US005508911A

United States Patent [19]

Vanko et al.

[11] **Patent Number: 5,508,911**

[45] **Date of Patent: Apr. 16, 1996**

[54] **ELECTRONIC DATA ENTRY AND ANALYSIS SYSTEM**

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[73] Assignee: **Fawn Industries, Inc.**, Hunt Valley, Md.

[21] Appl. No.: **268,650**

[22] Filed: **Jun. 30, 1994**

[51] **Int. Cl.**^{6} **G06F 19/00**

[52] **U.S. Cl.** **364/188**; 345/113; 345/173; 364/507

[58] **Field of Search** 364/188, 189, 364/550, 551.01, 507; 371/29.1; 340/524, 525; 395/155–161; 345/4–6, 113, 114, 173, 129, 169, 904, 905

[56] **References Cited**

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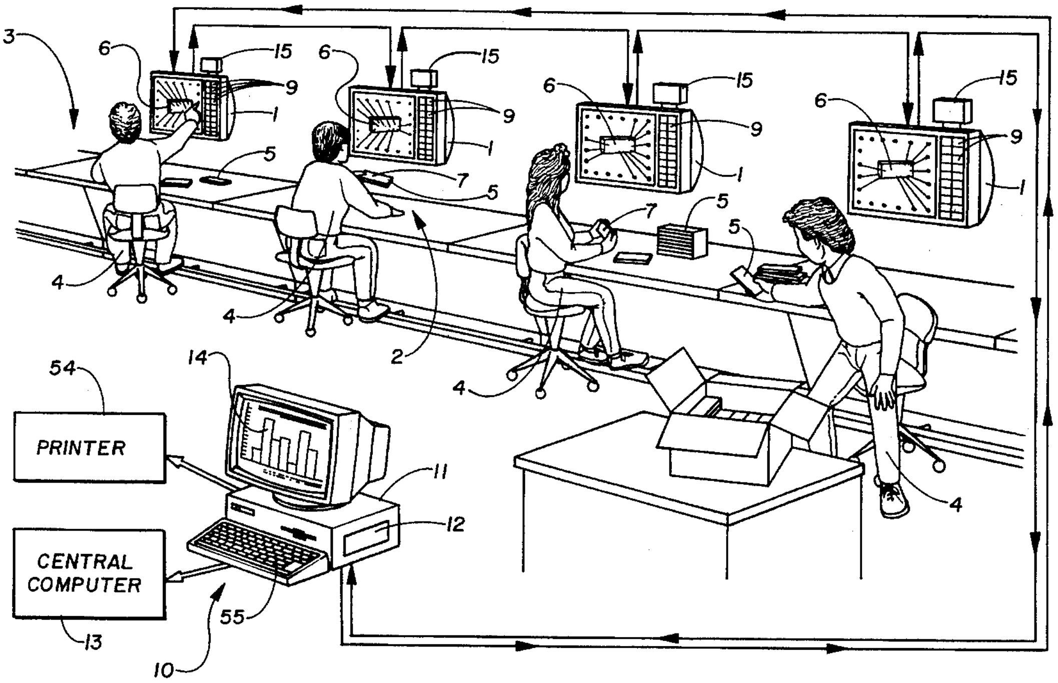
Primary Examiner—Joseph Ruggiero
Attorney, Agent, or Firm—Leonard Bloom

[57] **ABSTRACT**

An electronic system for entering and analyzing data relating to at least one attribute of an object includes a data entry means displaying a pictorial image of the object and providing a plurality of first indicia for identifying a location of the attribute in the object, and a plurality of additional indicia for identifying a parameter of the attribute. The data identifying the attribute are entered in the system when one of the first indicia in combination with at least one of the additional indicia are activated. A controlling means within the data entry means controls the data entry means in response to the entered data, which are processed by a processing means. When installed on a workstation on a production line, the electronic system and the data entry means find particular utility in entering and processing data relating to location and nature of a defect occurring in a workplace, thereby providing in-depth readily-usable information on the status of the production process, such that effective corrective actions can be undertaken immediately. A unique software operates the system.

36 Claims, 46 Drawing Sheets



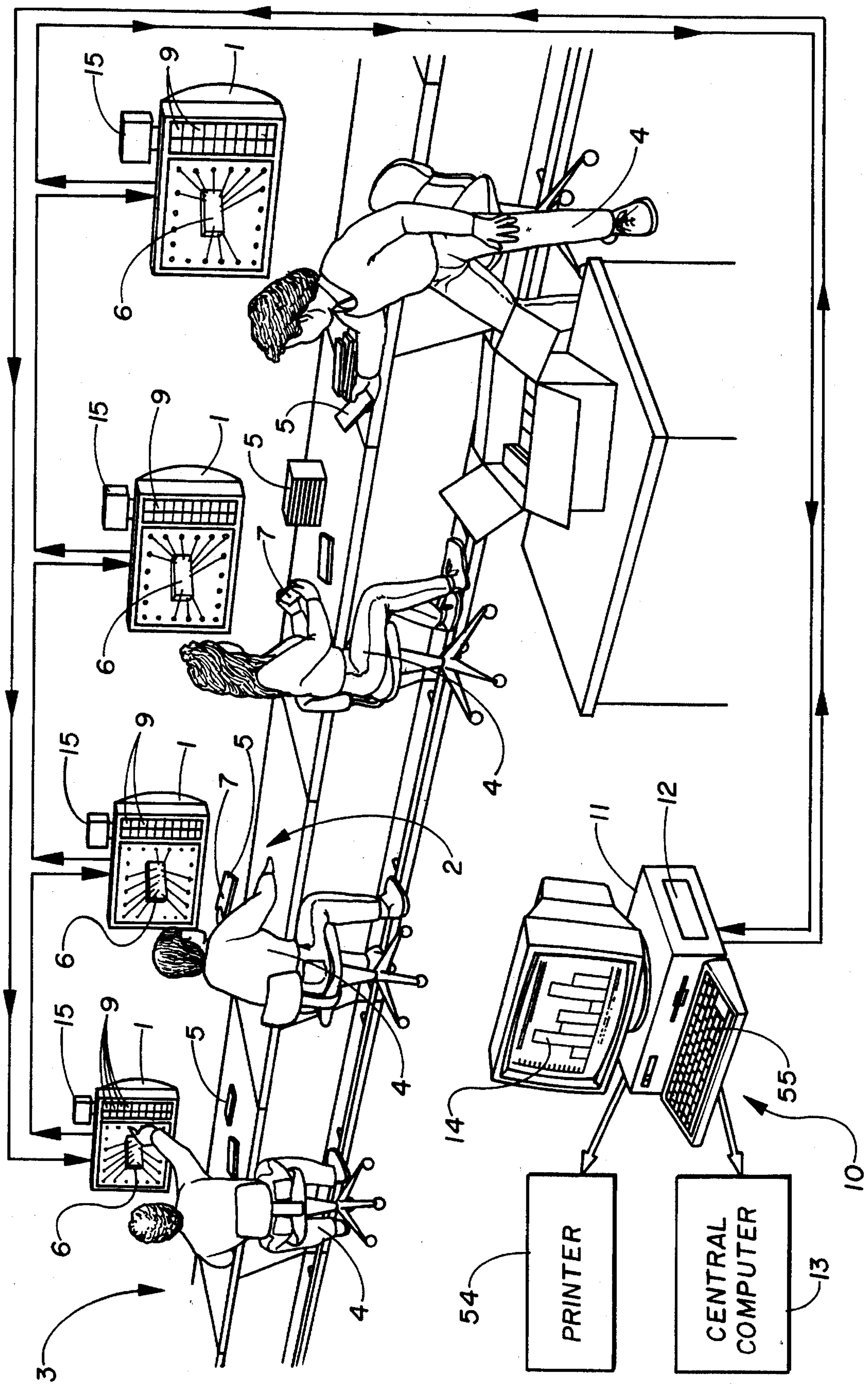


FIG. 1

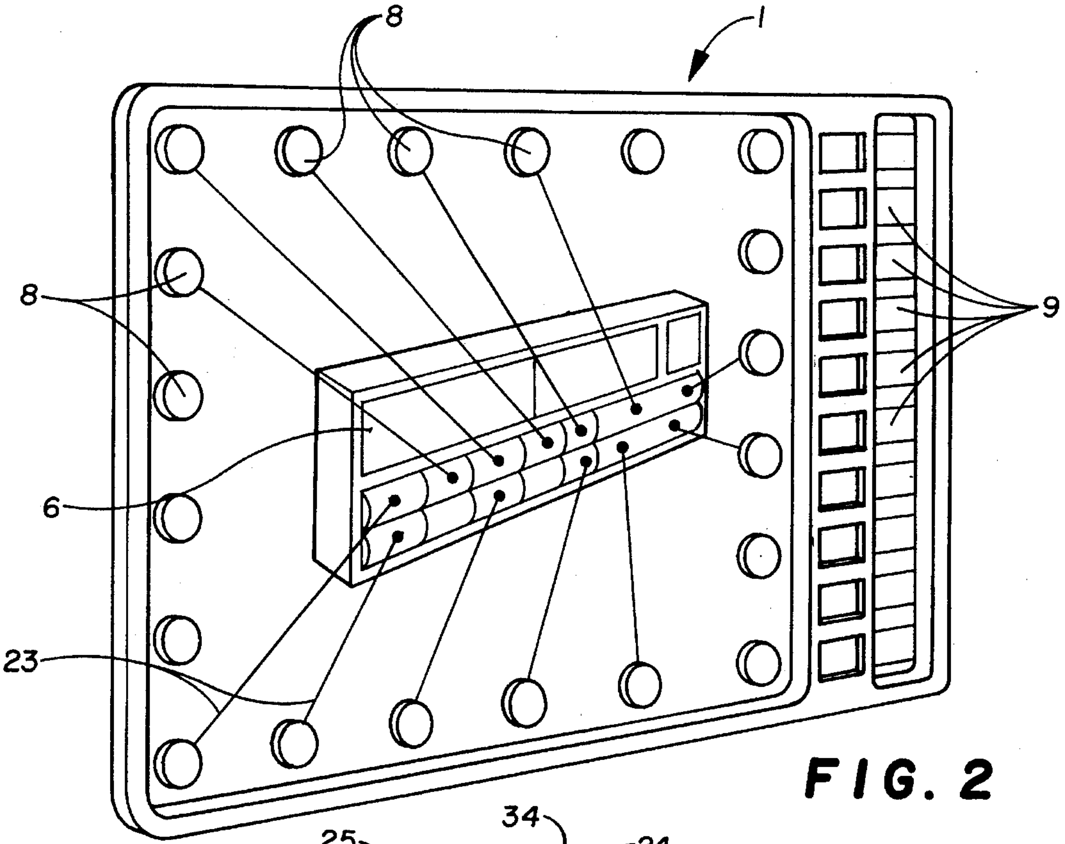


FIG. 2

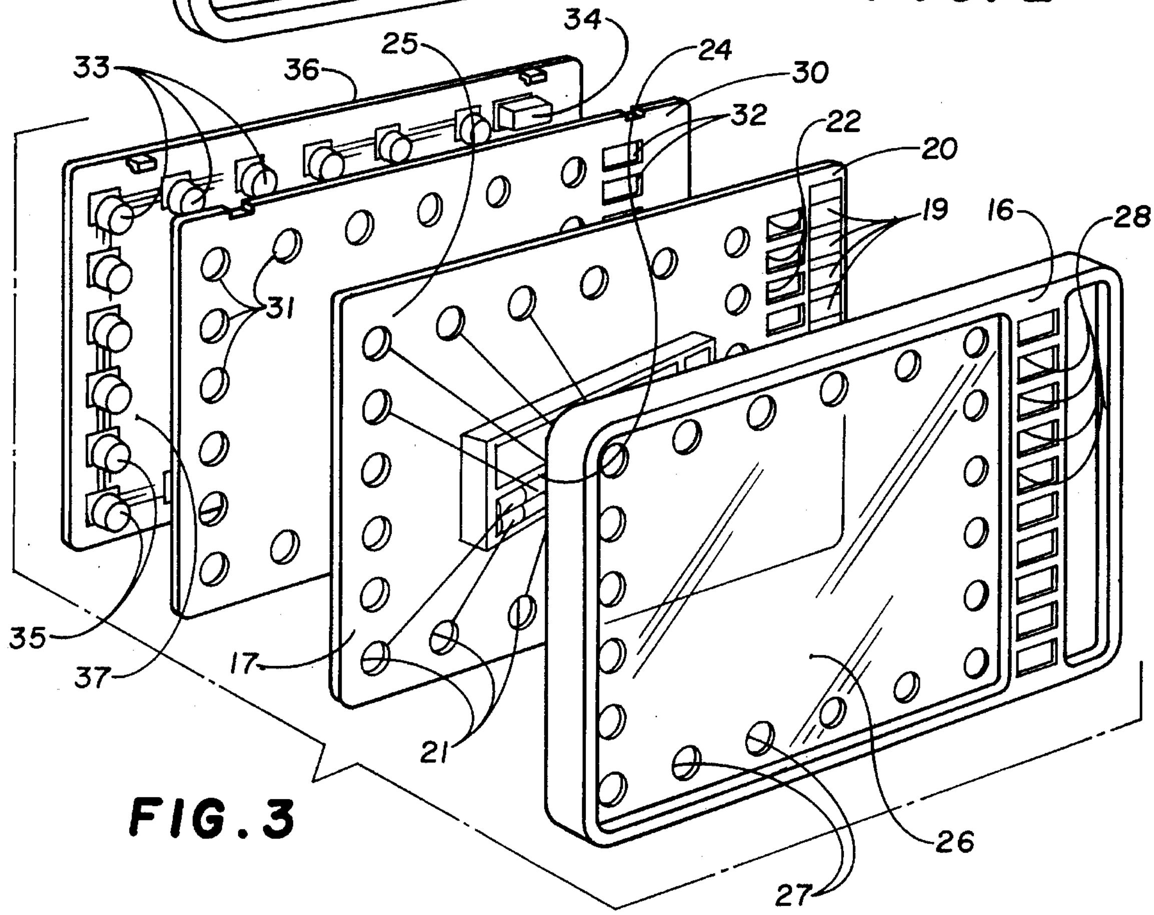


FIG. 3

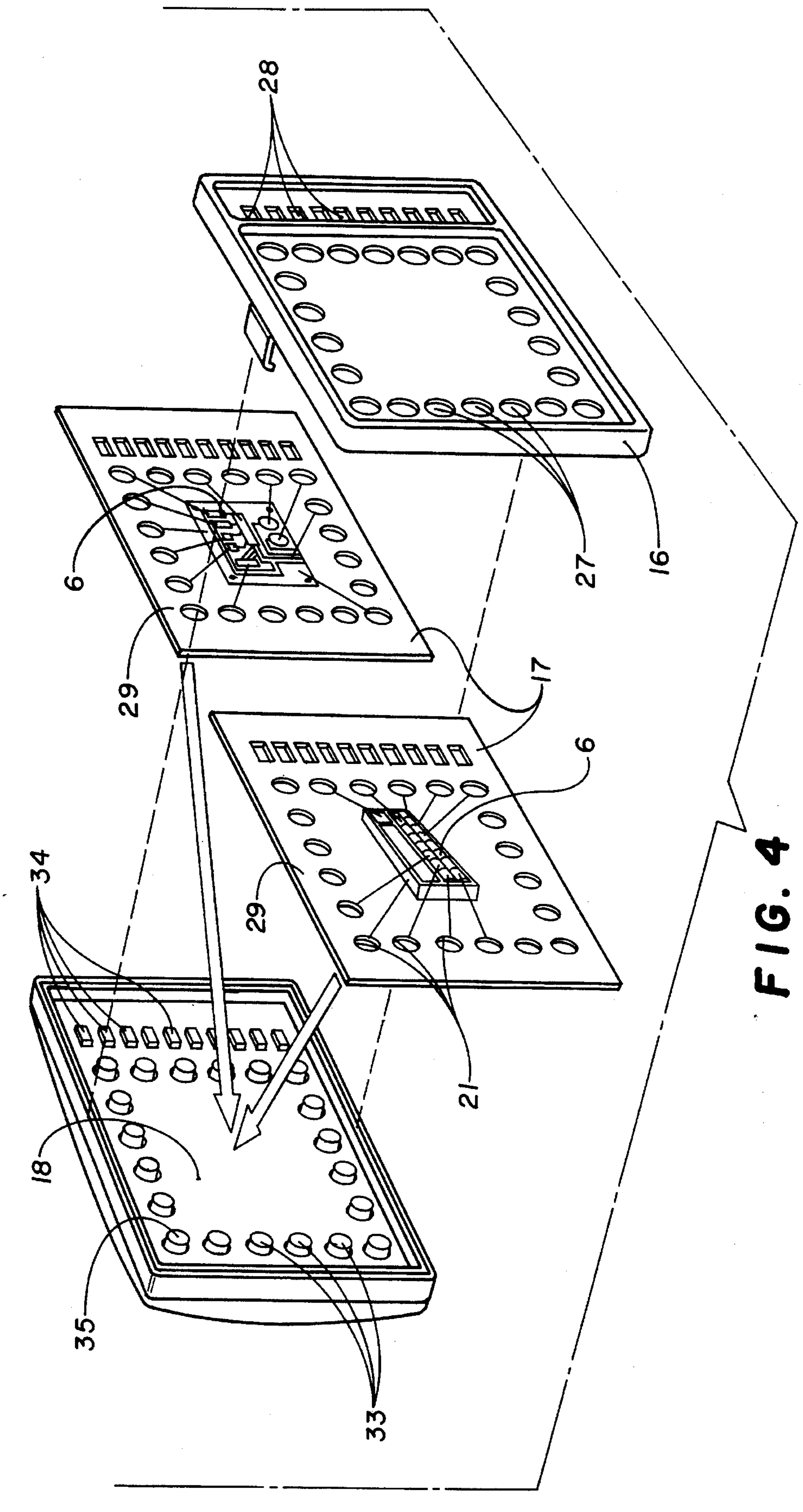


FIG. 4

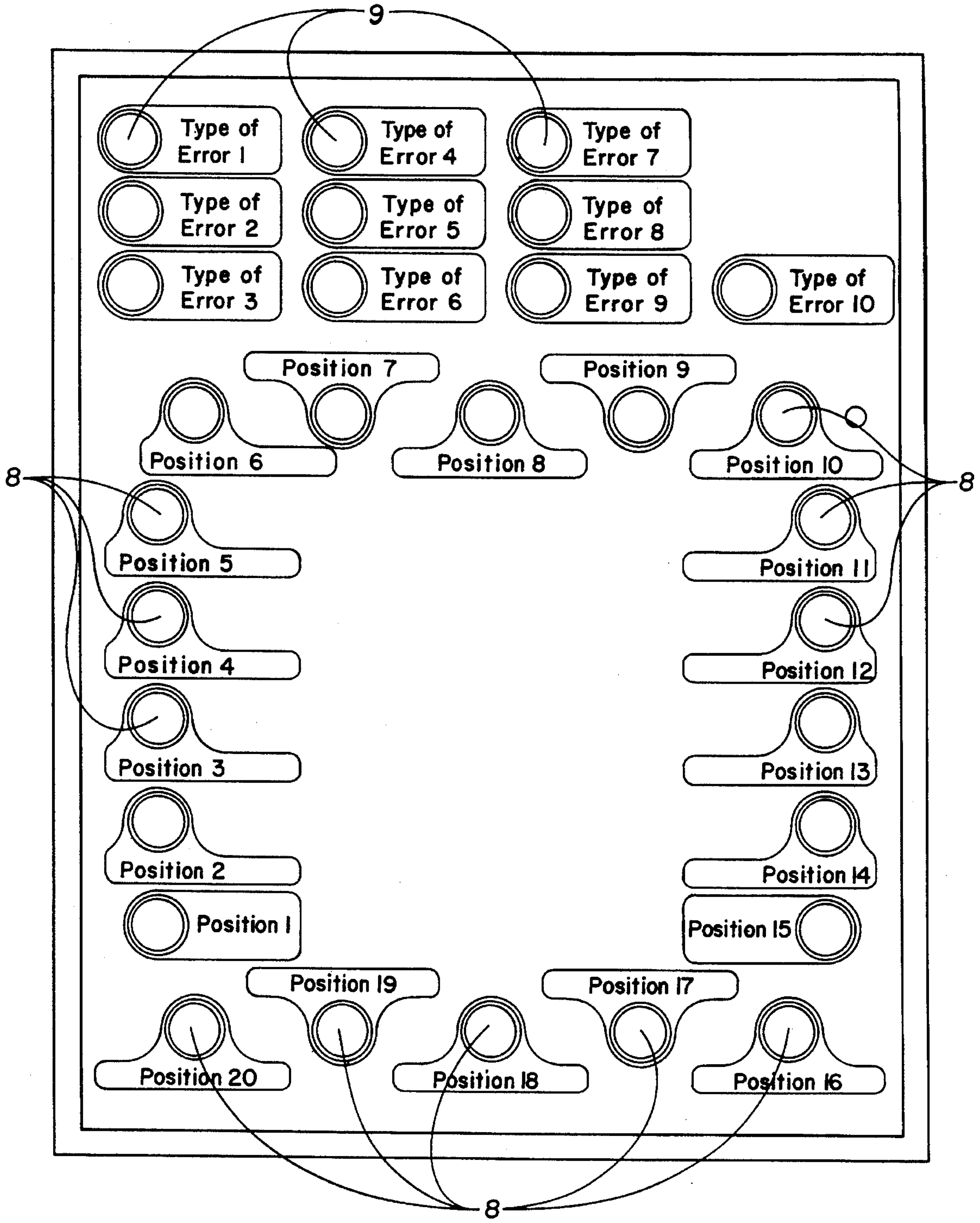

9
Type of Error 1
Type of Error 4
Type of Error 7
Type of Error 2
Type of Error 5
Type of Error 8
Type of Error 3
Type of Error 6
Type of Error 9
Type of Error 10
Position 7
Position 9
Position 6
Position 8
Position 10
8
8
Position 5
Position 11
Position 4
Position 12
Position 3
Position 13
Position 2
Position 14
Position 1
Position 15
Position 19
Position 17
Position 20
Position 18
Position 16
8

FIG. 5

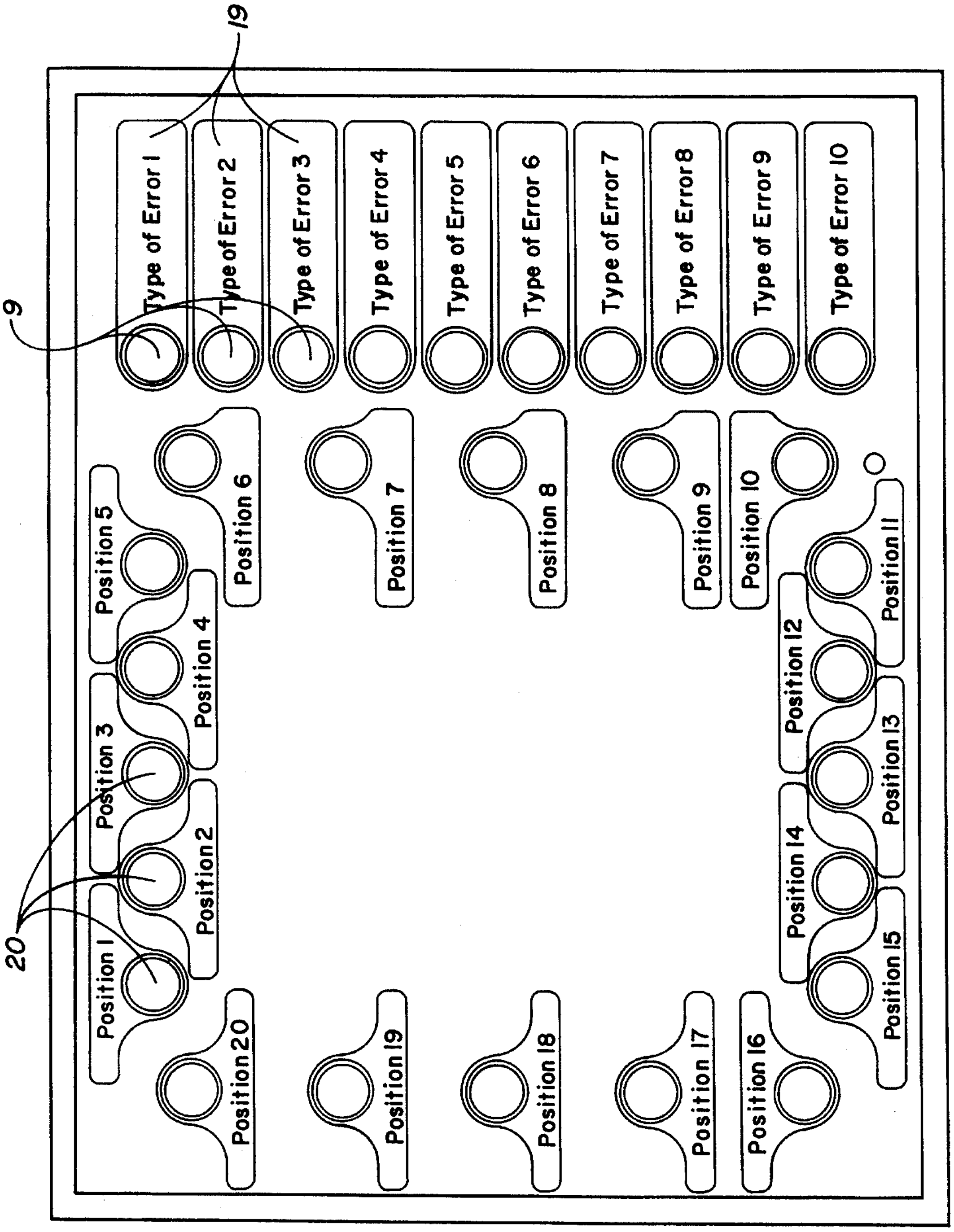

19
9
Type of Error 1
Type of Error 2
Type of Error 3
Type of Error 4
Type of Error 5
Type of Error 6
Type of Error 7
Type of Error 8
Type of Error 9
Type of Error 10
Position 1
Position 2
Position 3
Position 4
Position 5
Position 6
Position 7
Position 8
Position 9
Position 10
Position 11
Position 12
Position 13
Position 14
Position 15
Position 16
Position 17
Position 18
Position 19
Position 20
20

FIG. 6

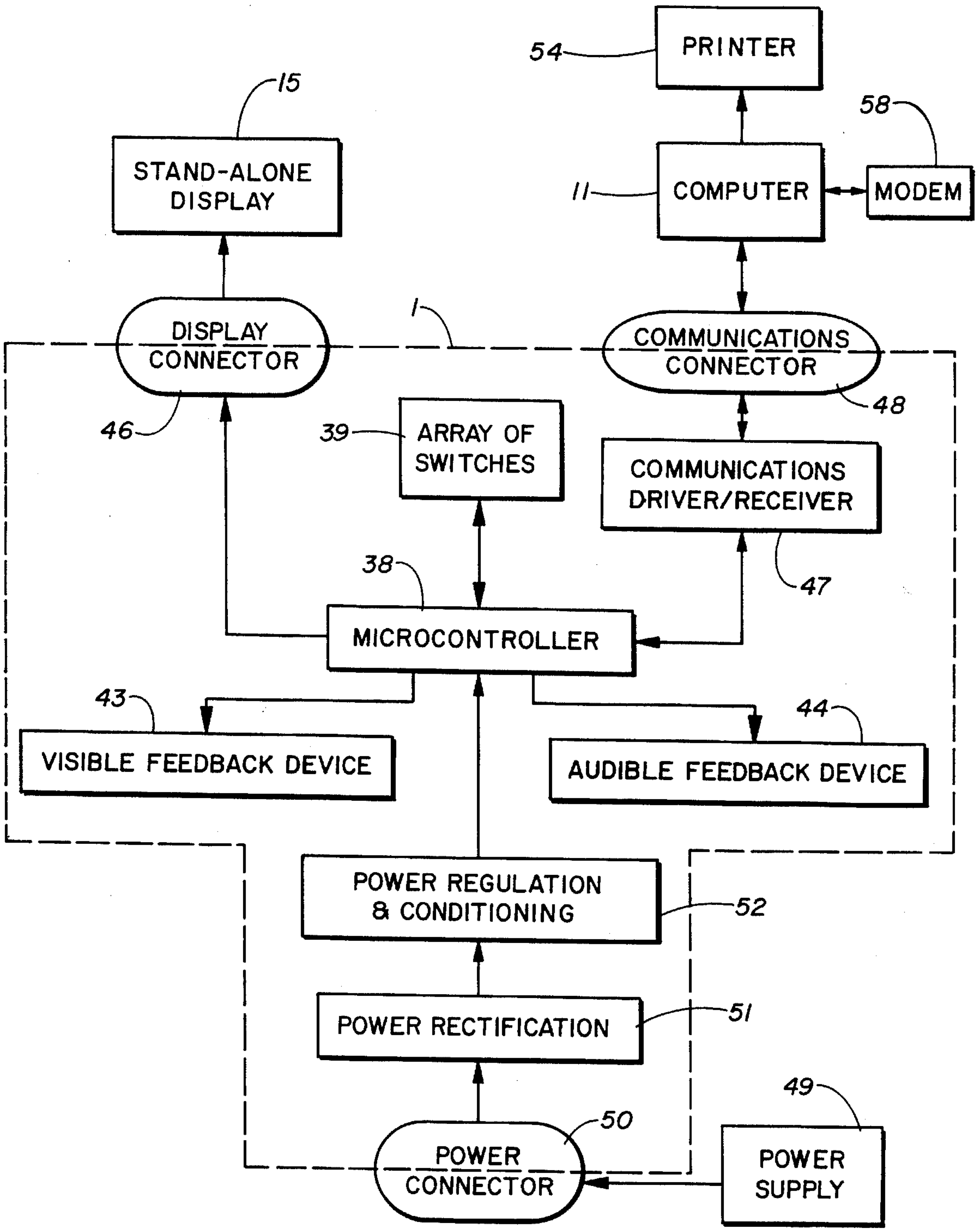

PRINTER
54
15
58
STAND-ALONE DISPLAY
11
COMPUTER
MODEM
1
DISPLAY CONNECTOR
COMMUNICATIONS CONNECTOR
48
46
39
ARRAY OF SWITCHES
COMMUNICATIONS DRIVER/RECEIVER
38
47
MICROCONTROLLER
43
44
VISIBLE FEEDBACK DEVICE
AUDIBLE FEEDBACK DEVICE
POWER REGULATION & CONDITIONING
52
POWER RECTIFICATION
51
49
50
POWER CONNECTOR
POWER SUPPLY

FIG. 7

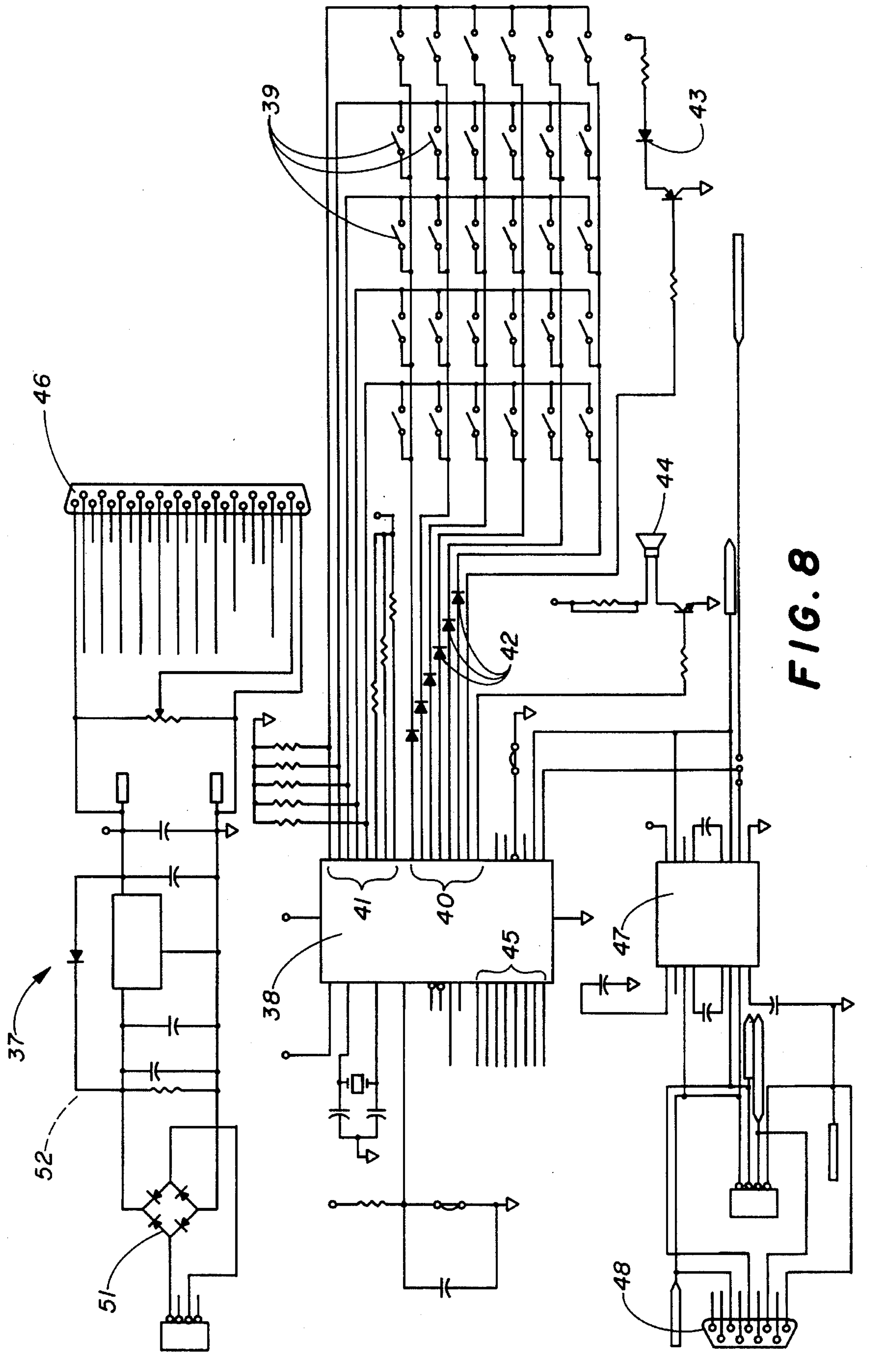


FIG. 8

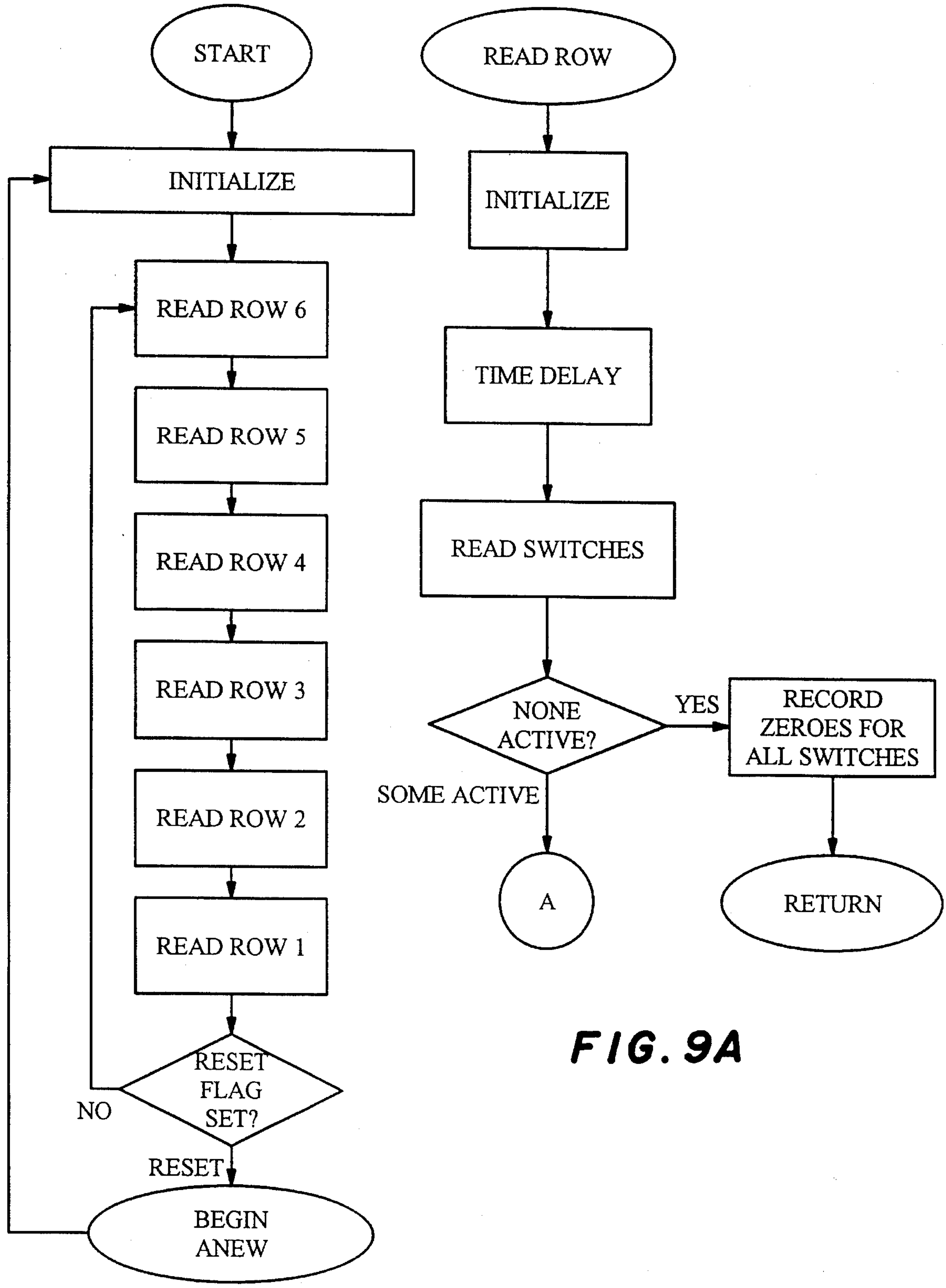

START
INITIALIZE
READ ROW 6
READ ROW 5
READ ROW 4
READ ROW 3
READ ROW 2
READ ROW 1
RESET FLAG SET?
NO
RESET
BEGIN ANEW
READ ROW
INITIALIZE
TIME DELAY
READ SWITCHES
NONE ACTIVE?
YES
RECORD ZEROES FOR ALL SWITCHES
SOME ACTIVE
A
RETURN

FIG. 9A

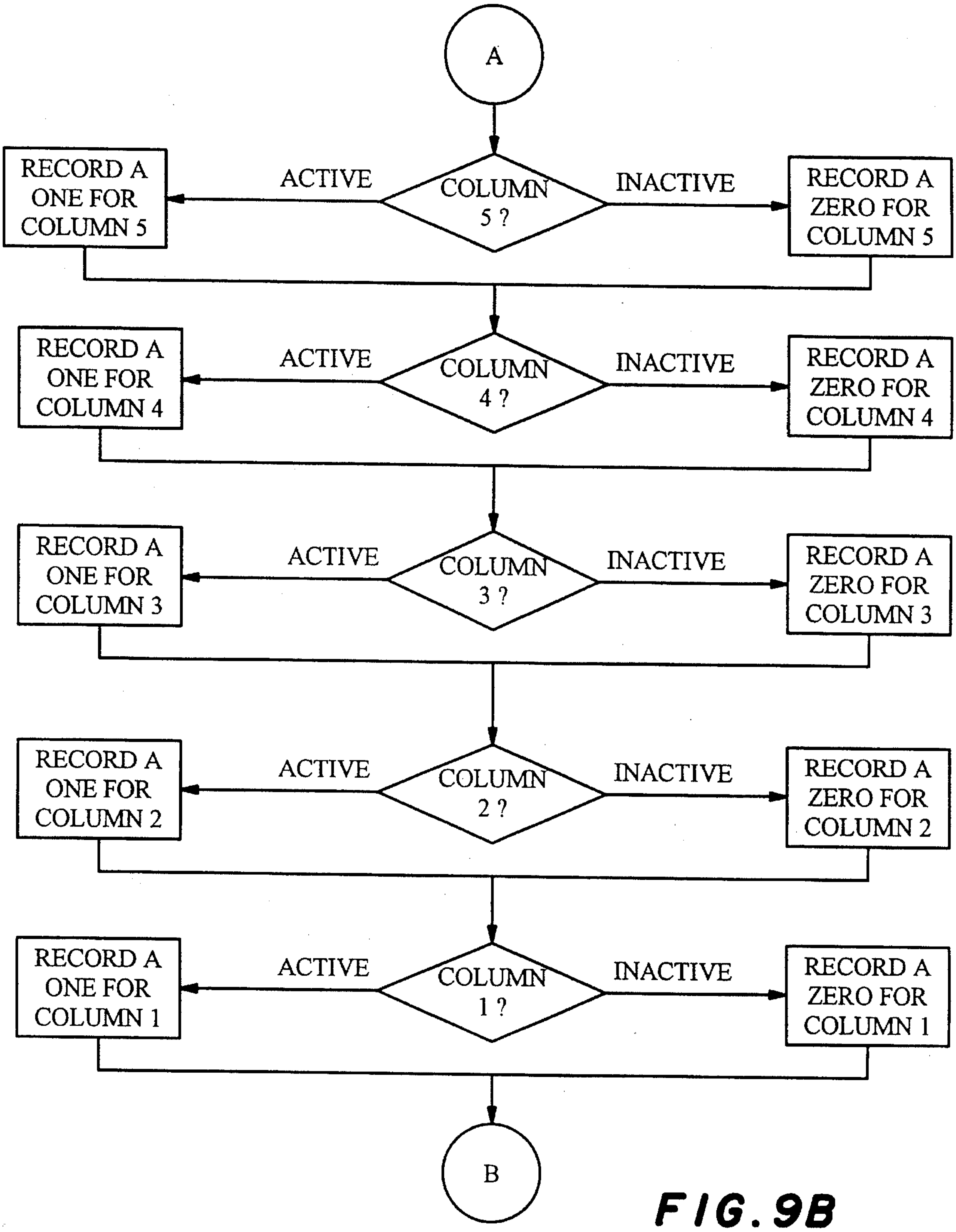

A
COLUMN 5 ?
ACTIVE
RECORD A ONE FOR COLUMN 5
INACTIVE
RECORD A ZERO FOR COLUMN 5
COLUMN 4 ?
ACTIVE
RECORD A ONE FOR COLUMN 4
INACTIVE
RECORD A ZERO FOR COLUMN 4
COLUMN 3 ?
ACTIVE
RECORD A ONE FOR COLUMN 3
INACTIVE
RECORD A ZERO FOR COLUMN 3
COLUMN 2 ?
ACTIVE
RECORD A ONE FOR COLUMN 2
INACTIVE
RECORD A ZERO FOR COLUMN 2
COLUMN 1 ?
ACTIVE
RECORD A ONE FOR COLUMN 1
INACTIVE
RECORD A ZERO FOR COLUMN 1
B

FIG. 9B

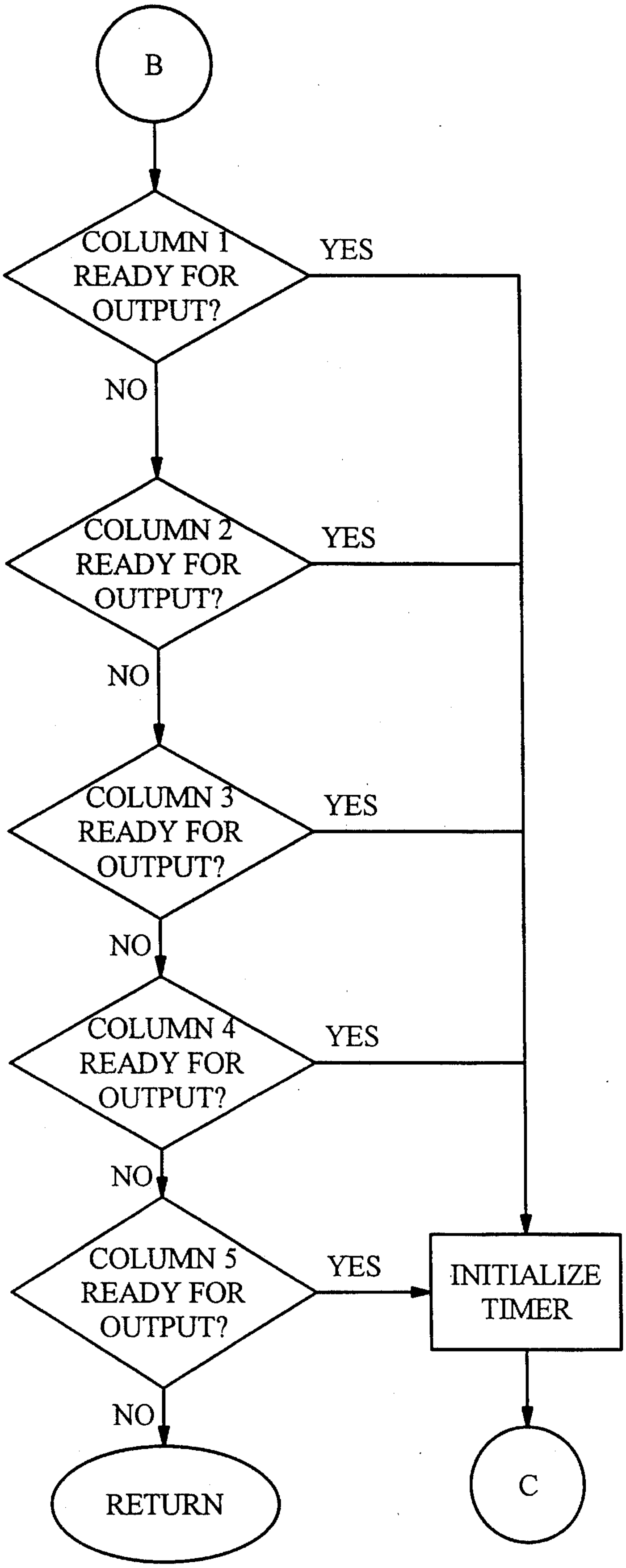

B
COLUMN 1 READY FOR OUTPUT?
YES
NO
COLUMN 2 READY FOR OUTPUT?
YES
NO
COLUMN 3 READY FOR OUTPUT?
YES
NO
COLUMN 4 READY FOR OUTPUT?
YES
NO
COLUMN 5 READY FOR OUTPUT?
YES
INITIALIZE TIMER
NO
RETURN
C

FIG. 9C

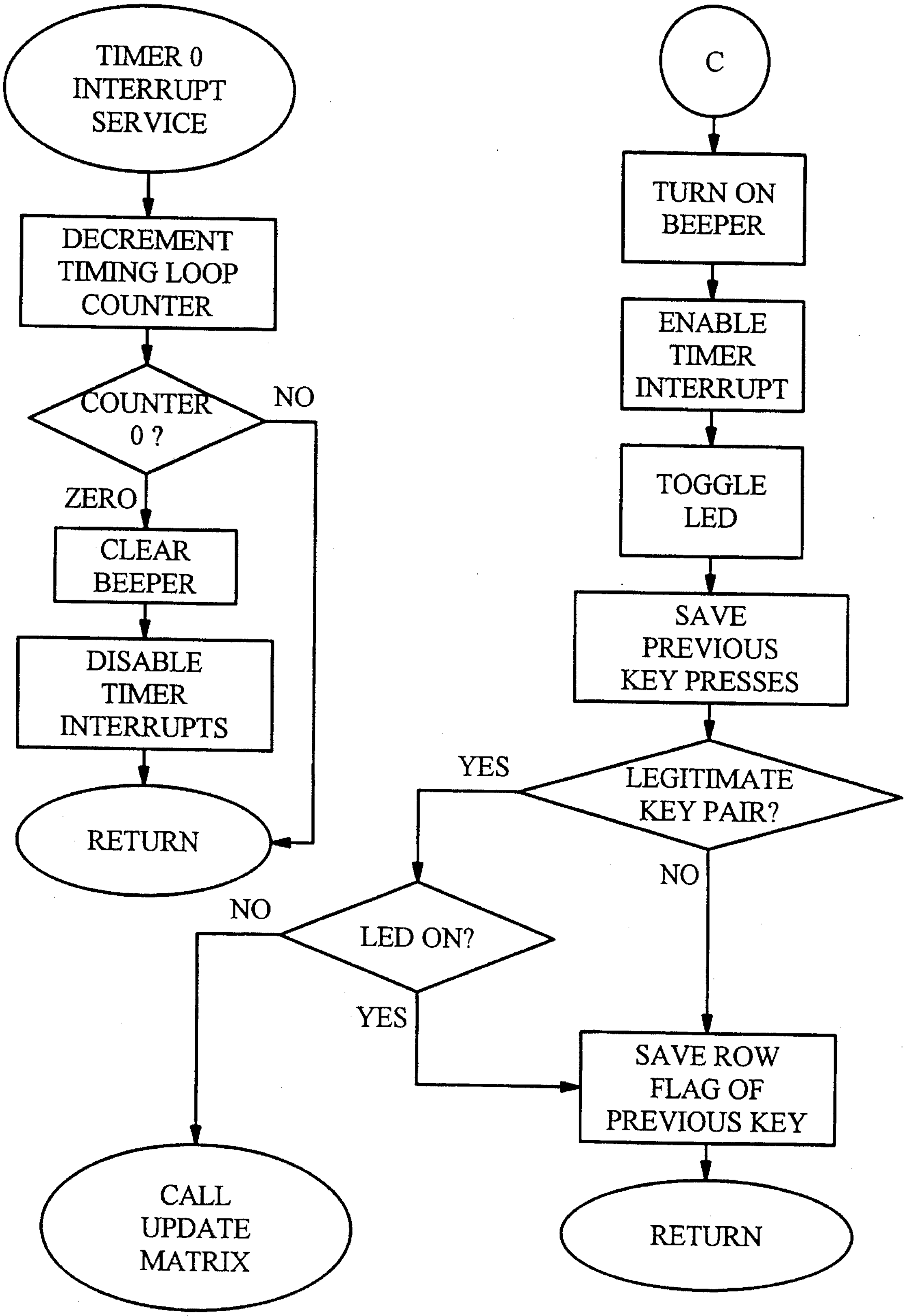

TIMER 0
INTERRUPT
SERVICE
DECREMENT
TIMING LOOP
COUNTER
COUNTER
0 ?
NO
ZERO
CLEAR
BEEPER
DISABLE
TIMER
INTERRUPTS
RETURN
C
TURN ON
BEEPER
ENABLE
TIMER
INTERRUPT
TOGGLE
LED
SAVE
PREVIOUS
KEY PRESSES
YES
LEGITIMATE
KEY PAIR?
NO
NO
LED ON?
YES
SAVE ROW
FLAG OF
PREVIOUS KEY
CALL
UPDATE
MATRIX
RETURN

FIG. 9D

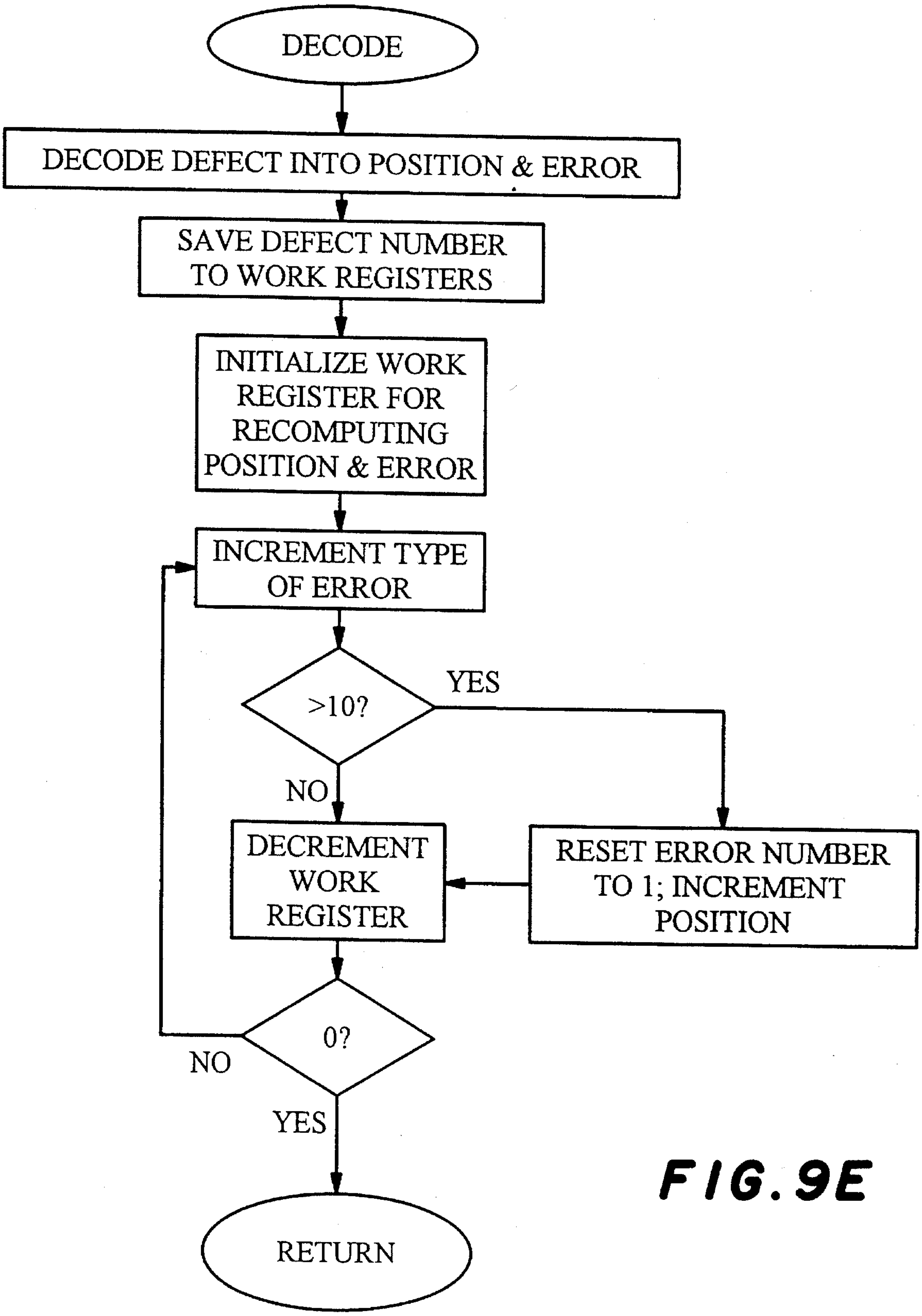

DECODE
DECODE DEFECT INTO POSITION & ERROR
SAVE DEFECT NUMBER TO WORK REGISTERS
INITIALIZE WORK REGISTER FOR RECOMPUTING POSITION & ERROR
INCREMENT TYPE OF ERROR
>10?
YES
NO
DECREMENT WORK REGISTER
RESET ERROR NUMBER TO 1; INCREMENT POSITION
0?
NO
YES
RETURN

FIG. 9E

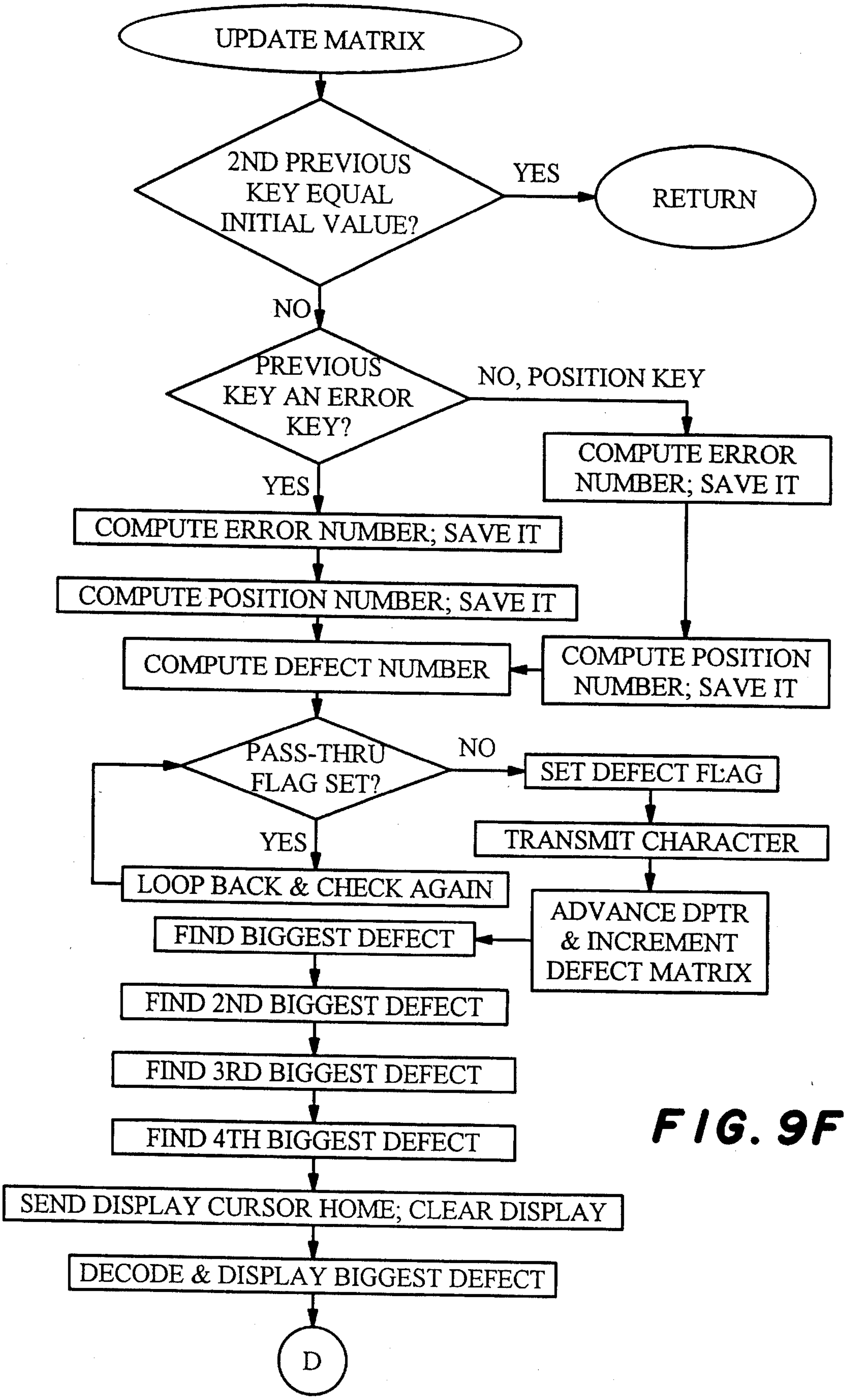

UPDATE MATRIX
2ND PREVIOUS KEY EQUAL INITIAL VALUE?
YES
RETURN
NO
PREVIOUS KEY AN ERROR KEY?
NO, POSITION KEY
COMPUTE ERROR NUMBER; SAVE IT
YES
COMPUTE ERROR NUMBER; SAVE IT
COMPUTE POSITION NUMBER; SAVE IT
COMPUTE DEFECT NUMBER
COMPUTE POSITION NUMBER; SAVE IT
PASS-THRU FLAG SET?
NO
SET DEFECT FLAG
YES
TRANSMIT CHARACTER
LOOP BACK & CHECK AGAIN
ADVANCE DPTR & INCREMENT DEFECT MATRIX
FIND BIGGEST DEFECT
FIND 2ND BIGGEST DEFECT
FIND 3RD BIGGEST DEFECT
FIND 4TH BIGGEST DEFECT
SEND DISPLAY CURSOR HOME; CLEAR DISPLAY
DECODE & DISPLAY BIGGEST DEFECT
D

FIG. 9F

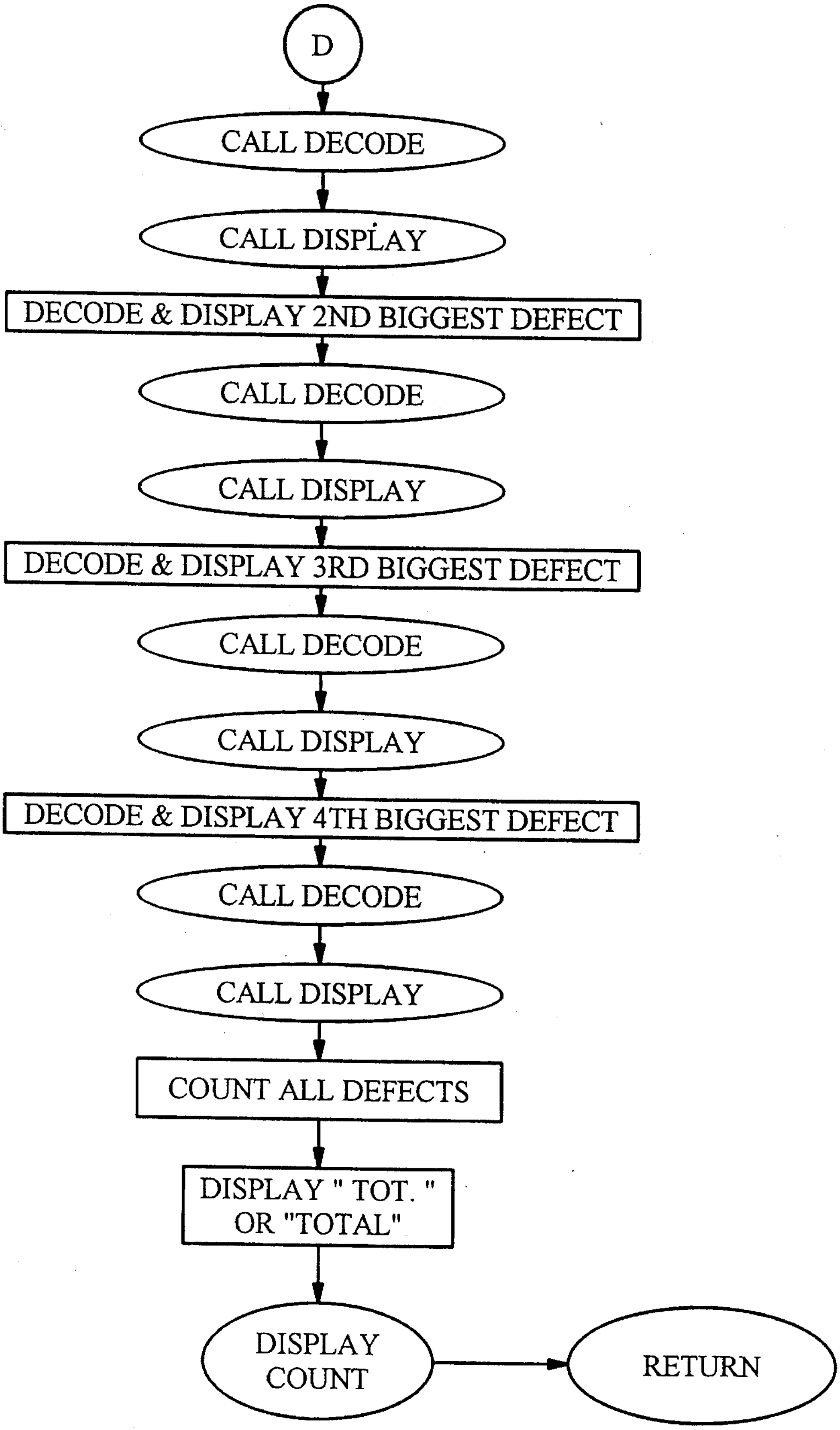

D
CALL DECODE
CALL DISPLAY
DECODE & DISPLAY 2ND BIGGEST DEFECT
CALL DECODE
CALL DISPLAY
DECODE & DISPLAY 3RD BIGGEST DEFECT
CALL DECODE
CALL DISPLAY
DECODE & DISPLAY 4TH BIGGEST DEFECT
CALL DECODE
CALL DISPLAY
COUNT ALL DEFECTS
DISPLAY " TOT. " OR "TOTAL"
DISPLAY COUNT
RETURN

FIG. 9G

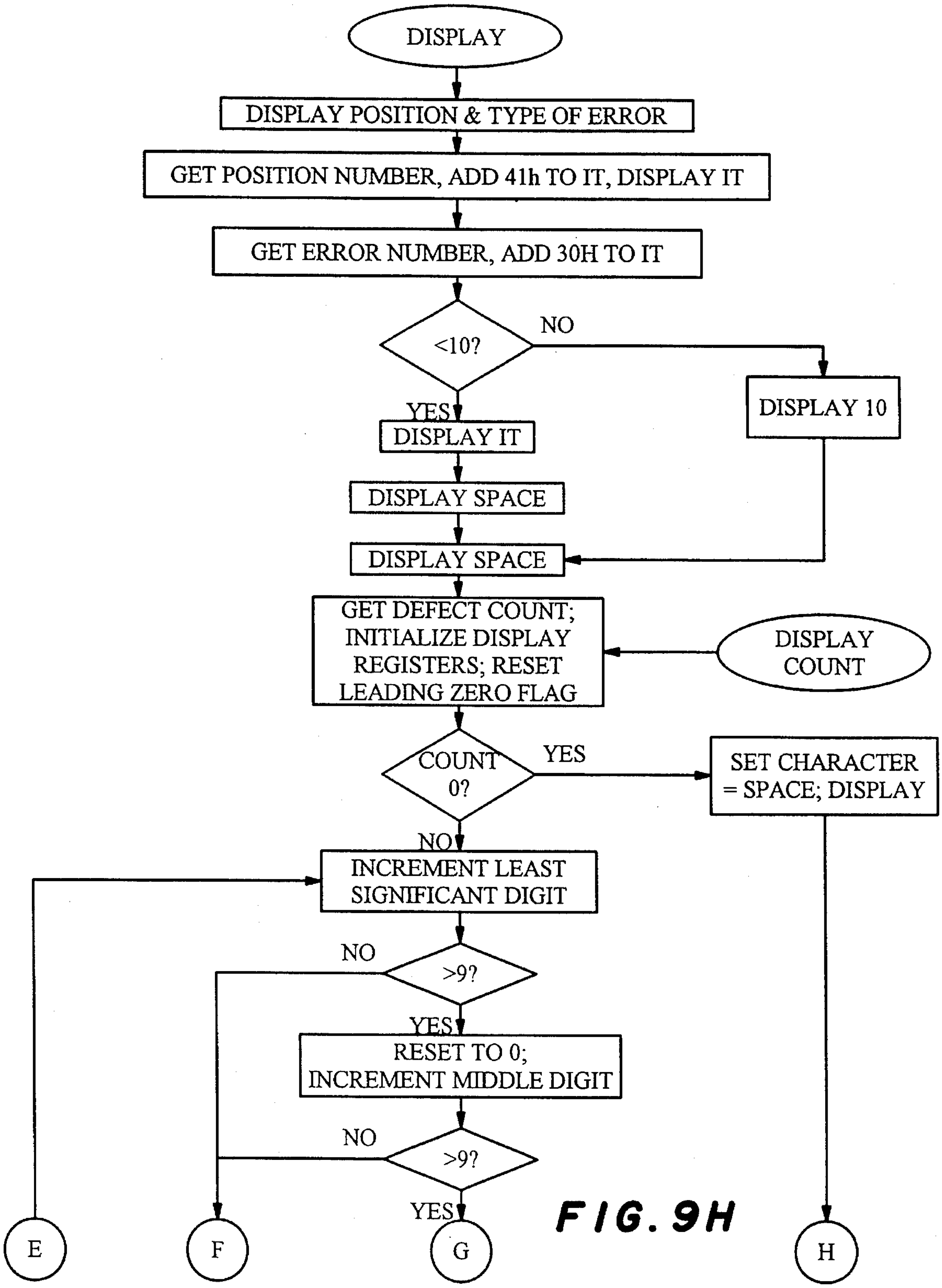

DISPLAY
DISPLAY POSITION & TYPE OF ERROR
GET POSITION NUMBER, ADD 41h TO IT, DISPLAY IT
GET ERROR NUMBER, ADD 30H TO IT
<10?
NO
DISPLAY 10
YES
DISPLAY IT
DISPLAY SPACE
DISPLAY SPACE
GET DEFECT COUNT; INITIALIZE DISPLAY REGISTERS; RESET LEADING ZERO FLAG
DISPLAY COUNT
COUNT 0?
YES
SET CHARACTER = SPACE; DISPLAY
NO
INCREMENT LEAST SIGNIFICANT DIGIT
NO
>9?
YES
RESET TO 0; INCREMENT MIDDLE DIGIT
NO
>9?
YES
E
F
G
H

FIG. 9H

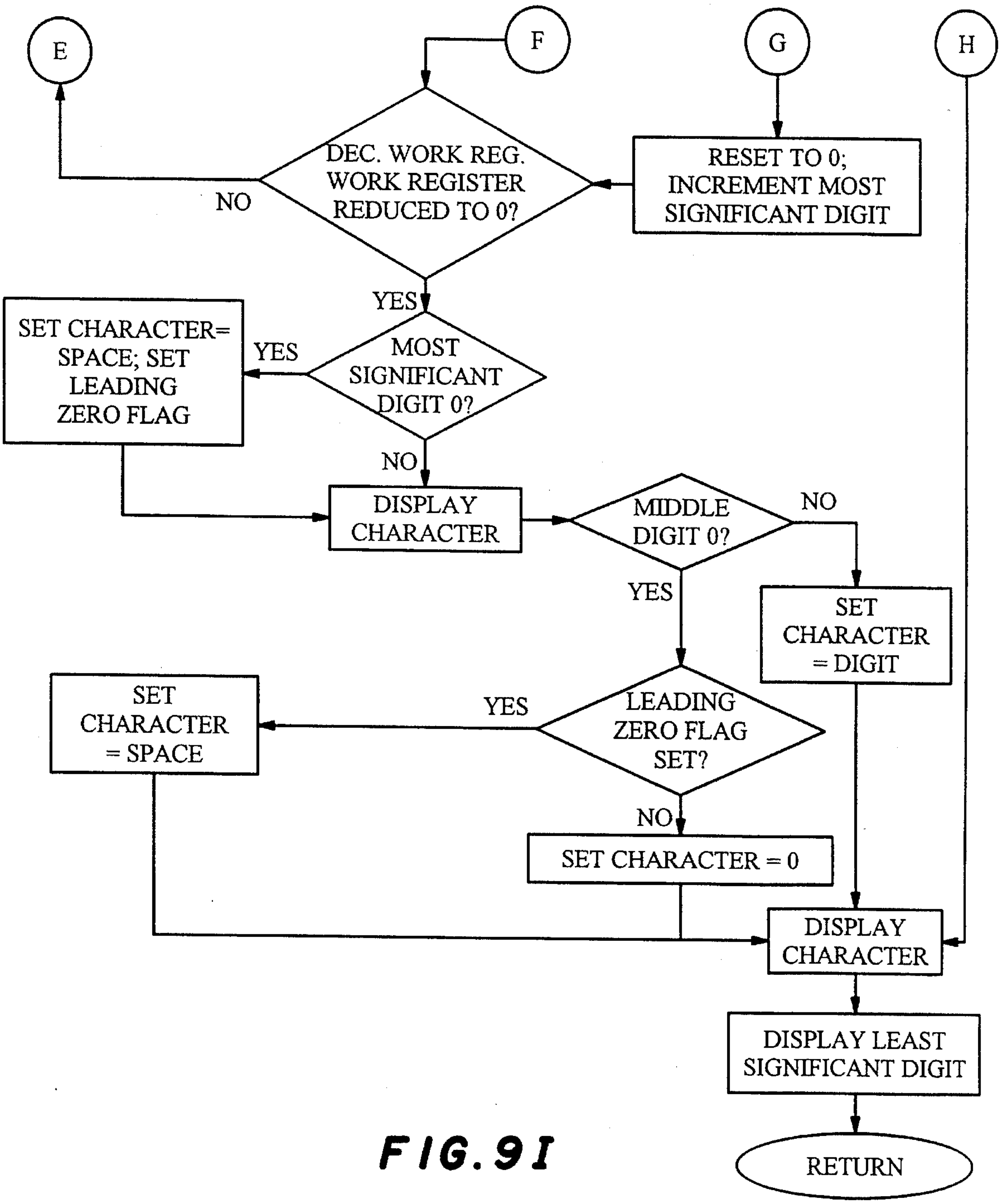

E
F
G
H
DEC. WORK REG. WORK REGISTER REDUCED TO 0?
NO
RESET TO 0; INCREMENT MOST SIGNIFICANT DIGIT
YES
MOST SIGNIFICANT DIGIT 0?
YES
SET CHARACTER= SPACE; SET LEADING ZERO FLAG
NO
DISPLAY CHARACTER
MIDDLE DIGIT 0?
NO
SET CHARACTER = DIGIT
YES
LEADING ZERO FLAG SET?
YES
SET CHARACTER = SPACE
NO
SET CHARACTER = 0
DISPLAY CHARACTER
DISPLAY LEAST SIGNIFICANT DIGIT
RETURN

FIG. 9I

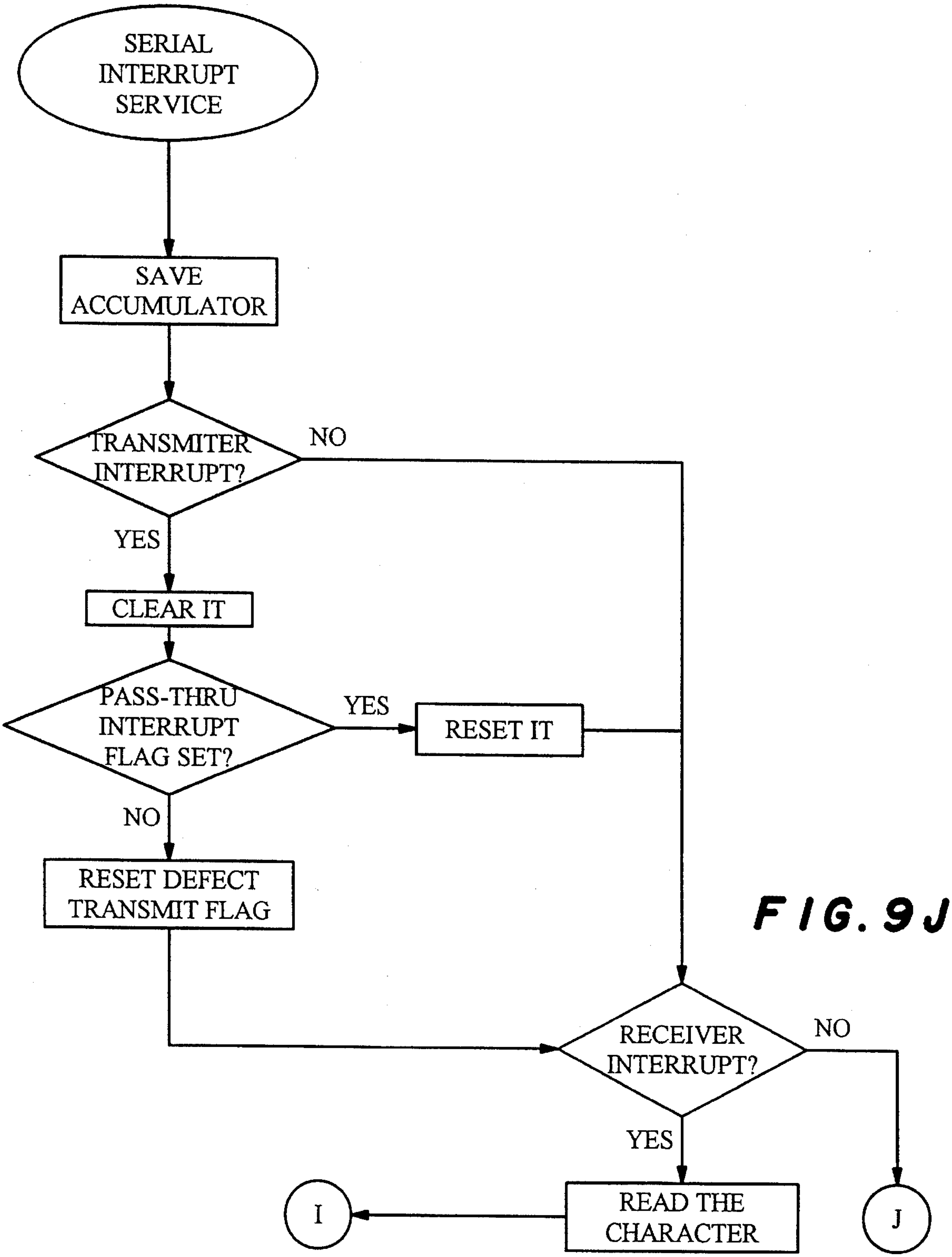

SERIAL INTERRUPT SERVICE
SAVE ACCUMULATOR
TRANSMITER INTERRUPT?
NO
YES
CLEAR IT
PASS-THRU INTERRUPT FLAG SET?
YES
RESET IT
NO
RESET DEFECT TRANSMIT FLAG
RECEIVER INTERRUPT?
NO
YES
READ THE CHARACTER
I
J

FIG. 9J

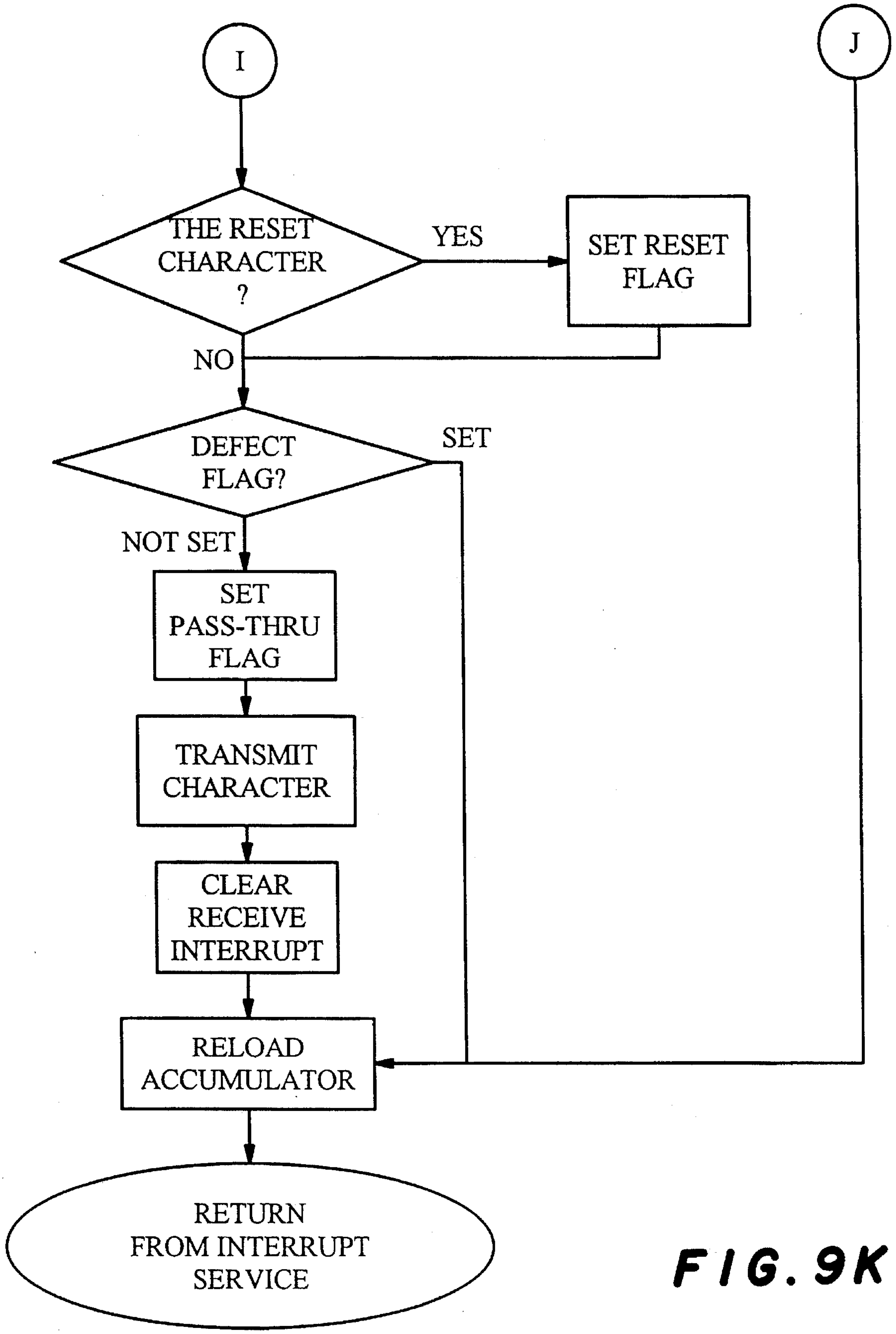

I
J
THE RESET CHARACTER ?
YES
SET RESET FLAG
NO
DEFECT FLAG?
SET
NOT SET
SET PASS-THRU FLAG
TRANSMIT CHARACTER
CLEAR RECEIVE INTERRUPT
RELOAD ACCUMULATOR
RETURN FROM INTERRUPT SERVICE

FIG. 9K

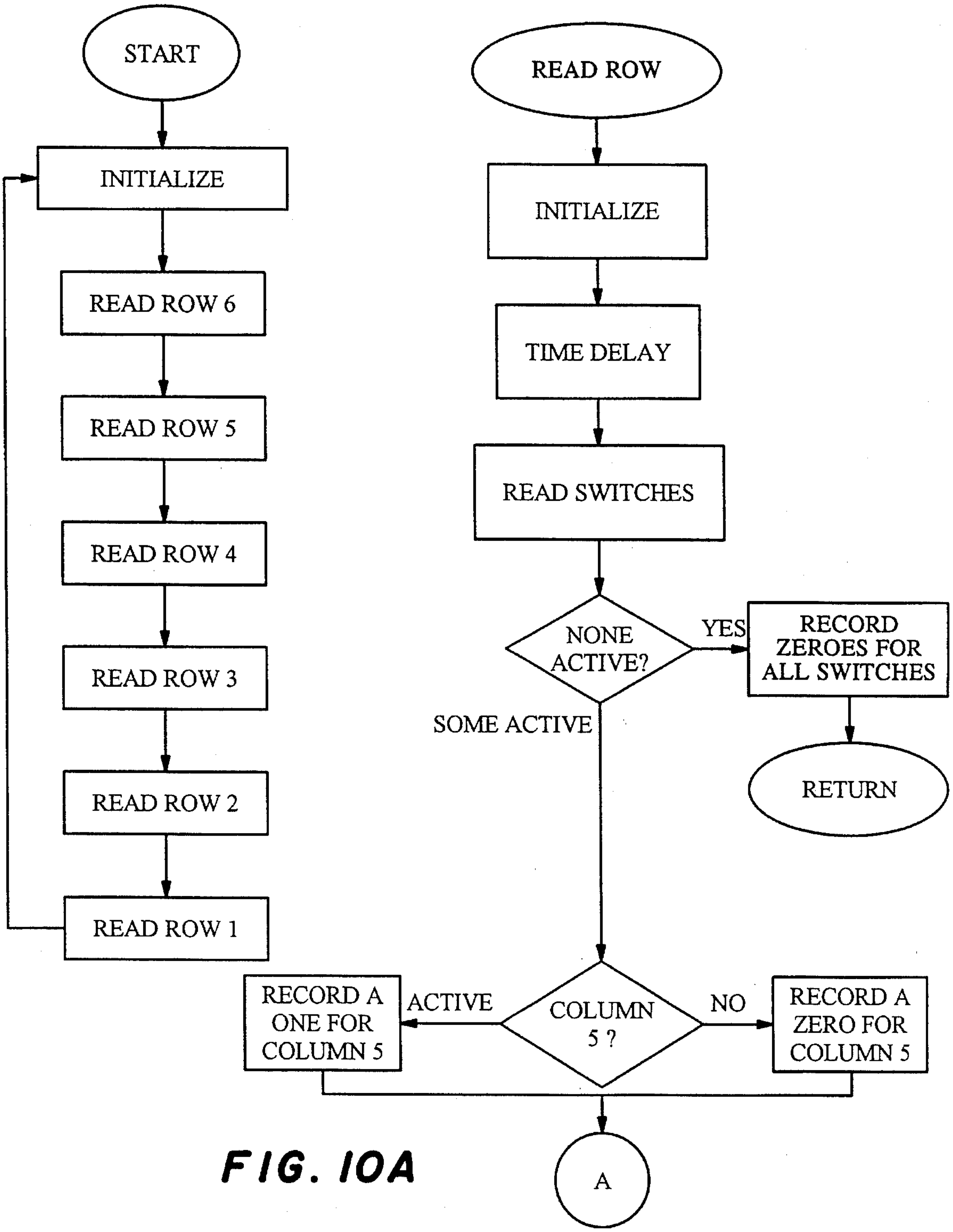

START
INITIALIZE
READ ROW 6
READ ROW 5
READ ROW 4
READ ROW 3
READ ROW 2
READ ROW 1
READ ROW
INITIALIZE
TIME DELAY
READ SWITCHES
NONE ACTIVE?
YES
RECORD ZEROES FOR ALL SWITCHES
RETURN
SOME ACTIVE
RECORD A ONE FOR COLUMN 5
ACTIVE
COLUMN 5 ?
NO
RECORD A ZERO FOR COLUMN 5
A

FIG. 10A

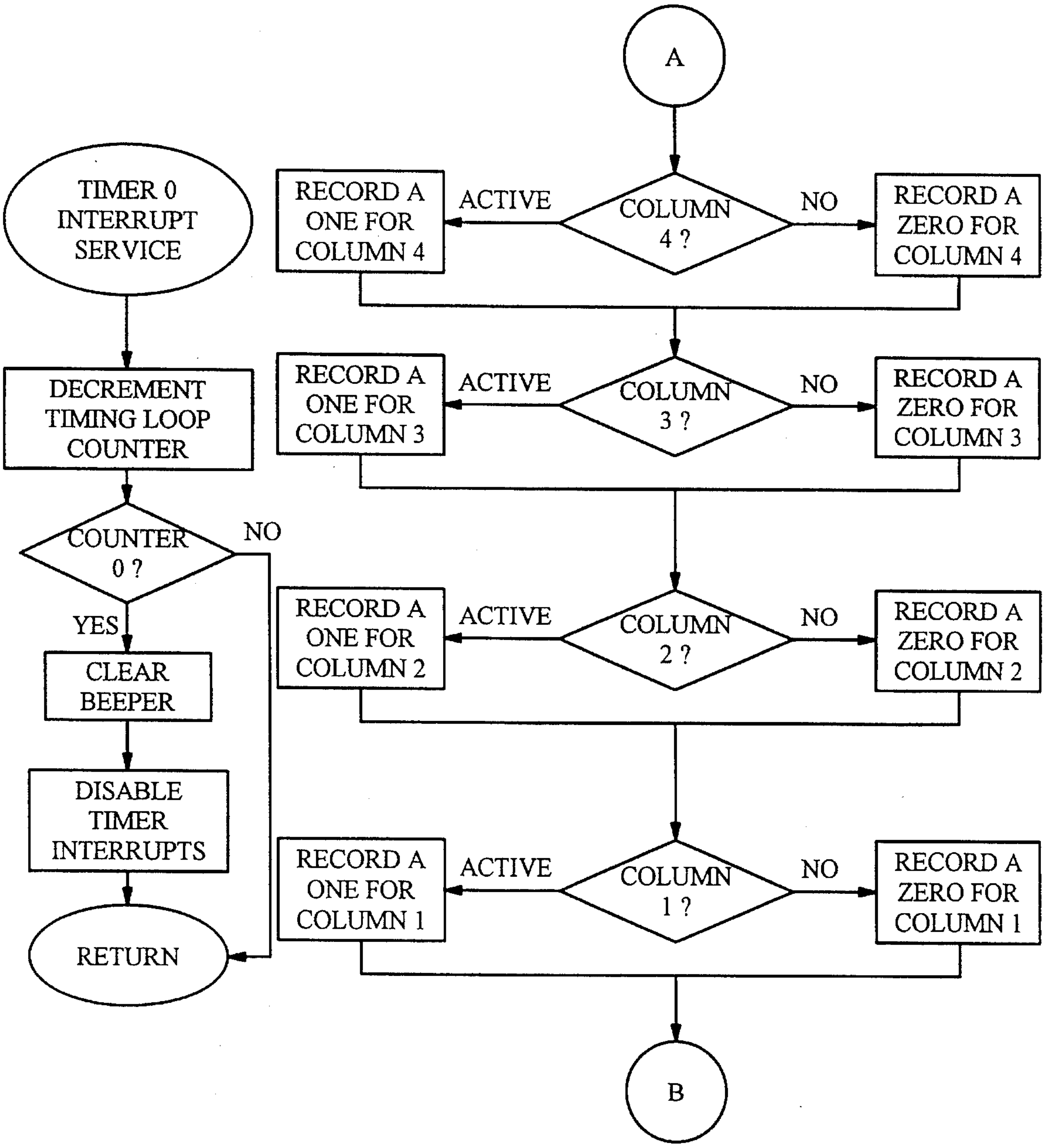

TIMER 0 INTERRUPT SERVICE
DECREMENT TIMING LOOP COUNTER
COUNTER 0 ?
NO
YES
CLEAR BEEPER
DISABLE TIMER INTERRUPTS
RETURN
A
COLUMN 4 ?
ACTIVE
RECORD A ONE FOR COLUMN 4
NO
RECORD A ZERO FOR COLUMN 4
COLUMN 3 ?
ACTIVE
RECORD A ONE FOR COLUMN 3
NO
RECORD A ZERO FOR COLUMN 3
COLUMN 2 ?
ACTIVE
RECORD A ONE FOR COLUMN 2
NO
RECORD A ZERO FOR COLUMN 2
COLUMN 1 ?
ACTIVE
RECORD A ONE FOR COLUMN 1
NO
RECORD A ZERO FOR COLUMN 1
B

FIG. 10B

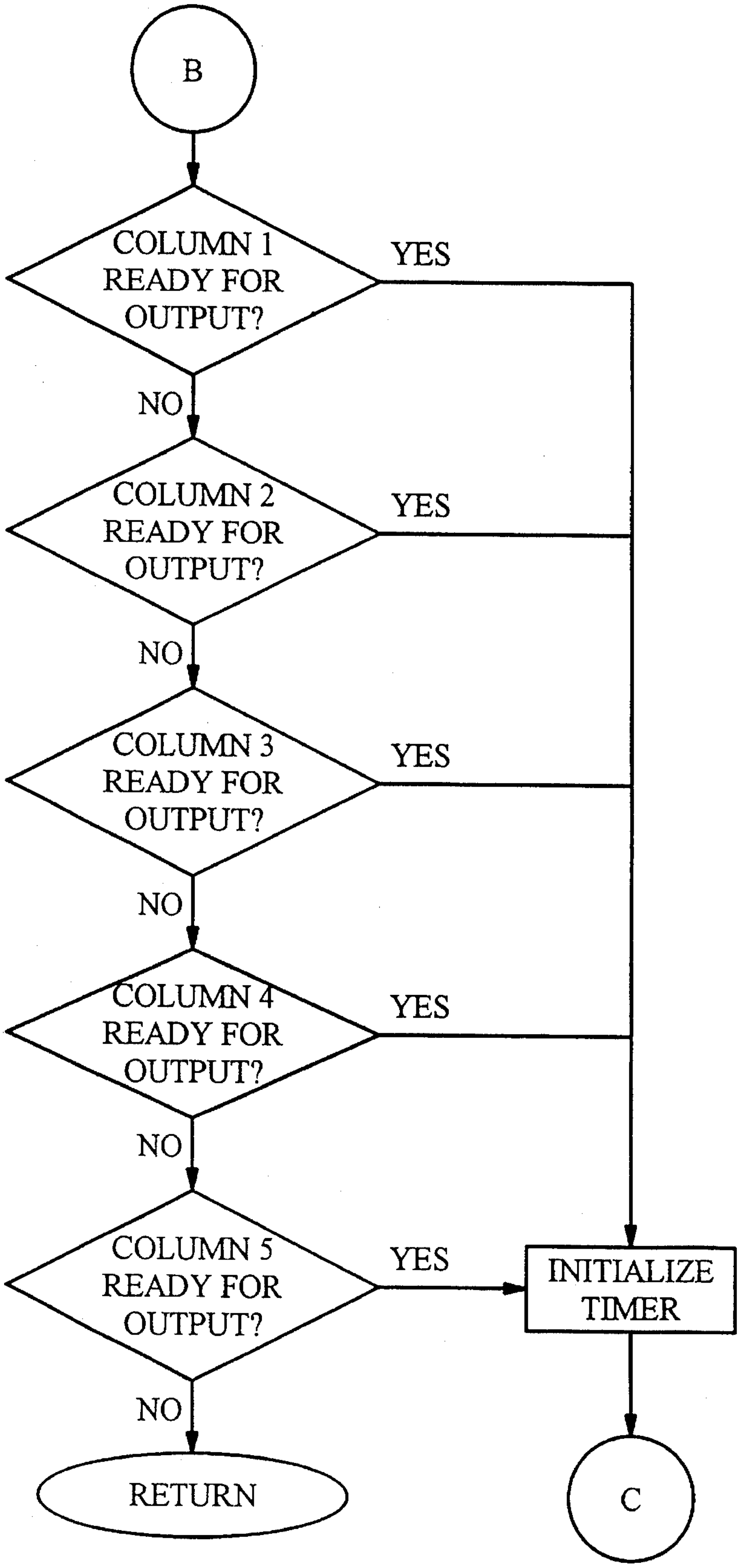

B
COLUMN 1 READY FOR OUTPUT?
YES
NO
COLUMN 2 READY FOR OUTPUT?
YES
NO
COLUMN 3 READY FOR OUTPUT?
YES
NO
COLUMN 4 READY FOR OUTPUT?
YES
NO
COLUMN 5 READY FOR OUTPUT?
YES
INITIALIZE TIMER
NO
RETURN
C

FIG. 10C

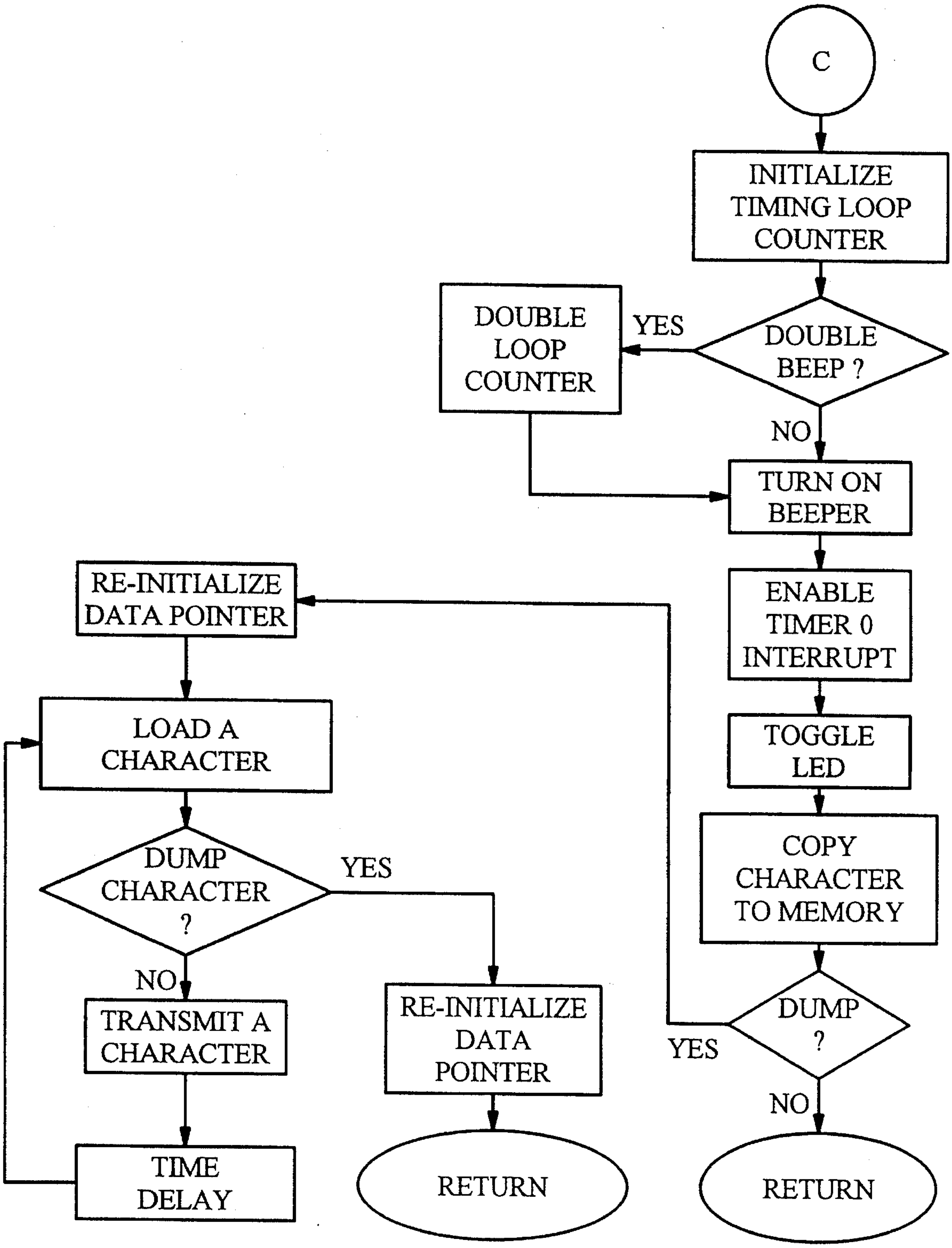

C
INITIALIZE TIMING LOOP COUNTER
DOUBLE BEEP ?
YES
DOUBLE LOOP COUNTER
NO
TURN ON BEEPER
ENABLE TIMER 0 INTERRUPT
TOGGLE LED
COPY CHARACTER TO MEMORY
DUMP ?
YES
NO
RETURN
RE-INITIALIZE DATA POINTER
LOAD A CHARACTER
DUMP CHARACTER ?
YES
NO
TRANSMIT A CHARACTER
TIME DELAY
RE-INITIALIZE DATA POINTER
RETURN

FIG. 10D

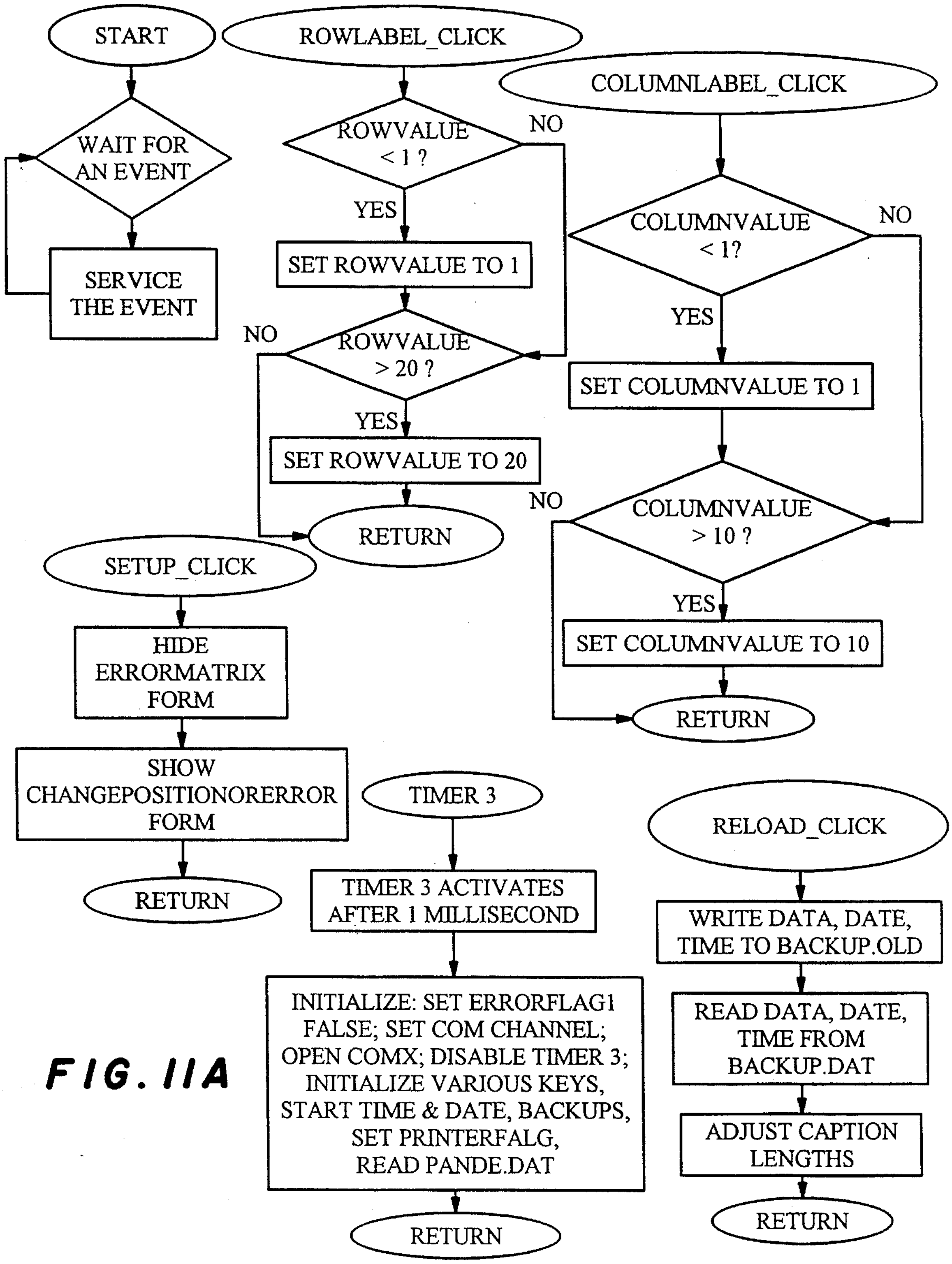

START
WAIT FOR AN EVENT
SERVICE THE EVENT
ROWLABEL_CLICK
ROWVALUE < 1 ?
NO
YES
SET ROWVALUE TO 1
ROWVALUE > 20 ?
NO
YES
SET ROWVALUE TO 20
RETURN
COLUMNLABEL_CLICK
COLUMNVALUE < 1?
NO
YES
SET COLUMNVALUE TO 1
COLUMNVALUE > 10 ?
NO
YES
SET COLUMNVALUE TO 10
RETURN
SETUP_CLICK
HIDE ERRORMATRIX FORM
SHOW CHANGEPOSITIONORERROR FORM
RETURN
TIMER 3
TIMER 3 ACTIVATES AFTER 1 MILLISECOND
INITIALIZE: SET ERRORFLAG1 FALSE; SET COM CHANNEL; OPEN COMX; DISABLE TIMER 3; INITIALIZE VARIOUS KEYS, START TIME & DATE, BACKUPS, SET PRINTERFALG, READ PANDE.DAT
RETURN
RELOAD_CLICK
WRITE DATA, DATE, TIME TO BACKUP.OLD
READ DATA, DATE, TIME FROM BACKUP.DAT
ADJUST CAPTION LENGTHS
RETURN

FIG. 11A

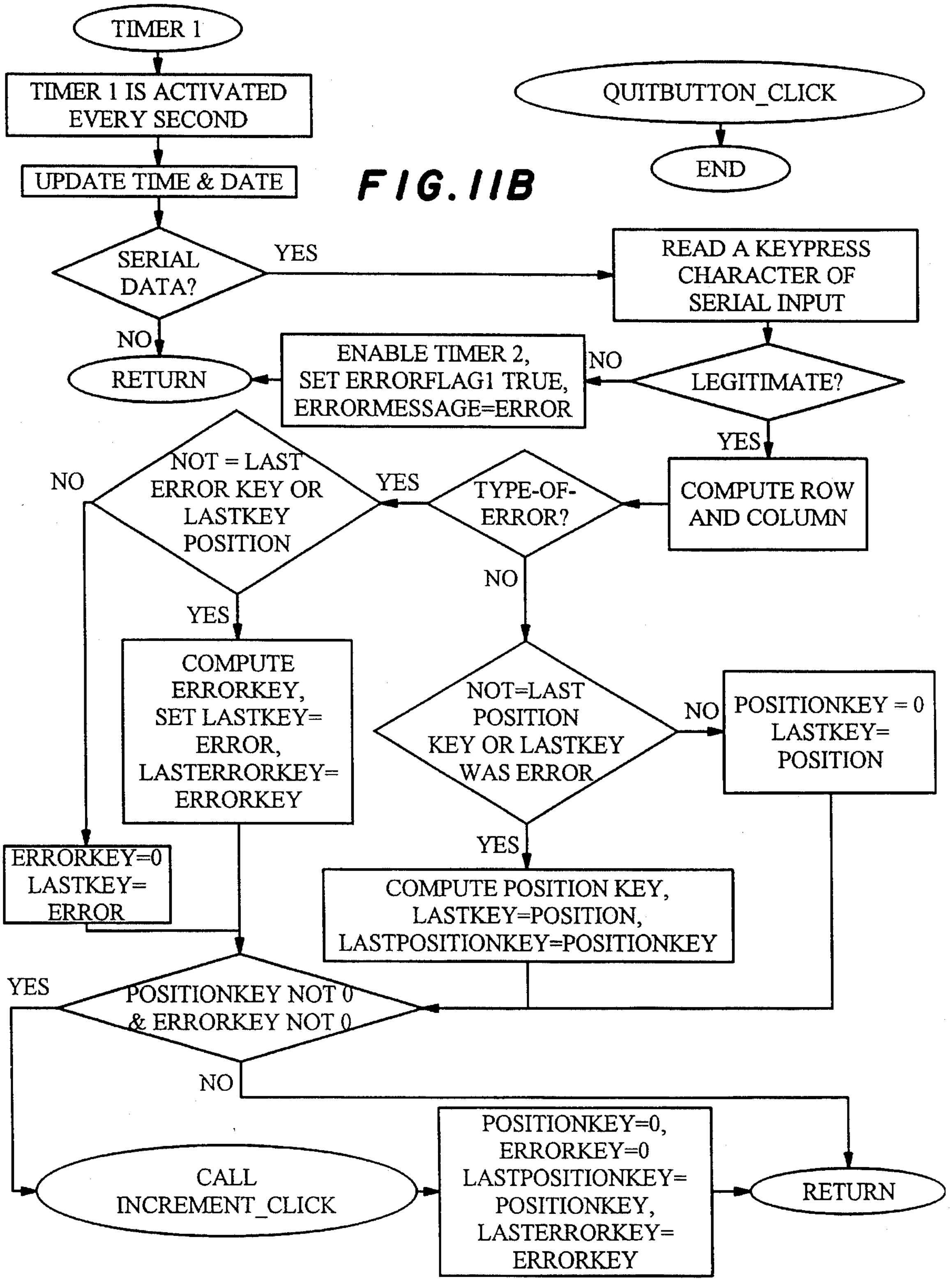

TIMER 1
TIMER 1 IS ACTIVATED EVERY SECOND
UPDATE TIME & DATE
SERIAL DATA?
YES
NO
RETURN
QUITBUTTON_CLICK
END
READ A KEYPRESS CHARACTER OF SERIAL INPUT
LEGITIMATE?
NO
ENABLE TIMER 2, SET ERRORFLAG1 TRUE, ERRORMESSAGE=ERROR
YES
COMPUTE ROW AND COLUMN
TYPE-OF-ERROR?
YES
NO
NOT = LAST ERROR KEY OR LASTKEY POSITION
NO
YES
COMPUTE ERRORKEY, SET LASTKEY= ERROR, LASTERRORKEY= ERRORKEY
ERRORKEY=0 LASTKEY= ERROR
NOT=LAST POSITION KEY OR LASTKEY WAS ERROR
NO
POSITIONKEY = 0 LASTKEY= POSITION
YES
COMPUTE POSITION KEY, LASTKEY=POSITION, LASTPOSITIONKEY=POSITIONKEY
POSITIONKEY NOT 0 & ERRORKEY NOT 0
YES
NO
CALL INCREMENT_CLICK
POSITIONKEY=0, ERRORKEY=0 LASTPOSITIONKEY= POSITIONKEY, LASTERRORKEY= ERRORKEY
RETURN

FIG. 11B

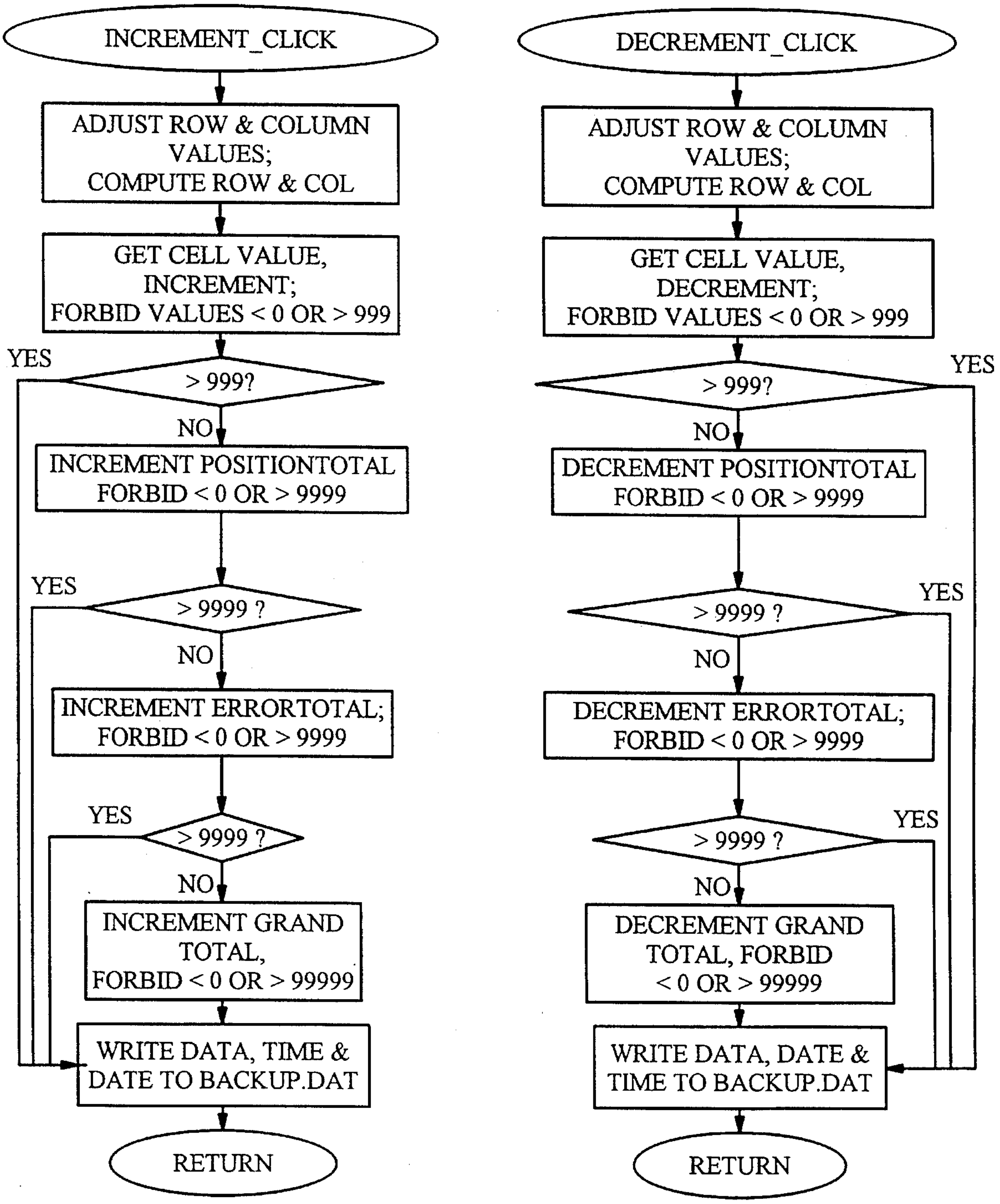

INCREMENT_CLICK
ADJUST ROW & COLUMN VALUES; COMPUTE ROW & COL
GET CELL VALUE, INCREMENT; FORBID VALUES < 0 OR > 999
> 999?
YES
NO
INCREMENT POSITIONTOTAL FORBID < 0 OR > 9999
> 9999 ?
YES
NO
INCREMENT ERRORTOTAL; FORBID < 0 OR > 9999
> 9999 ?
YES
NO
INCREMENT GRAND TOTAL, FORBID < 0 OR > 99999
WRITE DATA, TIME & DATE TO BACKUP.DAT
RETURN
DECREMENT_CLICK
ADJUST ROW & COLUMN VALUES; COMPUTE ROW & COL
GET CELL VALUE, DECREMENT; FORBID VALUES < 0 OR > 999
> 999?
YES
NO
DECREMENT POSITIONTOTAL FORBID < 0 OR > 9999
> 9999 ?
YES
NO
DECREMENT ERRORTOTAL; FORBID < 0 OR > 9999
> 9999 ?
YES
NO
DECREMENT GRAND TOTAL, FORBID < 0 OR > 99999
WRITE DATA, DATE & TIME TO BACKUP.DAT
RETURN

FIG. 11C

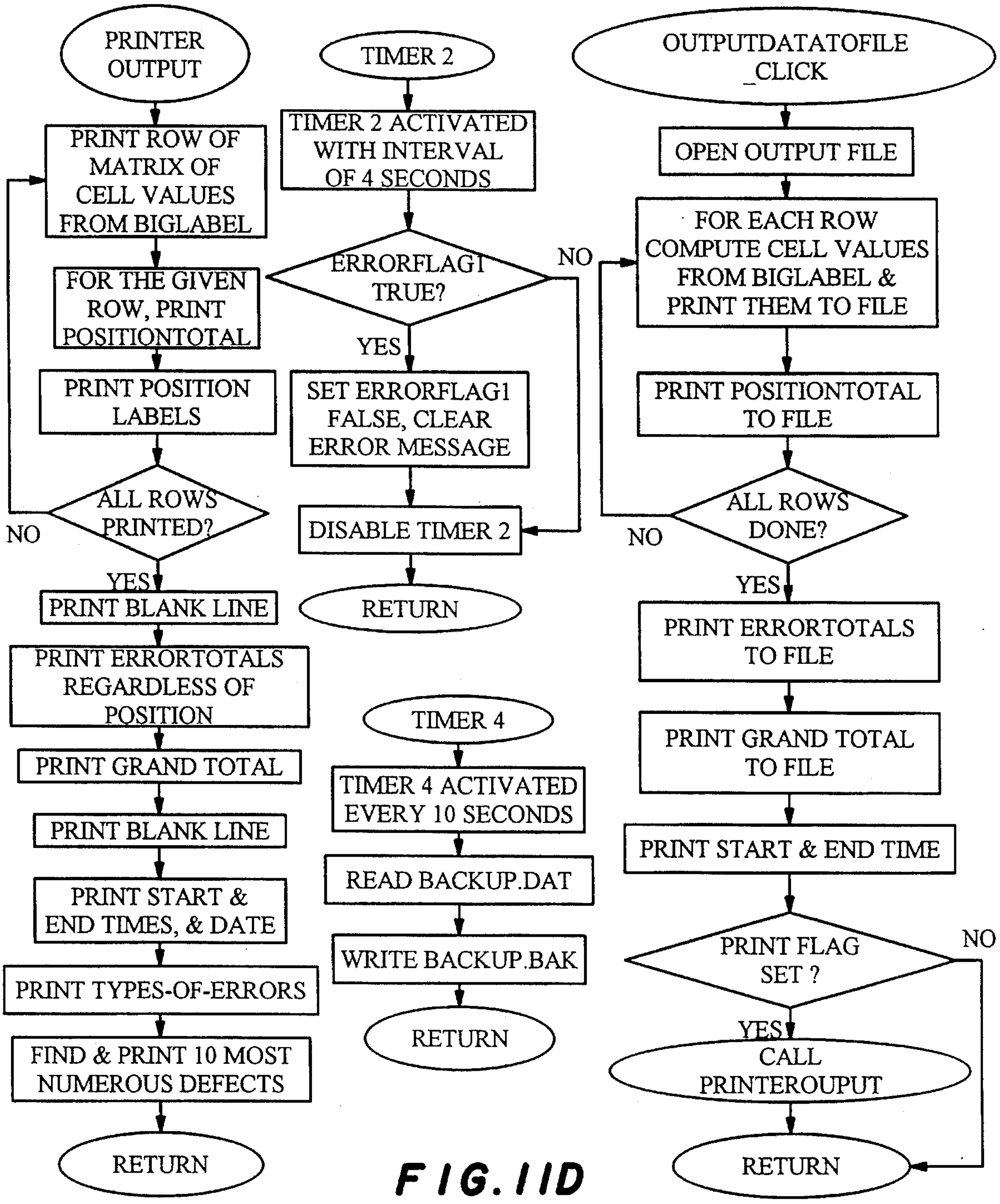
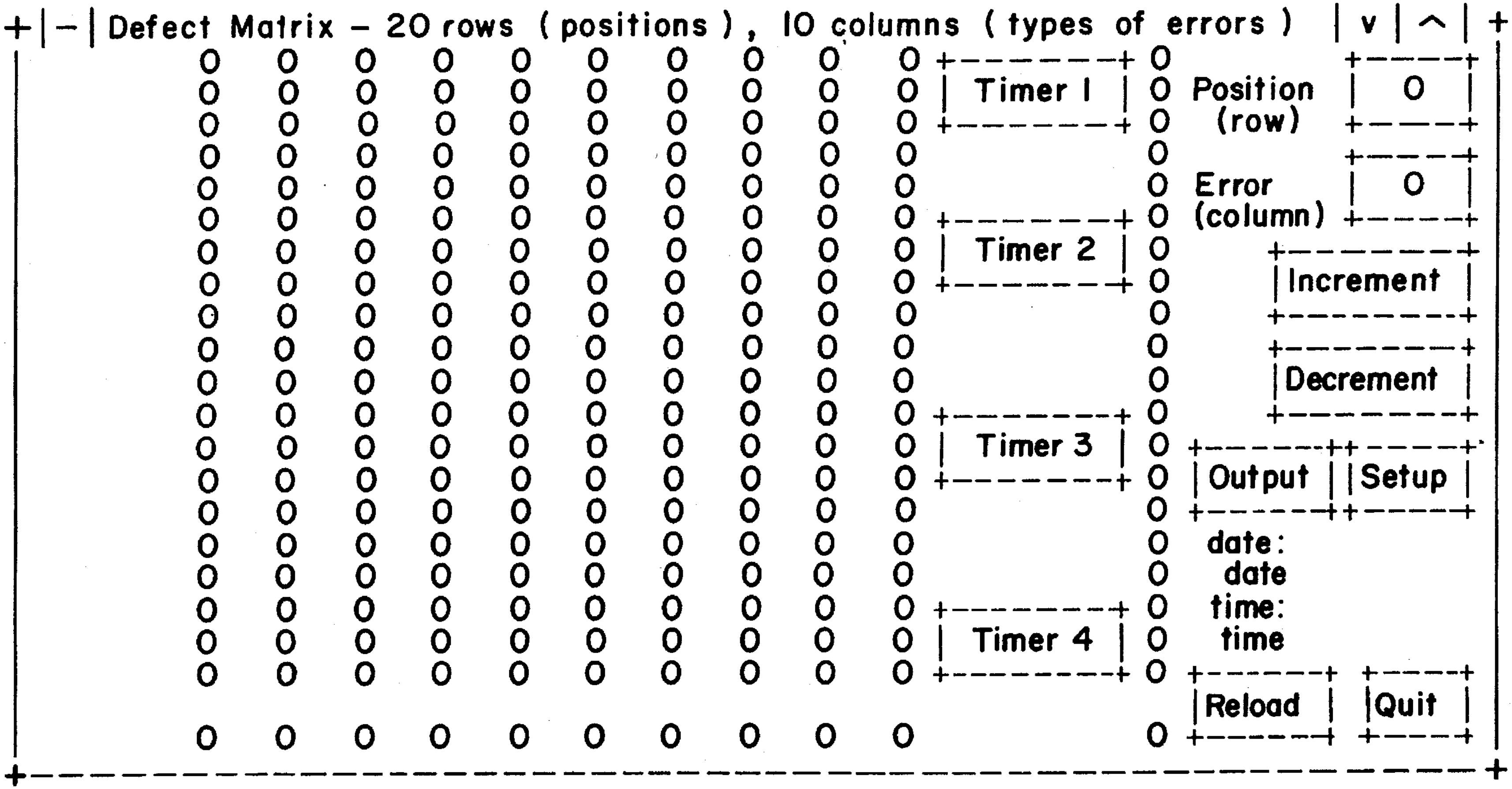
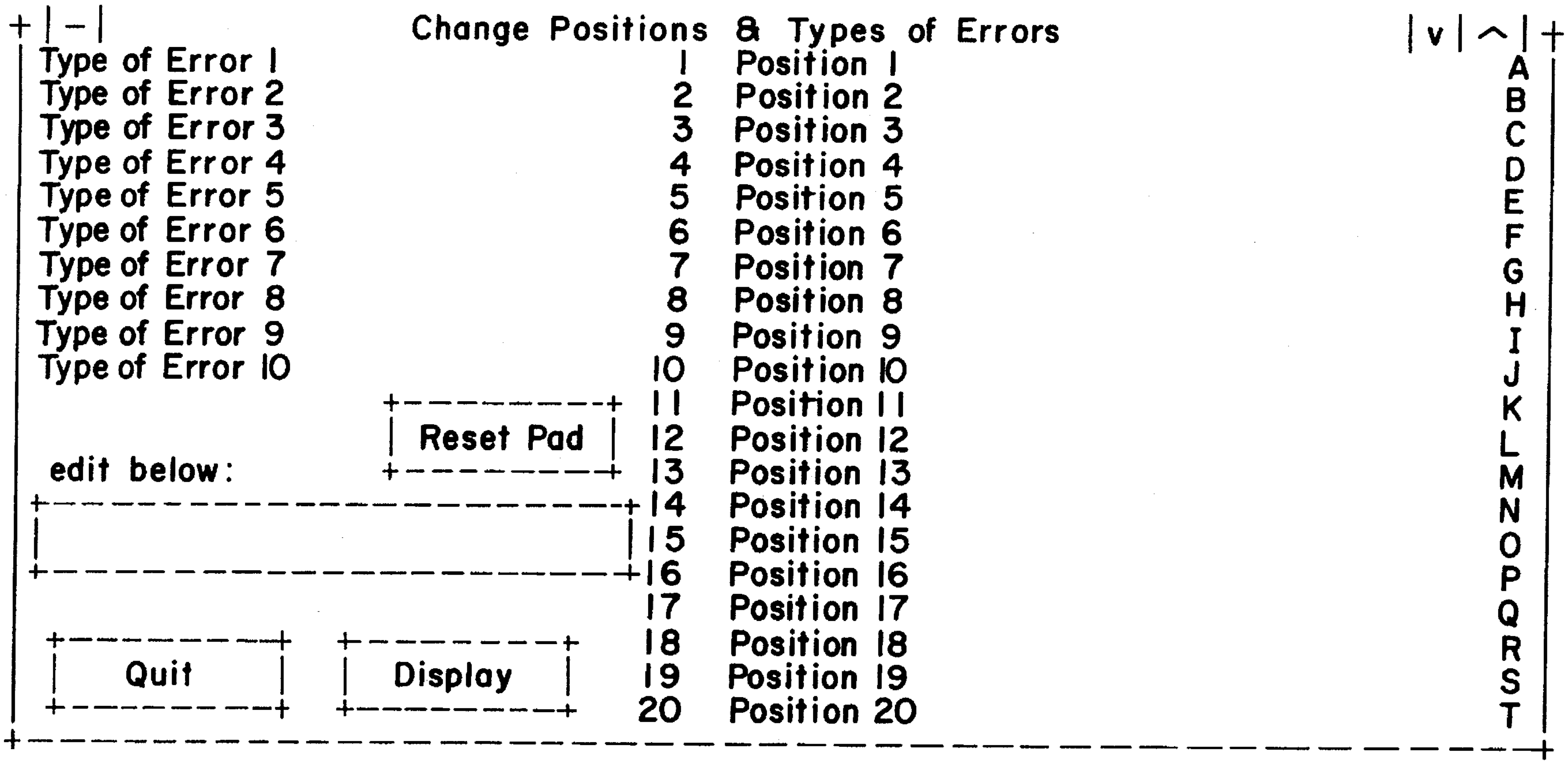

PRINTER OUTPUT
PRINT ROW OF MATRIX OF CELL VALUES FROM BIGLABEL
FOR THE GIVEN ROW, PRINT POSITIONTOTAL
PRINT POSITION LABELS
ALL ROWS PRINTED?
NO
YES
PRINT BLANK LINE
PRINT ERRORTOTALS REGARDLESS OF POSITION
PRINT GRAND TOTAL
PRINT BLANK LINE
PRINT START & END TIMES, & DATE
PRINT TYPES-OF-ERRORS
FIND & PRINT 10 MOST NUMEROUS DEFECTS
RETURN
TIMER 2
TIMER 2 ACTIVATED WITH INTERVAL OF 4 SECONDS
ERRORFLAG1 TRUE?
NO
YES
SET ERRORFLAG1 FALSE, CLEAR ERROR MESSAGE
DISABLE TIMER 2
RETURN
TIMER 4
TIMER 4 ACTIVATED EVERY 10 SECONDS
READ BACKUP.DAT
WRITE BACKUP.BAK
RETURN
OUTPUTDATATOFILE _CLICK
OPEN OUTPUT FILE
FOR EACH ROW COMPUTE CELL VALUES FROM BIGLABEL & PRINT THEM TO FILE
PRINT POSITIONTOTAL TO FILE
ALL ROWS DONE?
NO
YES
PRINT ERRORTOTALS TO FILE
PRINT GRAND TOTAL TO FILE
PRINT START & END TIME
PRINT FLAG SET ?
NO
YES
CALL PRINTEROUPUT
RETURN

FIG. 11D



```
+|-|Defect Matrix - 20 rows ( positions ), 10 columns ( types of errors ) | v | ^ | +
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0           +-----+  |
|      0  0  0  0  0  0  0  0  0  0 | Timer 1 | 0 Position  |  0  |  |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0  (row)    +-----+  |
|      0  0  0  0  0  0  0  0  0  0             0           +-----+  |
|      0  0  0  0  0  0  0  0  0  0             0 Error     |  0  |  |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0 (column)  +-----+  |
|      0  0  0  0  0  0  0  0  0  0 | Timer 2 | 0      +-----------+  |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0      |Increment  |  |
|      0  0  0  0  0  0  0  0  0  0             0      +-----------+  |
|      0  0  0  0  0  0  0  0  0  0             0      +-----------+  |
|      0  0  0  0  0  0  0  0  0  0             0      |Decrement  |  |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0      +-----------+  |
|      0  0  0  0  0  0  0  0  0  0 | Timer 3 | 0 +--------++------+  |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0 |Output  ||Setup |  |
|      0  0  0  0  0  0  0  0  0  0             0 +--------++------+  |
|      0  0  0  0  0  0  0  0  0  0             0  date:             |
|      0  0  0  0  0  0  0  0  0  0             0   date             |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0  time:             |
|      0  0  0  0  0  0  0  0  0  0 | Timer 4 | 0   time             |
|      0  0  0  0  0  0  0  0  0  0 +---------+ 0 +-------+ +-----+  |
|                                                |Reload | |Quit |  |
|      0  0  0  0  0  0  0  0  0  0             0 +-------+ +-----+  |
+-------------------------------------------------------------------+
```

FIG. 12



```
+|-|                    Change Positions  & Types of Errors                 |v|^|+
|Type of Error 1                       1  Position 1                           A|
|Type of Error 2                       2  Position 2                           B|
|Type of Error 3                       3  Position 3                           C|
|Type of Error 4                       4  Position 4                           D|
|Type of Error 5                       5  Position 5                           E|
|Type of Error 6                       6  Position 6                           F|
|Type of Error 7                       7  Position 7                           G|
|Type of Error 8                       8  Position 8                           H|
|Type of Error 9                       9  Position 9                           I|
|Type of Error 10                     10  Position 10                          J|
|                   +---------+       11  Position 11                          K|
|                   | Reset Pad |     12  Position 12                          L|
| edit below:       +---------+       13  Position 13                          M|
|+-------------------------------+ 14  Position 14                             N|
||                               | 15  Position 15                             O|
|+-------------------------------+ 16  Position 16                             P|
|                                  17  Position 17                             Q|
| +---------+   +---------+        18  Position 18                             R|
| |  Quit   |   | Display |        19  Position 19                             S|
| +---------+   +---------+        20  Position 20                             T|
+-------------------------------------------------------------------------------+
```

FIG. 13

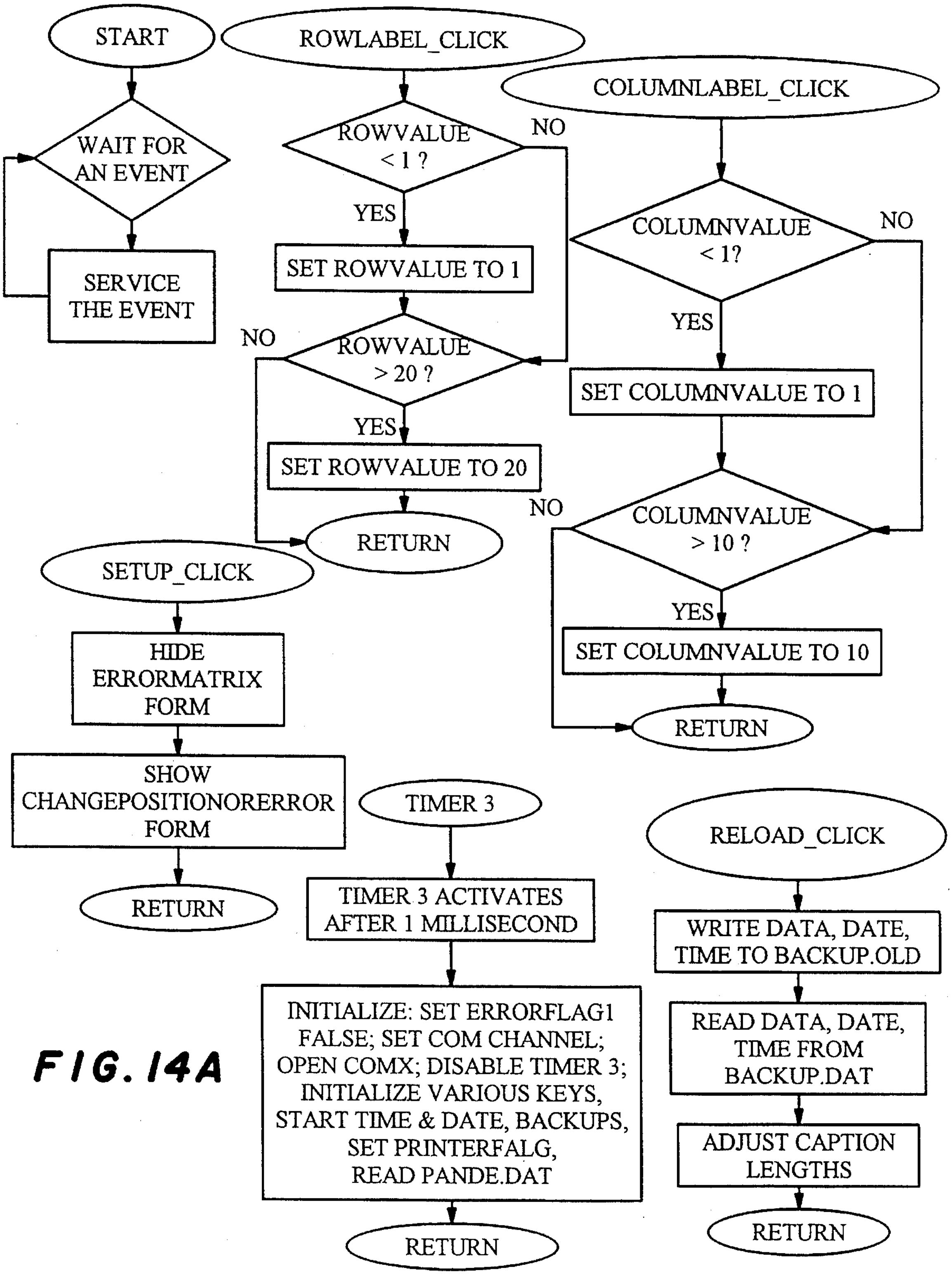

START
WAIT FOR AN EVENT
SERVICE THE EVENT
ROWLABEL_CLICK
ROWVALUE < 1 ?
NO
YES
SET ROWVALUE TO 1
NO
ROWVALUE > 20 ?
YES
SET ROWVALUE TO 20
RETURN
COLUMNLABEL_CLICK
COLUMNVALUE < 1?
NO
YES
SET COLUMNVALUE TO 1
NO
COLUMNVALUE > 10 ?
YES
SET COLUMNVALUE TO 10
RETURN
SETUP_CLICK
HIDE ERRORMATRIX FORM
SHOW CHANGEPOSITIONORERROR FORM
RETURN
TIMER 3
TIMER 3 ACTIVATES AFTER 1 MILLISECOND
INITIALIZE: SET ERRORFLAG1 FALSE; SET COM CHANNEL; OPEN COMX; DISABLE TIMER 3; INITIALIZE VARIOUS KEYS, START TIME & DATE, BACKUPS, SET PRINTERFALG, READ PANDE.DAT
RETURN
RELOAD_CLICK
WRITE DATA, DATE, TIME TO BACKUP.OLD
READ DATA, DATE, TIME FROM BACKUP.DAT
ADJUST CAPTION LENGTHS
RETURN

FIG. 14A

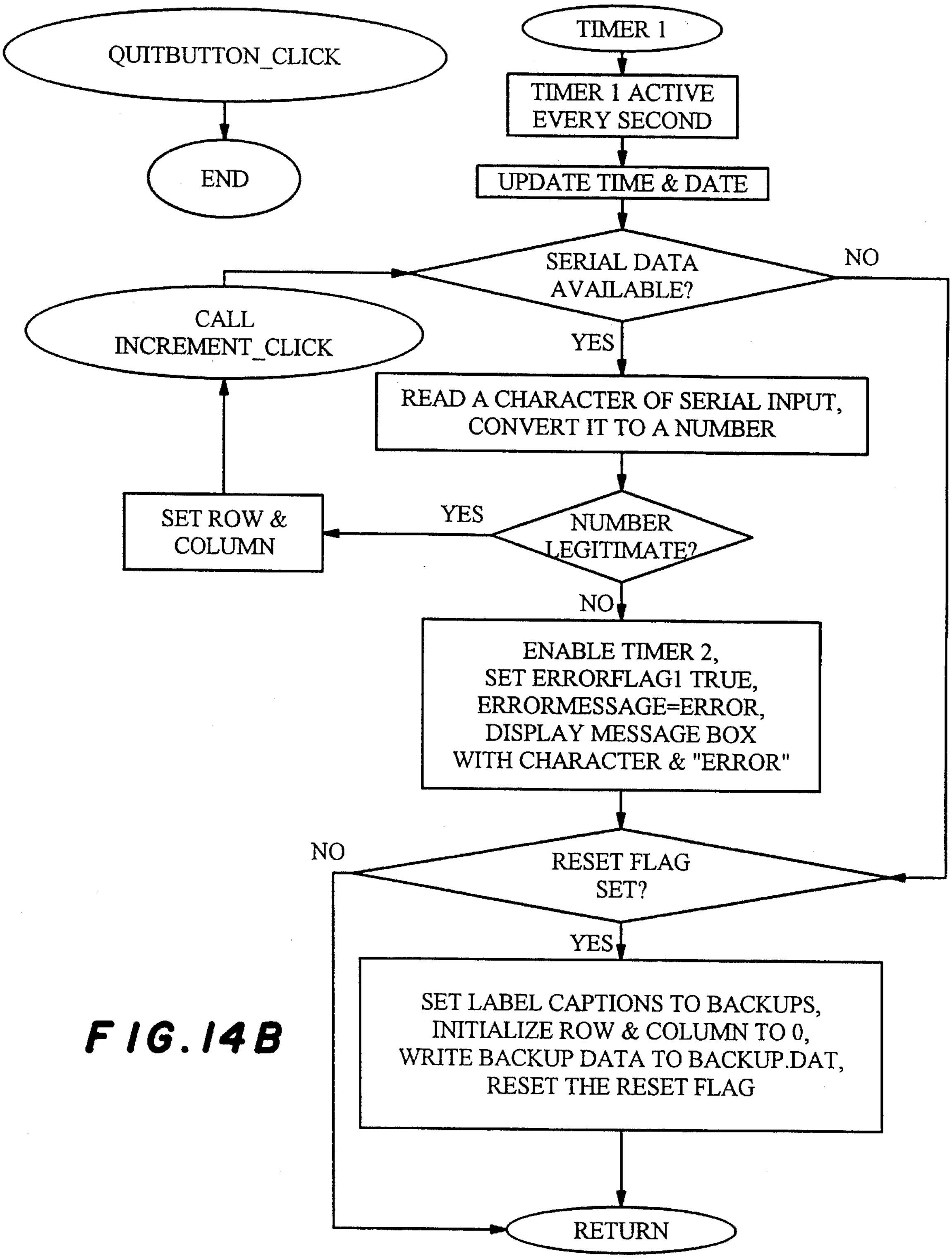

QUITBUTTON_CLICK
END
TIMER 1
TIMER 1 ACTIVE EVERY SECOND
UPDATE TIME & DATE
SERIAL DATA AVAILABLE?
NO
YES
CALL INCREMENT_CLICK
READ A CHARACTER OF SERIAL INPUT, CONVERT IT TO A NUMBER
SET ROW & COLUMN
YES
NUMBER LEGITIMATE?
NO
ENABLE TIMER 2, SET ERRORFLAG1 TRUE, ERRORMESSAGE=ERROR, DISPLAY MESSAGE BOX WITH CHARACTER & "ERROR"
NO
RESET FLAG SET?
YES
SET LABEL CAPTIONS TO BACKUPS, INITIALIZE ROW & COLUMN TO 0, WRITE BACKUP DATA TO BACKUP.DAT, RESET THE RESET FLAG
RETURN

FIG.14B

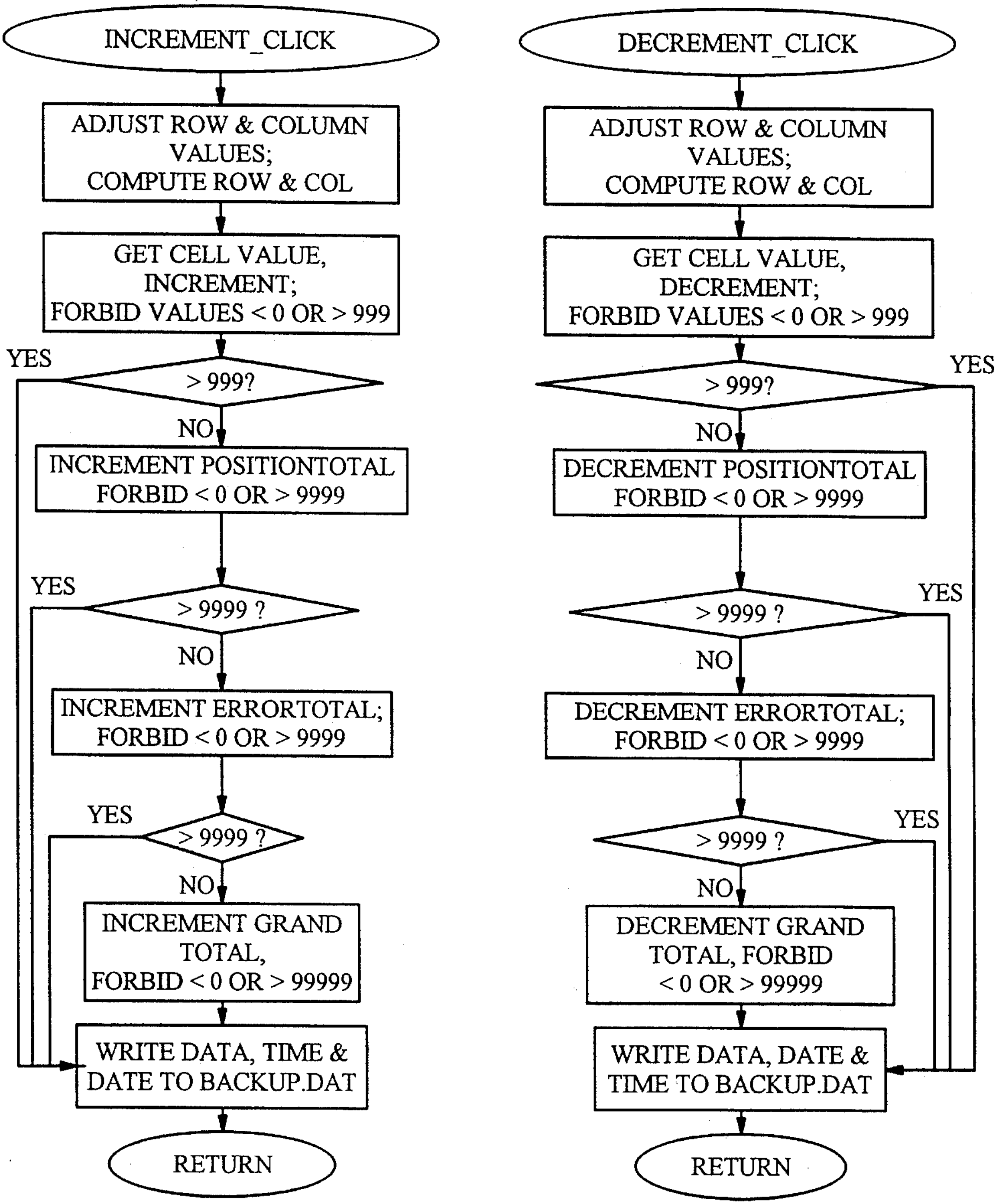

INCREMENT_CLICK
ADJUST ROW & COLUMN VALUES; COMPUTE ROW & COL
GET CELL VALUE, INCREMENT; FORBID VALUES < 0 OR > 999
> 999?
YES
NO
INCREMENT POSITIONTOTAL FORBID < 0 OR > 9999
> 9999 ?
YES
NO
INCREMENT ERRORTOTAL; FORBID < 0 OR > 9999
> 9999 ?
YES
NO
INCREMENT GRAND TOTAL, FORBID < 0 OR > 99999
WRITE DATA, TIME & DATE TO BACKUP.DAT
RETURN
DECREMENT_CLICK
ADJUST ROW & COLUMN VALUES; COMPUTE ROW & COL
GET CELL VALUE, DECREMENT; FORBID VALUES < 0 OR > 999
> 999?
YES
NO
DECREMENT POSITIONTOTAL FORBID < 0 OR > 9999
> 9999 ?
YES
NO
DECREMENT ERRORTOTAL; FORBID < 0 OR > 9999
> 9999 ?
YES
NO
DECREMENT GRAND TOTAL, FORBID < 0 OR > 99999
WRITE DATA, DATE & TIME TO BACKUP.DAT
RETURN

FIG.14C

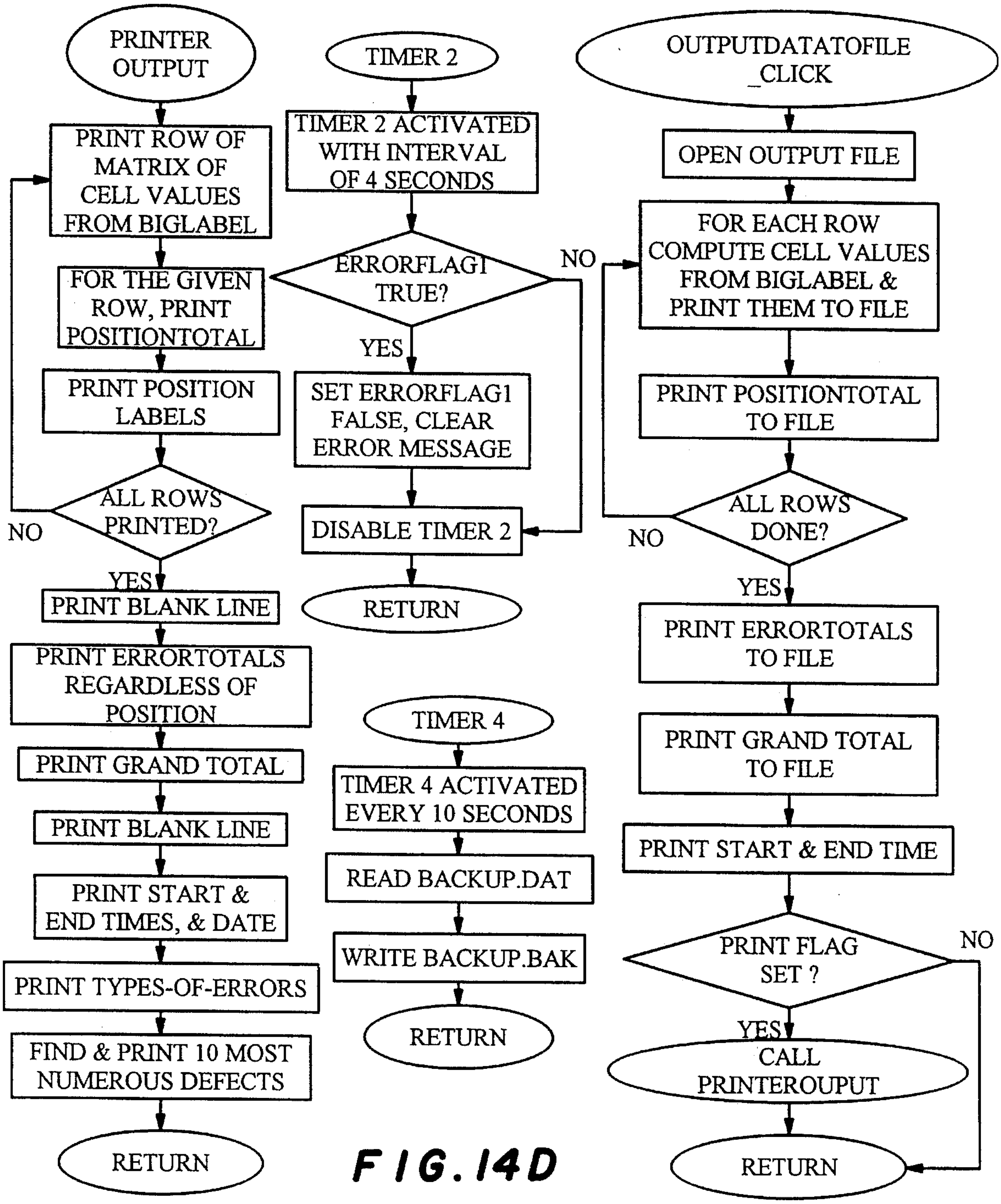

PRINTER OUTPUT
PRINT ROW OF MATRIX OF CELL VALUES FROM BIGLABEL
FOR THE GIVEN ROW, PRINT POSITIONTOTAL
PRINT POSITION LABELS
ALL ROWS PRINTED?
NO
YES
PRINT BLANK LINE
PRINT ERRORTOTALS REGARDLESS OF POSITION
PRINT GRAND TOTAL
PRINT BLANK LINE
PRINT START & END TIMES, & DATE
PRINT TYPES-OF-ERRORS
FIND & PRINT 10 MOST NUMEROUS DEFECTS
RETURN
TIMER 2
TIMER 2 ACTIVATED WITH INTERVAL OF 4 SECONDS
ERRORFLAG1 TRUE?
NO
YES
SET ERRORFLAG1 FALSE, CLEAR ERROR MESSAGE
DISABLE TIMER 2
RETURN
TIMER 4
TIMER 4 ACTIVATED EVERY 10 SECONDS
READ BACKUP.DAT
WRITE BACKUP.BAK
RETURN
OUTPUTDATATOFILE _CLICK
OPEN OUTPUT FILE
FOR EACH ROW COMPUTE CELL VALUES FROM BIGLABEL & PRINT THEM TO FILE
PRINT POSITIONTOTAL TO FILE
ALL ROWS DONE?
NO
YES
PRINT ERRORTOTALS TO FILE
PRINT GRAND TOTAL TO FILE
PRINT START & END TIME
PRINT FLAG SET ?
NO
YES
CALL PRINTEROUPUT
RETURN

FIG. 14D

```
1   0   0   0   0   0   0   0   0   1      2   FADE/BASS/TREBLE REGION
0   1   0   0   0   0   0   0   1   0      2   BAL/VOL/SEL REGION
0   0   1   0   0   0   0   1   0   0      2   SEEK BUTTON
0   0   0   1   0   0   1   0   0   0      2   AM/FM BUTTON
0   0   0   0   1   1   0   0   0   0      2   UPPER CENTRAL REGION
0   0   0   0   1   1   0   0   0   0      2   UPPER RIGHT REGION
200 0   0   1   0   0   1   0   0   0      202  1 BUTTON
0   0   1   0   0   0   0   1   0   0      2   2 BUTTON
0   1   0   0   0   0   0   0   1   0      2   3 BUTTON
1   0   0   0   0   0   0   0   0   1      2   4 BUTTON
0   1   0   0   0   0   0   0   1   0      2   5 BUTTON
0   0   1   0   0   0   0   1   0   0      2   LOWER RIGHT REGION
0   0   0   1   0   0   1   0   0   0      2   LOWER CENTRAL REGION
0   0   0   0   1   1   0   0   0   0      2   SET BUTTON
0   0   0   0   1   1   0   0   0   0      2   LOWER LEFT REGION
0   0   0   1   0   0   1   0   0   0      2   BASS/TREBLE GRAPHIC OR PLASTIC
0   0   1   0   0   0   0   1   0   0      2   FADE GRAPHIC OR PLASTIC
0   1   0   0   0   0   0   0   1   0      2   VOL/POWER GRAPHIC
1   0   0   0   0   0   0   0   0   1      2   SEL/PUSH GRAPHIC
0   1   0   0   0   0   0   0   1   0      1   BAL/L/R GRAPHIC

203 5   4   4   4   4   4   4   5   3      240  GRAND TOTAL

 START           END
 03-16-1994      03-16-1994
 10:36:53        10:55:39
                                                   POOR HEAT STAKE/LONG GATE
TRASH IN PAINT                                BROKEN LEG/BAD OPTIC
   BAD GRAPHIC                          BUTTON FAILURE
       BROKEN PIN/USDB            LIGHT LEAK
           SCRATCH      SHORT SHOT
               OFF LOCATION GRAPHIC
```

FIG. 15A

10 MOST NUMEROUS DEFECTS

POSITION	TYPE OF ERROR	NUMBER
1 BUTTON	TRASH IN PAINT	200
FADE/BASS/TREBLE REGION	TRASH IN PAINT	1
FADE/BASS/TREBLE REGION	POOR HEAT STAKE/LONG GATE	1
BAL/VOL/SEL REGION	BAD GRAPHIC	1
BAL/VOL/SEL REGION	BROKEN LEG/BAD OPTIC	1
SEEK BUTTON	BROKEN PIN/USDB	1
SEEK BUTTON	BUTTON FAILURE	1
AM/FM BUTTON	SCRATCH	1
AM/FM BUTTON	LIGHT LEAK	1
UPPER CENTRAL REGION	OFF LOCATION GRAPHIC	1

FIG. 15B

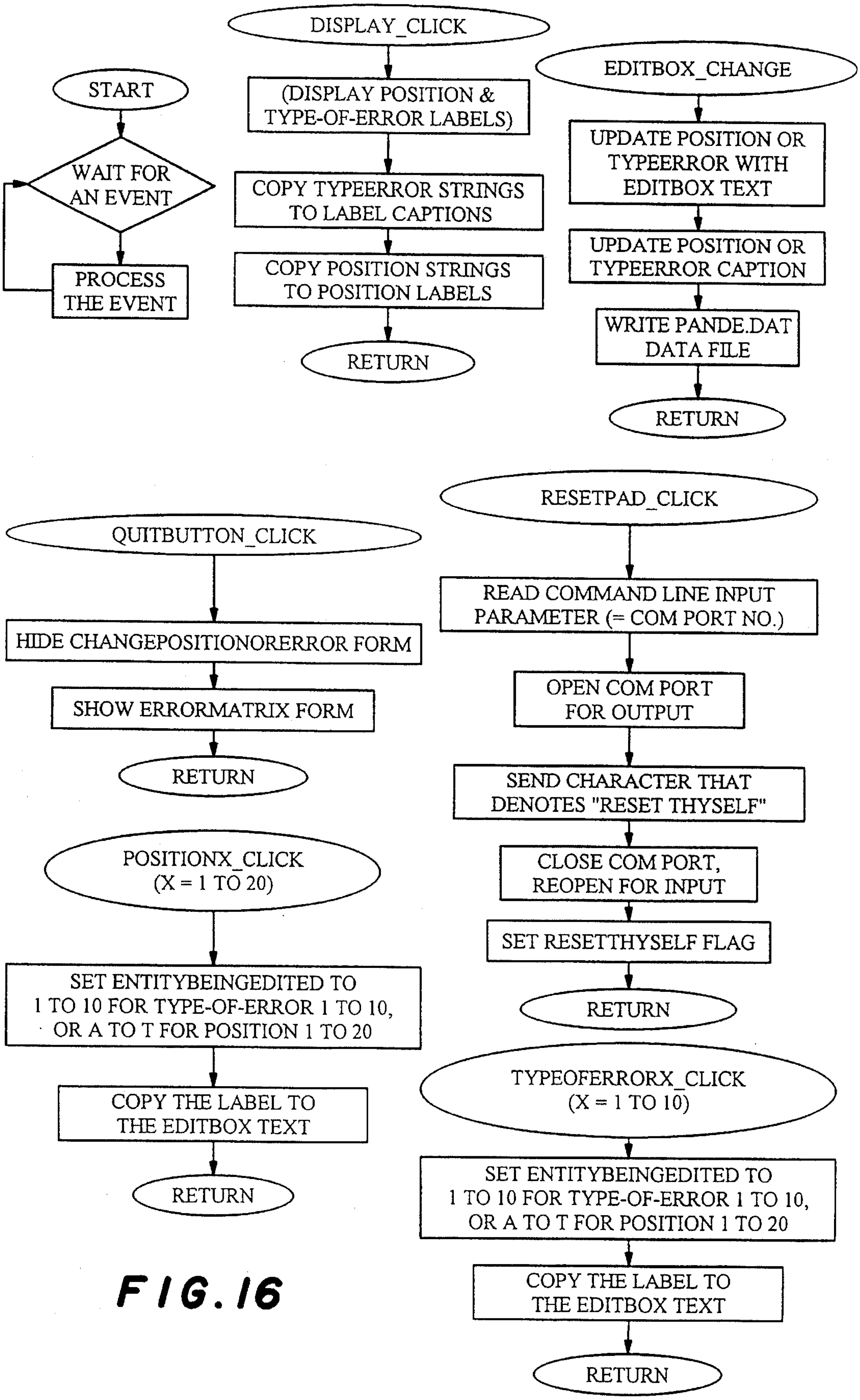

START
WAIT FOR AN EVENT
PROCESS THE EVENT
DISPLAY_CLICK
(DISPLAY POSITION & TYPE-OF-ERROR LABELS)
COPY TYPEERROR STRINGS TO LABEL CAPTIONS
COPY POSITION STRINGS TO POSITION LABELS
RETURN
EDITBOX_CHANGE
UPDATE POSITION OR TYPEERROR WITH EDITBOX TEXT
UPDATE POSITION OR TYPEERROR CAPTION
WRITE PANDE.DAT DATA FILE
RETURN
QUITBUTTON_CLICK
HIDE CHANGEPOSITIONORERROR FORM
SHOW ERRORMATRIX FORM
RETURN
POSITIONX_CLICK (X = 1 TO 20)
SET ENTITYBEINGEDITED TO 1 TO 10 FOR TYPE-OF-ERROR 1 TO 10, OR A TO T FOR POSITION 1 TO 20
COPY THE LABEL TO THE EDITBOX TEXT
RETURN
RESETPAD_CLICK
READ COMMAND LINE INPUT PARAMETER (= COM PORT NO.)
OPEN COM PORT FOR OUTPUT
SEND CHARACTER THAT DENOTES "RESET THYSELF"
CLOSE COM PORT, REOPEN FOR INPUT
SET RESETTHYSELF FLAG
RETURN
TYPEOFERRORX_CLICK (X = 1 TO 10)
SET ENTITYBEINGEDITED TO 1 TO 10 FOR TYPE-OF-ERROR 1 TO 10, OR A TO T FOR POSITION 1 TO 20
COPY THE LABEL TO THE EDITBOX TEXT
RETURN

FIG. 16

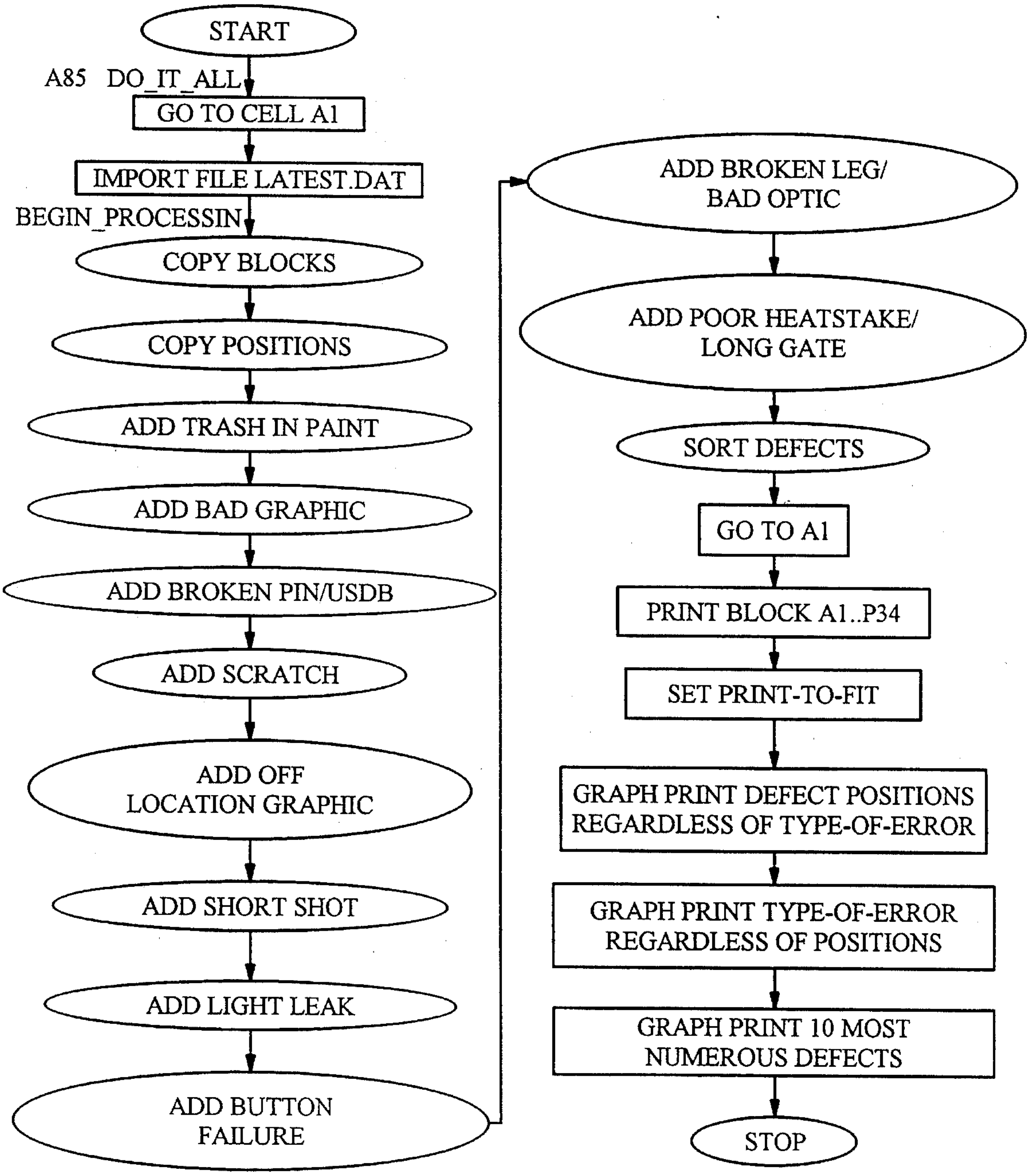

START
A85 DO_IT_ALL
GO TO CELL A1
IMPORT FILE LATEST.DAT
BEGIN_PROCESSIN
COPY BLOCKS
COPY POSITIONS
ADD TRASH IN PAINT
ADD BAD GRAPHIC
ADD BROKEN PIN/USDB
ADD SCRATCH
ADD OFF LOCATION GRAPHIC
ADD SHORT SHOT
ADD LIGHT LEAK
ADD BUTTON FAILURE
ADD BROKEN LEG/ BAD OPTIC
ADD POOR HEATSTAKE/ LONG GATE
SORT DEFECTS
GO TO A1
PRINT BLOCK A1..P34
SET PRINT-TO-FIT
GRAPH PRINT DEFECT POSITIONS REGARDLESS OF TYPE-OF-ERROR
GRAPH PRINT TYPE-OF-ERROR REGARDLESS OF POSITIONS
GRAPH PRINT 10 MOST NUMEROUS DEFECTS
STOP

FIG. 17

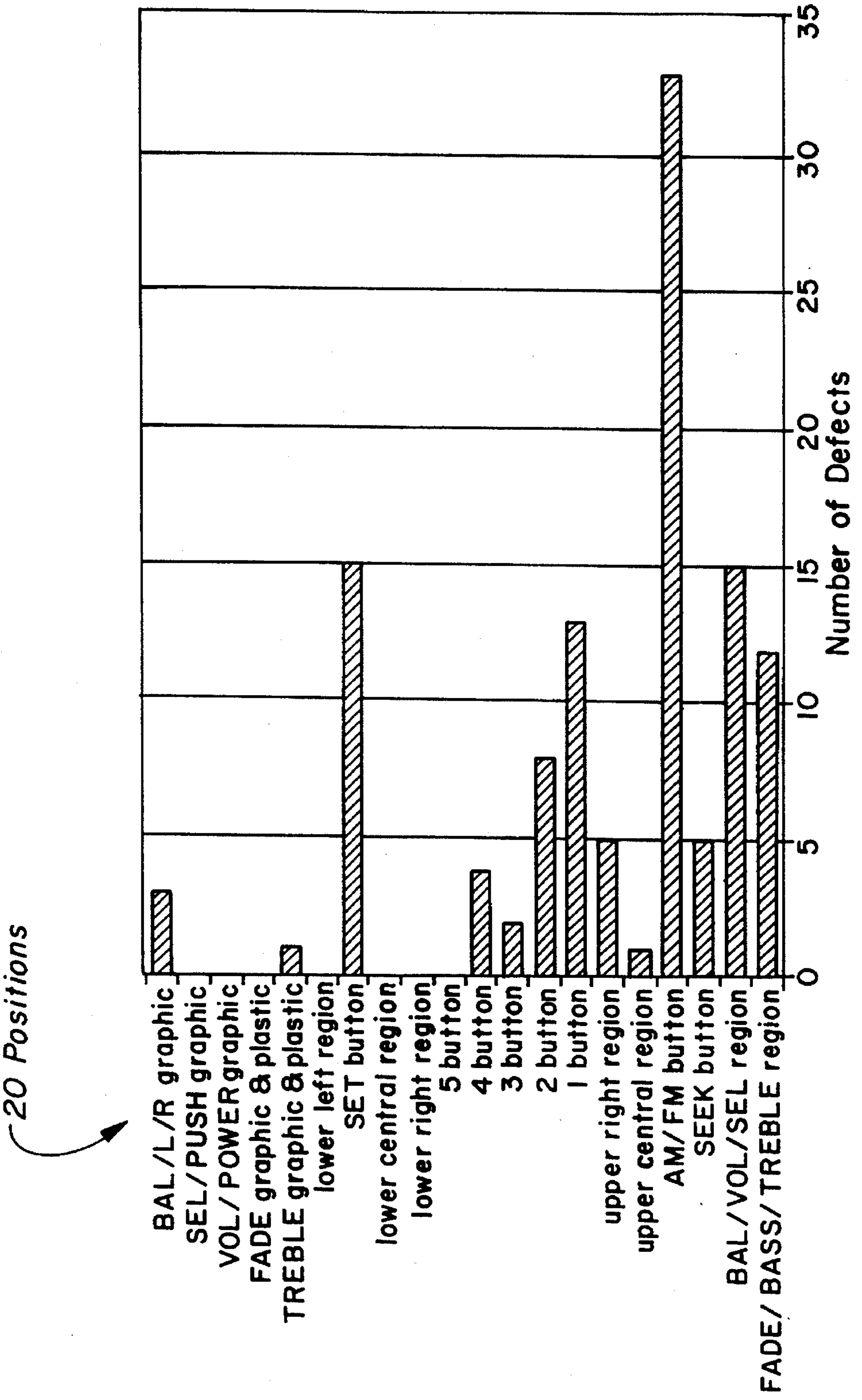

20 Positions
BAL/L/R graphic
SEL/PUSH graphic
VOL/POWER graphic
FADE graphic & plastic
TREBLE graphic & plastic
lower left region
SET button
lower central region
lower right region
5 button
4 button
3 button
2 button
1 button
upper right region
upper central region
AM/FM button
SEEK button
BAL/VOL/SEL region
FADE/BASS/TREBLE region
0
5
10
15
20
25
30
35
Number of Defects

FIG. 18

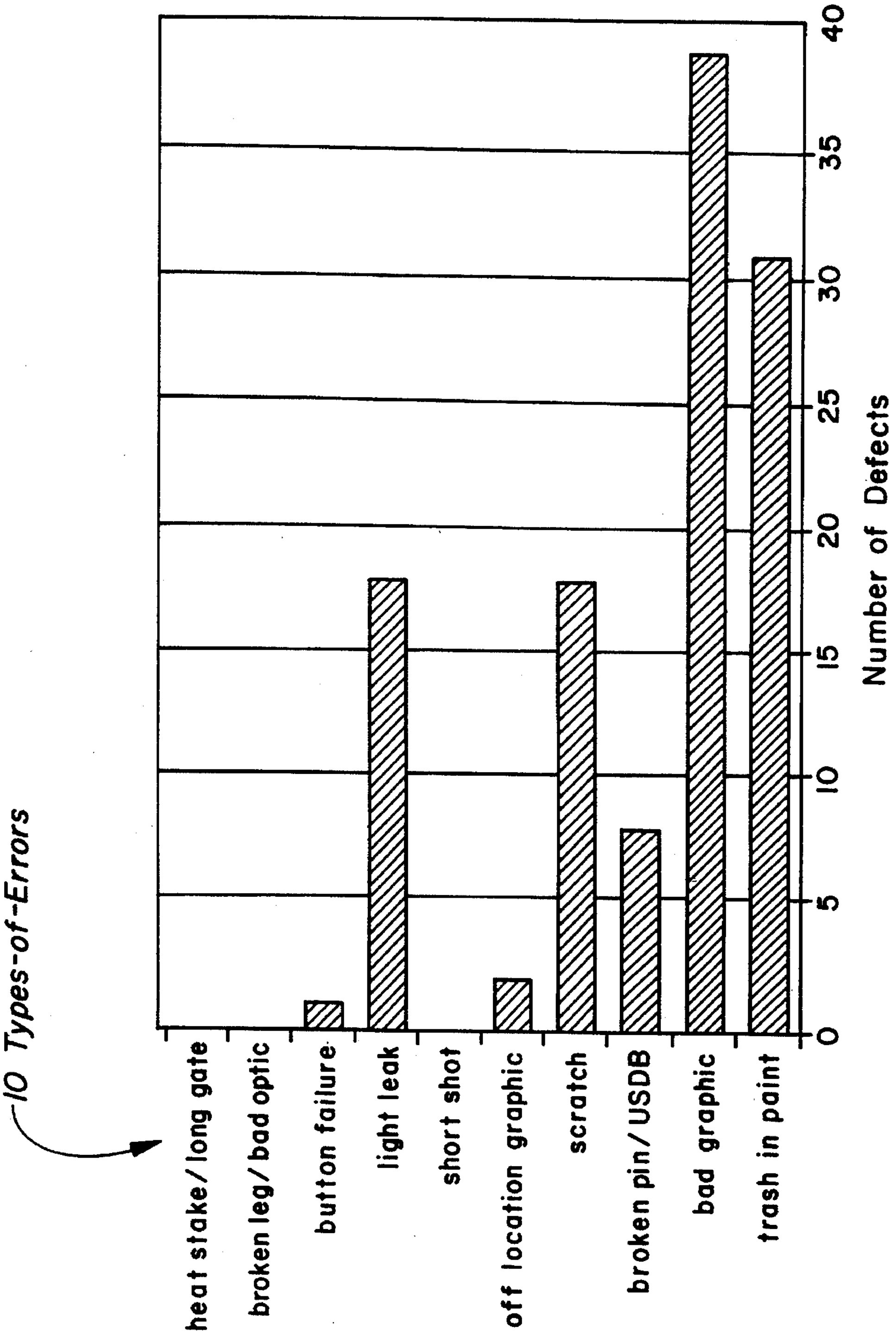

10 Types-of-Errors
heat stake/long gate
broken leg/bad optic
button failure
light leak
short shot
off location graphic
scratch
broken pin/USDB
bad graphic
trash in paint
0
5
10
15
20
25
30
35
40
Number of Defects

FIG. 19

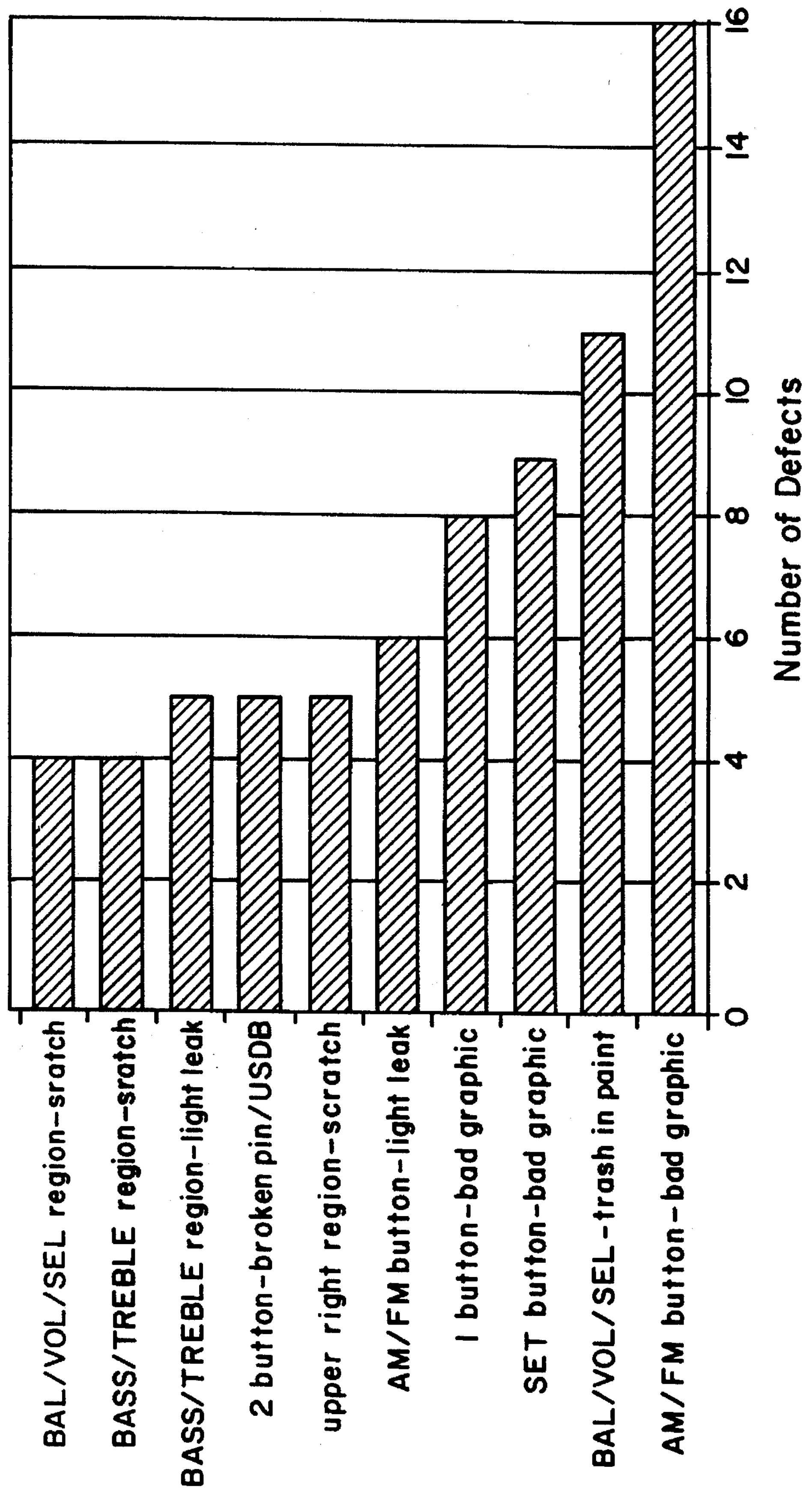

BAL/VOL/SEL region-sratch
BASS/TREBLE region-sratch
BASS/TREBLE region-light leak
2 button-broken pin/USDB
upper right region-scratch
AM/FM button-light leak
1 button-bad graphic
SET button-bad graphic
BAL/VOL/SEL-trash in paint
AM/FM button-bad graphic
0
2
4
6
8
10
12
14
16
Number of Defects

FIG. 20

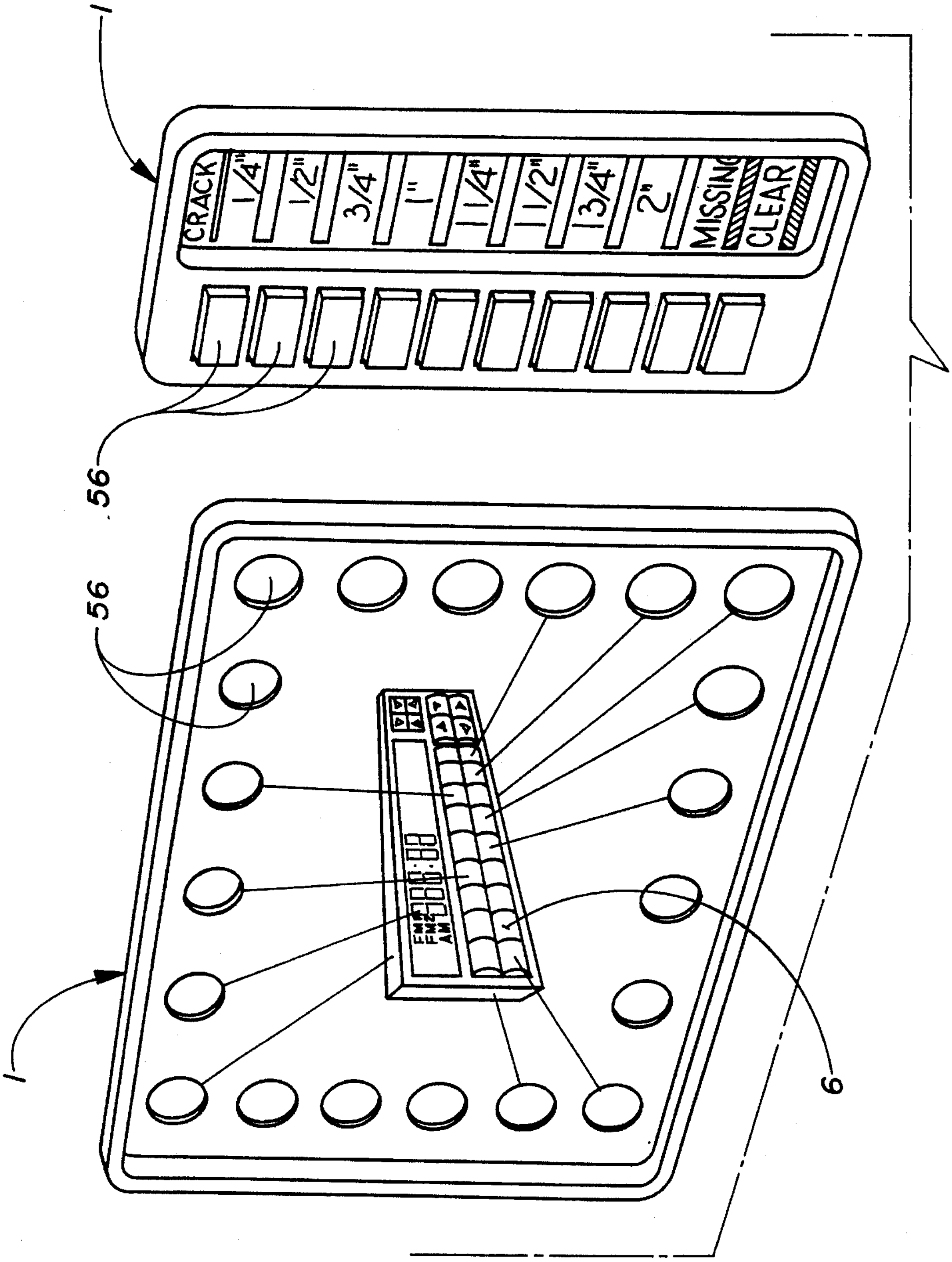


FIG. 21

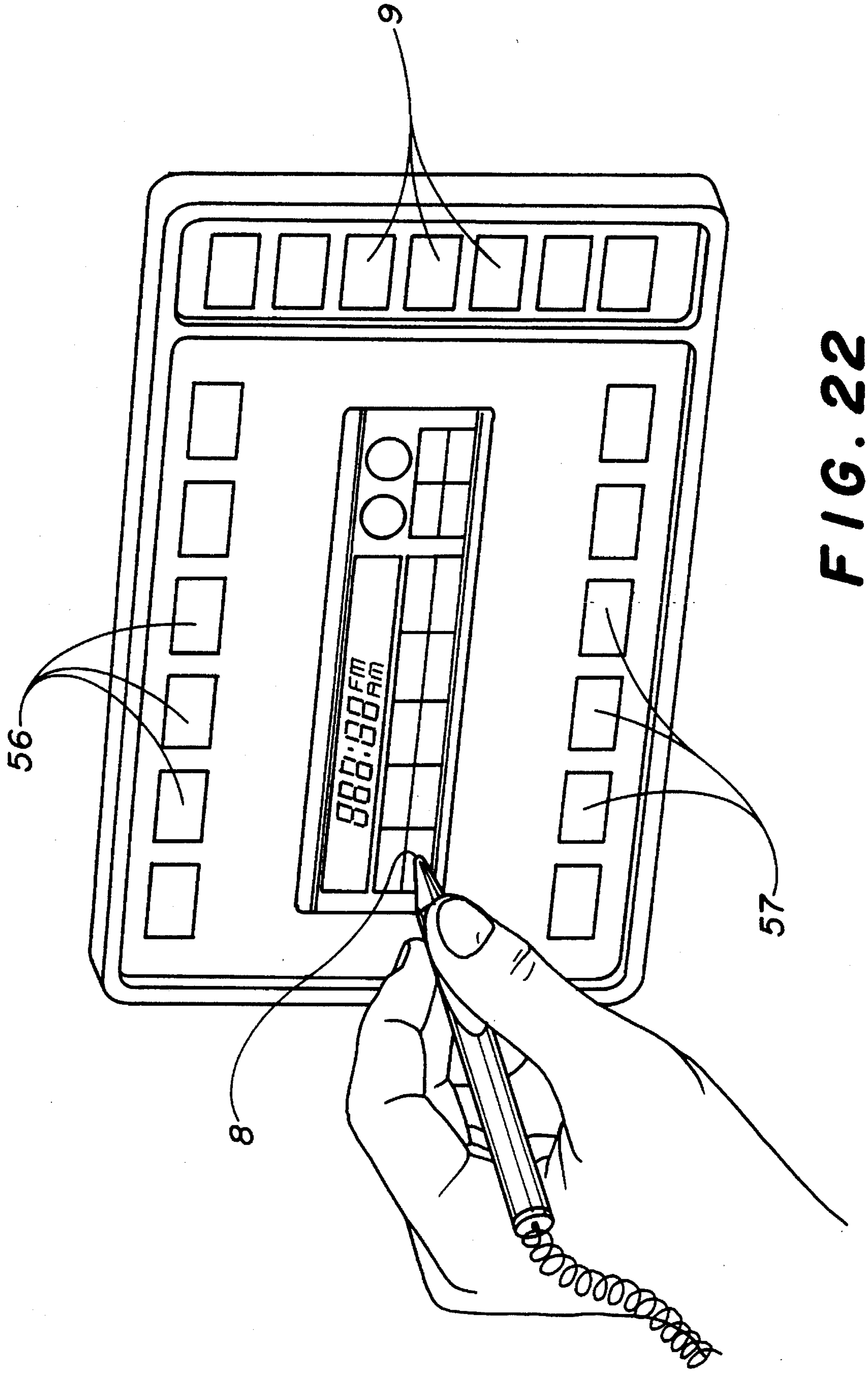


FIG. 22

```
0,1,3,6,0,0,5,0,3,0,                  ,18
8,3,1,6,0,0,5,0,0,0,                  ,23
1,4,0,1,0,0,0,0,0,0,                  ,6
0,6,3,0,5,0,1,0,0,0,                  ,15
1,0,0,2,0,0,0,0,0,0,                  ,3
0,0,0,4,0,0,0,0,0,0,                  ,4
1,0,1,0,0,0,3,0,0,0,                  ,5
1,0,3,0,0,0,0,5,0,0,                  ,9
0,0,0,1,0,0,2,6,0,0,                  ,9
1,1,2,0,0,0,2,3,0,0,                  ,9
0,1,0,1,0,0,0,1,0,0,                  ,3
0,0,0,0,0,0,0,0,2,0,                  ,2
0,0,0,0,0,0,0,2,0,0,                  ,2
0,7,1,0,0,0,1,0,0,0,                  ,9
0,0,0,0,0,0,0,0,0,0,                  ,0
0,0,0,0,0,0,0,0,0,0,                  ,0
0,0,0,0,0,0,0,0,0,0,                  ,0
0,0,0,0,0,0,0,0,0,0,                  ,0
0,0,0,0,0,0,0,0,0,0,                  ,0
0,3,0,0,0,0,0,0,0,0,                  ,3

13,26,14,21,5,0,19,17,5,0,                  ,120

"START,,,END"
"05-02-1994",,,"05-03-1994"
"23:10:33",,,"06:03:05"
```

FIG. 23

```
1482:0100  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:0110  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:0120  20 20 20 30 20 20 20-30 20 20 20 20 30 20 20      0   0    0
1482:0130  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:0140  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:0150  30 20 20 20 20 30 20-20 20 30 20 20 20 30 20   0    0   0   0
1482:0160  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:0170  20 30 20 20 20 30 20-20 20 30 20 20 20 20 30    0   0   0    0
1482:0180  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:0190  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:01A0  20 20 30 20 20 20 20-30 20 20 20 30 20 20 20     0    0   0   0
1482:01B0  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:01C0  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0
1482:01D0  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:01E0  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:01F0  30 20 20 20 30 20 20-20 20 30 20 20 20 30 20   0   0    0   0
1482:0200  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:0210  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:0220  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:0230  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:0240  20 20 30 20 20 20 30-20 20 20 20 30 20 20 20     0   0    0   0
1482:0250  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:0260  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:0270  20 20 20 20 30 20 20-20 30 20 20 20 30 20 20       0   0   0
-
```

FIG. 24A

```
1482:0280  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:0290  30 20 20 20 30 20 20-20 30 20 20 20 20 30 20   0   0   0    0
1482:02A0  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:02B0  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:02C0  20 30 20 20 20 20 30-20 20 20 30 20 20 20 30    0    0   0   0
1482:02D0  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:02E0  20 20 30 20 20 20 30-20 20 20 30 20 20 20 20     0   0   0    0
1482:02F0  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:0300  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:0310  20 20 20 30 20 20 20-20 30 20 20 20 30 20 20      0    0   0
1482:0320  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:0330  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:0340  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:0350  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
1482:0360  20 30 20 20 20 30 20-20 20 20 30 20 20 20 30    0   0    0   0
1482:0370  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:0380  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30     0   0   0   0
1482:0390  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:03A0  20 20 20 30 20 20 20-30 20 20 20 30 20 20 20      0   0   0   0
1482:03B0  20 20 20 30 20 20 20-30 20 20 20 20 30 20 20      0   0    0
1482:03C0  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:03D0  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20   0   0   0   0
1482:03E0  30 20 20 20 20 30 20-20 20 30 20 20 20 30 20   0    0   0   0
1482:03F0  20 30 20 20 20 30 20-20 20 30 20 20 20 30 20    0   0   0   0
-
```

FIG. 24B

```
1482:0400  20 30 20 20 20 30 20-20 20 30 20 20 20 20 30      0   0   0    0
1482:0410  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30       0   0   0   0
1482:0420  20 20 30 20 20 20 30-20 20 20 30 20 20 20 30       0   0   0   0
1482:0430  20 20 30 0D 0A 20 20-20 30 20 20 20 30 20 20       0..   0   0
1482:0440  30 20 20 20 30 20 20-20 30 20 20 20 30 20 20     0   0   0   0
1482:0450  30 20 20 20 30 20 20-20 30 20 20 20 30 20 0D     0   0   0   0 ..
1482:0460  20 20 20 30 20 20 20-20 30 20 20 20 20 30 20        0    0    0
1482:0470  20 20 30 20 20 20 20-30 20 20 20 20 30 20 20       0    0    0
1482:0480  20 30 20 20 20 20 30-20 20 20 20 30 20 20 20      0    0    0
1482:0490  30 20 20 20 20 30 20-20 20 20 30 20 20 20 20     0    0    0    0
1482:04A0  20 20 20 20 30 20 20-20 20 30 20 20 20 20 30         0    0    0
1482:04B0  20 20 20 30 20 20 20-20 30 20 20 20 20 30 20        0    0    0
1482:04C0  20 20 30 0D 0A 20 20-20 20 30 0D 0A 30 35 2D       0..    0..05-1
1482:04D0  30 2D 31 39 39 34 0D-0A 31 34 3A 33 35 3A 31     0-1994..14:35:17
1482:04E0  0D 0A                                            ..
```

FIG. 24C

TRASH IN PAINT
BAD GRAPHIC
BROKEN PIN/USDB
SCRATCH
OFF LOCATION GRAPHIC
SHORT SHOT
LIGHT LEAK
BUTTON FAILURE
BROKEN LEG/BAD OPTIC
POOR HEAT STAKE/LONG GATE
FADE/BASS/TREBLE REGION
BAL/VOL/SEL REGION
SEEK BUTTON
AM/FM BUTTON
UPPER CENTRAL REGION
UPPER RIGHT REGION
1 BUTTON
2 BUTTON
3 BUTTON
4 BUTTON
5 BUTTON
LOWER RIGHT REGION
LOWER CENTRAL REGION
SET BUTTON
LOWER LEFT REGION
BASS/TREBLE GRAPHIC OR PLASTIC
FADE GRAPHIC OR PLASTIC
VOL/POWER GRAPHIC
SEL/PUSH GRAPHIC
BAL/L/R GRAPHIC

FIG. 25

ELECTRONIC DATA ENTRY AND ANALYSIS SYSTEM

FIELD OF THE INVENTION

The present invention relates to the field of data entry and analysis, and more particularly, to an apparatus and method employed on a production line for the automatic entry of data and for the further processing of said data.

BACKGROUND OF THE INVENTION

In today's manufacturing environment, monitoring a production process and collecting statistical information on the status of the production process is considered essential in achieving world class quality standards.

Usually, in order to register a defect occurring in a workpiece, an operator fills out a tally sheet where a brief written identification of each occurred defect should be included. At the end of a shift, a quality engineer enters data taken from all tally sheets into a computer system for computation and graphing in order to analyze the entered data and to undertake needed corrective actions.

Unfortunately, many manufacturing companies may find little benefit from data thus collected. Sometimes, the vague nature of the data collected does not provide causal clues, and the difficulty in collecting the data slows down the production process itself and leads to both errors in the data content and decreases productivity effectiveness.

Contemporary data collectors like, for example, Genesis models QA3000/QA8300, are intended, among many other functions, for structuring a data-base on the basis of user-defined identifiers of the defect occurred, such as model, serial number, location of the defect, severity, disposition and so on. The Genesis collectors accept inspection input from keyboard, bar code wand, cases scanner, CCD wand and/or voice recognition circuits. However, these collectors are expensive, and sometimes provide much more functions than the manufacturing company either expects or wants.

Therefore, it would be highly desirable to devise an easy-to-use and inexpensive system for data entry and analysis which would provide in-depth readily-useable information on the status of the production process without slowing the production process itself.

SUMMARY OF THE INVENTION

In an attempt to overcome the disadvantages of the prior art, the present invention uses an electronic system and method for data entry and analysis, which bridges the gap between the need for complete inspection information and the reality of amassing data in the production environment.

This is achieved by employment of a unique, easy-to-use, and extremely inexpensive apparatus for entering data, completely identifying the defect, wherein tallying, checking or written description are not required, in combination with real-time computer based data evaluation, such that effective corrective actions can be undertaken immediately.

It is, therefore, an object of the present invention to provide an electronic system for entering data completely describing the defect occurring in the workpiece in combination with means for further processing said data in order to effectively monitor the production process.

It is another object of the present invention to provide an apparatus and method for entering data relating to location and nature of the defect occurring in the workpiece.

It is still another object of the present invention to provide an electronic system for entering data relating to an attribute of an object, and further processing said data.

The present invention finds particular utility if installed on a work station on a production line in order to monitor a production process.

In accordance with the teachings of the present invention, a system for entering and analysis of data relating to a defect occurring in a workpiece includes a data entry means for displaying a pictorial image of the workpiece and for providing a plurality of first and second indicia, respectively. A defect is identified by its position in the workpiece and by a type-of-error. Each of the first indicia identifies the position of the defect in the Workpiece, and each of the second indicia identifies the type-of-error in the workpiece. In the preferred embodiment, the data entry means includes a front screen, a sketch board and a keyboard disposed behind the sketch board and providing a controlling means and first and second keys corresponding to first and second indicia.

Once data relating to the defect are entered by activating one of the first indicia in combination with one of the second indicia, the controlling means provides delivering of said data (in real-time and/or periodically) to a processing means, including a computer, for collecting, processing, and outputting said data to the computer display or printer. Data are also displayed on a display, which can be implemented as a stand-alone display or as a display integral with the data entry means.

The present invention also finds utility as a system for entry and analysis data relating to any attribute of any object.

A data entry means displays a pictorial image of the object, and provides a plurality of first indicia thereon in juxtaposition to the pictorial image of the object {or located directly on it), each first indicia for identifying a position of the attribute of the object. The data entry means also provides at least one group of second indicia, each second indicia for identifying a required characteristic of the attribute of the object. The data identifying the attribute are entered in the system when one of the first indicia in combination with at least one of the second indicia are activated.

The present invention also may find application as an apparatus for entering and analysis of one data associated with an object.

These and other objects of the present invention will become apparent from a reading of the following specification taken in conjunction with the enclosed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a pictorial view of a preferred embodiment of the present invention installed on a production line.

FIG. **2** is a perspective view of the data entry means of the present invention.

FIG. **3** is a perspective exploded view of the data entry means of the present invention.

FIG. **4** is a perspective exploded view of the data entry means including a plurality of sketch boards, each sketch board for a particular workpiece.

FIGS. **5** and **6** are top plan views of two alternative dispositions of indicia, respectively.

FIG. **7** is a schematic block diagram of the present system.

FIG. **8** is an electrical wiring diagram of the circuit disposed on a PCB within the data entry means.

FIGS. 9A–9I are flowcharts of the PADD program.

FIGS. 9J–9K are flowcharts of interrupt service used in PADD program.

FIGS. 10A–10D are flowcharts of the PAD8 program.

FIGS. 11A, 11B, 11C and 11D are flowcharts of the MULTIP& MULTINP programs.

FIG. 12 is an example of the defect matrix form.

FIG. 13 is a change-position-or-error form.

FIGS. 14A, 14B, 14C and 14D are flowcharts of the MATRIXP& MATRIXP programs.

FIG. 15A and 15B are examples of a printout from MATRIXP or MULTIP.

FIG. 16 is a flowchart of CHANGE&P program.

FIG. 17 is a flowchart of PRTDSCHR.WQ2.

FIG. 18 is a Pareto chart of all defect positions regardless of type-of-error.

FIG. 19 is a Pareto chart of all defect types-of-errors regardless of defect positions.

FIG. 20 is a Pareto chart of the ten most numerous defects.

FIG. 21 is a perspective view of one of the modifications of data entry means, according to the present invention.

FIG. 22 is a perspective view of another modification of data entry means, according to the present invention.

FIG. 23 is a printout of the LATEST.DAT file.

FIGS. 24A, B, C are printout of the BACKUP.DAT, BACKUP.OLD, and BACKUP.BAK files.

FIG. 25 is a data file PANDE.DAT.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 1–3, data entry means **1** of the present invention are installed on work stations **2** of a production line **3**. Each operator **4** inspects a workpiece **5**. A pictorial image **6** of the workpiece **5** is displayed on the data entry means **1**. When the operator **4** finds a defect **7** in the workpiece **5**, he (or she) touches (or presses) one of indicia **8**, related to a position of the defect **7** in the workpiece **5**, and one of indicia **9** related to a type-of-error.

It will be appreciated that there are a plurality of possible defect positions in the workpiece, and that there are different types-of-errors which may occur in the workpiece. Availability of a plurality of indicia **8** and a plurality of indicia **9** allow the operator **4** to register significant combinations of information, thereby covering practically any defect situation by a simple pushing (or touching) of the position indicia **8** in combination with the type-of-error indicia **9**.

Being entered, the data are processed by a processing means **10**. The processing means **10** includes a computer **11** operated by software **12**. A central computer **13** can be used, if desired. The computer **11** can be any commonly available personal computer ("PC"), preferably with a computer display **14**, to perform analytical and data transmissions functions and to display the collected data.

The software **12** executes four basic functions: (1) displays the data transmitted from the data entry means **1** in a matrix format on the computer display **14** as it is received; (2) provides a simple histogram of accumulated defects for all positions and the histogram for all types-of-errors; (3) writes the data in a file for transfer to other programs and/or computers or writes the data directly to another computer; and (4), if a printer is connected, prints the entire defect matrix as well as the ten (10) most numerous defects arranged sequentially. In addition, the software **12** may allow the user to configure multiple data entry means **1** in a different communication network, as well as provide meaningful labels to the various locations and types-of-errors related to defect **7**.

Each data entry means **1** also may be implemented with a display **15**, which may be a stand-alone display or may be integral with the data entry means **1**.

By having the knowledge of position and nature of the defect **7**, the quality engineer can determine wherein the process and by what means the defect **7** was created. Rapidly, corrective action can take place, and the effects can be learned in a real-time fashion as the data can be accessed anytime during or after the production process, and the information is available immediately on the computer display **14**.

The data entry means **1**, as shown in FIGS. **2**, **3** and **4**, is a device for automatic entry of data, and actually provides a structural electronic alternative to a tally sheet.

In one embodiment, the data entry means **1** is an approximate 12"×18" tablet, which consists of a front screen **16**, a sketch board **17** disposed behind the front screen **16** and a key board **18** behind the sketch board **17**. The data entry means **1** provides multiple position indicia **8** (in the present embodiment, twenty) for identification of locations of the defects in the workpiece **5**, and multiple type-of-error indicia **9** (in the present embodiment, ten). The indicia **8**, **9** may be implemented as buttons to be pressed or as tactile membranes to be touched. Their disposition on the front screen **16** can be different, for example, as shown in FIGS. **5** and **6**. Also, the indicia **8** can be disposed directly on the pictorial image **6**.

The sketch board **17** is a pre-printed die cut paper sheet. On this sheet a manufacturing manager will dispose a pictorial image **6** of the workpiece **5** or a portion thereof, and also a description of the workpiece **5** with illustrations, photos, etc. In addition, each type-of-error possible for the workpiece **5** can be described in the numbered column **19** close to the right side **20** of the sketch board **17**. The sketch board **17** has a plurality of apertures **21** corresponding to position indicia **8** and a plurality of apertures **22** corresponding to type-of-error indicia **9**. Each aperture **21** can be connected by a reference line **23** to the area **24** of possible location of the defect **7**. The apertures **21** are disposed along the perimeter **25** of the sketch board **17**. However, if the indicia **8** are disposed directly on the pictorial image **6**, each of indicia **8** on the respective area **24**, the apertures **21** will be disposed in precise registration with said indicia **8**.

The front screen **16** has a transparent portion **26**, through which the sketch board with all sketched thereon information is displayed. The front screen **16** has also a plurality of apertures **27** and **28**, respective to the apertures **21** and **22**. Apertures **21**, **27** and position indicia **8** are in precise registration with each other, as well as the apertures **22**, **28** and type-of-error indicia **9**.

The data entry means **1** may include a plurality of sketch boards **17**, each for a particular workpiece **5**. The sketch boards **17** will accompany the data entry means **1** in a tear-off pad arrangement **29** (FIG. 4) to be removably interchangeable. Each sketch board **17** will include a detailed pictorial description including the pictorial image **6** of each particular workpieces **5**, and also a numbered column of types-of-errors possible for this particular workpiece **5**.

Supporting the die-cut sketch board **17** is some sort of light-weight, inexpensive backing support board **30**, which provides apertures **31** corresponding to apertures **21**, **27** and indicia **8**, and apertures **32** corresponding to apertures **22**, **28** and indicia **9**, and being in precise registration with the corresponding apertures and the indicia.

The keyboard **18** is disposed behind the support board **30** and contains **20** position keys **33** and **10** type-of-error keys **34**. Keys **33** and **34** each includes a contact portion **35**, such that the contact portions **35** of keys **33** are protruded through the apertures **21**, **27** **31**, and the contact portions **35** of the keys **34** are protruded through the apertures **22**, **28**, **36**, respectively.

The contact portions **35** may be implemented as buttons to be pressed, or as a tactile membranes to be touched by fingers or by a probe, thus activating the respective keys **33**, **34**. It will be appreciated by those skilled in the art that many other implementations are also allowable, for example, the keys **33**, **34** can be activated by laser means, or by another means providing a focused beam.

The keyboard **18** may be a single Printed Circuit Board (PCB) **36**, or a combination of PCBs hard-wired together. The PCB **36** includes an electronic circuitry **37**.

Assembled together, the front screen **16**, the sketch board **17**, the keyboard **18** and the support board **30** are fastened together by means well known by those skilled in the art, such that to provide protrusion of each contact members **35** through the respective apertures.

Referring to FIGS. **7**, **8** the electronic circuitry **37**, which implements the data entry means **1**, includes a microcontroller **38**, disposed on the PCB **36**, and central to the operation of the system. The micro-controller **38** is connected directly to the array of switches **39** by means of rows and columns of switches **39** connected to two 8-bit parallel ports **40**, **41** of the microcontroller **38**, respectively. Switches **39** correspond to respective keys **33**, **34** and are energized when the respective keys **33**, **34** are activated. Port **40** drives 6 rows of the switches **39** through steering diodes **42**. The remaining two pins of the port **40** are used for the light emitting diode (LED) **43**, which serves as a visual feed-back means, and for the audible feed-back means **44**. The LED **43** lights when the first key (**33** or **34**) of the possible pair of keys **33** and **34**, is pressed, touched or somehow else is activated. The LED **43** extinguishes when the second key of this pair of keys (**33** and **34**) is activated.

The audible means **44** beeps a long beep for the defect position key **33**, and a short beep for the defect type-of-error key **34**. The LED **43** alerts the operator **4** that the first key of the pair of keys (**33**, **34**) has been activated, and that the second key needs to be activated to complete the defect **7** indication. The audible beep is supplemental feedback that informs the operator **4** that his (or her) intentions have been registered.

The operator must press both a defect position key **33** and a defect type-of-error key **34** to register one defect **7**. The sequence (position-then-type-of-error or type-of-error-then-position) is unimportant, although the operator is encouraged to establish a habit of one sequence or the other.

If the operator presses a key (**33** or **34**) incorrectly for the first key, there is a way to correct it. Simply press the same first key or the correct key (of the same kind, i.e. position or type-of-error) to clear the LED **43**. Then press the correct key of the same kind and the LED **43** will illuminate again.

To correct an error in the second key, the operator must report the error to the production line manager, and the manager will remove that incorrect defect report from the tally displayed on the computer **11**.

Port **41** is used to read **5** columns of switches **39**. The remaining three pins are used to control the stand-alone display **15**. The microcontroller **38** delivers data to the display **15** through port **45**. All communication to the stand-alone display **15** are accomplished via the display connector **46**. Any technology of display **15** can be used; however, for this particular system two types, a vacuum fluorescent display and a liquid crystal display, have been chosen. One signal (DB25-3) is used by the microcontroller **38** to distinguish between these two types of displays **15**. This signal is hard-wired to either ground or +5 Volts to indicate the type of the display **15**.

The microcontroller **38** uses the driver/receiver **47** to communicate with the computer **11**, and, particularly, to deliver entered data to the computer **11**. The driver/receiver **47** can be any means of communication; however, in the this implementation is either RS-232C or Frequency Shift Keying ("FSK") for the PCB **36**. The communication of the microcontroller passes through a communication connector **48**, preferably a DB-9 connector.

The electronic circuitry **37** on the PCB **36** is fed by a power supply **49**. Raw power enters the PCB **36** by means of a power connector **50**. It is then rectified by a bridge rectifier **51**, and conditioned and regulated by power regulating and conditioning means **52**.

The embodiments of the invention, described herein by figures and by flowcharts, record defects as the coincidence of two different attributes corresponding to two different kinds of indicia. In this case, the attribute and indicia of the first kind represent the defect position on the workpiece. The attribute and indicia of the second kind represent the defect type-of-error on the workpiece. The data being recorded is a defect specified by a position and a type-of-error. However, it could be any kind of data, not necessarily a defect, specified by any number of attributes, not necessarily two. Furthermore, a given attribute may have any number of instances, and may relate to any object.

In the examples described herein, the instances of the attribute and indicia of the first kind (indicia **8**) number twenty, and have the following names: FADE/BASS/TREBLE region, BAL/VOL/SEL region, SEEK button, AM/FM button, upper central region, upper right region, 1 button, 2 button, 3 button, 4 button, 5 button, lower right region, lower central region, SET button, lower left region, BASS/TREBLE graphic & plastic, FADE graphic & plastic, VOL/POWER graphic, SEL/PUSH graphic, and BAL/L/R graphic.

The instances of the attribute and indicia of the second kind (indicia **9**) number ten, and have the following names: trash in paint, bad graphic, broken pin/USDB, scratch, off location graphic, short, light leak, button failure, broken leg/bad optic, and poor heat stake/long gate. In this case, the third instance of the indicia of the second kind, broken pin/USDB, combines two types-of-errors, namely a broken pin and an up-side-down button, that can never occur together in the same position, being mutually exclusive so far as the attribute and indicia of the first kind is concerned. Thus, in combination with the attribute and indicia of the first kind, namely the position (indicia **8**), the type-of-error can be uniquely determined. This method of combining mutually exclusive instances is valuable when more instances exist than buttons are available on the data entry means. Other occurrences of mutually exclusive instances, in this example, are broken leg/bad optic and poor heat stake/long gate.

The three embodiments of the invention serve different requirements. The first requirement is that of a single data entry means **1** which accumulates data throughout an entire shift or throughout an entire day. At the end of that shift, or day, a computer **11** is connected, and the data is uploaded from the data entry means **1** to the computer **11**. The data can be examined, printed, analyzed, and plotted. Then the computer **11** is turned-off (to await the conclusion of another day or another shift), or perhaps taken to another production line for the uploading of more data of a different type (this requires either that the personal computer program be restarted or that the RESET PAD button on the computer screen be activated to clear the defect matrix), or taken to another production line for the uploading of more data of the same (in which case this new data is accumulated onto the existing defect matrix). The entire process begins again at the commencement of the next shift or next day. Data printing, analysis and plotting are accomplished, in this case, with the spreadsheet PRTDSCHR.WQ2, designed to operate with the commercial spreadsheet package Quattro® Pro (registered trademark of Borland International, Inc.).

The first embodiment uses the program PAD8 in the microcontroller, and either MATRIXP or MATRIXNP in the personal computer (for computers connected to printers or not connected to printers, respectively).

The second requirement is that of multiple data entry means **1** continuously connected to a computer **11**. The computer **11** is used to continuously display defect data in real-time. At the end of a shift, the OUTPUT button on the computer display **14** is activated with the mouse (or alternatively by the computer keyboard **55**), and the data files are written. Then those files are either transferred to another computer for off-line processing so as not to interrupt or delay the next shift, or if processing is speedy then processing can be accomplished immediately after the files are written and just before the next shift begins. This processing is, as before, data printing, analysis and plotting with the spreadsheet PRTDSCHR.WQ2, designed to operate with the commercial spreadsheet package Quattro® Pro.

This second embodiment uses the program PADD in the microcontroller **38**, and either MULTIP or MULTINP in the personal computer **11** (for computers connected to printers or not connected to printers, respectively).

The third embodiment of the invention uses a display **15** (stand-alone or integral), and never needs to be connected to a computer **11**. In this case, the display **15** can be any of several types, including, but not limited to, Liquid Crystal Display (LCD), Vacuum Fluorescent (V/F) display, Field Emission Device display, Light Emitting Diode display, Cathode Ray Tube display, and Plasma Discharge display. Program PADD incorporates code to sense one of two particular displays (one is an LCD; the other is a V/F display), determine the four defects with the greatest counts, and display those four most numerous defects. Realizations of the invention with stand-alone Or integral display **15** need not make use of data processing.

A fourth embodiment, not described by flowcharts or figures herein, would incorporate the features of PAD8 and PADD into a single microcontroller program, and incorporate the features of MATRIXP and MULTIP, or MATRIXNP and MULTINP, into a single personal computer program. This personal computer program would appear much the same as MULTIP or MULTINP, but would include an additional button on the same screen that includes the RESET PAD button. This button would be named UPLOAD, and would cause a command to be sent from the computer **11** to each of the data entry means **1**. This command would cause each data entry means **1** to send its defect data back to the computer **11**.

Thus, the battery back-up feature of the microcontroller **38** would be put to good use, allowing recovery from a manufacturing plant-wide power failure. In this case, the computer operator would, after initiation of the personal computer program, activate the SETUP button to display the screen that exhibits the RESET PAD and UPLOAD buttons. Then they would activate the UPLOAD button. Then all defect data from all the data entry means **1** connected to the computer **11** would be accumulated in the defect matrix on the DefectMatrix screen, effecting a complete recovery from the power failure.

The procedure to begin a new shift would be slightly different. Upon initiating the personal computer program, the operator would have to activate the RESET PAD button in order to clear the defect matrix in the memory of the microcontroller. Otherwise, in the event of a future UPLOAD, the defect matrix would be contaminated by data from earlier shifts.

Data processing is the same as for the first two embodiments described above.

The microcontroller **38** uses the PADD program inside the data entry means **1** to communicate with the computer **11** and the computer display **14** continually, and also to deliver data to the display **15** (stand-alone or integral) continually. Referring to FIGS. **9A–9K** and Appendix A, PADD consists of an outer loop that begins by initializing pertinent registers, variables, and workspaces. Then each row of the switches **39** is interrogated. After the last row is interrogated, determination is made of the state of a flag called the reset flag. If the reset flag is set, the process begins again with initialization. Otherwise, if the reset flag is not set, the process begins again with the reading of the next row of switches **39**.

The subroutine, which reads a row of switches **39**, begins by initializing necessary variables, registers, and workspaces. Next, a time delay is introduced to slow the rate of scan of the array of switches **39**. Then the switches **39** within the given row are read.

A determination is made of whether any switch **39** is active. If none is active, then a sequence of zeroes are written into memory for each column of this row. If some column is active, then the program proceeds to determine which column is active. As each column is examined, a zero or a one is written into memory for that column.

Then the recent history of column one is examined for a condition that indicates a valid key (**33**, **34**) press. If column one has a valid key (**33**, **34**) press, then the program initializes timer **0**. Otherwise, the recent history of column two is examined for a valid key (**33**, **34**) press, and so forth through column **5**.

If no valid key (**33**, **34**) presses are detected, then the subroutine returns. If a valid key (**33**, **34**) press is detected, then timer **0** is initialized, the timing loop counter is initialized, and a determination is made of the necessity of a double-length beep. If a double-length beep is required (because the key pressed was a defect position key **33**) then the timing loop counter is doubled.

Next, the beeper is turned on. Then timer **0** interrupts are enabled. The LED **43** is toggled. The previous key pressed is stored in memory as the "2nd previous key". The present key press is stored as the "previous key".

Next, a determination is made of whether the "previous key" and the "2nd previous key" constitute a legitimate key press pair, i.e. a combination of a defect position key **33** and a defect type-of-error key **34** or a combination of a defect type-of-error key **34** and a defect position key **33**. If the pair is legitimate, then a determination is made of the state of the LED **43**. If the LED **43** is not turned on, then the program goes on to update the defect matrix in memory. If the LED **43** is off, the program saves the row flag of the previous key, and returns. If the pair of key (**33**, **34**) presses is not legitimate, the program saves the row flag of the previous key, and returns. The row flag is set in one state for defect type-of-error keys **34**, and in another state for defect position keys **33**.

The update of the defect matrix begins with an inspection of the "2nd previous key". If it equals the initial value it means that only one key has been pressed since the data entry means **1** has been turned on, and no further action is required other than returning from this subroutine.

Then a determination is made of whether the "2nd previous key" was a defect position key **33** or a defect type-of-error key **34**. If it was a defect position key **33**, then the previous key was a type-of-error key **34**, and the pair are processed appropriately to produce a defect type-of-error number (from 1 to 10) and a defect position number (from 1 to 20), corresponding to A to T.

If the "2nd previous key" was a defect type-of-error key **34**, then the previous key was a defect position key **33**, and the pair are processed appropriately to produce a defect type-of-error number and a defect position number.

Next, the unique defect number is computed.

A determination is made to see if the serial transmitter is occupied with the chore of transmitting a defect character received from another data entry means **1** or a reset character or other command character received from the computer **11**. In this case, the pass-through transmission flag is set. If not, then the defect transmission flag is set in order to claim the resources of the serial transmitter. Then the defect character is transmitted. The data pointer is advanced to the appropriate memory cell, and the data in this memory cell is incremented by **1** count.

If the pass-through transmission flag is set, then the program loops back to test it again until it becomes inactive.

After the defect character is transmitted, and the defect matrix is incremented, the program searches the defect matrix for the biggest defect. This defect and its location, or defect number, is recorded. Then the defect count is replaced with zero.

Next the second biggest defect is found. Likewise, it and its location are recorded, and it is replaced with zero.

The third and fourth biggest defects are found.

Now the display **15** is initialized by sending the cursor to the home position, and the display **15** is cleared.

The biggest defect is decoded and then displayed on the display **15**.

The decoding subroutine breaks the defect location into a position number and a type-of-error number. It begins by saving the defect location to work registers. Then other registers are initialized. Now a loop begins with the incrementing of the defect type-of-error. If it is greater than 10, it is reset to 0 and the position number is incremented. The loop counter work register is decremented, tested for zero, in which case the subroutine returns, otherwise the loop begins again.

The display subroutine begins by obtaining the position number, and then displaying it. Next it obtains the defect type-of-error number and determines whether it is less than 9. If it is, then it is displayed along with two spaces. If not, then 10 is displayed followed by a single space.

Next is the entry point to display a defect count. It begins by obtaining the count, initializing the display registers and resetting the leading zero flag.

Then if the count is zero, two spaces are displayed before displaying the 0. If it is not zero, then the least significant digit character is incremented. If this is not greater than the 9 character, then the work register is decremented and tested for zero. If it has not been reduced to zero, then the loop begins again with the incrementing of the least significant digit character.

If this character is great than the 9 character, then it is reset to the 0 character and the middle digit character is incremented. If this character is not greater than the 9 character, then the work register is decremented and tested for zero, as above. If the middle digit character is greater that the 9 character, it is reset to the 0 character and the most significant digit character is incremented. Then the work register is decremented and tested for zero, as above.

When the work register is reduced to zero, the most significant digit character is tested for the 0 character. If it is the 0 character, then the character to be displayed is set to the space character and the leading zero flag is set and the space character is displayed. If the most significant digit character is not the 0 character, then it is displayed.

Next the middle digit character is tested for the 0 character. If it is not, then it is the character to be displayed, otherwise the leading zero flag is tested. If it is set, then the character to be displayed is set to the space character. If it is not set, then the character to be displayed is set to the 0 character. The character is displayed.

Finally, the least significant digit character is displayed, and the display subroutine ends with a return.

The serial interrupt service routine begins by saving the accumulator onto the stack.

Then a determination is made about the serial transmitter interrupt flag. If it is set, then this is a serial transmitter interrupt, and the serial transmitter interrupt flag is cleared. Then the serial pass-through flag is tested. If it is set, then it is cleared, and interrupt service moves on to test for serial receiver interrupt tests. Otherwise, if the serial pass-through flag was not set then the serial defect transmission flag is set, and interrupt service moves on to test for serial receiver interrupt tests.

The serial interrupt flag is tested. If it is not set, then this is not a serial interrupt, and interrupt service terminates after the accumulator is reloaded from the stack.

If the serial interrupt flag is set, then a character is read from the received serial data buffer. This character is tested for the special reset character. If it is the reset character, then the reset flag is set. If it is not, then the serial defect transmission flag is tested.

If the serial transmission flag is set, then interrupt service jumps ahead to reload the accumulator and return from interrupt service. If the serial transmission flag is not set, then the serial pass-through transmission flag is set. The appropriate character is transmitted. The serial receiver interrupt flag is cleared, and finally the accumulator is reloaded before returning from interrupt service.

Timer **0** interrupt service is executed only upon receipt of a timer **0** interrupt. These interrupts are generated internally by timer **0**, the rate depending upon constants previously loaded when timer **0** was initialized.

Interrupt service begins by decrementing the timing loop counter. If this counter is now zero, then the beeper is turned off, timer **0** interrupts are disabled, and interrupt service terminates with a return. Otherwise, if the timing loop counter is not zero, the program returns from interrupt service.

The microcontroller **38** uses the PAD 8 program inside the data entry means **1** for implementations of the system of the present invention, that utilize the DUMP key **53** to output data to the computer **11** and to the computer display **14**. This program also includes back-up procedures to protect the system against data loss from power failure. In this version, the DUMP key **53** is activated periodically for example at the end of the shift, and data are up-loaded into the computer **11**. It is possible, in other embodiments, to activate the communication from the data entry means **1** to the computer **11** in other ways besides by pressing a DUMP key **53**. If desired, activation by telephone modem **58** (shown in FIG.7) is possible. This telephone modem **58** connects directly to the computer **11**, which upon receipt of appropriate commands, queries the data entry means **1** for its data. Another possibility of initiating this communication has been discussed earlier in reference to the UPLOAD button in a personal computer program of the fourth embodiment of the present invention.

Referring to FIGS. **10**A, **10**D and Appendix B, PAD8 program consists of an outer loop that begins by initializing pertinent registers, variables, and workspaces. Then each row of the switches **39** is interrogated. After the last row is interrogated, the process begins again with initialization.

The subroutine which reads a row of switches **39** begins by initializing necessary variables, registers, and workspaces. Next, a time delay is introduced to slow the rate of scan of the array of switches **39**. Then the switches **39** within the given row are read.

A determination is made of whether any switches **39** are active. If none are active, then a sequence of zeroes are written into memory for each column of this row. If some column is active, then the program proceeds to determine which column is active. As each column is examined, a zero or a one is written into memory for that column.

Then the recent history of column one is examined for a condition that indicates a valid key (**33**,**34**) press. If column one has a valid key press, then the program initializes timer **0**. Otherwise, the recent history of column two is examined for a valid key press, and so forth through column 5.

If no valid key presses are detected, then the subroutine returns. If a valid key press is detected, then timer **0** is initialized, the timing loop counter is initialized, and a determination is made of the necessity of a double-length beep. If a double-length beep is required (because the key pressed was a position key as opposed to a type-of-error key) then the timing loop counter is doubled.

Next the beeper is turned on. Then timer **0** interrupts are enabled. The LED **43** is toggled. The appropriate character, that represents the key pressed, is stored in memory.

A determination is made of the key pressed. If it was not the DUMP key **53**, then the subroutine returns. If it was the DUMP key **53**, then the data pointer is initialized, and a character is loaded from memory. If this character is not the DUMP character, then it is transmitted out the serial port (to be captured by the computer **11** if it is present). Then some time delay is introduced to allow the computer to receive the transmission. Then a new character is loaded from memory. This loop continues until the DUMP character is loaded from memory. At this point, the data pointer is initialized, and the subroutine returns to them main loop of the program.

Timer **0** interrupt service is executed only upon receipt of a timer **0** interrupt. These interrupts are generated internally by timer **0**, the rate depending upon constants previously loaded when timer **0** was initialized.

Interrupt service begins by decrementing the timing loop counter. If this counter is now zero, then the beeper is turned off, timer **0** interrupts are disabled, and interrupt service terminates with a return. Otherwise, if the timing loop counter is not zero, the program returns from interrupt service.

Two kinds of interrupt service are used in PADD (FIG. **9**J–**9**K), and one kind is used in PAD8 (FIG. **10**B).

Both use Timer **0** interrupt service, and PADD uses Serial Input/Output interrupt service. If Timer **0** and Serial Input/Output interrupts are enabled, then they can interrupt the execution of PAD8 or PADD at any point of execution and at any time.

Upon receipt of the interrupt, either because Timer **0** has Overflowed or because Serial Input data is available in the serial input buffer or because Serial Output data has finished shifting out of the shift register, PADD or PAD8 completes its currently executing instruction. Then the Program Counter is incremented to the next instruction. The Stack Pointer is incremented to the next memory location. The low byte of the Program Counter is stored at memory pointed to by the Stack Pointer. Then the Stack pointer is incremented again. Now the high byte of the Program Counter is stored in memory pointed to by the Stack Pointer. Now the Program Counter is loaded with the starting address of the appropriate interrupts service routine and interrupt service commences.

At the conclusion of this interrupt service routine, the final instruction, RETI—return from interrupt, reverses the above procedure. First the high byte of the future value of the Program Counter is loaded from memory pointed to by the Stack Pointer. Next the Stack Pointer is decremented. Then the low byte of the future value of the Program Counter is loaded from memory pointed to by the Stack Pointer. Now the Stack Pointer is decremented again. Finally,the Program Counter is replaced with the future value, just retrieved from the Stack, and program execution continues where it left off before the interrupt.

Timer **0** generates an interrupt when it overflows. It overflows when it increments to its limit from its initial count. It is set to some convenient value that generates a single length beep of acceptable length. A flag in the PAD8 or PADD program, whose value depends of which type of key has been pressed (position or type-of-error), determines whether the beep is lengthened to a double-length beep.

Referring to FIG. **11**A, **11**B, **11**C, **11**D and Appendixes C and D, MULTIP and MULTINP are printing and non-printing versions of programs for systems of multiple data entry means **1** which execute the PADD program that require the computer **11** to be connected continually in order to provide data collection and data display in real-time.

The displayed form is the same for both programs. MULTIP and MULTINP are event driven programs.

Clicking the Position (row) label causes the Row Value displayed in the Row Value Text box to be tested. Values less than one (1) are set to one (1). Values greater than twenty (20) are set to twenty (20). Then execution returns to await another event.

Clicking the Error (column) label causes the Column Value displayed in the Column Value Text box to be tested. Values less than one (1) are set to one (1). Values greater than ten (10) are set to ten (10).

Clicking in the Row Value Text box or Column Value Text box allows keyboard **55** editing of those values. Subsequent clicking of the Increment button or Decrement button then adjusts the defect count specified by the Row Value and Column Value displayed in the defect matrix (shown in FIG. **12**).

Increment and Decrement, but especially Decrement, provide the computer operator (or the quality engineer) the means to correct the operator's 4 mistakes.

Clicking the Output button activates the Output Date To File Click subroutine. First, an output file is opened. Its name reflects the date and time. For each row, defect data is written to file, then the sum of that row is written to file. After all twenty (20) rows are completed, the sums of each column are written to file along with the grand total. Finally the start and end times and dates are written to file. If the print flag is set, then PrinterOutput is called to output data to the printer **54**.

Clicking the Setup button hides the DefectMatrix form (FIG. **12**) and shows the ChangePositionOrError form (FIG. **13**).

The date and time are displayed in the date and time labels respectively. They are updated every second by the one (1) second timer (Timer **1**).

Clicking the Reload button saves current defect data and start time and date to BACKUP.OLD, and reloads defect data, and start date and time from BACKUP.DAT. This button, and BACKUP.DAT, provide the means to recover from power failure, because BACKUP.DAT is updated every time the defect matrix changes. In case the Reload button is activated unintentionally, BACKUP.OLD provides the means to recover from such a mistake. This recovery is not automatic. The computer operator (or the quality engineer) must copy BACKUP.OLD to BACKUP.DAT at the DOS command line prompt, execute MULTIP or MULTINP and click the Reload button.

Clicking the Quit button ends the program and returns to the DOS prompt.

Timer **1** invokes an interrupt every second. First the time and date labels are updated. Then, if serial data is available, a character is read from the input serial port. It is converted to a number. If this number is within the legitimate range, then the Row and Column for the defect are computed and the appropriate defect is incremented. Otherwise, Timer **2**, the error message timer, is activated, ErrorFlag1 is set true, the ErrorMessage is set to "Error," and a message box is displayed with the character and "Error". Next, the reset flag is tested. If it is set, then label captions are set to their backup values (all zeroes), Row and Column are initialized to zeroes, backup data is written to BACKUP.DAT, and the reset flag is reset to zero.

Timer **2** is the error timer that lasts for four (4) seconds. It tests ErrorFlag1. If it is true then it is set false, the ErrorMessage is cleared, and future Timer interrupts are disabled. These actions turn off an error message, that had been turned on in the Timer **1** subroutine, after four (4) seconds.

Timer **3** is activated once, one millisecond after initiation of the program. Its purpose is to set default and initial values. It is never executed again.

Timer **4** interrupts every ten (10) seconds. It writes BACKUP.DAT to BACKUP.BAK as a safety precaution in case power should be lost while BACKUP.DAT is being written by Increment-Click or Decrement-Click, for instance.

The main defect matrix consisting of ten (10) columns and twenty (20) rows is displayed as one big label (FIG. **12**).

The twenty (20) sums to the right of the twenty (20) rows are the sums of defects for each row regardless of the type-of-error. They are incorporated into one label.

The ten (10) sums below the defect matrix are the sums of defects for each column regardless of the defect position. They are incorporated into one label.

Finally, the grand total is a label below the twenty (20) sums regardless of type-of-error and right of the ten (10) sums regardless of positions.

Referring to FIGS. **14**A, **14**B, **14**C, **14**D and Appendixes E and F, MATRIXP and MATRIXNP are printing and non-printing versions of programs for single data entry means **1** systems that require the computer **11** to be connected only when data is dumped by pressing the DUMP key **53** on the data entry means **1**.

MATRIXP and MATRIXNP are event driven programs.

The displayed form, shown in FIG. **12**, is the same for both programs, and is the same as the displayed form for MULTIP and MULTINP as well.

The principal differences between MULTIP and MATRIXP, and MULTINP and MATRIXNP, are to be found in the Timer **1** subroutine.

Timer **1** invokes an interrupt every second. First the time and date labels are updated. Then, if serial data is available, a character is read from the input serial port. If it is within the legitimate range then the Row and Column for the defect are computed. Otherwise, Timer **2**, the error message timer, is activated, ErrorFlag **1** is set true, the ErrorMessage is set to "Error", and a message box is displayed with the character and "Error" and the subroutine returns. After Row and Column are computed, a determination is made to see if this keypress is a type-of-error. If it is then a determination is made to see if this key is not equal to the LastErrorKey or if the LastKey was a Position. If so, then the ErrorKey is computed, LastKey is set to Error, and LastErrorKey is set to this ErrorKey. If not, then ErrorKey is set to 0 and LastKey is set to Error. If this keypress is a position, then a determination is made to see if this key is not equal to the LastPositionKey or if the LastKey was an Error. If so, then the Position Key is computed, LastKey is set to Position, and LastPositionKey is set to Position. If not, then PositionKey is set to 0 and LastKey is set to Position. Next, the reset flag is tested. If it is set, then label captions are set to their backup values (all zeroes), Row and Column are initialized to zeroes, backup data is written to BACKUP.DAT, and the reset flag is reset to zero.

Just as in MULTIP and MULTINP, MATRIXP and MATRIXNP allow for recovery from a mistake caused by inadvertently activating the Reload button. The computer operator (or the quality engineer) must quit MATRIXP (or MATRIXNP), copy BACKUP.OLD to BACKUP.DAT at the DOS command line prompt, execute MATRIXP (or MATRIXNP) again, and click the Reload button. This restores the original defect matrix (FIG.**12**).

An example printout from MATRIXP or MULTIP is shown in FIG. 5A. FIG. **15**B shows the ten (10) most numerous defects.

Referring to FIG. **16** and Appendix G, CHANGE&P is a Visual Basic form, used by MULTIP, MULTINP, MATRIXP, and MATRIXNP, to examine and edit the twenty (20) position and ten (10) type-of-defect labels, and to effect a reset of the display means **1** and the defect matrix displayed on the computer display **14** (shown in FIG. **12**).

It contains a Display button, a Reset Pad button, a Quit button, an Edit Box, ten (10) Type-of-error labels, and twenty (20) Position labels.

Upon clicking the Display button with the mouse, the ten (10) TypeError strings are copied to the type-of-error label captions, and the twenty (20) Position strings are copied to the position label captions. Then execution returns to await another event.

Clicking any Position label or TypeOfError label sets the EntityBeingEdited variable to the appropriate value, and copies that label to the Edit Box.

Clicking on the EditBox allows keyboard **55** edits to change the corresponding label, and updates the position and type-of-error label data file, PANDE.DAT.

Clicking the Reset Pad button reads the command line input parameter, opens the appropriate COM port on the computer **11** if it was legitimate, sends the "reset thyself" character out the serial port to any data entry means **1** connected to the computer **11**, closes that COM port, reopens it for input, and finally sets the ResetThyself flag.

Clicking the Quit button hides the ChangePositionOrError form (FIG. **13**), and shows the DefectMatrix form, that displays the defect matrix (FIG. **12**).

Referring to FIG. **17**, PRTDSCHR.WQ2 is an example of a spreadsheet, designed for the commercial program Quattro® Pro. It summarizes and plots the data output called LATEST.DAT (shown in FIG. **23**). This data is generated when a computer operator actuates the OUTPUT button within the program MULTINP, MULTIP, MATRIXNP, or MATRIXP, and is an exact copy of the same output data stored in a file with a name that incorporates the date and time. One of these four programs is used to capture data from the data entry means **1**.

First, PRTDSCHR.WQ2 imports the latest data file, designated LATEST.DAT, beginning at spreadsheet cell location A**1**.

Next it copies the data columns to a work space beginning at A**101** and ending at A**300**. Then it copies the position names to B**101** through B**300**. It will be appreciated by those skilled in the art that each cell is designated by a letter and a number, wherein the letter corresponds to a respective column, and a number corresponds to a respective row.

Now the types-of-errors can be appended to those positions in B**101** through B**300**.

Next, sorting can commence, leaving the most numerous defect at A**101**, the next most numerous at A**102**, and so on.

Then the original data can be printed. It resides in spreadsheet cells A**1** through P**32**.

Now three, predefined plots are printed. The first (FIG. **18**) is the Pareto chart of all defect positions regardless of type-of-error. Then the Pareto chart of all types-of-errors regardless of position, is printed (FIG. **19**). Lastly, the Pareto chart of the ten (10) most numerous defects is printed (FIG. **20**).

This concludes the execution of the example spreadsheet PRTDSCHR.WQ2.

As described above, programs MULTINP, MULTIP, MATRIXP, and MATRIXNP produce output files which serve two purposes. The first purpose is that of recording the defect data for subsequent printing, analysis, and plotting. The second purpose is that of recovering from a power failure.

In the first instance, the defect data, and the start and end time and date, are recorded twice, with two different file names, in an easily read format. An example of such a file is shown in FIG. **23**.

The first line consists of the counts for ten defects, each one representing one of the ten types-of-errors, separated by commas and followed by their sum. This first line represents all the defects for the first of twenty positions. The second line consists of the counts for ten defects, each one representing one of the ten types-of-errors (in the same sequence as for line one above), separated by commas and followed by their sum. This second line represents all the defects for the second of twenty positions. Lines three through twenty follow the pattern of lines one and two above. Line twenty-one is a blank line. Line twenty-two consists of the sums of the counts for the ten defects, each one representing one of the ten types-of-errors (in the same sequence as for lines one through twenty above) for all lines one through twenty above, separated by commas and followed by their sum. Line twenty-three is a blank line. Line twenty-four contains the words "Start" and "End". Line twenty-five contains the start date and the end date, expressed in a numerical format such that the two-digit month occurs first, separated by a hyphen from the two-digit day of the month, separated by a hyphen from the four-digit year. Line twenty-five contains the start time and the end time, expressed in a numerical format such that the hour is the two-digit number of whole hours past midnight, separated by a colon from the two-digit number of minutes past the hour, separated by a colon from the number of seconds past the minute.

The first recording is assigned a file name that reflects the date and time at the moment the OUTPUT button was activated. The first two characters of the filename are the last two digits of the year, like 94 for the year 1994. The second pair of characters of the filename are two digits which represent the month, like 05 for the month of May. The third pair of characters in the file name are two digits which represent the day of the month, like 03 for the third day of the month.

The extension of the file name is the time. The first two characters represent the hour in military time, like 15 for 3:00 pm and 06 for 6:00 am. The third and last character represents the tens of minutes past the hour, like 1 for the period 3:10 through 3:19.

Thus the file name, recorded on May the third, 1994, at 3:09 pm, would be 940503.150.

The second recording of the data is assigned to a file with the name LATEST.DAT (FIG. **23**). This generic file name is used by the spreadsheet PRTDSCHR.WQ2 to import the defect data for the purpose of printing, analysis, and plotting.

The two recordings contain exactly the same information, but have different file names.

Output files for recovering from a power failure, as mentioned above, are named BACKUP.DAT, BACKUP.OLD, and BACKUP.BAK. They all have the same format and appearance as shown in FIGS. **24**A, B, C.

The first four characters of BACKUP.DAT represent the defect count of the first type-of-error and the first position. In FIGS. **24**A, B, C it is represented by 20 20 20 30, which constitutes three blank spaces followed by a zero. In a different example, a defect count of ninety-nine would be represented by 20 20 39 39, two blank spaces followed by the digit nine followed by another digit nine. Continuing with FIGS. **24**A, B, C the second group of four characters, 20 20 20 30, represent the defect count of the second type-of-error and the first position, and, again, they constitute three blank spaces followed by a zero. The third group of four characters represent the defect count of the third type-of-error and the first position. The fourth group of four characters represent the defect count of the fourth type-of-error and the first position. This pattern continues until the tenth group of four characters, which represent the tenth type-of-error and the first position. This ends all defects which are specified by the first position.

Now an addition blank space character, a 20, is included before the next four characters, which represent the defect count of the first type-of-error and the second position.

Groups of four characters represent the types-of-errors through the tenth type-of-error, which concludes all defects which are specified by the second position.

Before beginning defects specified by the third position, a single blank space character, a 20, is appended. Then groups of four characters represent the ten types-of-errors for the third position.

This pattern continues, with a single blank space character, a 20, before the first type-of-error on a new position. It concludes with the group of four characters which represent the tenth type-of-error and the twentieth position. After this last defect, two characters, OD OA, represent a carriage return and a linefeed.

The next ten groups of four characters, like 20 20 20 30, represent the ten sums of the counts of all defects with the ten types-of-errors, but any position. These ten sums are in the same sequence as the ten types-of-errors described above.

After the tenth sum, three characters 20 OD OA, represent a blank space, a carriage return, and a linefeed.

The next group of four characters, like 20 20 20 30, represent the sum of the counts of defects of the first position, but any type-of-error. The next nineteen groups of five characters, like 20 20 20 20 30, represent the twenty sums of the counts of defects of the twenty positions, but any type-of-error. These twenty sums are in the same sequence as the twenty positions described above. After the last sum, two characters, OD OA, represent a carriage return and a linefeed.

The next five characters, like 20 20 20 20 30, represent the grand total of all defects. After the grand total, two characters, OD OA, represent a carriage return and a linefeed.

Then the next ten characters, like 30 35 2D 31 30 2D 31 39 39 34, represent the starting date May 10, 1994, in this case May 10th, 1994. The next two characters OD OA, represent a carriage return and a linefeed.

The next eight characters, like 31 34 3A 33 35 3A 31 37, represent the starting time 14:35:17, in this case 2:35 pm and 17 seconds. The last two characters, OD OA, represent a carriage return and a linefeed.

One other data file, PANDE,DAT, is generally used as an input. It contains the names of the twenty (20) positions and ten (10) types-of-errors used in the printing of the defect matrix, FIG. **15**A, and the ten (10) most numerous defects, FIG. **15**B. These names are displayed on the ChangePositionOrError form (FIG. **13**) when the DISPLAY button is activated. These names can be edited by first clicking on the desired name, and then editing that name in the edit box on the screen. As a name is edited, it appears in its proper display position, and the file PANDE.DAT is written with the new name.

This file contains the information needed by MULTIP, MULTINP, MATRIXP, and MATRIXNP, that is specific to a particular production line. An example of this file is listed in FIG. **25**.

Table 1 (below) shows possible combinations of displays and computer connections, along with the programs executing in the computer **11** and the microcontroller **38**.

TABLE 1

	No Display	Stand-alone Display	Computer Display
computer connected continually PADD&MULTINP or PADD&MULTIP	possible, not preferred	example described herein	example described herein
dump of data periodically PAD8&MATRIXP or PAD8&MATRIXNP	possible, not preferred	example described herein	example described herein
computer never connected PADD	no output; no data collected	V/F&LCD display units	not applicable

Obviously, many modifications may be made without departing from the basic spirit of the present invention. The invention is herein described with particular reference to a defect occurring on a workpiece, and, even more particularly, to entering and analysis of data relating to position and type-of-error. However, the principles of the invention are applicable to any physical event occurring in any physical object. Then, the sketch board will contain a pictorial image of said object, and the indicia **8** will identify the position of said attribute in the object. The indicia **9** will be used to identify any chosen qualitative or quantitative characteristic of the attribute. For example, for a water supply system the attribute may be a place of water leakage. The position of the water leakage place will be identified by the indicia **8**, then indicia **9** may identify a nature of this damage, for instance, size, shape, rate of flow through this damage, possible reason, etc.

If the object is a geographical area, and the attribute (or event) is a disease of animals, then the indicia **8** will identify location of sick animals, and the indicia **9** will identify either number of sick animals, or severity of illness, or special symptoms of said disease for this particular location, source of water, level of radiation, etc.

Referring to FIG. **21**, another modification of the system of present invention includes sensing members **56** disposed on the front screen **16** to identify one type of parameter. The key board **18** includes electronic circuitry **37** adapted for this design. For example, this system may be employed for entering data relating to size of cracks occurring in certain area of a workpiece. Then, each sensing members **56** will be associated with certain size and activating the respective sensing member **56**, the parameter will be entered in the system for further processing. The system can be also utilized for multiple-choice examination.

Referring to FIG. **22**, another modification of the data entry means **1** display a pictorial image of an object, and indicia **8** are located directly on the pictorial image, such that indicia **8** can be activated by simply touching the respective area of the pictorial image. Indicia **9** can be used for defining a first type-of-attribute (event), while sensing members **56** can be employed for entering data identifying a second type-of-attribute like production line, shift, operator, etc. Another sensing members **57** can be used for entering a third type-of-attribute like color, or model, serial number, disposition, etc. In principle, the present invention is not limited to the number of types-of-attributes described herein.

Actually, the system of present invention and the data entry means itself may find a plurality of applications in any industry where data are to be entered and analyzed by means of easy-to-use, inexpensive, flexible and effective electronic systems affordable and adaptable to any process.

Accordingly, it will be appreciated by those skilled in the art that within the scope of the appended claims, the invention may be practiced other than has been specifically described herein.

```
0000                   CPU     "DS5000.TBL"
0000                   HOF     "INT8"

                       ; define variable names for Special Function Registers
00F0 =        B_reg:   EQU     0F0H     ; B register for MUL & DIV, 00
00E0 =        ACC:     EQU     0E0H     ; accumulator, 00
00D0 =        PSW:     EQU     0D0H     ; program status word, 00
00C7 =        TA:      EQU     0C7H     ; timed access, ??
00C6 =        MCON:    EQU     0C6H     ; memory control, RT
00C5 =        EK4:     EQU     0C5H     ; encryption key 4, RT
00C4 =        EK3:     EQU     0C4H     ; encryption key 3, RT
00C3 =        EK2:     EQU     0C3H     ; encryption key 2, RT
00C2 =        EK1:     EQU     0C2H     ; encryption key 1, RT
00C1 =        EK0:     EQU     0C1H     ; encryption key 0, RT
00B8 =        IPC:     EQU     0B8H     ; interrupt priority control, 00
00B0 =        P3:      EQU     0B0H     ; port 3 latch, FF
00A8 =        IEC:     EQU     0A8H     ; interrupt enable control, 00
00A0 =        P2:      EQU     0A0H     ; port 2 latch, FF
0099 =        SBUF:    EQU     099H     ; serial data buffer, ??
0098 =        SCON:    EQU     098H     ; serial control, 00
0090 =        P1:      EQU     090H     ; port 1 latch, FF
008D =        TH1:     EQU     08DH     ; timer 1 high byte, 00
008C =        TH0:     EQU     08CH     ; timer 0 high byte, 00
008B =        TL1:     EQU     08BH     ; timer 1 low byte, 00
008A =        TL0:     EQU     08AH     ; timer 0 low byte, 00
0089 =        TMOD:    EQU     089H     ; timer mode select, 00
0088 =        TCON:    EQU     088H     ; timer control, 00
0087 =        PCON:    EQU     087H     ; power control, RT
0083 =        DPH:     EQU     083H     ; data pointer high byte, 00
0082 =        DPL:     EQU     082H     ; data pointer low byte, 00
0081 =        SP:      EQU     081H     ; stack pointer, 07
0080 =        P0:      EQU     080H     ; port 0 latch, FF

0000 =        R0:      EQU     000H     ; addr of each ROW-COLUMN combination
0001 =        R1:      EQU     001H     ; base addr of each row
0002 =        R2:      EQU     002H     ; contents of Port 0
0003 =        R3:      EQU     003H     ; timing delay loop counter
0004 =        R4:      EQU     004H     ; timing delay loop counter
0005 =        R5:      EQU     005H     ; timing loop counter
0006 =        R6:      EQU     006H     ; beep length flag
0007 =        R7:      EQU     007H     ; row 3 or 4 flag
0008 =        R8:      EQU     008H     ; previous value of R7
0009 =        R9:      EQU     009H     ; flag signifying defect XMIT owns transmitter.
              ;RA:      EQU     00AH     ; flag signifying pass-thru XMIT owns transmitter.
000B =        RB:      EQU     00BH     ; previously transmitted character
000C =        RC:      EQU     00CH     ; second previously transmitted character
000D =        RD:      EQU     00DH     ; FILL_MATRIX error number, 1 to 10
                                        ; DISPLAY_COUNT least significant character
```

```
000E =          RE:     EQU     00EH    ; FILL_MATRIX position number, 1 to 19
                                        ; DISPLAY_COUNT middle character
000F =          RF:     EQU     00FH    ; FILL_MATRIX loop counter for number of defects
                                        ; DISPLAY_COUNT most significant character
                ;       R10h    R16d    ; used in WAT4MS as a loop counter
                ;       R11h    R17d    ; used in WAT100MS as a loop counter
                ;       R12h    R18d    ; "reset thyself" flag
                ;       R13h    R19d    ; defect number in FILL_MATRIX
                ;       R14h    R20d    ; SERIAL input character, temporary storage
                ;       R15h    R21d    ; biggest offender, location
                ;       R16h    R22d    ; 2nd biggest offender, location
                ;       R17h    R23d    ; 3rd biggest offender, location
                ;       R18h    R24d    ; 4th biggest offender, location
                ;       R19h    R25d    ; loop counter for number of defects, 200d
                ;       R1Ah    R26d    ; DPTR shadow
                ;       R1Bh    R27d    ; biggest offender, count
                ;       R1Ch    R28d    ; 2nd biggest offender, count
                ;       R1Dh    R29d    ; 3rd biggest offender, count
                ;       R1Eh    R30d    ; 4th biggest offender, count
                ;       R1Fh    R31d    ; LCD/VF* switch; 1=LCD, 0=VF

00E0 =          RESET_CHAR:     EQU     224     ; "reset thyself" command character
00EA =          OMEGA:          EQU     234     ; "send me your data" command character
                                                ; OMEGA unused in this program
0080 =          P0_0:   EQU     080H
0081 =          P0_1:   EQU     081H
0082 =          P0_2:   EQU     082H
0083 =          P0_3:   EQU     083H
0084 =          P0_4:   EQU     084H
0085 =          P0_5:   EQU     085H
0085 =          RS:     EQU     085H            ; LCD register select, 1=data, 0=instruction
0085 =          TEST_:  EQU     085H            ; V/F NOT(self test)
0086 =          P0_6:   EQU     086H
0086 =          RW:     EQU     086H            ; LCD read/write
0087 =          P0_7:   EQU     087H
0087 =          ENABLE: EQU     087H            ; LCD enable, active on falling edge
0087 =          WR_:    EQU     087H            ; V/F NOT(write)

0088 =          TCON_0: EQU     088H
0089 =          TCON_1: EQU     089H
008A =          TCON_2: EQU     08AH
008B =          TCON_3: EQU     08BH
008C =          TCON_4: EQU     08CH
008D =          TCON_5: EQU     08DH
008E =          TCON_6: EQU     08EH
008F =          TCON_7: EQU     08FH

0090 =          P1_0:   EQU     090H
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0091 =          P1_1:    EQU     091H
0092 =          P1_2:    EQU     092H
0093 =          P1_3:    EQU     093H
0094 =          P1_4:    EQU     094H
0095 =          P1_5:    EQU     095H
0096 =          P1_6:    EQU     096H
0097 =          P1_7:    EQU     097H

0098 =          SCON_0:  EQU     098H
0099 =          SCON_1:  EQU     099H
009A =          SCON_2:  EQU     09AH
009B =          SCON_3:  EQU     09BH
009C =          SCON_4:  EQU     09CH
009D =          SCON_5:  EQU     09DH
009E =          SCON_6:  EQU     09EH
009F =          SCON_7:  EQU     09FH

00A0 =          P2_0:    EQU     0A0H
00A1 =          P2_1:    EQU     0A1H
00A2 =          P2_2:    EQU     0A2H
00A3 =          P2_3:    EQU     0A3H
00A4 =          P2_4:    EQU     0A4H
00A5 =          P2_5:    EQU     0A5H
00A6 =          P2_6:    EQU     0A6H
00A6 =          LED:     EQU     0A6H
00A7 =          P2_7:    EQU     0A7H

00A8 =          IEC_0:   EQU     0A8H
00A9 =          IEC_1:   EQU     0A9H
00AA =          IEC_2:   EQU     0AAH
00AB =          IEC_3:   EQU     0ABH
00AC =          IEC_4:   EQU     0ACH
00AF =          IEC_7:   EQU     0AFH

00B0 =          P3_0:    EQU     0B0H
00B1 =          P3_1:    EQU     0B1H
00B2 =          P3_2:    EQU     0B2H
00B3 =          P3_3:    EQU     0B3H
00B4 =          P3_4:    EQU     0B4H
00B5 =          P3_5:    EQU     0B5H
00B6 =          P3_6:    EQU     0B6H
00B7 =          P3_7:    EQU     0B7H

00B8 =          IPC_0:   EQU     0B8H
00B9 =          IPC_1:   EQU     0B9H
00BA =          IPC_2:   EQU     0BAH
00BB =          IPC_3:   EQU     0BBH
00BC =          IPC_4:   EQU     0BCH
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00BD =          IPC_5:  EQU     0BDH
00BE =          IPC_6:  EQU     0BEH
00BF =          IPC_7:  EQU     0BFH

00D0 =          PSW_0:  EQU     0D0H
00D1 =          PSW_1:  EQU     0D1H
00D2 =          PSW_2:  EQU     0D2H
00D3 =          PSW_3:  EQU     0D3H
00D4 =          PSW_4:  EQU     0D4H
00D5 =          PSW_5:  EQU     0D5H
00D6 =          PSW_6:  EQU     0D6H
00D7 =          PSW_7:  EQU     0D7H

00E0 =          ACC_0:  EQU     0E0H
00E1 =          ACC_1:  EQU     0E1H
00E2 =          ACC_2:  EQU     0E2H
00E3 =          ACC_3:  EQU     0E3H
00E4 =          ACC_4:  EQU     0E4H
00E5 =          ACC_5:  EQU     0E5H
00E6 =          ACC_6:  EQU     0E6H
00E7 =          ACC_7:  EQU     0E7H

00F0 =          B_reg_0: EQU    0F0H
00F1 =          B_reg_1: EQU    0F1H
00F2 =          B_reg_2: EQU    0F2H
00F3 =          B_reg_3: EQU    0F3H
00F4 =          B_reg_4: EQU    0F4H
00F5 =          B_reg_5: EQU    0F5H
00F6 =          B_reg_6: EQU    0F6H
00F7 =          B_reg_7: EQU    0F7H


0000                    ORG     0000H   ; start at addr 0000H
0000 020100             JMP     HERE    ; jump ahead to begin program.
0003                    ORG     0003H
0003 020050     EXT0:   JMP     STOP    ; external interrupt 0 starting addr
000B                    ORG     000BH
000B 02057C     TC0:    JMP     TIMER0  ; timer/counter 0 interrupt start addr
0013                    ORG     0013H
0013 020050     EXT1:   JMP     STOP    ; external interrupt 1 starting addr
001B                    ORG     001BH
001B 020050     TC1:    JMP     STOP    ; timer/counter 1 interrupt start addr
0023                    ORG     0023H
0023 020585     SER:    JMP     SERIAL  ; serial port interrupt starting addr

0050                    ORG     0050H
0050 1205D6     STOP:   CALL    WAT4MS
0053 1205D6             CALL    WAT4MS
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0056 1205D6           CALL    WAT4MS
0059 1205D6           CALL    WAT4MS
005C 1205D6           CALL    WAT4MS
005F C2A6             BCLR    LED
0061 1205D6           CALL    WAT4MS
0064 1205D6           CALL    WAT4MS
0067 1205D6           CALL    WAT4MS
006A 1205D6           CALL    WAT4MS
006D 1205D6           CALL    WAT4MS
0070 D2A6             BSET    LED
0072 80DC             BRA     STOP

               ;      COL 1   COL 2   COL 3   COL 4   COL 5

               ;      30 0    31 1    32 2    33 3    34 4
               ; ROW 1  S1      S7     S13     S19     S25
               ;         T       S       R       Q       P

               ;      35 5    36 6    37 7    38 8    39 9
               ; ROW 2  S2      S8     S14     S20     S26
               ;         O       N       M       L       K

               ;      3A :    3B ;    3C <    3D =    3E >
               ; ROW 3  S3      S9     S15     S21     S27
               ;        10       9       8       7       6

               ;      3F ?    40 @    41 A    42 B    43 C
               ; ROW 4  S4     S10     S16     S22     S28
               ;         5       4       3       2       1

               ;      44 D    45 E    46 F    47 G    48 H
               ; ROW 5  S5     S11     S17     S23     S29
               ;         J       I       H       G       F

               ;      49 I    4A J    4B K    4C L    4D M
               ; ROW 6  S6     S12     S18     S24     S30
               ;         E       D       C       B       A

               ; ***************************************************************************
0100                  ORG     0100H
0100           HERE:
0100 75814E           LDR     SP,#4EH          ; set Stack Pointer to MEM above last good
                                               ; "character" = addr.
0103 7580FF           LDR     P0,#0FFH         ; initialize port 0 to FFh.
0106 75A040           LDR     P2,#40H          ; turn LED off, other bits to zeroes
0109 75B0FF           LDR     P3.#0FFH         ; write all 1's to Port 3.
010C 759878           LDR     SCON, #78H       ; enable 8-bit UART, 01xx xxxx.
                                               ; frame error rejection enabled, xxx1x xxxx.
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                                          ; receive shift register enabled, xxx1 xxxx.
                                          ; force 9th serial bit to 1 always, xxxx 1xxx.
010F 75A880         LDR     IEC,#80H      ; interrupts to be individually set, 1xxx xxxx.
                                          ; timer 1 interrupts disabled,
                                          ; which is required for baud generation.
                                          ; timer 0 interrupts will be set later.
0112 758921         LDR     TMOD,#21H     ; set timer 1 to 8-bit soft reload mode,
                                          ; xx10 xx1 & timer 0 to 16-bit mode.
0115 758DE8         LDR     TH1, #0E8H    ; load timer 1 with reload value for 1200 baud
0118 758850         LDR     TCON, #50H    ; enable timer 1, enable timer 0.


011B 901F00         LDR     DPTR,#1F00H   ; set data pointer to minimum, ie bot of stack.
                                          ; for the matrix memory.
                                          ; This requires the Partition be set to 1000h.
011E 7400           LDR     A,#00H        ; load the accumulator with 00h.
0120 F0             LDX     @DPTR,A       ; load memory pointed to by DPTR with 00h.
0121 7F1F           LDR     R7,#1FH       ; use R7,R6 to simulate DPTR
0123 7E00           LDR     R6,#00H
0125 A3       H0:   INC     DPTR          ; highest key character memory is 1EFF .
0126 0E             INC     R6            ; 1F00 to 1FFF is matrix memory.
0127 EE             LDR     A,R6          ; zero the whole page of memory.
0128 B40007         CBNE    A,#00H,H1     ; if low byte not zero, branch ahead.

012B 0F             INC     R7
012C EF             LDR     A,R7
012D B42002         CBNE    A,#20H,H1     ; if high byte not #20h, branch ahead.

0130 8005           BRA     H2            ; otherwise, data memory initialized to 00h
                                          ; so branch ahead to continue with rest.
0132 7400     H1:   LDR     A,#000H       ; else load 00h into data memory via accum.
0134 F0             LDX     @DPTR,A
0135 80EE           BRA     H0            ; loop back & continue intializing data mem.

0137          H2:
0137 7EFF           LDR     R6,#0FFH      ; Register 6 is the single/double beep flag,
                                          ; initialized to single beep.
0139 7508FF         LDR     R8,#0FFH      ; initialize R8 with "no previous key" value.
013C 750BFF         LDR     RB,#0FFH
013F 750CFF         LDR     RC,#0FFH      ; set RB & RC to "no previous character".
0142 750900         LDR     R9,#0         ; reset defect XMIT flag to zero.
0145 750A00         LDR     0AH,#0        ; reset pass-thru XMIT flag to zero.
0148 7513FF         LDR     19,#0FFH      ; initial defect number.


014B          H:
                    ;LDR     31,#1        ; set LCD/VF* flag to LCD
014B E5B0           LDR     A,P3
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014D 5410              AND     A,#10H
014F 03                RRA
0150 03                RRA
0151 03                RRA
0152 03                RRA
0153 F51F              LDR     31,A            ; set R31 by the value of P3.4, pin 14.
0155 E51F              LDR     A,31
0157 B40111            CBNE    A,#1,H_VF
015A 120613            CALL    INIT_LCD        ; initialize display.
015D 75900F            LDR     P1,#0FH         ; display ON, with cursor, & blink.
0160 12060B            CALL    INSTRUCT
0163 759080            LDR     P1,#80H         ; set display data RAM to addr 00h
0166 12060B            CALL    INSTRUCT
0169 8003              BRA     H_INITD
016B           H_VF:
016B 1206A1            CALL    INIT_VF
016E           H_INITD:
016E 751200            LDR     18,#0           ; reset the "reset thyself" flag.


0171           HERE2:
0171 D2AC              BSET    IEC_4           ; enable serial interrupts.
0173 794D              LDR     R1,#4DH         ; initialize R1 to max memory addr needed.

0175 D2A5              BSET    P2_5            ; read row 6
0177 7F00              LDR     R7,#00H         ; reset flag to signal rows 1,2,5,6.
0179 1201B3            CALL    DELAY_READ
017C C2A5              BCLR    P2_5

017E D2A4              BSET    P2_4            ; read row 5
0180 7F00              LDR     R7,#00H         ; reset flag to signal rows 1,2,5,6.
0182 1201B3            CALL    DELAY_READ
0185 C2A4              BCLR    P2_4

0187 D2A3              BSET    P2_3            ; read row 4
0189 7F01              LDR     R7,#01H         ; set flag that signals row 3 or 4.
018B 1201B3            CALL    DELAY_READ
018E C2A3              BCLR    P2_3

0190 D2A2              BSET    P2_2            ; read row 3
0192 7F01              LDR     R7,#01H         ; set flag that signals row 3 or 4.
0194 1201B3            CALL    DELAY_READ
0197 C2A2              BCLR    P2_2

0199 D2A1              BSET    P2_1            ; read row 2
019B 7F00              LDR     R7,#00H         ; reset flag to signal rows 1,2,5,6.
019D 1201B3            CALL    DELAY_READ
01A0 C2A1              BCLR    P2_1
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01A2 D2A0               BSET    P2_0            ; read row 1
01A4 7F00               LDR     R7,#00H         ; reset flag to signal rows 1,2,5,6.
01A6 1201B3             CALL    DELAY_READ
01A9 C2A0               BCLR    P2_0

01AB E512               LDR     A,18            ; get the "reset thyself" flag.
01AD B4FFC1             CBNE    A,#0FFH,HERE2   ; if it's not FFh then loop back to HERE2.
01B0 020100             JMP     HERE            ; else start over at HERE.
                ; ********************************************************************
01B3            DELAY_READ:                     ; Delay & Read subroutine.
01B3 7B04               LDR     R3,#04H         ;R3 is a timing loop constant.

01B5 7C00       ND1:    LDR     R4,#00H         ;R4 is another timing loop constant.
01B7 DCFE               DBNZ    R4,*            ; another internal delay loop.
01B9 DBFA               DBNZ    R3,ND1

01BB 19                 DEC     R1              ; decrement R1 five times.
01BC 19                 DEC     R1
01BD 19                 DEC     R1
01BE 19                 DEC     R1
01BF 19                 DEC     R1              ; R1 now contains the base addr, less 1.
01C0 7580FF             LDR     P0,#0FFH        ; write 1's to Port 0.
01C3 AA80               LDR     R2,P0           ; read Port 0 into R2.
01C5 53021F             AND     R2,#1FH         ; mask out unconnected bits.
01C8 BA0018             CBNE    R2,#00H,ND2     ; if remaining bits not all 0, branch ahead.

01CB A801               LDR     R0,R1           ; else enter a zero bit for this sampling.
                                                ; now R0 has the base address.
01CD 1201DD             CALL    ROT_0           ; call the rotation subroutine.
                                                ; to record closed & open switches.
01D0 1201DD             CALL    ROT_0

01D3 1201DD             CALL    ROT_0

01D6 1201DD             CALL    ROT_0

01D9 1201DD             CALL    ROT_0

01DC 22                 RET                     ; return from Delay & Read subroutine.

                ; ********************************************************************
01DD 08         ROT_0:  INC     R0              ; Rotation subroutine.
01DE E6                 LDR     A,@R0           ; load M(R0) into accumulator A.
01DF C3                 CLR     C               ; clear the carry bit.
01E0 13                 RRC     A               ; rotate right with carry going into MSB.
01E1 F6                 LDR     @R0,A           ; load accumulator A back into M(R0).
01E2 22                 RET
```

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                ; ***************************************************************************
01E3 E9         ND2:    LDR    A,R1            ; load accumulator with R1, the base addr.
01E4 2405               ADD    A,#5            ; add 5 to R1 in accumulator.
01E6 F8                 LDR    R0,A
01E7 E6                 LDR    A,@R0           ; load accumulator with M(R1+5).
01E8 BA0103             CBNE   R2,#01H,ND25    ; branch ahead if R2 isn't 01, column 5.
01EB D3                 BSET   C               ; if it is, set the carry bit.
01EC 8001               BRA    ND27            ; then branch ahead.
01EE C3         ND25:   CLR    C               ; if it isn't, then clear the carry bit.
01EF 13         ND27:   RRC    A               ; now rotate the carry bit into the cell.
01F0 F6                 LDR    @R0,A           ; save accumulator to M(R1+5).

01F1 E9         ND3:    LDR    A,R1            ; do it all again for M(R1+4).
01F2 2404               ADD    A,#4            ; add 4 to R1 in accumulator.
01F4 F8                 LDR    R0,A
01F5 E6                 LDR    A,@R0
01F6 BA0203             CBNE   R2,#02H,ND35    ; branch ahead if R2 isn't 02, column 4.
01F9 D3                 BSET   C
01FA 8001               BRA    ND37
01FC C3         ND35:   CLR    C
01FD 13         ND37:   RRC    A
01FE F6                 LDR    @R0,A

01FF E9         ND4:    LDR    A,R1
0200 2403               ADD    A,#3            ; add 3 to R1
0202 F8                 LDR    R0,A
0203 E6                 LDR    A,@R0
0204 BA0403             CBNE   R2,#04H,ND45    ; branch ahead if R2 isn't 04, column 3.
0207 D3                 BSET   C
0208 8001               BRA    ND47
020A C3         ND45:   CLR    C
020B 13         ND47:   RRC    A
020C F6                 LDR    @R0,A

020D E9         ND5:    LDR    A,R1
020E 2402               ADD    A,#2            ; add 2 to R1
0210 F8                 LDR    R0,A
0211 E6                 LDR    A,@R0
0212 BA0803             CBNE   R2,#08H,ND55    ; branch ahead if R2 isn't 08, column 2.
0215 D3                 BSET   C
0216 8001               BRA    ND57
0218 C3         ND55:   CLR    C
0219 13         ND57:   RRC    A
021A F6                 LDR    @R0,A

021B E9         ND6:    LDR    A,R1
021C 2401               ADD    A,#1            ; add 1 to R1
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021E F8                LDR     R0,A
021F E6                LDR     A,@R0
0220 BA1003            CBNE    R2,#10H,ND65     ; branch ahead if R2 isn't 10, column 1.
0223 D3                BSET    C
0224 8001              BRA     ND67
0226 C3       ND65:    CLR     C
0227 13       ND67:    RRC     A
0228 F6                LDR     @R0,A
                                                ; now test all memory cells for a good key.
0229 A801              LDR     R0,R1            ; R1 is base address for the row.

022B 08                INC     R0               ; column 1.
022C E6                LDR     A,@R0
022D B4F002            CBNE    A,#0F0H,ND7
0230 801D              BRA     BEEPER

0232 08       ND7:     INC     R0               ; column 2.
0233 E6                LDR     A,@R0
0234 B4F002            CBNE    A,#0F0H,ND8
0237 8016              BRA     BEEPER

0239 08       ND8:     INC     R0               ; column 3.
023A E6                LDR     A,@R0
023B B4F002            CBNE    A,#0F0H,ND9
023E 800F              BRA     BEEPER

0240 08       ND9:     INC     R0               ; column 4.
0241 E6                LDR     A,@R0
0242 B4F002            CBNE    A,#0F0H,ND10
0245 8008              BRA     BEEPER

0247 08       ND10:    INC     R0               ; column 5.
0248 E6                LDR     A,@R0
0249 B4F002            CBNE    A,#0F0H,ND11
024C 8001              BRA     BEEPER
024E 22       ND11:    RET                      ; return

              ; ***************************************************************************
024F 758C80   BEEPER:  LDR     TH0,#80H         ; pattern is good (i.e.#0F0H), so
0252 758A00            LDR     TL0,#00H         ; load timer 0 with a timing constant.
0255 7D02              LDR     R5,#02H          ; load R5 with a timing constant loop counter.
0257 BF0003            CBNE    R7,#00H,BEEPC    ; see if single length beep requested.
025A ED                LDR     A,R5             ; load accumulator with R5.
025B 23                RL      A                ; shift up one time.
025C FD                LDR     R5,A             ; load accumulator back into R5.
025D D2A7     BEEPC:   BSET    P2_7             ; turn on the beeper.
025F D2A9              BSET    IEC_1            ; enable timer 0 interrupts.
0261 63A040            XOR     P2,#40H          ; toggle LED
```

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0264 850B0C            LDR    RC,RB            ; copy previous key to 2nd previous key.
0267 880B              LDR    RB,R0            ; copy this key to previous key.

                                               ; R7 is row 3 or 4 flag.
0269 E508    BEEPEX:   LDR    A,R8             ; R8 is previous value of R7; FFh on startup.
026B B4FF02            CBNE   A,#0FFH,BP3      ; if R8 <> initial value, branch to next test.
026E 8010              BRA    BP8              ; else branch to BP8.
0270 EF      BP3:      LDR    A,R7             ; get row 3 or 4 flag for comparison.
0271 B50802            CBNE   A,R8,BP7         ; if R8 <> R7 then branch to BP7.
0274 800A              BRA    BP8              ; else branch to BP8.
0276 E5A0    BP7:      LDR    A,P2             ; read current state of LED.
0278 5440              AND    A,#40H           ; mask out all but LED bit.
027A B44003            CBNE   A,#40H,BP8       ; if LED ON (P2_6=0) then branch ahead.
027D 120283            CALL   FILL_MATRIX      ; decode key pair & update one matrix element.
0280 8F08    BP8:      LDR    R8,R7            ; save "previous" R7 in R8

0282 22                RET                     ; return from subroutine.

             ; *************************************************************************
0283         FILL_MATRIX:     ; previous two keys were a position & type of error (or vice
                              ; versa), so now let us decode them into a defect.
0283 E50C              LDR    A,RC             ; get 2nd previous key.
0285 B4FF01            CBNE   A,#0FFH,F0       ; if it's not the initial value, continue.
0288 22                RET
0289         F0:
0289 BF011C            CBNE   R7,#01H,F2       ; if R7<>1 then RB is a position, branch F2.

028C 7444              LDR    A,#44H           ; else RB is a type of error; subtract it
028E C3                CLR    C                ; from #44h to get error number.
028F 950B              SBC    A,RB             ; get previous key.
0291 F50D              LDR    RD,A             ; save error number in RD, 1 to 10.

0293 744D              LDR    A,#4DH           ; now subtract position character from #4Dh.
0295 C3                CLR    C                ; to get position number.
0296 950C              SBC    A,RC             ; subtract 2nd previous key.
0298 F50E              LDR    RE,A             ; temporarily save position number in RE
                                               ; 0 to 19 for A to T (skip over errors below).
029A C3                CLR    C
029B 940B              SBC    A,#11            ; subtract 11d from position number.
029D 4007              BC     F1               ; branch ahead if carry set for borrow;

029F C3                CLR    C
02A0 E50E              LDR    A,RE             ; retrieve position number from RE.
02A2 940A              SBC    A,#10            ; subtract 10d from character to get position
02A4 F50E              LDR    RE,A             ; number.

02A6 801A    F1:       BRA    F3
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02A8              F2:
02A8 7444                LDR     A,#44H          ; else RB is a type of error; subtract it
02AA C3                  CLR     C               ; from #44h to get error number.
02AB 950C                SBC     A,RC            ; get 2nd previous key.
02AD F50D                LDR     RD,A            ; save error number in RD.

02AF 744D                LDR     A,#4DH          ; now subtract position character from #4Dh
02B1 C3                  CLR     C               ; to get position number.
02B2 950B                SBC     A,RB            ; subtract previous key.
02B4 F50E                LDR     RE,A            ; save position number in RE.

02B6 C3                  CLR     C
02B7 940B                SBC     A,#11           ; subtract 11d from position number.
02B9 4007                BC      F3              ; branch ahead if carry set for borrow;

02BB C3                  CLR     C
02BC E50E                LDR     A,RE
02BE 940A                SBC     A,#10           ; subtract 10d from character to get position
02C0 F50E                LDR     RE,A            ; number, temporarily saving results in RE.

02C2 75F00A       F3:    LDR     B_reg,#10       ; for each position there are 10 errors.
02C5 E50E                LDR     A,RE            ; retrieve position number from RE, 0 to 19.
02C7 A4                  MUL     AB              ; multiply number of errors times position #.
02C8 250D                ADD     A,RD            ; add the type-of-error number, 1 to 10.
                                                 ; now accumulator A has the addr to increment.
02CA F50F                LDR     RF,A            ; save it in RF.
02CC F513                LDR     19,A            ; register 19 holds defect number, 1 to 200.
                                                 ; defect initialization = FFh.
02CE              F640:
02CE E50A                LDR     A,0AH           ; test the pass-thru XMIT flag.
02D0 B400FB              CBNE    A,#0,F640       ; wait for it to clear.
02D3 7509FF              LDR     R9,#0FFH        ; set defect XMIT flag to non-zero
                                                 ; claiming transmitter resources.
02D6 851399              LDR     SBUF,19         ; transmit the defect number.



02D9 901F00              LDR     DPTR,#1F00H     ; preset DPTR to #1F00h.

02DC A3           F64:   INC     DPTR            ; increment DPTR in matrix memory
02DD D50FFC              DBNZ    RF,F64          ; to the correct element; RF now zero.

02E0              F65:
02E0 E0                  LDX     A,@DPTR         ; get current count.
02E1 B4FF02              CBNE    A,#0FFH,F66     ; branch to increment if it's not #FFh.
02E4 8002                BRA     F67             ; else branch to F67.
02E6 04           F66:   INC     A               ; increment the count.
```

```
02E7 F0                 LDX     @DPTR,A         ; store count back into last page of dat mem.
02E8           F67:



                                                ; seek 4 biggest offenders.
02E8 901F01             LDR     DPTR,#1F01H     ; initialize DPTR to first defect cell.
02EB 751601             LDR     22,#1
02EE E0                 LDX     A,@DPTR
02EF F51B               LDR     27,A            ; initialize R27 to contents of M(R21).

02F1 901F00             LDR     DPTR,#1F00H
02F4 7519C8             LDR     25,#200         ; initialize R25 with number of defects.
02F7 751A00             LDR     26,#0           ; shadow the DPTR.

                                                ; now increment thru defect memory cells.
02FA A3        F68:     INC     DPTR            ; increment the DPTR.
02FB 051A               INC     26              ; increment the shadow.
02FD E0                 LDX     A,@DPTR         ; get the count in this cell.
02FE C3                 CLR     C               ; clear carry as a prerequisite to subtraction
02FF 951B               SBC     A,27            ; subtract from it the biggest so far (in R21)
0301 4006               BC      F69             ; if R21 > A, there was a carry so jump ahead
0303 851A15             LDR     21,26           ; addr's updated.
0306 E0                 LDX     A,@DPTR
0307 F51B               LDR     27,A            ; counts updated.
0309 D519EE    F69:     DBNZ    25,F68          ; decrement counter register, branch back<>0.
                                                ; now R27 has the count, R21 the location.
                                                ; now load that location with zero count.
030C 901F00             LDR     DPTR,#1F00H
030F 851519             LDR     25,21
0312 A3        F6901:   INC     DPTR
0313 D519FC             DBNZ    25,F6901
0316 7400               LDR     A,#0
0318 F0                 LDX     @DPTR,A

0319 901F01             LDR     DPTR,#1F01H     ; initialize DPTR to first defect cell.
031C 751601             LDR     22,#1
031F E0                 LDX     A,@DPTR
0320 F51C               LDR     28,A

0322 901F00             LDR     DPTR,#1F00H     ; initialize DPTR to first defect cell minus 1
0325 7519C8             LDR     25,#200         ; initialize R25 with number of defects.
0328 751A00             LDR     26,#0           ; shadow the DPTR.
032B           F691:
032B A3                 INC     DPTR
032C 051A               INC     26
032E E0                 LDX     A,@DPTR
032F C3                 CLR     C
0330 951C               SBC     A,28
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0332 4006              BC      F6912
0334 851A16            LDR     22,26
0337 E0                LDX     A,@DPTR
0338 F51C              LDR     28,A
033A D519EE   F6912:   DBNZ    25,F691          ; finished 2nd offender.

                                                ; now R28 has the count, R22 the location.
                                                ; now load that location with zero count.
033D 901F00            LDR     DPTR,#1F00H
0340 851619            LDR     25,22
0343 A3       F6913:   INC     DPTR
0344 D519FC            DBNZ    25,F6913
0347 7400              LDR     A,#0
0349 F0                LDX     @DPTR,A

034A 901F01            LDR     DPTR,#1F01H      ; initialize DPTR to first defect cell.
034D 751701            LDR     23,#1
0350 E0                LDX     A,@DPTR
0351 F51D              LDR     29,A

0353 901F00            LDR     DPTR,#1F00H      ; initialize DPTR to first defect cell minus 1
0356 7519C8            LDR     25,#200          ; initialize R25 with number of defects
0359 751A00             LDR     26.#0            ; shadow the DPTR.
035C          F692:
035C A3                INC     DPTR
035D 051A              INC     26
035F E0                LDX     A,@DPTR
0360 C3                CLR     C
0361 951D              SBC     A,29
0363 4006              BC      F6928
0365 851A17            LDR     23,26
0368 E0                LDX     A,@DPTR
0369 F51D              LDR     29,A
036B D519EE   F6928:   DBNZ    25,F692          ; finished 3rd offender.

                                                ; now R29 has the count, R23 the location.
                                                ; now load that location with zero count.
036E 901F00            LDR     DPTR,#1F00H
0371 851719            LDR     25,23
0374 A3       F6929:   INC     DPTR
0375 D519FC            DBNZ    25,F6929
0378 7400              LDR     A,#0
037A F0                LDX     @DPTR,A

037B 901F01            LDR     DPTR,#1F01H      ; initialize DPTR to first defect cell.
037E 751801            LDR     24,#1
0381 E0                LDX     A,@DPTR
0382 F51E              LDR     30,A
```

```
0384 901F00            LDR    DPTR,#1F00H     ; initialize DPTR to first defect cell minus 1
0387 7519C8            LDR    25,#200         ; initialize R25 with number of defects
038A 751A00            LDR    26,#0           ; shadow the DPTR.
038D          F693:
038D A3                INC    DPTR
038E 051A              INC    26
0390 E0                LDX    A,@DPTR
0391 C3                CLR    C
0392 951E              SBC    A,30
0394 4006              BC     F6938
0396 851A18            LDR    24,26
0399 E0                LDX    A,@DPTR
039A F51E              LDR    30,A
039C D519EE   F6938:   DBNZ   25,F693         ; finished 4th offender.

                                              ; now restore the counts in top 3 offenders
039F 901F00            LDR    DPTR,#1F00H
03A2 851719            LDR    25,23
03A5 A3       F695:    INC    DPTR
03A6 D519FC            DBNZ   25,F695
03A9 E51D              LDR    A,29
03AB F0                LDX    @DPTR,A

03AC 901F00            LDR    DPTR,#1F00H
03AF 851619            LDR    25,22
03B2 A3       F696:    INC    DPTR
03B3 D519FC            DBNZ   25,F696
03B6 E51C              LDR    A,28
03B8 F0                LDX    @DPTR,A

03B9 901F00            LDR    DPTR,#1F00H
03BC 851519            LDR    25,21
03BF A3       F697:    INC    DPTR
03C0 D519FC            DBNZ   25,F697
03C3 E51B              LDR    A,27
03C5 F0                LDX    @DPTR,A

03C6 E51F              LDR    A,31
03C8 B40108            CBNE   A,#1,F697V
03CB 1204BF            CALL   CLEAR_LCD
03CE 1204B1            CALL   HOME_LCD
03D1 8006              BRA    F698
03D3          F697V:
03D3 1204C6            CALL   CLEAR_VF
03D6 1204B8            CALL   HOME_VF
03D9          F698:
03D9 E515              LDR    A,21
```

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03DB 851B1A            LDR    26,27
03DE 1204CD            CALL   DECODE          ; decode RE & RD from Accumulator
03E1 1204E4            CALL   DISPLAY         ; RE is position #, RD is type of error #.
                                              ; R3, R4, RD, RE, RF get used.
03E4 E51F              LDR    A,31
03E6 B40108            CBNE   A,#1,F698V
03E9 7590C0            LDR    P1,#0C0H        ; set cursor to 1st space, 2nd line.
03EC 12060B            CALL   INSTRUCT
03EF 8003              BRA    F698Z
03F1          F698V:
03F1 120734            CALL   CRLF
03F4          F698Z:
03F4 E516              LDR    A,22
03F6 851C1A            LDR    26,28
03F9 1204CD            CALL   DECODE
03FC 1204E4            CALL   DISPLAY

03FF E51F              LDR    A,31
0401 B40108            CBNE   A,#1,F698V2
0404 759090            LDR    P1,#90H         ; set cursor to 1st space, 3rd line.
0407 12060B            CALL   INSTRUCT
040A 8003              BRA    F698Z2
040C          F698V2:
040C 120734            CALL   CRLF
040F          F698Z2:
040F E517              LDR    A,23
0411 851D1A            LDR    26,29
0414 1204CD            CALL   DECODE
0417 1204E4            CALL   DISPLAY

041A E51F              LDR    A,31
041C B40108            CBNE   A,#1,F698V3
041F 7590D0            LDR    P1,#0D0H        ; set cursor to 1st space, 4th line.
0422 12060B            CALL   INSTRUCT
0425 8003              BRA    F698Z3
0427          F698V3:
0427 120734            CALL   CRLF
042A          F698Z3:
042A E518              LDR    A,24
042C 851E1A            LDR    26,30
042F 1204CD            CALL   DECODE
0432 1204E4            CALL   DISPLAY
0435          F9:
                       ;now totalize all the defects & display it on the 4th line.
0435 901F00            LDR    DPTR,#1F00H
0438 751A00            LDR    26,#0           ; R26 will hold the total.
043B 751900            LDR    25,#0           ; R25 will shadow the DPTR, & test for done.
043E A3       F99:     INC    DPTR            ; increment the DPTR and its shadow
```

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043F 0519              INC     25
0441 E0                LDX     A,@DPTR          ; else get the defect count pointed by DPTR
0442 C3                CLR     C                ; clear carry bit for ADC to come below.
0443 351A              ADC     A,26             ; add current grand total to it
0445 5002              BNC     F991             ; if no overflow, continue at F991
0447 74FF              LDR     A,#255           ; else set grand total to 255
0449 F51A      F991:   LDR     26,A             ; store current grand total back to R26
044B E519              LDR     A,25             ; get shadow to test for done
044D B4C8EE            CBNE    A,#0C8H,F99      ; branch back if not done

0450 E51F              LDR     A,31
0452 B40128            CBNE    A,#1,F992V
0455 759020            LDR     P1,#" "
0458 1205FA            CALL    DATA
045B 759054            LDR     P1,#"T"
045E 1205FA            CALL    DATA
0461 75904F            LDR     P1,#"O"
0464 1205FA            CALL    DATA
0467 759054            LDR     P1,#"T"
046A 1205FA            CALL    DATA
046D 75902E            LDR     P1,#"."
0470 1205FA            CALL    DATA
0473 759020            LDR     P1,#" "
0476 1205FA            CALL    DATA
0479 120518            CALL    DISPLAY_COUNT
047C 22                RET                      ; return.
047D           F992V:
047D 759020            LDR     P1,#" "
0480 1205F2            CALL    E_TOGL_VF
0483 759020            LDR     P1,#" "
0486 1205F2            CALL    E_TOGL_VF
0489 759054            LDR     P1,#"T"
048C 1205F2            CALL    E_TOGL_VF
048F 75904F            LDR     P1,#"O"
0492 1205F2            CALL    E_TOGL_VF
0495 759054            LDR     P1,#"T"
0498 1205F2            CALL    E_TOGL_VF
049B 759041            LDR     P1,#"A"
049E 1205F2            CALL    E_TOGL_VF
04A1 75904C            LDR     P1,#"L"
04A4 1205F2            CALL    E_TOGL_VF
04A7 759020            LDR     P1,#" "
04AA 1205F2            CALL    E_TOGL_VF
04AD 120518            CALL    DISPLAY_COUNT
04B0 22                RET
               ; *****************************************************************************
04B1           HOME_LCD:
04B1 759080            LDR     P1,#80H          ; set cursor to 1st space, 1st line.
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04B4 12060B          CALL    INSTRUCT
04B7 22              RET
               ; ***********************************************************************
04B8           HOME_VF:
04B8 759016          LDR     P1,#16H         ; cursor home.
04BB 1205F2          CALL    E_TOGL_VF
04BE 22              RET
               ; ***********************************************************************
04BF           CLEAR_LCD:
04BF 759001          LDR     P1,#01H
04C2 12060B          CALL    INSTRUCT
04C5 22              RET
               ; ***********************************************************************
04C6           CLEAR_VF:
04C6 759015          LDR     P1,#15H         ; clear display.
04C9 1205F2          CALL    E_TOGL_VF
04CC 22              RET
               ; ***********************************************************************
04CD           DECODE: ;Begin with A, uses R3&4, puts position # into RE, error # into RD.
                     ; Count up from zero. Every time the type of error increments past
                     ; 10, reset it to 1, and increment the position.  When the defect
                     ; number is decremented to zero, then the error & position are good.
04CD FB              LDR     R3,A            ; put it in R3.
04CE FC              LDR     R4,A
04CF 750E00          LDR     RE,#0
04D2 750D00          LDR     RD,#0           ; load results registers with zeroes.
04D5           D7:
04D5 050D            INC     RD              ; increment type of error.
04D7 E50D            LDR     A,RD
04D9 B40B05          CBNE    A,#0BH,D75      ; test it for > 10.
04DC 750D01          LDR     RD,#01H         ; if >, then reset to 1.
04DF 050E            INC     RE              ; increment position number.
04E1           D75:
04E1 DBF2            DBNZ    R3,D7           ; decrement the count & test to see if more.

04E3 22              RET
               ; ***********************************************************************
04E4           DISPLAY:                ; RE has position, RD has type of error.
                                       ; R3, R4, RD, RE, RF all used by this routine.
04E4 E50E            LDR     A,RE            ; get the position (0 to 19d for A to T).
04E6 2441            ADD     A,#41H
04E8 F590            LDR     P1,A
04EA 1205FA          CALL    DATA              ; display the position letter.
04ED E50D            LDR     A,RD            ; get the type of error (1 to 10).
04EF 2430            ADD     A,#30H
04F1 F50D            LDR     RD,A
04F3 C3              CLR     C
04F4 943A            SBC     A,#3AH
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04F6 400E             BC      F62

04F8 759031           LDR     P1,#"1"
04FB 1205FA           CALL    DATA
04FE 759030           LDR     P1,#"0"
0501 1205FA           CALL    DATA              ; display a "10" if type of error is 10.
0504 800C             BRA     F63

0506 850D90     F62:  LDR     P1,RD
0509 1205FA           CALL    DATA              ; display type of error if 0 to 9.
050C 759020           LDR     P1,#" "
050F 1205FA           CALL    DATA              ; display a space.
0512 759020     F63:  LDR     P1,#" "
0515 1205FA           CALL    DATA              ; display a space.
                ; ***********************************************************************
0518            DISPLAY_COUNT:
                                              ; convert from binary to ASCII.
0518 AB1A             LDR     R3,26           ; get the count.
051A 7C00             LDR     R4,#0           ; reset leading zero flag, R4.
051C 750F30           LDR     RF,#30H
051F 750E30           LDR     RE,#30H
0522 750D30           LDR     RD,#30H         ; load results registers with ASCII zeroes.
0525 E51A             LDR     A,26
0527 B40008           CBNE    A,#0,F7
052A 759020           LDR     P1,#" "
052D 1205FA           CALL    DATA
0530 8040             BRA     F85
0532            F7:
0532 050D             INC     RD              ; increment LSD.
0534 E50D             LDR     A,RD
0536 B43A0F           CBNE    A,#3AH,F75      ; test it for > "9".
0539 750D30           LDR     RD,#30H         ; if >, then reset to "0".
053C 050E             INC     RE              ; increment middle digit.
053E E50E             LDR     A,RE
0540 B43A05           CBNE    A,#3AH,F75      ; test it for > "9".
0543 750E30           LDR     RE,#30H         ; if >, then reset to "0".
0546 050F             INC     RF              ; and increment MSD.
0548            F75:
0548 DBE8             DBNZ    R3,F7           ; decrement the count & test to see if more.

054A            F8:
054A E50F             LDR     A,RF            ; get the MSD.
054C B43007           CBNE    A,#30H,F81      ; is it "0"?
054F 759020           LDR     P1,#" "         ; then display a space.
0552 7C01             LDR     R4,#1           ; set leading zero flag, R4.
0554 8003             BRA     F82
0556            F81:
0556 850F90           LDR     P1,RF           ; else display the ASCII character.
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0559            F82:
0559 1205FA             CALL    DATA

055C E50E               LDR     A,RE             ; get middle digit.
055E B4300E             CBNE    A,#30H,F84       ; test it for "0", branch ahead if not.
0561 EC                 LDR     A,R4             ; get leading zero flag.
0562 B40105             CBNE    A,#1,F83         ; test MSD equal to "0", branch ahead if not.
0565 759020             LDR     P1,#" "          ; load a blank since 0 and RF = 0.
0568 8008               BRA     F85              ; branch ahead to display.
056A 759030     F83:    LDR     P1,#"0"          ; load "0" since 0 and RF <> 0.
056D 8003               BRA     F85              ; branch ahead to display.
056F 850E90     F84:    LDR     P1,RE            ; not 0, so load middle digit.
0572 1205FA     F85:    CALL    DATA               ; display ASCII character.

0575 850D90             LDR     P1,RD            ; display LSD; never 0, never undisplayable.
0578 1205FA             CALL    DATA

057B 22                 RET
                ; ***********************************************************************
                                                 ; interrupt service.
057C 1D         TIMER0: DEC     R5               ; decrement timing loop counter.
057D BD0004             CBNE    R5,#0,TIMERX     ; if loop counter not 0, then return.
0580 C2A7               BCLR    P2_7             ; else clear the beeper.
0582 C2A9               BCLR    IEC_1            ; clear timer 0 interrupt enable.
0584 32         TIMERX: RETI                     ; return from interrupt service.
                ; ***********************************************************************
0585            SERIAL:                          ; serial interrupt service.
                                                 ; push certain registers onto the stack.
0585 C0E0               PUSH    ACC              ; used throughout interrupt service.

0587 E598       S1:     LDR     A,SCON           ; get serial control register.
0589 5402               AND     A,#02H
058B B4020F             CBNE    A,#02H,S2        ; if it's the transmit interrupt
                                                 ; then clear it and test R9 & RA.
058E C299               BCLR    SCON_1
0590 E50A               LDR     A,0AH            ; get pass-thru XMIT flag, RA.
0592 B4FF05             CBNE    A,#0FFH,S15      ; if it's reset, jump ahead to reset R9.
0595 750A00             LDR     0AH,#0           ; otherwise, reset RA.
0598 8003               BRA     S2               ; then return from interrupt.
059A            S15:
059A 750900             LDR     R9,#0            ; reset defect XMIT flag, R9.

059D            S2:                              ; this must be a received serial interrupt.
059D E598               LDR     A,SCON
059F 5401               AND     A,#01H
05A1 B40002             CBNE    A,#00H,S25
05A4 801C               BRA     S10
05A6            S25:
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05A6 859914           LDR      20,SBUF          ; read the character.
05A9 E514             LDR      A,20
05AB B4E005           CBNE     A,#RESET_CHAR,S3; if not the "reset thyself" character, go on.
05AE 7512FF           LDR      18,#0FFH         ; set the "reset thyself" flag.
05B1 8000             BRA      S4
05B3           S3:
               ;       CBNE     A,#13,S4        ; if it's a carriage return, skip it & return.
               ;       BRA      S10
05B3           S4:
05B3 E509             LDR      A,R9             ; get the defect XMIT flag.
05B5 B4FF02           CBNE     A,#0FFH,S5       ; if it's not set, then set the pass-thru flag
05B8 8008             BRA      S10              ; else return from interrupt service w/o XMIT.

05BA 750AFF    S5:    LDR      0AH,#0FFH        ; set the pass-thru flag.
05BD 851499           LDR      SBUF,20          ; retransmit the character out the ser. port.
05C0 C298             BCLR     SCON_0           ; clear the received serial interrupt bit.
05C2           S10:
05C2 D0E0             PULL     ACC              ; restore accumulator.
05C4 32               RETI                      ; return.

               ; ************************************************************************
05C5           WAT200MS:
05C5 1205CC           CALL     WAT100MS
05C8 1205CC           CALL     WAT100MS
05CB 22               RET
               ; ************************************************************************
05CC           WAT100MS:
05CC 751119           LDR      17,#19H
05CF 1205D6    W101:  CALL     WAT4MS
05D2 D511FA           DBNZ     17,W101
05D5 22               RET
               ; ************************************************************************
05D6 7510FF    WAT4MS: LDR     16,#0FFH
05D9 00        WAT1:  NOP
05DA 00               NOP
05DB 00               NOP
05DC 00               NOP
05DD 00               NOP
05DE 00               NOP
05DF 00               NOP
05E0 00               NOP
05E1 00               NOP
05E2 00               NOP
05E3 00               NOP
05E4 00               NOP
05E5 00               NOP
05E6 D510F0           DBNZ     16,WAT1
05E9 22               RET
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                ; ********************************************************************
05EA            E_TOGL_LCD:
05EA D287               BSET    ENABLE
05EC 1205D6             CALL    WAT4MS
05EF C287               BCLR    ENABLE
05F1 22                 RET
                ; ********************************************************************
05F2            E_TOGL_VF:
05F2 1205D6             CALL    WAT4MS
05F5 C287               BCLR    ENABLE
05F7 D287               BSET    ENABLE
05F9 22                 RET
                ; ********************************************************************
05FA            DATA:
05FA D285               BSET    RS              ;*****
05FC C286               BCLR    RW
05FE E51F               LDR     A,31
0600 B40104             CBNE    A,#1,DATAV
0603 1205EA             CALL    E_TOGL_LCD
0606 22                 RET
0607            DATAV:
0607 1205F2             CALL    E_TOGL_VF
060A 22                 RET
                ; ********************************************************************
060B            INSTRUCT:
060B C285               BCLR    RS
060D C286               BCLR    RW
060F 1205EA             CALL    E_TOGL_LCD
0612 22                 RET
                ; ********************************************************************
0613            INIT_LCD:
0613 1205CC             CALL    WAT100MS
0616 C287               BCLR    ENABLE
0618 C285               BCLR    RS
061A C286               BCLR    RW
061C 759030             LDR     P1,#30H         ; set 8-bit, 1 line, 5x7
061F 1205D6             CALL    WAT4MS

0622 1205EA             CALL    E_TOGL_LCD
0625 1205D6             CALL    WAT4MS
0628 1205EA             CALL    E_TOGL_LCD
062B 12060B             CALL    INSTRUCT

062E 759038             LDR     P1,#38H         ; set 8-bit, 2 line, 5x7
0631 12060B             CALL    INSTRUCT

0634 759008             LDR     P1,#08H         ; set display off, no cursor, no blink
0637 12060B             CALL    INSTRUCT
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063A 759001          LDR     P1,#01H         ; set display clear
063D 12060B          CALL    INSTRUCT

0640 759006          LDR     P1,#06H         ; set increment +1, no shift
0643 12060B          CALL    INSTRUCT

0646 759020          LDR     P1,#" "         ; cursor visible & blinking.
0649 1205FA          CALL    DATA
064C          READY:
064C 759052          LDR     P1,#"R"
064F 1205FA          CALL    DATA
0652 759045          LDR     P1,#"E"
0655 1205FA          CALL    DATA
0658 759041          LDR     P1,#"A"
065B 1205FA          CALL    DATA
065E 759044          LDR     P1,#"D"
0661 1205FA          CALL    DATA
0664 759059          LDR     P1,#"Y"
0667 1205FA          CALL    DATA
066A 759020          LDR     P1,#" "
066D 1205FA          CALL    DATA
0670 759054          LDR     P1,#"T"
0673 1205FA          CALL    DATA
0676 75904F          LDR     P1,#"O"
0679 1205FA          CALL    DATA
067C 759020          LDR     P1,#" "
067F 1205FA          CALL    DATA
0682 759042          LDR     P1,#"B"
0685 1205FA          CALL    DATA
0688 759045          LDR     P1,#"E"
068B 1205FA          CALL    DATA
068E 759047          LDR     P1,#"G"
0691 1205FA          CALL    DATA
0694 759049          LDR     P1,#"I"
0697 1205FA          CALL    DATA
069A 75904E          LDR     P1,#"N"
069D 1205FA          CALL    DATA
06A0 22              RET
              ; ***************************************************************************
06A1          INIT_VF:
06A1 D287            BSET    WR_
06A3 D285            BSET    TEST_
06A5 1205CC          CALL    WAT100MS
06A8 1205CC          CALL    WAT100MS
06AB 1205CC          CALL    WAT100MS
06AE 1205CC          CALL    WAT100MS
06B1 1205CC          CALL    WAT100MS
```

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06B4 D287              BSET     WR_
06B6 D285              BSET     TEST_
06B8 759014            LDR      P1,#14H        ; software reset display.
06BB 1205F2            CALL     E_TOGL_VF
06BE 759015            LDR      P1,#15H        ; clear display.
06C1 1205F2            CALL     E_TOGL_VF
06C4 759016            LDR      P1,#16H        ; cursor home.
06C7 1205F2            CALL     E_TOGL_VF
06CA 75900E            LDR      P1,#0EH        ; cursor invisible.
06CD 1205F2            CALL     E_TOGL_VF
06D0 02064C            JMP      READY

06D3 759052            LDR      P1,#"R"        ; this code never executed.
06D6 1205F2            CALL     E_TOGL_VF      ; delete it in next assembly.
06D9 759045            LDR      P1,#"E"
06DC 1205F2            CALL     E_TOGL_VF
06DF 759041            LDR      P1,#"A"
06E2 1205F2            CALL     E_TOGL_VF
06E5 759044            LDR      P1,#"D"
06E8 1205F2            CALL     E_TOGL_VF
06EB 759059            LDR      P1,#"Y"
06EE 1205F2            CALL     E_TOGL_VF
06F1 75902C            LDR      P1,#" "
06F4 1205F2            CALL     E_TOGL_VF
06F7 759054            LDR      P1,#"T"
06FA 1205F2            CALL     E_TOGL_VF
06FD 75904F            LDR      P1,#"O"
0700 1205F2            CALL     E_TOGL_VF
0703 759020            LDR      P1,#" "
0706 1205F2            CALL     E_TOGL_VF
0709 759042            LDR      P1,#"B"
070C 1205F2            CALL     E_TOGL_VF
070F 759045            LDR      P1,#"E"
0712 1205F2            CALL     E_TOGL_VF
0715 759047            LDR      P1,#"G"
0718 1205F2            CALL     E_TOGL_VF
071B 759049            LDR      P1,#"I"
071E 1205F2            CALL     E_TOGL_VF
0721 75904E            LDR      P1,#"N"
0724 1205F2            CALL     E_TOGL_VF
0727 22                RET
                 ; ***************************************************************************
0728 C2A6        BLINK2: BCLR     LED
072A 1205CC            CALL     WAT100MS
072D D2A6              BSET     LED
072F 1205CC            CALL     WAT100MS
0732 80F4              BRA      BLINK2
                 ; ***************************************************************************
```

```
0734            CRLF:
0734 75900D              LDR      P1,#0DH         ; carriage return.
0737 1205F2              CALL     E_TOGL_VF
073A 75900A              LDR      P1,#0AH         ; linefeed.
073D 1205F2              CALL     E_TOGL_VF
0740 22                  RET
                ; ***************************************************************************

0000                     END

00E0  ACC              00E0  ACC_0              00E1  ACC_1
00E2  ACC_2            00E3  ACC_3              00E4  ACC_4
00E5  ACC_5            00E6  ACC_6              00E7  ACC_7
025D  BEEPC            024F  BEEPER             0269  BEEPEX
0728  BLINK2           0270  BP3                0276  BP7
0280  BP8              00F0  B_REG              00F0  B_REG_0
00F1  B_REG_1          00F2  B_REG_2            00F3  B_REG_3
00F4  B_REG_4          00F5  B_REG_5            00F6  B_REG_6
00F7  B_REG_7          04BF  CLEAR_LCD          04C6  CLEAR_VF
0734  CRLF             04D5  D7                 04E1  D75
05FA  DATA             0607  DATAV              04CD  DECODE
01B3  DELAY_READ       04E4  DISPLAY            0518  DISPLAY_COUNT
0083  DPH              0082  DPL                00C1  EK0
00C2  EK1              00C3  EK2                00C4  EK3
00C5  EK4              0087  ENABLE             0003  EXT0
0013  EXT1             05EA  E_TOGL_LCD         05F2  E_TOGL_VF
0289  F0               02A6  F1                 02A8  F2
02C2  F3               0506  F62                0512  F63
02DC  F64              02CE  F640               02E0  F65
02E6  F66              02E8  F67                02FA  F68
0309  F69              0312  F6901              032B  F691
033A  F6912            0343  F6913              035C  F692
036B  F6928            0374  F6929              038D  F693
039C  F6938            03A5  F695               03B2  F696
03BF  F697             03D3  F697V              03D9  F698
03F1  F698V            040C  F698V2             0427  F698V3
03F4  F698Z            040F  F698Z2             042A  F698Z3
0532  F7               0548  F75                054A  F8
0556  F81              0559  F82                056A  F83
056F  F84              0572  F85                0435  F9
043E  F99              0449  F991               047D  F992V
0283  FILL_MATRIX      014B  H                  0125  H0
0132  H1               0137  H2                 0100  HERE
0171  HERE2            04B1  HOME_LCD           04B8  HOME_VF
016E  H_INITD          016B  H_VF               00A8  IEC
00A8  IEC_0            00A9  IEC_1              00AA  IEC_2
00AB  IEC_3            00AC  IEC_4              00AF  IEC_7
0613  INIT_LCD         06A1  INIT_VF            06CB  INSTRUCT
00B8  IPC              00B8  IPC_0              00B9  IPC_1
```

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00BA  IPC_2          00BB  IPC_3          00BC  IPC_4
00BD  IPC_5          00BE  IPC_6          00BF  IPC_7
00A6  LED            00C6  MCON           01B5  ND1
0247  ND10           024E  ND11           01E3  ND2
01EE  ND25           01EF  ND27           01F1  ND3
01FC  ND35           01FD  ND37           01FF  ND4
020A  ND45           020B  ND47           020D  ND5
0218  ND55           0219  ND57           021B  ND6
0226  ND65           0227  ND67           0232  ND7
0239  ND8            0240  ND9            00EA  OMEGA
0080  P0             0080  PC_0           0081  P0_1
0082  P0_2           0083  P0_3           0084  P0_4
0085  P0_5           0086  P0_6           0087  P0_7
0090  P1             0090  P1_0           0091  P1_1
0092  P1_2           0093  P1_3           0094  P1_4
0095  P1_5           0096  P1_6           0097  P1_7
00A0  P2             00A0  P2_0           00A1  P2_1
00A2  P2_2           00A3  P2_3           00A4  P2_4
00A5  P2_5           00A6  P2_6           00A7  P2_7
00B0  P3             00B0  P3_0           00B1  P3_1
00B2  P3_2           00B3  P3_3           00B4  P3_4
00B5  P3_5           00B6  P3_6           00B7  P3_7
0087  PCON           00D0  PSW            00D0  PSW_0
00D1  PSW_1          00D2  PSW_2          00D3  PSW_3
00D4  PSW_4          00D5  PSW_5          00D6  PSW_6
00D7  PSW_7          0000  R0             0001  R1
0002  R2             0003  R3             0004  R4
0005  R5             0006  R6             0007  R7
0008  R8             0009  R9             000B  RB
000C  RC             000D  RD             000E  RE
064C  READY          00E0  RESET_CHAR     000F  RF
01DD  ROT_0          0085  RS             0086  RW
0587  S1             05C2  S10            059A  S15
059D  S2             05A6  S25            05B3  S3
05B3  S4             05BA  S5             0099  SBUF
0098  SCON           0098  SCON_0         0099  SCON_1
009A  SCON_2         009B  SCON_3         009C  SCON_4
009D  SCON_5         009E  SCON_6         009F  SCON_7
0023  SER            0585  SERIAL         0081  SP
0050  STOP           00C7  TA             000B  TC0
001B  TC1            0088  TCON           0088  TCON_0
0089  TCON_1         008A  TCON_2         008B  TCON_3
008C  TCON_4         008D  TCON_5         008E  TCON_6
008F  TCON_7         0085  TEST_          008C  TH0
008D  TH1            057C  TIMER0         0584  TIMERX
008A  TL0            008B  TL1            0089  TMOD
05CF  W101           05D9  WAT1           05CC  WAT100MS
05C5  WAT200MS       05D6  WAT4MS         0087  WR_
```

APPENDIX B
TO FIG. 10A&10B

```
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0000                    CPU     "DS5000.TBL"
0000                    HOF     "INT8"

                        ; define variable names for Special Function Registers
00F0 =          B_reg:  EQU     0F0H    ; B register for MUL & DIV, 00
00E0 =          ACC:    EQU     0E0H    ; accumulator, 00
00D0 =          PSW:    EQU     0D0H    ; program status word, 00
00C7 =          TA:     EQU     0C7H    ; timed access, ??
00C6 =          MCON:   EQU     0C6H    ; memory control, RT
00C5 =          EK4:    EQU     0C5H    ; encryption key 4, RT
00C4 =          EK3:    EQU     0C4H    ; encryption key 3, RT
00C3 =          EK2:    EQU     0C3H    ; encryption key 2, RT
00C2 =          EK1:    EQU     0C2H    ; encryption key 1, RT
00C1 =          EK0:    EQU     0C1H    ; encryption key 0, RT
00B8 =          IPC:    EQU     0B8H    ; interrupt priority control, 00
00B0 =          P3:     EQU     0B0H    ; port 3 latch, FF
00A8 =          IEC:    EQU     0A8H    ; interrupt enable control, 00
00A0 =          P2:     EQU     0A0H    ; port 2 latch, FF
0099 =          SBUF:   EQU     099H    ; serial data buffer, ??
0098 =          SCON:   EQU     098H    ; serial control, 00
0090 =          P1:     EQU     090H    ; port 1 latch, FF
008D =          TH1:    EQU     08DH    ; timer 1 high byte, 00
008C =          TH0:    EQU     08CH    ; timer 0 high byte, 00
008B =          TL1:    EQU     08BH    ; timer 1 low byte, 00
008A =          TL0:    EQU     08AH    ; timer 0 low byte, 00
0089 =          TMOD:   EQU     089H    ; timer mode select, 00
0088 =          TCON:   EQU     088H    ; timer control, 00
0087 =          PCON:   EQU     087H    ; power control, RT
0083 =          DPH:    EQU     083H    ; data pointer high byte, 00
0082 =          DPL:    EQU     082H    ; data pointer low byte, 00
0081 =          SP:     EQU     081H    ; stack pointer, 07
0080 =          P0:     EQU     080H    ; port 0 latch, FF

0000 =          R0:     EQU     000H
0001 =          R1:     EQU     001H
0002 =          R2:     EQU     002H
0003 =          R3:     EQU     003H
0004 =          R4:     EQU     004H
0005 =          R5:     EQU     005H
0006 =          R6:     EQU     006H
0007 =          R7:     EQU     007H
0008 =          R8:     EQU     008H
0009 =          R9:     EQU     009H
000A =          RA:     EQU     00AH
000B =          RB:     EQU     00BH
000C =          RC:     EQU     00CH
000D =          RD:     EQU     00DH
000E =          RE:     EQU     00EH
```

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000F =          RF:      EQU     00FH

0080 =          P0_0:    EQU     080H
0081 =          P0_1:    EQU     081H
0082 =          P0_2:    EQU     082H
0083 =          P0_3:    EQU     083H
0084 =          P0_4:    EQU     084H
0085 =          P0_5:    EQU     085H
0086 =          P0_6:    EQU     086H
0087 =          P0_7:    EQU     087H

0088 =          TCON_0: EQU      088H
0089 =          TCON_1: EQU      089H
008A =          TCON_2: EQU      08AH
008B =          TCON_3: EQU      08BH
008C =          TCON_4: EQU      08CH
008D =          TCON_5: EQU      08DH
008E =          TCON_6: EQU      08EH
008F =          TCON_7: EQU      08FH

0090 =          P1_0:    EQU     090H
0091 =          P1_1:    EQU     091H
0092 =          P1_2:    EQU     092H
0093 =          P1_3:    EQU     093H
0094 =          P1_4:    EQU     094H
0095 =          P1_5:    EQU     095H
0096 =          P1_6:    EQU     096H
0097 =          P1_7:    EQU     097H

0098 =          SCON_0: EQU      098H
0099 =          SCON_1: EQU      099H
009A =          SCON_2: EQU      09AH
009B =          SCON_3: EQU      09BH
009C =          SCON_4: EQU      09CH
009D =          SCON_5: EQU      09DH
009E =          SCON_6: EQU      09EH
009F =          SCON_7: EQU      09FH

00A0 =          P2_0:    EQU     0A0H
00A1 =          P2_1:    EQU     0A1H
00A2 =          P2_2:    EQU     0A2H
00A3 =          P2_3:    EQU     0A3H
00A4 =          P2_4:    EQU     0A4H
00A5 =          P2_5:    EQU     0A5H
00A6 =          P2_6:    EQU     0A6H
00A7 =          P2_7:    EQU     0A7H

00A8 =          IEC_0:   EQU     0A8H
```

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00A9 =         IEC_1:  EQU     0A9H
00AA =         IEC_2:  EQU     0AAH
00AB =         IEC_3:  EQU     0ABH
00AC =         IEC_4:  EQU     0ACH
00AF =         IEC_7:  EQU     0AFH

00B0 =         P3_0:   EQU     0B0H
00B1 =         P3_1:   EQU     0B1H
00B2 =         P3_2:   EQU     0B2H
00B3 =         P3_3:   EQU     0B3H
00B4 =         P3_4:   EQU     0B4H
00B5 =         P3_5:   EQU     0B5H
00B6 =         P3_6:   EQU     0B6H
00B7 =         P3_7:   EQU     0B7H

00B8 =         IPC_0:  EQU     0B8H
00B9 =         IPC_1:  EQU     0B9H
00BA =         IPC_2:  EQU     0BAH
00BB =         IPC_3:  EQU     0BBH
00BC =         IPC_4:  EQU     0BCH
00BD =         IPC_5:  EQU     0BDH
00BE =         IPC_6:  EQU     0BEH
00BF =         IPC_7:  EQU     0BFH

00D0 =         PSW_0:  EQU     0D0H
00D1 =         PSW_1:  EQU     0D1H
00D2 =         PSW_2:  EQU     0D2H
00D3 =         PSW_3:  EQU     0D3H
00D4 =         PSW_4:  EQU     0D4H
00D5 =         PSW_5:  EQU     0D5H
00D6 =         PSW_6:  EQU     0D6H
00D7 =         PSW_7:  EQU     0D7H

00E0 =         ACC_0:  EQU     0E0H
00E1 =         ACC_1:  EQU     0E1H
00E2 =         ACC_2:  EQU     0E2H
00E3 =         ACC_3:  EQU     0E3H
00E4 =         ACC_4:  EQU     0E4H
00E5 =         ACC_5:  EQU     0E5H
00E6 =         ACC_6:  EQU     0E6H
00E7 =         ACC_7:  EQU     0E7H

00F0 =         B_reg_0: EQU    0F0H
00F1 =         B_reg_1: EQU    0F1H
00F2 =         B_reg_2: EQU    0F2H
00F3 =         B_reg_3: EQU    0F3H
00F4 =         B_reg_4: EQU    0F4H
00F5 =         B_reg_5: EQU    0F5H
```

```
00F6 =          B_reg_6: EQU    0F6H
00F7 =          B_reg_7: EQU    0F7H


0000                     ORG    0000H   ; start at addr 0000H
0000 020700              JMP    HERE    ; jump ahead to begin program.
0003                     ORG    0003H
0003 021000     EXT0:    JMP    STOP    ; external interrupt 0 starting addr
000B                     ORG    000BH
000B 02084F     TC0:     JMP    TIMER0  ; timer/counter 0 interrupt start addr
0013                     ORG    0013H
0013 021000     EXT1:    JMP    STOP    ; external interrupt 1 starting addr
001B                     ORG    001BH
001B 021000     TC1:     JMP    STOP    ; timer/counter 1 interrupt start addr
0023                     ORG    0023H
0023 021000     SER:     JMP    STOP    ; serial port interrupt starting addr

1000                     ORG    1000H
1000 80FE       STOP:    BRA    *       ; the Stack Pointer is not set to 030h
                                        ; because 30h to 4Dh is used to map the keys.

                                                ; 30h="0" is row 1, col 1
                                                ; 31h="1" is row 1, col 2
                                                ; 32h="2" is row 1, col 3
                                                ; 33h="3" is row 1, col 4
                                                ; 34h="4" is row 1, col 5
                                                ; 35h="5" is row 2, col 1
                                                ; 36h="6" is row 2, col 2
                                                ; 37h="7" is row 2, col 3
                                                ; 38h="8" is row 2, col 4
                                                ; 39h="9" is row 2, col 5
                                                ; 3Ah=":" is row 3, col 1
                                                ; 3Bh=";" is row 3, col 2
                                                ; 3Ch="<" is row 3, col 3
                                                ; 3Dh="=" is row 3, col 4
                                                ; 3Eh=">" is row 3, col 5
                                                ; 3Fh="?" is row 4, col 1
                                                ; 40h="@" is row 4, col 2
                                                ; 41h="A" is row 4, col 3
                                                ; 42h="B" is row 4, col 4
                                                ; 43h="C" is row 4, col 5
                                                ; 44h="D" is row 5, col 1
                                                ; 45h="E" is row 5, col 2
                                                ; 46h="F" is row 5, col 3
                                                ; 47h="G" is row 5, col 4
                                                ; 48h="H" is row 5, col 5
                                                ; 49h="I" is row 6, col 1
                                                ; 4Ah="J" is row 6, col 2
```

```
                                           ; 4Bh="K" is row 6, col 3
                                           ; 4Ch="L" is row 6, col 4
                                           ; 4Dh="M" is row 6, col 5


0700                    ORG     0700H
0700 7580FF    HERE:    LDR     P0,#0FFH
0703 75A040             LDR     P2,#40H         ; turn LED off, other bits to zeroes
0706 759848             LDR     SCON, #48H      ; enable 8-bit UART, 01xx xxxx.
                                                ; force 9th serial bit to 1 always, xxxx 1xxx.
0709 75A880             LDR     IEC,#80H        ; disable all interrupts, 1xxx xxxx.
                                                ; but especially timer 1 interrupt.
                                                ; which is required for baud generation.
070C 758921             LDR     TMOD,#21H       ; set timer 1 to 8-bit soft reload mode,
                                                ; xx10 xx1 & timer 0 to 16-bit mode.
070F 758DE8             LDR     TH1, #0E8H      ; load timer 1 with reload value for 1200 baud
0712 758850             LDR     TCON, #50H      ; enable timer 1, enable timer 0.
0715 901000             LDR     DPTR,#1000H     ; set data pointer to minimum, ie bot of stack.
                                                ; for the data buffer.
                                                ; This requirese the Partition be set to 1000h.
0718 7400               LDR     A,#00H          ; load the accumulator with 00h.
071A F0                 LDX     @DPTR,A         ; load memory pointered to by DPTR with 00h.
071B 7F10               LDR     R7,#10H         ; use R7,R6 to simulate DPTR
071D 7E00               LDR     R6,#00H
071F A3        H0:      INC     DPTR
0720 0E                 INC     R6
0721 BE0006             CBNE    R6,#00H,H1      ; if low byte not zero, branch ahead.

0724 0F                 INC     R7
0725 BF2002             CBNE    R7,#20H,H1      ; if high byte not #20h, branch ahead.

0728 8005               BRA     H2              ; otherwise, data memory initialized to 00h
                                                ; so branch ahead to continue with rest.
072A 7400      H1:      LDR     A,#000H          ; else load 00h into data memory via accum.
072C F0                 LDX     @DPTR,A
072D 80F0               BRA     H0              ; loop back & continue intializing data mem.

072F 901000    H2:      LDR     DPTR,#1000H     ; re-initialize data pointer.
0732 7EFF               LDR     R6,#0FFH        ; Register 6 is the single/double beep flag,
                                                ; initialized to single beep.

0734 794D      HERE2:   LDR     R1,#4DH         ; initialize R1 to max memory addr needed.
0736 D2A5               BSET    P2_5            ; read row 6
0738 7F00               LDR     R7,#00H         ; reset flag that signals rows 1,2,5,6.
073A 12076F             CALL    DELAY_READ
073D C2A5               BCLR    P2_5

073F D2A4               BSET    P2_4            ; read row 5
```

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0741 7F00               LDR     R7,#00H         ; reset flag that signals rows 1,2,5,6.
0743 12076F             CALL    DELAY_READ
0746 C2A4               BCLR    P2_4

0748 D2A3               BSET    P2_3            ; read row 4
074A 7F01               LDR     R7,#01H         ; set flag that signals row 3 or 4.
074C 12076F             CALL    DELAY_READ
074F C2A3               BCLR    P2_3

0751 D2A2               BSET    P2_2            ; read row 3
0753 7F01               LDR     R7,#01H         ; set flag that signals row 3 or 4.
0755 12076F             CALL    DELAY_READ
0758 C2A2               BCLR    P2_2

075A D2A1               BSET    P2_1            ; read row 2
075C 7F00               LDR     R7,#00H         ; reset flag that signals rows 1,2,5,6.
075E 12076F             CALL    DELAY_READ
0761 C2A1               BCLR    P2_1

0763 D2A0               BSET    P2_0            ; read row 1
0765 7F00               LDR     R7,#00H         ; reset flag that signals rows 1,2,5,6.
0767 12076F             CALL    DELAY_READ
076A C2A0               BCLR    P2_0

076C 020734             JMP     HERE2

076F           DELAY_READ:                      ; Delay & Read subroutine.
076F 7B04               LDR     R3,#04H         ;R3 is a timing loop constant.

0771 7C00      ND1:     LDR     R4,#00H         ;R4 is another timing loop constant.
0773 DCFE               DBNZ    R4,*            ; another internal delay loop.
0775 DBFA               DBNZ    R3,ND1

0777 19                 DEC     R1              ; decrement R1 five times.
0778 19                 DEC     R1
0779 19                 DEC     R1
077A 19                 DEC     R1
077B 19                 DEC     R1              ; R1 now contains the base addr, less 1.
077C 7580FF             LDR     P0,#0FFH        ; write 1's to Port 0.
077F AA80               LDR     R2,P0           ; read Port 0 into R2.
0781 53021F             AND     R2,#1FH         ; mask out unconnected bits.
0784 BA0018             CBNE    R2,#00H,ND2     ; if remaining bits not all 0, branch ahead.

0787 AB01               LDR     R0,R1           ; else enter a zero bit for this sampling.
                                                ; now R0 has the base address.
0789 120799             CALL    ROT_0           ; call the rotation subroutine.
                                                ; to record closed & open switches.
078C 120799             CALL    ROT_0
```

```
                                                                    Page   7
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                                                                    PAD8.LST

078F 120799          CALL    ROT_0

0792 120799          CALL    ROT_0

0795 120799          CALL    ROT_0

0798 22              RET                     ; return from Delay & Read subroutine.

0799 08       ROT_0: INC     R0              ; Rotation subroutine.
079A E6              LDR     A,@R0           ; load M(R0) into accumulator A.
079B C3              CLR     C               ; clear the carry bit.
079C 13              RRC     A               ; rotate right with carry going into MSB.
079D F6              LDR     @R0,A           ; load accumulator A back into M(R0).
079E 22              RET

079F E9       ND2:   LDR     A,R1            ; load accumulator with R1, the base addr.
07A0 2405            ADD     A,#5            ; add 5 to R1 in accumulator.
07A2 F8              LDR     R0,A
07A3 E6              LDR     A,@R0           ; load accumulator with M(R1+5).
07A4 BA0103          CBNE    R2,#01H,ND25    ; branch ahead if R2 isn't 01, column 5.
07A7 D3              BSET    C               ; if it is, set the carry bit.
07A8 8001            BRA     ND27            ; then branch ahead.
07AA C3       ND25:  CLR     C               ; if it isn't, then clear the carry bit.
07AB 13       ND27:  RRC     A               ; now rotate the carry bit into the cell.
07AC F6              LDR     @R0,A           ; save accumulator to M(R1+5).

07AD E9       ND3:   LDR     A,R1            ; do it all again for M(R1+4).
07AE 2404            ADD     A,#4            ; add 4 to R1 in accumulator.
07B0 F8              LDR     R0,A
07B1 E6              LDR     A,@R0
07B2 BA0203          CBNE    R2,#02H,ND35    ; branch ahead if R2 isn't 02, column 4.
07B5 D3              BSET    C
07B6 8001            BRA     ND37
07B8 C3       ND35:  CLR     C
07B9 13       ND37:  RRC     A
07BA F6              LDR     @R0,A

07BB E9       ND4:   LDR     A,R1
07BC 2403            ADD     A,#3            ; add 3 to R1
07BE F8              LDR     R0,A
07BF E6              LDR     A,@R0
07C0 BA0403          CBNE    R2,#04H,ND45    ; branch ahead if R2 isn't 04, column 3.
07C3 D3              BSET    C
07C4 8001            BRA     ND47
07C6 C3       ND45:  CLR     C
07C7 13       ND47:  RRC     A
07C8 F6              LDR     @R0,A
```

```
07C9 E9        ND5:    LDR     A,R1
07CA 2402              ADD     A,#2            ; add 2 to R1
07CC F8                LDR     R0,A
07CD E6                LDR     A,@R0
07CE BA0803            CBNE    R2,#08H,ND55    ; branch ahead if R2 isn't 08, column 2.
07D1 D3                BSET    C
07D2 8001              BRA     ND57
07D4 C3        ND55:   CLR     C
07D5 13        ND57:   RRC     A
07D6 F6                LDR     @R0,A

07D7 E9        ND6:    LDR     A,R1
07D8 2401              ADD     A,#1            ; add 1 to R1
07DA F8                LDR     R0,A
07DB E6                LDR     A,@R0
07DC BA1003            CBNE    R2,#10H,ND65    ; branch ahead if R2 isn't 10, column 1.
07DF D3                BSET    C
07E0 8001              BRA     ND67
07E2 C3        ND65:   CLR     C
07E3 13        ND67:   RRC     A
07E4 F6                LDR     @R0,A
                                               ; now test all memory cells for a good key.
07E5 A801              LDR     R0,R1           ; R1 is base address for the row.
07E7 08                INC     R0              ; column 1.
07E8 E6                LDR     A,@R0
07E9 B4F002            CBNE    A,#0F0H,ND7
07EC 801D              BRA     BEEPER

07EE 08        ND7:    INC     R0              ; column 2.
07EF E6                LDR     A,@R0
07F0 B4F002            CBNE    A,#0F0H,ND8
07F3 8016              BRA     BEEPER

07F5 08        ND8:    INC     R0              ; column 3.
07F6 E6                LDR     A,@R0
07F7 B4F002            CBNE    A,#0F0H,ND9
07FA 800F              BRA     BEEPER

07FC 08        ND9:    INC     R0              ; column 4.
07FD E6                LDR     A,@R0
07FE B4F002            CBNE    A,#0F0H,ND10
0801 8008              BRA     BEEPER

0803 08        ND10:   INC     R0              ; column 5.
0804 E6                LDR     A,@R0
0805 B4F002            CBNE    A,#0F0H,ND11
0808 8001              BRA     BEEPER
```

```
080A 22         ND11:   RET                     ; return

080B 758C80     BEEPER: LDR     TH0,#80H        ; if pattern is good (i.e.#0F0H), then
080E 758A00             LDR     TL0,#00H        ; load timer 0 with a timing constant.
0811 7D02               LDR     R5,#02H         ; load R5 with a timing constant loop counter.
0813 AE07               LDR     R6,R7
0815 BE0003             CBNE    R6,#00H,BEEPC   ; see if single length beep requested.
0818 ED                 LDR     A,R5            ; load accumulator with R5.
0819 23                 RL      A               ; shift up one time.
081A FD                 LDR     R5,A            ; load accumulator back into R5.
081B D2A7       BEEPC:  BSET    P2_7            ; turn on the beeper.
081D D2A9               BSET    IEC_1           ; enable timer 0 interrupts.
081F 63A040             XOR     P2,#40H         ; toggle LED
                ;        LDR     SBUF,R0         ; send out the serial character=addr in R0.
0822 E8                 LDR     A,R0            ; copy the character to the accumulator.
0823 F0                 LDX     @DPTR,A         ; save the character onto the stack.
0824 A3                 INC     DPTR            ; increment DPTR.

0825 B83926             CBNE    R0,#39H,BEEPEX  ; test key pressed for Position K.

0828 901000             LDR     DPTR,#1000H     ; initialize DPTR to 1000h.
082B E0         BP22:   LDX     A,@DPTR         ; load accum with data from data memory.
082C B43902             CBNE    A,#39H,BP23     ; branch to output the character.
082F 801A               BRA     BP29            ; branch ahead if it's the download character.

0831 E0         BP23:   LDX     A,@DPTR         ; else, get the data from data memory.
0832 F599               LDR     SBUF,A          ; copy the data from accum to serial buffer.
0834 A3                 INC     DPTR            ; increment DPTR to next data.
                                                ; now delay to allow PC program to catch up.
0835 750880     BP26:   LDR     R8,#80H         ; load R8 with 01h.
0838 750900     BP27:   LDR     R9,#00H         ; load R9 with 00h.
083B 00         BP28:   NOP
083C 00                 NOP
083D 00                 NOP
083E 00                 NOP
083F 00                 NOP
0840 00                 NOP
0841 00                 NOP
0842 00                 NOP
0843 D509F5             DBNZ    R9,BP28
0846 D508EF             DBNZ    R8,BP27

0849 80E0               BRA     BP22            ; loop back for more.

084B 901000     BP29:   LDR     DPTR,#1000H     ; re-initialize DPTR for next download.

084E 22         BEEPEX: RET                     ; return from subroutine.
```

```
                                                   ; interrupt service.
084F 1D          TIMER0: DEC     R5                ; decrement timing constant loop counter.
0850 BD0004              CBNE    R5,#0,TIMERX      ; if loop counter not 0, then return.
0853 C2A7                BCLR    P2_7              ; else clear the beeper.
0855 C2A9                BCLR    IEC_1             ; clear timer 0 interrupt enable.
0857 32          TIMERX: RETI                      ; return from interrupt service.

0000                     END

00E0  ACC             00E0  ACC_0           00E1  ACC_1
00E2  ACC_2           00E3  ACC_3           00E4  ACC_4
00E5  ACC_5           00E6  ACC_6           00E7  ACC_7
081B  BEEPC           080B  BEEPER          084E  BEEPEX
082B  BP22            0831  BP23            0835  BP26
0838  BP27            083B  BP28            084B  BP29
00F0  B_REG           00F0  B_REG_0         00F1  B_REG_1
00F2  B_REG_2         00F3  B_REG_3         00F4  B_REG_4
00F5  B_REG_5         00F6  B_REG_6         00F7  B_REG_7
076F  DELAY_READ      0083  DPH             0082  DPL
00C1  EK0             00C2  EK1             00C3  EK2
00C4  EK3             00C5  EK4             0003  EXT0
0013  EXT1            071F  H0              072A  H1
072F  H2              0700  HERE            0734  HERE2
00A8  IEC             00A8  IEC_0           00A9  IEC_1
00AA  IEC_2           00AB  IEC_3           00AC  IEC_4
00AF  IEC_7           00B8  IPC             00B8  IPC_0
00B9  IPC_1           00BA  IPC_2           00BB  IPC_3
00BC  IPC_4           00BD  IPC_5           00BE  IPC_6
00BF  IPC_7           00C6  MCON            0771  ND1
0803  ND10            080A  ND11            079F  ND2
07AA  ND25            07AB  ND27            07AD  ND3
07B8  ND35            07B9  ND37            07BB  ND4
07C6  ND45            07C7  ND47            07C9  ND5
07D4  ND55            07D5  ND57            07D7  ND6
07E2  ND65            07E3  ND67            07EE  ND7
07F5  ND8             07FC  ND9             0080  P0
0080  P0_0            0081  P0_1            0082  P0_2
0083  P0_3            0084  P0_4            0085  P0_5
0086  P0_6            0087  P0_7            0090  P1
0090  P1_0            0091  P1_1            0092  P1_2
0093  P1_3            0094  P1_4            0095  P1_5
0096  P1_6            0097  P1_7            00A0  P2
00A0  P2_0            00A1  P2_1            00A2  P2_2
00A3  P2_3            00A4  P2_4            00A5  P2_5
00A6  P2_6            00A7  P2_7            00B0  P3
00B0  P3_0            00B1  P3_1            00B2  P3_2
00B3  P3_3            00B4  P3_4            00B5  P3_5
00B6  P3_6            00B7  P3_7            0087  PCON
```

```
                                                                              Page  11
                                                                              04-19-94
                                                                              08:47:32
                                                                              PAD8.LST

00D0  PSW            00D0  PSW_0          00D1  PSW_1
00D2  PSW_2          00D3  PSW_3          00D4  PSW_4
00D5  PSW_5          00D6  PSW_6          00D7  PSW_7
0000  R0             0001  R1             0002  R2
0003  R3             0004  R4             0005  R5
0006  R6             0007  R7             0008  R8
0009  R9             000A  RA             000B  RB
000C  RC             000D  RD             000E  RE
000F  RF             0799  ROT_0          0099  SBUF
0098  SCON           0098  SCON_0         0099  SCON_1
009A  SCON_2         009B  SCON_3         009C  SCON_4
009D  SCON_5         009E  SCON_6         009F  SCON_7
0023  SER            0081  SP             1000  STOP
00C7  TA             000B  TC0            001B  TC1
0088  TCON           0088  TCON_0         0089  TCON_1
008A  TCON_2         008B  TCON_3         008C  TCON_4
008D  TCON_5         008E  TCON_6         008F  TCON_7
008C  TH0            008D  TH1            084F  TIMER0
0857  TIMERX         008A  TL0            008B  TL1
0089  TMOD
```

APPENDIX C
TO FIG. 11A-11D

Page 1
04-19-94
09:07:18
MULTIP.LST

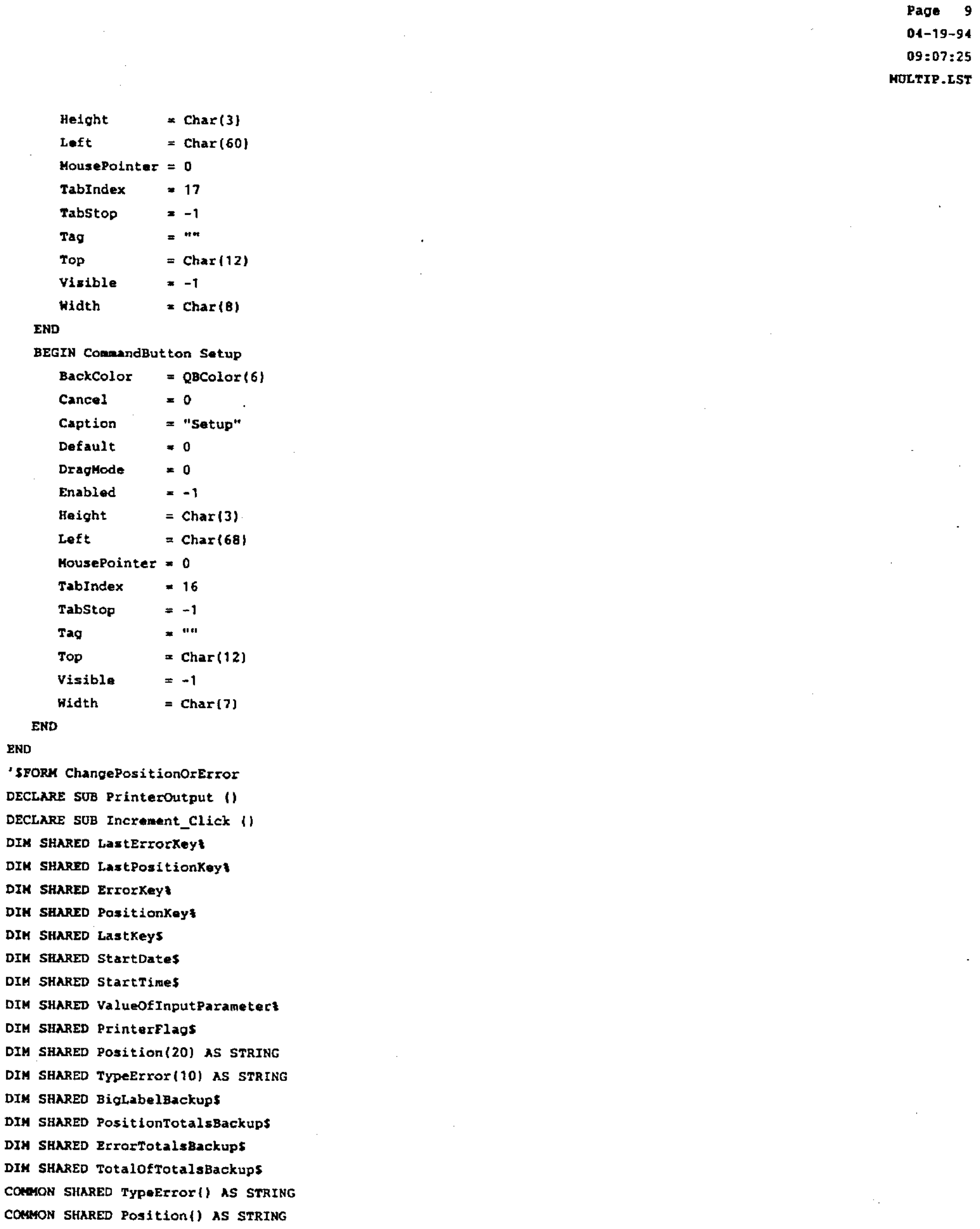
```
Version 1.00
BEGIN Form ErrorMatrix
   AutoRedraw    = 0
   BackColor     = QBColor(7)
   BorderStyle   = 2
   Caption       = "Defect Matrix - 20 rows (positions), 10 columns (types of errors)"
   ControlBox    = -1
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(24)
   Left          = Char(1)
   MaxButton     = -1
   MinButton     = -1
   MousePointer  = 0
   Tag           = ""
   Top           = Char(1)
   Visible       = -1
   Width         = Char(78)
   WindowState   = 0
   BEGIN Label ErrorMessage
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = ""
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(62)
      MousePointer  = 0
      TabIndex      = 13
      Tag           = ""
      Top           = Char(14)
      Visible       = -1
      Width         = Char(13)
   END
   BEGIN Label TotalofTotals
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = "     0"
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(54)
   MousePointer = 0
   TabIndex     = 10
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(5)
END
BEGIN Label ErrorTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0   0   0   0   0   0   0   0   0   0 "
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(6)
   MousePointer = 0
   TabIndex     = 9
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(40)
END
BEGIN Label PositionTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
 0"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(20)
   Left         = Char(55)
   MousePointer = 0
   TabIndex     = 8
   Tag          = ""
   Top          = Char(0)
   Visible      = -1
   Width        = Char(4)
END
BEGIN Label TimeLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
```

```
                                                                  Page   3
                                                                  04-19-94
                                                                  09:07:20
                                                                MULTIP.LST
   BorderStyle  = 0
   Caption      = "time:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 15
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentDate
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 11
   Tag          = ""
   Top          = Char(16)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label DateLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 14
   Tag          = ""
   Top          = Char(15)
   Visible      = -1
```

```
                                                                    Page    4
                                                                    04-19-94
                                                                    09:07:21
                                                                  MULTIP.LST
   Width        = Char(7)
END
BEGIN Label CurrentTime
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "time"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 12
   Tag          = ""
   Top          = Char(18)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label ErrorMesage
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = ""
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(49)
   MousePointer = 0
   TabIndex     = 19
   Tag          = ""
   Top          = Char(20)
   Visible      = -1
   Width        = Char(6)
END
BEGIN Label BigLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0
 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0
0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0
0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0
 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0
```

```
  0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0   0   0
 0   0   0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0
0   0   0   0   0   0   0   0"
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(20)
      Left         = Char(6)
      MousePointer = 0
      TabIndex     = 7
      Tag          = ""
      Top          = Char(0)
      Visible      = -1
      Width        = Char(40)
   END
   BEGIN Timer Timer3
      Enabled      = -1
      Interval     = 1
      Left         = Char(47)
      Tag          = ""
      Top          = Char(5)
   END
   BEGIN Timer Timer4
      Enabled      = -1
      Interval     = 10000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(0)
   END
   BEGIN Timer Timer2
      Enabled      = -1
      Interval     = 4000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(11)
   END
   BEGIN Timer Timer1
      Enabled      = -1
      Interval     = 1000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(17)
   END
   BEGIN Label RowLabel
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
   Caption      = "Position  (row)"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(2)
   Left         = Char(60)
   MousePointer = 0
   TabIndex     = 3
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(8)
END
BEGIN Label ColumnLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Error (column)"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(2)
   Left         = Char(60)
   MousePointer = 0
   TabIndex     = 4
   Tag          = ""
   Top          = Char(4)
   Visible      = -1
   Width        = Char(8)
END
BEGIN TextBox RowValue
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(68)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 0
   TabStop      = -1
   Tag          = ""
   Text         = "  0"
   Top          = Char(0)
   Visible      = -1
   Width        = Char(7)
END
BEGIN TextBox ColumnValue
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(68)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 1
   TabStop      = -1
   Tag          = ""
   Text         = "  0"
   Top          = Char(3)
   Visible      = -1
   Width        = Char(7)
END
BEGIN CommandButton QuitButton
   BackColor    = QBColor(12)
   Cancel       = 0
   Caption      = "Quit"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(69)
   MousePointer = 0
   TabIndex     = 2
   TabStop      = -1
   Tag          = ""
   Top          = Char(19)
   Visible      = -1
   Width        = Char(6)
END
BEGIN CommandButton Reload
   BackColor    = QBColor(5)
   Cancel       = 0
   Caption      = "Reload"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(60)
   MousePointer = 0
```

```
    TabIndex      = 18
    TabStop       = -1
    Tag           = ""
    Top           = Char(19)
    Visible       = -1
    Width         = Char(8)
END
BEGIN CommandButton Decrement
    BackColor     = QBColor(3)
    Cancel        = 0
    Caption       = "Decrement"
    Default       = 0
    DragMode      = 0
    Enabled       = -1
    Height        = Char(3)
    Left          = Char(64)
    MousePointer  = 0
    TabIndex      = 6
    TabStop       = -1
    Tag           = ""
    Top           = Char(9)
    Visible       = -1
    Width         = Char(11)
END
BEGIN CommandButton Increment
    BackColor     = QBColor(2)
    Cancel        = 0
    Caption       = "Increment"
    Default       = 0
    DragMode      = 0
    Enabled       = -1
    Height        = Char(3)
    Left          = Char(64)
    MousePointer  = 0
    TabIndex      = 5
    TabStop       = -1
    Tag           = ""
    Top           = Char(6)
    Visible       = -1
    Width         = Char(11)
END
BEGIN CommandButton OutputDataToFile
    BackColor     = QBColor(14)
    Cancel        = 0
    Caption       = "Output"
    Default       = 0
    DragMode      = 0
    Enabled       = -1
```



```
                                                                    Page   9
                                                                    04-19-94
                                                                    09:07:25
                                                                    MULTIP.LST
         Height       = Char(3)
         Left         = Char(60)
         MousePointer = 0
         TabIndex     = 17
         TabStop      = -1
         Tag          = ""
         Top          = Char(12)
         Visible      = -1
         Width        = Char(8)
      END
      BEGIN CommandButton Setup
         BackColor    = QBColor(6)
         Cancel       = 0
         Caption      = "Setup"
         Default      = 0
         DragMode     = 0
         Enabled      = -1
         Height       = Char(3)
         Left         = Char(68)
         MousePointer = 0
         TabIndex     = 16
         TabStop      = -1
         Tag          = ""
         Top          = Char(12)
         Visible      = -1
         Width        = Char(7)
      END
   END
'$FORM ChangePositionOrError
DECLARE SUB PrinterOutput ()
DECLARE SUB Increment_Click ()
DIM SHARED LastErrorKey%
DIM SHARED LastPositionKey%
DIM SHARED ErrorKey%
DIM SHARED PositionKey%
DIM SHARED LastKey$
DIM SHARED StartDate$
DIM SHARED StartTime$
DIM SHARED ValueOfInputParameter%
DIM SHARED PrinterFlag$
DIM SHARED Position(20) AS STRING
DIM SHARED TypeError(10) AS STRING
DIM SHARED BigLabelBackup$
DIM SHARED PositionTotalsBackup$
DIM SHARED ErrorTotalsBackup$
DIM SHARED TotalOfTotalsBackup$
COMMON SHARED TypeError() AS STRING
COMMON SHARED Position() AS STRING
COMMON SHARED ResetThyself AS INTEGER

SUB ColumnLabel_Click ()
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
END SUB

SUB Decrement_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, subtract 1 from it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) - 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"           'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN     'forbid CellValue$ greater than 999
        CellValue$ = " 999"
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalOfTotals.Caption) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 5 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 99999
        'insert new CellValue$
        TotalOfTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalOfTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

END SUB

SUB Demo_Click ()
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            RowValue.Text = STR$(Row%)
            ColumnValue.Text = STR$(Col%)
            'FOR i% = 1 TO Row% + Col%
                IF Row% >= Col% THEN CALL Increment_Click
            'NEXT i%
        NEXT Col%
    NEXT Row%
END SUB

SUB Increment_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, add 1 to it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) + 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"           'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN
        CellValue$ = " 999"          'forbid CellValue$ greater than 999
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalOfTotals.Caption) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$    'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 9999
        'insert new CelValue$
        TotalOfTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalOfTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3
END SUB

SUB OutputDataToFile_Click ()
    FileName$ = MID$(DATE$, 9, 2) + MID$(DATE$, 1, 2) + MID$(DATE$, 4, 2) + "." + MID$(TIME$, 1, 2) + MID$(TIME$, 4,
 1)
    OPEN FileName$ FOR OUTPUT AS #2
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            'PRINT #2, CHR$(34) + CellValue$ + CHR$(34) + ",";
            PRINT #2, CellValue$ + ",";
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, "          " + "," + CellValue$
    NEXT Row%
    PRINT #2,
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, CellValue$ + ",";
    NEXT Col%
    CellValue$ = TotalOfTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    PRINT #2, "          " + "," + CellValue$
    PRINT #2,
    PRINT #2, CHR$(34) + "Start,,,End" + CHR$(34)
    PRINT #2, CHR$(34) + StartDate$ + CHR$(34) + ",,," + CHR$(34) + DATE$ + CHR$(34)
    PRINT #2, CHR$(34) + StartTime$ + CHR$(34) + ",,," + CHR$(34) + TIME$ + CHR$(34)
    CLOSE #2
    SHELL "copy " + FileName$ + " LATEST.DAT"
    IF PrinterFlag$ = "p" THEN CALL PrinterOutput
END SUB

SUB PrinterOutput ()
    DIM MostNumerousDefects(10) AS STRING
    DIM MostNumerousDefectsRow(10) AS INTEGER
    DIM MostNumerousDefectsCol(10) AS INTEGER
    DIM MatrixOfCellValues(20, 10) AS STRING
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            MatrixOfCellValues(Row%, Col%) = CellValue$
            LPRINT CellValue$; TAB(Col% * 4 + 1);
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT "  " + CellValue$; "  " + Position(Row%)
        'LPRINT   'this makes the matrix print out in doublespace
    NEXT Row%
    LPRINT
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT CellValue$; TAB(Col% * 4 + 1);
    NEXT Col%
    CellValue$ = TotalOfTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    LPRINT "  " + CellValue$; "  GRAND TOTAL"
    LPRINT
    LPRINT CHR$(32) + "Start          End" + CHR$(32)
    LPRINT CHR$(32) + StartDate$ + CHR$(32) + "   " + CHR$(32) + DATE$ + CHR$(32]
    LPRINT CHR$(32) + StartTime$ + CHR$(32) + "     " + CHR$(32) + TIME$ + CHR$(32)
    LPRINT TAB(62 - 12); TypeError(10)' "                                          poor heat stake/USDB/long
gate"
    LPRINT TypeError(1); TAB(56 - 12); TypeError(9)       '   "trash in paint                             broken leg
/bad optic"
    LPRINT TAB(4); TypeError(2); TAB(48 - 12); TypeError(8) ' "   bad graphic                   button failure"
    LPRINT TAB(20 - 12); TypeError(3); TAB(42 - 12); TypeError(7)' "      broken pin            light leak"
    LPRINT TAB(24 - 12); TypeError(4); TAB(36 - 12); TypeError(6)' "          scratch     short shot"
    LPRINT TAB(28 - 12); TypeError(5)' "                  off location graphic"

    FOR i% = 1 TO 10
        MostNumerousDefectsRow(i%) = 0
        MostNumerousDefectsCol(i%) = 0
    NEXT i%
    ' now find the 10 most numerous defects
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        MaxValue$ = "-1"
        FOR Row% = 1 TO 20
            FOR Col% = 1 TO 10
                IF VAL(MatrixOfCellValues(Row%, Col%)) > VAL(MaxValue$) THEN
                    MostNumerousDefectsRow(i%) = Row%
                    MostNumerousDefectsCol(i%) = Col%
                    MaxValue$ = MatrixOfCellValues(Row%, Col%)
                END IF
            NEXT Col%
        NEXT Row%
        MostNumerousDefects(i%) = MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%))
        MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%)) = "0"
    NEXT NumberOfMostNumerousDefects%
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT "                             10 MOST NUMEROUS DEFECTS"
    LPRINT
    LPRINT "  position                   type of error                   number"
    LPRINT
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        LPRINT Position(MostNumerousDefectsRow(i%)); TAB(30);
        LPRINT TypeError(MostNumerousDefectsCol(i%)); TAB(65);
        LPRINT MostNumerousDefects(i%)
    NEXT
    LPRINT CHR$(12)
END SUB

SUB QuitButton_Click ()
    END
END SUB

SUB Reload_Click ()
    OPEN "backup.old" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalOfTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, StartDate$, StartTime$
    CLOSE #3

    IF MID$(A$, 2, 1) = " " THEN
        BigLabel.Caption = "   " + A$
    ELSEIF MID$(A$, 3, 1) = " " THEN
        BigLabel.Caption = "  " + A$
    ELSEIF MID$(A$, 4, 1) = " " THEN
        BigLabel.Caption = " " + A$
    ELSE
        BigLabel.Caption = A$
    END IF

    IF MID$(B$, 2, 1) = " " THEN
        ErrorTotals.Caption = "   " + B$
    ELSEIF MID$(B$, 3, 1) = " " THEN
        ErrorTotals.Caption = "  " + B$
    ELSEIF MID$(B$, 4, 1) = " " THEN
        ErrorTotals.Caption = " " + B$
    ELSE
        ErrorTotals.Caption = B$
    END IF

    IF MID$(C$, 2, 1) = " " THEN
        PositionTotals.Caption = "   " + C$
    ELSEIF MID$(C$, 3, 1) = " " THEN
        PositionTotals.Caption = "  " + C$
    ELSEIF MID$(C$, 4, 1) = " " THEN
        PositionTotals.Caption = " " + C$
    ELSE
        PositionTotals.Caption = C$
    END IF

    IF LEN(D$) = 1 THEN
        TotalOfTotals.Caption = "    " + D$
    ELSEIF LEN(D$) = 2 THEN
        TotalOfTotals.Caption = "   " + D$
    ELSEIF LEN(D$) = 3 THEN
        TotalOfTotals.Caption = "  " + D$
    ELSEIF LEN(D$) = 4 THEN
        TotalOfTotals.Caption = " " + D$
    ELSE
        TotalOfTotals.Caption = D$
    END IF
END SUB

SUB RowLabel_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
END SUB

SUB Setup_Click ()
    'TypeOfError1.Caption1 = TypeError$(1)
    ErrorMatrix.HIDE
    ChangePositionOrError.SHOW
END SUB

SUB Timer1_Timer () ' 1 second timer
    ON LOCAL ERROR RESUME NEXT
    CurrentTime.Caption = TIME$
    CurrentDate.Caption = DATE$
    IF ValueOfInputParameter% > 0 AND ValueOfInputParameter% < 3 THEN
        DO WHILE NOT EOF(1)
```

```
            Acharacter$ = INPUT$(1, #1)
            NumericalValue% = ASC(Acharacter$)
            IF (NumericalValue% > 200 AND NumericalValue% <> 224) OR NumericalValue% = 0 THEN
                Timer2.Enabled = True
                ErrorFlag1 = True
                ErrorMessage.Caption = "ERROR"
                MSGBOX "character = CHR$(" + STR$(NumericalValue%) + ")", 0, "ERROR"
            ELSEIF NumericalValue% > 0 AND NumericalValue% <= 200 THEN
                DefectMatrixRow% = (NumericalValue% - 1) \ 10 + 1
                DefectMatrixColumn% = ((NumericalValue% - 1) MOD 10) + 1
                RowValue.Text = STR$(DefectMatrixRow%)
                ColumnValue.Text = STR$(DefectMatrixColumn%)
                CALL Increment_Click
'            ELSEIF NumericalValue% = 224 THEN ' reset thyself, nothing to do
            END IF
        LOOP
    END IF

'    CLOSE #1

    IF ResetThyself = 1 THEN
                BigLabel.Caption = BigLabelBackup$
                PositionTotals.Caption = PositionTotalsBackup$
                ErrorTotals.Caption = ErrorTotalsBackup$
                TotalOfTotals.Caption = TotalOfTotalsBackup$
                RowValue.Text = " 0"
                ColumnValue.Text = " 0"
                OPEN "backup.dat" FOR OUTPUT AS #3
                PRINT #3, BigLabel.Caption
                PRINT #3, ErrorTotals.Caption
                PRINT #3, PositionTotals.Caption
                PRINT #3, TotalOfTotals.Caption
                PRINT #3, StartDate$
                PRINT #3, StartTime$
                CLOSE #3
                ResetThyself = 0
    END IF

END SUB

SUB Timer2_Timer () ' 4 second timer
    IF ErrorFlag1 = True THEN
        ErrorFlag1 = False
        ErrorMessage.Caption = ""
    END IF
    Timer2.Enabled = False
END SUB
```

```
SUB Timer3_Timer ()
    'This timer has a short interval, like 1 millisecond.
    'It is executed once, and not again because it disables itself.

    ErrorFlag1 = False
    BigLabelBackup$ = BigLabel.Caption
    PositionTotalsBackup$ = PositionTotals.Caption
    ErrorTotalsBackup$ = ErrorTotals.Caption
    TotalOfTotalsBackup$ = TotalOfTotals.Caption
    PrinterFlag$ = "p"

    ValueOfInputParameter% = VAL(COMMAND$)
    SELECT CASE ValueOfInputParameter%
        CASE 1: OPEN "COM1:1200,n,8,1" FOR INPUT AS #1
        CASE 2: OPEN "COM2:1200,n,8,1" FOR INPUT AS #1
        CASE 3: MSGBOX "Visual Basic and DOS do not support COM3", 0, "Operation will continue without COM"
        CASE 4: MSGBOX "Visual Basic and DOS do not support COM4", 0, "Operation will continue without COM"
        CASE ELSE: ' do nothing
    END SELECT

    Timer3.Enabled = False
    LastErrorKey% = 0
    LastPositionKey% = 0
    ErrorKey% = 0
    PositionKey% = 0
    LastKey$ = ""
    StartTime$ = TIME$
    StartDate$ = DATE$
    NextFileFree% = FREEFILE
    OPEN "PandE.dat" FOR INPUT AS NextFileFree%
    FOR i% = 1 TO 10
        INPUT #NextFileFree%, TypeError(i%)
    NEXT i%
    FOR i% = 1 TO 20
        INPUT #NextFileFree%, Position(i%)
    NEXT i%
    CLOSE #NextFileFree%
    ResetThyself = 0
END SUB

SUB Timer4_Timer ()       ' 10 second timer

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, E$, F$
    CLOSE #3

    OPEN "backup.bak" FOR OUTPUT AS #4
    PRINT #4, A$
    PRINT #4, B$
    PRINT #4, C$
    PRINT #4, D$
    PRINT #4, E$
    PRINT #4, F$
    CLOSE #4

END SUB
```

APPENDIX D
TO FIG. 11A-11D

```
                                                         Page   1
                                                         04-19-94
                                                         08:56:00
                                                     MULTINP.LST

Version 1.00
BEGIN Form ErrorMatrix
   AutoRedraw    = 0
   BackColor     = QBColor(7)
   BorderStyle   = 2
   Caption       = "Defect Matrix - 20 rows (positions), 10 columns (types of errors)"
   ControlBox    = -1
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(24)
   Left          = Char(1)
   MaxButton     = -1
   MinButton     = -1
   MousePointer  = 0
   Tag           = ""
   Top           = Char(1)
   Visible       = -1
   Width         = Char(78)
   WindowState   = 0
   BEGIN Label ErrorMessage
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = ""
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(62)
      MousePointer  = 0
      TabIndex      = 13
      Tag           = ""
      Top           = Char(14)
      Visible       = -1
      Width         = Char(13)
   END
   BEGIN Label TotalofTotals
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = "     0"
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(54)
```

```
                                                                                Page    2
                                                                                04-19-94
                                                                                08:56:01
                                                                              MULTINP.LST
   MousePointer = 0
   TabIndex     = 10
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(5)
END
BEGIN Label ErrorTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0   0   0   0   0   0   0   0   0   0 "
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(6)
   MousePointer = 0
   TabIndex     = 9
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(40)
END
BEGIN Label PositionTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
 0"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(20)
   Left         = Char(55)
   MousePointer = 0
   TabIndex     = 8
   Tag          = ""
   Top          = Char(0)
   Visible      = -1
   Width        = Char(4)
END
BEGIN Label TimeLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
```

```
                                                                   Page   3
                                                                   04-19-94
                                                                   08:56:02
                                                                 MULTINP.LST

   BorderStyle  = 0
   Caption      = "time:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 15
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentDate
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 11
   Tag          = ""
   Top          = Char(16)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label DateLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 14
   Tag          = ""
   Top          = Char(15)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentTime
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "time"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 12
   Tag          = ""
   Top          = Char(18)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label ErrorMesage
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = ""
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(49)
   MousePointer = 0
   TabIndex     = 19
   Tag          = ""
   Top          = Char(20)
   Visible      = -1
   Width        = Char(6)
END
BEGIN Label BigLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0
 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0
0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0
0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0
 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0
```

```
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0"
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(20)
      Left         = Char(6)
      MousePointer = 0
      TabIndex     = 7
      Tag          = ""
      Top          = Char(0)
      Visible      = -1
      Width        = Char(40)
   END
   BEGIN Timer Timer3
      Enabled      = -1
      Interval     = 1
      Left         = Char(47)
      Tag          = ""
      Top          = Char(5)
   END
   BEGIN Timer Timer4
      Enabled      = -1
      Interval     = 10000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(0)
   END
   BEGIN Timer Timer2
      Enabled      = -1
      Interval     = 4000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(11)
   END
   BEGIN Timer Timer1
      Enabled      = -1
      Interval     = 1000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(17)
   END
   BEGIN Label RowLabel
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
   Caption      = "Position  (row)"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(2)
   Left         = Char(60)
   MousePointer = 0
   TabIndex     = 3
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(8)
END
BEGIN Label ColumnLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Error (column)"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(2)
   Left         = Char(60)
   MousePointer = 0
   TabIndex     = 4
   Tag          = ""
   Top          = Char(4)
   Visible      = -1
   Width        = Char(8)
END
BEGIN TextBox RowValue
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(68)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 0
   TabStop      = -1
   Tag          = ""
   Text         = "  0"
   Top          = Char(0)
   Visible      = -1
   Width        = Char(7)
END
BEGIN TextBox ColumnValue
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(68)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 1
   TabStop      = -1
   Tag          = ""
   Text         = "  0"
   Top          = Char(3)
   Visible      = -1
   Width        = Char(7)
END
BEGIN CommandButton QuitButton
   BackColor    = QBColor(12)
   Cancel       = 0
   Caption      = "Quit"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(69)
   MousePointer = 0
   TabIndex     = 2
   TabStop      = -1
   Tag          = ""
   Top          = Char(19)
   Visible      = -1
   Width        = Char(6)
END
BEGIN CommandButton Reload
   BackColor    = QBColor(5)
   Cancel       = 0
   Caption      = "Reload"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(60)
   MousePointer = 0
   TabIndex      = 18
   TabStop       = -1
   Tag           = ""
   Top           = Char(19)
   Visible       = -1
   Width         = Char(8)
END
BEGIN CommandButton Decrement
   BackColor     = QBColor(3)
   Cancel        = 0
   Caption       = "Decrement"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
   Height        = Char(3)
   Left          = Char(64)
   MousePointer  = 0
   TabIndex      = 6
   TabStop       = -1
   Tag           = ""
   Top           = Char(9)
   Visible       = -1
   Width         = Char(11)
END
BEGIN CommandButton Increment
   BackColor     = QBColor(2)
   Cancel        = 0
   Caption       = "Increment"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
   Height        = Char(3)
   Left          = Char(64)
   MousePointer  = 0
   TabIndex      = 5
   TabStop       = -1
   Tag           = ""
   Top           = Char(6)
   Visible       = -1
   Width         = Char(11)
END
BEGIN CommandButton OutputDataToFile
   BackColor     = QBColor(14)
   Cancel        = 0
   Caption       = "Output"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
```

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      Height       = Char(3)
      Left         = Char(60)
      MousePointer = 0
      TabIndex     = 17
      TabStop      = -1
      Tag          = ""
      Top          = Char(12)
      Visible      = -1
      Width        = Char(8)
   END
   BEGIN CommandButton Setup
      BackColor    = QBColor(6)
      Cancel       = 0
      Caption      = "Setup"
      Default      = 0
      DragMode     = 0
      Enabled      = -1
      Height       = Char(3)
      Left         = Char(68)
      MousePointer = 0
      TabIndex     = 16
      TabStop      = -1
      Tag          = ""
      Top          = Char(12)
      Visible      = -1
      Width        = Char(7)
   END
END
'$FORM ChangePositionOrError
DECLARE SUB PrinterOutput ()
DECLARE SUB Increment_Click ()
DIM SHARED LastErrorKey%
DIM SHARED LastPositionKey%
DIM SHARED ErrorKey%
DIM SHARED PositionKey%
DIM SHARED LastKey$
DIM SHARED StartDate$
DIM SHARED StartTime$
DIM SHARED ValueOfInputParameter%
DIM SHARED PrinterFlag$
DIM SHARED Position(20) AS STRING
DIM SHARED TypeError(10) AS STRING
DIM SHARED BigLabelBackup$
DIM SHARED PositionTotalsBackup$
DIM SHARED ErrorTotalsBackup$
DIM SHARED TotalOfTotalsBackup$
COMMON SHARED TypeError() AS STRING
COMMON SHARED Position() AS STRING
COMMON SHARED ResetThyself AS INTEGER

SUB ColumnLabel_Click ()
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
END SUB

SUB Decrement_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, subtract 1 from it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) - 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"            'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN     'forbid CellValue$ greater than 999
        CellValue$ = " 999"
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalOfTotals.Caption) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 5 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"    'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 99999
        'insert new CellValue$
        TotalOfTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalOfTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

END SUB

SUB Demo_Click ()
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            RowValue.Text = STR$(Row%)
            ColumnValue.Text = STR$(Col%)
            'FOR i% = 1 TO Row% + Col%
                IF Row% >= Col% THEN CALL Increment_Click
            'NEXT i%
        NEXT Col%
    NEXT Row%
END SUB

SUB Increment_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, add 1 to it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) + 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"           'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN
        CellValue$ = " 999"            'forbid CellValue$ greater than 999
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalOfTotals.Caption) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$    'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 9999
        'insert new CelValue$
        TotalOfTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalOfTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3
END SUB

SUB OutputDataToFile_Click ()
    FileName$ = MID$(DATE$, 9, 2) + MID$(DATE$, 1, 2) + MID$(DATE$, 4, 2) + "." + MID$(TIME$, 1, 2) + MID$(TIME$, 4,
 1)
    OPEN FileName$ FOR OUTPUT AS #2
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            'PRINT #2, CHR$(34) + CellValue$ + CHR$(34) + ",";
            PRINT #2, CellValue$ + ",";
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, "         " + "," + CellValue$
    NEXT Row%
    PRINT #2,
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, CellValue$ + ",";
    NEXT Col%
    CellValue$ = TotalOfTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    PRINT #2, "          " + "," + CellValue$
    PRINT #2,
    PRINT #2, CHR$(34) + "Start,,,End" + CHR$(34)
    PRINT #2, CHR$(34) + StartDate$ + CHR$(34) + ",,," + CHR$(34) + DATE$ + CHR$(34)
    PRINT #2, CHR$(34) + StartTime$ + CHR$(34) + ",,," + CHR$(34) + TIME$ + CHR$(34)
    CLOSE #2
    SHELL "copy " + FileName$ + " LATEST.DAT"
'    IF PrinterFlag$ = "p" THEN CALL PrinterOutput
END SUB

SUB PrinterOutput ()
    DIM MostNumerousDefects(10) AS STRING
    DIM MostNumerousDefectsRow(10) AS INTEGER
    DIM MostNumerousDefectsCol(10) AS INTEGER
    DIM MatrixOfCellValues(20, 10) AS STRING
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            MatrixOfCellValues(Row%, Col%) = CellValue$
            LPRINT CellValue$; TAB(Col% * 4 + 1);
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT "  " + CellValue$; "  " + Position(Row%)
        'LPRINT   'this makes the matrix print out in doublespace
    NEXT Row%
    LPRINT
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT CellValue$; TAB(Col% * 4 + 1);
    NEXT Col%
    CellValue$ = TotalOfTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    LPRINT "  " + CellValue$; "  GRAND TOTAL"
    LPRINT
    LPRINT CHR$(32) + "Start         End" + CHR$(32)
    LPRINT CHR$(32) + StartDate$ + CHR$(32) + "   " + CHR$(32) + DATE$ + CHR$(32)
    LPRINT CHR$(32) + StartTime$ + CHR$(32) + "     " + CHR$(32) + TIME$ + CHR$(32)
    LPRINT TAB(62 - 12); TypeError(10)' "                                               poor heat stake/USDB/long
gate"
    LPRINT TypeError(1); TAB(56 - 12); TypeError(9)       '   "trash in paint                           broken leg
/bad optic"
    LPRINT TAB(4); TypeError(2); TAB(48 - 12); TypeError(8) ' "  bad graphic                    button failure"
    LPRINT TAB(20 - 12); TypeError(3); TAB(42 - 12); TypeError(7)' "     broken pin           light leak"
    LPRINT TAB(24 - 12); TypeError(4); TAB(36 - 12); TypeError(6)' "         scratch    short shot"
    LPRINT TAB(28 - 12); TypeError(5)' "             off location graphic"

    FOR i% = 1 TO 10
        MostNumerousDefectsRow(i%) = 0
        MostNumerousDefectsCol(i%) = 0
    NEXT i%
    ' now find the 10 most numerous defects
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        MaxValue$ = "-1"
        FOR Row% = 1 TO 20
            FOR Col% = 1 TO 10
                IF VAL(MatrixOfCellValues(Row%, Col%)) > VAL(MaxValue$) THEN
                    MostNumerousDefectsRow(i%) = Row%
                    MostNumerousDefectsCol(i%) = Col%
                    MaxValue$ = MatrixOfCellValues(Row%, Col%)
                END IF
            NEXT Col%
        NEXT Row%
        MostNumerousDefects(i%) = MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%))
        MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%)) = "0"
    NEXT NumberOfMostNumerousDefects%
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT "                             10 MOST NUMEROUS DEFECTS"
    LPRINT
    LPRINT "  position                   type of error                   number"
    LPRINT
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        LPRINT Position(MostNumerousDefectsRow(i%)); TAB(30);
        LPRINT TypeError(MostNumerousDefectsCol(i%)); TAB(65);
        LPRINT MostNumerousDefects(i%)
    NEXT
    LPRINT CHR$(12)
END SUB

SUB QuitButton_Click ()
    END
END SUB

SUB Reload_Click ()
    OPEN "backup.old" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalOfTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, StartDate$, StartTime$
    CLOSE #3

    IF MID$(A$, 2, 1) = " " THEN
        BigLabel.Caption = "   " + A$
    ELSEIF MID$(A$, 3, 1) = " " THEN
        BigLabel.Caption = "  " + A$
    ELSEIF MID$(A$, 4, 1) = " " THEN
        BigLabel.Caption = " " + A$
    ELSE
        BigLabel.Caption = A$
    END IF

    IF MID$(B$, 2, 1) = " " THEN
        ErrorTotals.Caption = "   " + B$
    ELSEIF MID$(B$, 3, 1) = " " THEN
        ErrorTotals.Caption = "  " + B$
    ELSEIF MID$(B$, 4, 1) = " " THEN
        ErrorTotals.Caption = " " + B$
    ELSE
        ErrorTotals.Caption = B$
    END IF

    IF MID$(C$, 2, 1) = " " THEN
        PositionTotals.Caption = "   " + C$
    ELSEIF MID$(C$, 3, 1) = " " THEN
        PositionTotals.Caption = "  " + C$
    ELSEIF MID$(C$, 4, 1) = " " THEN
        PositionTotals.Caption = " " + C$
    ELSE
        PositionTotals.Caption = C$
    END IF

    IF LEN(D$) = 1 THEN
        TotalOfTotals.Caption = "    " + D$
    ELSEIF LEN(D$) = 2 THEN
        TotalOfTotals.Caption = "   " + D$
    ELSEIF LEN(D$) = 3 THEN
        TotalOfTotals.Caption = "  " + D$
    ELSEIF LEN(D$) = 4 THEN
        TotalOfTotals.Caption = " " + D$
    ELSE
        TotalOfTotals.Caption = D$
    END IF
END SUB

SUB RowLabel_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
END SUB

SUB Setup_Click ()
    'TypeOfError1.Caption1 = TypeError$(1)
    ErrorMatrix.HIDE
    ChangePositionOrError.SHOW
END SUB

SUB Timer1_Timer () ' 1 second timer
    ON LOCAL ERROR RESUME NEXT
    CurrentTime.Caption = TIME$
    CurrentDate.Caption = DATE$
    IF ValueOfInputParameter% > 0 AND ValueOfInputParameter% < 3 THEN
        DO WHILE NOT EOF(1)
```

```
            Acharacter$ = INPUT$(1, #1)
            NumericalValue% = ASC(Acharacter$)
            IF (NumericalValue% > 200 AND NumericalValue% <> 224) OR NumericalValue% = 0 THEN
                Timer2.Enabled = True
                ErrorFlag1 = True
                ErrorMessage.Caption = "ERROR"
                MSGBOX "character = CHR$(" + STR$(NumericalValue%) + ")", 0, "ERROR"
            ELSEIF NumericalValue% > 0 AND NumericalValue% <= 200 THEN
                DefectMatrixRow% = (NumericalValue% - 1) \ 10 + 1
                DefectMatrixColumn% = ((NumericalValue% - 1) MOD 10) + 1
                RowValue.Text = STR$(DefectMatrixRow%)
                ColumnValue.Text = STR$(DefectMatrixColumn%)
                CALL Increment_Click
'            ELSEIF NumericalValue% = 224 THEN ' reset thyself, nothing to do
            END IF
        LOOP
    END IF

'    CLOSE #1

    IF ResetThyself = 1 THEN
                BigLabel.Caption = BigLabelBackup$
                PositionTotals.Caption = PositionTotalsBackup$
                ErrorTotals.Caption = ErrorTotalsBackup$
                TotalOfTotals.Caption = TotalOfTotalsBackup$
                RowValue.Text = " 0"
                ColumnValue.Text = " 0"
                OPEN "backup.dat" FOR OUTPUT AS #3
                PRINT #3, BigLabel.Caption
                PRINT #3, ErrorTotals.Caption
                PRINT #3, PositionTotals.Caption
                PRINT #3, TotalOfTotals.Caption
                PRINT #3, StartDate$
                PRINT #3, StartTime$
                CLOSE #3
                ResetThyself = 0
    END IF

END SUB

SUB Timer2_Timer () ' 4 second timer
    IF ErrorFlag1 = True THEN
        ErrorFlag1 = False
        ErrorMessage.Caption = ""
    END IF
    Timer2.Enabled = False
END SUB
```

```
SUB Timer3_Timer ()
    'This timer has a short interval, like 1 millisecond.
    'It is executed once, and not again because it disables itself.

    ErrorFlag1 = False
    BigLabelBackup$ = BigLabel.Caption
    PositionTotalsBackup$ = PositionTotals.Caption
    ErrorTotalsBackup$ = ErrorTotals.Caption
    TotalOfTotalsBackup$ = TotalOfTotals.Caption
    PrinterFlag$ = "p"

    ValueOfInputParameter% = VAL(COMMAND$)
    SELECT CASE ValueOfInputParameter%
        CASE 1: OPEN "COM1:1200,n,8,1" FOR INPUT AS #1
        CASE 2: OPEN "COM2:1200,n,8,1" FOR INPUT AS #1
        CASE 3: MSGBOX "Visual Basic and DOS do not support COM3", 0, "Operation will continue without COM"
        CASE 4: MSGBOX "Visual Basic and DOS do not support COM4", 0, "Operation will continue without COM"
        CASE ELSE: ' do nothing
    END SELECT

    Timer3.Enabled = False
    LastErrorKey% = 0
    LastPositionKey% = 0
    ErrorKey% = 0
    PositionKey% = 0
    LastKey$ = ""
    StartTime$ = TIME$
    StartDate$ = DATE$
    NextFileFree% = FREEFILE
    OPEN "PandE.dat" FOR INPUT AS NextFileFree%
    FOR i% = 1 TO 10
        INPUT #NextFileFree%, TypeError(i%)
    NEXT i%
    FOR i% = 1 TO 20
        INPUT #NextFileFree%, Position(i%)
    NEXT i%
    CLOSE #NextFileFree%
    ResetThyself = 0
END SUB

SUB Timer4_Timer ()      ' 10 second timer

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, E$, F$
    CLOSE #3

    OPEN "backup.bak" FOR OUTPUT AS #4
    PRINT #4, A$
    PRINT #4, B$
    PRINT #4, C$
    PRINT #4, D$
    PRINT #4, E$
    PRINT #4, F$
    CLOSE #4

END SUB
```

APPENDIX E
TO FIG. 14A-14D

```
                                                                    Page    1
                                                                    04-19-94
                                                                    09:10:39
                                                                    MATRIXP.LST

Version 1.00
BEGIN Form ErrorMatrix
   AutoRedraw   = 0
   BackColor    = QBColor(7)
   BorderStyle  = 2
   Caption      = "Defect Matrix - 20 rows (positions), 10 columns (types of errors)"
   ControlBox   = -1
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(24)
   Left         = Char(1)
   MaxButton    = -1
   MinButton    = -1
   MousePointer = 0
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(78)
   WindowState  = 0
   BEGIN Label ErrorMessage
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
      Caption      = ""
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(1)
      Left         = Char(62)
      MousePointer = 0
      TabIndex     = 13
      Tag          = ""
      Top          = Char(14)
      Visible      = -1
      Width        = Char(13)
   END
   BEGIN Label TotalofTotals
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
      Caption      = "     0"
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(1)
      Left         = Char(54)
   MousePointer = 0
   TabIndex     = 10
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(5)
END
BEGIN Label ErrorTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0   0   0   0   0   0   0   0   0   0 "
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(6)
   MousePointer = 0
   TabIndex     = 9
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(40)
END
BEGIN Label PositionTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
 0"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(20)
   Left         = Char(55)
   MousePointer = 0
   TabIndex     = 8
   Tag          = ""
   Top          = Char(0)
   Visible      = -1
   Width        = Char(4)
END
BEGIN Label TimeLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "time:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 15
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentDate
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 11
   Tag          = ""
   Top          = Char(16)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label DateLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 14
   Tag          = ""
   Top          = Char(15)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentTime
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "time"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 12
   Tag          = ""
   Top          = Char(18)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label ErrorMesage
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = ""
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(49)
   MousePointer = 0
   TabIndex     = 19
   Tag          = ""
   Top          = Char(20)
   Visible      = -1
   Width        = Char(6)
END
BEGIN Label BigLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0
 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0
 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0
0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0
 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0
 0  0  0  0   0  0  0  0  0  0  0  0  0  0   0  0  0  0  0  0  0  0  0  0   0  0  0  0
0  0  0  0  0  0   0  0  0  0  0  0  0  0  0  0   0  0  0  0  0  0  0  0  0  0   0  0
0  0  0  0  0  0  0  0"
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(20)
      Left          = Char(6)
      MousePointer = 0
      TabIndex      = 7
      Tag           = ""
      Top           = Char(0)
      Visible       = -1
      Width         = Char(40)
   END
   BEGIN Timer Timer3
      Enabled       = -1
      Interval      = 1
      Left          = Char(47)
      Tag           = ""
      Top           = Char(5)
   END
   BEGIN Timer Timer4
      Enabled       = -1
      Interval      = 10000
      Left          = Char(47)
      Tag           = ""
      Top           = Char(0)
   END
   BEGIN Timer Timer2
      Enabled       = -1
      Interval      = 4000
      Left          = Char(47)
      Tag           = ""
      Top           = Char(11)
   END
   BEGIN Timer Timer1
      Enabled       = -1
      Interval      = 1000
      Left          = Char(47)
      Tag           = ""
      Top           = Char(17)
   END
   BEGIN Label RowLabel
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
   Caption      = "Position  (row)"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(2)
   Left         = Char(60)
   MousePointer = 0
   TabIndex     = 3
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(8)
END
BEGIN Label ColumnLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Error (column)"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(2)
   Left         = Char(60)
   MousePointer = 0
   TabIndex     = 4
   Tag          = ""
   Top          = Char(4)
   Visible      = -1
   Width        = Char(8)
END
BEGIN TextBox RowValue
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(68)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 0
   TabStop      = -1
   Tag          = ""
   Text         = "  0"
   Top          = Char(0)
   Visible      = -1
   Width        = Char(7)
END
BEGIN TextBox ColumnValue
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(68)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 1
   TabStop      = -1
   Tag          = ""
   Text         = "  0"
   Top          = Char(3)
   Visible      = -1
   Width        = Char(7)
END
BEGIN CommandButton QuitButton
   BackColor    = QBColor(12)
   Cancel       = 0
   Caption      = "Quit"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(69)
   MousePointer = 0
   TabIndex     = 2
   TabStop      = -1
   Tag          = ""
   Top          = Char(19)
   Visible      = -1
   Width        = Char(6)
END
BEGIN CommandButton Reload
   BackColor    = QBColor(5)
   Cancel       = 0
   Caption      = "Reload"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(60)
   MousePointer = 0
```

```
    TabIndex      = 18
    TabStop       = -1
    Tag           = ""
    Top           = Char(19)
    Visible       = -1
    Width         = Char(8)
END
BEGIN CommandButton Decrement
    BackColor     = QBColor(3)
    Cancel        = 0
    Caption       = "Decrement"
    Default       = 0
    DragMode      = 0
    Enabled       = -1
    Height        = Char(3)
    Left          = Char(64)
    MousePointer  = 0
    TabIndex      = 6
    TabStop       = -1
    Tag           = ""
    Top           = Char(9)
    Visible       = -1
    Width         = Char(11)
END
BEGIN CommandButton Increment
    BackColor     = QBColor(2)
    Cancel        = 0
    Caption       = "Increment"
    Default       = 0
    DragMode      = 0
    Enabled       = -1
    Height        = Char(3)
    Left          = Char(64)
    MousePointer  = 0
    TabIndex      = 5
    TabStop       = -1
    Tag           = ""
    Top           = Char(6)
    Visible       = -1
    Width         = Char(11)
END
BEGIN CommandButton OutputDataToFile
    BackColor     = QBColor(14)
    Cancel        = 0
    Caption       = "Output"
    Default       = 0
    DragMode      = 0
    Enabled       = -1
```

```
      Height       = Char(3)
      Left         = Char(60)
      MousePointer = 0
      TabIndex     = 17
      TabStop      = -1
      Tag          = ""
      Top          = Char(12)
      Visible      = -1
      Width        = Char(8)
   END
   BEGIN CommandButton Setup
      BackColor    = QBColor(6)
      Cancel       = 0
      Caption      = "Setup"
      Default      = 0
      DragMode     = 0
      Enabled      = -1
      Height       = Char(3)
      Left         = Char(68)
      MousePointer = 0
      TabIndex     = 16
      TabStop      = -1
      Tag          = ""
      Top          = Char(12)
      Visible      = -1
      Width        = Char(7)
   END
END
'$FORM ChangePositionOrError
DECLARE SUB PrinterOutput ()
DECLARE SUB Increment_Click ()
DIM SHARED LastErrorKey%
DIM SHARED LastPositionKey%
DIM SHARED ErrorKey%
DIM SHARED PositionKey%
DIM SHARED LastKey$
DIM SHARED StartDate$
DIM SHARED StartTime$
DIM SHARED ValueOfInputParameter%
DIM SHARED PrinterFlag$
DIM SHARED Position(20) AS STRING
DIM SHARED TypeError(10) AS STRING
COMMON SHARED TypeError() AS STRING
COMMON SHARED Position() AS STRING

SUB ColumnLabel_Click ()
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
```

```
END SUB

SUB Decrement_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, subtract 1 from it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) - 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"           'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN     'forbid CellValue$ greater than 999
        CellValue$ = " 999"
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) - 1)
        DO WHILE MIDS(CellValue$, 1, 1) = CHRS(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
```

```
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalofTotals.Caption) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 5 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 99999
        'insert new CellValue$
        TotalofTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalofTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

END SUB

SUB Demo_Click ()
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            RowValue.Text = STR$(Row%)
            ColumnValue.Text = STR$(Col%)
            'FOR i% = 1 TO Row% + Col%
                IF Row% >= Col% THEN CALL Increment_Click
            'NEXT i%
        NEXT Col%
    NEXT Row%
END SUB

SUB Increment_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, add 1 to it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) + 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"           'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN
        CellValue$ = " 999"           'forbid CellValue$ greater than 999
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalofTotals.Caption) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$    'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 9999
        'insert new CelValue$
        TotalofTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalofTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3
END SUB

SUB OutputDataToFile_Click ()
    FileName$ = MID$(DATE$, 9, 2) + MID$(DATE$, 1, 2) + MID$(DATE$, 4, 2) + "." + MID$(TIME$, 1, 2) + MID$(TIME$, 4,
 1)
    OPEN FileName$ FOR OUTPUT AS #2
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            'PRINT #2, CHR$(34) + CellValue$ + CHR$(34) + ",";
            PRINT #2, CellValue$ + ",";
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, "          " + "," + CellValue$
    NEXT Row%
    PRINT #2,
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
```

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```
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, CellValue$ + ",";
    NEXT Col%
    CellValue$ = TotalofTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    PRINT #2, "          " + "," + CellValue$
    PRINT #2,
    PRINT #2, CHR$(34) + "Start,,,End" + CHR$(34)
    PRINT #2, CHR$(34) + StartDate$ + CHR$(34) + ",,," + CHR$(34) + DATE$ + CHR$(34)
    PRINT #2, CHR$(34) + StartTime$ + CHR$(34) + ",,," + CHR$(34) + TIME$ + CHR$(34)
    CLOSE #2
    SHELL "copy " + FileName$ + " LATEST.DAT"
    IF PrinterFlag$ = "p" THEN CALL PrinterOutput
END SUB

SUB PrinterOutput ()
    DIM MostNumerousDefects(10) AS STRING
    DIM MostNumerousDefectsRow(10) AS INTEGER
    DIM MostNumerousDefectsCol(10) AS INTEGER
    DIM MatrixOfCellValues(20, 10) AS STRING
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            MatrixOfCellValues(Row%, Col%) = CellValue$
            LPRINT CellValue$; TAB(Col% * 4 + 1);
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT "  " + CellValue$; "  " + Position(Row%)
        'LPRINT  'this makes the matrix print out in doublespace
    NEXT Row%
    LPRINT
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
```

```
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT CellValue$; TAB(Col% * 4 + 1);
    NEXT Col%
    CellValue$ = TotalofTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    LPRINT "  " + CellValue$; "  GRAND TOTAL"
    LPRINT
    LPRINT CHR$(32) + "Start          End" + CHR$(32)
    LPRINT CHR$(32) + StartDate$ + CHR$(32) + "   " + CHR$(32) + DATE$ + CHR$(32)
    LPRINT CHR$(32) + StartTime$ + CHR$(32) + "     " + CHR$(32) + TIME$ + CHR$(32)
    LPRINT TAB(62 - 12); TypeError(10)' "                                        poor heat stake/USDB/long
gate"
    LPRINT TypeError(1); TAB(56 - 12); TypeError(9)      '   "trash in paint                            broken leg
/bad optic"
    LPRINT TAB(4); TypeError(2); TAB(48 - 12); TypeError(8) ' "  bad graphic                  button failure"
    LPRINT TAB(20 - 12); TypeError(3); TAB(42 - 12); TypeError(7)' "      broken pin          light leak"
    LPRINT TAB(24 - 12); TypeError(4); TAB(36 - 12); TypeError(6)' "          scratch     short shot"
    LPRINT TAB(28 - 12); TypeError(5)' "                 off location graphic"

    'LPRINT CHR$(12)
    'LPRINT
    'FOR Row% = 1 TO 20
    '    FOR Col% = 1 TO 10
    '        LPRINT MatrixOfCellValues(Row%, Col%);
    '    NEXT Col%
    '    LPRINT
     'NEXT Row%
    'LPRINT
    FOR i% = 1 TO 10
        MostNumerousDefectsRow(i%) = 0
        MostNumerousDefectsCol(i%) = 0
    NEXT i%
    ' now find the 10 most numerous defects
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        MaxValue$ = "-1"
        FOR Row% = 1 TO 20
            FOR Col% = 1 TO 10
                IF VAL(MatrixOfCellValues(Row%, Col%)) > VAL(MaxValue$) THEN
                    MostNumerousDefectsRow(i%) = Row%
                    MostNumerousDefectsCol(i%) = Col%
                    MaxValue$ = MatrixOfCellValues(Row%, Col%)
                END IF
            NEXT Col%
        NEXT Row%
        MostNumerousDefects(i%) = MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%))
        MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%)) = "0"
    NEXT NumberOfMostNumerousDefects%
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT "                             10 MOST NUMEROUS DEFECTS"
    LPRINT
    LPRINT "  position                   type of error                    number"
    LPRINT
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        LPRINT Position(MostNumerousDefectsRow(i%)); TAB(30);
        LPRINT TypeError(MostNumerousDefectsCol(i%)); TAB(65);
        LPRINT MostNumerousDefects(i%)
    NEXT
    LPRINT CHR$(12)
    'LPRINT
    'FOR Row% = 1 TO 20
    '    FOR Col% = 1 TO 10
    '        LPRINT MatrixOfCellValues(Row%, Col%);
    '    NEXT Col%
    '    LPRINT
    'NEXT Row%
    'LPRINT
END SUB

SUB QuitButton_Click ()
    END
END SUB

SUB Reload_Click ()
    OPEN "backup.old" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalofTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, StartDate$, StartTime$
    CLOSE #3
```

```
IF MID$(A$, 2, 1) = " " THEN
    BigLabel.Caption = "   " + A$
ELSEIF MID$(A$, 3, 1) = " " THEN
    BigLabel.Caption = "  " + A$
ELSEIF MID$(A$, 4, 1) = " " THEN
    BigLabel.Caption = " " + A$
ELSE
    BigLabel.Caption = A$
END IF

IF MID$(B$, 2, 1) = " " THEN
    ErrorTotals.Caption = "   " + B$
ELSEIF MID$(B$, 3, 1) = " " THEN
    ErrorTotals.Caption = "  " + B$
ELSEIF MID$(B$, 4, 1) = " " THEN
    ErrorTotals.Caption = " " + B$
ELSE
    ErrorTotals.Caption = B$
END IF

IF MID$(C$, 2, 1) = " " THEN
    PositionTotals.Caption = "   " + C$
ELSEIF MID$(C$, 3, 1) = " " THEN
    PositionT
```

APPENDIX F
TO FIG. 14A-14D

```
                                                                    Page    1
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Version 1.00
BEGIN Form ErrorMatrix
   AutoRedraw    = 0
   BackColor     = QBColor(7)
   BorderStyle   = 2
   Caption       = "Defect Matrix - 20 rows (positions), 10 columns (types of errors)"
   ControlBox    = -1
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(24)
   Left          = Char(1)
   MaxButton     = -1
   MinButton     = -1
   MousePointer  = 0
   Tag           = ""
   Top           = Char(1)
   Visible       = -1
   Width         = Char(78)
   WindowState   = 0
   BEGIN Label ErrorMessage
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = ""
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(62)
      MousePointer  = 0
      TabIndex      = 13
      Tag           = ""
      Top           = Char(14)
      Visible       = -1
      Width         = Char(13)
   END
   BEGIN Label TotalofTotals
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = "     0"
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(54)
   MousePointer = 0
   TabIndex     = 10
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(5)
END
BEGIN Label ErrorTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0   0   0   0   0   0   0   0   0   0 "
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(6)
   MousePointer = 0
   TabIndex     = 9
   Tag          = ""
   Top          = Char(21)
   Visible      = -1
   Width        = Char(40)
END
BEGIN Label PositionTotals
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "   0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0
 0"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(20)
   Left         = Char(55)
   MousePointer = 0
   TabIndex     = 8
   Tag          = ""
   Top          = Char(0)
   Visible      = -1
   Width        = Char(4)
END
BEGIN Label TimeLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "time:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 15
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentDate
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 11
   Tag          = ""
   Top          = Char(16)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label DateLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "date:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(61)
   MousePointer = 0
   TabIndex     = 14
   Tag          = ""
   Top          = Char(15)
   Visible      = -1
   Width        = Char(7)
END
BEGIN Label CurrentTime
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "time"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(62)
   MousePointer = 0
   TabIndex     = 12
   Tag          = ""
   Top          = Char(18)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label ErrorMesage
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = ""
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(49)
   MousePointer = 0
   TabIndex     = 19
   Tag          = ""
   Top          = Char(20)
   Visible      = -1
   Width        = Char(6)
END
BEGIN Label BigLabel
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0
 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0
0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0
0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0. 0 0 0
 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 0 0  0 0 0 0 0 0
```

```
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  0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0   0   0
 0   0   0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0   0   0   0   0   0   0   0   0    0   0
0   0   0   0   0   0   0   0"
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(20)
      Left         = Char(6)
      MousePointer = 0
      TabIndex     = 7
      Tag          = ""
      Top          = Char(0)
      Visible      = -1
      Width        = Char(40)
   END
   BEGIN Timer Timer3
      Enabled      = -1
      Interval     = 1
      Left         = Char(47)
      Tag          = ""
      Top          = Char(5)
   END
   BEGIN Timer Timer4
      Enabled      = -1
      Interval     = 10000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(0)
   END
   BEGIN Timer Timer2
      Enabled      = -1
      Interval     = 4000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(11)
   END
   BEGIN Timer Timer1
      Enabled      = -1
      Interval     = 1000
      Left         = Char(47)
      Tag          = ""
      Top          = Char(17)
   END
   BEGIN Label RowLabel
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
   Caption       = "Position  (row)"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(2)
   Left          = Char(60)
   MousePointer = 0
   TabIndex      = 3
   Tag           = ""
   Top           = Char(1)
   Visible       = -1
   Width         = Char(8)
END
BEGIN Label ColumnLabel
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Error (column)"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(2)
   Left          = Char(60)
   MousePointer = 0
   TabIndex      = 4
   Tag           = ""
   Top           = Char(4)
   Visible       = -1
   Width         = Char(8)
END
BEGIN TextBox RowValue
   BackColor     = QBColor(7)
   BorderStyle   = 1
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(3)
   Left          = Char(68)
   MousePointer = 0
   MultiLine     = 0
   ScrollBars    = 0
   TabIndex      = 0
   TabStop       = -1
   Tag           = ""
   Text          = "  0"
   Top           = Char(0)
   Visible       = -1
   Width         = Char(7)
END
BEGIN TextBox ColumnValue
   BackColor     = QBColor(7)
   BorderStyle   = 1
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(3)
   Left          = Char(68)
   MousePointer = 0
   MultiLine     = 0
   ScrollBars    = 0
   TabIndex      = 1
   TabStop       = -1
   Tag           = ""
   Text          = "  0"
   Top           = Char(3)
   Visible       = -1
   Width         = Char(7)
END
BEGIN CommandButton QuitButton
   BackColor     = QBColor(12)
   Cancel        = 0
   Caption       = "Quit"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
   Height        = Char(3)
   Left          = Char(69)
   MousePointer = 0
   TabIndex      = 2
   TabStop       = -1
   Tag           = ""
   Top           = Char(19)
   Visible       = -1
   Width         = Char(6)
END
BEGIN CommandButton Reload
   BackColor     = QBColor(5)
   Cancel        = 0
   Caption       = "Reload"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
   Height        = Char(3)
   Left          = Char(60)
   MousePointer = 0
```

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   TabIndex      = 18
   TabStop       = -1
   Tag           = ""
   Top           = Char(19)
   Visible       = -1
   Width         = Char(8)
END
BEGIN CommandButton Decrement
   BackColor     = QBColor(3)
   Cancel        = 0
   Caption       = "Decrement"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
   Height        = Char(3)
   Left          = Char(64)
   MousePointer  = 0
   TabIndex      = 6
   TabStop       = -1
   Tag           = ""
   Top           = Char(9)
   Visible       = -1
   Width         = Char(11)
END
BEGIN CommandButton Increment
   BackColor     = QBColor(2)
   Cancel        = 0
   Caption       = "Increment"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
   Height        = Char(3)
   Left          = Char(64)
   MousePointer  = 0
   TabIndex      = 5
   TabStop       = -1
   Tag           = ""
   Top           = Char(6)
   Visible       = -1
   Width         = Char(11)
END
BEGIN CommandButton OutputDataToFile
   BackColor     = QBColor(14)
   Cancel        = 0
   Caption       = "Output"
   Default       = 0
   DragMode      = 0
   Enabled       = -1
```

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      Height  .    = Char(3)
      Left         = Char(60)
      MousePointer = 0
      TabIndex     = 17
      TabStop      = -1
      Tag          = ""
      Top          = Char(12)
      Visible      = -1
      Width        = Char(8)
   END
   BEGIN CommandButton Setup
      BackColor    = QBColor(6)
      Cancel       = 0
      Caption      = "Setup"
      Default      = 0
      DragMode     = 0
      Enabled      = -1
      Height       = Char(3)
      Left         = Char(68)
      MousePointer = 0
      TabIndex     = 16
      TabStop      = -1
      Tag          = ""
      Top          = Char(12)
      Visible      = -1
      Width        = Char(7)
   END
END
'$FORM ChangePositionOrError
DECLARE SUB PrinterOutput ()
DECLARE SUB Increment_Click ()
DIM SHARED LastErrorKey%
DIM SHARED LastPositionKey%
DIM SHARED ErrorKey%
DIM SHARED PositionKey%
DIM SHARED LastKey$
DIM SHARED StartDate$
DIM SHARED StartTime$
DIM SHARED ValueOfInputParameter%
DIM SHARED PrinterFlag$
DIM SHARED Position(20) AS STRING
DIM SHARED TypeError(10) AS STRING
COMMON SHARED TypeError() AS STRING
COMMON SHARED Position() AS STRING

SUB ColumnLabel_Click ()
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
```

```
END SUB

SUB Decrement_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, subtract 1 from it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) - 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"          'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN     'forbid CellValue$ greater than 999
        CellValue$ = " 999"
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
```

```
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"          'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"          'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CellValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltDecrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalofTotals.Caption) - 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 5 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 99999
        'insert new CellValue$
        TotalofTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalofTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

END SUB

SUB Demo_Click ()
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            RowValue.Text = STR$(Row%)
            ColumnValue.Text = STR$(Col%)
            'FOR i% = 1 TO Row% + Col%
                IF Row% >= Col% THEN CALL Increment_Click
            'NEXT i%
        NEXT Col%
    NEXT Row%
END SUB

SUB Increment_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
    IF VAL(ColumnValue.Text) < 1 THEN ColumnValue.Text = "  1"
    IF VAL(ColumnValue.Text) > 10 THEN ColumnValue.Text = " 10"
    Row% = VAL(RowValue.Text)
    Col% = VAL(ColumnValue.Text)
    HaltDecrementFlag$ = "go"
    HaltIncrementFlag$ = "go"

    'work on cell values in the big label
    'get the CellValue$, add 1 to it
    CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)) + 1)
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    DO WHILE LEN(CellValue$) <> 4
        CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
    LOOP
    IF VAL(CellValue$) < 0 THEN
        CellValue$ = "   0"          'forbid CellValue$ less than 0
        HaltDecrementFlag$ = "stop"
    END IF
    IF VAL(CellValue$) > 999 THEN
        CellValue$ = " 999"          'forbid CellValue$ greater than 999
        HaltIncrementFlag$ = "stop"
    END IF
    'insert new CelValue$
    BigLabel.Caption = MID$(BigLabel.Caption, 1, 4 * (Col% - 1) + 41 * (Row% - 1)) + CellValue$ + MID$(BigLabel.Capt
ion, 4 * (Col% - 1) + 41 * (Row% - 1) + 5)

    'work on the sum of all kinds of errors for each position (column right of big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        PositionTotals.Caption = MID$(PositionTotals.Caption, 1, 5 * (Row% - 1)) + CellValue$ + " " + MID$(PositionT
otals.Caption, 5 * Row% + 1)
    END IF

    'work on the sum of the errors of each kind for all positions (row below big matrix)
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 4
            CellValue$ = " " + CellValue$ 'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN
            CellValue$ = "   0"           'forbid CellValue$ less than 0
            HaltDecrementFlag$ = "stop"
        END IF
        IF VAL(CellValue$) > 9999 THEN
            CellValue$ = "9999"           'forbid CellValue$ greater than 9999
            HaltIncrementFlag$ = "stop"
        END IF
        'insert new CelValue$
        ErrorTotals.Caption = MID$(ErrorTotals.Caption, 1, 4 * (Col% - 1)) + CellValue$ + MID$(ErrorTotals.Caption,
4 * Col% + 1)
    END IF

    'work on the totals of all errors of all kinds and all positions
    IF HaltIncrementFlag$ <> "stop" THEN
        CellValue$ = STR$(VAL(TotalofTotals.Caption) + 1)
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32)
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        DO WHILE LEN(CellValue$) <> 5
            CellValue$ = " " + CellValue$    'pad CellValue$ with leading blanks until it is 4 characters long
        LOOP
        IF VAL(CellValue$) < 0 THEN CellValue$ = "    0"     'forbid CellValue$ less than 0
        IF VAL(CellValue$) > 99999 THEN CellValue$ = "99999" 'forbid CellValue$ greater than 9999
        'insert new CelValue$
        TotalofTotals.Caption = CellValue$
    END IF
    OPEN "backup.dat" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalofTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3
END SUB

SUB OutputDataToFile_Click ()
    FileName$ = MID$(DATE$, 9, 2) + MID$(DATE$, 1, 2) + MID$(DATE$, 4, 2) + "." + MID$(TIME$, 1, 2) + MID$(TIME$, 4,
 1)
    OPEN FileName$ FOR OUTPUT AS #2
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            'PRINT #2, CHR$(34) + CellValue$ + CHR$(34) + ",";
            PRINT #2, CellValue$ + ",";
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, "          " + "," + CellValue$
    NEXT Row%
    PRINT #2,
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        PRINT #2, CellValue$ + ",";
    NEXT Col%
    CellValue$ = TotalofTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    PRINT #2, "          " + "," + CellValue$
    PRINT #2,
    PRINT #2, CHR$(34) + "Start,,,End" + CHR$(34)
    PRINT #2, CHR$(34) + StartDate$ + CHR$(34) + ",,," + CHR$(34) + DATE$ + CHR$(34)
    PRINT #2, CHR$(34) + StartTime$ + CHR$(34) + ",,," + CHR$(34) + TIME$ + CHR$(34)
    CLOSE #2
    SHELL "copy " + FileName$ + " LATEST.DAT"
'    IF PrinterFlag$ = "p" THEN CALL PrinterOutput
END SUB

SUB PrinterOutput ()
    DIM MostNumerousDefects(10) AS STRING
    DIM MostNumerousDefectsRow(10) AS INTEGER
    DIM MostNumerousDefectsCol(10) AS INTEGER
    DIM MatrixOfCellValues(20, 10) AS STRING
    FOR Row% = 1 TO 20
        FOR Col% = 1 TO 10
            CellValue$ = STR$(VAL(MID$(BigLabel.Caption, 4 * (Col% - 1) + 41 * (Row% - 1) + 1, 4)))
            'remove leading blanks
            DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
                CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
            LOOP
            MatrixOfCellValues(Row%, Col%) = CellValue$
            LPRINT CellValue$; TAB(Col% * 4 + 1);
        NEXT Col%
        CellValue$ = STR$(VAL(MID$(PositionTotals.Caption, 5 * (Row% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT "  " + CellValue$; "  " + Position(Row%)
        'LPRINT   'this makes the matrix print out in doublespace
    NEXT Row%
    LPRINT
    FOR Col% = 1 TO 10
        CellValue$ = STR$(VAL(MID$(ErrorTotals.Caption, 4 * (Col% - 1) + 1, 4)))
        'remove leading blanks
        DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
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            CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
        LOOP
        LPRINT CellValue$; TAB(Col% * 4 + 1);
    NEXT Col%
    CellValue$ = TotalofTotals.Caption
    'remove leading blanks
    DO WHILE MID$(CellValue$, 1, 1) = CHR$(32) 'do while 1st character is a blank
        CellValue$ = MID$(CellValue$, 2) 'remove 1 leading blank from CellValue$
    LOOP
    LPRINT "  " + CellValue$; "  GRAND TOTAL"
    LPRINT
    LPRINT CHR$(32) + "Start          End" + CHR$(32)
    LPRINT CHR$(32) + StartDate$ + CHR$(32) + "   " + CHR$(32) + DATE$ + CHR$(32)
    LPRINT CHR$(32) + StartTime$ + CHR$(32) + "     " + CHR$(32) + TIME$ + CHR$(32)
    LPRINT TAB(62 - 12); TypeError(10)' "                                          poor heat stake/USDB/long
gate"
    LPRINT TypeError(1); TAB(56 - 12); TypeError(9)       '   "trash in paint                             broken leg
/bad optic"
    LPRINT TAB(4); TypeError(2); TAB(48 - 12); TypeError(8) ' "   bad graphic                    button failure"
    LPRINT TAB(20 - 12); TypeError(3); TAB(42 - 12); TypeError(7)' "      broken pin           light leak"
    LPRINT TAB(24 - 12); TypeError(4); TAB(36 - 12); TypeError(6)' "          scratch     short shot"
    LPRINT TAB(28 - 12); TypeError(5)' "                off location graphic"

    'LPRINT CHR$(12)
    'LPRINT
    'FOR Row% = 1 TO 20
    '    FOR Col% = 1 TO 10
    '        LPRINT MatrixOfCellValues(Row%, Col%);
    '    NEXT Col%
    '    LPRINT
     'NEXT Row%
    'LPRINT
    FOR i% = 1 TO 10
        MostNumerousDefectsRow(i%) = 0
        MostNumerousDefectsCol(i%) = 0
    NEXT i%
    ' now find the 10 most numerous defects
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        MaxValue$ = "-1"
        FOR Row% = 1 TO 20
            FOR Col% = 1 TO 10
                IF VAL(MatrixOfCellValues(Row%, Col%)) > VAL(MaxValue$) THEN
                    MostNumerousDefectsRow(i%) = Row%
                    MostNumerousDefectsCol(i%) = Col%
                    MaxValue$ = MatrixOfCellValues(Row%, Col%)
                END IF
            NEXT Col%
        NEXT Row%
        MostNumerousDefects(i%) = MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%))
        MatrixOfCellValues(MostNumerousDefectsRow(i%), MostNumerousDefectsCol(i%)) = "0"
    NEXT NumberOfMostNumerousDefects%
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT
    LPRINT "                           10 MOST NUMEROUS DEFECTS"
    LPRINT
    LPRINT "  position                   type of error                    number"
    LPRINT
    FOR NumberOfMostNumerousDefects% = 1 TO 10
        i% = NumberOfMostNumerousDefects%
        LPRINT Position(MostNumerousDefectsRow(i%)); TAB(30);
        LPRINT TypeError(MostNumerousDefectsCol(i%)); TAB(65);
        LPRINT MostNumerousDefects(i%)
    NEXT
    LPRINT CHR$(12)
    'LPRINT
    'FOR Row% = 1 TO 20
    '    FOR Col% = 1 TO 10
    '        LPRINT MatrixOfCellValues(Row%, Col%);
    '    NEXT Col%
    '    LPRINT
    'NEXT Row%
    'LPRINT
END SUB

SUB QuitButton_Click ()
    END
END SUB

SUB Reload_Click ()
    OPEN "backup.old" FOR OUTPUT AS #3
    PRINT #3, BigLabel.Caption
    PRINT #3, ErrorTotals.Caption
    PRINT #3, PositionTotals.Caption
    PRINT #3, TotalofTotals.Caption
    PRINT #3, StartDate$
    PRINT #3, StartTime$
    CLOSE #3

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, StartDate$, StartTime$
    CLOSE #3
```

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```
    IF MID$(A$, 2, 1) = " " THEN
        BigLabel.Caption = "   " + A$
    ELSEIF MID$(A$, 3, 1) = " " THEN
        BigLabel.Caption = "  " + A$
    ELSEIF MID$(A$, 4, 1) = " " THEN
        BigLabel.Caption = " " + A$
    ELSE
        BigLabel.Caption = A$
    END IF

    IF MID$(B$, 2, 1) = " " THEN
        ErrorTotals.Caption = "   " + B$
    ELSEIF MID$(B$, 3, 1) = " " THEN
        ErrorTotals.Caption = "  " + B$
    ELSEIF MID$(B$, 4, 1) = " " THEN
        ErrorTotals.Caption = " " + B$
    ELSE
        ErrorTotals.Caption = B$
    END IF

    IF MID$(C$, 2, 1) = " " THEN
        PositionTotals.Caption = "   " + C$
    ELSEIF MID$(C$, 3, 1) = " " THEN
        PositionTotals.Caption = "  " + C$
    ELSEIF MID$(C$, 4, 1) = " " THEN
        PositionTotals.Caption = " " + C$
    ELSE
        PositionTotals.Caption = C$
    END IF

    IF LEN(D$) = 1 THEN
        TotalofTotals.Caption = "    " + D$
    ELSEIF LEN(D$) = 2 THEN
        TotalofTotals.Caption = "   " + D$
    ELSEIF LEN(D$) = 3 THEN
        TotalofTotals.Caption = "  " + D$
    ELSEIF LEN(D$) = 4 THEN
        TotalofTotals.Caption = " " + D$
    ELSE
        TotalofTotals.Caption = D$
    END IF
END SUB

SUB RowLabel_Click ()
    IF VAL(RowValue.Text) < 1 THEN RowValue.Text = "  1"
    IF VAL(RowValue.Text) > 20 THEN RowValue.Text = " 20"
END SUB
```

```
SUB Setup_Click ()
    'TypeOfError1.Caption1 = TypeError$(1)
    ErrorMatrix.HIDE
    ChangePositionOrError.SHOW
END SUB

SUB Timer1_Timer () ' 1 second timer
    ON LOCAL ERROR RESUME NEXT
    CurrentTime.Caption = TIME$
    CurrentDate.Caption = DATE$
    IF ValueOfInputParameter% > 0 AND ValueOfInputParameter% < 3 THEN
        DO WHILE NOT EOF(1)
            Acharacter$ = INPUT$(1, #1)
            IF ASC(Acharacter$) < 48 OR ASC(Acharacter$) > 77 THEN
                Timer2.Enabled = True
                ErrorFlag1 = True
                ErrorMessage.Caption = "ERROR"
            ELSE
                NumericalValue% = ASC(Acharacter$) - 48
                Row% = NumericalValue% \ 5 + 1
                Column% = NumericalValue% - 5 * (Row% - 1) + 1
                IF Row% = 3 OR Row% = 4 THEN ' this key is a type-of-error key
                    IF NOT (ErrorKey% = LastErrorKey% AND LastKey$ = "Error") THEN
                        ErrorKey% = 11 - ((Row% - 3) * 5 + Column%)
                        LastKey$ = "Error"
                        LastErrorKey% = ErrorKey%
                    ELSE
                        ErrorKey% = 0
                        LastKey$ = "Error"
                    END IF
                ELSEIF Row% = 5 OR Row% = 6 THEN
                    IF NOT (PositionKey% = LastPositionKey% AND LastKey$ = "Position") THEN
                        PositionKey% = 11 - ((Row% - 5) * 5 + Column%)
                        LastKey$ = "Position"
                        LastPositionKey% = PositionKey%
                    ELSE
                        PositionKey% = 0
                        LastKey$ = "Position"
                    END IF
                ELSE
                    IF NOT (PositionKey% = LastPositionKey% AND LastKey$ = "Position") THEN
                        PositionKey% = 11 - ((Row% - 1) * 5 + Column%) + 10
                        LastKey$ = "Position"
                        LastPositionKey% = PositionKey%
                    ELSE
                        PositionKey% = 0
                        LastKey$ = "Position"
                    END IF
                END IF
                RowValue.Text = STR$(PositionKey%)
                ColumnValue.Text = STR$(ErrorKey%)
                IF PositionKey% <> 0 AND ErrorKey% <> 0 THEN
                    CALL Increment_Click
                    LastPositionKey% = PositionKey%
                    LastErrorKey% = ErrorKey%
                    PositionKey% = 0
                    ErrorKey% = 0
                END IF
            END IF
        LOOP
    END IF
END SUB

SUB Timer2_Timer () ' 4 second timer
    IF ErrorFlag1 = True THEN
        ErrorFlag1 = False
        ErrorMessage.Caption = ""
    END IF
    Timer2.Enabled = False
END SUB

SUB Timer3_Timer ()
    'This timer has a short interval, like 1 millisecond.
    'It is executed once, and not again because it disables itself.

    ErrorFlag1 = False

        PrinterFlag$ = "p"
    ValueOfInputParameter% = VAL(COMMAND$)
    SELECT CASE ValueOfInputParameter%
        CASE 1: OPEN "COM1:1200,n,8,1" FOR INPUT AS #1
        CASE 2: OPEN "COM2:1200,n,8,1" FOR INPUT AS #1
        CASE 3: MSGBOX "Visual Basic and DOS do not support COM3", 0, "Operation will continue without COM"
        CASE 4: MSGBOX "Visual Basic and DOS do not support COM4", 0, "Operation will continue without COM"
        CASE ELSE: ' do nothing
    END SELECT
    Timer3.Enabled = False
    LastErrorKey% = 0
    LastPositionKey% = 0
    ErrorKey% = 0
    PositionKey% = 0
    LastKey$ = ""
    StartTime$ = TIME$
    StartDate$ = DATE$
    NextFileFree% = FREEFILE
    OPEN "PandE.dat" FOR INPUT AS NextFileFree%
    FOR i% = 1 TO 10
        INPUT #NextFileFree%, TypeError(i%)
    NEXT i%
    FOR i% = 1 TO 20
        INPUT #NextFileFree%, Position(i%)
    NEXT i%
    CLOSE #NextFileFree%
END SUB

SUB Timer4_Timer ()      ' 10 second timer

    OPEN "backup.dat" FOR INPUT AS #3
    INPUT #3, A$, B$, C$, D$, E$, F$
    CLOSE #3

    OPEN "backup.bak" FOR OUTPUT AS #4
    PRINT #4, A$
    PRINT #4, B$
    PRINT #4, C$
    PRINT #4, D$
    PRINT #4, E$
    PRINT #4, F$
    CLOSE #4

END SUB
```

APPENDIX G
TO FIG. 16

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CHANGE&P.LST

```
Version 1.00
BEGIN Form ChangePositionOrError
   AutoRedraw   = 0
   BackColor    = QBColor(7)
   BorderStyle  = 2
   Caption      = "Change Positions & Types of Errors"
   ControlBox   = -1
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(22)
   Left         = Char(2)
   MaxButton    = -1
   MinButton    = -1
   MousePointer = 0
   Tag          = ""
   Top          = Char(2)
   Visible      = -1
   Width        = Char(76)
   WindowState  = 0
   BEGIN Label Label1
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
      Caption      = "1"
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(1)
      Left         = Char(31)
      MousePointer = 0
      TabIndex     = 2
      Tag          = ""
      Top          = Char(0)
      Visible      = -1
      Width        = Char(2)
   END
   BEGIN Label Label2
      Alignment    = 0
      AutoSize     = 0
      BackColor    = QBColor(7)
      BorderStyle  = 0
      Caption      = "2"
      DragMode     = 0
      Enabled      = -1
      ForeColor    = QBColor(0)
      Height       = Char(1)
      Left         = Char(31)
```

```
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                                                               CHANGE&P.LST

   MousePointer = 0
   TabIndex     = 3
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label3
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "3"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(31)
   MousePointer = 0
   TabIndex     = 4
   Tag          = ""
   Top          = Char(2)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label4
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "4"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(31)
   MousePointer = 0
   TabIndex     = 5
   Tag          = ""
   Top          = Char(3)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label5
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "5"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(31)
   MousePointer = 0
   TabIndex     = 6
   Tag          = ""
   Top          = Char(4)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label6
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "6"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(31)
   MousePointer = 0
   TabIndex     = 7
   Tag          = ""
   Top          = Char(5)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label7
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "7"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(31)
   MousePointer = 0
   TabIndex     = 8
   Tag          = ""
   Top          = Char(6)
   Visible      = -1
   Width        = Char(2)
```

```
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                                                          CHANGE&P.LST
END
BEGIN Label Label8
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "8"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(31)
   MousePointer  = 0
   TabIndex      = 9
   Tag           = ""
   Top           = Char(7)
   Visible       = -1
   Width         = Char(2)
END
BEGIN Label Label9
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "9"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(31)
   MousePointer  = 0
   TabIndex      = 10
   Tag           = ""
   Top           = Char(8)
   Visible       = -1
   Width         = Char(2)
END
BEGIN Label Label10
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "10"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer = 0
   TabIndex     = 11
   Tag          = ""
   Top          = Char(9)
   Visible      = -1
   Width        = Char(3)
END
BEGIN Label Label11
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "11"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(30)
   MousePointer = 0
   TabIndex     = 12
   Tag          = ""
   Top          = Char(10)
   Visible      = -1
   Width        = Char(3)
END
BEGIN Label Label12
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "12"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(30)
   MousePointer = 0
   TabIndex     = 13
   Tag          = ""
   Top          = Char(11)
   Visible      = -1
   Width        = Char(3)
END
BEGIN Label Label13
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption       = "13"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer  = 0
   TabIndex      = 14
   Tag           = ""
   Top           = Char(12)
   Visible       = -1
   Width         = Char(3)
END
BEGIN Label Label14
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "14"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer  = 0
   TabIndex      = 15
   Tag           = ""
   Top           = Char(13)
   Visible       = -1
   Width         = Char(3)
END
BEGIN Label Label15
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "15"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer  = 0
   TabIndex      = 16
   Tag           = ""
   Top           = Char(14)
   Visible       = -1
   Width         = Char(3)
```

```
END
BEGIN Label Label16
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "16"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer  = 0
   TabIndex      = 17
   Tag           = ""
   Top           = Char(15)
   Visible       = -1
   Width         = Char(3)
END
BEGIN Label Label17
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "17"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer  = 0
   TabIndex      = 18
   Tag           = ""
   Top           = Char(16)
   Visible       = -1
   Width         = Char(3)
END
BEGIN Label Label18
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "18"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(30)
   MousePointer = 0
   TabIndex     = 19
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(3)
END
BEGIN Label Label19
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "19"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(30)
   MousePointer = 0
   TabIndex     = 20
   Tag          = ""
   Top          = Char(18)
   Visible      = -1
   Width        = Char(3)
END
BEGIN Label Label20
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "20"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(30)
   MousePointer = 0
   TabIndex     = 21
   Tag          = ""
   Top          = Char(19)
   Visible      = -1
   Width        = Char(3)
END
BEGIN CommandButton Display
   BackColor    = QBColor(7)
   Cancel       = 0
   Caption      = "Display"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(15)
   MousePointer = 0
   TabIndex     = 1
   TabStop      = -1
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label Label21
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "edit below:"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(1)
   MousePointer = 0
   TabIndex     = 53
   Tag          = ""
   Top          = Char(12)
   Visible      = -1
   Width        = Char(12)
END
BEGIN TextBox EditBox
   BackColor    = QBColor(7)
   BorderStyle  = 1
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(3)
   Left         = Char(0)
   MousePointer = 0
   MultiLine    = 0
   ScrollBars   = 0
   TabIndex     = 52
   TabStop      = -1
   Tag          = ""
   Text         = ""
   Top          = Char(13)
   Visible      = -1
   Width        = Char(30)
```

```
END
BEGIN Label TypeOfError1
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "TypeOfError1"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(0)
   MousePointer  = 0
   TabIndex      = 42
   Tag           = ""
   Top           = Char(0)
   Visible       = -1
   Width         = Char(30)
END
BEGIN Label TypeOfError2
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "TypeOfError2"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(0)
   MousePointer  = 0
   TabIndex      = 43
   Tag           = ""
   Top           = Char(1)
   Visible       = -1
   Width         = Char(30)
END
BEGIN Label TypeOfError3
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "TypeOfError3"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(0)
   MousePointer = 0
   TabIndex     = 44
   Tag          = ""
   Top          = Char(2)
   Visible      = -1
   Width        = Char(30)
END
BEGIN Label TypeOfError4
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError4"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 45
   Tag          = ""
   Top          = Char(3)
   Visible      = -1
   Width        = Char(30)
END
BEGIN Label TypeOfError5
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError5"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 46
   Tag          = ""
   Top          = Char(4)
   Visible      = -1
   Width        = Char(30)
END
BEGIN Label TypeOfError6
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError6"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 47
   Tag          = ""
   Top          = Char(5)
   Visible      = -1
   Width        = Char(30)
END
BEGIN Label TypeOfError7
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError7"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 48
   Tag          = ""
   Top          = Char(6)
   Visible      = -1
   Width        = Char(30)
END
BEGIN Label TypeOfError8
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError8"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 49
   Tag          = ""
   Top          = Char(7)
   Visible      = -1
   Width        = Char(30)
```

```
END
BEGIN Label TypeOfError9
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError9"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 50
   Tag          = ""
   Top          = Char(8)
   Visible      = -1
   Width        = Char(30)
END
BEGIN CommandButton QuitButton
   BackColor    = QBColor(7)
   Cancel       = 0
   Caption      = "Quit"
   Default      = 0
   DragMode     = 0
   Enabled      = -1
   Height       = Char(3)
   Left         = Char(1)
   MousePointer = 0
   TabIndex     = 0
   TabStop      = -1
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(12)
END
BEGIN Label TypeOfError10
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "TypeOfError10"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(0)
   MousePointer = 0
   TabIndex     = 51
   Tag          = ""
   Top          = Char(9)
   Visible      = -1
   Width        = Char(30)
END
BEGIN Label Position1
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position1"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 22
   Tag          = ""
   Top          = Char(0)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position2
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position2"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 23
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position3
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position3"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 24
   Tag          = ""
   Top          = Char(2)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position4
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position4"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 25
   Tag          = ""
   Top          = Char(3)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position5
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position5"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 26
   Tag          = ""
   Top          = Char(4)
   Visible      = -1
   Width        = Char(37)
END
```

```
BEGIN Label Position6
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position6"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 27
   Tag          = ""
   Top          = Char(5)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position7
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position7"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 28
   Tag          = ""
   Top          = Char(6)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position8
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position8"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex      = 29
   Tag           = ""
   Top           = Char(7)
   Visible       = -1
   Width         = Char(37)
END
BEGIN Label Position9
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Position9"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(34)
   MousePointer  = 0
   TabIndex      = 30
   Tag           = ""
   Top           = Char(8)
   Visible       = -1
   Width         = Char(37)
END
BEGIN Label Position10
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Position10"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(34)
   MousePointer  = 0
   TabIndex      = 31
   Tag           = ""
   Top           = Char(9)
   Visible       = -1
   Width         = Char(37)
END
BEGIN Label Position11
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Position11"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 32
   Tag          = ""
   Top          = Char(10)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position12
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position12"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 33
   Tag          = ""
   Top          = Char(11)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position13
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position13"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 34
   Tag          = ""
   Top          = Char(12)
   Visible      = -1
   Width        = Char(37)
END
```

```
                                                                    Page  19
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                                                                  CHANGE&P.LST

BEGIN Label Position14
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Position14"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(34)
   MousePointer  = 0
   TabIndex      = 35
   Tag           = ""
   Top           = Char(13)
   Visible       = -1
   Width         = Char(37)
END
BEGIN Label Position15
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Position15"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(34)
   MousePointer  = 0
   TabIndex      = 36
   Tag           = ""
   Top           = Char(14)
   Visible       = -1
   Width         = Char(37)
END
BEGIN Label Position16
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "Position16"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(34)
   MousePointer  = 0
   TabIndex     = 37
   Tag          = ""
   Top          = Char(15)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position17
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position17"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 38
   Tag          = ""
   Top          = Char(16)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position18
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position18"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(34)
   MousePointer = 0
   TabIndex     = 39
   Tag          = ""
   Top          = Char(17)
   Visible      = -1
   Width        = Char(37)
END
BEGIN Label Position19
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "Position19"
```

```
     DragMode       = 0
     Enabled        = -1
     ForeColor      = QBColor(0)
     Height         = Char(1)
     Left           = Char(34)
     MousePointer   = 0
     TabIndex       = 40
     Tag            = ""
     Top            = Char(18)
     Visible        = -1
     Width          = Char(37)
  END
  BEGIN Label Position20
     Alignment      = 0
     AutoSize       = 0
     BackColor      = QBColor(7)
     BorderStyle    = 0
     Caption        = "Position20"
     DragMode       = 0
     Enabled        = -1
     ForeColor      = QBColor(0)
     Height         = Char(1)
     Left           = Char(34)
     MousePointer   = 0
     TabIndex       = 41
     Tag            = ""
     Top            = Char(19)
     Visible        = -1
     Width          = Char(37)
  END
  BEGIN Label Label22
     Alignment      = 0
     AutoSize       = 0
     BackColor      = QBColor(7)
     BorderStyle    = 0
     Caption        = "Λ"
     DragMode       = 0
     Enabled        = -1
     ForeColor      = QBColor(0)
     Height         = Char(1)
     Left           = Char(72)
     MousePointer   = 0
     TabIndex       = 54
     Tag            = ""
     Top            = Char(0)
     Visible        = -1
     Width          = Char(2)
  END
```

```
BEGIN Label Label23
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "B"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 55
   Tag          = ""
   Top          = Char(1)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label24
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "C"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 56
   Tag          = ""
   Top          = Char(2)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label25
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "D"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
```

```
    TabIndex      = 57
    Tag           = ""
    Top           = Char(3)
    Visible       = -1
    Width         = Char(2)
END
BEGIN Label Label26
    Alignment     = 0
    AutoSize      = 0
    BackColor     = QBColor(7)
    BorderStyle   = 0
    Caption       = "E"
    DragMode      = 0
    Enabled       = -1
    ForeColor     = QBColor(0)
    Height        = Char(1)
    Left          = Char(72)
    MousePointer  = 0
    TabIndex      = 58
    Tag           = ""
    Top           = Char(4)
    Visible       = -1
    Width         = Char(2)
END
BEGIN Label Label27
    Alignment     = 0
    AutoSize      = 0
    BackColor     = QBColor(7)
    BorderStyle   = 0
    Caption       = "F"
    DragMode      = 0
    Enabled       = -1
    ForeColor     = QBColor(0)
    Height        = Char(1)
    Left          = Char(72)
    MousePointer  = 0
    TabIndex      = 59
    Tag           = ""
    Top           = Char(5)
    Visible       = -1
    Width         = Char(2)
END
BEGIN Label Label28
    Alignment     = 0
    AutoSize      = 0
    BackColor     = QBColor(7)
    BorderStyle   = 0
    Caption       = "C"
    DragMode     = 0
    Enabled      = -1
    ForeColor    = QBColor(0)
    Height       = Char(1)
    Left         = Char(72)
    MousePointer = 0
    TabIndex     = 60
    Tag          = ""
    Top          = Char(6)
    Visible      = -1
    Width        = Char(2)
END
BEGIN Label Label29
    Alignment    = 0
    AutoSize     = 0
    BackColor    = QBColor(7)
    BorderStyle  = 0
    Caption      = "H"
    DragMode     = 0
    Enabled      = -1
    ForeColor    = QBColor(0)
    Height       = Char(1)
    Left         = Char(72)
    MousePointer = 0
    TabIndex     = 61
    Tag          = ""
    Top          = Char(7)
    Visible      = -1
    Width        = Char(2)
END
BEGIN Label Label30
    Alignment    = 0
    AutoSize     = 0
    BackColor    = QBColor(7)
    BorderStyle  = 0
    Caption      = "I"
    DragMode     = 0
    Enabled      = -1
    ForeColor    = QBColor(0)
    Height       = Char(1)
    Left         = Char(72)
    MousePointer = 0
    TabIndex     = 62
    Tag          = ""
    Top          = Char(8)
    Visible      = -1
    Width        = Char(2)
END
```

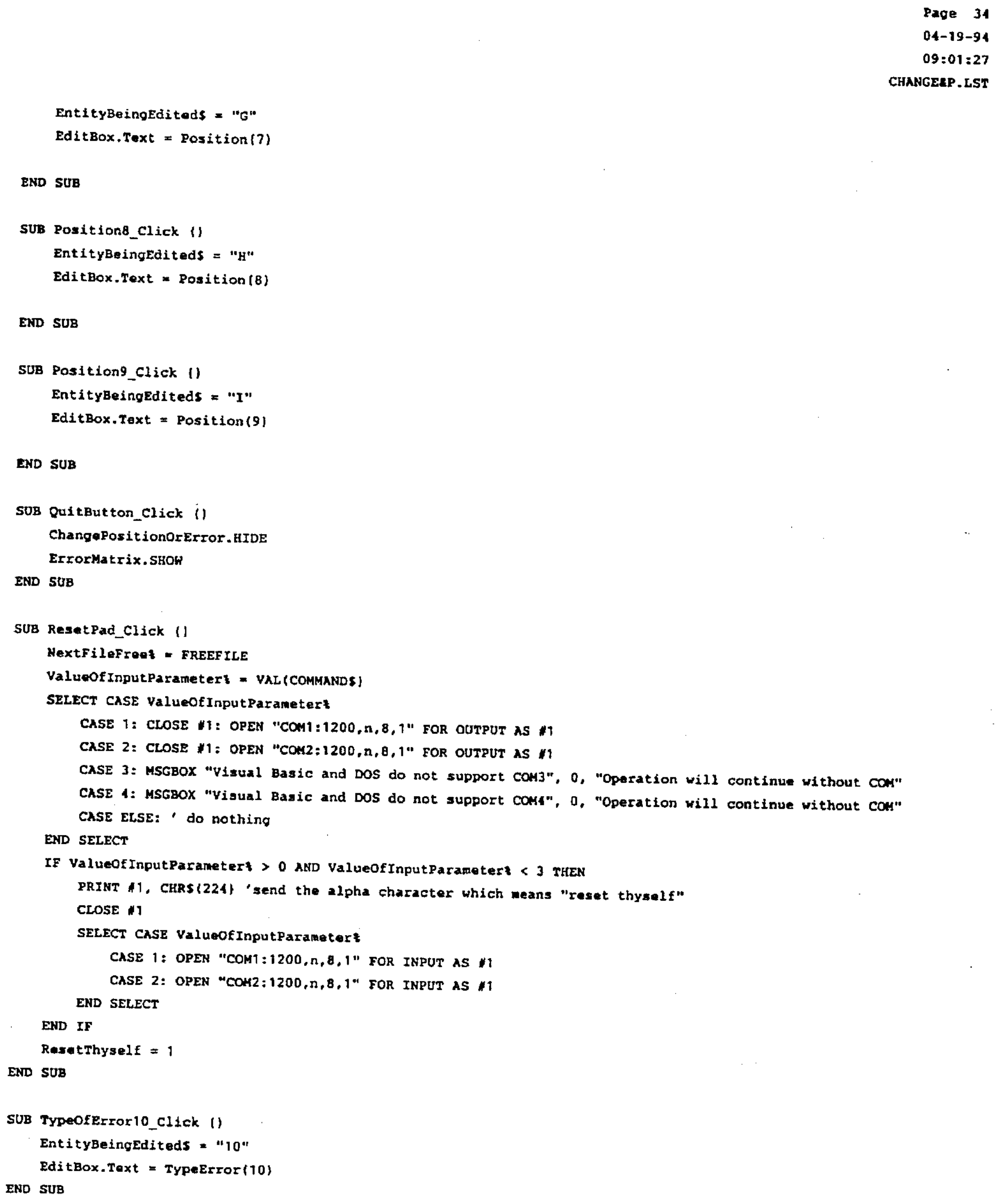
```
BEGIN Label Label31
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "J"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 63
   Tag          = ""
   Top          = Char(9)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label32
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "K"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 64
   Tag          = ""
   Top          = Char(10)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label33
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "L"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 65
   Tag          = ""
   Top          = Char(11)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label34
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "M"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 66
   Tag          = ""
   Top          = Char(12)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label35
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "N"
   DragMode     = 0
   Enabled      = -1
   ForeColor    = QBColor(0)
   Height       = Char(1)
   Left         = Char(72)
   MousePointer = 0
   TabIndex     = 67
   Tag          = ""
   Top          = Char(13)
   Visible      = -1
   Width        = Char(2)
END
BEGIN Label Label36
   Alignment    = 0
   AutoSize     = 0
   BackColor    = QBColor(7)
   BorderStyle  = 0
   Caption      = "O"
```

```
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(72)
      MousePointer  = 0
      TabIndex      = 68
      Tag           = ""
      Top           = Char(14)
      Visible       = -1
      Width         = Char(2)
   END
   BEGIN Label Label37
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = "P"
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(72)
      MousePointer  = 0
      TabIndex      = 69
      Tag           = ""
      Top           = Char(15)
      Visible       = -1
      Width         = Char(2)
   END
   BEGIN Label Label38
      Alignment     = 0
      AutoSize      = 0
      BackColor     = QBColor(7)
      BorderStyle   = 0
      Caption       = "Q"
      DragMode      = 0
      Enabled       = -1
      ForeColor     = QBColor(0)
      Height        = Char(1)
      Left          = Char(72)
      MousePointer  = 0
      TabIndex      = 70
      Tag           = ""
      Top           = Char(16)
      Visible       = -1
      Width         = Char(2)
   END
```

```
BEGIN Label Label39
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "R"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(72)
   MousePointer  = 0
   TabIndex      = 71
   Tag           = ""
   Top           = Char(17)
   Visible       = -1
   Width         = Char(2)
END
BEGIN Label Label40
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "S"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(72)
   MousePointer  = 0
   TabIndex      = 72
   Tag           = ""
   Top           = Char(18)
   Visible       = -1
   Width         = Char(2)
END
BEGIN Label Label41
   Alignment     = 0
   AutoSize      = 0
   BackColor     = QBColor(7)
   BorderStyle   = 0
   Caption       = "T"
   DragMode      = 0
   Enabled       = -1
   ForeColor     = QBColor(0)
   Height        = Char(1)
   Left          = Char(72)
   MousePointer  = 0
```

```
        TabIndex       = 73
        Tag            = ""
        Top            = Char(19)
        Visible        = -1
        Width          = Char(2)
    END
    BEGIN CommandButton ResetPad
        BackColor      = QBColor(7)
        Cancel         = 0
        Caption        = "Reset Pad"
        Default        = 0
        DragMode       = 0
        Enabled        = -1
        Height         = Char(3)
        Left           = Char(17)
        MousePointer   = 0
        TabIndex       = 74
        TabStop        = -1
        Tag            = ""
        Top            = Char(10)
        Visible        = -1
        Width          = Char(12)
    END
END
'$FORM ErrorMatrix
DIM SHARED Position(20) AS STRING
DIM SHARED TypeError(10) AS STRING
DIM SHARED EntityBeingEdited AS STRING
COMMON SHARED TypeError() AS STRING
COMMON SHARED Position() AS STRING
COMMON SHARED ResetThyself AS INTEGER

SUB Display_Click ()
    TypeOfError1.Caption = TypeError(1)
    TypeOfError2.Caption = TypeError(2)
    TypeOfError3.Caption = TypeError(3)
    TypeOfError4.Caption = TypeError(4)
    TypeOfError5.Caption = TypeError(5)
    TypeOfError6.Caption = TypeError(6)
    TypeOfError7.Caption = TypeError(7)
    TypeOfError8.Caption = TypeError(8)
    TypeOfError9.Caption = TypeError(9)
    TypeOfError10.Caption = TypeError(10)
'    FOR i% = 1 TO 10
'        TypesOfErrors.Text = TypeError(i)
'    NEXT i%
    Position1.Caption = Position(1)
    Position2.Caption = Position(2)
    Position3.Caption = Position(3)
    Position4.Caption = Position(4)
    Position5.Caption = Position(5)
    Position6.Caption = Position(6)
    Position7.Caption = Position(7)
    Position8.Caption = Position(8)
    Position9.Caption = Position(9)
    Position10.Caption = Position(10)
    Position11.Caption = Position(11)
    Position12.Caption = Position(12)
    Position13.Caption = Position(13)
    Position14.Caption = Position(14)
    Position15.Caption = Position(15)
    Position16.Caption = Position(16)
    Position17.Caption = Position(17)
    Position18.Caption = Position(18)
    Position19.Caption = Position(19)
    Position20.Caption = Position(20)
END SUB

SUB EditBox_Change ()
    SELECT CASE EntityBeingEdited$
        CASE "1": TypeError(1) = EditBox.Text
        CASE "2": TypeError(2) = EditBox.Text
        CASE "3": TypeError(3) = EditBox.Text
        CASE "4": TypeError(4) = EditBox.Text
        CASE "5": TypeError(5) = EditBox.Text
        CASE "6": TypeError(6) = EditBox.Text
        CASE "7": TypeError(7) = EditBox.Text
        CASE "8": TypeError(8) = EditBox.Text
        CASE "9": TypeError(9) = EditBox.Text
        CASE "10": TypeError(10) = EditBox.Text
        CASE "A": Position(1) = EditBox.Text
        CASE "B": Position(2) = EditBox.Text
        CASE "C": Position(3) = EditBox.Text
        CASE "D": Position(4) = EditBox.Text
        CASE "E": Position(5) = EditBox.Text
        CASE "F": Position(6) = EditBox.Text
        CASE "G": Position(7) = EditBox.Text
        CASE "H": Position(8) = EditBox.Text
        CASE "I": Position(9) = EditBox.Text
        CASE "J": Position(10) = EditBox.Text
        CASE "K": Position(11) = EditBox.Text
        CASE "L": Position(12) = EditBox.Text
        CASE "M": Position(13) = EditBox.Text
        CASE "N": Position(14) = EditBox.Text
        CASE "O": Position(15) = EditBox.Text
        CASE "P": Position(16) = EditBox.Text
        CASE "Q": Position(17) = EditBox.Text
        CASE "R": Position(18) = EditBox.Text
        CASE "S": Position(19) = EditBox.Text
        CASE "T": Position(20) = EditBox.Text
    END SELECT
    TypeOfError1.Caption = TypeError(1)
    TypeOfError2.Caption = TypeError(2)
    TypeOfError3.Caption = TypeError(3)
    TypeOfError4.Caption = TypeError(4)
    TypeOfError5.Caption = TypeError(5)
    TypeOfError6.Caption = TypeError(6)
    TypeOfError7.Caption = TypeError(7)
    TypeOfError8.Caption = TypeError(8)
    TypeOfError9.Caption = TypeError(9)
    TypeOfError10.Caption = TypeError(10)
    Position1.Caption = Position(1)
    Position2.Caption = Position(2)
    Position3.Caption = Position(3)
    Position4.Caption = Position(4)
    Position5.Caption = Position(5)
    Position6.Caption = Position(6)
    Position7.Caption = Position(7)
    Position8.Caption = Position(8)
    Position9.Caption = Position(9)
    Position10.Caption = Position(10)
    Position11.Caption = Position(11)
    Position12.Caption = Position(12)
    Position13.Caption = Position(13)
    Position14.Caption = Position(14)
    Position15.Caption = Position(15)
    Position16.Caption = Position(16)
    Position17.Caption = Position(17)
    Position18.Caption = Position(18)
    Position19.Caption = Position(19)
    Position20.Caption = Position(20)
    NextFileFree% = FREEFILE
    OPEN "PandE.dat" FOR OUTPUT AS NextFileFree%
    FOR i% = 1 TO 10
        PRINT #NextFileFree%, TypeError(i%)
    NEXT i%
    FOR i% = 1 TO 20
        PRINT #NextFileFree%, Position(i%)
    NEXT i%
    CLOSE #NextFileFree%
END SUB

SUB Position10_Click ()
    EntityBeingEdited$ = "J"
    EditBox.Text = Position(10)

END SUB

SUB Position11_Click ()
    EntityBeingEdited$ = "K"
    EditBox.Text = Position(11)
END SUB

SUB Position12_Click ()
    EntityBeingEdited$ = "L"
    EditBox.Text = Position(12)

END SUB

SUB Position13_Click ()
    EntityBeingEdited$ = "M"
    EditBox.Text = Position(13)

END SUB

SUB Position14_Click ()
    EntityBeingEdited$ = "N"
    EditBox.Text = Position(14)

END SUB

SUB Position15_Click ()
    EntityBeingEdited$ = "O"
    EditBox.Text = Position(15)

END SUB

SUB Position16_Click ()
    EntityBeingEdited$ = "P"
    EditBox.Text = Position(16)

END SUB

SUB Position17_Click ()
    EntityBeingEdited$ = "Q"
    EditBox.Text = Position(17)

END SUB

SUB Position18_Click ()
    EntityBeingEdited$ = "R"
    EditBox.Text = Position(18)
```

```
END SUB

SUB Position19_Click ()
    EntityBeingEdited$ = "S"
    EditBox.Text = Position(19)

END SUB

SUB Position1_Click ()
    EntityBeingEdited$ = "A"
    EditBox.Text = Position(1)
END SUB

SUB Position20_Click ()
    EntityBeingEdited$ = "T"
    EditBox.Text = Position(20)

END SUB

SUB Position2_Click ()
    EntityBeingEdited$ = "B"
    EditBox.Text = Position(2)
END SUB

SUB Position3_Click ()
    EntityBeingEdited$ = "C"
    EditBox.Text = Position(3)
END SUB

SUB Position4_Click ()
    EntityBeingEdited$ = "D"
    EditBox.Text = Position(4)
END SUB

SUB Position5_Click ()
    EntityBeingEdited$ = "E"
    EditBox.Text = Position(5)

END SUB

SUB Position6_Click ()
    EntityBeingEdited$ = "F"
    EditBox.Text = Position(6)

END SUB

SUB Position7_Click ()
```



```
    EntityBeingEdited$ = "G"
    EditBox.Text = Position(7)

END SUB

SUB Position8_Click ()
    EntityBeingEdited$ = "H"
    EditBox.Text = Position(8)

END SUB

SUB Position9_Click ()
    EntityBeingEdited$ = "I"
    EditBox.Text = Position(9)

END SUB

SUB QuitButton_Click ()
    ChangePositionOrError.HIDE
    ErrorMatrix.SHOW
END SUB

SUB ResetPad_Click ()
    NextFileFree% = FREEFILE
    ValueOfInputParameter% = VAL(COMMAND$)
    SELECT CASE ValueOfInputParameter%
        CASE 1: CLOSE #1: OPEN "COM1:1200,n,8,1" FOR OUTPUT AS #1
        CASE 2: CLOSE #1: OPEN "COM2:1200,n,8,1" FOR OUTPUT AS #1
        CASE 3: MSGBOX "Visual Basic and DOS do not support COM3", 0, "Operation will continue without COM"
        CASE 4: MSGBOX "Visual Basic and DOS do not support COM4", 0, "Operation will continue without COM"
        CASE ELSE: ' do nothing
    END SELECT
    IF ValueOfInputParameter% > 0 AND ValueOfInputParameter% < 3 THEN
        PRINT #1, CHR$(224) 'send the alpha character which means "reset thyself"
        CLOSE #1
        SELECT CASE ValueOfInputParameter%
            CASE 1: OPEN "COM1:1200,n,8,1" FOR INPUT AS #1
            CASE 2: OPEN "COM2:1200,n,8,1" FOR INPUT AS #1
        END SELECT
    END IF
    ResetThyself = 1
END SUB

SUB TypeOfError10_Click ()
    EntityBeingEdited$ = "10"
    EditBox.Text = TypeError(10)
END SUB
```

```
SUB TypeOfError1_Click ()
    EntityBeingEdited$ = "1"
    EditBox.Text = TypeError(1)
END SUB

SUB TypeOfError2_Click ()
    EntityBeingEdited$ = "2"
    EditBox.Text = TypeError(2)
END SUB

SUB TypeOfError3_Click ()
    EntityBeingEdited$ = "3"
    EditBox.Text = TypeError(3)
END SUB

SUB TypeOfError4_Click ()
    EntityBeingEdited$ = "4"
    EditBox.Text = TypeError(4)
END SUB

SUB TypeOfError5_Click ()
    EntityBeingEdited$ = "5"
    EditBox.Text = TypeError(5)
END SUB

SUB TypeOfError6_Click ()
    EntityBeingEdited$ = "6"
    EditBox.Text = TypeError(6)
END SUB

SUB TypeOfError7_Click ()
    EntityBeingEdited$ = "7"
    EditBox.Text = TypeError(7)
END SUB

SUB TypeOfError8_Click ()
    EntityBeingEdited$ = "8"
    EditBox.Text = TypeError(8)
END SUB

SUB TypeOfError9_Click ()
    EntityBeingEdited$ = "9"
    EditBox.Text = TypeError(9)
END SUB
```

What is claimed is:

1. A system for entering and analyzing data which identify a defect occurring in a workpiece, the defect being identified by its position in the workpiece and by a type-of-error, said system comprising:

a data entry means for displaying a pictorial image of the workpiece,

the data entry means further providing a plurality of first indicia thereon in juxtaposition to the pictorial image of the workpiece, each first indicia for identifying the position of the defect in the workpiece, and

the data entry means further providing a plurality of second indicia thereon, each second indicia for identifying the type-of-error in the workpiece, wherein

the data identifying the defect are entered in the system when one of the first indicia in combination with one of the second indicia are activated;

a processing means for processing the entered data; and

a controlling means controlling said data entry means in response to the entered data.

2. The system of claim **1**, wherein said processing means includes a computer, and wherein said controlling means includes means for delivering the entered data to the computer.

3. The system of claim **2**, wherein said computer includes a computer display.

4. The system of claim **3**, wherein said controlling means further includes means for communicating to the computer from the controlling means continually, and wherein the computer includes means for collecting and displaying on the computer display the delivered data in real time.

5. The system of claim **4**, wherein said controlling means further includes means for delivering data to the computer periodically, and wherein the computer includes means for collecting and displaying on the computer display the periodically delivered data.

6. The system of claim **5**, wherein said controlling means further includes means for activating the periodical delivery of data to the computer, and wherein said controlling means further includes means for activating said means for continual communication between the computer and said controlling means.

7. The system of claim **2**, further including a printing means, and wherein the computer includes means for output of the delivered data to the printing means.

8. The system of claim **7**, wherein the computer further includes means for summarizing and printing data on the ten most serious defects.

9. The system of claim **1**, further including a stand-alone display, wherein said controlling means includes means for delivering data to said stand-alone display.

10. The system of claim **1**, further including a display integral with the data entry means, wherein said controlling means includes means for delivering data to said integral display.

11. The system of claim **1**, wherein said one of the first indicia in combination with one of the second indicia are activated in any order.

12. The system of claim **1**, further including an audio feedback means controlled by the controlling means.

13. The system of claim **1**, further including a visual feedback means controlled by the controlling means.

14. The system of claim **1**, further including a printed circuit board for disposing said controlling means thereon.

15. The system of claim **1**, wherein the controlling means includes a micro-controller.

16. The system of claim **1**, wherein the controlling means are fed from a power supply,further including a power regulating and conditioning means disposed between the power supply and the controlling means.

17. The system of claim **16**, wherein the controlling means and the processing means each further includes a safeguard means providing for recovering the entered data in the event a power failure occurs.

18. An apparatus for entering data on at least one defect occurring in a workpiece, the defect being identified by a position in the workpiece and a type-of-error, wherein the workpiece has a plurality of defect positions therein, and wherein there are different types-of-errors occurring in the workpiece, the apparatus comprising a display means for displaying the pictorial image of the workpiece, the display means having a plurality of first indicia thereon in juxtaposition to the workpiece displayed thereon, such that one of the first indicia is associated with the position of the error in the workpiece, and the display means further having a plurality of second indicia thereon indicating the type-of-error.

19. The apparatus of claim **18**, wherein the first indicia are disposed around the pictorial image of the workpiece, displayed on the display means.

20. The apparatus of claim **18**, wherein the second indicia are arranged in a column on the display means.

21. The apparatus of claim **18**, wherein the display means further includes a front screen and a sketch board disposed behind the front screen.

22. The apparatus of claim **21**, wherein the sketch board has a perimeter including a plurality of first apertures in precise registration with the respective first indicia,

each of the first apertures being connected by a reference line to the respective possible positions of said at least one defect in the workpiece,

wherein the sketch board further includes a group of second apertures disposed on the sketch board in precise registration with the respective said second indicia, and

wherein each second aperture is associated with the respective type of error of said at least one defect in the workpiece.

23. The apparatus of claim **21**, wherein the front screen includes a transparent portion,

wherein the pictorial image of the workpiece and a list of possible types of error of said at least one defect in said workpiece being sketched on the sketch board are displayed through the transparent portion,

wherein the front screen further includes first apertures and second apertures in precise registration with corresponding first and second apertures of the sketch board.

24. The apparatus of claim **21**, further including a plurality of sketch boards, each sketch board for a particular workpiece.

25. The apparatus of claim **24**, wherein said sketch boards are in a tear-off arrangement.

26. The apparatus of claim **24**, wherein said sketch boards are removably interchangeable, such that each sketch board includes a detailed pictorial description of the particular workpiece, or a portion thereof, along with the list of types of errors possible for this workpiece.

27. The apparatus of claim **21**, further including a support board carrying on the sketch board, wherein the support board provides first and second apertures, wherein first and second apertures of the support board correspond to and are in precise registration with the first and second apertures of both the sketch board and the front screen, respectively.

28. The apparatus of claim **21**, further including a key board, wherein said key board provides first and second keys, corresponding to first and second indicia, respectively, each first and second key including a contact portion, wherein first and second keys are in precise registration with the first and second apertures of both the sketch board and the front board, respectively, such that the contact portions of each of the first and second keys are protruded through the respective apertures.

29. The apparatus of claim **28**, wherein the key board includes at least one printed circuit board with an electronic circuitry thereon.

30. The apparatus of claim **21**, wherein the sketch board includes a pre-printed die-cut paper sheet.

31. A method for entering data relating to a defect occurring in a workpiece, wherein the workpiece has a plurality of defect positions therein, and wherein there are different types of errors occurring in the workpiece, the method comprising the steps of:

providing a data entry means, wherein a pictorial image of the workpiece is displayed thereon,

providing a plurality of first indicia disposed on the data entry means in juxtaposition to the pictorial image of the workpiece displayed thereon, such that each one of the first indicia is associated with one of said plurality of defect positions in the workpiece, and

providing a plurality of second indicia disposed on the data entry means, such that each one of the second indicia is associated with one of said types-of-errors occurring in the workpiece; and

activating one of the first indicia corresponding to the position of the defect in combination with one of the second indicia corresponding to the type-of-error, thereby entering data indicating the position and the type-of-error occurring in the workpiece.

32. The method of claim **31**, wherein said first and second indicia are activated in any order.

33. The method of claim **31**, further including the step of providing an audible feed-back means.

34. The method of claim **31**, further including the step of providing a visual feed-back means.

35. The method of claim **31**, further including the step of providing the processing means for processing the entered data.

36. A system for data entry and analysis, said data relating to an attribute occurring in an object, said system comprising:

a data entry means for displaying a pictorial image of said object,

the data entry means further providing a plurality of first indicia thereon associated with the pictorial image of the object, each first indicia for identifying a location of the attribute in the object, and

the data entry means further providing at least one group of additional indicia thereon, each additional indicia for identifying a parameter of the attribute in the object,

wherein the data identifying the attribute are entered in the system when one of the first indicia in combination with at least one of the additional indicia are activated;

a processing means for processing the entered data; and

a controlling means controlling said data entry means in response to the entered data.

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