T,K,L,NTAPE1,NTAPE2)                     PAGE  1
```



SUBROUTINE RDLN (NTAPE2, NTAPE3, I) PAGE 1



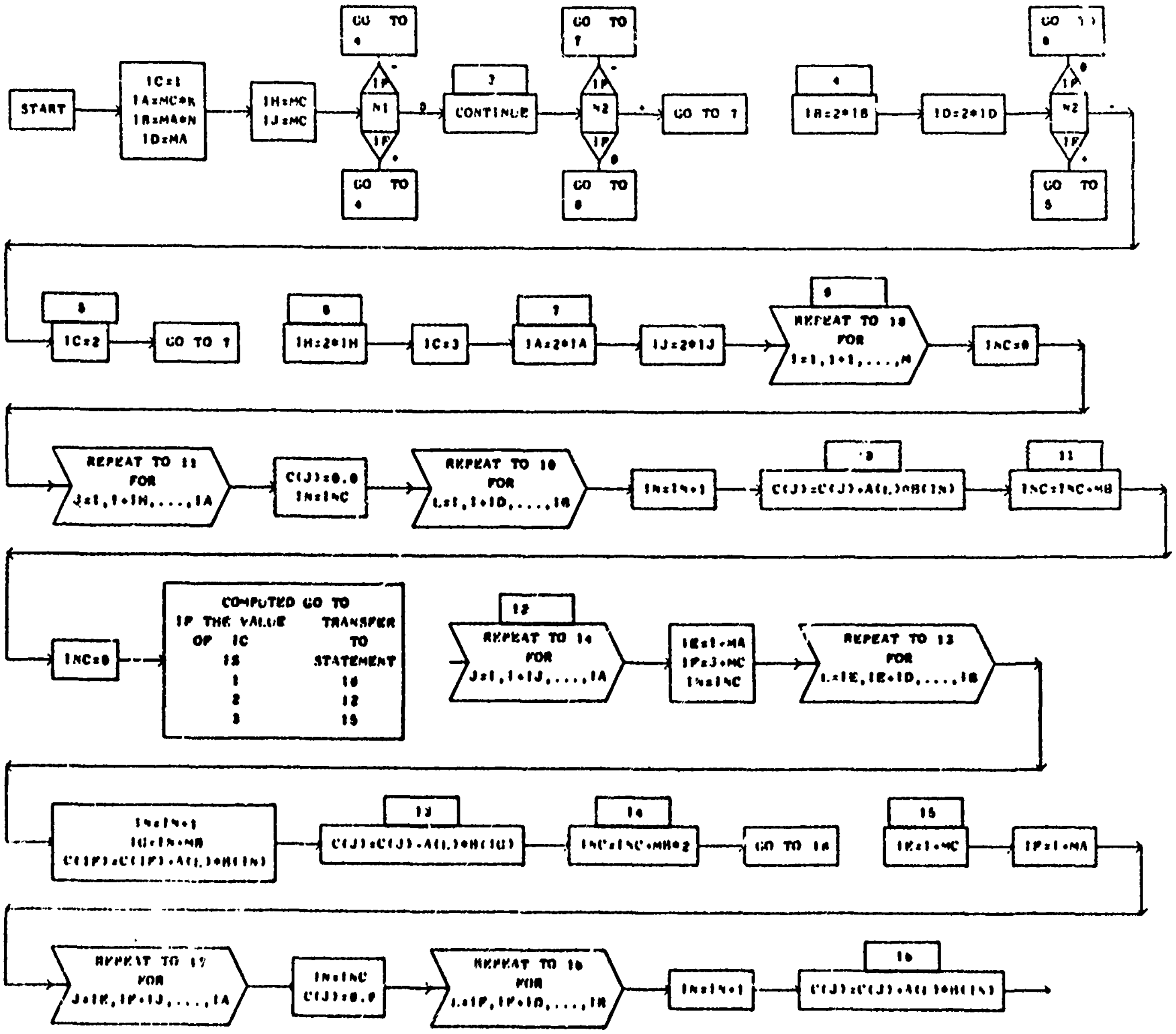
```
                                   MMULTD

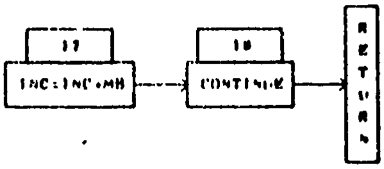
                        D I M E N S I O N E D   V A R I A B L E S

SYMBOL    STORAGES  SYMBOL    STORAGES  SYMBOL    STORAGES  SYMBOL    STORAGES  SYMBOL    STORAGES

  A          1        B          1        C          1
```

SUBROUTINE MMULTD (A,N1,B,N2,C,M,N,K,MA,MB,MC) PAGE 1




17
INC=INC+MB
18
CONTINUE
RETURN

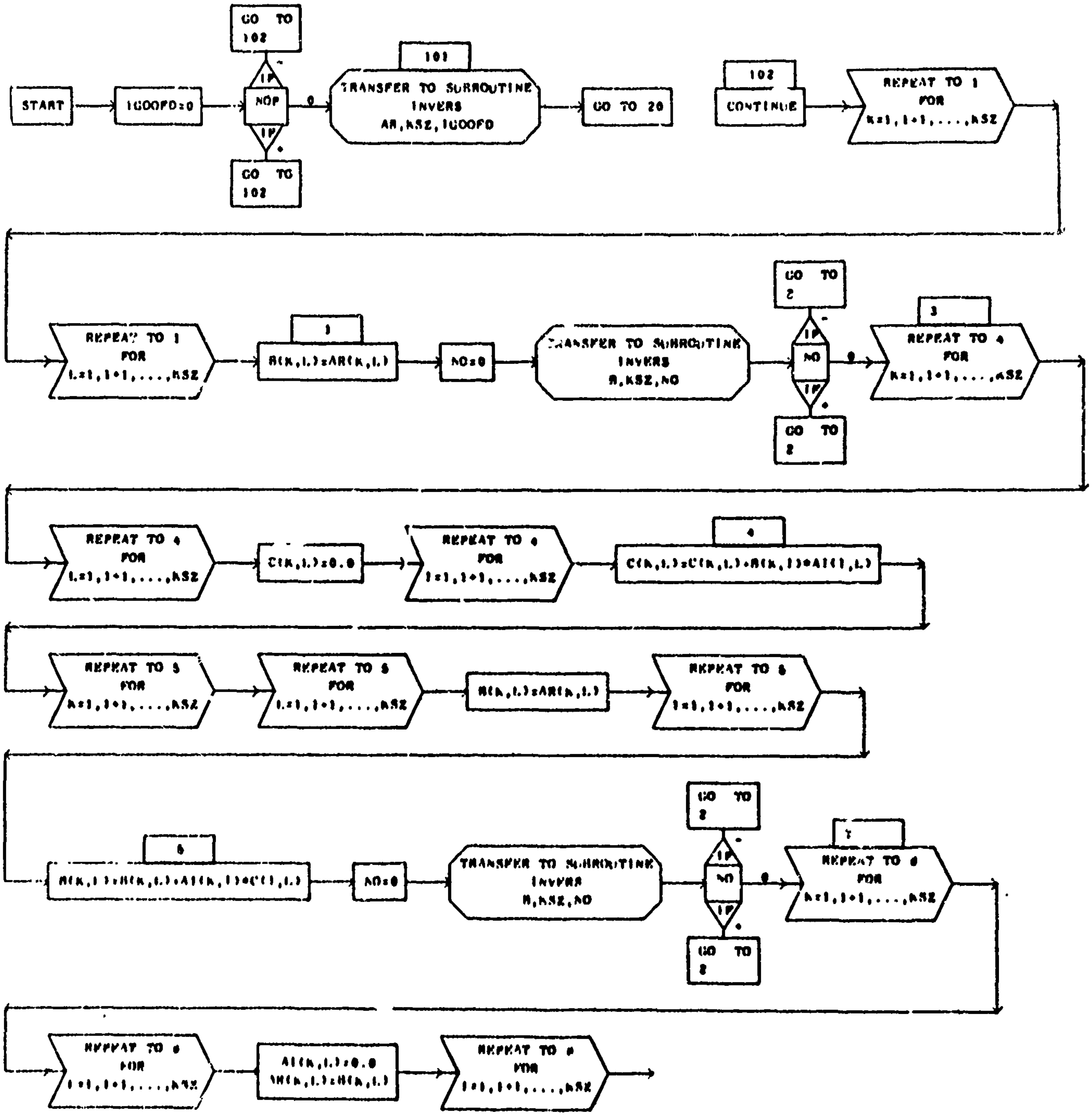
```
                                   MNVRSR
```

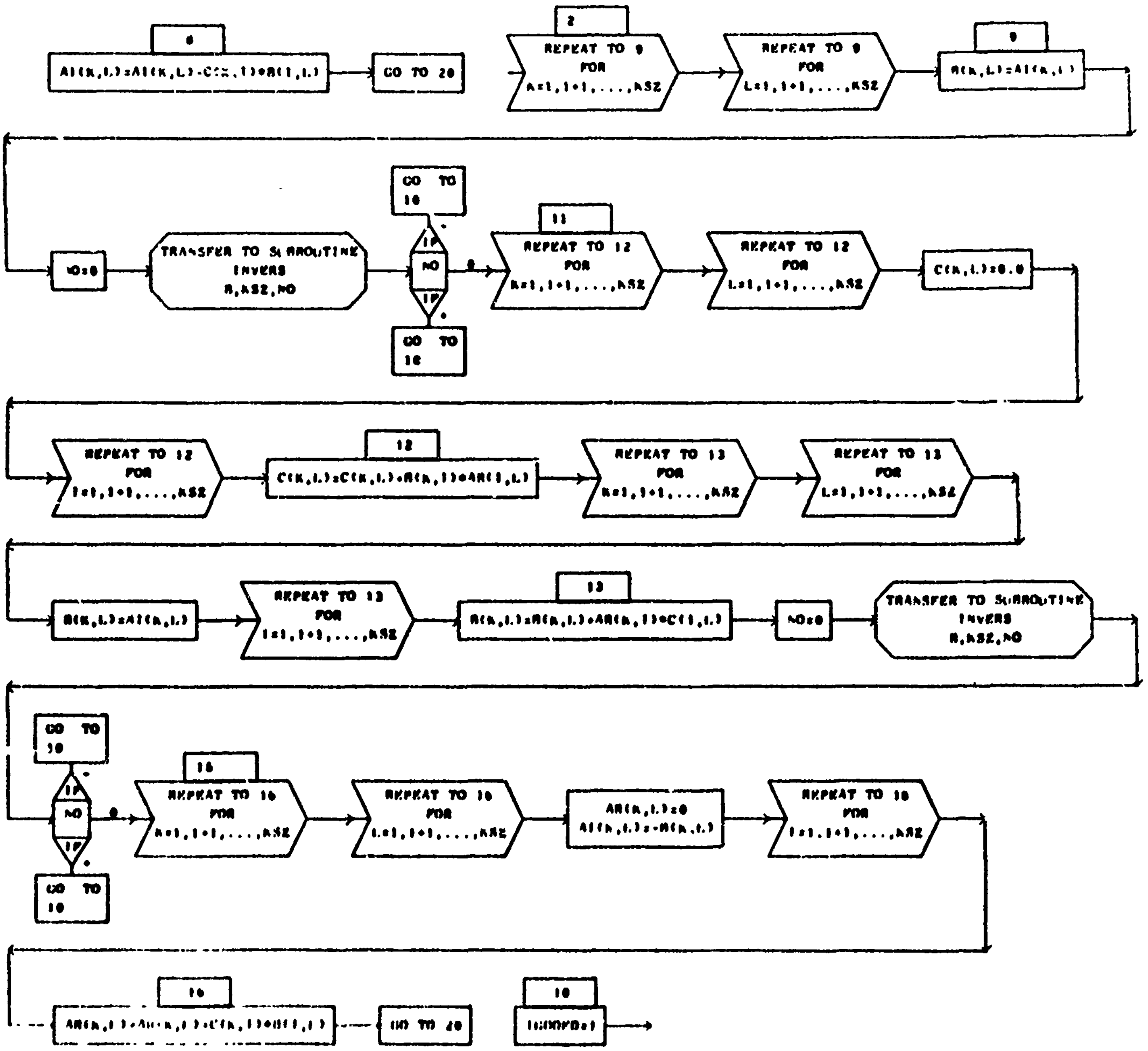
```
                         D I M E N S I O N E D   V A R I A B L E S

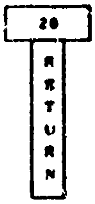
SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES

 AR          6,6        AI         6,6        B          6,6        C          6,6
```

SUBROUTINE MNVRSX (AR,AI,B,C,KSZ,IGOOFD,NO) PAGE 1




8
AI(K,L)=AI(K,L)-C(K,I)*B(I,L)
GO TO 20
2
REPEAT TO 9 FOR K=1,1+1,...,KSZ
REPEAT TO 9 FOR L=1,1+1,...,KSZ
9
B(K,L)=AI(K,L)
NO=0
TRANSFER TO SUBROUTINE INVERS B,KSZ,NO
GO TO 10
IF NO
IF
0
GO TO 10
11
REPEAT TO 12 FOR K=1,1+1,...,KSZ
REPEAT TO 12 FOR L=1,1+1,...,KSZ
C(K,L)=0.0
REPEAT TO 12 FOR I=1,1+1,...,KSZ
12
C(K,L)=C(K,L)+B(K,I)*AR(I,L)
REPEAT TO 13 FOR K=1,1+1,...,KSZ
REPEAT TO 13 FOR L=1,1+1,...,KSZ
B(K,L)=AI(K,L)
REPEAT TO 13 FOR I=1,1+1,...,KSZ
13
B(K,L)=B(K,L)+AR(K,I)*C(I,L)
NO=0
TRANSFER TO SUBROUTINE INVERS B,KSZ,NO
GO TO 10
IF NO
IF
0
GO TO 10
15
REPEAT TO 16 FOR K=1,1+1,...,KSZ
REPEAT TO 16 FOR L=1,1+1,...,KSZ
AR(K,L)=0
AI(K,L)=-B(K,L)
REPEAT TO 16 FOR I=1,1+1,...,KSZ
16
AR(K,L)=AR(K,L)+C(K,I)*B(I,L)
GO TO 20
10
IGOOFD=1


20
RETURN

```
                                        INVERS

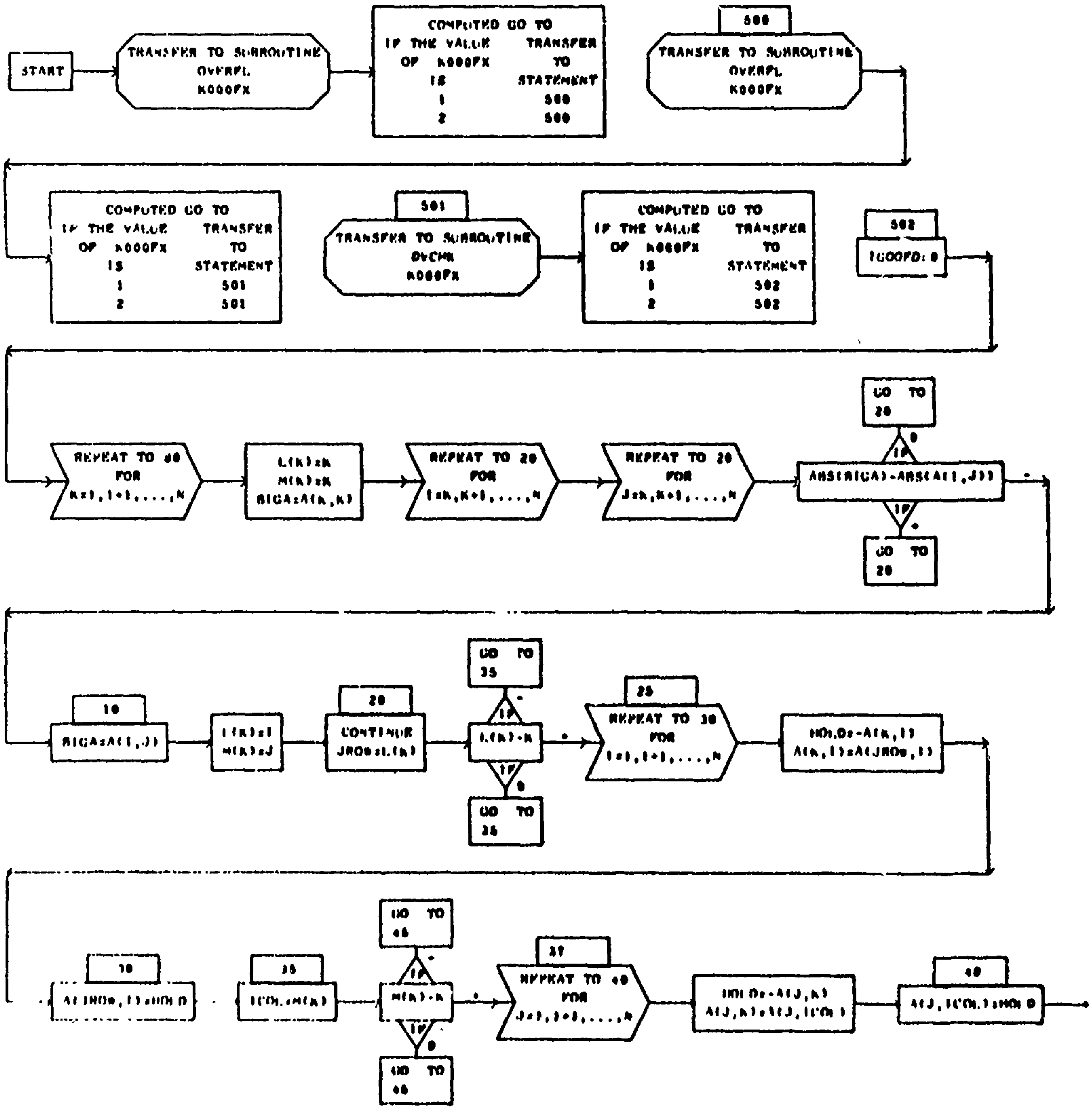


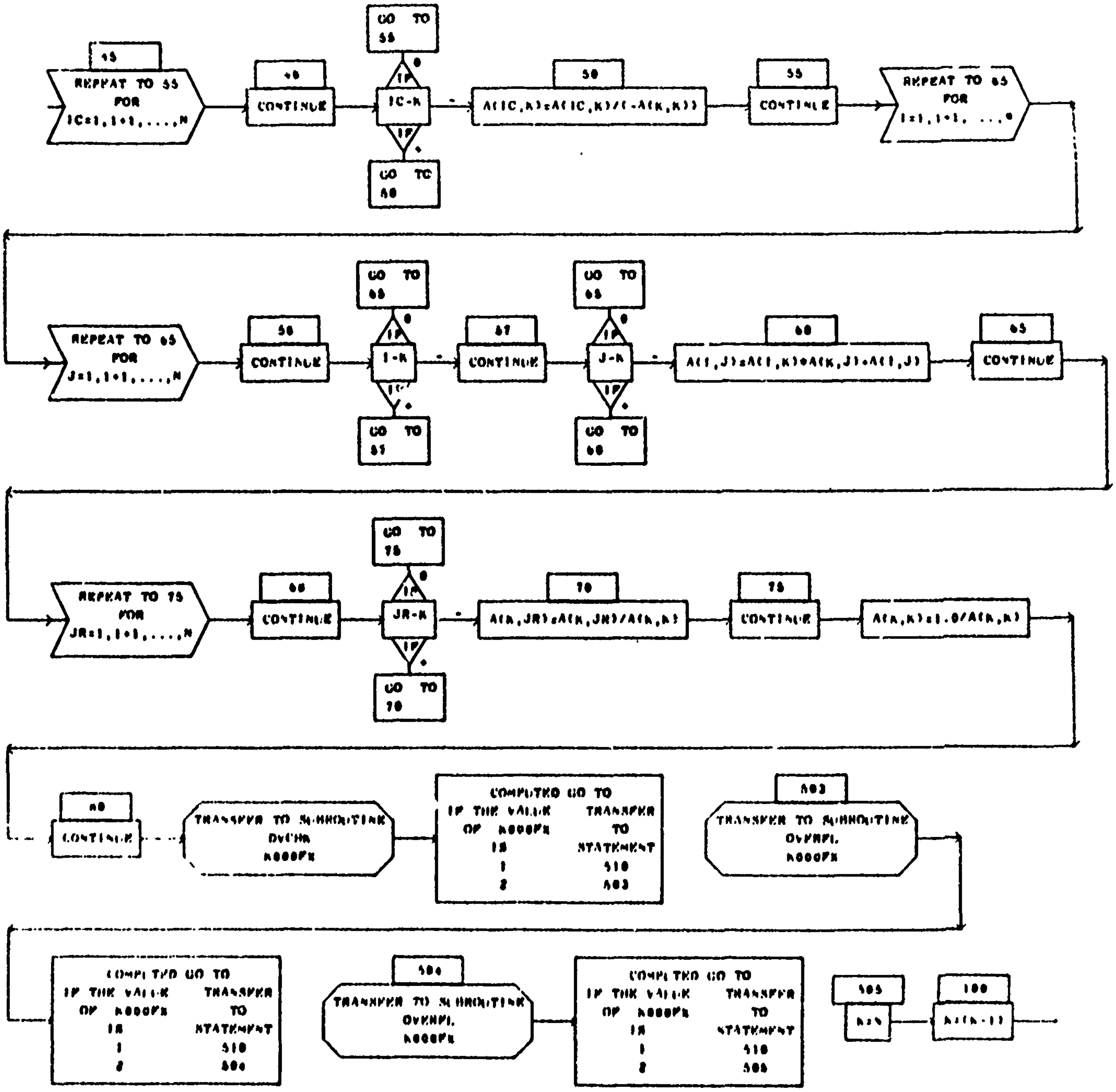

                                   D I M E N S I O N E D   V A R I A B L E S

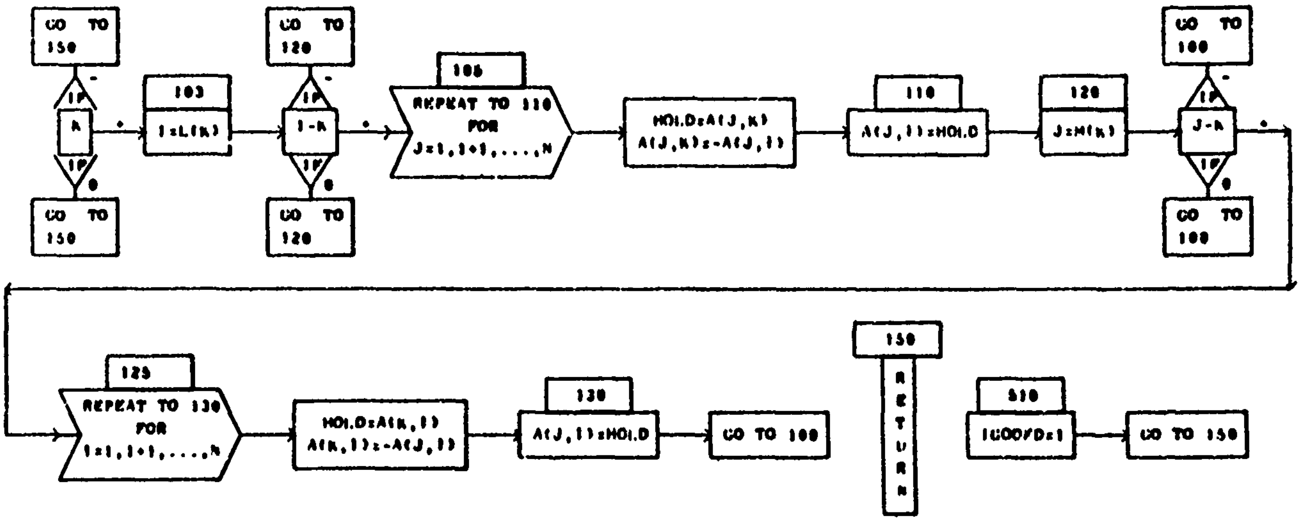
SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES

  A          6,6        L          6          M          6
```

SUBROUTINE INVERS (A,N,IGOOFD)




45
REPEAT TO 55
FOR
IC=1,I+1,....,N
48
CONTINUE
GO TO
55
IF
IC-K
IF
GO TO
50
50
A(IC,K)=A(IC,K)/(-A(K,K))
55
CONTINUE
REPEAT TO 65
FOR
I=1,I+1, ...,N
REPEAT TO 65
FOR
J=1,I+1,....,N
56
CONTINUE
GO TO
65
I-K
GO TO
57
57
CONTINUE
GO TO
65
J-K
GO TO
60
60
A(I,J)=A(I,K)*A(K,J)+A(I,J)
65
CONTINUE
REPEAT TO 75
FOR
JR=1,I+1,....,N
66
CONTINUE
GO TO
75
JR-K
GO TO
70
70
A(K,JR)=A(K,JR)/A(K,K)
75
CONTINUE
A(K,K)=1.0/A(K,K)
80
CONTINUE
TRANSFER TO SUBROUTINE
DVCHK
KODOFX
COMPUTED GO TO
IF THE VALUE OF KODOFX IS
TRANSFER TO STATEMENT
1
510
2
503
503
TRANSFER TO SUBROUTINE
OVERFL
KODOFX
COMPUTED GO TO
IF THE VALUE OF KODOFX IS
TRANSFER TO STATEMENT
1
510
2
504
504
TRANSFER TO SUBROUTINE
OVERFL
KODOFX
COMPUTED GO TO
IF THE VALUE OF KODOFX IS
TRANSFER TO STATEMENT
1
510
2
505
505
K=N
100
K=(K-1)


GO TO 150
IF
K
+
-
0
GO TO 150
103
I=L(K)
GO TO 120
IF
I-K
+
-
0
GO TO 120
105
REPEAT TO 110 FOR J=1,I+1,....,N
HOLD=A(J,K)
A(J,K)=-A(J,I)
110
A(J,I)=HOLD
120
J=M(K)
GO TO 100
IF
J-K
+
-
0
GO TO 100
125
REPEAT TO 130 FOR I=1,I+1,....,N
HOLD=A(K,I)
A(K,I)=-A(J,I)
130
A(J,I)=HOLD
GO TO 100
150
RETURN
510
IGOOFD=1
GO TO 150

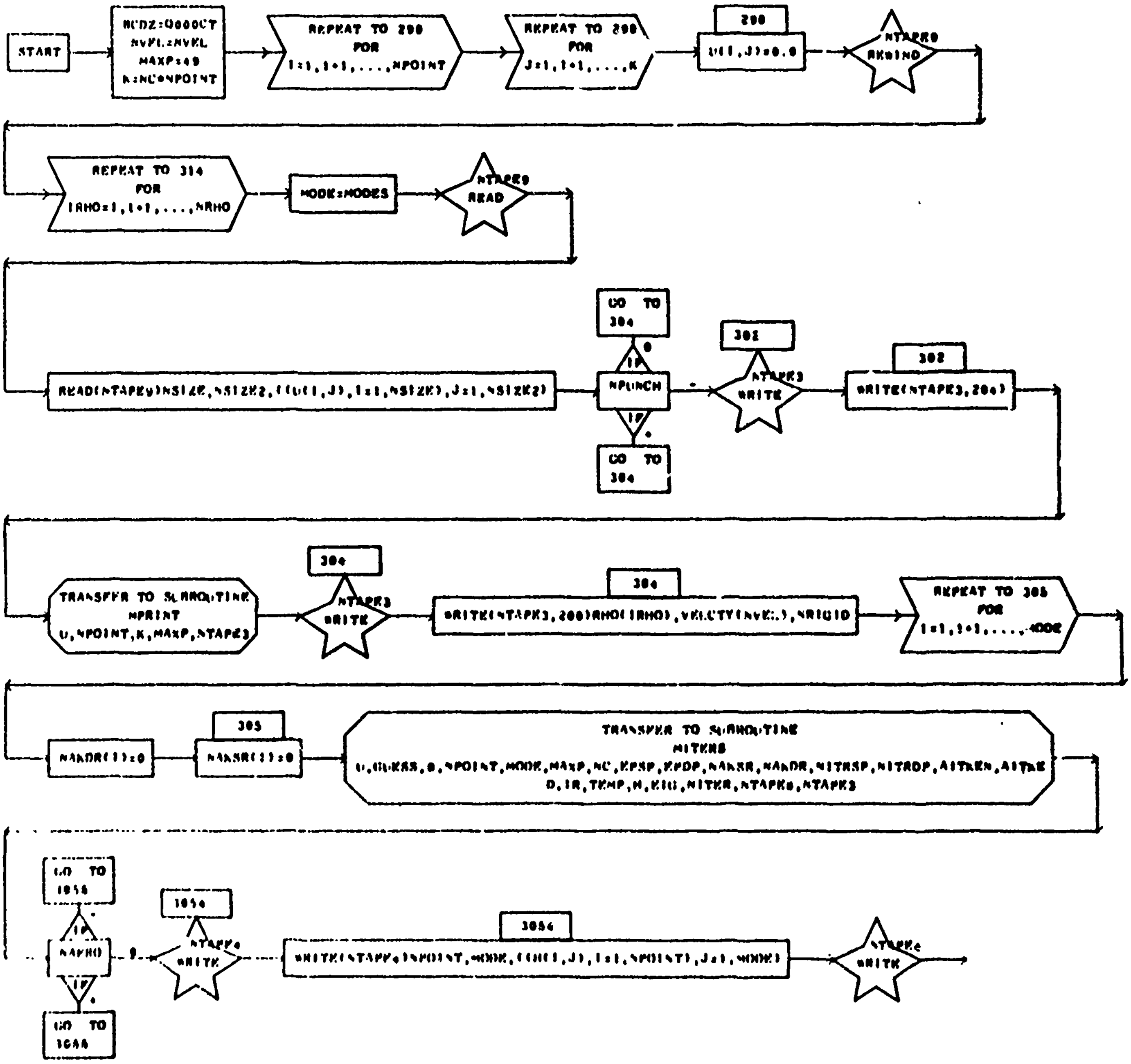
```
                                        PART2

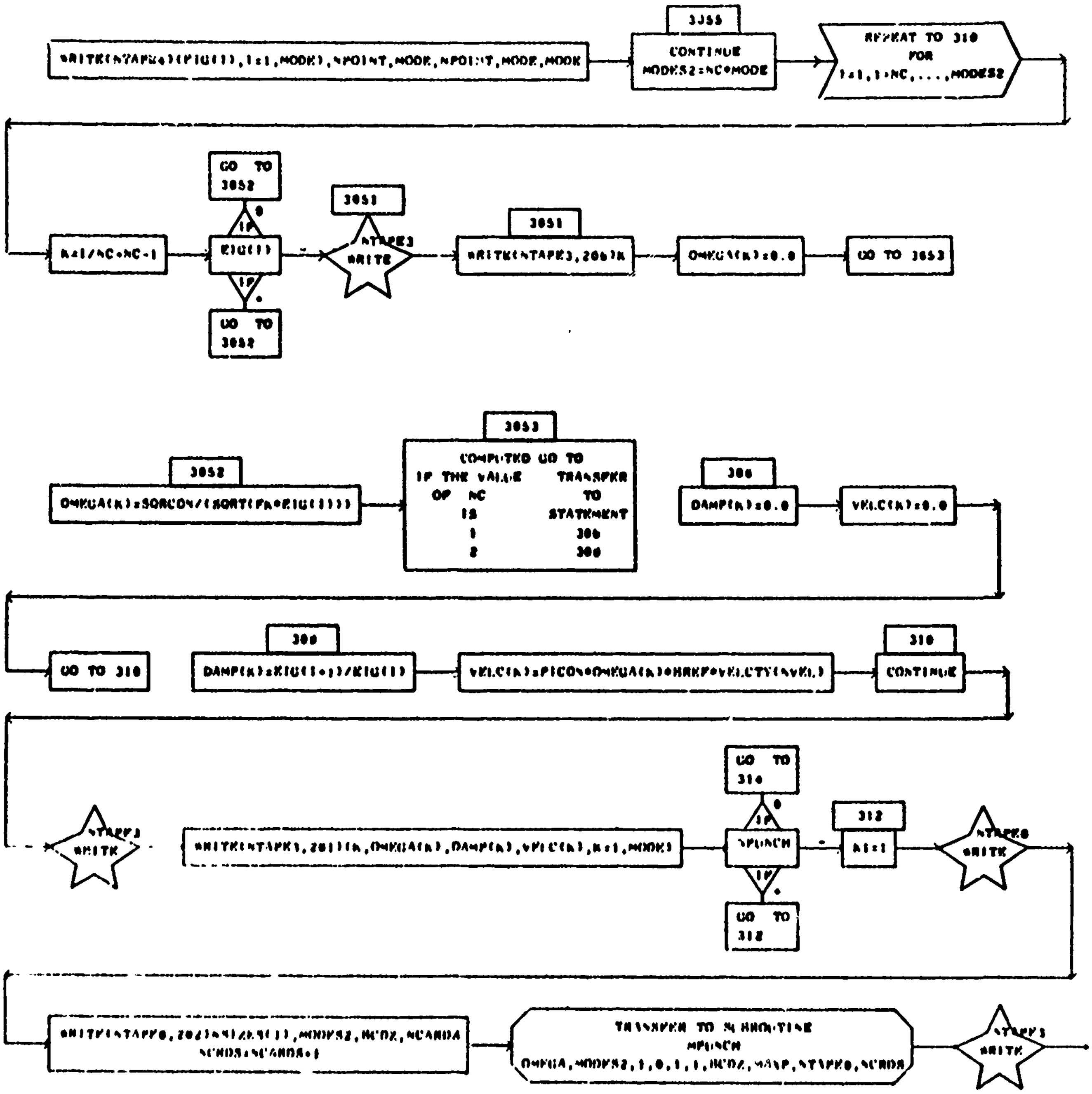


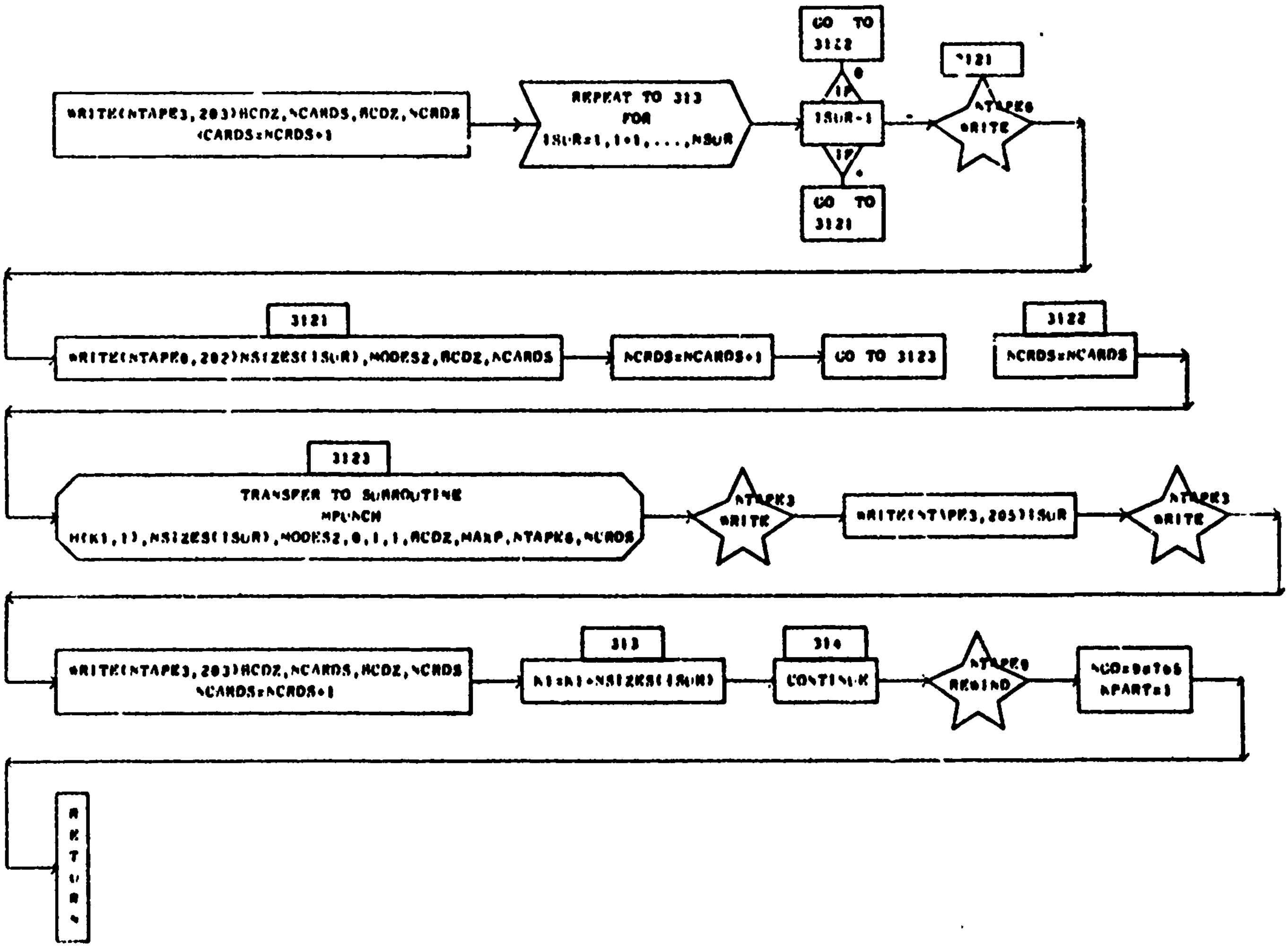

                          D I M E N S I O N E D   V A R I A B L E S

SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES

 IT         216        VELCTY     20         NSIZES     20         DM         6,6        RHO        20
```


START
NCDZ=Q000CT
NVEL=NVEL
MAXP=49
K=NC*NPOINT
REPEAT TO 290 FOR I=1,I+1,...,NPOINT
REPEAT TO 290 FOR J=1,I+1,...,K
290
U(I,J)=0.0
NTAPE9 REWIND
REPEAT TO 314 FOR IRHO=1,I+1,...,NRHO
MODE=MODES
NTAPE9 READ
READ(NTAPE9)NSIZE,NSIZE2,((U(I,J),I=1,NSIZE),J=1,NSIZE2)
GO TO 304
IF
0
NPUNCH
+
IF
GO TO 304
301
NTAPE3 WRITE
302
WRITE(NTAPE3,204)
TRANSFER TO SUBROUTINE NPRINT U,NPOINT,K,MAXP,NTAPE3
304
NTAPE3 WRITE
304
WRITE(NTAPE3,200)RHO(IRHO),VELCTY(NVEL),NRIGID
REPEAT TO 305 FOR I=1,I+1,...,MODE
NAKDR(I)=0
305
NAKSR(I)=0
TRANSFER TO SUBROUTINE NITERS U,GUESS,B,NPOINT,MODE,MAXP,NC,EPSP,EPDP,NAKSR,NAKDR,NITRSP,NITRDP,AITKEN,AITKED,IR,TEMP,H,EIG,NITER,NTAPE4,NTAPE3
GO TO 1056
IF
NRHO
IF
GO TO 1066
1054
NTAPE4 WRITE
3056
WRITE(NTAPE4)NPOINT,MODE,((H(I,J),I=1,NPOINT),J=1,MODE)
NTAPE4 WRITE


WRITE(NTAPE4)(EIG(I),I=1,MODE),NPOINT,MODE,NPOINT,MODE,MODE
3355
CONTINUE
MODES2=NC*MODE
REPEAT TO 310
FOR
I=1,1+NC,...,MODES2
K=I/NC+NC-1
GO TO
3052
0
IF
EIG(I)
IF
+
GO TO
3052
-
3051
NTAPE3
WRITE
3051
WRITE(NTAPE3,206)K
OMEGA(K)=0.0
GO TO 3053
3052
OMEGA(K)=SQRCON/(SQRT(FK*EIG(I)))
3053
COMPUTED GO TO
IF THE VALUE
OF NC
IS
1
2
TRANSFER
TO
STATEMENT
306
308
306
DAMP(K)=0.0
VELC(K)=0.0
GO TO 310
308
DAMP(K)=EIG(I+1)/EIG(I)
VELC(K)=PICON*OMEGA(K)*HREF*VELCTY(NVEL)
310
CONTINUE
NTAPE3
WRITE
WRITE(NTAPE3,201)(K,OMEGA(K),DAMP(K),VELC(K),K=1,MODE)
GO TO
314
0
IF
NPUNCH
IF
+
GO TO
312
-
312
KI=1
NTAPE8
WRITE
WRITE(NTAPE8,202)NSIZE(1),MODES2,NCDZ,NCARDA
NCRDS=NCARDS+1
TRANSFER TO SUBROUTINE
MPUNCH
OMEGA,MODES2,1,0,1,1,NCDZ,MANP,NTAPE8,NCRDS
NTAPE3
WRITE


WRITE(NTAPE3,203)NCDZ,NCARDS,NCDZ,NCRDS
NCARDS=NCRDS+1
REPEAT TO 313
FOR
ISUR=1,1+1,...,NSUR
GO TO
3122
0
IF
ISUR-1
IF
+
GO TO
3121
-
3121
NTAPE6
WRITE
3121
WRITE(NTAPE6,202)NSIZES(ISUR),MODES2,NCDZ,NCARDS
NCRDS=NCARDS+1
GO TO 3123
3122
NCRDS=NCARDS
3123
TRANSFER TO SUBROUTINE
MPUNCH
M(K1,1),NSIZES(ISUR),MODES2,0,1,1,NCDZ,MAXP,NTAPE6,NCRDS
NTAPE3
WRITE
WRITE(NTAPE3,205)ISUR
NTAPE3
WRITE
WRITE(NTAPE3,203)NCDZ,NCARDS,NCDZ,NCRDS
NCARDS=NCRDS+1
313
K1=K1+NSIZES(ISUR)
314
CONTINUE
NTAPE6
REWIND
NCD=9*T*6
NPART=1
RETURN

```
                                   NORMZ



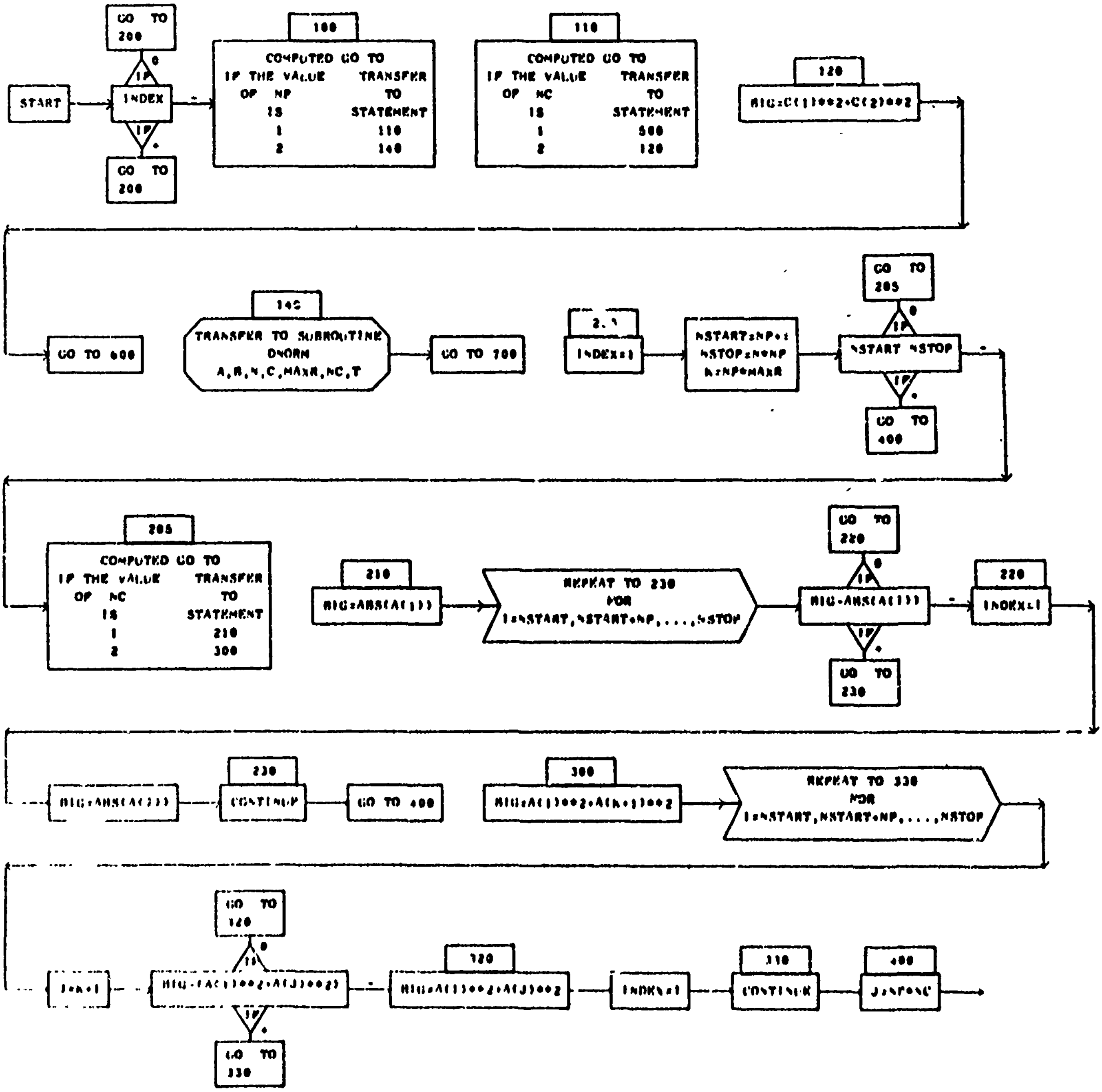


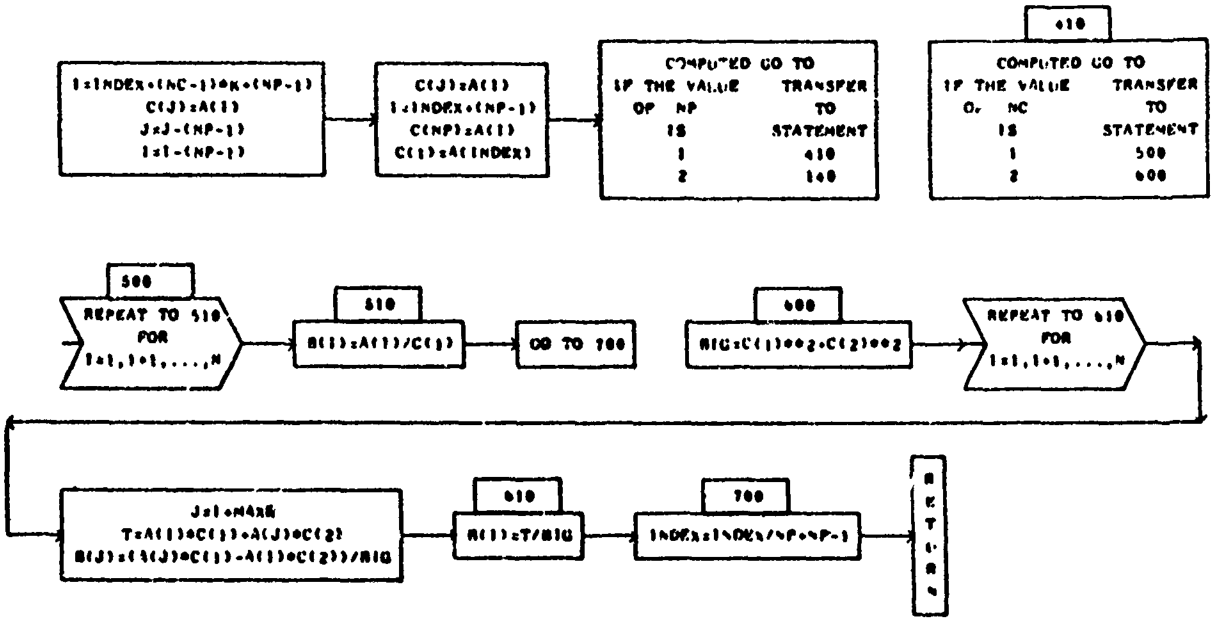
                          D I M E N S I O N E D   V A R I A B L E S

SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES

A          1          B          1          C          1          T          2
```

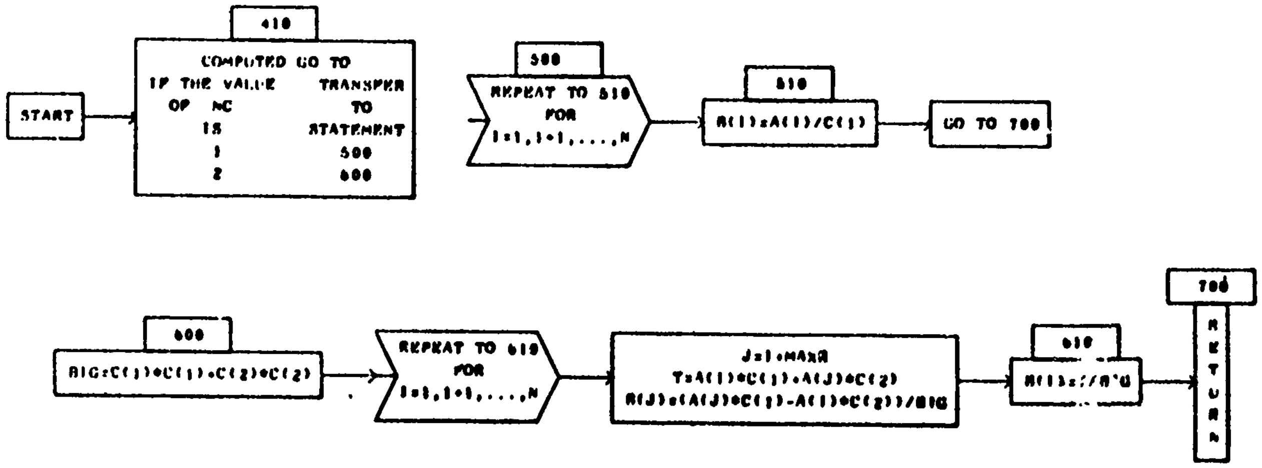
SUBROUTINE NORM (A,B,N,C,INDEX,MAXR,NC,NP)




I=INDEX+(NC-1)*N+(NP-1)
C(J)=A(I)
J=J-(NP-1)
I=I-(NP-1)
C(J)=A(I)
I=INDEX+(NP-1)
C(NP)=A(I)
C(1)=A(INDEX)
COMPUTED GO TO
IF THE VALUE OF NP IS
TRANSFER TO STATEMENT
1 410
2 140
410
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1 500
2 600
500
REPEAT TO 510 FOR I=1,I+1,...,N
510
B(I)=A(I)/C(1)
GO TO 700
600
BIG=C(1)**2+C(2)**2
REPEAT TO 610 FOR I=1,I+1,...,N
J=I+MAXB
T=A(I)*C(1)+A(J)*C(2)
B(J)=(A(J)*C(1)-A(I)*C(2))/BIG
610
B(I)=T/BIG
700
INDEX=INDEX/NP+NP-1
RETURN

DNORM2

SUBROUTINE DNORM (A,B,N,C,MAXR,NC,T)

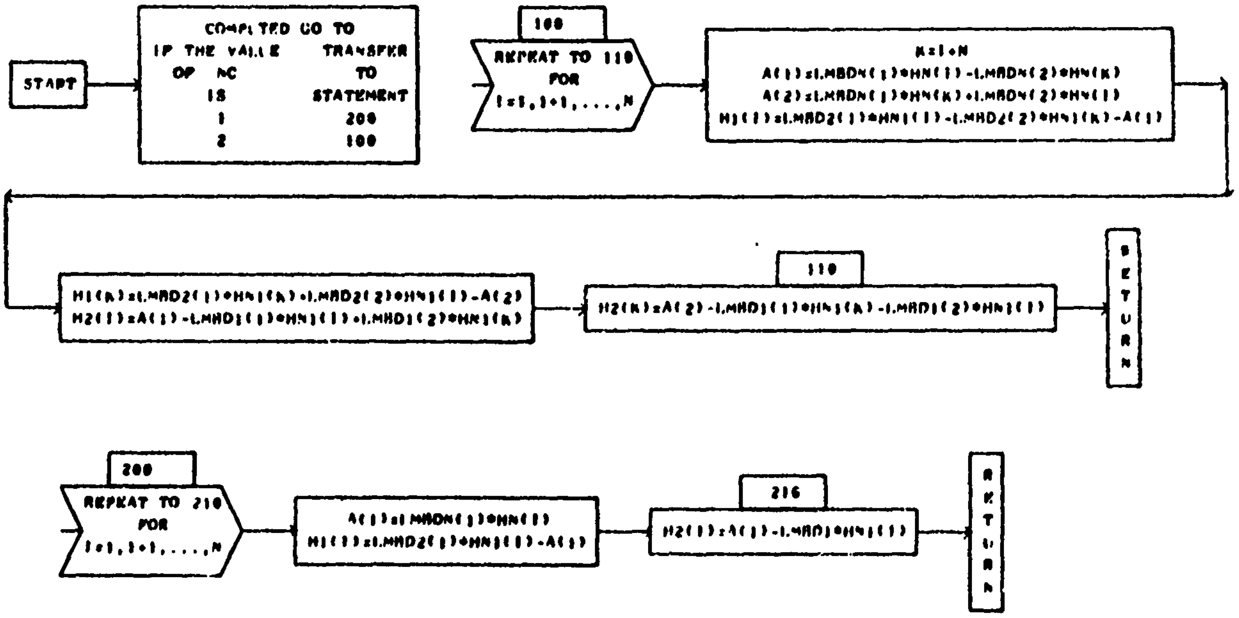


FGHS

D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
LMBDN	1	LMBD1	2	LMBD2	1	HN	1	HN1	1
H1	1	H2	1	A	2				

SUBROUTINE FGH (LMBDN,LMBD1,LMBD2,HN,HN1,H1,H2,N,NC) PAGE 1



```
                                        AITKNS                                                   1

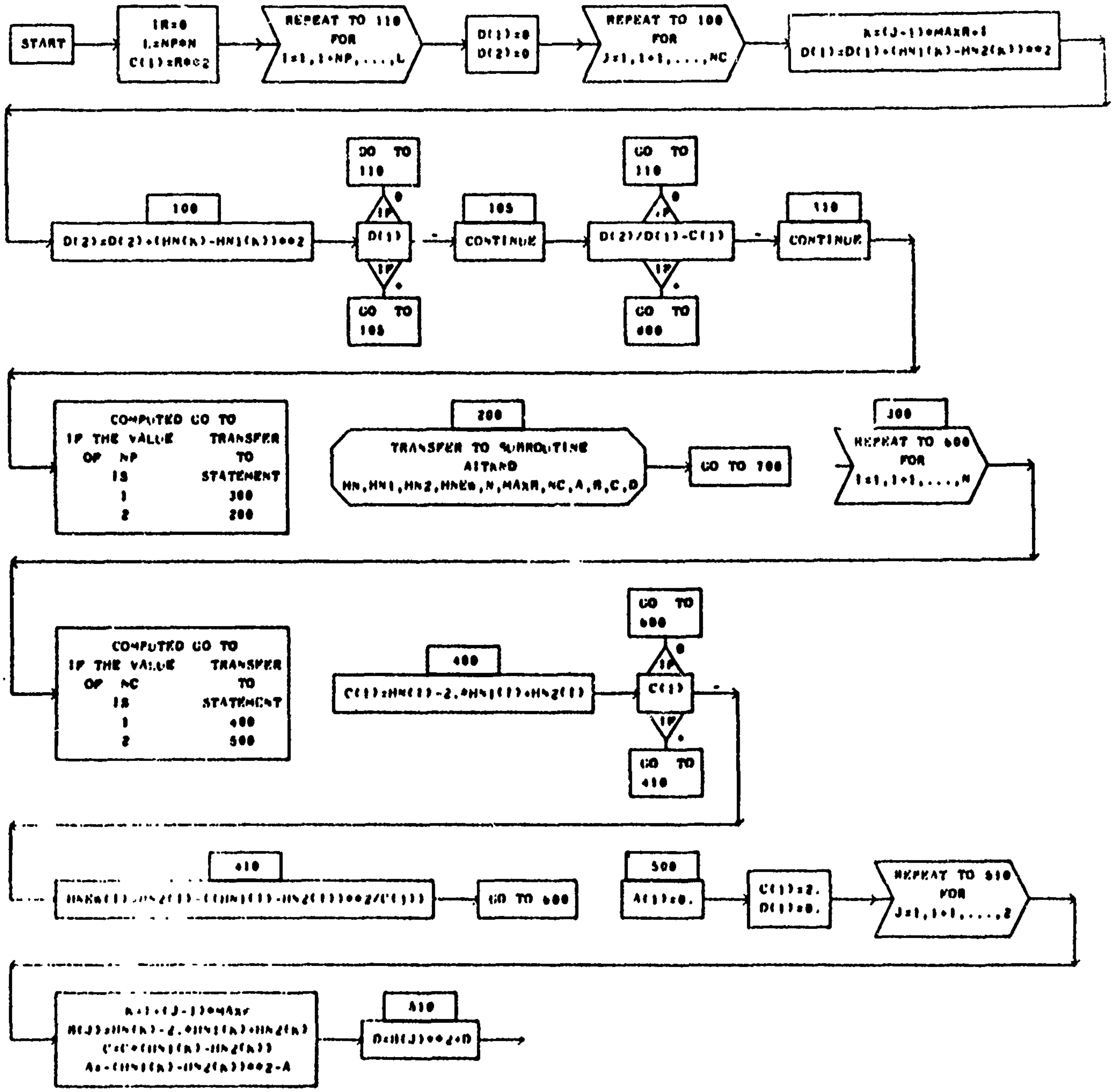


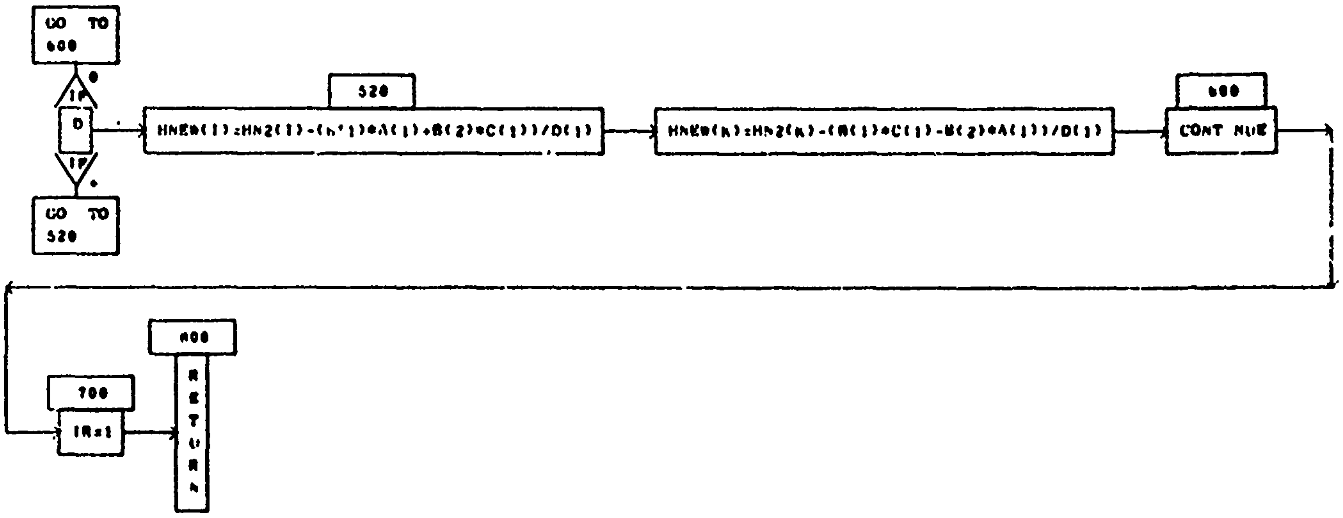
                           D I M E N S I O N E D   V A R I A B L E S                              1

SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES

HN          1           HN1         1           HN2         1           HNEW        1           A           2
B           4           C           2           D           2
```

SUBROUTINE AITKNS (HN,HN1,HN2,HNEW,R,N,MAXR,NC,NP,IR) PAGE 1




GO TO 600
0
IF
D
IF
+
GO TO 520
520
HNEW(J)=HN2(J)-(B(1)*A(J)+B(2)*C(J))/D(J)
HNEW(K)=HN2(K)-(B(1)*C(J)-B(2)*A(J))/D(J)
600
CONTINUE
700
IR=1
800
RETURN

```
                                   AITKND

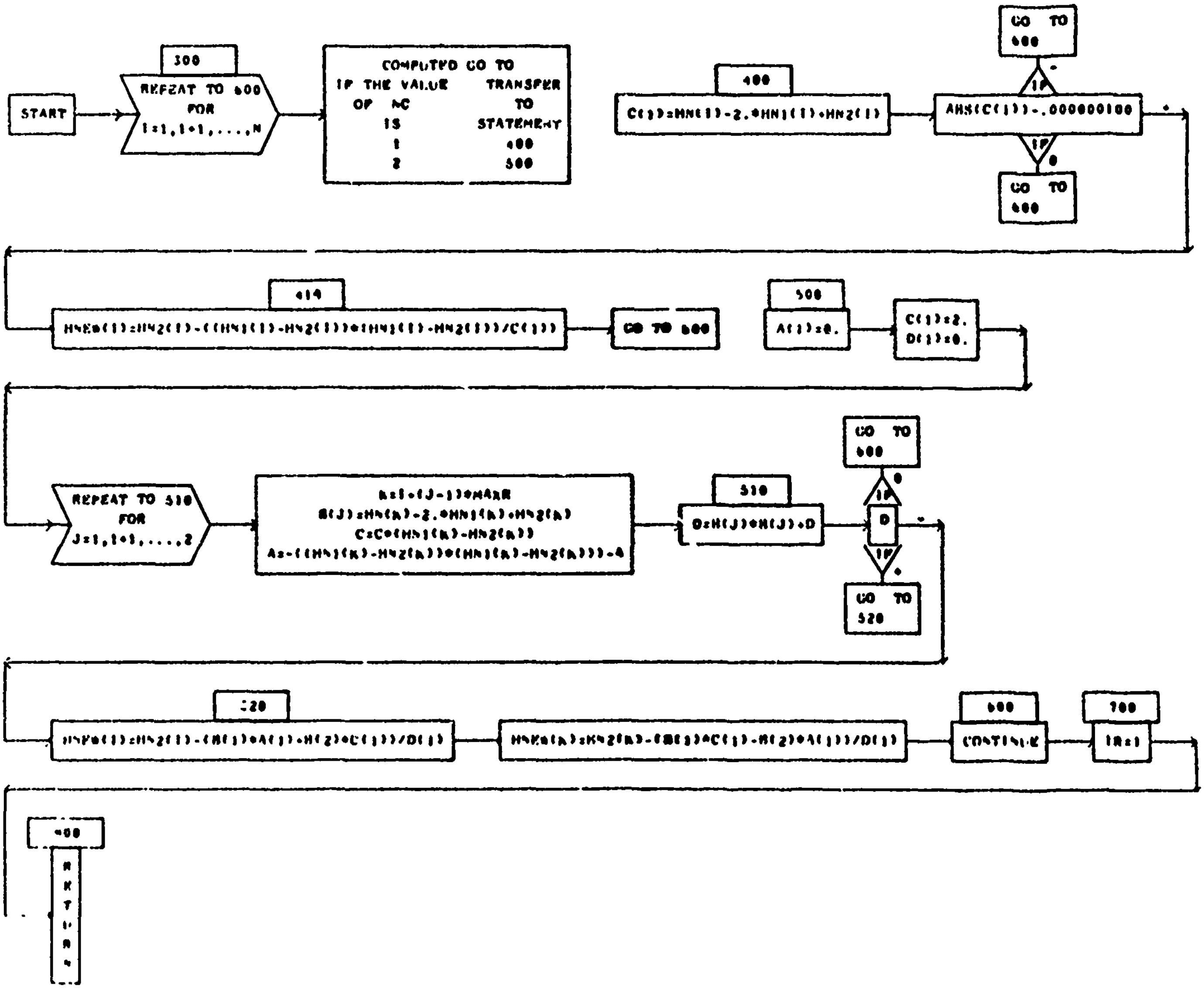



                              D I M E N S I O N E D   V A R I A B L E S

SYMBOL      STORAGES   SYMBOL      STORAGES   SYMBOL      STORAGES   SYMBOL      STORAGES   SYMBOL      STORAGES

 HN            1        HN1           1        HN2           1         HNEW         1          A           1
 B             2        C             1        D             1
```

SUBROUTINE AITKND (HN,HN1,HN2,HNEW,N,MAXR,NC,A,B,C,D) PAGE 1



```
                                   LEGISS



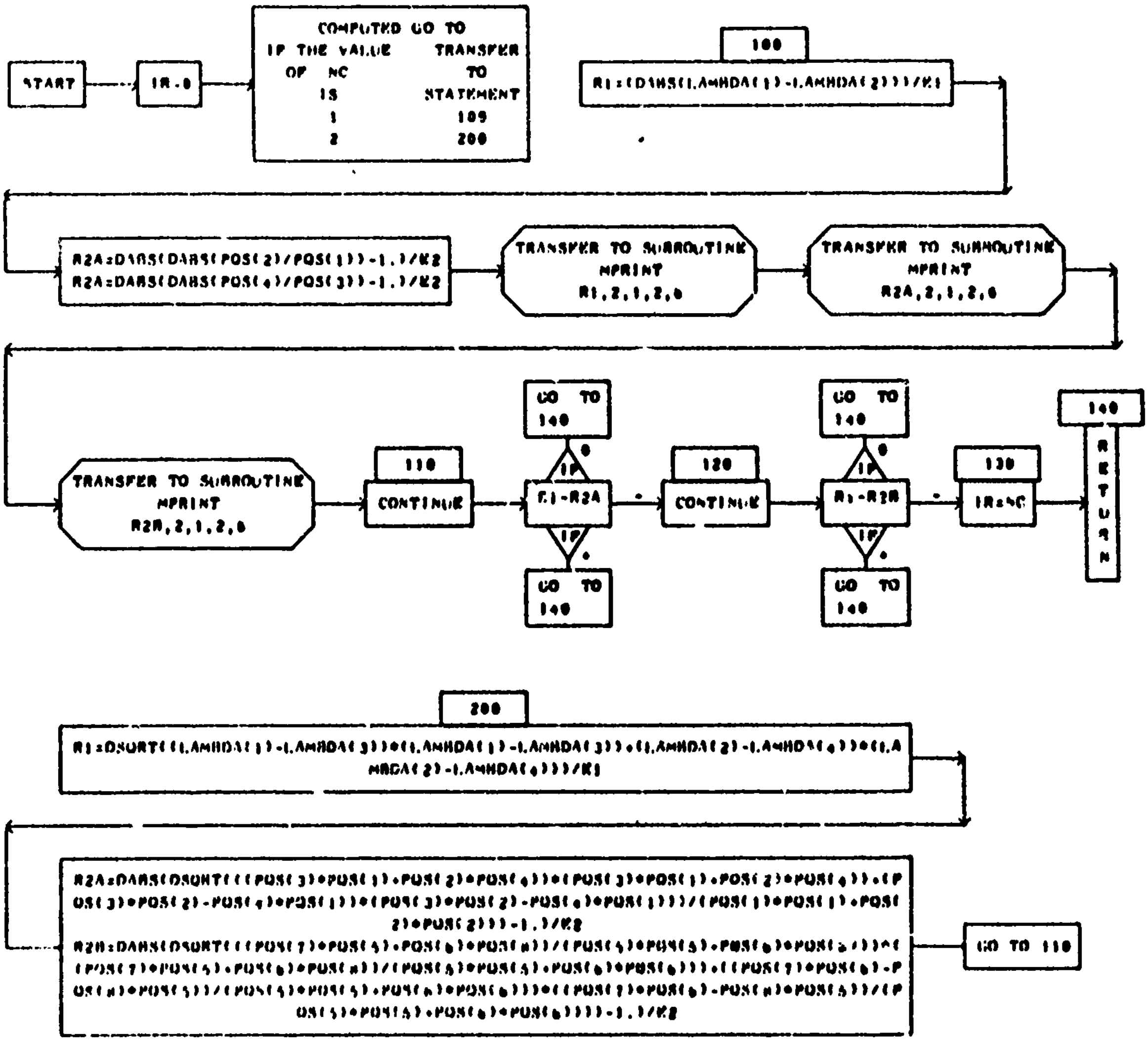


                    D I M E N S I O N E D   V A R I A B L E S

SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES

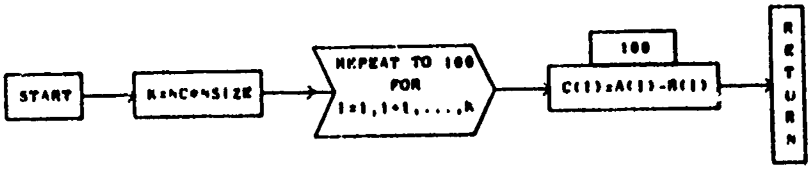
 LAMBDA     1          POS        1
```

SUBROUTINE LEWIS (LAMBDA,POS,K1,K2,NC,IR)



MADS

SUBROUTINE MADS (A,B,C,NSIZE,NC)

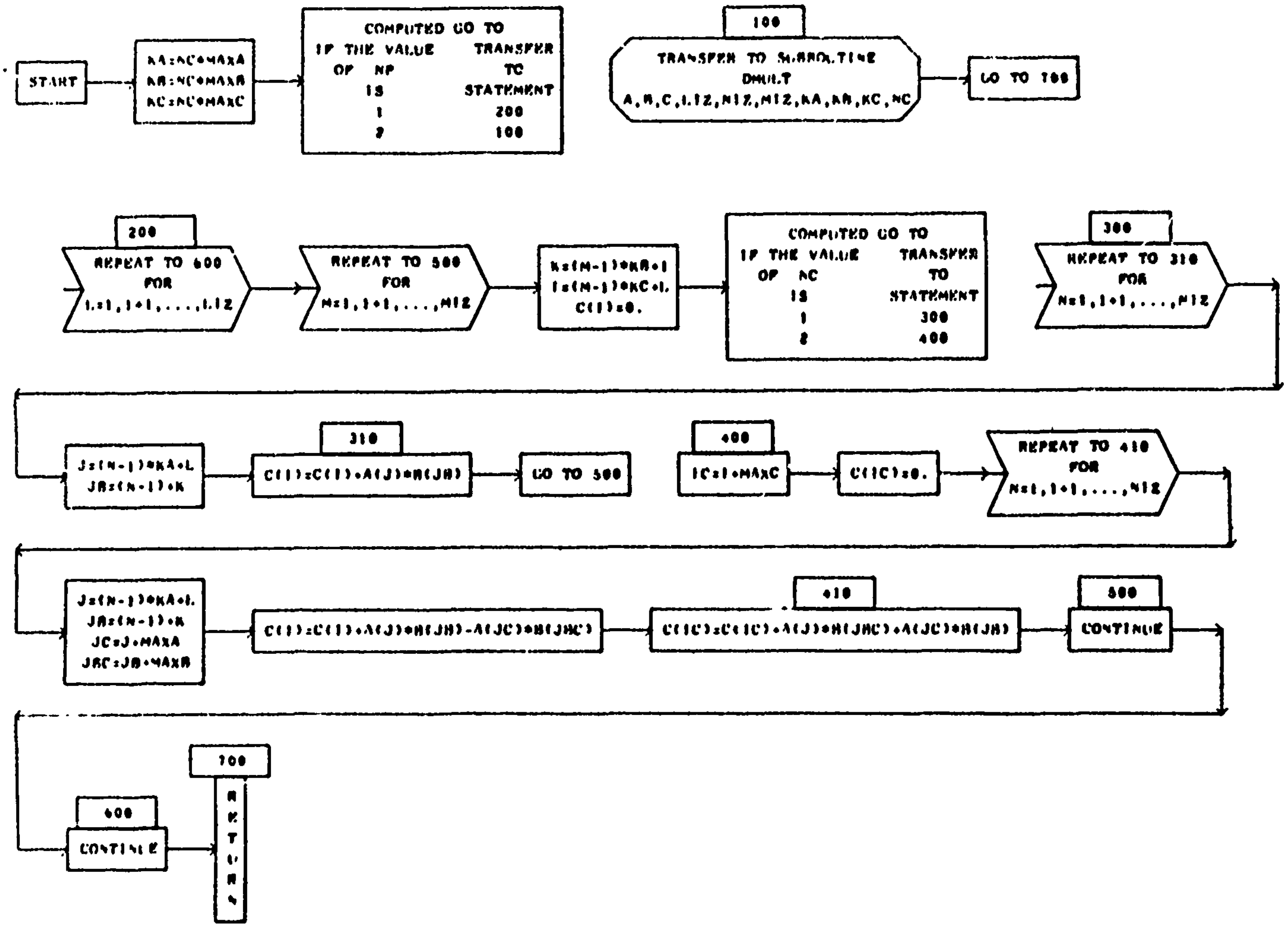


MULTS

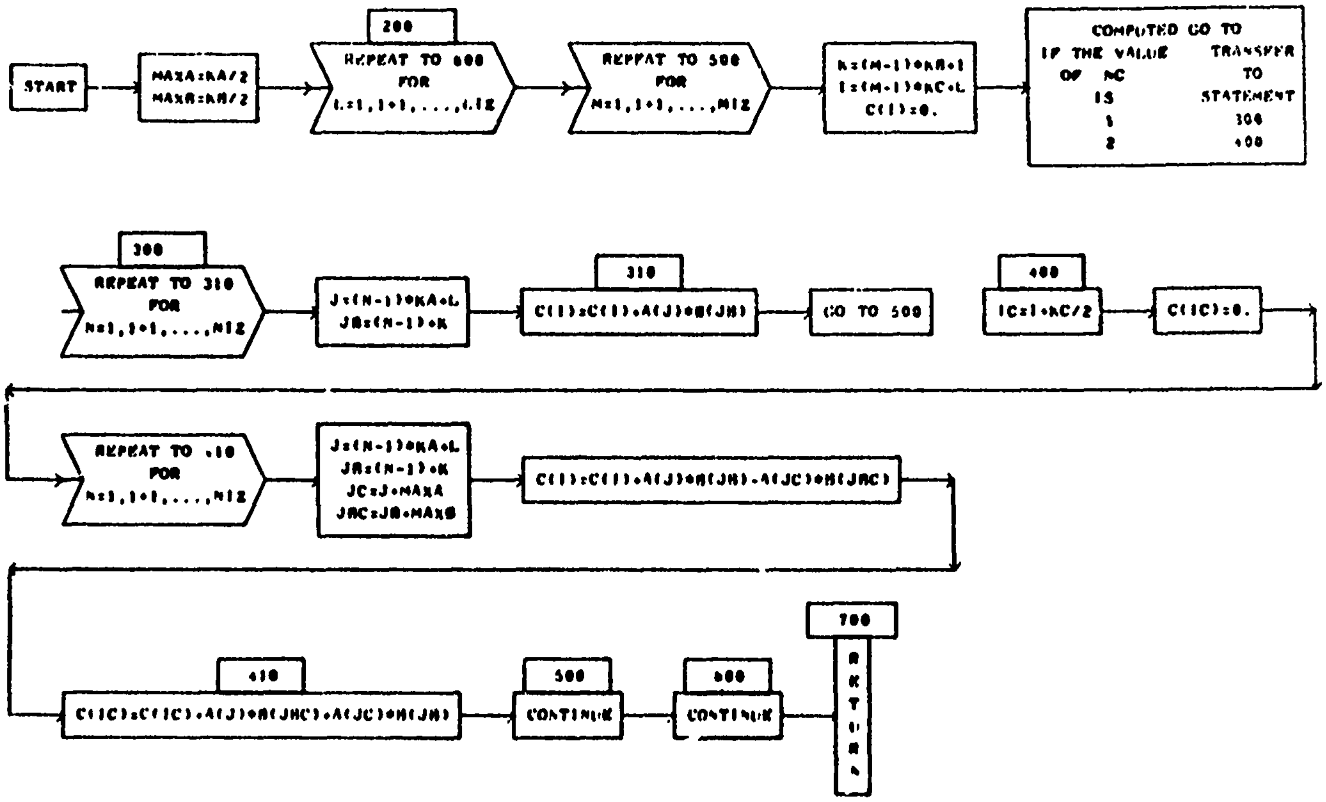
D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
A	1	B	1	C	1				

SUBROUTINE MULT (A,B,C,L1Z,N1Z,M1Z,MAXA,MAXB,MAXC,NC,NP) PAGE 1



SUBROUTINE DMULT (A,B,C,LIZ,NIZ,MIZ,KA,KB,KC,NC) PAGE 1



```
                                        POLMS

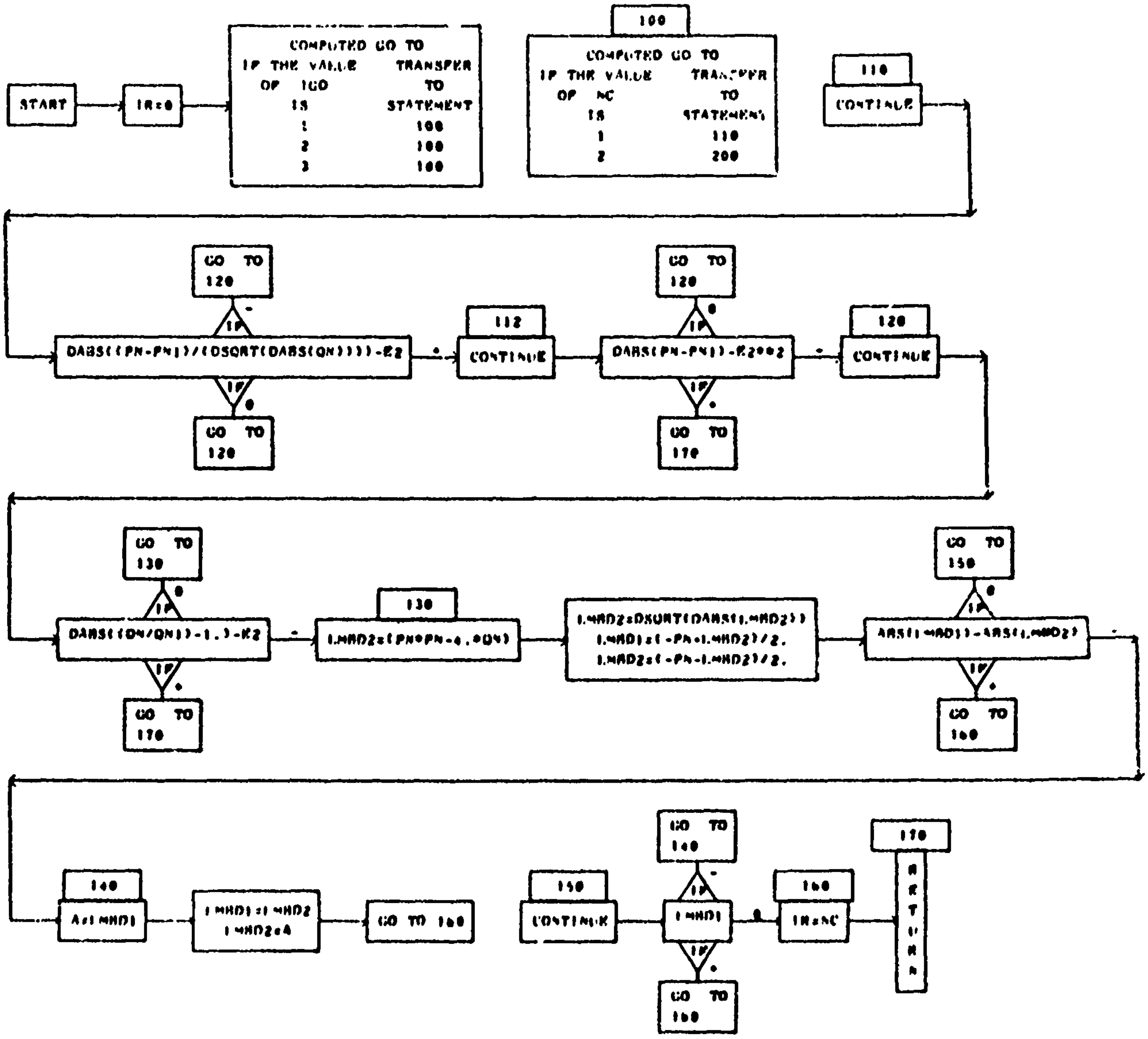


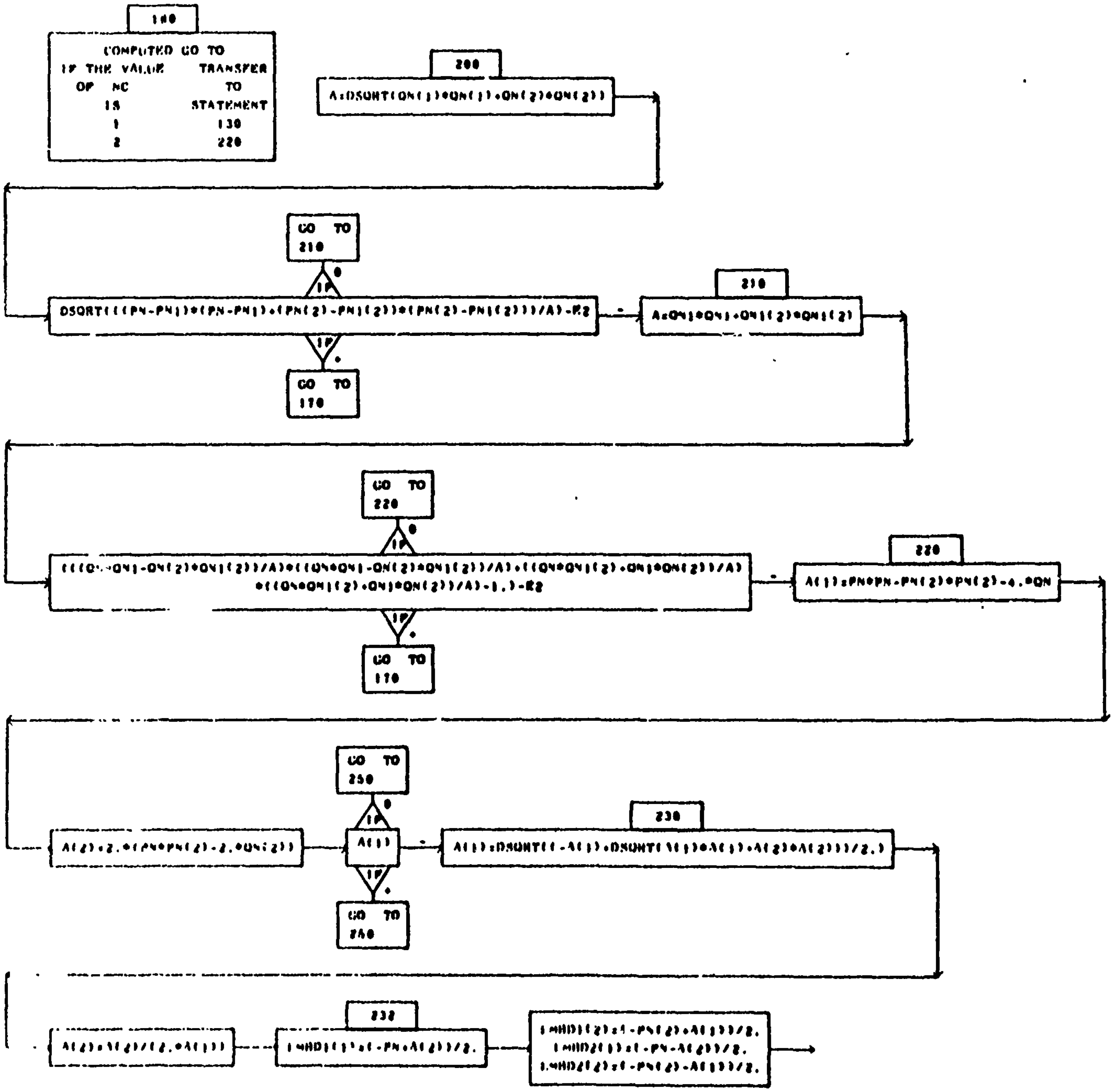
                              D I M E N S I O N E D   V A R I A B L E S

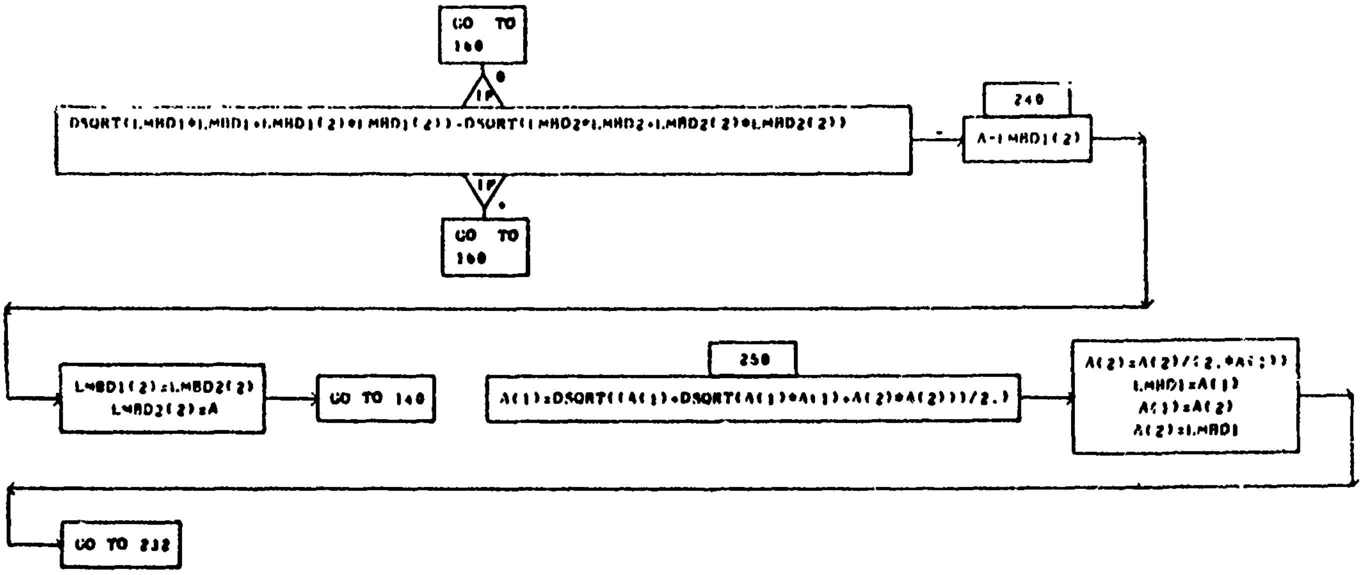
SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES

PN              1       PN1             1       QN              1       QN1             1       E2              1
LMBD1           1       LMBD2           1
```

SUBROUTINE POLM (PN,PN1,QN,QN1,E2,LMHD1,LMHD2,NC,IR,IGO) PAGE 1




140
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1 130
2 220
200
A=DSQRT(QN(1)*QN(1)+QN(2)*QN(2))
GO TO 210
0
IF
DSQRT(((PN-PN1)*(PN-PN1)+(PN(2)-PN1(2))*(PN(2)-PN1(2)))/A)-R2
-
+
GO TO 170
210
A=QN1*QN1+QN1(2)*QN1(2)
GO TO 220
0
IF
(((QN*QN1-QN(2)*QN1(2))/A)*((QN*QN1-QN(2)*QN1(2))/A)+((QN*QN1(2)+QN1*QN(2))/A)
*((QN*QN1(2)+QN1*QN(2))/A)-1.)-R2
-
+
GO TO 170
220
A(1)=PN*PN-PN(2)*PN(2)-4.*QN
A(2)=2.*(PN*PN(2)-2.*QN(2))
GO TO 250
0
IF
A(1)
-
+
GO TO 260
230
A(1)=DSQRT((-A(1)+DSQRT(A(1)*A(1)+A(2)*A(2)))/2.)
A(2)=A(2)/(2.*A(1))
232
LMBD1(1)=(-PN+A(2))/2.
LMBD1(2)=(-PN(2)+A(1))/2.
LMBD2(1)=(-PN-A(2))/2.
LMBD2(2)=(-PN(2)-A(1))/2.

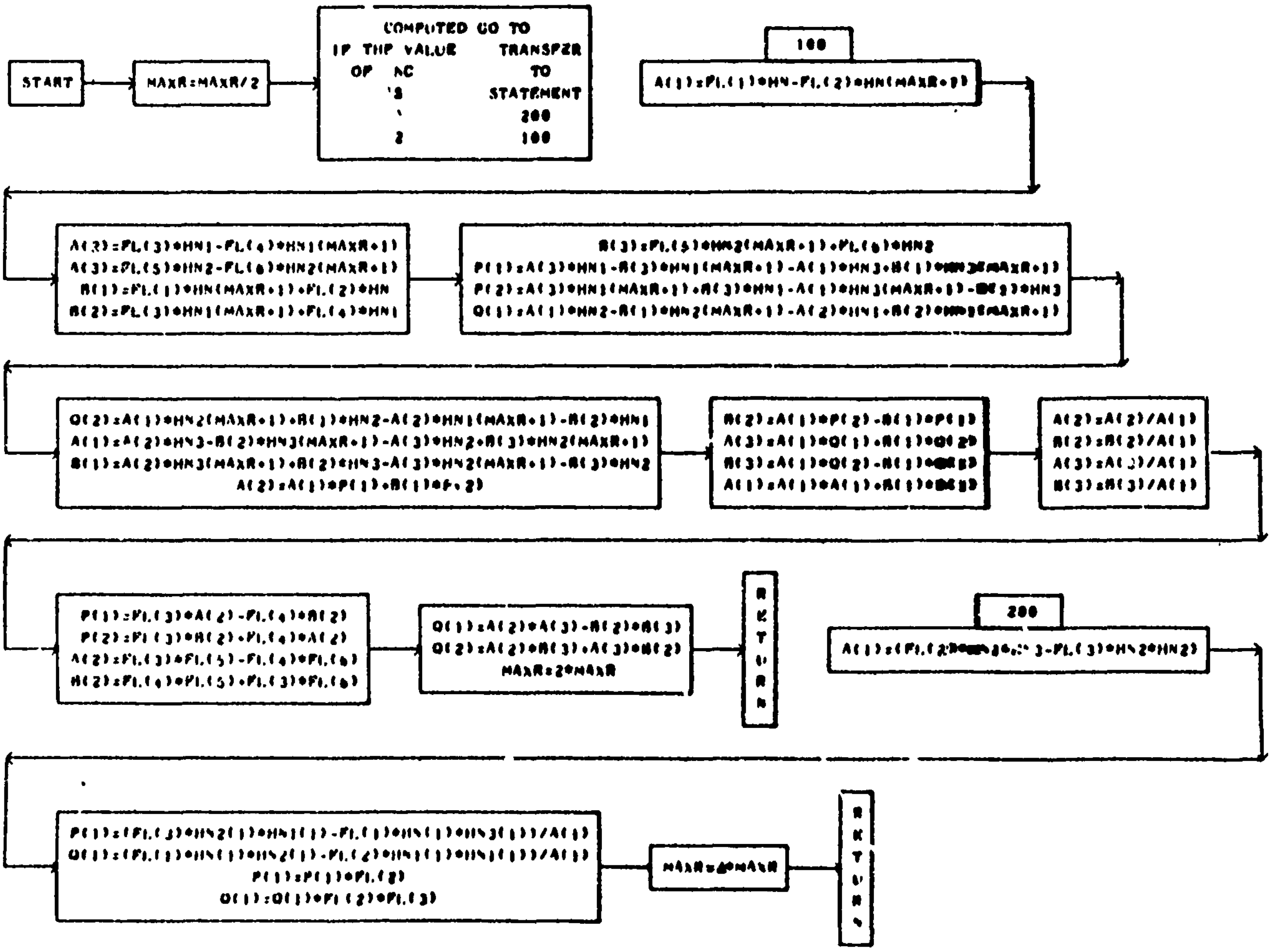

GO TO 160
0
IF
DSQRT(LMBD1*LMBD1+LMBD1(2)*LMBD1(2))-DSQRT(LMBD2*LMBD2+LMBD2(2)*LMBD2(2))
-
240
A=LMBD1(2)
IF
+
GO TO 160
LMBD1(2)=LMBD2(2)
LMBD2(2)=A
GO TO 140
250
A(1)=DSQRT((A(1)+DSQRT(A(1)*A(1)+A(2)*A(2)))/2.)
A(2)=A(2)/(2.*A(1))
LMBD1=A(1)
A(1)=A(2)
A(2)=LMBD1
GO TO 232

PUS

DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
FL	1	HN	1	HN1	1	HN2	1	HN3	1
P	1	Q	1	A	3	B	3		

SUBROUTINE PQ (FL, HN, HN1, HN2, HN3, P, Q, NC, MAXR) PAGE 1



```
                         CLOSES

       SUBROUTINE  CLOSE,        COMPUTES 2 CLOSE ROOTS.


              U = MATRIX, DIMENSIONED  (MAXR,2*NC*MAXR)

       H = STARTING GUESS, DIMENSIONED((MAXR,2*NC*4)+2*NC*N)

                     NSIZE = SIZE OF MATRIX

            MAXR = DIMENSIONED NUMBER OF ROWS OF U AND H

       MAXTRY = MAXIMUM NUMBER OF DOUBLZ PRECISION ITERATIONS.

               EPS1 = SINGLE ROOT CONVERGENCE CRITERIA

               EPS2 = DOUBLE ROOT CONVERGENCE CRITERIA

                  R= AITKENS CONVERGENCE CRITERIA

            IRR = ERROR RETURN INDICATER.    =1, OVERFLOW

                                         =2, DIVIDE CHECK

                                    =3, BOTH OVERFLOW AND DIVIDE

                                                      CHECK.

       ITERS= NUMBER OF ITERATIONS PERFORMED, - FOR DOUBLE ROOT

                                            + FOR SINGLE ROOT

                    NC = 1, REAL.      2, COMPLEX

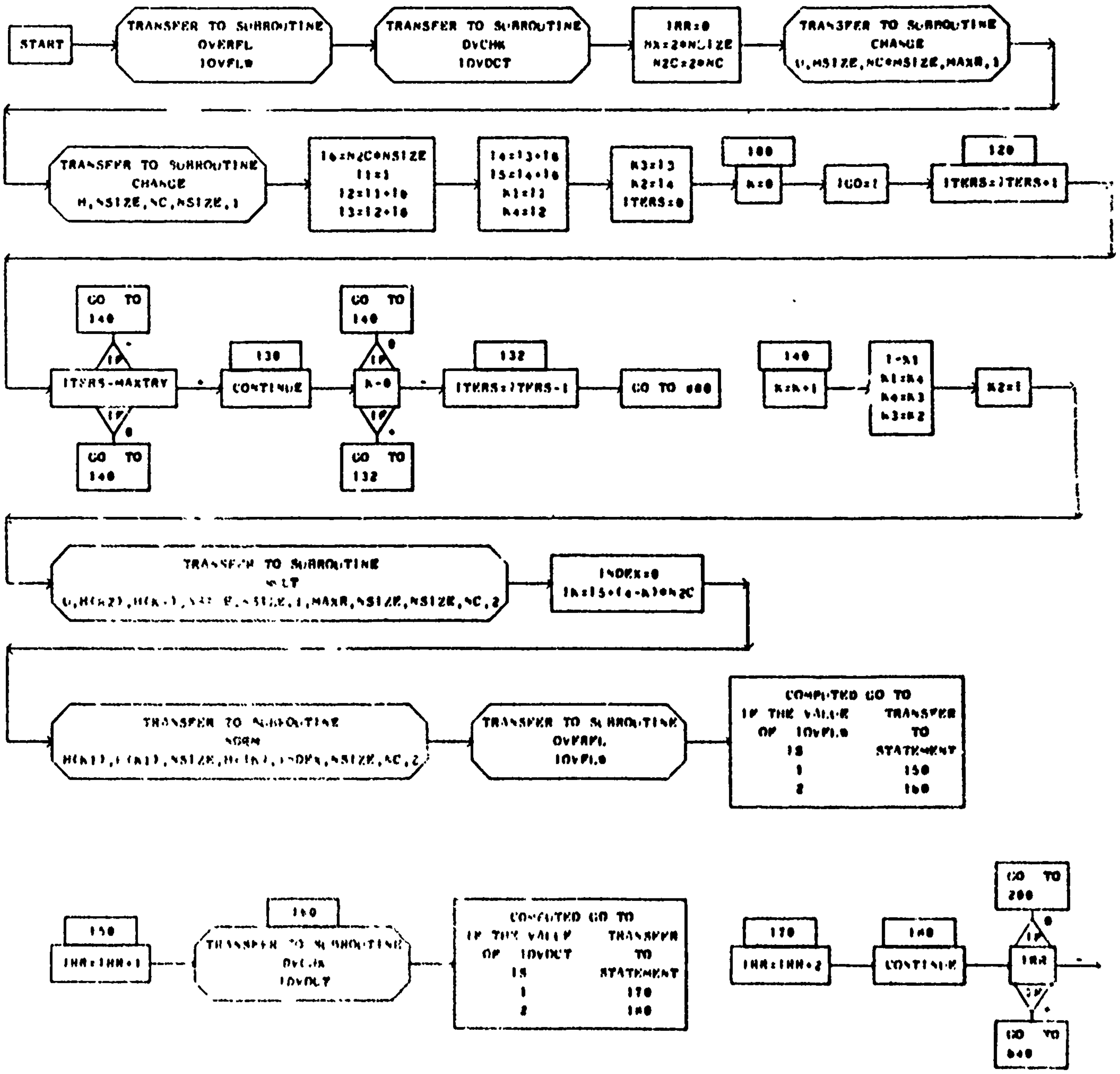


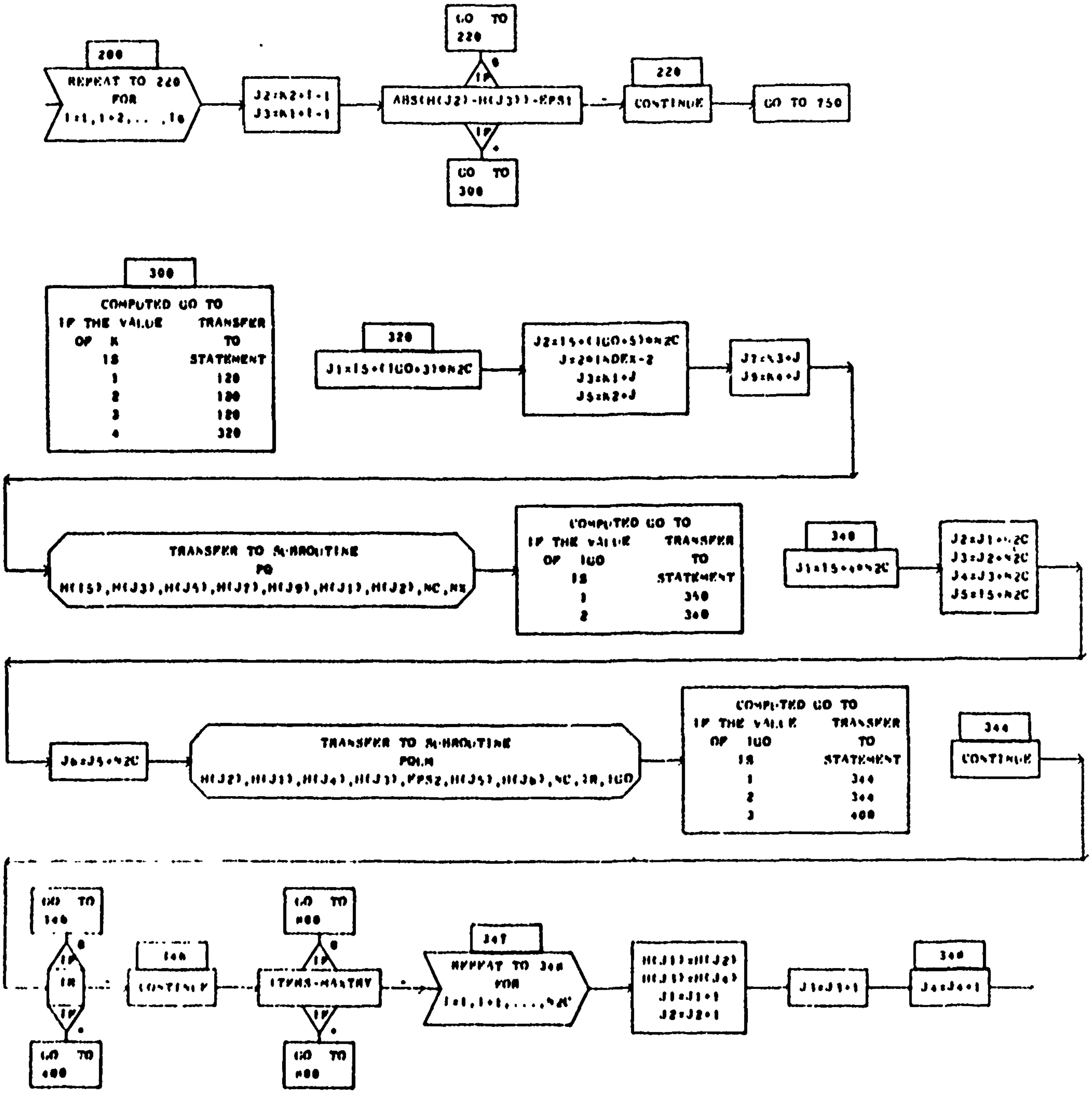
                   D I M E N S I O N E D   V A R I A B L E S

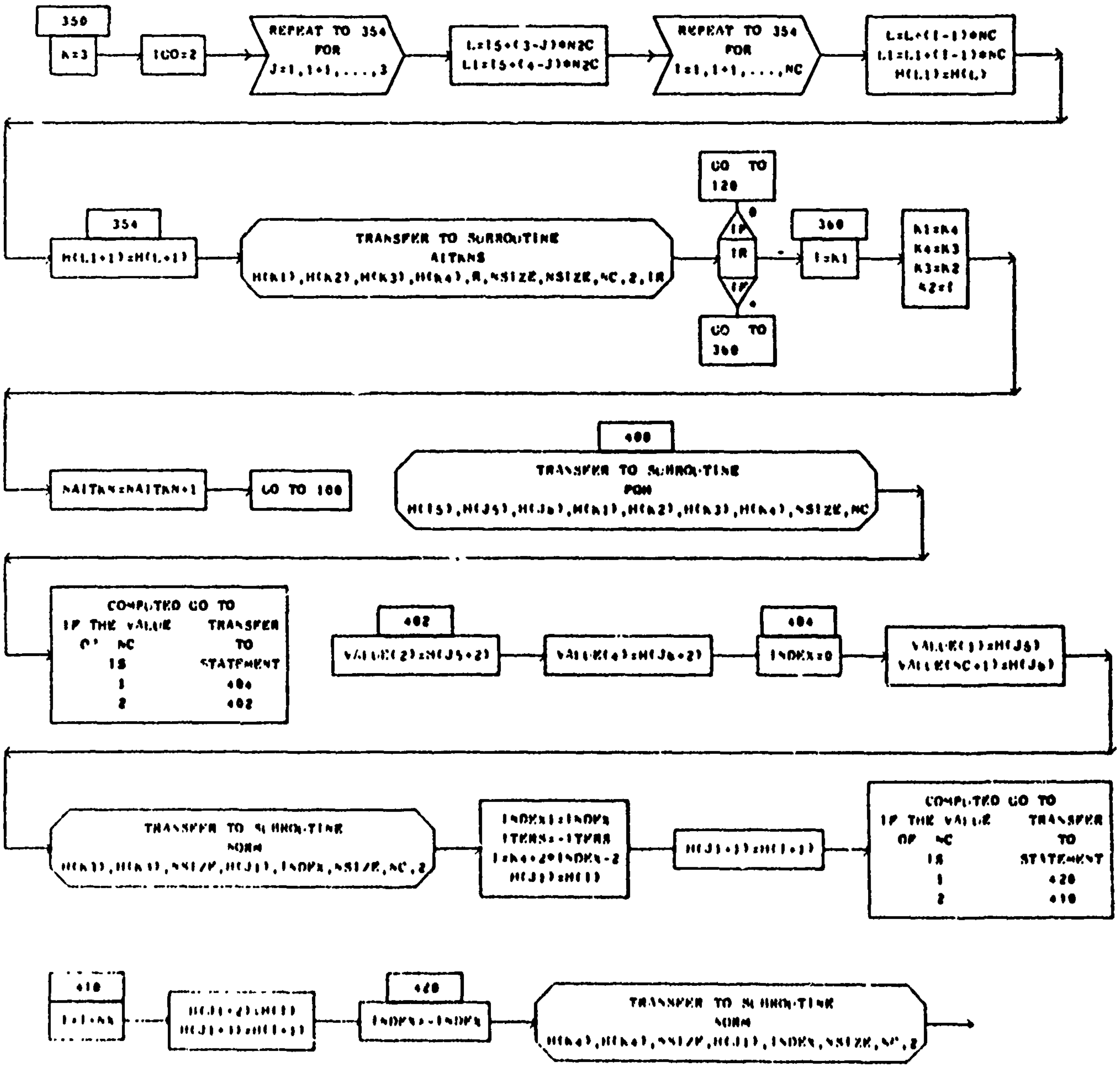
SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES    SYMBOL      STORAGES

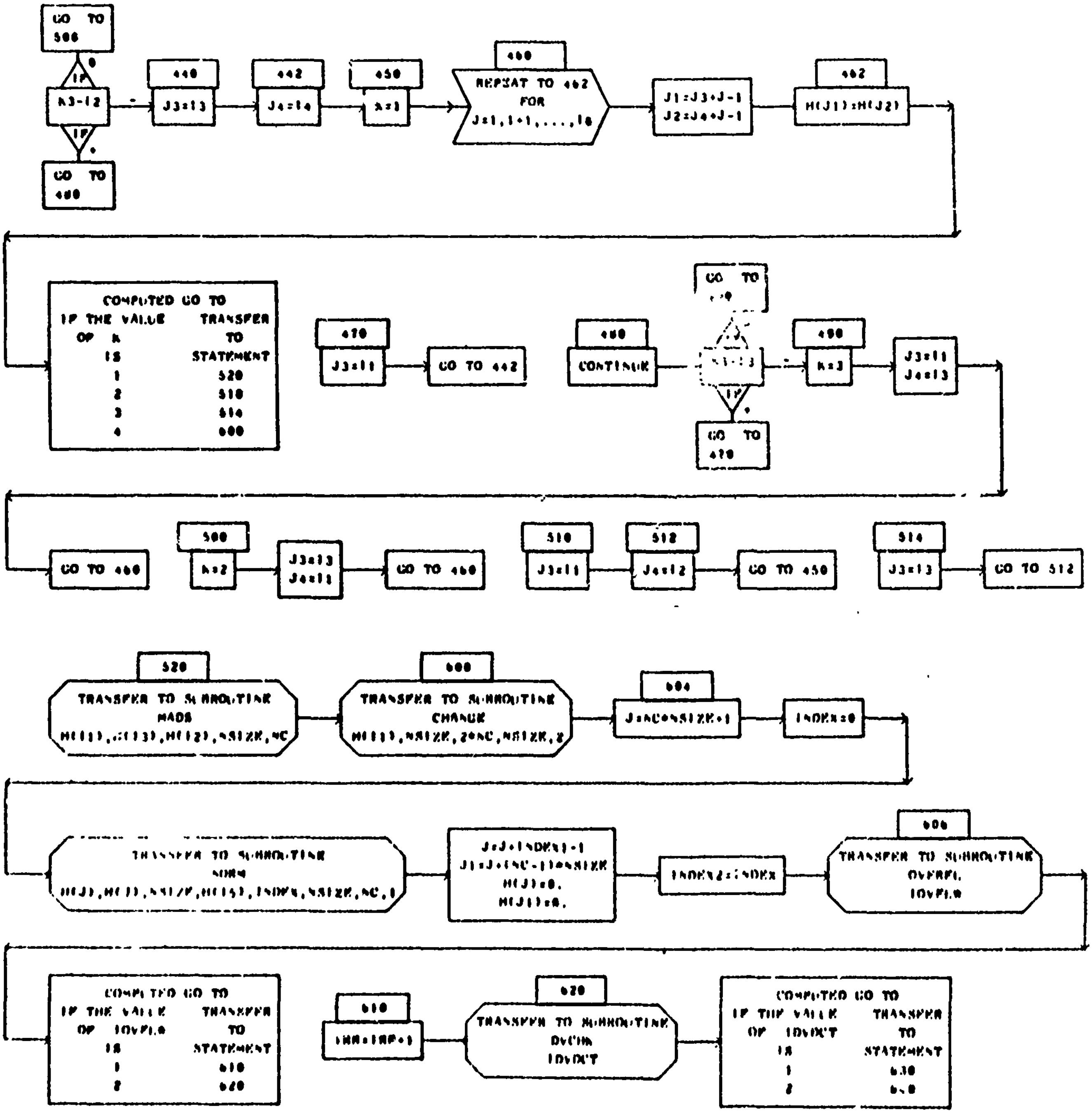
  U            1          H            1        VALUE          1
```

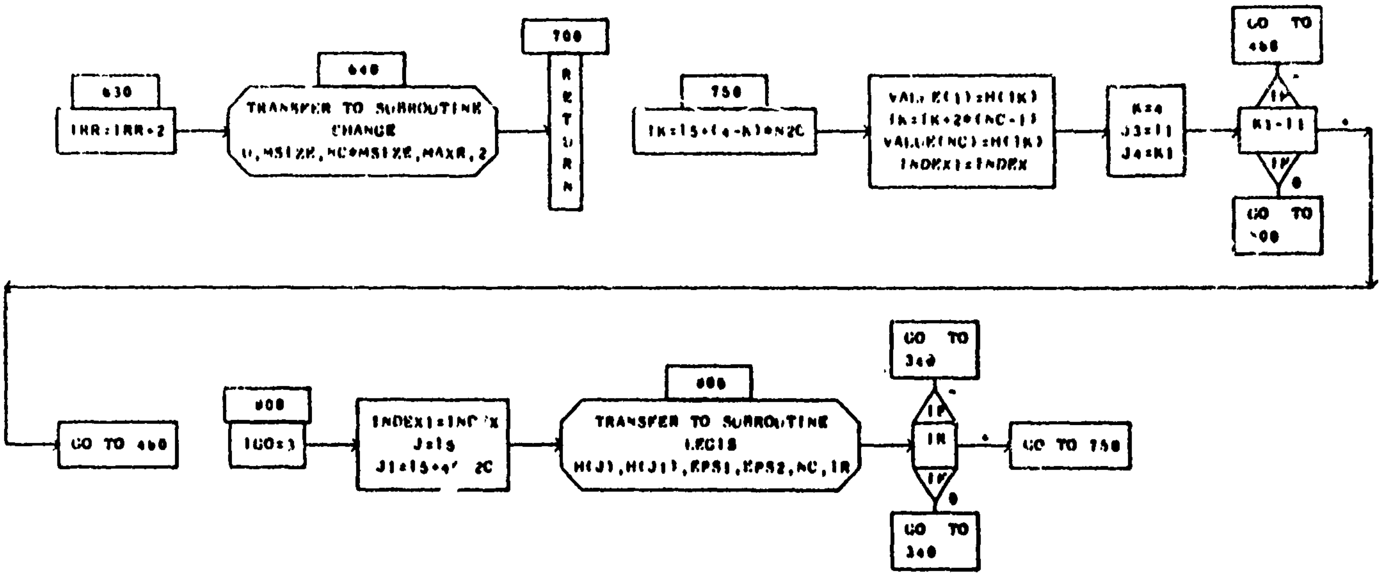
SUBROUTINE CLOSES (U,H,NSIZE,MAXR,R,EPS1,EPS2,NC,IRR,MAXTRY,ITERS, PAGE 1




200
REPEAT TO 220
FOR
I=1,I+2,... ,16
J2=K2+I-1
J3=K1+I-1
GO TO
220
IF
ABS(H(J2)-H(J3))-EPS1
IF
GO TO
300
220
CONTINUE
GO TO 750
300
COMPUTED GO TO
IF THE VALUE
OF K
IS
TRANSFER
TO
STATEMENT
1 120
2 120
3 120
4 320
320
J1=15+(IGO+3)*N2C
J2=15+(IGO+5)*N2C
J=2*INDEX-2
J3=K1+J
J5=K2+J
J7=K3+J
J9=K4+J
TRANSFER TO SUBROUTINE
PQ
H(15),H(J3),H(J5),H(J7),H(J9),H(J1),H(J2),NC,NX
COMPUTED GO TO
IF THE VALUE
OF IGO
IS
TRANSFER
TO
STATEMENT
1 340
2 340
340
J1=15+4*N2C
J2=J1+N2C
J3=J2+N2C
J4=J3+N2C
J5=15+N2C
J6=J5+N2C
TRANSFER TO SUBROUTINE
POLM
H(J2),H(J3),H(J4),H(J1),EPS2,H(J5),H(J6),NC,IR,IGO
COMPUTED GO TO
IF THE VALUE
OF IGO
IS
TRANSFER
TO
STATEMENT
1 344
2 344
3 400
344
CONTINUE
GO TO
146
IF
IR
IF
GO TO
400
146
CONTINUE
GO TO
800
IF
ITERS-MAXTRY
IF
GO TO
800
347
REPEAT TO 348
FOR
I=1,I+1,...,N2C
H(J1)=H(J2)
H(J3)=H(J4)
J1=J1+1
J2=J2+1
J3=J3+1
348
J4=J4+1


350
K=3
ICO=2
REPEAT TO 354 FOR J=1,1+1,...,3
L=I5+(3-J)*N2C
L1=I5+(4-J)*N2C
REPEAT TO 354 FOR I=1,1+1,...,NC
L=L+(I-1)*NC
L1=L1+(I-1)*NC
H(L1)=H(L)
354
H(L1+1)=H(L+1)
TRANSFER TO SUBROUTINE AITKNS
H(K1),H(K2),H(K3),H(K4),R,NSIZE,NSIZE,NC,2,IR
GO TO 120
0
IF
IR
IF
+
-
GO TO 360
360
I=K1
K1=K4
K4=K3
K3=K2
K2=I
NAITKN=NAITKN+1
GO TO 100
400
TRANSFER TO SUBROUTINE POW
H(I5),H(J5),H(J6),H(K1),H(K2),H(K3),H(K4),NSIZE,NC
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1
404
2
402
402
VALUE(2)=H(J5+2)
VALUE(4)=H(J6+2)
404
INDEX=0
VALUE(1)=H(J5)
VALUE(NC+1)=H(J6)
TRANSFER TO SUBROUTINE NORM
H(K1),H(K1),NSIZE,H(J1),INDEX,NSIZE,NC,2
INDEX1=INDEX
ITERS=-ITERS
I=K4+2*INDEX-2
H(J1)=H(I)
H(J1+1)=H(I+1)
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1
420
2
410
410
I=I+NX
H(J1+2)=H(I)
H(J1+3)=H(I+1)
420
INDEX=-INDEX
TRANSFER TO SUBROUTINE NORM
H(K4),H(K4),NSIZE,H(J1),INDEX,NSIZE,NC,2


GO TO 500
0
IF
K3-12
-
IF
+
GO TO 480
440
J3=13
442
J4=14
450
K=1
460
REPEAT TO 462 FOR J=1,1+1,...,16
J1=J3+J-1
J2=J4+J-1
462
H(J1)=H(J2)
COMPUTED GO TO
IF THE VALUE OF K IS
TRANSFER TO STATEMENT
1 520
2 510
3 514
4 600
470
J3=11
GO TO 442
480
CONTINUE
GO TO 470
IF
K3-13
-
IF
+
GO TO 470
490
K=3
J3=11
J4=13
GO TO 460
500
K=2
J3=13
J4=11
GO TO 460
510
J3=11
512
J4=12
GO TO 450
514
J3=13
GO TO 512
520
TRANSFER TO SUBROUTINE HADS
H(1),U(13),H(12),NSIZE,NC
600
TRANSFER TO SUBROUTINE CHANGE
H(1),NSIZE,2*NC,NSIZE,2
604
J=NC*NSIZE+1
INDEX=0
TRANSFER TO SUBROUTINE NORM
H(J),H(1),NSIZE,H(15),INDEX,NSIZE,NC,1
J=J+INDEX1-1
J1=J+(NC-1)*NSIZE
H(J)=0.
H(J1)=0.
INDEX2=INDEX
606
TRANSFER TO SUBROUTINE OVERFL
IOVFLO
COMPUTED GO TO
IF THE VALUE OF IOVFLO IS
TRANSFER TO STATEMENT
1 610
2 620
610
IRR=IRR+1
620
TRANSFER TO SUBROUTINE DVCHK
IDVCT
COMPUTED GO TO
IF THE VALUE OF IDVCT IS
TRANSFER TO STATEMENT
1 630
2 640


630
IRR=IRR+2
640
TRANSFER TO SUBROUTINE
CHANGE
U,NSIZE,NC*NSIZE,MAXR,2
700
RETURN
750
IK=IS+(4-K)*N2C
VALUE(1)=H(IK)
IK=IK+2*(NC-1)
VALUE(NC)=H(IK)
INDEX1=INDEX
K=4
J3=I1
J4=K1
K1-I1
IF
GO TO
460
GO TO
800
GO TO 460
800
IGO=3
INDEX1=INDEX
J=IS
J1=IS+4*N2C
806
TRANSFER TO SUBROUTINE
LEGIS
H(J),H(J1),EPS1,EPS2,NC,IR
IR
IF
GO TO
340
GO TO 750
GO TO
340

```
                         NITERS

          A IS STORED IN CORE AT A.     (MAXR X NC*NP*NSIZE )

        NTAPUT IS A UTILITY TAPE, FOR CHECK VECTORS IF DESIRED.

     EPSP = EPSILON ONE = SINGLE PRECISION CONVERGENCE TEST NUMBER

      EPDP = EPSILON TWO = DOUBLE PRECISION      ..        ..   ..

    NC = 1, IF REAL                      NP = 1, IF SINGLE PRECISION

         2, IF COMPLEX                      = 2, IF DOUBLE     ..

         NGUESS = 0, IF FIRST GUESS IS TO BE A COLUMN OF ONES.

                MODOUT = NO. OF MODES TO BE COMPUTED.

   NAKSR = NO. TIMES AITKENS ACCELERATION WAS USED IN SINGLE PRECISION.

   NAKDR = ..     ..     ..      ..        ..    ..   .. DOUBLE     ..   .

        MAXSR = MAXIMUM ITERATIONS ALLOWED IN SINGLE PRECISION.

        MAXDR =    ..       ..           ..    .. DOUBLE     ..    .

                IER = ERROR RETURN  = 1, FOR OVERFLOW

                                      2, FOR DIVIDE CHECK

                              3, FOR BOTH OVERFLOW AND DIVIDE CHECK

                 NSIZE = NO. OF ROWS AND COLUMNS OF A

  RSP =  R, AITKENS ACCELERATION CONVERGENCE CONTROL FOR SINGLE PRECIS.

  RDP =  R  AITKENS ACCELERATION CONVERGENCE CONTROL FOR DOUBLE PRECIS.

          MAXR  =  DIMENSIONED NUMBER OF ROWS OF A AND GUESS

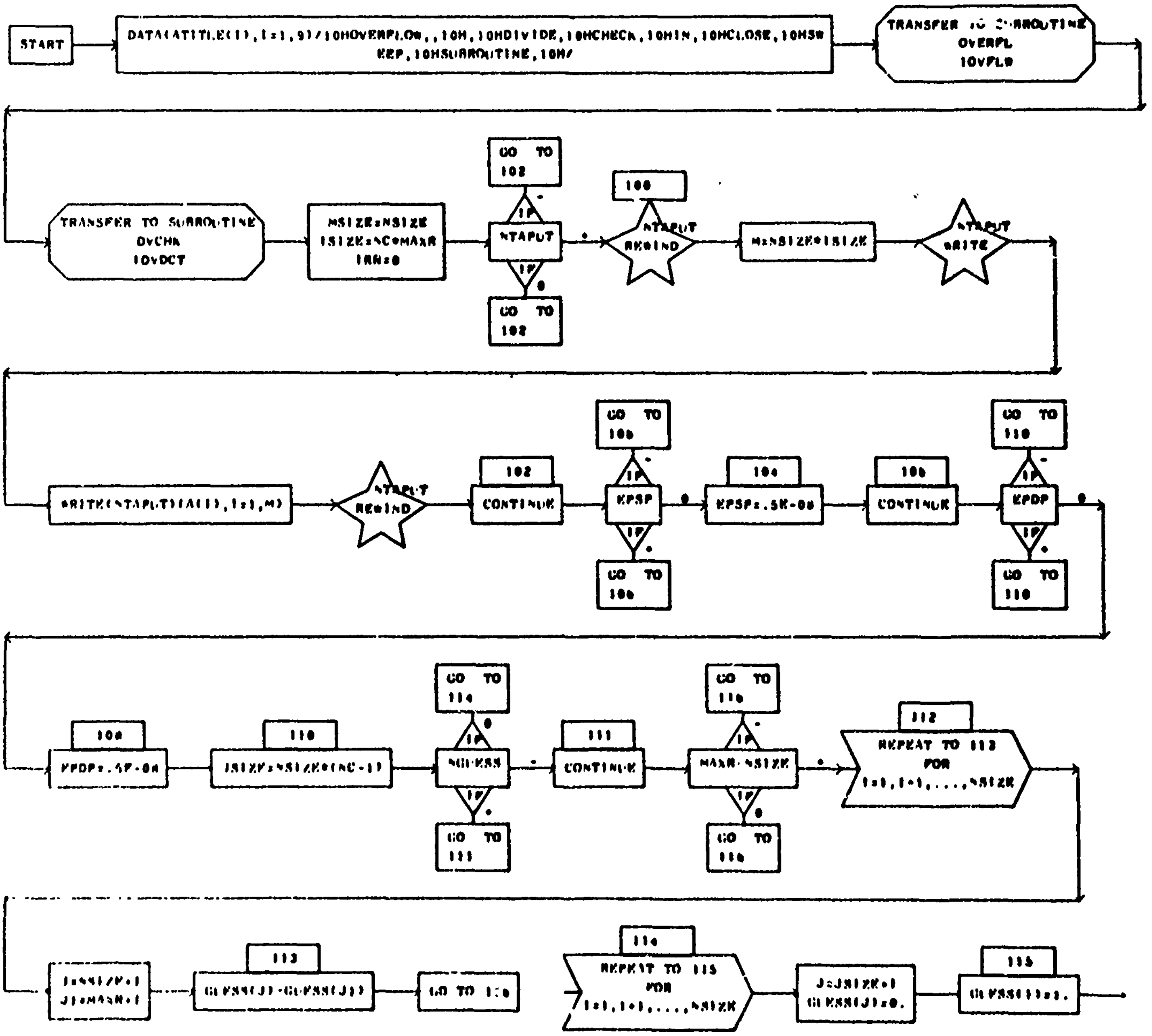


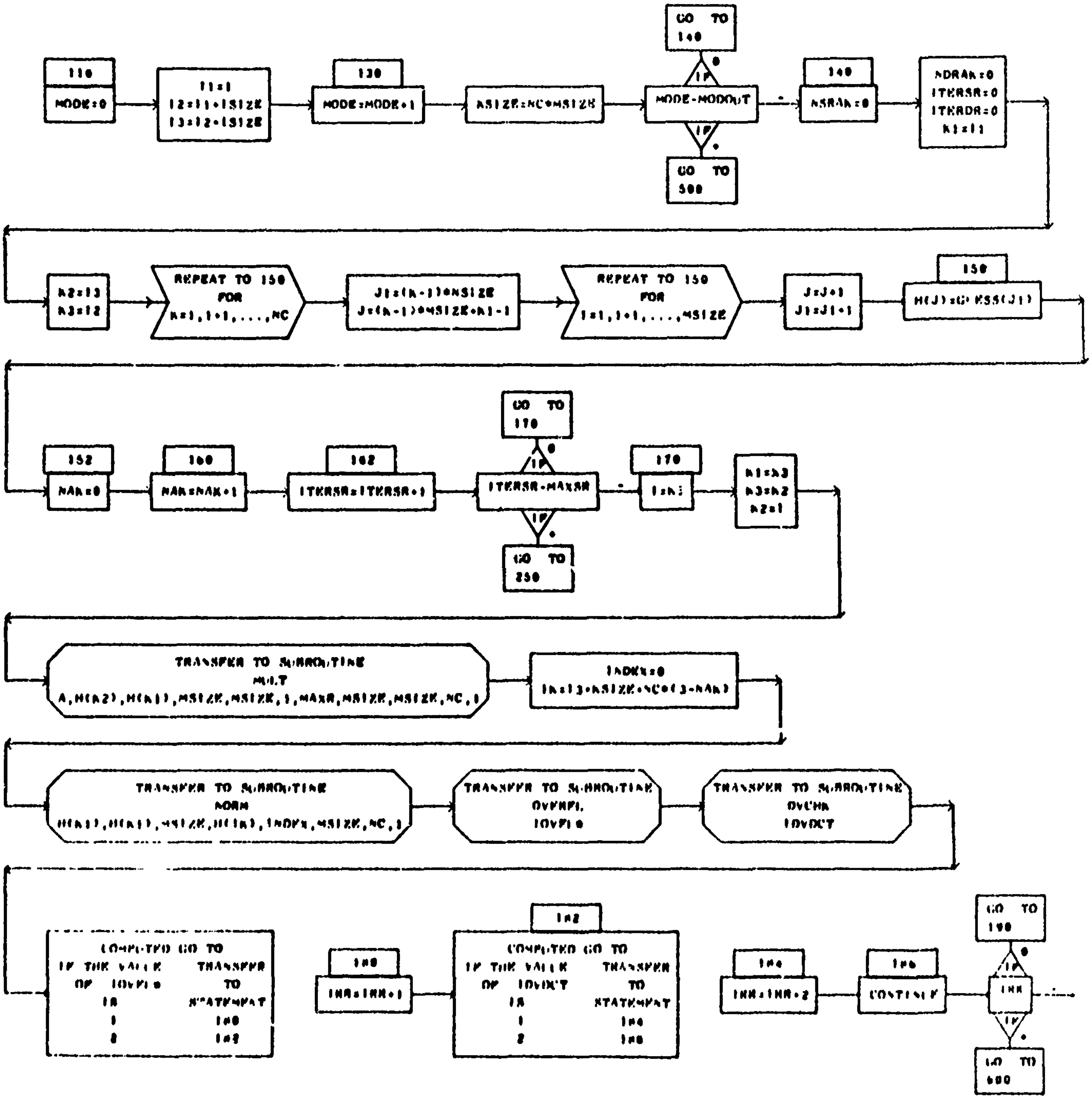
                    D I M E N S I O N E D   V A R I A B L E S

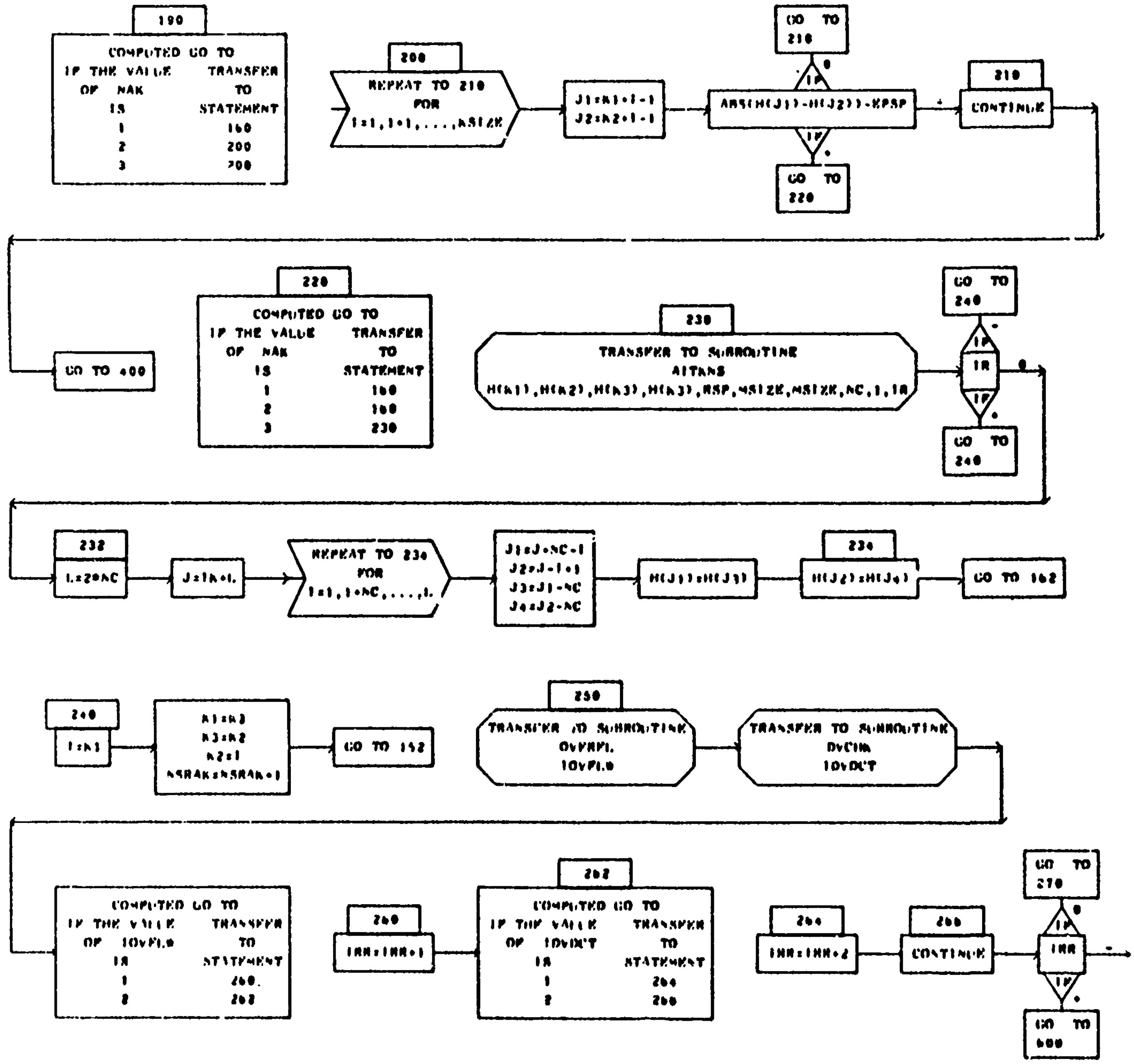
SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES   SYMBOL     STORAGES

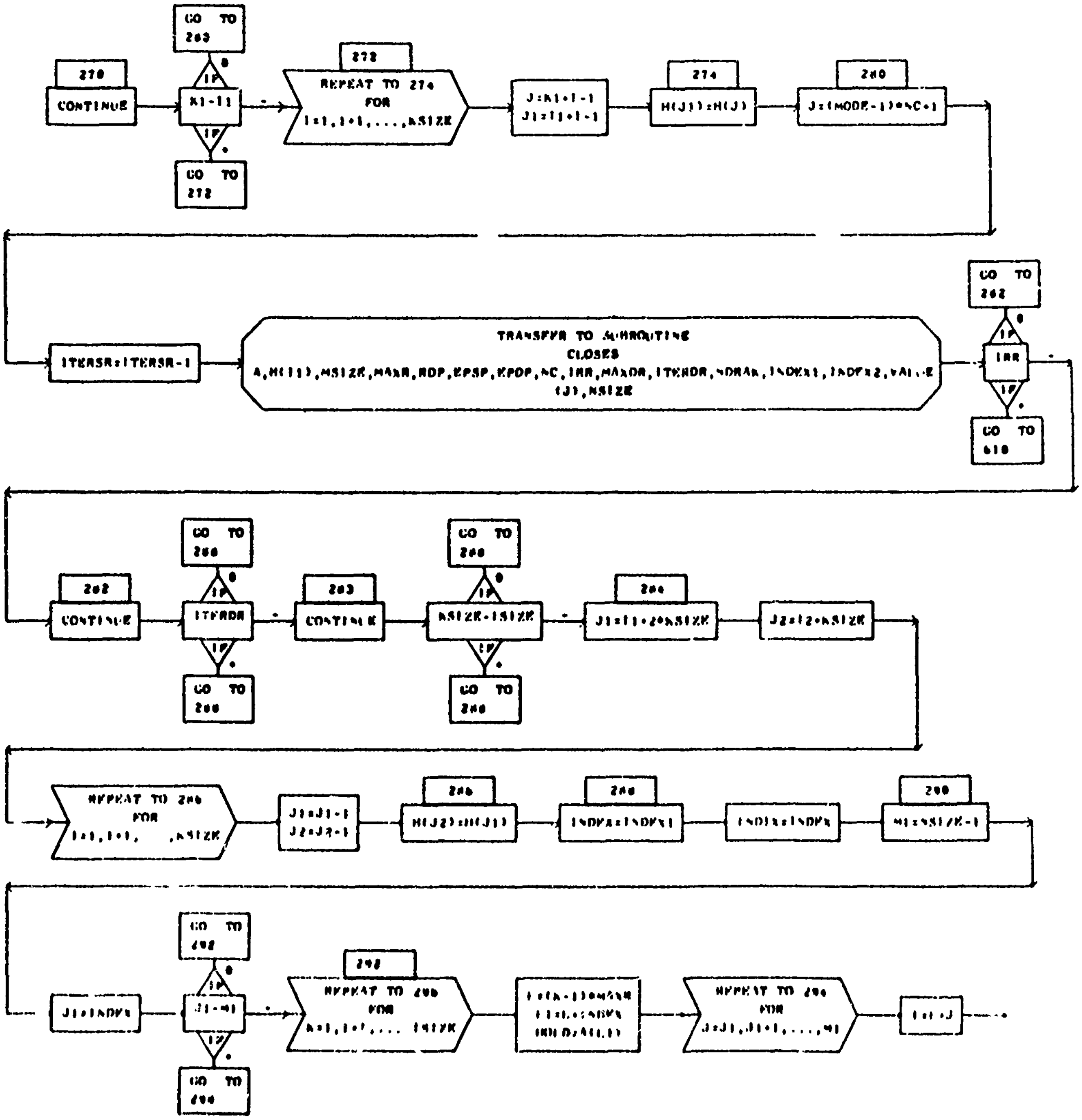
 A            1        GUESS        1        N            1        NITER        1        NAKSR        1
 NAKDR        1        ATITLE       8        VECTOR       1        VALUE        1
```

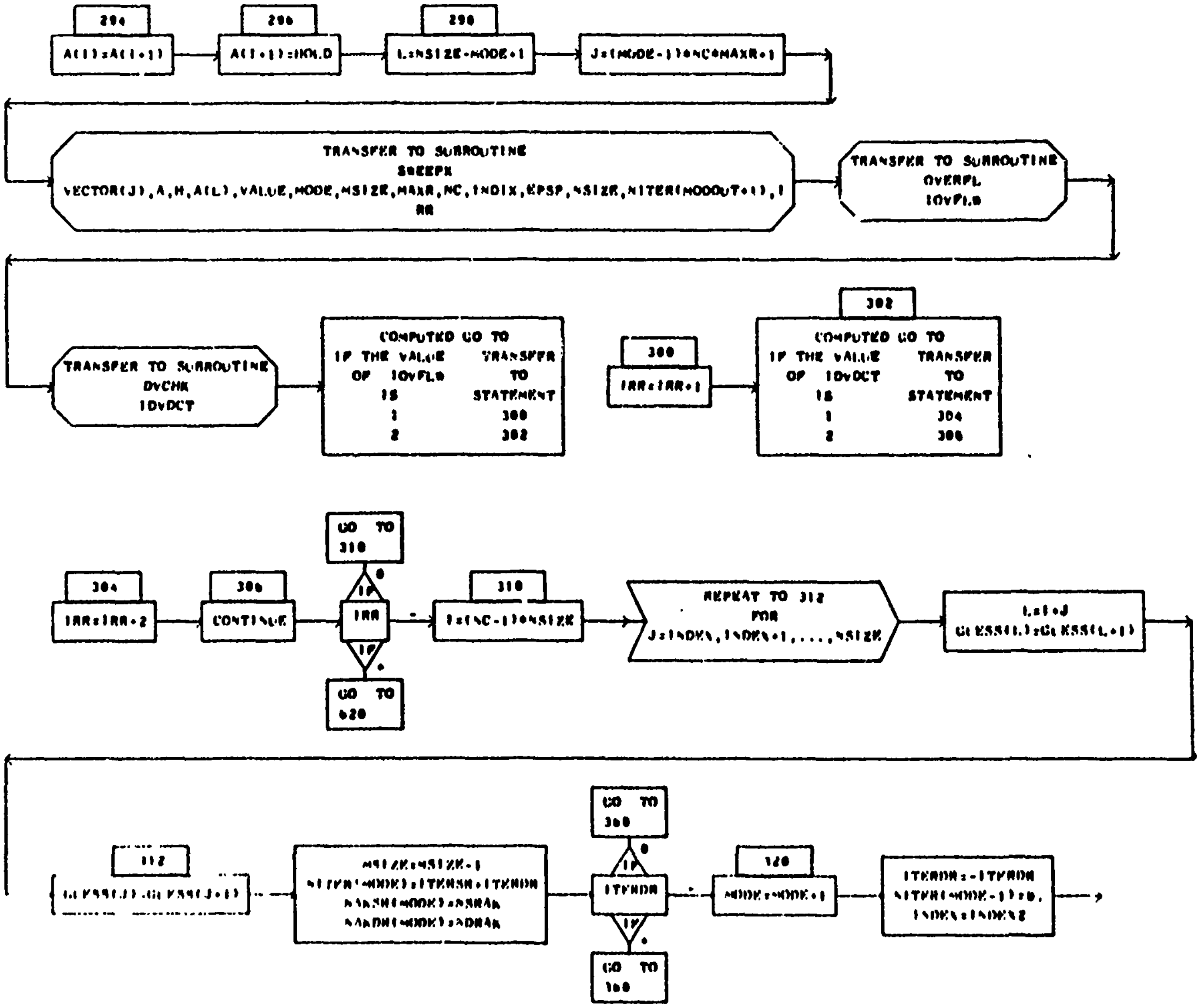
SUBROUTINE MITERS(A,GUESS,NGUESS,NSIZE,MODOUT,MAXR,NC,EPSP,EPDP,   PAGE 1

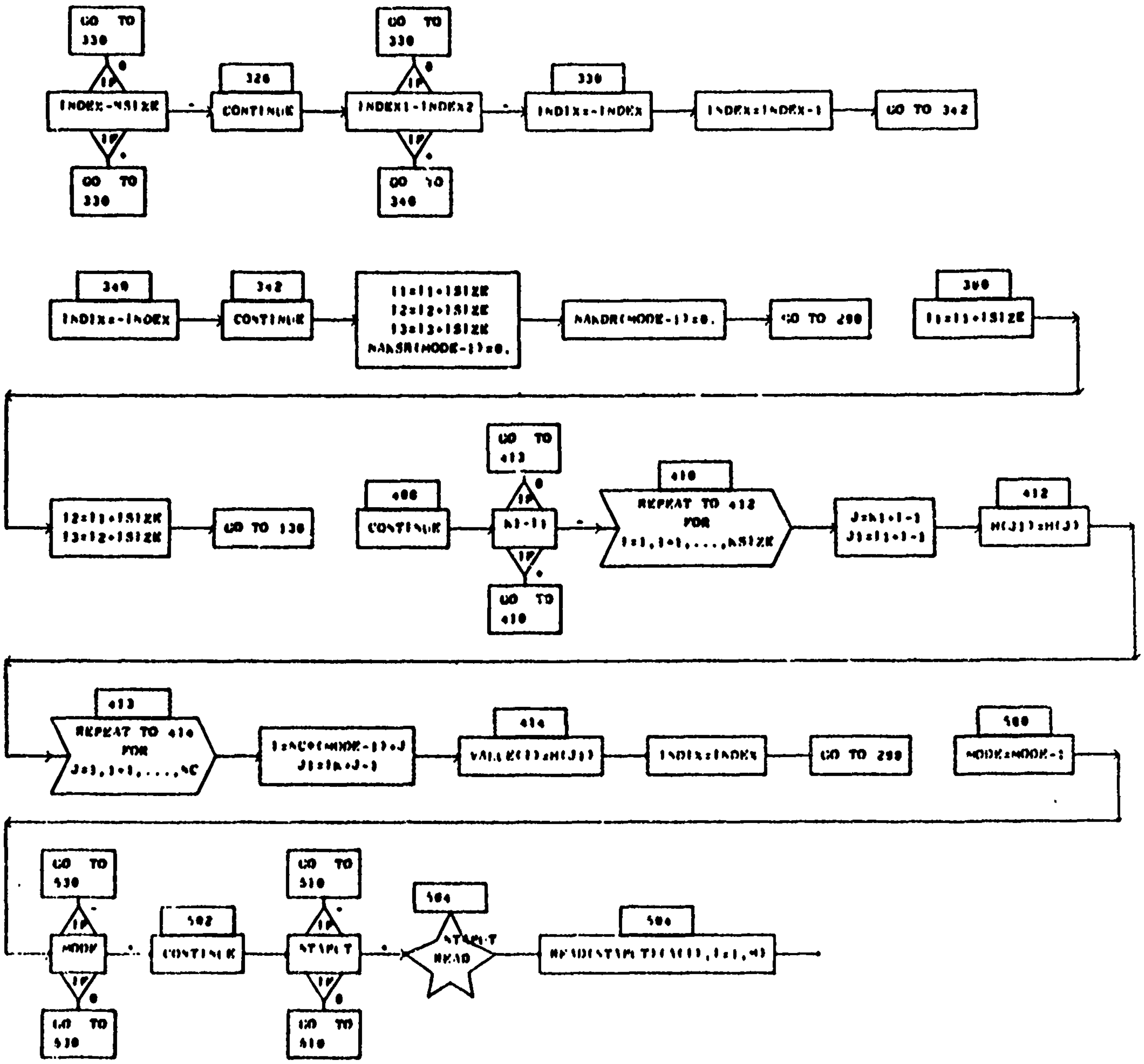


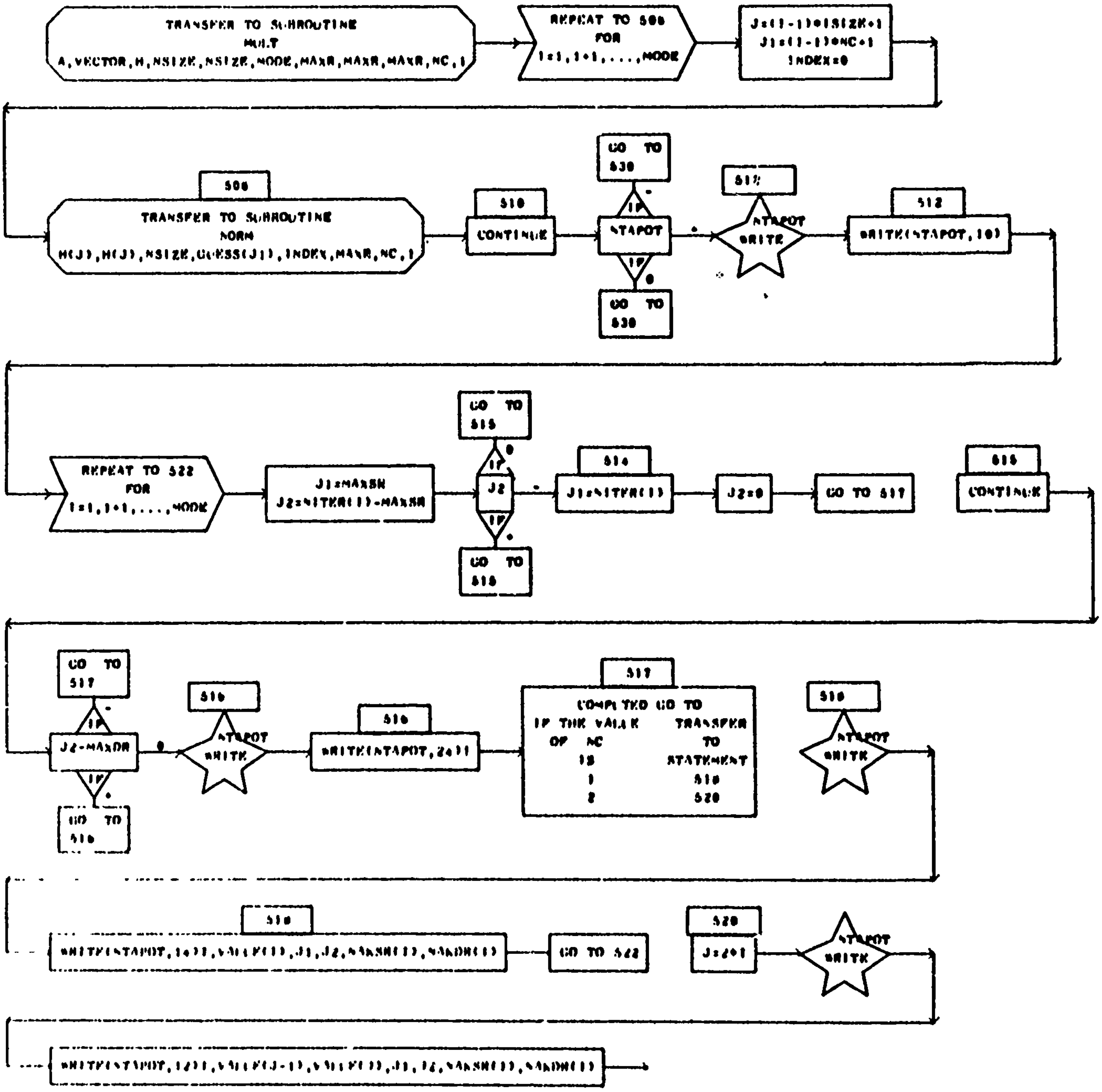

110
MODE=0
I1=1
I2=I1+ISIZE
I3=I2+ISIZE
120
MODE=MODE+1
KSIZE=NC*NSIZE
GO TO 140
IF
MODE-MODOUT
IF
GO TO 500
140
NSRAK=0
NDRAK=0
ITERSR=0
ITERDR=0
K1=I1
K2=I3
K3=I2
REPEAT TO 150 FOR K=1,1+1,...,NC
J1=(K-1)*NSIZE
J=(K-1)*NSIZE+K1-1
REPEAT TO 150 FOR I=1,1+1,...,NSIZE
J=J+1
J1=J1+1
150
H(J)=GUESS(J1)
152
NAK=0
160
NAK=NAK+1
162
ITERSR=ITERSR+1
GO TO 170
IF
ITERSR-MAXSR
IF
GO TO 250
170
I=K1
K1=K3
K3=K2
K2=I
TRANSFER TO SUBROUTINE MULT
A,H(K2),H(K1),NSIZE,NSIZE,1,MAXR,NSIZE,NSIZE,NC,1
INDEX=0
IK=I3+NSIZE*NC*(3-NAK)
TRANSFER TO SUBROUTINE NORM
H(K1),H(K1),NSIZE,H(IK),INDEX,NSIZE,NC,1
TRANSFER TO SUBROUTINE OVERFL
IOVFL0
TRANSFER TO SUBROUTINE DVCHK
IDVDCT
COMPUTED GO TO
IF THE VALUE OF IOVFL0 IS
TRANSFER TO STATEMENT
1 180
2 182
180
INR=INR+1
182
COMPUTED GO TO
IF THE VALUE OF IDVDCT IS
TRANSFER TO STATEMENT
1 184
2 186
184
INR=INR+2
186
CONTINUE
GO TO 190
IF
INR
IF
GO TO 600

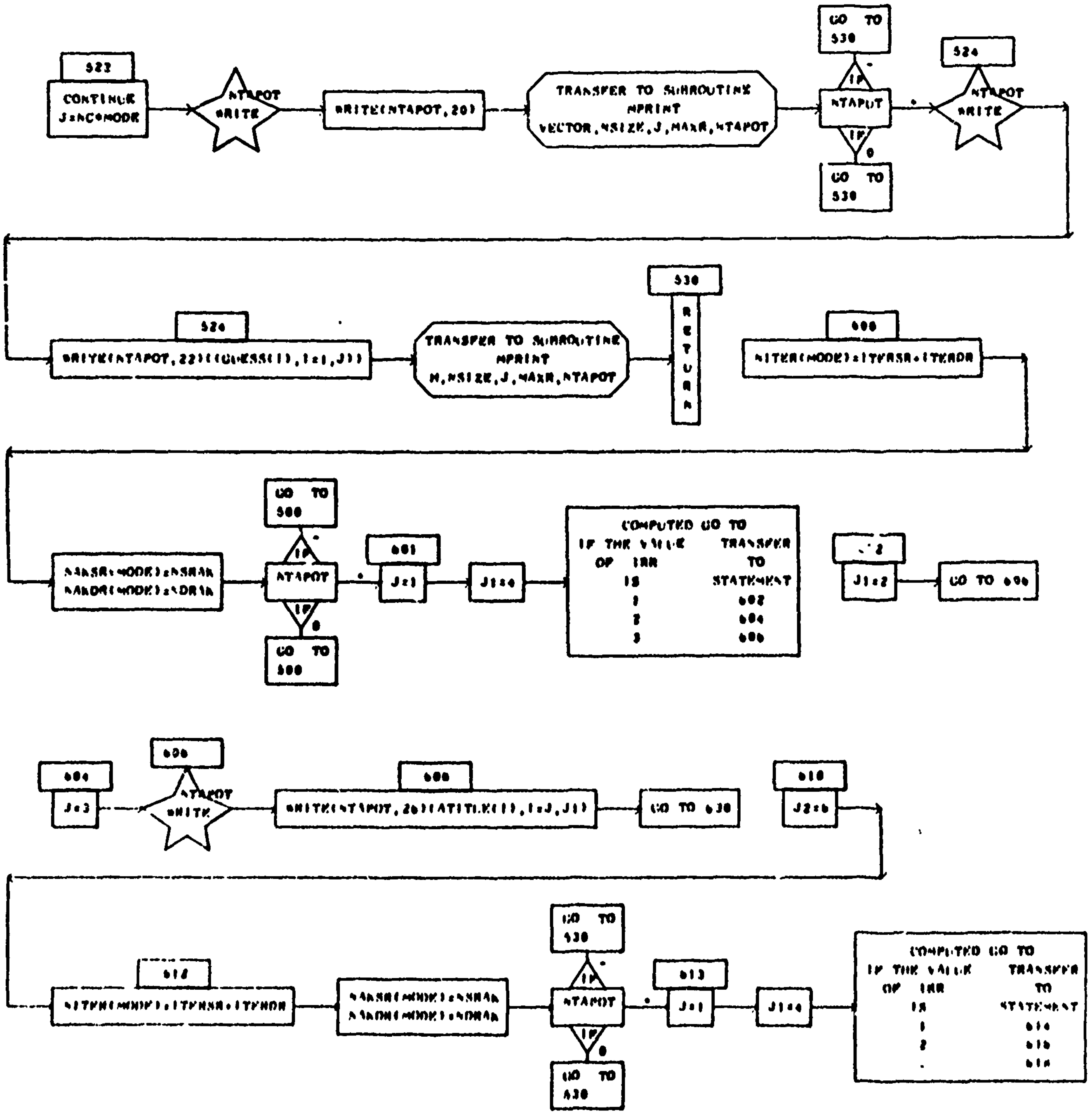

190
COMPUTED GO TO
IF THE VALUE OF NAK IS
TRANSFER TO STATEMENT
1 160
2 200
3 200
200
REPEAT TO 210 FOR I=1,I+1,...,NSIZE
J1=K1+I-1
J2=K2+I-1
ABS(H(J1)-H(J2))-EPSP
IF
GO TO 210
GO TO 220
210
CONTINUE
GO TO 400
220
COMPUTED GO TO
IF THE VALUE OF NAK IS
TRANSFER TO STATEMENT
1 160
2 160
3 230
230
TRANSFER TO SUBROUTINE AITKNS
H(K1),H(K2),H(K3),H(K3),RSP,NSIZE,NSIZE,NC,1,IR
IR
GO TO 240
GO TO 240
232
L=2*NC
J=IK+L
REPEAT TO 234 FOR I=1,I+NC,...,L
J1=J+NC-1
J2=J-I+1
J3=J1-NC
J4=J2-NC
H(J1)=H(J3)
234
H(J2)=H(J4)
GO TO 162
240
I=K1
K1=K3
K3=K2
K2=I
NSRAK=NSRAK+1
GO TO 152
250
TRANSFER TO SUBROUTINE OVERFL IOVFLO
TRANSFER TO SUBROUTINE DVCHK IOVDCT
COMPUTED GO TO
IF THE VALUE OF IOVFLO IS
TRANSFER TO STATEMENT
1 260
2 262
260
INR=INR+1
262
COMPUTED GO TO
IF THE VALUE OF IOVDCT IS
TRANSFER TO STATEMENT
1 264
2 266
264
INR=INR+2
266
CONTINUE
INR
GO TO 270
GO TO 600

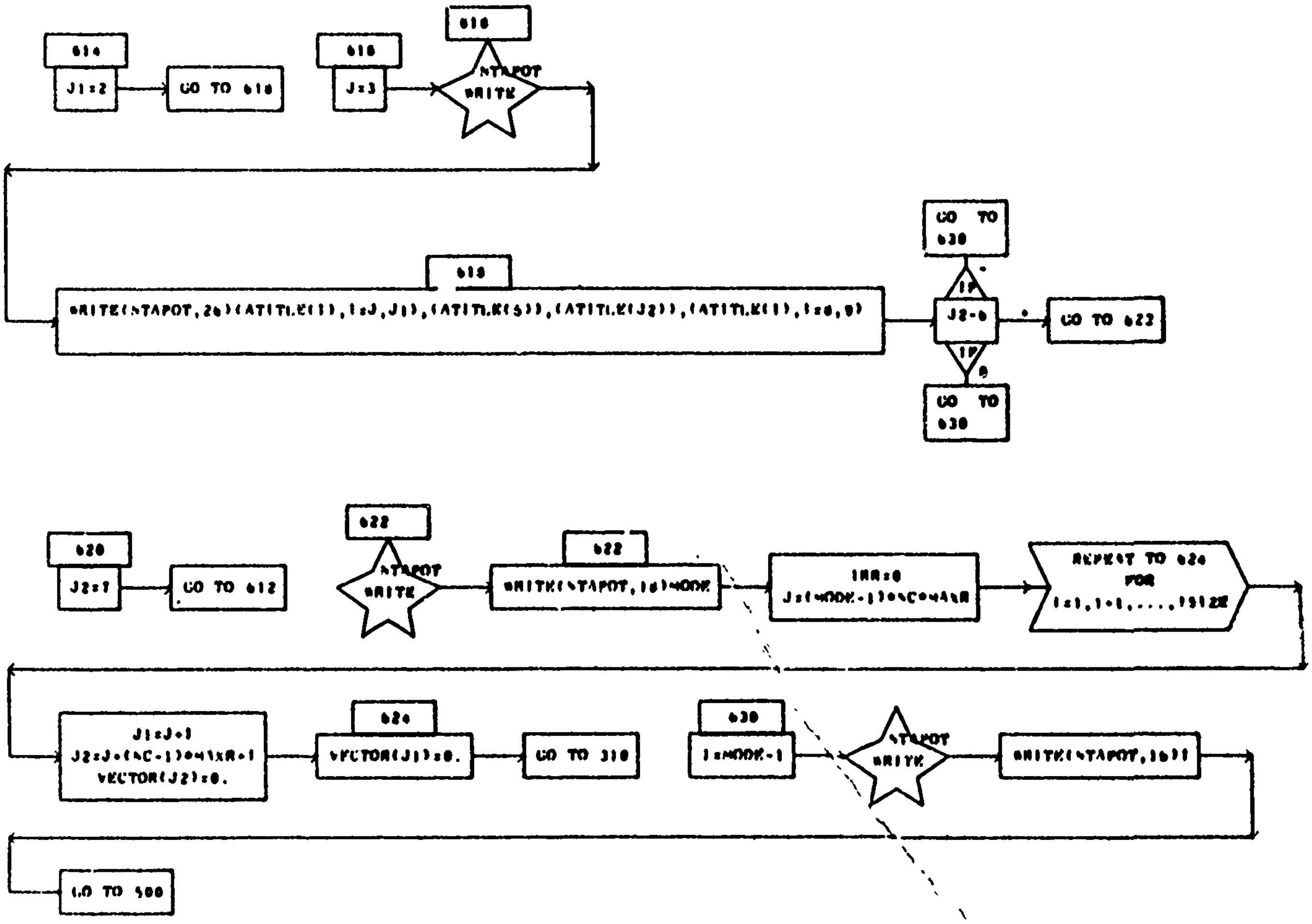

270
CONTINUE
GO TO 283
IF
K1-I1
IF
GO TO 272
272
REPEAT TO 274 FOR I=1,I+1,...,NSIZE
J=K1+I-1
J1=I1+I-1
274
H(J1)=H(J)
280
J=(MODE-1)*NC+1
ITERSR=ITERSR-1
TRANSFER TO SUBROUTINE CLOSES
A,H(I1),NSIZE,MAXR,RDP,EPSP,EPDP,NC,IRR,MAXDR,ITERDR,NDRAW,INDEX1,INDEX2,VALUE(J),NSIZE
GO TO 282
IF
IRR
IF
GO TO 610
282
CONTINUE
GO TO 288
IF
ITERDR
IF
GO TO 288
283
CONTINUE
GO TO 288
IF
NSIZE-ISIZE
IF
GO TO 288
284
J1=I1+2*NSIZE
J2=I2+NSIZE
REPEAT TO 286 FOR I=1,I+1,...,NSIZE
J1=J1-1
J2=J2-1
286
H(J2)=H(J1)
288
INDEX=INDEX1
INDEX=INDEX
290
M1=NSIZE-1
J1=INDEX
GO TO 292
IF
J1-M1
IF
GO TO 294
292
REPEAT TO 296 FOR K=1,K+1,... ISIZE
I=(K-1)*MAXR
I1=L+INDEX
HOLD=A(L,I)
REPEAT TO 294 FOR J=J1,J1+1,...,M1
I=I+J


294
A(I)=A(I+1)
296
A(I+1)=HOLD
298
L=NSIZE-MODE+1
J=(MODE-1)*NC*MAXR+1
TRANSFER TO SUBROUTINE
SWEEPX
VECTOR(J),A,H,A(L),VALUE,MODE,NSIZE,MAXR,NC,INDIX,EPSP,NSIZE,NITER(MODOUT+1),I
RR
TRANSFER TO SUBROUTINE
OVERFL
IOVFLW
TRANSFER TO SUBROUTINE
DVCHK
IDVDCT
COMPUTED GO TO
IF THE VALUE OF IOVFLW IS
TRANSFER TO STATEMENT
1
300
2
302
300
IRR=IRR+1
302
COMPUTED GO TO
IF THE VALUE OF IDVDCT IS
TRANSFER TO STATEMENT
1
304
2
306
304
IRR=IRR+2
306
CONTINUE
GO TO
310
0
IF
IRR
-
IF
+
GO TO
620
310
I=(NC-1)*NSIZE
REPEAT TO 312
FOR
J=INDEX,INDEX+1,....,NSIZE
L=I+J
GUESS(L)=GUESS(L+1)
312
GUESS(J)=GUESS(J+1)
NSIZE=NSIZE-1
NITER(MODE)=ITERSM+ITERDM
NAKSM(MODE)=NSRAK
NAKDM(MODE)=NDRAK
GO TO
360
0
IF
ITERDM
-
IF
+
GO TO
160
320
MODE=MODE+1
ITERDM=-ITERDM
NITER(MODE-1)=0,
INDEX=INDEX2


GO TO 330
IF
0
INDEX-NSIZE
+
IF
-
GO TO 330
320
CONTINUE
GO TO 330
IF
0
INDEX1-INDEX2
+
IF
-
GO TO 340
330
INDIX=-INDEX
INDEX=INDEX-1
GO TO 342
340
INDIX=-INDEX
342
CONTINUE
I1=I1+ISIZE
I2=I2+ISIZE
I3=I3+ISIZE
NANSR(MODE-1)=0.
NANDR(MODE-1)=0.
GO TO 290
390
I1=I1+ISIZE
I2=I1+ISIZE
I3=I2+ISIZE
GO TO 130
400
CONTINUE
GO TO 413
IF
0
NI-11
+
IF
-
GO TO 410
410
REPEAT TO 412
FOR
I=1,1+1,...,NSIZE
J=NI+I-1
J1=I1+I-1
412
H(J1)=H(J)
413
REPEAT TO 414
FOR
J=1,1+1,...,NC
I=NC*(MODE-1)+J
J1=IN+J-1
414
VALUE(I)=H(J1)
INDIX=INDEX
GO TO 290
500
MODE=MODE-1
GO TO 530
IF
-
MODE
+
IF
0
GO TO 530
502
CONTINUE
GO TO 510
IF
-
STAPLT
+
IF
0
GO TO 510
504
STAPLT
READ
506
READ(STAPLT)(A(I),I=1,N)


TRANSFER TO SUBROUTINE
MULT
A,VECTOR,H,NSIZE,NSIZE,MODE,MAXR,MAXR,MAXR,NC,1
REPEAT TO 506
FOR
I=1,I+1,...,MODE
J=(I-1)*NSIZE+1
J1=(I-1)*NC+1
INDEX=0
506
TRANSFER TO SUBROUTINE
NORM
H(J),H(J),NSIZE,GUESS(J1),INDEX,MAXR,NC,1
510
CONTINUE
GO TO
530
IF
NTAPOT
IF
-
+
0
GO TO
530
511
NTAPOT
WRITE
512
WRITE(NTAPOT,10)
REPEAT TO 522
FOR
I=1,I+1,...,MODE
J1=MAXSR
J2=NITER(I)-MAXSR
GO TO
515
IF
J2
IF
0
-
+
GO TO
515
514
J1=NITER(I)
J2=0
GO TO 517
515
CONTINUE
GO TO
517
IF
J2-MAXDR
IF
-
0
+
GO TO
516
516
NTAPOT
WRITE
516
WRITE(NTAPOT,24)
517
COMPUTED GO TO
IF THE VALUE
OF NC
IS
1
2
TRANSFER
TO
STATEMENT
518
520
518
NTAPOT
WRITE
518
WRITE(NTAPOT,14),VALUE(I),J1,J2,NAKSR(I),NAKDR(I)
GO TO 522
520
J=2*I
NTAPOT
WRITE
WRITE(NTAPOT,12),VALUE(J-1),VALUE(J),J1,J2,NAKSR(I),NAKDR(I)


522
CONTINUE
J=NC*MODE
NTAPOT
WRITE
WRITE(NTAPOT,20)
TRANSFER TO SUBROUTINE
MPRINT
VECTOR,NSIZE,J,MAXR,NTAPOT
GO TO
530
IF
NTAPOT
IF
0
GO TO
530
524
NTAPOT
WRITE
524
WRITE(NTAPOT,22)((GUESS(I),I=1,J))
TRANSFER TO SUBROUTINE
MPRINT
M,NSIZE,J,MAXR,NTAPOT
530
RETURN
600
NITER(MODE)=ITERSR+ITERDR
NAKSR(MODE)=NSRAK
NAKDR(MODE)=NDRAK
GO TO
500
IF
NTAPOT
IF
0
GO TO
500
601
J=1
J1=4
COMPUTED GO TO
IF THE VALUE OF IRR IS
TRANSFER TO STATEMENT
1 602
2 604
3 606
602
J1=2
GO TO 606
604
J=3
606
NTAPOT
WRITE
608
WRITE(NTAPOT,26)(ATITLE(I),I=J,J1)
GO TO 630
610
J2=6
612
NITER(MODE)=ITERSR+ITERDR
NAKSR(MODE)=NSRAK
NAKDR(MODE)=NDRAK
GO TO
530
IF
NTAPOT
IF
0
GO TO
630
613
J=1
J1=4
COMPUTED GO TO
IF THE VALUE OF IRR IS
TRANSFER TO STATEMENT
1 614
2 616
. 618


614
J1=2
GO TO 618
616
J=3
618
NTAPOT
WRITE
618
WRITE(NTAPOT,26)(ATITLE(I),I=J,J1),(ATITLE(5)),(ATITLE(J2)),(ATITLE(I),I=8,9)
GO TO
630
-
IF
J2-6
+
GO TO 622
IF
0
GO TO
630
620
J2=7
GO TO 612
622
NTAPOT
WRITE
622
WRITE(NTAPOT,18)MODE
IRR=0
J=(MODE-1)*NC*MAXR
REPEAT TO 624
FOR
I=1,1+1,....,NSIZE
J1=J+I
J2=J+(NC-1)*MAXR+I
VECTOR(J2)=0.
624
VECTOR(J1)=0.
GO TO 310
630
I=MODE-1
NTAPOT
WRITE
WRITE(NTAPOT,16)I
GO TO 500

SWEEPS

SWEEPS SUBROUTINE

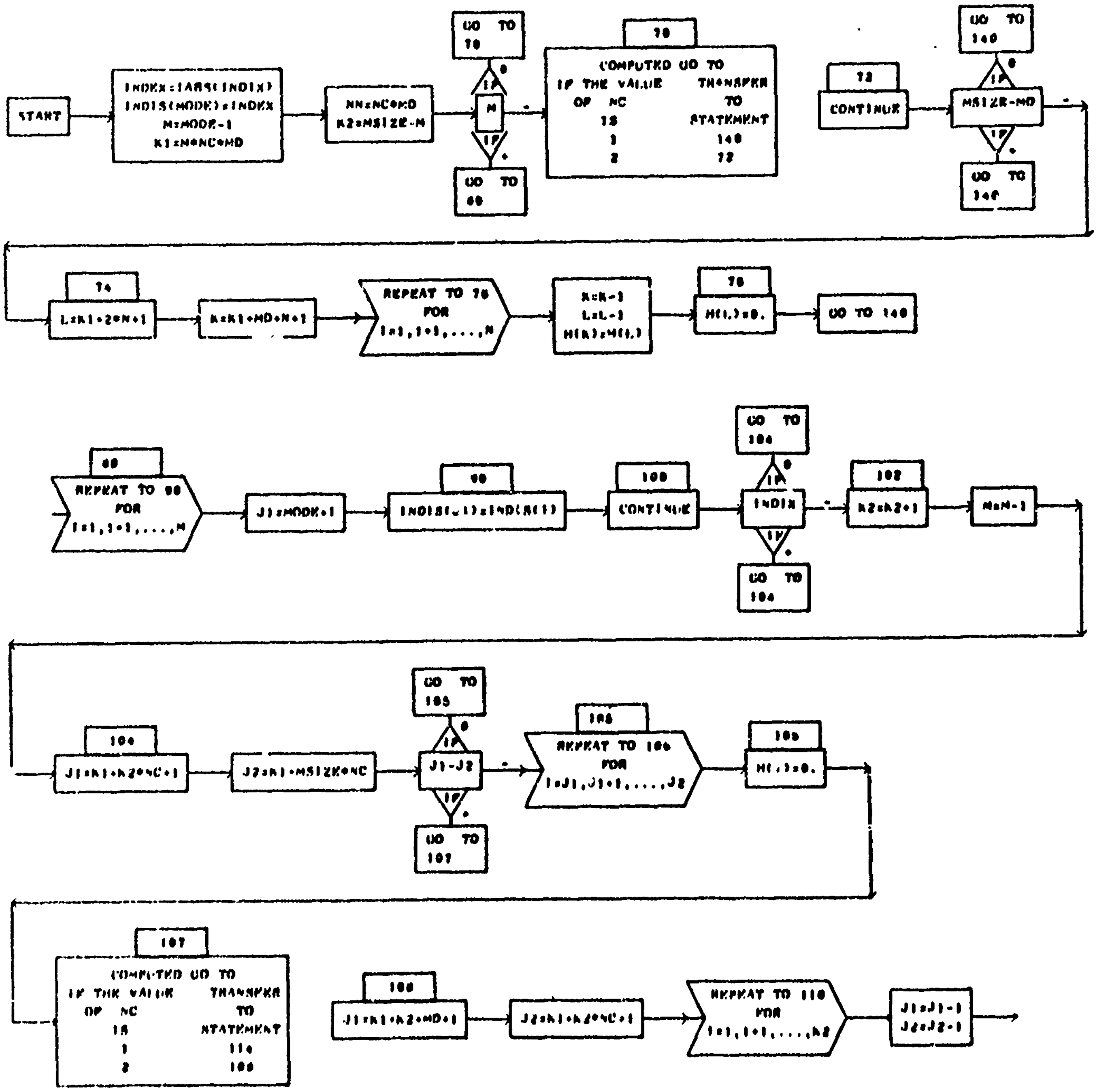
COMPUTES TRUE MODE AND SWEEPS IT FROM THE MATRIX. (REAL OR COMPLEX)

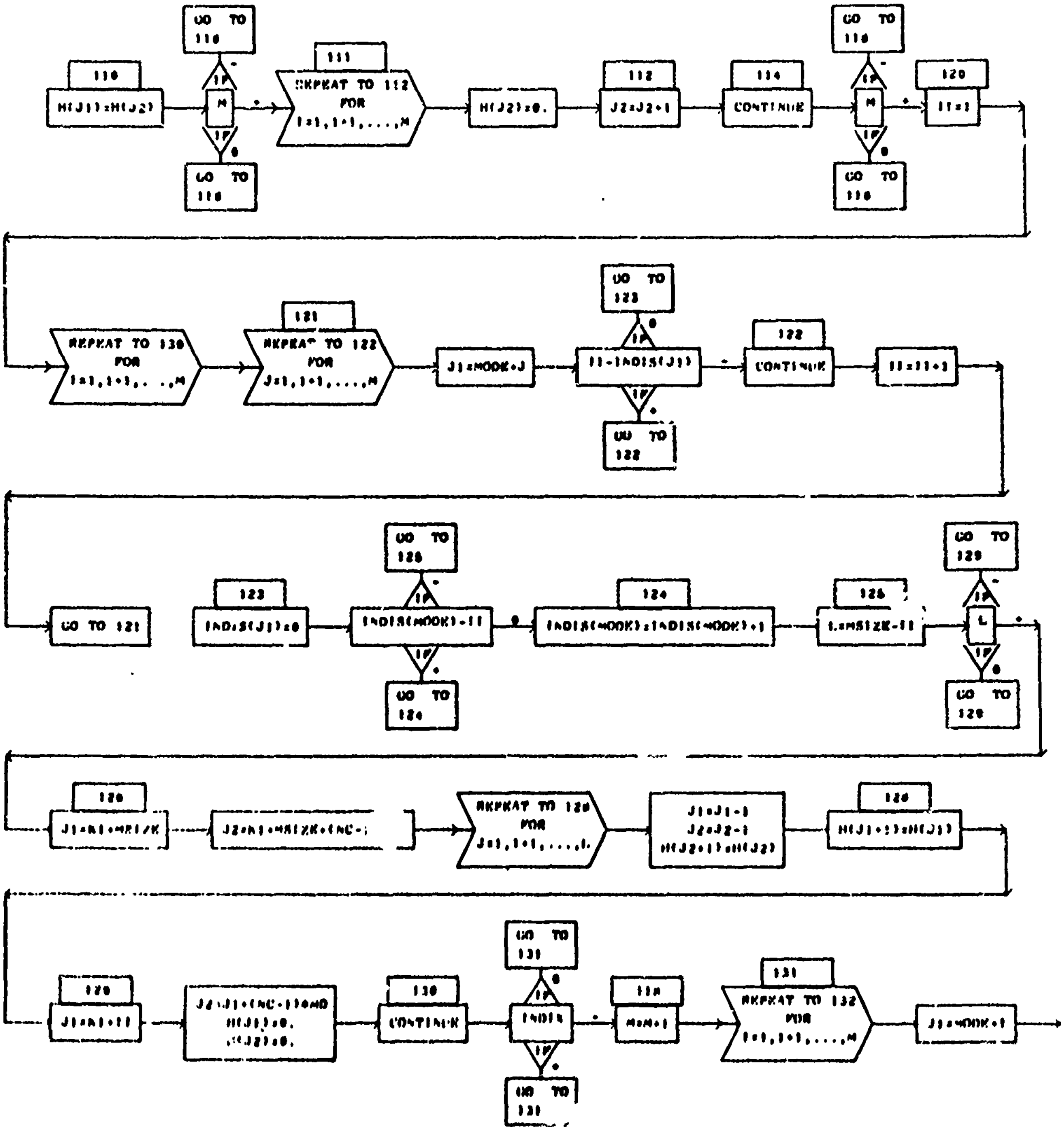
HTRUE = TRUE MODAL COLUMNS, AS COMPUTED. U = DYNAMIC MATRIX.
H = SERIES OF MODIFIED MODAL COLUMNS.EL= COLUMN OF EIGENVALUES.
US = SERIES OF MODIFIED MODAL ROWS OF U.
MODE = MODE NOW BEING COMPUTED.   N = SIZE
ND = DIMENSIONED NUMBER OF ROWS OF U,US,H,HTRUE
NN = 1 IF PROBLEM IS REAL.
= 2 IF PROBLEM IS COMPLEX.

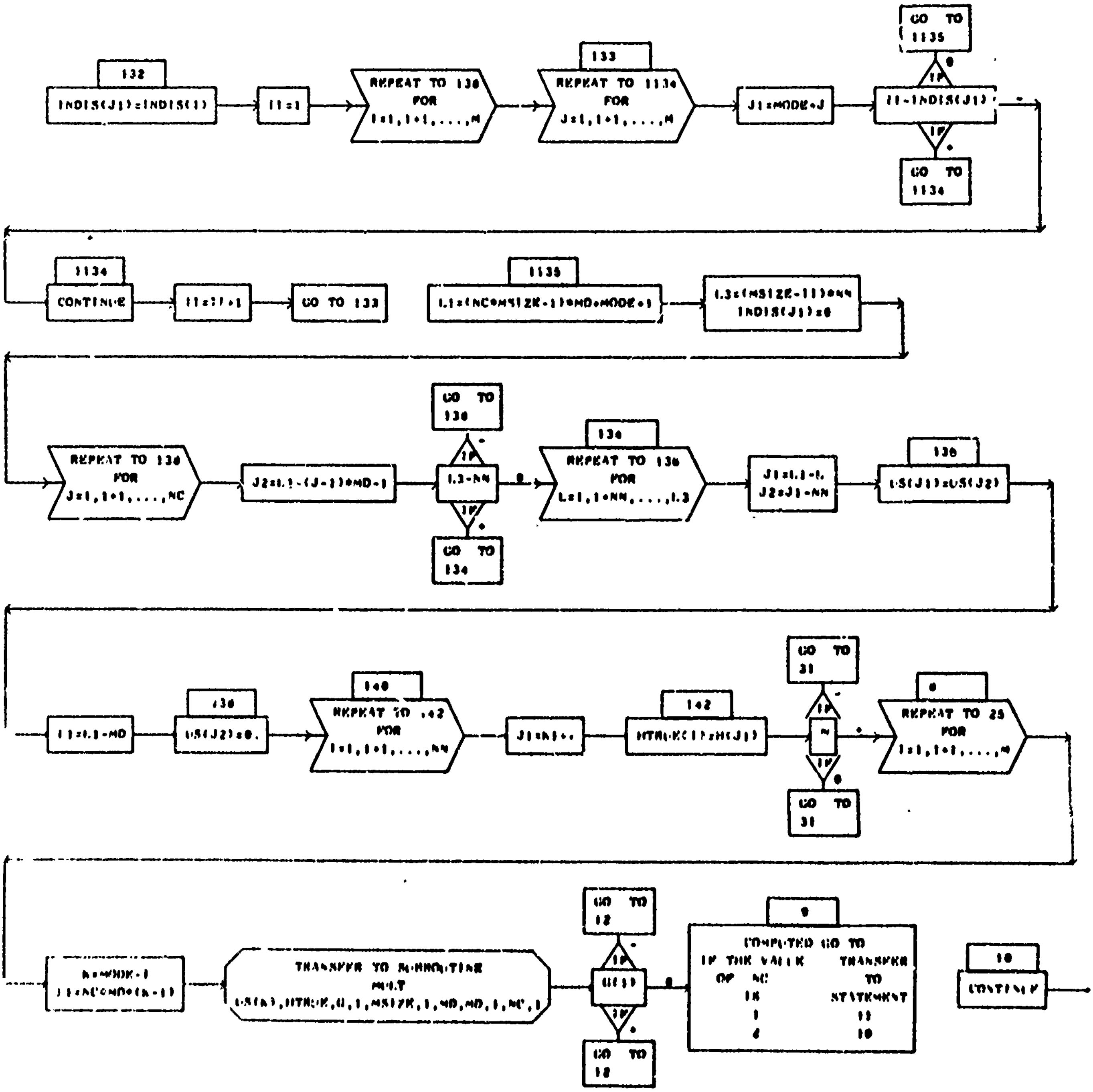
DIMENSIONED VARIABLES

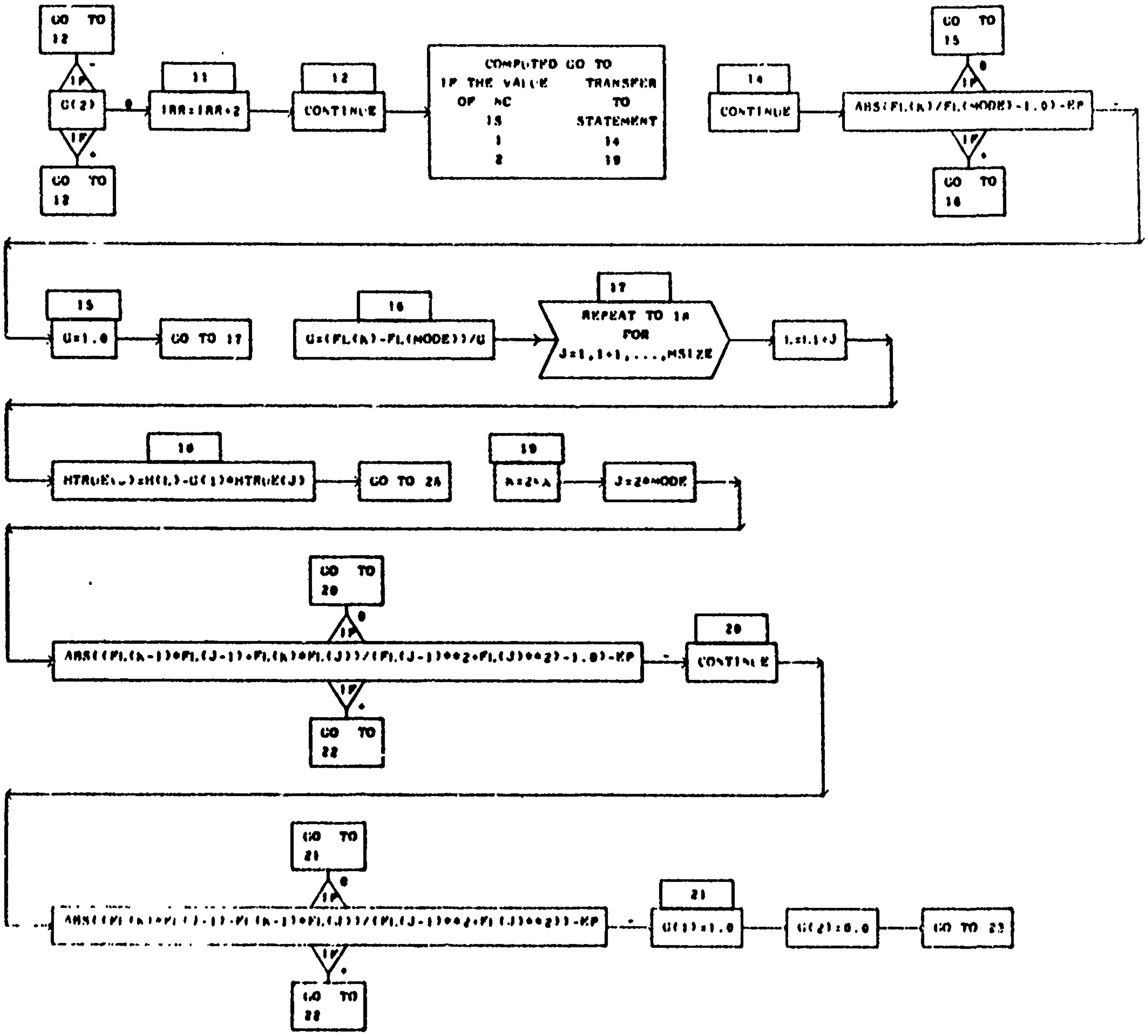
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
H	1	US	1	U	1	HTRUE	1	E	1
G	4	INDIS	1						

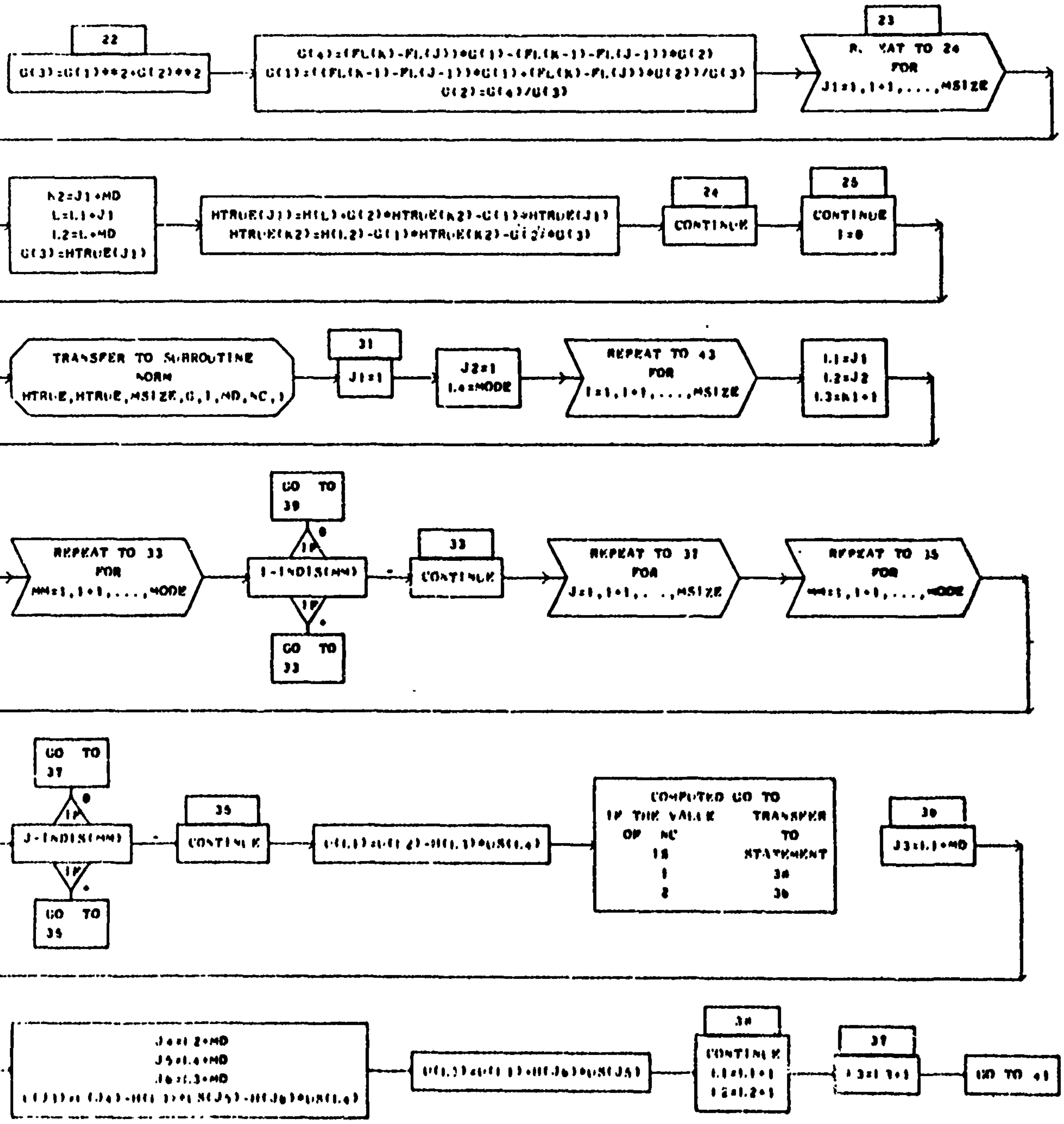
SUBROUTINE SWEEPX (HTRUE, U, M, US, FL, MODE, N, MD, NC, INDIX,

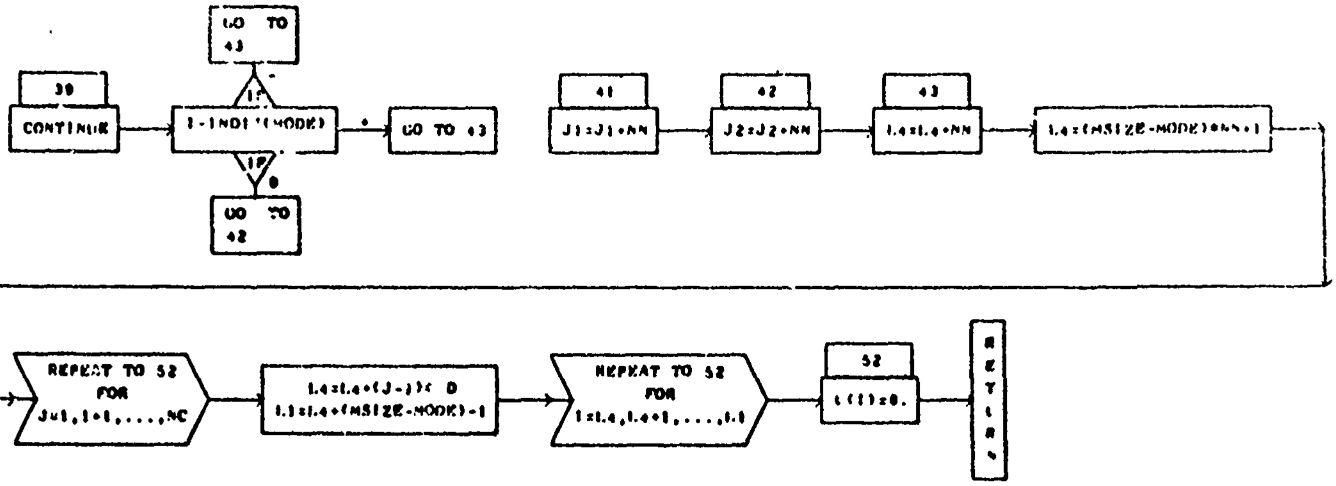



110
H(J1)=H(J2)
IF M
-
GO TO 116
+
0
GO TO 116
111
REPEAT TO 112 FOR I=1,1+1,...,M
H(J2)=0.
112
J2=J2+1
114
CONTINUE
IF M
GO TO 116
GO TO 116
120
I1=1
REPEAT TO 130 FOR I=1,1+1,...,M
121
REPEAT TO 122 FOR J=1,1+1,...,M
J1=MODE+J
IF I1-INDIS(J1)
GO TO 123
GO TO 122
122
CONTINUE
I1=I1+1
GO TO 121
123
INDIS(J1)=0
IF INDIS(MODE)-I1
GO TO 125
GO TO 124
124
INDIS(MODE)=INDIS(MODE)+1
125
L=MSIZE-I1
IF L
GO TO 129
GO TO 126
126
J1=K1+MSIZK
J2=K1+MSIZK+(NC-
REPEAT TO 128 FOR J=1,1+1,...,L
J1=J1-1
J2=J2-1
H(J2+1)=H(J2)
128
H(J1+1)=H(J1)
129
J1=K1+I1
J2=J1+(NC+1)*MD
H(J1)=0.
H(J2)=0.
130
CONTINUE
IF INDIX
GO TO 131
GO TO 131
118
M=M+1
131
REPEAT TO 132 FOR I=1,1+1,...,M
J1=MODE+I


132
INDIS(J1)=INDIS(I)
I1=1
REPEAT TO 138 FOR I=1,1+1,...,M
133
REPEAT TO 1134 FOR J=1,1+1,...,M
J1=MODE+J
GO TO 1135
IF
0
I1-INDIS(J1)
-
IF
+
GO TO 1134
1134
CONTINUE
I1=I1+1
GO TO 133
1135
L1=(NC*MSIZE-1)*MD+MODE+1
L3=(MSIZE-1)*NN
INDIS(J1)=0
REPEAT TO 138 FOR J=1,1+1,...,NC
J2=L1-(J-1)*MD-1
GO TO 136
IF
-
L3-NN
0
IF
+
GO TO 134
134
REPEAT TO 136 FOR L=1,1+NN,...,L3
J1=L1-L
J2=J1-NN
136
US(J1)=US(J2)
I1=L1-MD
138
US(J2)=0.
140
REPEAT TO 142 FOR I=1,1+1,...,NN
J1=K1+I
142
HTRUE(I)=H(J1)
GO TO 31
IF
-
N
+
IF
0
GO TO 31
8
REPEAT TO 25 FOR I=1,1+1,...,M
K=MODE-1
I1=NC*MD*(K-1)
TRANSFER TO SUBROUTINE MULT
US(K),HTRUE,U,1,MSIZE,1,MD,MD,1,NC,1
GO TO 12
IF
-
U(1)
0
IF
+
GO TO 12
9
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1
11
4
10
10
CONTINUE


GO TO 12
IF
G(2)
-
0
+
GO TO 12
11
IRR=IRR+2
12
CONTINUE
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1
14
2
19
14
CONTINUE
GO TO 15
0
IF
ABS(FL(K)/FL(MODE)-1.0)-EP
-
IF
+
GO TO 16
15
U=1.0
GO TO 17
16
U=(FL(K)-FL(MODE))/U
17
REPEAT TO 18 FOR J=1,I+1,...,MSIZE
L=L+J
18
HTRUE(L)=H(L)-U(J)*HTRUE(J)
GO TO 28
19
K=2*K
J=2*MODE
GO TO 20
0
IF
ABS((FL(K-1)*FL(J-1)+FL(K)*FL(J))/(FL(J-1)**2+FL(J)**2)-1.0)-EP
-
20
CONTINUE
IF
+
GO TO 22
GO TO 21
0
IF
ABS((FL(K)*FL(J-1)-FL(K-1)*FL(J))/(FL(J-1)**2+FL(J)**2))-EP
-
21
U(1)=1.0
U(2)=0.0
GO TO 23
IF
+
GO TO 22


22
G(3)=G(1)**2+G(2)**2
G(4)=(FL(K)-FL(J))*G(1)-(FL(K-1)-FL(J-1))*G(2)
G(1)=((FL(K-1)-FL(J-1))*G(1)+(FL(K)-FL(J))*G(2))/G(3)
G(2)=G(4)/G(3)
23
REPEAT TO 24 FOR J1=1,1+1,...,MSIZE
K2=J1+MD
L=L1+J1
L2=L+MD
G(3)=HTRUE(J1)
HTRUE(J1)=H(L)+G(2)*HTRUE(K2)-G(1)*HTRUE(J1)
HTRUE(K2)=H(L2)-G(1)*HTRUE(K2)-G(2)*G(3)
24
CONTINUE
25
CONTINUE
I=0
TRANSFER TO SUBROUTINE NORM HTRUE,HTRUE,MSIZE,G,1,ND,NC,1)
31
J1=1
J2=1
L4=MODE
REPEAT TO 43 FOR I=1,1+1,...,MSIZE
L1=J1
L2=J2
L3=K1+1
REPEAT TO 33 FOR MM=1,1+1,...,MODE
GO TO 39
0
IF
I-INDIS(MM)
IF
+
GO TO 33
-
33
CONTINUE
REPEAT TO 37 FOR J=1,1+1,...,MSIZE
REPEAT TO 35 FOR MM=1,1+1,...,MODE
GO TO 37
0
IF
J-INDIS(MM)
IF
+
GO TO 35
-
35
CONTINUE
U(L1)=U(L2)-H(L3)*US(L4)
COMPUTED GO TO
IF THE VALUE OF NC IS
TRANSFER TO STATEMENT
1 34
2 36
36
J3=L1+MD
J4=L2+MD
J5=L4+MD
J6=L3+MD
U(J3)=U(J4)-H(L3)*US(J5)-H(J6)*US(L4)
U(L1)=U(L1)+H(J6)*US(J5)
34
CONTINUE
L1=L1+1
L2=L2+1
37
L3=L3+1
GO TO 41



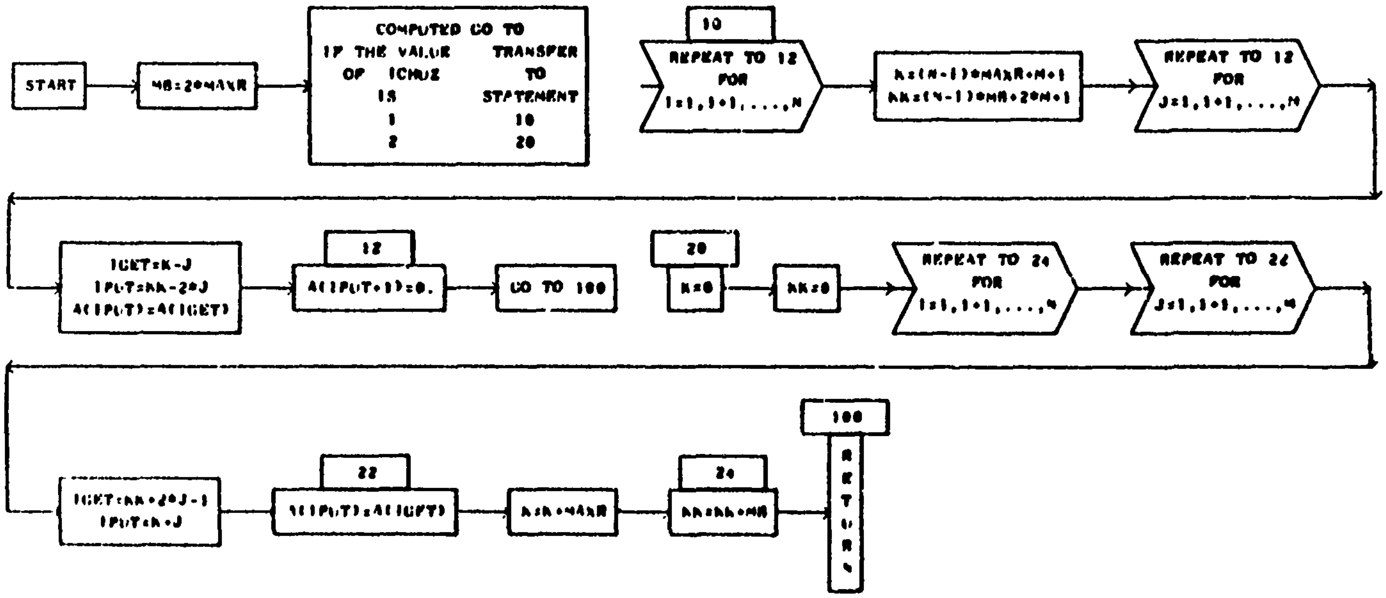
39
CONTINUE
I-INDIX(MODE)
IF
-
GO TO 43
+
GO TO 43
IF
0
GO TO 42
41
J1=J1+NN
42
J2=J2+NN
43
L4=L4+NN
L4=(MSIZE-MODE)*NN+1
REPEAT TO 52 FOR J=1,1+1,...,NC
L4=L4+(J-1)* D
L1=L4+(MSIZE-MODE)-1
REPEAT TO 52 FOR I=L4,L4+1,...,L1
52
U(I)=0.
RETURN

CHANGES

D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
A	1								

SUBROUTINE CHANGE (A,M,N,MAXR,ICHUZ) PAGE 1



SECTION 10

NOMENCLATURE

NOMENCLATURE

a	Element of flexibility matrix, in./lb
a_R	Generalized amplitude coefficient of rigid-body modal series, in. or rad
b_r	Reference semichord, ft
C_h	Element of oscillatory aerodynamic influence coefficient matrix, dimensionless
F	Control point force, lb
g	Structural damping coefficient, dimensionless
h_o	Control point deflection due to rigid-body motion, in.
h_R	Element in rigid-body modal matrix, in. or dimensionless (see Section II)
h_1	Control point deflection, in.
K	Flexibility matrix normalizing constant, dimensionless
k_r	Reference reduced frequency, dimensionless
M	Element of mass matrix, lb.
$\bar{M}$	Element of complex mass matrix (includes aerodynamic effects), lb
m	Element of generalized mass matrix, lb., in.-lb, or lb-in^2.
$\bar{m}$	Element of sum of generalized mass and aerodynamic matrices, lb, in.-lb, or lb-in^2.
Q	Element of generalized aerodynamic force matrix, lb, in.-lb, or lb-in^2.
R	Number of rigid-body modes
s	Reference semispan, ft (i.e., span measured from root to tip)
U	Element of dynamic matrix, in.
V	Velocity, knots
W	Element of aerodynamic weighting matrix, dimensionless

SYMBOLS (continued)

λ	Eigenvalue, $\lambda = \lambda_R + i\lambda_I$, in.
ρ	Atmospheric density, slugs/ft^3
f	Frequency, cps

<u>Matrix Notation</u>

$\left[\quad\right]$	Square
$\left\{\quad\right\}$	Column
$\left[\quad\right]^T$	Transposed
$\lceil I \rfloor$	Unit

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13. ABSTRACT

THIS STUDY COVERS THE DEVELOPMENT OF A SET OF COMPUTER PROGRAM TO PERFORM FLUTTER ANALYSIS BY THE COLLOCATION METHOD. WHILE THIS METHOD HAS BEEN KNOWN FOR SOME TIME, ONLY RECENTLY HAVE ADVANCES IN COMPUTER TECHNOLOGY MADE THE METHOD TECHNICALLY AND FINANCIALLY FEASIBLE. THE INGREDIENTS OF A COLLOCATION FLUTTER ANALYSIS ARE 1) A FLEXIBILITY MATRIX, 2) AERODYNAMIC INFLUENCE COEFFICIENT MATRIX, AND 3) AN EIGENVALUE SOLUTION. THIS STUDY IS PRESENTED IN FOUR VOLUMES. VOLUME I CONTAINS A GENERAL PROGRAM DISCUSSION. VOLUME II CONTAINS THE PROGRAM FLUENC WHICH CALCULATES THE FLEXIBILITY MATRIX. VOLUME III CONTAINS A SET OF THREE PROGRAMS TO CALCULATE AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC, TRANSONIC, AND SUPERSONIC FLIGHT REGIMES. VOLUME IV CONTAINS THE PROGRAM COFA WHICH SETS UP AND SOLVES THE FLUTTER EIGENVALUE MATRIX.

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