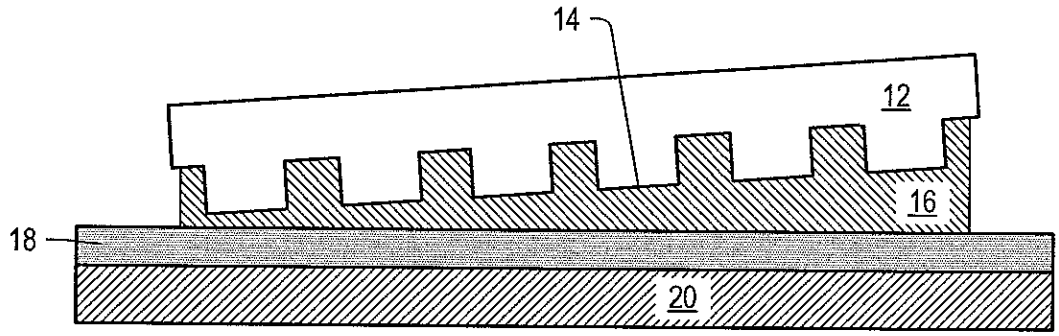


FIG. 1A

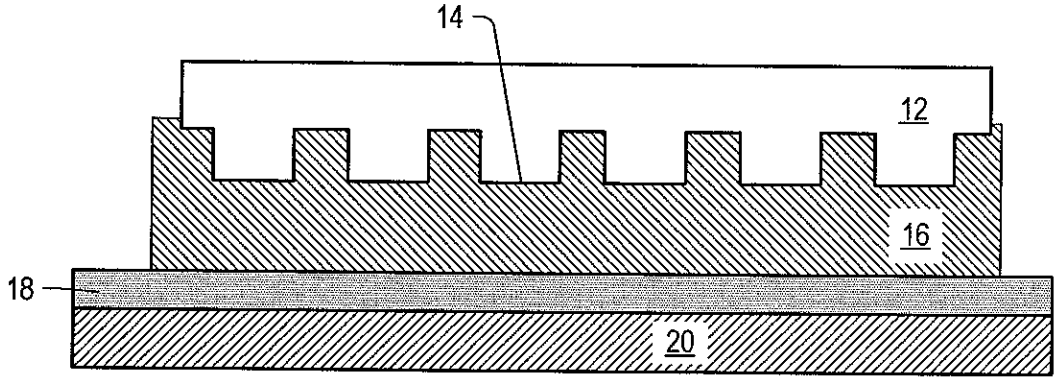


FIG. 1B

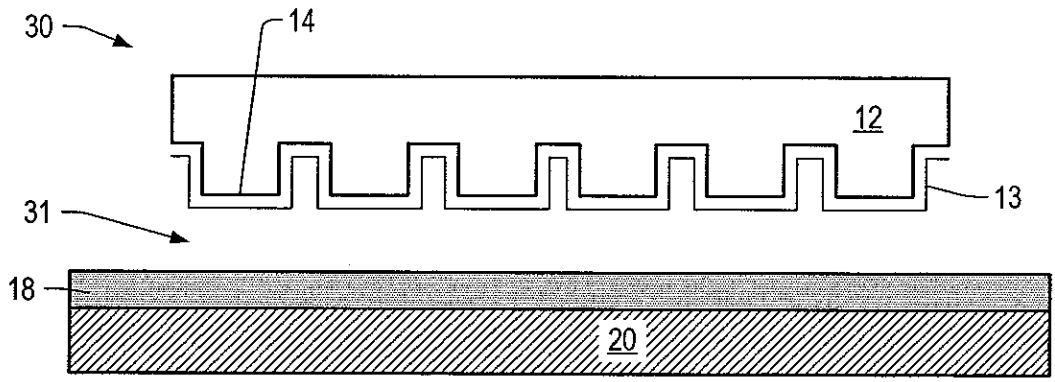


FIG. 2A

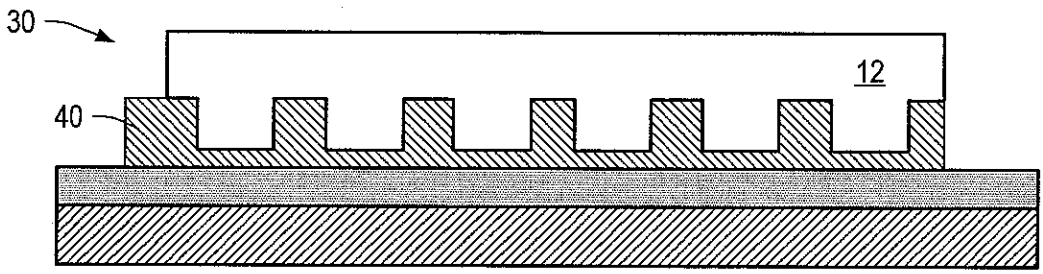


FIG. 2B

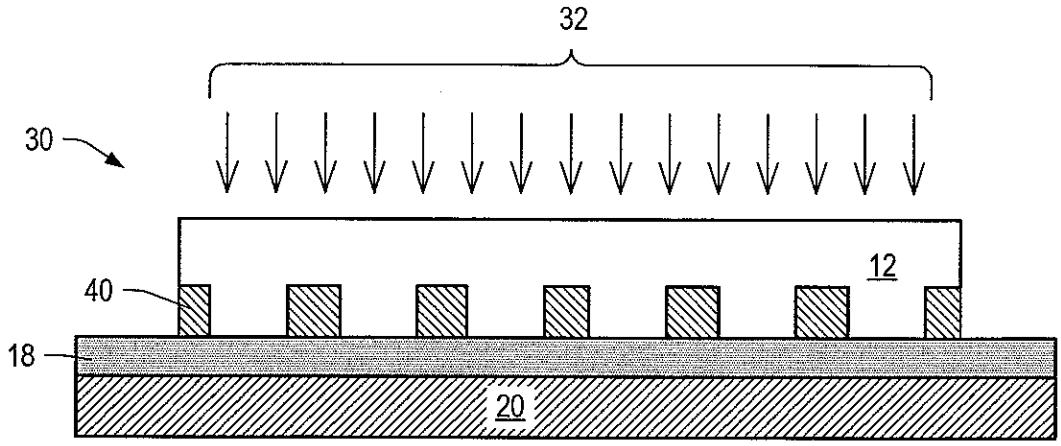


FIG. 2C

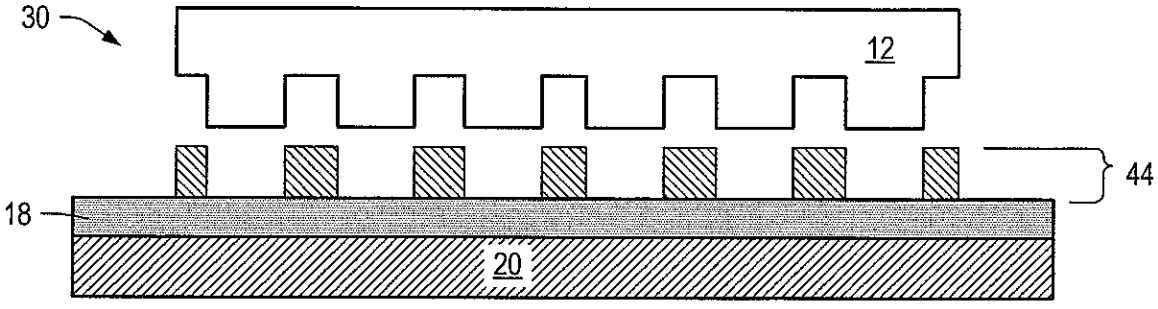


FIG. 2D

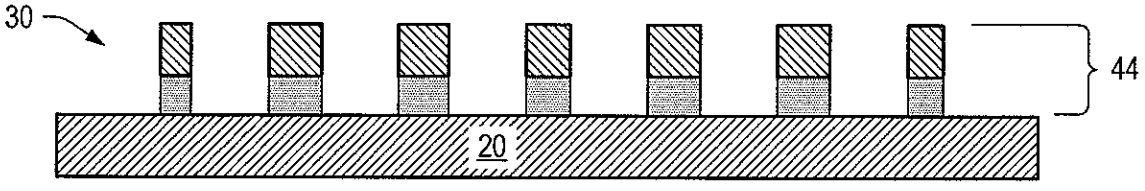


FIG. 2E

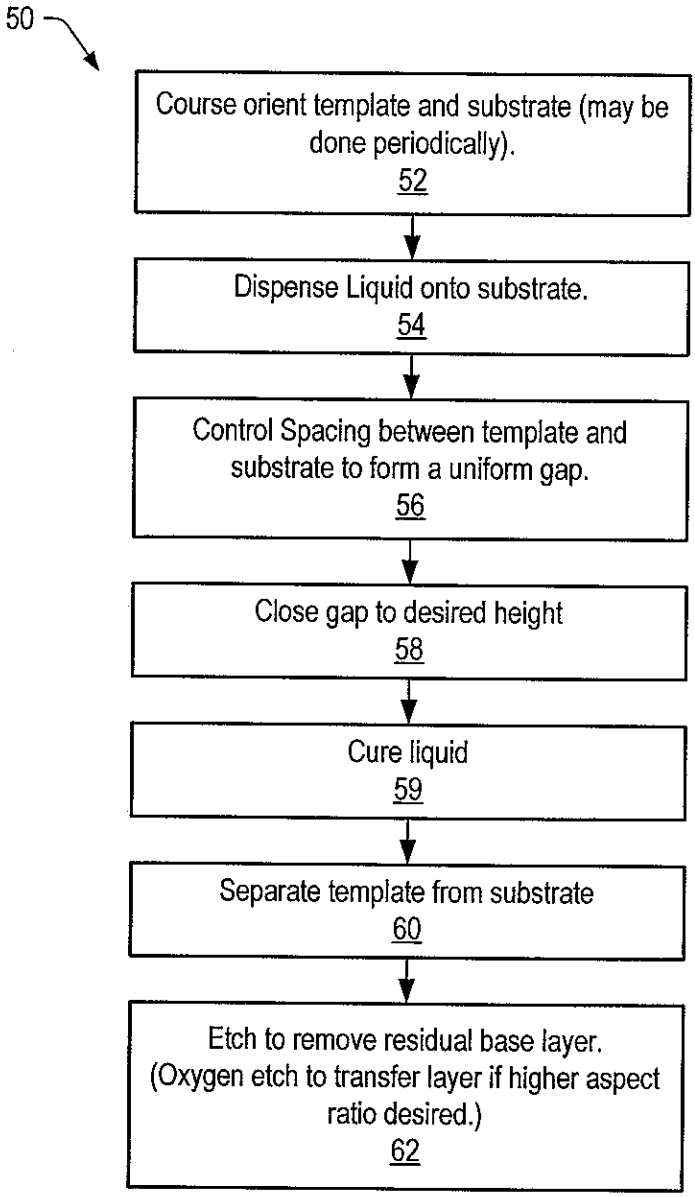

50
Course orient template and substrate (may be done periodically).
52
Dispense Liquid onto substrate.
54
Control Spacing between template and substrate to form a uniform gap.
56
Close gap to desired height
58
Cure liquid
59
Separate template from substrate
60
Etch to remove residual base layer. (Oxygen etch to transfer layer if higher aspect ratio desired.)
62

FIG. 3

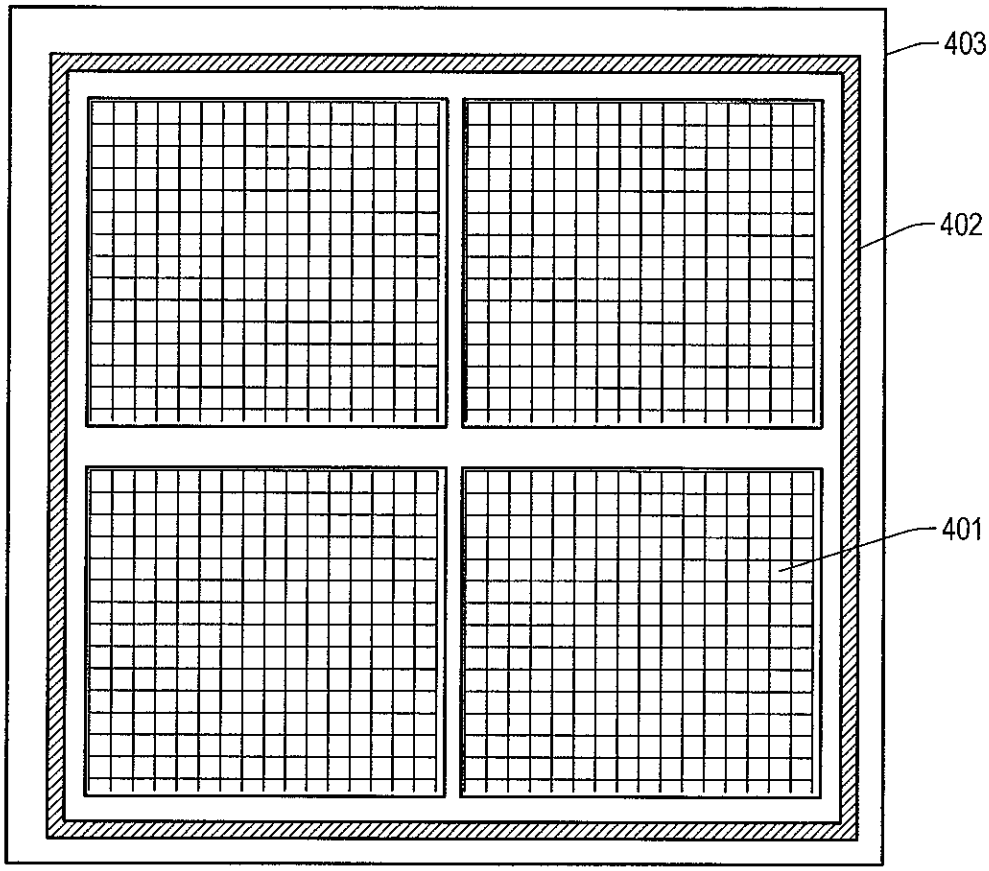


FIG. 4

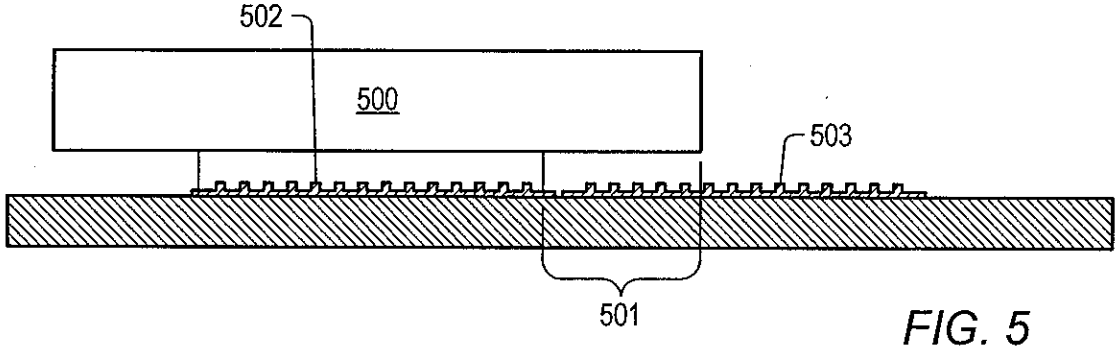


FIG. 5

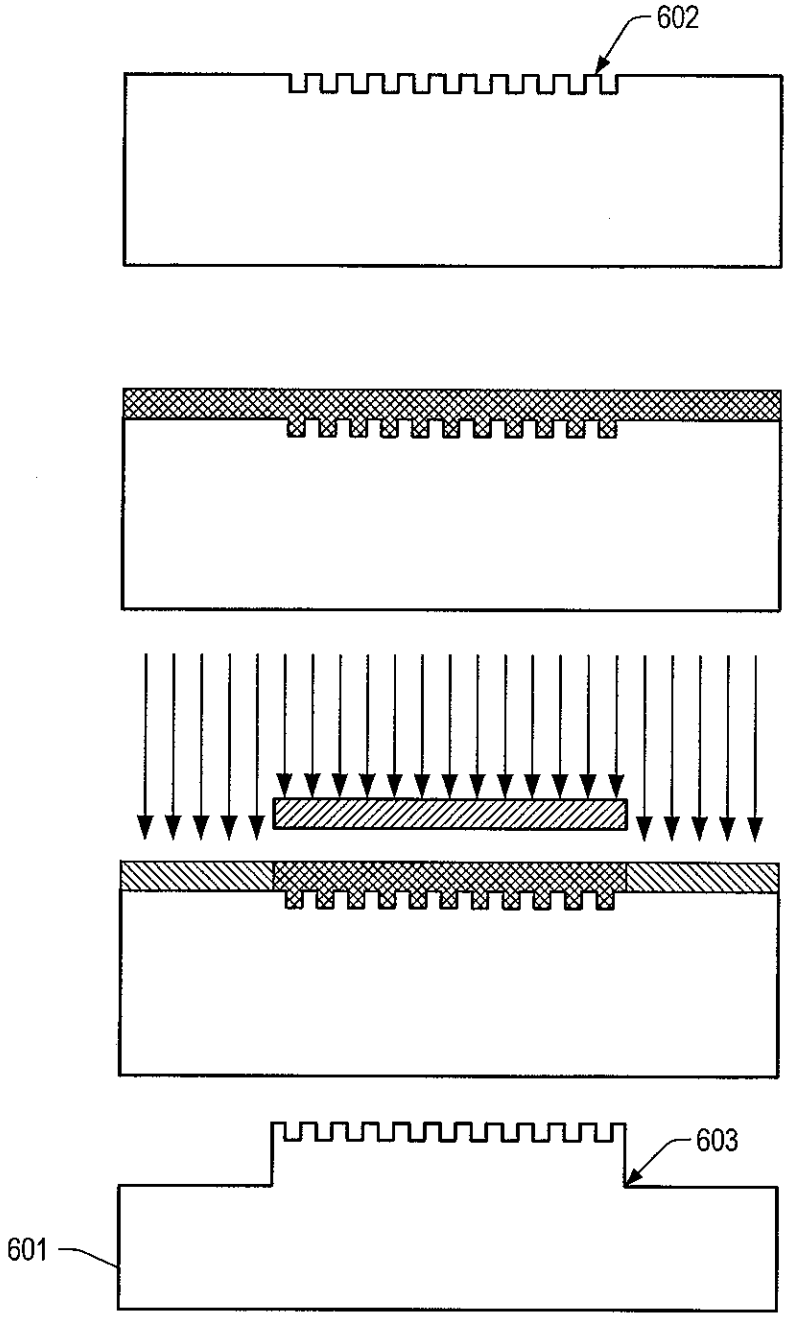


FIG. 6

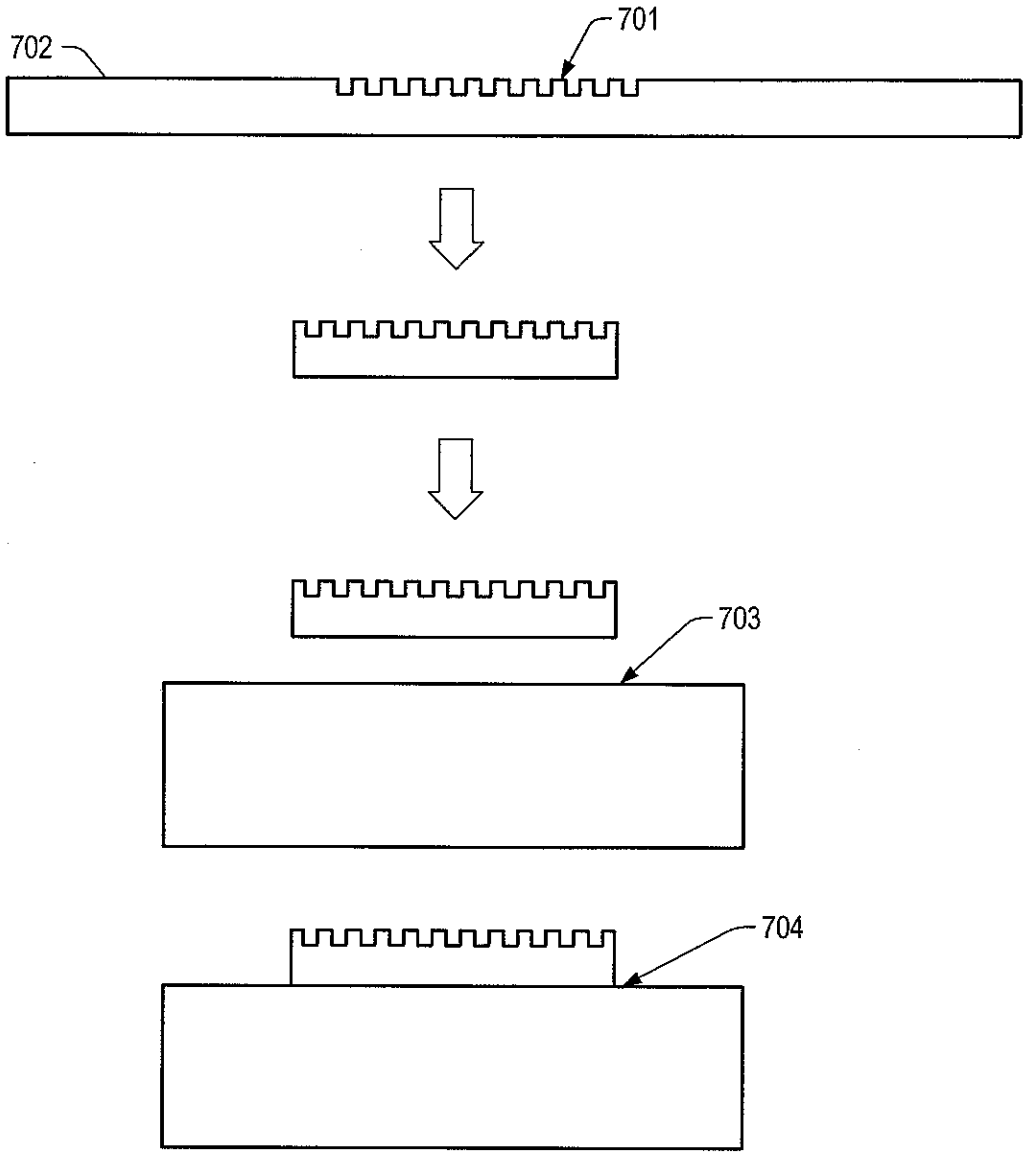


FIG. 7

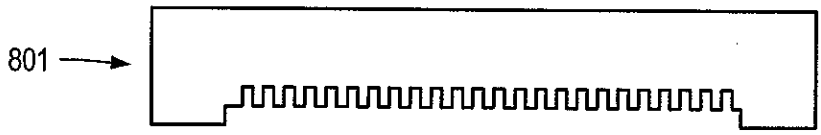


FIG. 8A



FIG. 8B

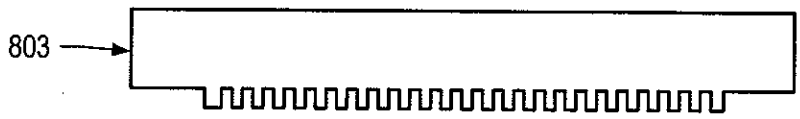


FIG. 8C

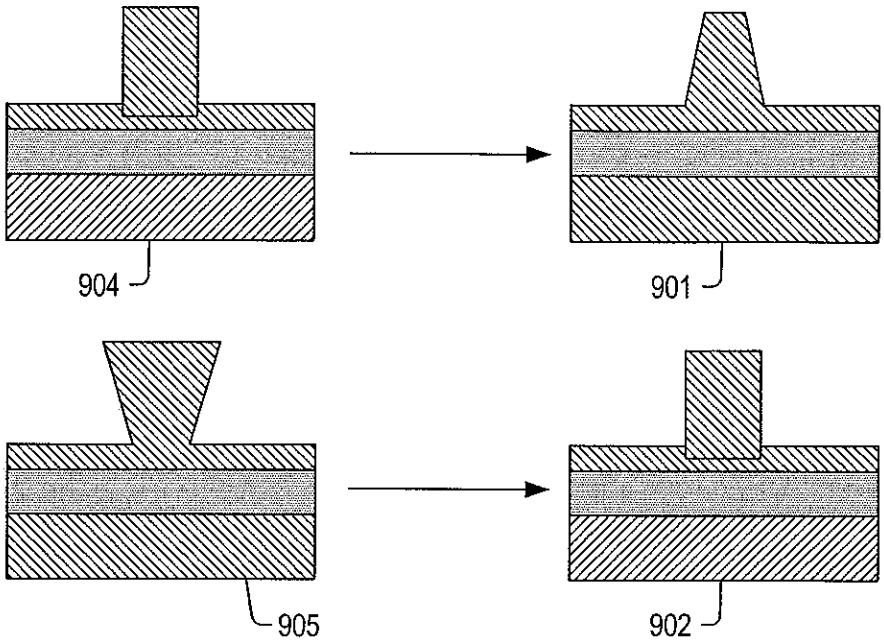


FIG. 9

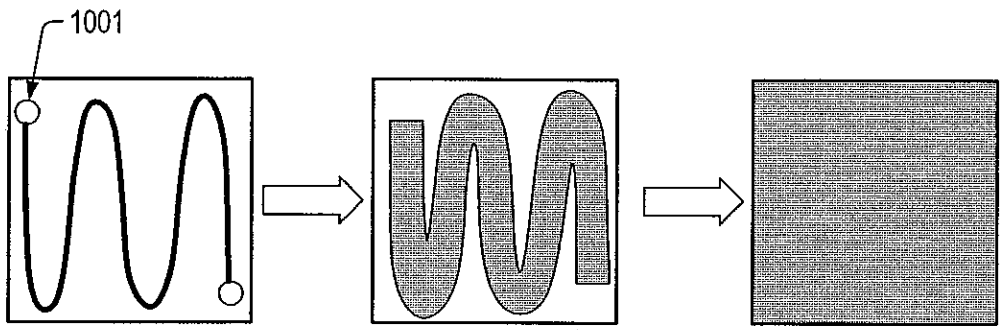


FIG. 10A



FIG. 10B

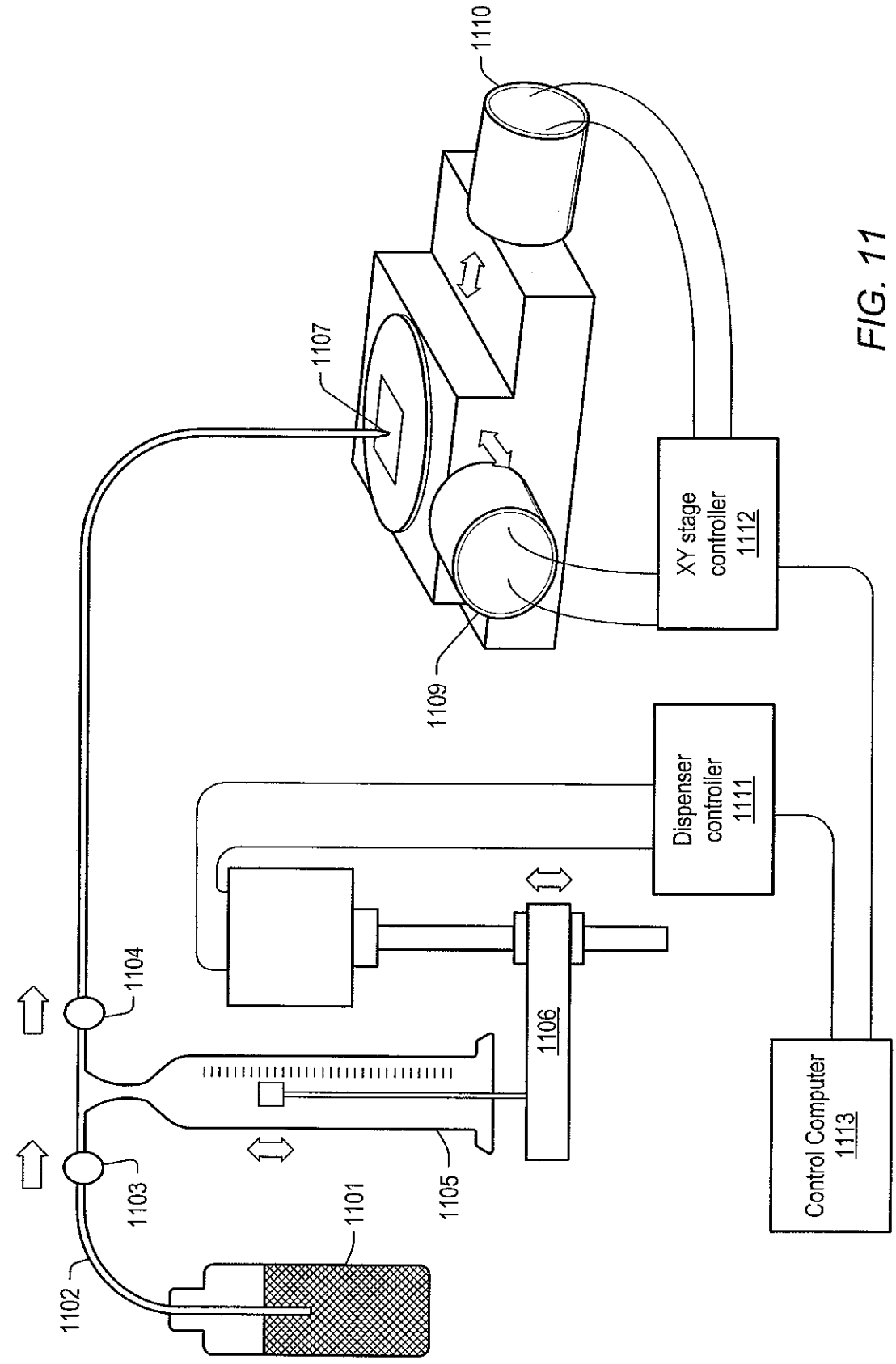

1110
1107
1109
XY stage controller 1112
Dispenser controller 1111
Control Computer 1113
1106
1104
1103
1105
1101
1102

FIG. 11

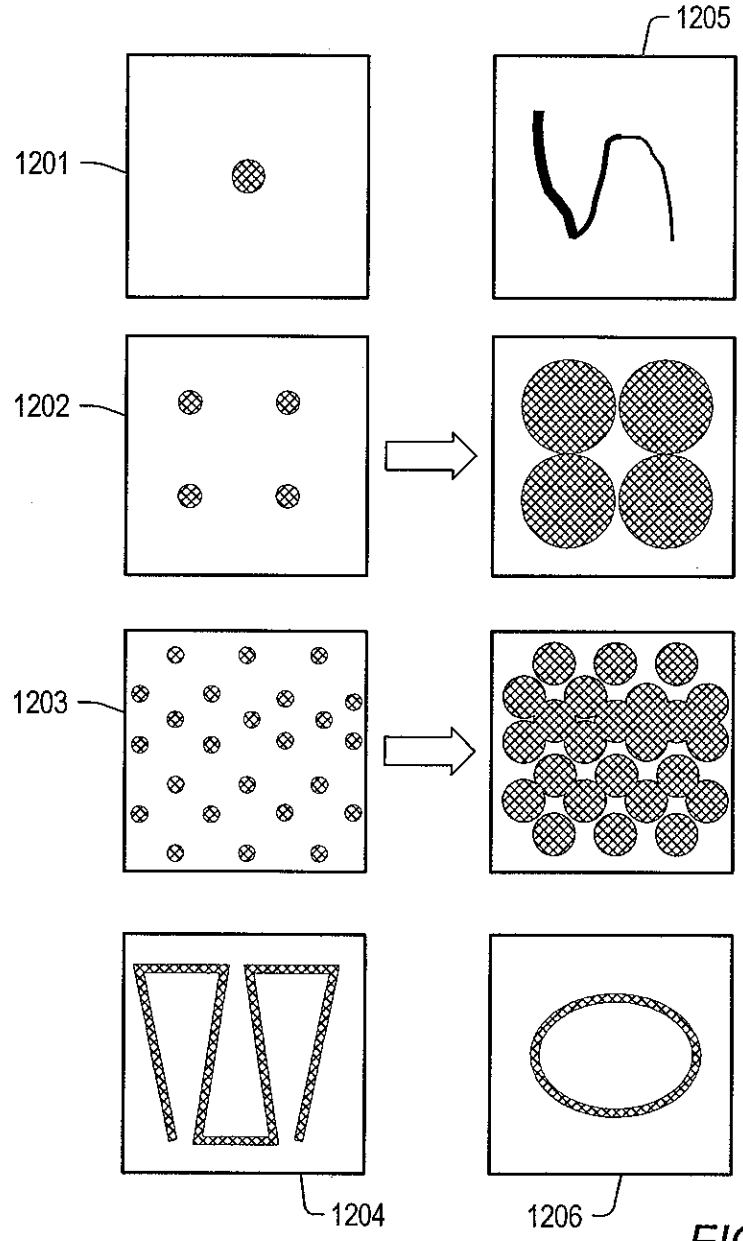


FIG. 12

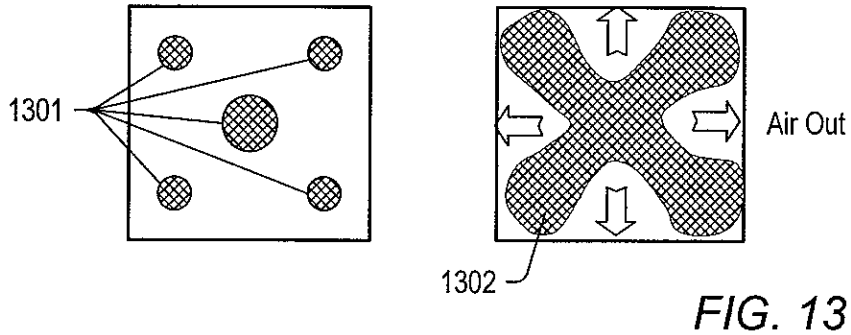


FIG. 13

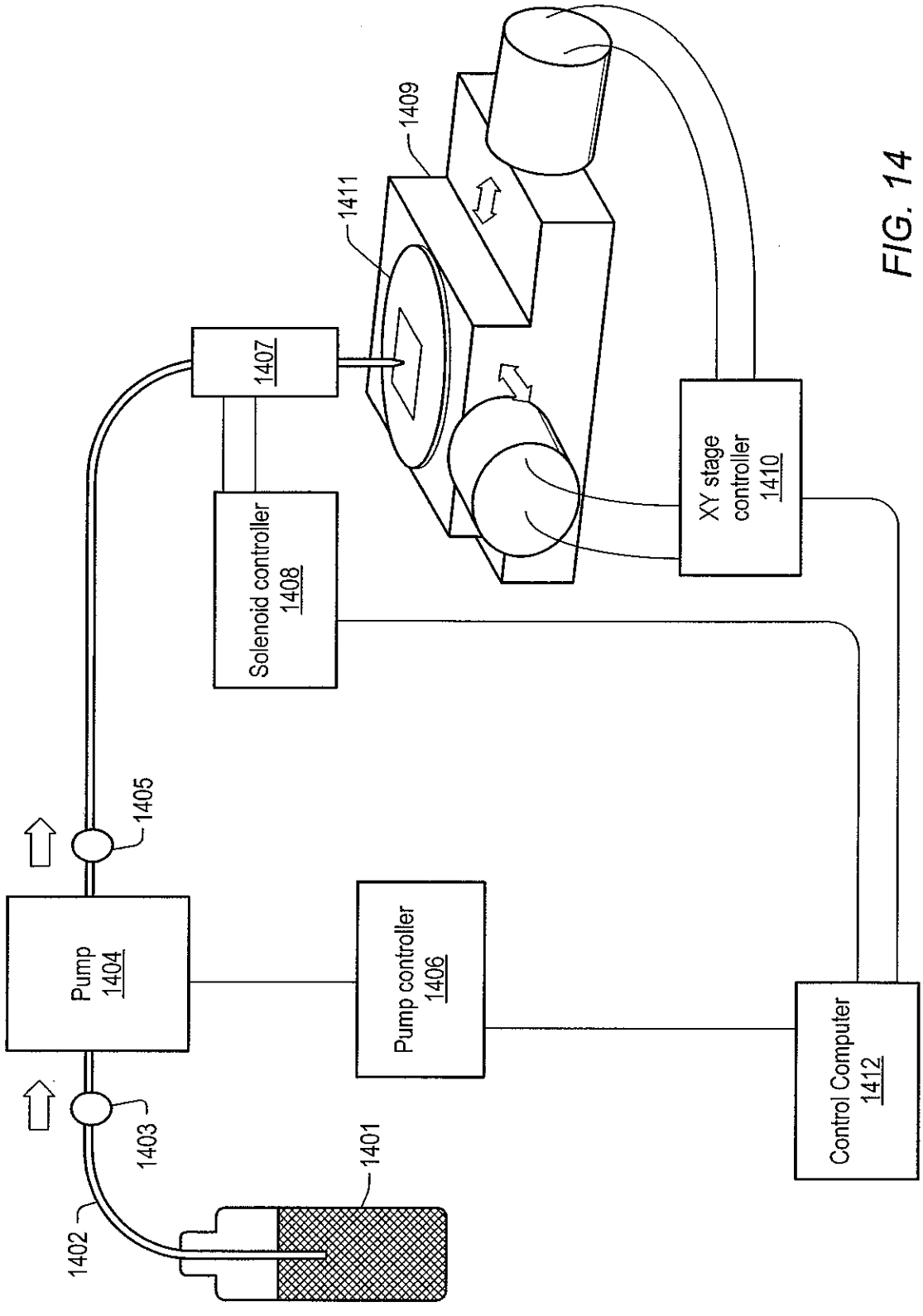

1409
1411
1407
Solenoid controller
1408
XY stage
controller
1410
1405
Pump
1404
Pump controller
1406
Control Computer
1412
1403
1401
1402

FIG. 14

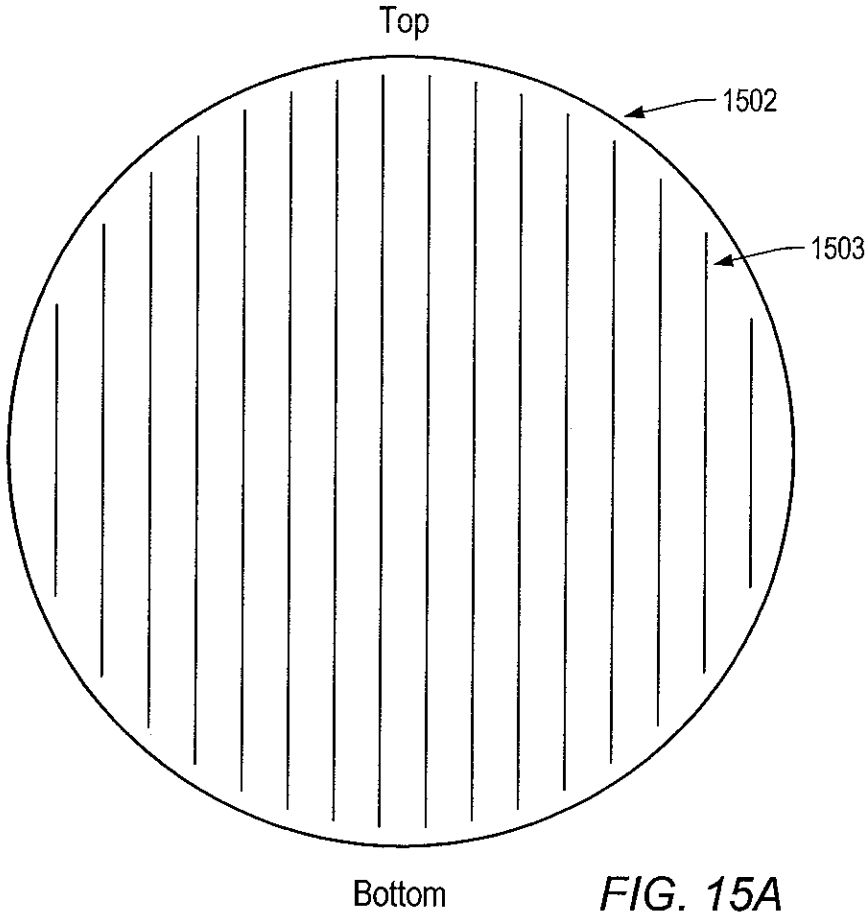


FIG. 15A

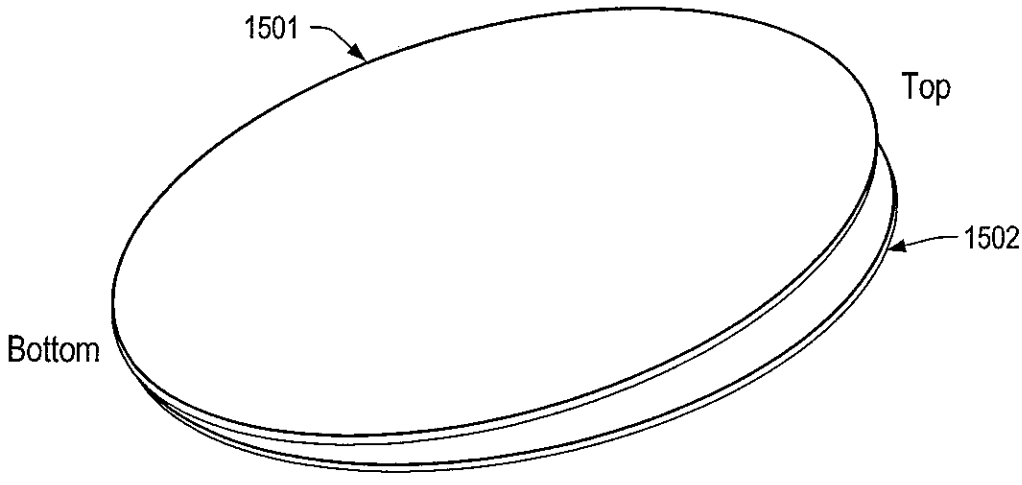


FIG. 15B

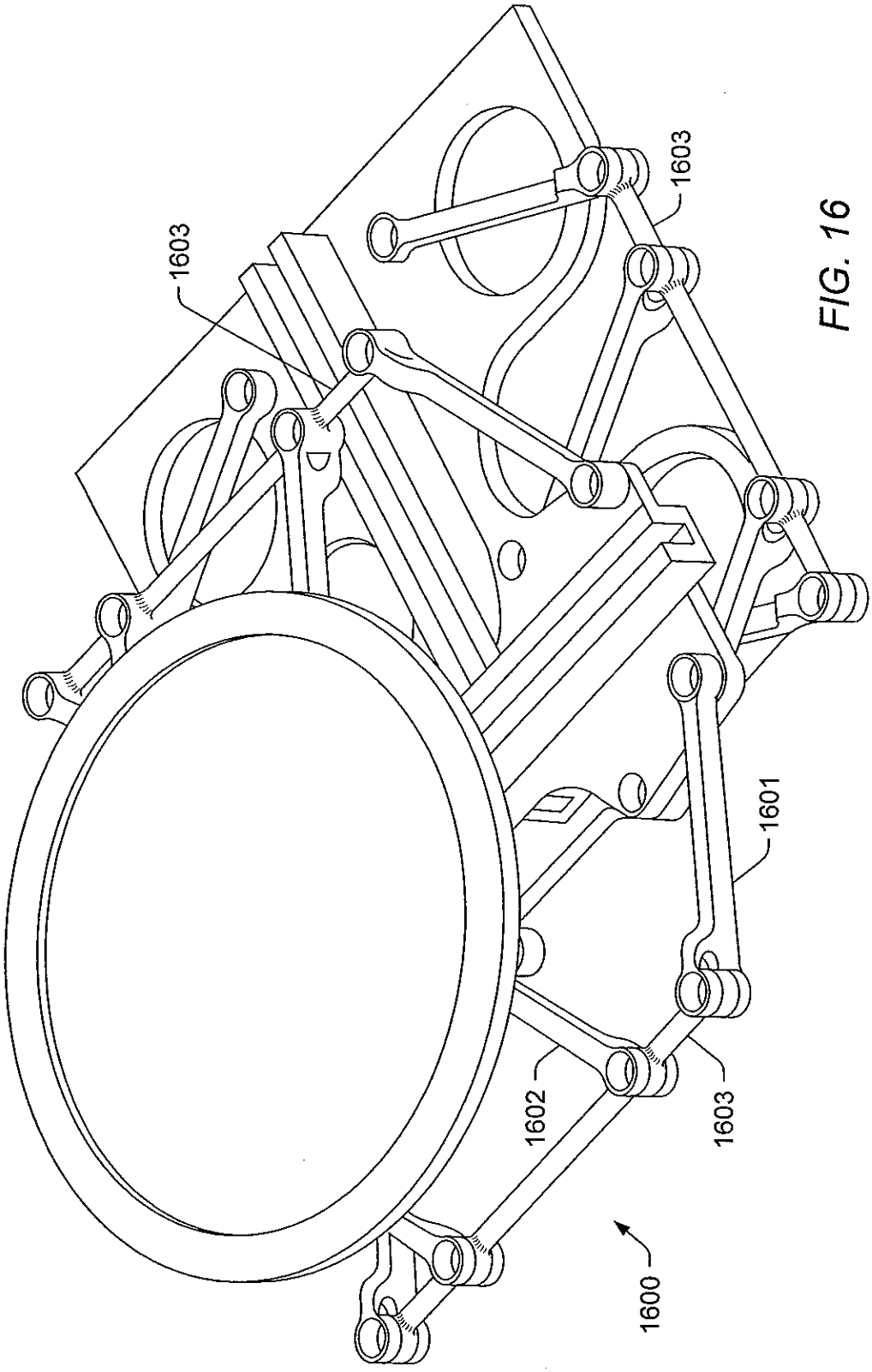


FIG. 16

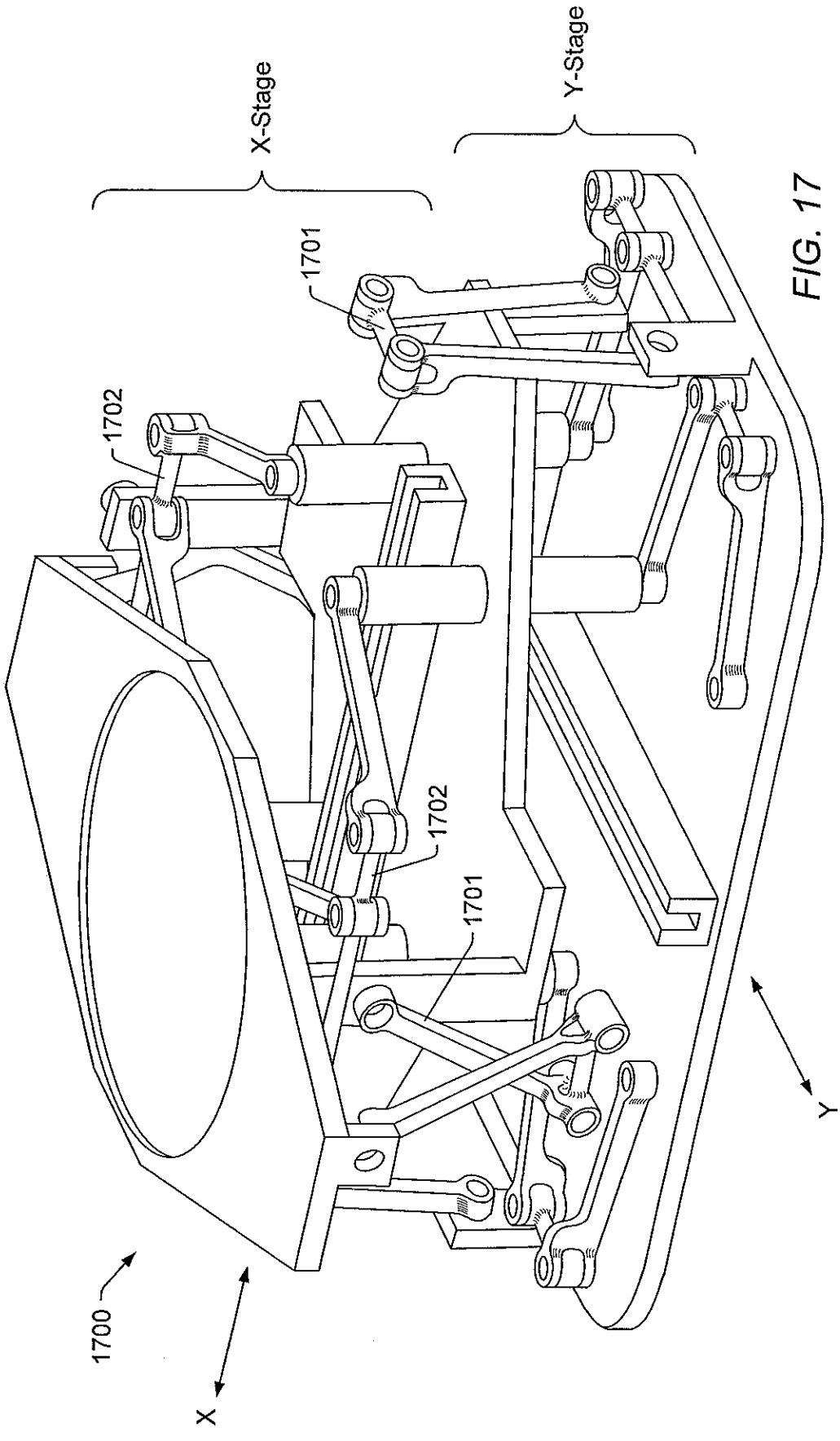


FIG. 17

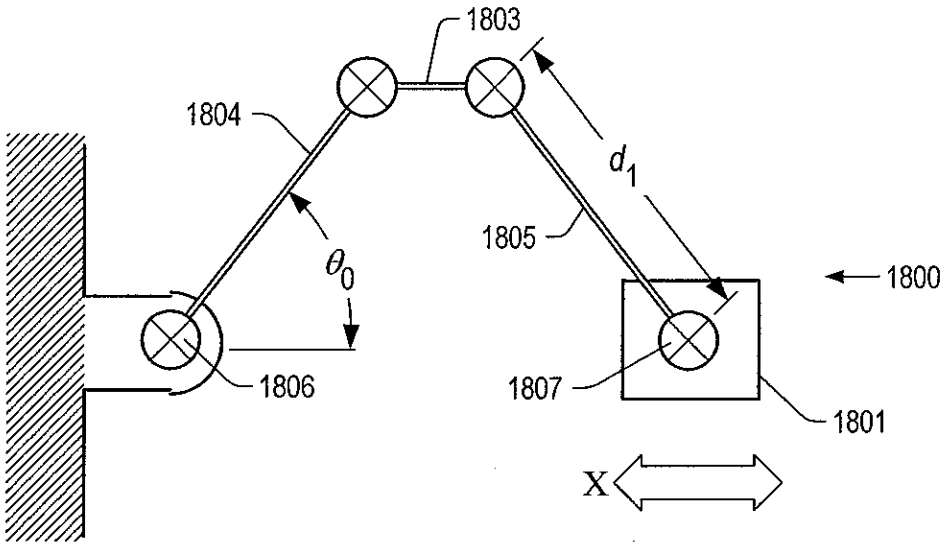

1803
1804
d_1
1805
θ_0
1800
1806
1807
1801
X

FIG. 18

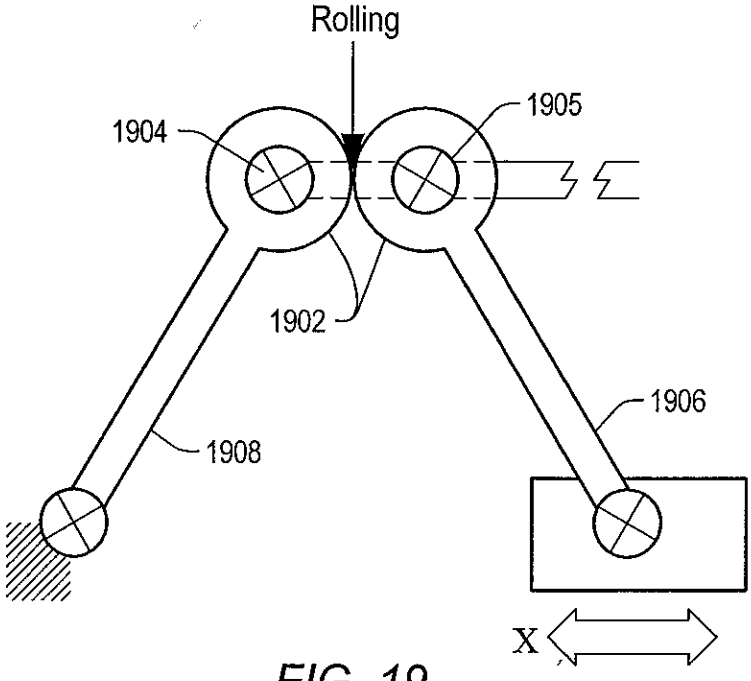

Rolling
1904
1905
1902
1906
1908
X

FIG. 19

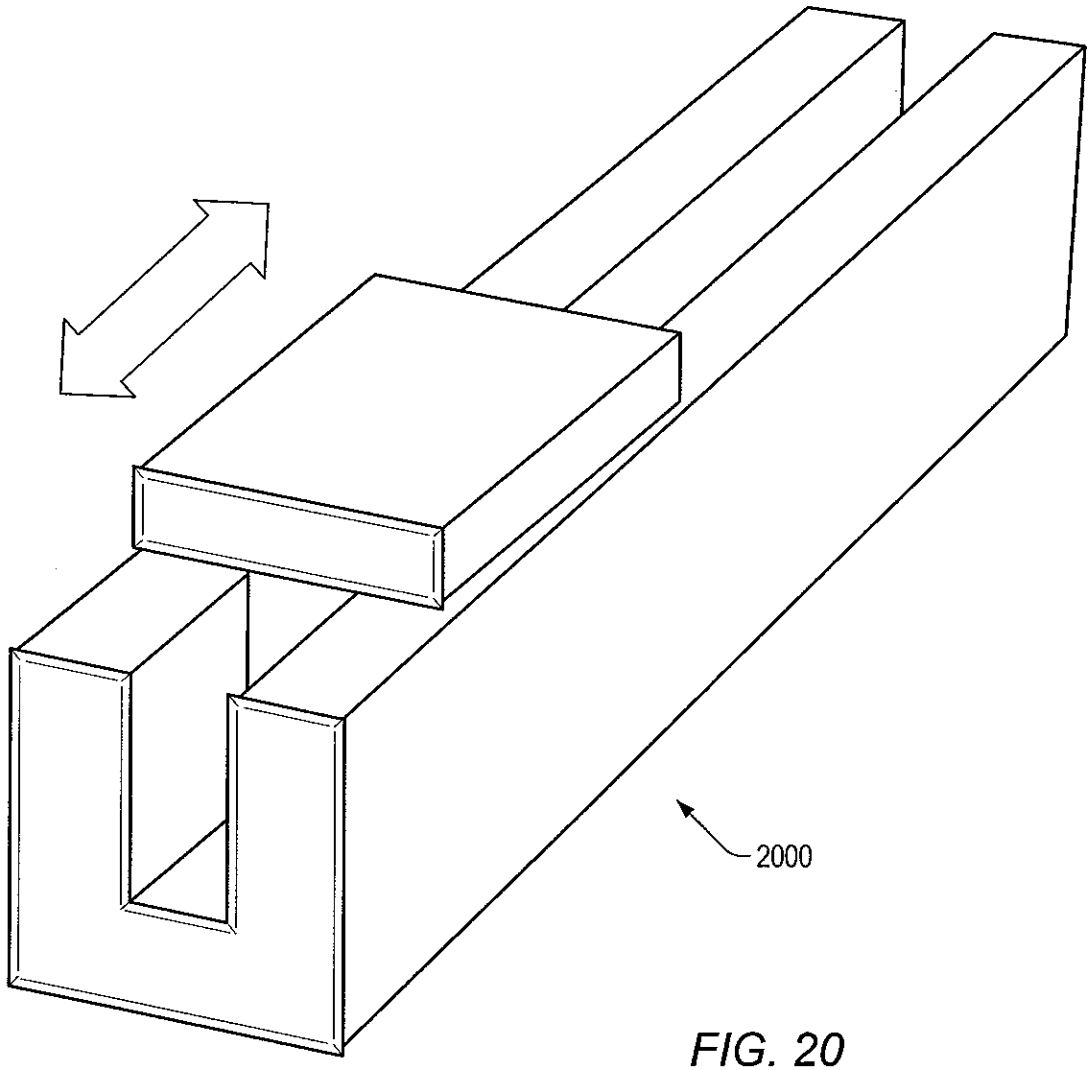


FIG. 20

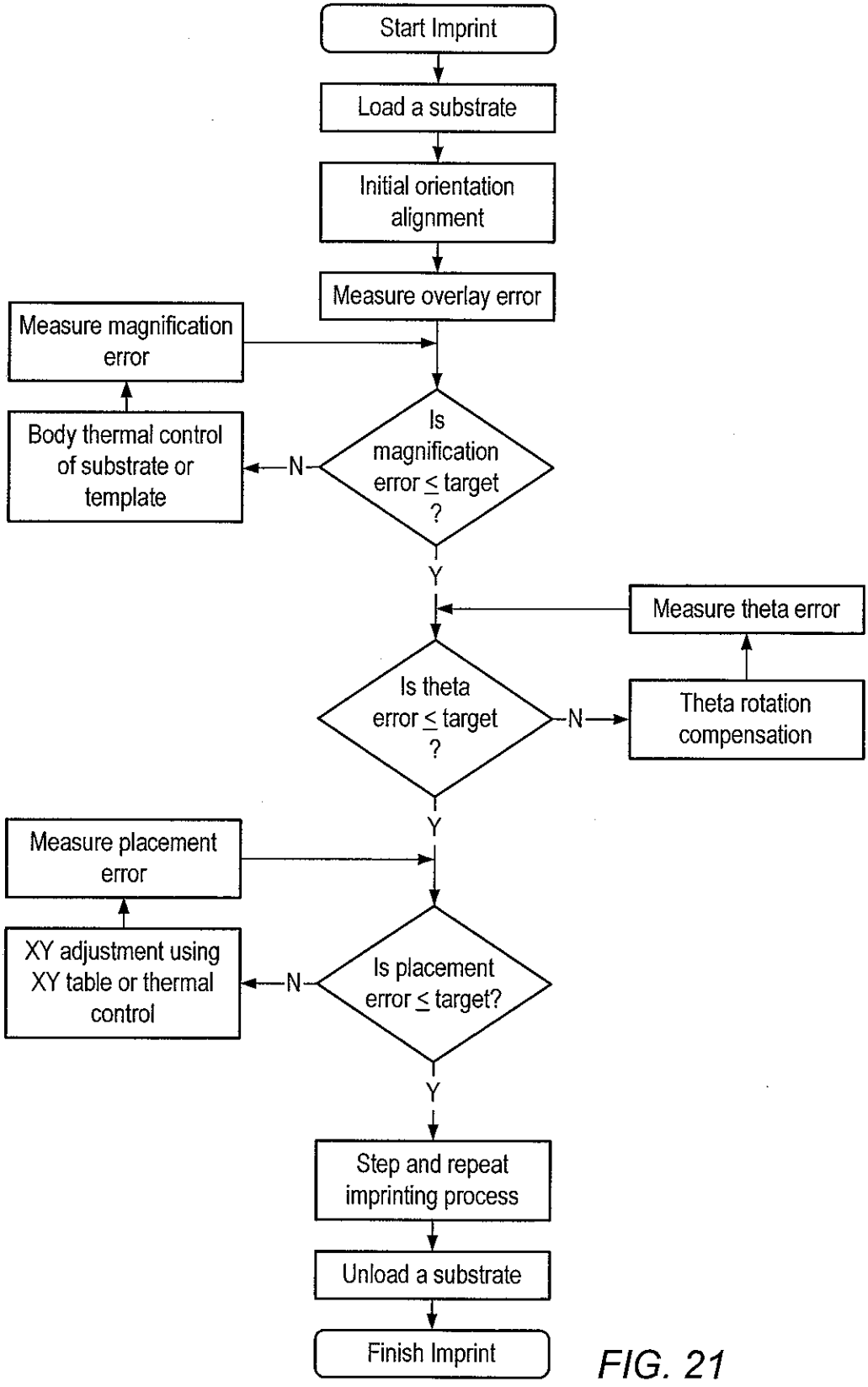

Start Imprint
Load a substrate
Initial orientation alignment
Measure overlay error
Measure magnification error
Body thermal control of substrate or template
Is magnification error ≤ target ?
N
Y
Measure theta error
Is theta error ≤ target ?
N
Theta rotation compensation
Y
Measure placement error
XY adjustment using XY table or thermal control
Is placement error ≤ target?
N
Y
Step and repeat imprinting process
Unload a substrate
Finish Imprint

FIG. 21

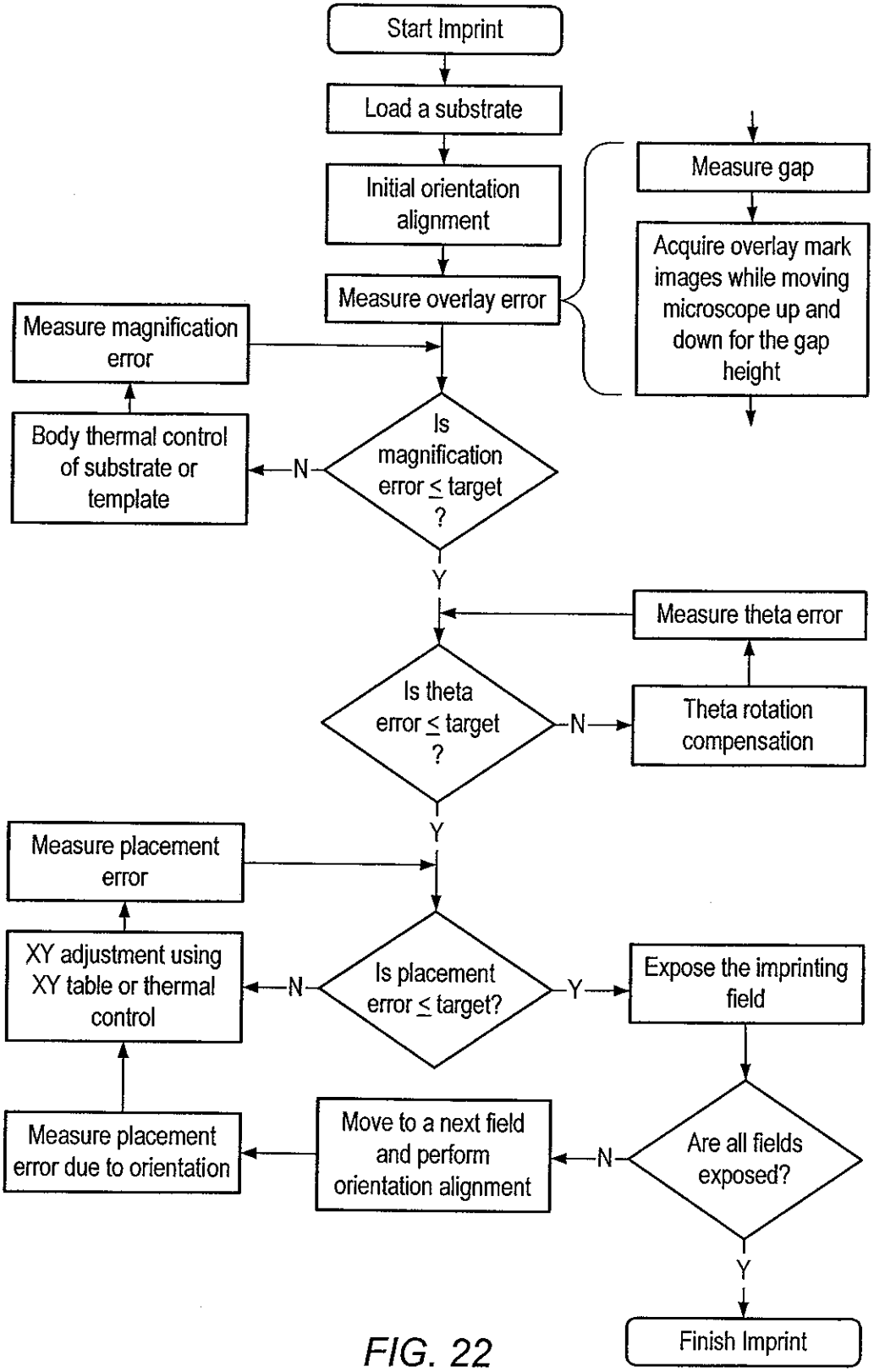

Start Imprint
Load a substrate
Initial orientation alignment
Measure overlay error
Measure gap
Acquire overlay mark images while moving microscope up and down for the gap height
Measure magnification error
Body thermal control of substrate or template
Is magnification error ≤ target ?
N
Y
Measure theta error
Is theta error ≤ target ?
N
Theta rotation compensation
Y
Measure placement error
XY adjustment using XY table or thermal control
Is placement error ≤ target?
N
Y
Expose the imprinting field
Measure placement error due to orientation
Move to a next field and perform orientation alignment
Are all fields exposed?
N
Y
Finish Imprint

FIG. 22

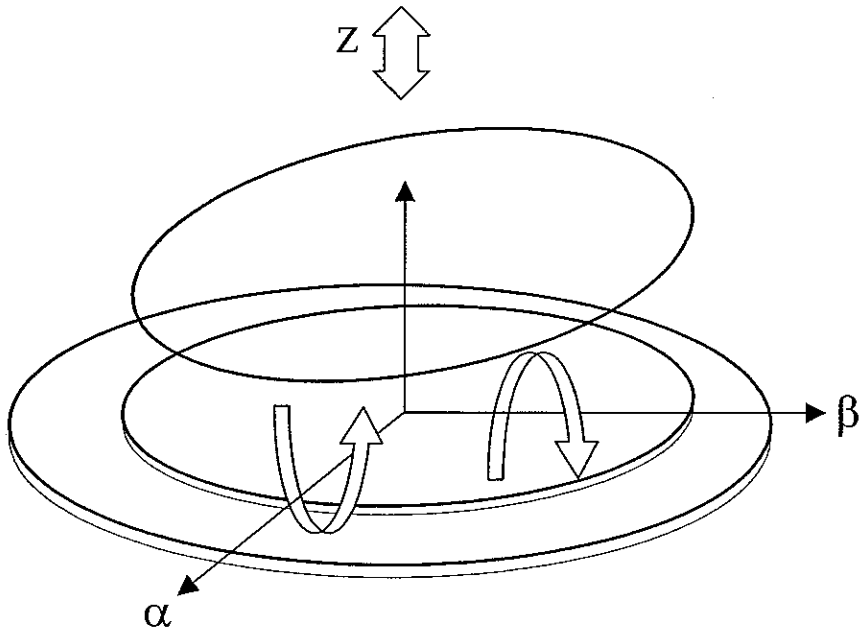


FIG. 23

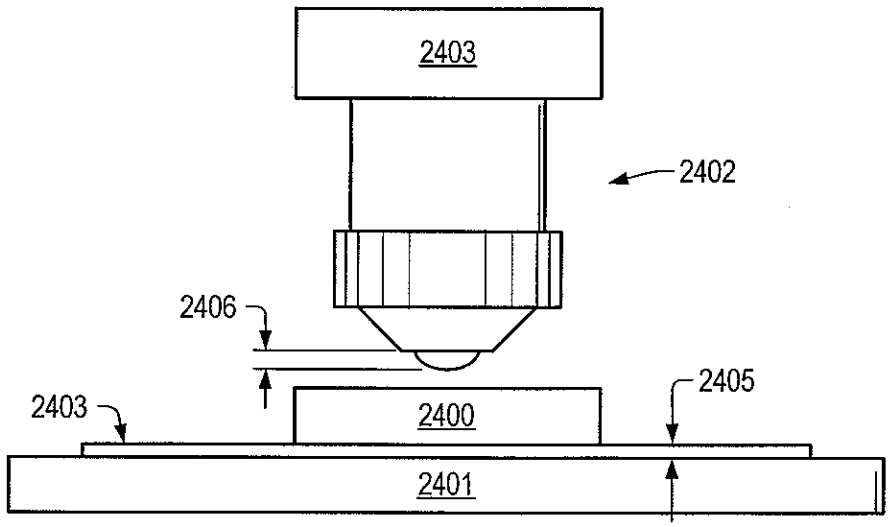


FIG. 24

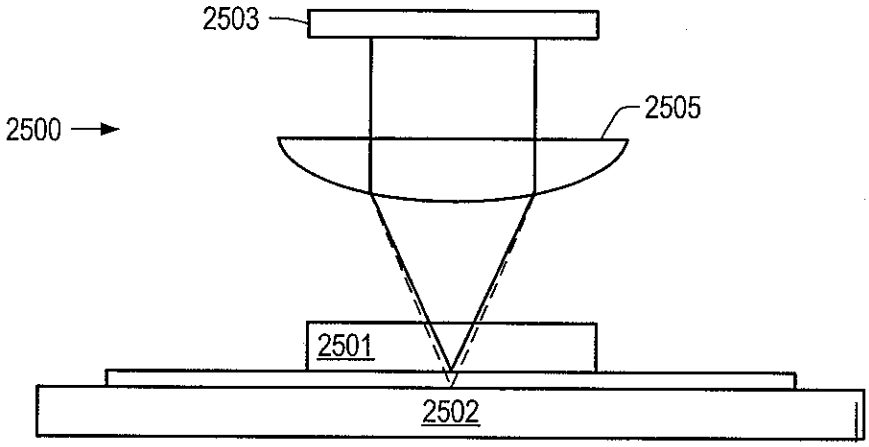


FIG. 25

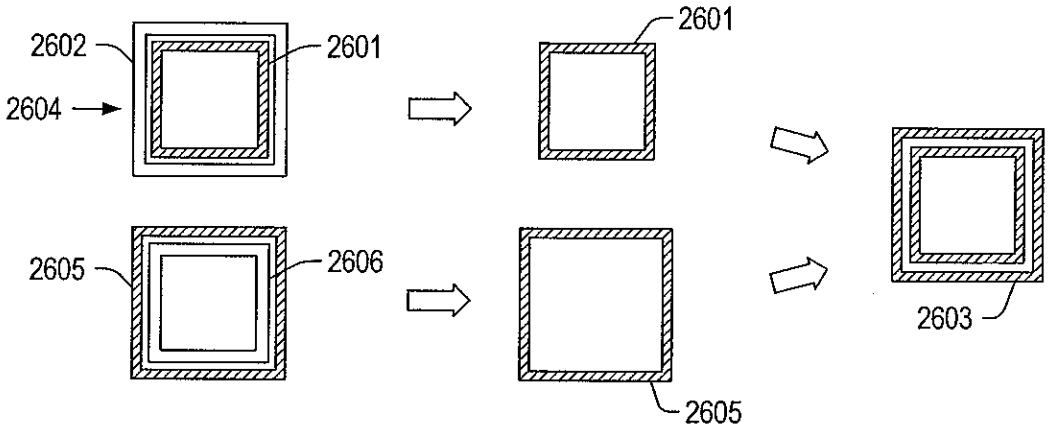


FIG. 26

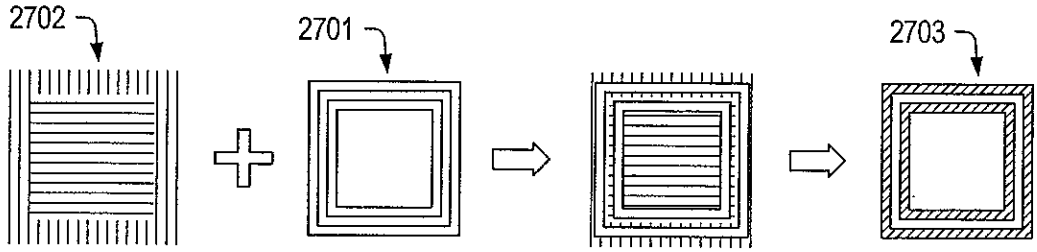


FIG. 27

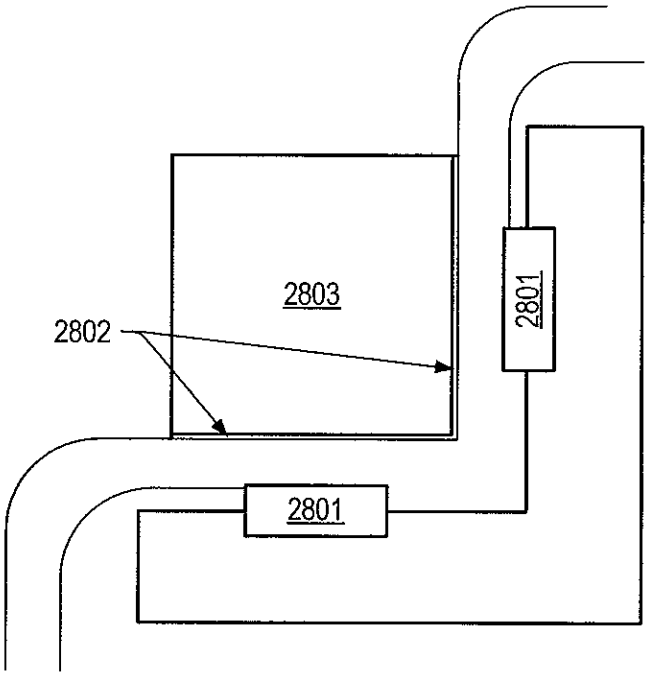


FIG. 28

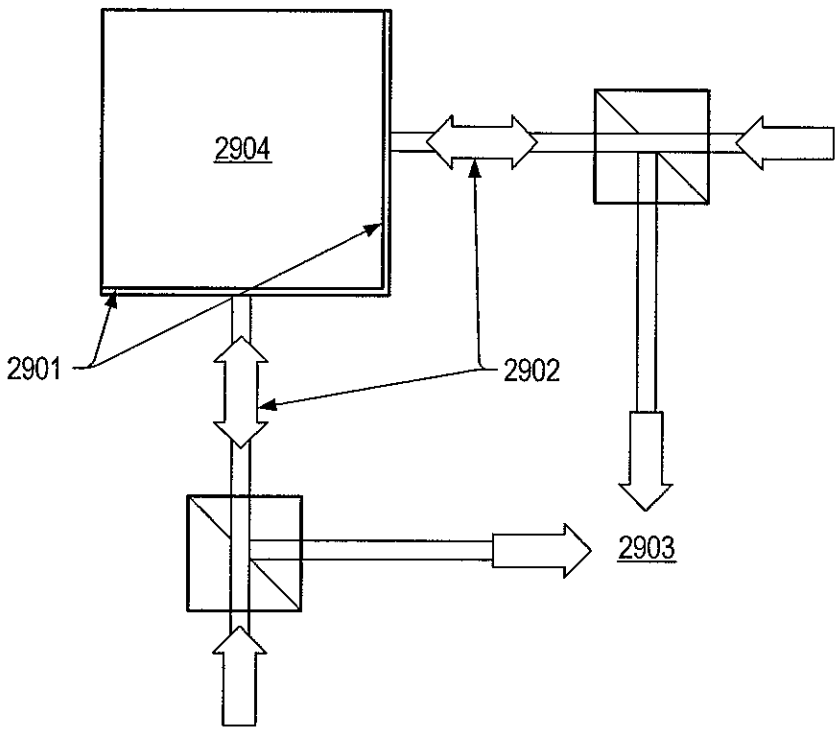


FIG. 29

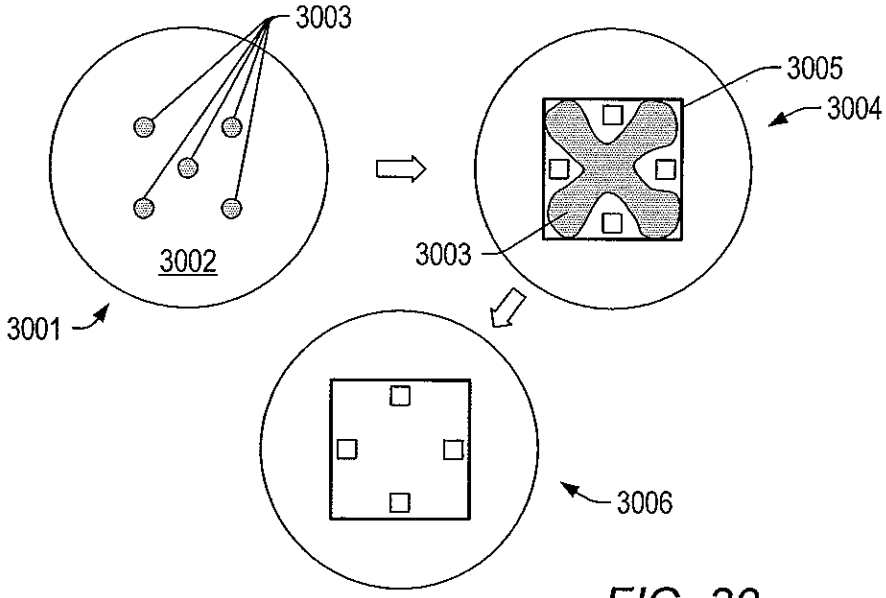


FIG. 30

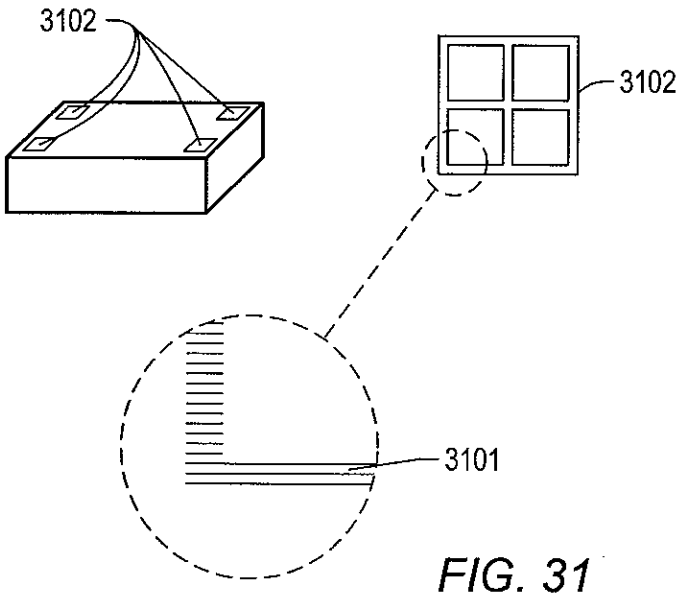


FIG. 31

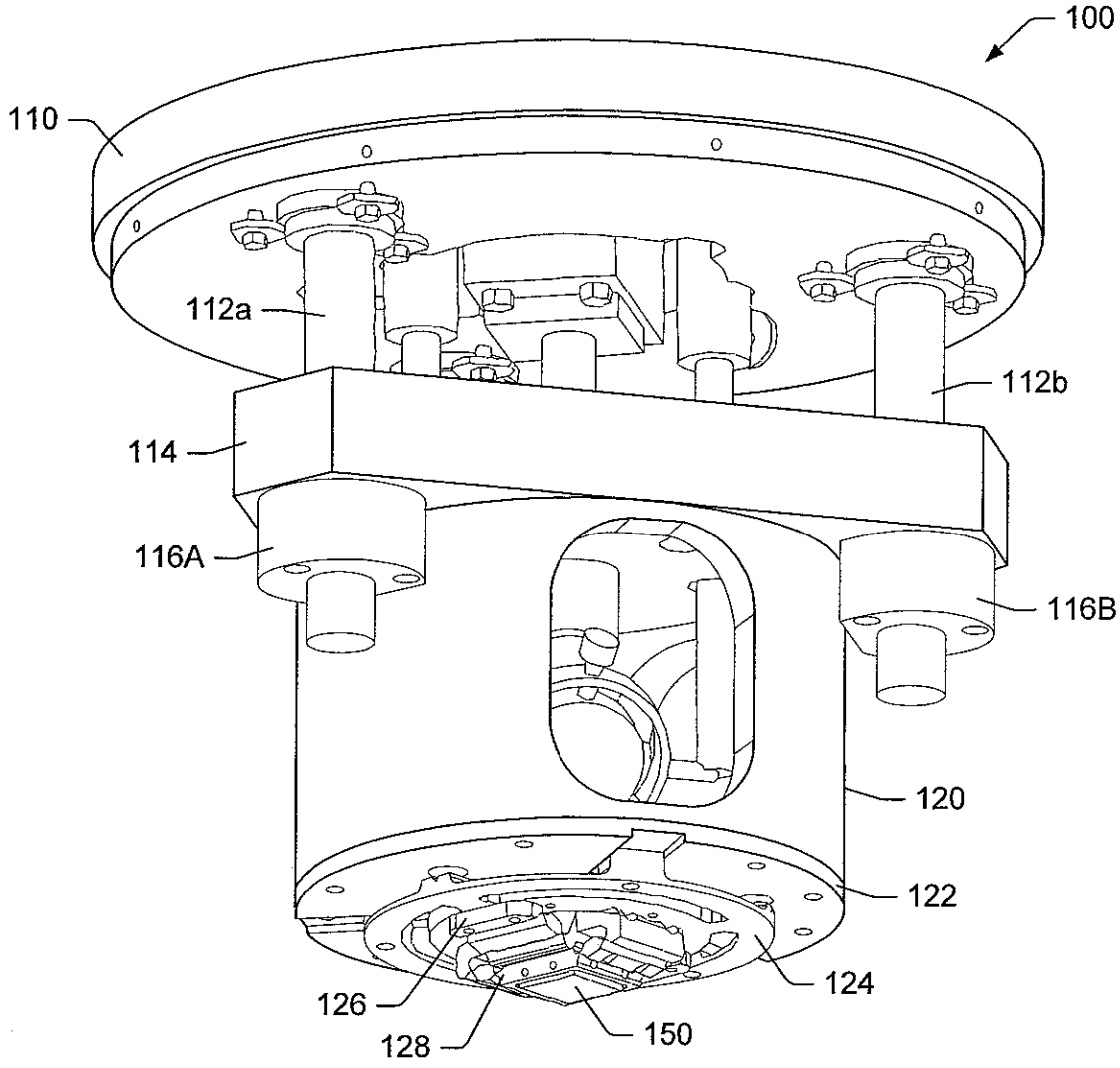


FIG. 32

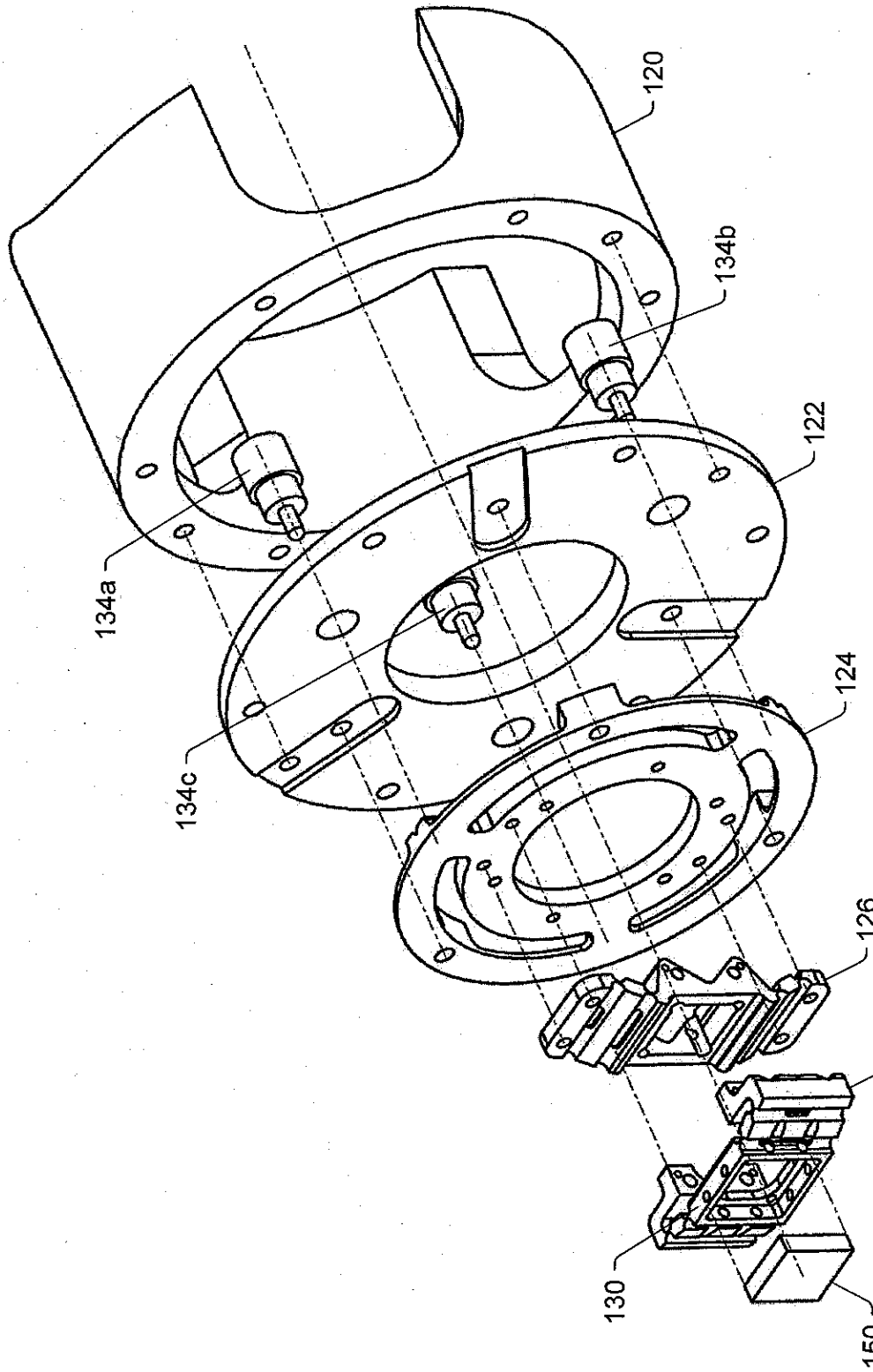


FIG. 33

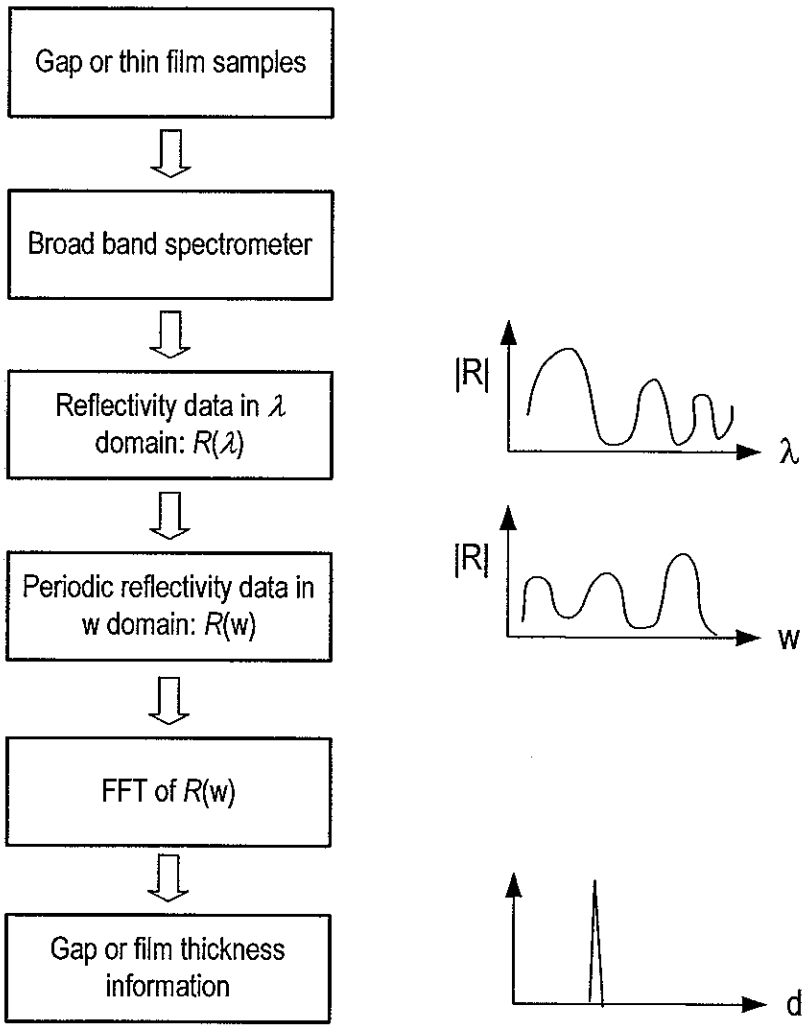

Gap or thin film samples
Broad band spectrometer
Reflectivity data in λ domain: R(λ)
Periodic reflectivity data in w domain: R(w)
FFT of R(w)
Gap or film thickness information
|R|
λ
|R|
w
d

FIG. 34

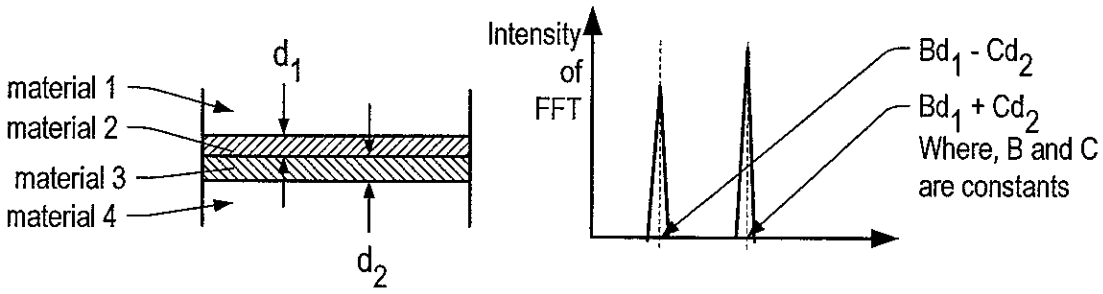

material 1
material 2
material 3
material 4
d_1
d_2
Intensity of FFT
$Bd_1 - Cd_2$
$Bd_1 + Cd_2$
Where, B and C are constants

FIG. 35

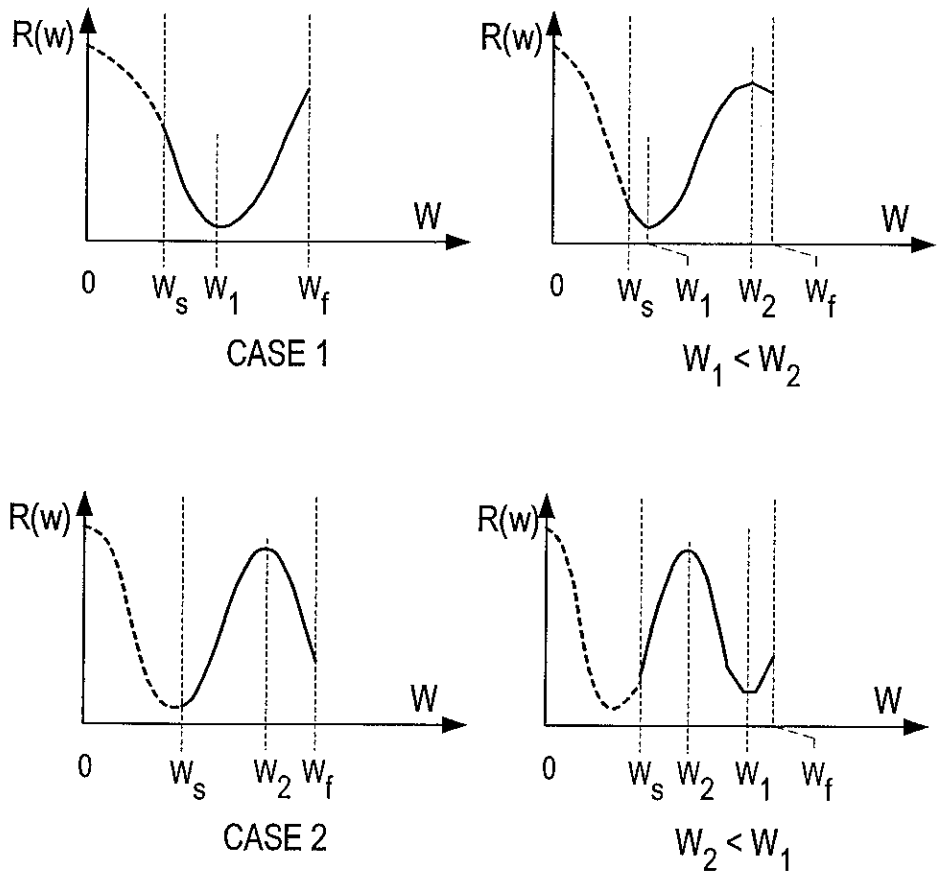

R(w)
W
0
W_s
W_1
W_f
CASE 1
R(w)
W
0
W_s
W_1
W_2
W_f
$W_1 < W_2$
R(w)
W
0
W_s
W_2
W_f
CASE 2
R(w)
W
0
W_s
W_2
W_1
W_f
$W_2 < W_1$

FIG. 36

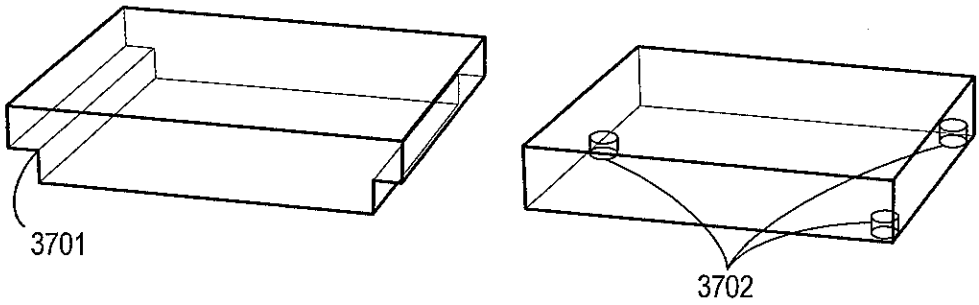


FIG. 37

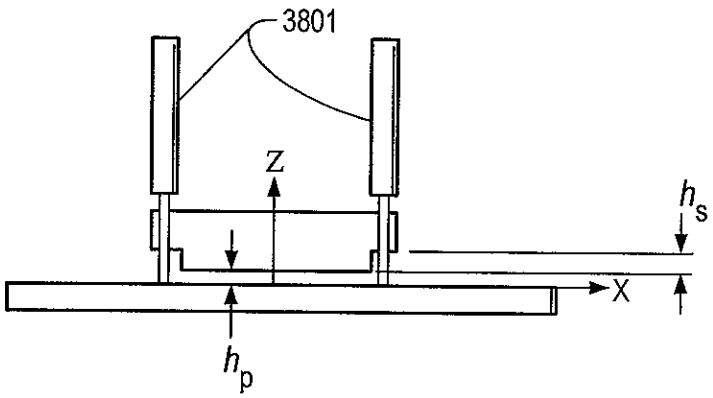


FIG. 38

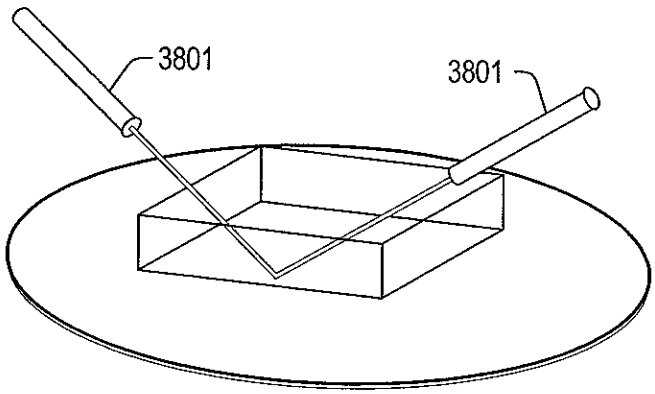


FIG. 39

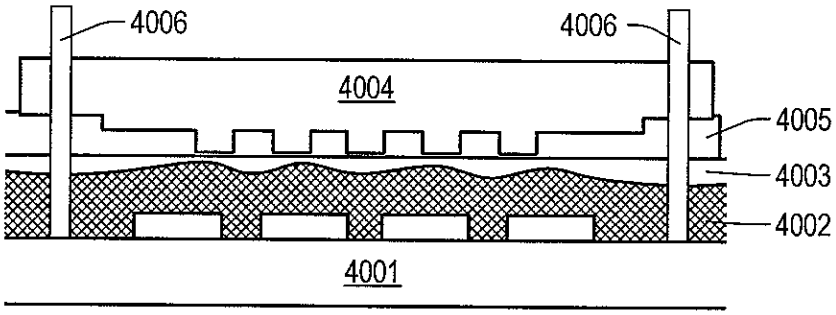


FIG. 40

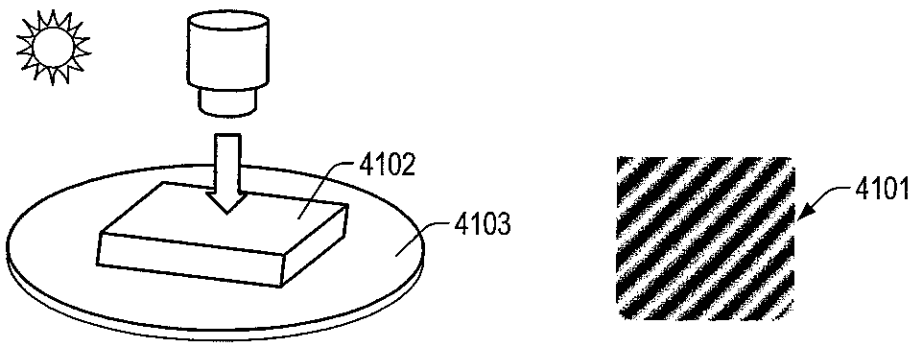


FIG. 41

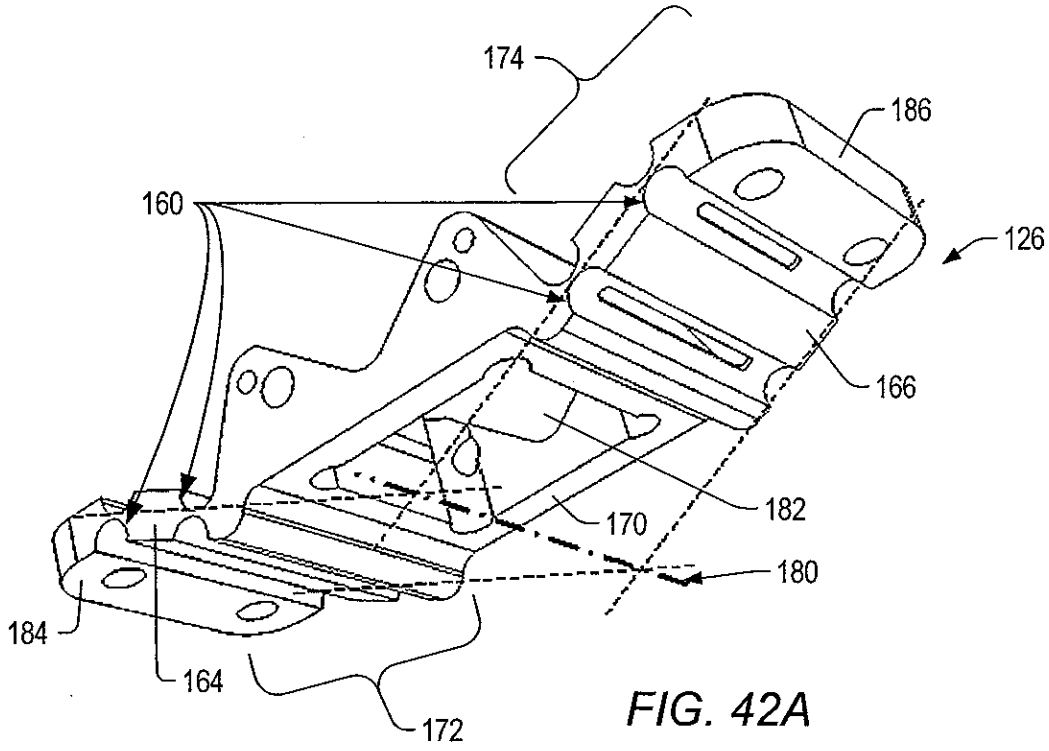


FIG. 42A

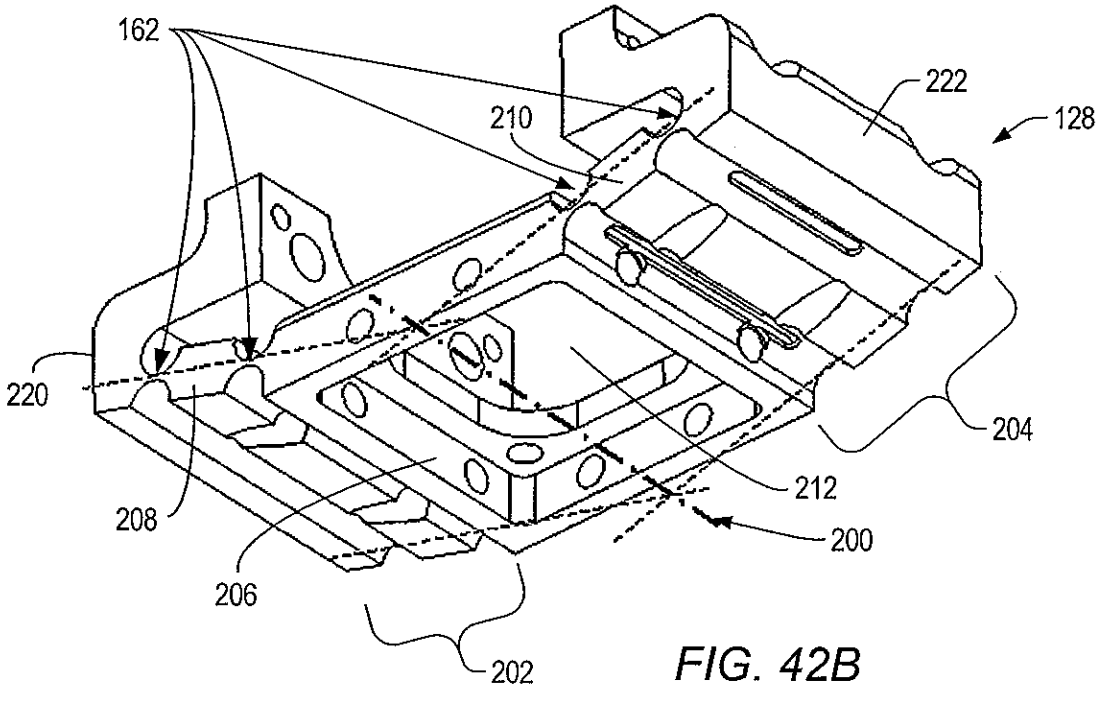


FIG. 42B

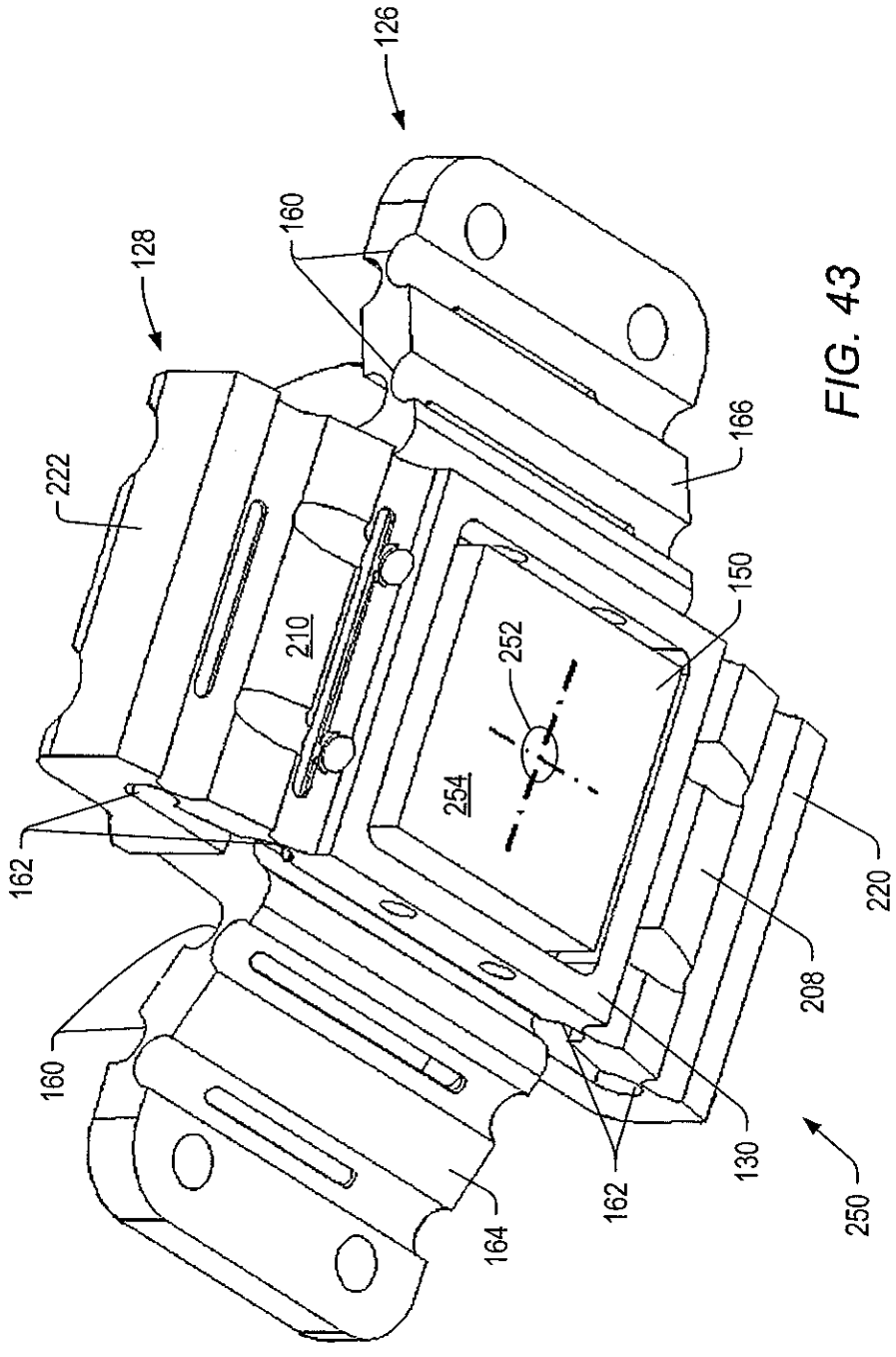

126
128
160
222
166
150
210
252
254
162
160
220
208
130
162
164
250

FIG. 43

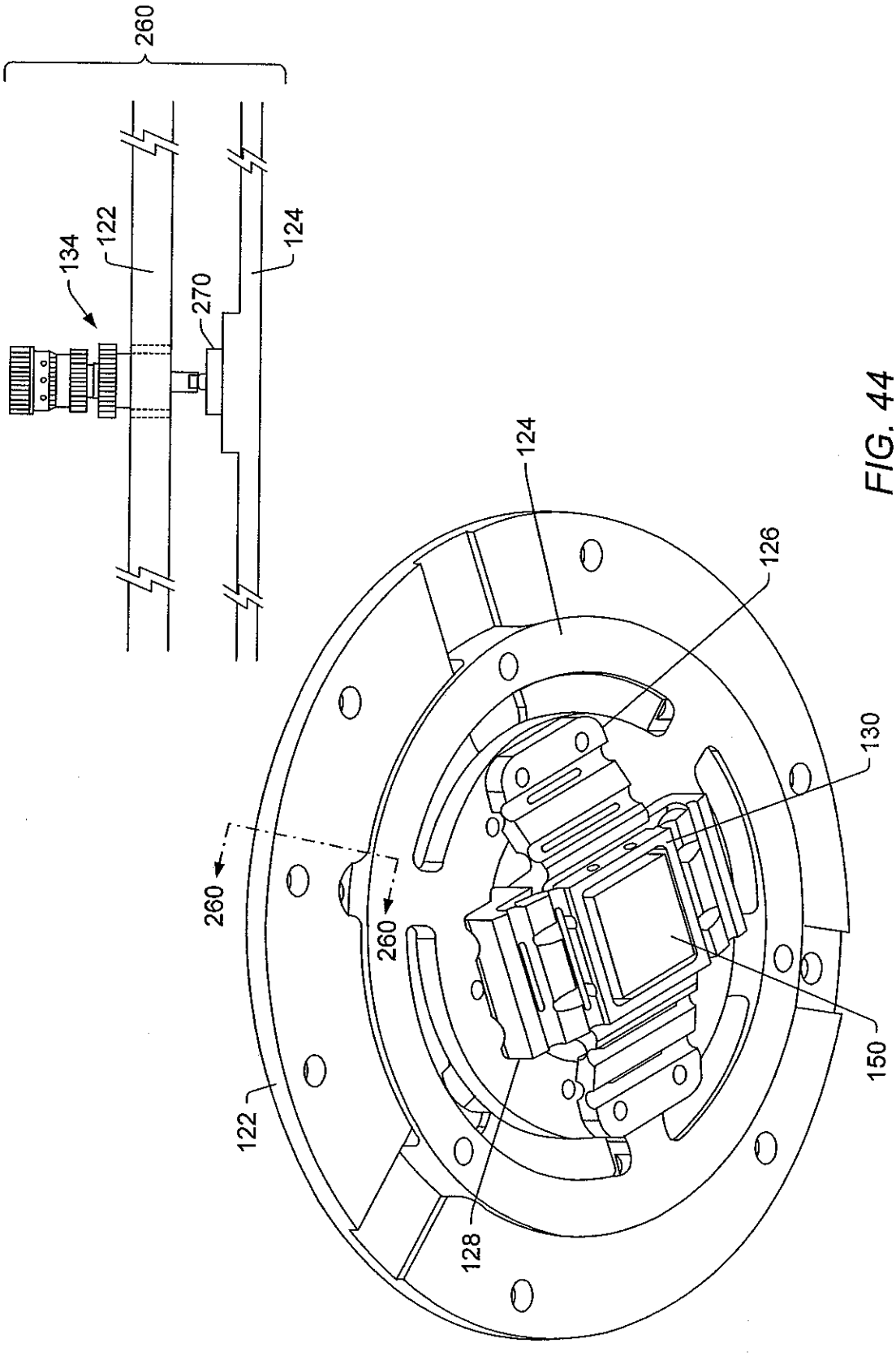


FIG. 44

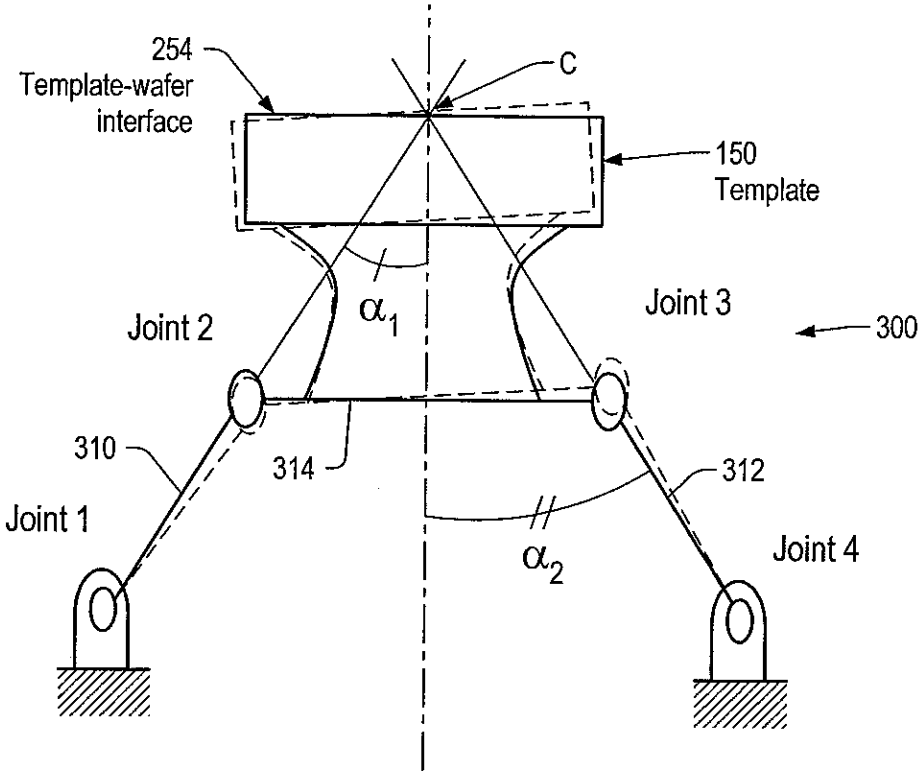

254
Template-wafer
interface
C
150
Template
Joint 2
α_1
Joint 3
300
310
314
312
Joint 1
α_2
Joint 4

FIG. 45

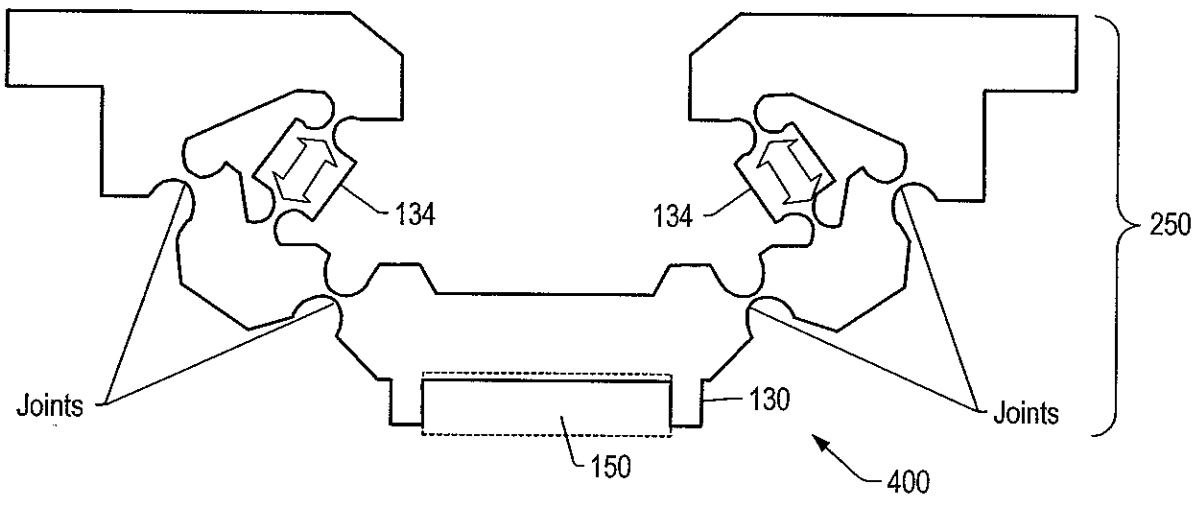

134
134
250
Joints
130
Joints
150
400

FIG. 46

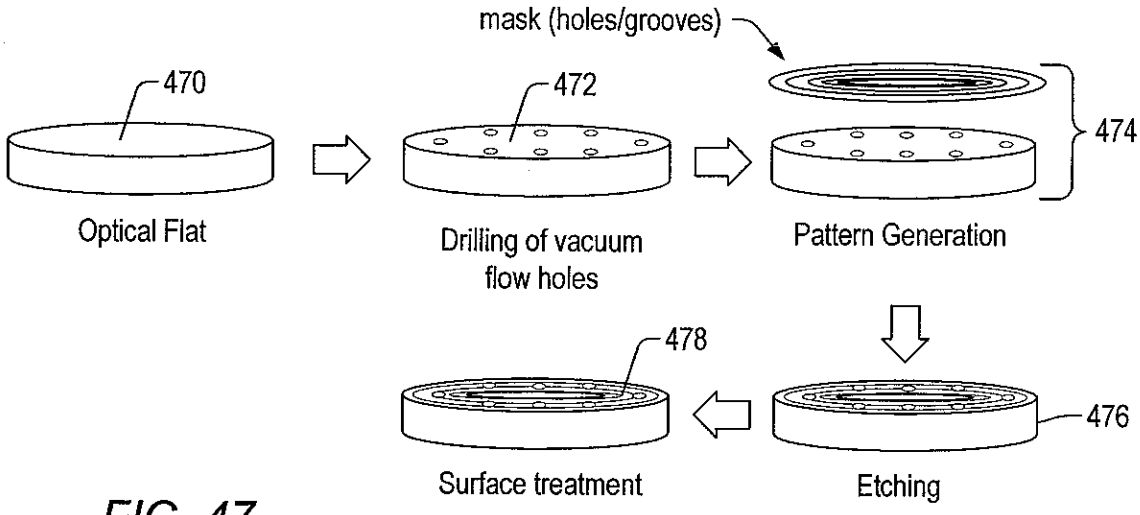


FIG. 47

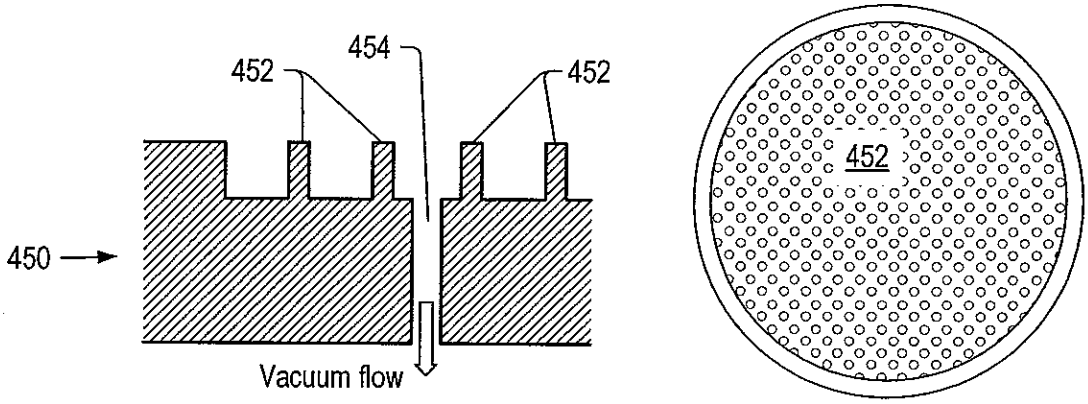


FIG. 48A

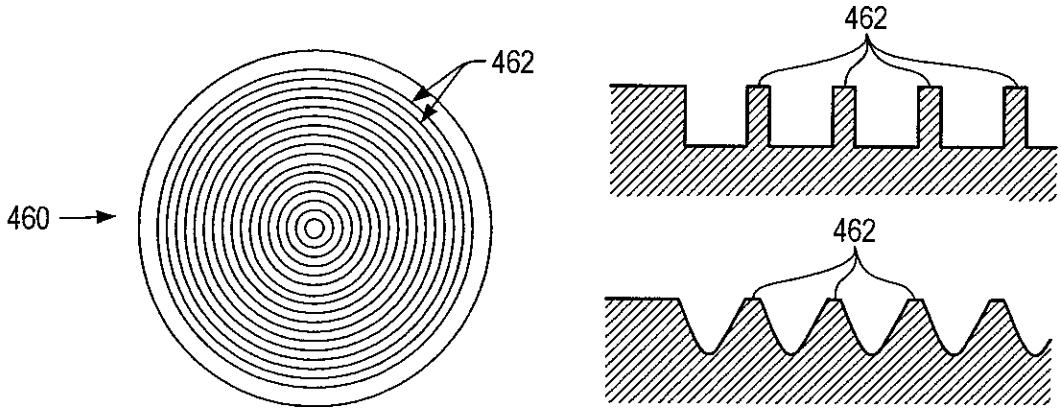


FIG. 48B

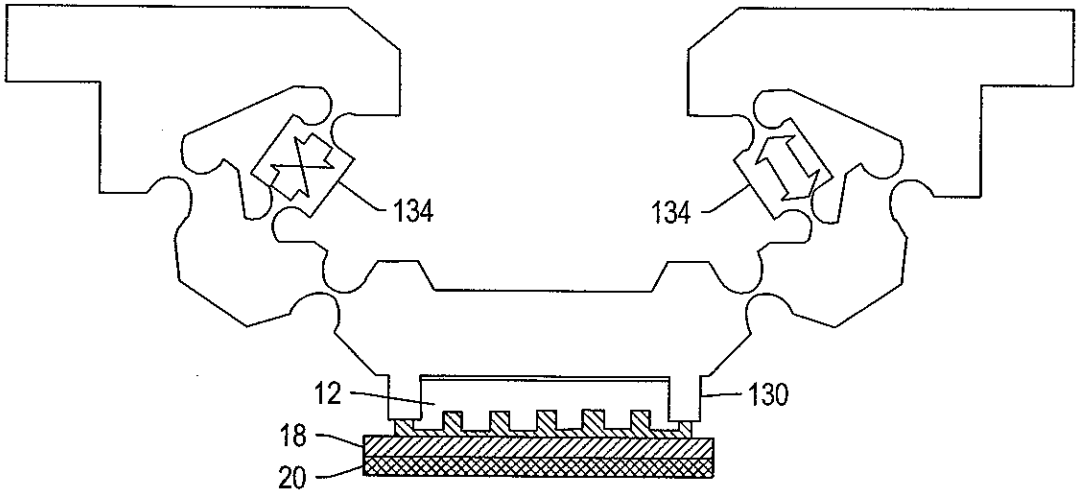


FIG. 49A

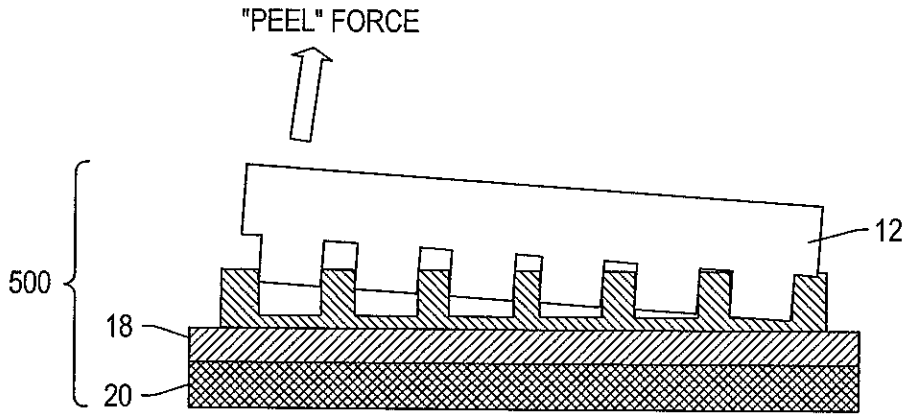


FIG. 49B

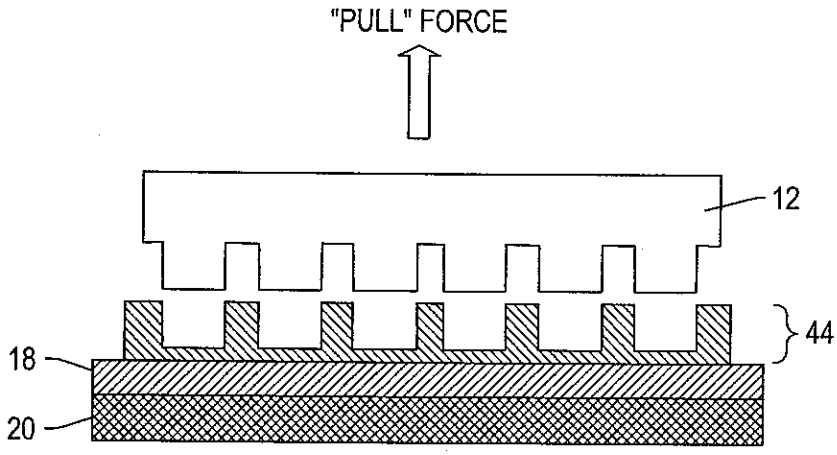


FIG. 49C

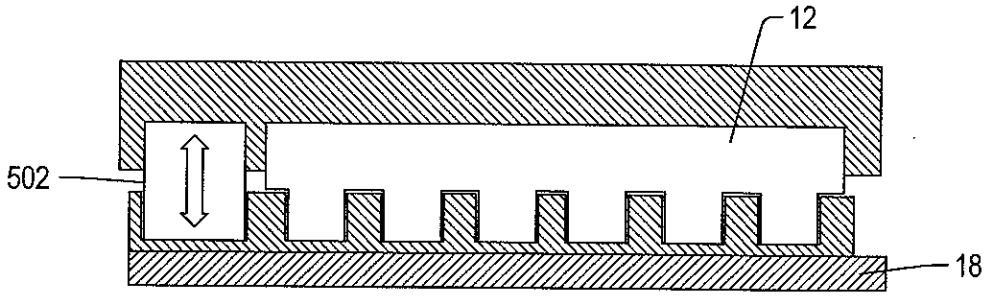


FIG. 50A

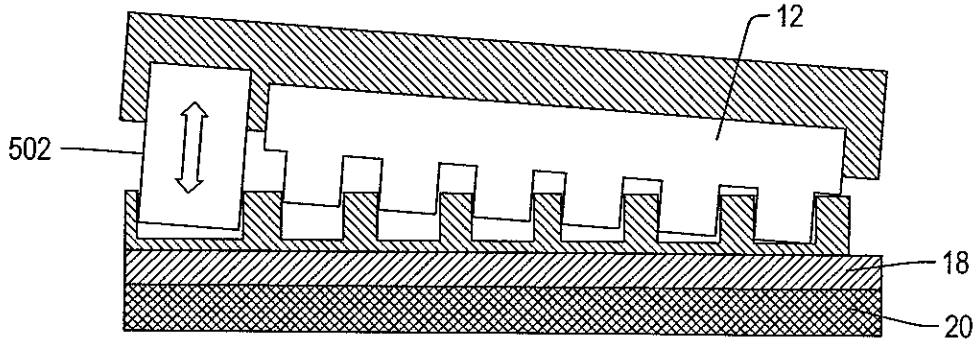


FIG. 50B

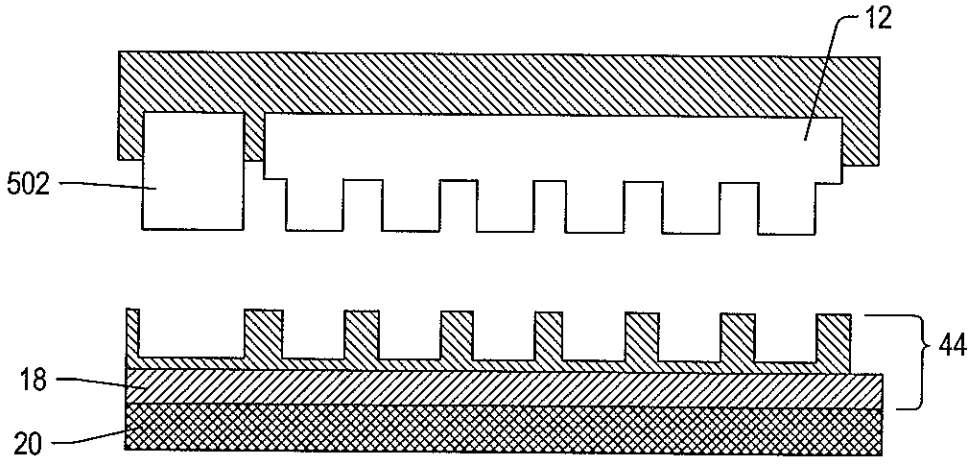


FIG. 50C

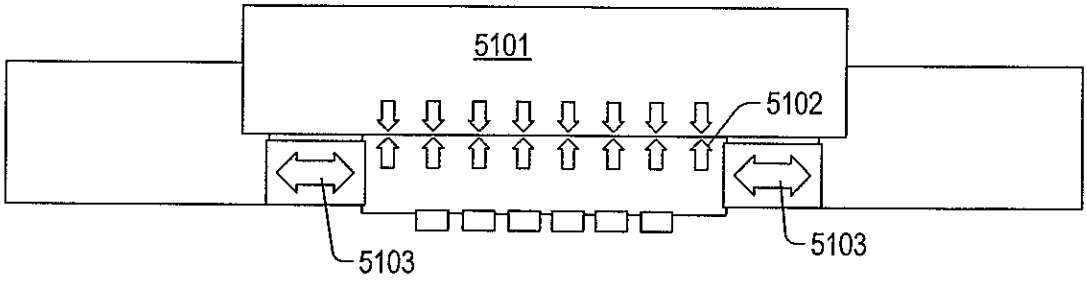


FIG. 51A

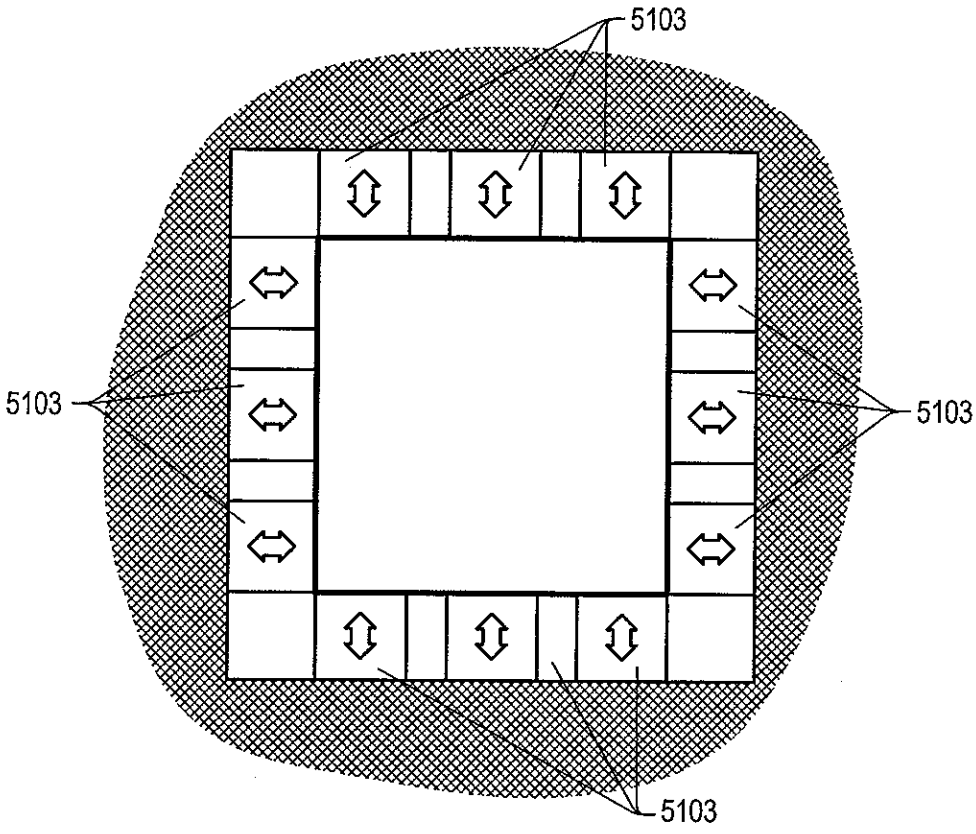


FIG. 51B

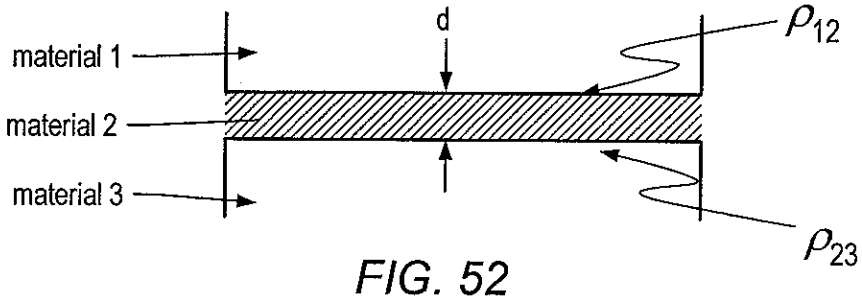


FIG. 52