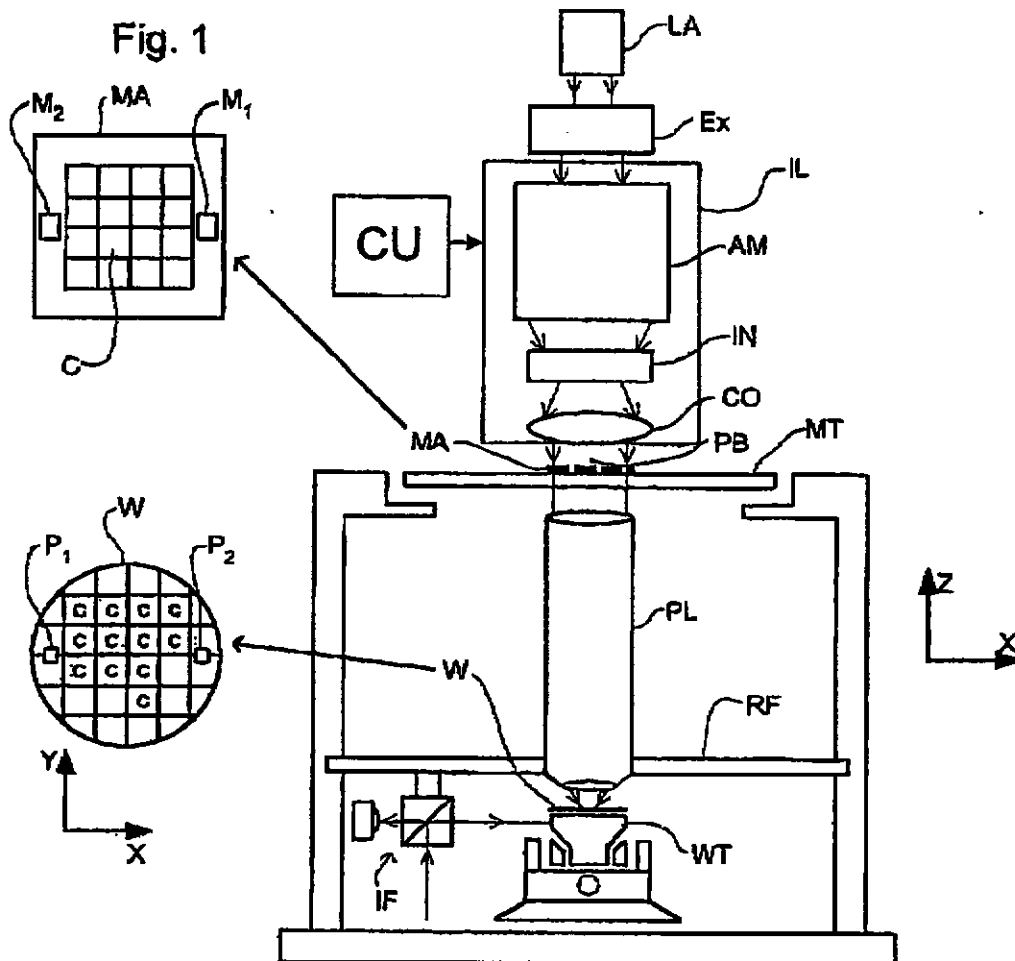




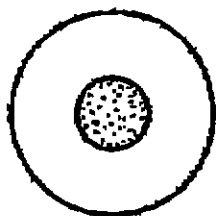


FIG. 2

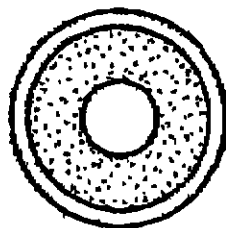


FIG. 3

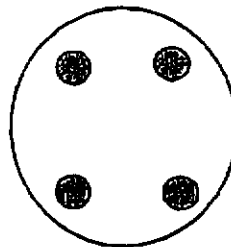


FIG. 4



FIG. 5

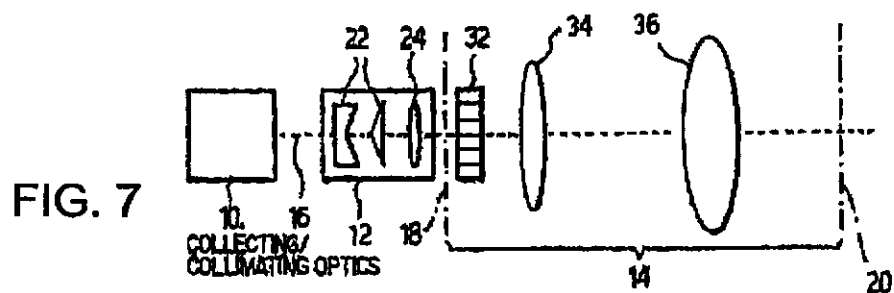
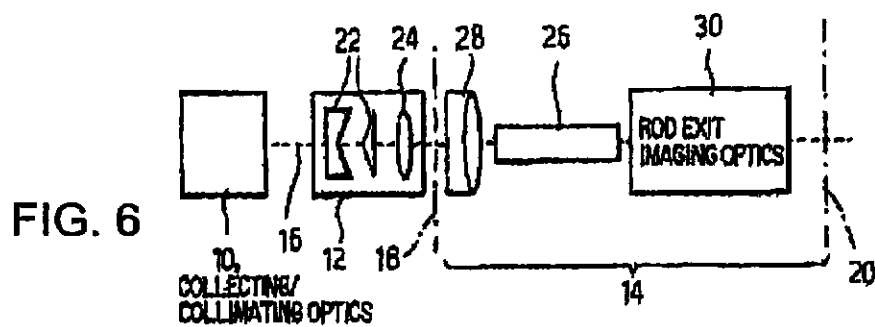


FIG. 8

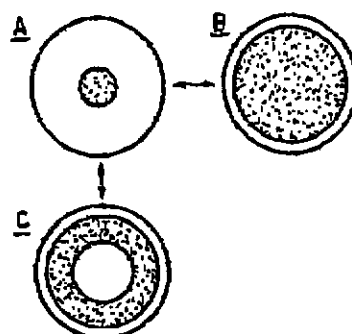
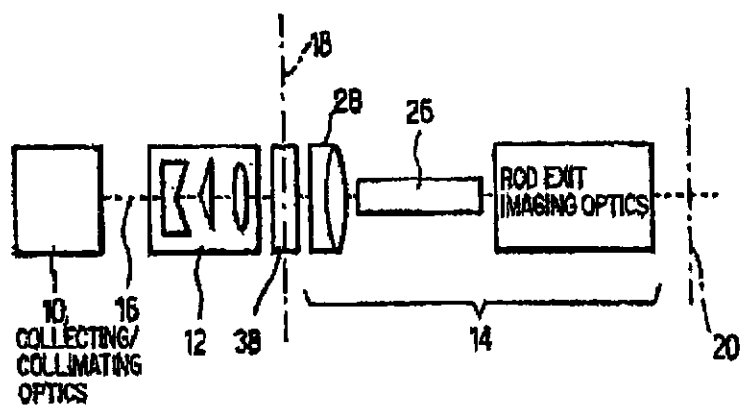


FIG. 9



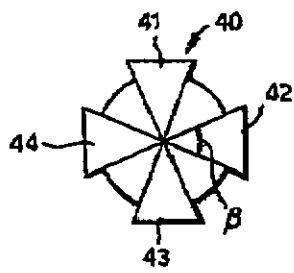


FIG. 10a

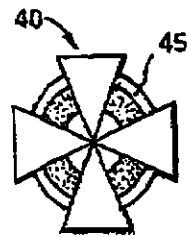


FIG. 10b

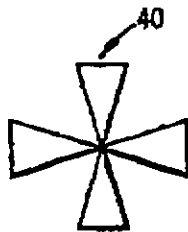


FIG. 11

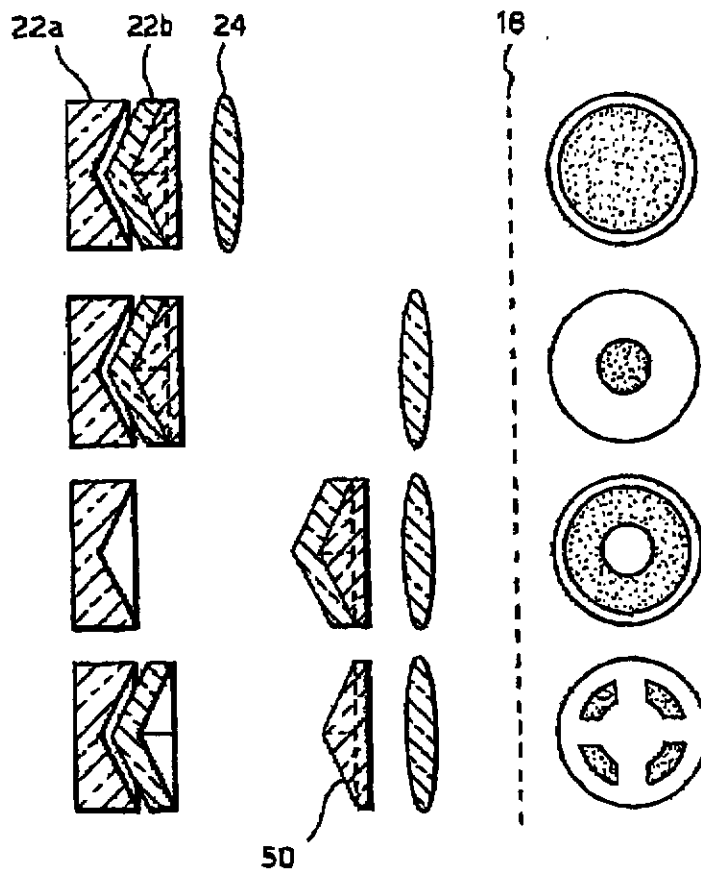


FIG. 12

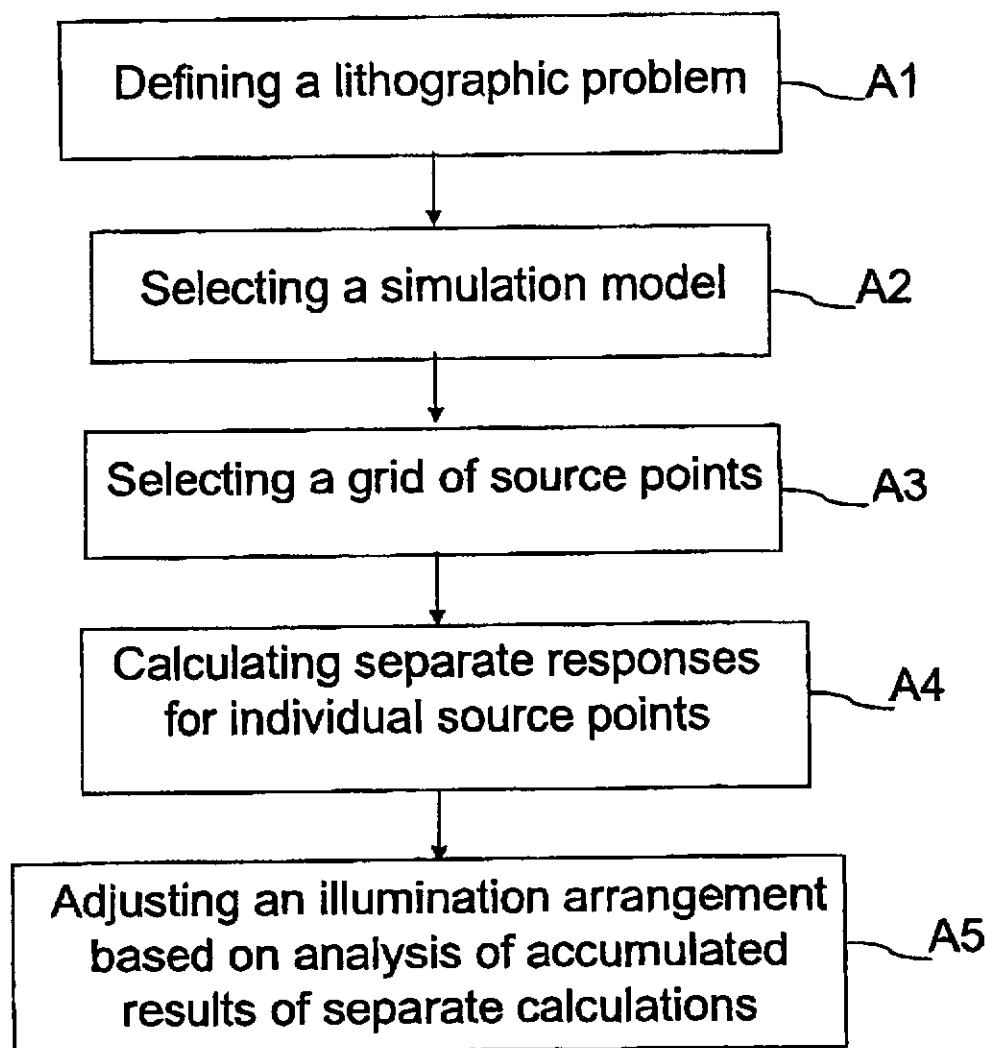
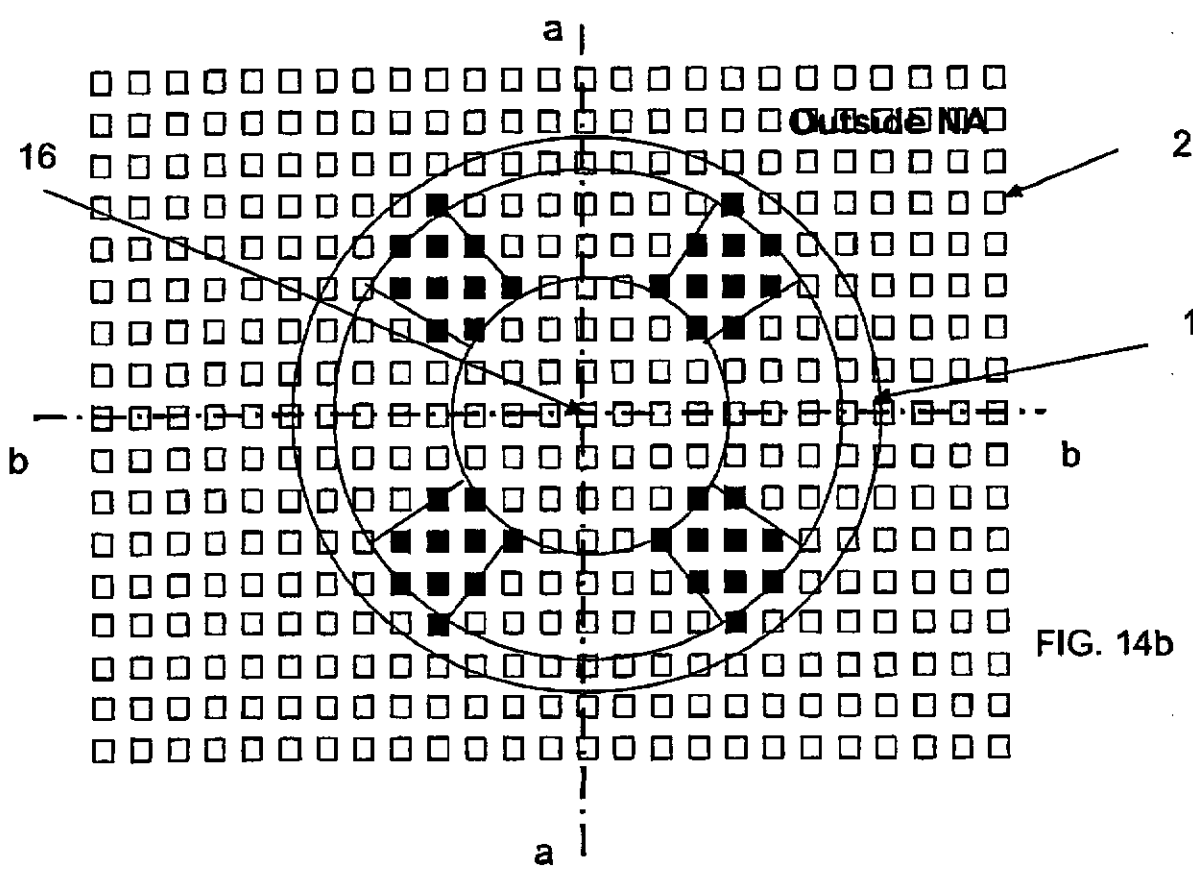
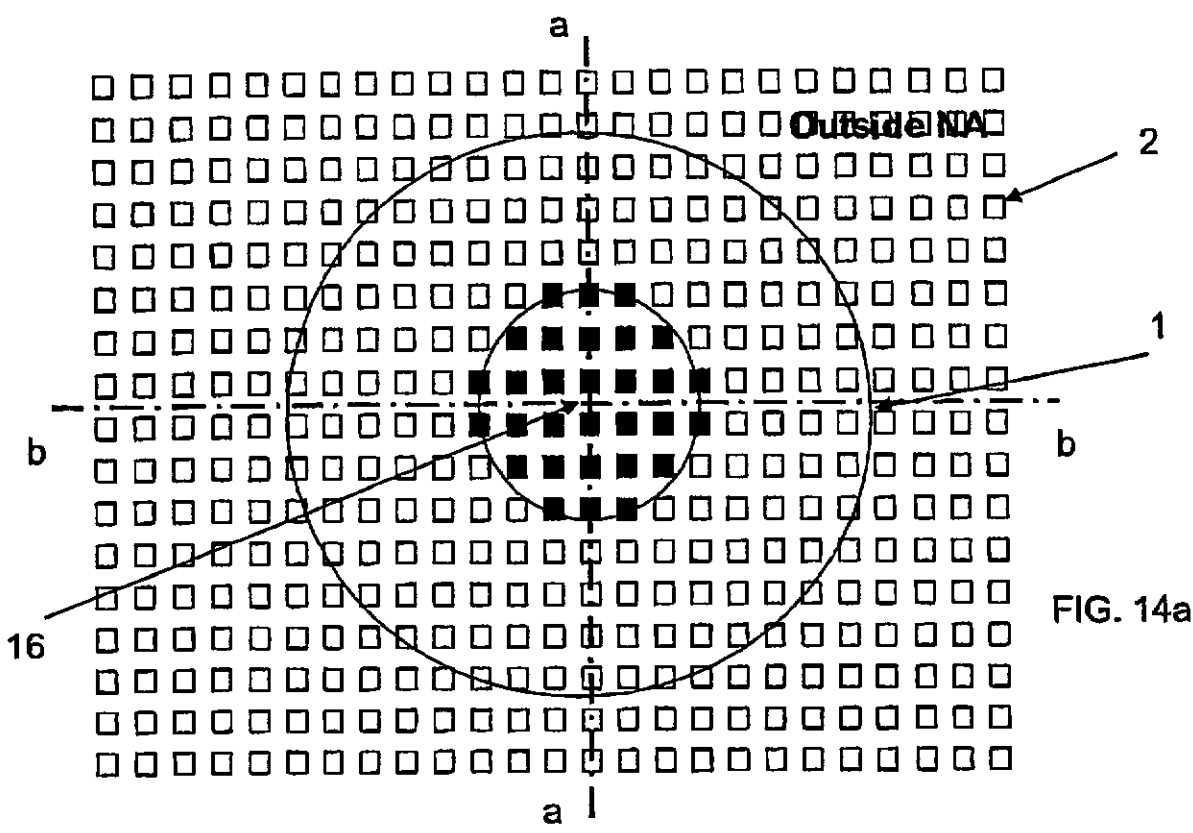


FIG. 13



65nm CPL isolated lines, 193nm
0.85NA, scalar aerial image simulations
0.2 μ m defocus

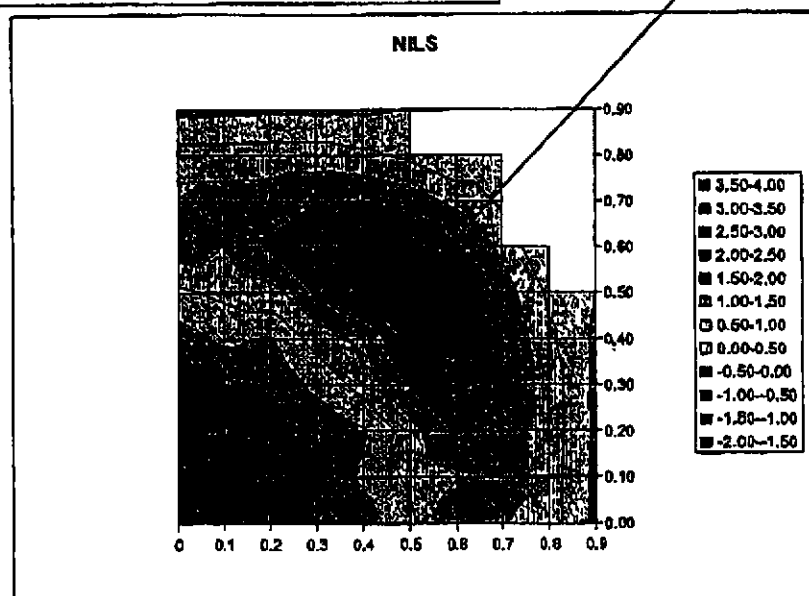


FIG. 15

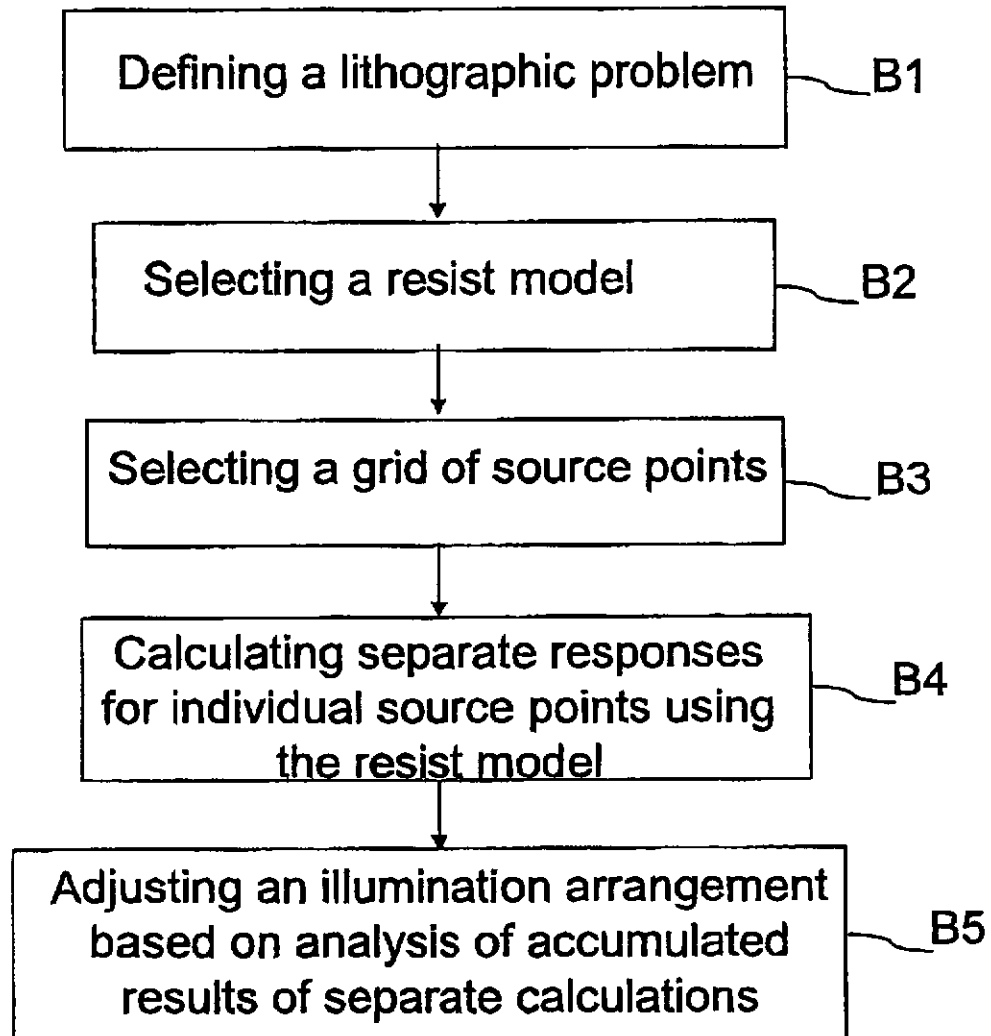


FIG. 16

65nm CPL isolated lines, 193nm
0.85NA, TOK63 vector resist simulations

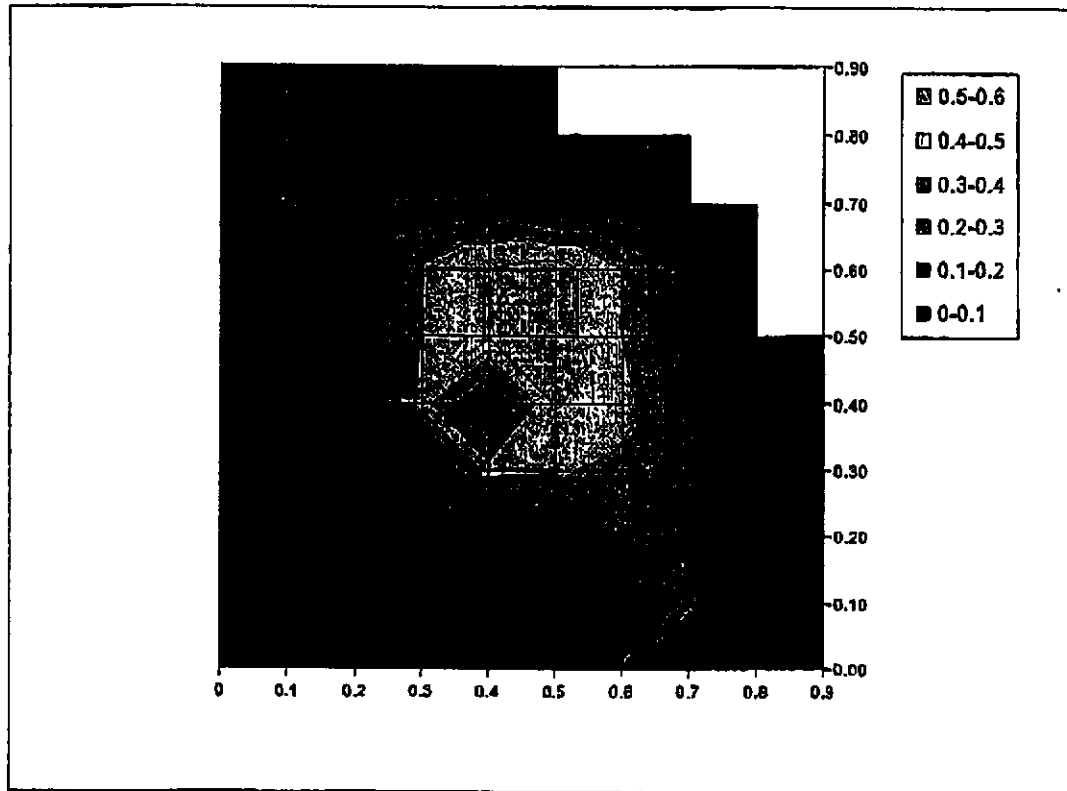


FIG. 17

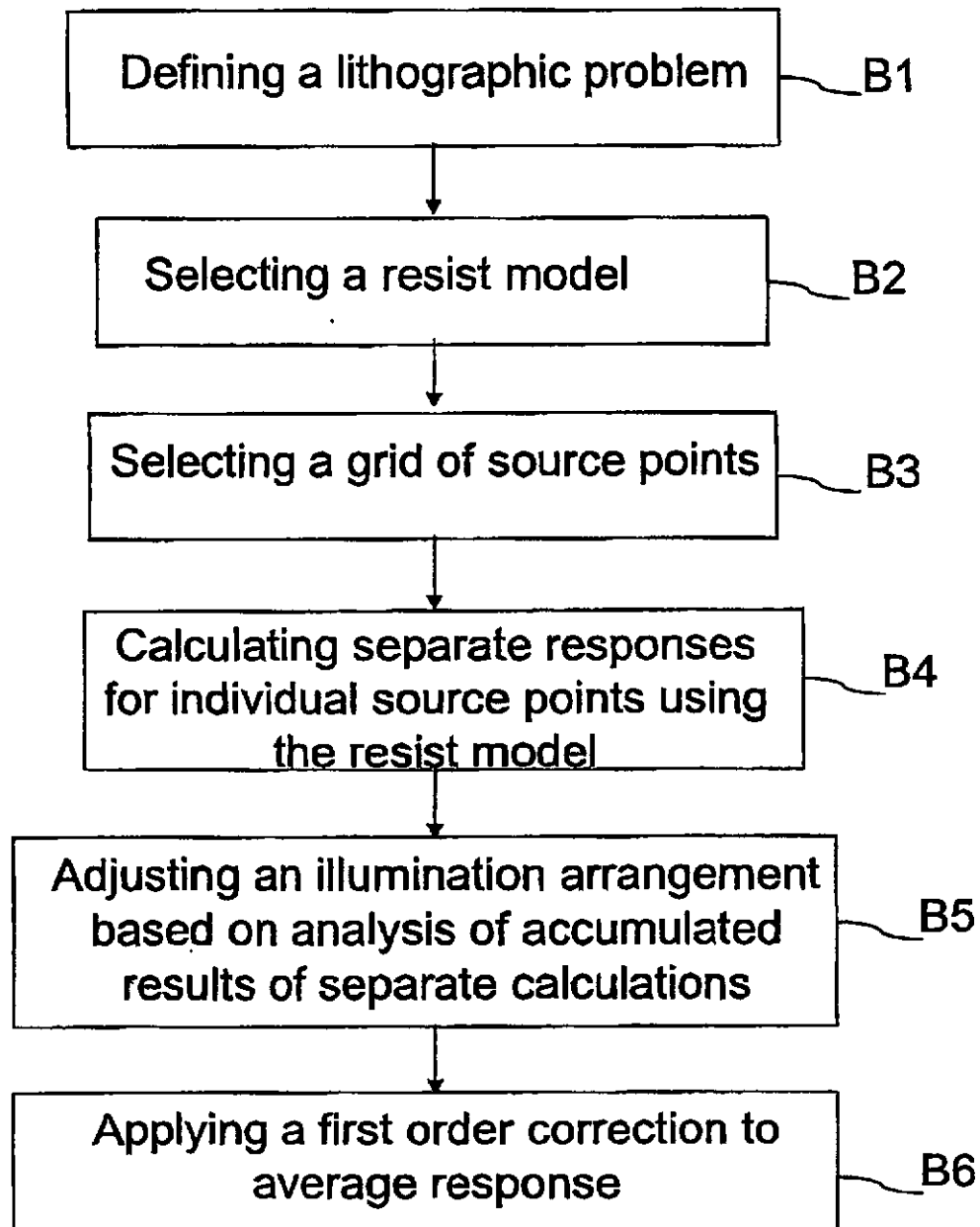


FIG. 18

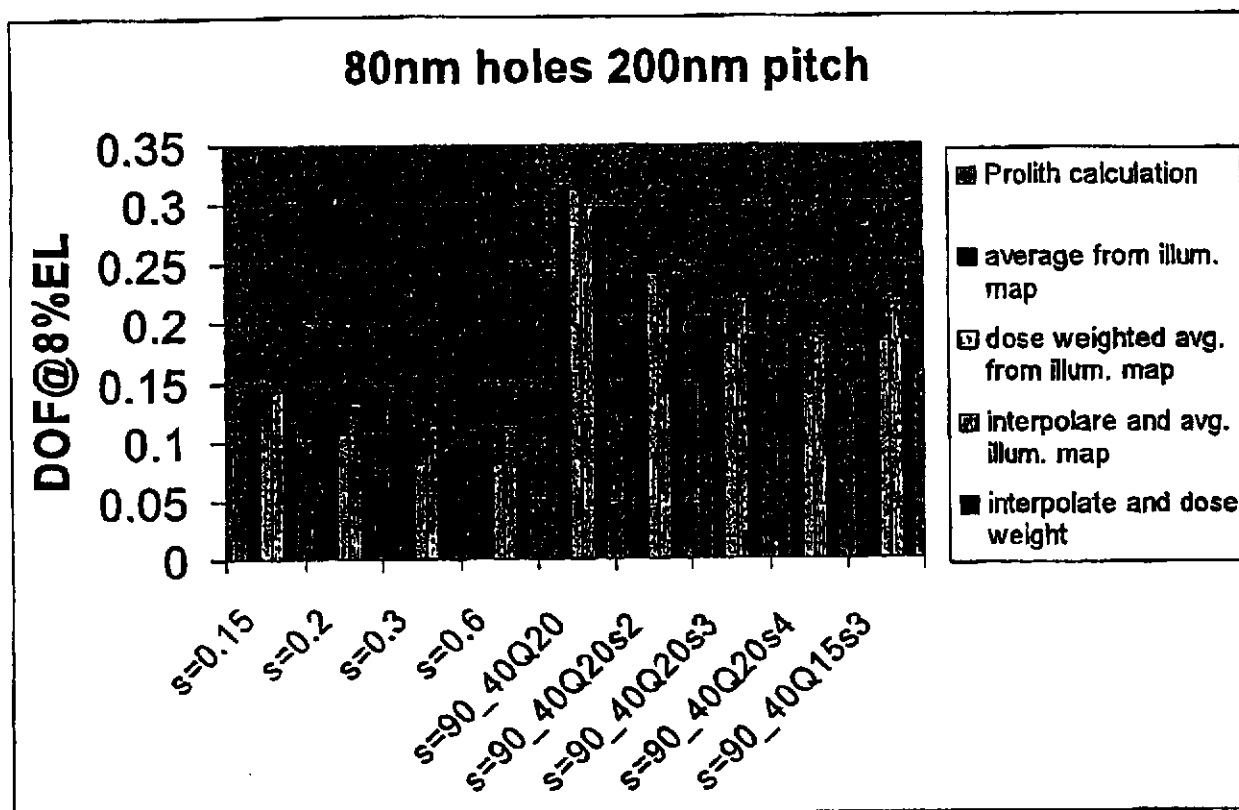
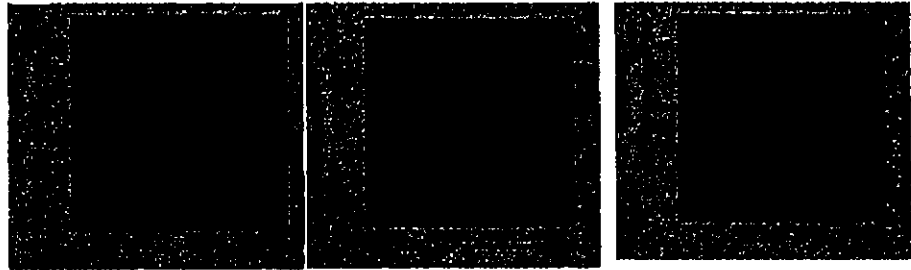
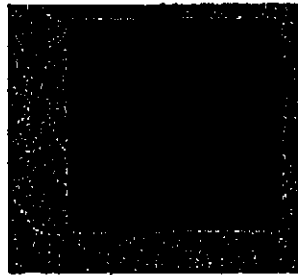


FIG. 19

- 0.15, 0.2, 0.3,
0.6 σ conv



- 0.9/0.4 Q20



- 0.2, 0.3, 0.4 σ + 0.9/0.4 Q20



- 0.3 σ + 0.9/0.4 Q15



FIG. 20

trial illuminator	prediction based on weighted and interpolated source measurements	Prolith simulation with this illuminator
0.85_0.55Q30	0.293u	0.23u
0.75_0.55Q20	0.416	0.41
0.80_0.60Q20	0.383	0.355
0.80_0.60annular	0.110	0.10
0.75_0.55annular	0.118	0.105

FIG. 21

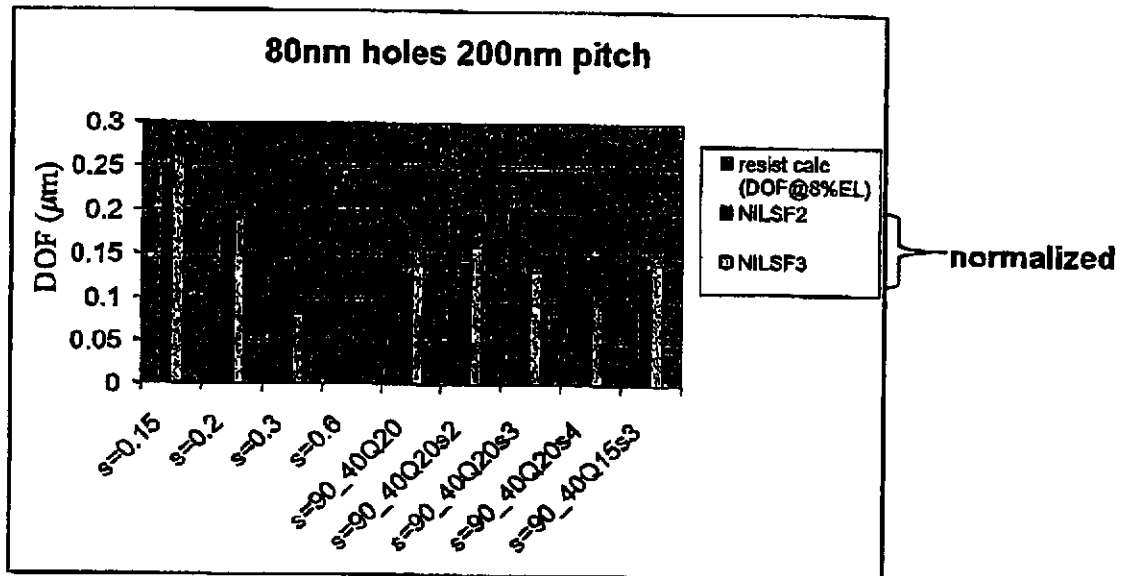


FIG. 22

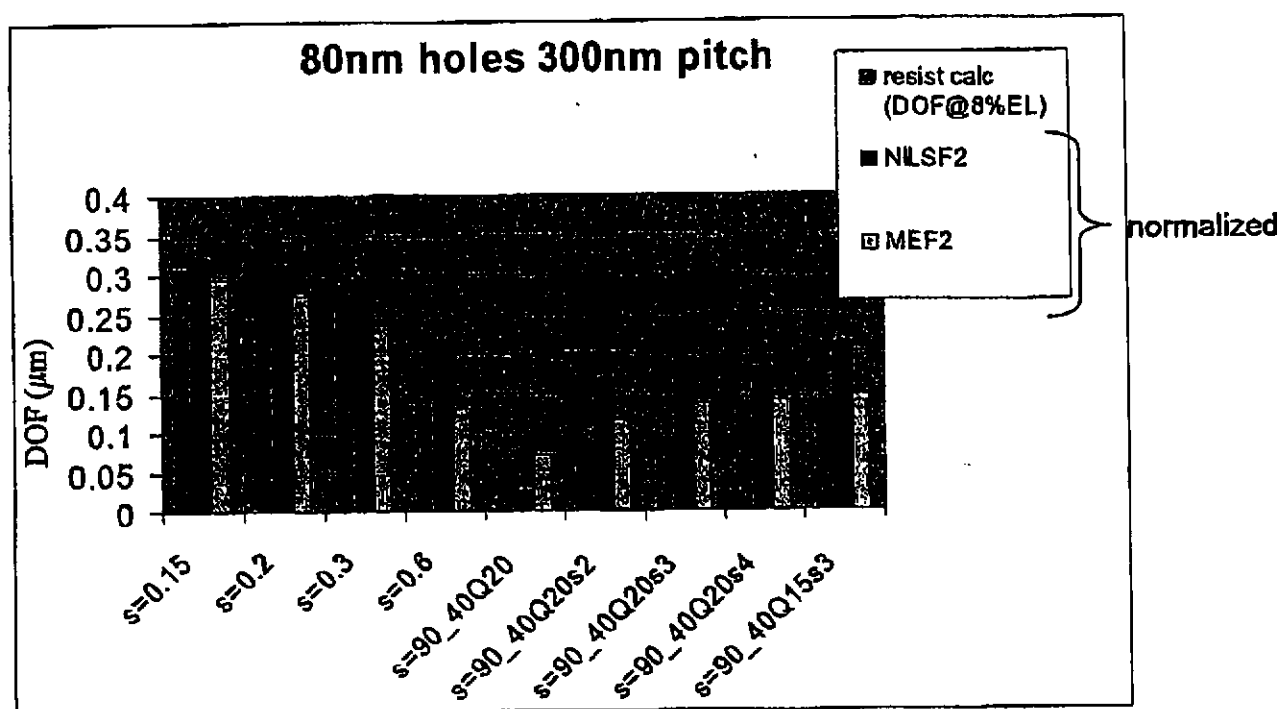


FIG. 23

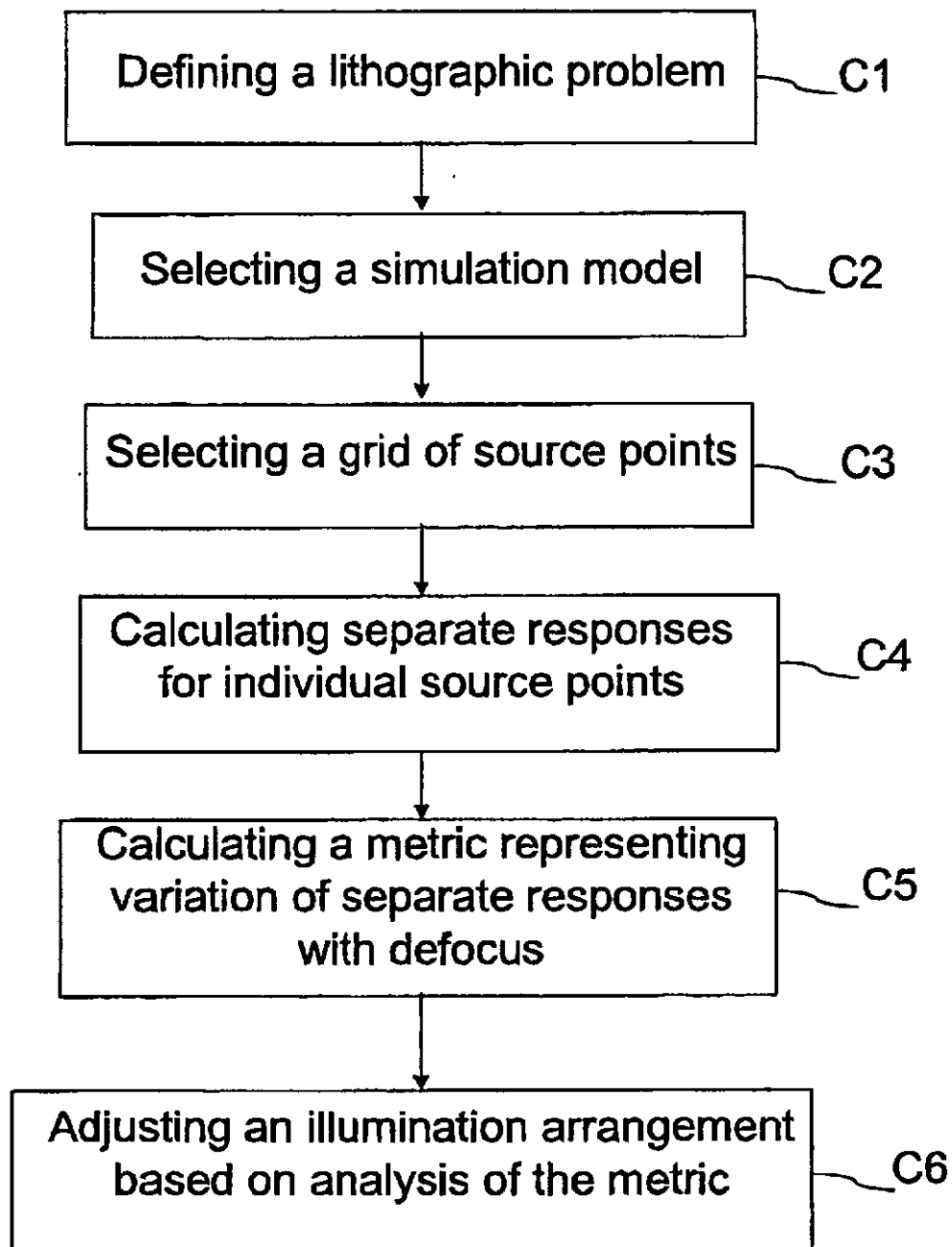


FIG. 24

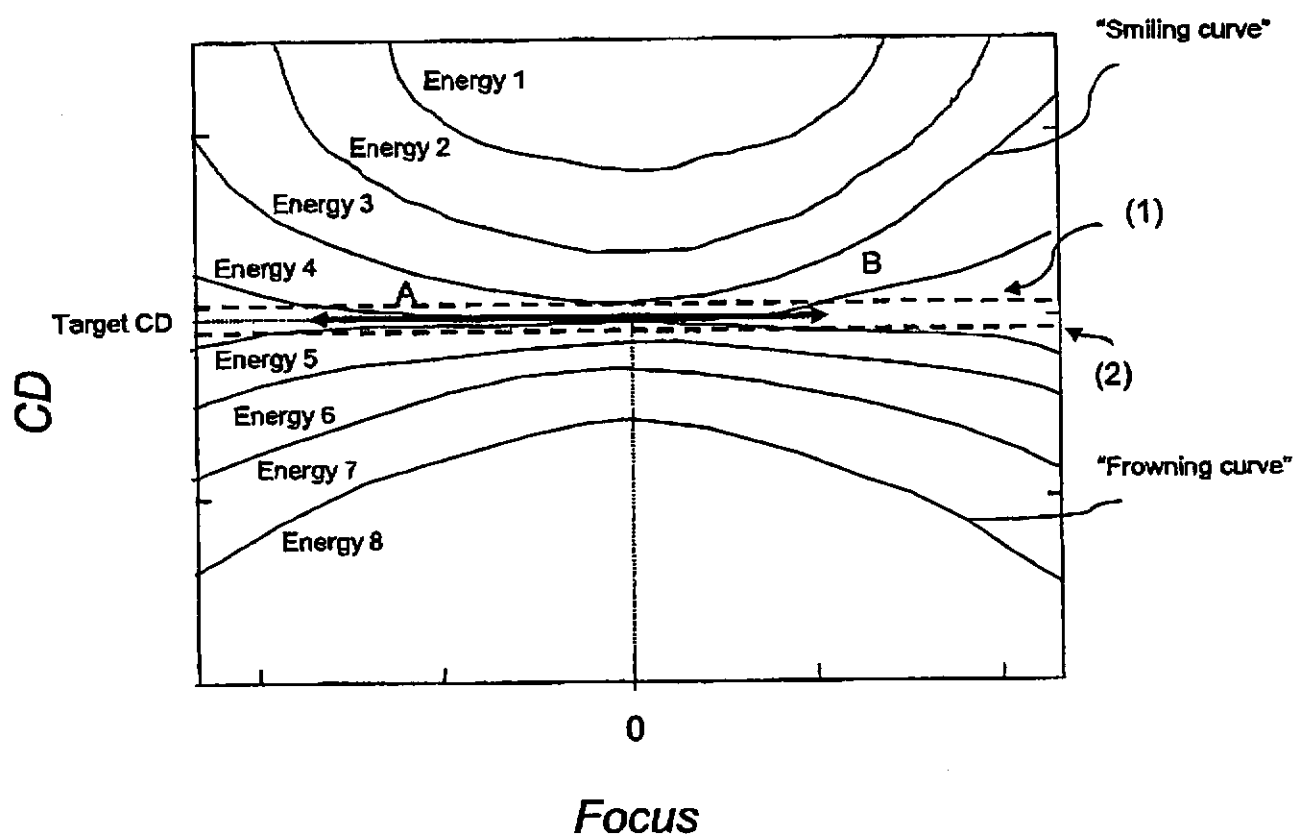


FIG. 25

Scanned with CD-Bench 4.0

FIG. 26a

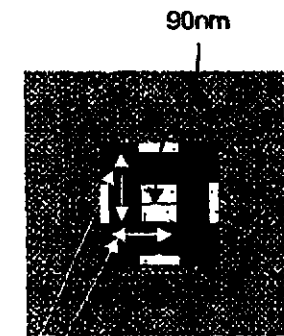
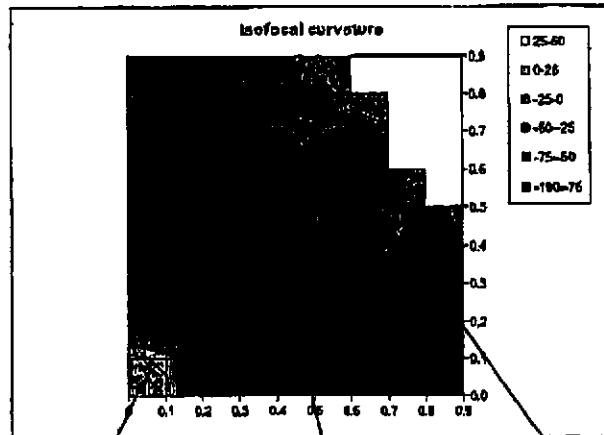
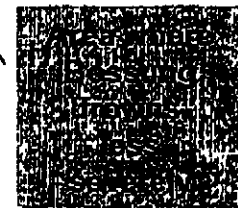
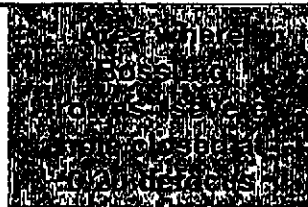
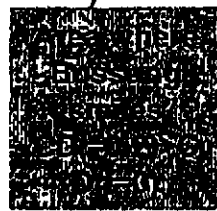
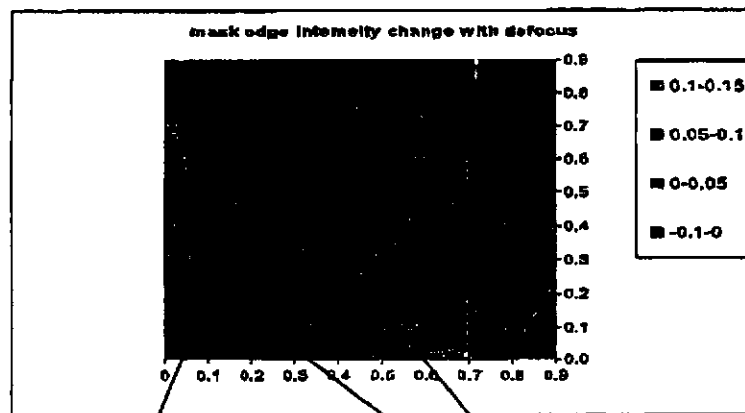


FIG. 26c



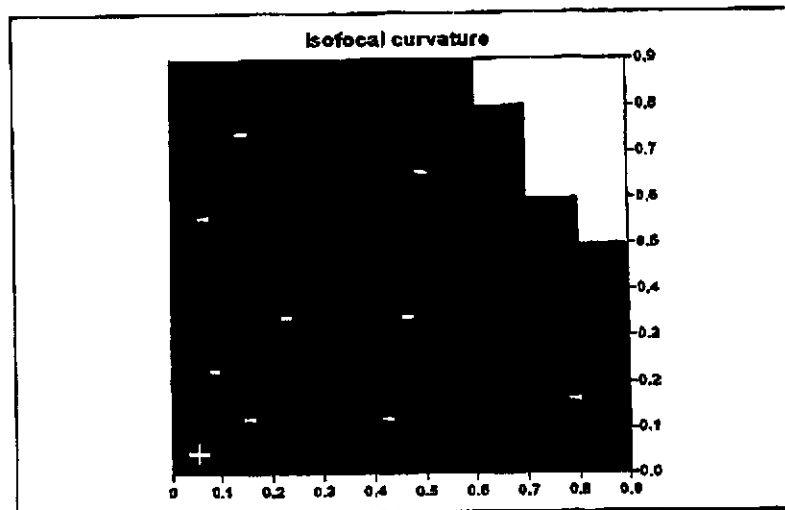
Scanned with CD-Bench 4.0

FIG. 26b



TEST: 1003 FILE: 024015

FIG. 27a



TEST: 1003 FILE: 024015

FIG. 27b

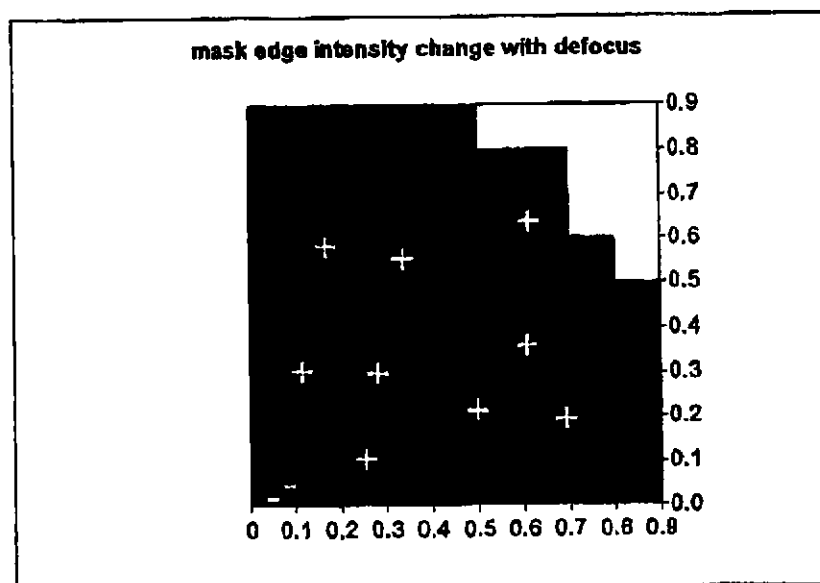


FIG. 28

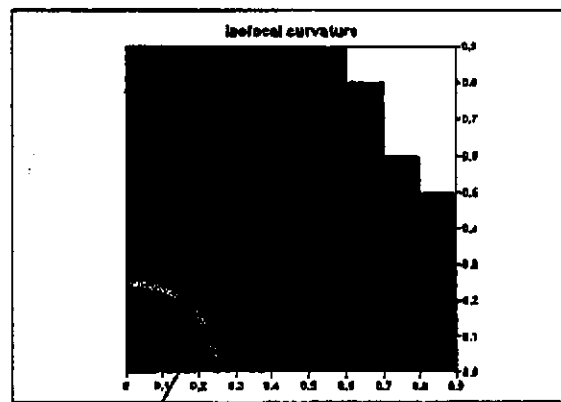


FIG. 29

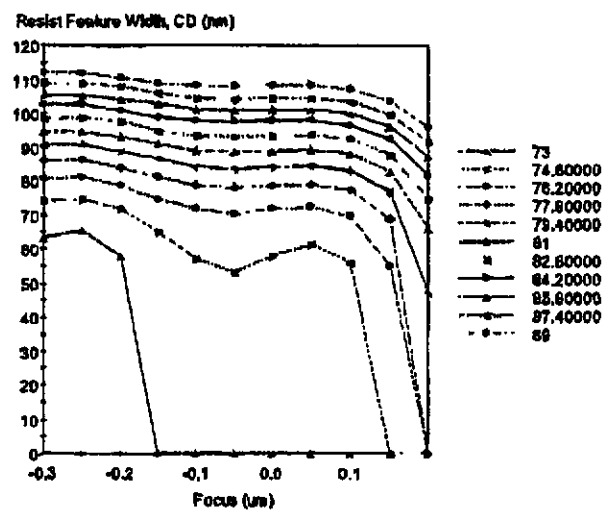


FIG. 30a

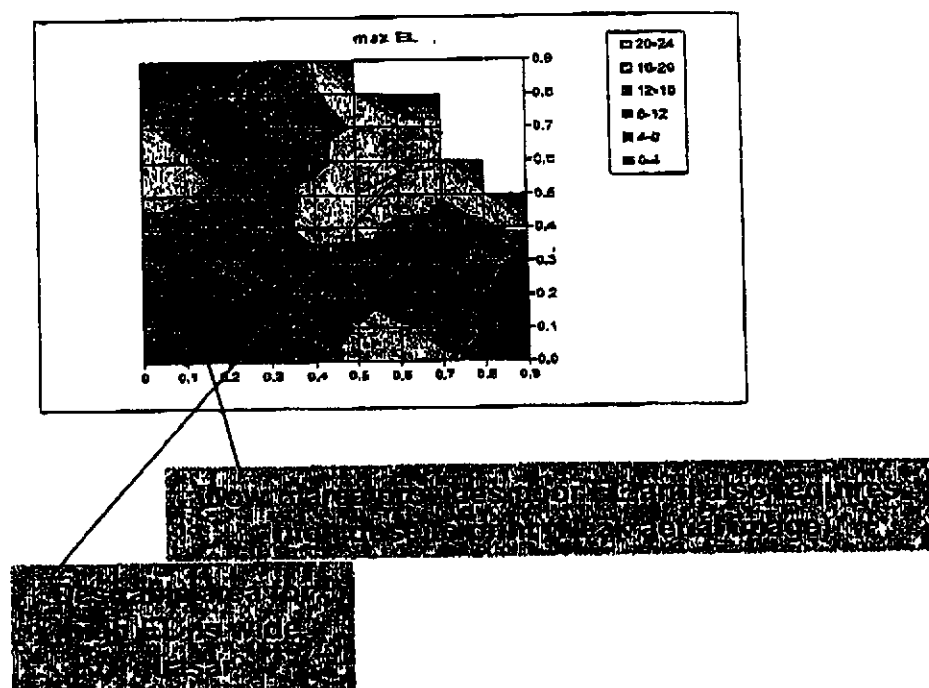
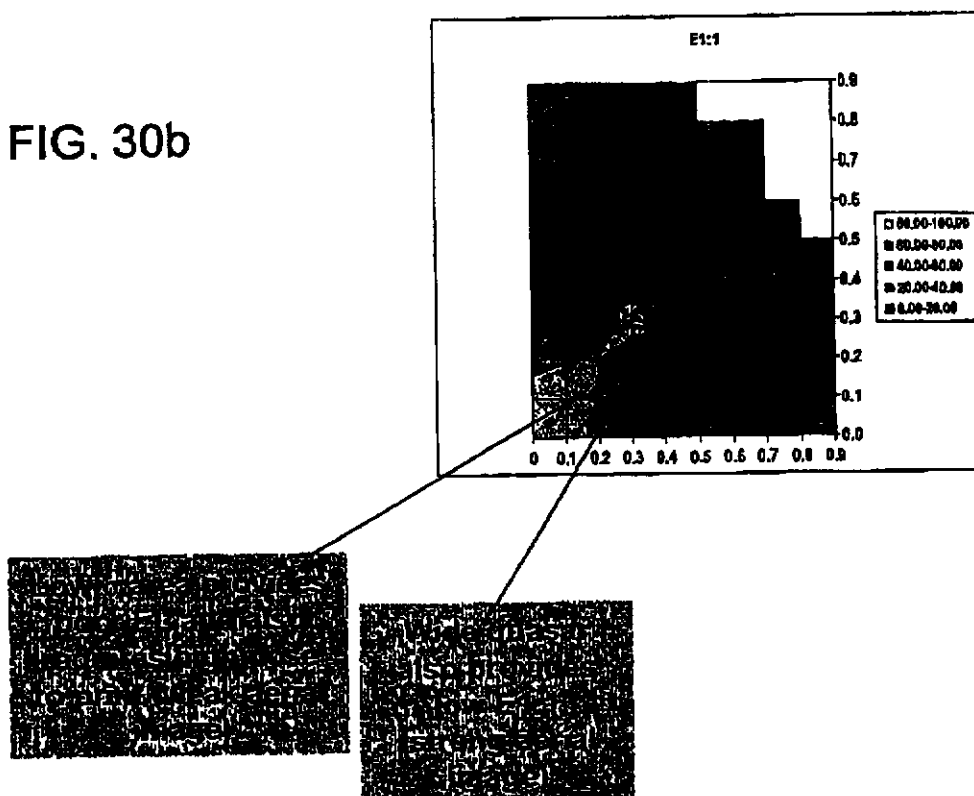


FIG. 30b



$$\text{Illuminator} = \sigma(0.1 \text{ conv}) + (0.92/0.88Q5^\circ)$$

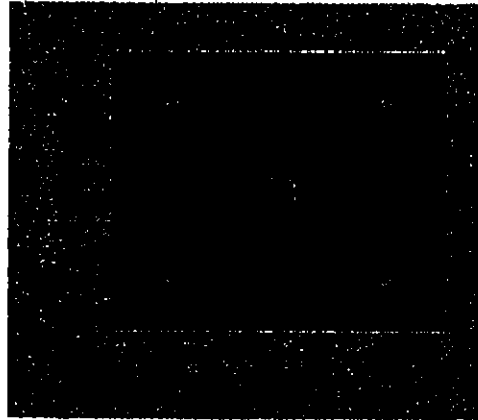


FIG. 31

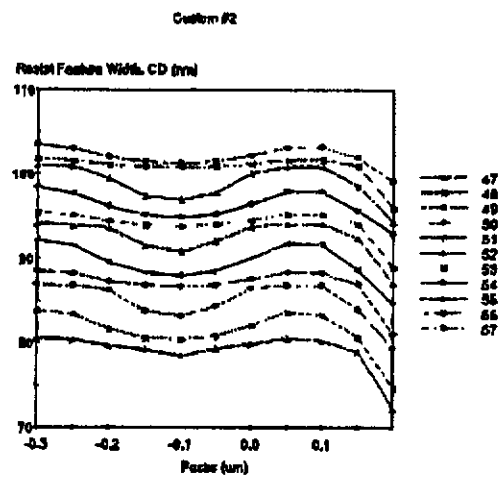


FIG. 32

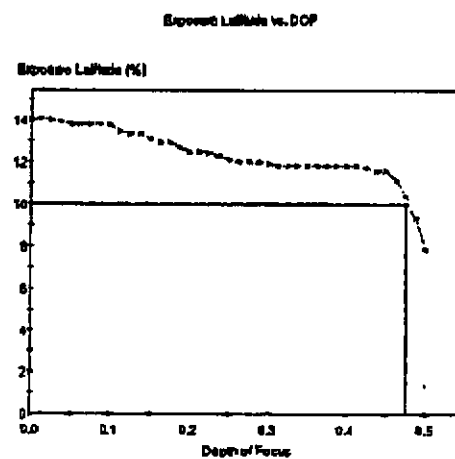


FIG. 33

optimization method	illumination	max EL	max DOF	DOF @ 10% EL	DOF @ 5% EL
standard	0.95/0.70/0.80	18%	0.3	0.19	0.24
simple isofocal compensation	0.26 cony	8%	>0.55	0	0.28
high EL isofocal compensation	0.82/0.86/0.5~0.18mV	18%	>0.85	0.57	0.63

FIG. 34

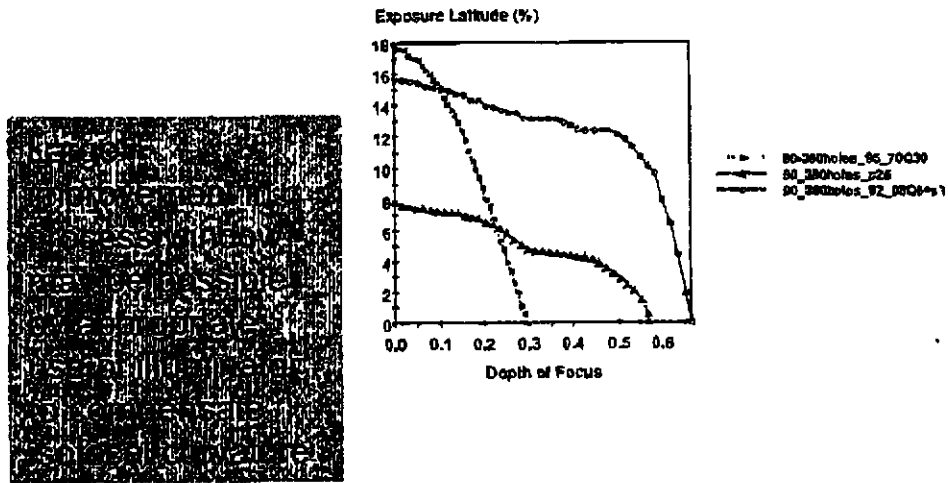


FIG. 35a

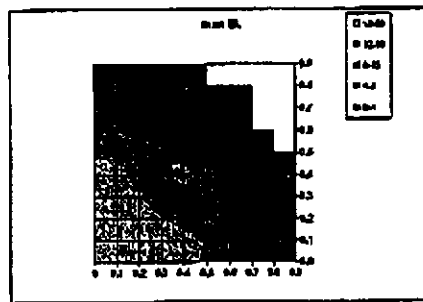


FIG. 35b

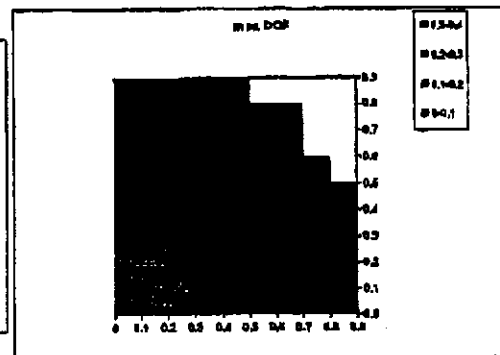


FIG. 35d

FIG. 35c

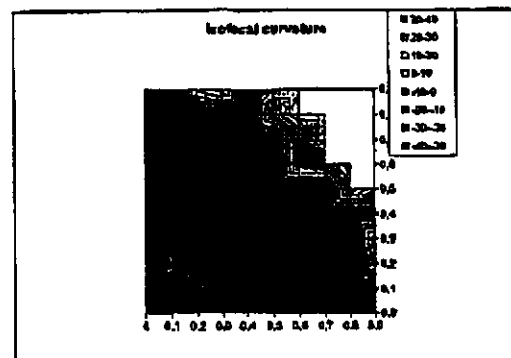
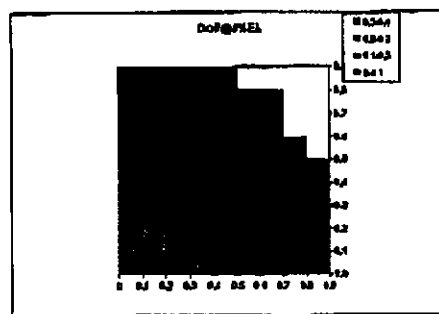


FIG. 36a

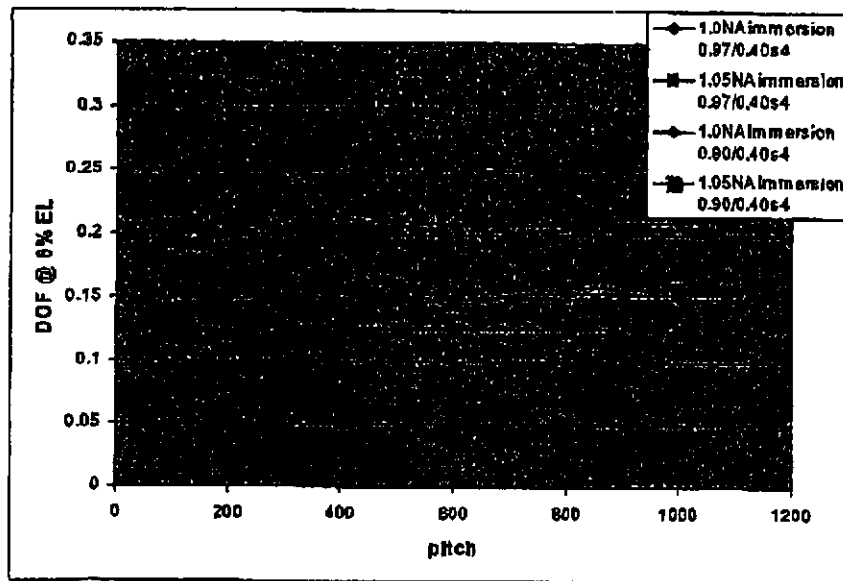


FIG. 36b

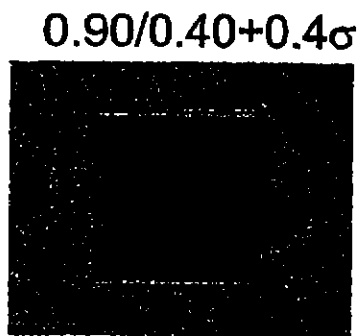
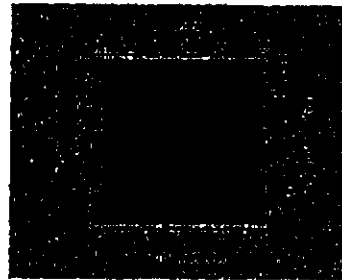
0.97/0.40+0.4 σ 

FIG. 36c

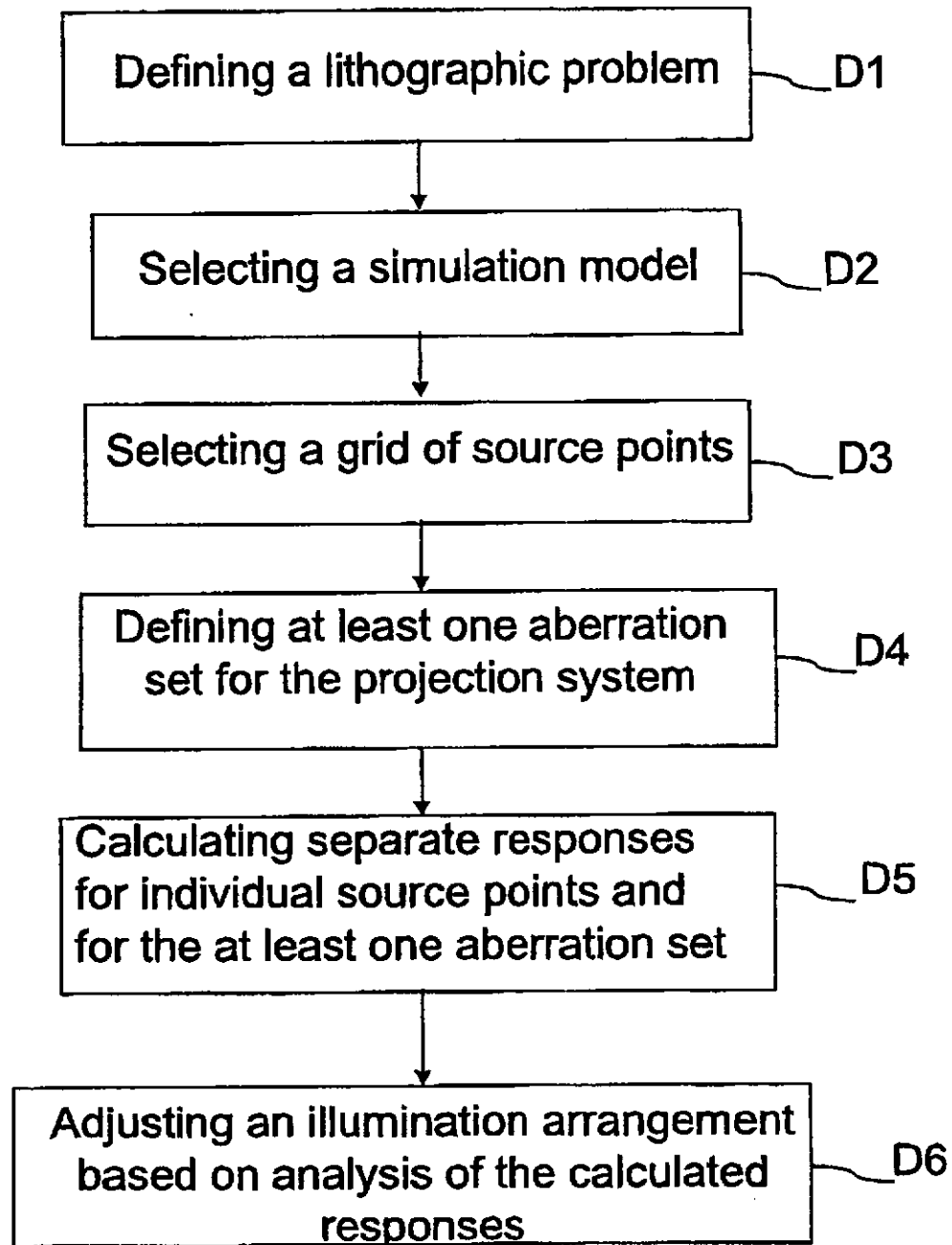


FIG. 37

Under these conditions, the structure
is very aberration sensitive

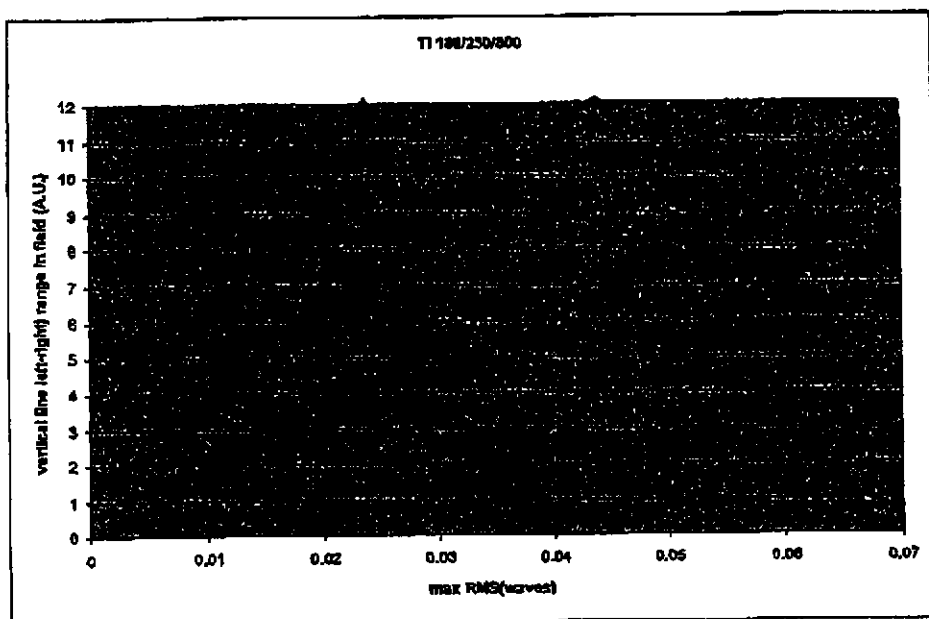


FIG. 38a

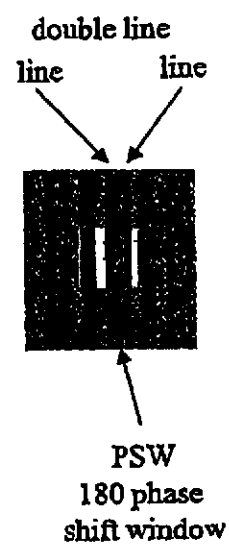


FIG. 38b

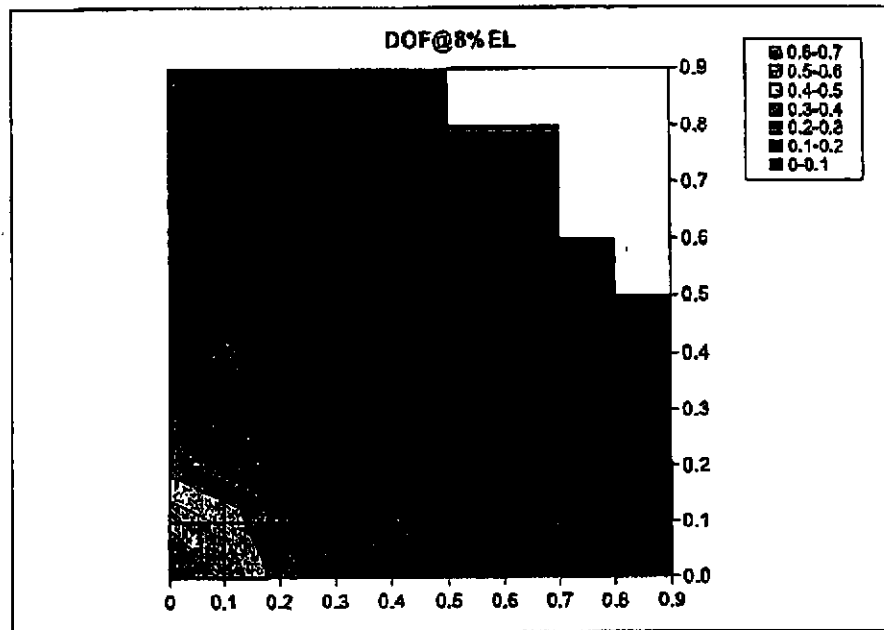


FIG. 39a

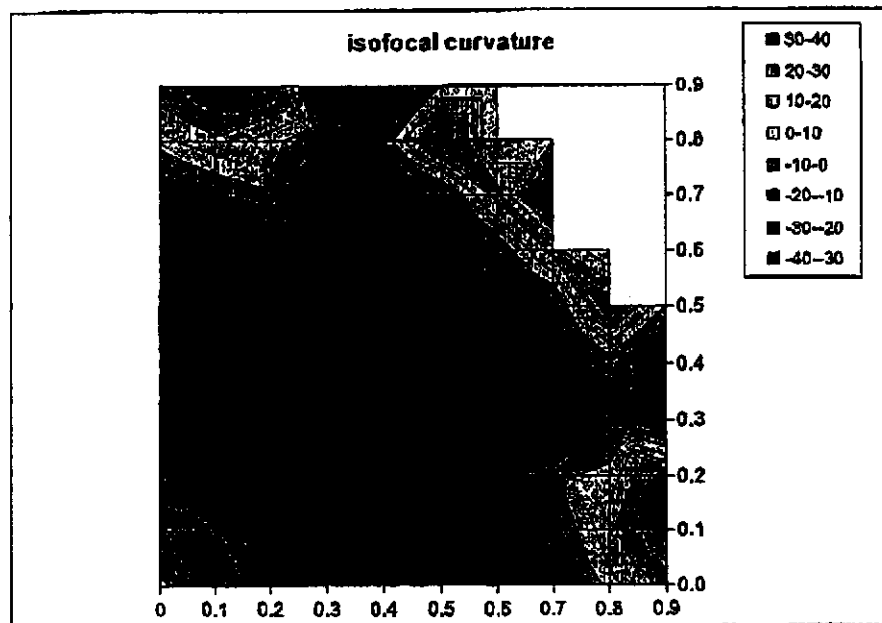


FIG. 39b

Illuminator comparison for double line

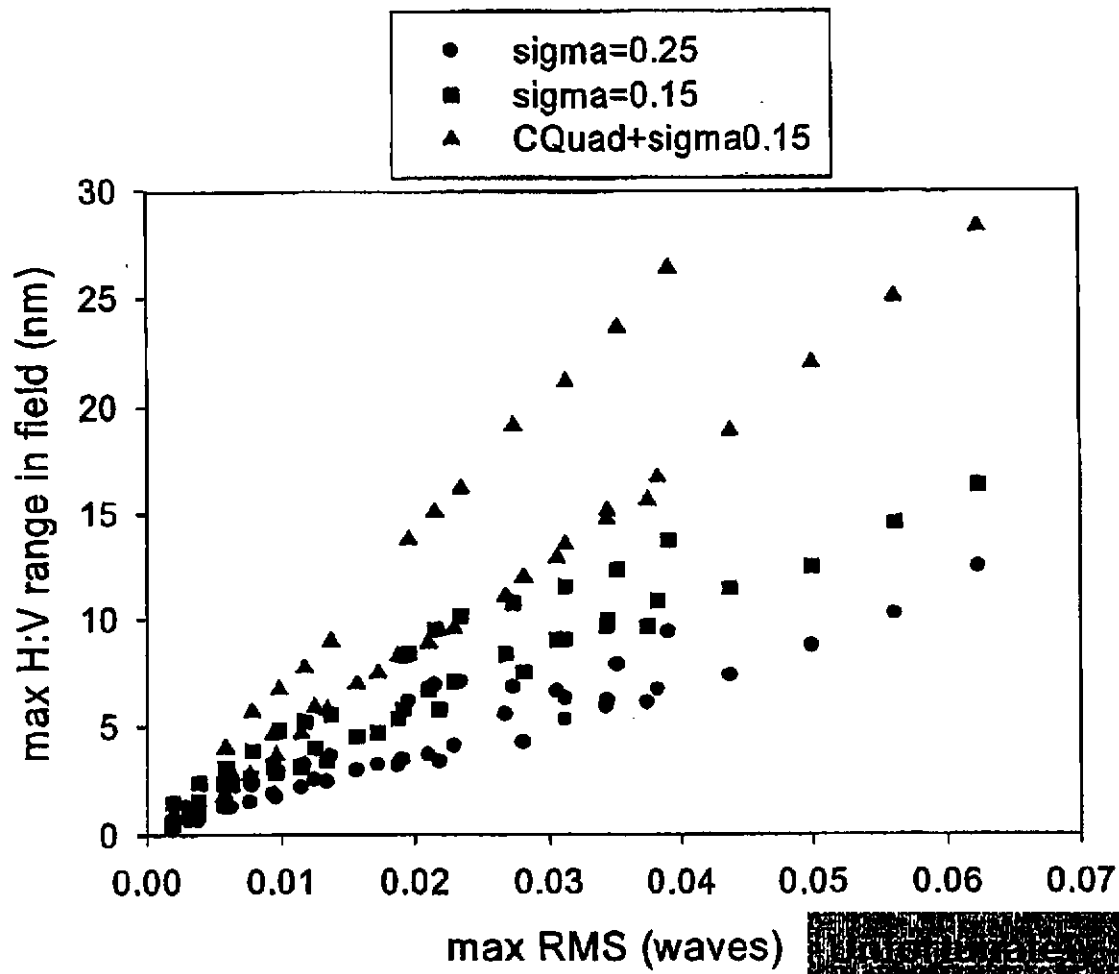
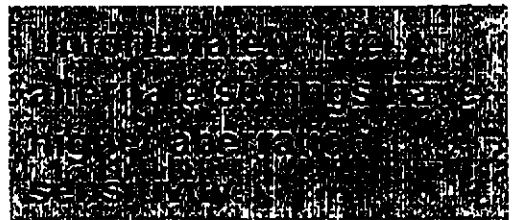


FIG. 40



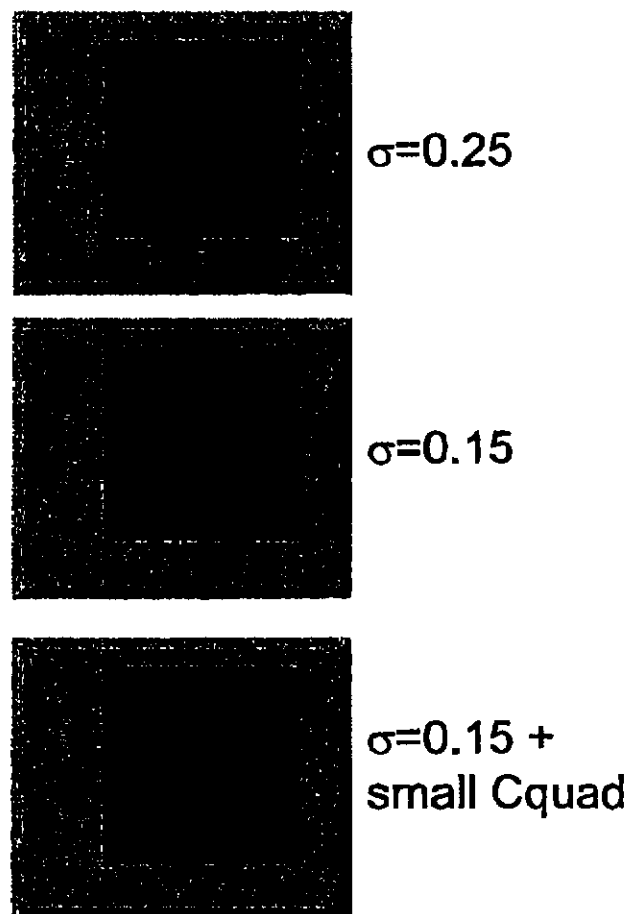


FIG. 41

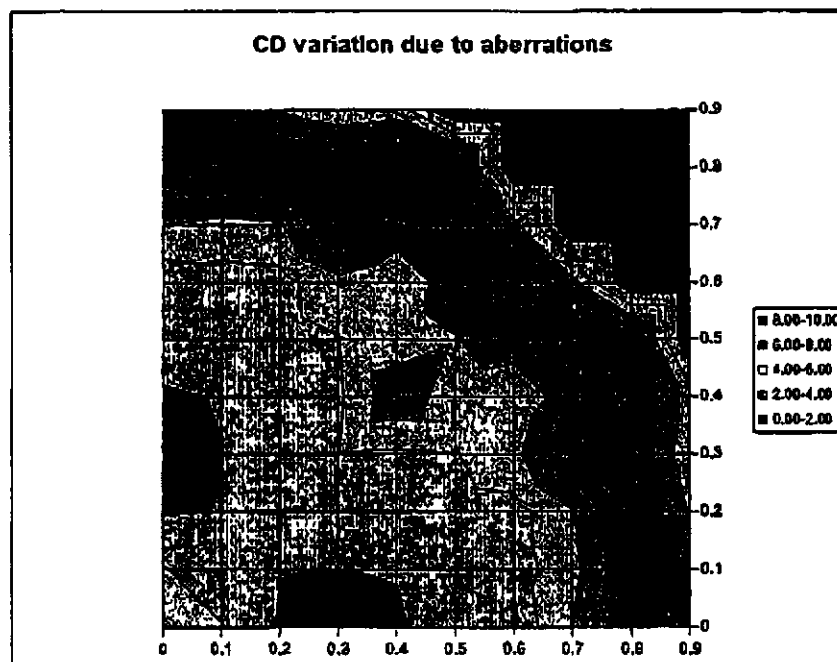
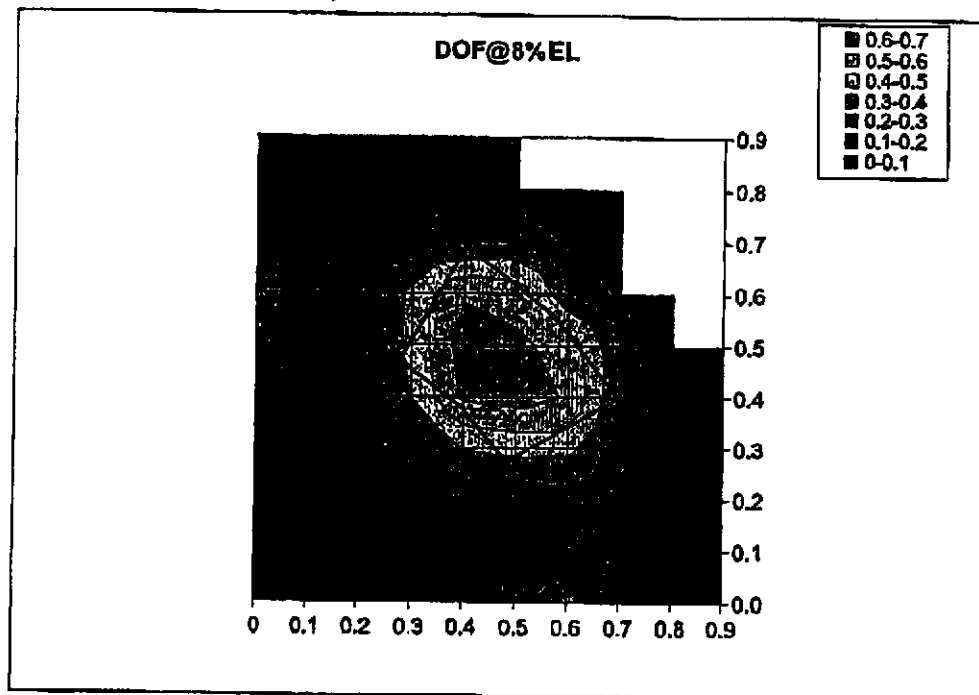


FIG. 42

Illum. Optimization with 0.75NA



tight Quasar looks best
 $\Rightarrow 0.80/0.55Q30^\circ$

FIG. 43

Source visualization of aberration sensitivity

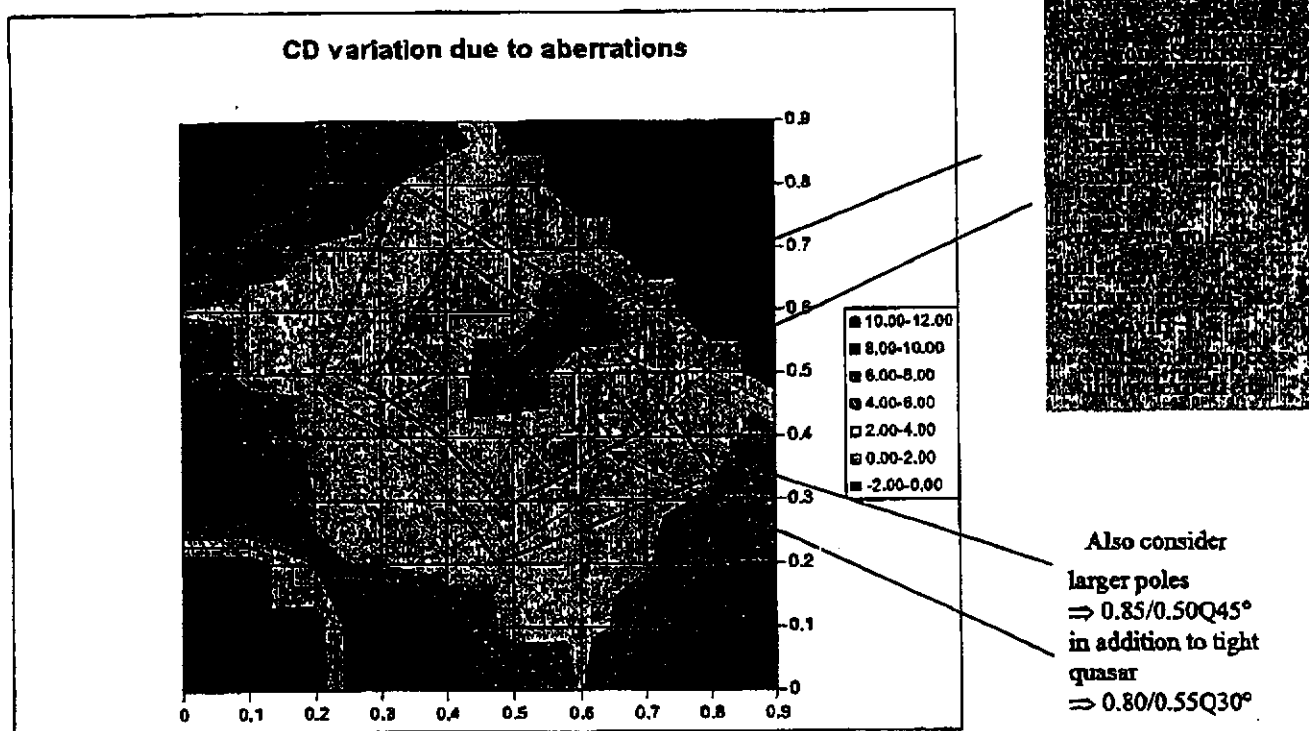


FIG. 44

Illuminator comparison for double line

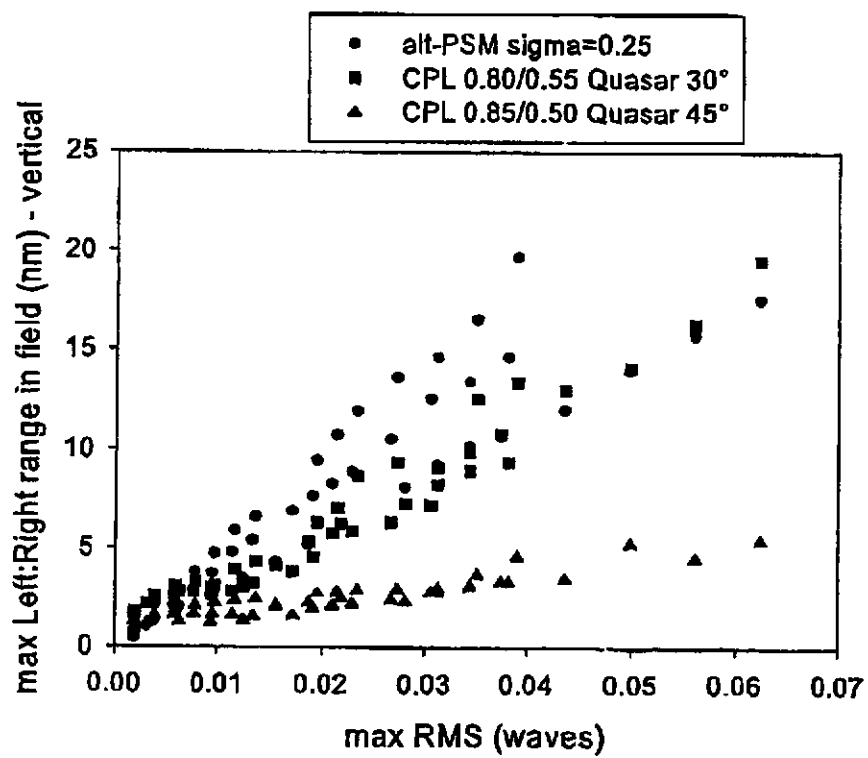


FIG. 45

CPL with reduced aberration sensitivity
increased pole size still gives favorable process window

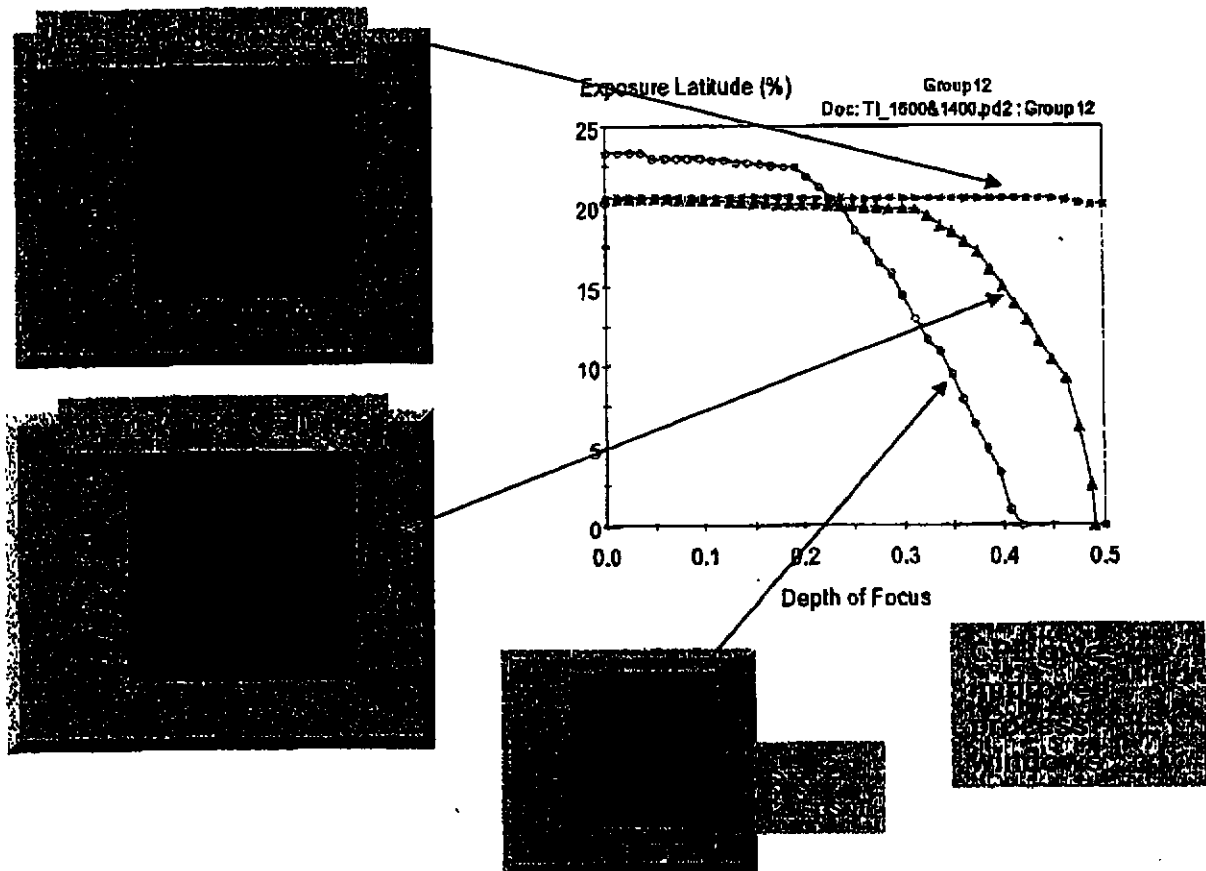


FIG. 46

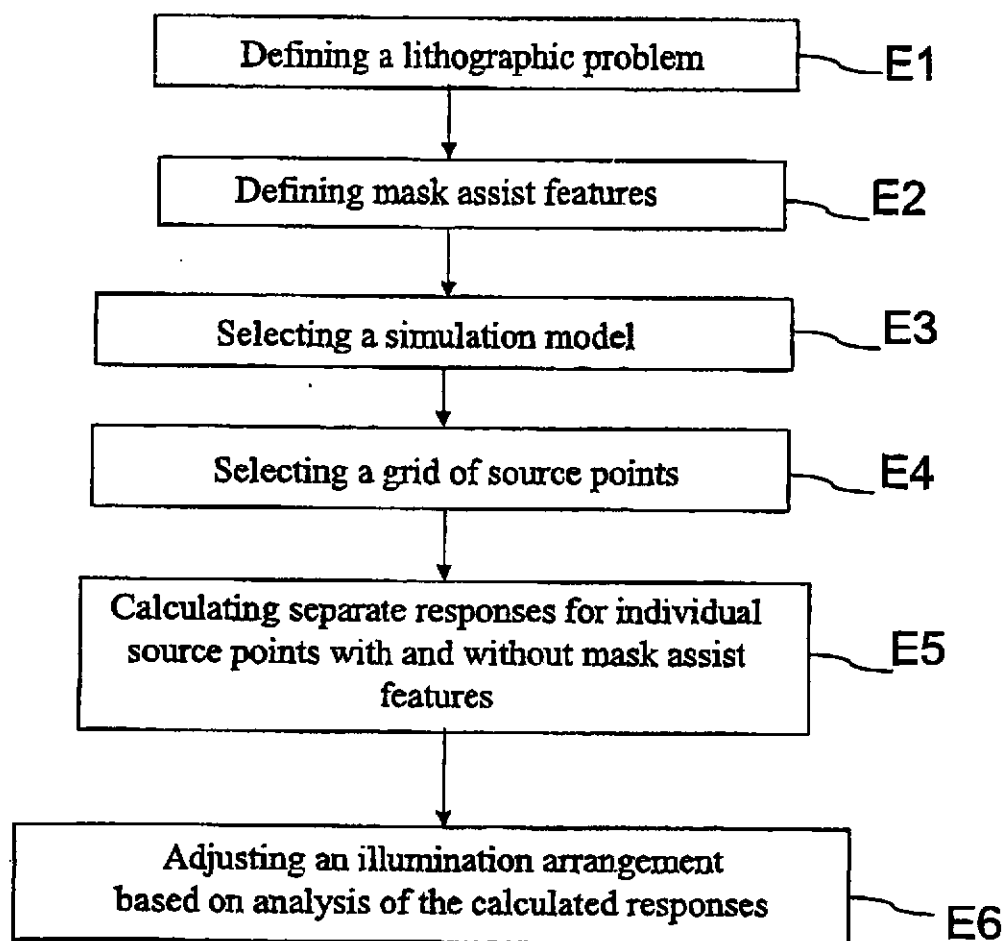


FIG. 47

6%Att-PSM, 1Anti-Scattering Bar (ASB)/side
50nm ASB, 150nm pitch

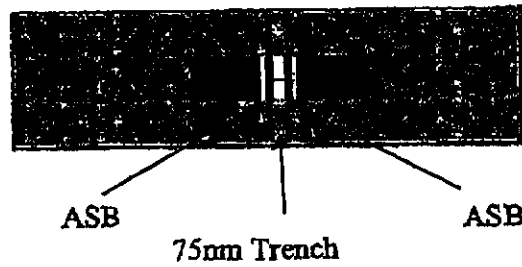


FIG. 48

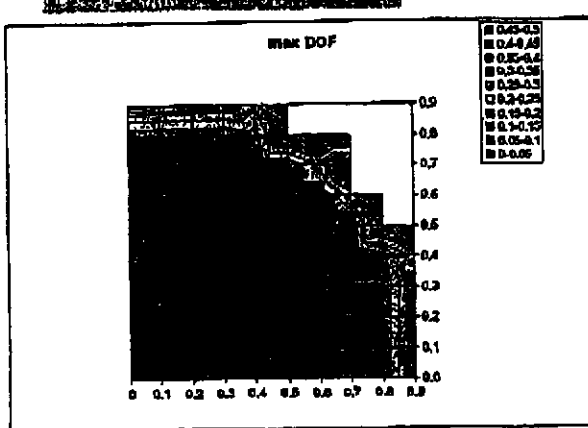
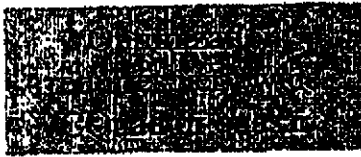


FIG. 49a

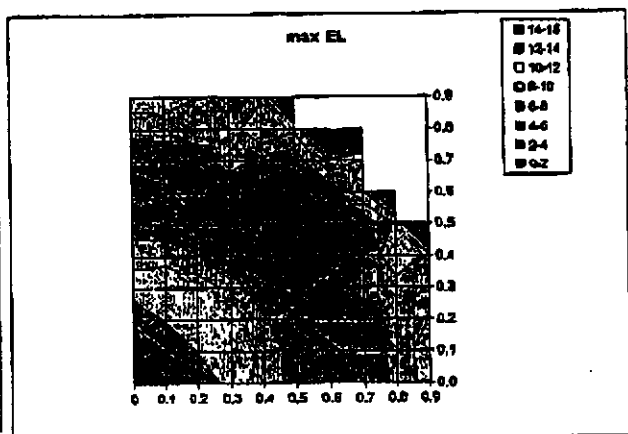


FIG. 49b



35°Cquad + 0.10σ

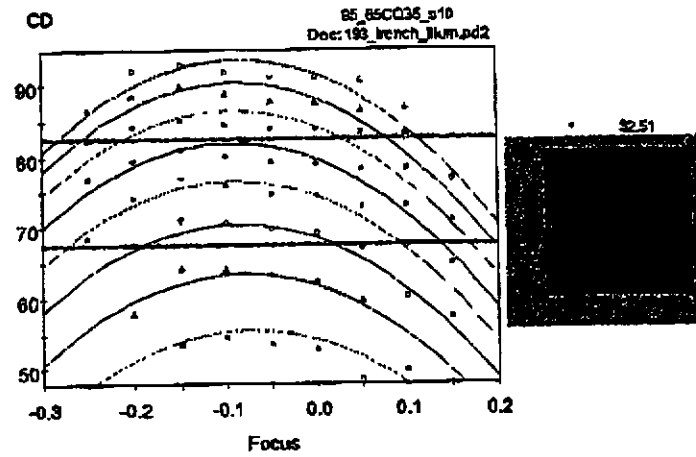


FIG. 52

Comparison of “mask assist” and “illuminator assist” for high DOF

• similar results

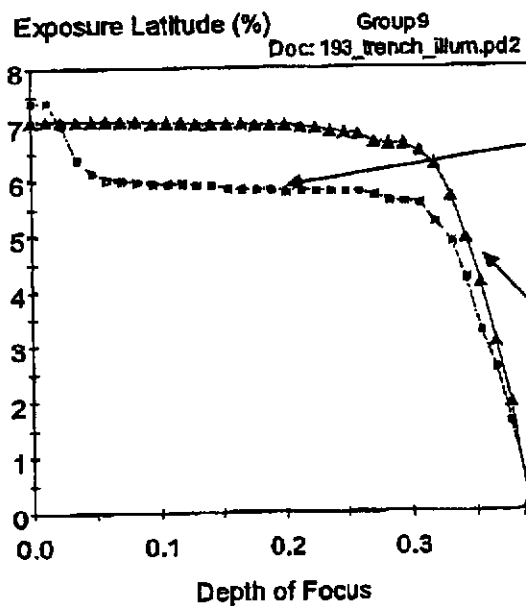


FIG. 53

Effect of bias

- Lower bias increases DOF. This is an advantage for the "simple mask, complex illuminator" case because there are no assist features to print when using low biases / high exposures.

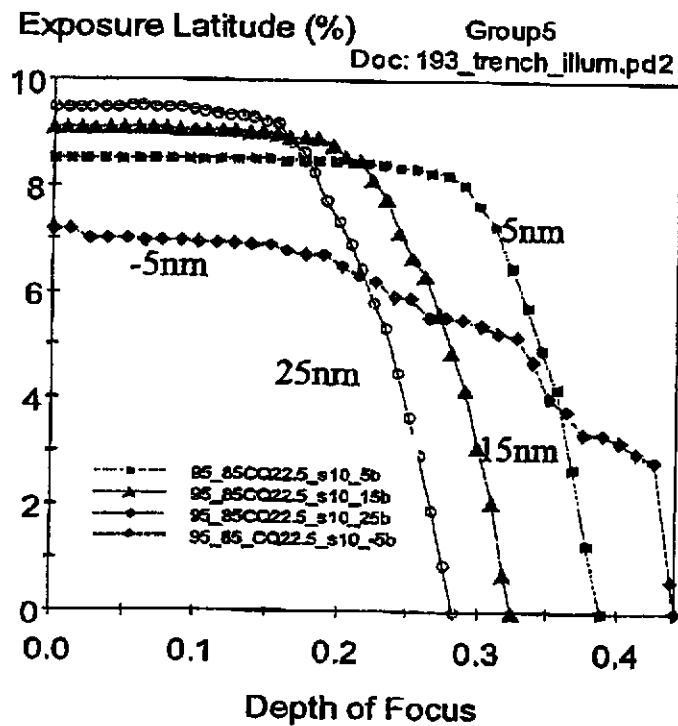
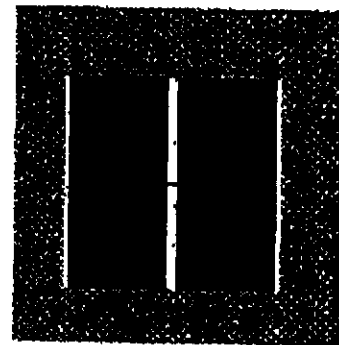
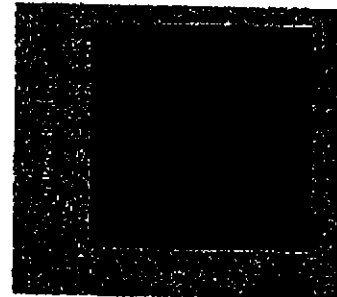
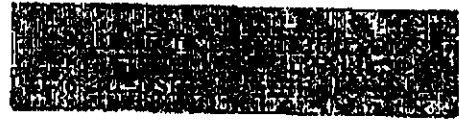


FIG.54



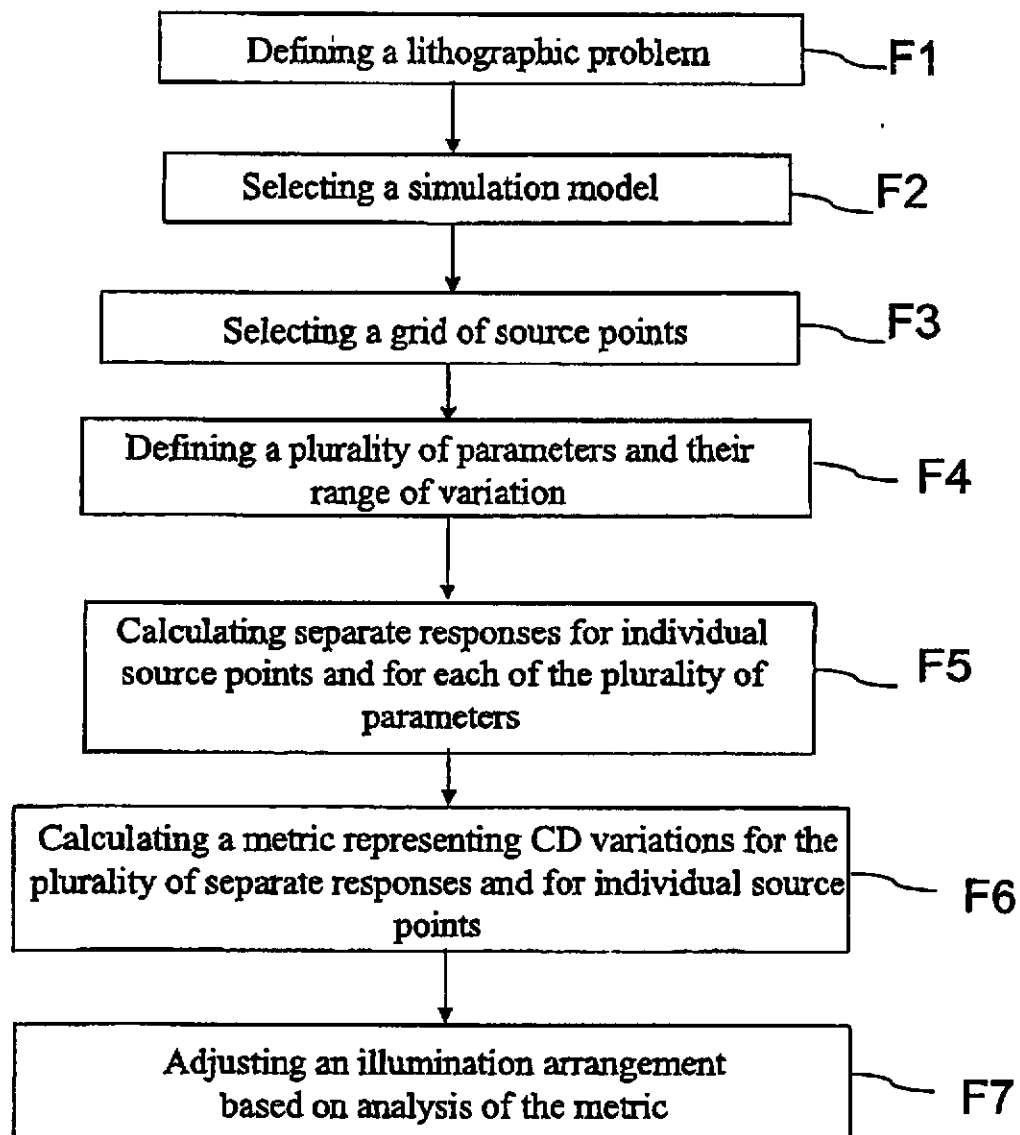


FIG. 55

CPL for double line



Print 50nm lines

FIG. 56

Source visualization map
based on resist simulations for a grid of
source points

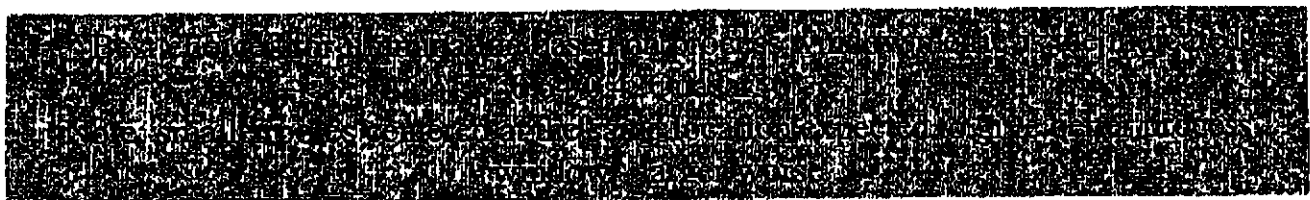
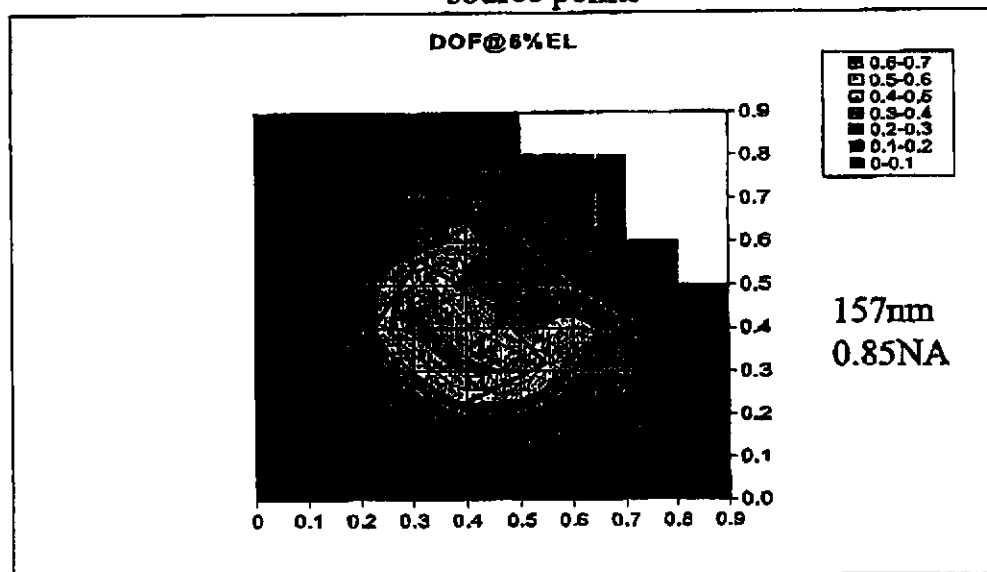


FIG. 57

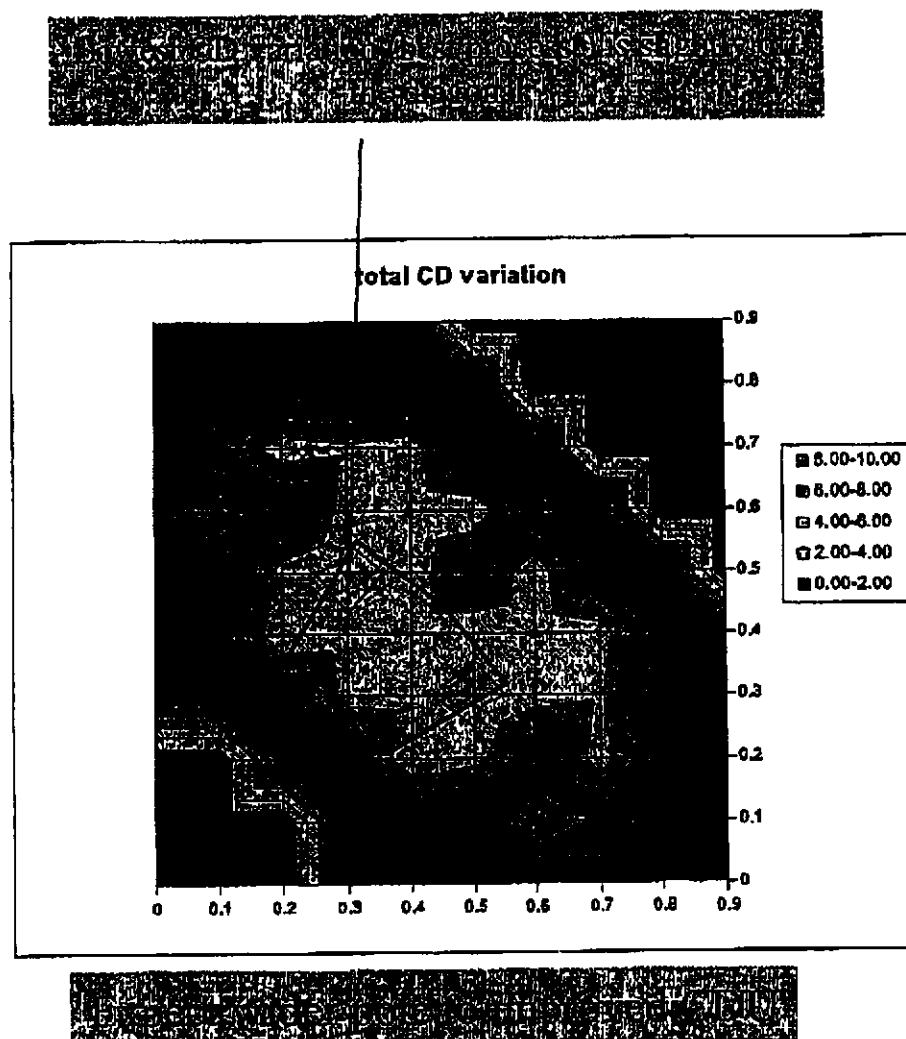


FIG. 58

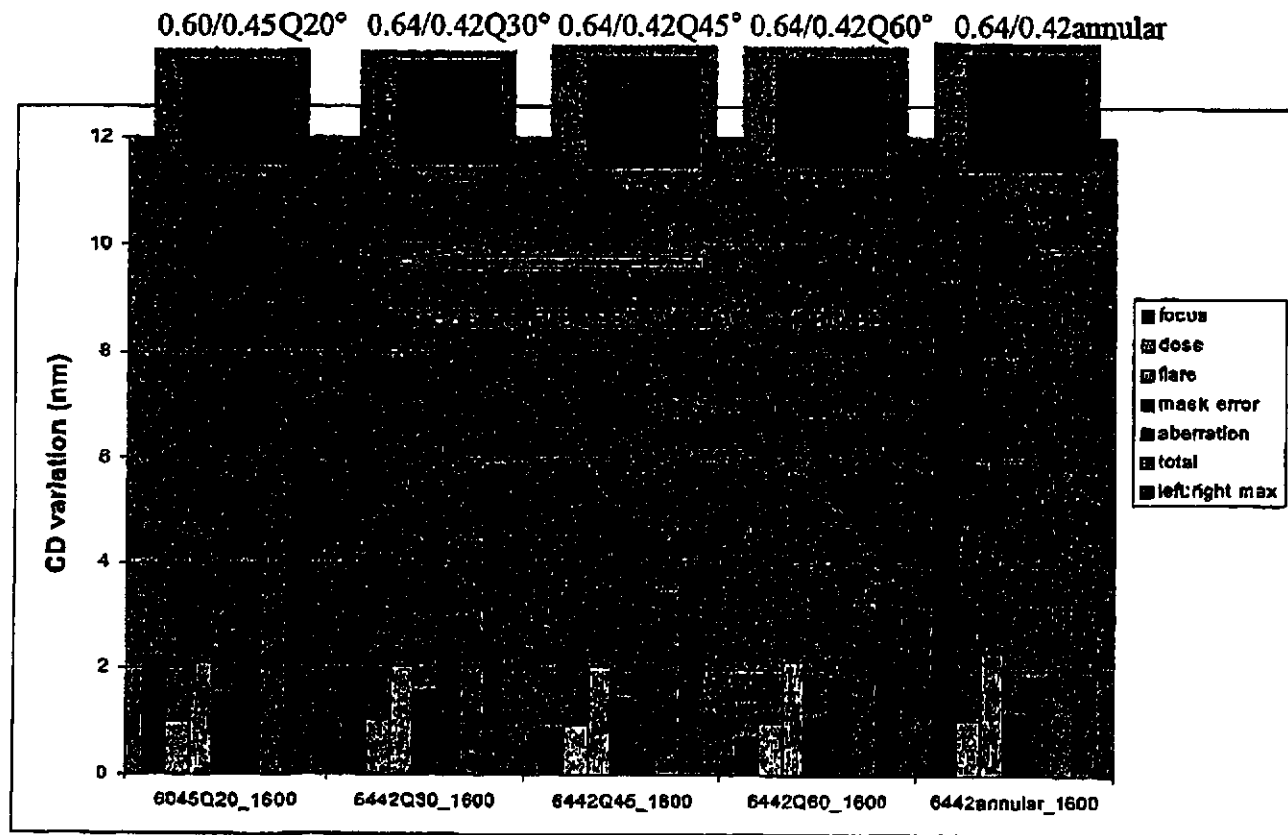


FIG. 59