FIG. 1

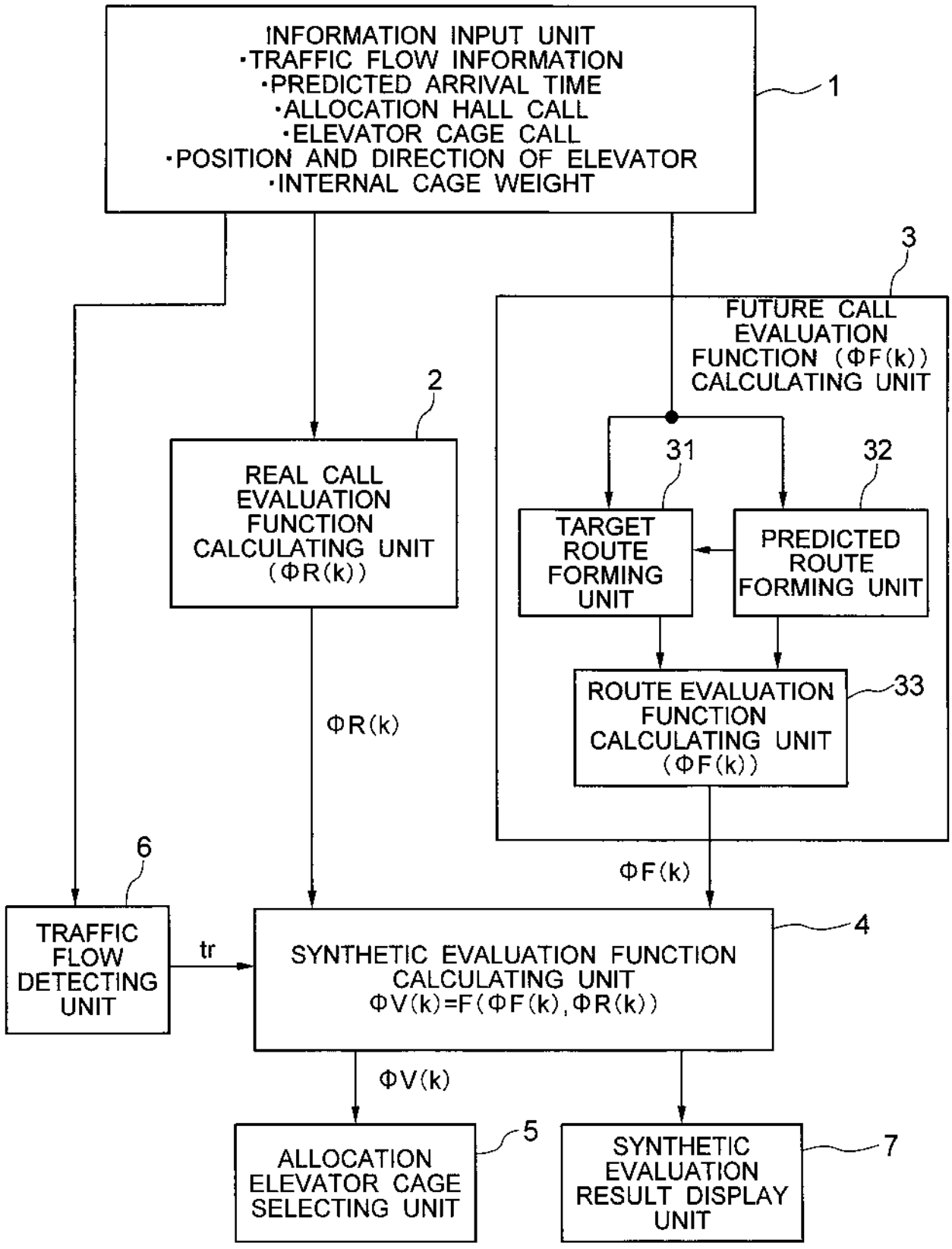

INFORMATION INPUT UNIT
·TRAFFIC FLOW INFORMATION
·PREDICTED ARRIVAL TIME
·ALLOCATION HALL CALL
·ELEVATOR CAGE CALL
·POSITION AND DIRECTION OF ELEVATOR
·INTERNAL CAGE WEIGHT
1
3
FUTURE CALL EVALUATION FUNCTION (ΦF(k)) CALCULATING UNIT
2
REAL CALL EVALUATION FUNCTION CALCULATING UNIT (ΦR(k))
31
32
TARGET ROUTE FORMING UNIT
PREDICTED ROUTE FORMING UNIT
ROUTE EVALUATION FUNCTION CALCULATING UNIT (ΦF(k))
33
ΦR(k)
ΦF(k)
6
TRAFFIC FLOW DETECTING UNIT
tr
SYNTHETIC EVALUATION FUNCTION CALCULATING UNIT
ΦV(k)=F(ΦF(k),ΦR(k))
4
ΦV(k)
ALLOCATION ELEVATOR CAGE SELECTING UNIT
5
SYNTHETIC EVALUATION RESULT DISPLAY UNIT
7

FIG. 2

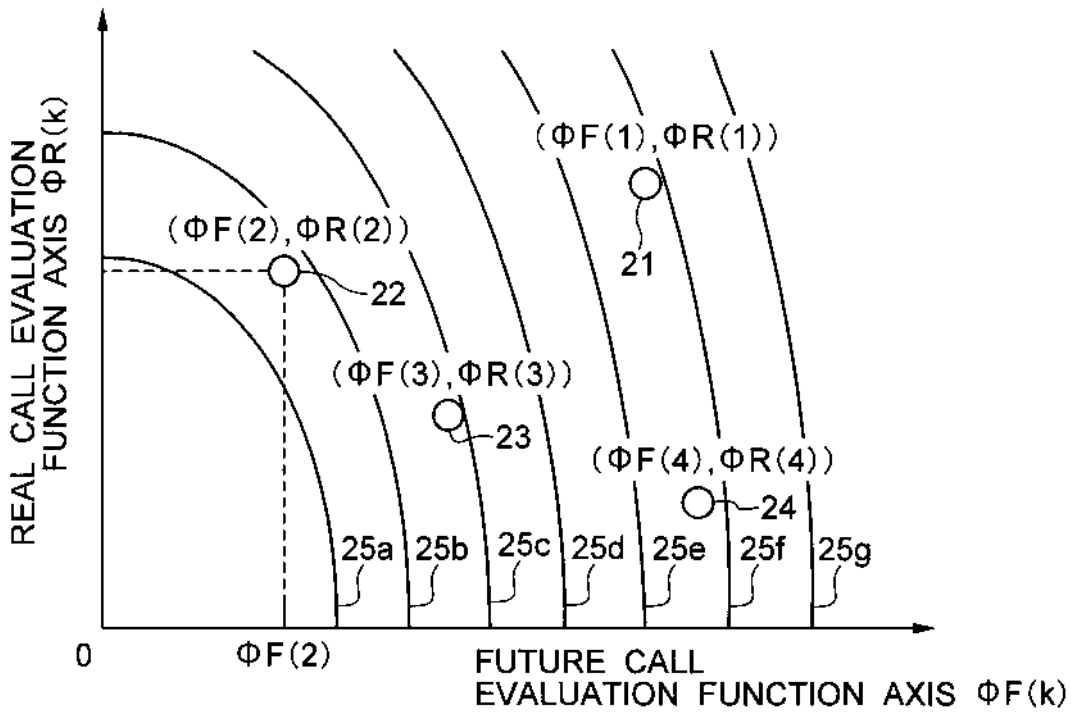

REAL CALL EVALUATION FUNCTION AXIS ΦR(k)
(ΦF(1),ΦR(1))
21
(ΦF(2),ΦR(2))
22
(ΦF(3),ΦR(3))
23
(ΦF(4),ΦR(4))
24
25a
25b
25c
25d
25e
25f
25g
0
ΦF(2)
FUTURE CALL EVALUATION FUNCTION AXIS ΦF(k)

FIG. 3

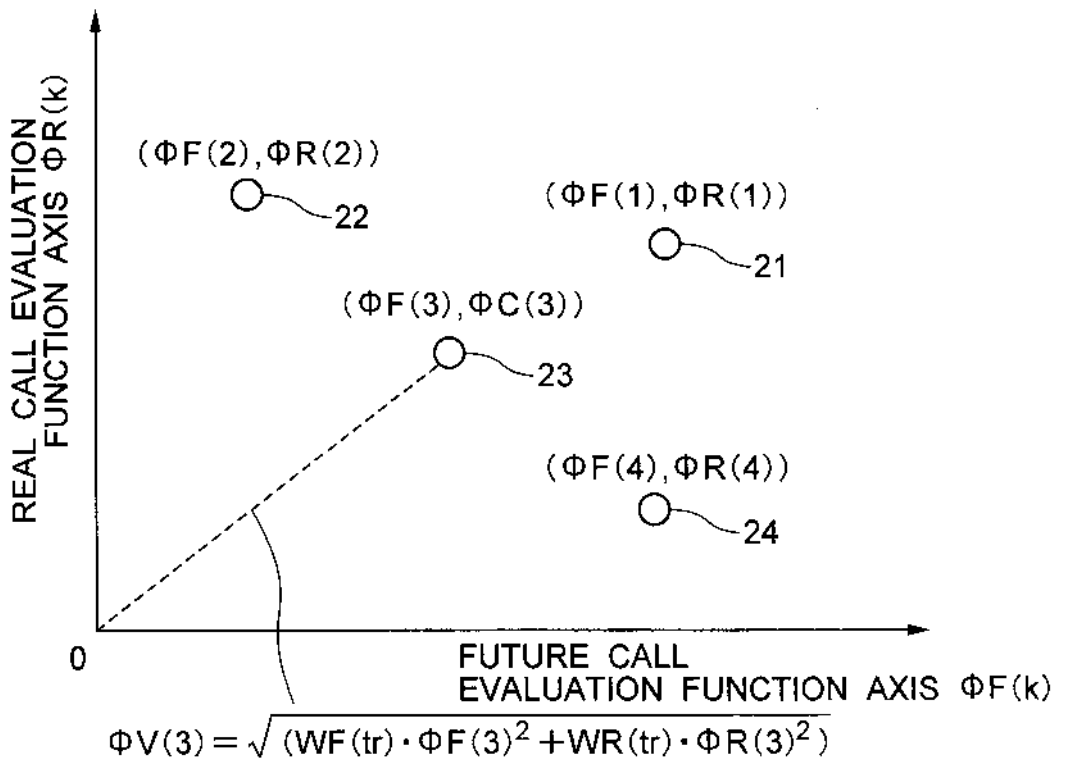

REAL CALL EVALUATION FUNCTION AXIS ΦR(k)
(ΦF(2),ΦR(2))
22
(ΦF(1),ΦR(1))
21
(ΦF(3),ΦC(3))
23
(ΦF(4),ΦR(4))
24
0
FUTURE CALL EVALUATION FUNCTION AXIS ΦF(k)
ΦV(3) = √(WF(tr)・ΦF(3)² + WR(tr)・ΦR(3)²)

FIG. 4

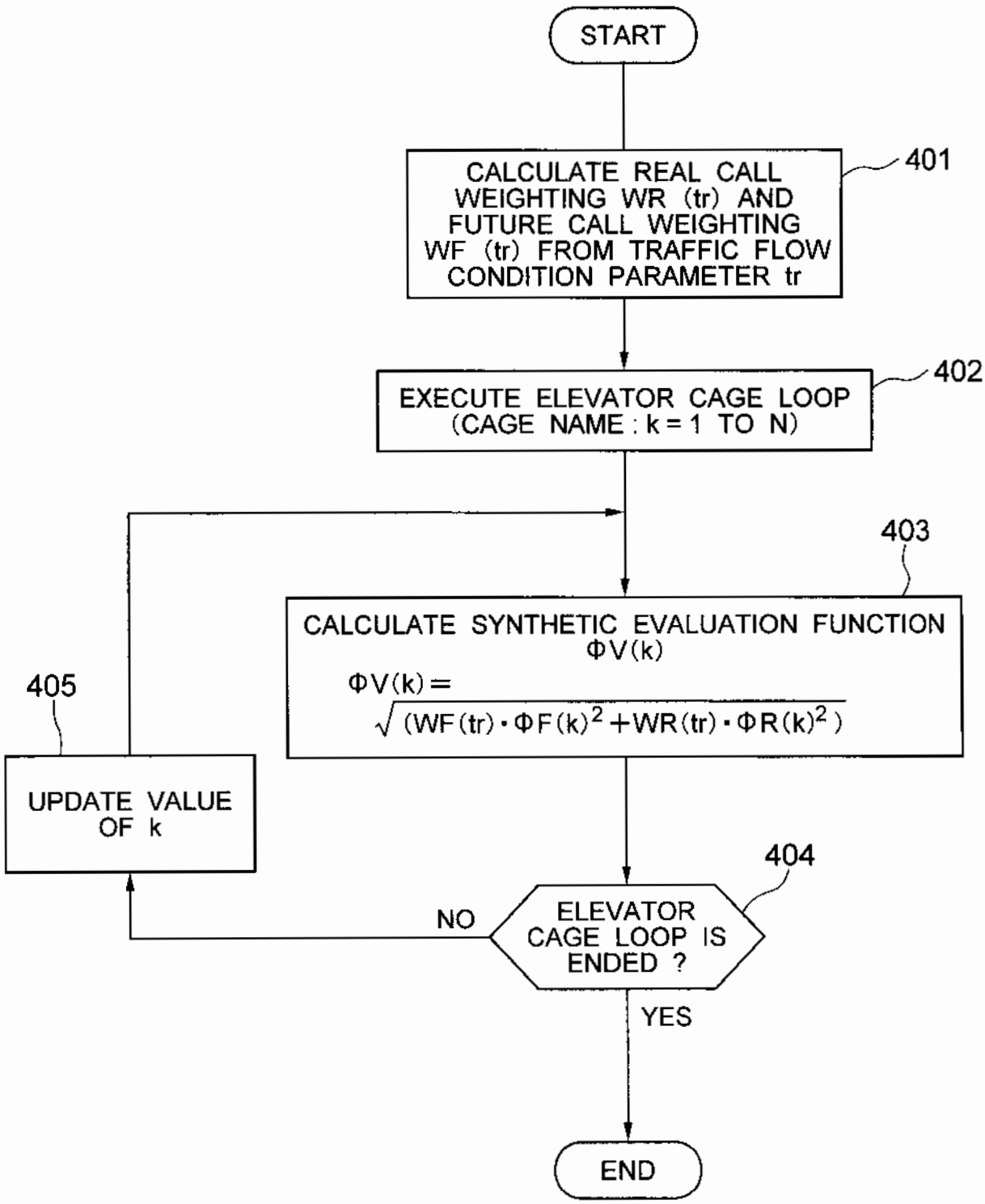

START
CALCULATE REAL CALL WEIGHTING WR (tr) AND FUTURE CALL WEIGHTING WF (tr) FROM TRAFFIC FLOW CONDITION PARAMETER tr
401
EXECUTE ELEVATOR CAGE LOOP (CAGE NAME : k = 1 TO N)
402
403
CALCULATE SYNTHETIC EVALUATION FUNCTION ΦV(k)
$\Phi V(k) = \sqrt{(WF(tr) \cdot \Phi F(k)^2 + WR(tr) \cdot \Phi R(k)^2)}$
405
UPDATE VALUE OF k
404
NO
ELEVATOR CAGE LOOP IS ENDED ?
YES
END

FIG. 5

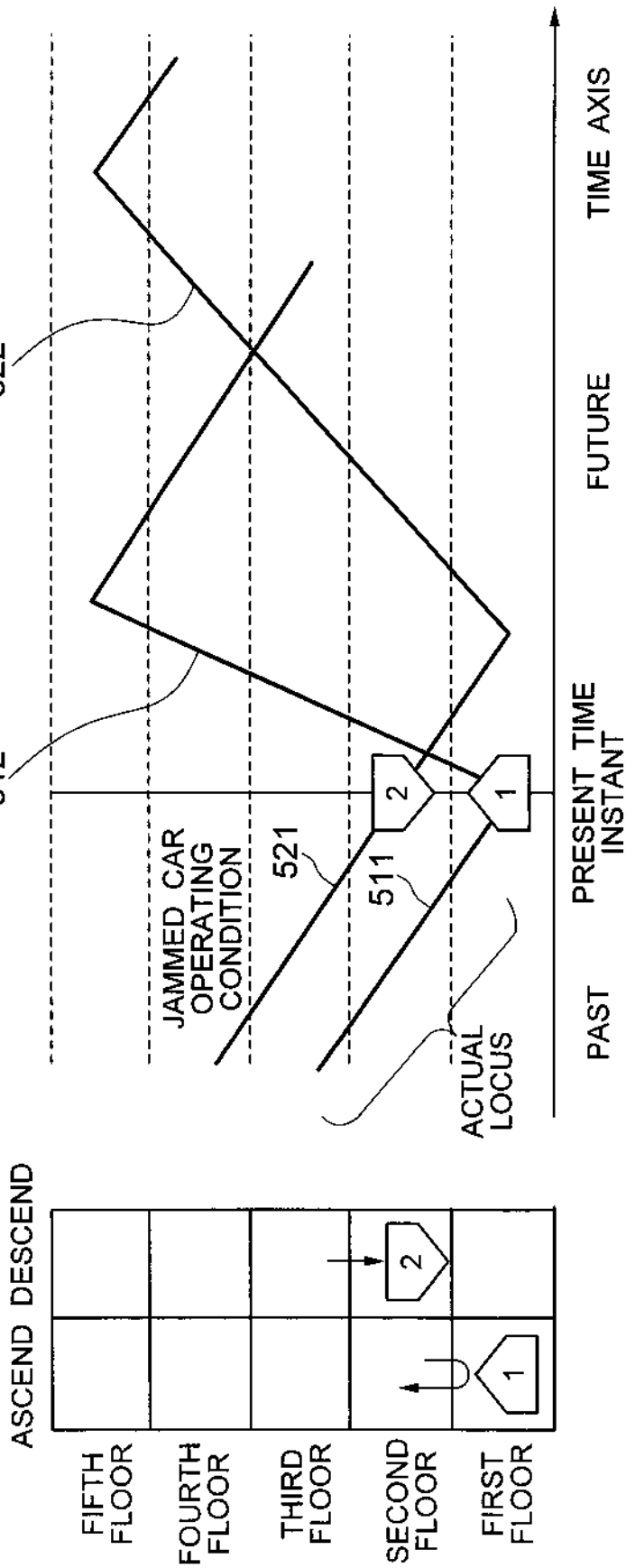

ASCEND
DESCEND
FIFTH FLOOR
FOURTH FLOOR
THIRD FLOOR
SECOND FLOOR
FIRST FLOOR
1
2
TARGET ROUTE OF FIRST ELEVATOR CAR 512
TARGET ROUTE OF SECOND ELEVATOR CAR 522
JAMMED CAR OPERATING CONDITION
521
511
ACTUAL LOCUS
PAST
PRESENT TIME INSTANT
FUTURE
TIME AXIS

FIG. 6

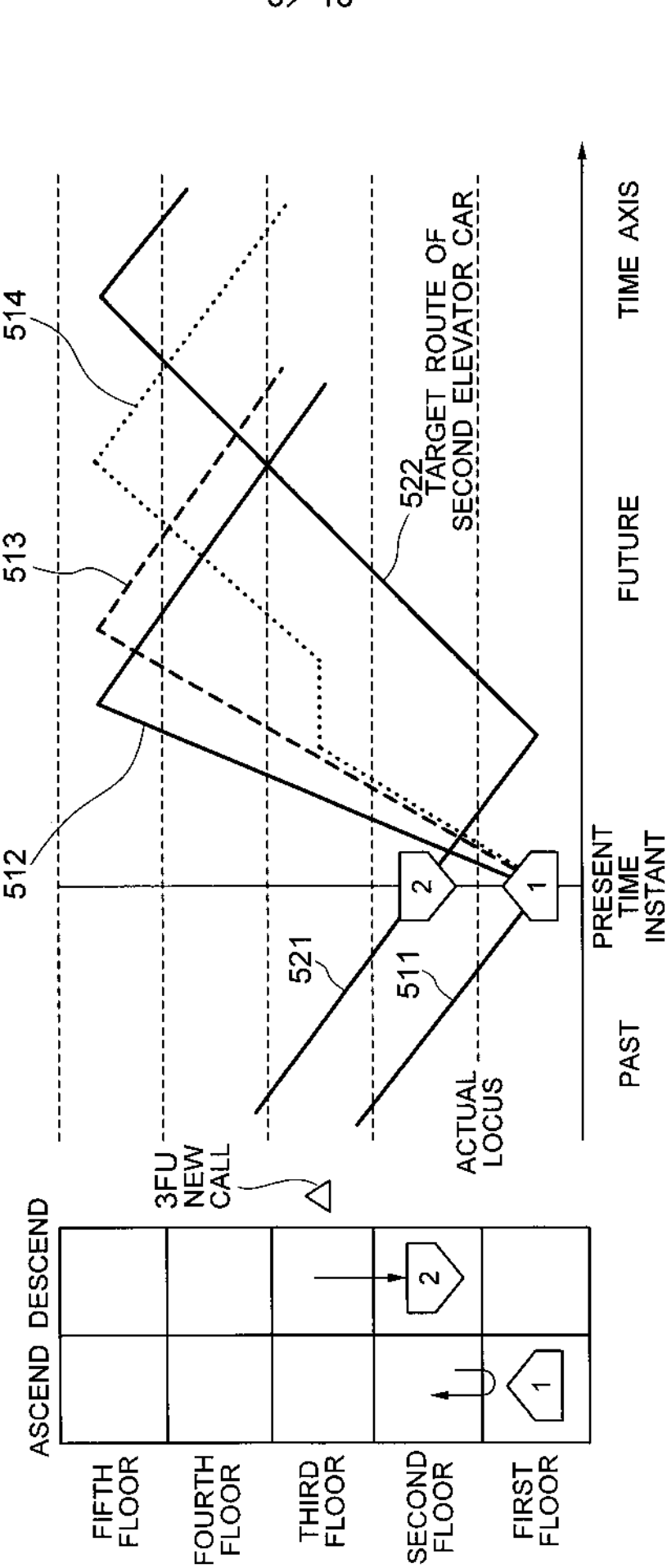

PREDICTED ROUTE (WHEN BEING ALLOCATED) 514
PREDICTED ROUTE (WHEN BEING PASSED) 513
TARGET ROUTE OF FIRST ELEVATOR CAR 512
522 TARGET ROUTE OF SECOND ELEVATOR CAR
TIME AXIS
FUTURE
PRESENT TIME INSTANT
PAST
521
511
ACTUAL LOCUS
3FU NEW CALL
ASCEND DESCEND
FIFTH FLOOR
FOURTH FLOOR
THIRD FLOOR
SECOND FLOOR
FIRST FLOOR
1
2

FIG. 7

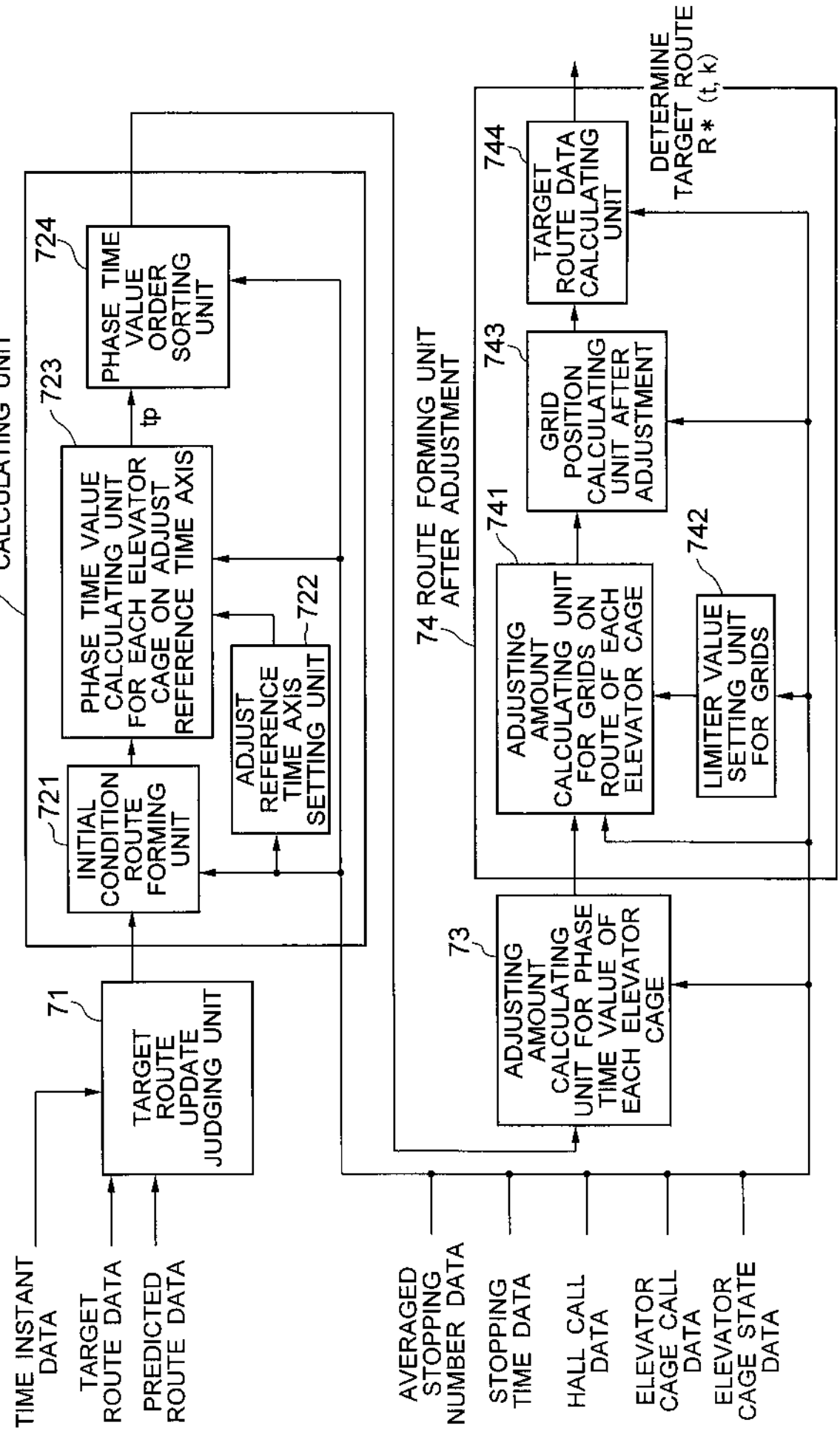

TIME INSTANT DATA
TARGET ROUTE DATA
PREDICTED ROUTE DATA
71
TARGET ROUTE UPDATE JUDGING UNIT
72 PRESENT PHASE TIME VALUE CALCULATING UNIT
721
INITIAL CONDITION ROUTE FORMING UNIT
722
ADJUST REFERENCE TIME AXIS SETTING UNIT
723
PHASE TIME VALUE CALCULATING UNIT FOR EACH ELEVATOR CAGE ON ADJUST REFERENCE TIME AXIS
tp
724
PHASE TIME VALUE ORDER SORTING UNIT
AVERAGED STOPPING NUMBER DATA
STOPPING TIME DATA
HALL CALL DATA
ELEVATOR CAGE CALL DATA
ELEVATOR CAGE STATE DATA
73
ADJUSTING AMOUNT CALCULATING UNIT FOR PHASE TIME VALUE OF EACH ELEVATOR CAGE
74 ROUTE FORMING UNIT AFTER ADJUSTMENT
741
ADJUSTING AMOUNT CALCULATING UNIT FOR GRIDS ON ROUTE OF EACH ELEVATOR CAGE
742
LIMITER VALUE SETTING UNIT FOR GRIDS
743
GRID POSITION CALCULATING UNIT AFTER ADJUSTMENT
744
TARGET ROUTE DATA CALCULATING UNIT
DETERMINE TARGET ROUTE R* (t, k)

FIG. 8A

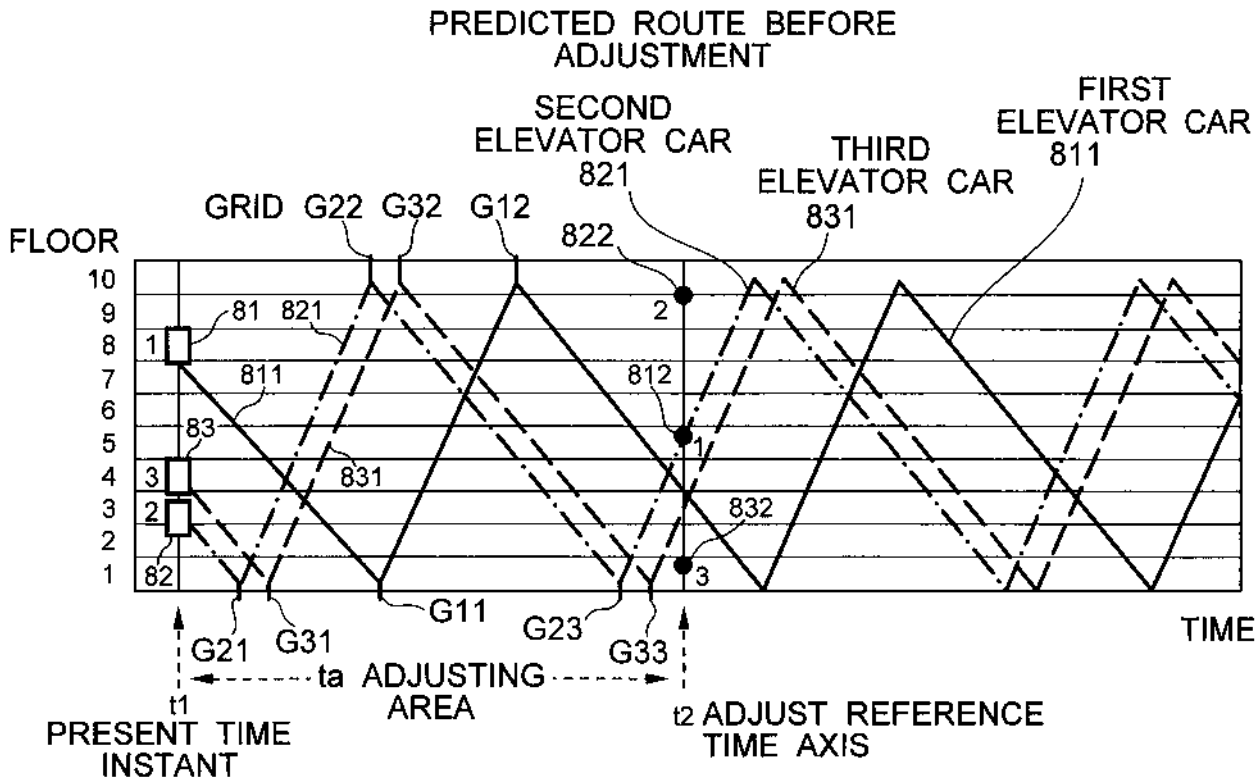

PREDICTED ROUTE BEFORE ADJUSTMENT
SECOND ELEVATOR CAR 821
THIRD ELEVATOR CAR 831
FIRST ELEVATOR CAR 811
GRID G22 G32 G12
FLOOR
10
9
8
7
6
5
4
3
2
1
81 821
811
83
831
82
822
812
832
G11
G21 G31
G23 G33
TIME
ta ADJUSTING AREA
t1 PRESENT TIME INSTANT
t2 ADJUST REFERENCE TIME AXIS

FIG. 8B

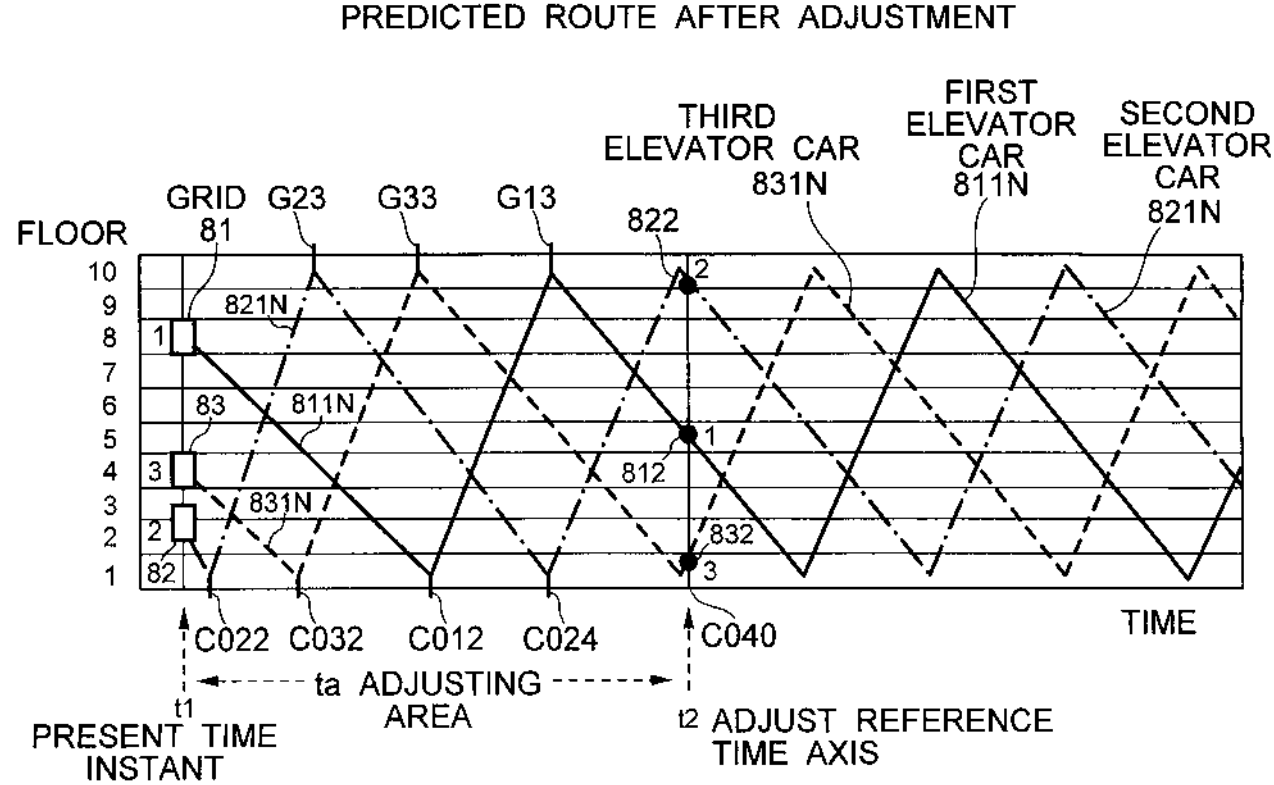

PREDICTED ROUTE AFTER ADJUSTMENT
THIRD ELEVATOR CAR 831N
FIRST ELEVATOR CAR 811N
SECOND ELEVATOR CAR 821N
GRID G23 G33 G13
FLOOR
81
10
9
8
7
6
5
4
3
2
1
821N
83
811N
831N
82
822
812
832
C022 C032 C012 C024
C040
TIME
ta ADJUSTING AREA
t1 PRESENT TIME INSTANT
t2 ADJUST REFERENCE TIME AXIS

FIG. 9

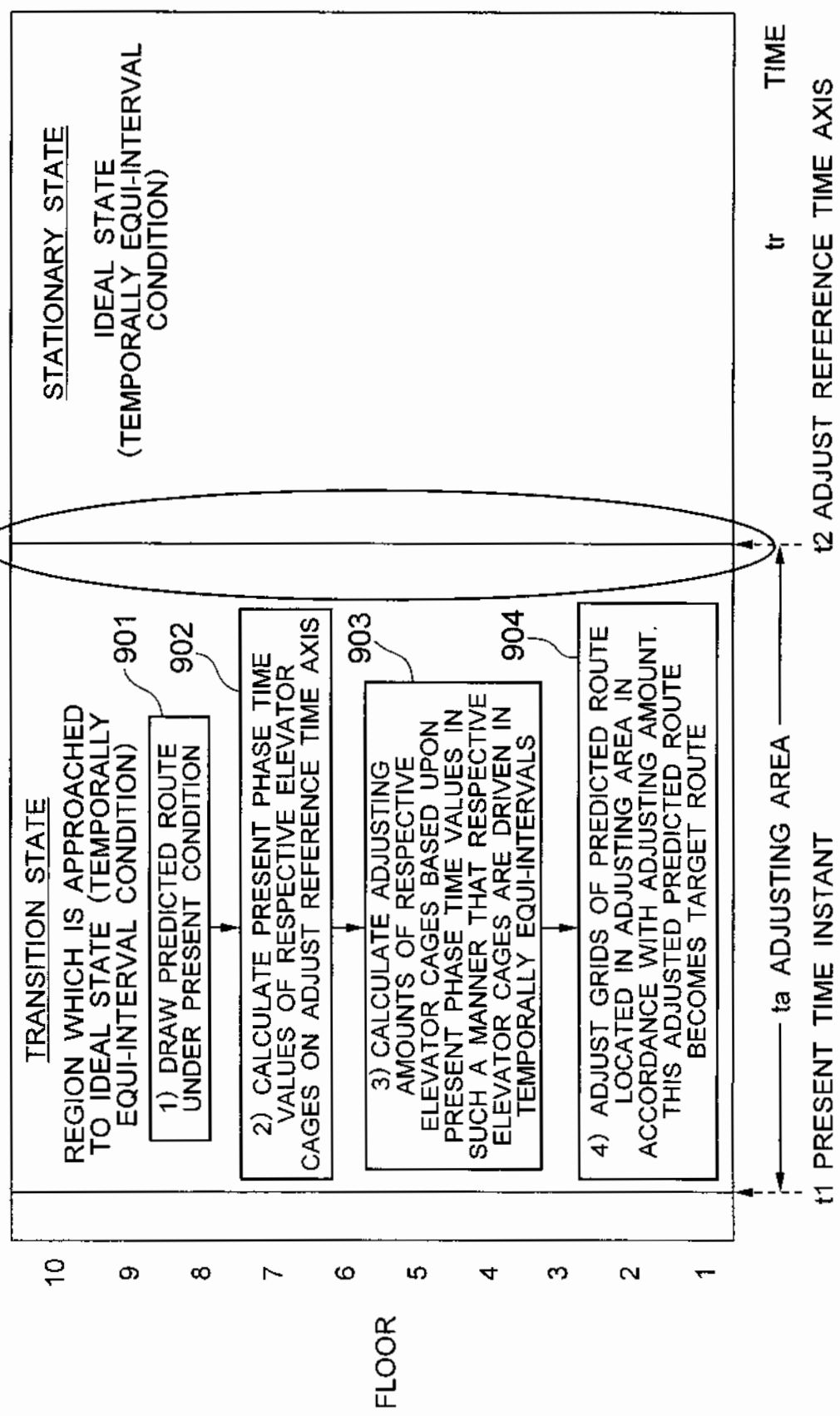

TRANSITION STATE
REGION WHICH IS APPROACHED TO IDEAL STATE (TEMPORALLY EQUI-INTERVAL CONDITION)
STATIONARY STATE
IDEAL STATE (TEMPORALLY EQUI-INTERVAL CONDITION)
901
902
903
904
1) DRAW PREDICTED ROUTE UNDER PRESENT CONDITION
2) CALCULATE PRESENT PHASE TIME VALUES OF RESPECTIVE ELEVATOR CAGES ON ADJUST REFERENCE TIME AXIS
3) CALCULATE ADJUSTING AMOUNTS OF RESPECTIVE ELEVATOR CAGES BASED UPON PRESENT PHASE TIME VALUES IN SUCH A MANNER THAT RESPECTIVE ELEVATOR CAGES ARE DRIVEN IN TEMPORALLY EQUI-INTERVALS
4) ADJUST GRIDS OF PREDICTED ROUTE LOCATED IN ADJUSTING AREA IN ACCORDANCE WITH ADJUSTING AMOUNT. THIS ADJUSTED PREDICTED ROUTE BECOMES TARGET ROUTE
FLOOR
10
9
8
7
6
5
4
3
2
1
ta ADJUSTING AREA
tr
TIME
t1 PRESENT TIME INSTANT
t2 ADJUST REFERENCE TIME AXIS

FIG. 10

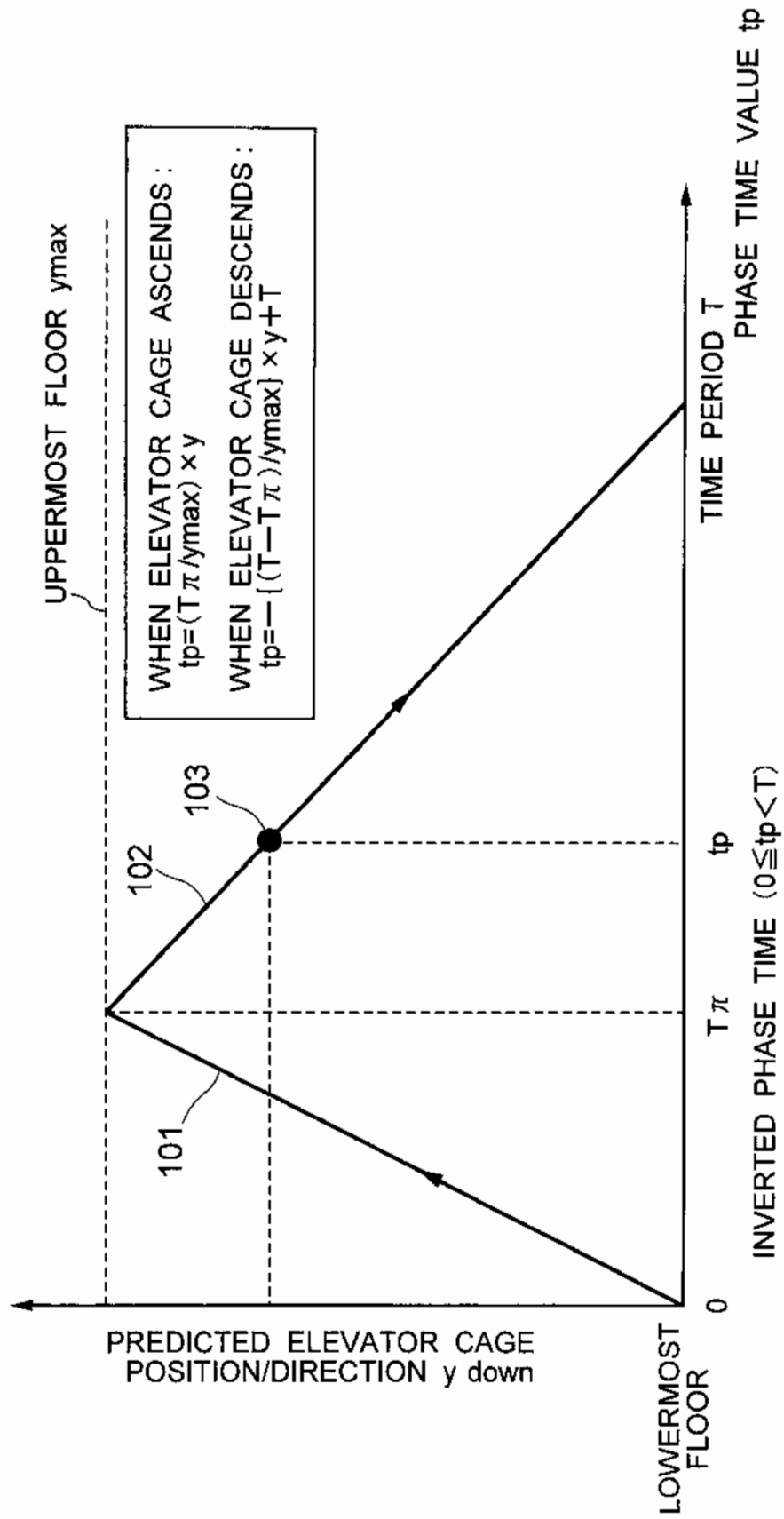

UPPERMOST FLOOR ymax
WHEN ELEVATOR CAGE ASCENDS :
tp=(Tπ/ymax) × y
WHEN ELEVATOR CAGE DESCENDS :
tp=—{(T—Tπ)/ymax} × y+T
103
102
101
PREDICTED ELEVATOR CAGE POSITION/DIRECTION y down
LOWERMOST FLOOR
0
Tπ
tp
TIME PERIOD T
PHASE TIME VALUE tp
INVERTED PHASE TIME (0≦tp<T)

FIG. 11A

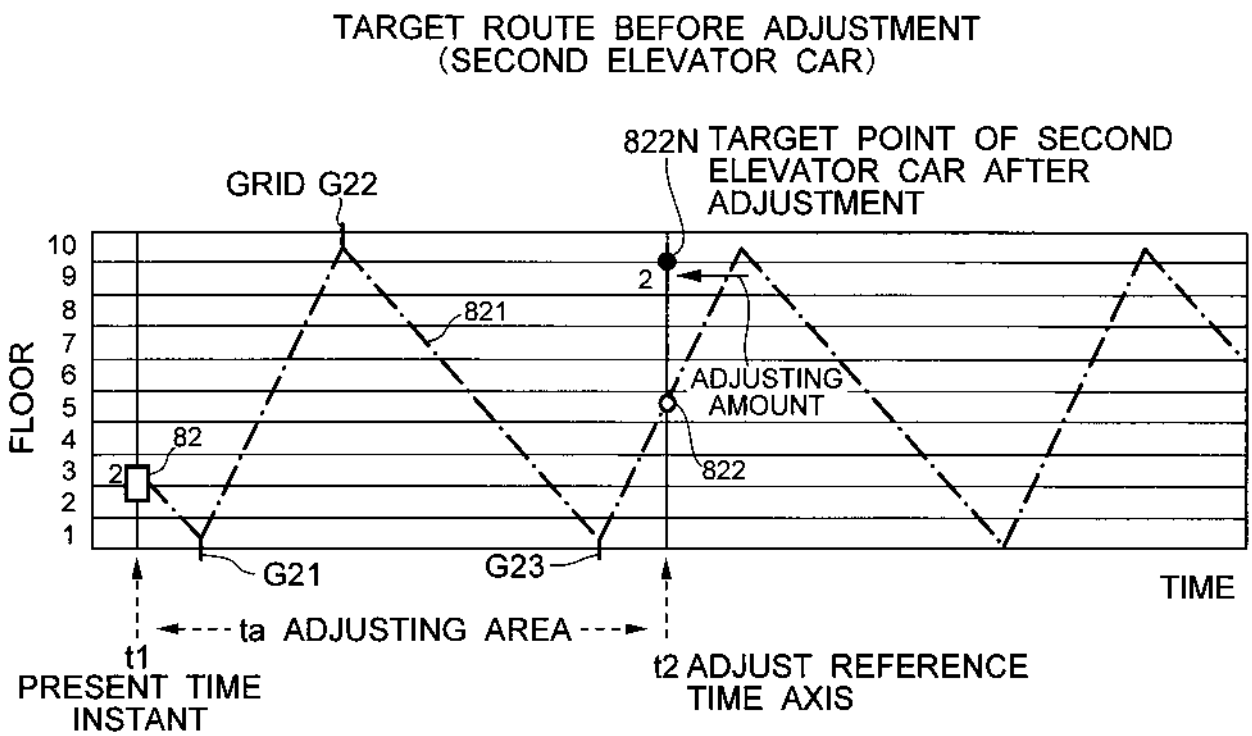


FIG. 11B

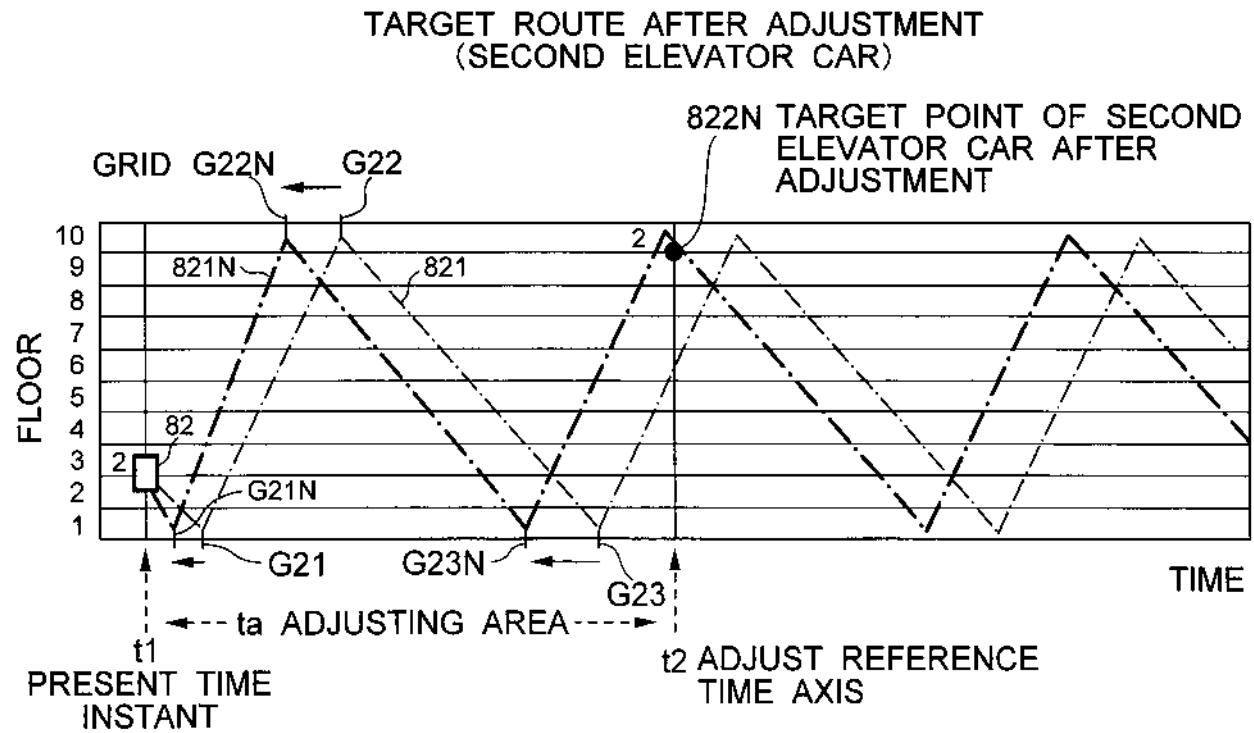


FIG. 12

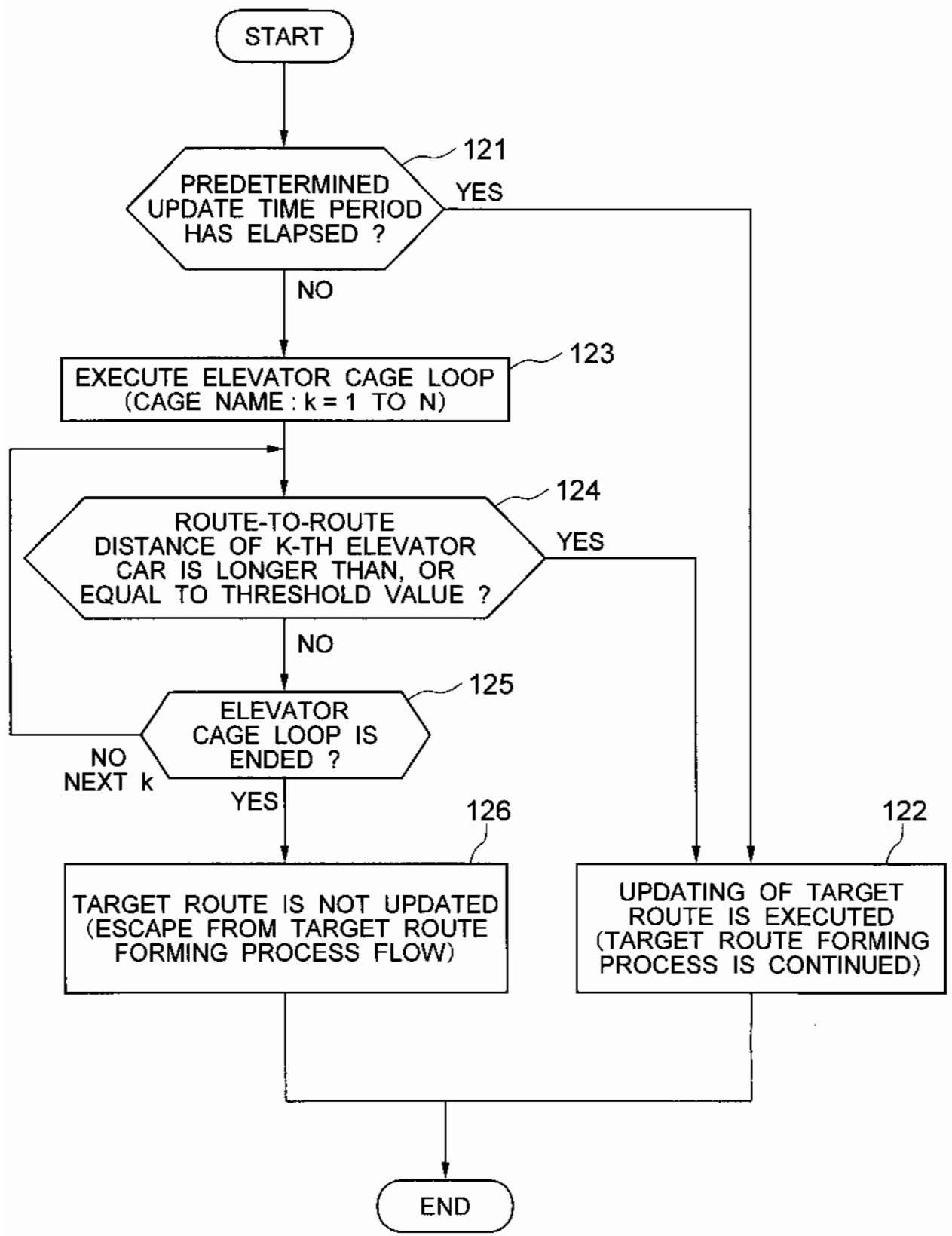

START
121
PREDETERMINED UPDATE TIME PERIOD HAS ELAPSED ?
YES
NO
123
EXECUTE ELEVATOR CAGE LOOP (CAGE NAME : k = 1 TO N)
124
ROUTE-TO-ROUTE DISTANCE OF K-TH ELEVATOR CAR IS LONGER THAN, OR EQUAL TO THRESHOLD VALUE ?
YES
NO
125
ELEVATOR CAGE LOOP IS ENDED ?
NO NEXT k
YES
126
TARGET ROUTE IS NOT UPDATED (ESCAPE FROM TARGET ROUTE FORMING PROCESS FLOW)
122
UPDATING OF TARGET ROUTE IS EXECUTED (TARGET ROUTE FORMING PROCESS IS CONTINUED)
END

FIG. 13

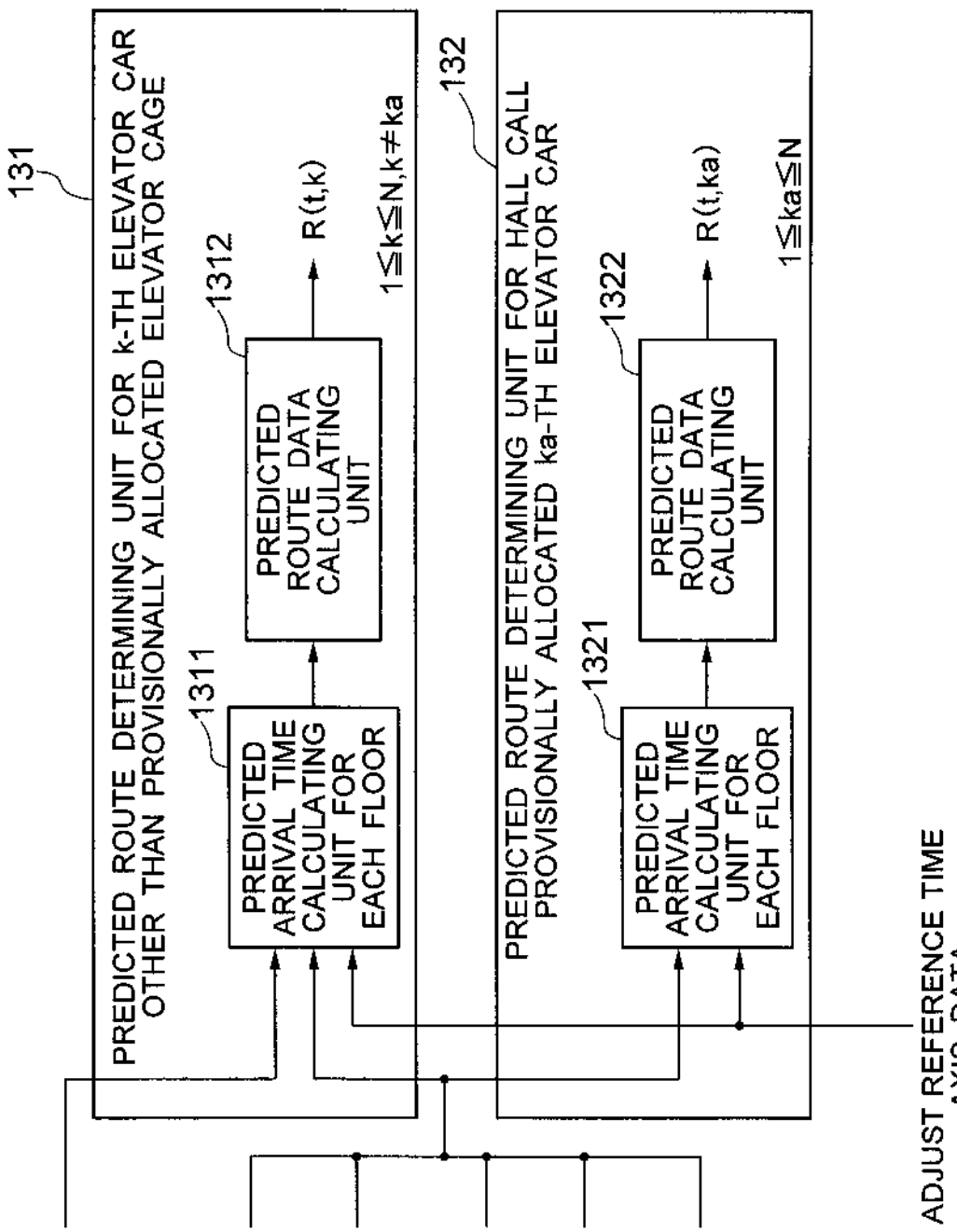

131
PREDICTED ROUTE DETERMINING UNIT FOR k-TH ELEVATOR CAR
OTHER THAN PROVISIONALLY ALLOCATED ELEVATOR CAGE
1311
PREDICTED ARRIVAL TIME CALCULATING UNIT FOR EACH FLOOR
1312
PREDICTED ROUTE DATA CALCULATING UNIT
R(t,k)
1≦k≦N,k≠ka
132
PREDICTED ROUTE DETERMINING UNIT FOR HALL CALL
PROVISIONALLY ALLOCATED ka-TH ELEVATOR CAR
1321
PREDICTED ARRIVAL TIME CALCULATING UNIT FOR EACH FLOOR
1322
PREDICTED ROUTE DATA CALCULATING UNIT
R(t,ka)
1≦ka≦N
PROVISIONAL ALLOCATION INFORMATION (PROVISIONALLY ALLOCATED ka-TH ELEVATOR CAR)
AVERAGED STOPPING PROBABILITY DATA
STOPPING TIME DATA
HALL CALL DATA
ELEVATOR CAGE CALL DATA
ELEVATOR CAGE STATE DATA
ADJUST REFERENCE TIME AXIS DATA

FIG. 14

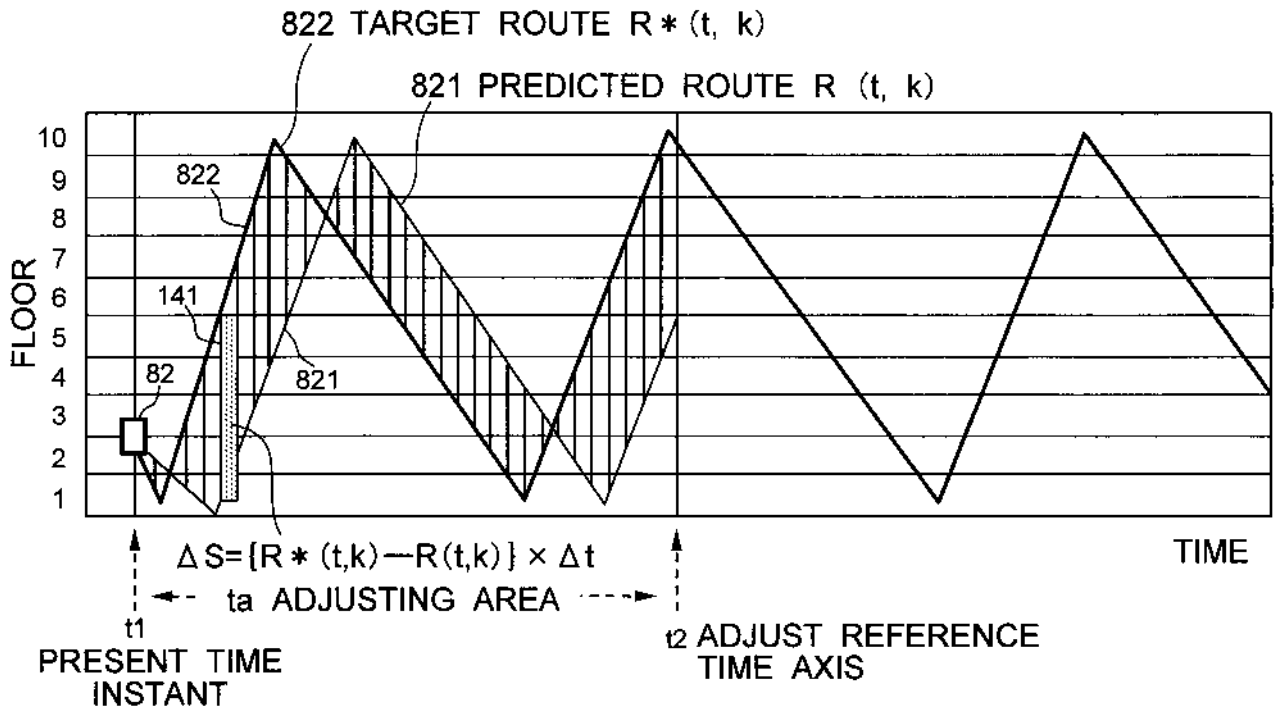

822 TARGET ROUTE R＊(t, k)
821 PREDICTED ROUTE R (t, k)
FLOOR
10
9
8
7
6
5
4
3
2
1
822
141
82
821
ΔS={R＊(t,k)—R(t,k)}×Δt
ta ADJUSTING AREA
TIME
t1
PRESENT TIME INSTANT
t2 ADJUST REFERENCE TIME AXIS

FIG. 15

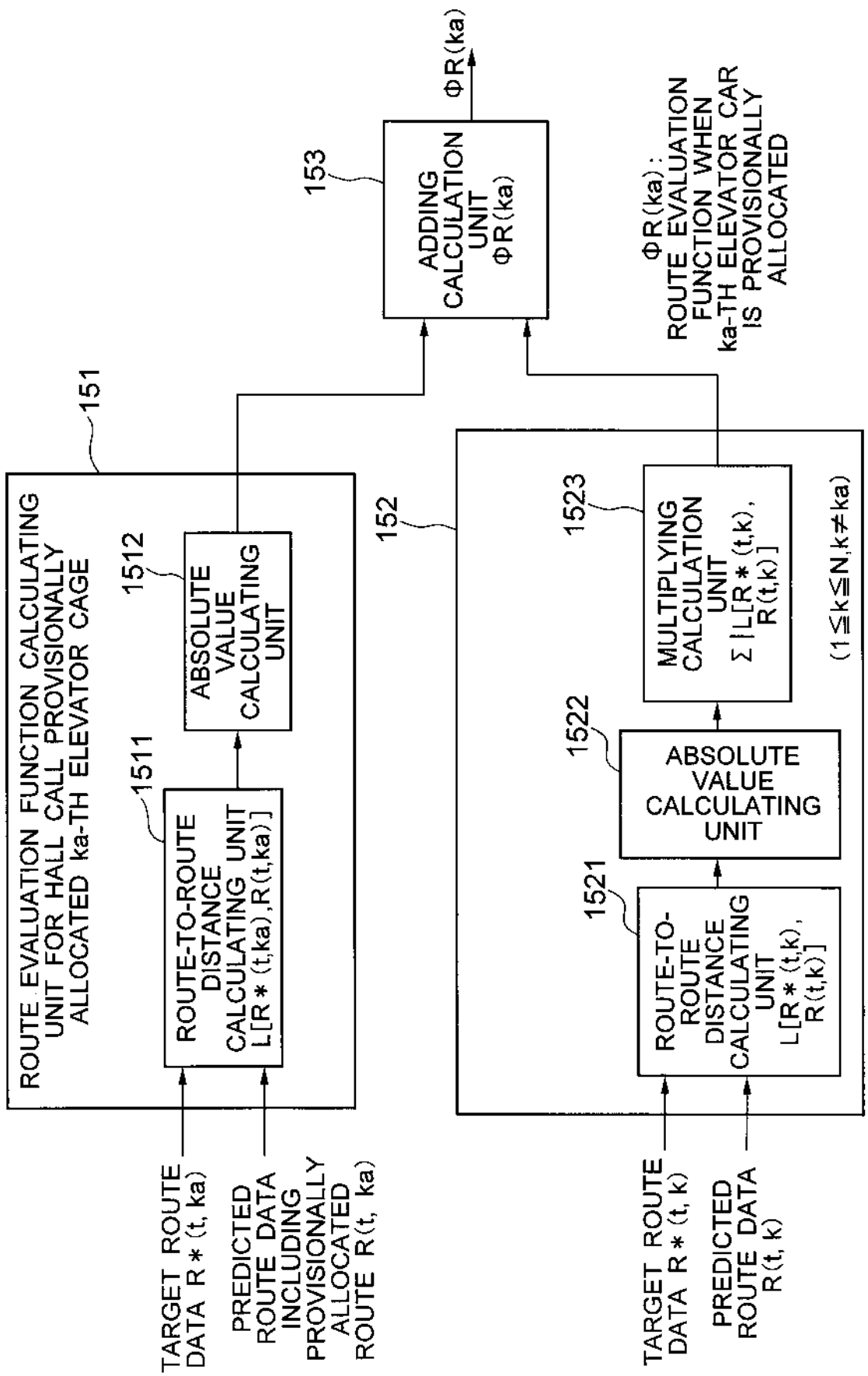

ROUTE EVALUATION FUNCTION CALCULATING UNIT FOR HALL CALL PROVISIONALLY ALLOCATED ka-TH ELEVATOR CAGE
151
ROUTE-TO-ROUTE DISTANCE CALCULATING UNIT L[R*(t,ka),R(t,ka)]
1511
ABSOLUTE VALUE CALCULATING UNIT
1512
TARGET ROUTE DATA R*(t, ka)
PREDICTED ROUTE DATA INCLUDING PROVISIONALLY ALLOCATED ROUTE R(t, ka)
152
ROUTE-TO-ROUTE DISTANCE CALCULATING UNIT L[R*(t,k), R(t,k)]
1521
ABSOLUTE VALUE CALCULATING UNIT
1522
MULTIPLYING CALCULATION UNIT Σ|L[R*(t,k), R(t,k)]
1523
(1≦k≦N,k≠ka)
TARGET ROUTE DATA R*(t, k)
PREDICTED ROUTE DATA R(t, k)
ADDING CALCULATION UNIT ΦR(ka)
153
ΦR(ka)
ΦR(ka): ROUTE EVALUATION FUNCTION WHEN ka-TH ELEVATOR CAR IS PROVISIONALLY ALLOCATED

FIG. 16

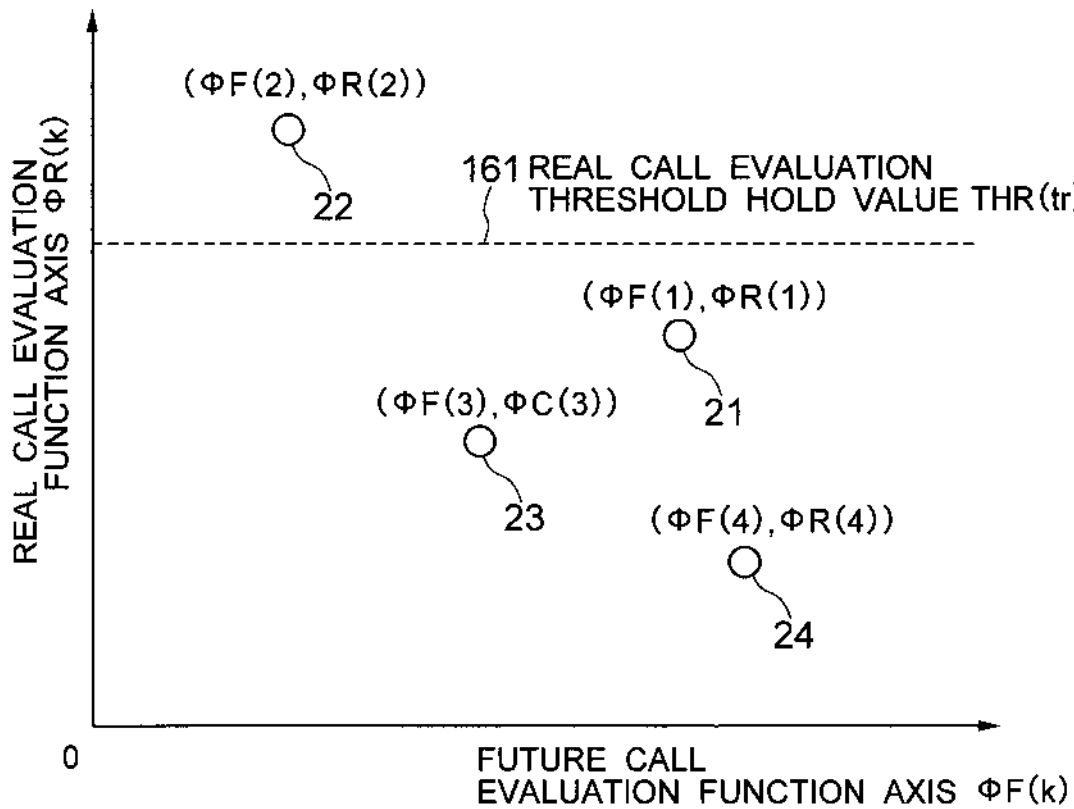

(ΦF(2),ΦR(2))
22
161 REAL CALL EVALUATION
THRESHOLD HOLD VALUE THR(tr)
(ΦF(1),ΦR(1))
21
(ΦF(3),ΦC(3))
23
(ΦF(4),ΦR(4))
24
REAL CALL EVALUATION
FUNCTION AXIS ΦR(k)
0
FUTURE CALL
EVALUATION FUNCTION AXIS ΦF(k)

FIG. 17

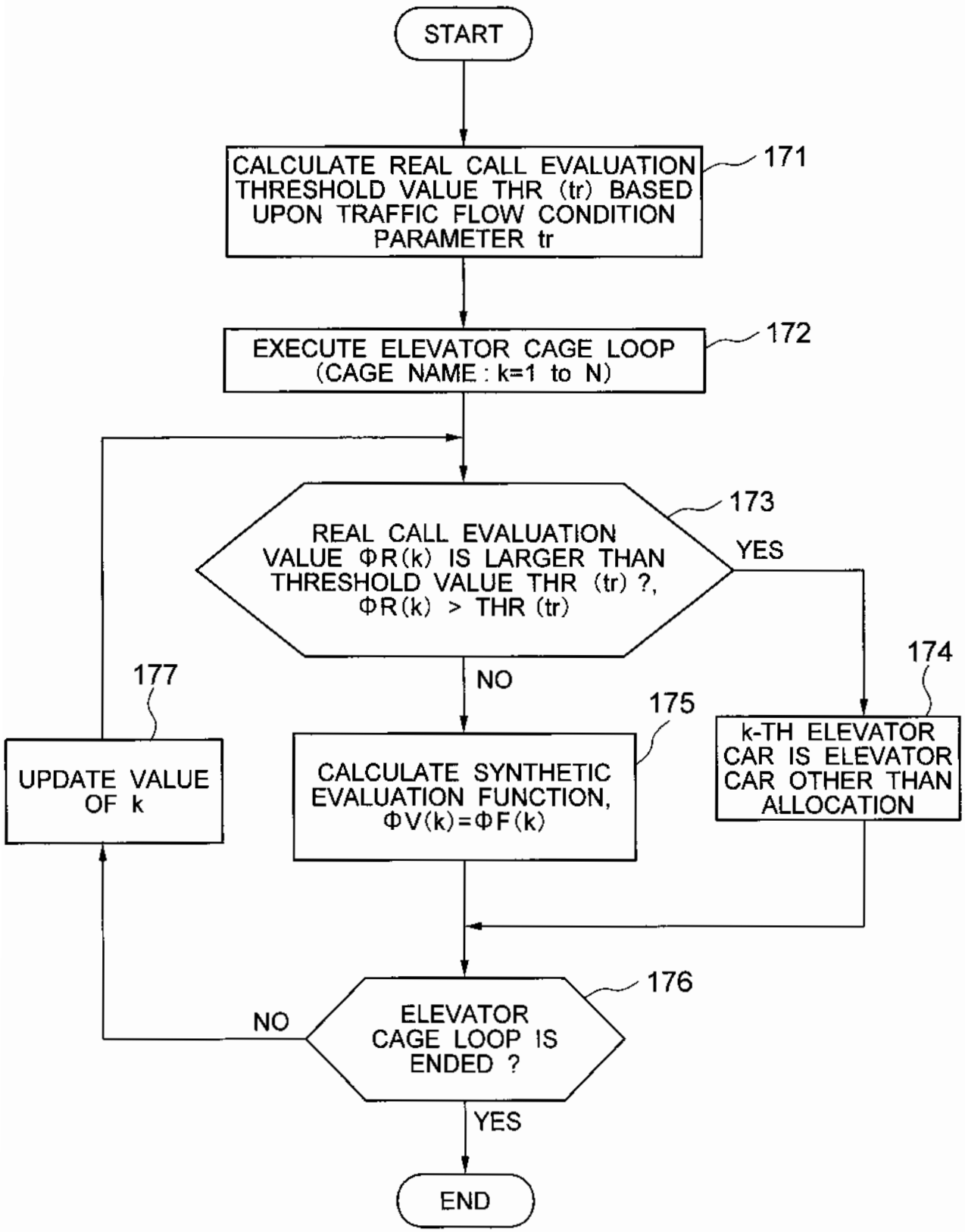

START
CALCULATE REAL CALL EVALUATION THRESHOLD VALUE THR (tr) BASED UPON TRAFFIC FLOW CONDITION PARAMETER tr
171
EXECUTE ELEVATOR CAGE LOOP (CAGE NAME : k=1 to N)
172
REAL CALL EVALUATION VALUE ΦR(k) IS LARGER THAN THRESHOLD VALUE THR (tr) ?, ΦR(k) > THR (tr)
173
YES
NO
174
k-TH ELEVATOR CAR IS ELEVATOR CAR OTHER THAN ALLOCATION
175
CALCULATE SYNTHETIC EVALUATION FUNCTION, ΦV(k)=ΦF(k)
177
UPDATE VALUE OF k
176
ELEVATOR CAGE LOOP IS ENDED ?
NO
YES
END

FIG. 18A

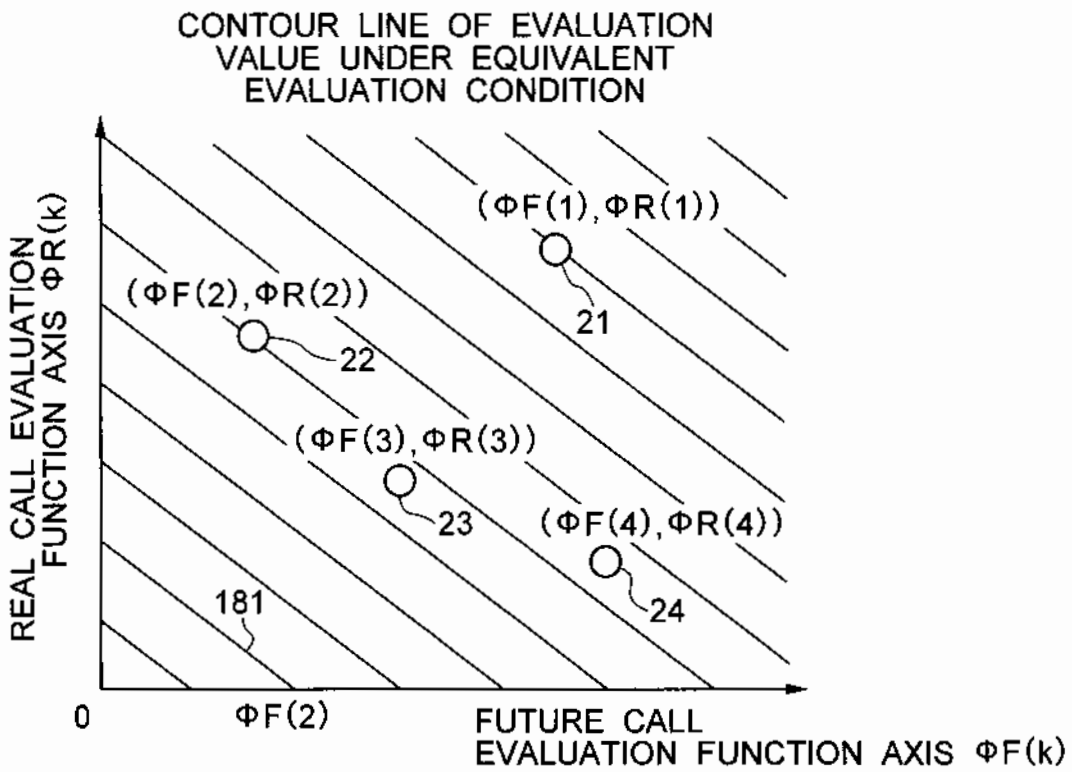


FIG. 18B

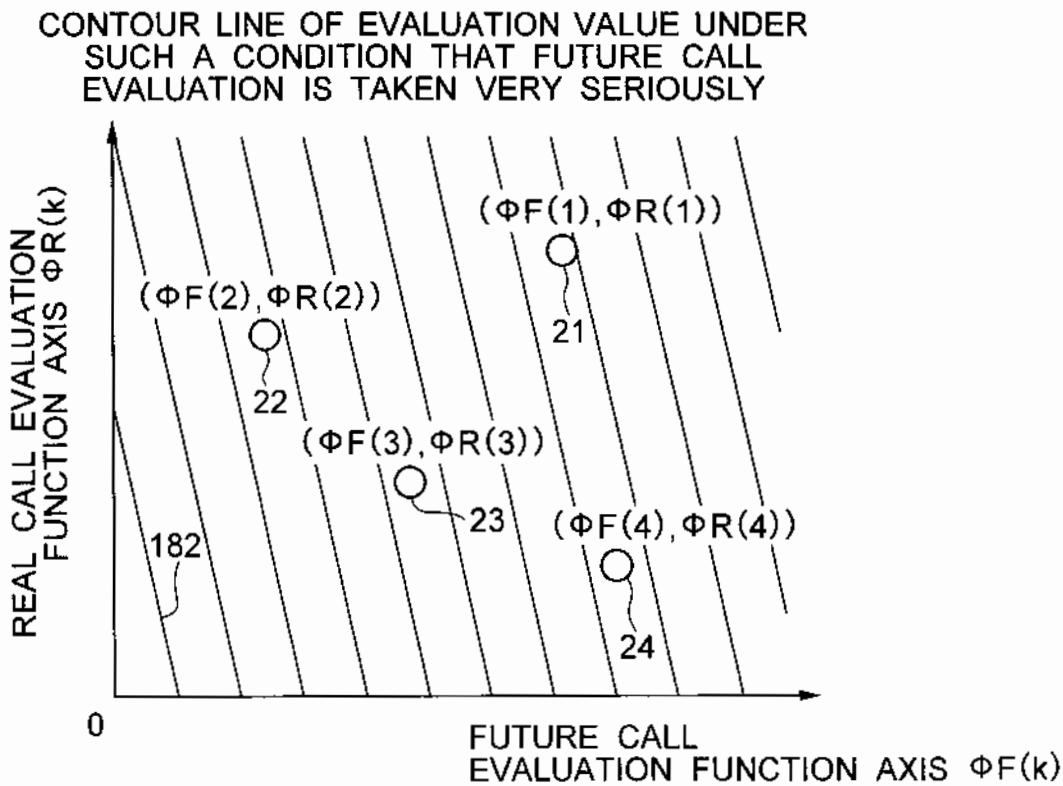


FIG. 19

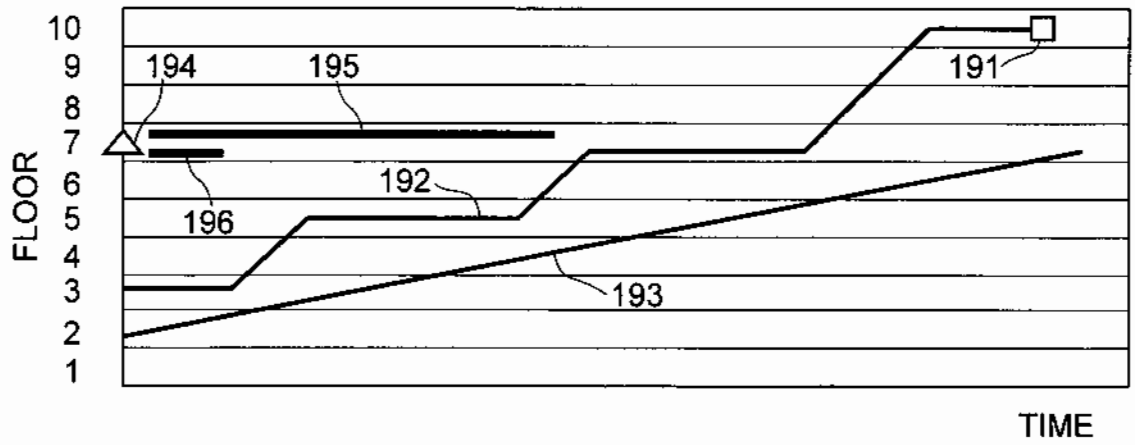


FIG. 20

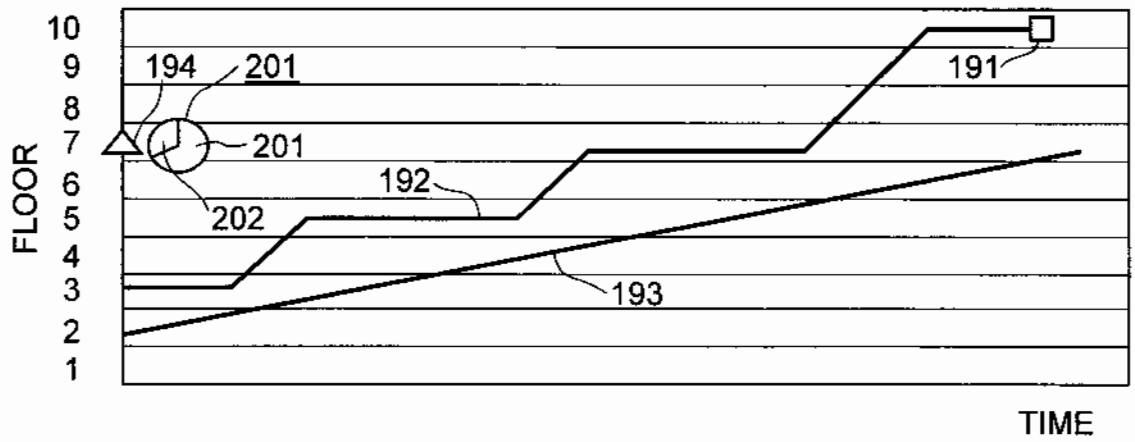


FIG. 21

