Fig 1

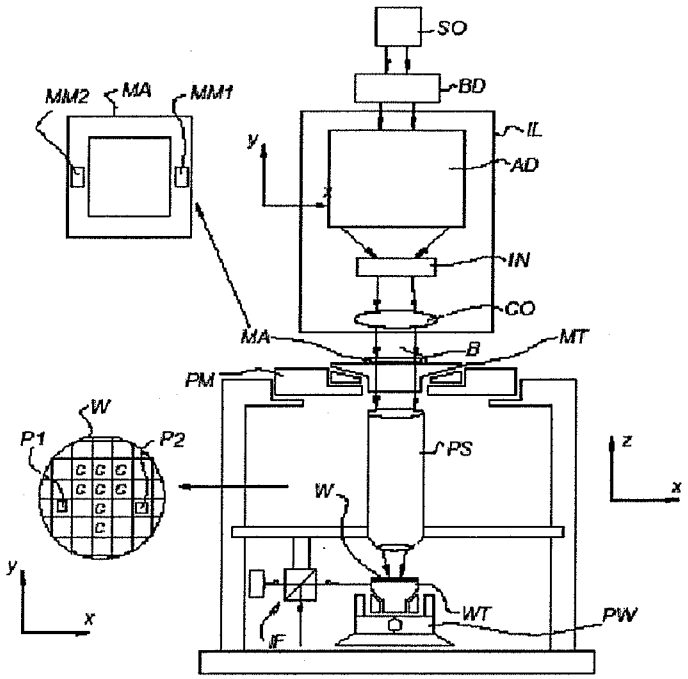


Fig 2

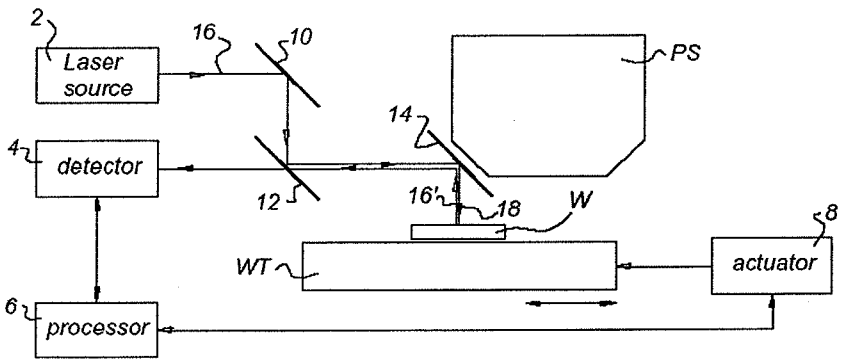

2
Laser source
16
10
PS
14
4
detector
12
16'
18
W
8
WT
actuator
6
processor

Fig 3

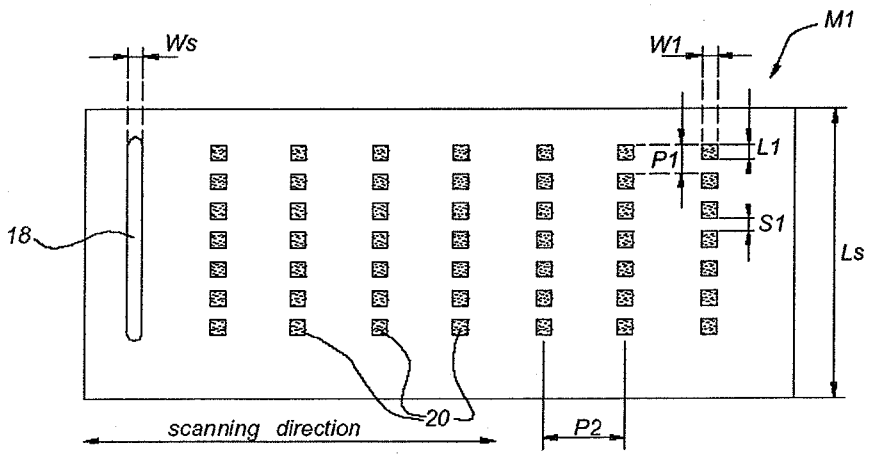

Ws
W1
M1
P1
L1
S1
Ls
18
20
scanning direction
P2

Fig 4

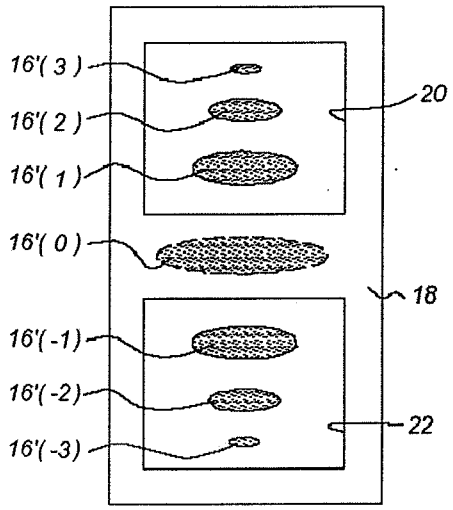

16'(3)
16'(2)
16'(1)
16'(0)
16'(-1)
16'(-2)
16'(-3)
20
18
22

Fig 5

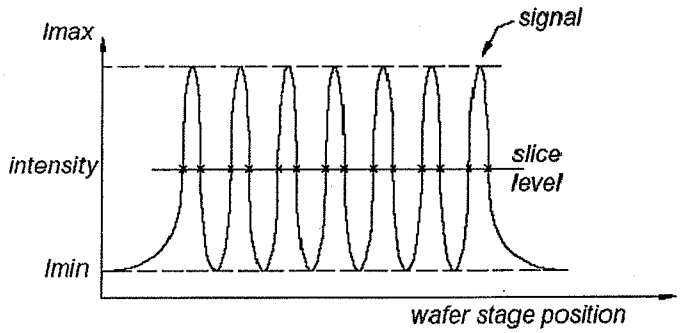

Imax
signal
intensity
slice
level
Imin
wafer stage position

Fig 6

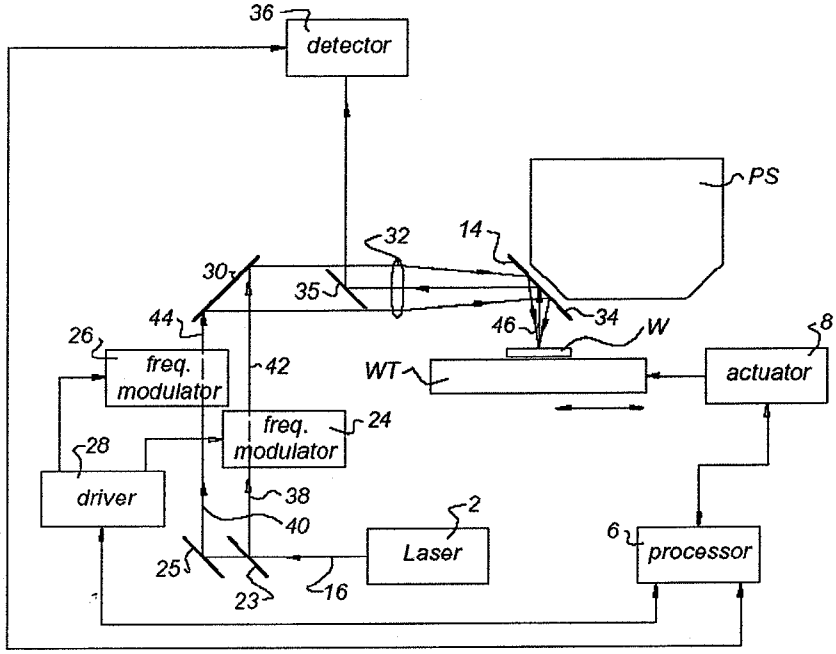
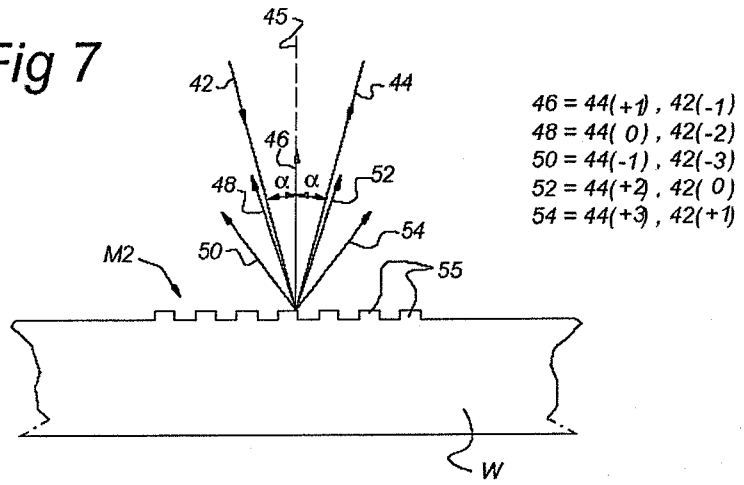


Fig 7



46 = 44(+1) , 42(-1)
48 = 44(0) , 42(-2)
50 = 44(-1) , 42(-3)
52 = 44(+2) , 42(0)
54 = 44(+3) , 42(+1)

Fig 8

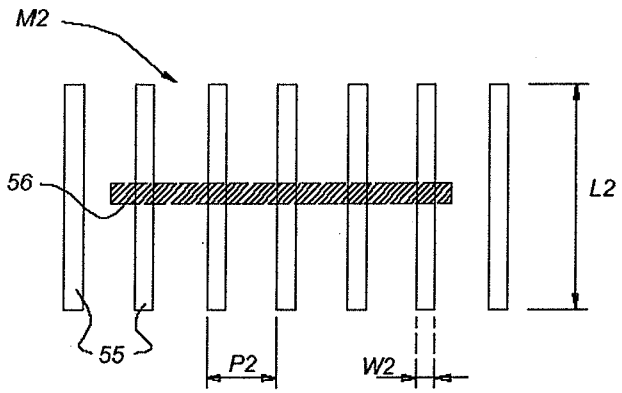

M2
56
55
P2
W2
L2

Fig 9

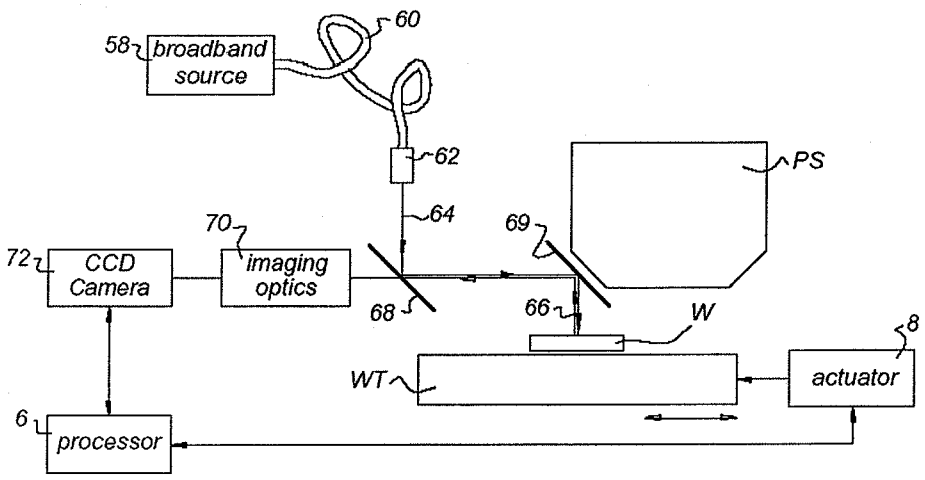

58
broadband source
60
62
PS
64
69
70
72
CCD Camera
imaging optics
68
66
W
8
WT
actuator
6
processor

Fig 10

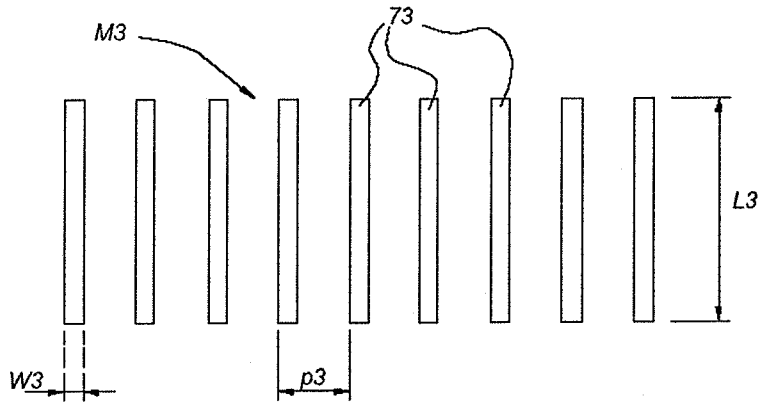

M3
73
L3
W3
p3

Fig 11

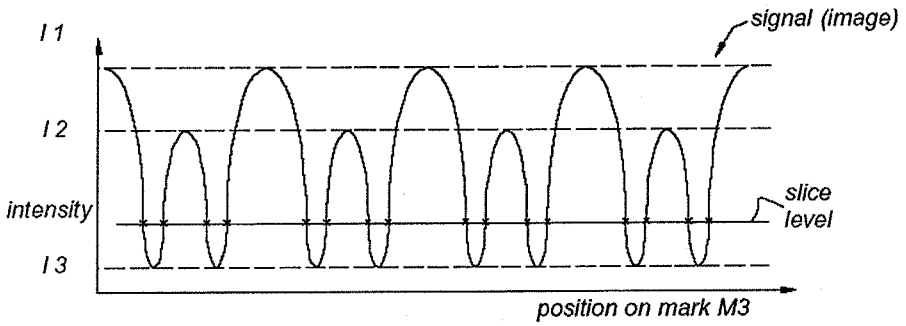

I 1
I 2
intensity
I 3
signal (image)
slice level
position on mark M3

Fig 12

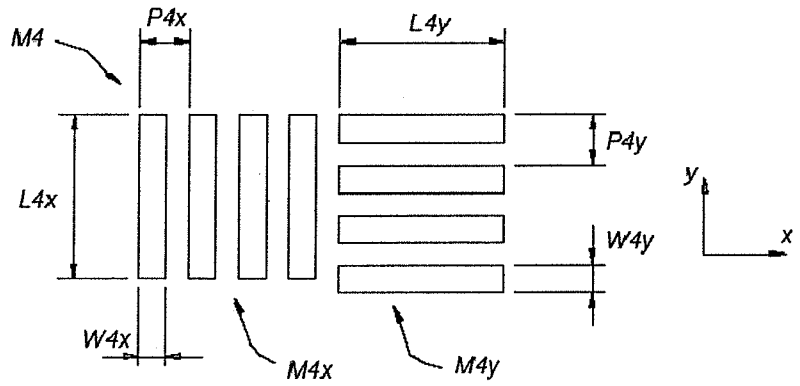

M4
P4x
L4y
P4y
L4x
W4y
y
x
W4x
M4x
M4y

Fig 13

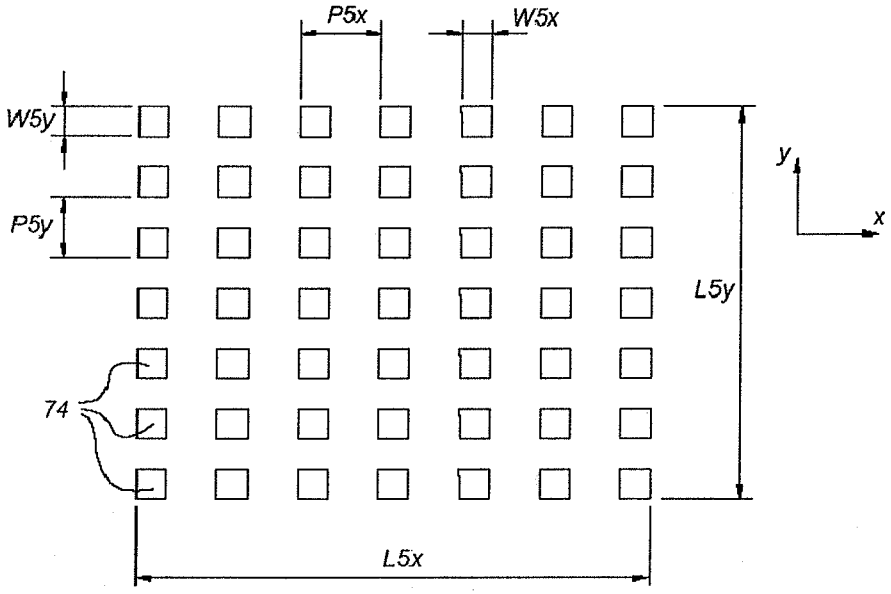

P5x
W5x
W5y
P5y
y
x
L5y
74
L5x

Fig 14

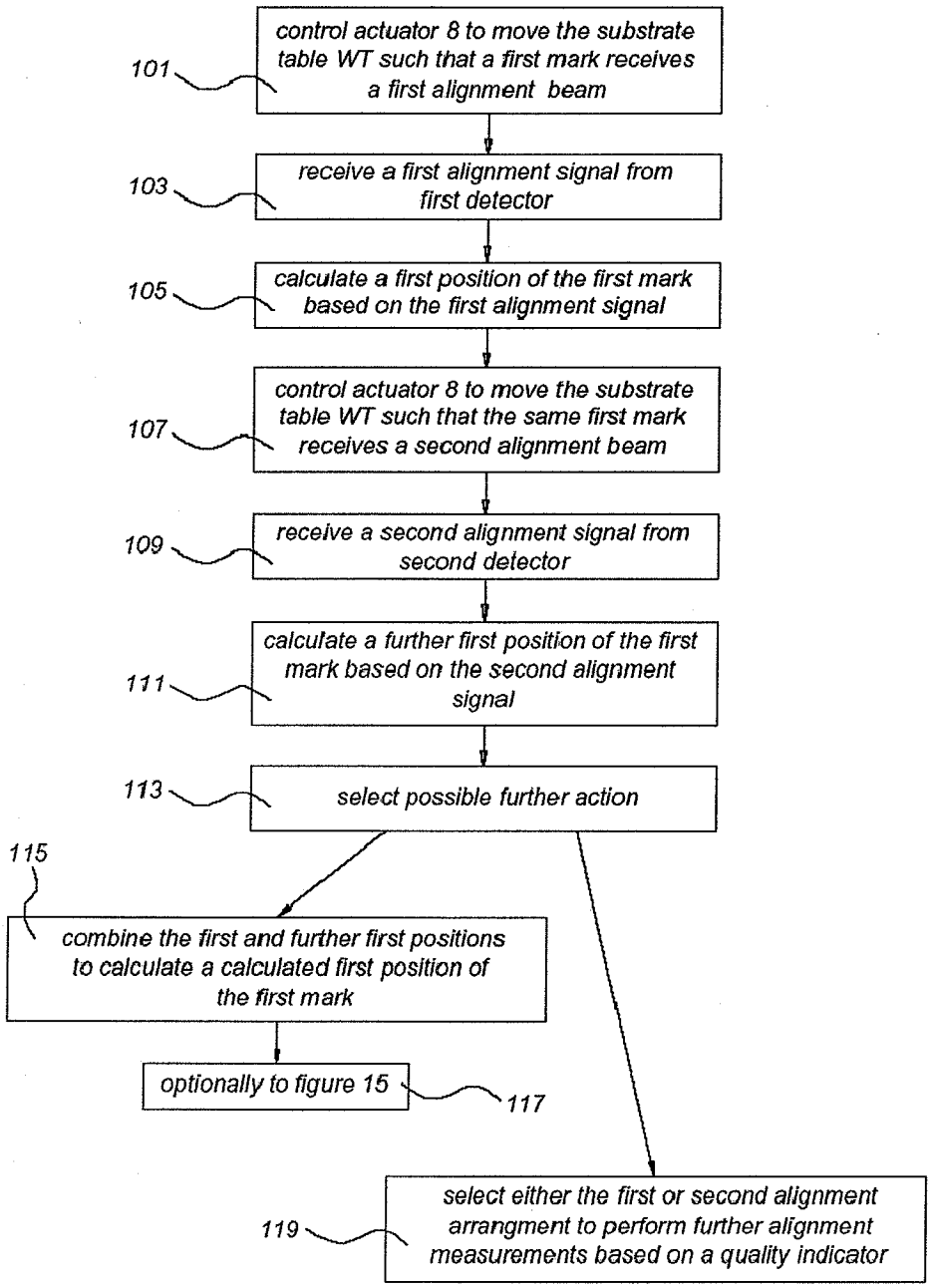

control actuator 8 to move the substrate table WT such that a first mark receives a first alignment beam
101
receive a first alignment signal from first detector
103
calculate a first position of the first mark based on the first alignment signal
105
control actuator 8 to move the substrate table WT such that the same first mark receives a second alignment beam
107
receive a second alignment signal from second detector
109
calculate a further first position of the first mark based on the second alignment signal
111
select possible further action
113
115
combine the first and further first positions to calculate a calculated first position of the first mark
optionally to figure 15
117
select either the first or second alignment arrangment to perform further alignment measurements based on a quality indicator
119

Fig 15

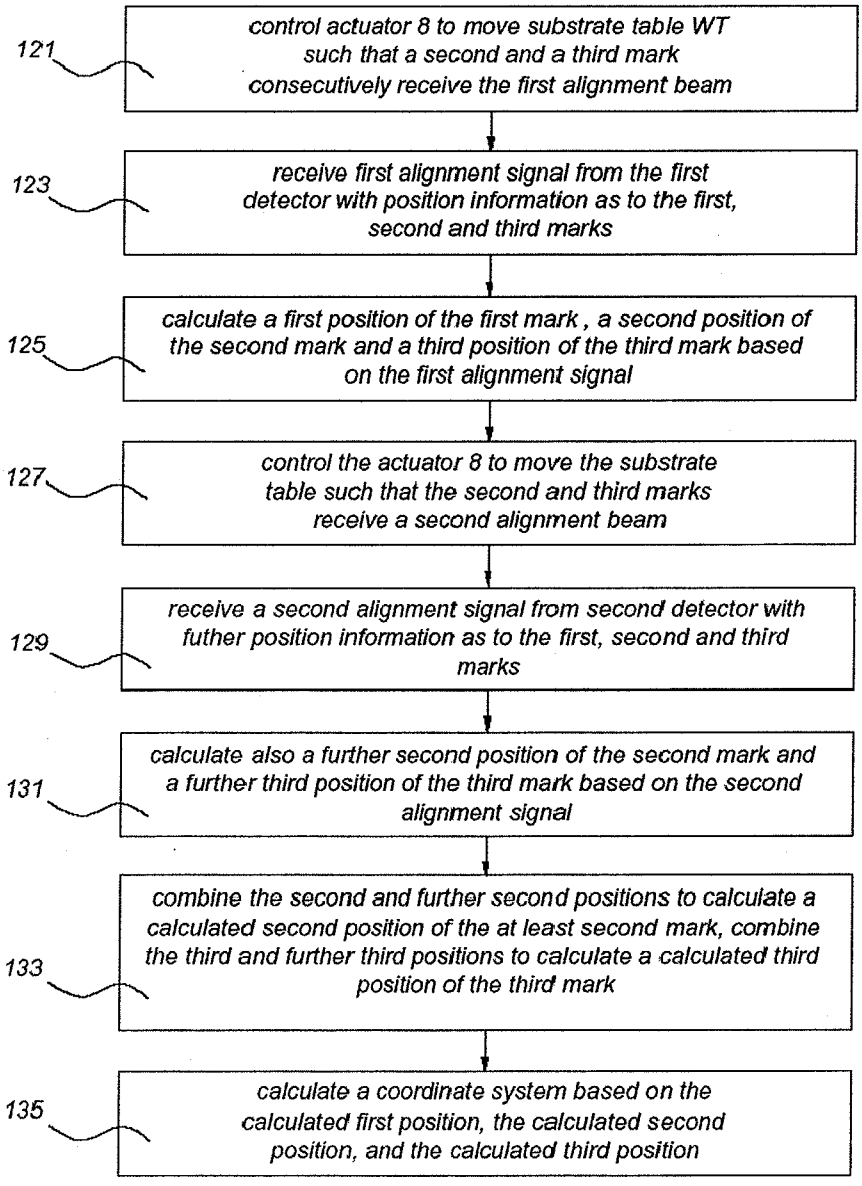
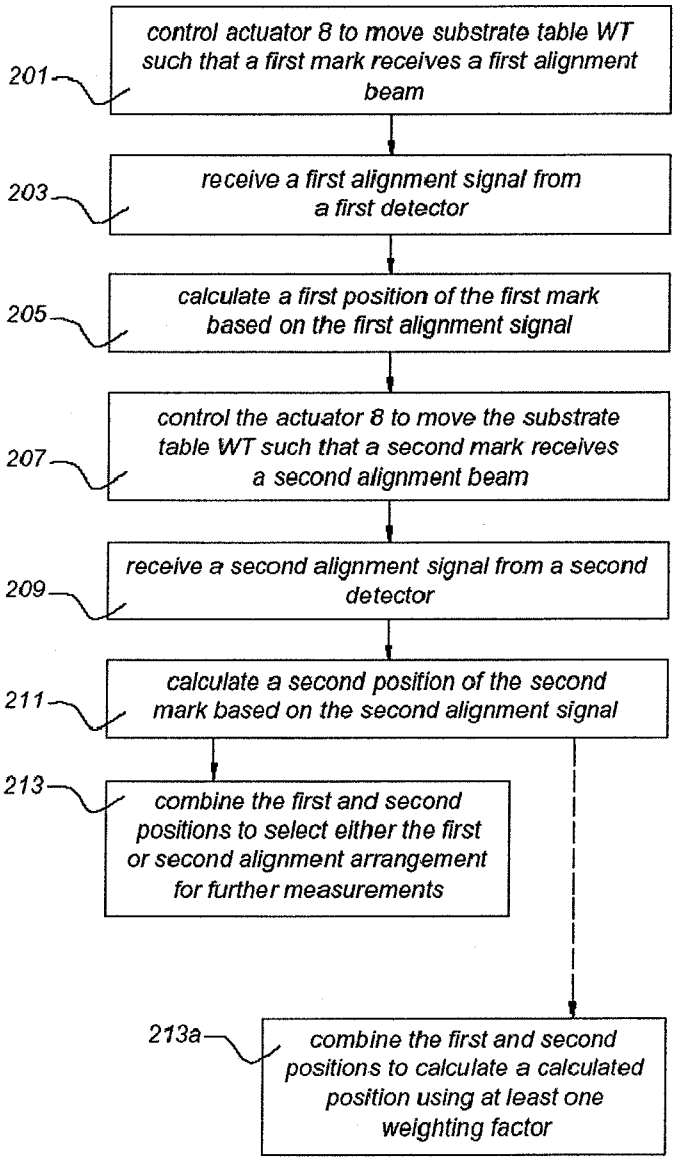

121
control actuator 8 to move substrate table WT such that a second and a third mark consecutively receive the first alignment beam
123
receive first alignment signal from the first detector with position information as to the first, second and third marks
125
calculate a first position of the first mark , a second position of the second mark and a third position of the third mark based on the first alignment signal
127
control the actuator 8 to move the substrate table such that the second and third marks receive a second alignment beam
129
receive a second alignment signal from second detector with futher position information as to the first, second and third marks
131
calculate also a further second position of the second mark and a further third position of the third mark based on the second alignment signal
133
combine the second and further second positions to calculate a calculated second position of the at least second mark, combine the third and further third positions to calculate a calculated third position of the third mark
135
calculate a coordinate system based on the calculated first position, the calculated second position, and the calculated third position

Fig 16


control actuator 8 to move substrate table WT such that a first mark receives a first alignment beam
201
receive a first alignment signal from a first detector
203
calculate a first position of the first mark based on the first alignment signal
205
control the actuator 8 to move the substrate table WT such that a second mark receives a second alignment beam
207
receive a second alignment signal from a second detector
209
calculate a second position of the second mark based on the second alignment signal
211
combine the first and second positions to select either the first or second alignment arrangement for further measurements
213
combine the first and second positions to calculate a calculated position using at least one weighting factor
213a