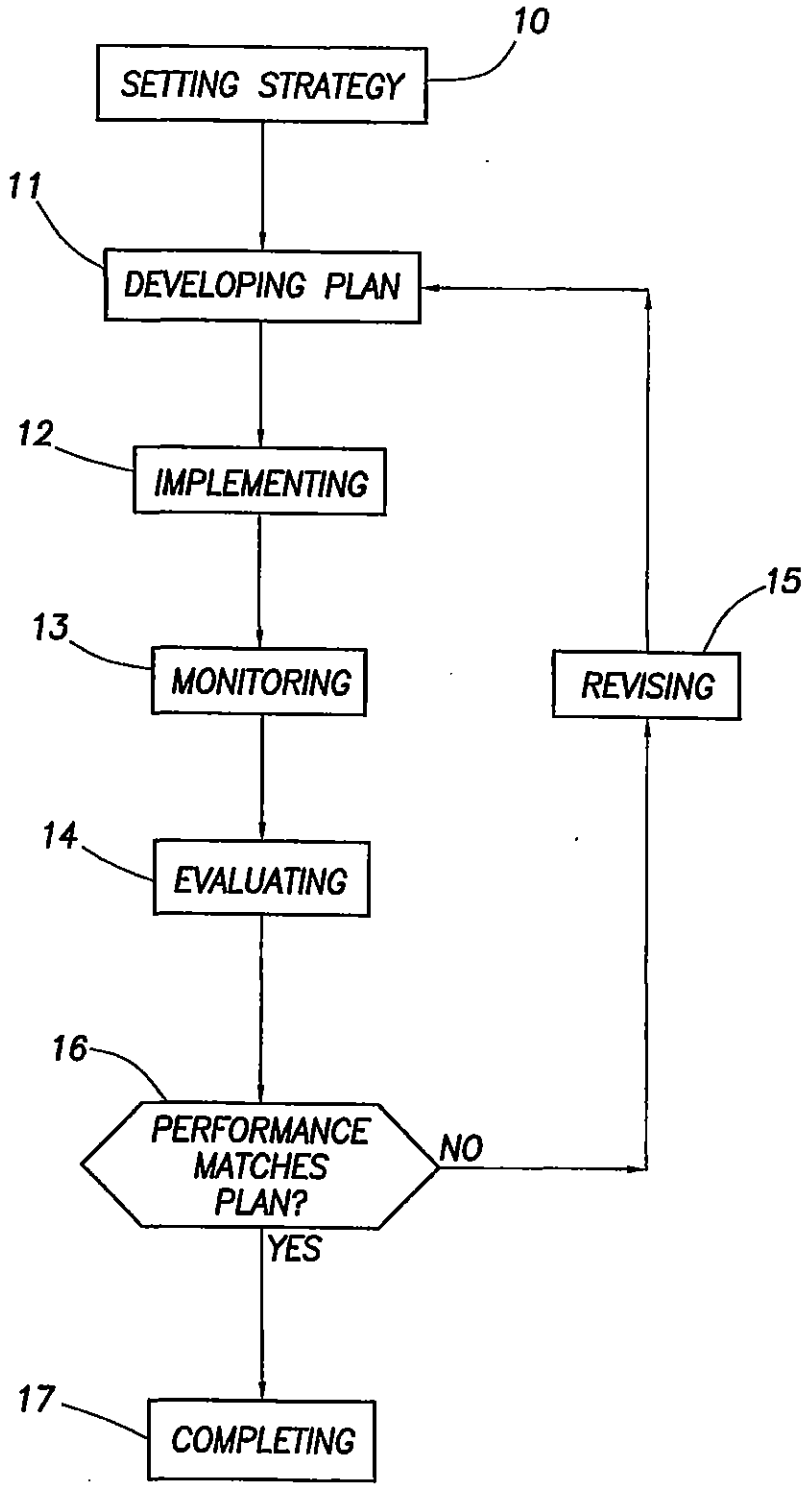
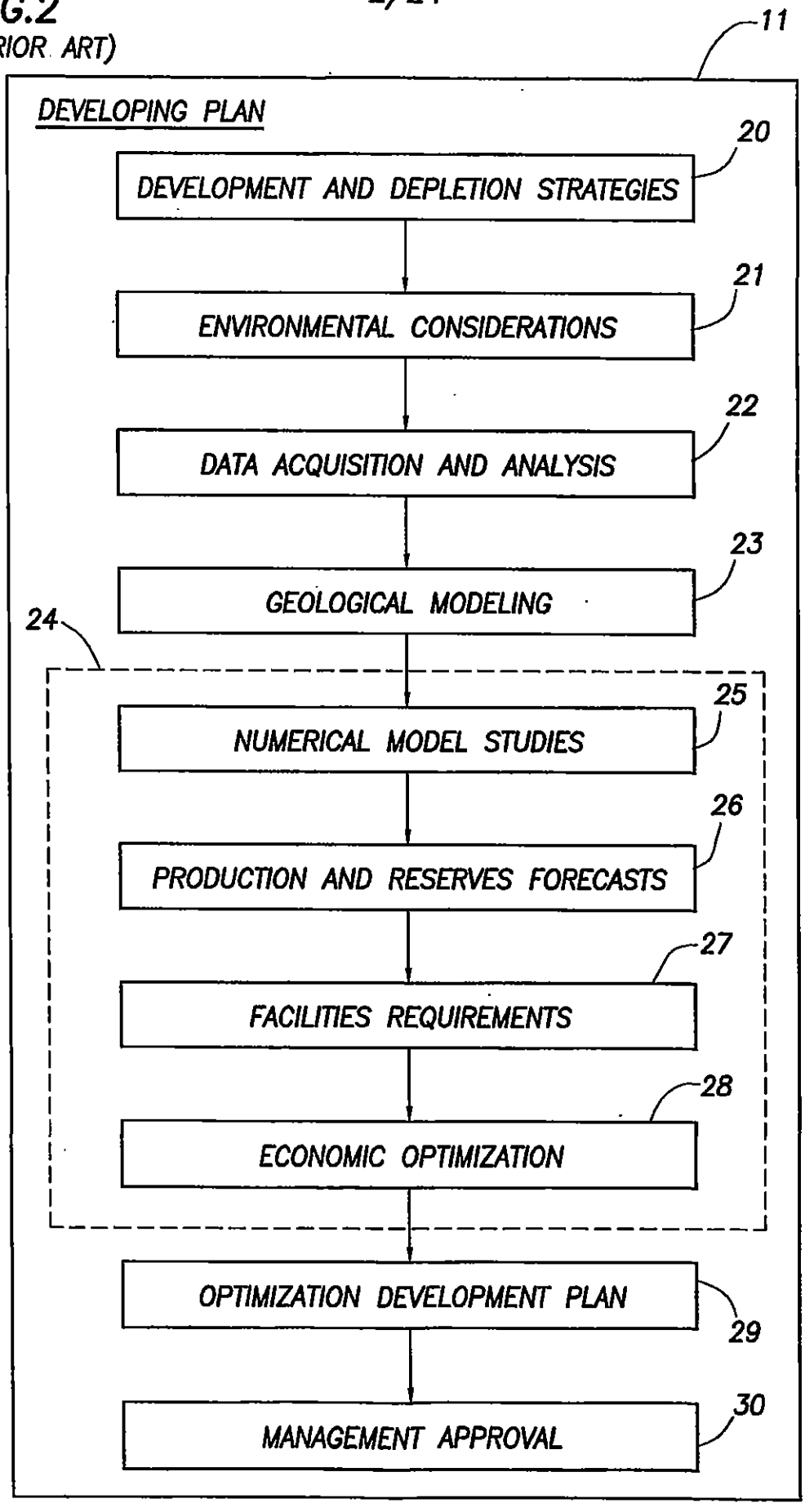


FIG. 1
(PRIOR ART)

FIG.2
(PRIOR ART)



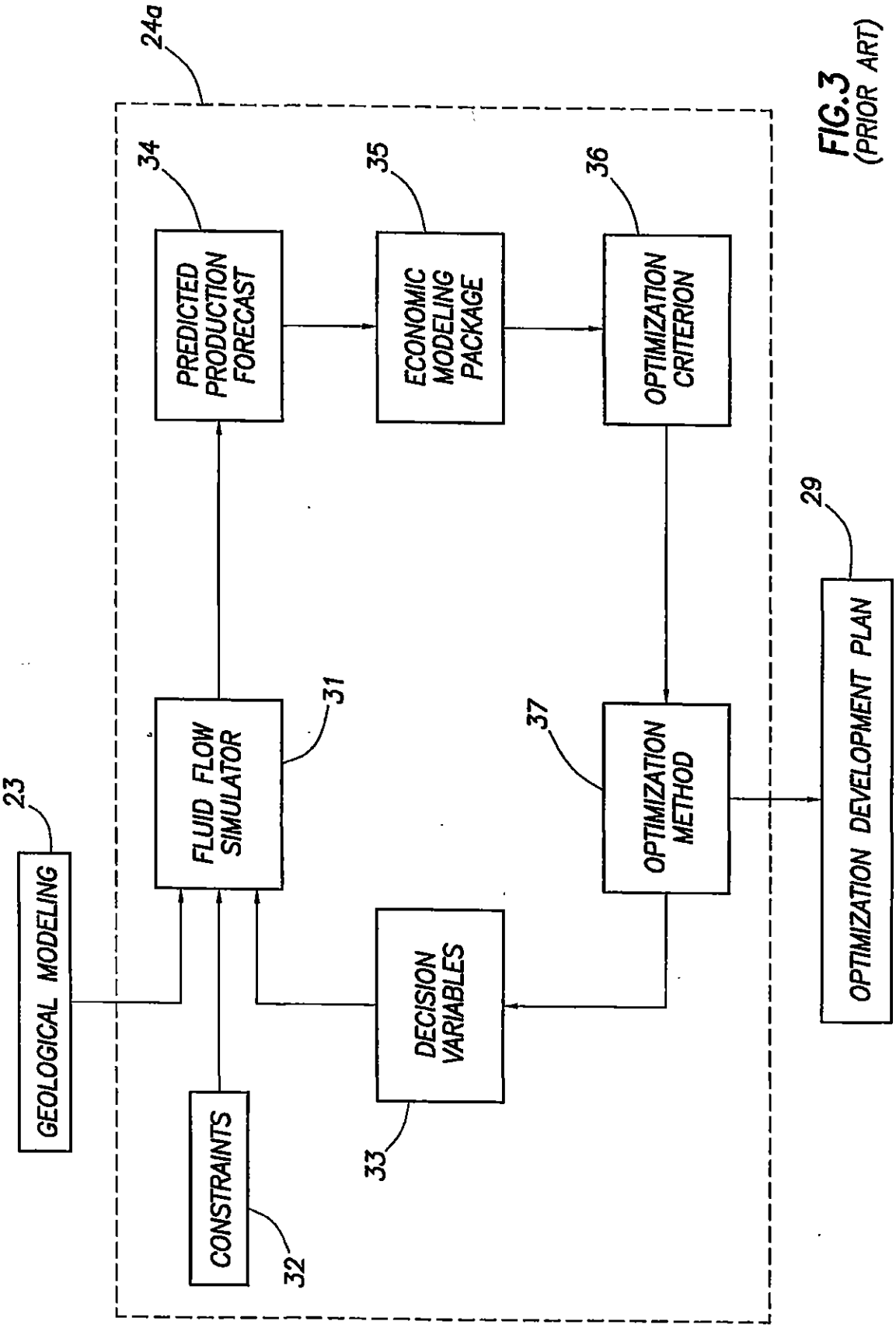


FIG.3
(PRIOR ART)

FIG.4

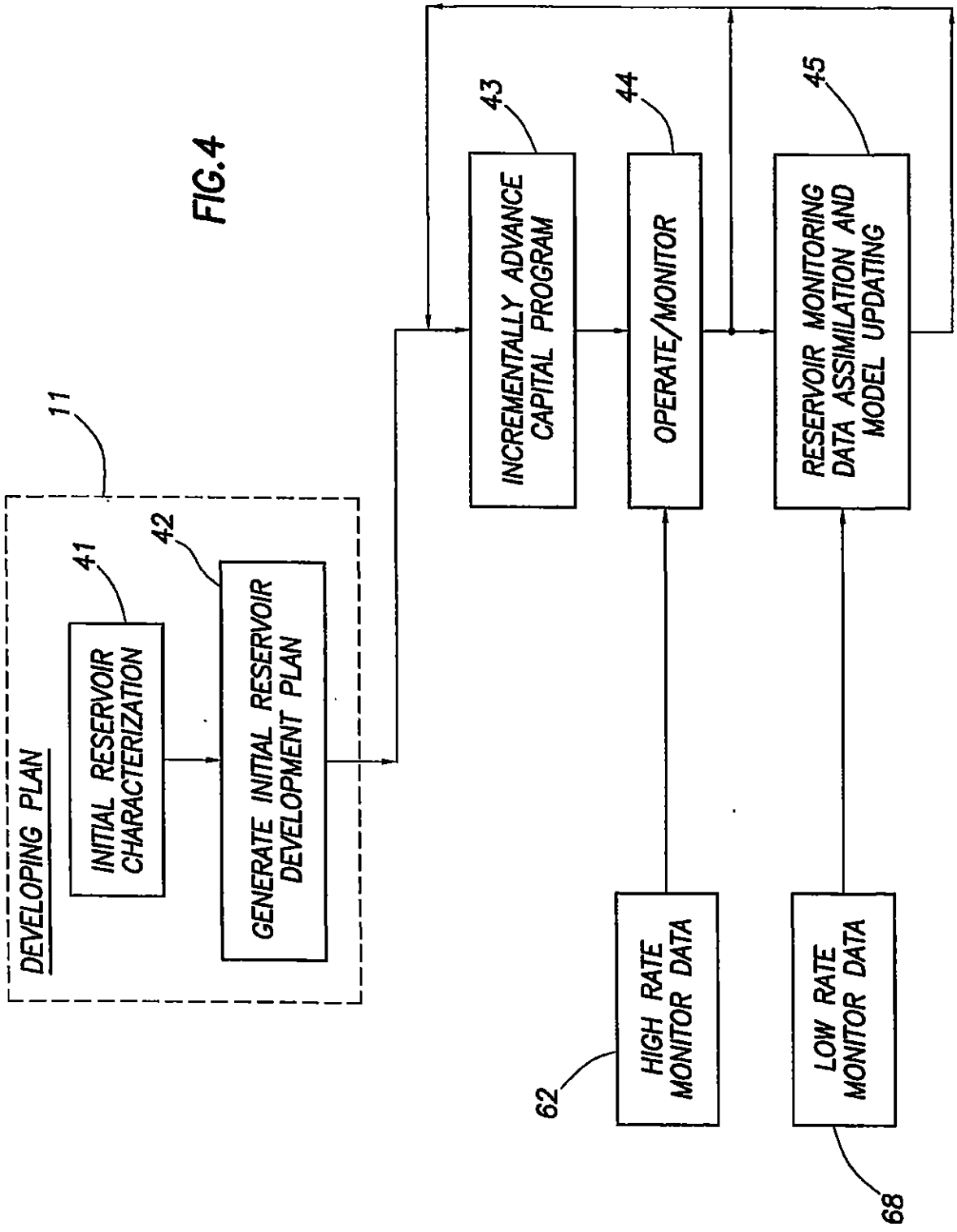
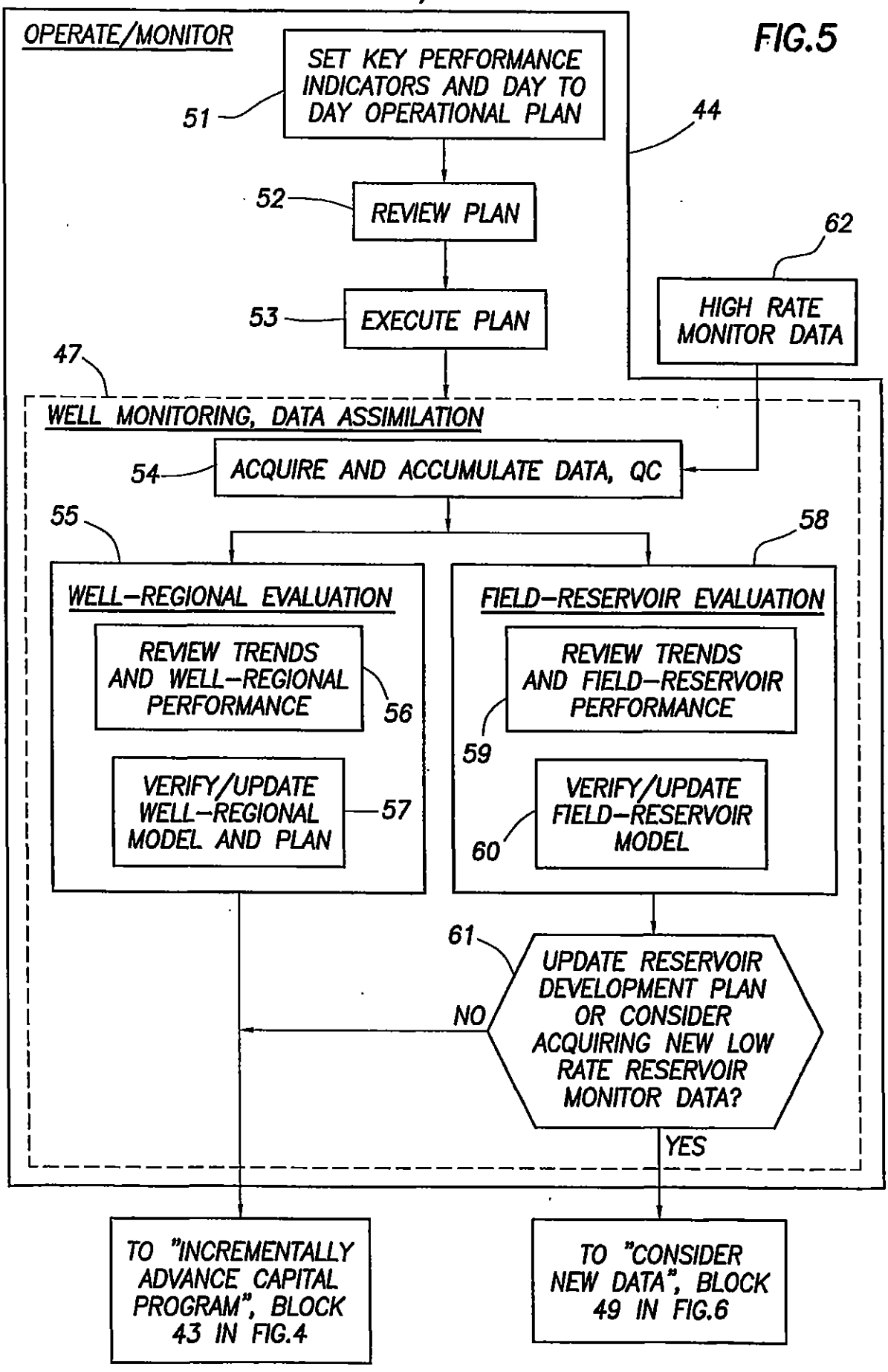

DEVELOPING PLAN
11
INITIAL RESERVOIR CHARACTERIZATION
41
GENERATE INITIAL RESERVOIR DEVELOPMENT PLAN
42
INCREMENTALLY ADVANCE CAPITAL PROGRAM
43
OPERATE/MONITOR
44
RESERVOIR MONITORING DATA ASSIMILATION AND MODEL UPDATING
45
HIGH RATE MONITOR DATA
62
LOW RATE MONITOR DATA
68

FIG.5


OPERATE/MONITOR
SET KEY PERFORMANCE INDICATORS AND DAY TO DAY OPERATIONAL PLAN
51
44
52
REVIEW PLAN
62
HIGH RATE MONITOR DATA
53
EXECUTE PLAN
47
WELL MONITORING, DATA ASSIMILATION
54
ACQUIRE AND ACCUMULATE DATA, QC
55
58
WELL–REGIONAL EVALUATION
REVIEW TRENDS AND WELL–REGIONAL PERFORMANCE
56
VERIFY/UPDATE WELL–REGIONAL MODEL AND PLAN
57
FIELD–RESERVOIR EVALUATION
REVIEW TRENDS AND FIELD–RESERVOIR PERFORMANCE
59
VERIFY/UPDATE FIELD–RESERVOIR MODEL
60
61
UPDATE RESERVOIR DEVELOPMENT PLAN OR CONSIDER ACQUIRING NEW LOW RATE RESERVOIR MONITOR DATA?
NO
YES
TO "INCREMENTALLY ADVANCE CAPITAL PROGRAM", BLOCK 43 IN FIG.4
TO "CONSIDER NEW DATA", BLOCK 49 IN FIG.6

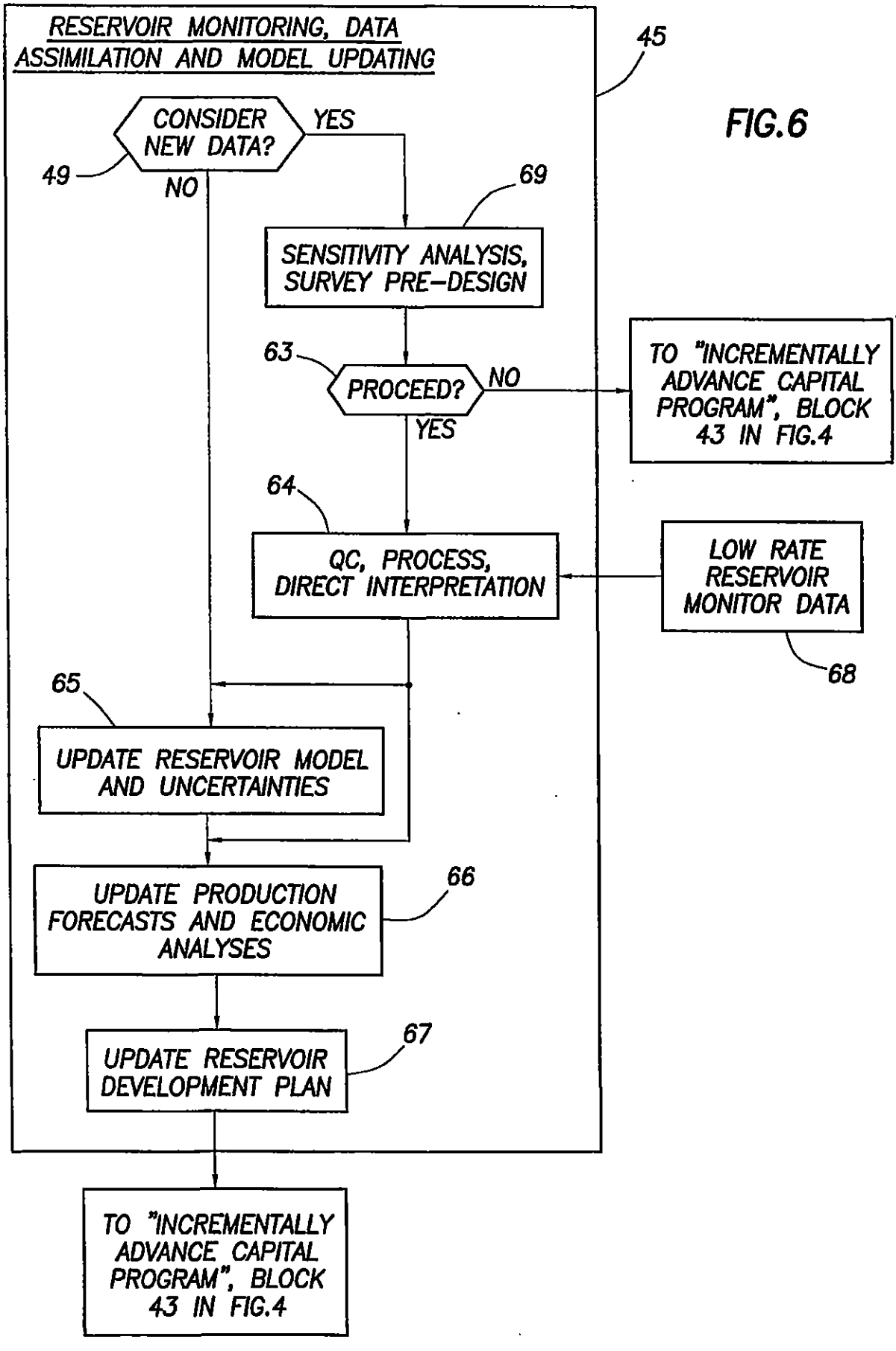

RESERVOIR MONITORING, DATA ASSIMILATION AND MODEL UPDATING
45
CONSIDER NEW DATA?
YES
NO
49
69
SENSITIVITY ANALYSIS, SURVEY PRE-DESIGN
63
PROCEED?
NO
YES
TO "INCREMENTALLY ADVANCE CAPITAL PROGRAM", BLOCK 43 IN FIG.4
64
QC, PROCESS, DIRECT INTERPRETATION
LOW RATE RESERVOIR MONITOR DATA
68
65
UPDATE RESERVOIR MODEL AND UNCERTAINTIES
UPDATE PRODUCTION FORECASTS AND ECONOMIC ANALYSES
66
UPDATE RESERVOIR DEVELOPMENT PLAN
67
TO "INCREMENTALLY ADVANCE CAPITAL PROGRAM", BLOCK 43 IN FIG.4

FIG.6

FIG.7

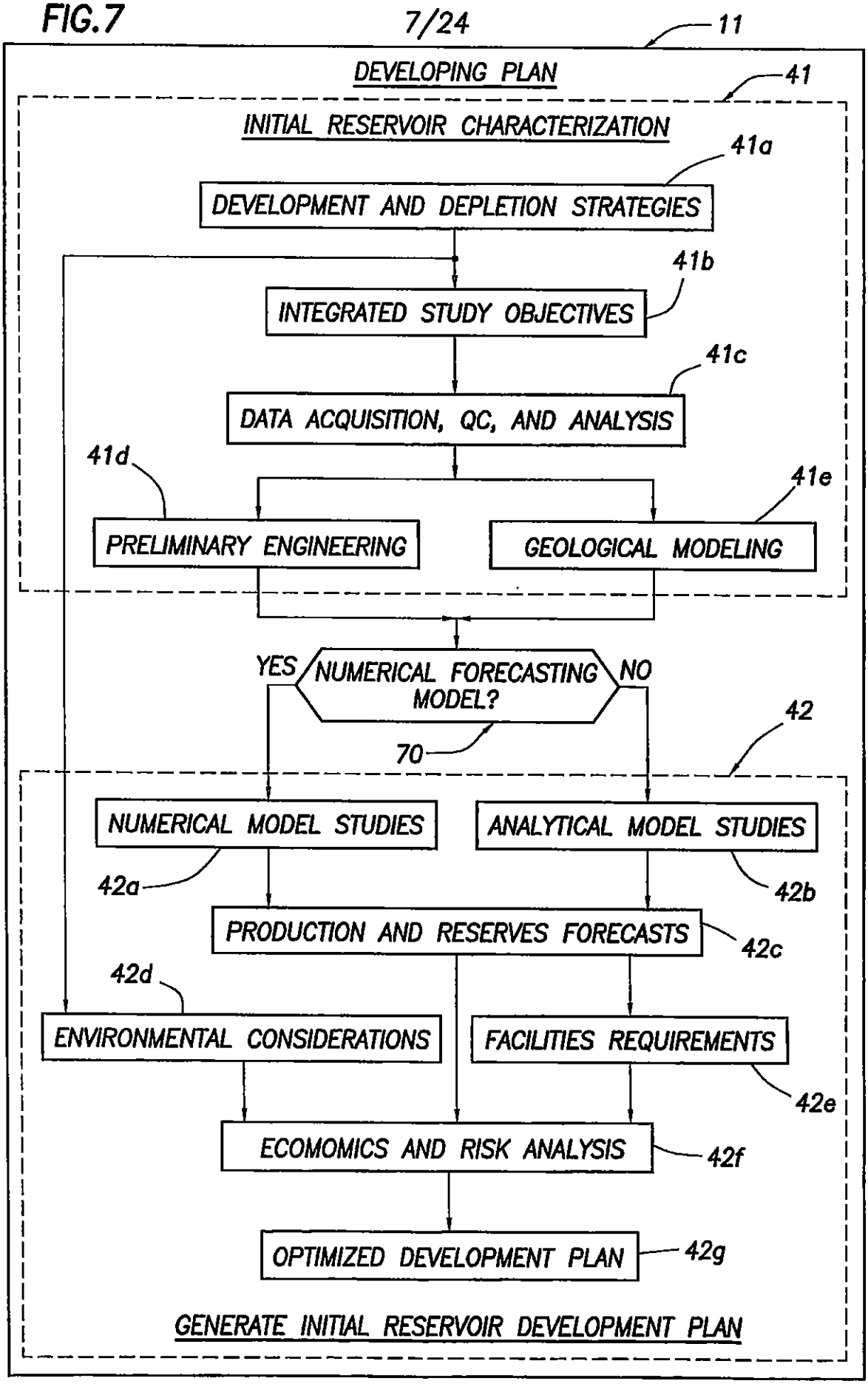

11
DEVELOPING PLAN
41
INITIAL RESERVOIR CHARACTERIZATION
41a
DEVELOPMENT AND DEPLETION STRATEGIES
41b
INTEGRATED STUDY OBJECTIVES
41c
DATA ACQUISITION, QC, AND ANALYSIS
41d
41e
PRELIMINARY ENGINEERING
GEOLOGICAL MODELING
YES
NUMERICAL FORECASTING MODEL?
NO
70
42
NUMERICAL MODEL STUDIES
ANALYTICAL MODEL STUDIES
42a
42b
PRODUCTION AND RESERVES FORECASTS
42c
42d
ENVIRONMENTAL CONSIDERATIONS
FACILITIES REQUIREMENTS
42e
ECOMOMICS AND RISK ANALYSIS
42f
OPTIMIZED DEVELOPMENT PLAN
42g
GENERATE INITIAL RESERVOIR DEVELOPMENT PLAN

FIG.8

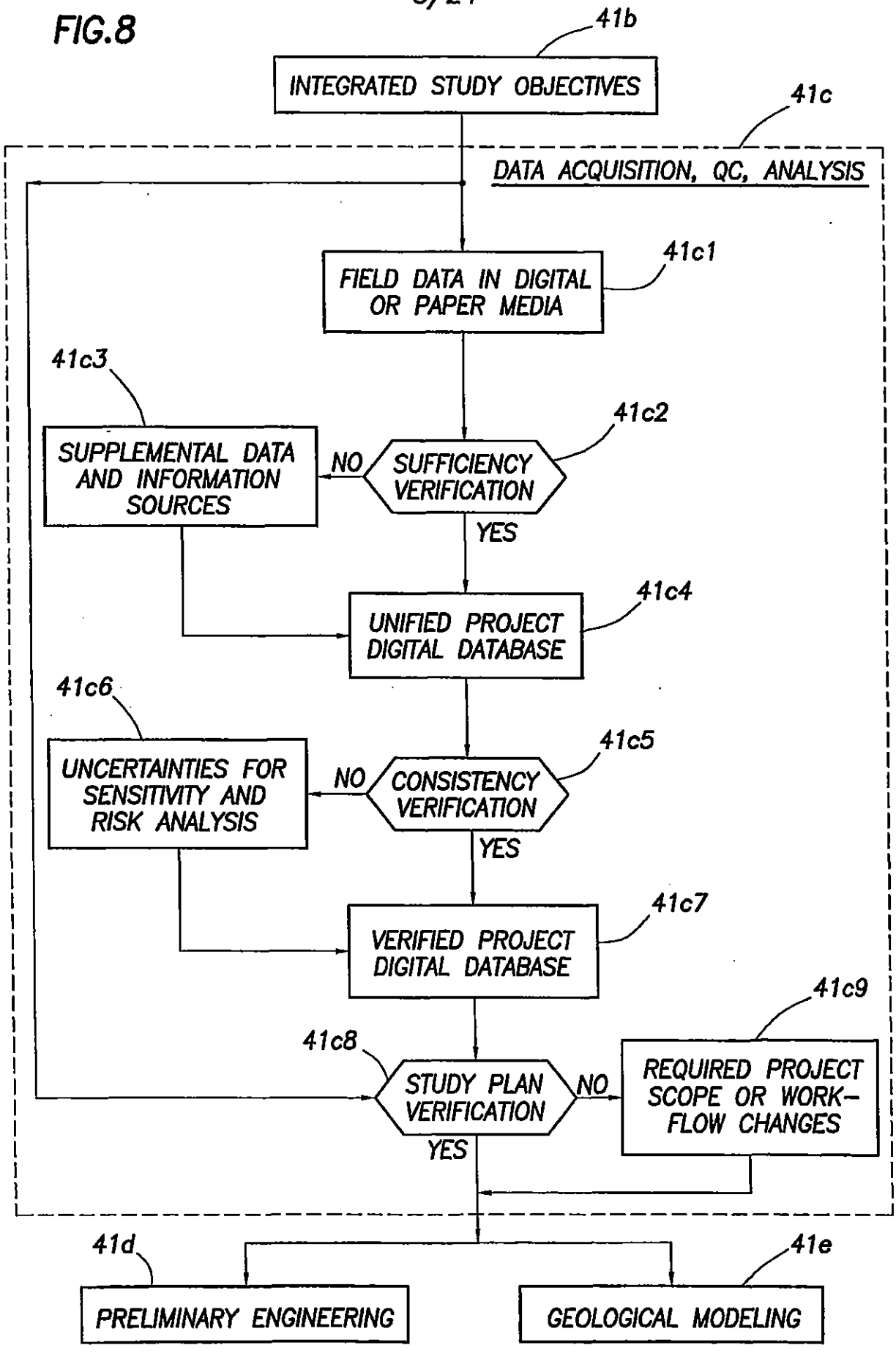
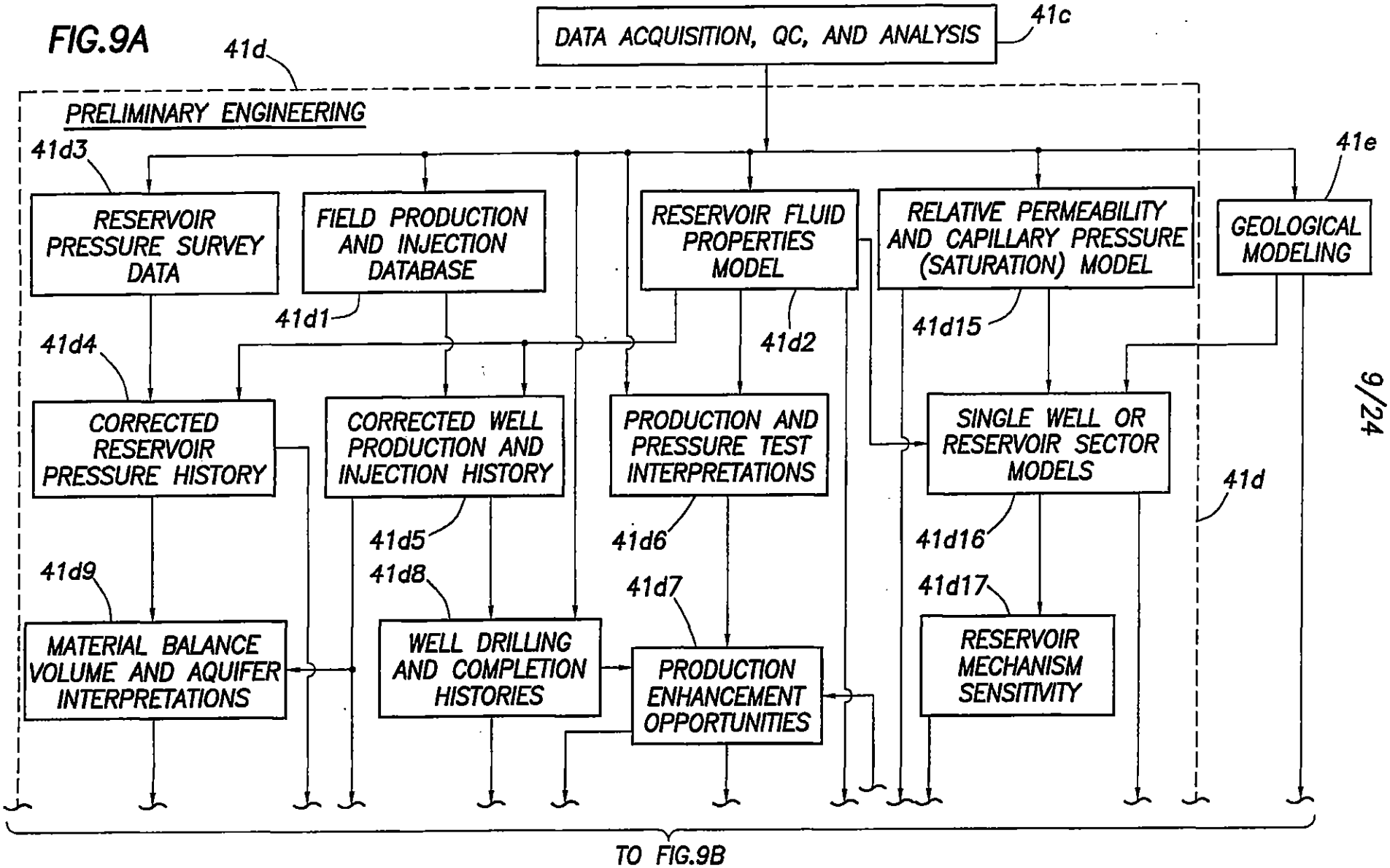

41b
INTEGRATED STUDY OBJECTIVES
41c
DATA ACQUISITION, QC, ANALYSIS
41c1
FIELD DATA IN DIGITAL OR PAPER MEDIA
41c3
SUPPLEMENTAL DATA AND INFORMATION SOURCES
NO
41c2
SUFFICIENCY VERIFICATION
YES
41c4
UNIFIED PROJECT DIGITAL DATABASE
41c6
UNCERTAINTIES FOR SENSITIVITY AND RISK ANALYSIS
NO
41c5
CONSISTENCY VERIFICATION
YES
41c7
VERIFIED PROJECT DIGITAL DATABASE
41c9
41c8
STUDY PLAN VERIFICATION
NO
REQUIRED PROJECT SCOPE OR WORK-FLOW CHANGES
YES
41d
PRELIMINARY ENGINEERING
41e
GEOLOGICAL MODELING

FIG.9A


41d
DATA ACQUISITION, QC, AND ANALYSIS
41c
PRELIMINARY ENGINEERING
41d3
41e
RESERVOIR PRESSURE SURVEY DATA
FIELD PRODUCTION AND INJECTION DATABASE
RESERVOIR FLUID PROPERTIES MODEL
RELATIVE PERMEABILITY AND CAPILLARY PRESSURE (SATURATION) MODEL
GEOLOGICAL MODELING
41d1
41d2
41d15
41d4
CORRECTED RESERVOIR PRESSURE HISTORY
CORRECTED WELL PRODUCTION AND INJECTION HISTORY
PRODUCTION AND PRESSURE TEST INTERPRETATIONS
SINGLE WELL OR RESERVOIR SECTOR MODELS
41d
41d5
41d6
41d16
41d9
41d8
41d7
41d17
MATERIAL BALANCE VOLUME AND AQUIFER INTERPRETATIONS
WELL DRILLING AND COMPLETION HISTORIES
PRODUCTION ENHANCEMENT OPPORTUNITIES
RESERVOIR MECHANISM SENSITIVITY
TO FIG.9B

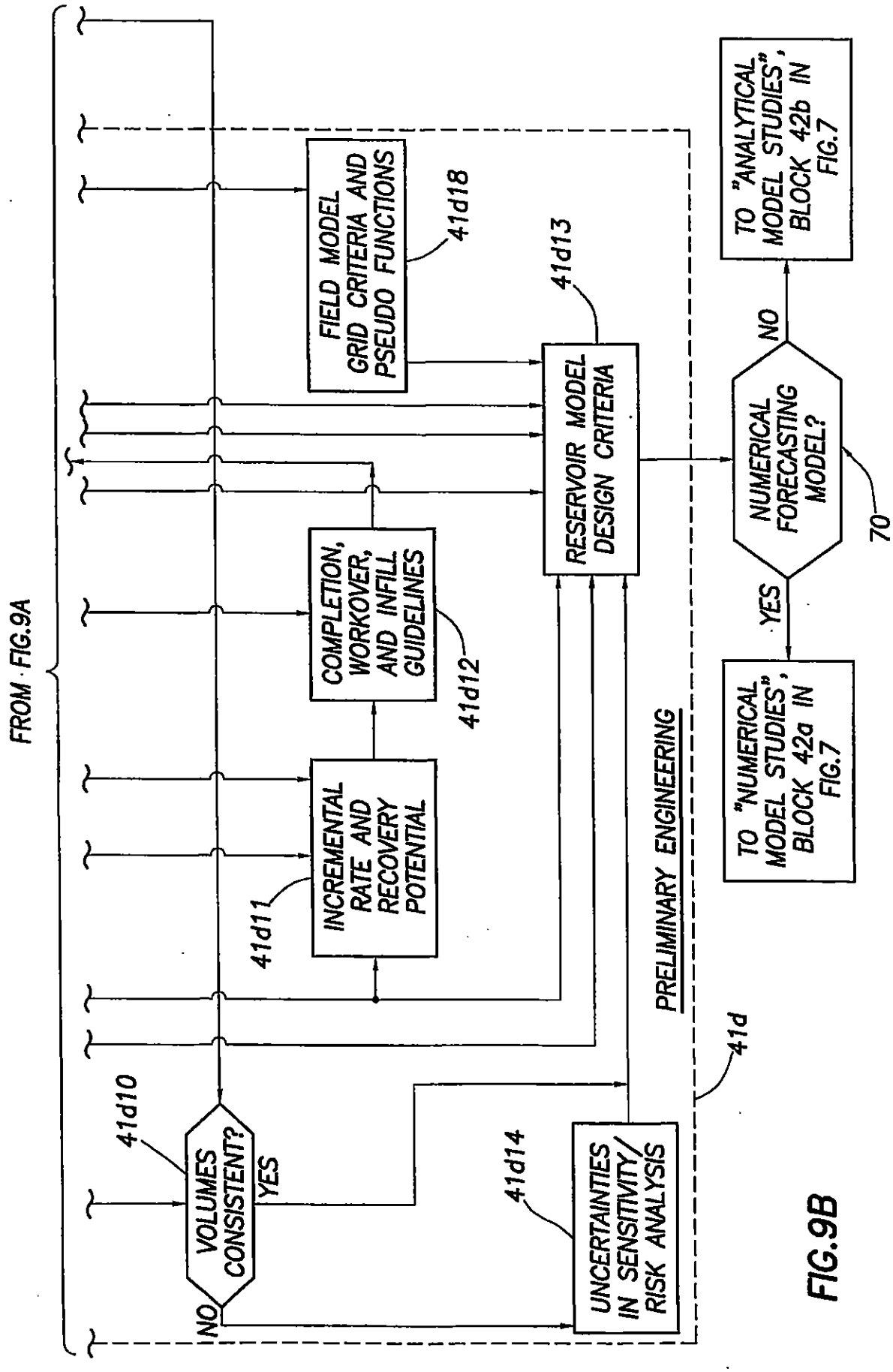

FROM FIG.9A
FIELD MODEL GRID CRITERIA AND PSEUDO FUNCTIONS
41d18
41d13
RESERVOIR MODEL DESIGN CRITERIA
COMPLETION, WORKOVER, AND INFILL GUIDELINES
41d12
INCREMENTAL RATE AND RECOVERY POTENTIAL
41d11
41d10
VOLUMES CONSISTENT?
YES
NO
41d14
UNCERTAINTIES IN SENSITIVITY/ RISK ANALYSIS
PRELIMINARY ENGINEERING
41d
NUMERICAL FORECASTING MODEL?
70
NO
YES
TO "ANALYTICAL MODEL STUDIES", BLOCK 42b IN FIG.7
TO "NUMERICAL MODEL STUDIES", BLOCK 42a IN FIG.7

FIG.9B

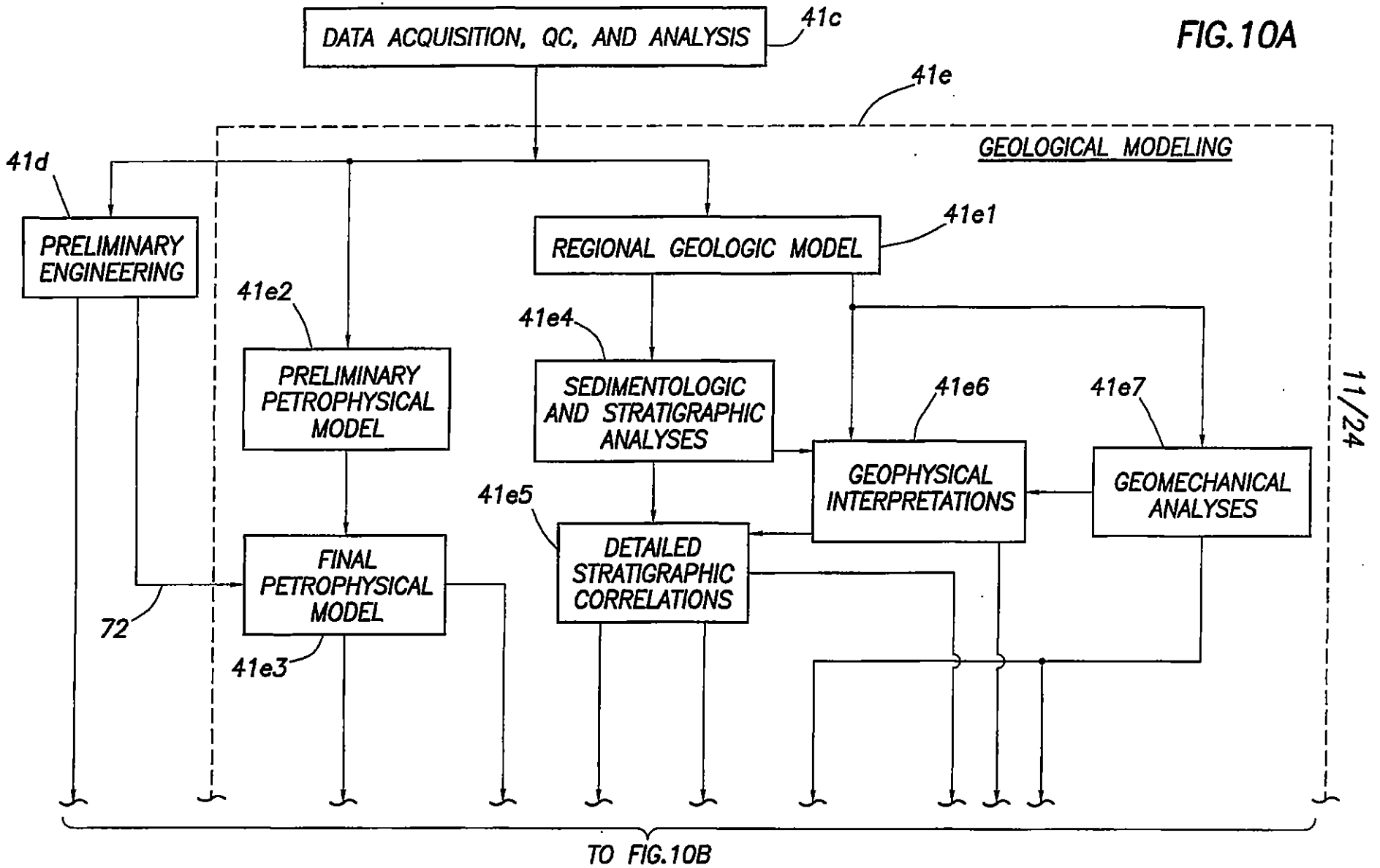

DATA ACQUISITION, QC, AND ANALYSIS
41c
41e
GEOLOGICAL MODELING
41d
PRELIMINARY ENGINEERING
REGIONAL GEOLOGIC MODEL
41e1
41e2
PRELIMINARY PETROPHYSICAL MODEL
41e4
SEDIMENTOLOGIC AND STRATIGRAPHIC ANALYSES
41e6
GEOPHYSICAL INTERPRETATIONS
41e7
GEOMECHANICAL ANALYSES
41e5
DETAILED STRATIGRAPHIC CORRELATIONS
FINAL PETROPHYSICAL MODEL
72
41e3
11/24
TO FIG.10B

FIG.10A

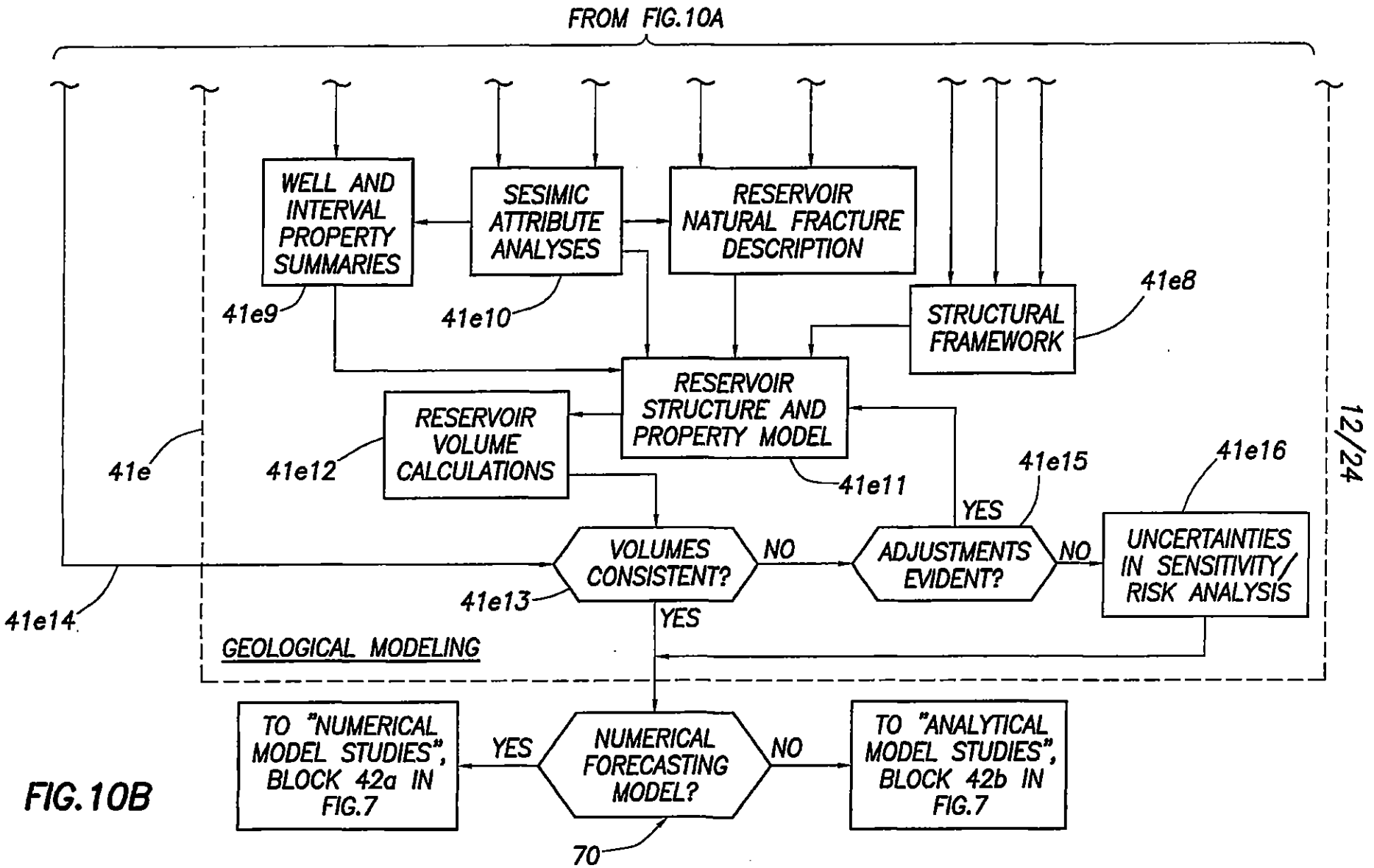

FROM FIG.10A
WELL AND INTERVAL PROPERTY SUMMARIES
SESIMIC ATTRIBUTE ANALYSES
RESERVOIR NATURAL FRACTURE DESCRIPTION
STRUCTURAL FRAMEWORK
41e8
41e9
41e10
RESERVOIR STRUCTURE AND PROPERTY MODEL
41e11
RESERVOIR VOLUME CALCULATIONS
41e12
41e
41e15
41e16
YES
VOLUMES CONSISTENT?
NO
ADJUSTMENTS EVIDENT?
NO
UNCERTAINTIES IN SENSITIVITY/ RISK ANALYSIS
41e13
41e14
YES
GEOLOGICAL MODELING
TO "NUMERICAL MODEL STUDIES", BLOCK 42a IN FIG.7
YES
NUMERICAL FORECASTING MODEL?
NO
TO "ANALYTICAL MODEL STUDIES", BLOCK 42b IN FIG.7
70
12/24

FIG. 10B

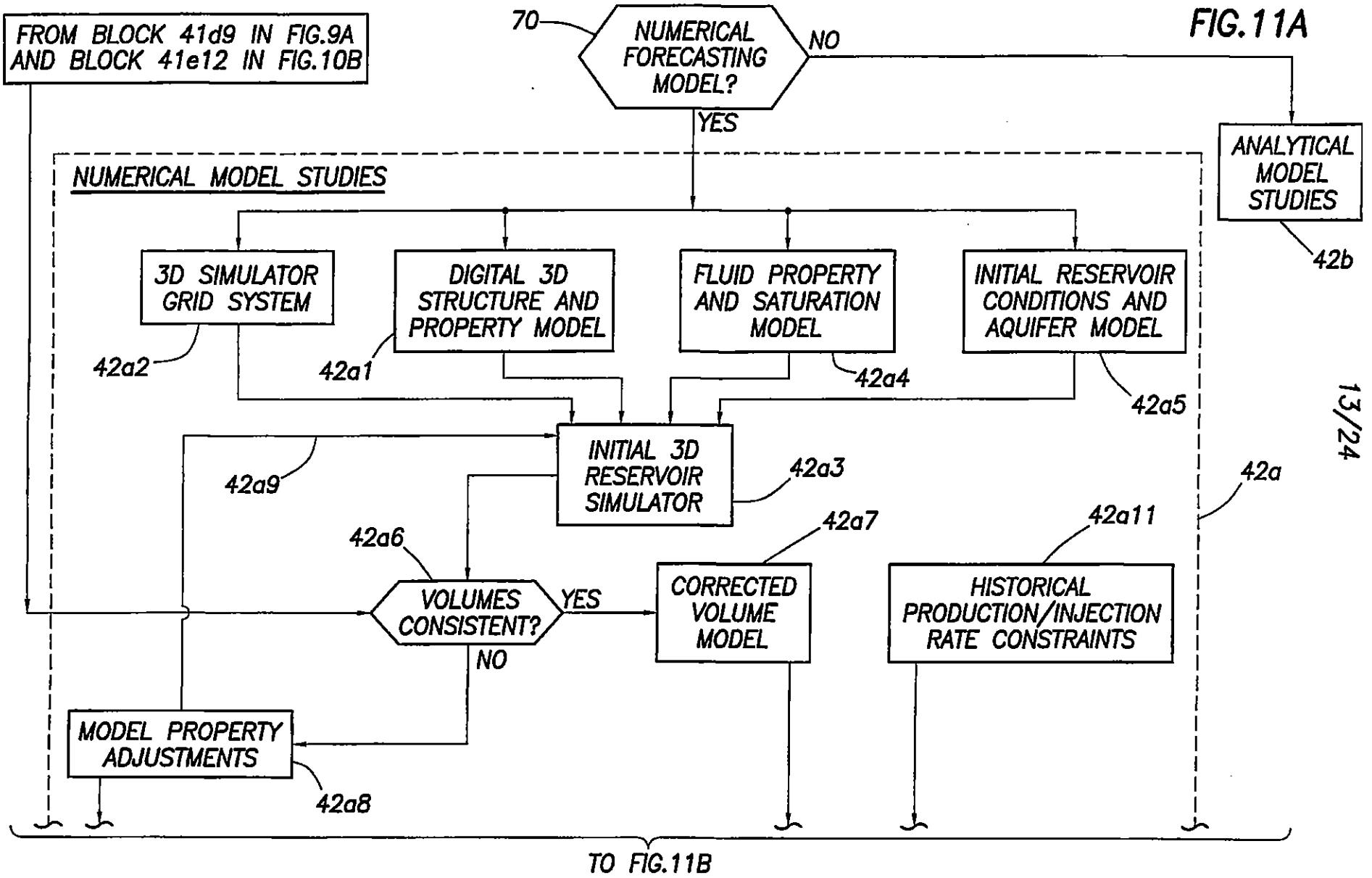

FROM BLOCK 41d9 IN FIG.9A AND BLOCK 41e12 IN FIG.10B
70
NUMERICAL FORECASTING MODEL?
NO
YES
ANALYTICAL MODEL STUDIES
42b
NUMERICAL MODEL STUDIES
3D SIMULATOR GRID SYSTEM
42a2
DIGITAL 3D STRUCTURE AND PROPERTY MODEL
42a1
FLUID PROPERTY AND SATURATION MODEL
42a4
INITIAL RESERVOIR CONDITIONS AND AQUIFER MODEL
42a5
42a9
INITIAL 3D RESERVOIR SIMULATOR
42a3
42a
42a6
42a7
42a11
VOLUMES CONSISTENT?
YES
CORRECTED VOLUME MODEL
HISTORICAL PRODUCTION/INJECTION RATE CONSTRAINTS
NO
MODEL PROPERTY ADJUSTMENTS
42a8
TO FIG.11B

FIG.11A

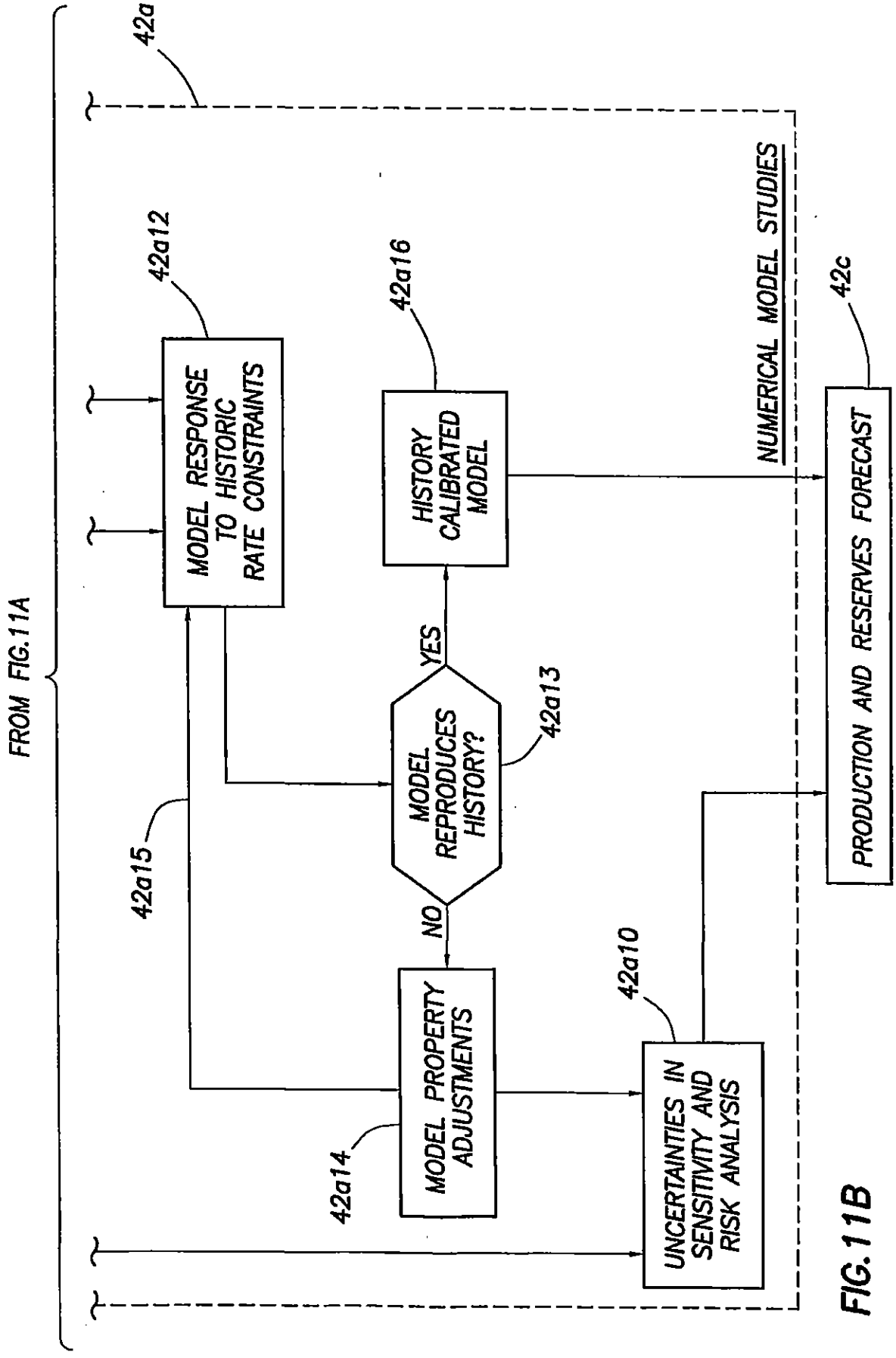

FROM FIG.11A
42a
NUMERICAL MODEL STUDIES
42a12
MODEL RESPONSE TO HISTORIC RATE CONSTRAINTS
42a16
HISTORY CALIBRATED MODEL
42c
PRODUCTION AND RESERVES FORECAST
YES
MODEL REPRODUCES HISTORY?
42a13
42a15
NO
42a10
MODEL PROPERTY ADJUSTMENTS
42a14
UNCERTAINTIES IN SENSITIVITY AND RISK ANALYSIS

FIG.11B

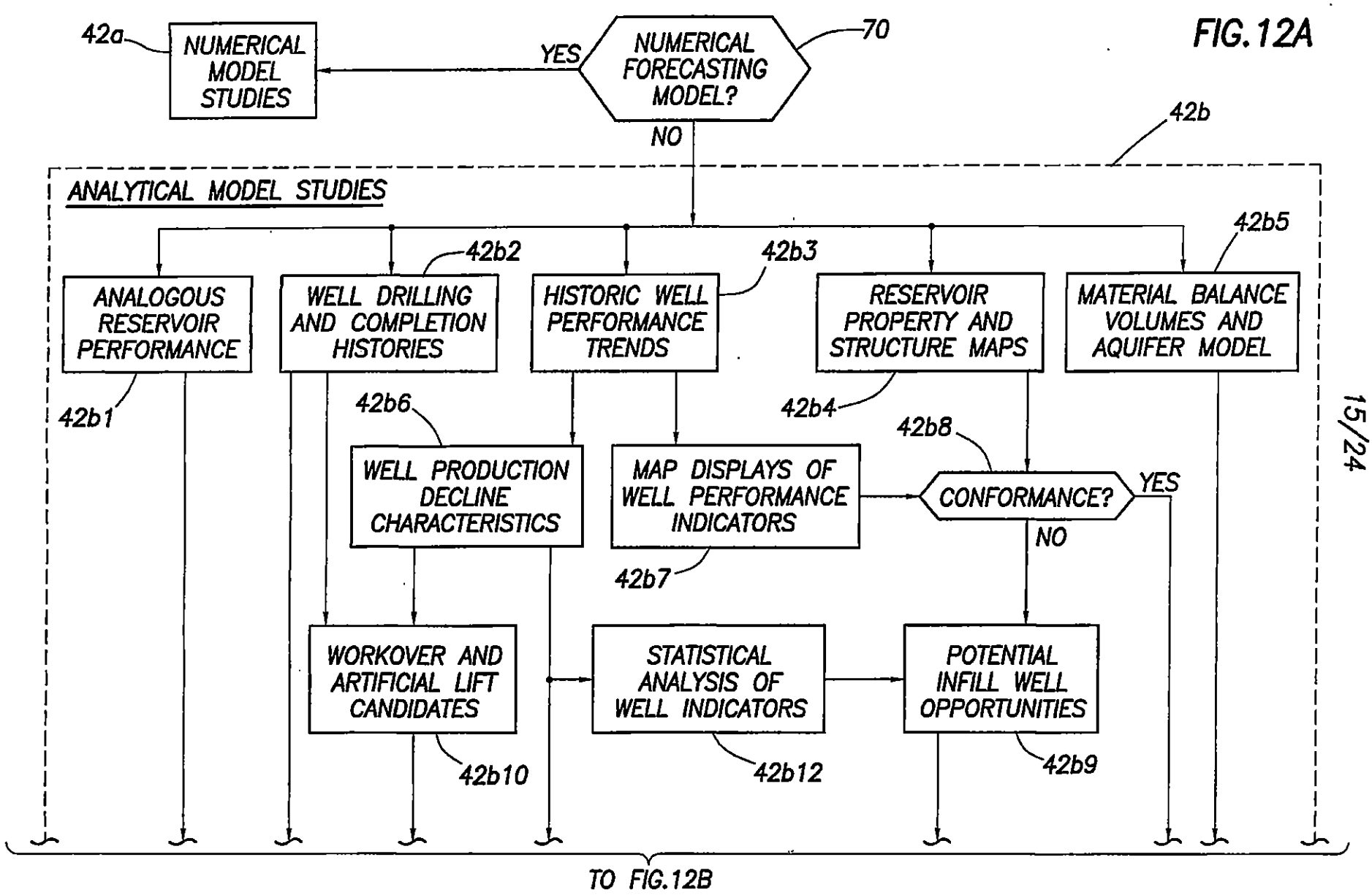

42a
NUMERICAL MODEL STUDIES
YES
NUMERICAL FORECASTING MODEL?
70
NO
42b
ANALYTICAL MODEL STUDIES
ANALOGOUS RESERVOIR PERFORMANCE
42b1
WELL DRILLING AND COMPLETION HISTORIES
42b2
HISTORIC WELL PERFORMANCE TRENDS
42b3
RESERVOIR PROPERTY AND STRUCTURE MAPS
42b4
MATERIAL BALANCE VOLUMES AND AQUIFER MODEL
42b5
WELL PRODUCTION DECLINE CHARACTERISTICS
42b6
MAP DISPLAYS OF WELL PERFORMANCE INDICATORS
42b7
CONFORMANCE?
42b8
YES
NO
WORKOVER AND ARTIFICIAL LIFT CANDIDATES
42b10
STATISTICAL ANALYSIS OF WELL INDICATORS
42b12
POTENTIAL INFILL WELL OPPORTUNITIES
42b9
TO FIG.12B

FIG.12A

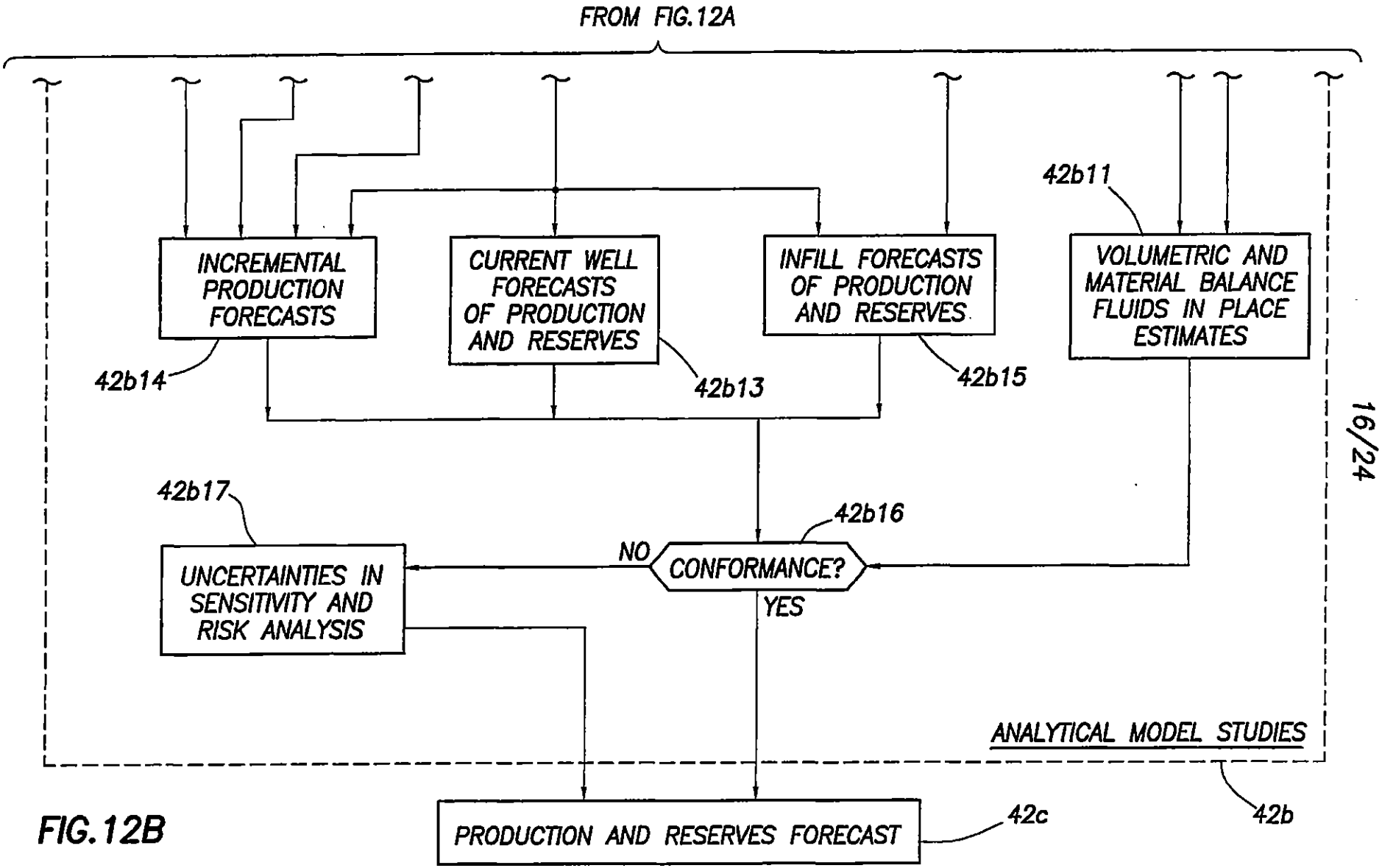

FROM FIG.12A
42b11
INCREMENTAL PRODUCTION FORECASTS
CURRENT WELL FORECASTS OF PRODUCTION AND RESERVES
INFILL FORECASTS OF PRODUCTION AND RESERVES
VOLUMETRIC AND MATERIAL BALANCE FLUIDS IN PLACE ESTIMATES
42b14
42b13
42b15
42b17
42b16
NO
CONFORMANCE?
YES
UNCERTAINTIES IN SENSITIVITY AND RISK ANALYSIS
ANALYTICAL MODEL STUDIES
42b
PRODUCTION AND RESERVES FORECAST
42c
16/24

FIG. 12B

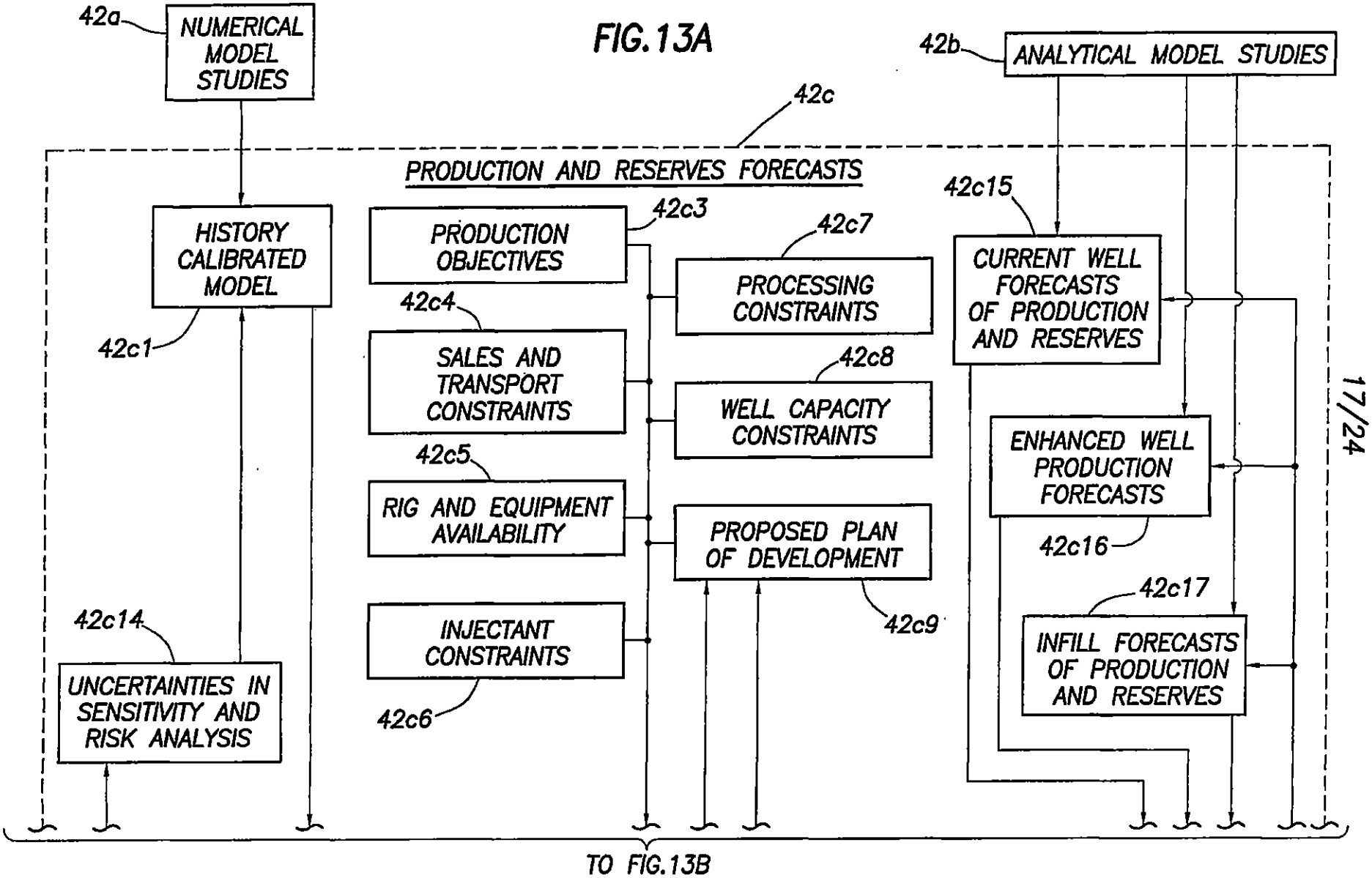

42a
NUMERICAL MODEL STUDIES
42b
ANALYTICAL MODEL STUDIES
42c
PRODUCTION AND RESERVES FORECASTS
HISTORY CALIBRATED MODEL
42c1
PRODUCTION OBJECTIVES
42c3
SALES AND TRANSPORT CONSTRAINTS
42c4
RIG AND EQUIPMENT AVAILABILITY
42c5
INJECTANT CONSTRAINTS
42c6
PROCESSING CONSTRAINTS
42c7
WELL CAPACITY CONSTRAINTS
42c8
PROPOSED PLAN OF DEVELOPMENT
42c9
UNCERTAINTIES IN SENSITIVITY AND RISK ANALYSIS
42c14
CURRENT WELL FORECASTS OF PRODUCTION AND RESERVES
42c15
ENHANCED WELL PRODUCTION FORECASTS
42c16
INFILL FORECASTS OF PRODUCTION AND RESERVES
42c17
TO FIG.13B

FIG.13A

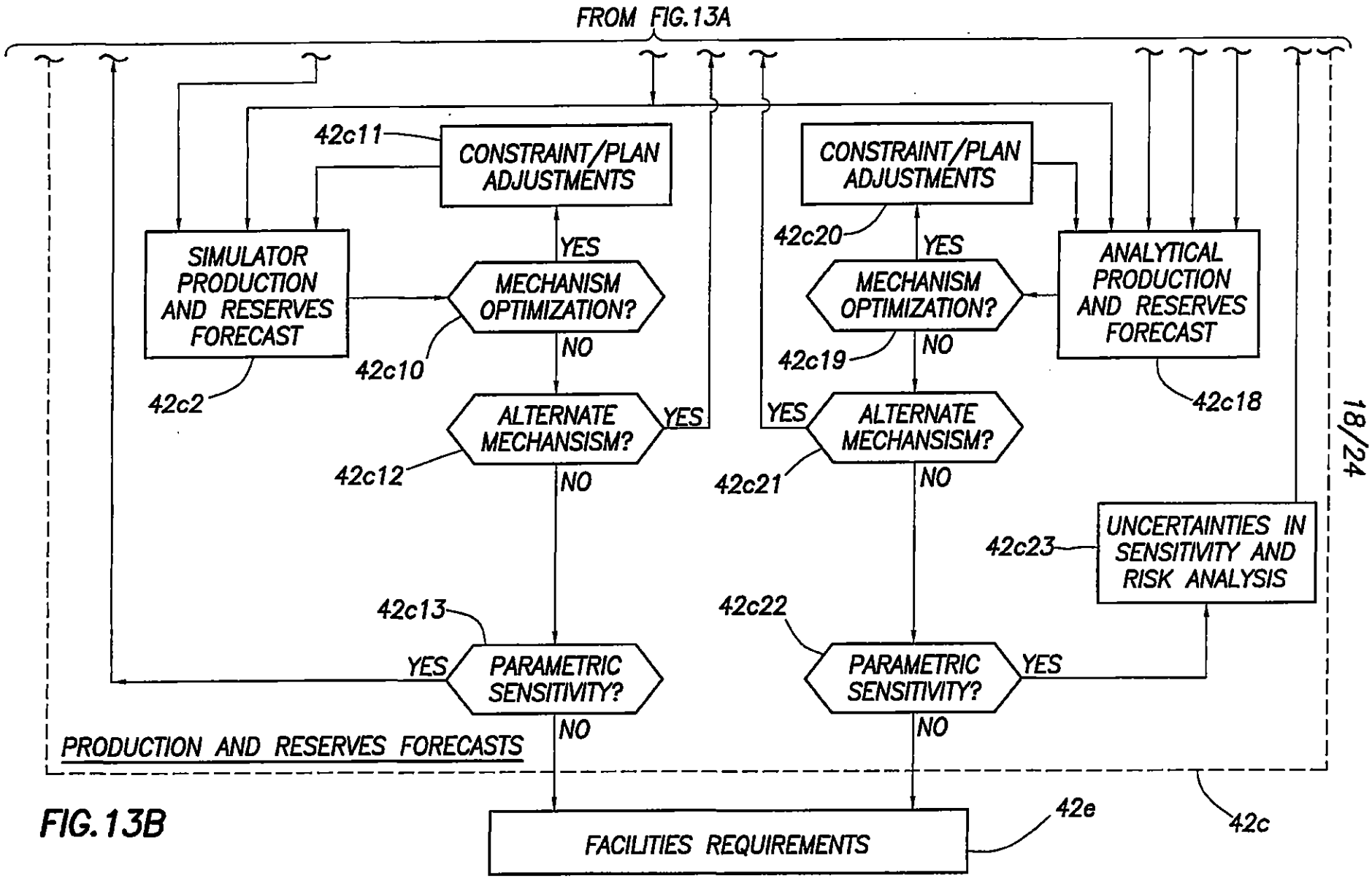
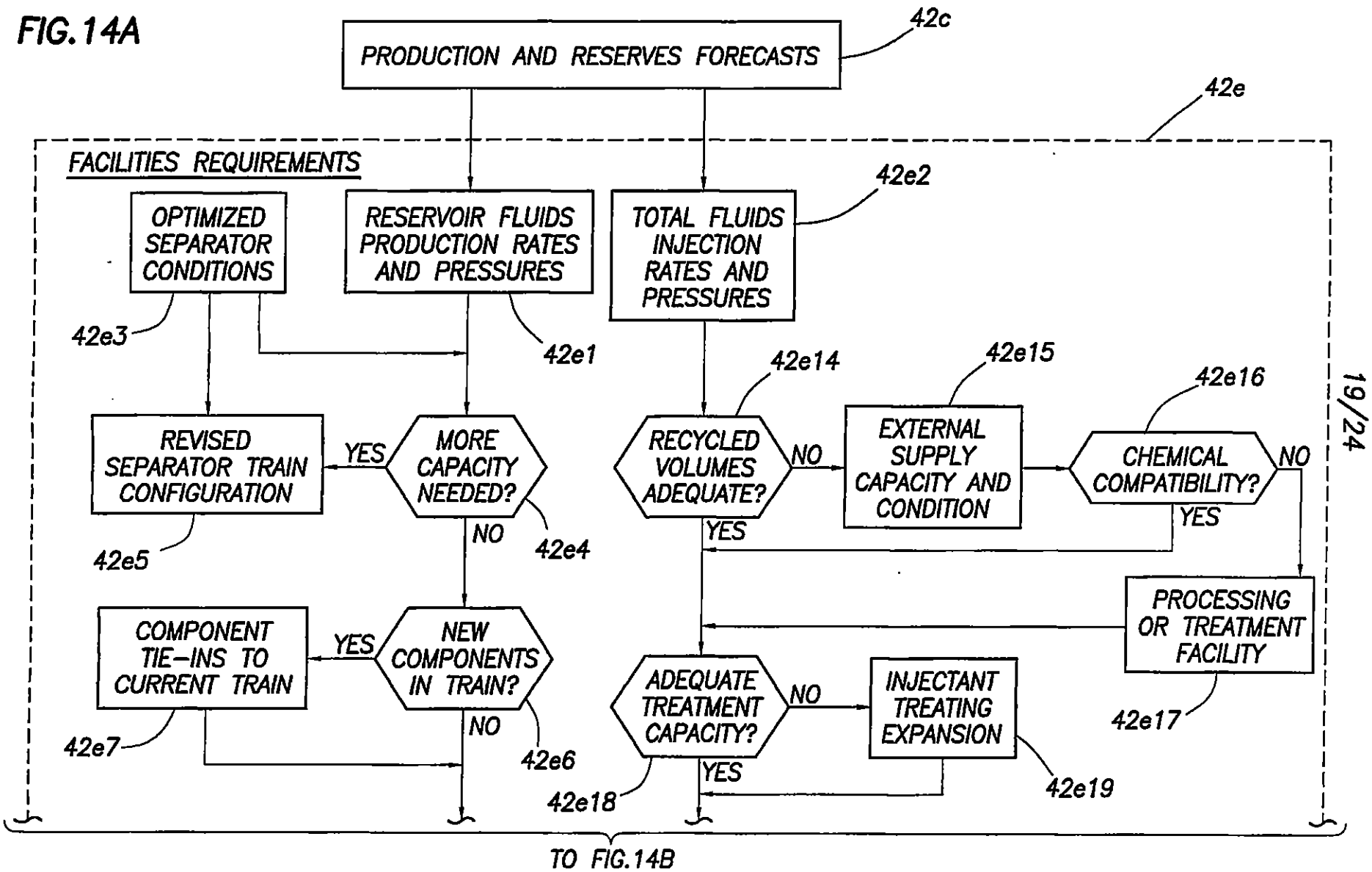

FROM FIG. 13A
42c11
CONSTRAINT/PLAN ADJUSTMENTS
CONSTRAINT/PLAN ADJUSTMENTS
42c20
YES
SIMULATOR PRODUCTION AND RESERVES FORECAST
MECHANISM OPTIMIZATION?
MECHANISM OPTIMIZATION?
ANALYTICAL PRODUCTION AND RESERVES FORECAST
42c10
NO
42c19
42c2
42c18
YES
ALTERNATE MECHANSISM?
YES
ALTERNATE MECHANSISM?
YES
42c12
42c21
NO
NO
UNCERTAINTIES IN SENSITIVITY AND RISK ANALYSIS
42c23
42c13
42c22
YES
PARAMETRIC SENSITIVITY?
PARAMETRIC SENSITIVITY?
YES
NO
NO
PRODUCTION AND RESERVES FORECASTS
FACILITIES REQUIREMENTS
42e
42c
18/24

FIG. 13B

FIG. 14A


PRODUCTION AND RESERVES FORECASTS
42c
42e
FACILITIES REQUIREMENTS
OPTIMIZED SEPARATOR CONDITIONS
RESERVOIR FLUIDS PRODUCTION RATES AND PRESSURES
TOTAL FLUIDS INJECTION RATES AND PRESSURES
42e2
42e3
42e1
42e14
42e15
42e16
REVISED SEPARATOR TRAIN CONFIGURATION
YES
MORE CAPACITY NEEDED?
RECYCLED VOLUMES ADEQUATE?
NO
EXTERNAL SUPPLY CAPACITY AND CONDITION
CHEMICAL COMPATIBILITY?
NO
YES
42e5
NO
42e4
YES
PROCESSING OR TREATMENT FACILITY
COMPONENT TIE-INS TO CURRENT TRAIN
YES
NEW COMPONENTS IN TRAIN?
ADEQUATE TREATMENT CAPACITY?
NO
INJECTANT TREATING EXPANSION
42e17
42e7
NO
42e6
42e18
YES
42e19
19/24
TO FIG. 14B

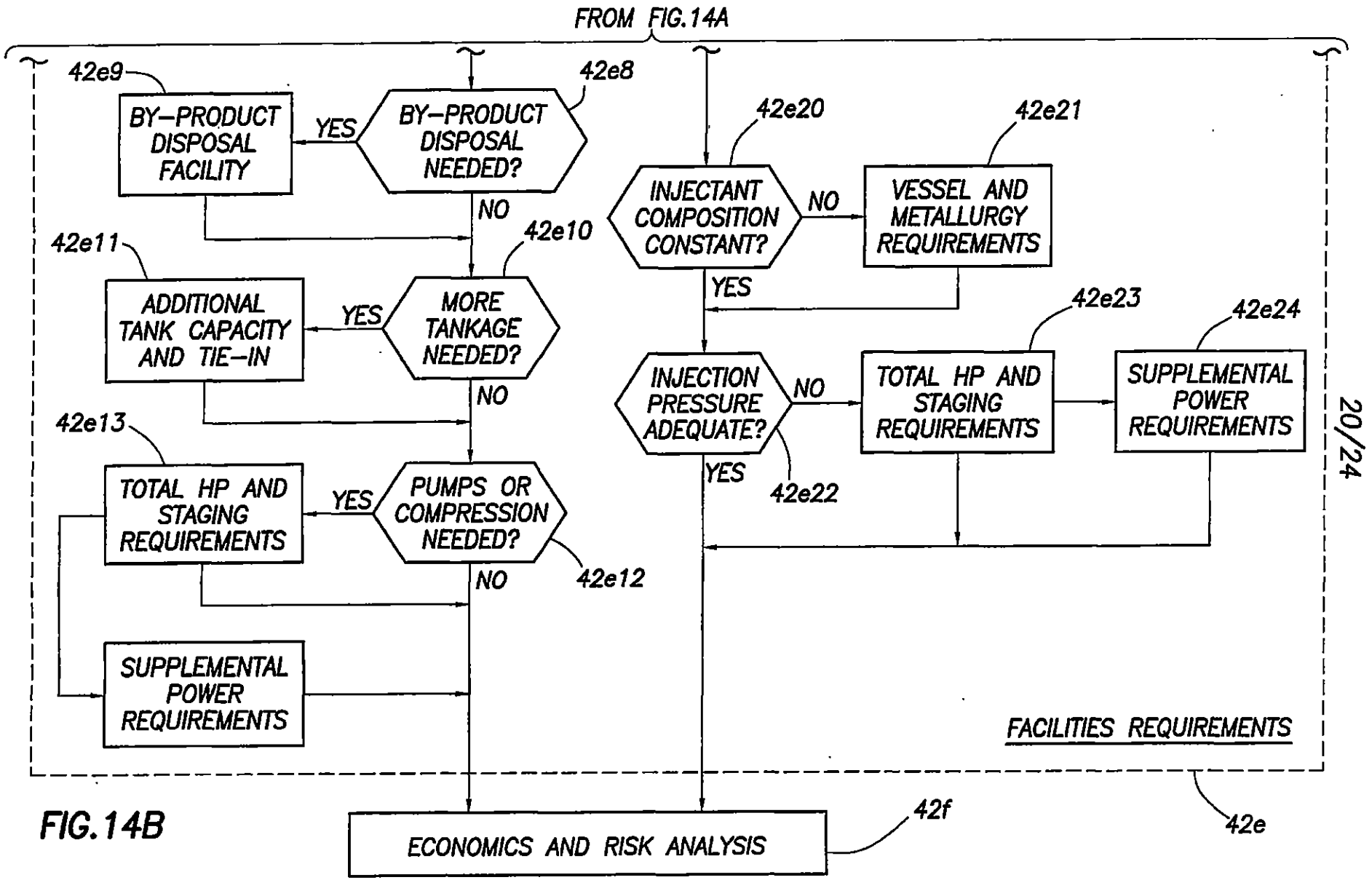
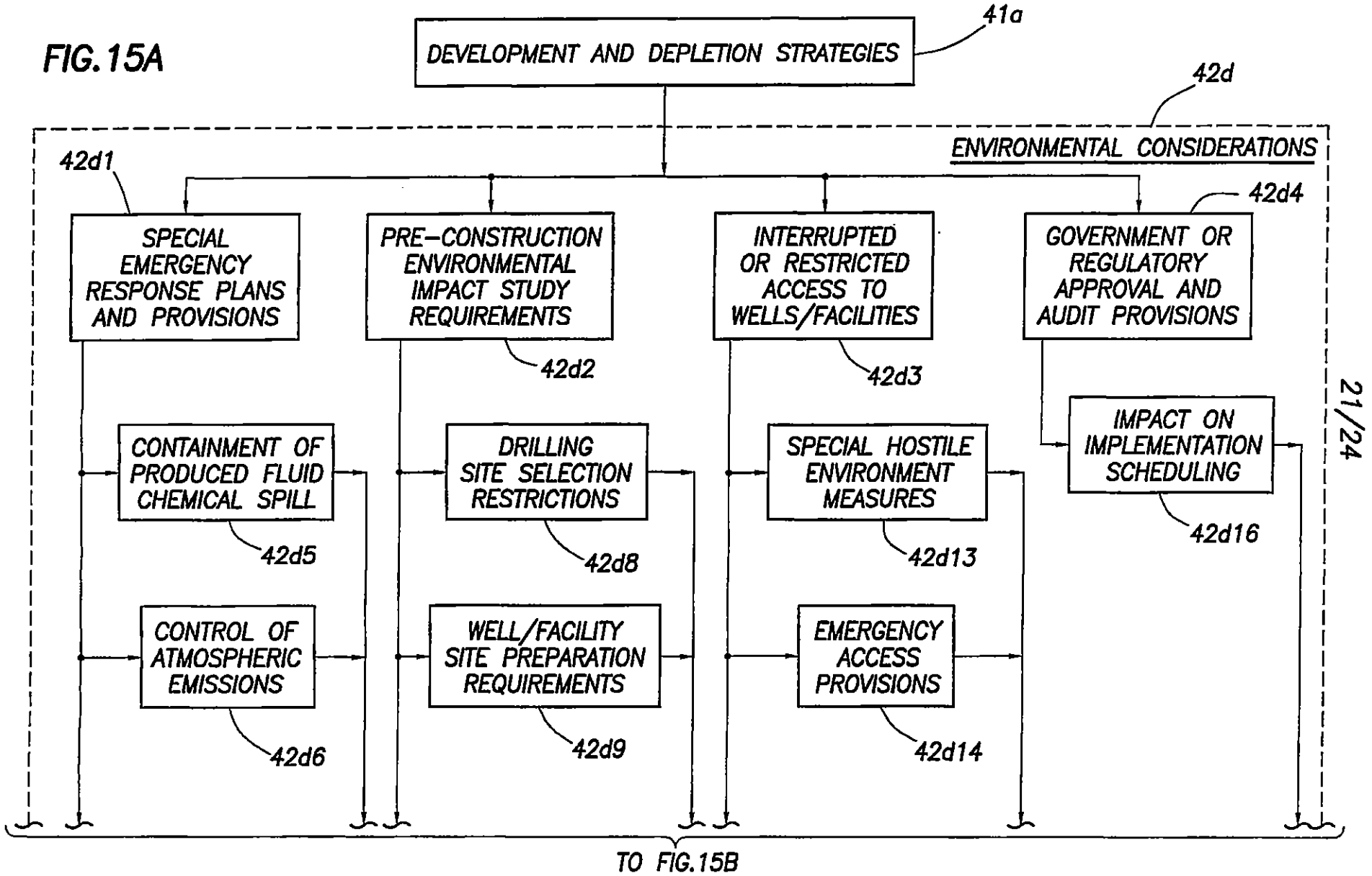

FROM FIG.14A
42e9
BY–PRODUCT DISPOSAL FACILITY
YES
42e8
BY–PRODUCT DISPOSAL NEEDED?
NO
42e11
ADDITIONAL TANK CAPACITY AND TIE–IN
YES
42e10
MORE TANKAGE NEEDED?
NO
42e13
TOTAL HP AND STAGING REQUIREMENTS
YES
PUMPS OR COMPRESSION NEEDED?
NO
42e12
SUPPLEMENTAL POWER REQUIREMENTS
42e20
INJECTANT COMPOSITION CONSTANT?
NO
42e21
VESSEL AND METALLURGY REQUIREMENTS
YES
42e23
INJECTION PRESSURE ADEQUATE?
NO
TOTAL HP AND STAGING REQUIREMENTS
42e24
SUPPLEMENTAL POWER REQUIREMENTS
YES
42e22
FACILITIES REQUIREMENTS
42e
42f
ECONOMICS AND RISK ANALYSIS
20/24

FIG.14B

FIG. 15A


DEVELOPMENT AND DEPLETION STRATEGIES
41a
42d
ENVIRONMENTAL CONSIDERATIONS
42d1
SPECIAL EMERGENCY RESPONSE PLANS AND PROVISIONS
PRE-CONSTRUCTION ENVIRONMENTAL IMPACT STUDY REQUIREMENTS
42d2
INTERRUPTED OR RESTRICTED ACCESS TO WELLS/FACILITIES
42d3
42d4
GOVERNMENT OR REGULATORY APPROVAL AND AUDIT PROVISIONS
CONTAINMENT OF PRODUCED FLUID CHEMICAL SPILL
42d5
DRILLING SITE SELECTION RESTRICTIONS
42d8
SPECIAL HOSTILE ENVIRONMENT MEASURES
42d13
IMPACT ON IMPLEMENTATION SCHEDULING
42d16
CONTROL OF ATMOSPHERIC EMISSIONS
42d6
WELL/FACILITY SITE PREPARATION REQUIREMENTS
42d9
EMERGENCY ACCESS PROVISIONS
42d14
21/24
TO FIG. 15B

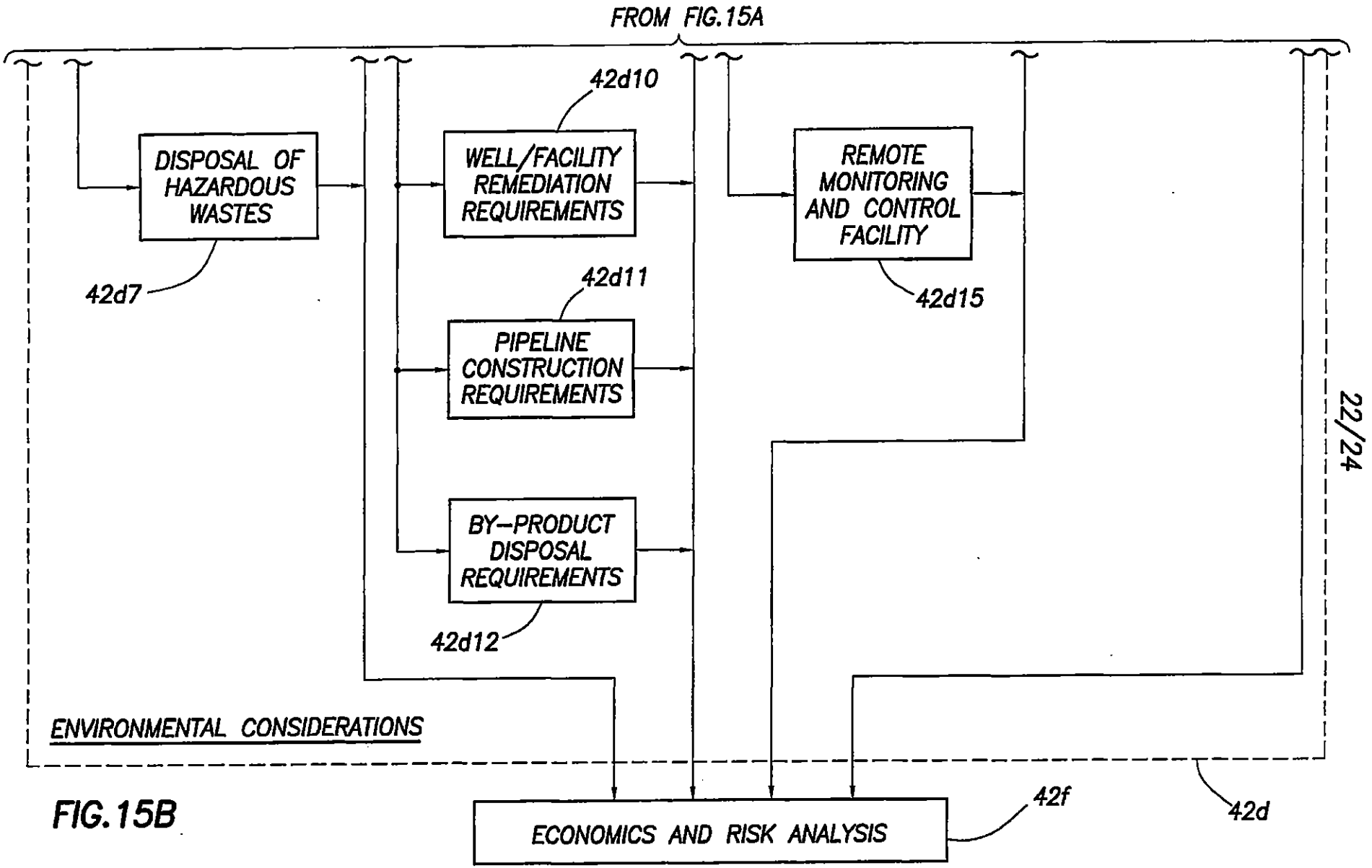
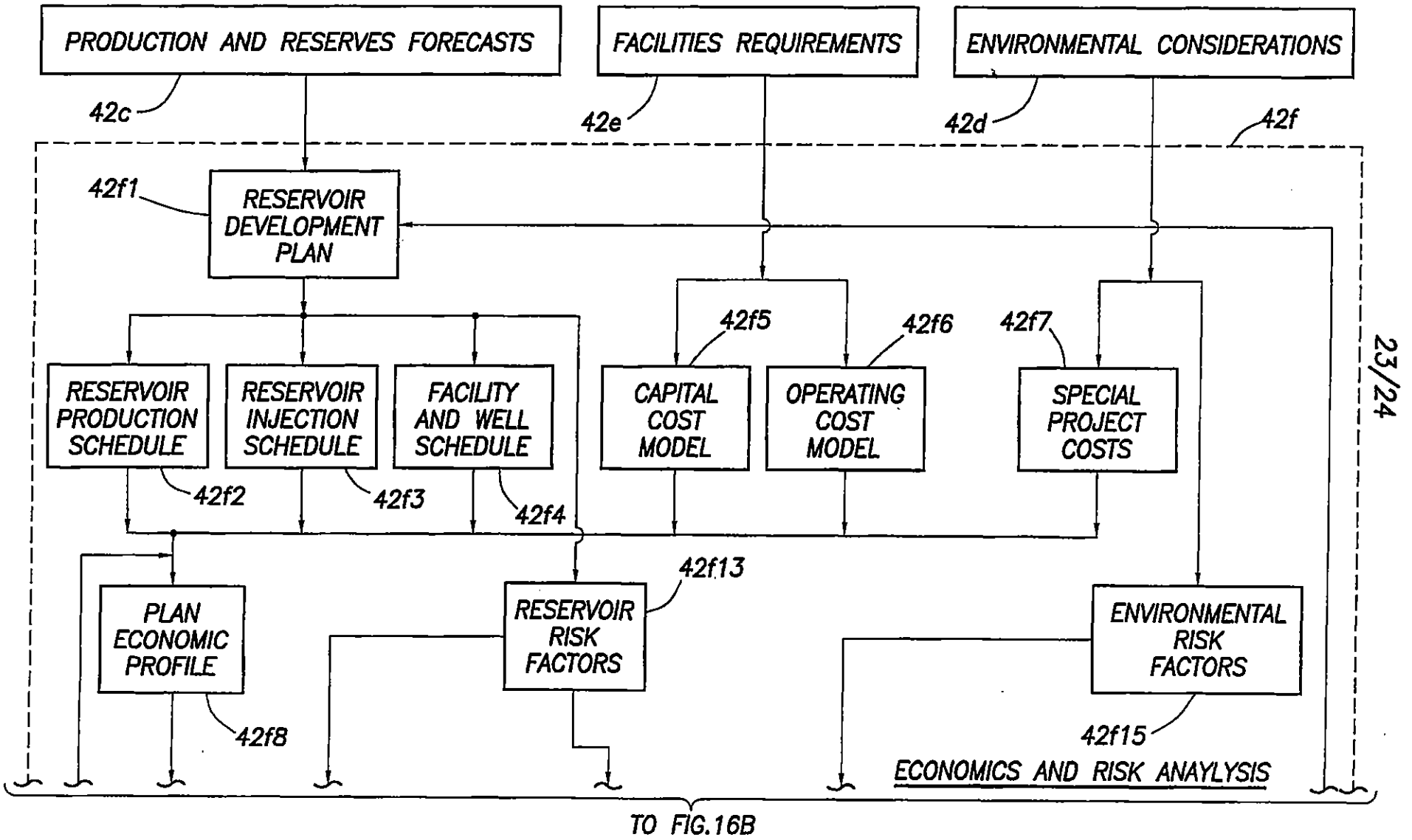

FROM FIG.15A
DISPOSAL OF HAZARDOUS WASTES
42d7
42d10
WELL/FACILITY REMEDIATION REQUIREMENTS
42d11
PIPELINE CONSTRUCTION REQUIREMENTS
BY-PRODUCT DISPOSAL REQUIREMENTS
42d12
REMOTE MONITORING AND CONTROL FACILITY
42d15
22/24
ENVIRONMENTAL CONSIDERATIONS
ECONOMICS AND RISK ANALYSIS
42f
42d

FIG.15B

FIG. 16A


PRODUCTION AND RESERVES FORECASTS
FACILITIES REQUIREMENTS
ENVIRONMENTAL CONSIDERATIONS
42c
42e
42d
42f
42f1
RESERVOIR DEVELOPMENT PLAN
42f5
42f6
42f7
RESERVOIR PRODUCTION SCHEDULE
RESERVOIR INJECTION SCHEDULE
FACILITY AND WELL SCHEDULE
CAPITAL COST MODEL
OPERATING COST MODEL
SPECIAL PROJECT COSTS
42f2
42f3
42f4
42f13
PLAN ECONOMIC PROFILE
RESERVOIR RISK FACTORS
ENVIRONMENTAL RISK FACTORS
42f8
42f15
ECONOMICS AND RISK ANAYLYSIS
23/24
TO FIG. 16B

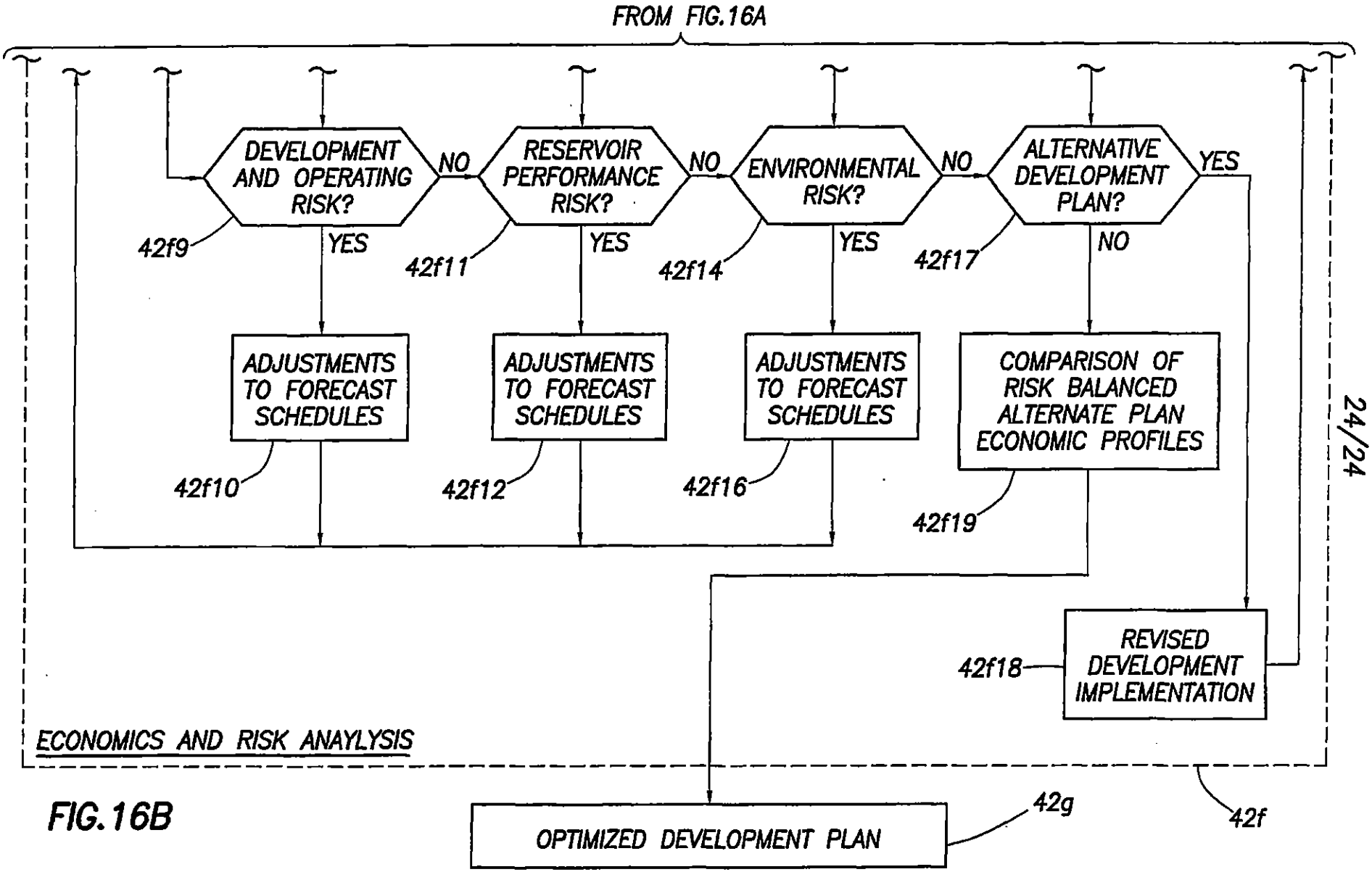

FROM FIG.16A
DEVELOPMENT AND OPERATING RISK?
NO
RESERVOIR PERFORMANCE RISK?
NO
ENVIRONMENTAL RISK?
NO
ALTERNATIVE DEVELOPMENT PLAN?
YES
42f9
YES
42f11
YES
42f14
YES
42f17
NO
ADJUSTMENTS TO FORECAST SCHEDULES
42f10
ADJUSTMENTS TO FORECAST SCHEDULES
42f12
ADJUSTMENTS TO FORECAST SCHEDULES
42f16
COMPARISON OF RISK BALANCED ALTERNATE PLAN ECONOMIC PROFILES
42f19
REVISED DEVELOPMENT IMPLEMENTATION
42f18
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ECONOMICS AND RISK ANAYLYSIS
OPTIMIZED DEVELOPMENT PLAN
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FIG. 16B