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925 O.G. 8

T925,003

ECG MONITORING METHOD

Raymond E. Bonner, Yorktown Heights, N.Y., assignor to International Business Machines Corporation, Armonk, N.Y.

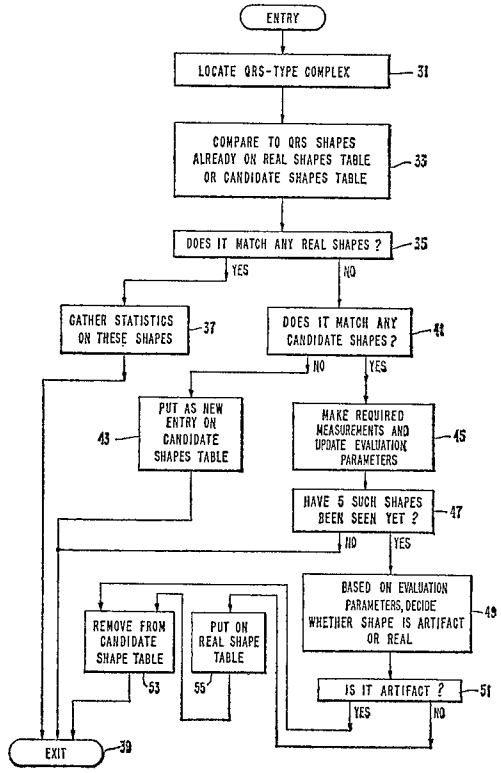
Continuation of application Ser. No. 51,236, July 30, 1970. This application June 29, 1973, Ser. No. 375,284

Int. Cl. A61b *5/04*

U.S. Cl. 444—1

6 Sheets Drawing. 32 Pages Specification

Methods of monitoring and analyzing electrocardiographic signal data, to identify arrhythmias and the like, require selection of real QRS complexes and rejection of artifacts that look like real QRS complexes. To achieve this end, two tables of QRS complex shapes are employed in a digital computer, with the first table containing the shapes of different versions of real QRS complexes and the second table containing the shapes of QRS-type complexes which have not yet been determined real but are candidates for being considered real. As shown in FIG. 3, a located QRS-type complex is first compared to the various shapes on the "real shapes" table, as represented by the steps of blocks **33** and **35**. If it compares with none, it is then compared to the shapes on the "candidate shapes" table, as represented by the steps of blocks **33–41**. If it compares with none of the shapes on the "candidate shapes" table, it is added thereto as a new candidate, as shown at step **43**. If it compares with one of the shapes on the "candidate shapes" table, that fact is noted at step **45** and more credence is given that shape as being a possible new version of a real QRS complex. Measurements are also made at step **45** for evaluating candidate shapes and decision logic is employed at step **49** to ultimately decide whether or not a candidate shape, after having been seen several times, is a new version of a real QRS complex.



Aug. 6, 1974 R. E. BONNER T925,003

EGG MONITORING METHOD

Original Filed July 30, 1970 6 Sheets-Sheet 1

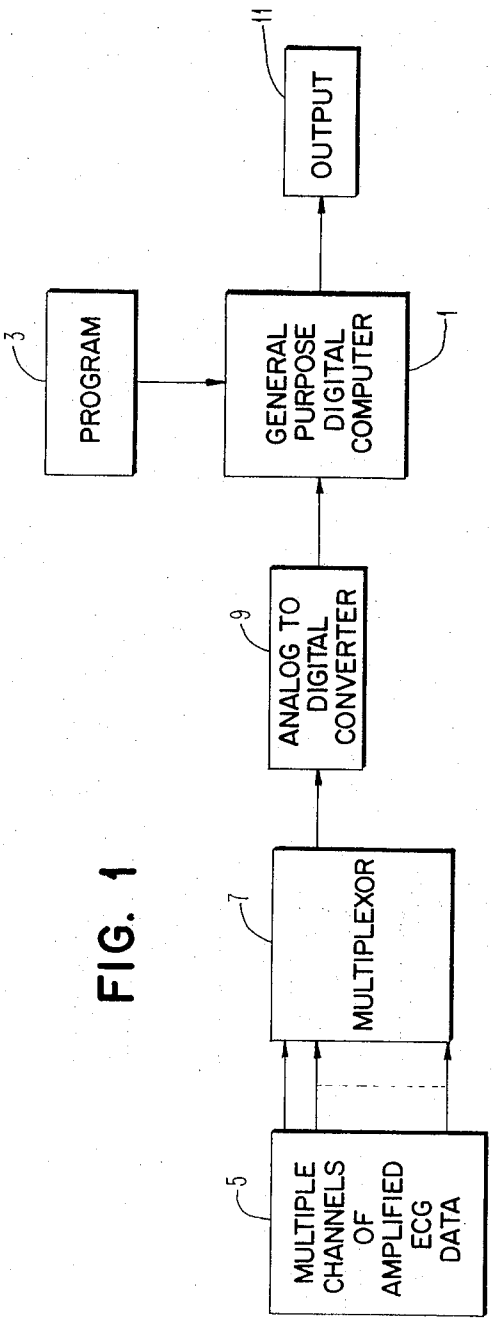


FIG. 1

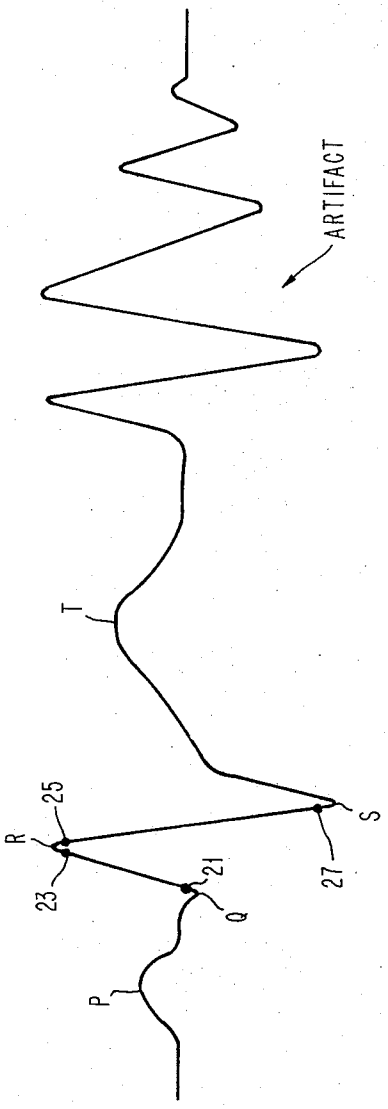


FIG. 2

INVENTOR
RAYMOND E. BONNER

BY John A. Gordan
ATTORNEY

FIG. 3

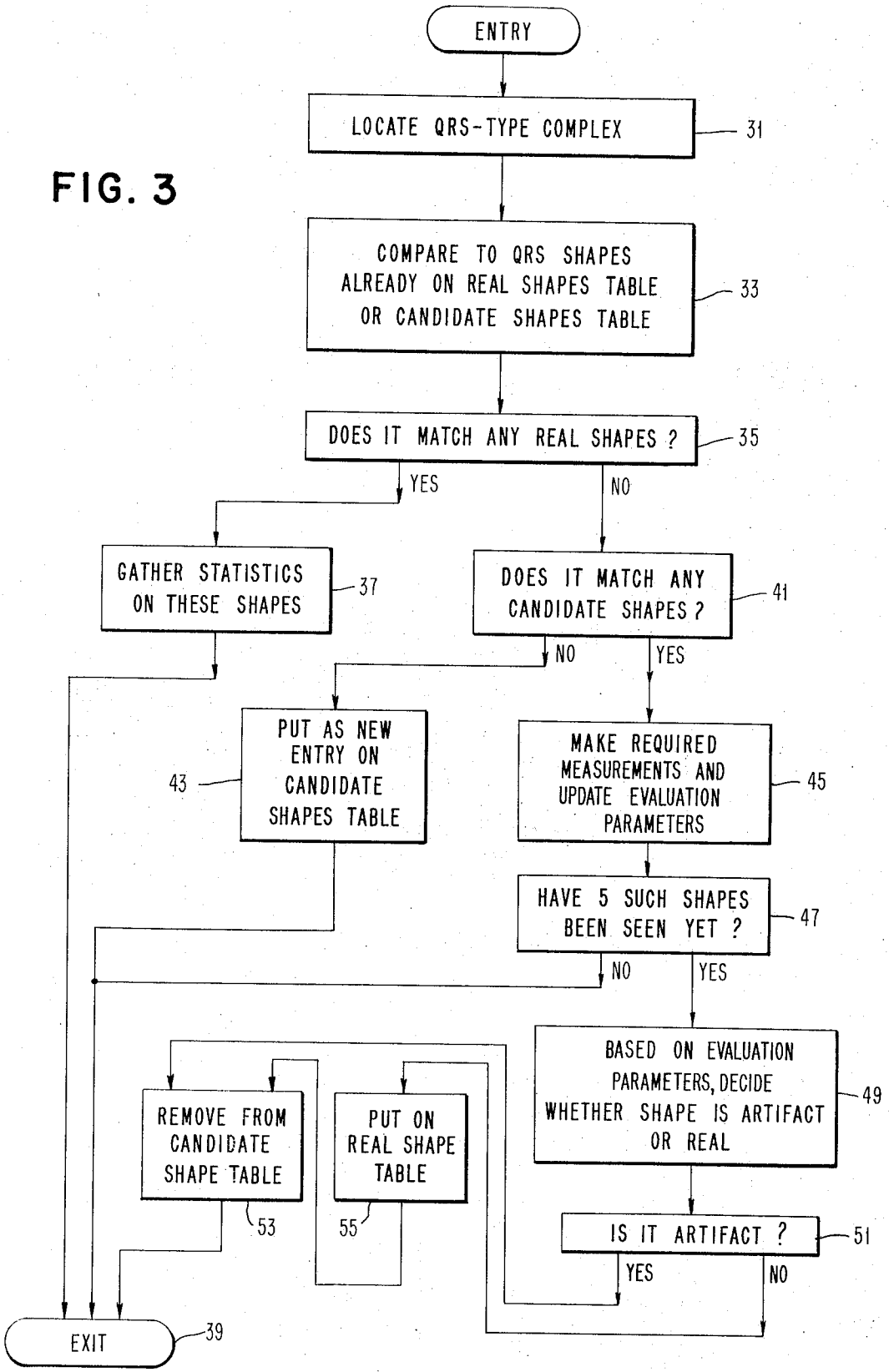

ENTRY
LOCATE QRS-TYPE COMPLEX
31
COMPARE TO QRS SHAPES ALREADY ON REAL SHAPES TABLE OR CANDIDATE SHAPES TABLE
33
DOES IT MATCH ANY REAL SHAPES ?
35
YES
NO
GATHER STATISTICS ON THESE SHAPES
37
DOES IT MATCH ANY CANDIDATE SHAPES ?
41
NO
YES
PUT AS NEW ENTRY ON CANDIDATE SHAPES TABLE
43
MAKE REQUIRED MEASUREMENTS AND UPDATE EVALUATION PARAMETERS
45
HAVE 5 SUCH SHAPES BEEN SEEN YET ?
47
NO
YES
BASED ON EVALUATION PARAMETERS, DECIDE WHETHER SHAPE IS ARTIFACT OR REAL
49
REMOVE FROM CANDIDATE SHAPE TABLE
53
PUT ON REAL SHAPE TABLE
55
IS IT ARTIFACT ?
51
YES
NO
EXIT
39

FIG. 4

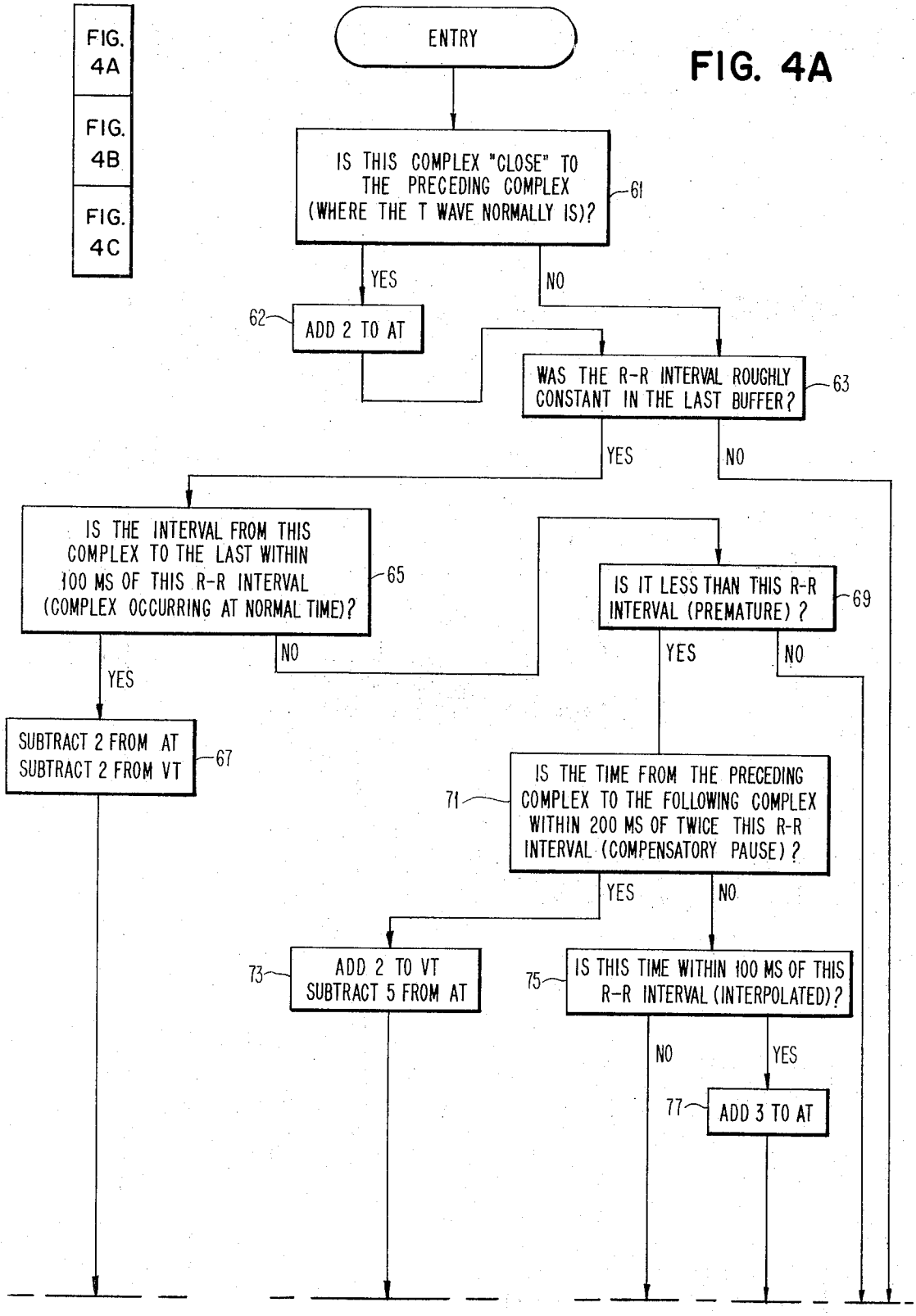

FIG. 4A
FIG. 4B
FIG. 4C
ENTRY
IS THIS COMPLEX "CLOSE" TO THE PRECEDING COMPLEX (WHERE THE T WAVE NORMALLY IS)?
61
YES
NO
62
ADD 2 TO AT
WAS THE R-R INTERVAL ROUGHLY CONSTANT IN THE LAST BUFFER?
63
YES
NO
IS THE INTERVAL FROM THIS COMPLEX TO THE LAST WITHIN 100 MS OF THIS R-R INTERVAL (COMPLEX OCCURRING AT NORMAL TIME)?
65
NO
YES
IS IT LESS THAN THIS R-R INTERVAL (PREMATURE) ?
69
YES
NO
SUBTRACT 2 FROM AT
SUBTRACT 2 FROM VT
67
71
IS THE TIME FROM THE PRECEDING COMPLEX TO THE FOLLOWING COMPLEX WITHIN 200 MS OF TWICE THIS R-R INTERVAL (COMPENSATORY PAUSE) ?
YES
NO
73
ADD 2 TO VT
SUBTRACT 5 FROM AT
75
IS THIS TIME WITHIN 100 MS OF THIS R-R INTERVAL (INTERPOLATED)?
NO
YES
77
ADD 3 TO AT

FIG. 4A

FIG. 4B

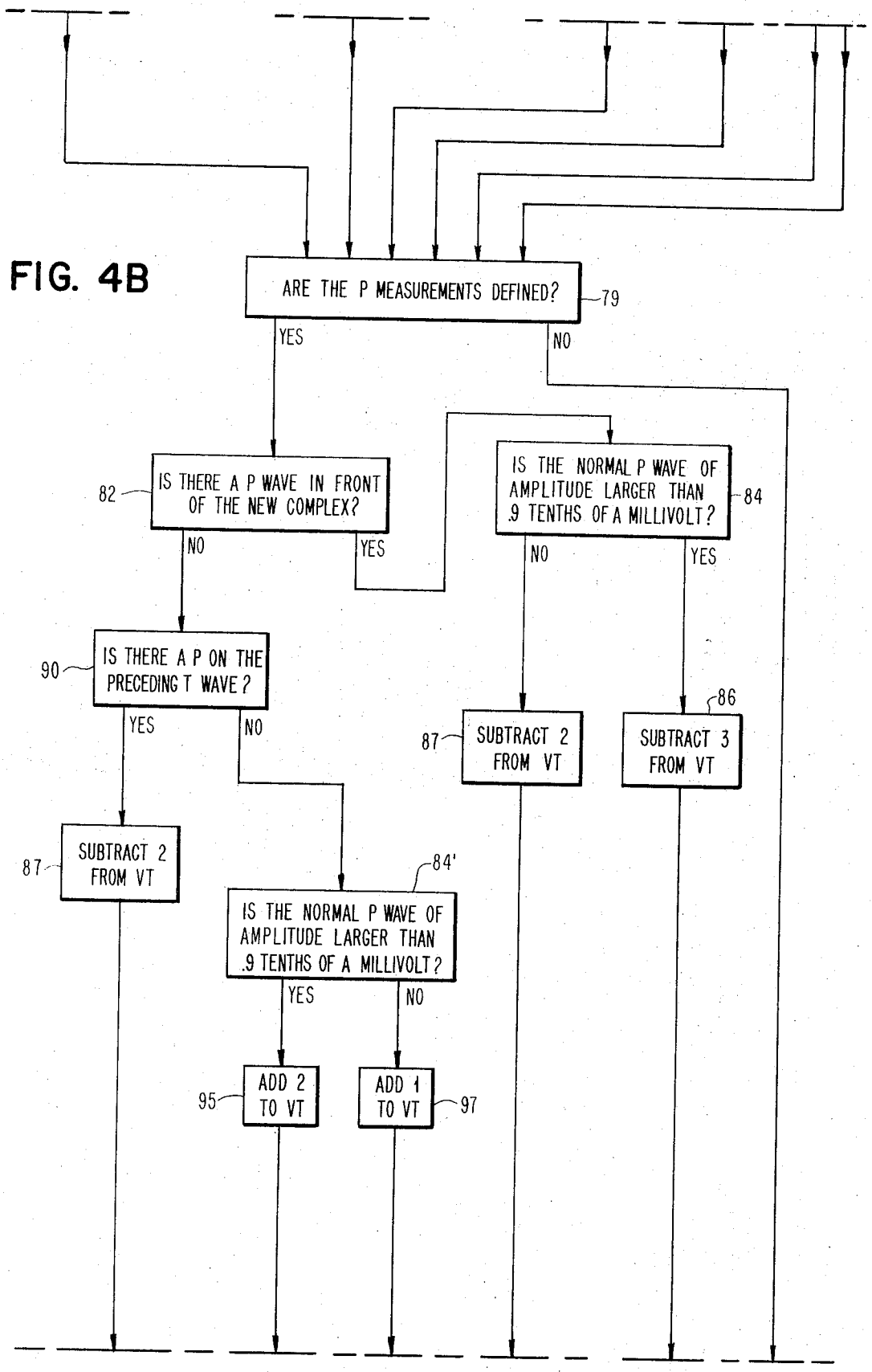
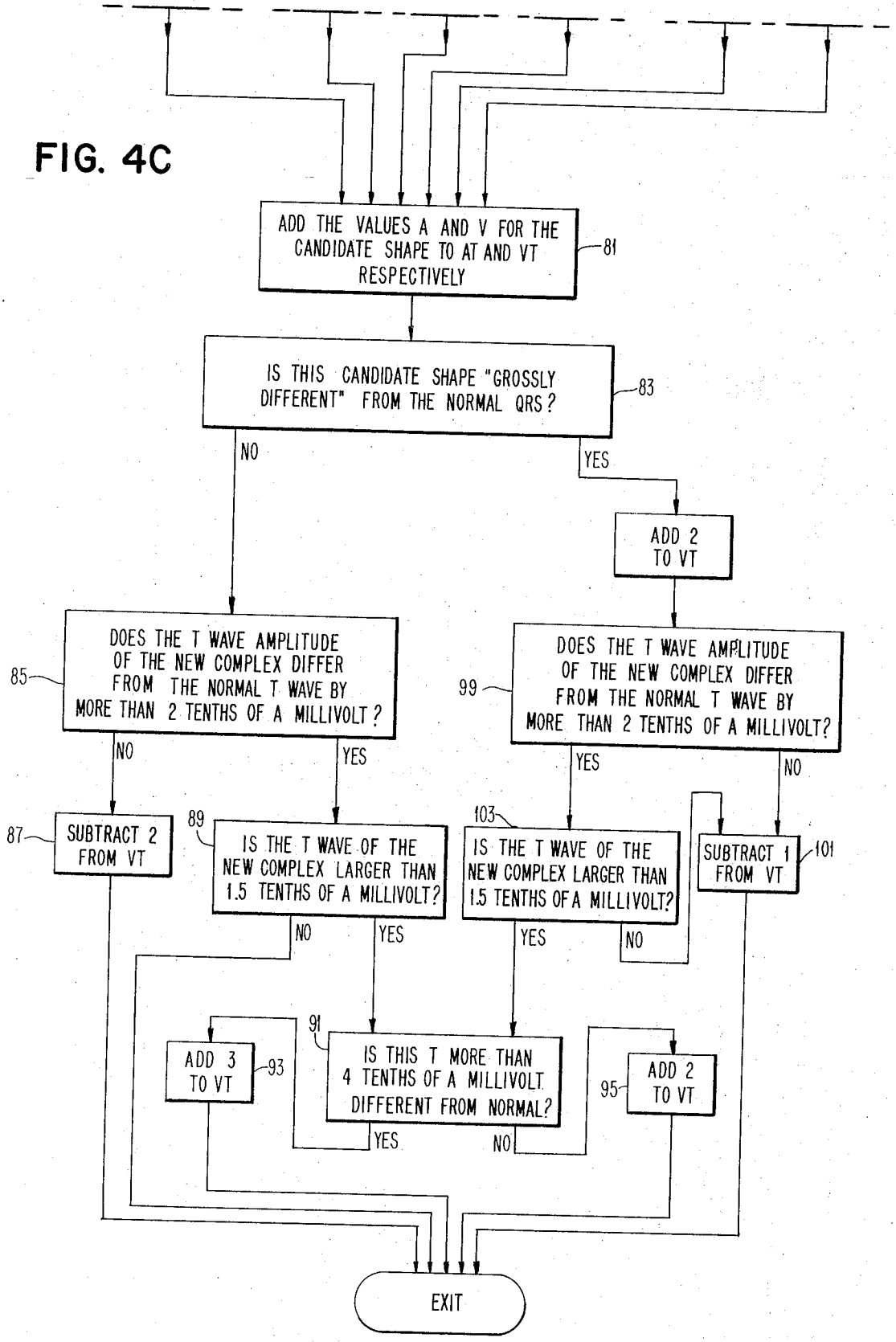

ARE THE P MEASUREMENTS DEFINED?
79
YES
NO
82
IS THERE A P WAVE IN FRONT OF THE NEW COMPLEX?
NO
YES
IS THE NORMAL P WAVE OF AMPLITUDE LARGER THAN .9 TENTHS OF A MILLIVOLT?
84
NO
YES
90
IS THERE A P ON THE PRECEDING T WAVE?
YES
NO
87
SUBTRACT 2 FROM VT
86
SUBTRACT 3 FROM VT
87
SUBTRACT 2 FROM VT
84'
IS THE NORMAL P WAVE OF AMPLITUDE LARGER THAN .9 TENTHS OF A MILLIVOLT?
YES
NO
95
ADD 2 TO VT
ADD 1 TO VT
97

FIG. 4C


ADD THE VALUES A AND V FOR THE CANDIDATE SHAPE TO AT AND VT RESPECTIVELY
81
IS THIS CANDIDATE SHAPE "GROSSLY DIFFERENT" FROM THE NORMAL QRS?
83
NO
YES
ADD 2 TO VT
DOES THE T WAVE AMPLITUDE OF THE NEW COMPLEX DIFFER FROM THE NORMAL T WAVE BY MORE THAN 2 TENTHS OF A MILLIVOLT?
85
99
NO
YES
YES
NO
SUBTRACT 2 FROM VT
87
IS THE T WAVE OF THE NEW COMPLEX LARGER THAN 1.5 TENTHS OF A MILLIVOLT?
89
103
IS THE T WAVE OF THE NEW COMPLEX LARGER THAN 1.5 TENTHS OF A MILLIVOLT?
SUBTRACT 1 FROM VT
101
NO
YES
YES
NO
ADD 3 TO VT
93
91
IS THIS T MORE THAN 4 TENTHS OF A MILLIVOLT DIFFERENT FROM NORMAL?
ADD 2 TO VT
95
YES
NO
EXIT

EGG MONITORING METHOD

Original Filed July 30, 1970 6 Sheets-Sheet 6

FIG. 5

