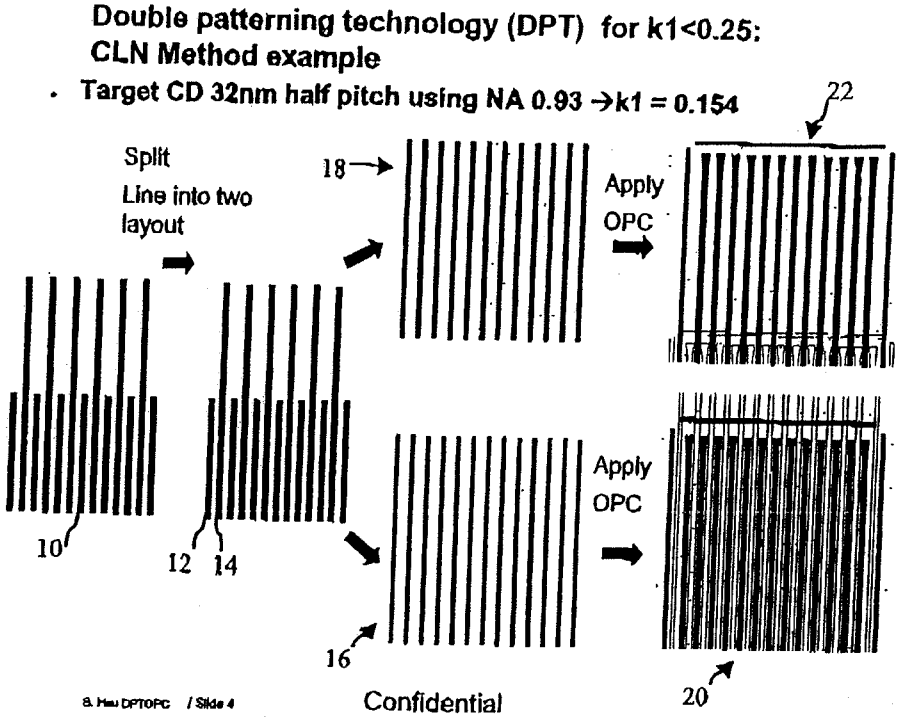

Double patterning technology (DPT) for k1<0.25:
CLN Method example
• Target CD 32nm half pitch using NA 0.93 →k1 = 0.154
Split
Line into two
layout
18
22
Apply
OPC
Apply
OPC
10
12
14
16
20
Confidential

FIG. 1

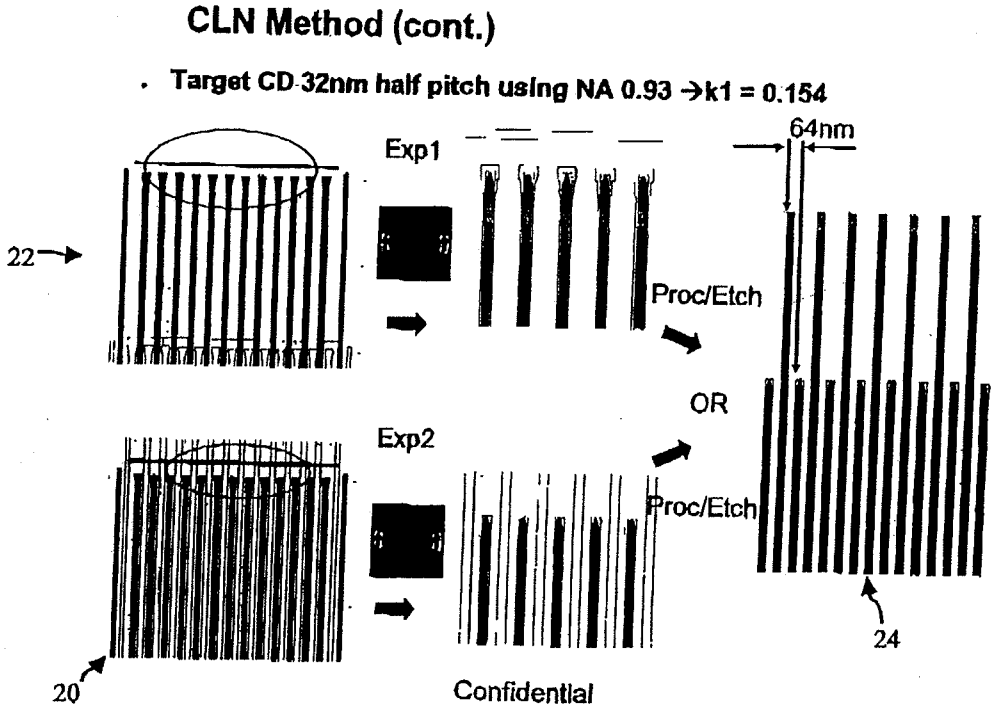

CLN Method (cont.)
• Target CD 32nm half pitch using NA 0.93 →k1 = 0.154
Exp1
64nm
22
Proc/Etch
OR
Exp2
Proc/Etch
24
20
Confidential

FIG. 2

DEL CLN imaging

- After double exposures the average intensity modulation is flat
- The final print image is the 'OR' of each exposure
- Needs materials/processing to preserve the images for each exposure

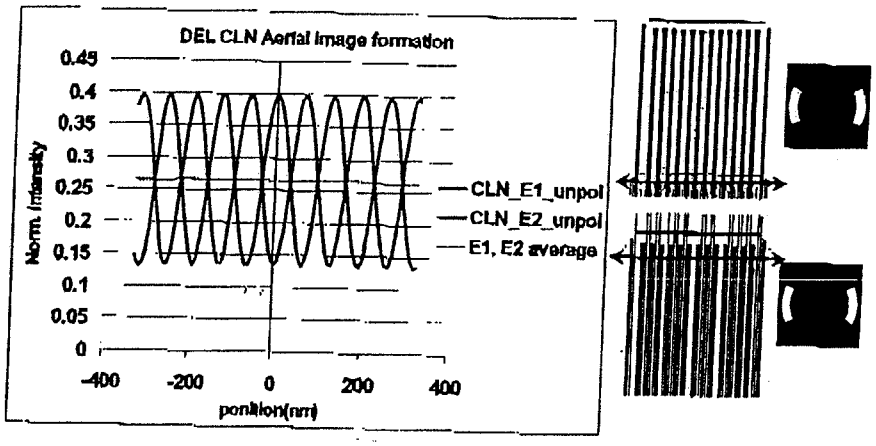


FIG. 3

Pattern split impact on patterning

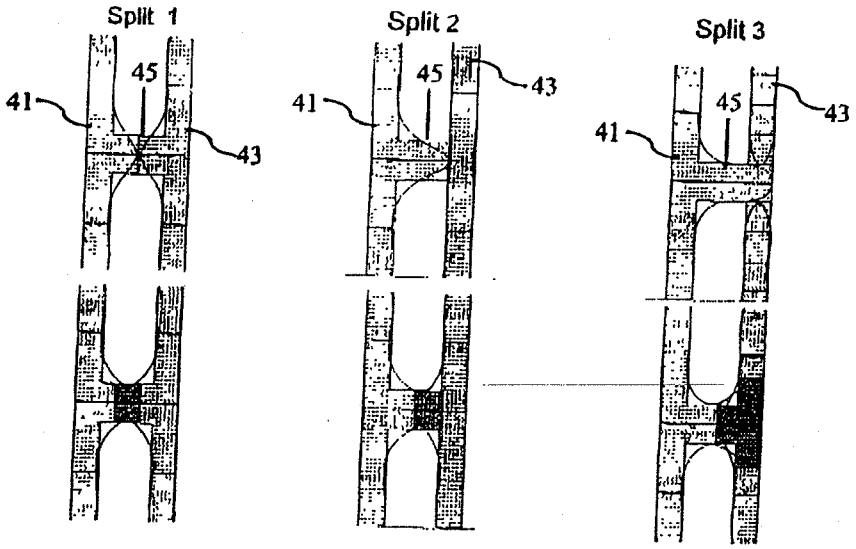


FIG. 4

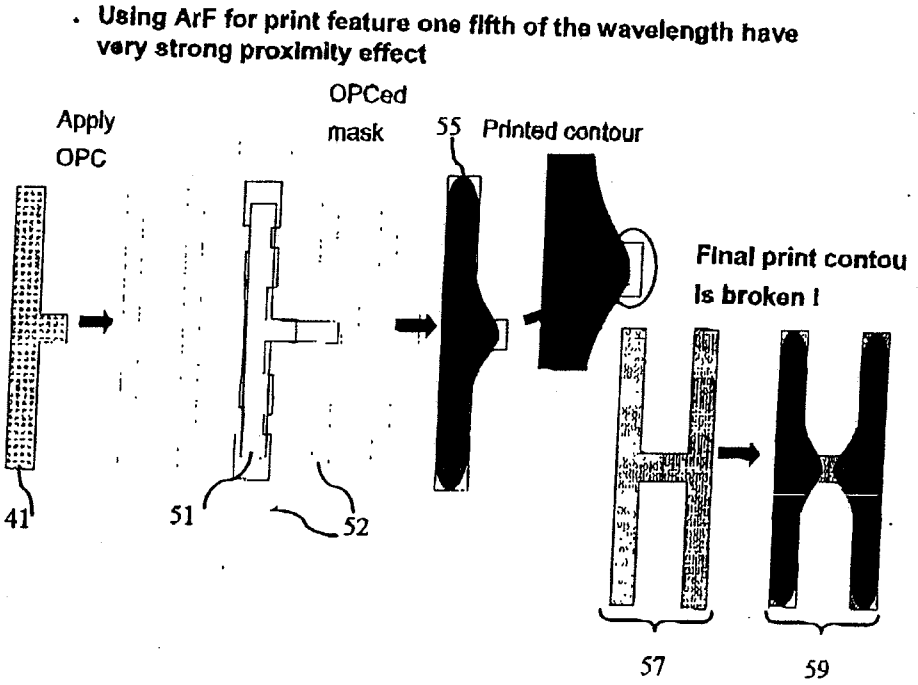

• Using ArF for print feature one fifth of the wavelength have very strong proximity effect
Apply OPC
OPCed mask
55
Printed contour
Final print contou
Is broken !
41
51
52
57
59

FIG. 5

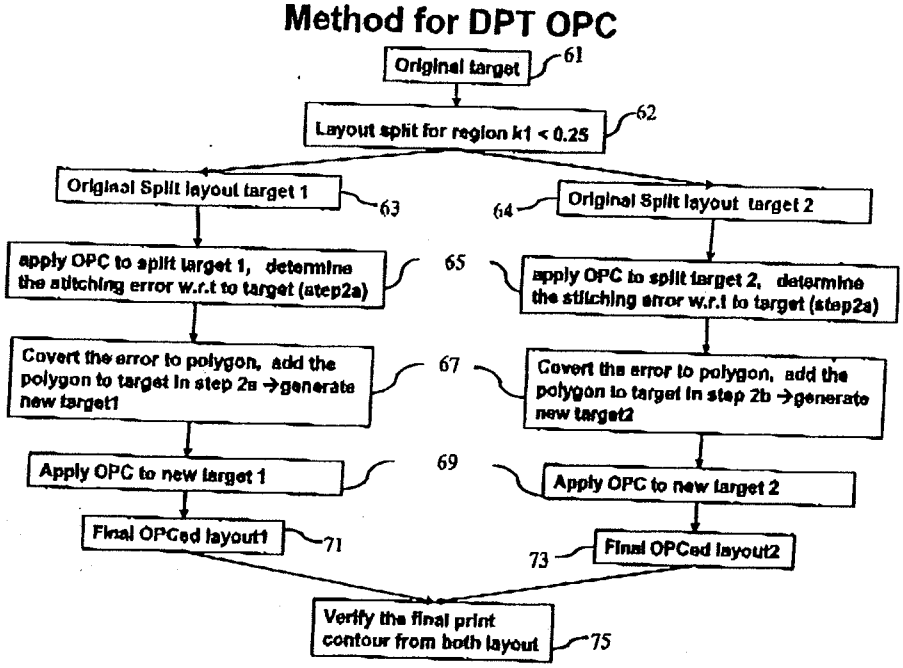

Method for DPT OPC
Original target
61
Layout split for region k1 < 0.25
62
Original Split layout target 1
63
64
Original Split layout target 2
apply OPC to split target 1, determine the stitching error w.r.t to target (step2a)
65
apply OPC to split target 2, determine the stitching error w.r.t to target (step2a)
Covert the error to polygon, add the polygon to target in step 2a →generate new target1
67
Covert the error to polygon, add the polygon to target in step 2b →generate new target2
Apply OPC to new target 1
69
Apply OPC to new target 2
Final OPCed layout1
71
73
Final OPCed layout2
Verify the final print contour from both layout
75

FIG. 6

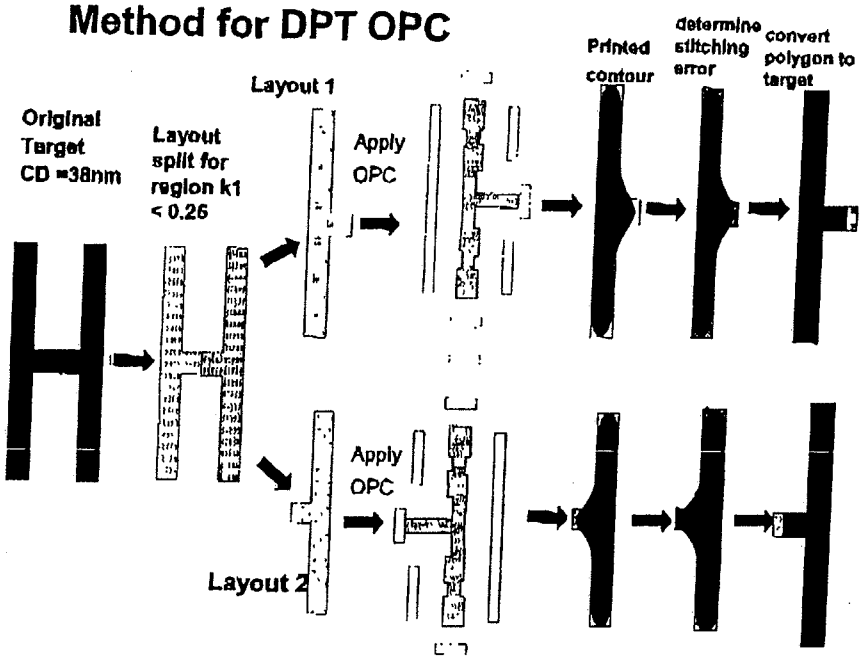

Method for DPT OPC
Original Target CD =38nm
Layout split for region k1 < 0.26
Layout 1
Layout 2
Apply OPC
Apply OPC
Printed contour
determine stitching error
convert polygon to target

FIG. 7

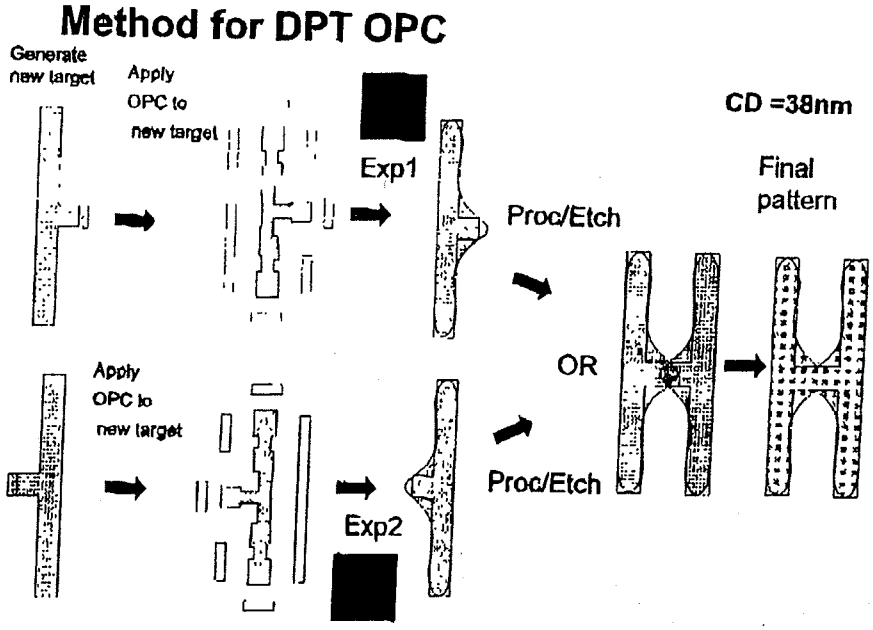

Method for DPT OPC
Generate new target
Apply OPC to new target
Exp1
Proc/Etch
CD =38nm
Final pattern
Apply OPC to new target
OR
Exp2
Proc/Etch

FIG. 8

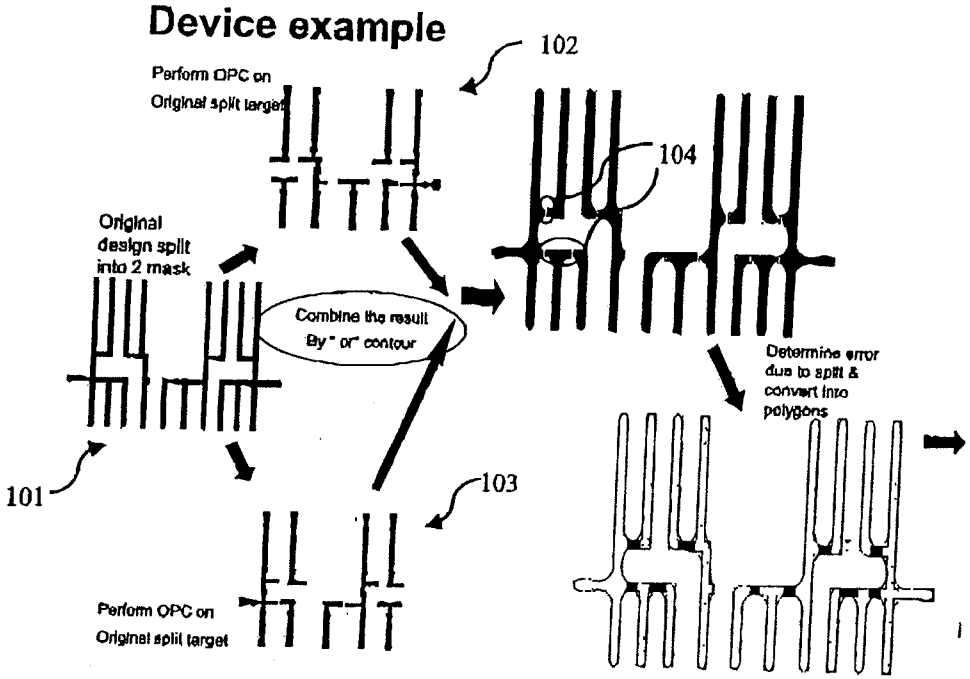

Device example
102
Perform OPC on
Original split target
104
Original
design split
into 2 mask
Combine the result
By " or" contour
Determine error
due to split &
convert into
polygons
101
103
Perform OPC on
Original split target

FIG. 9

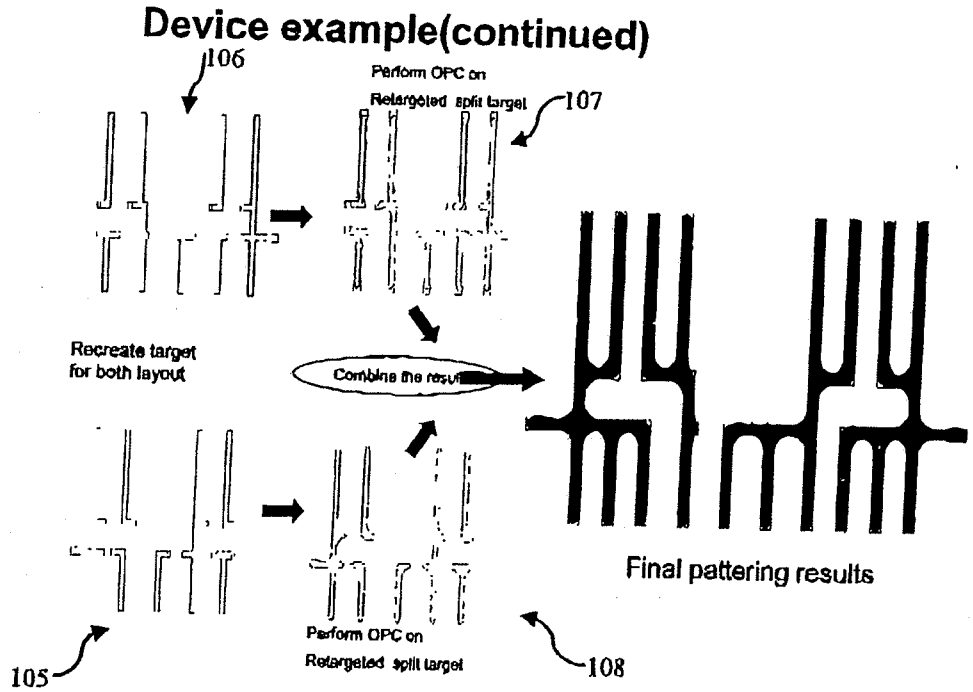

Device example(continued)
106
Perform OPC on
Retargeted split target
107
Recreate target
for both layout
Combine the result
Final pattering results
105
Perform OPC on
Retargeted split target
108

FIG. 10

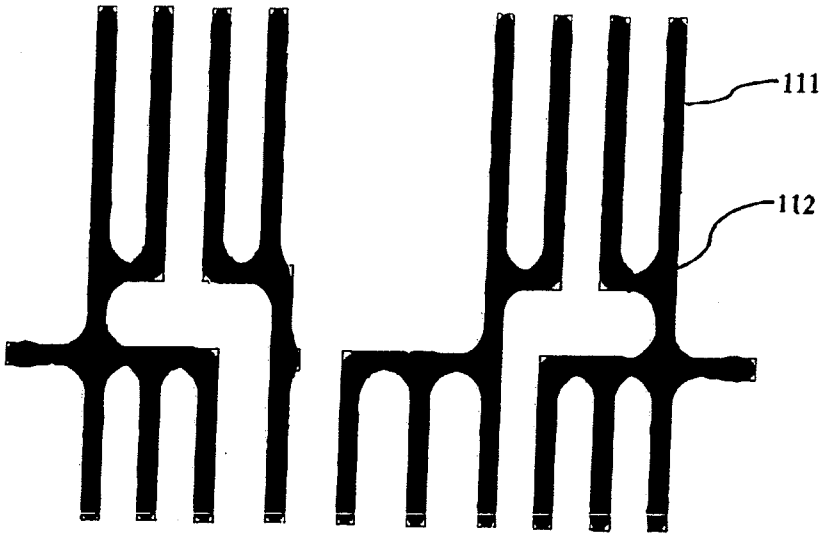


FIG. 11

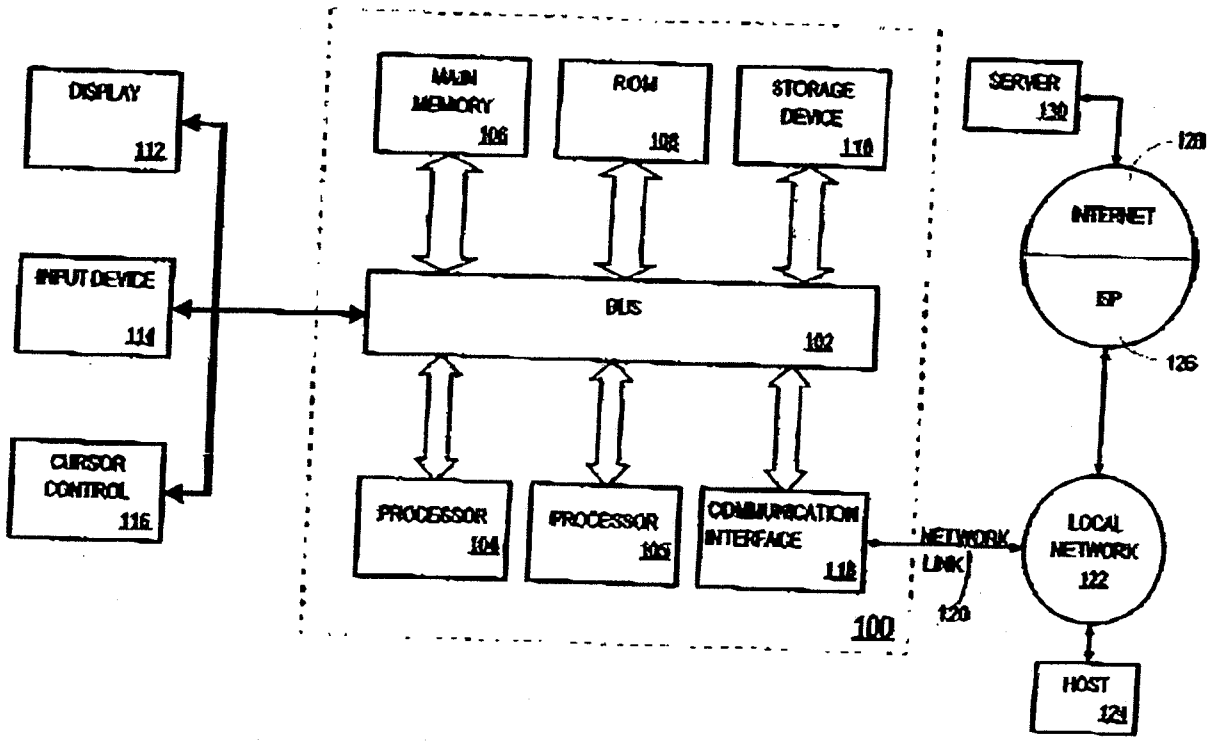

DISPLAY
112
INPUT DEVICE
114
CURSOR CONTROL
116
MAIN MEMORY
106
ROM
108
STORAGE DEVICE
110
BUS
102
PROCESSOR
104
PROCESSOR
105
COMMUNICATION INTERFACE
118
100
NETWORK LINK
120
SERVER
130
INTERNET
ISP
128
126
LOCAL NETWORK
122
HOST
124

FIG. 12

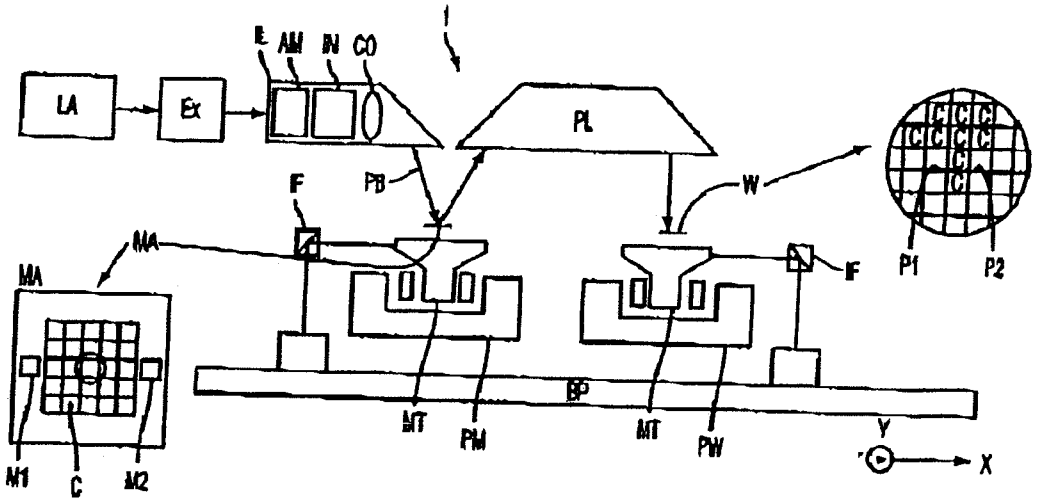


FIG. 13