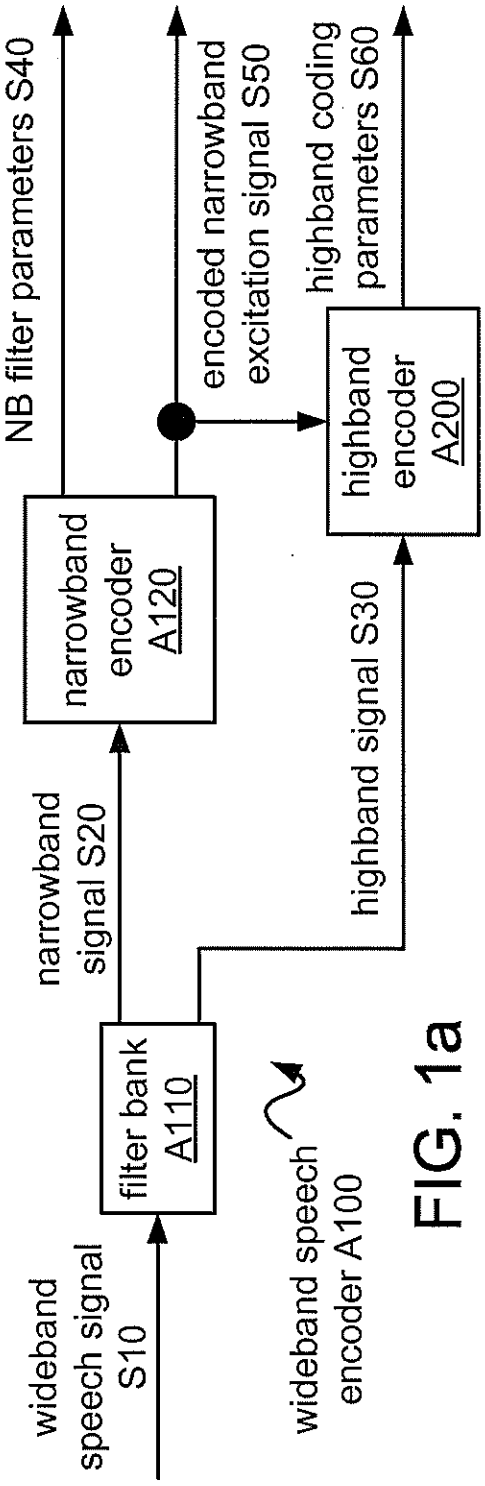

wideband speech signal S10
filter bank A110
narrowband signal S20
narrowband encoder A120
NB filter parameters S40
encoded narrowband excitation signal S50
highband signal S30
highband encoder A200
highband coding parameters S60
wideband speech encoder A100

FIG. 1a

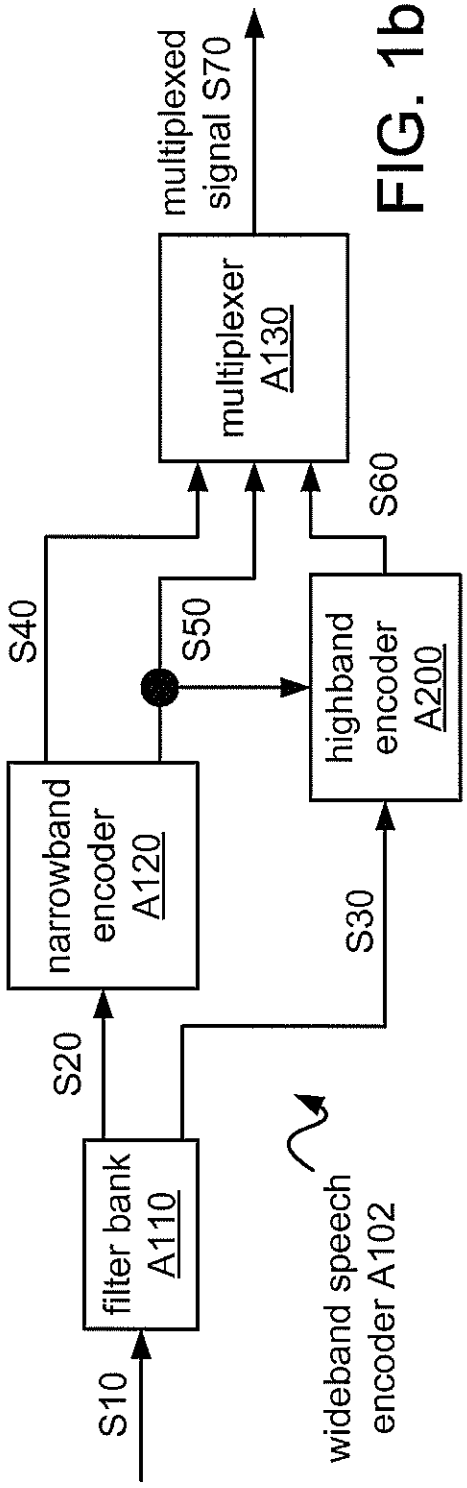

S10
filter bank A110
S20
narrowband encoder A120
S40
S50
S30
highband encoder A200
S60
multiplexer A130
multiplexed signal S70
wideband speech encoder A102

FIG. 1b

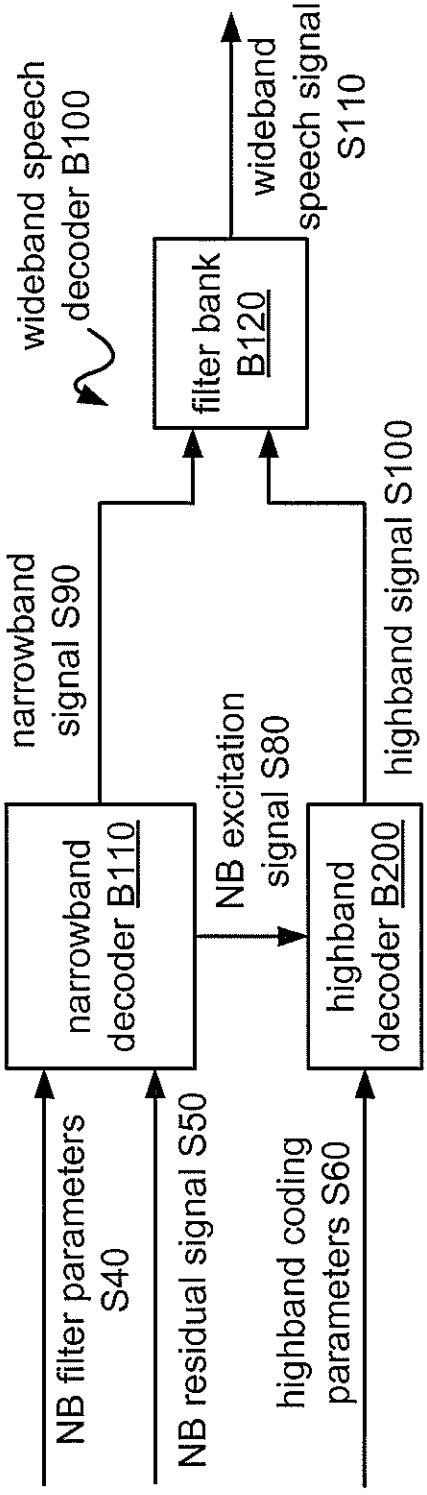

wideband speech decoder B100
NB filter parameters S40
NB residual signal S50
highband coding parameters S60
narrowband decoder B110
highband decoder B200
filter bank B120
narrowband signal S90
NB excitation signal S80
highband signal S100
wideband speech signal S110

FIG. 2a

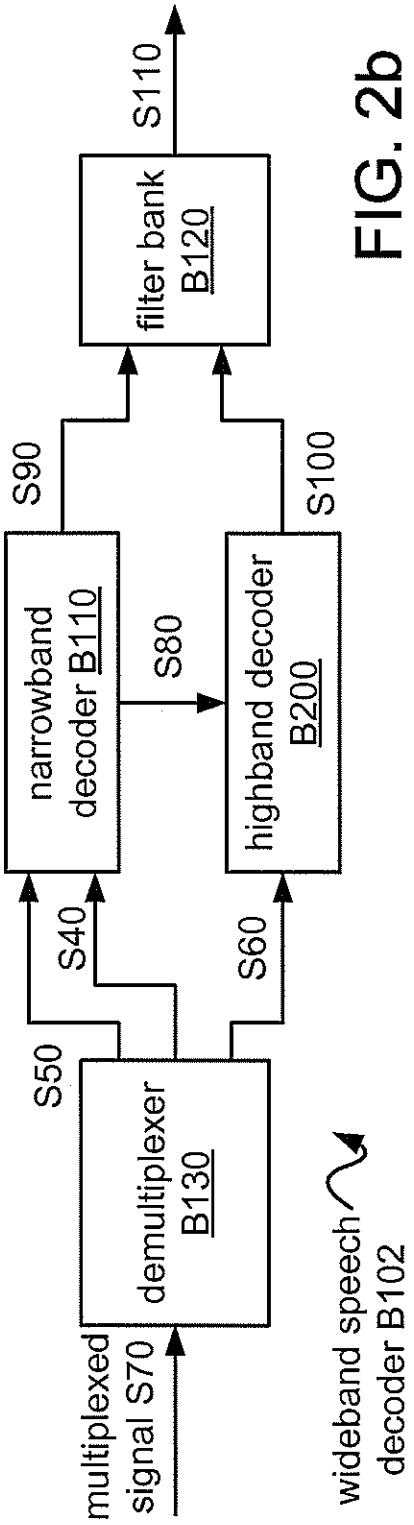

wideband speech decoder B102
multiplexed signal S70
demultiplexer B130
S50
S40
S60
narrowband decoder B110
highband decoder B200
S90
S80
S100
filter bank B120
S110

FIG. 2b

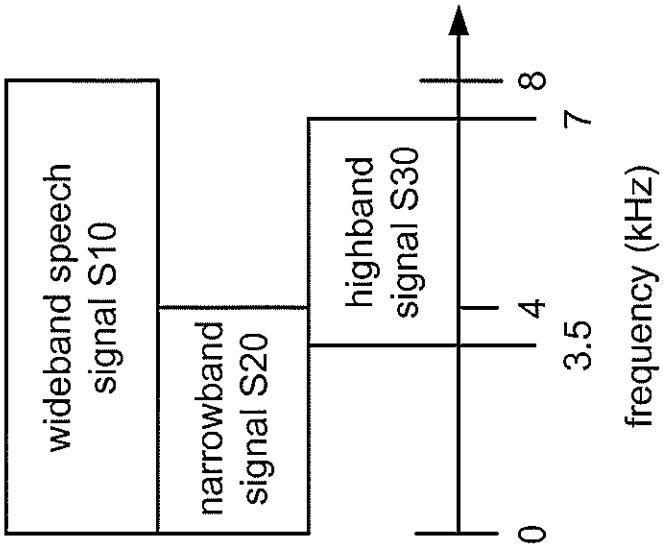

wideband speech signal S10
narrowband signal S20
highband signal S30
0
3.5
4
7
8
frequency (kHz)

FIG. 3b

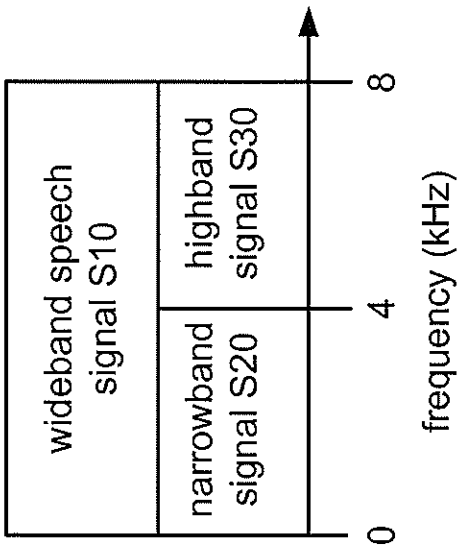

wideband speech signal S10
narrowband signal S20
highband signal S30
0
4
8
frequency (kHz)

FIG. 3a

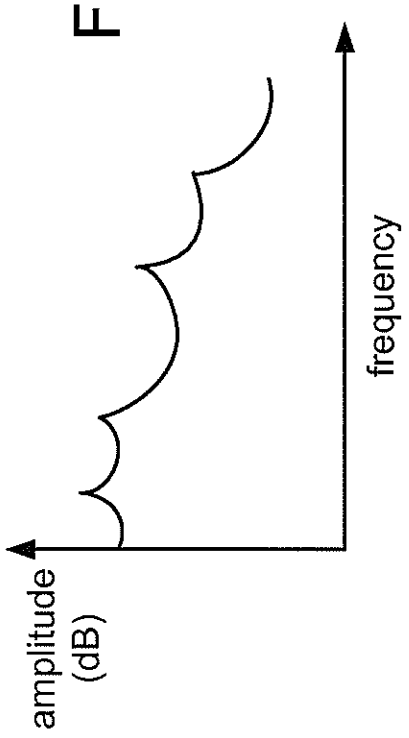

amplitude
(dB)
frequency

FIG. 4a

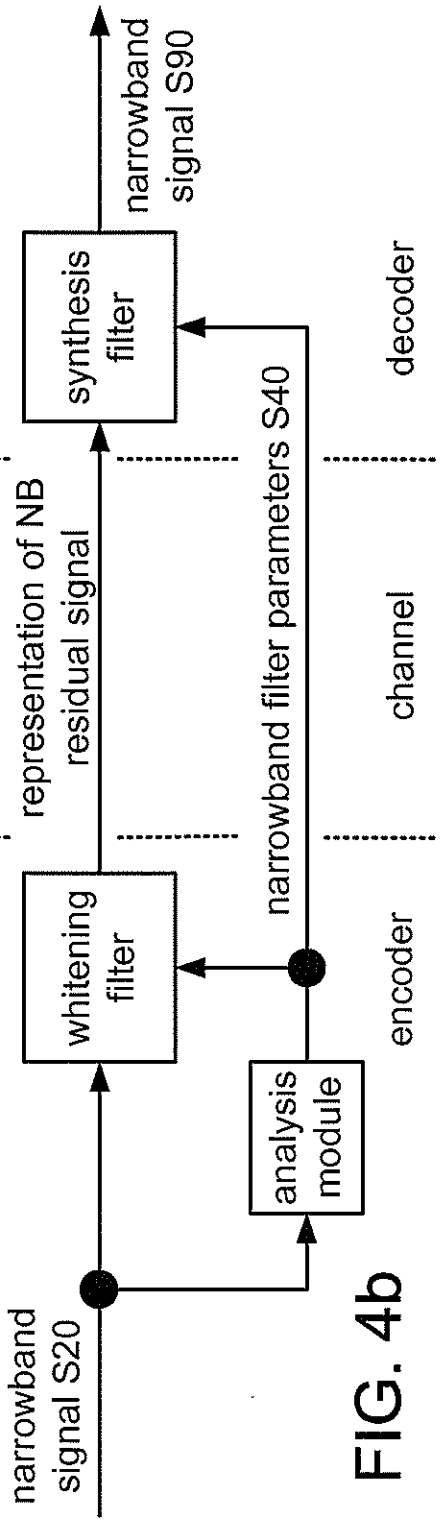

narrowband
signal S20
analysis
module
whitening
filter
representation of NB
residual signal
narrowband filter parameters S40
synthesis
filter
narrowband
signal S90
encoder
channel
decoder

FIG. 4b

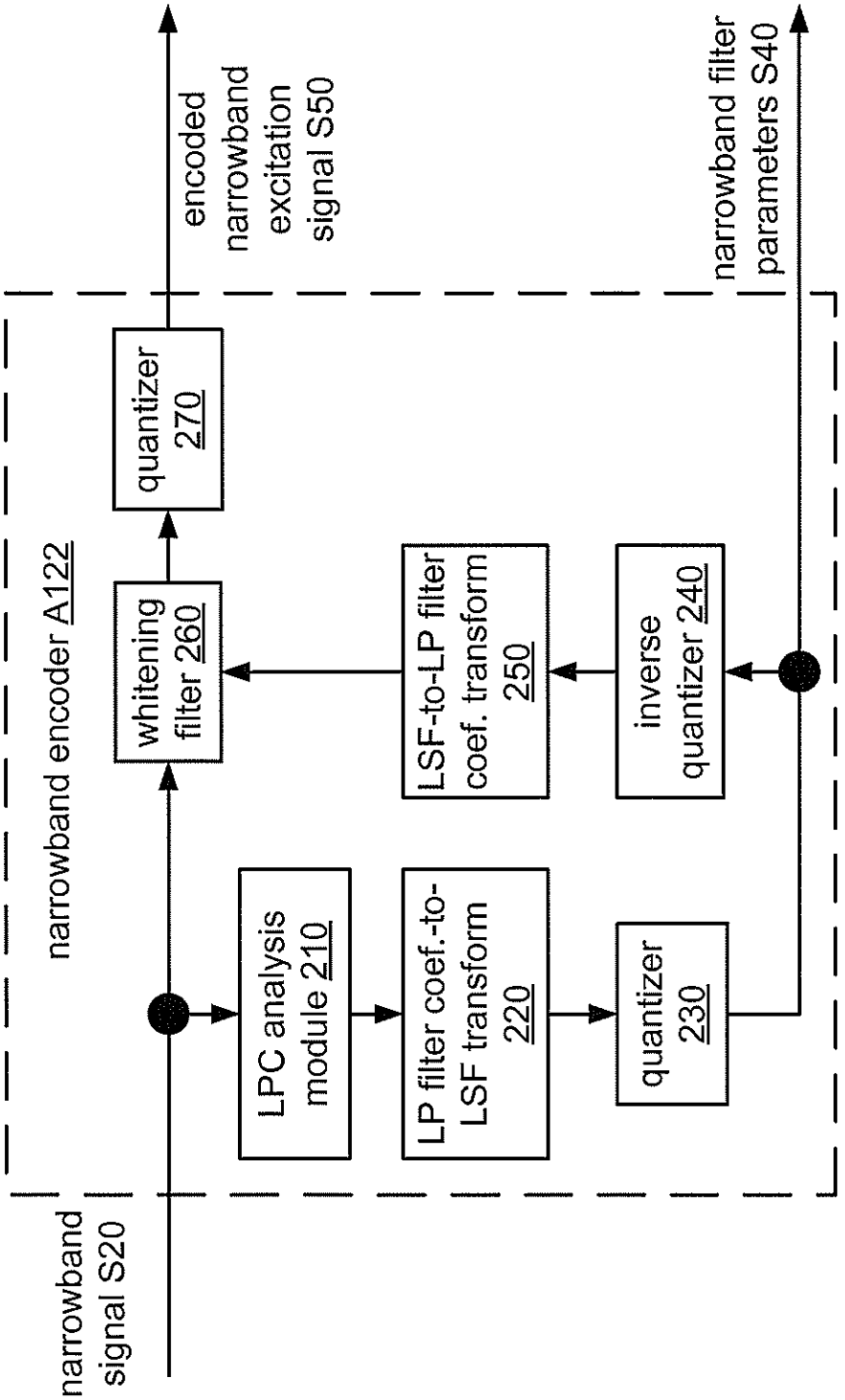

narrowband signal S20
narrowband encoder A122
LPC analysis module 210
LP filter coef.-to-LSF transform 220
quantizer 230
LSF-to-LP filter coef. transform 250
inverse quantizer 240
whitening filter 260
quantizer 270
encoded narrowband excitation signal S50
narrowband filter parameters S40

FIG. 5

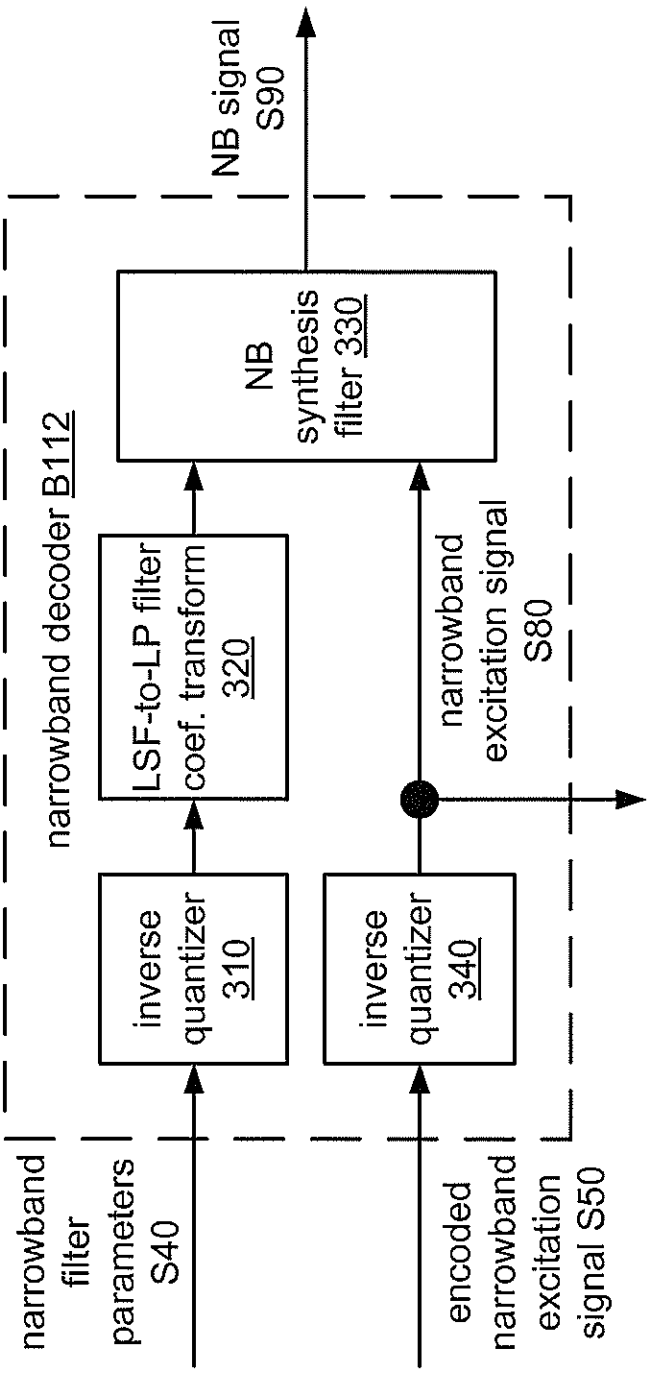

narrowband decoder B112
narrowband filter parameters S40
encoded narrowband excitation signal S50
inverse quantizer 310
LSF-to-LP filter coef. transform 320
inverse quantizer 340
narrowband excitation signal S80
NB synthesis filter 330
NB signal S90

FIG. 6

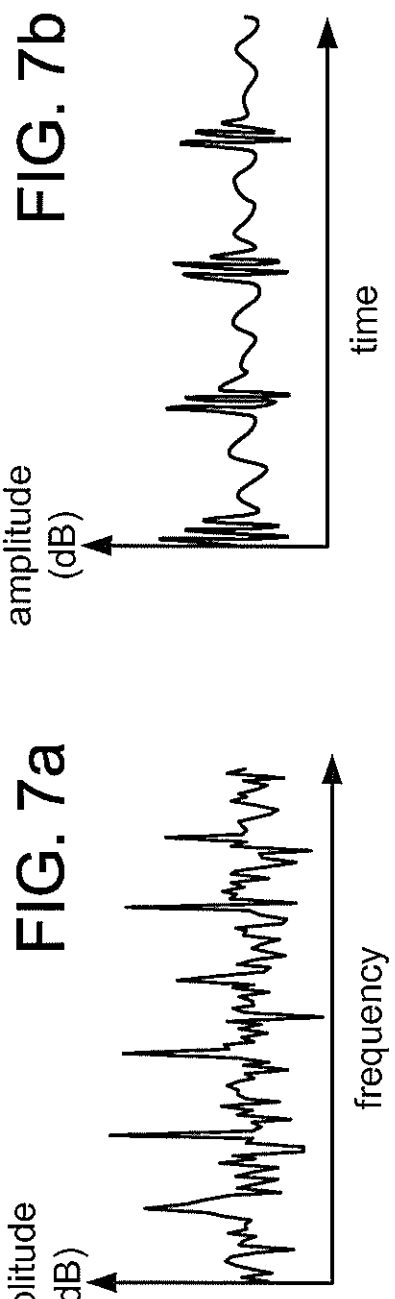



FIG. 7a




FIG. 7b

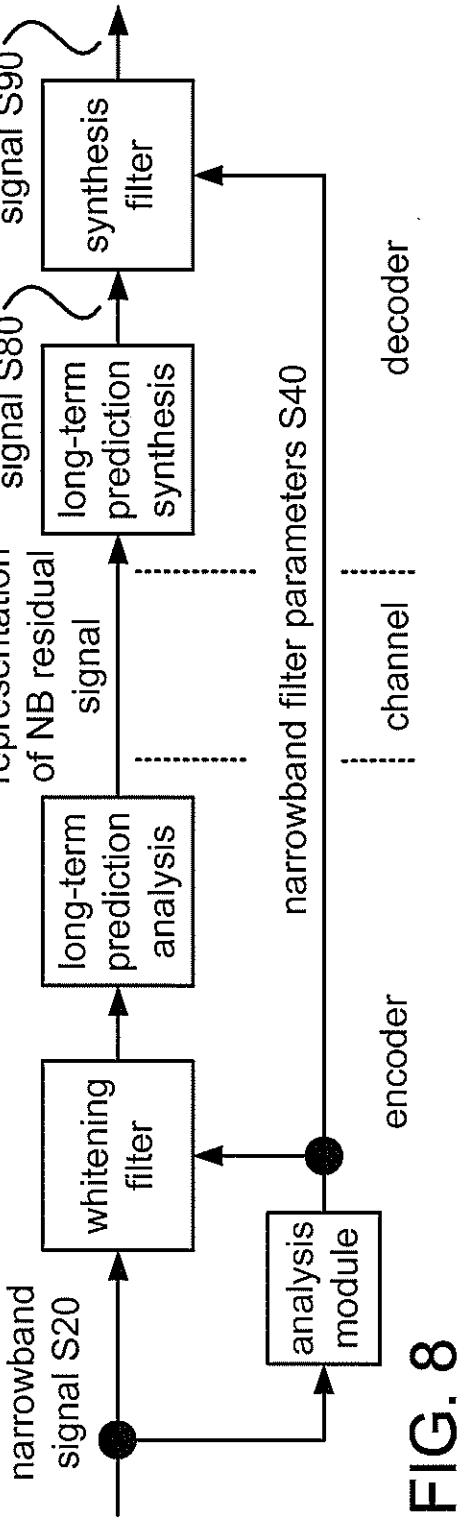



FIG. 8

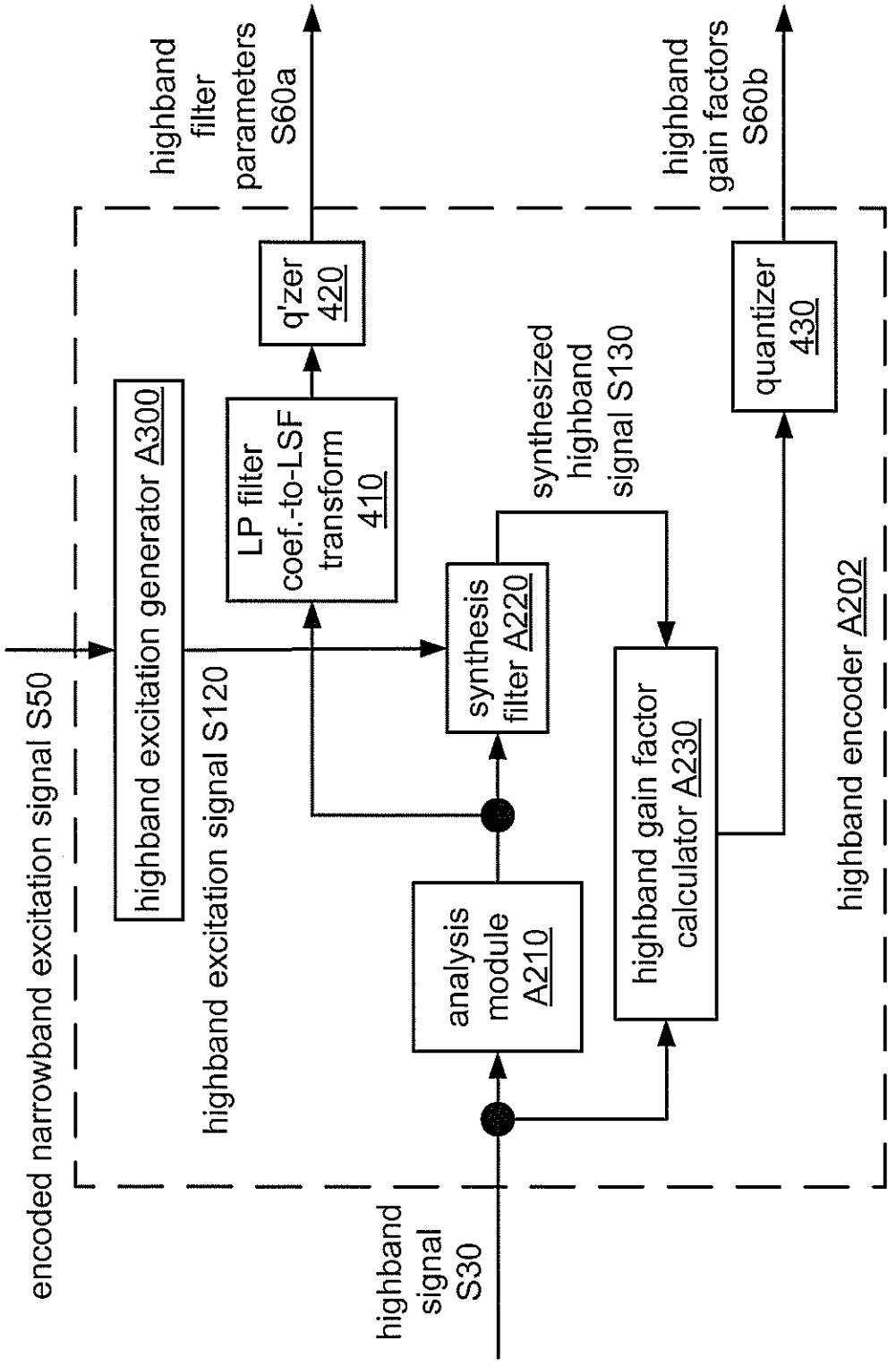

encoded narrowband excitation signal S50
highband excitation generator A300
highband excitation signal S120
LP filter coef.-to-LSF transform 410
q'zer 420
highband filter parameters S60a
synthesis filter A220
synthesized highband signal S130
highband signal S30
analysis module A210
highband gain factor calculator A230
quantizer 430
highband gain factors S60b
highband encoder A202

FIG. 9

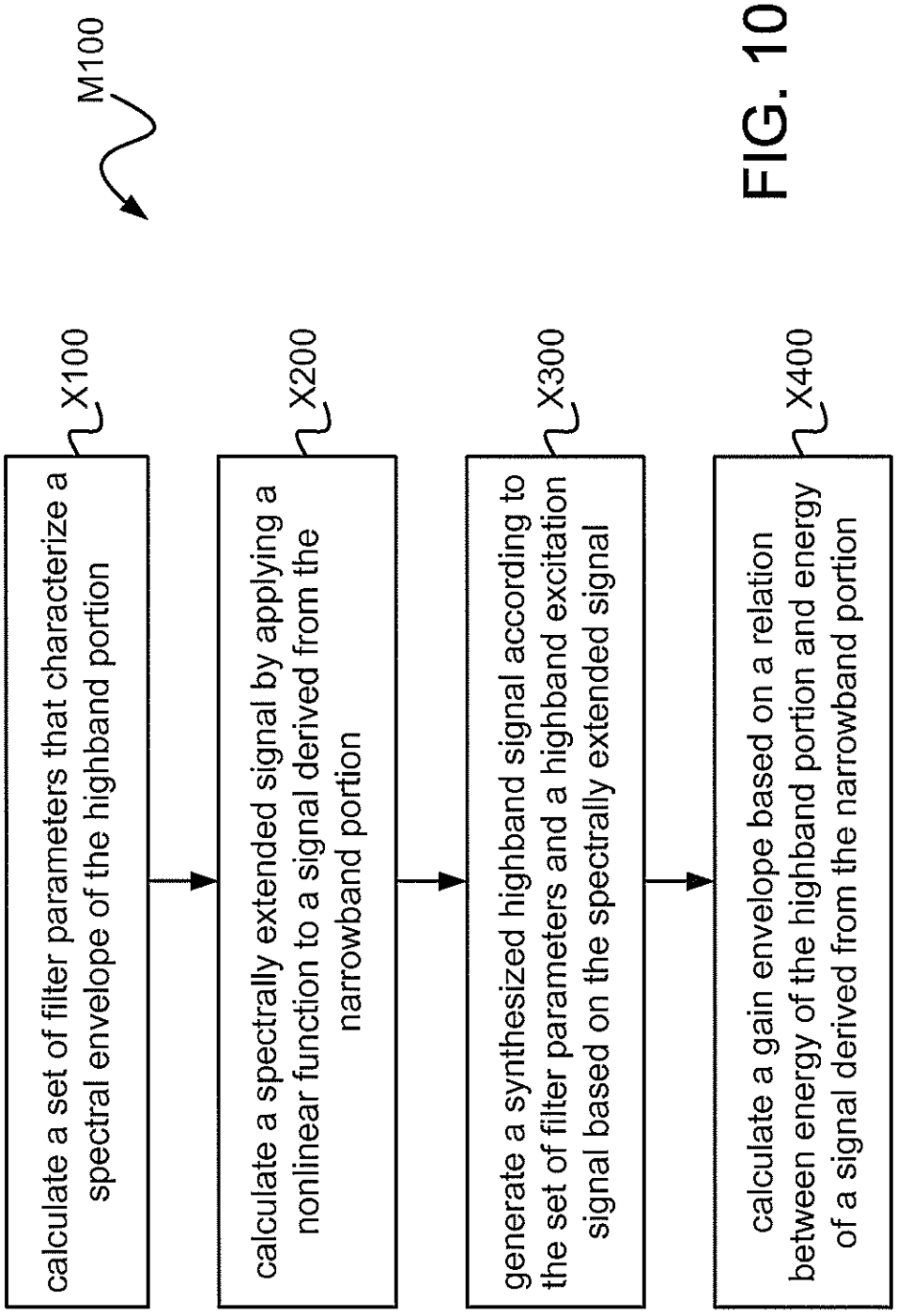

M100
X100
calculate a set of filter parameters that characterize a spectral envelope of the highband portion
X200
calculate a spectrally extended signal by applying a nonlinear function to a signal derived from the narrowband portion
X300
generate a synthesized highband signal according to the set of filter parameters and a highband excitation signal based on the spectrally extended signal
X400
calculate a gain envelope based on a relation between energy of the highband portion and energy of a signal derived from the narrowband portion

FIG. 10

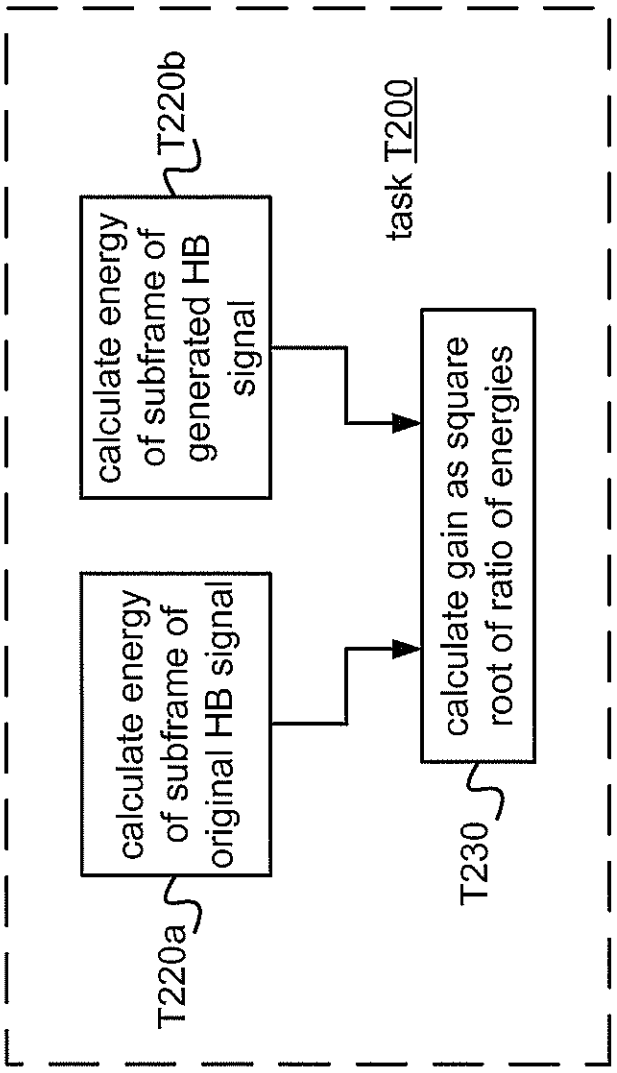

task T200
calculate energy of subframe of original HB signal
T220a
calculate energy of subframe of generated HB signal
T220b
calculate gain as square root of ratio of energies
T230

FIG. 11

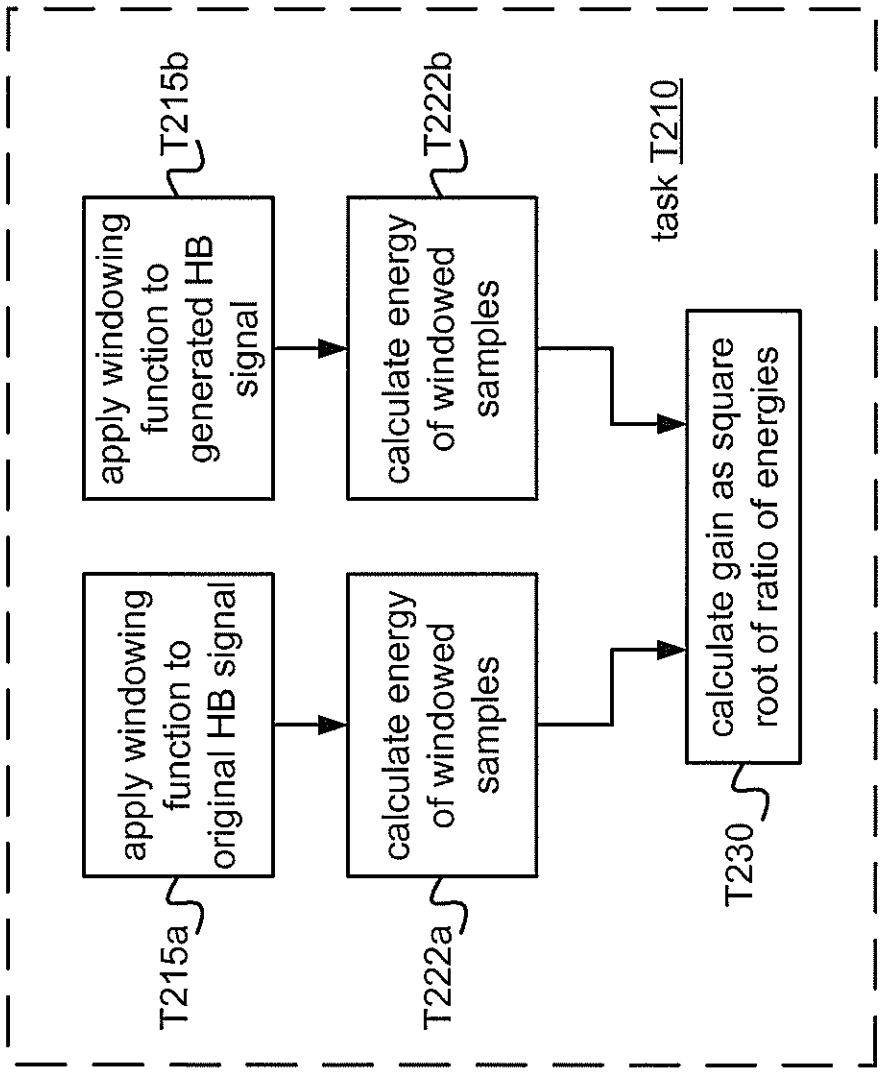

task T210
apply windowing function to original HB signal
T215a
apply windowing function to generated HB signal
T215b
calculate energy of windowed samples
T222a
calculate energy of windowed samples
T222b
calculate gain as square root of ratio of energies
T230

FIG. 12

FIG. 13a

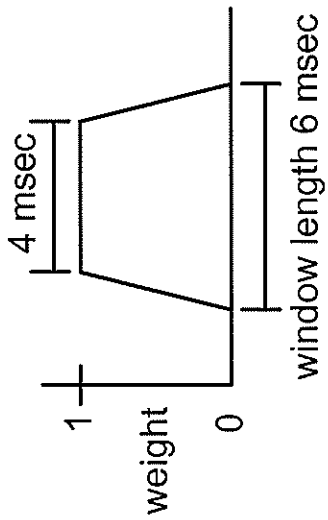
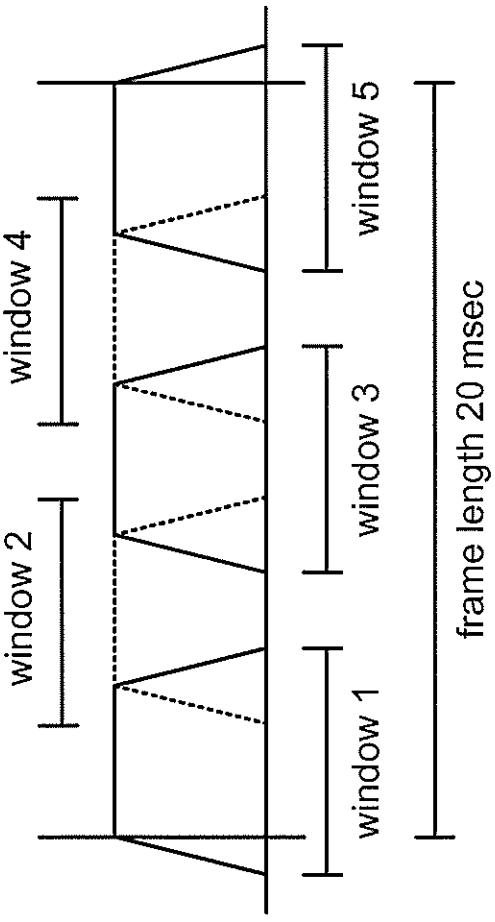



FIG. 13b



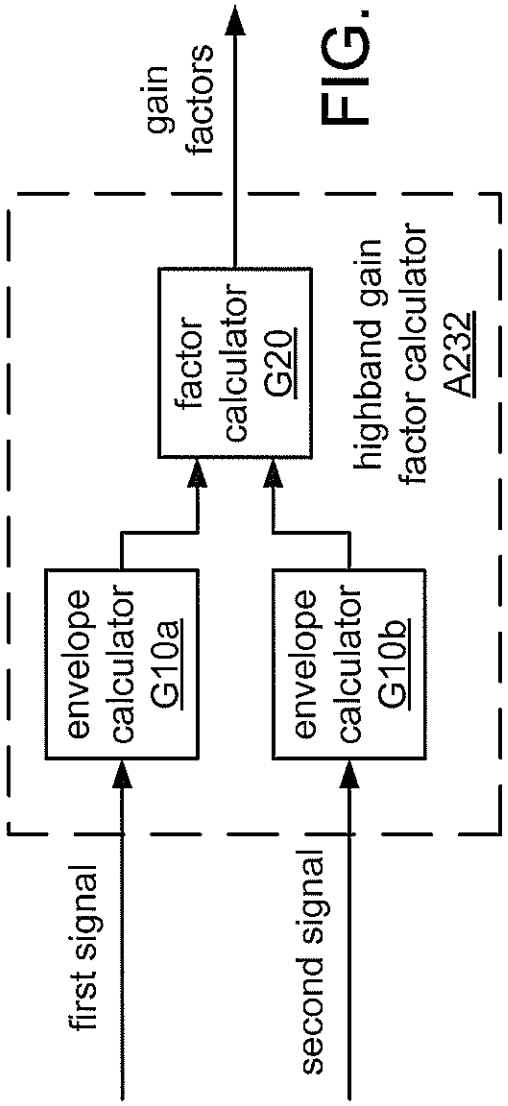



FIG. 14a

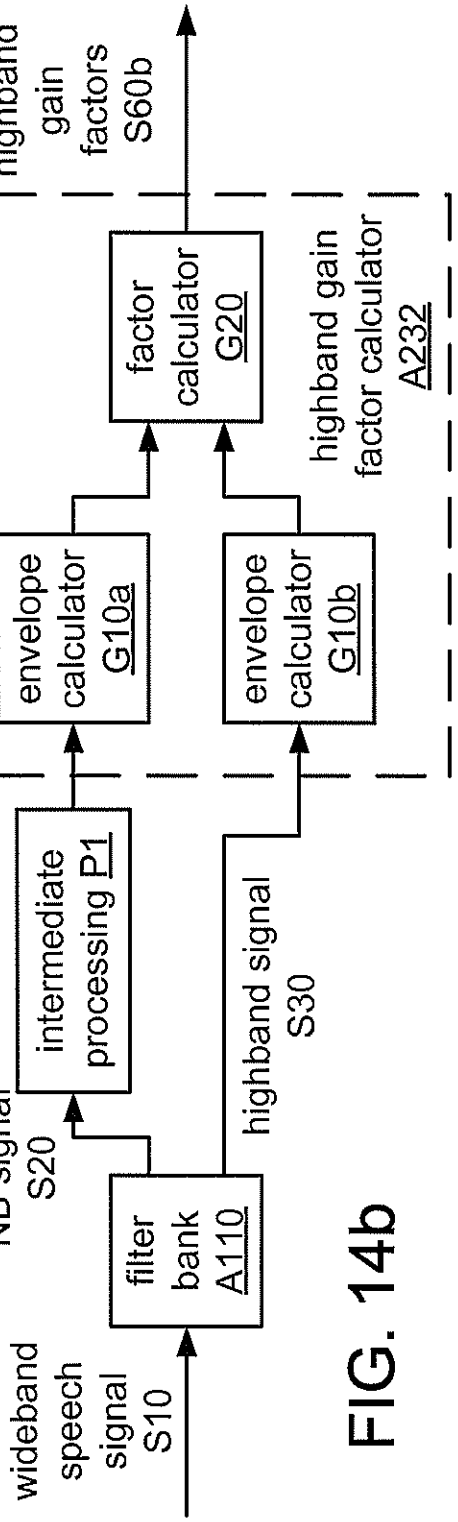



FIG. 14b

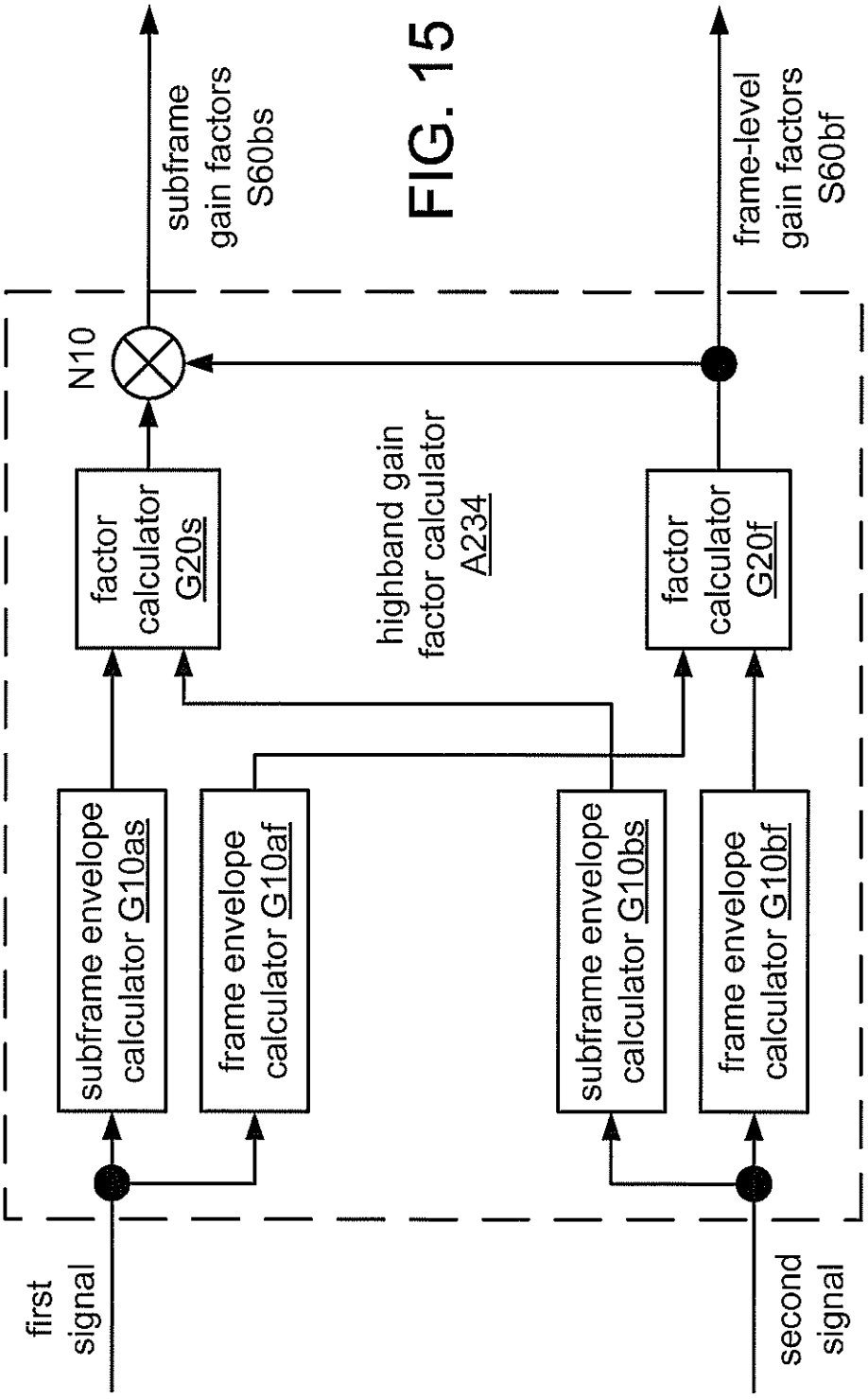

first signal
second signal
subframe envelope calculator G10as
frame envelope calculator G10af
subframe envelope calculator G10bs
frame envelope calculator G10bf
factor calculator G20s
factor calculator G20f
highband gain factor calculator A234
N10
subframe gain factors S60bs
frame-level gain factors S60bf

FIG. 15

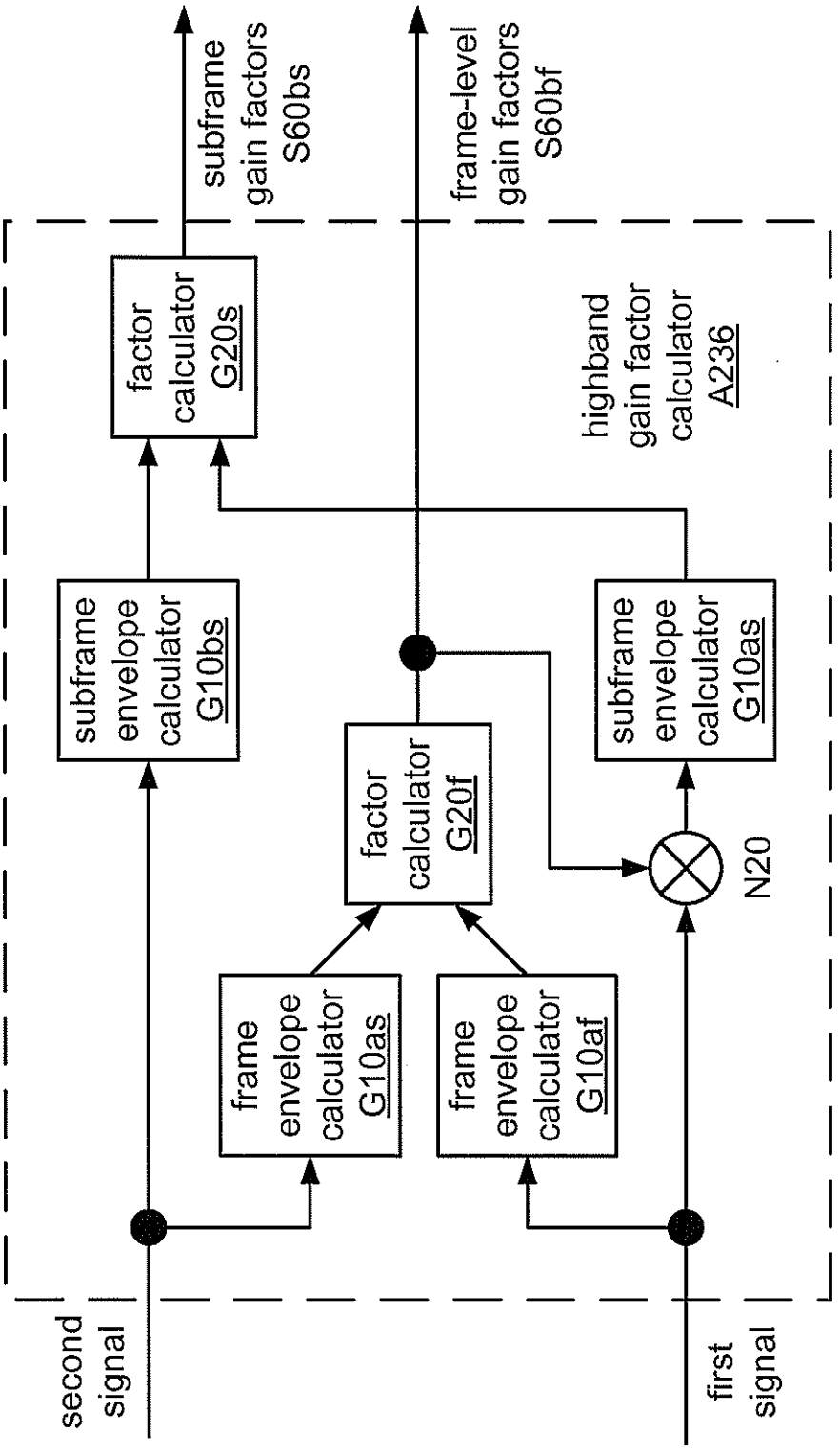

subframe gain factors S60bs
frame-level gain factors S60bf
factor calculator G20s
highband gain factor calculator A236
subframe envelope calculator G10bs
factor calculator G20f
subframe envelope calculator G10as
N20
frame envelope calculator G10as
frame envelope calculator G10af
second signal
first signal

FIG. 16

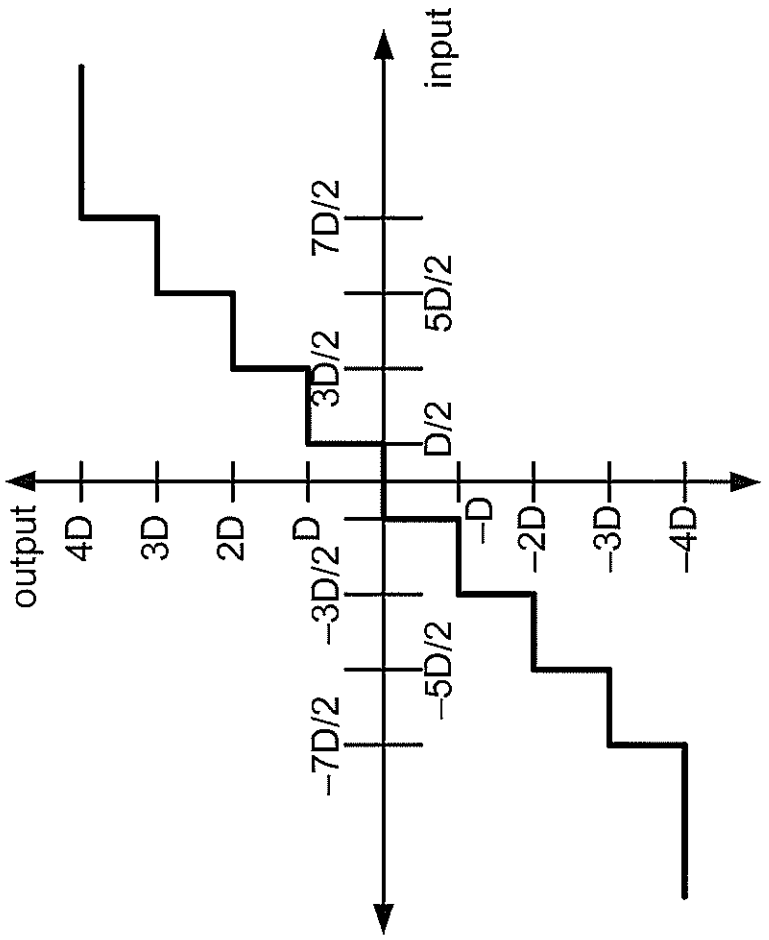



FIG. 17

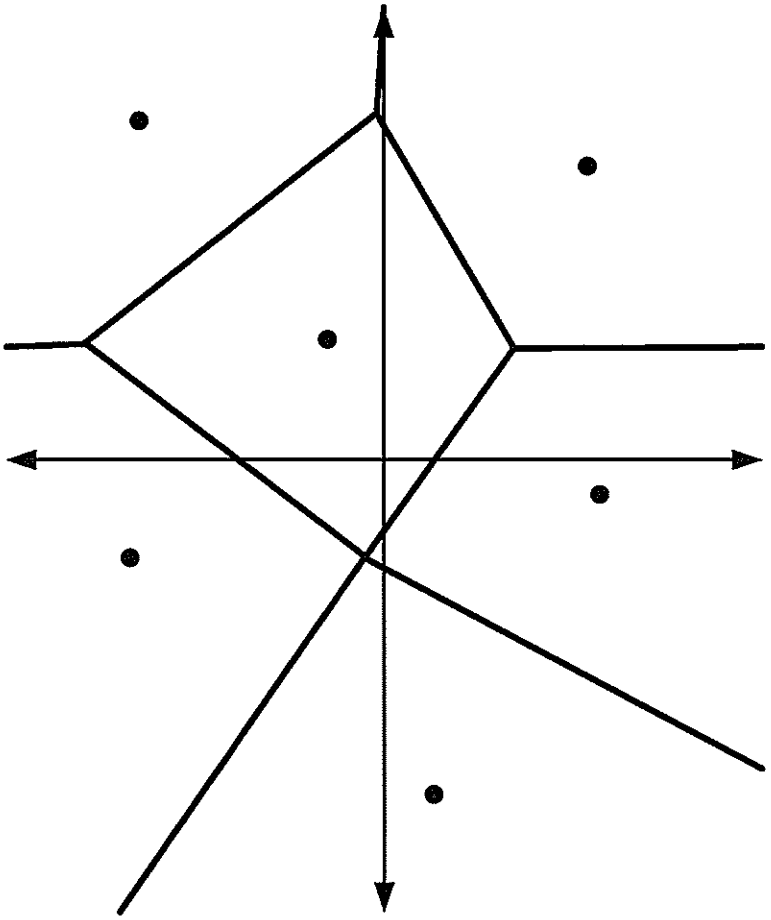


FIG. 18

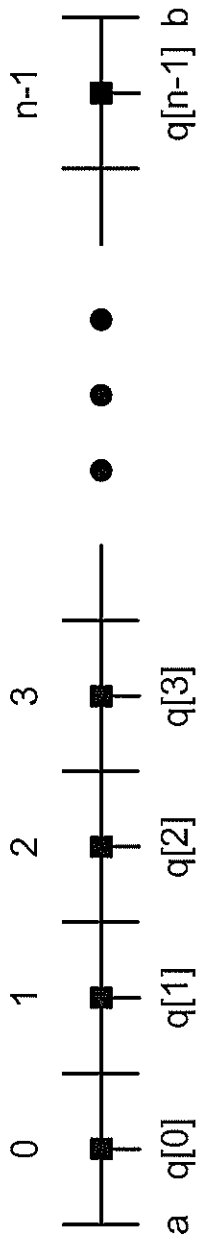



FIG. 19a

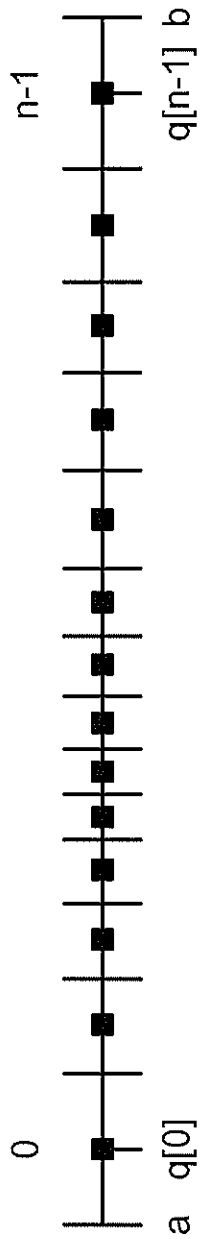



FIG. 19b

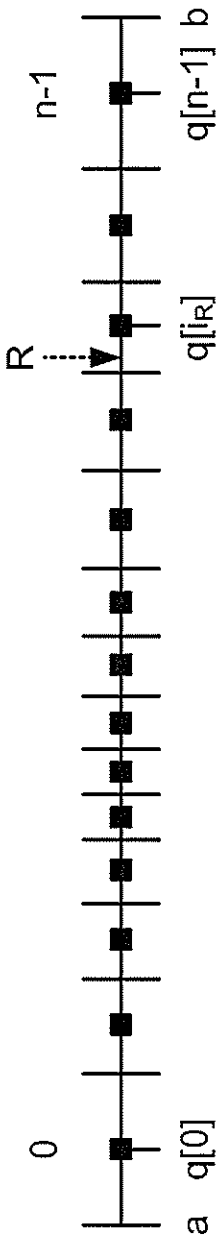



FIG. 19c

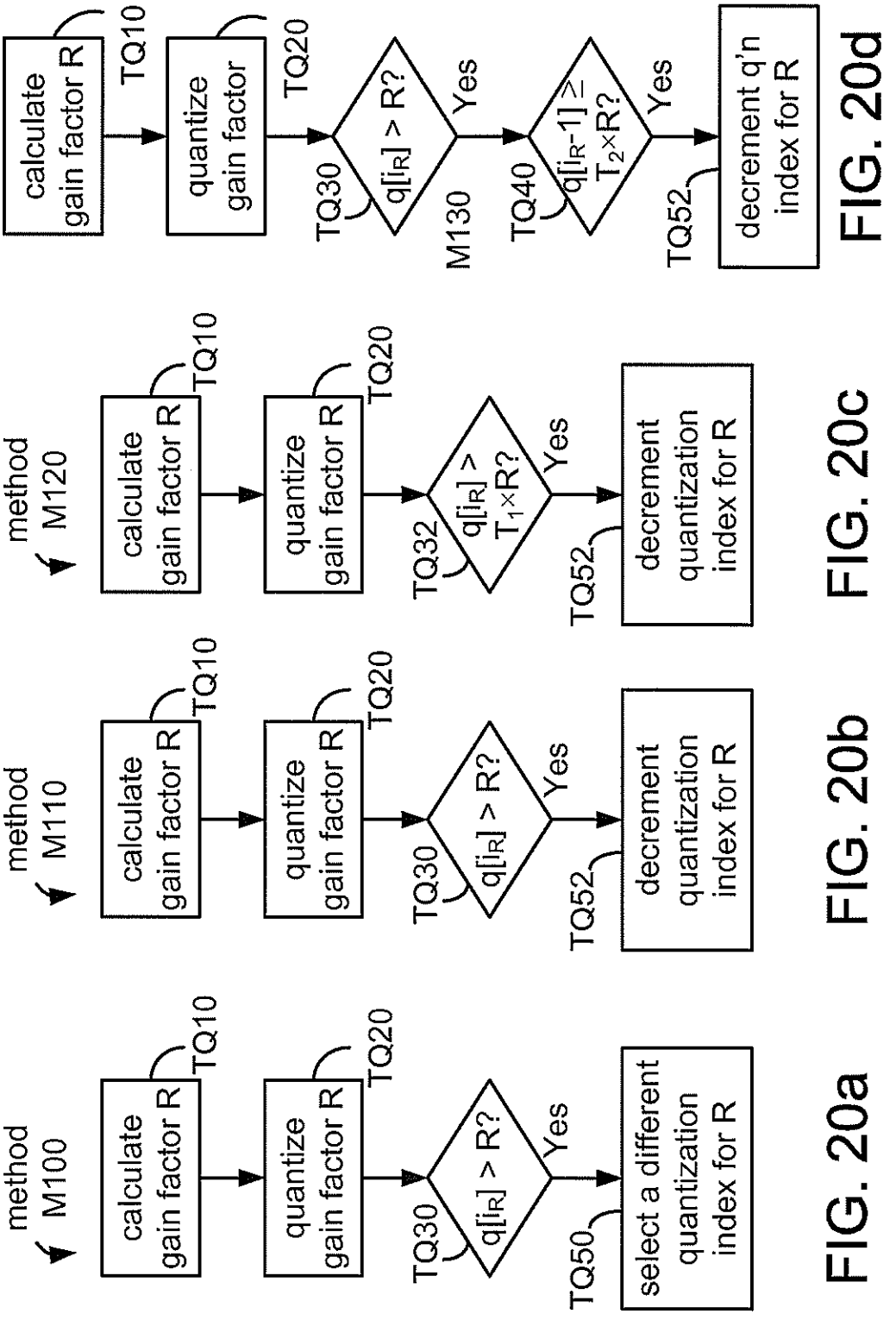



FIG. 20a FIG. 20b FIG. 20c FIG. 20d

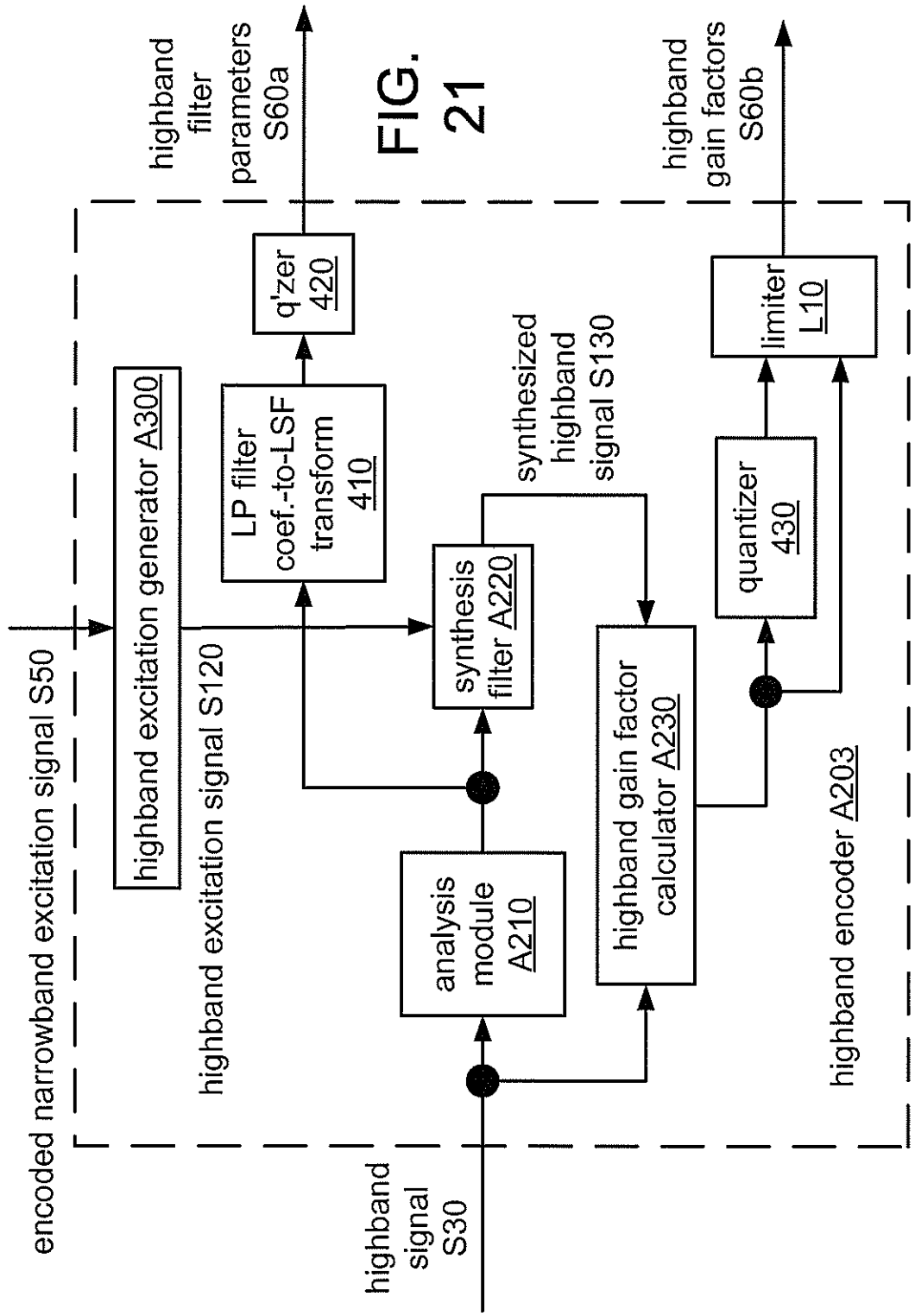

encoded narrowband excitation signal S50
highband excitation generator A300
highband excitation signal S120
LP filter coef.-to-LSF transform 410
q'zer 420
highband filter parameters S60a
synthesis filter A220
synthesized highband signal S130
analysis module A210
highband gain factor calculator A230
quantizer 430
limiter L10
highband gain factors S60b
highband signal S30
highband encoder A203

FIG. 21

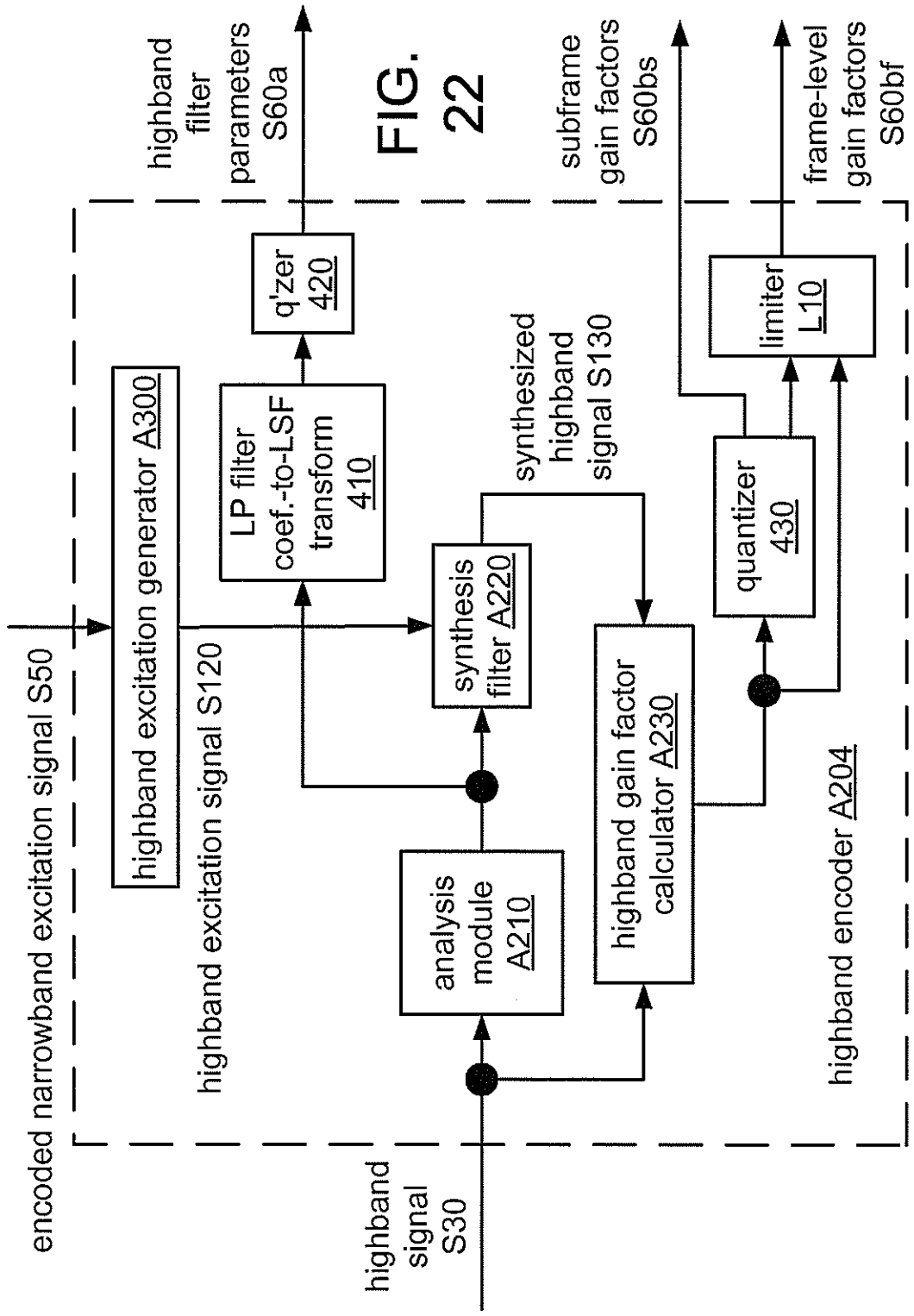

encoded narrowband excitation signal S50
highband excitation signal S120
highband signal S30
highband encoder A204
highband excitation generator A300
analysis module A210
LP filter coef.-to-LSF transform 410
q'zer 420
synthesis filter A220
highband gain factor calculator A230
quantizer 430
limiter L10
highband filter parameters S60a
synthesized highband signal S130
subframe gain factors S60bs
frame-level gain factors S60bf

FIG. 22

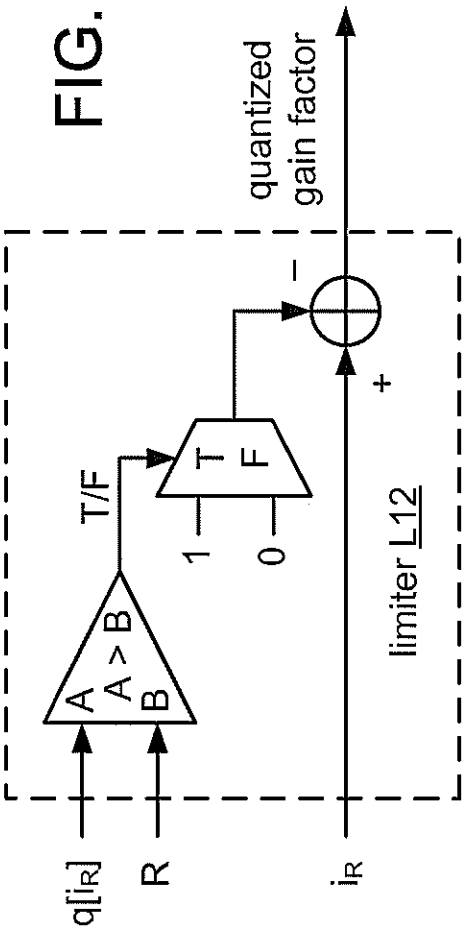



FIG. 23a

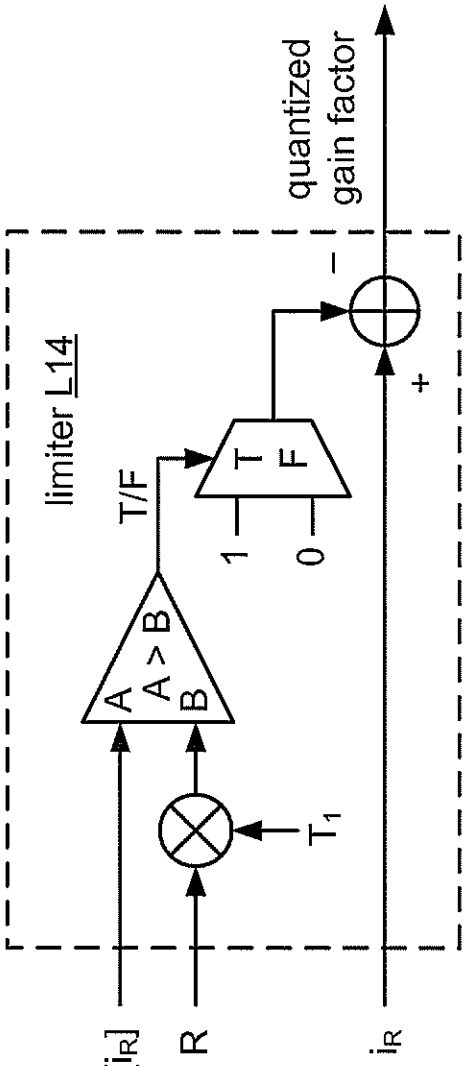



FIG. 23b

FIG. 23c

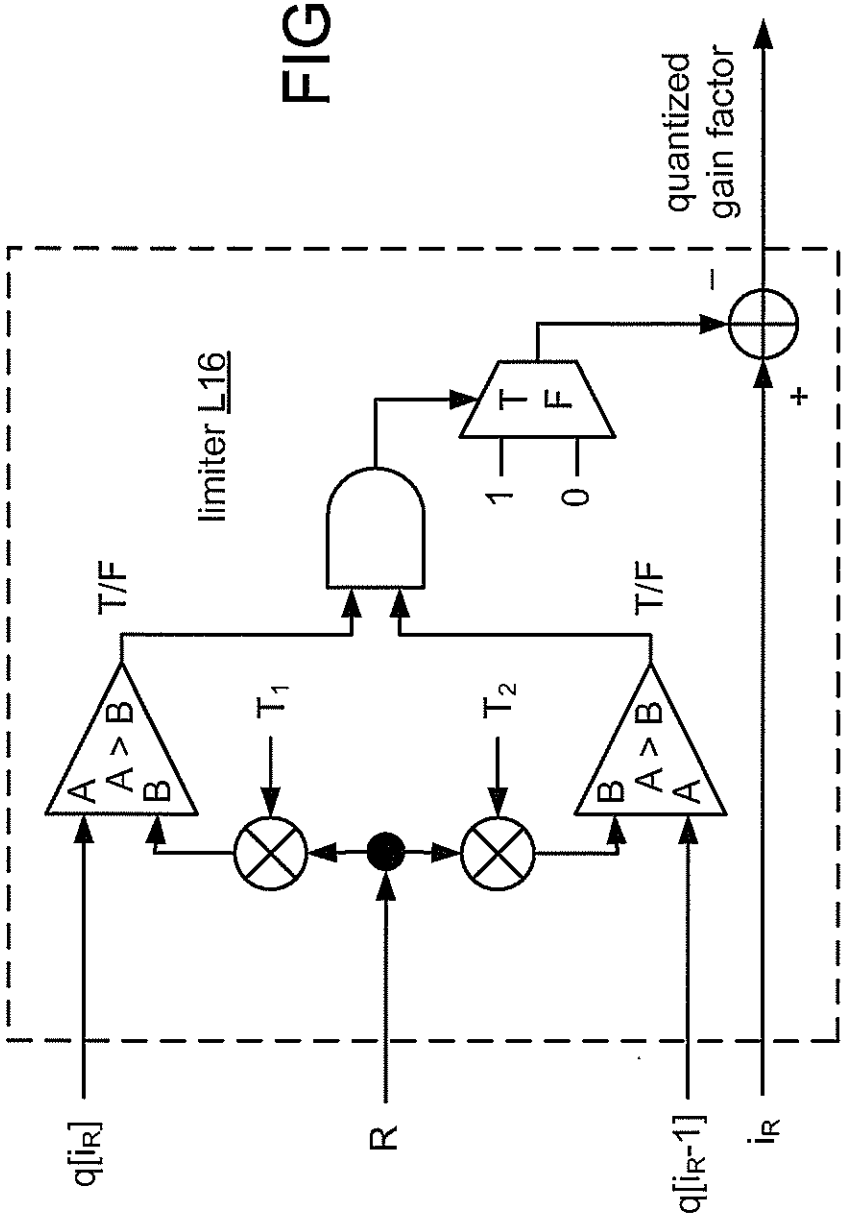
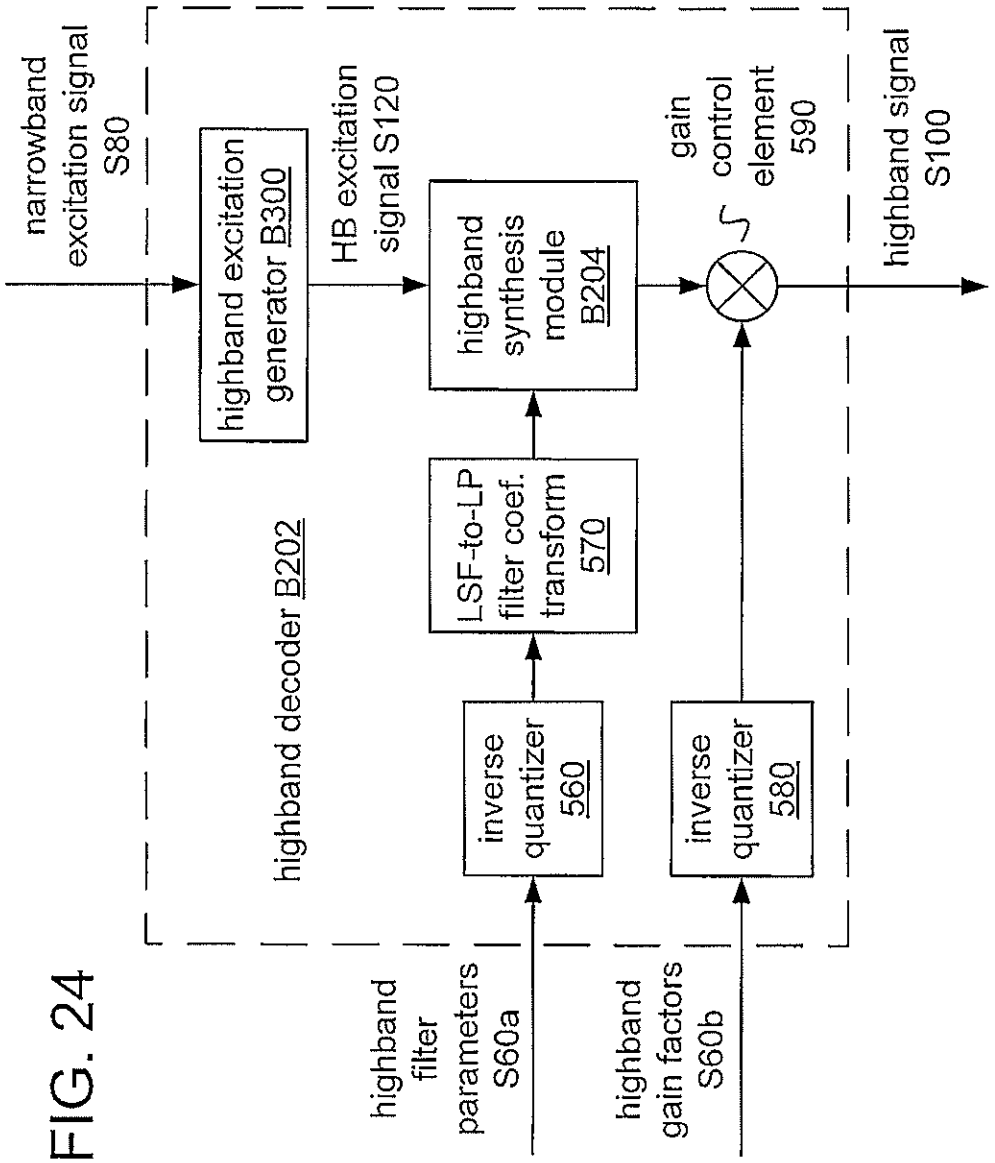

quantized gain factor
limiter L16
T/F
T/F
A > B
A
B
B > A
B
A
T
F
1
0
$T_1$
$T_2$
+
−
$q[i_R]$
R
$q[i_R-1]$
$i_R$

FIG. 24


narrowband excitation signal S80
highband excitation generator B300
HB excitation signal S120
highband synthesis module B204
gain control element 590
highband signal S100
highband decoder B202
LSF-to-LP filter coef. transform 570
inverse quantizer 560
inverse quantizer 580
highband filter parameters S60a
highband gain factors S60b