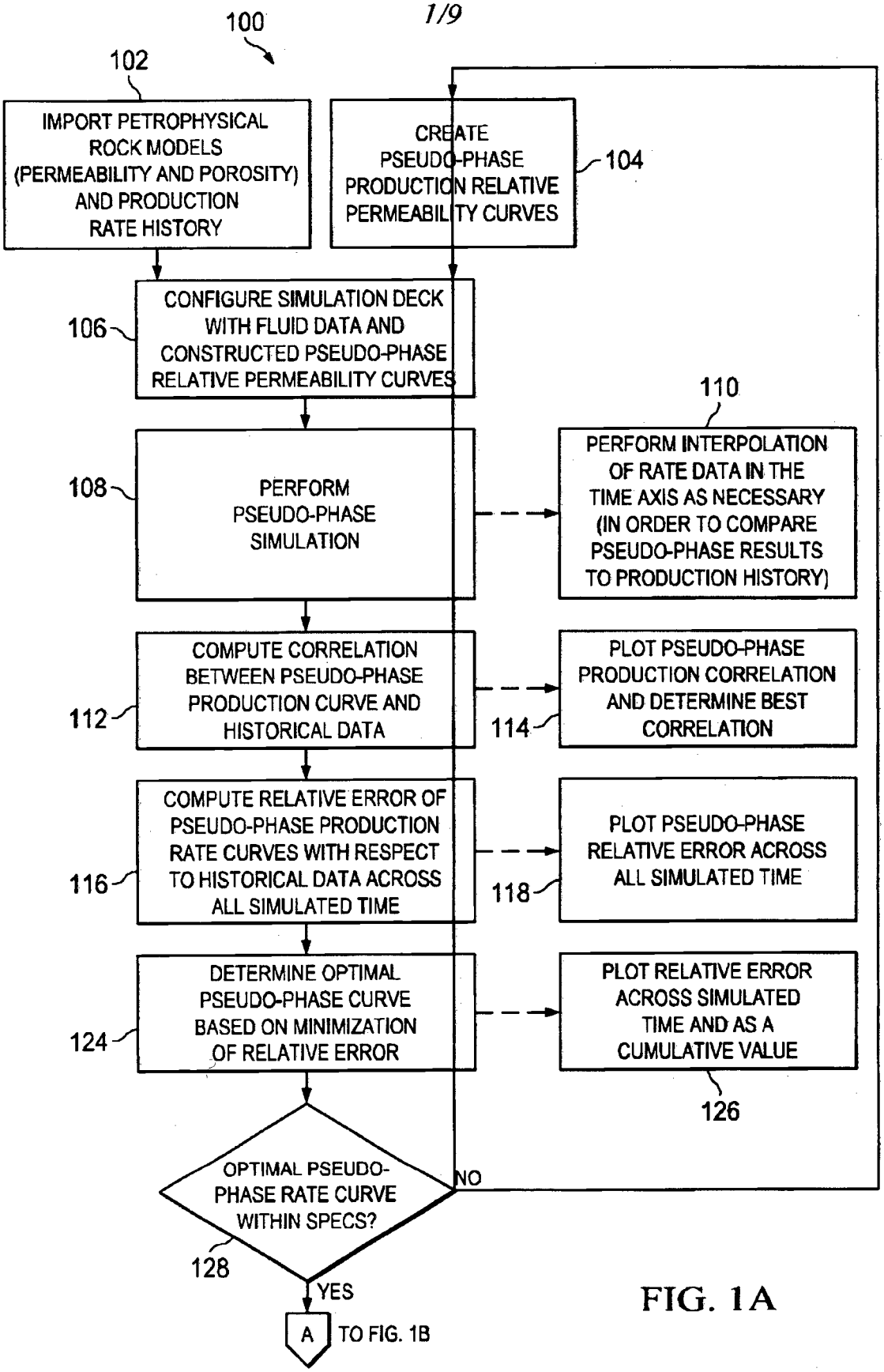

100
102
IMPORT PETROPHYSICAL ROCK MODELS (PERMEABILITY AND POROSITY) AND PRODUCTION RATE HISTORY
CREATE PSEUDO-PHASE PRODUCTION RELATIVE PERMEABILITY CURVES
104
CONFIGURE SIMULATION DECK WITH FLUID DATA AND CONSTRUCTED PSEUDO-PHASE RELATIVE PERMEABILITY CURVES
106
110
PERFORM PSEUDO-PHASE SIMULATION
108
PERFORM INTERPOLATION OF RATE DATA IN THE TIME AXIS AS NECESSARY (IN ORDER TO COMPARE PSEUDO-PHASE RESULTS TO PRODUCTION HISTORY)
COMPUTE CORRELATION BETWEEN PSEUDO-PHASE PRODUCTION CURVE AND HISTORICAL DATA
112
PLOT PSEUDO-PHASE PRODUCTION CORRELATION AND DETERMINE BEST CORRELATION
114
COMPUTE RELATIVE ERROR OF PSEUDO-PHASE PRODUCTION RATE CURVES WITH RESPECT TO HISTORICAL DATA ACROSS ALL SIMULATED TIME
116
PLOT PSEUDO-PHASE RELATIVE ERROR ACROSS ALL SIMULATED TIME
118
DETERMINE OPTIMAL PSEUDO-PHASE CURVE BASED ON MINIMIZATION OF RELATIVE ERROR
124
PLOT RELATIVE ERROR ACROSS SIMULATED TIME AND AS A CUMULATIVE VALUE
126
OPTIMAL PSEUDO-PHASE RATE CURVE WITHIN SPECS?
128
NO
YES
A
TO FIG. 1B

FIG. 1A

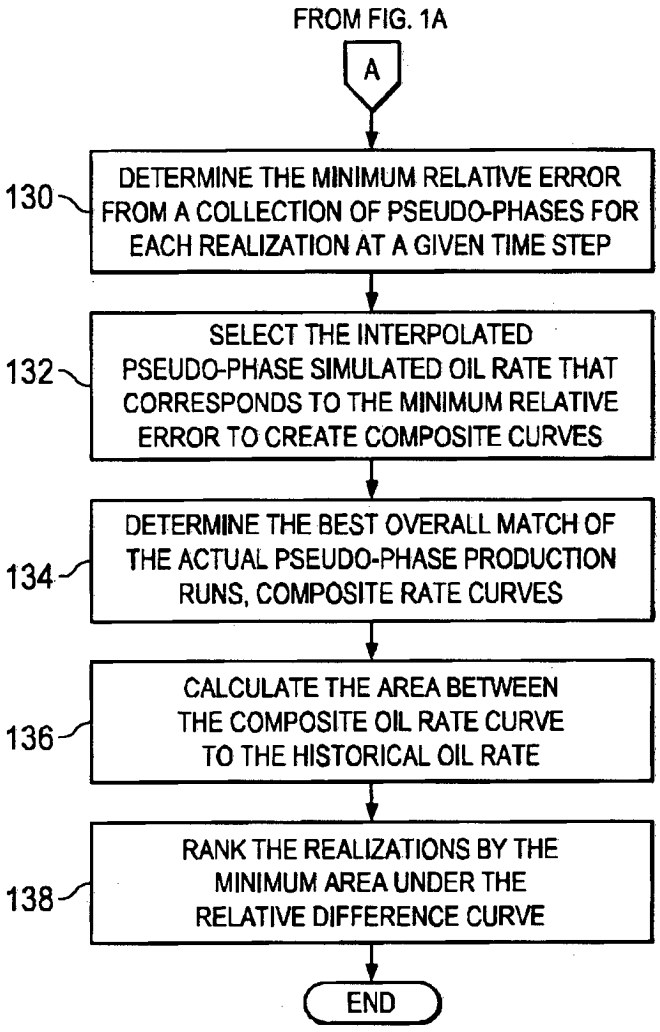

FROM FIG. 1A
A
130
DETERMINE THE MINIMUM RELATIVE ERROR FROM A COLLECTION OF PSEUDO-PHASES FOR EACH REALIZATION AT A GIVEN TIME STEP
132
SELECT THE INTERPOLATED PSEUDO-PHASE SIMULATED OIL RATE THAT CORRESPONDS TO THE MINIMUM RELATIVE ERROR TO CREATE COMPOSITE CURVES
134
DETERMINE THE BEST OVERALL MATCH OF THE ACTUAL PSEUDO-PHASE PRODUCTION RUNS, COMPOSITE RATE CURVES
136
CALCULATE THE AREA BETWEEN THE COMPOSITE OIL RATE CURVE TO THE HISTORICAL OIL RATE
138
RANK THE REALIZATIONS BY THE MINIMUM AREA UNDER THE RELATIVE DIFFERENCE CURVE
END

FIG. 1B

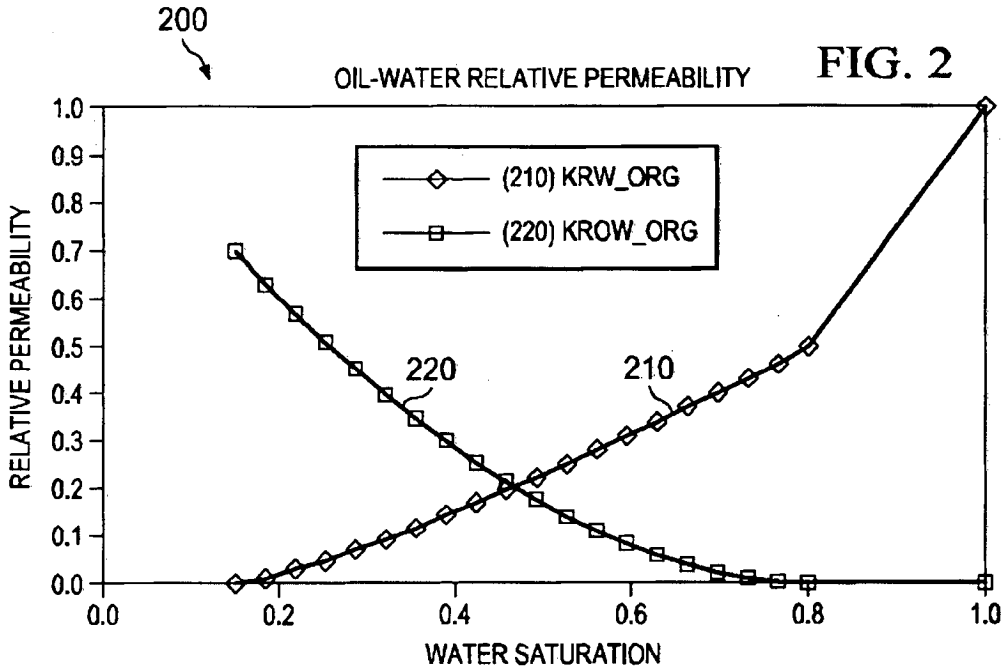

200
OIL-WATER RELATIVE PERMEABILITY
(210) KRW_ORG
(220) KROW_ORG
220
210
RELATIVE PERMEABILITY
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
WATER SATURATION

FIG. 2

FIG. 3

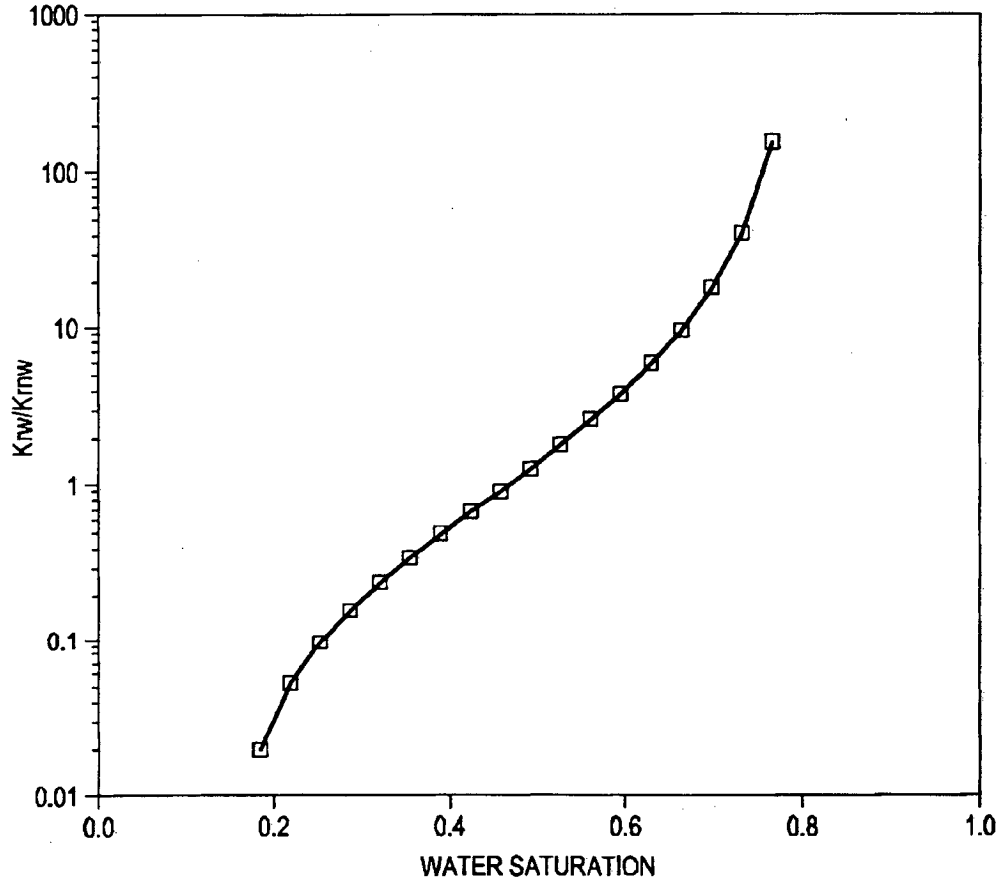
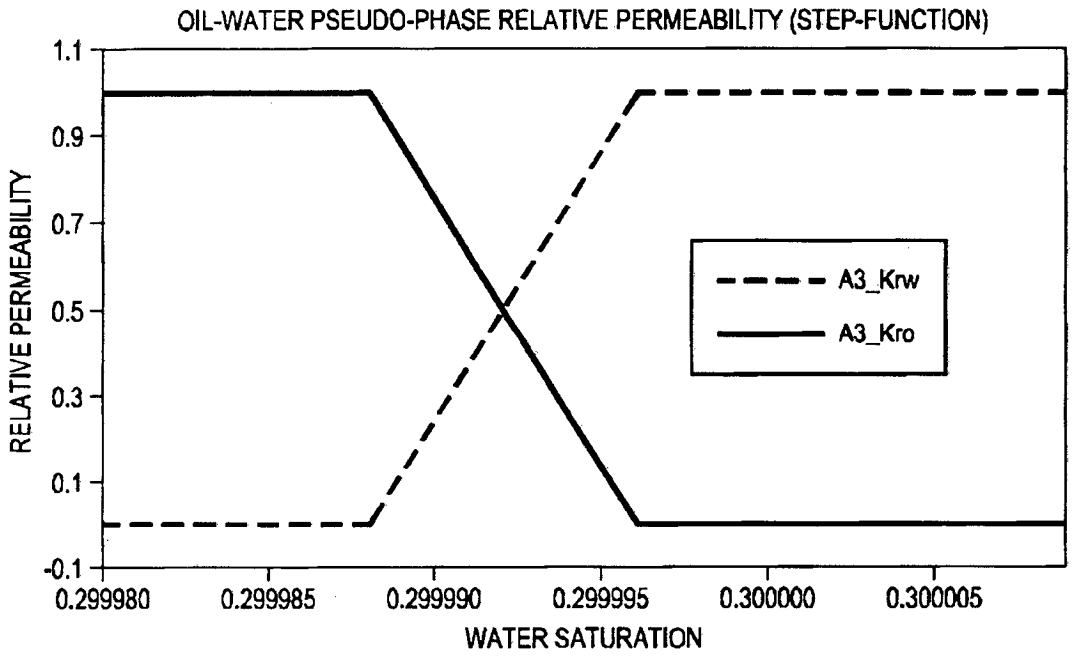

1000
100
10
1
0.1
0.01
Krw/Kmw
0.0
0.2
0.4
0.6
0.8
1.0
WATER SATURATION

FIG. 4


OIL-WATER PSEUDO-PHASE RELATIVE PERMEABILITY (STEP-FUNCTION)
RELATIVE PERMEABILITY
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
0.299980
0.299985
0.299990
0.299995
0.300000
0.300005
WATER SATURATION
A3_Krw
A3_Kro

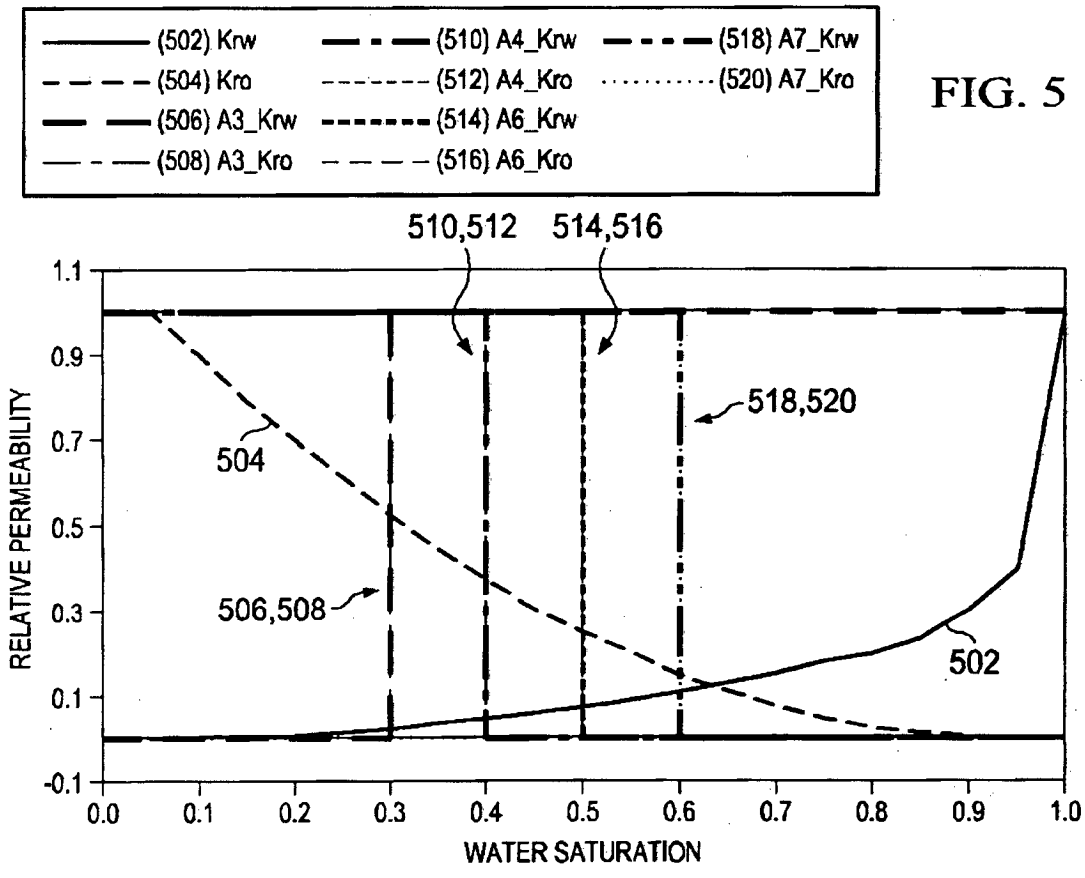

(502) Krw
(504) Kro
(506) A3_Krw
(508) A3_Kro
(510) A4_Krw
(512) A4_Kro
(514) A6_Krw
(516) A6_Kro
(518) A7_Krw
(520) A7_Kro
510,512
514,516
518,520
504
506,508
502
RELATIVE PERMEABILITY
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
WATER SATURATION

FIG. 5

FIG. 6

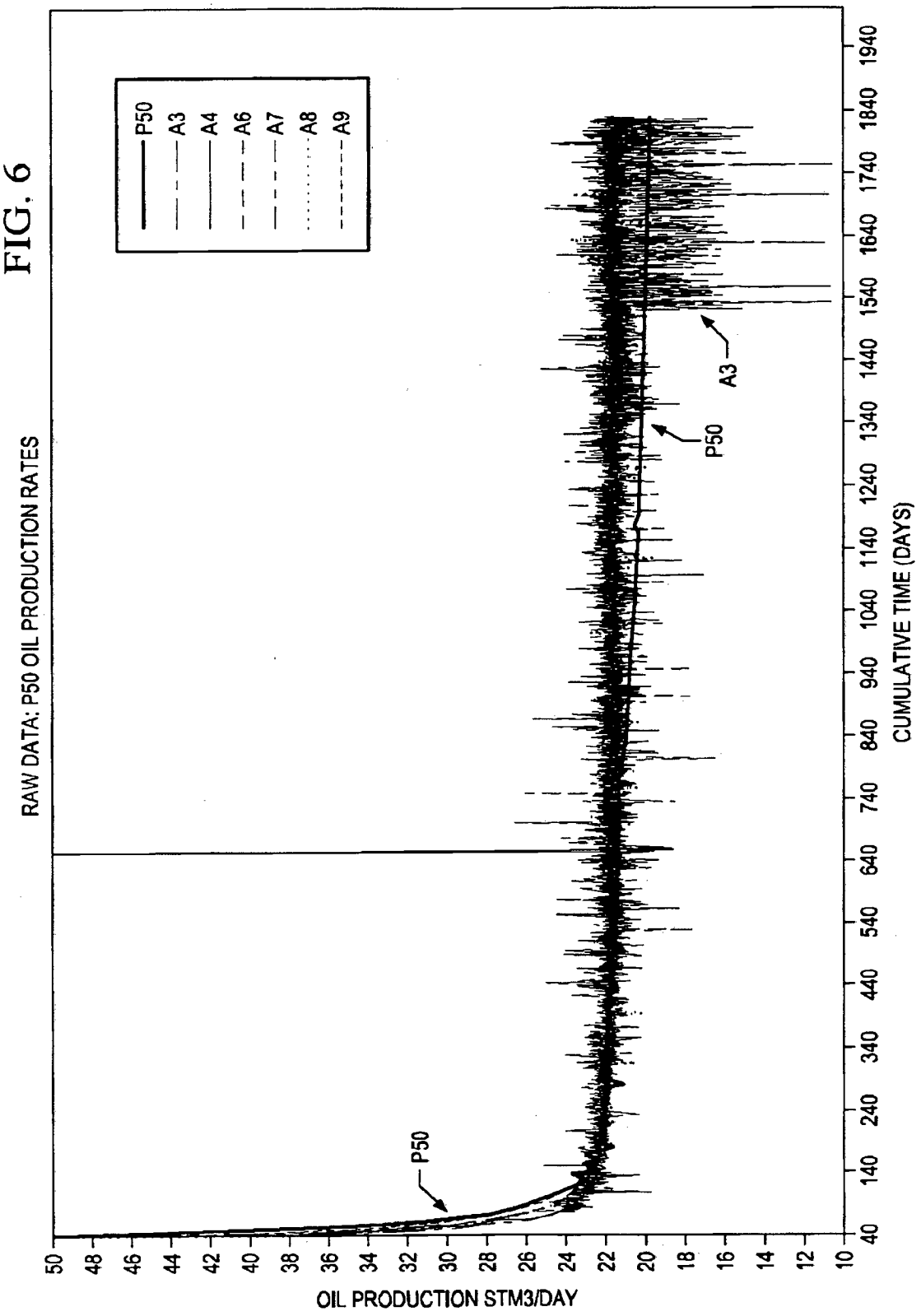

RAW DATA: P50 OIL PRODUCTION RATES
P50
A3
A4
A6
A7
A8
A9
P50
A3
P50
OIL PRODUCTION STM3/DAY
CUMULATIVE TIME (DAYS)
50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10
40 140 240 340 440 540 640 740 840 940 1040 1140 1240 1340 1440 1540 1640 1740 1840 1940

FIG. 7

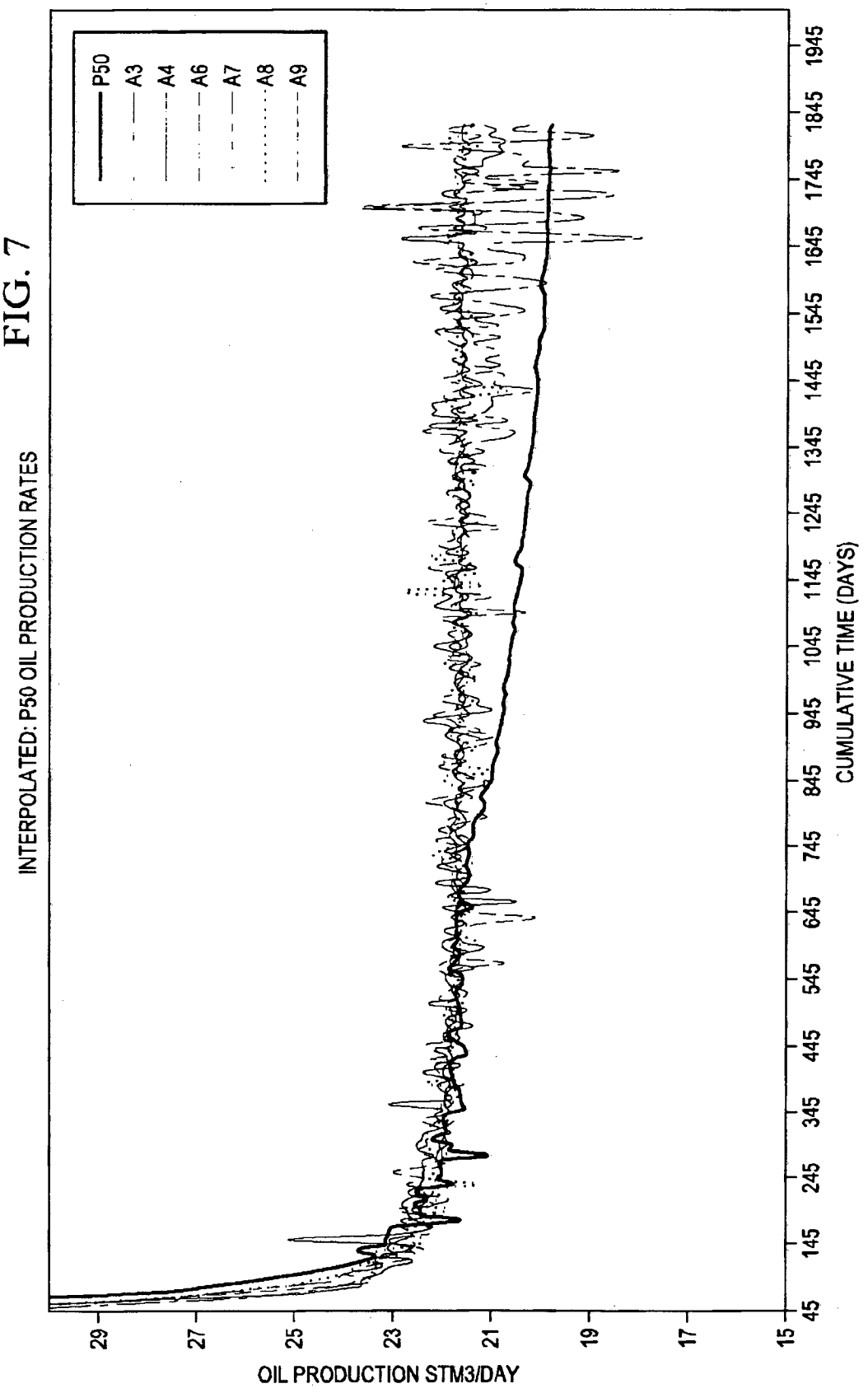

INTERPOLATED: P50 OIL PRODUCTION RATES
P50
A3
A4
A6
A7
A8
A9
OIL PRODUCTION STM3/DAY
29
27
25
23
21
19
17
15
CUMULATIVE TIME (DAYS)
45
145
245
345
445
545
645
745
845
945
1045
1145
1245
1345
1445
1545
1645
1745
1845
1945

FIG. 8

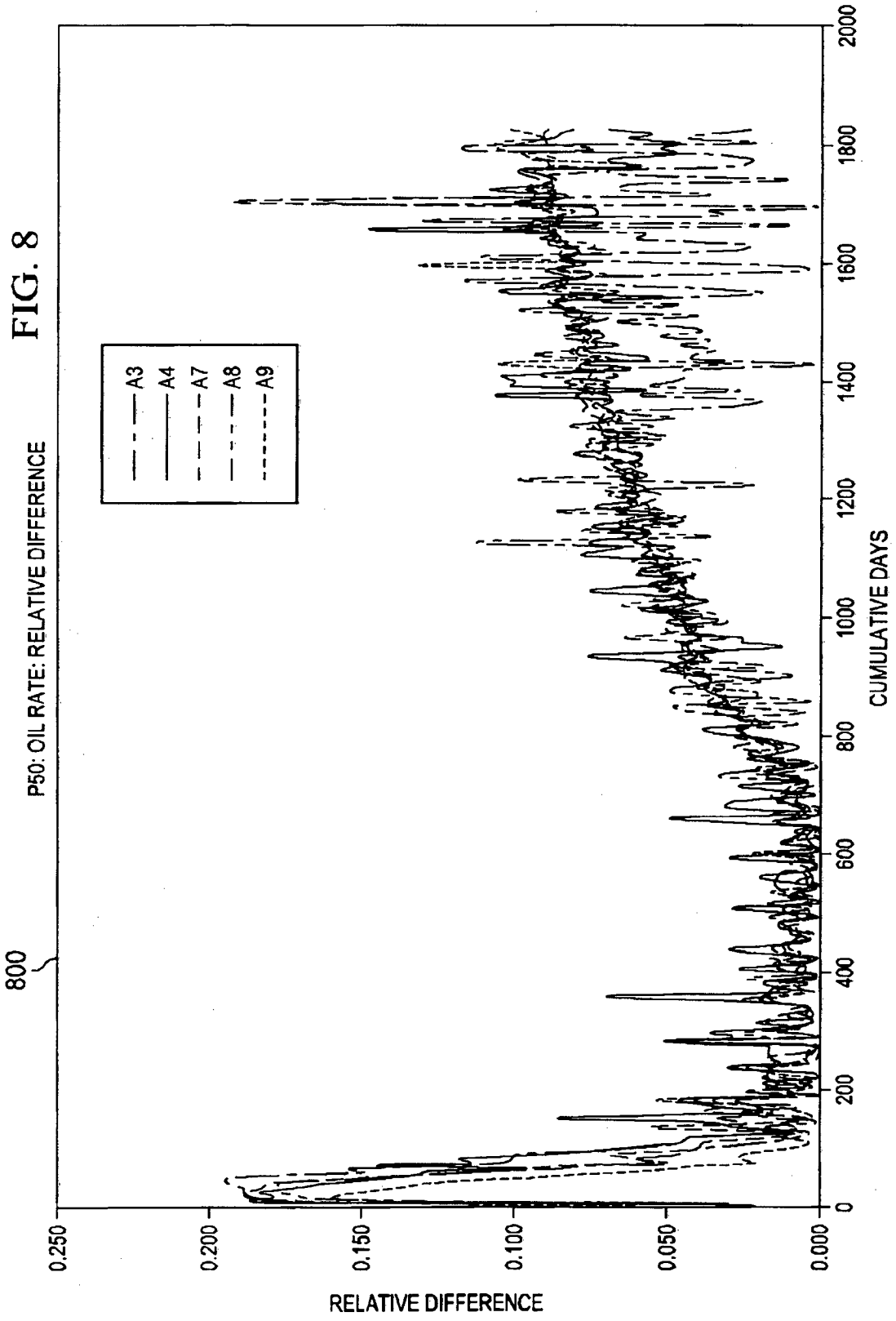
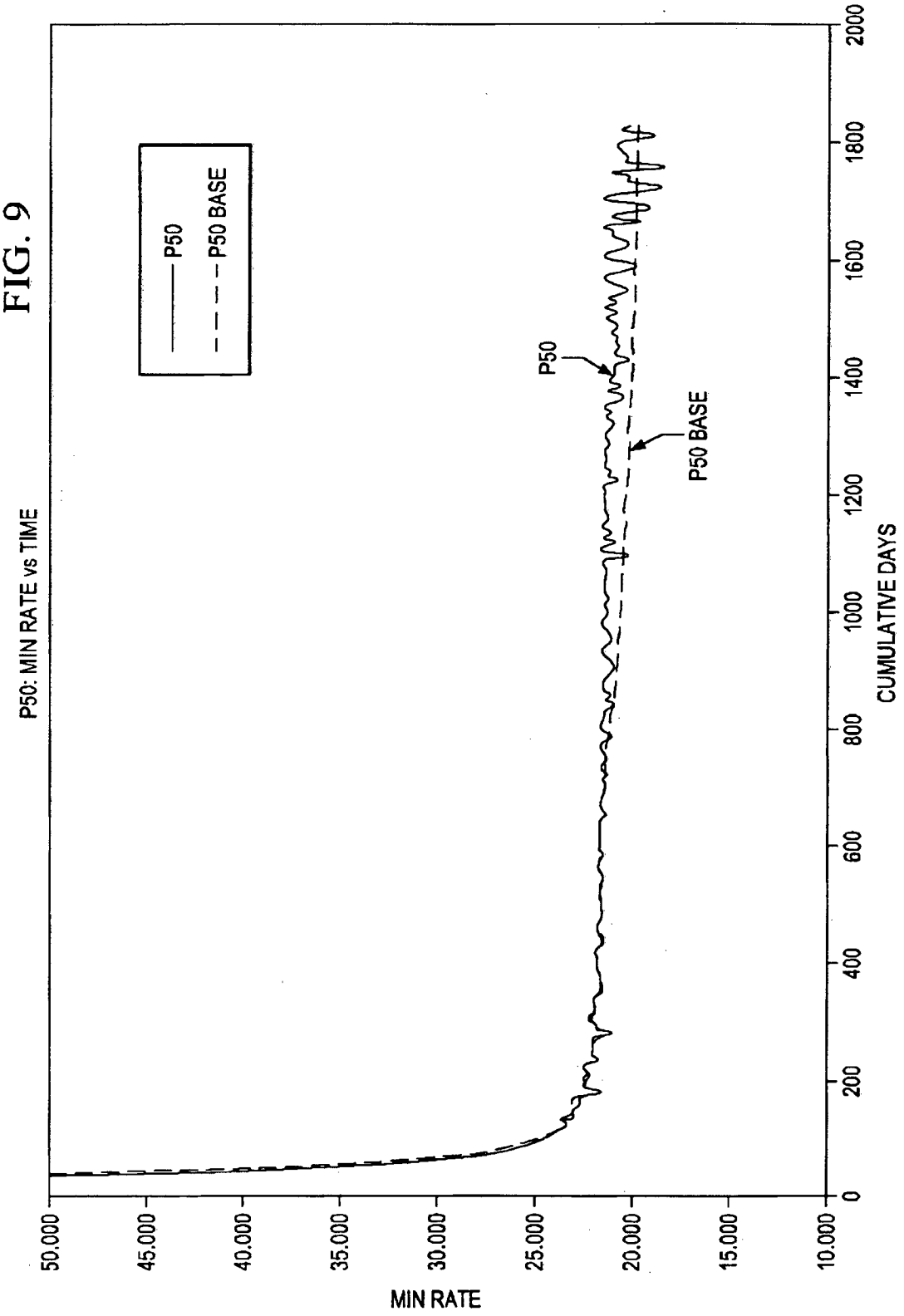

800
P50: OIL RATE: RELATIVE DIFFERENCE
A3
A4
A7
A8
A9
0.250
0.200
0.150
0.100
0.050
0.000
RELATIVE DIFFERENCE
0
200
400
600
800
1000
1200
1400
1600
1800
2000
CUMULATIVE DAYS

FIG. 9


P50: MIN RATE vs TIME
P50
P50 BASE
P50
P50 BASE
MIN RATE
50.000
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
CUMULATIVE DAYS
0
200
400
600
800
1000
1200
1400
1600
1800
2000

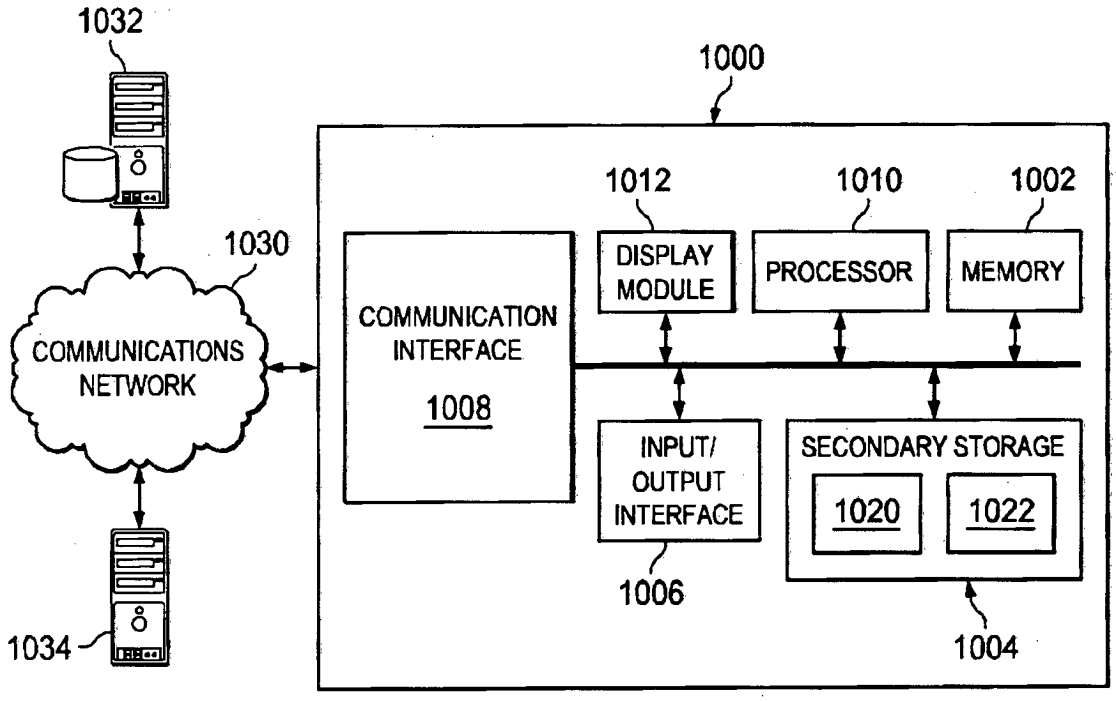

1032
1000
1012
1010
1002
1030
DISPLAY MODULE
PROCESSOR
MEMORY
COMMUNICATIONS NETWORK
COMMUNICATION INTERFACE
1008
INPUT/ OUTPUT INTERFACE
SECONDARY STORAGE
1020
1022
1006
1004
1034

FIG. 10