FIG 1

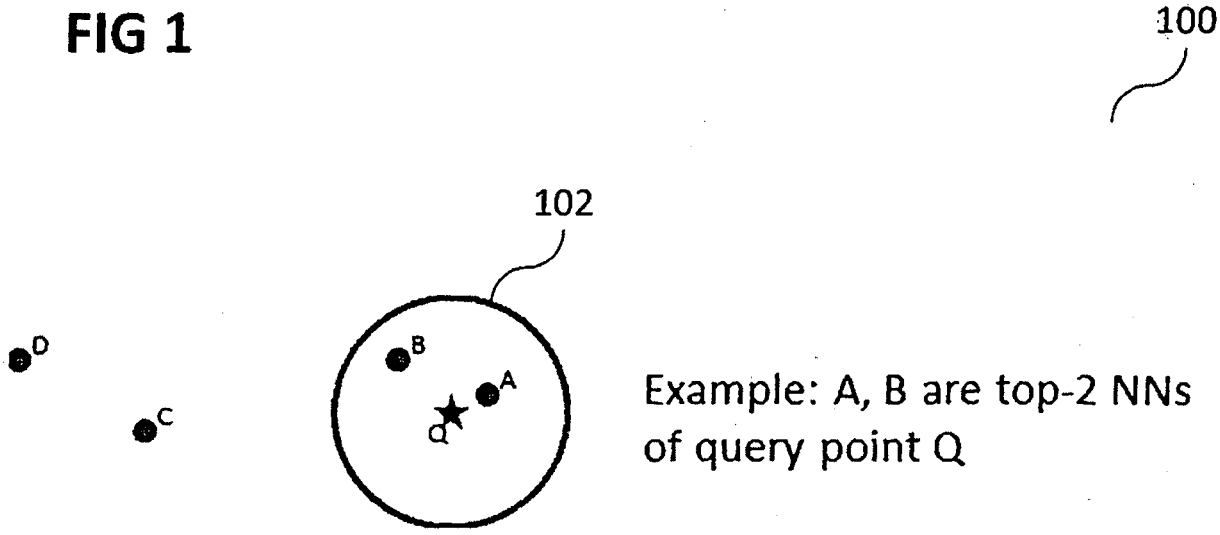

100
102
D
C
B
A
Q
Example: A, B are top-2 NNs
of query point Q

FIG 2

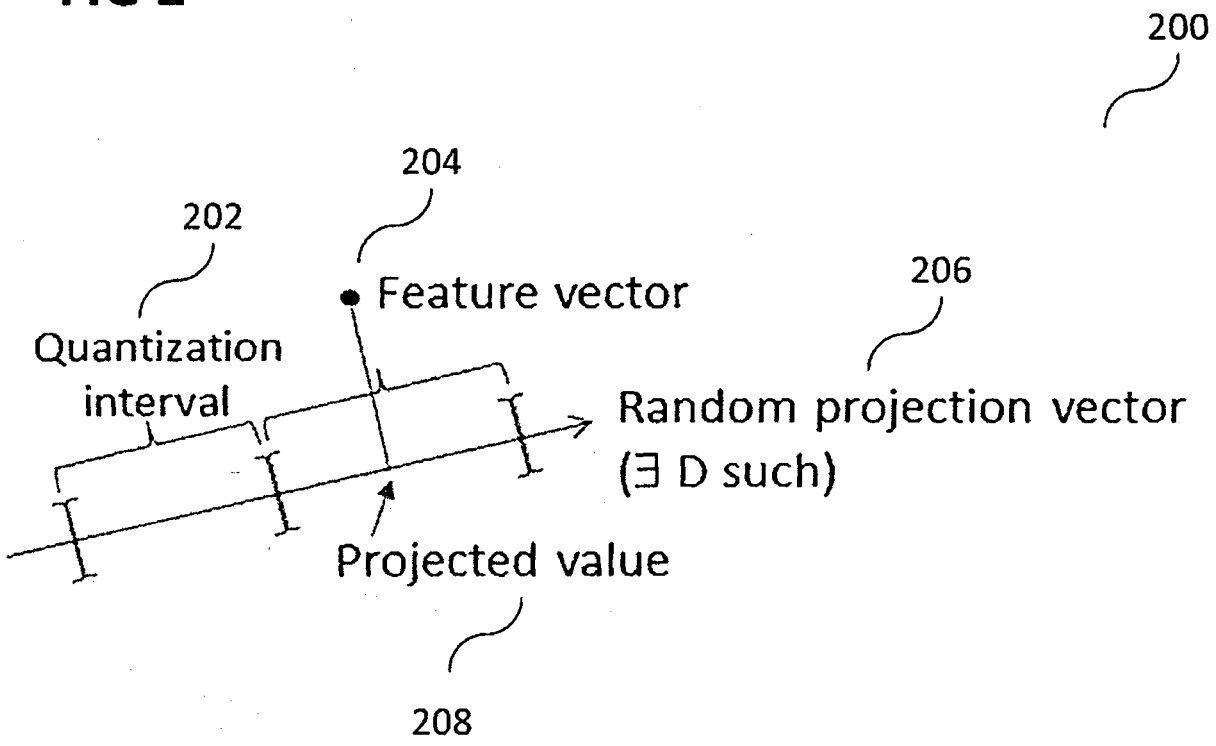

200
204
202
Feature vector
206
Quantization
interval
Random projection vector
(∃ D such)
Projected value
208

FIG 3

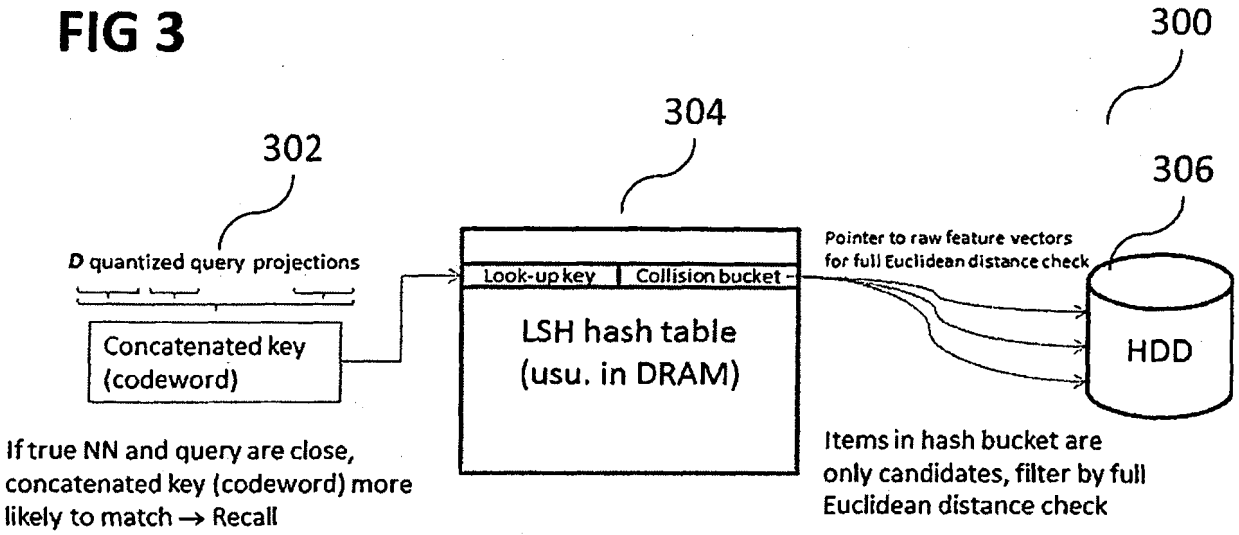


FIG 4A

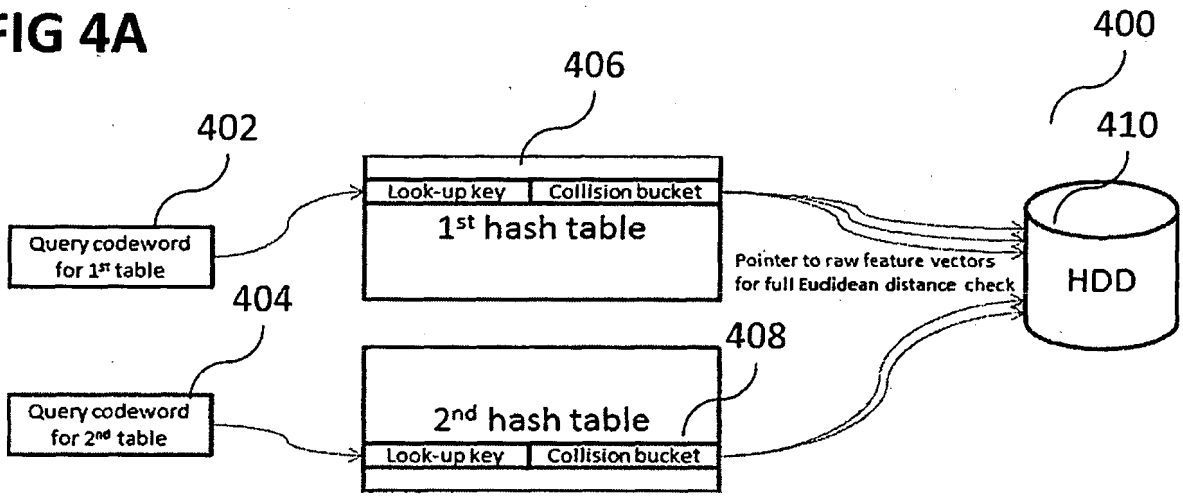


FIG 4B

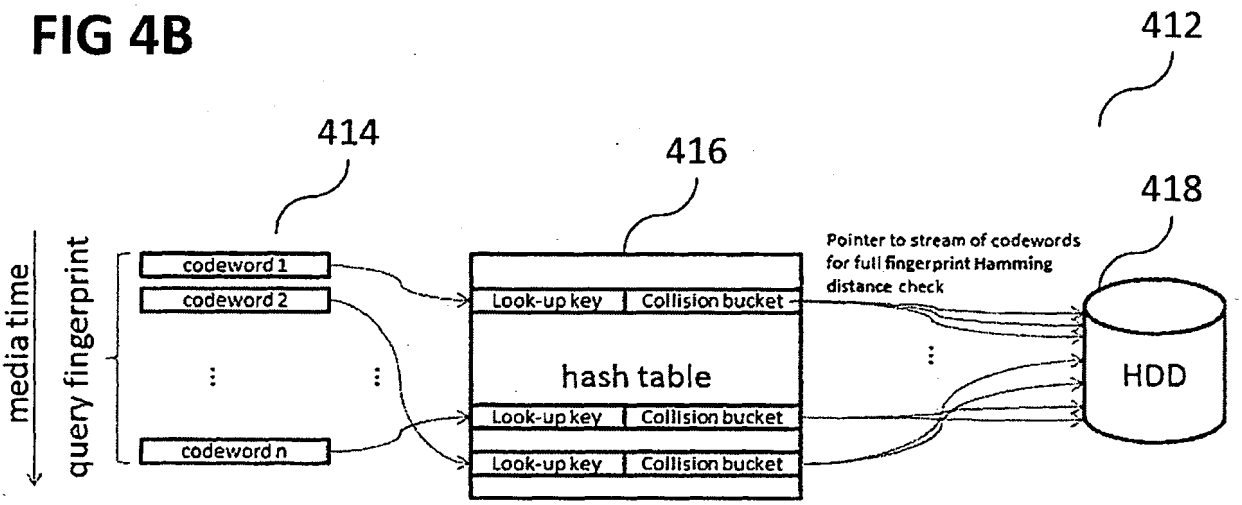


FIG 5

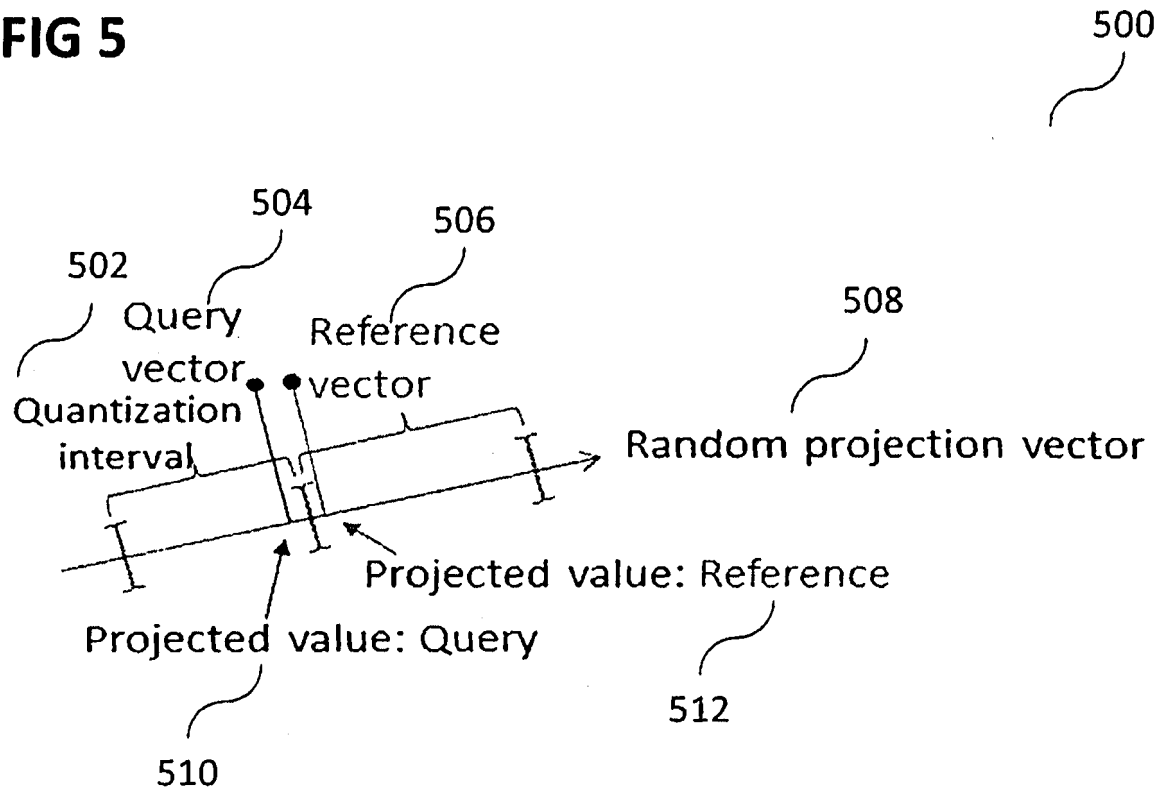

500
504
506
502
Query vector
Reference vector
508
Quantization interval
Random projection vector
Projected value: Reference
Projected value: Query
512
510

FIG 6

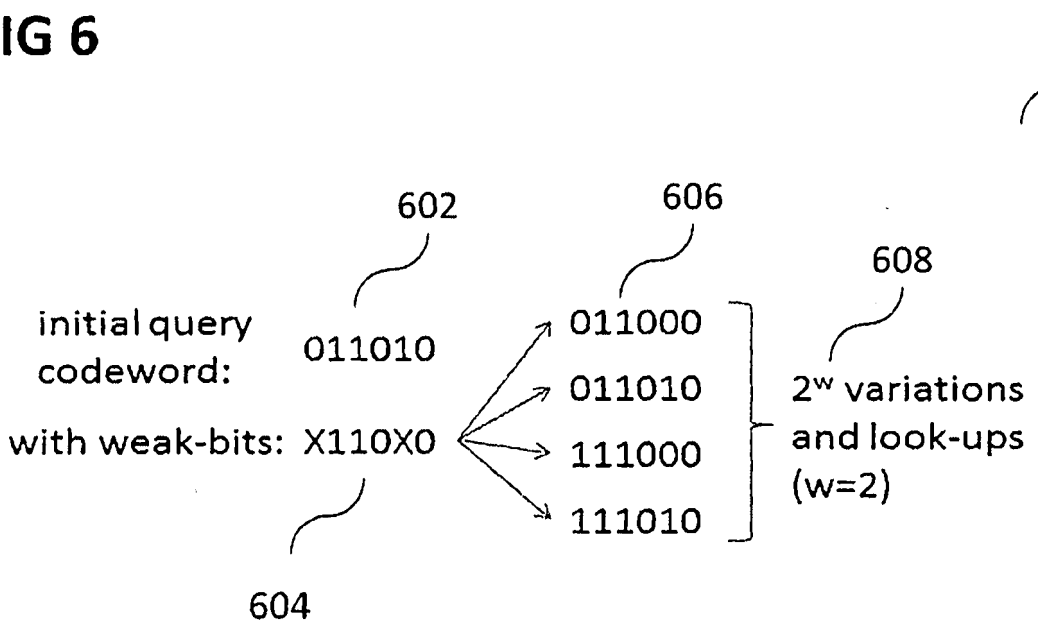

600
602
606
608
initial query codeword:
011010
011000
011010
111000
111010
2^w variations and look-ups (w=2)
with weak-bits: X110X0
604

FIG 7

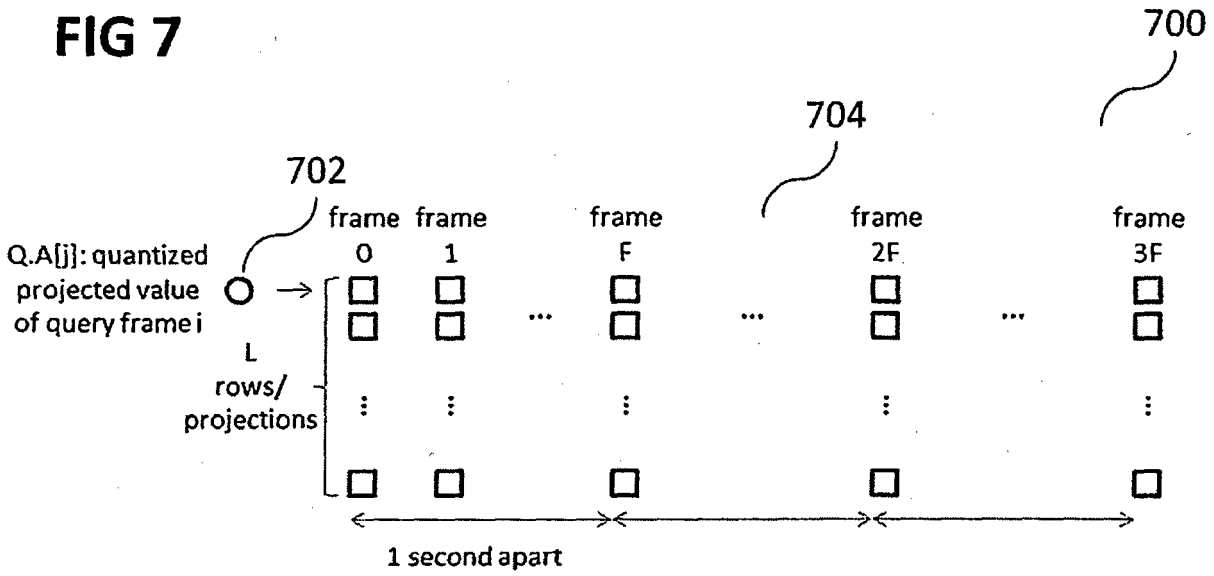

700
704
702
frame 0
frame 1
frame F
frame 2F
frame 3F
Q.A[j]: quantized projected value of query frame i
L rows/ projections
1 second apart

FIG 8

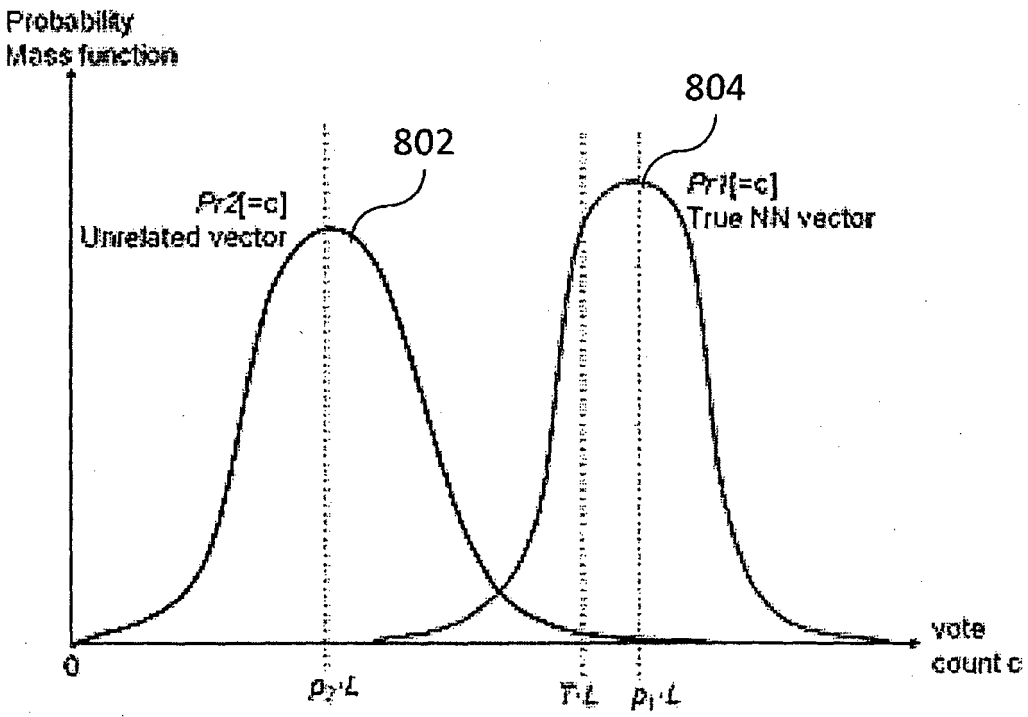

800
Probability Mass function
804
802
Pr2[=c] Unrelated vector
Pr1[=c] True NN vector
0
vote count c

FIG 9A

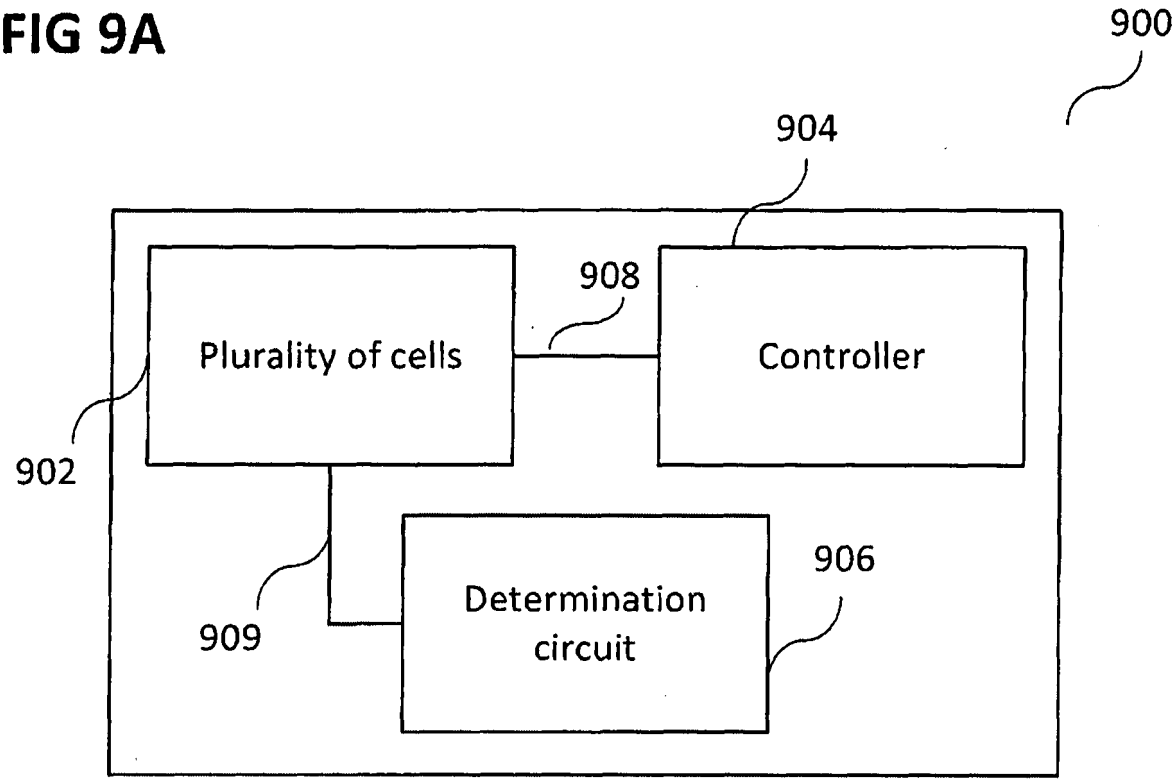

900
904
908
Plurality of cells
Controller
902
909
Determination circuit
906

FIG 9B

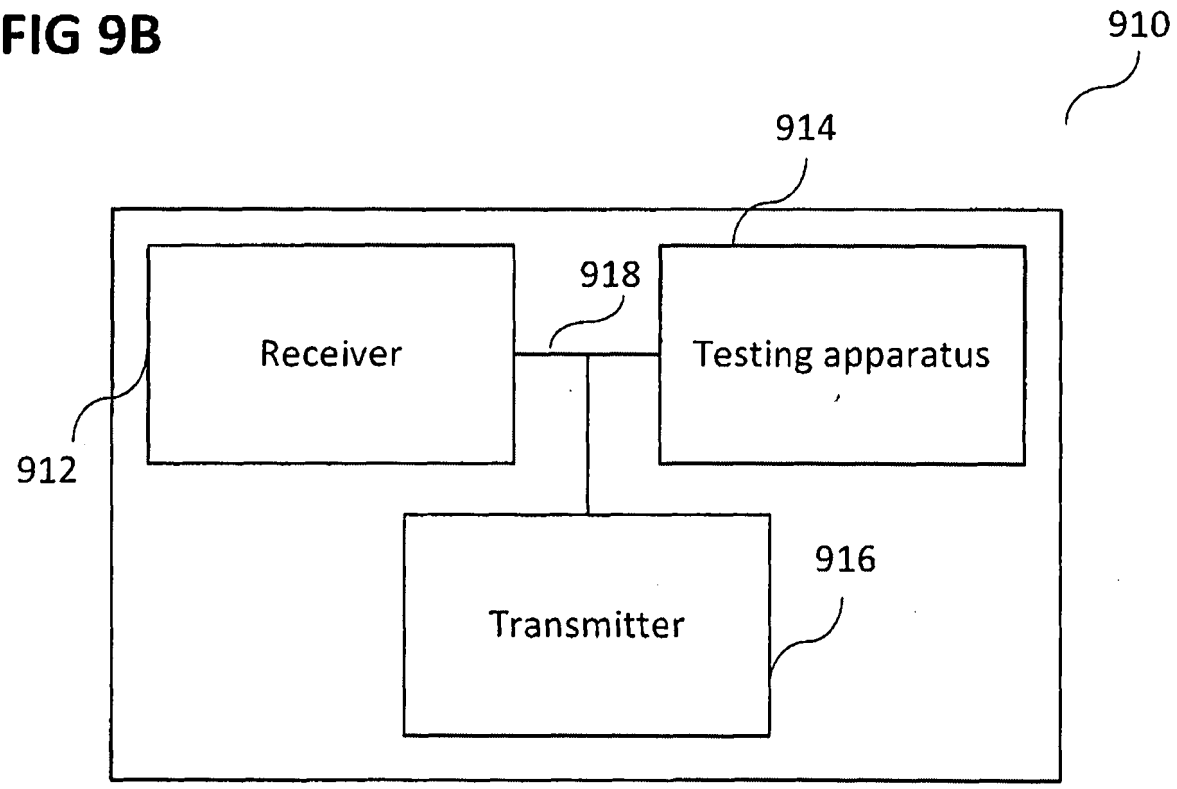

910
914
918
Receiver
Testing apparatus
912
Transmitter
916

FIG 9C

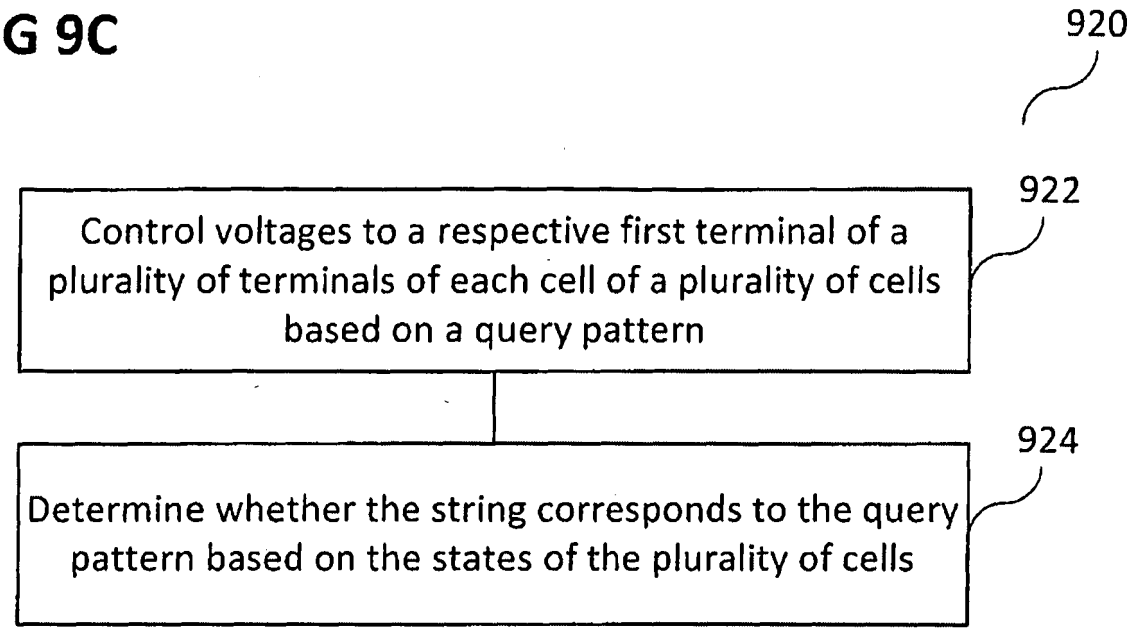

920
922
Control voltages to a respective first terminal of a plurality of terminals of each cell of a plurality of cells based on a query pattern
924
Determine whether the string corresponds to the query pattern based on the states of the plurality of cells

FIG 10

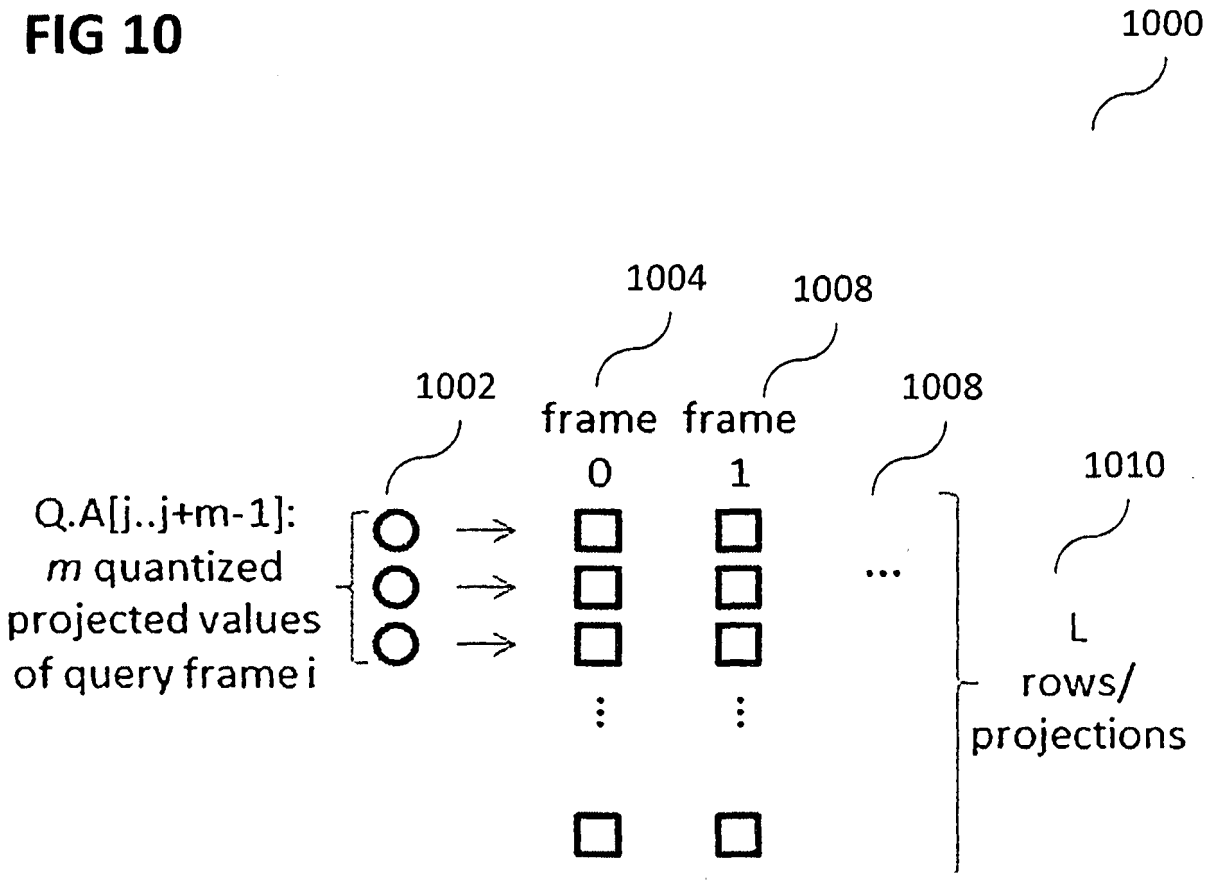

1000
1004
1008
1002
1008
frame 0
frame 1
1010
Q.A[j..j+m-1]: m quantized projected values of query frame i
...
L rows/ projections

FIG 11A

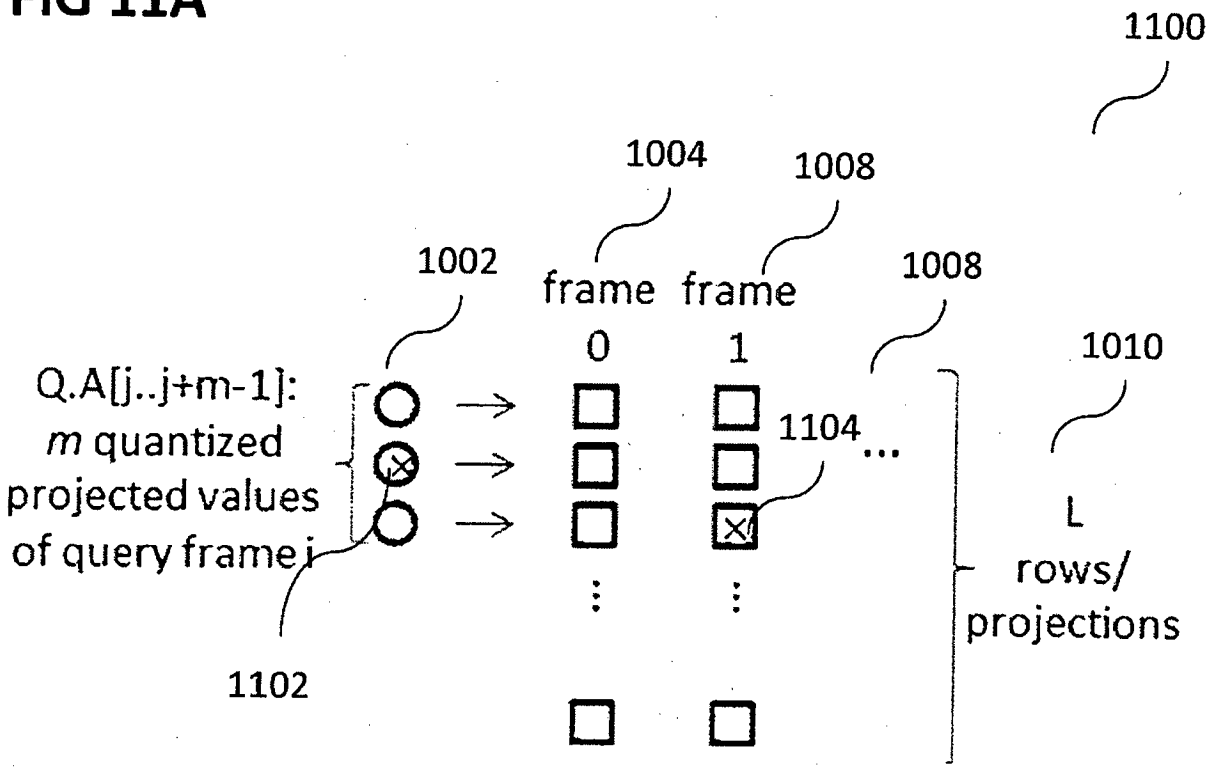


FIG 11B

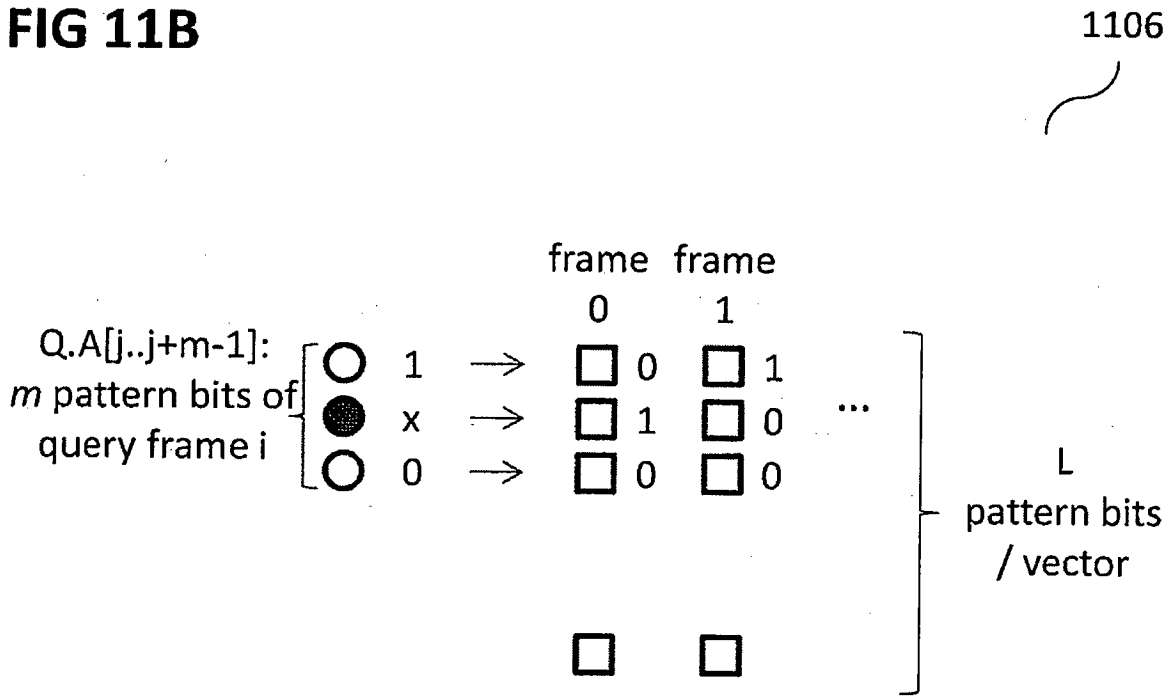


FIG 12

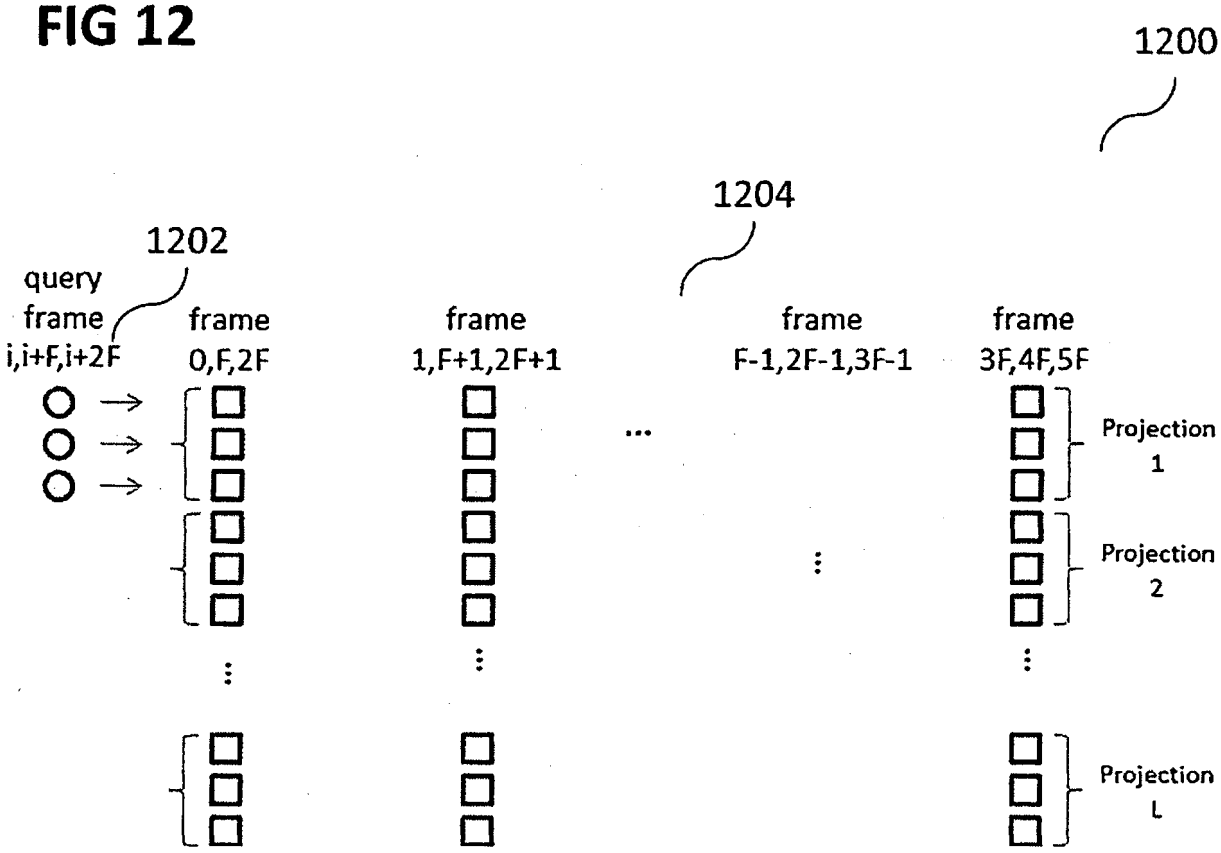

1200
1202
1204
query frame i,i+F,i+2F
frame 0,F,2F
frame 1,F+1,2F+1
frame F-1,2F-1,3F-1
frame 3F,4F,5F
Projection 1
Projection 2
Projection L

FIG 13

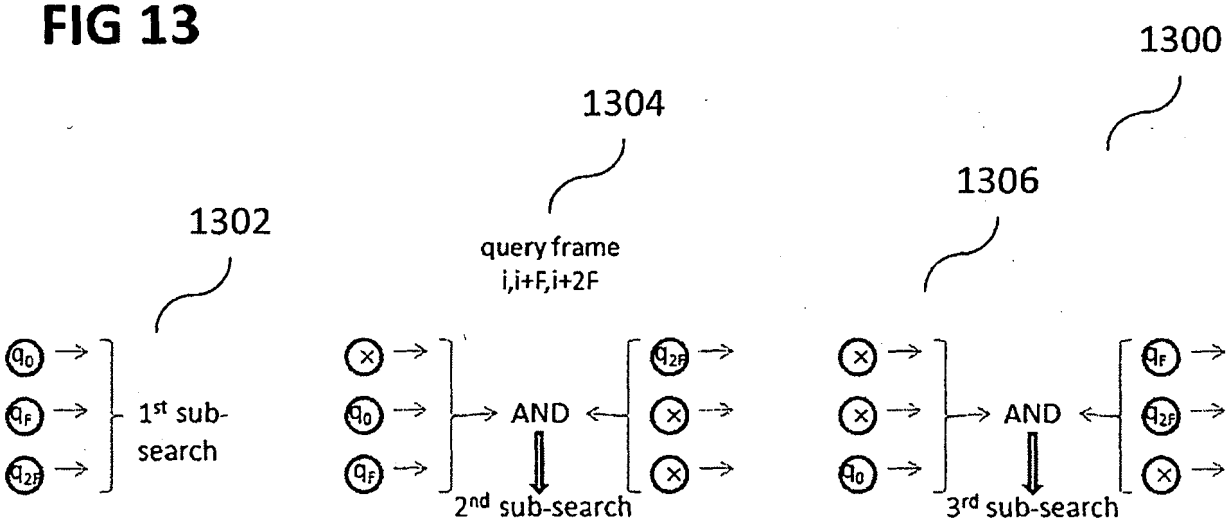

1300
1302
1304
1306
query frame i,i+F,i+2F
1st sub-search
AND
2nd sub-search
AND
3rd sub-search

FIG 14

1400

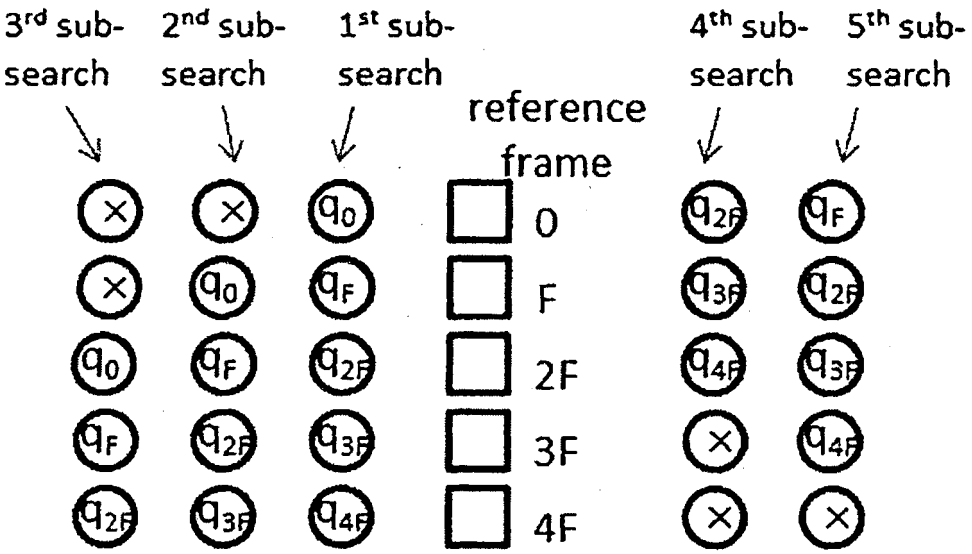


FIG 15

1500

Not present in FIG 12

frame 0	frame 1		frame F-1	frame F	frame F+1		frame 2F-1	frame 2F		frame 3F-1	frame 3F
F	F+1	...	2F-1	2F	2F+1	...	3F-1	3F	...	4F-1	4F
2F	2F+1		3F-1	3F	3F+1		4F-1	4F		5F-1	5F

FIG 16

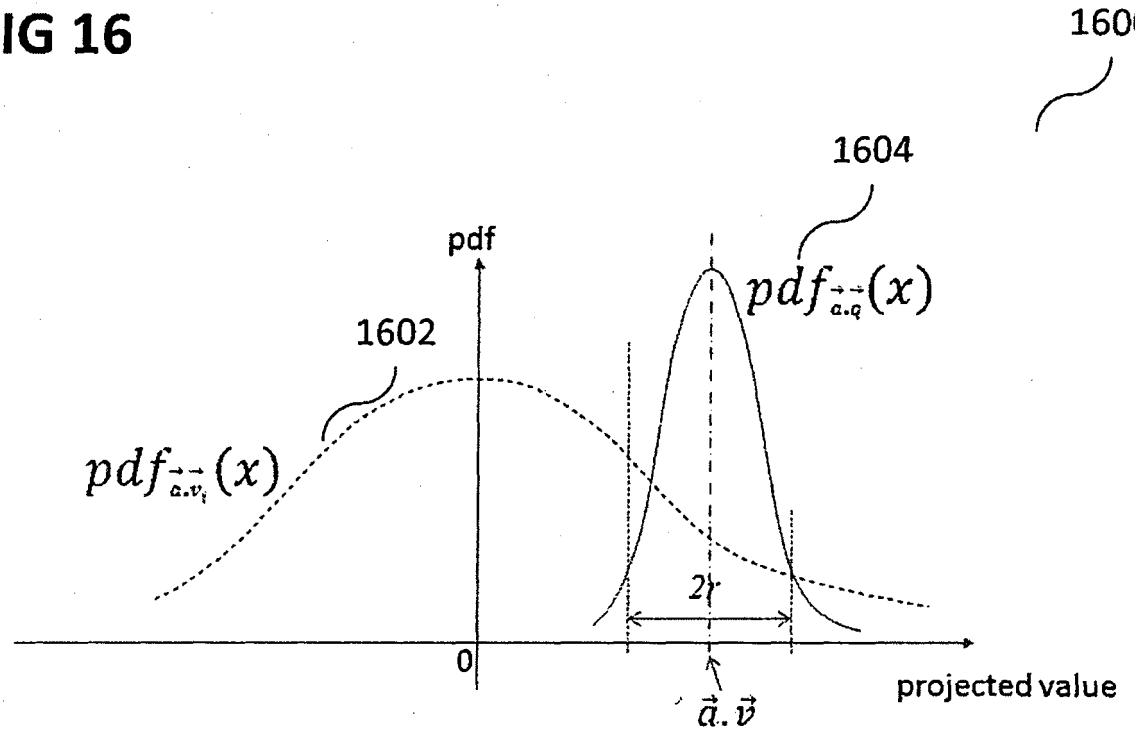

1600
1604
pdf
$pdf_{\vec{a}.\vec{q}}(x)$
1602
$pdf_{\vec{a}.\vec{v}_i}(x)$
2r
0
projected value
$\vec{a}.\vec{v}$

FIG 17

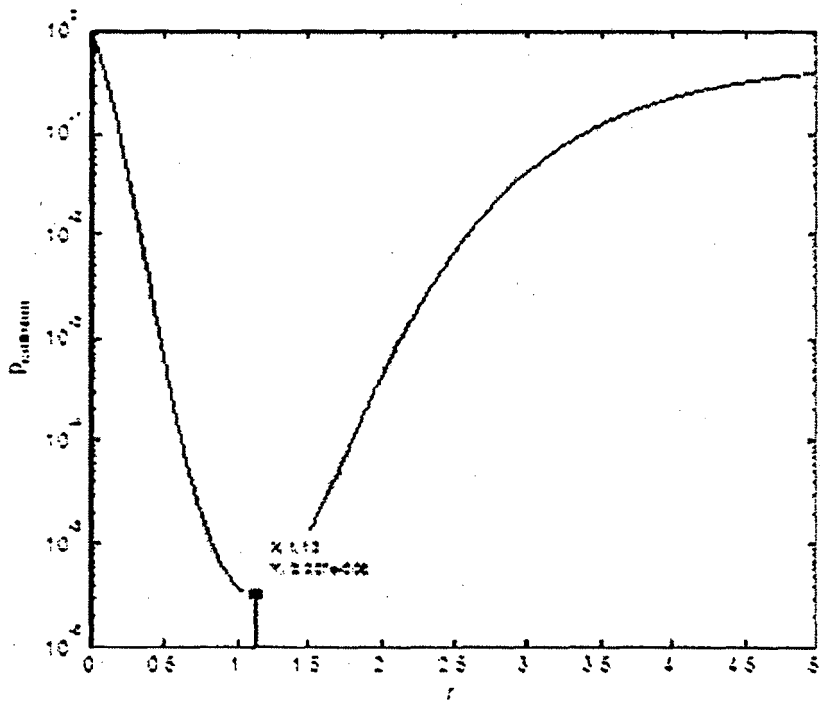

1700
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
r

FIG 18

1800

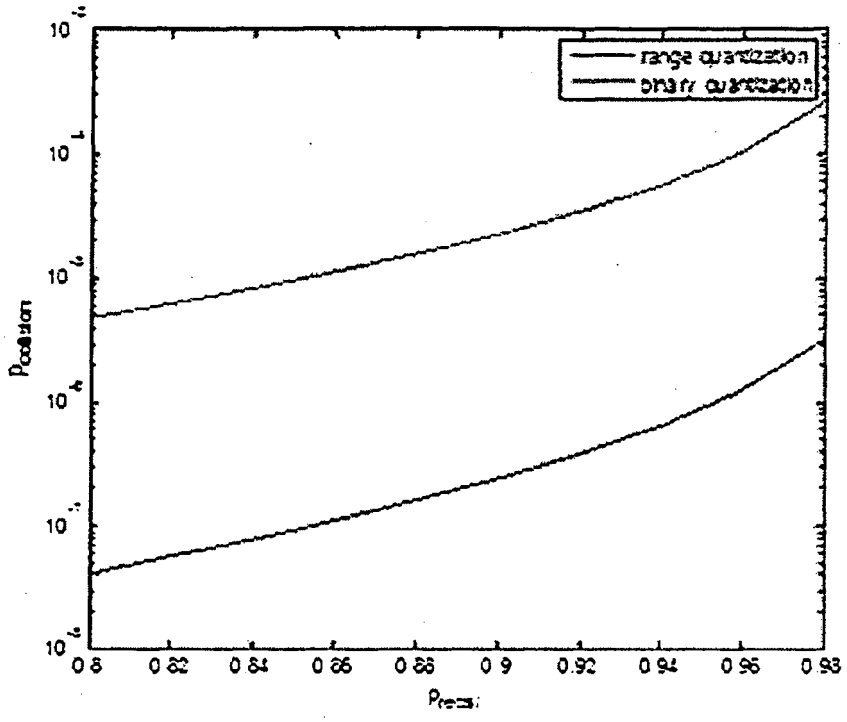


FIG 20

2000

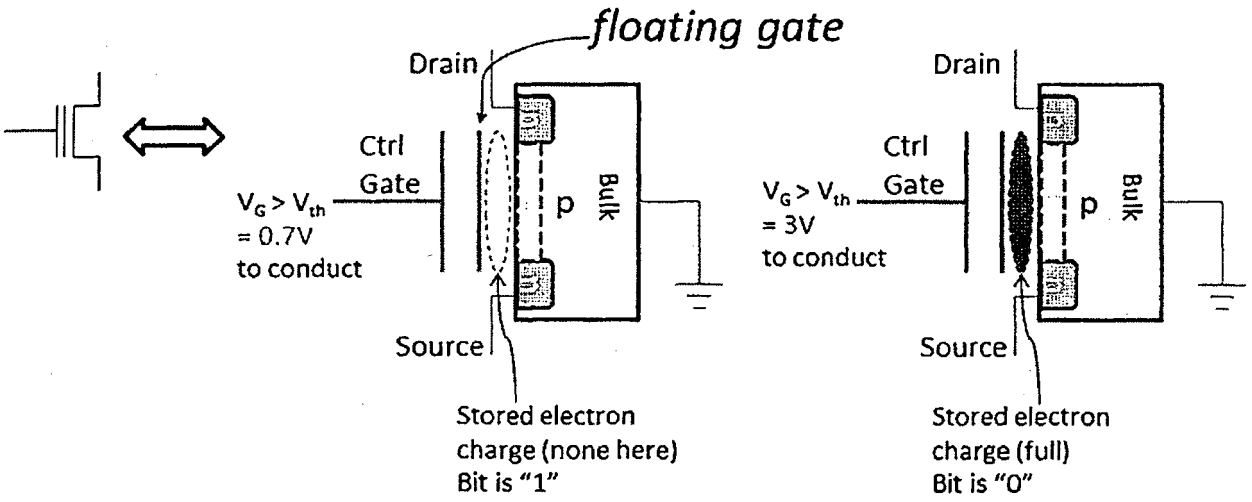


FIG 19

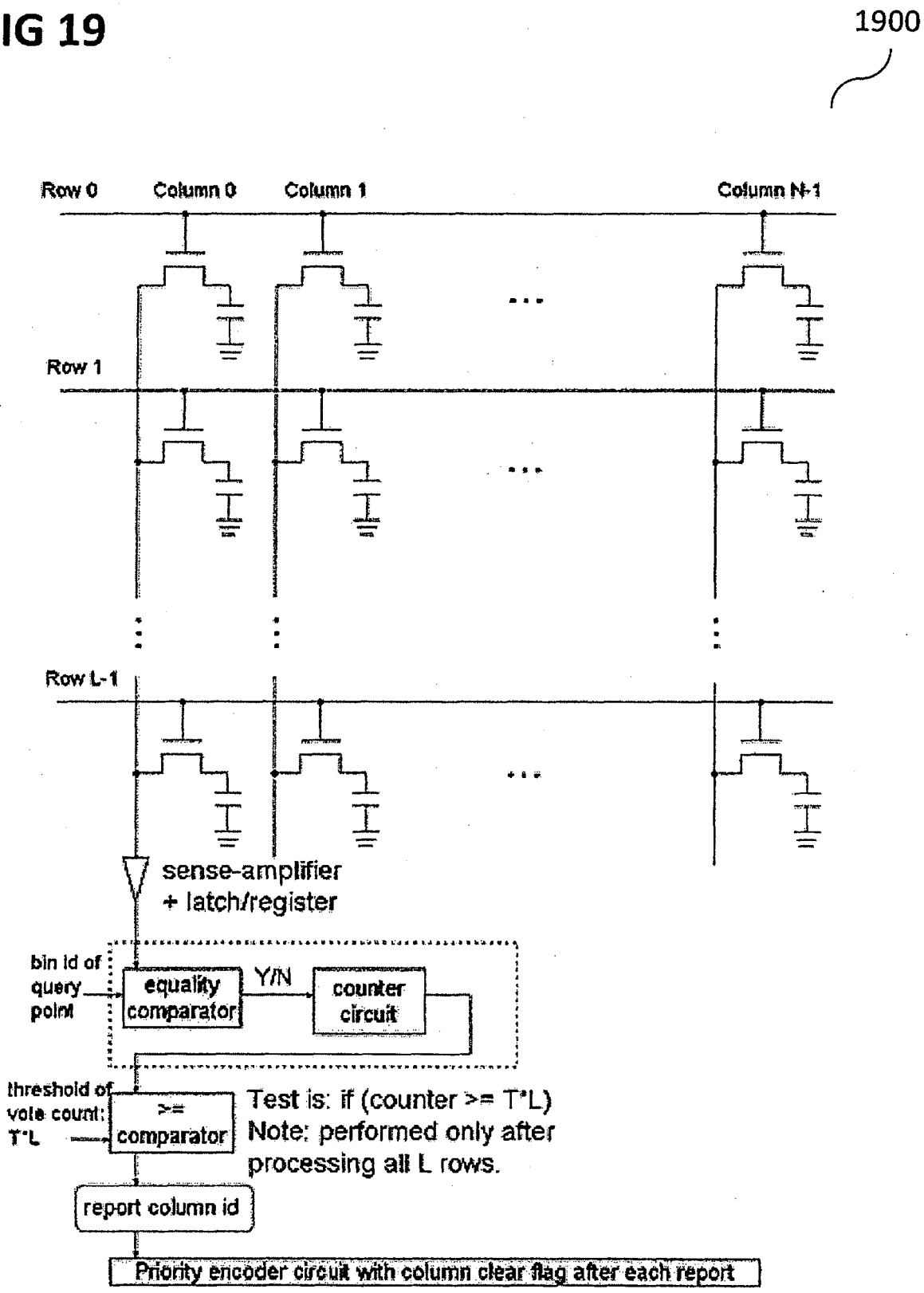

1900
Row 0
Column 0
Column 1
Column N-1
Row 1
Row L-1
sense-amplifier
+ latch/register
bin id of query point
equality comparator
Y/N
counter circuit
threshold of vote count: T*L
>= comparator
Test is: if (counter >= T*L)
Note: performed only after processing all L rows.
report column id
Priority encoder circuit with column clear flag after each report

FIG 21

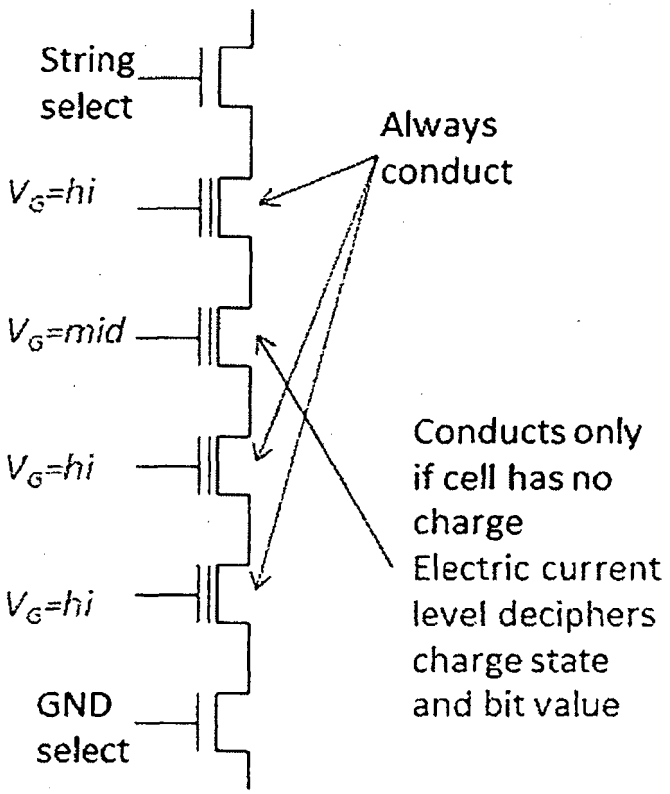


FIG 22A

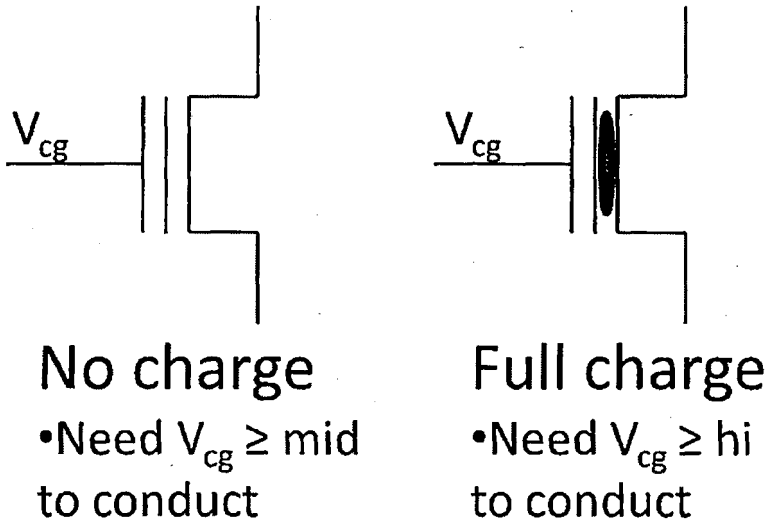


FIG 22B

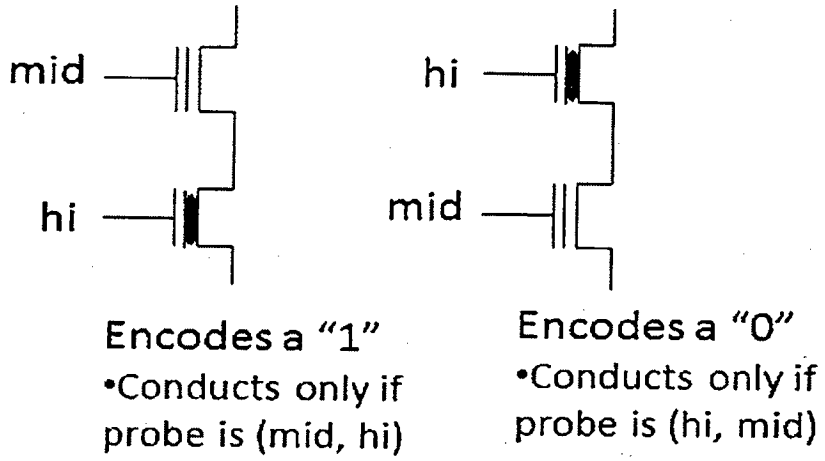


FIG 23

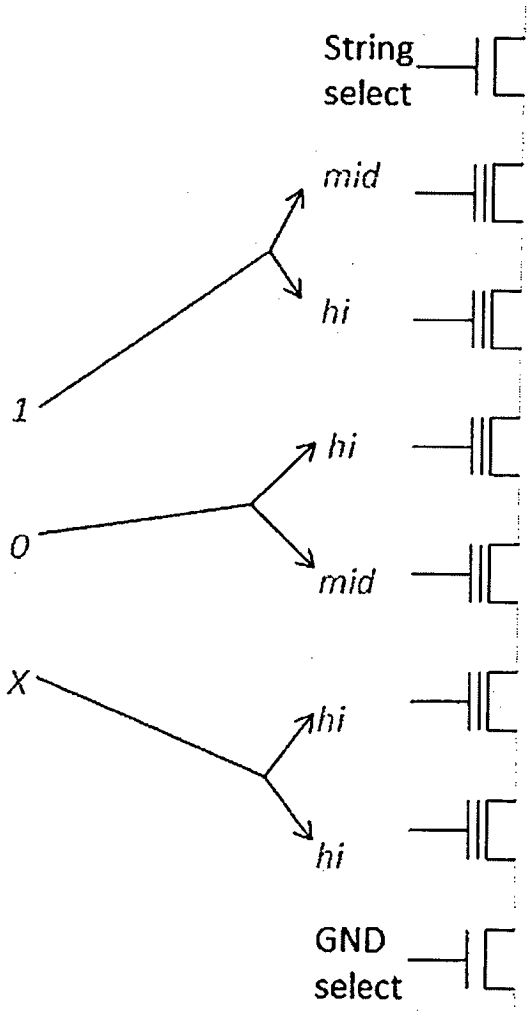


FIG 24

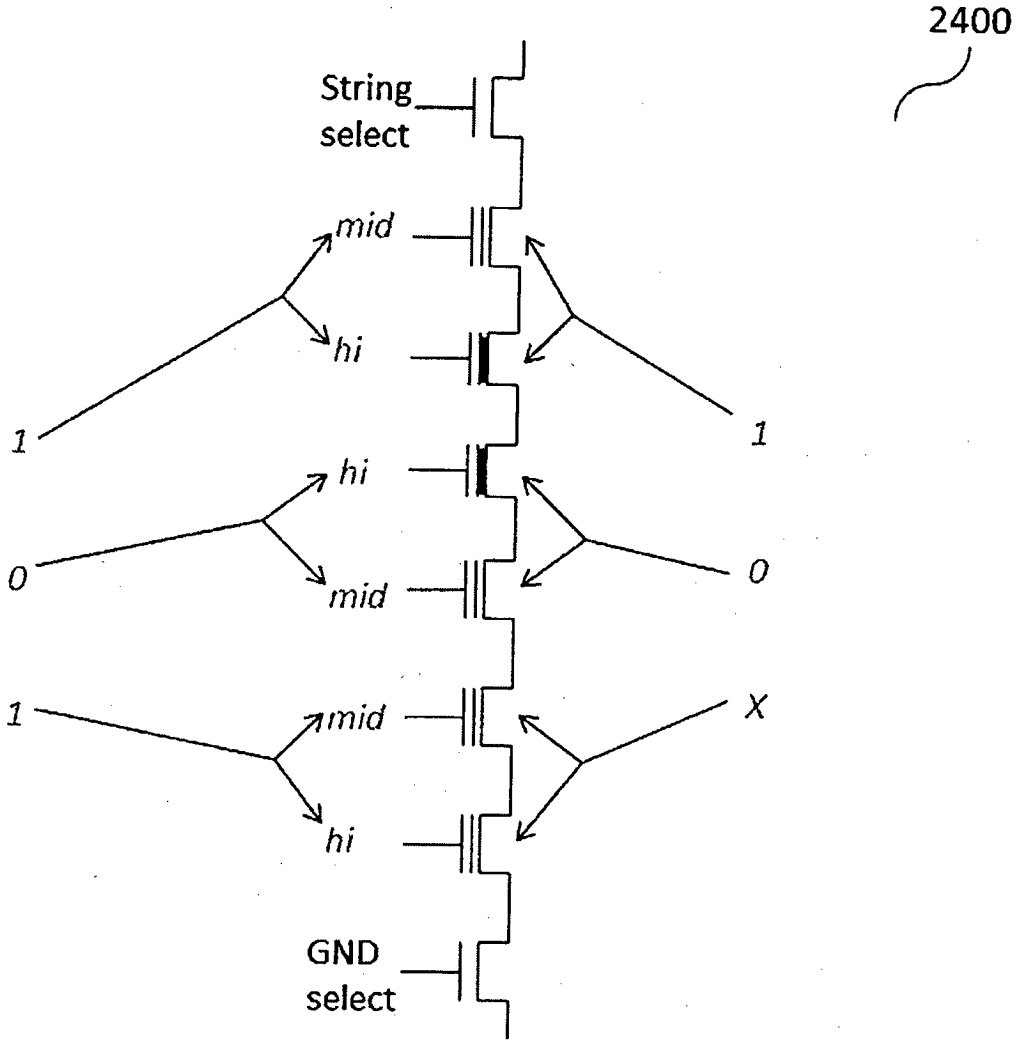

2400
String select
mid
hi
1
1
hi
0
0
mid
1
mid
X
hi
GND select

FIG 26

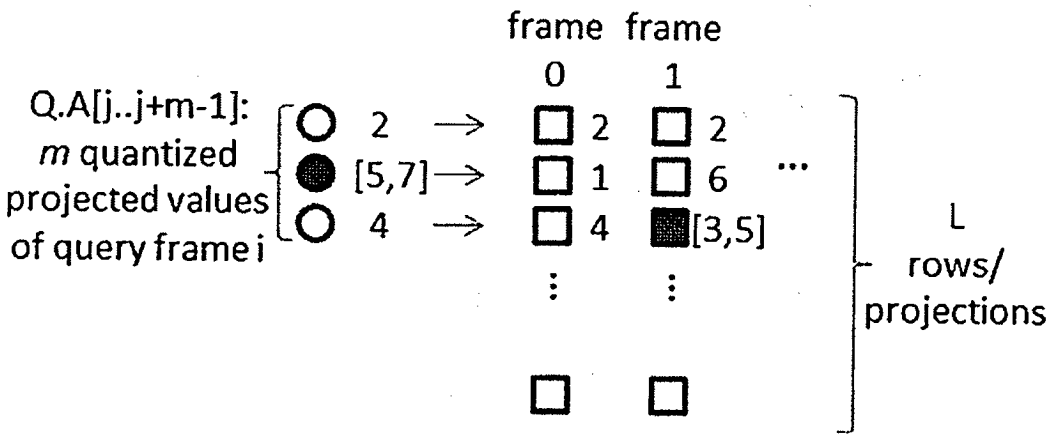

2600
frame 0
frame 1
Q.A[j..j+m-1]:
m quantized projected values of query frame i
2
[5,7]
4
2
2
1
6
4
[3,5]
L rows/ projections

FIG 25A

2500

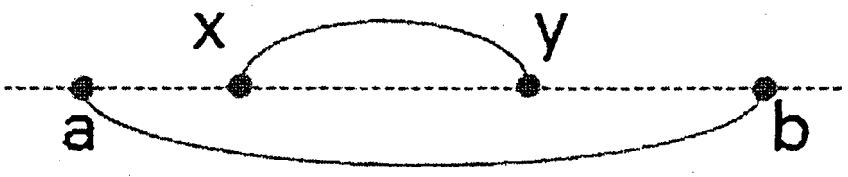


FIG 25B

2502

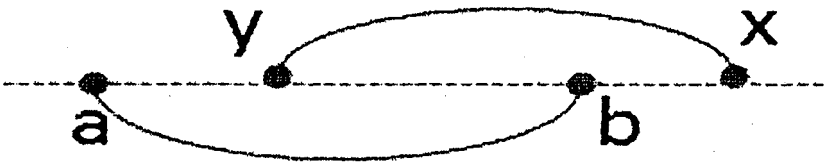


FIG 25C

2504

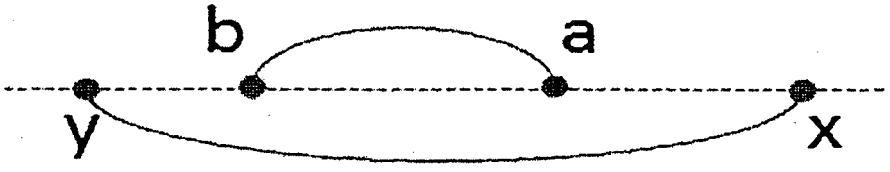


FIG 27

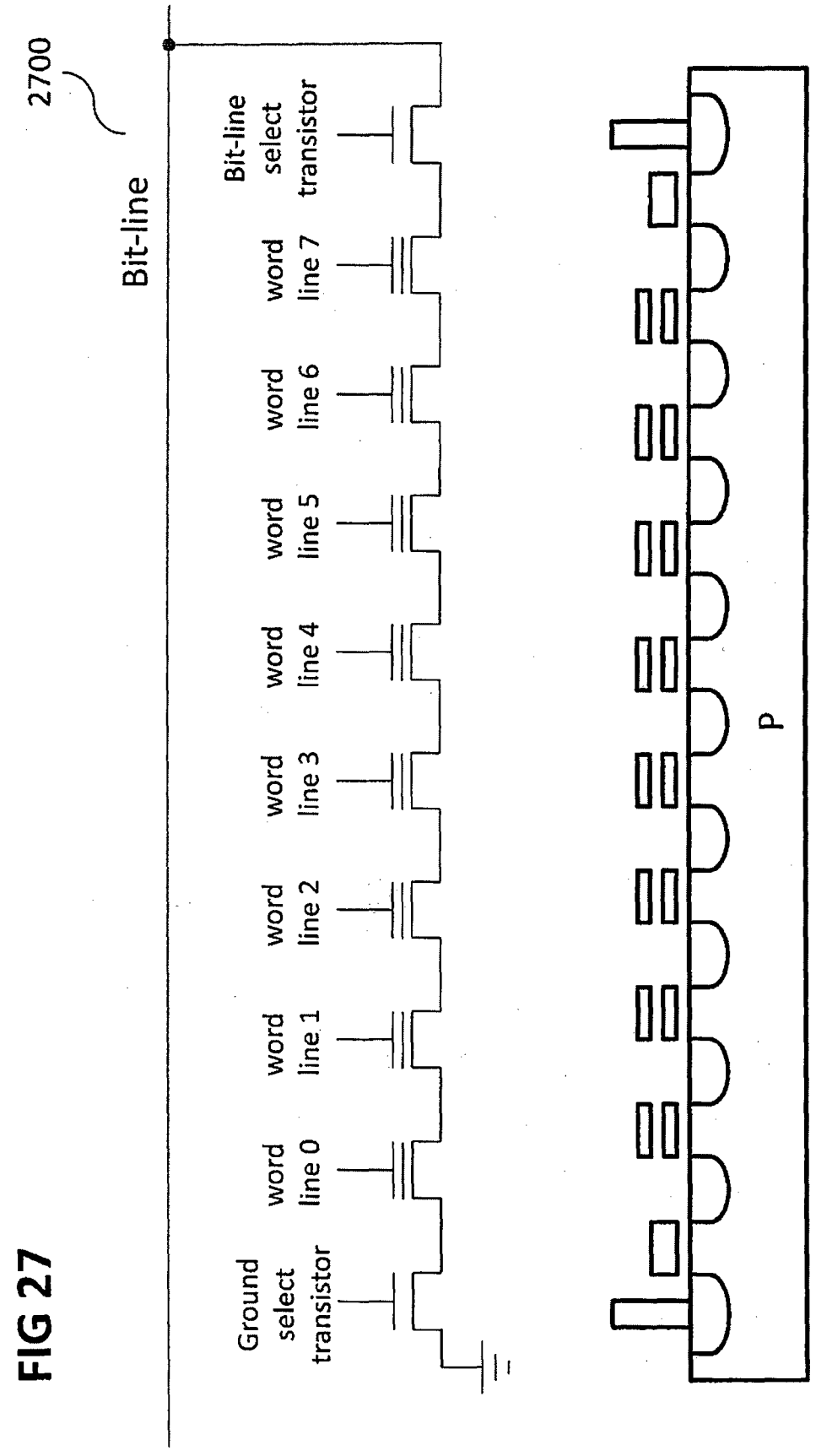

2700
Bit-line
Ground select transistor
word line 0
word line 1
word line 2
word line 3
word line 4
word line 5
word line 6
word line 7
Bit-line select transistor
P

FIG 28A

2800

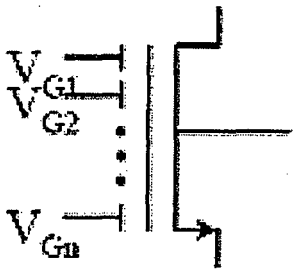
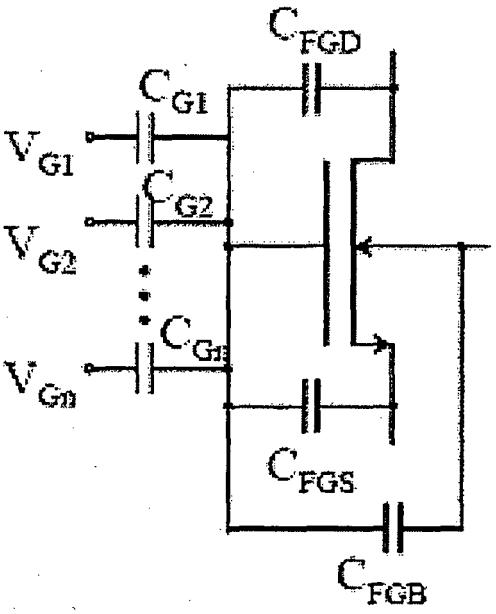


FIG 28B

2802