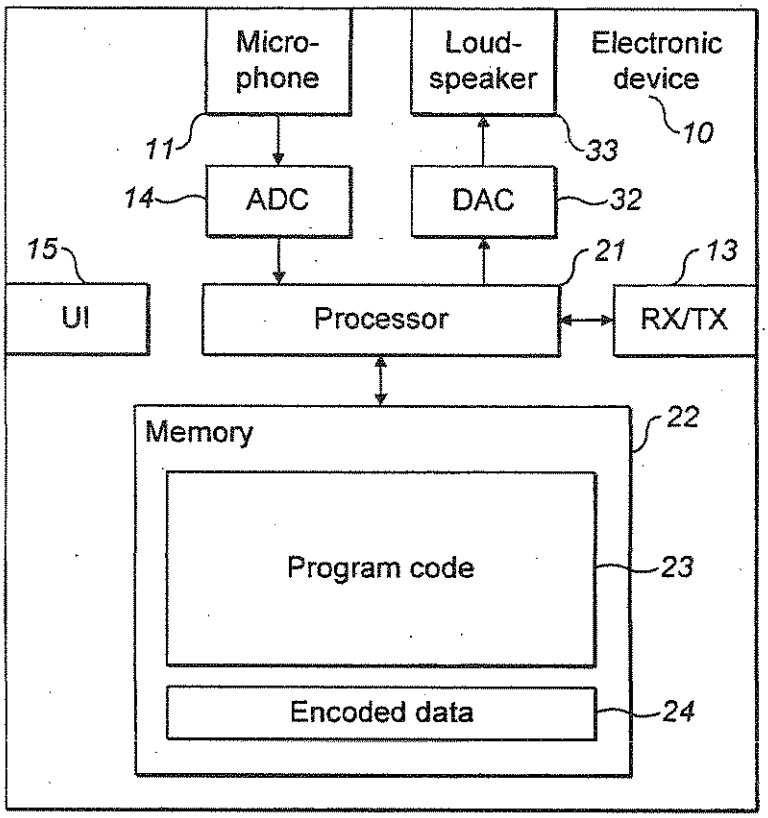


FIG. 1

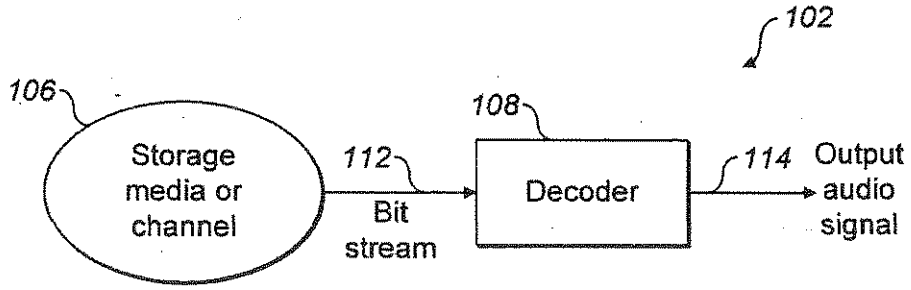


FIG. 2

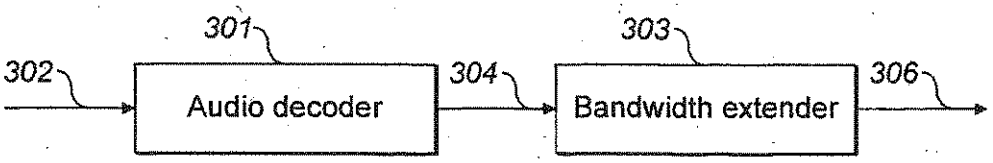


FIG. 3

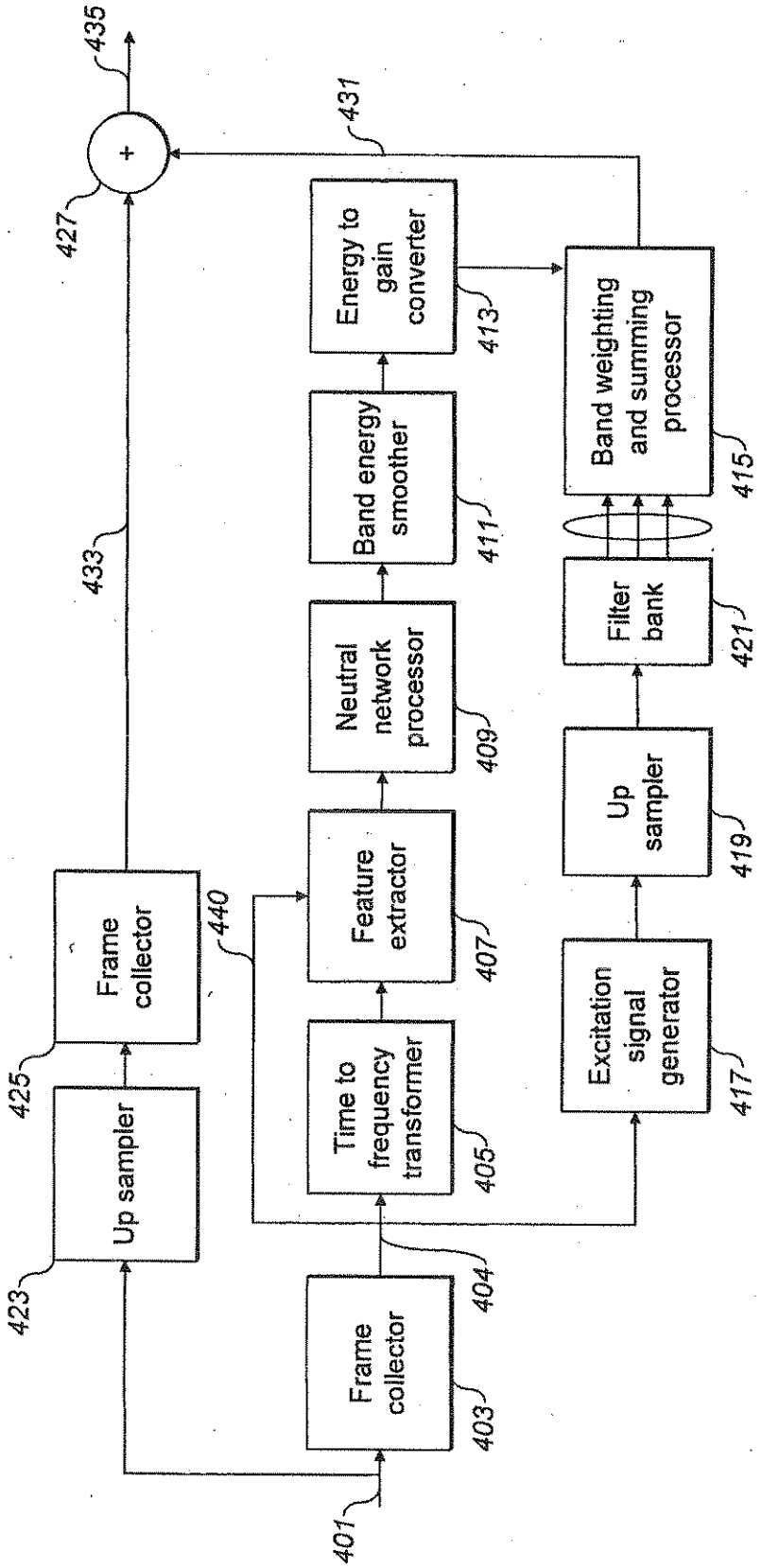

435
431
427
+
Energy to gain converter
413
Band weighting and summing processor
415
Band energy smoother
411
433
Neutral network processor
409
Filter bank
421
Feature extractor
407
Up sampler
419
Frame collector
440
425
Time to frequency transformer
405
Excitation signal generator
417
Up sampler
423
404
Frame collector
403
401

FIG. 4

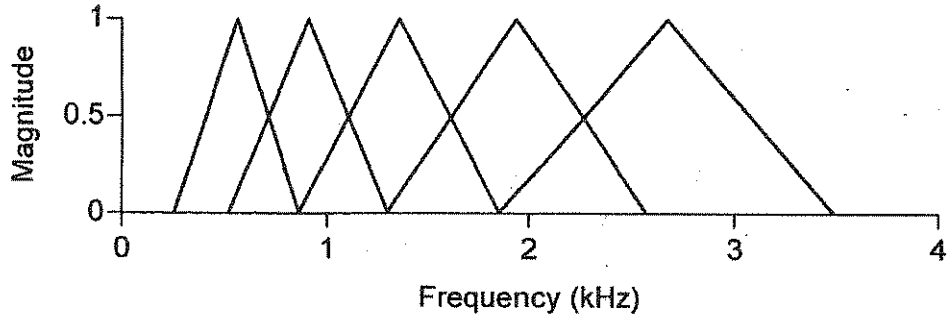


FIG. 5

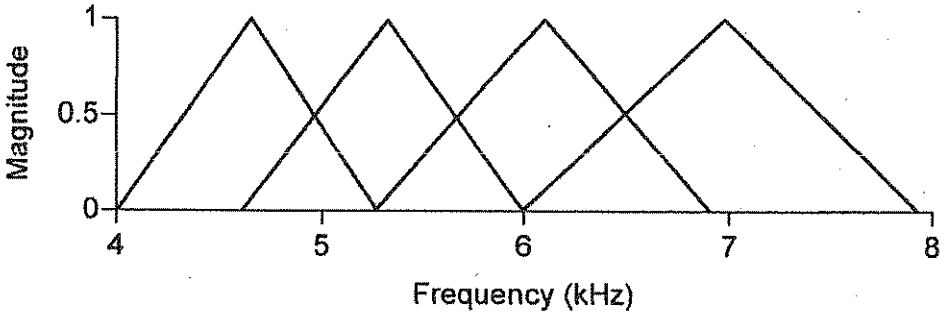


FIG. 6

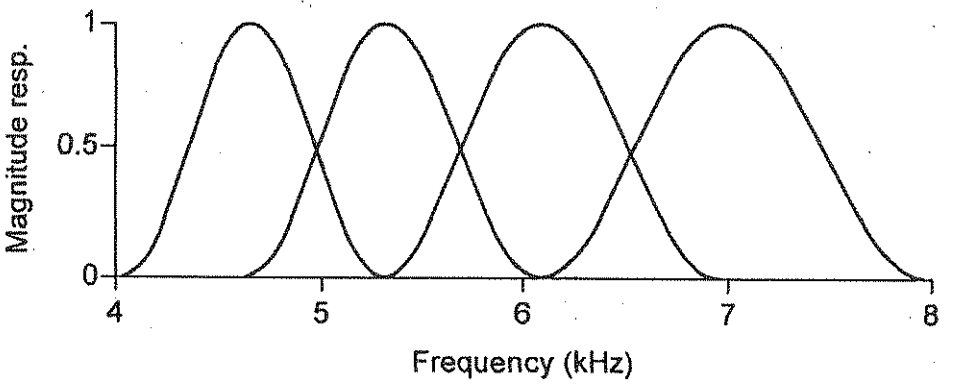


FIG. 7

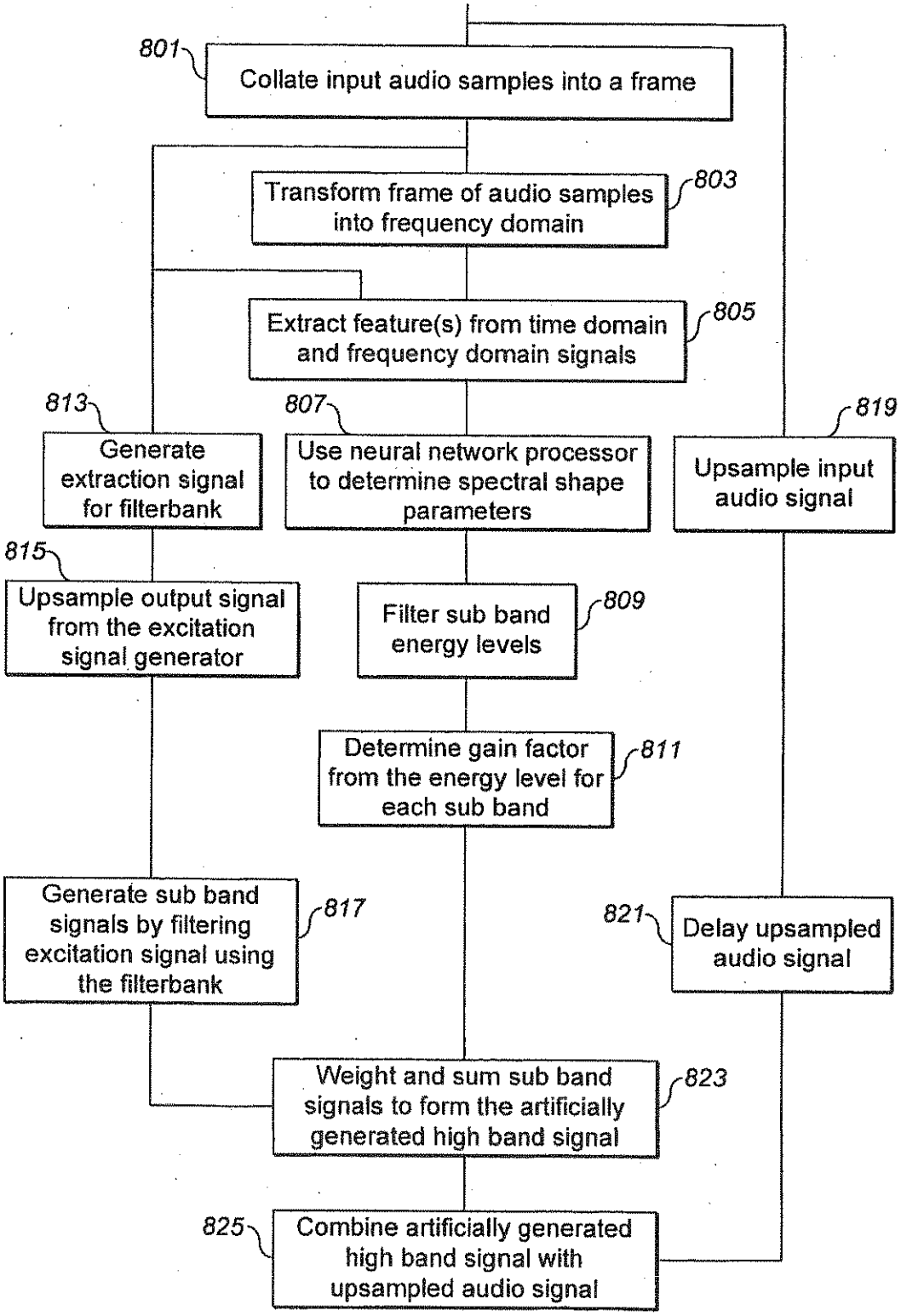

801
Collate input audio samples into a frame
803
Transform frame of audio samples into frequency domain
805
Extract feature(s) from time domain and frequency domain signals
813
Generate extraction signal for filterbank
807
Use neural network processor to determine spectral shape parameters
819
Upsample input audio signal
815
Upsample output signal from the excitation signal generator
809
Filter sub band energy levels
811
Determine gain factor from the energy level for each sub band
817
Generate sub band signals by filtering excitation signal using the filterbank
821
Delay upsampled audio signal
823
Weight and sum sub band signals to form the artificially generated high band signal
825
Combine artificially generated high band signal with upsampled audio signal

FIG. 8

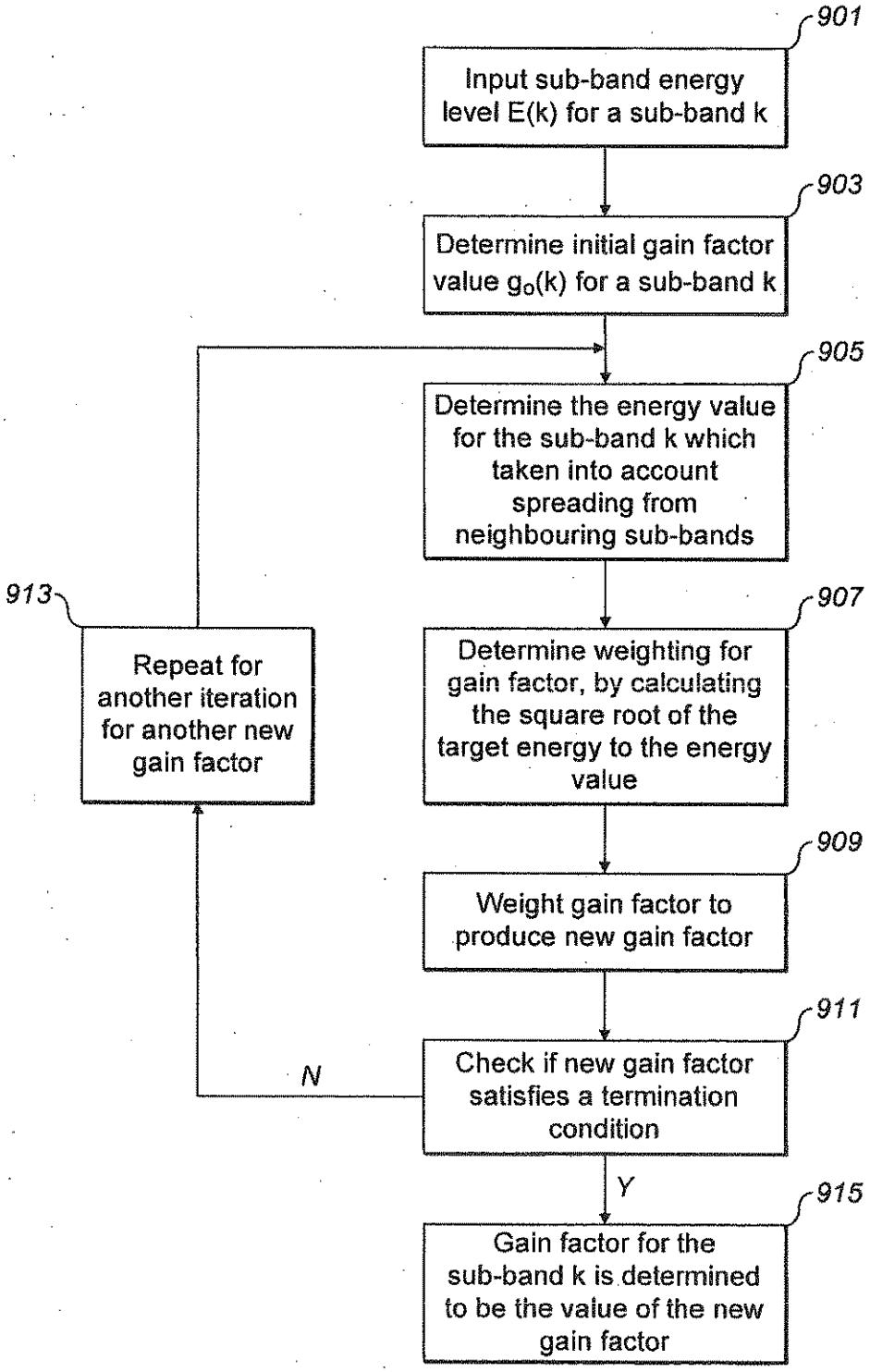

901
Input sub-band energy level E(k) for a sub-band k
903
Determine initial gain factor value $g_o(k)$ for a sub-band k
905
Determine the energy value for the sub-band k which taken into account spreading from neighbouring sub-bands
907
Determine weighting for gain factor, by calculating the square root of the target energy to the energy value
909
Weight gain factor to produce new gain factor
911
Check if new gain factor satisfies a termination condition
N
913
Repeat for another iteration for another new gain factor
Y
915
Gain factor for the sub-band k is determined to be the value of the new gain factor

FIG. 9

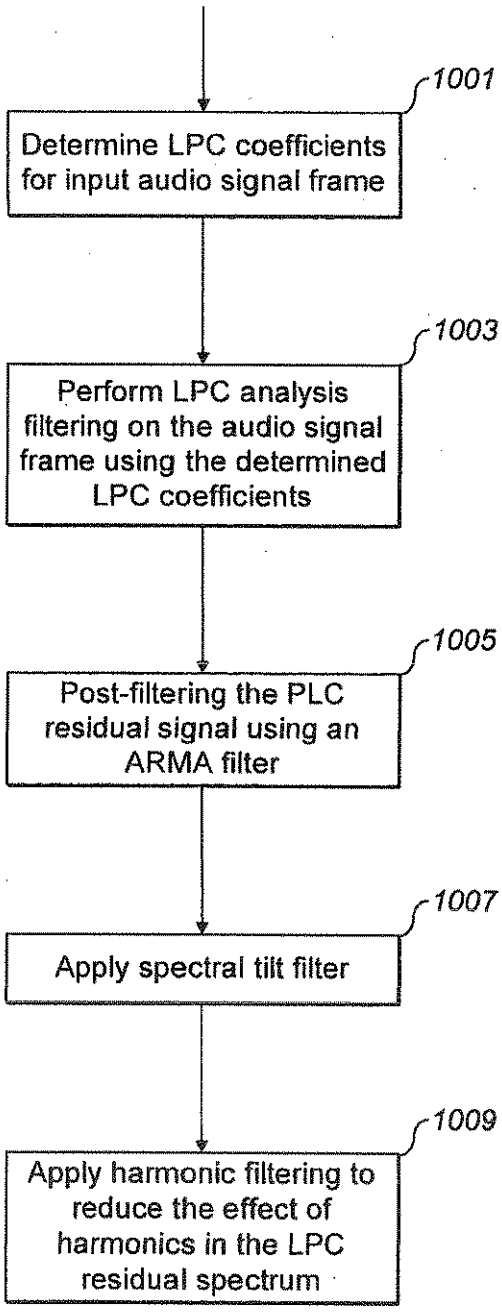

1001
Determine LPC coefficients for input audio signal frame
1003
Perform LPC analysis filtering on the audio signal frame using the determined LPC coefficients
1005
Post-filtering the PLC residual signal using an ARMA filter
1007
Apply spectral tilt filter
1009
Apply harmonic filtering to reduce the effect of harmonics in the LPC residual spectrum

FIG. 10