FIG 1

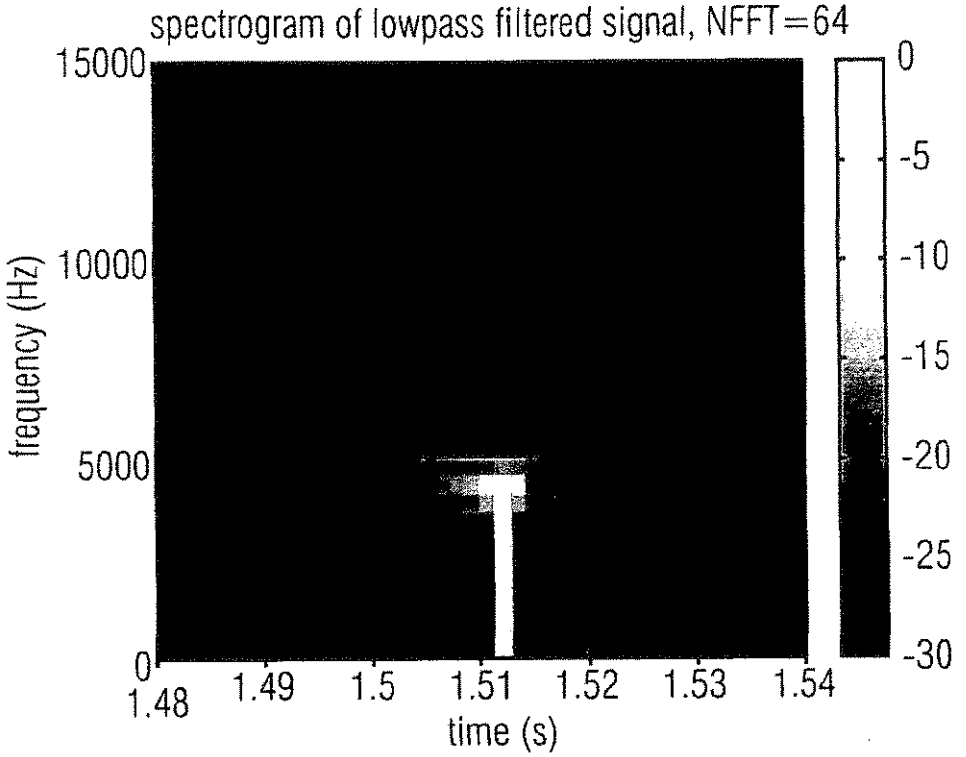

spectrogram of lowpass filtered signal, NFFT=64
15000
10000
5000
0
frequency (Hz)
1.48
1.49
1.5
1.51
1.52
1.53
1.54
time (s)
0
-5
-10
-15
-20
-25
-30

FIG 2

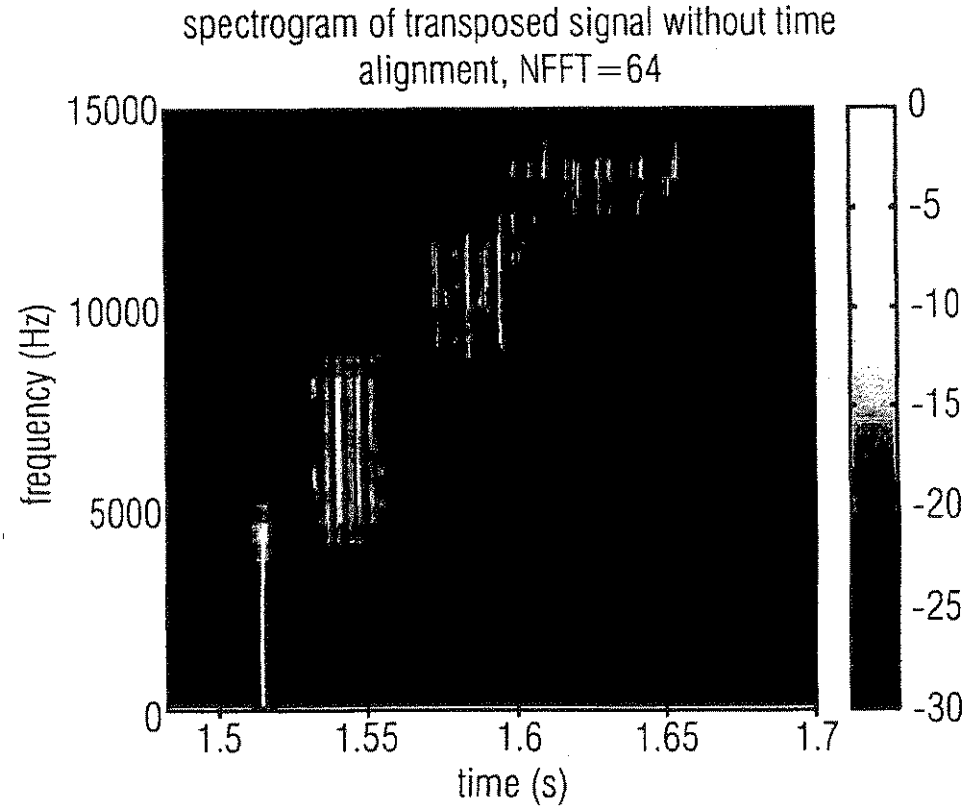

spectrogram of transposed signal without time alignment, NFFT=64
15000
10000
5000
0
frequency (Hz)
1.5
1.55
1.6
1.65
1.7
time (s)
0
-5
-10
-15
-20
-25
-30

FIG 3

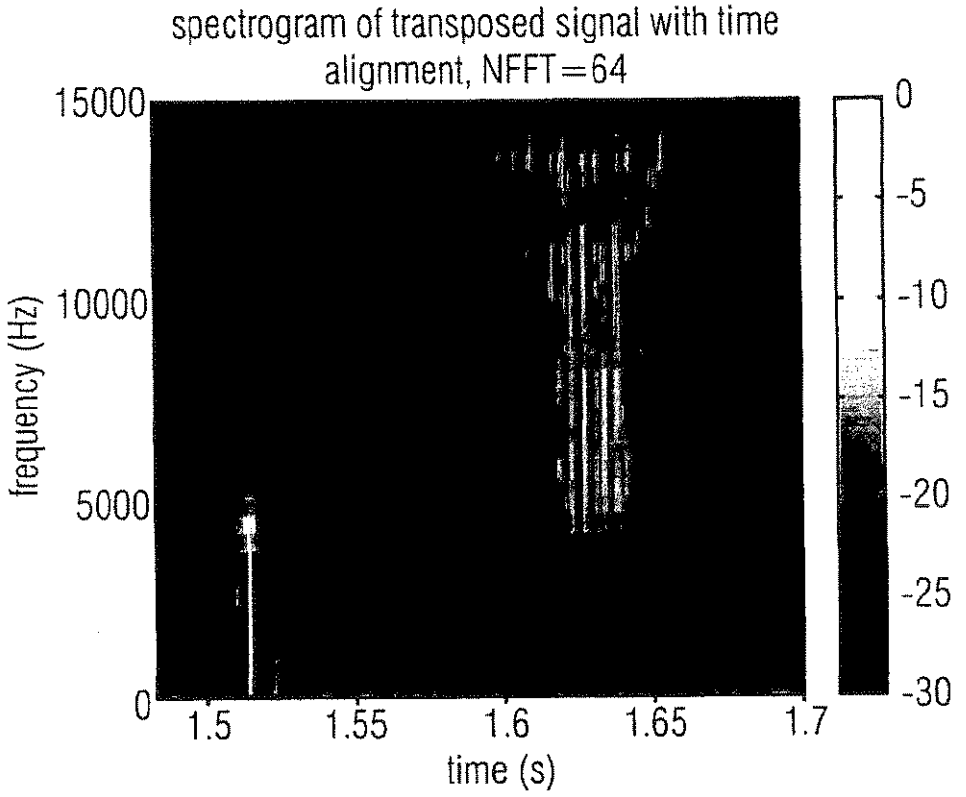

spectrogram of transposed signal with time alignment, NFFT=64
15000
10000
5000
0
frequency (Hz)
1.5
1.55
1.6
1.65
1.7
time (s)
0
-5
-10
-15
-20
-25
-30

FIG 4

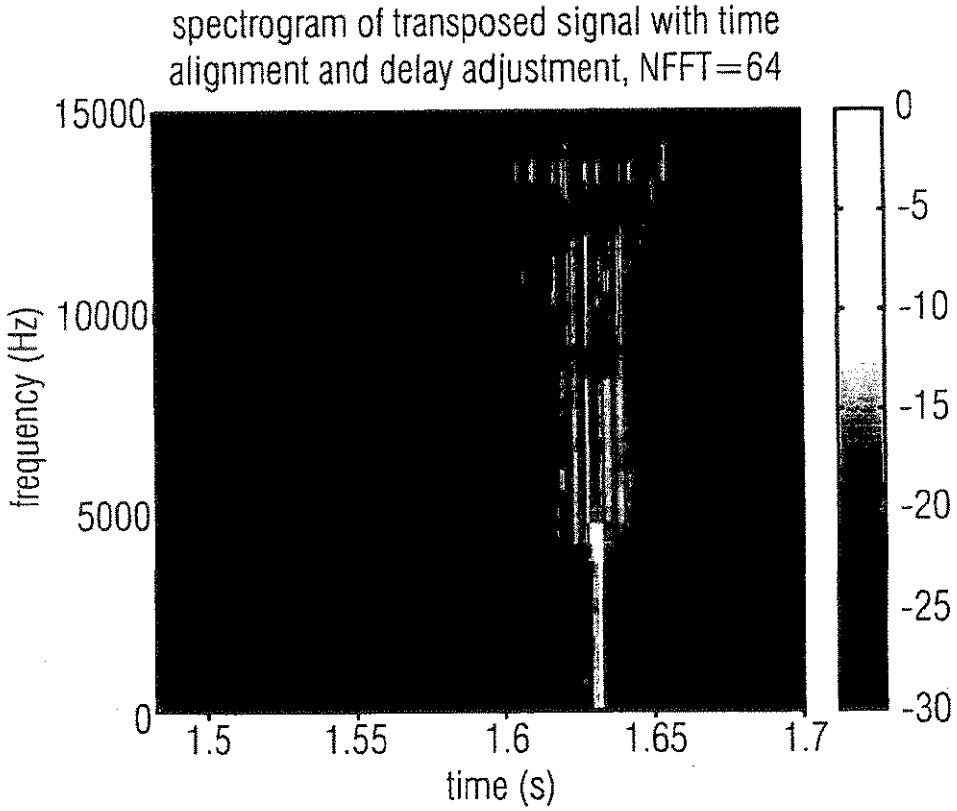

spectrogram of transposed signal with time alignment and delay adjustment, NFFT=64
15000
10000
5000
0
frequency (Hz)
1.5
1.55
1.6
1.65
1.7
time (s)
0
-5
-10
-15
-20
-25
-30

FIG 5

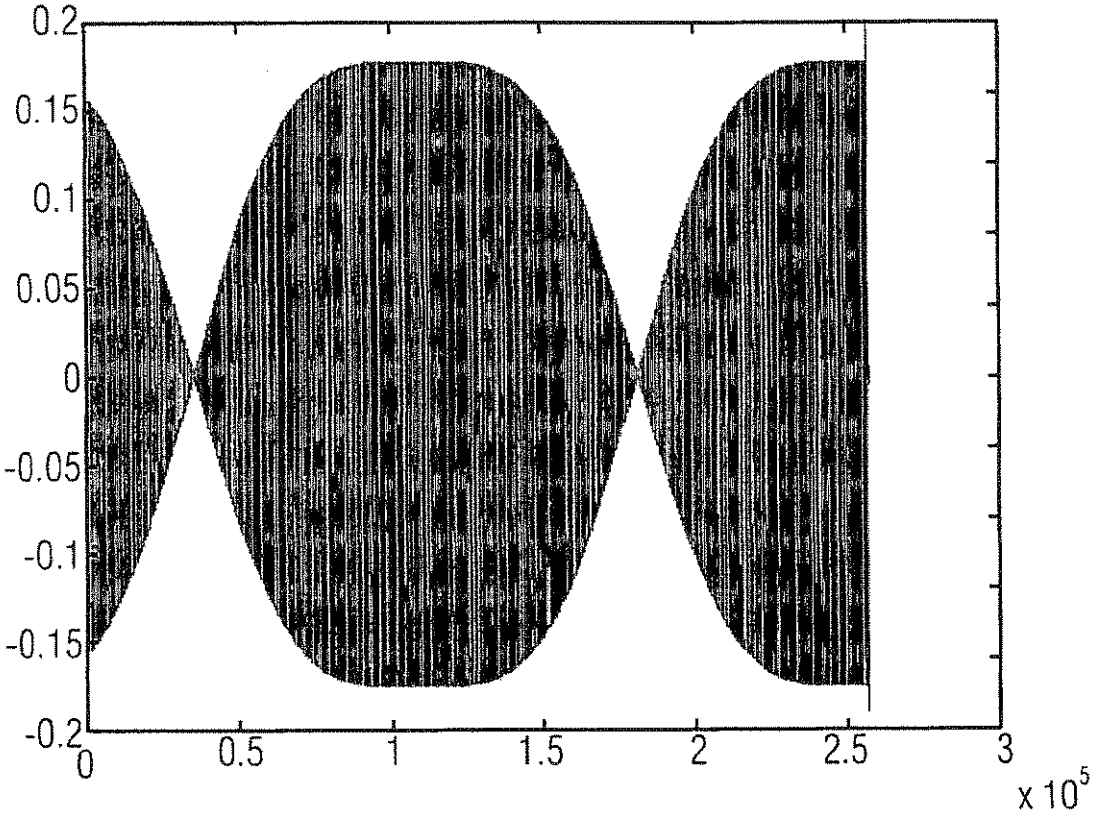
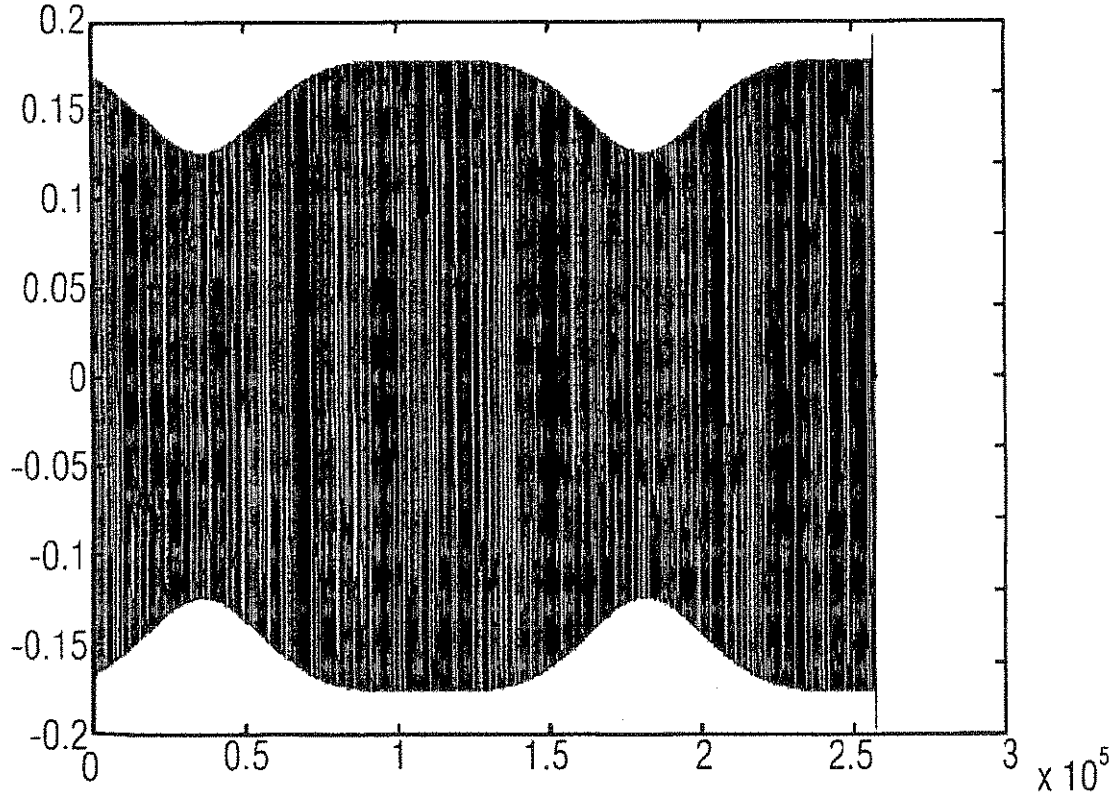

0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
0.5
1
1.5
2
2.5
3
x 10^5

FIG 6


0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
0.5
1
1.5
2
2.5
3
x 10^5

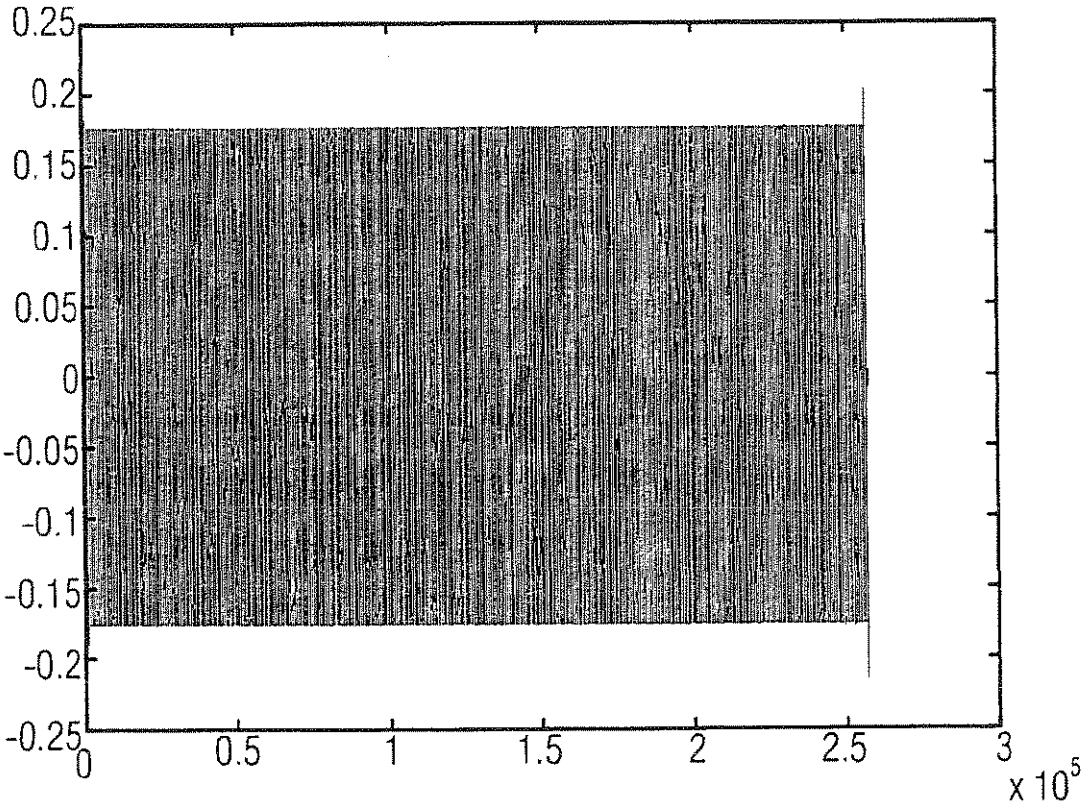


FIG 7

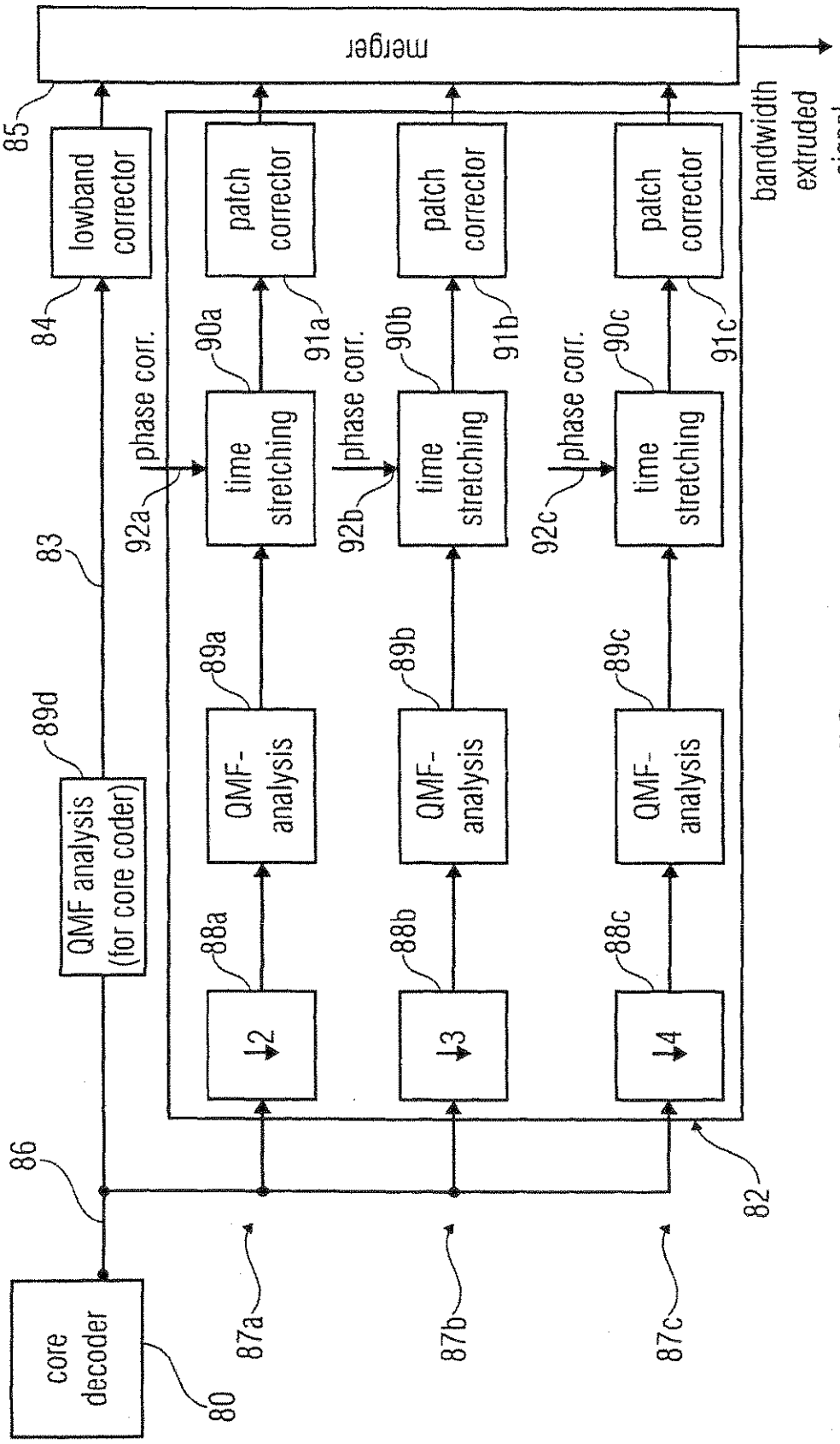

merger
bandwidth extruded signal
85
lowband corrector
84
patch corrector
91a
patch corrector
91b
patch corrector
91c
phase corr.
90a
phase corr.
90b
phase corr.
90c
92a
92b
92c
time stretching
time stretching
time stretching
83
89a
89b
89c
89d
QMF-analysis
QMF-analysis
QMF-analysis
QMF analysis (for core coder)
88a
88b
88c
↓2
↓3
↓4
86
82
87a
87b
87c
core decoder
80

FIG 8

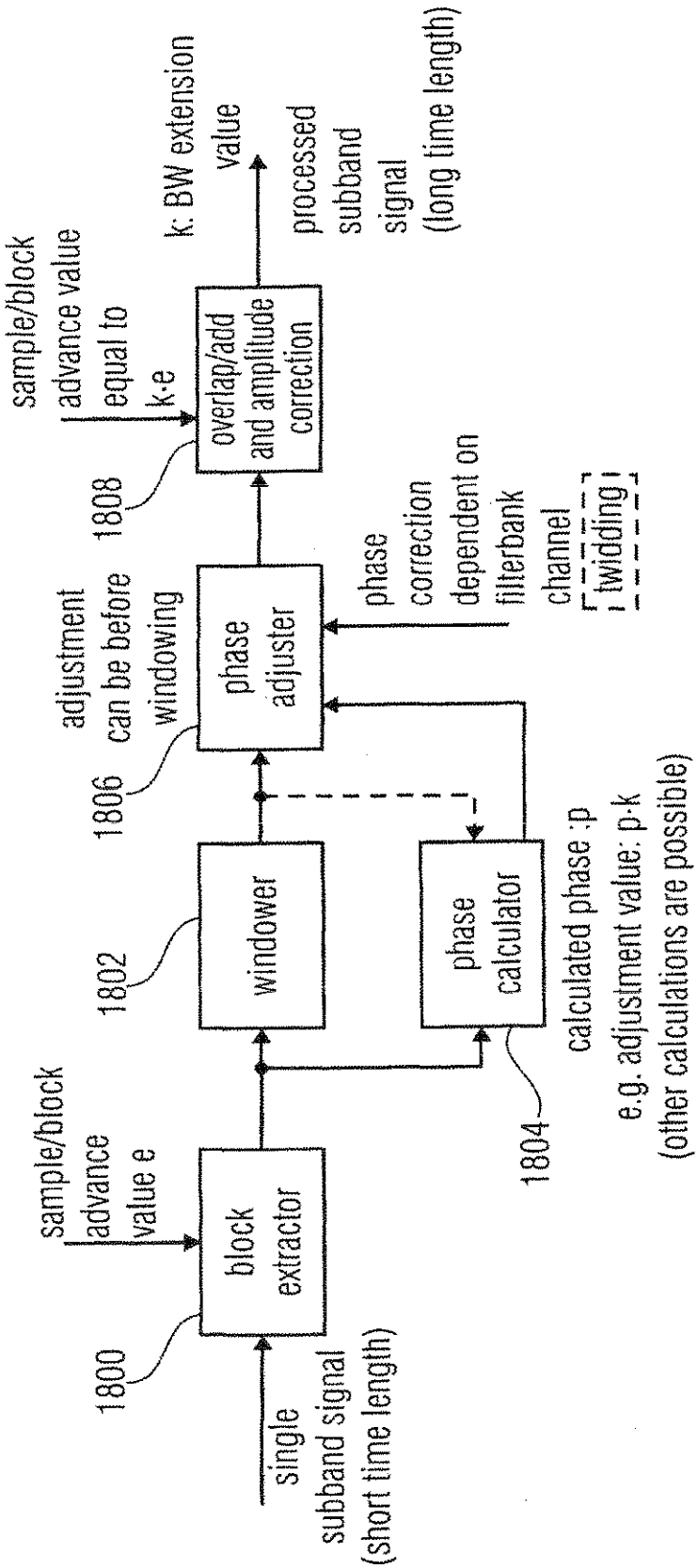

single subband signal (short time length)
1800
block extractor
sample/block advance value e
1802
windower
1804
phase calculator
calculated phase :p
e.g. adjustment value: p·k
(other calculations are possible)
1806
phase adjuster
adjustment can be before windowing
phase correction dependent on filterbank channel
twidding
1808
overlap/add and amplitude correction
sample/block advance value equal to k·e
k: BW extension value
processed subband signal (long time length)

FIG 9

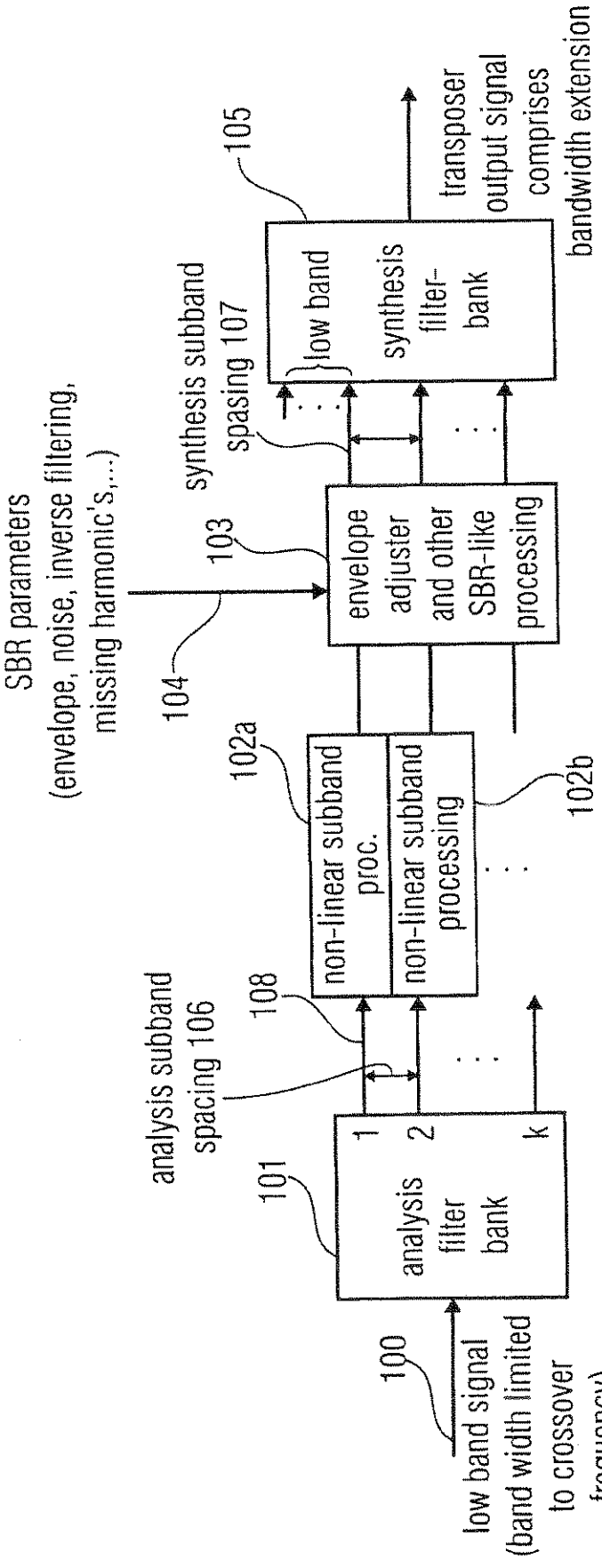

low band signal
(band width limited
to crossover
frequency)
100
analysis
filter
bank
101
1
2
k
analysis subband
spacing 106
108
non-linear subband
proc.
non-linear subband
processing
102a
102b
SBR parameters
(envelope, noise, inverse filtering,
missing harmonic's,...)
104
103
envelope
adjuster
and other
SBR-like
processing
synthesis subband
spasing 107
low band
synthesis
filter-
bank
105
transposer
output signal
comprises
bandwidth extension
by 2,3,4
(not bandwidth
limited to
crossover
frequency)

FIG 10

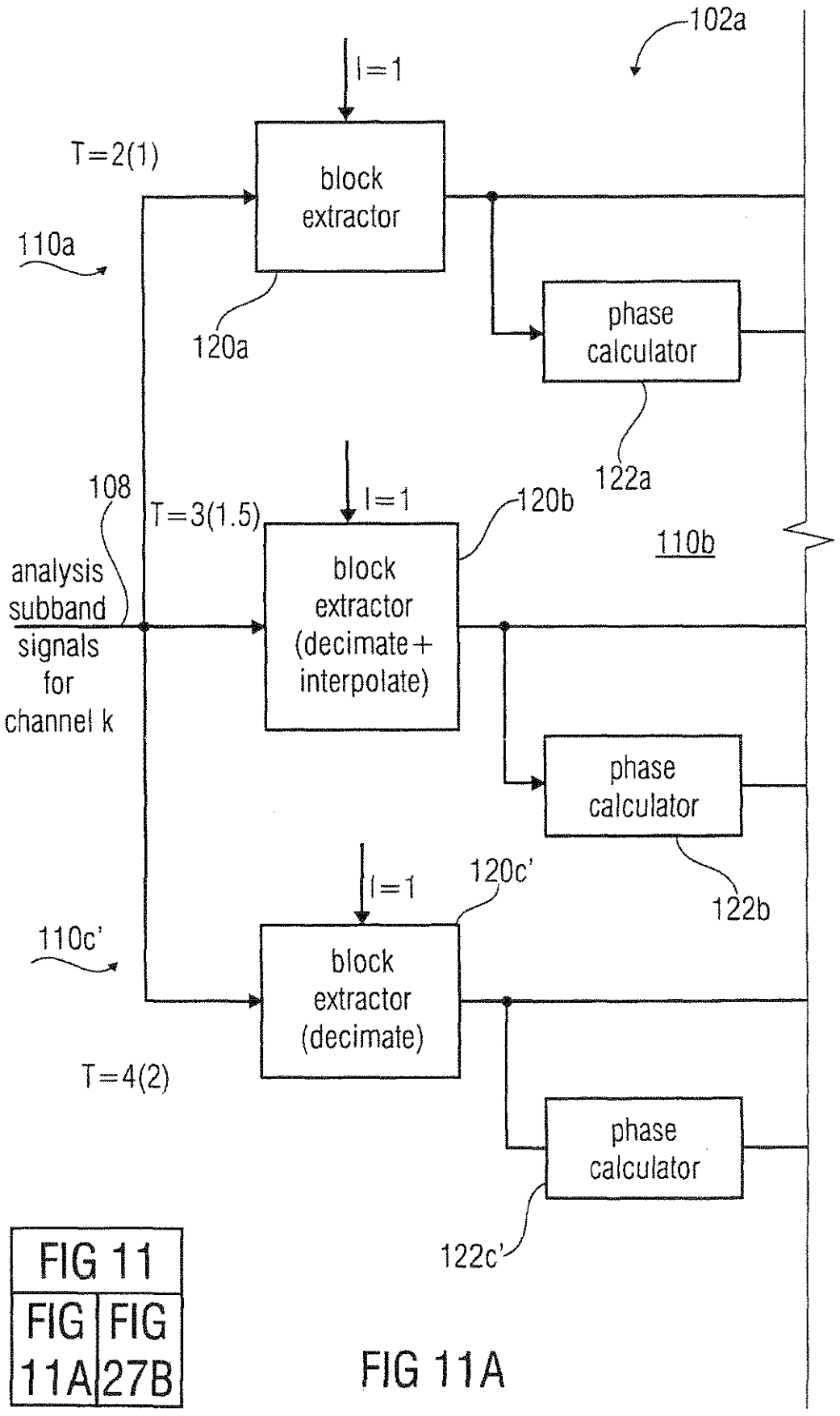


FIG 11

FIG 11A	FIG 27B

FIG 11A

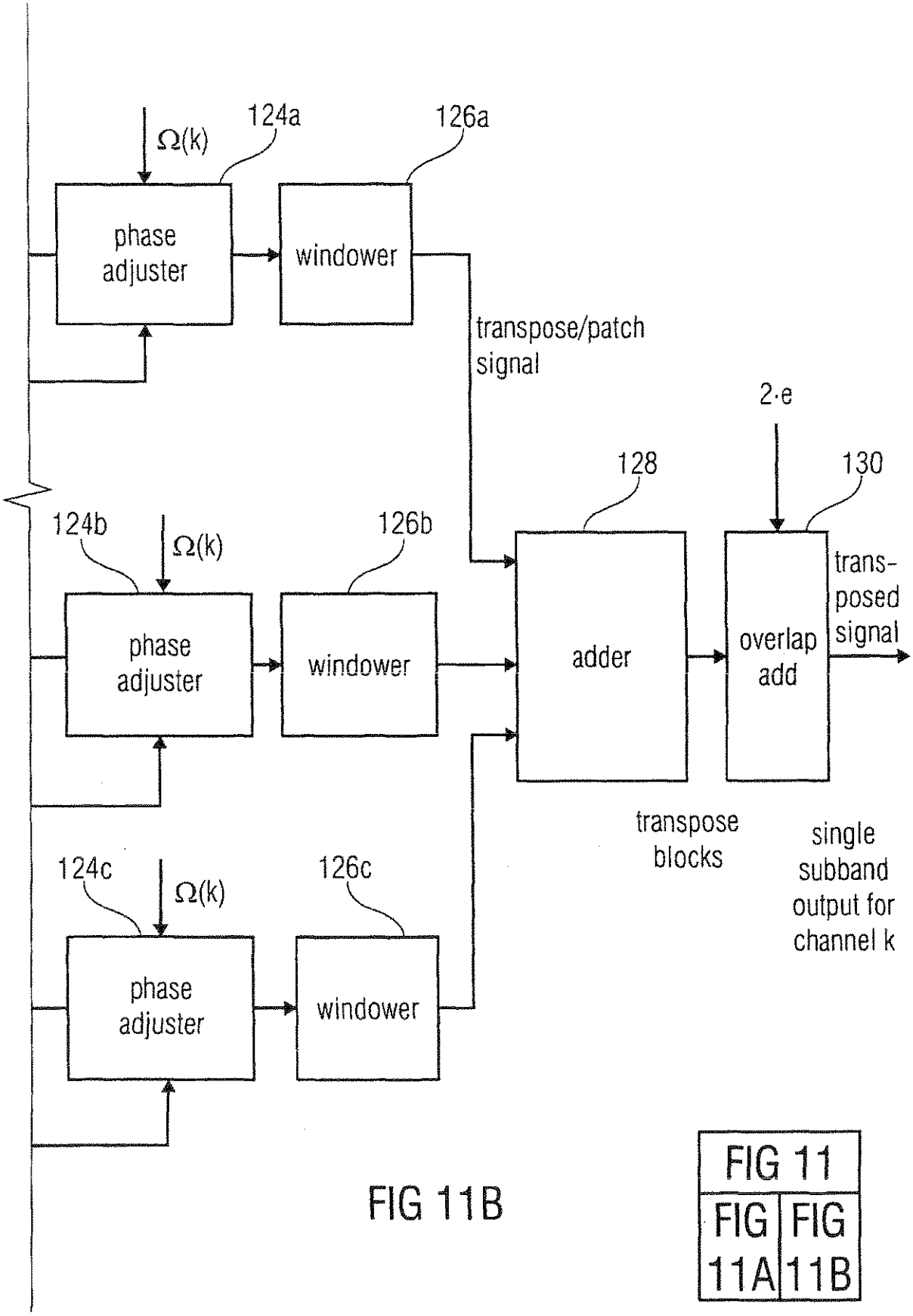


FIG 11B

FIG 11	
FIG 11A	FIG 11B

phase corrections for avoiding amplitude variations

- symmetric situation of analysis/ synthesis filterbank pair:

151 $\Delta\Theta_n = \frac{\pi}{2}(T\text{-}1)(n+\frac{1}{2})$; T: transposition factor, n: filterbank channel

151a (T-1), 151b $(n+\frac{1}{2})$

- asymmetric distribution of phase twiddles:

$\Delta\Theta_n = (1\text{-}T)(\Theta_n\text{-}\Psi_n)$; Ψ_n: phase twiddles

e.g. a 64 band QMF filterbank pair

152 $\Delta\Theta_n = \frac{385}{128}\pi(T\text{-}1)(n+\frac{1}{2})$;

152a (T-1), 152b $(n+\frac{1}{2})$

(depends on channel and transpos. factor)

- specific application of phase twiddles:

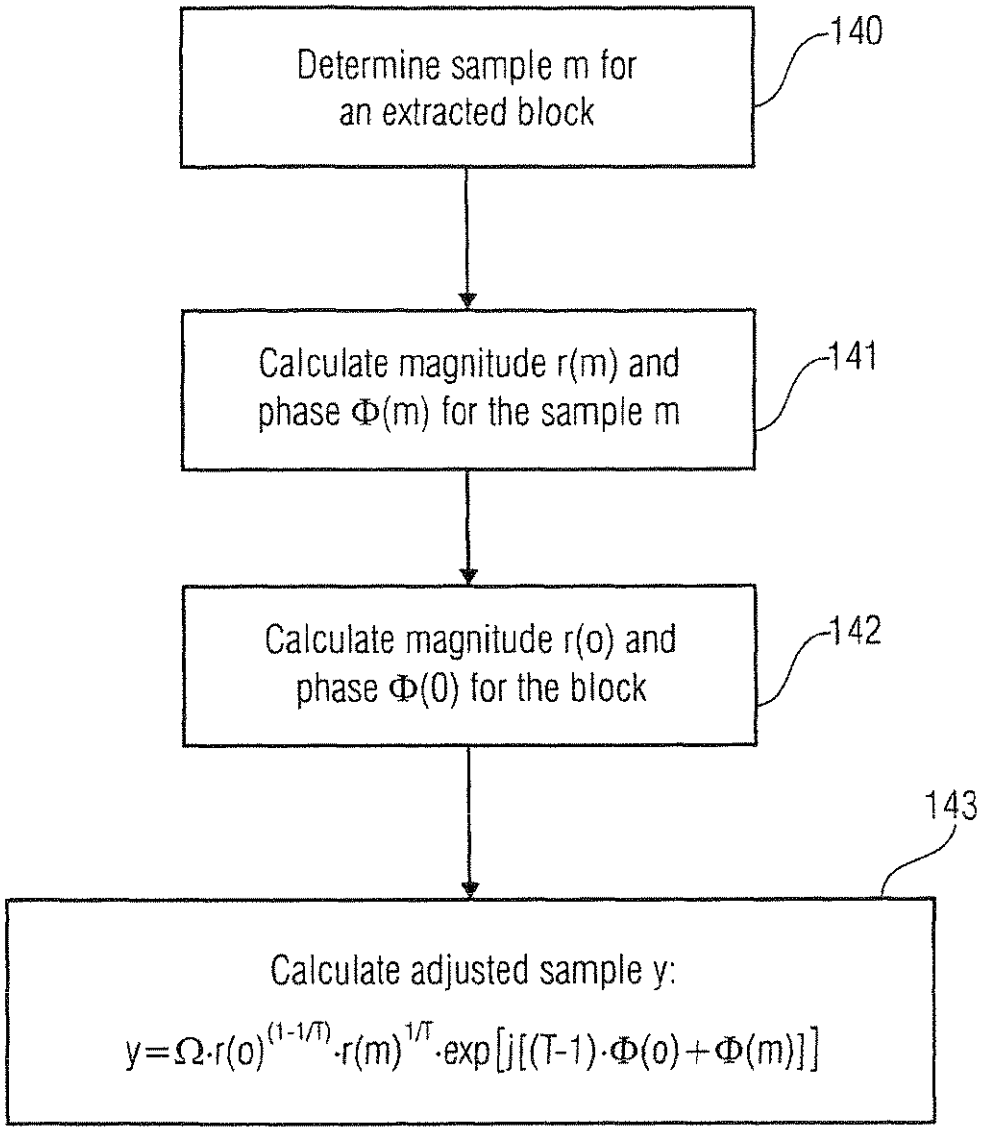
153 $\Delta\Theta_n = -\frac{385}{128}\pi(n+\frac{1}{2})$;

(depends on channel only)

→ analysis filterbank adds a phase of

$\frac{385}{128}\pi(n+\frac{1}{2})$; compared to above case

FIG 12



Ω: filterbank-channel dependent phase correction
(T-1)·Φ(o): signal-dependent phase term
Φ(m): phase of the current sample
T: transposition factor

FIG 13

synthSize: number of channels of synthesis bank

k: subband index
l: sample index

```
L=2*synthSize;
for (k=0; k<L; k++) {
    for (l=0; l<2*L; l++) {
        MM.real[k][l]=cos(PI/(2*L)*(k+0.5)*(2*l-2*L));
        MM.imag[k][l]=sin(PI/(2*L)*(k+0.5)*(2*l-2*L));
    }
}
```

phase correction independent on transposition factor

FIG 14A

analysis filterbank modulation matching with complex SBR filterbank in ISO/IEC 14496-3, section 4.6.18.4.2

ks: index of a starting channel

```
L=2*synthSize;
for (k=0; k<L; k++) {
    for (l=0; l<2*L; l++) {
        MM.real[k][l]=cos(PI/(2*L)*((k+0.5)*(2*l-L/64.0)-L/32.0*ks));
        MM.imag[k][l]=sin(PI/(2*L)*((k+0.5)*(2*l-L/64.0)-L/32.0*ks));
    }
}
```

transposition factor dependent phase correction

FIG 14B