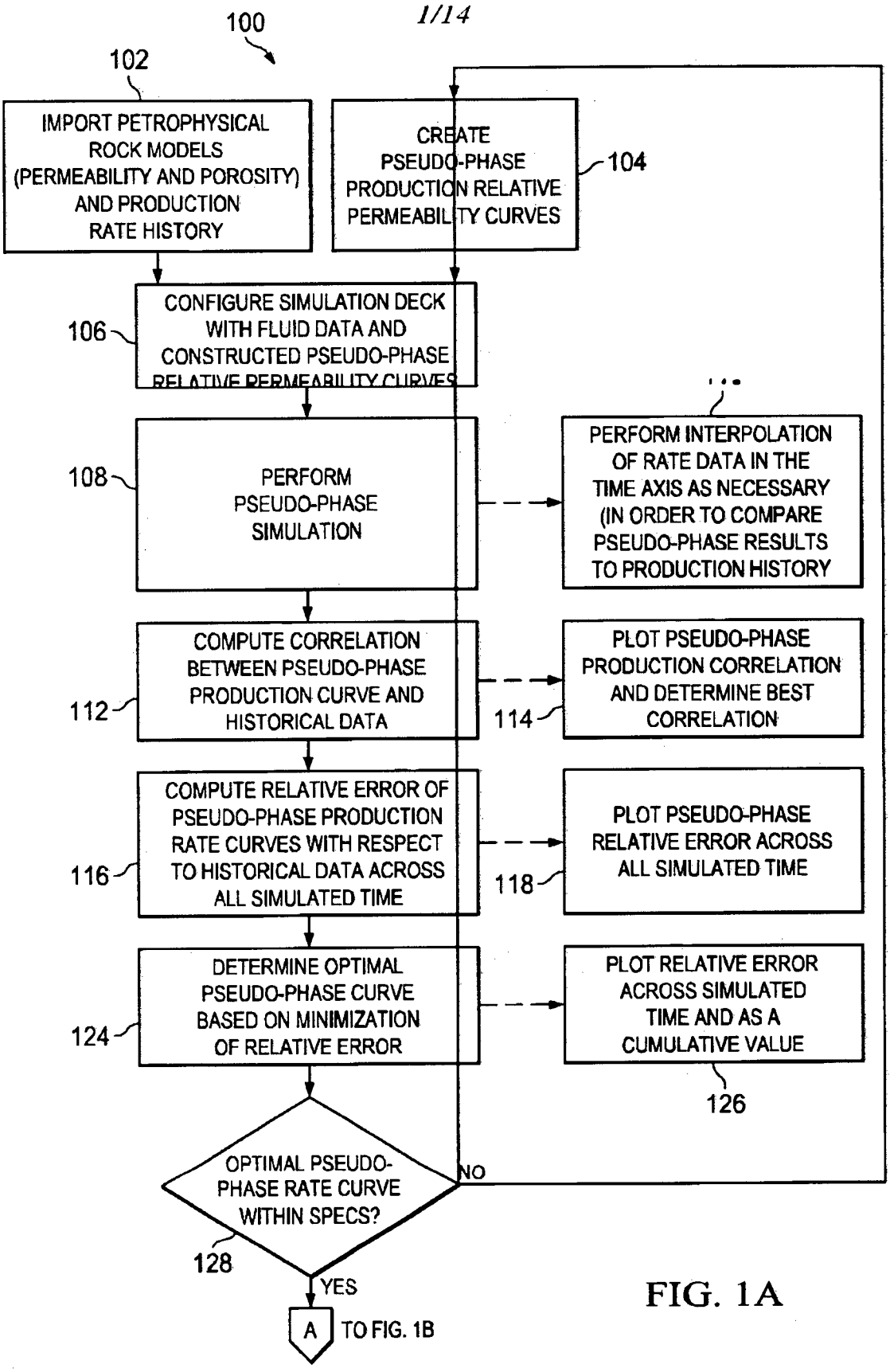

100
102
IMPORT PETROPHYSICAL ROCK MODELS (PERMEABILITY AND POROSITY) AND PRODUCTION RATE HISTORY
CREATE PSEUDO-PHASE PRODUCTION RELATIVE PERMEABILITY CURVES
104
CONFIGURE SIMULATION DECK WITH FLUID DATA AND CONSTRUCTED PSEUDO-PHASE RELATIVE PERMEABILITY CURVES
106
PERFORM PSEUDO-PHASE SIMULATION
108
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

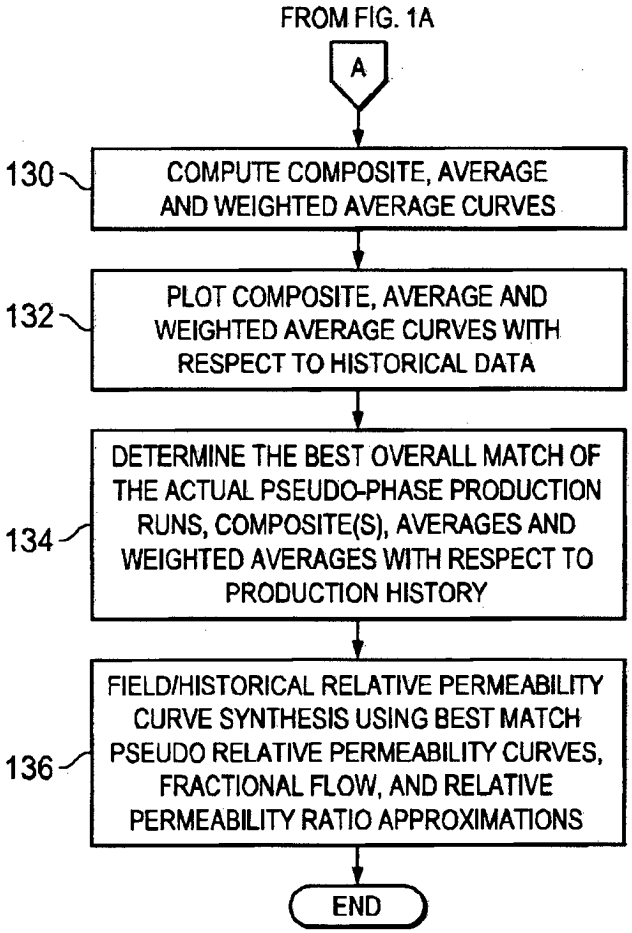

FROM FIG. 1A
A
130
COMPUTE COMPOSITE, AVERAGE AND WEIGHTED AVERAGE CURVES
132
PLOT COMPOSITE, AVERAGE AND WEIGHTED AVERAGE CURVES WITH RESPECT TO HISTORICAL DATA
134
DETERMINE THE BEST OVERALL MATCH OF THE ACTUAL PSEUDO-PHASE PRODUCTION RUNS, COMPOSITE(S), AVERAGES AND WEIGHTED AVERAGES WITH RESPECT TO PRODUCTION HISTORY
136
FIELD/HISTORICAL RELATIVE PERMEABILITY CURVE SYNTHESIS USING BEST MATCH PSEUDO RELATIVE PERMEABILITY CURVES, FRACTIONAL FLOW, AND RELATIVE PERMEABILITY RATIO APPROXIMATIONS
END

FIG. 1B

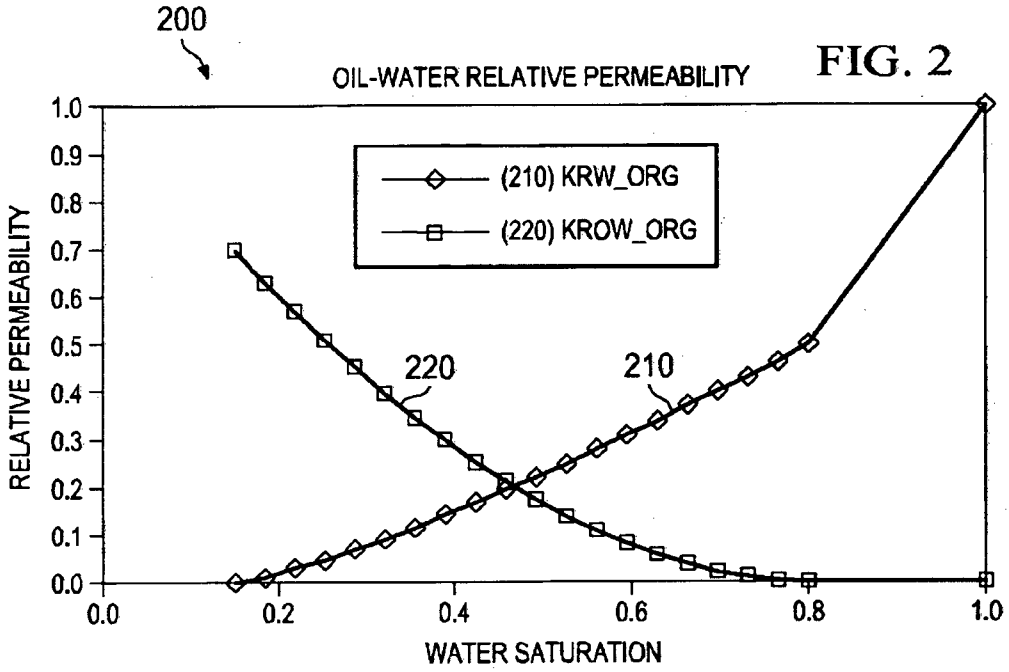

200
OIL-WATER RELATIVE PERMEABILITY
(210) KRW_ORG
(220) KROW_ORG
220
210
RELATIVE PERMEABILITY
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
WATER SATURATION

FIG. 2

FIG. 3

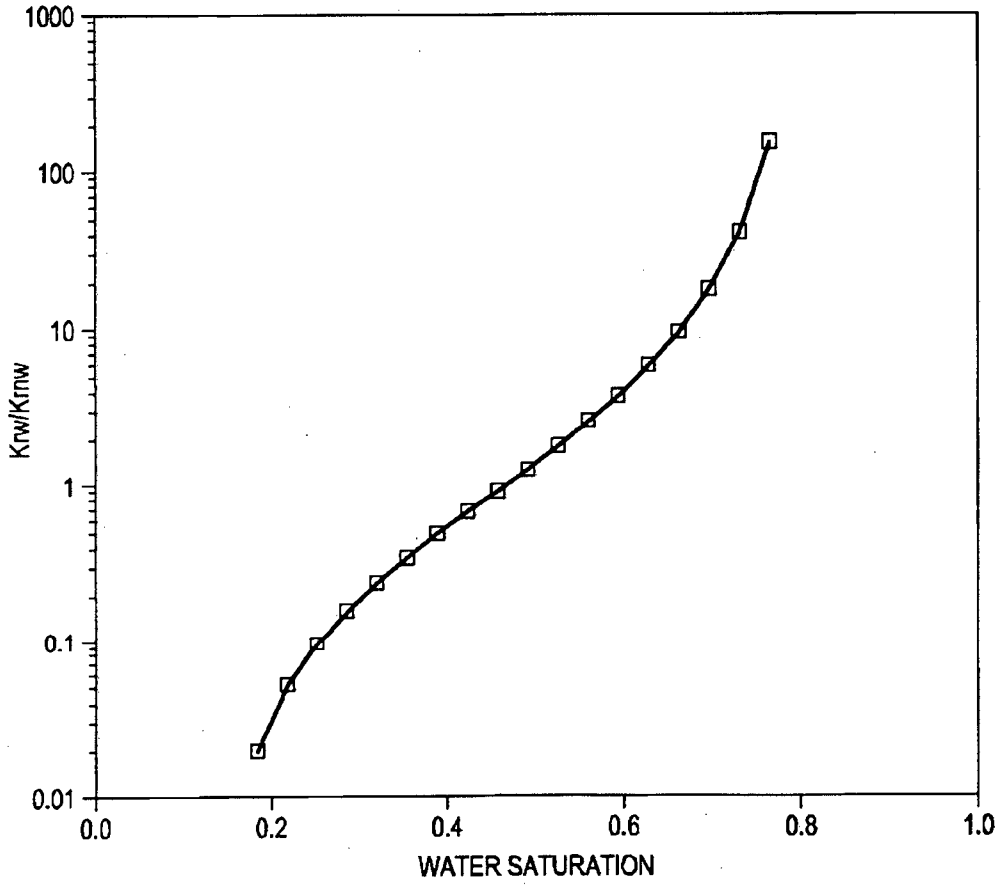

1000
100
10
1
0.1
0.01
Krw/Kmw
0.0
0.2
0.4
0.6
0.8
1.0
WATER SATURATION

FIG. 4

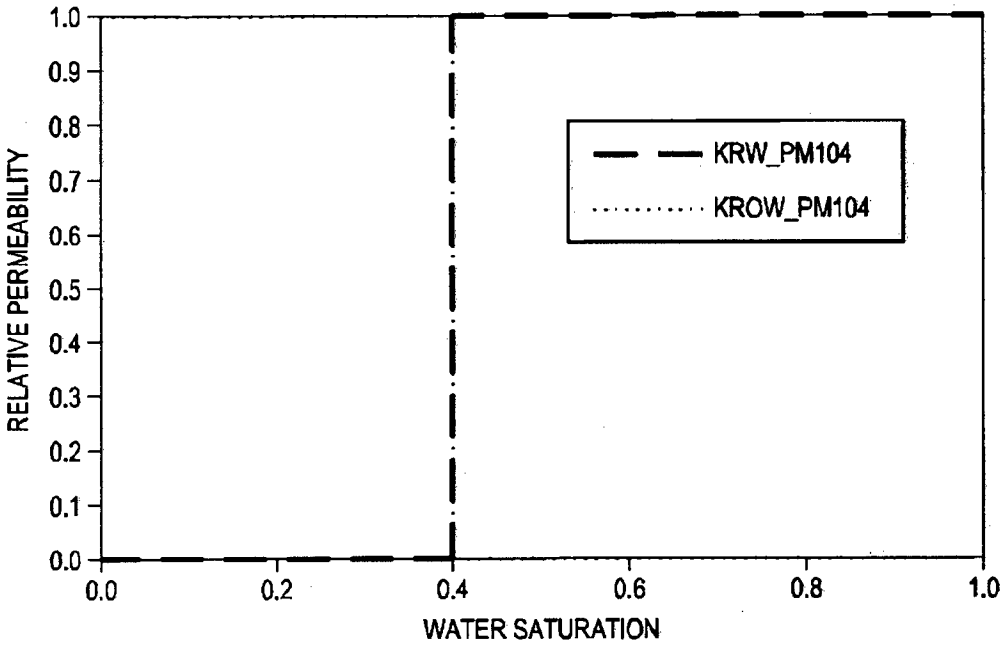
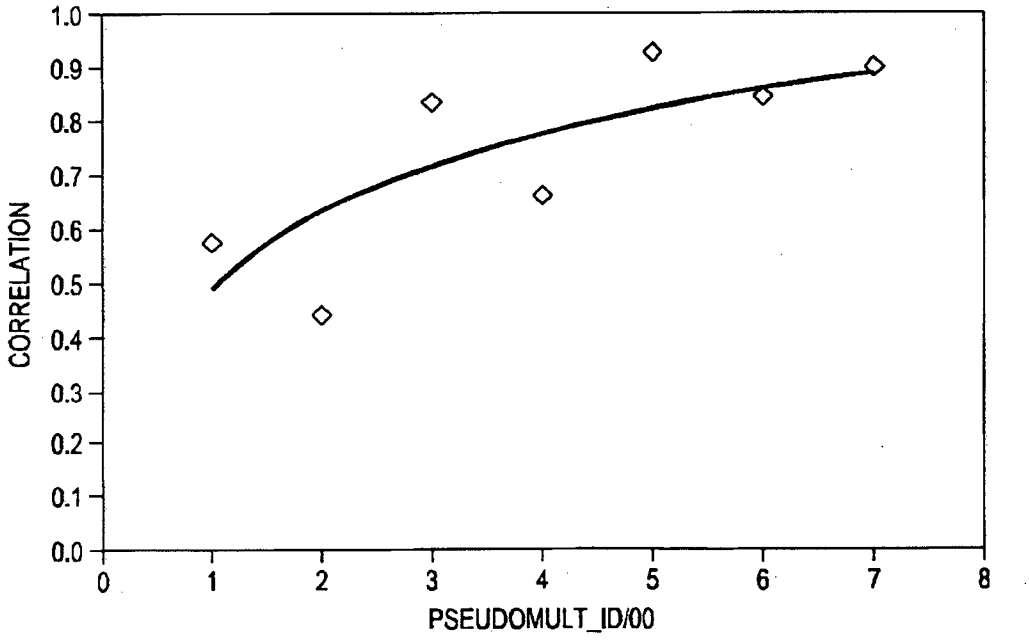

RELATIVE PERMEABILITY
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
WATER SATURATION
KRW_PM104
KROW_PM104

FIG. 8


CORRELATION
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5
6
7
8
PSEUDOMULT_ID/00

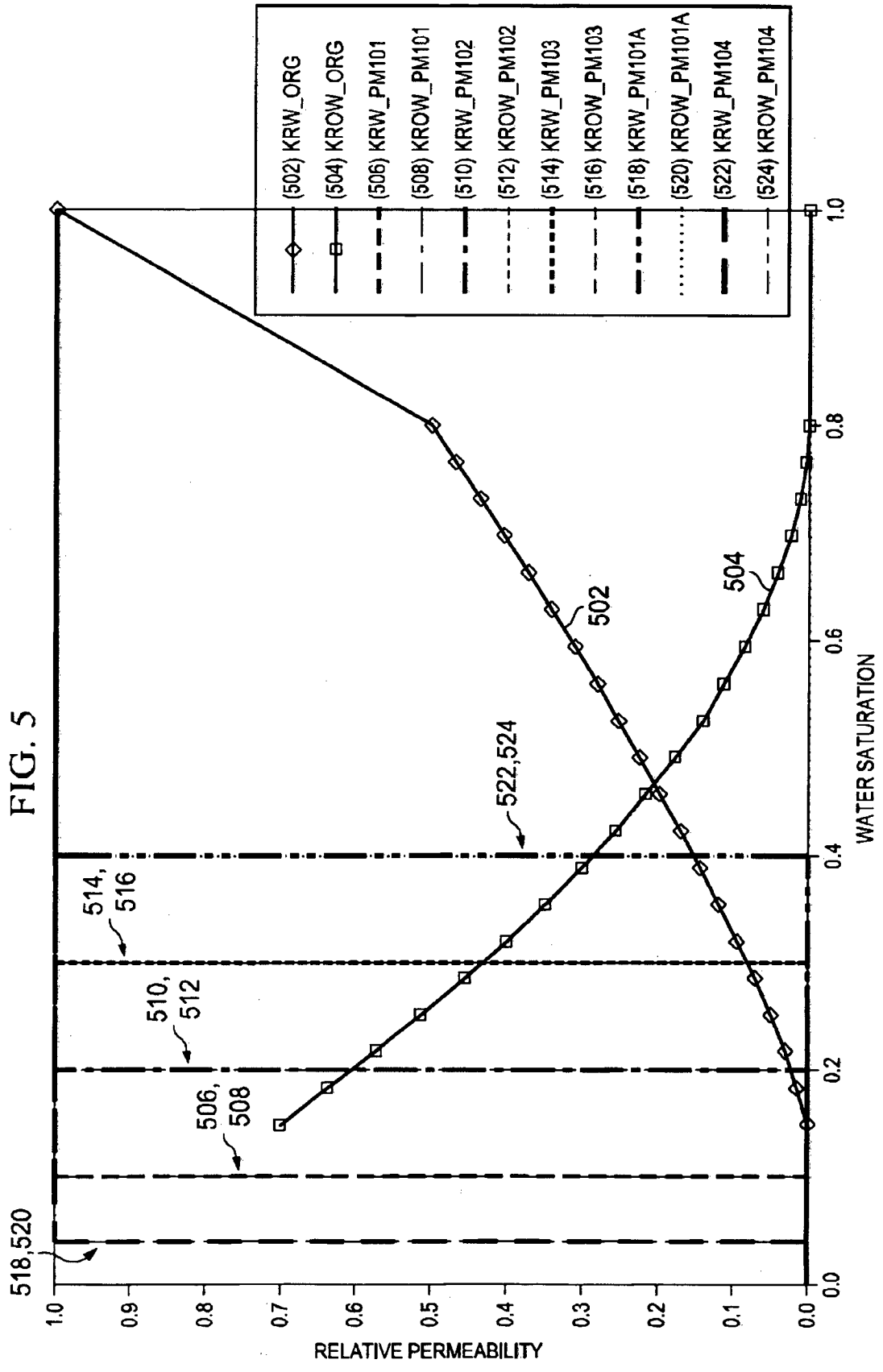

(502) KRW_ORG
(504) KROW_ORG
(506) KRW_PM101
(508) KROW_PM101
(510) KRW_PM102
(512) KROW_PM102
(514) KRW_PM103
(516) KROW_PM103
(518) KRW_PM101A
(520) KROW_PM101A
(522) KRW_PM104
(524) KROW_PM104
502
504
522,524
514, 516
510, 512
506, 508
518,520
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.0
RELATIVE PERMEABILITY
0.0 0.2 0.4 0.6 0.8 1.0
WATER SATURATION

FIG. 5

FIG. 6

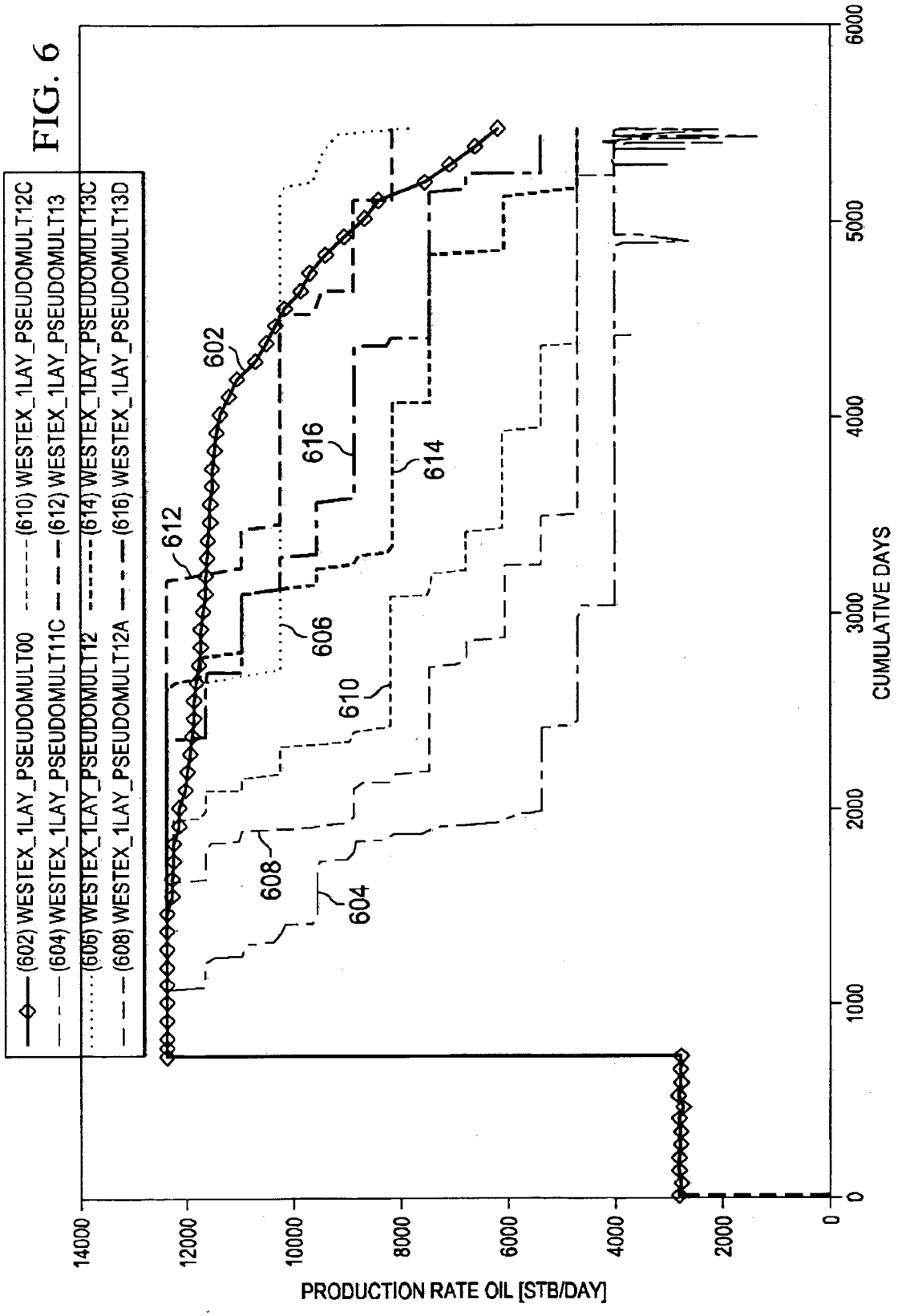

(602) WESTEX_1LAY_PSEUDOMULT00
(604) WESTEX_1LAY_PSEUDOMULT11C
(606) WESTEX_1LAY_PSEUDOMULT12
(608) WESTEX_1LAY_PSEUDOMULT12A
(610) WESTEX_1LAY_PSEUDOMULT12C
(612) WESTEX_1LAY_PSEUDOMULT13
(614) WESTEX_1LAY_PSEUDOMULT13C
(616) WESTEX_1LAY_PSEUDOMULT13D
602
604
606
608
610
612
614
616
PRODUCTION RATE OIL [STB/DAY]
14000
12000
10000
8000
6000
4000
2000
0
CUMULATIVE DAYS
0
1000
2000
3000
4000
5000
6000

FIG. 7

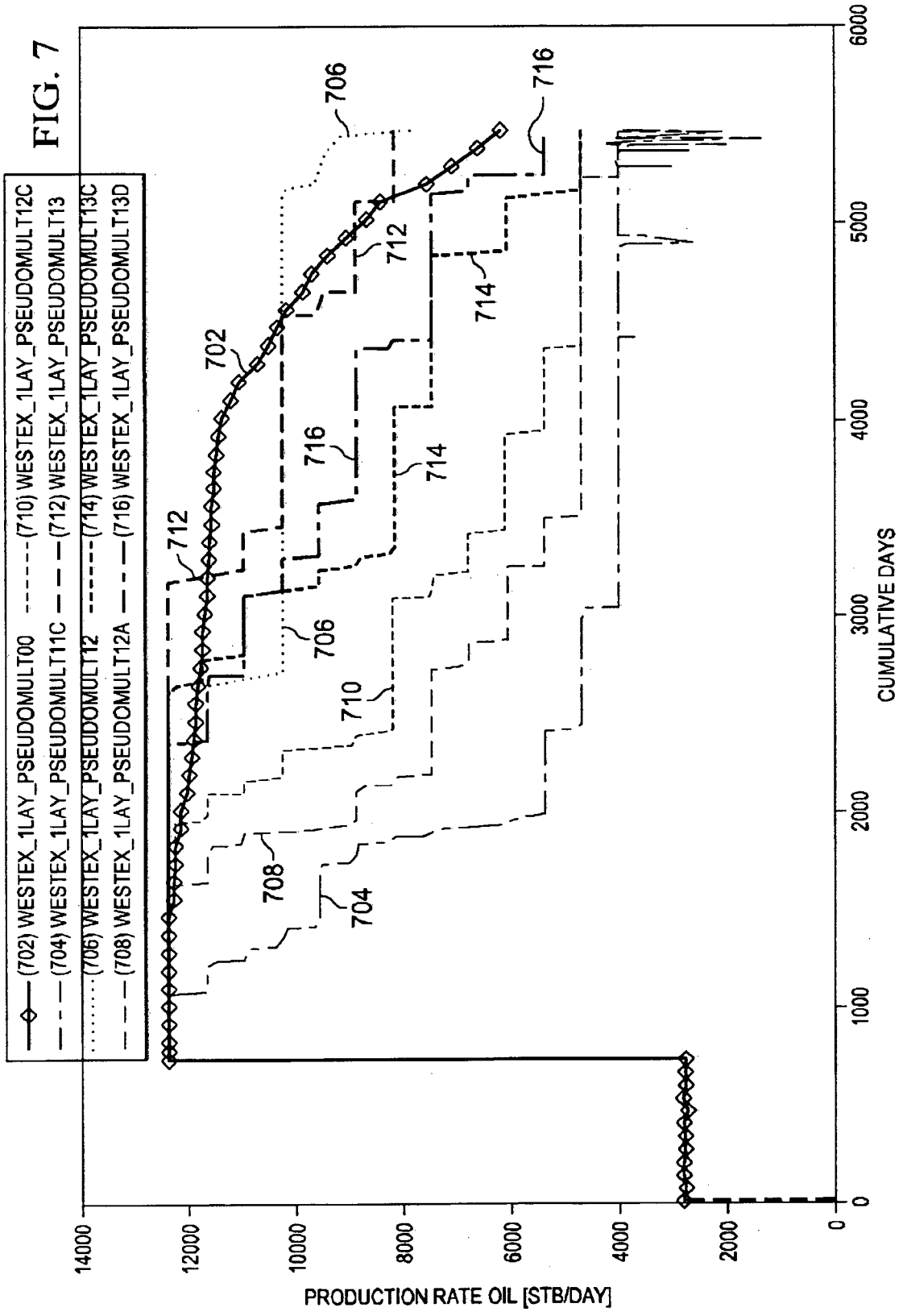

(702) WESTEX_1LAY_PSEUDOMULT00
(704) WESTEX_1LAY_PSEUDOMULT11C
(706) WESTEX_1LAY_PSEUDOMULT12
(708) WESTEX_1LAY_PSEUDOMULT12A
(710) WESTEX_1LAY_PSEUDOMULT12C
(712) WESTEX_1LAY_PSEUDOMULT13
(714) WESTEX_1LAY_PSEUDOMULT13C
(716) WESTEX_1LAY_PSEUDOMULT13D
PRODUCTION RATE OIL [STB/DAY]
CUMULATIVE DAYS
14000
12000
10000
8000
6000
4000
2000
0
6000
5000
4000
3000
2000
1000
0
702
704
706
708
710
712
714
716

FIG. 9

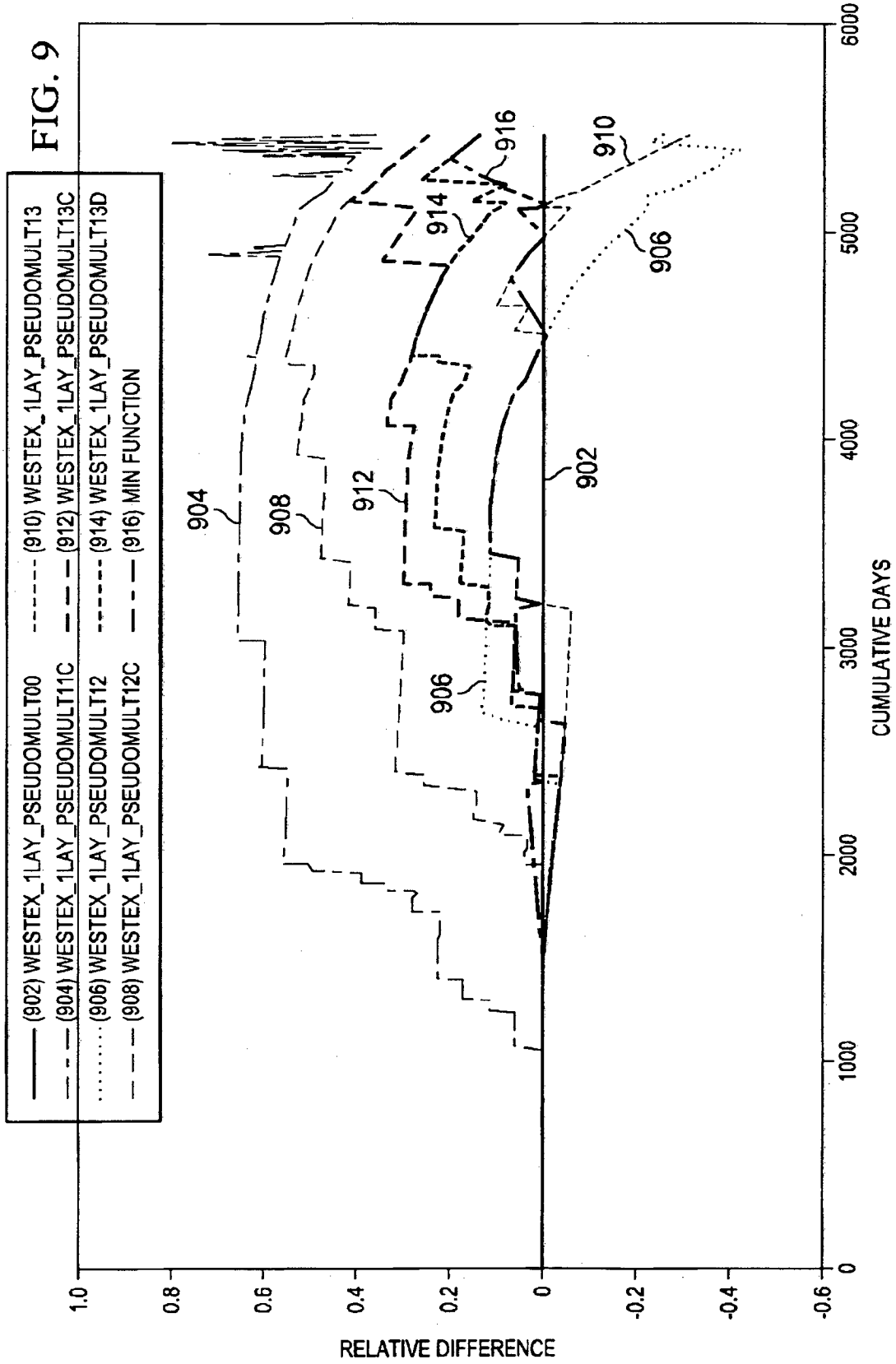

(902) WESTEX_1LAY_PSEUDOMULT00
(904) WESTEX_1LAY_PSEUDOMULT11C
(906) WESTEX_1LAY_PSEUDOMULT12
(908) WESTEX_1LAY_PSEUDOMULT12C
(910) WESTEX_1LAY_PSEUDOMULT13
(912) WESTEX_1LAY_PSEUDOMULT13C
(914) WESTEX_1LAY_PSEUDOMULT13D
(916) MIN FUNCTION
902
904
906
908
910
912
914
916
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
RELATIVE DIFFERENCE
0
1000
2000
3000
4000
5000
6000
CUMULATIVE DAYS

FIG. 10

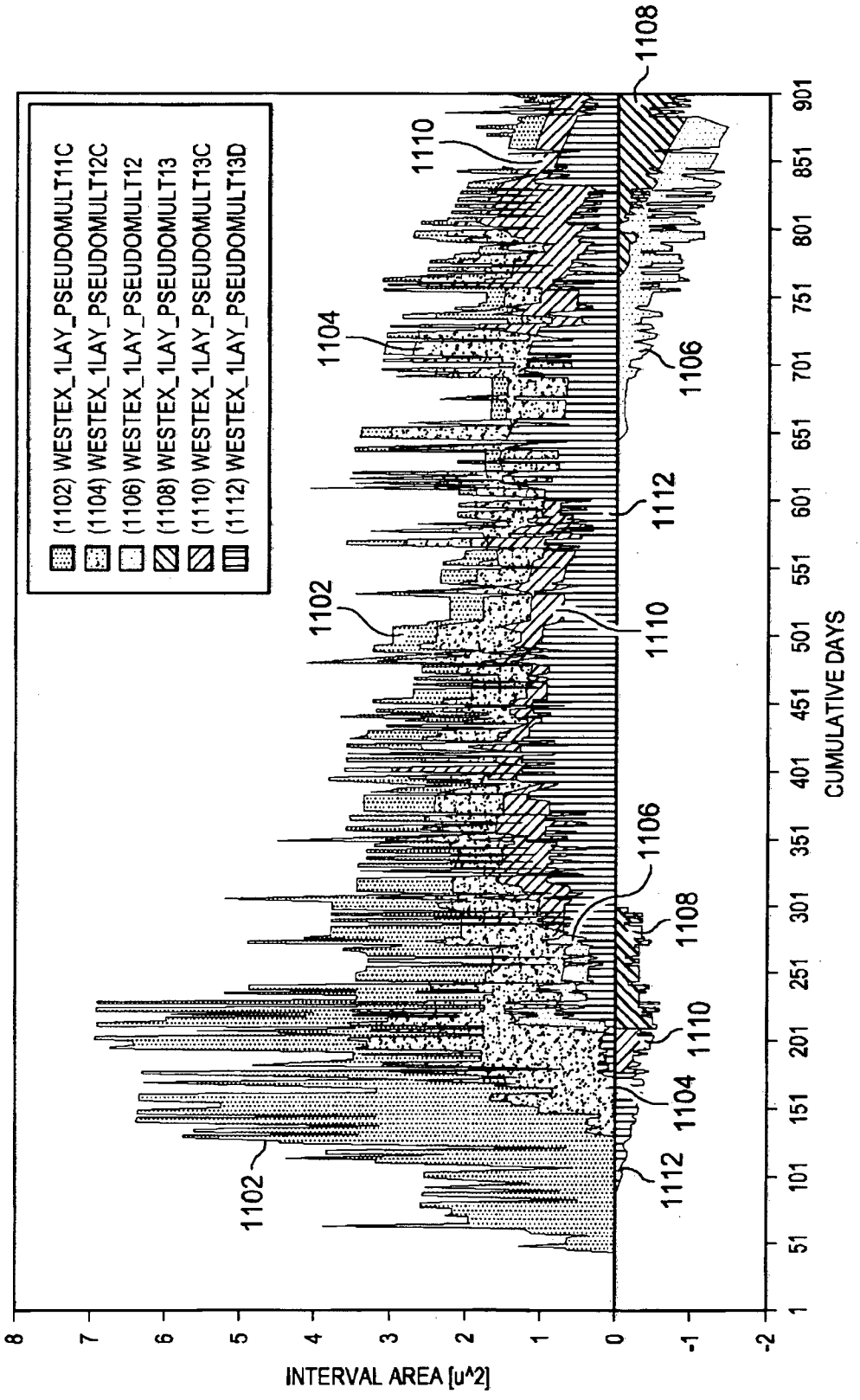

(1102) WESTEX_1LAY_PSEUDOMULT11C
(1104) WESTEX_1LAY_PSEUDOMULT12C
(1106) WESTEX_1LAY_PSEUDOMULT12
(1108) WESTEX_1LAY_PSEUDOMULT13
(1110) WESTEX_1LAY_PSEUDOMULT13C
(1112) WESTEX_1LAY_PSEUDOMULT13D
INTERVAL AREA [u^2]
CUMULATIVE DAYS
8
7
6
5
4
3
2
1
0
-1
-2
1
51
101
151
201
251
301
351
401
451
501
551
601
651
701
751
801
851
901
1102
1104
1106
1108
1110
1112

FIG. 11

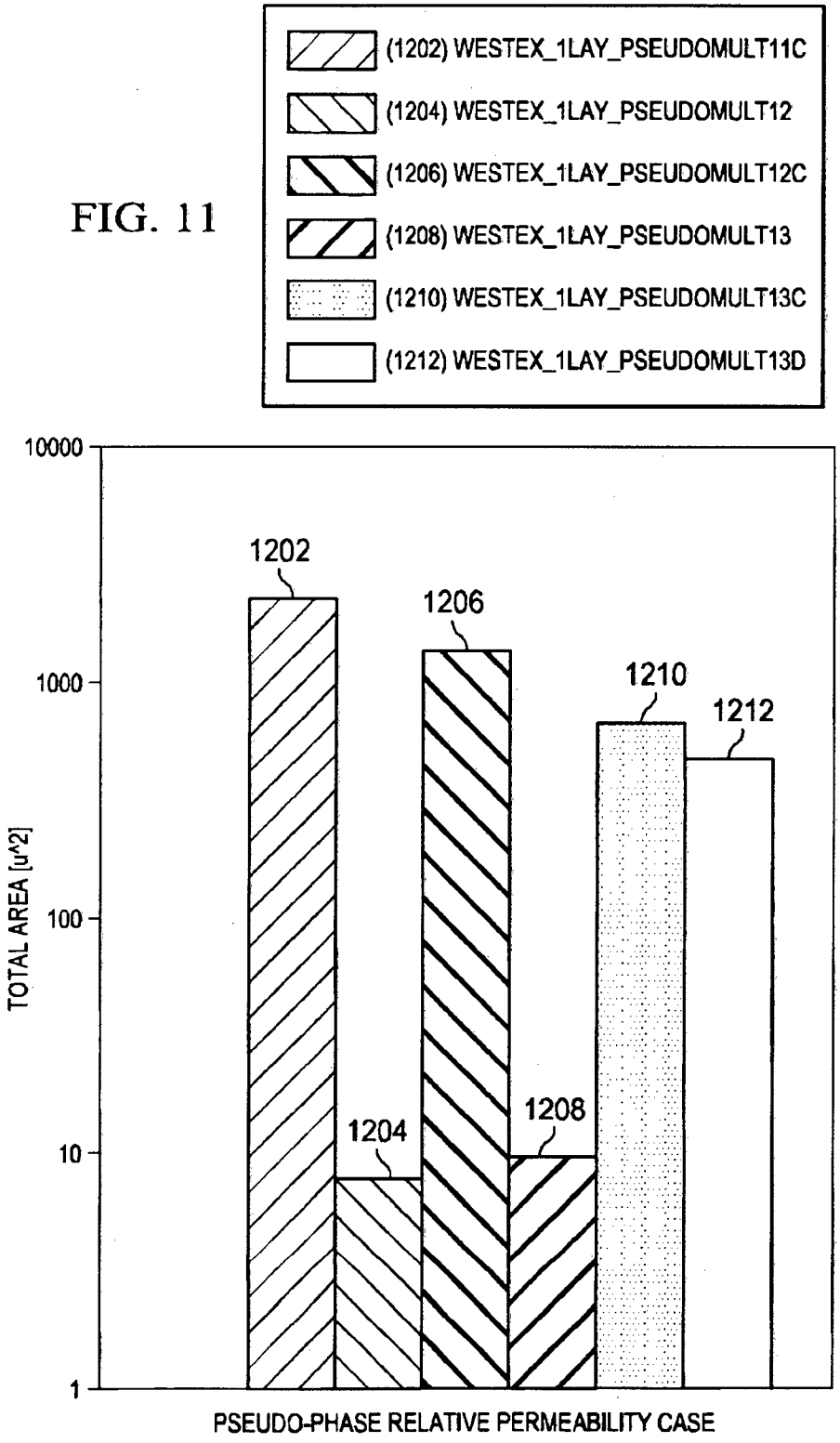

(1202) WESTEX_1LAY_PSEUDOMULT11C
(1204) WESTEX_1LAY_PSEUDOMULT12
(1206) WESTEX_1LAY_PSEUDOMULT12C
(1208) WESTEX_1LAY_PSEUDOMULT13
(1210) WESTEX_1LAY_PSEUDOMULT13C
(1212) WESTEX_1LAY_PSEUDOMULT13D
10000
1000
100
10
1
TOTAL AREA [u^2]
1202
1204
1206
1208
1210
1212
PSEUDO-PHASE RELATIVE PERMEABILITY CASE

FIG. 12

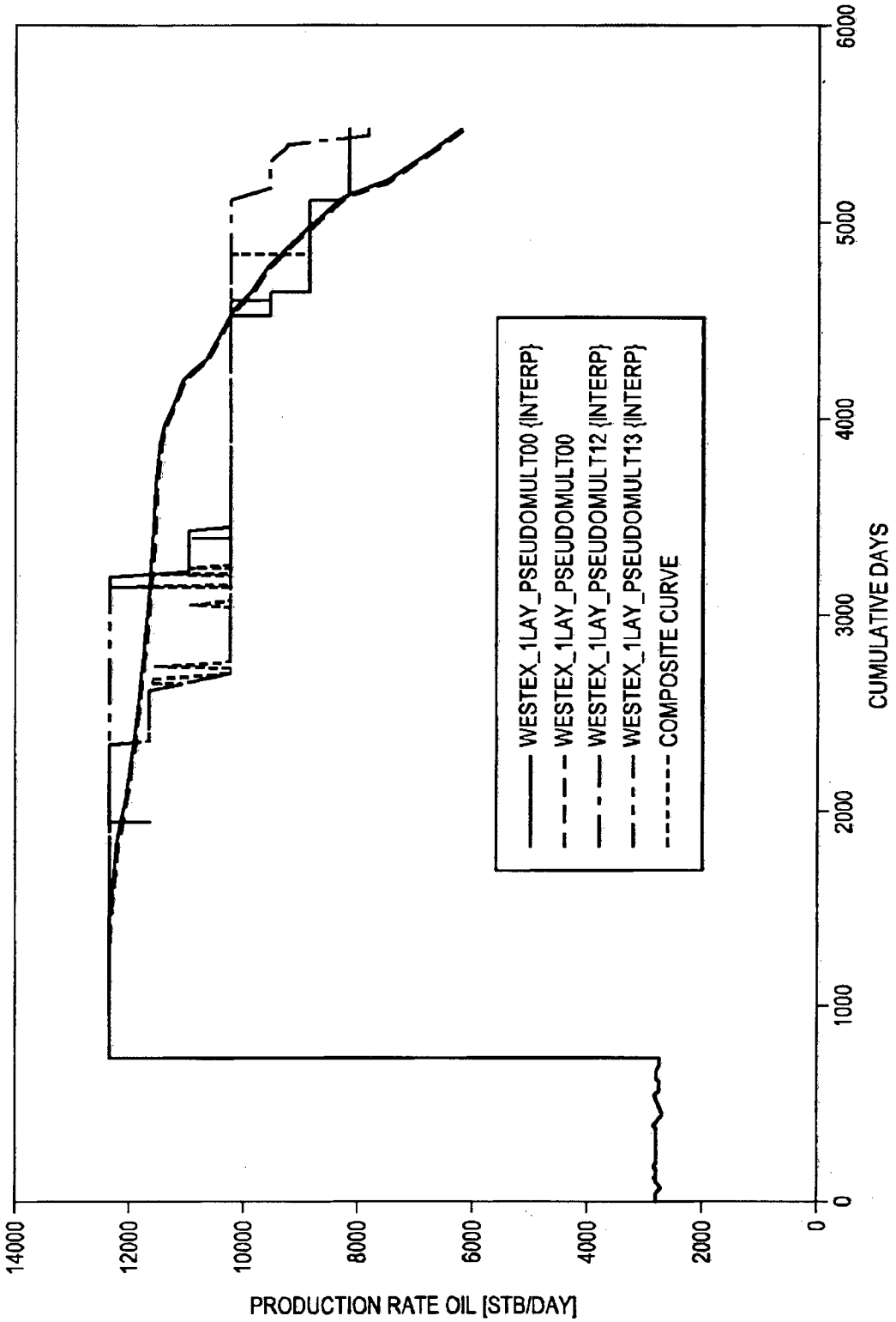

WESTEX_1LAY_PSEUDOMULT00 {INTERP}
WESTEX_1LAY_PSEUDOMULT00
WESTEX_1LAY_PSEUDOMULT12 {INTERP}
WESTEX_1LAY_PSEUDOMULT13 {INTERP}
COMPOSITE CURVE
PRODUCTION RATE OIL [STB/DAY]
14000
12000
10000
8000
6000
4000
2000
0
CUMULATIVE DAYS
0
1000
2000
3000
4000
5000
6000

FIG. 13

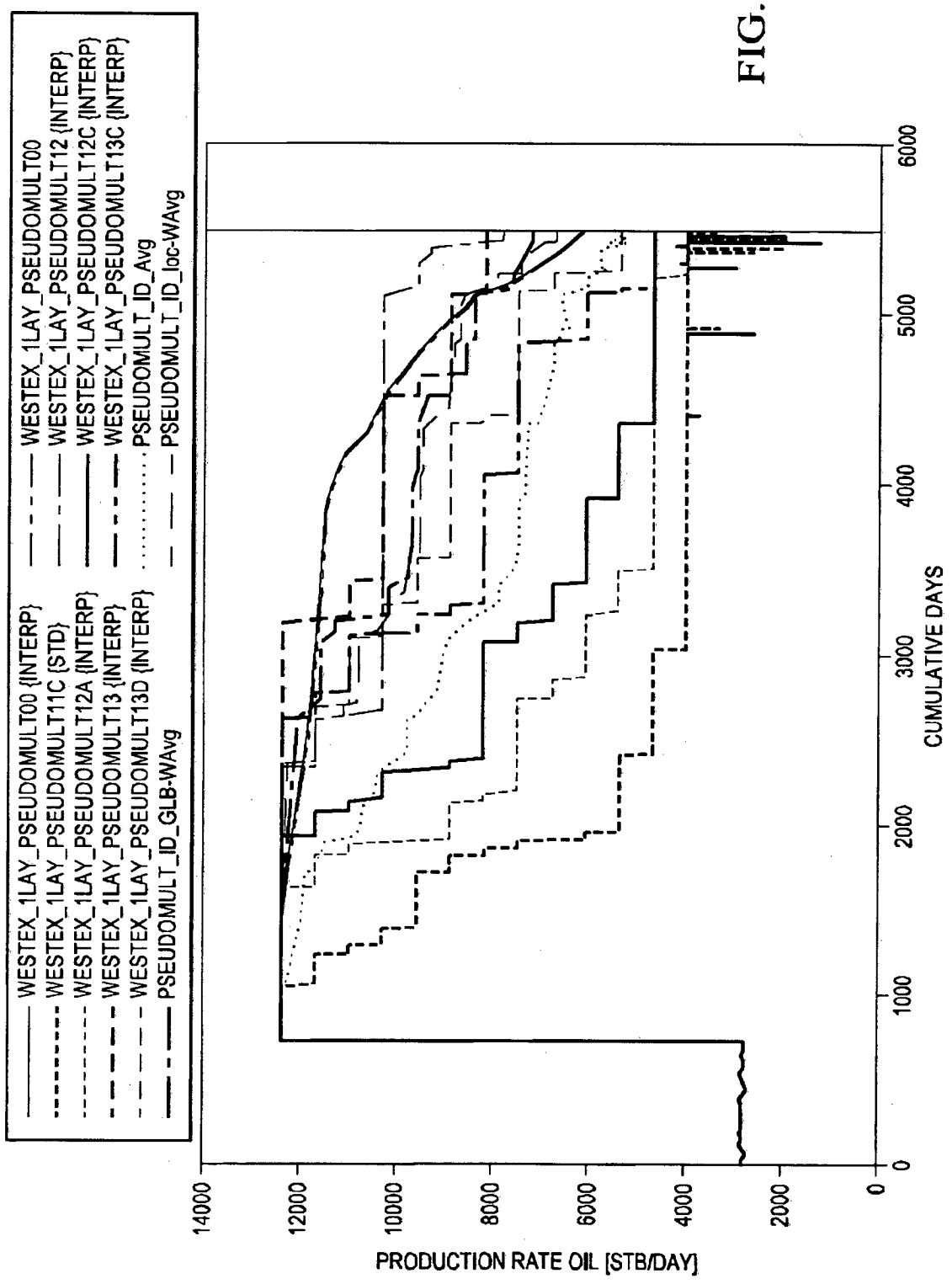

WESTEX_1LAY_PSEUDOMULT00 {INTERP}
WESTEX_1LAY_PSEUDOMULT11C {STD}
WESTEX_1LAY_PSEUDOMULT12A {INTERP}
WESTEX_1LAY_PSEUDOMULT13 {INTERP}
WESTEX_1LAY_PSEUDOMULT13D {INTERP}
PSEUDOMULT_ID_GLB-WAvg
WESTEX_1LAY_PSEUDOMULT00
WESTEX_1LAY_PSEUDOMULT12 {INTERP}
WESTEX_1LAY_PSEUDOMULT12C {INTERP}
WESTEX_1LAY_PSEUDOMULT13C {INTERP}
PSEUDOMULT_ID_Avg
PSEUDOMULT_ID_loc-WAvg
14000
12000
10000
8000
6000
4000
2000
0
PRODUCTION RATE OIL [STB/DAY]
0
1000
2000
3000
4000
5000
6000
CUMULATIVE DAYS

FIG. 14A

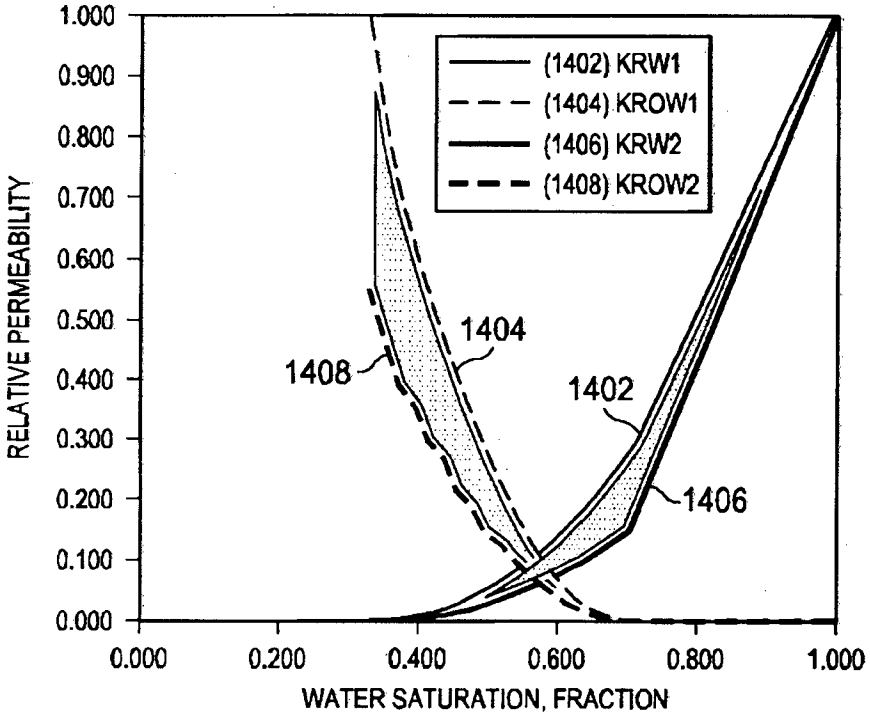
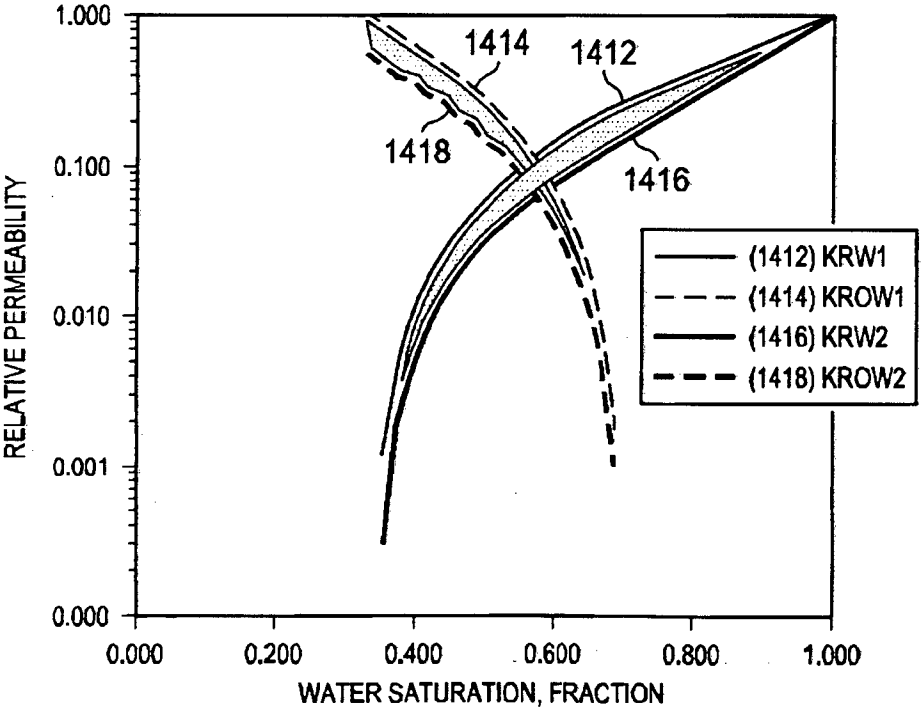


FIG. 14B



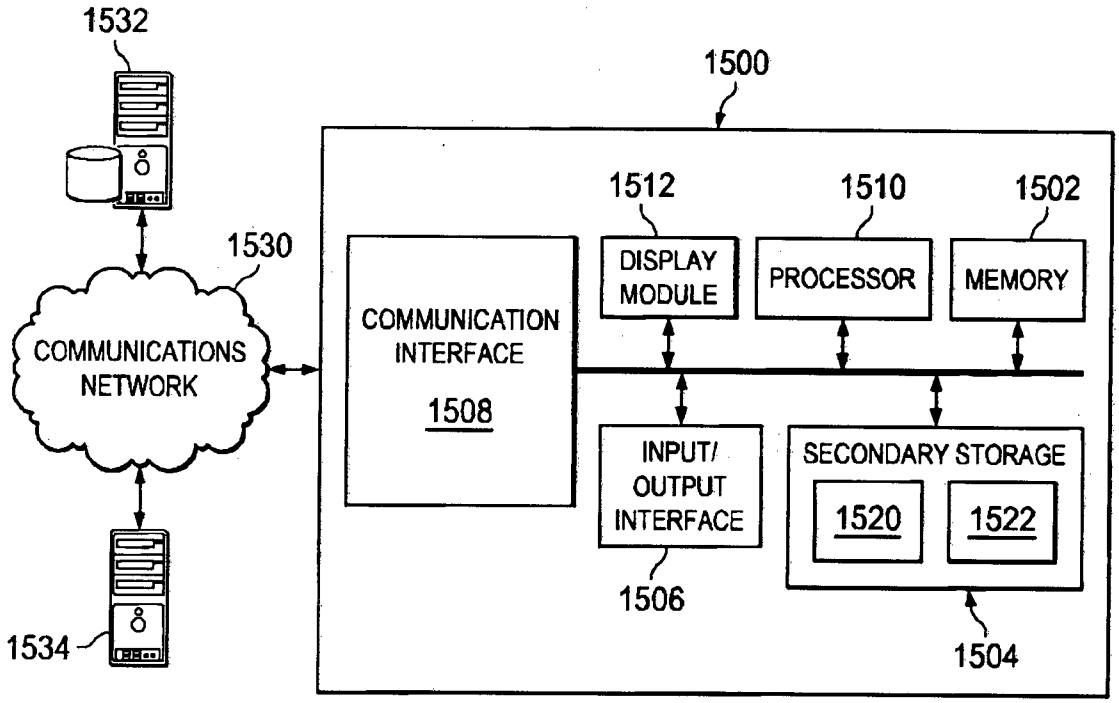

1532
1500
1512
1510
1502
1530
DISPLAY MODULE
PROCESSOR
MEMORY
COMMUNICATIONS NETWORK
COMMUNICATION INTERFACE
1508
INPUT/ OUTPUT INTERFACE
SECONDARY STORAGE
1520
1522
1506
1504
1534

FIG. 15