
Deposition of Tungsten Nucleation Layer on Substrate (101)
CVD Deposition of Tungsten Bulk Layer H2 reduction of WF6 with no N2 (103)
CVD Deposition of Tungsten Bulk Layer H2 reduction of WF6 in presence of N2 (105)
CVD Deposition of Tungsten Bulk Layer H2 reduction of WF6 with no N2 (107)
CVD Deposition of Tungsten Bulk Layer H2 reduction of WF6 in presence of N2 (109)
Repeat operations 105 and 107 if necessary to achieve desired thickness (109)

FIGURE 1

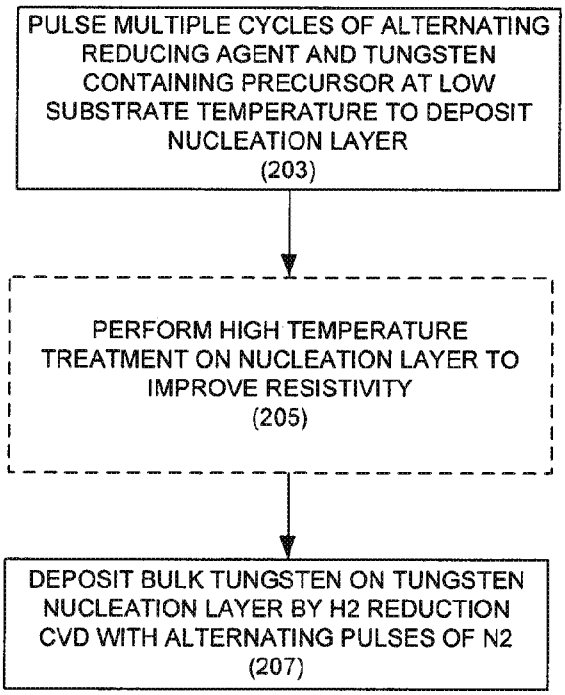

PULSE MULTIPLE CYCLES OF ALTERNATING REDUCING AGENT AND TUNGSTEN CONTAINING PRECURSOR AT LOW SUBSTRATE TEMPERATURE TO DEPOSIT NUCLEATION LAYER
(203)
PERFORM HIGH TEMPERATURE TREATMENT ON NUCLEATION LAYER TO IMPROVE RESISTIVITY
(205)
DEPOSIT BULK TUNGSTEN ON TUNGSTEN NUCLEATION LAYER BY H2 REDUCTION CVD WITH ALTERNATING PULSES OF N2
(207)

FIGURE 2

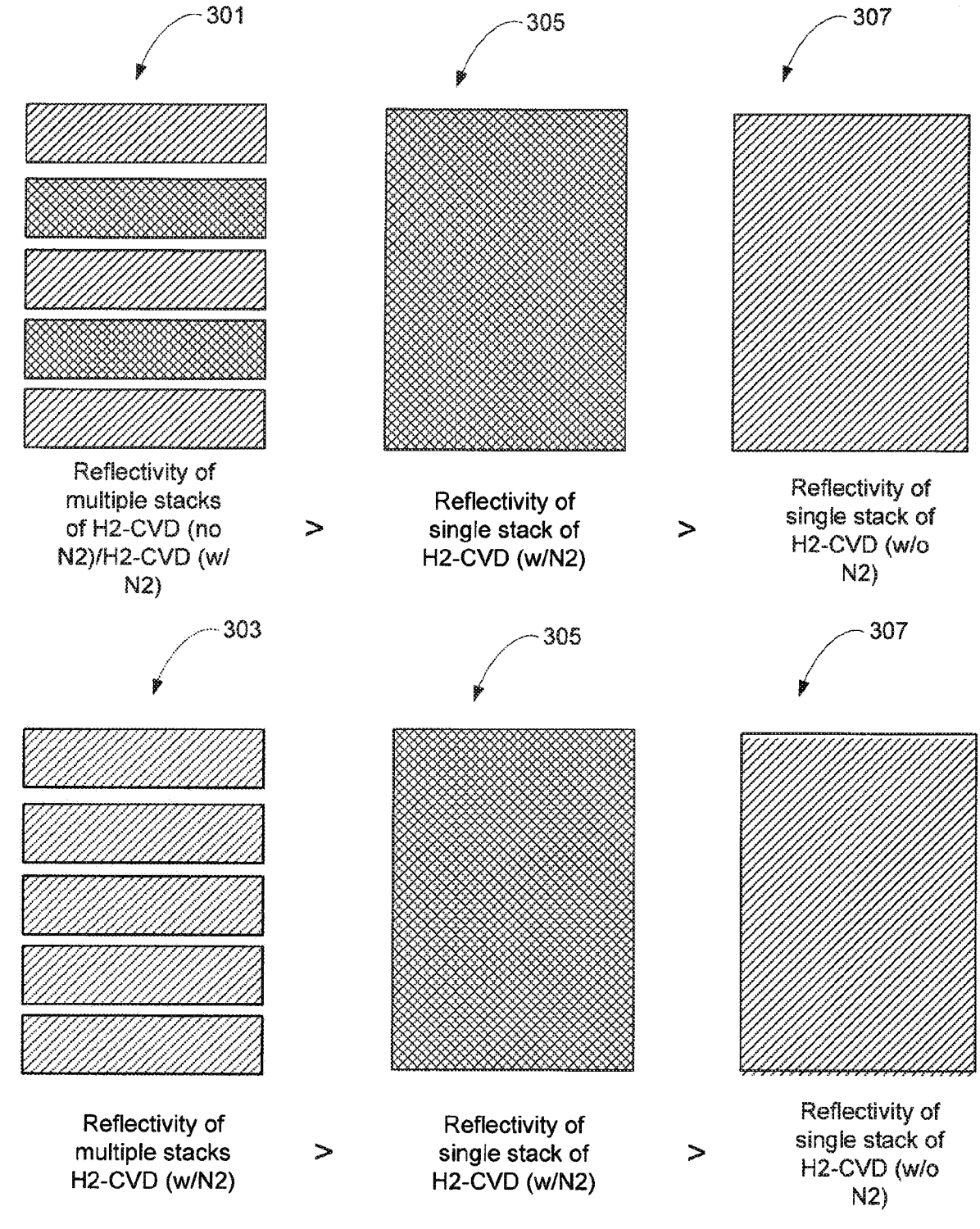

301
305
307
Reflectivity of multiple stacks of H2-CVD (no N2)/H2-CVD (w/ N2)
>
Reflectivity of single stack of H2-CVD (w/N2)
>
Reflectivity of single stack of H2-CVD (w/o N2)
303
305
307
Reflectivity of multiple stacks H2-CVD (w/N2)
>
Reflectivity of single stack of H2-CVD (w/N2)
>
Reflectivity of single stack of H2-CVD (w/o N2)
Between each stack W growth is interrupted for at least 1 second
Stack formed by H2 reduction of W precursor in presence of N2
Stack formed by H2 reduction of W precursor in absence of N2

FIGURE 3A

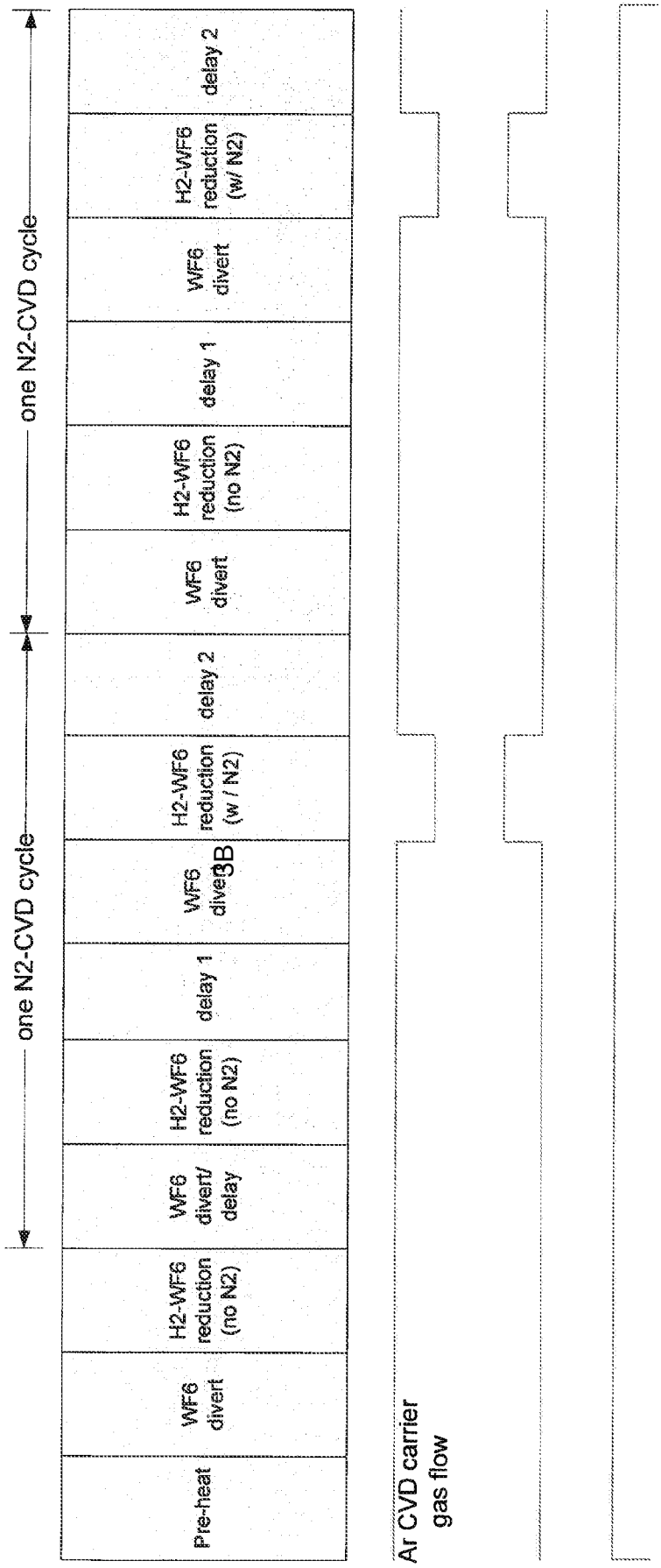

one N2-CVD cycle
one N2-CVD cycle
Pre-heat
WF6 divert
H2-WF6 reduction (no N2)
WF6 divert/ delay
H2-WF6 reduction (no N2)
delay 1
WF6 divert
H2-WF6 reduction (w / N2)
delay 2
WF6 divert
H2-WF6 reduction (no N2)
delay 1
WF6 divert
H2-WF6 reduction (w/ N2)
delay 2
Ar CVD carrier gas flow

FIGURE 3B

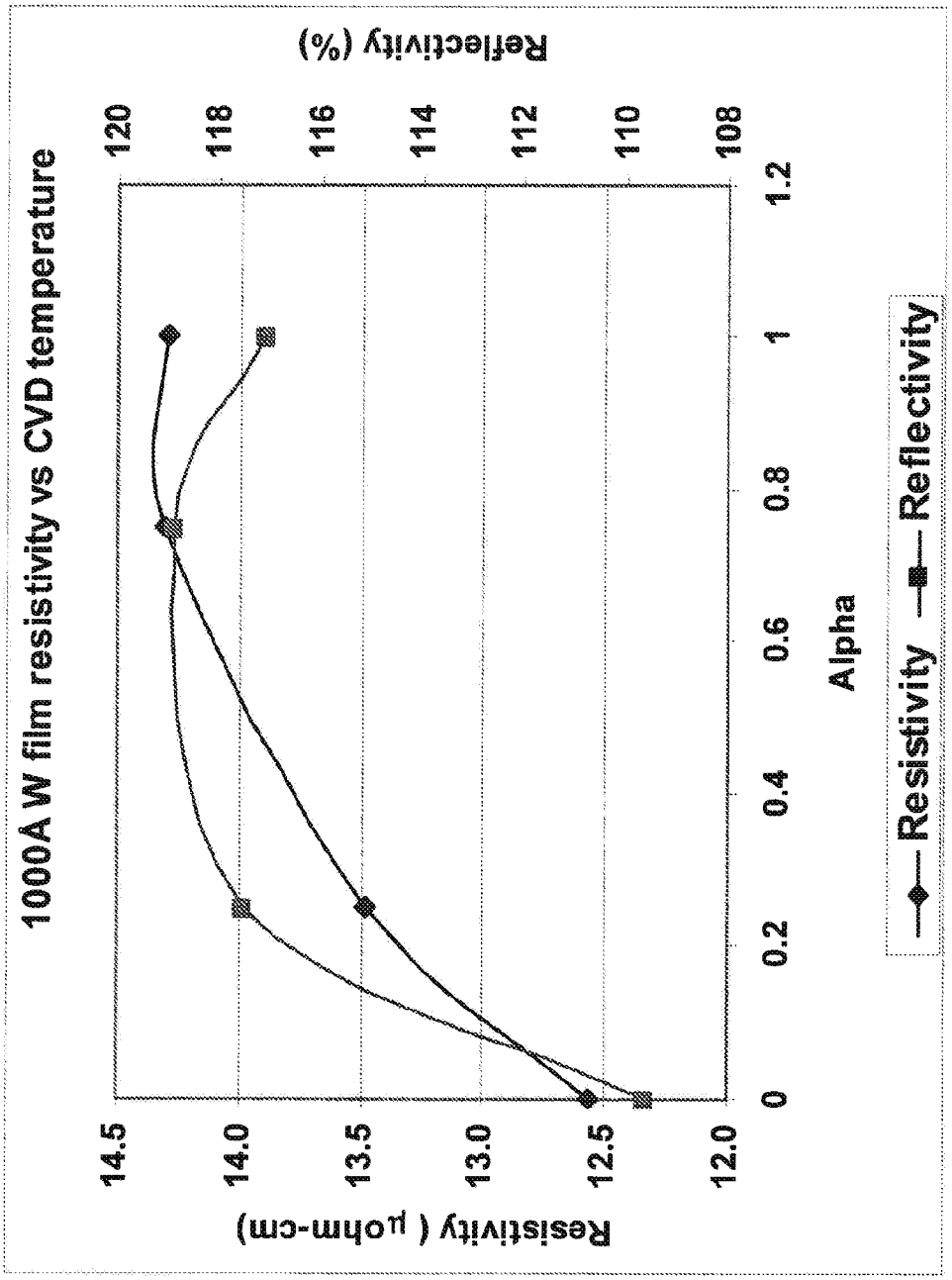

1000Å W film resistivity vs CVD temperature
Resistivity (μohm-cm)
Reflectivity (%)
Alpha
Resistivity
Reflectivity
14.5
14.0
13.5
13.0
12.5
12.0
120
118
116
114
112
110
108
0
0.2
0.4
0.6
0.8
1
1.2

FIGURE 4

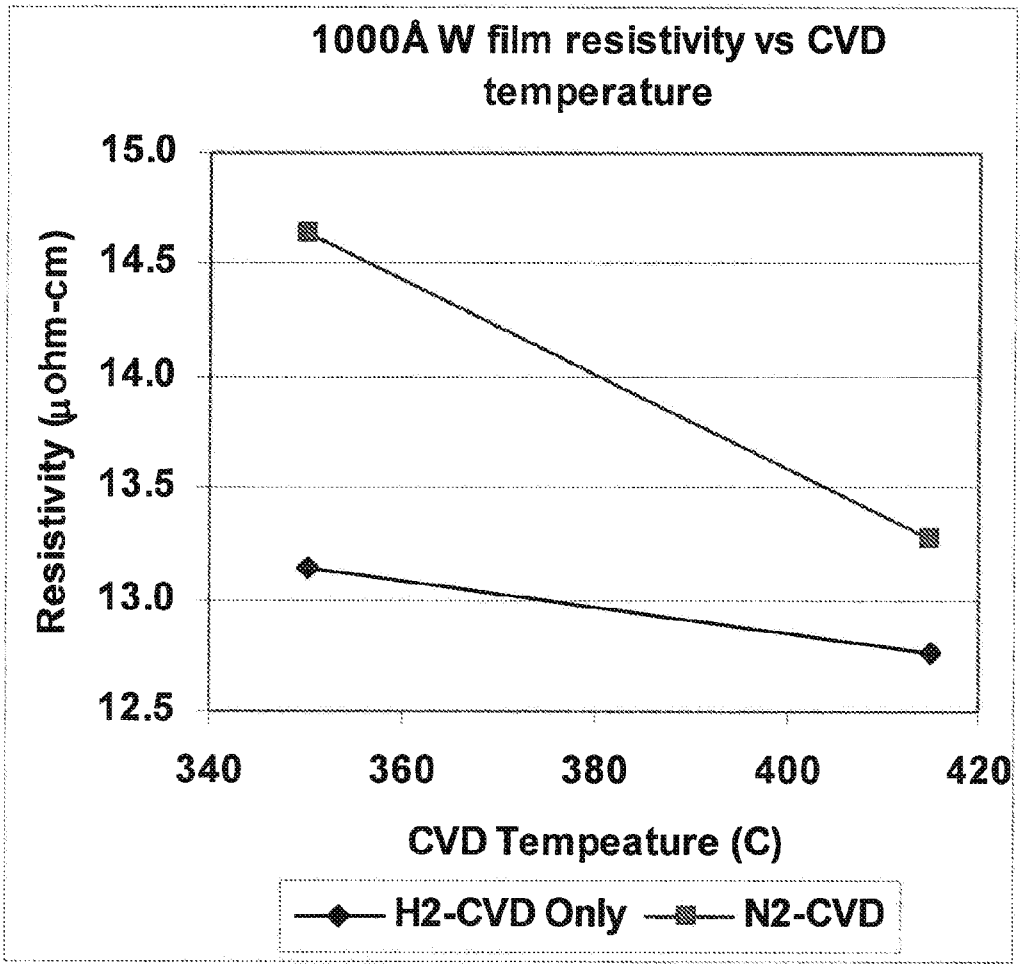

1000Å W film resistivity vs CVD temperature
Resistivity (μohm-cm)
15.0
14.5
14.0
13.5
13.0
12.5
340
360
380
400
420
CVD Tempeature (C)
H2-CVD Only
N2-CVD

FIGURE 5

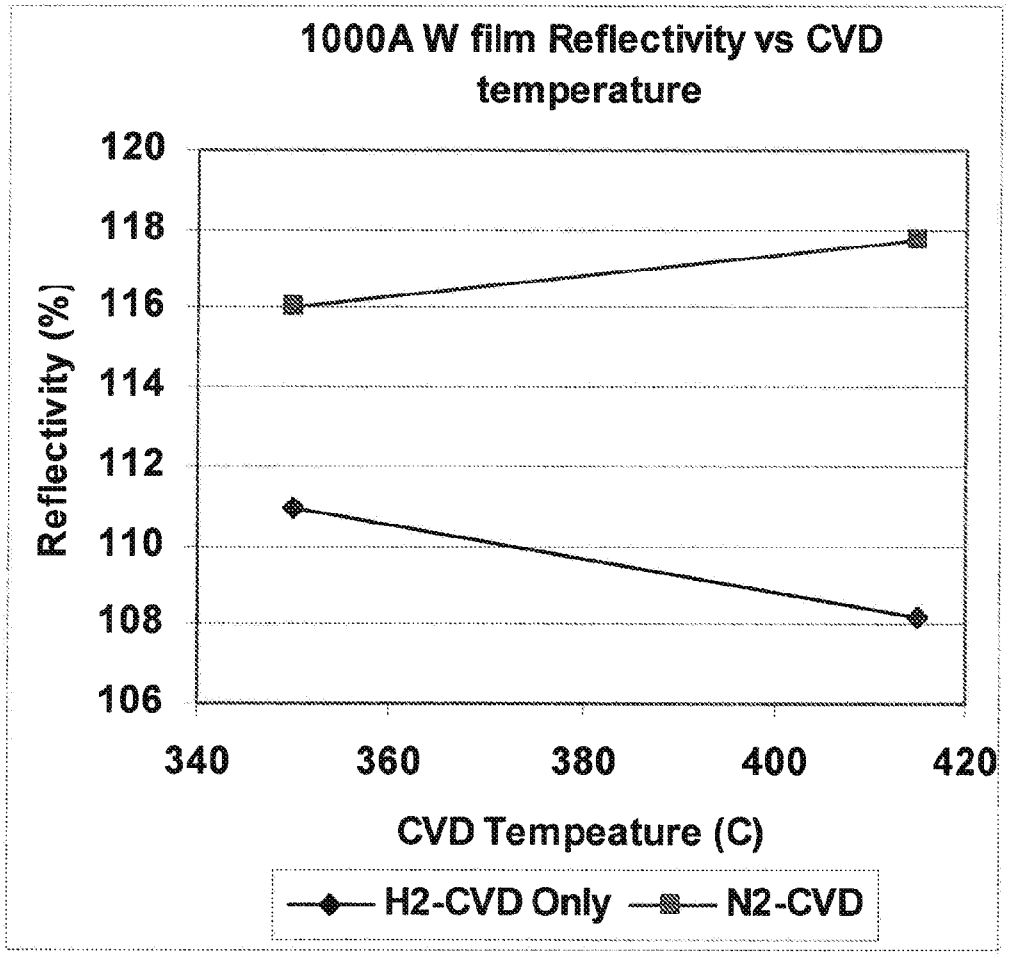

1000A W film Reflectivity vs CVD temperature
120
118
116
114
112
110
108
106
Reflectivity (%)
340
360
380
400
420
CVD Tempeature (C)
H2-CVD Only
N2-CVD

FIGURE 6

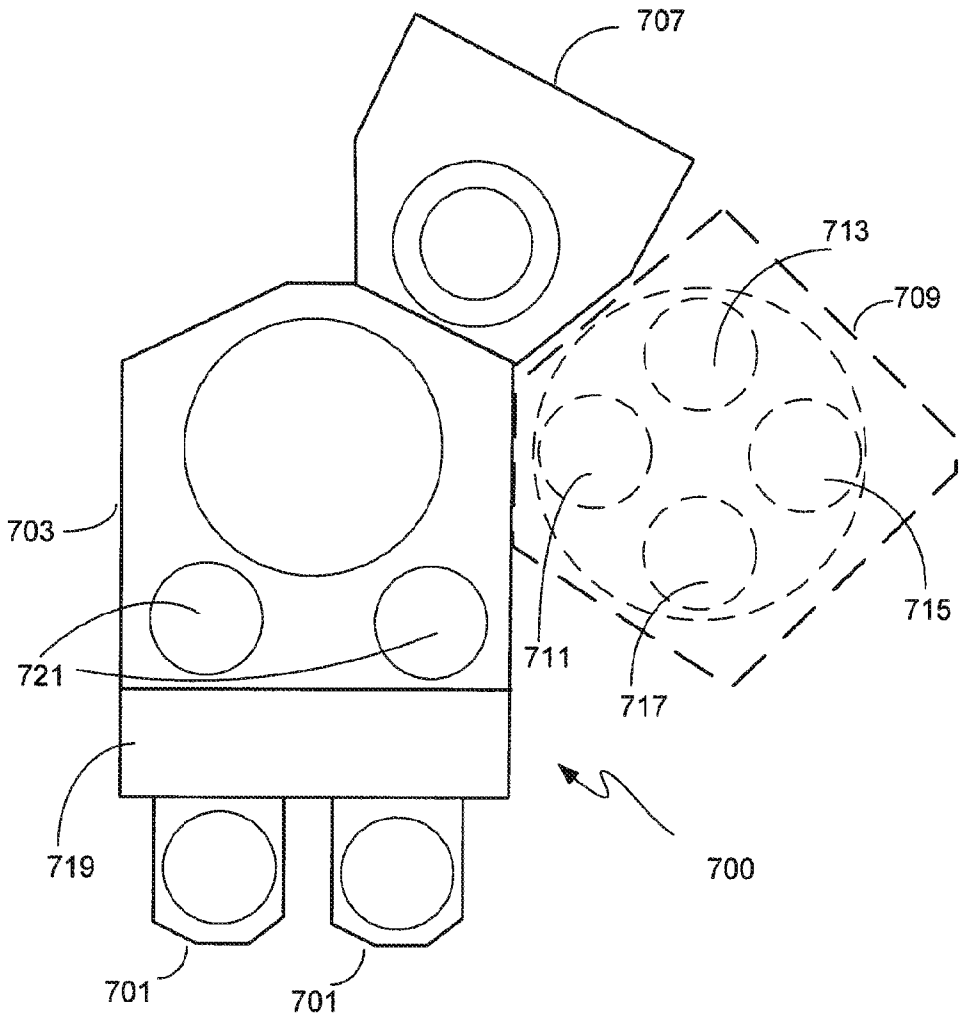


FIG. 7