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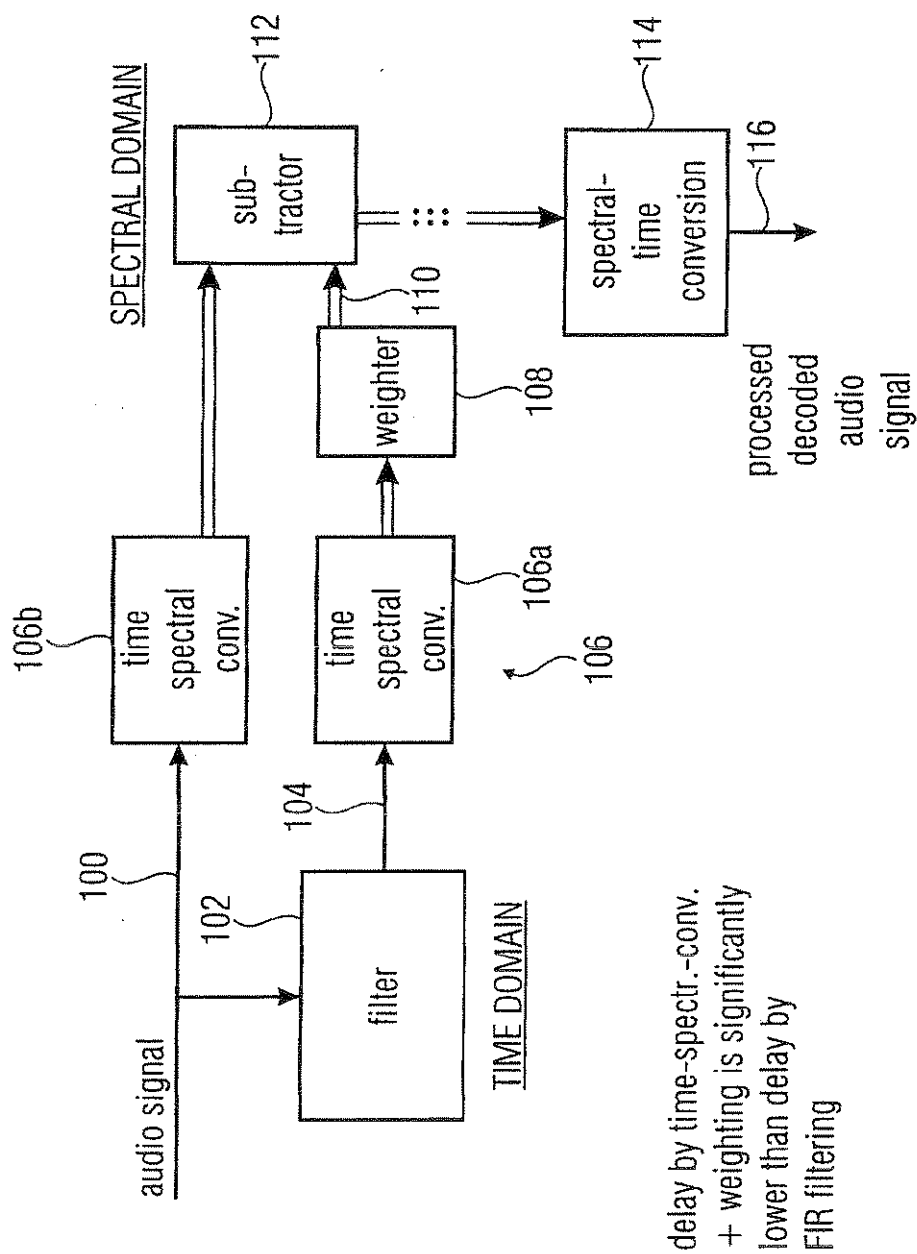


FIG 1A

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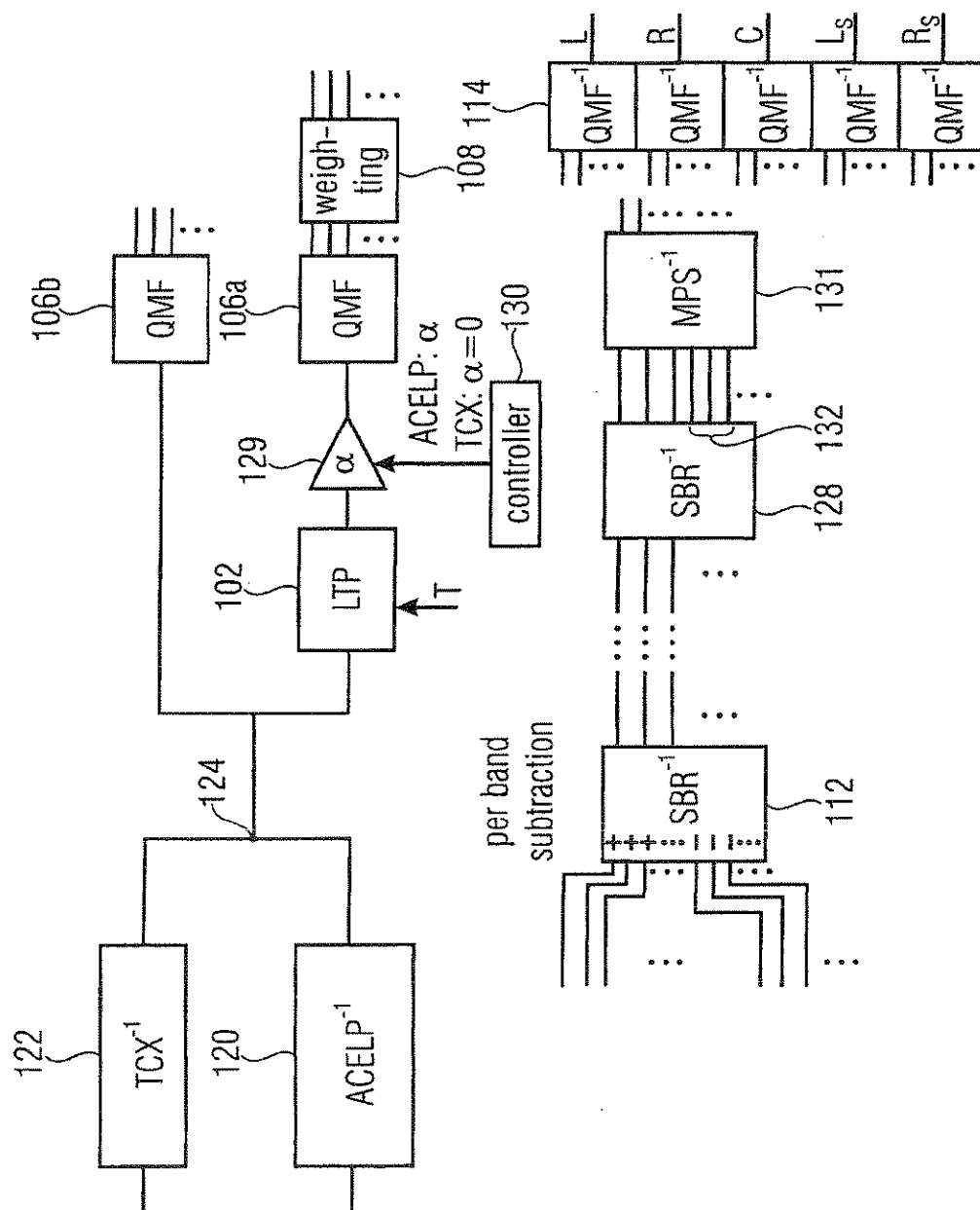


FIG 1B

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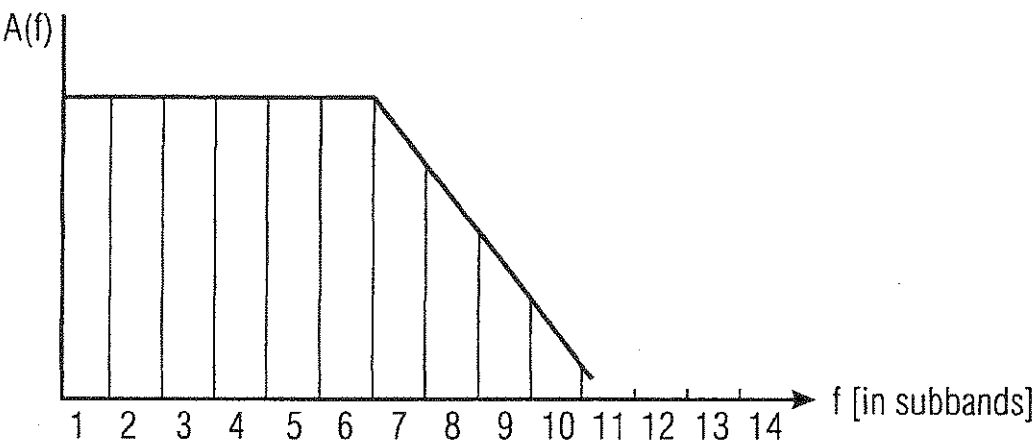


FIG 2A

subband no.	weighting coeff.
1	1
⋮	⋮
6	1
7	0.8
8	0.6
9	0.4
10	0.2
11	0
12	0
13	0
14	0

FIG 2B

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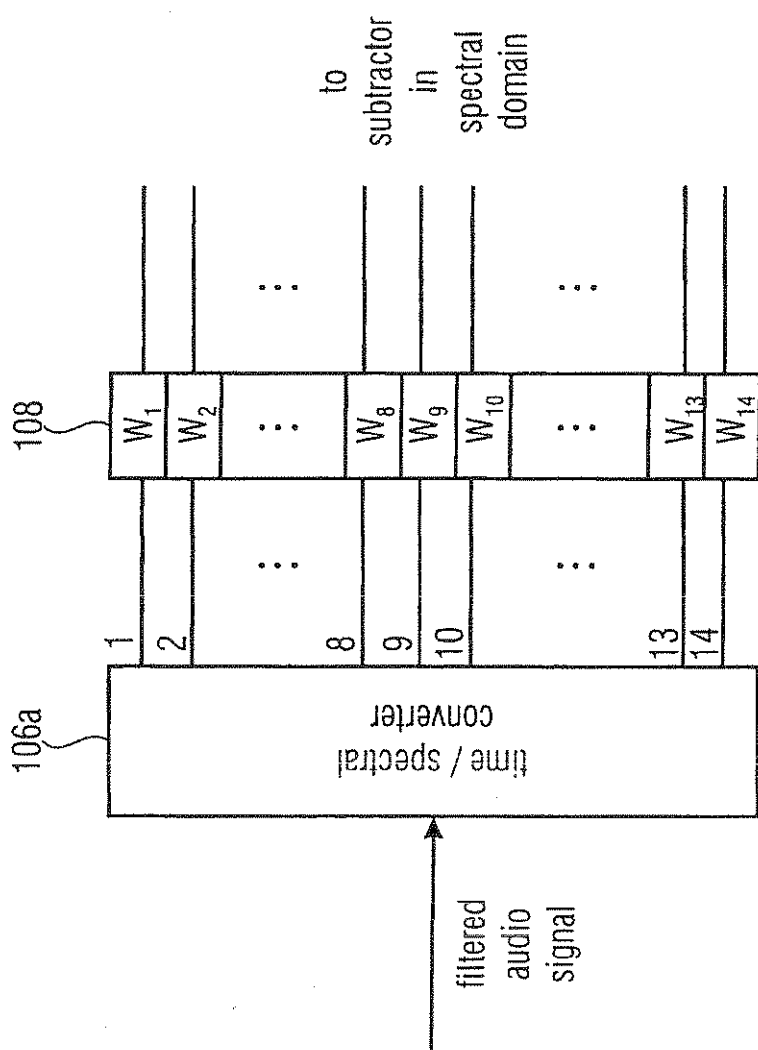
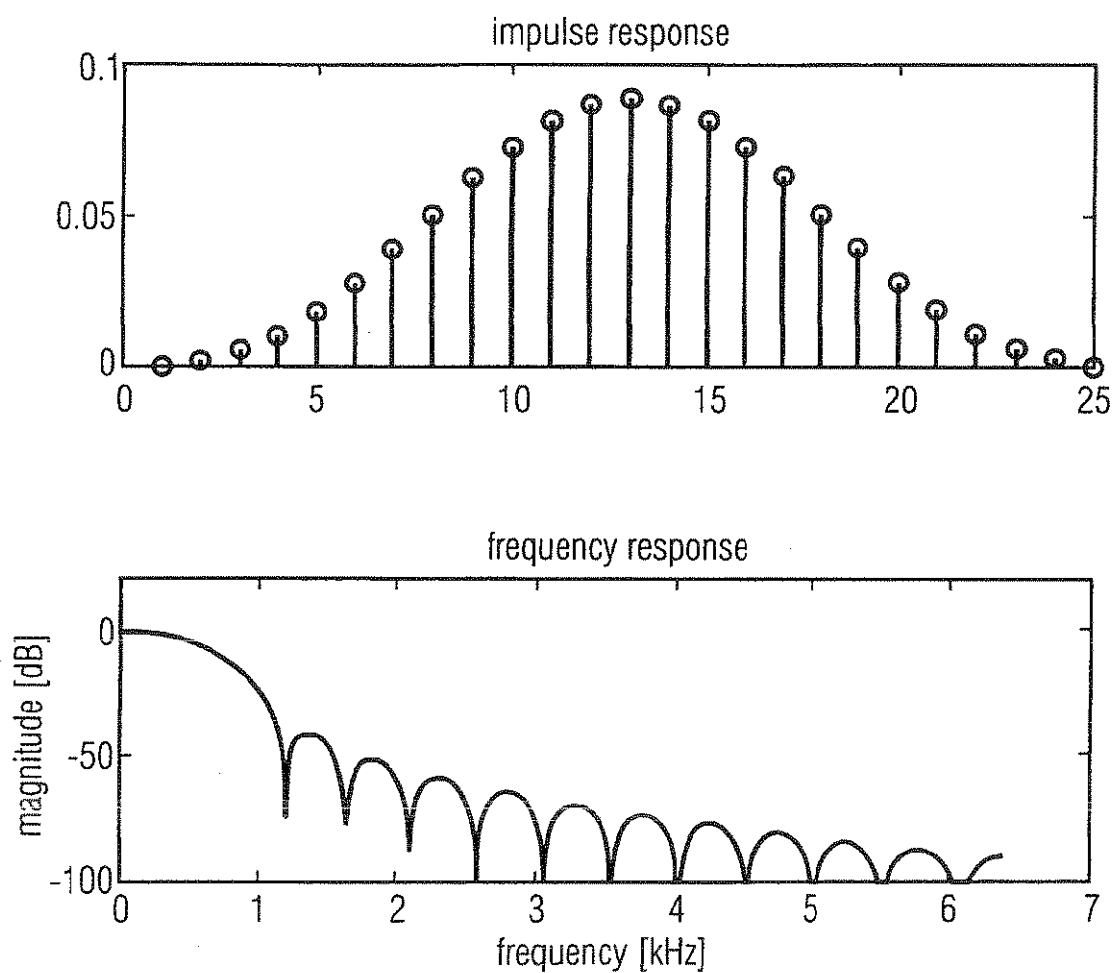


FIG 2C

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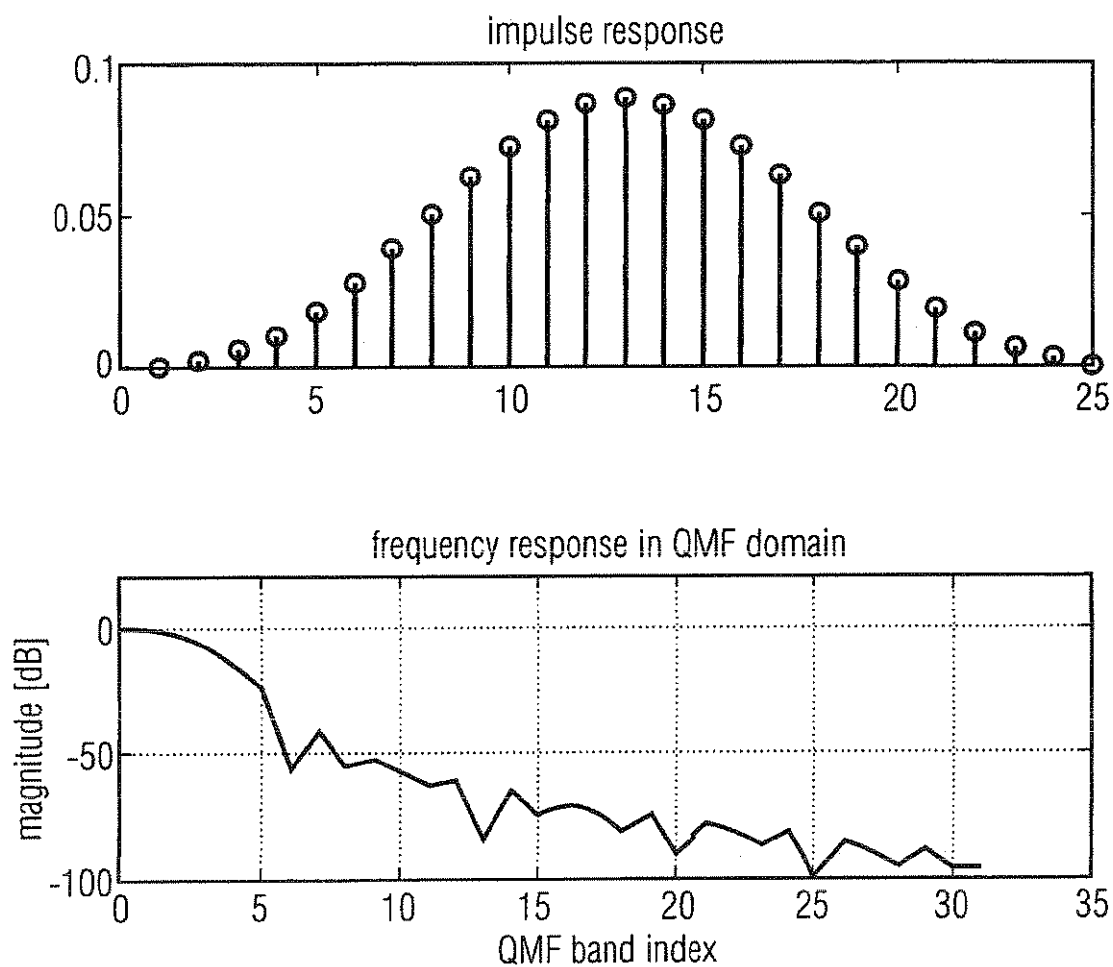


impulse response and frequency response
of the low pass filter in AMR-WB+

FIG 3

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sampling frequency: 12.8 kHz
QMF band resolution: 400 Hz
32 QMF bands



impulse response and frequency response
in the QMF domain

FIG 4

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$W[32] = \{ 1.000040f, 0.917218f, 0.702561f, 0.438018f, 0.208838f, 0.063451f, 0.001553f, \\
0.008564f, 0.001777f, 0.002472f, 0.001370f, 0.000718f, \\
0.000926f, 0.000060f, 0.000554f, 0.000182f, 0.000270f, 0.000229f, 0.000080f, 0.000191f, \\
0.000030f, 0.000122f, 0.000082f, 0.000045f, 0.000081f, \\
0.000010f, 0.000052f, 0.000035f, 0.000017f, 0.000037f, 0.000016f, 0.000015f \};$

weights for 32 QMF subbands

FIG 5

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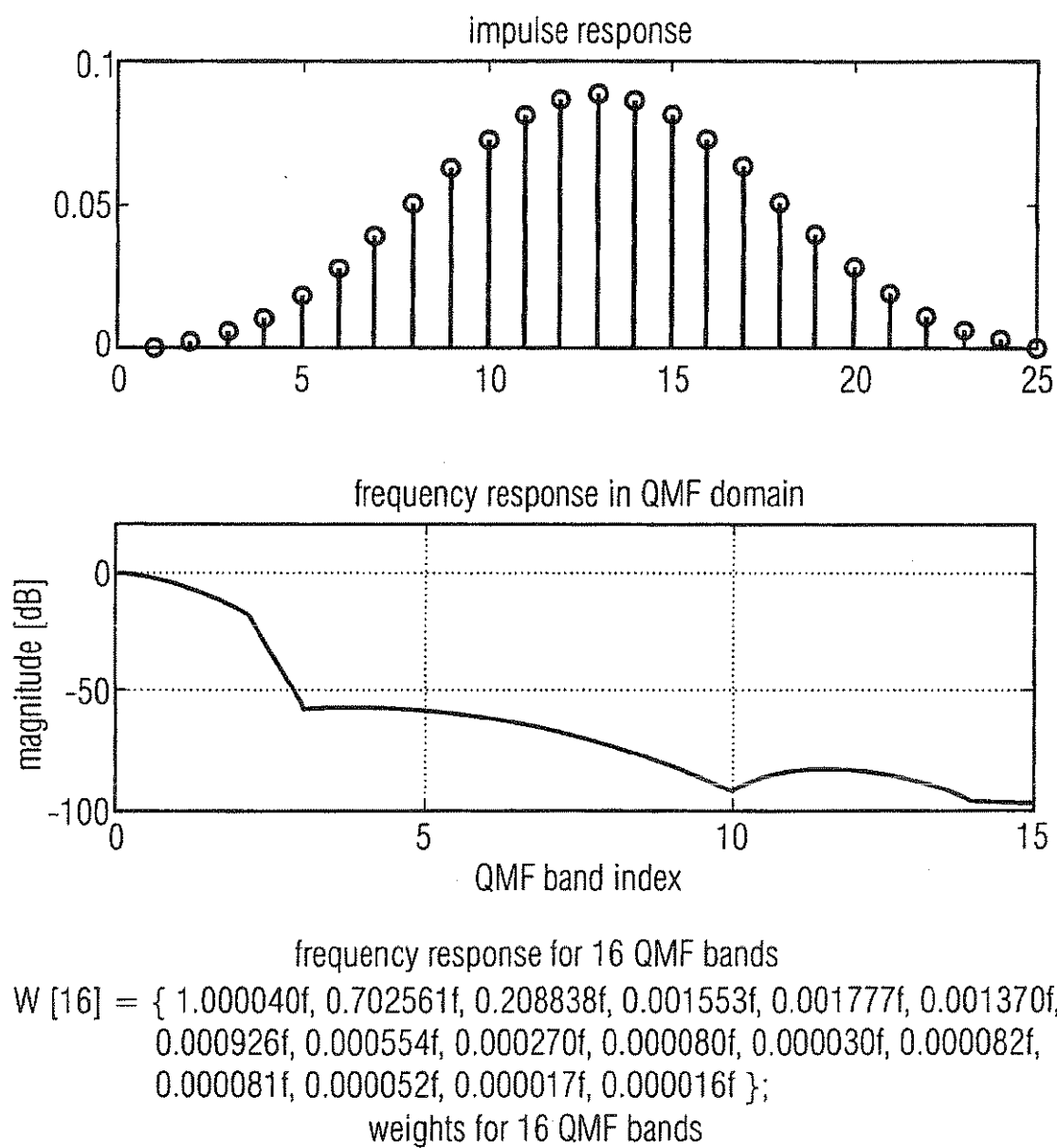
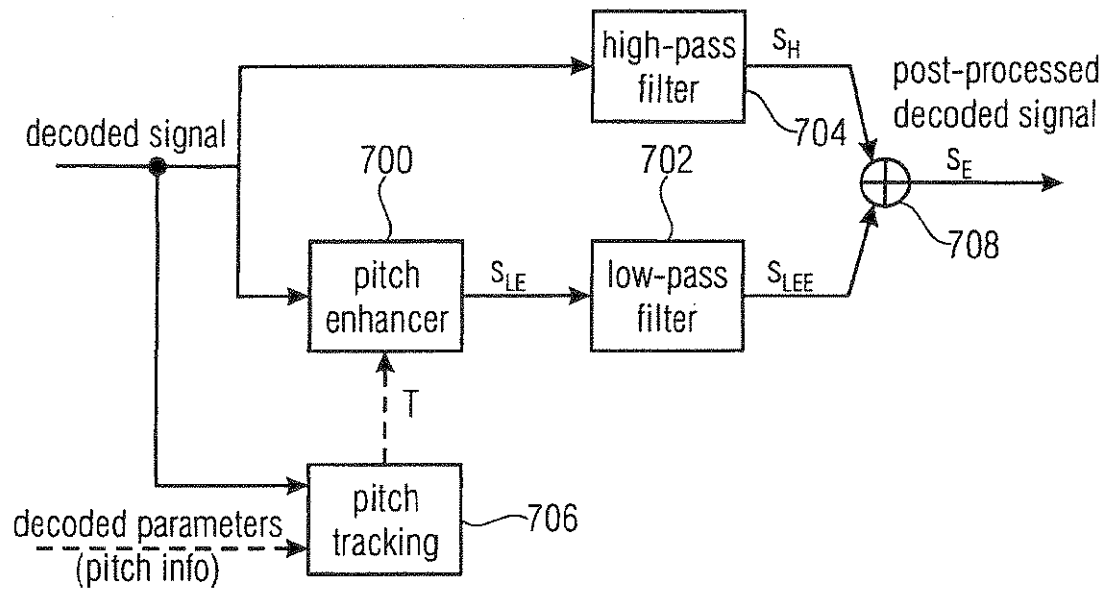
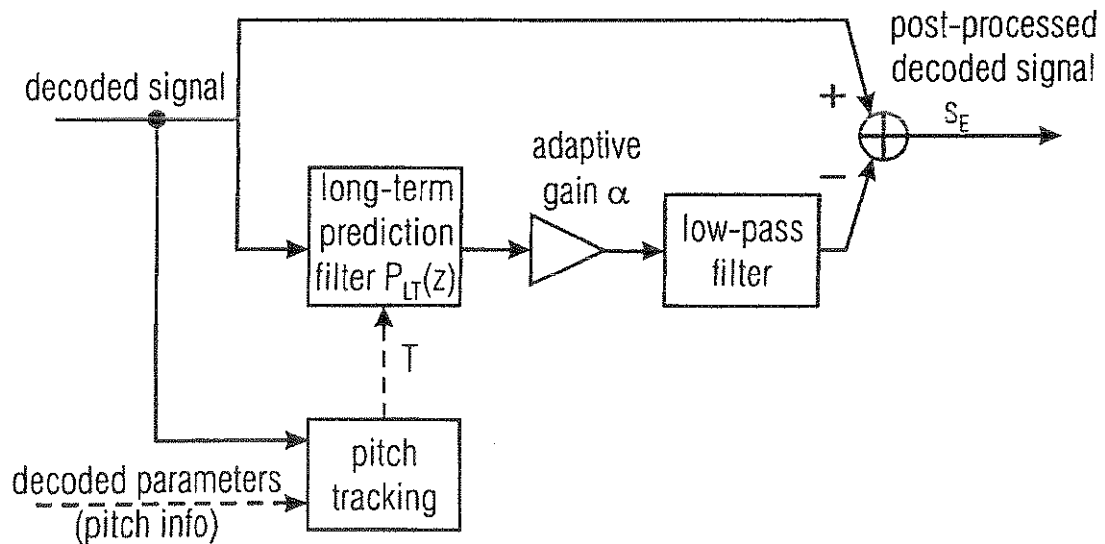


FIG 6

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block diagram of the low frequency pitch enhancer

FIG 7
(PRIOR ART)

implemented post-processing configuration

FIG 8
(PRIOR ART)

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$$H_E(z) = (1-\alpha) + \frac{\alpha}{2} z^T + \frac{\alpha}{2} z^{-T}$$

$$s_{LE}(n) = (1-\alpha)\hat{s}(n) + \frac{\alpha}{2}\hat{s}(n-T) + \frac{\alpha}{2}\hat{s}(n+T)$$

$$\begin{aligned} s_E(n) &= \hat{s}(n) * h_{HP}(n) + s_{LE}(n) * h_{LP}(n) \\ &= \hat{s}(n) * h_{HP}(n) + \left((1-\alpha)\hat{s}(n) + \frac{\alpha}{2}\hat{s}(n-T) + \frac{\alpha}{2}\hat{s}(n+T) \right) * h_{LP}(n) \\ &= \hat{s}(n) * h_{HP}(n) + \hat{s}(n) * h_{LP}(n) - \left(\alpha\hat{s}(n) - \frac{\alpha}{2}\hat{s}(n-T) - \frac{\alpha}{2}\hat{s}(n+T) \right) * h_{LP}(n) \\ &= \hat{s}(n) - \alpha \left(\hat{s}(n) - \frac{1}{2}\hat{s}(n-T) - \frac{1}{2}\hat{s}(n+T) \right) * h_{LP}(n) \\ &= \hat{s}(n) - \alpha e_{LT}(n) * h_{LP}(n) \\ P_{LT}(z) &= 1 - 0.5 z^T - 0.5 z^{-T} \end{aligned}$$

FIG 9
(PRIOR ART)

low delay implementation of
long term prediction filter:

$\hat{s}(n+T)$ is replaced by $\hat{s}$

$$\begin{aligned} s_E(n) &= \hat{s}(n) - \alpha \left[\hat{s}(n) - \frac{1}{2}\hat{s}(n-T) - \frac{1}{2}\hat{s}(n) \right] \\ &= \hat{s}(n) - \frac{\alpha}{2} [\hat{s}(n) - \hat{s}(n-T)] \end{aligned}$$

$$P_{LT}(z) = 0.5 - 0.5 z^T$$

FIG 10