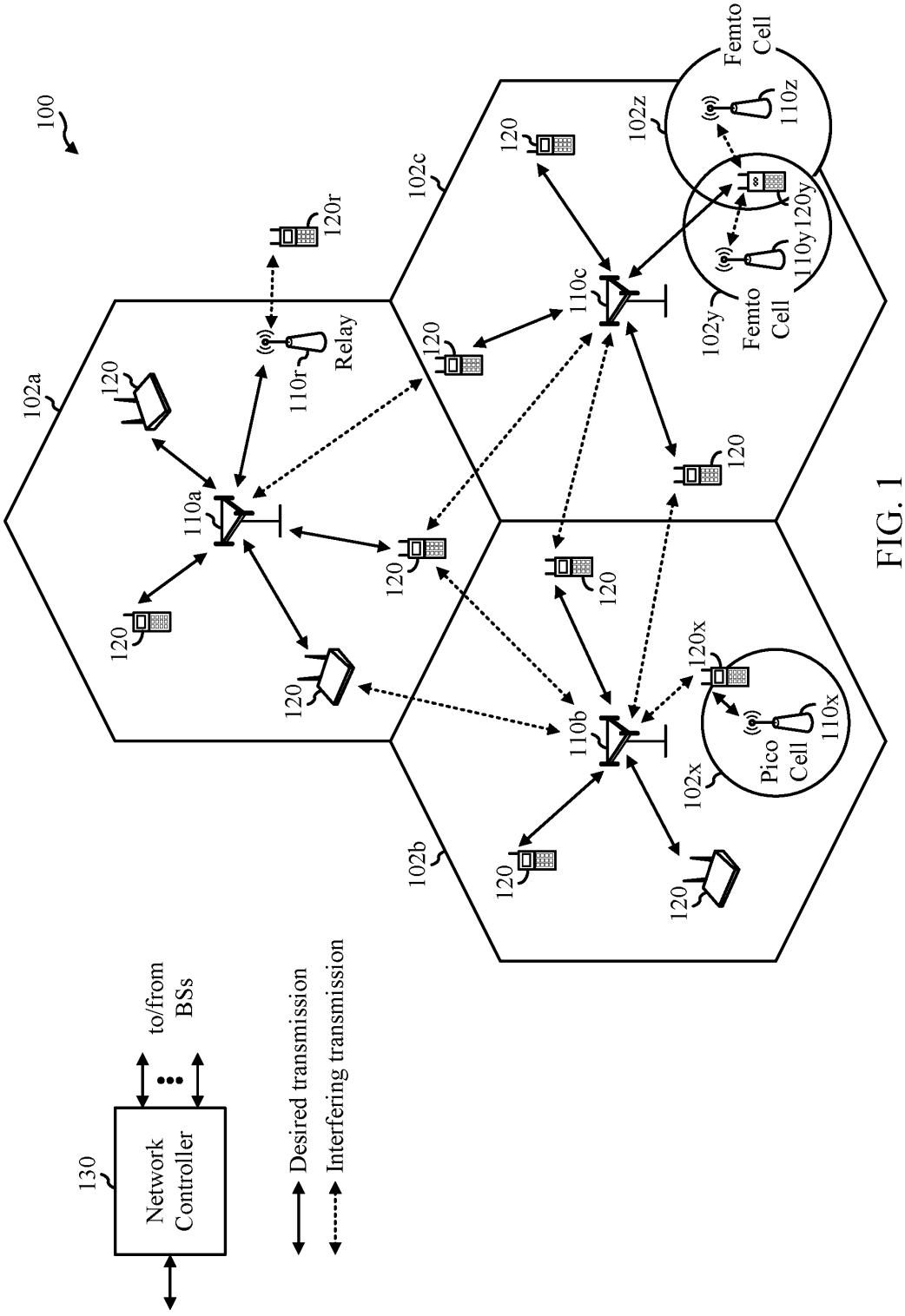
100
102a
102b
102c
102x
102y
102z
110a
110b
110c
110r
110x
110y
110z
120
120r
120x
120y
Relay
Pico Cell
Femto Cell
Femto Cell
130
Network Controller
to/from BSs
Desired transmission
Interfering transmission

FIG. 1

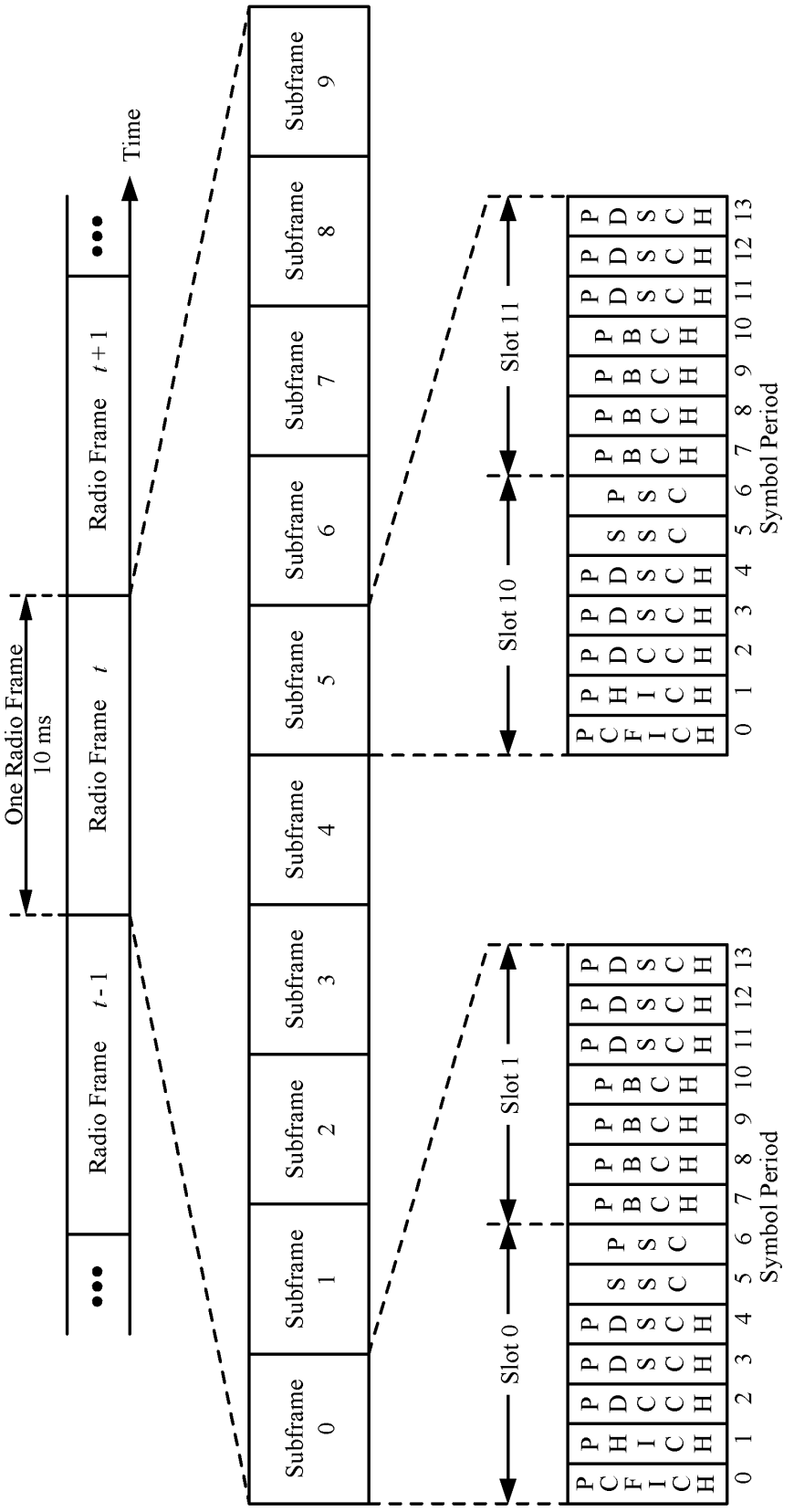
Time
One Radio Frame
10 ms
Radio Frame t - 1
Radio Frame t
Radio Frame t + 1
Subframe 0
Subframe 1
Subframe 2
Subframe 3
Subframe 4
Subframe 5
Subframe 6
Subframe 7
Subframe 8
Subframe 9
Slot 0
Slot 1
Slot 10
Slot 11
PCFICH
Symbol Period
0 1 2 3 4 5 6 7 8 9 10 11 12 13

FIG. 2

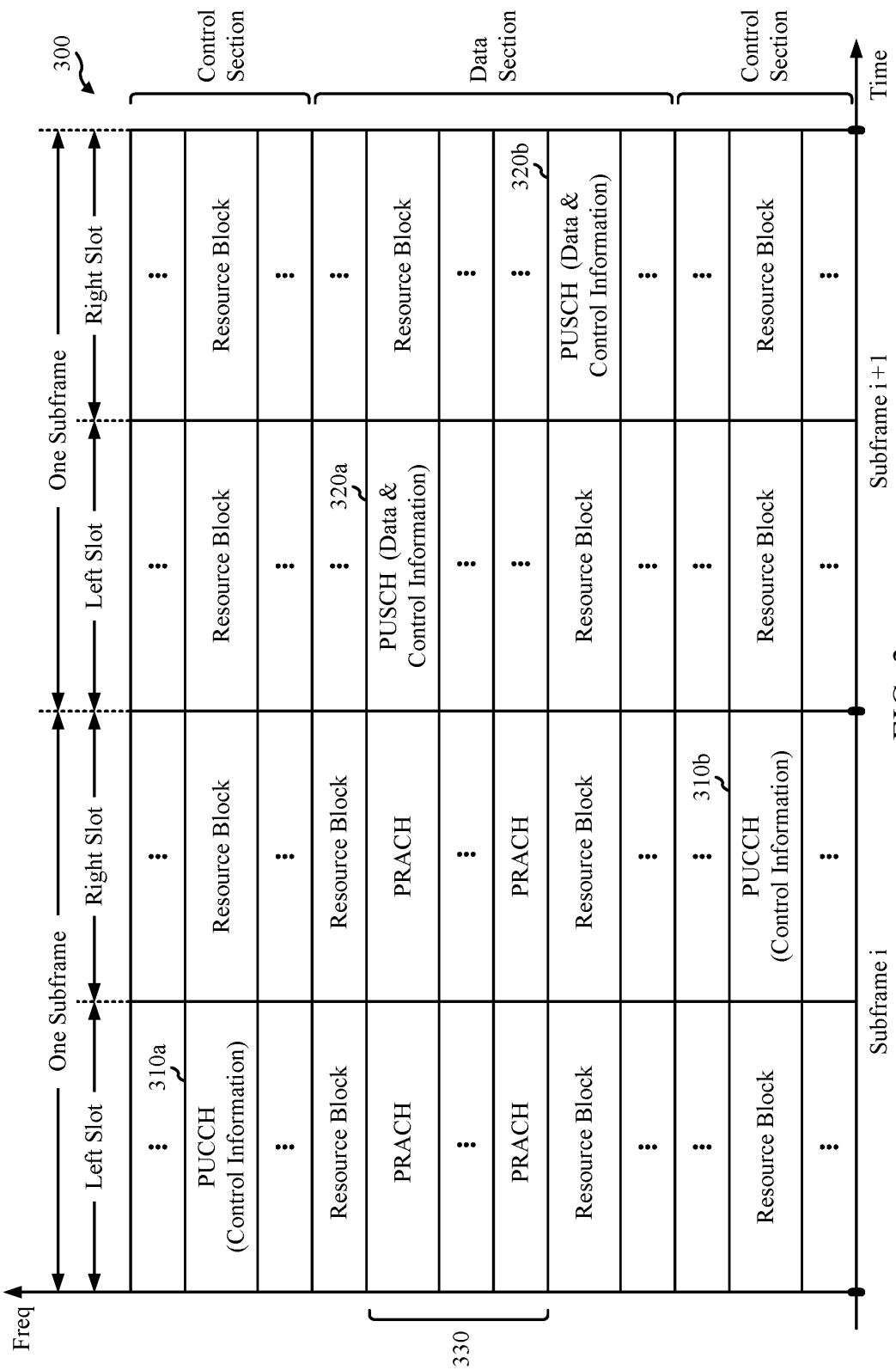
300
Control Section
Data Section
Control Section
One Subframe
Left Slot
Right Slot
Left Slot
Right Slot
Time
Freq
Subframe i
Subframe i+1
310a
310b
320a
320b
330
PUCCH (Control Information)
PRACH
PUSCH (Data & Control Information)
Resource Block

FIG. 3

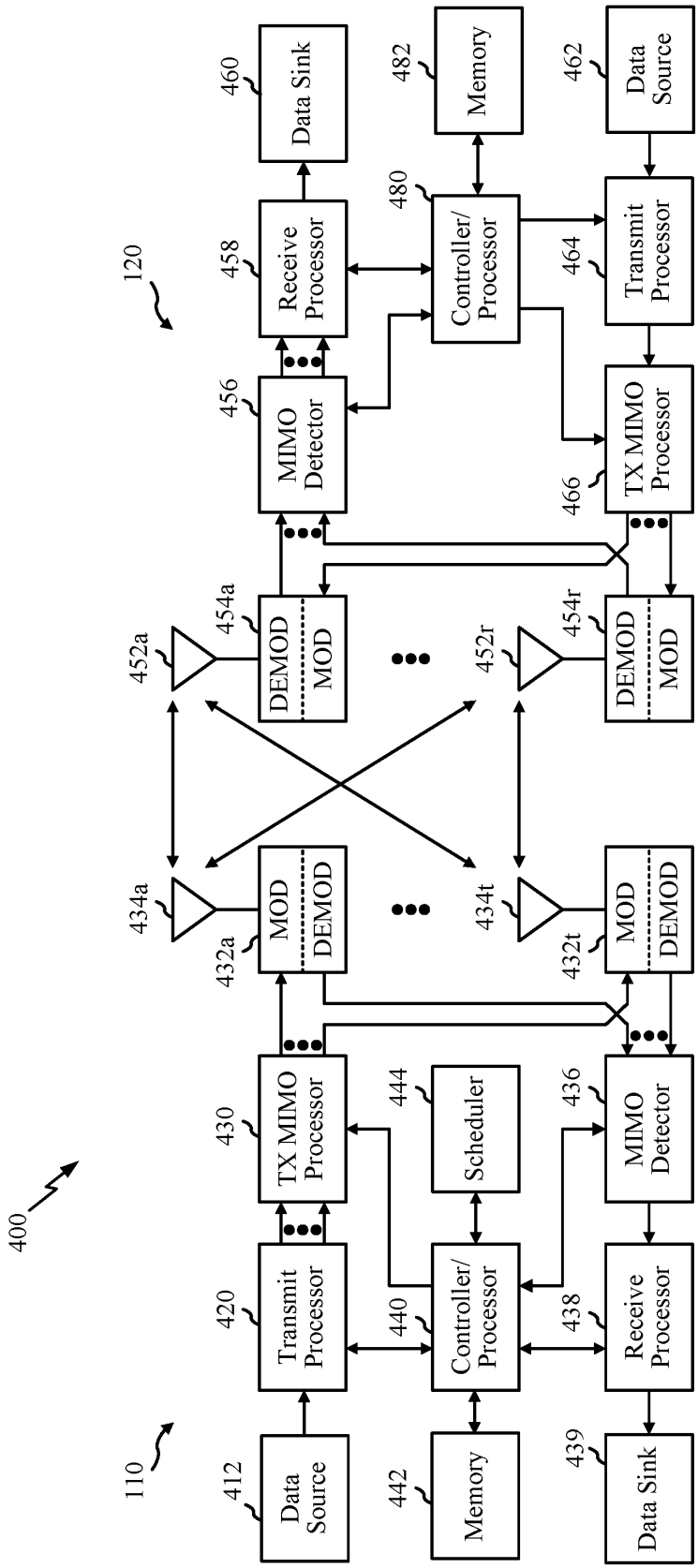
400
110
120
412
Data Source
420
Transmit Processor
430
TX MIMO Processor
432a
MOD
DEMOD
434a
452a
454a
DEMOD
MOD
456
MIMO Detector
458
Receive Processor
460
Data Sink
442
Memory
440
Controller/ Processor
444
Scheduler
482
Memory
480
Controller/ Processor
462
Data Source
464
Transmit Processor
466
TX MIMO Processor
452r
454r
DEMOD
MOD
434t
432t
MOD
DEMOD
436
MIMO Detector
438
Receive Processor
439
Data Sink

FIG. 4

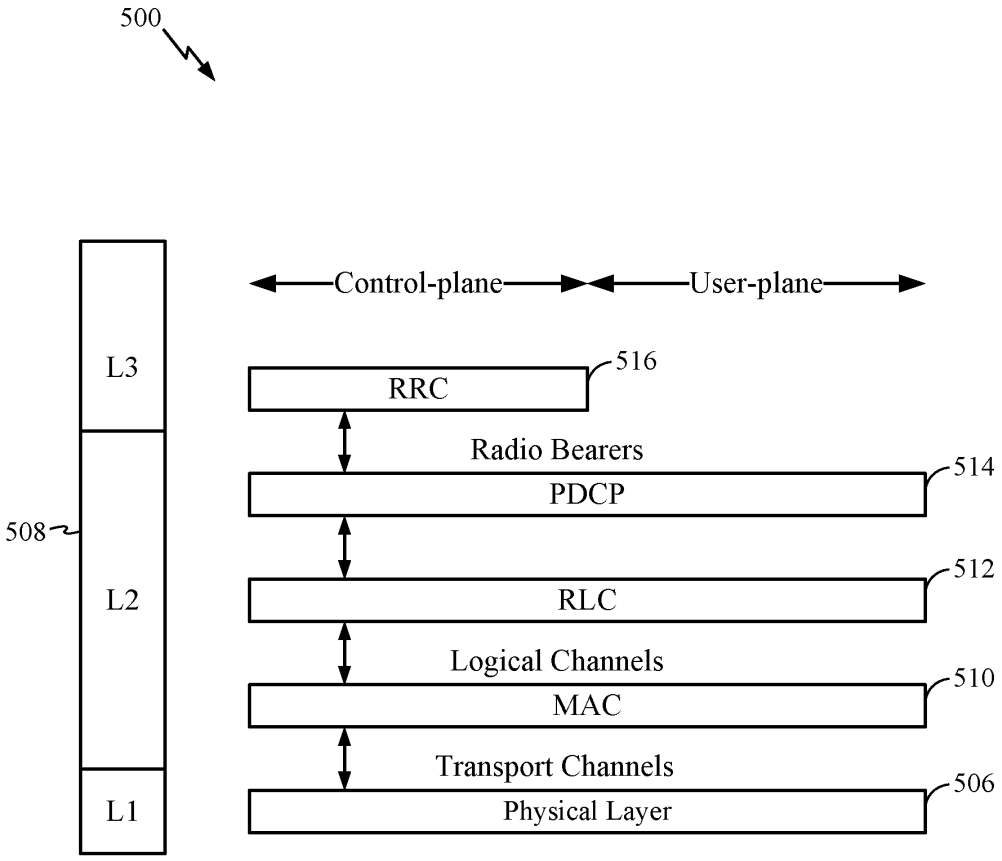
500
Control-plane
User-plane
L3
L2
L1
508
RRC
516
Radio Bearers
PDCP
514
RLC
512
Logical Channels
MAC
510
Transport Channels
Physical Layer
506

FIG. 5

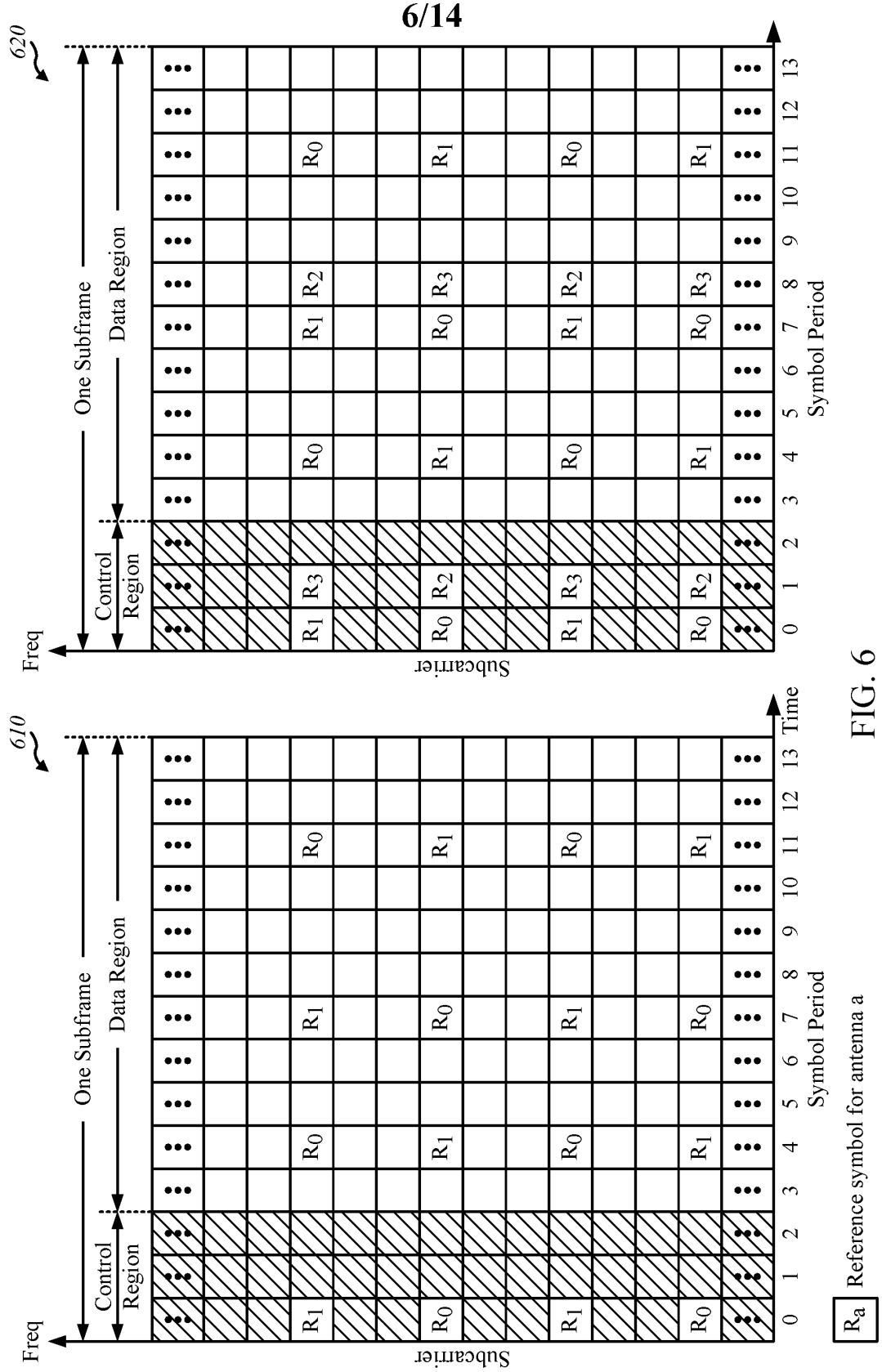
610
620
One Subframe
Data Region
Control Region
Freq
Subcarrier
Time
Symbol Period
0 1 2 3 4 5 6 7 8 9 10 11 12 13
R_a Reference symbol for antenna a

FIG. 6

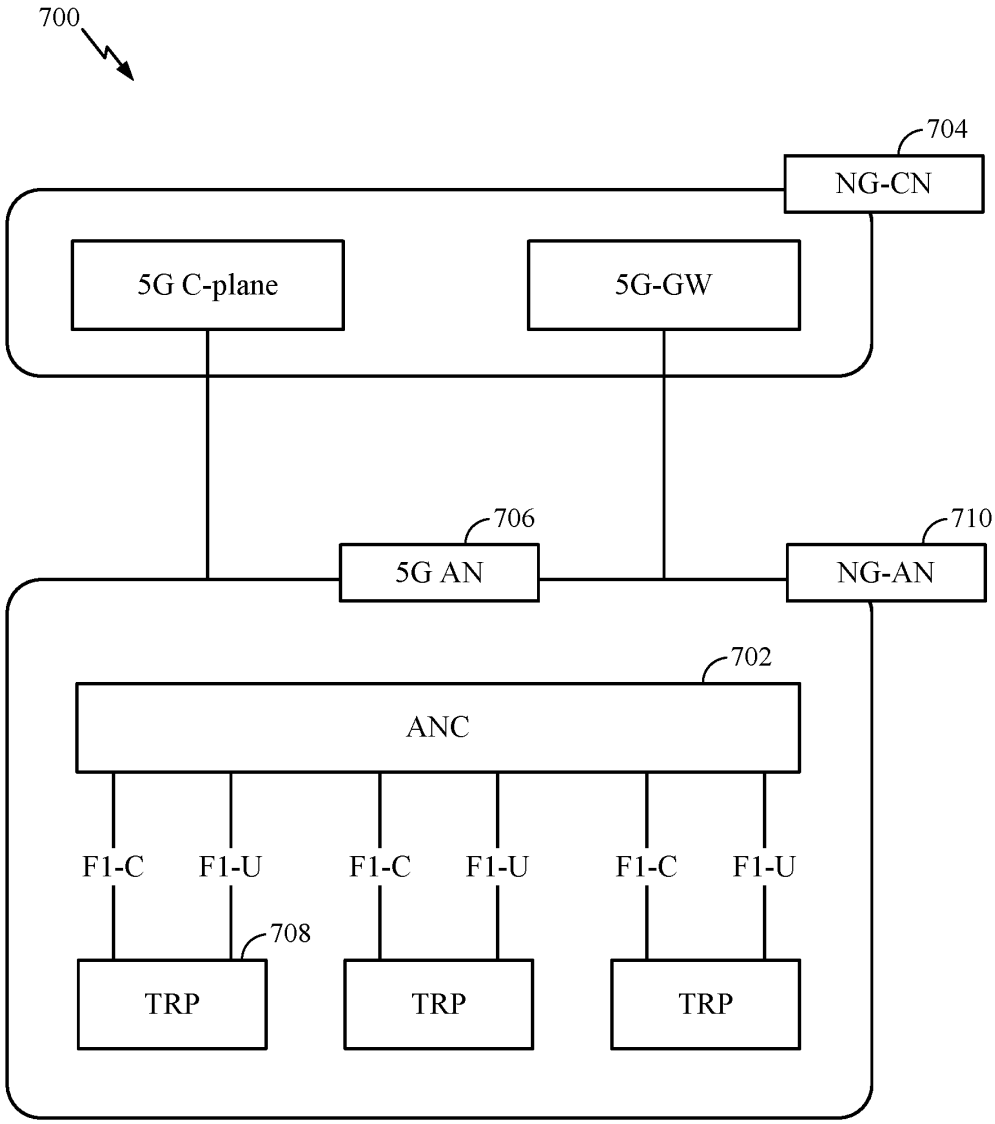
700
704
NG-CN
5G C-plane
5G-GW
706
5G AN
710
NG-AN
702
ANC
F1-C
F1-U
F1-C
F1-U
F1-C
F1-U
708
TRP
TRP
TRP

FIG. 7

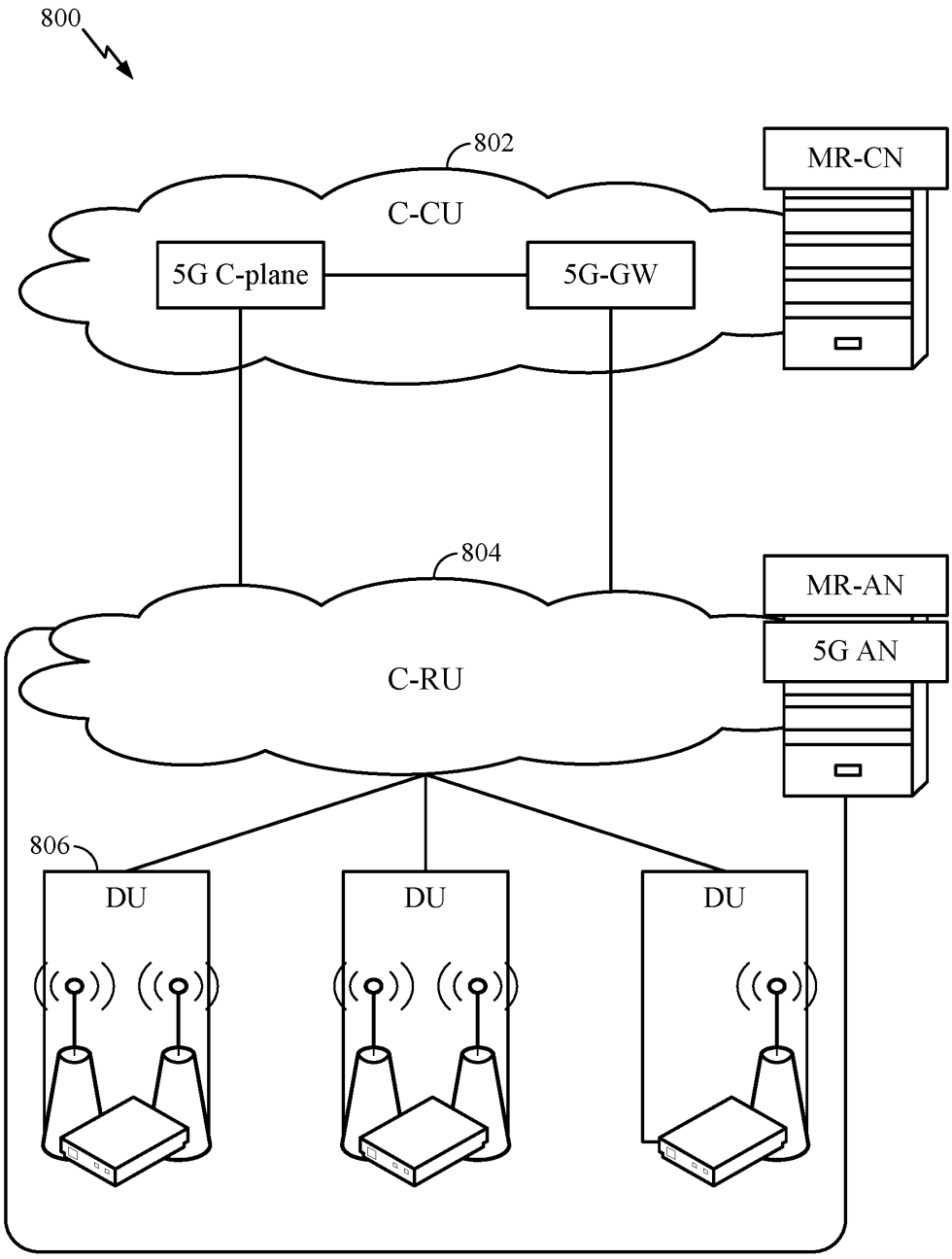

FIG. 8

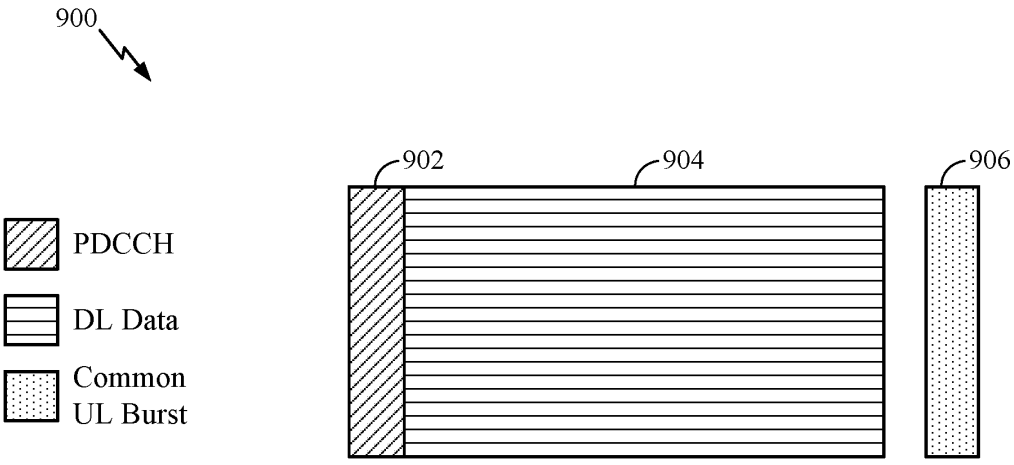
900
902
904
906
PDCCH
DL Data
Common
UL Burst

FIG. 9

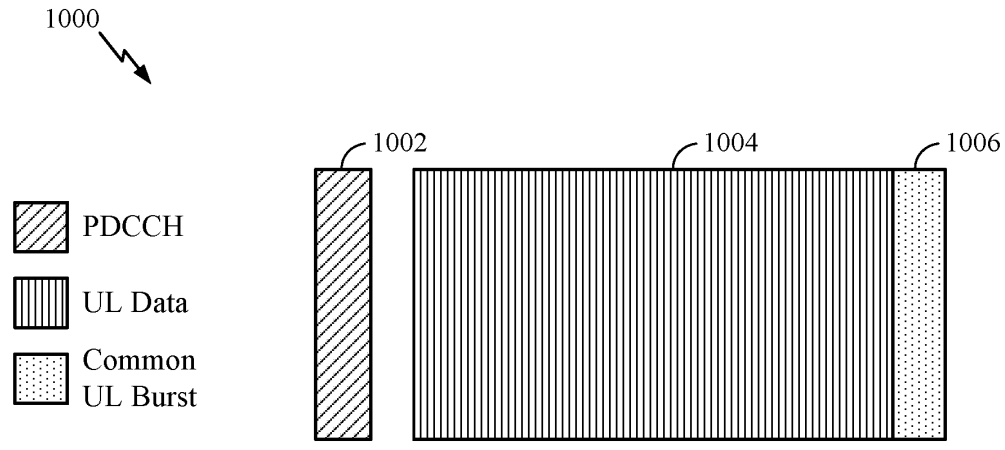
1000
1002
1004
1006
PDCCH
UL Data
Common
UL Burst

FIG. 10

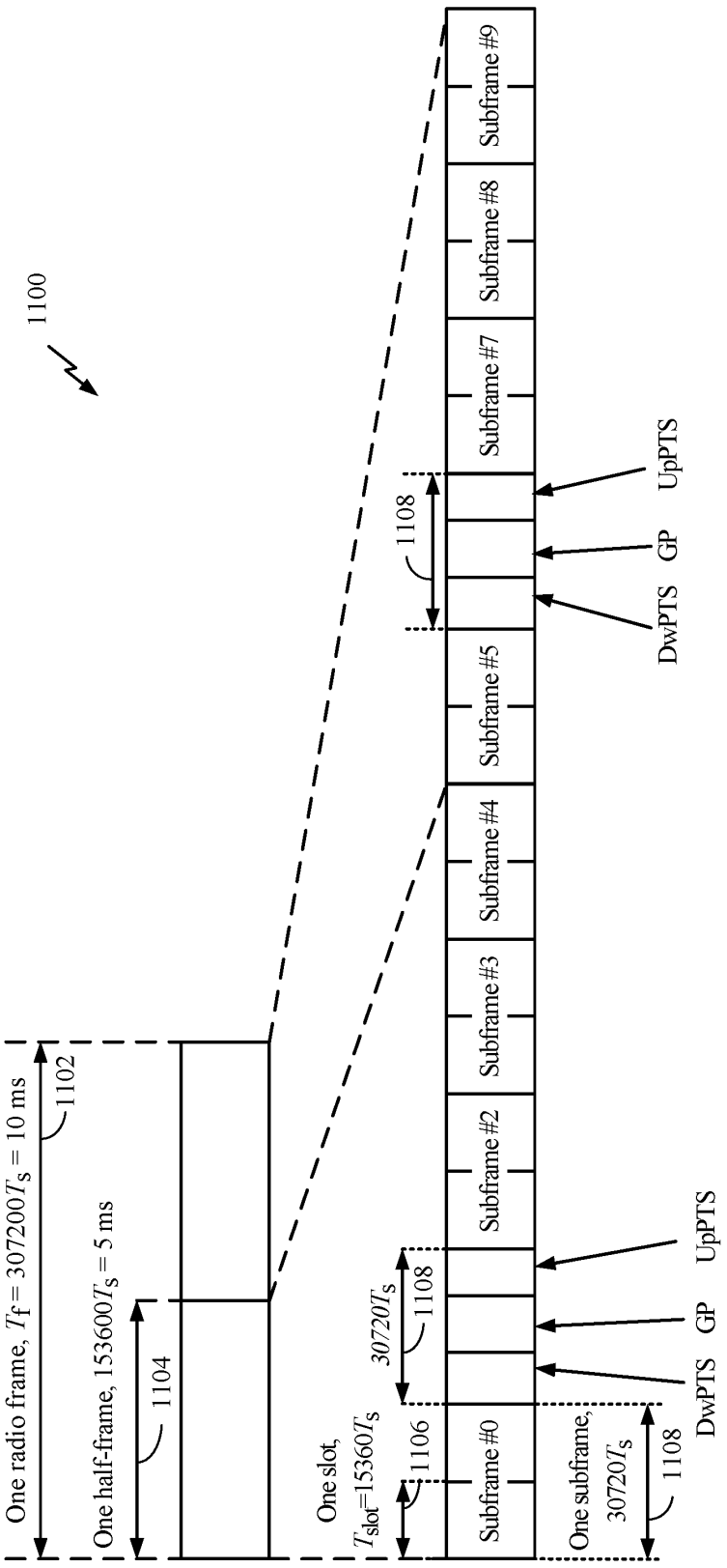
1100
One radio frame, $T_f = 307200T_S = 10$ ms
1102
One half-frame, $153600T_S = 5$ ms
1104
One slot, $T_{slot}=15360T_S$
1106
$30720T_S$
1108
Subframe #0
Subframe #2
Subframe #3
Subframe #4
Subframe #5
Subframe #7
Subframe #8
Subframe #9
DwPTS
GP
UpPTS
One subframe, $30720T_S$
1108

FIG. 11

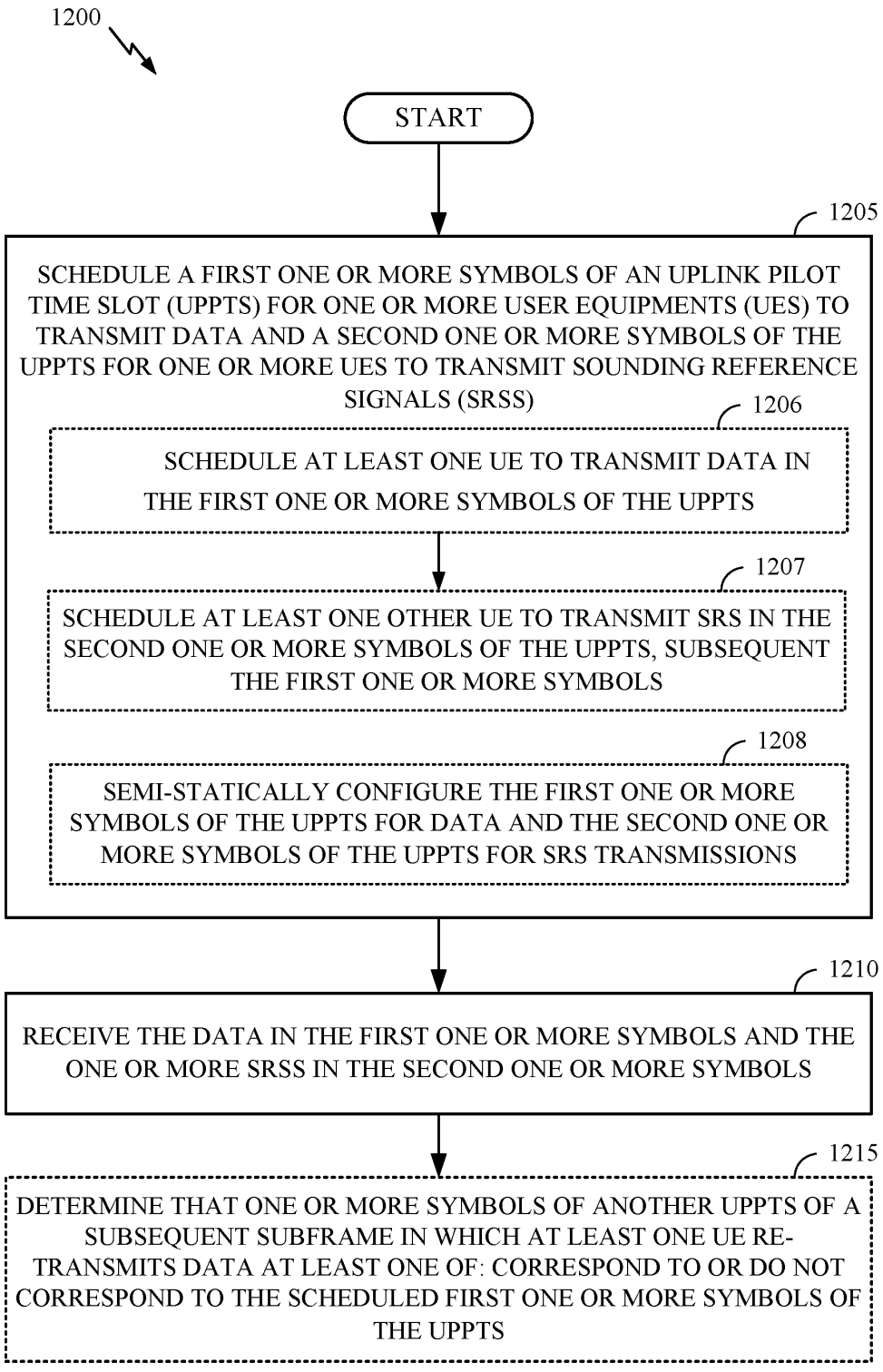
1200
START
1205
SCHEDULE A FIRST ONE OR MORE SYMBOLS OF AN UPLINK PILOT TIME SLOT (UPPTS) FOR ONE OR MORE USER EQUIPMENTS (UES) TO TRANSMIT DATA AND A SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR ONE OR MORE UES TO TRANSMIT SOUNDING REFERENCE SIGNALS (SRSS)
1206
SCHEDULE AT LEAST ONE UE TO TRANSMIT DATA IN THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS
1207
SCHEDULE AT LEAST ONE OTHER UE TO TRANSMIT SRS IN THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS, SUBSEQUENT THE FIRST ONE OR MORE SYMBOLS
1208
SEMI-STATICALLY CONFIGURE THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS FOR DATA AND THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR SRS TRANSMISSIONS
1210
RECEIVE THE DATA IN THE FIRST ONE OR MORE SYMBOLS AND THE ONE OR MORE SRSS IN THE SECOND ONE OR MORE SYMBOLS
1215
DETERMINE THAT ONE OR MORE SYMBOLS OF ANOTHER UPPTS OF A SUBSEQUENT SUBFRAME IN WHICH AT LEAST ONE UE RE-TRANSMITS DATA AT LEAST ONE OF: CORRESPOND TO OR DO NOT CORRESPOND TO THE SCHEDULED FIRST ONE OR MORE SYMBOLS OF THE UPPTS

FIG. 12

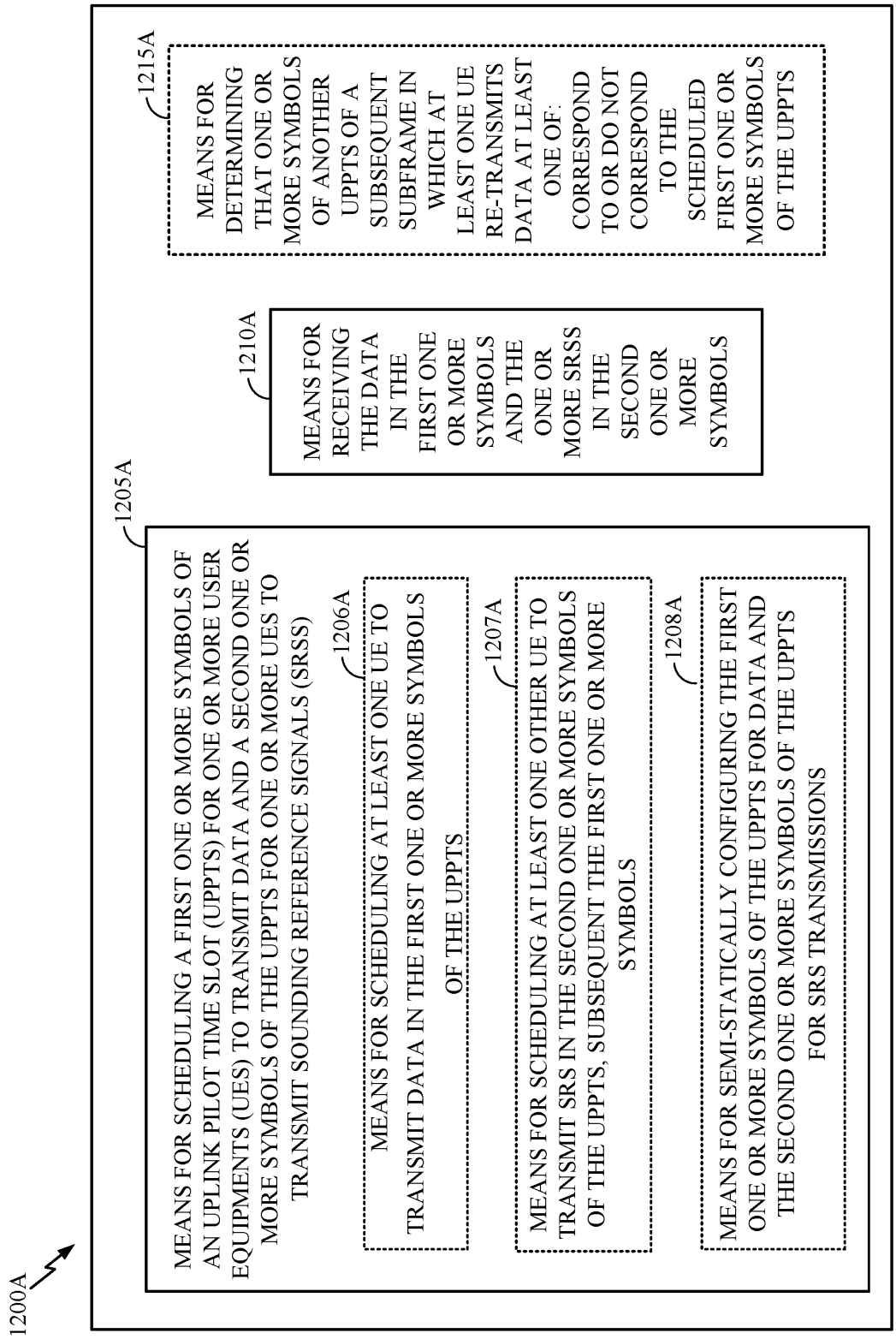
1200A
1205A
MEANS FOR SCHEDULING A FIRST ONE OR MORE SYMBOLS OF AN UPLINK PILOT TIME SLOT (UPPTS) FOR ONE OR MORE USER EQUIPMENTS (UES) TO TRANSMIT DATA AND A SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR ONE OR MORE UES TO TRANSMIT SOUNDING REFERENCE SIGNALS (SRSS)
1206A
MEANS FOR SCHEDULING AT LEAST ONE UE TO TRANSMIT DATA IN THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS
1207A
MEANS FOR SCHEDULING AT LEAST ONE OTHER UE TO TRANSMIT SRS IN THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS, SUBSEQUENT THE FIRST ONE OR MORE SYMBOLS
1208A
MEANS FOR SEMI-STATICALLY CONFIGURING THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS FOR DATA AND THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR SRS TRANSMISSIONS
1210A
MEANS FOR RECEIVING THE DATA IN THE FIRST ONE OR MORE SYMBOLS AND THE ONE OR MORE SRSS IN THE SECOND ONE OR MORE SYMBOLS
1215A
MEANS FOR DETERMINING THAT ONE OR MORE SYMBOLS OF ANOTHER UPPTS OF A SUBSEQUENT SUBFRAME IN WHICH AT LEAST ONE UE RE-TRANSMITS DATA AT LEAST ONE OF: CORRESPOND TO OR DO NOT CORRESPOND TO THE SCHEDULED FIRST ONE OR MORE SYMBOLS OF THE UPPTS

FIG. 12A

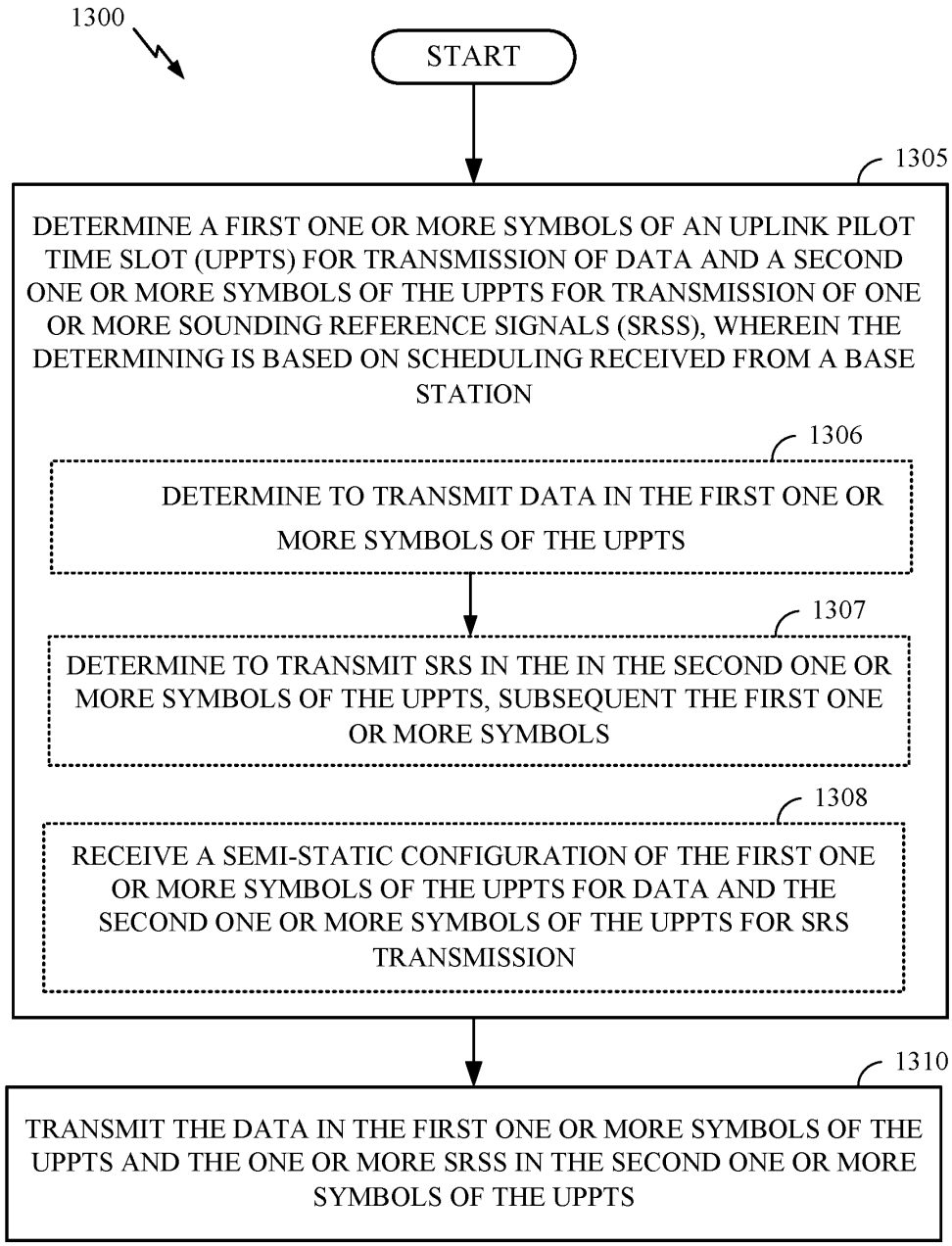
1300
START
1305
DETERMINE A FIRST ONE OR MORE SYMBOLS OF AN UPLINK PILOT TIME SLOT (UPPTS) FOR TRANSMISSION OF DATA AND A SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR TRANSMISSION OF ONE OR MORE SOUNDING REFERENCE SIGNALS (SRSS), WHEREIN THE DETERMINING IS BASED ON SCHEDULING RECEIVED FROM A BASE STATION
1306
DETERMINE TO TRANSMIT DATA IN THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS
1307
DETERMINE TO TRANSMIT SRS IN THE IN THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS, SUBSEQUENT THE FIRST ONE OR MORE SYMBOLS
1308
RECEIVE A SEMI-STATIC CONFIGURATION OF THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS FOR DATA AND THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR SRS TRANSMISSION
1310
TRANSMIT THE DATA IN THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS AND THE ONE OR MORE SRSS IN THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS

FIG. 13

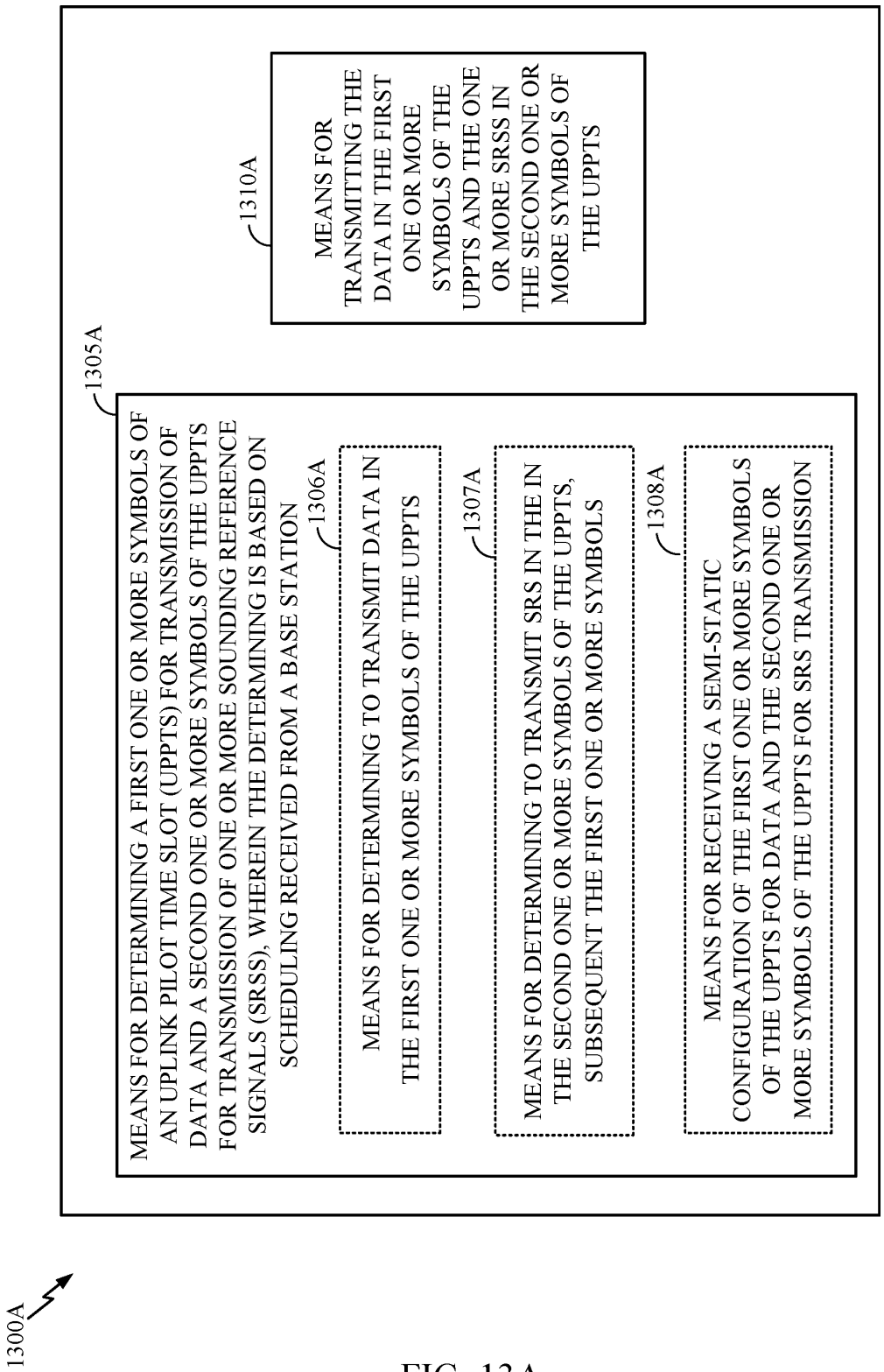
1300A
1305A
MEANS FOR DETERMINING A FIRST ONE OR MORE SYMBOLS OF AN UPLINK PILOT TIME SLOT (UPPTS) FOR TRANSMISSION OF DATA AND A SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR TRANSMISSION OF ONE OR MORE SOUNDING REFERENCE SIGNALS (SRSS), WHEREIN THE DETERMINING IS BASED ON SCHEDULING RECEIVED FROM A BASE STATION
1306A
MEANS FOR DETERMINING TO TRANSMIT DATA IN THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS
1307A
MEANS FOR DETERMINING TO TRANSMIT SRS IN THE IN THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS, SUBSEQUENT THE FIRST ONE OR MORE SYMBOLS
1308A
MEANS FOR RECEIVING A SEMI-STATIC CONFIGURATION OF THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS FOR DATA AND THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS FOR SRS TRANSMISSION
1310A
MEANS FOR TRANSMITTING THE DATA IN THE FIRST ONE OR MORE SYMBOLS OF THE UPPTS AND THE ONE OR MORE SRSS IN THE SECOND ONE OR MORE SYMBOLS OF THE UPPTS

FIG. 13A