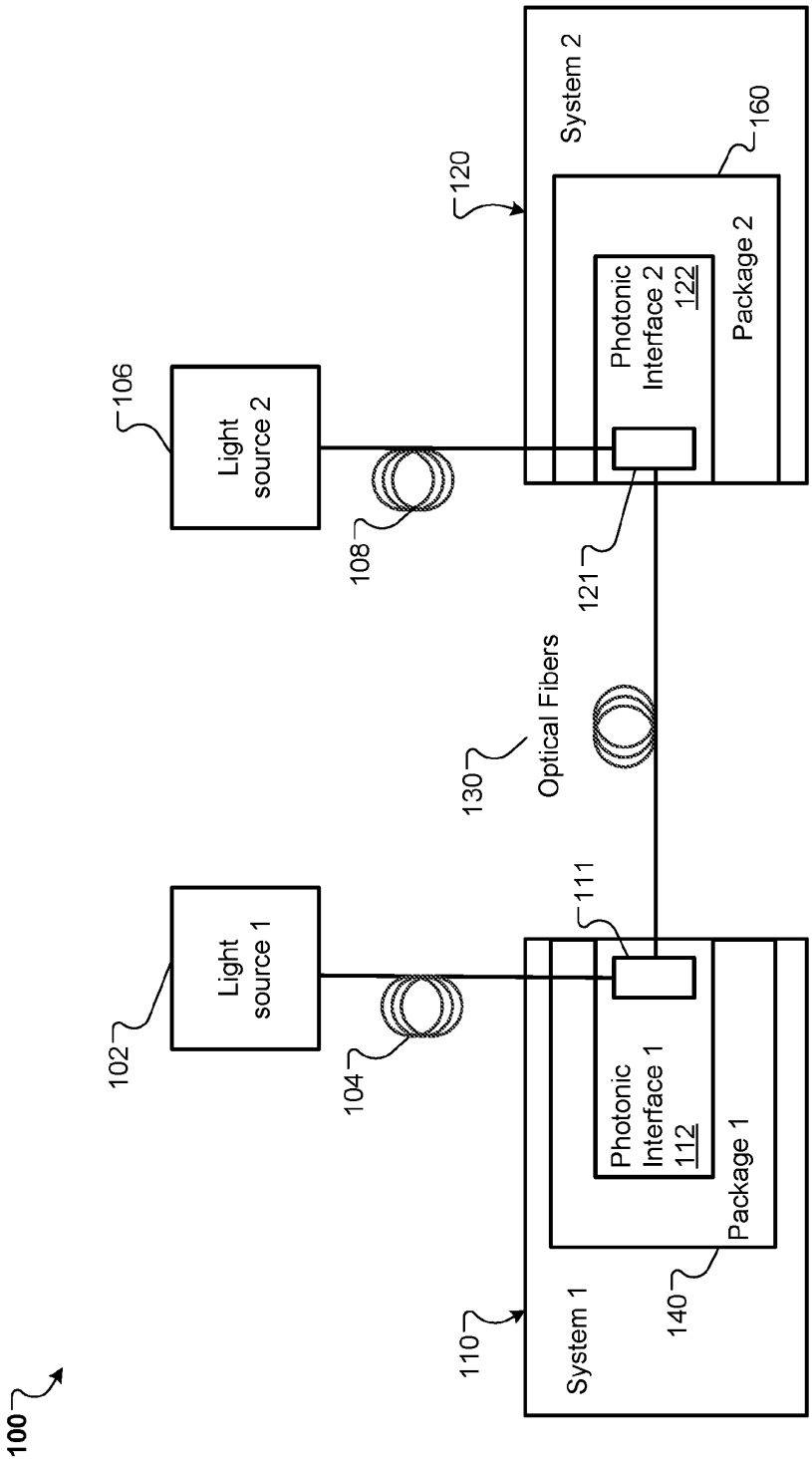

100
System 1
110
Package 1
140
Photonic Interface 1 112
111
Light source 1
102
104
System 2
120
Package 2
160
Photonic Interface 2 122
121
Light source 2
106
108
130
Optical Fibers

FIG. 1A

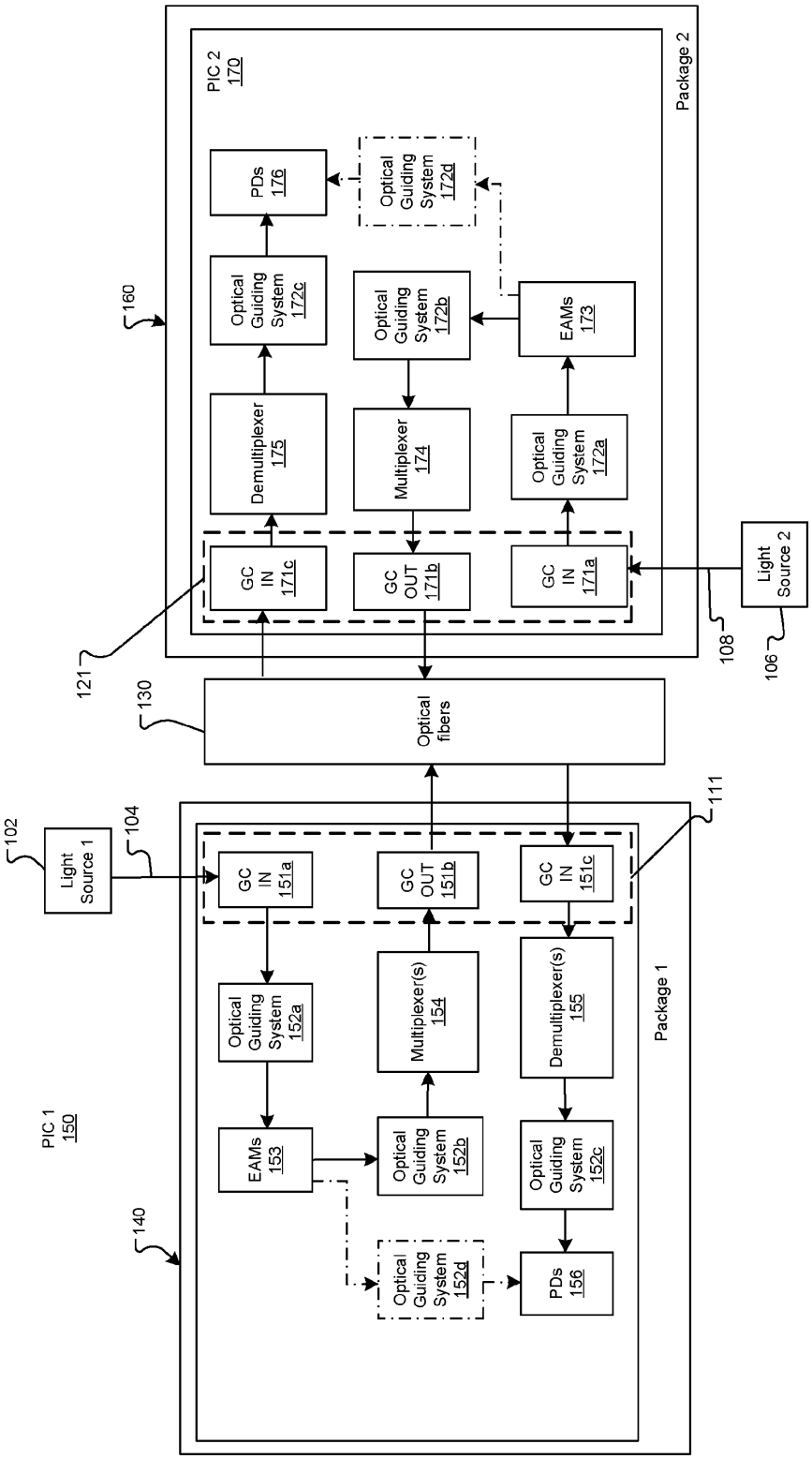

Package 2
PIC 2
170
PDs
176
Optical Guiding System
172d
Optical Guiding System
172c
Optical Guiding System
172b
EAMs
173
160
Demultiplexer
175
Multiplexer
174
Optical Guiding System
172a
GC IN
171c
GC OUT
171b
GC IN
171a
Light Source 2
108
106
121
130
Optical fibers
111
102
Light Source 1
104
GC IN
151a
GC OUT
151b
GC IN
151c
Optical Guiding System
152a
Multiplexer(s)
154
Demultiplexer(s)
155
Package 1
PIC 1
150
EAMs
153
Optical Guiding System
152b
Optical Guiding System
152c
140
Optical Guiding System
152d
PDs
156

FIG. 1B

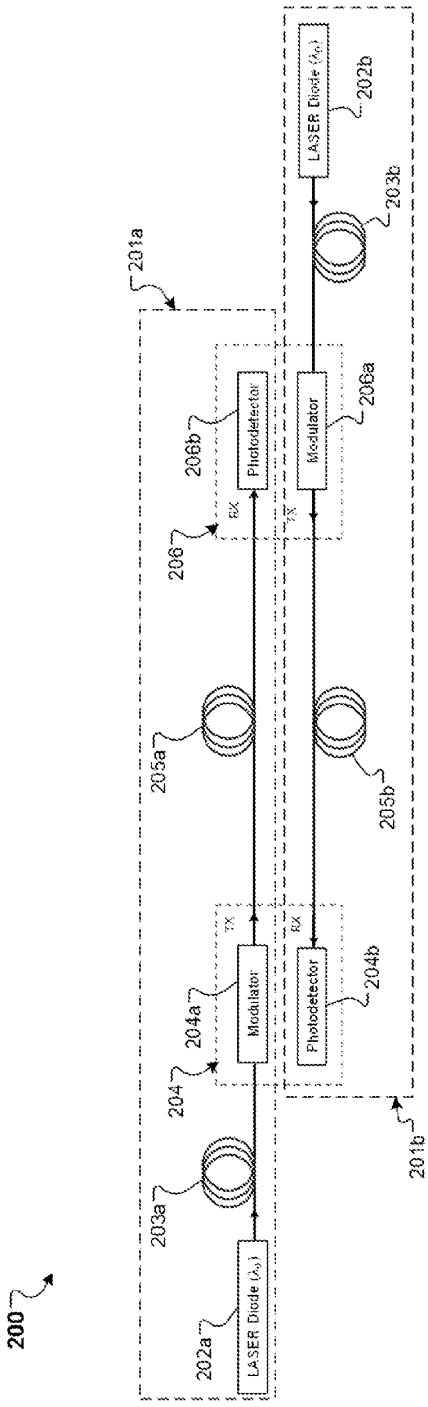

200
201a
201b
LASER Diode (λ_1)
202a
LASER Diode (λ_2)
202b
203a
203b
204
Modulator
204a
Photodetector
204b
205a
205b
206
Photodetector
206b
Modulator
206a
TX
RX
TX
RX

FIG. 2A

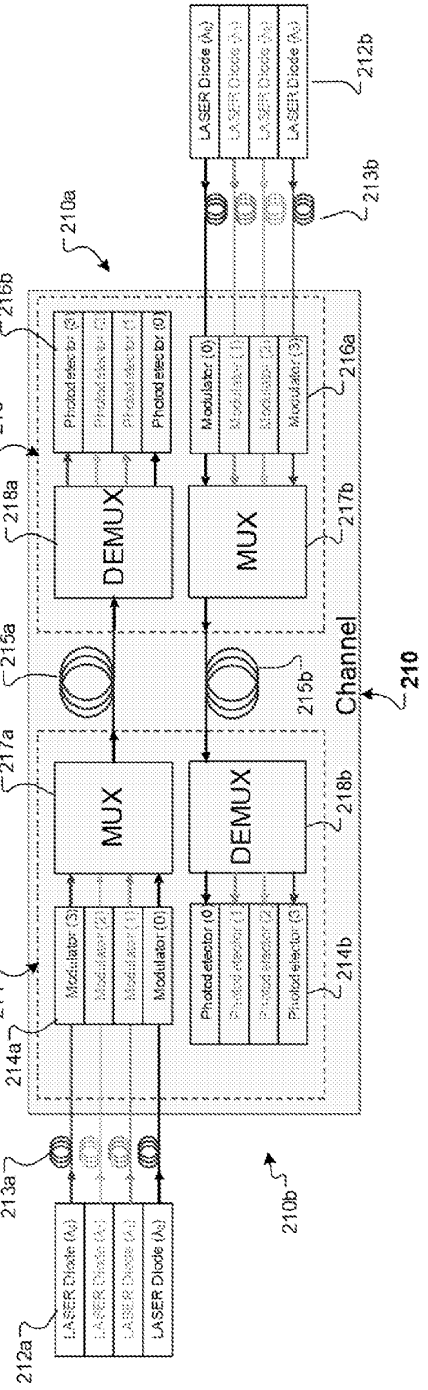

LASER Diode (λ0)
LASER Diode (λ1)
LASER Diode (λ2)
LASER Diode (λ3)
212b
213b
210a
216b
Photodetector (0)
Modulator (0)
216a
216
218a
DEMUX
MUX
217b
215a
215b
Channel
210
217a
MUX
DEMUX
218b
Modulator (3)
Photodetector (0)
214b
214
214a
213a
210b
212a

FIG. 2B

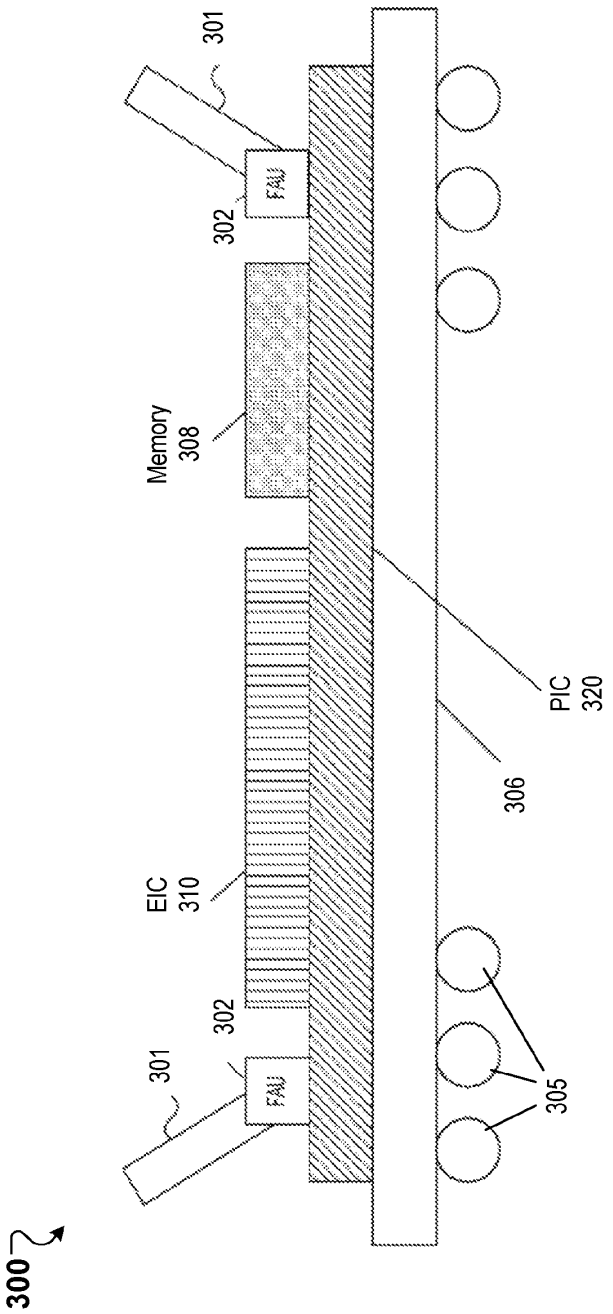


FIG. 3A

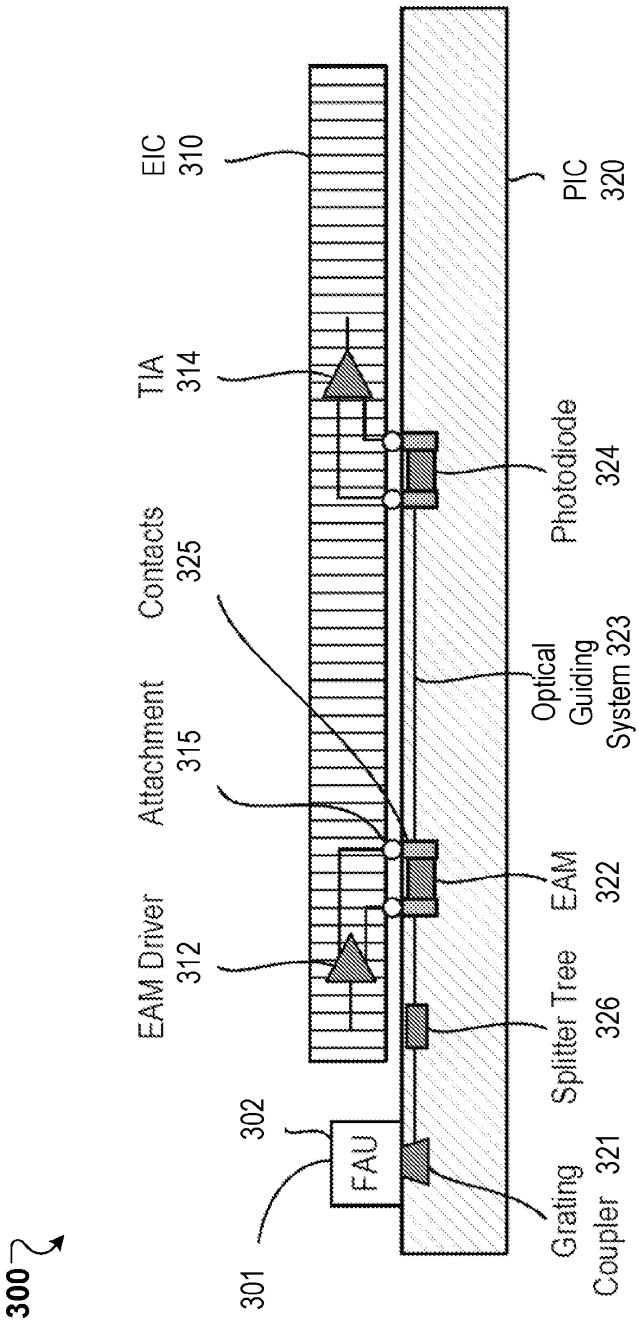

300
301
302
FAU
Grating Coupler 321
Splitter Tree 326
EAM 322
Optical Guiding System 323
Photodiode 324
Contacts 325
Attachment 315
EAM Driver 312
TIA 314
EIC 310
PIC 320

FIG. 3B

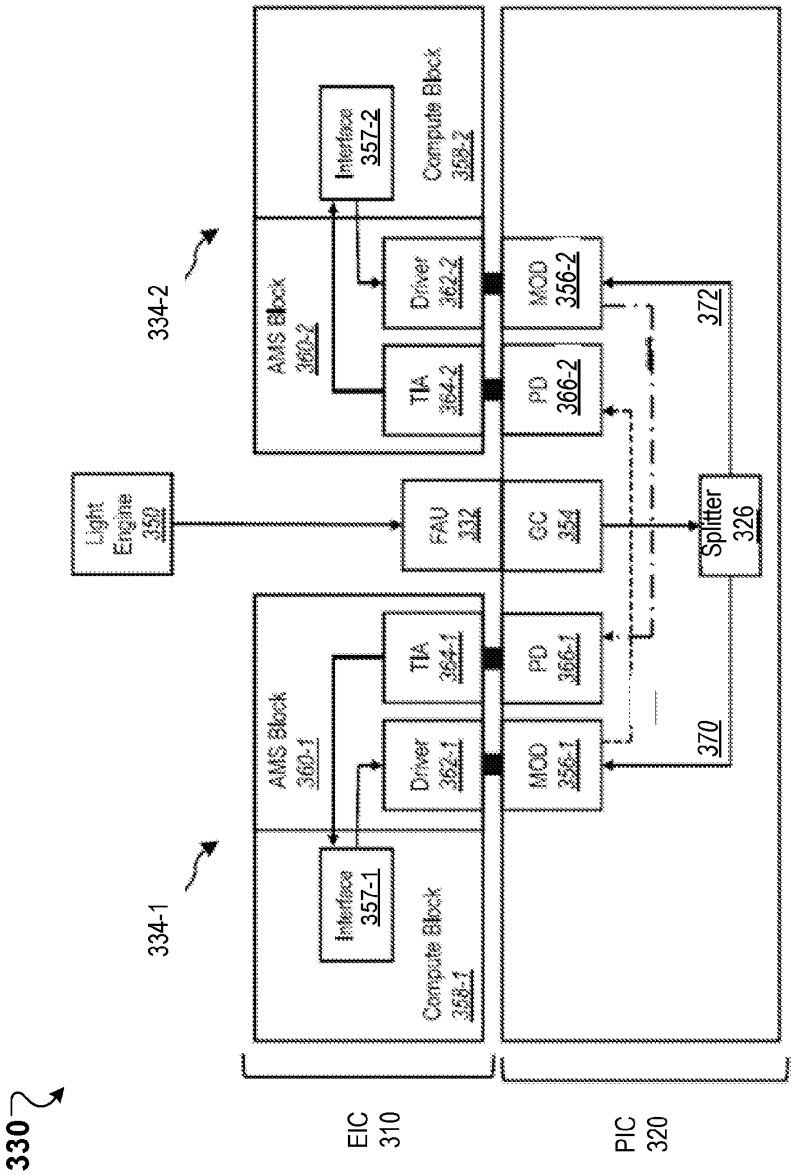

330
EIC 310
PIC 320
334-1
334-2
Compute Block 368-1
Interface 357-1
AMS Block 360-1
Driver 362-1
TIA 364-1
MOD 356-1
PD 366-1
Compute Block 368-2
Interface 357-2
AMS Block 360-2
Driver 362-2
TIA 364-2
MOD 356-2
PD 366-2
Light Engine 350
FAU 332
GC 354
Splitter 326
370
372

FIG. 3C

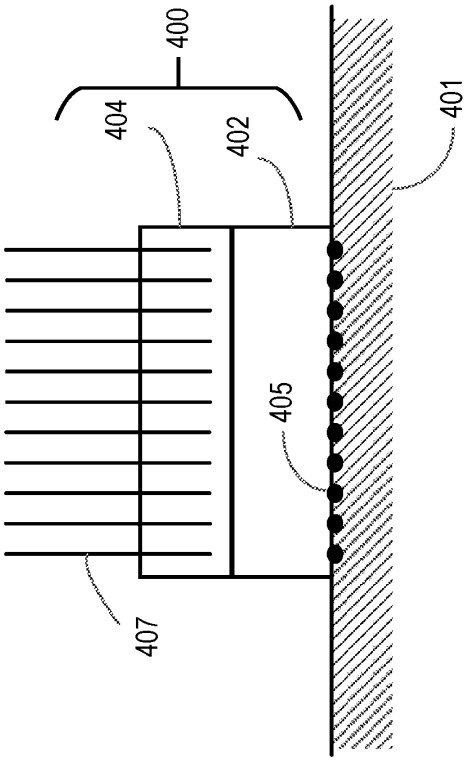

400
404
402
401
405
407

FIG. 4A

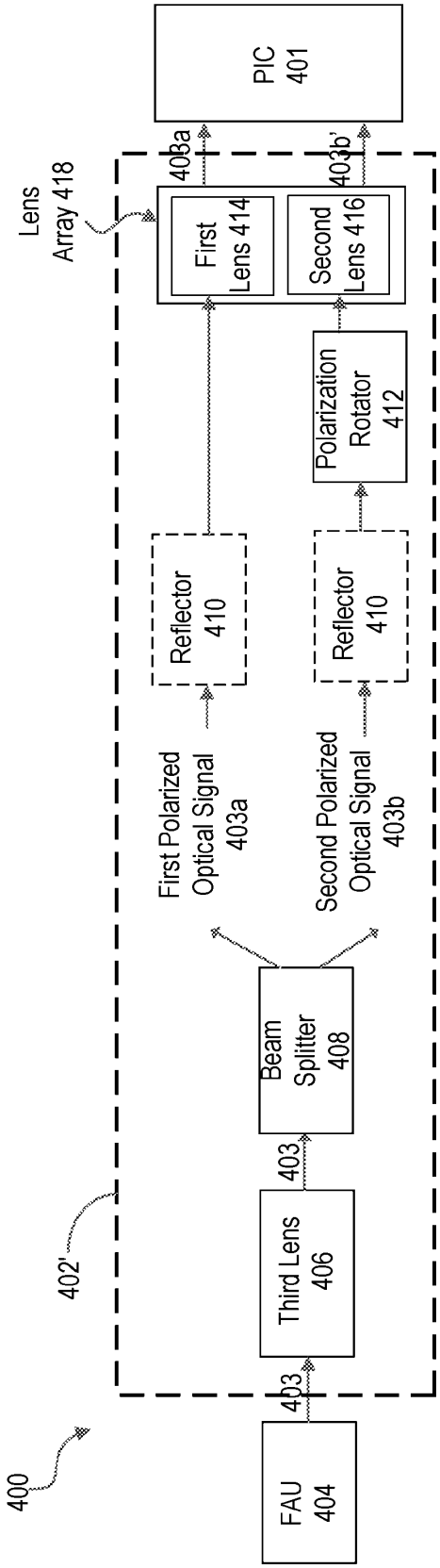

PIC 401
403a
403b'
Lens Array 418
First Lens 414
Second Lens 416
Polarization Rotator 412
Reflector 410
Reflector 410
First Polarized Optical Signal 403a
Second Polarized Optical Signal 403b
Beam Splitter 408
403
Third Lens 406
403
FAU 404
402'
400

FIG. 4B

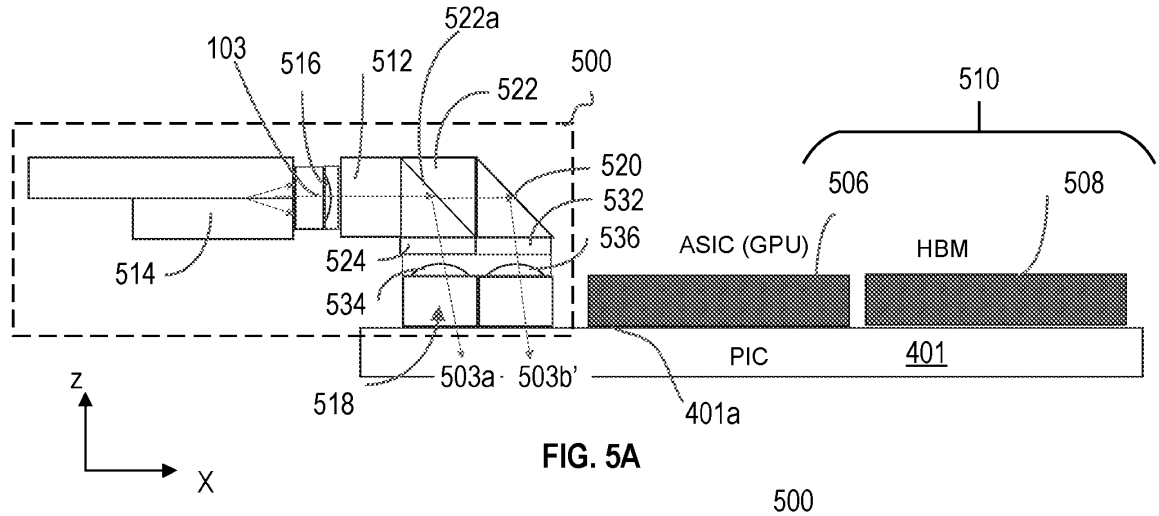


FIG. 5A

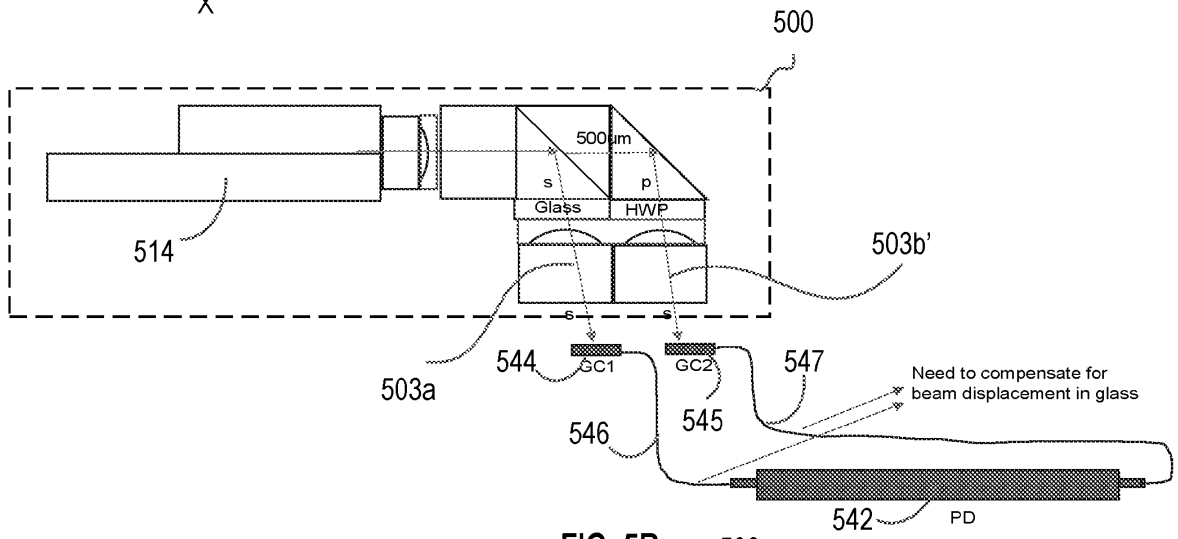


FIG. 5B

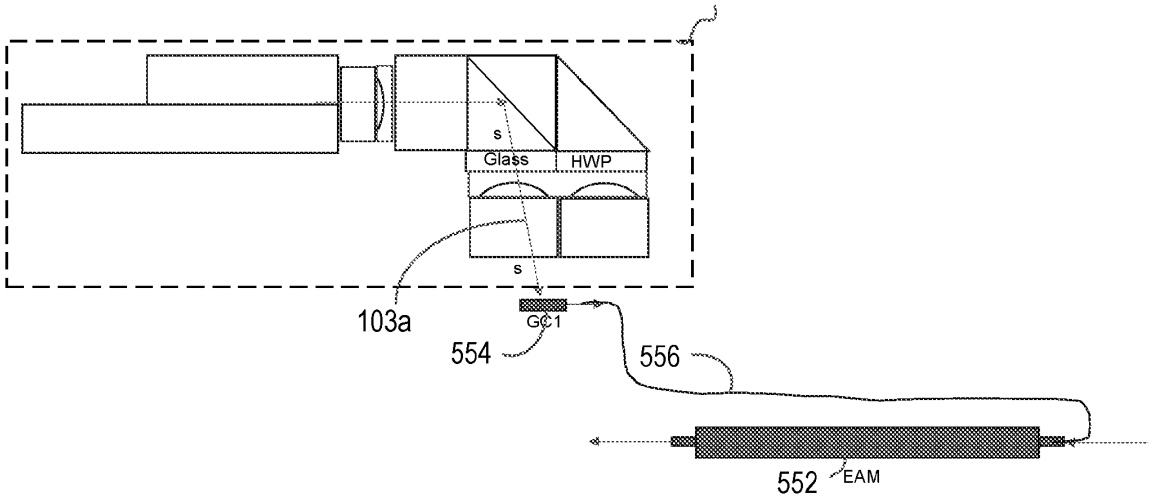


FIG. 5C

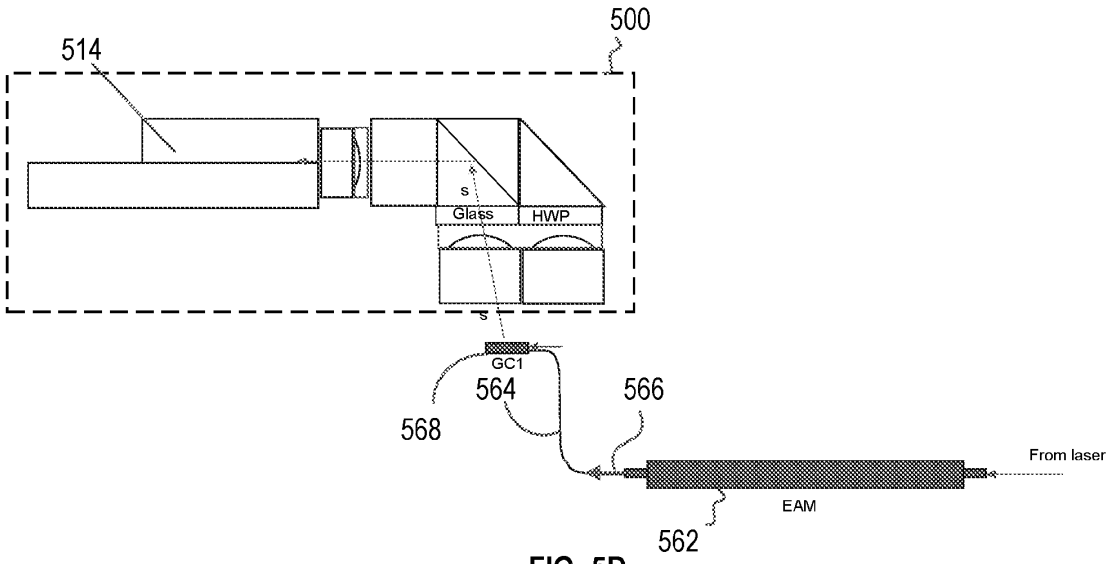

500
514
s
Glass
HWP
s
GC1
564
566
568
From laser
EAM
562

FIG. 5D

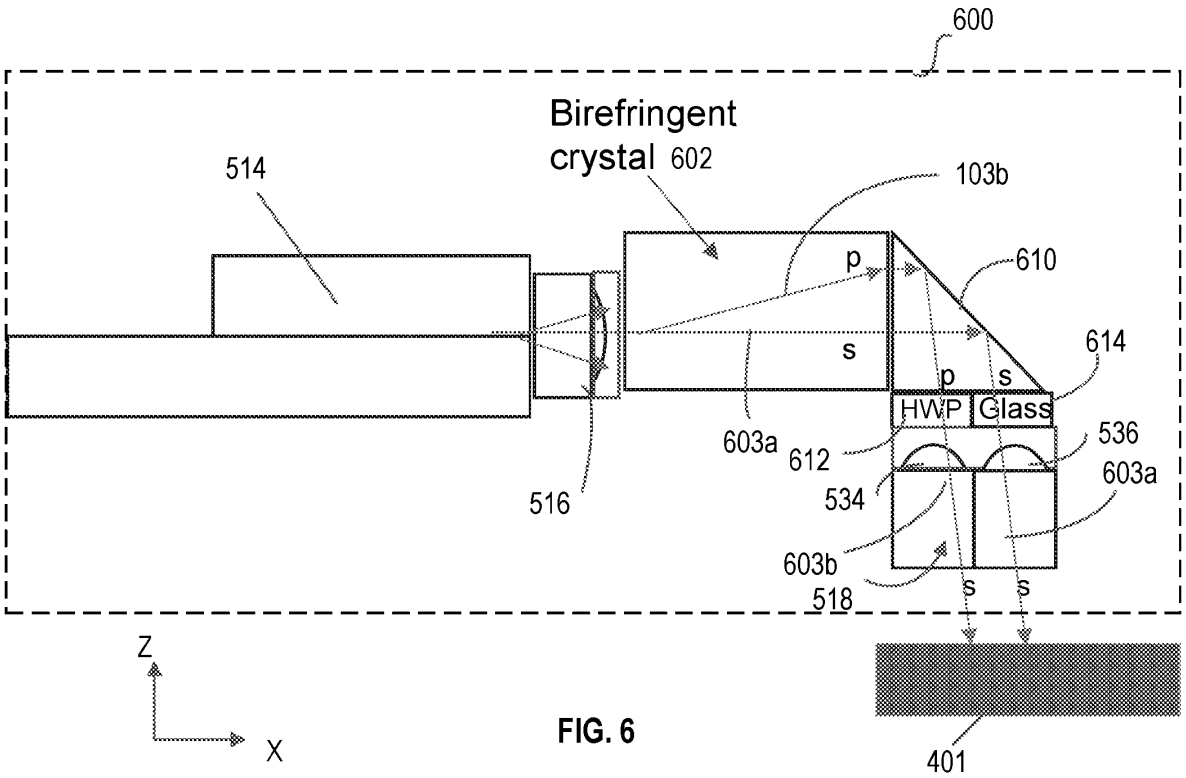

600
Birefringent
crystal 602
514
103b
p
610
s
614
p
s
HWP
Glass
603a
612
536
603a
516
534
603b
518
s
s
Z
X
401

FIG. 6

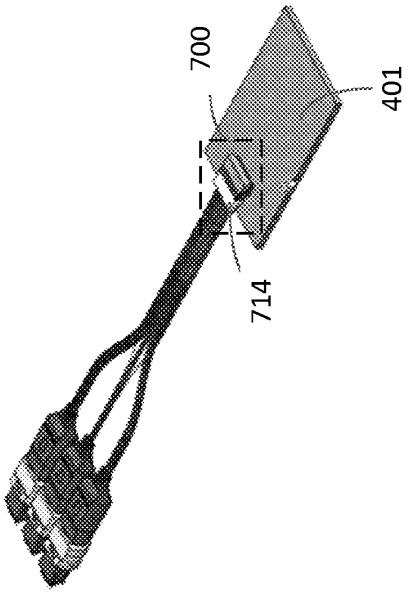

700
401
714

FIG. 7B

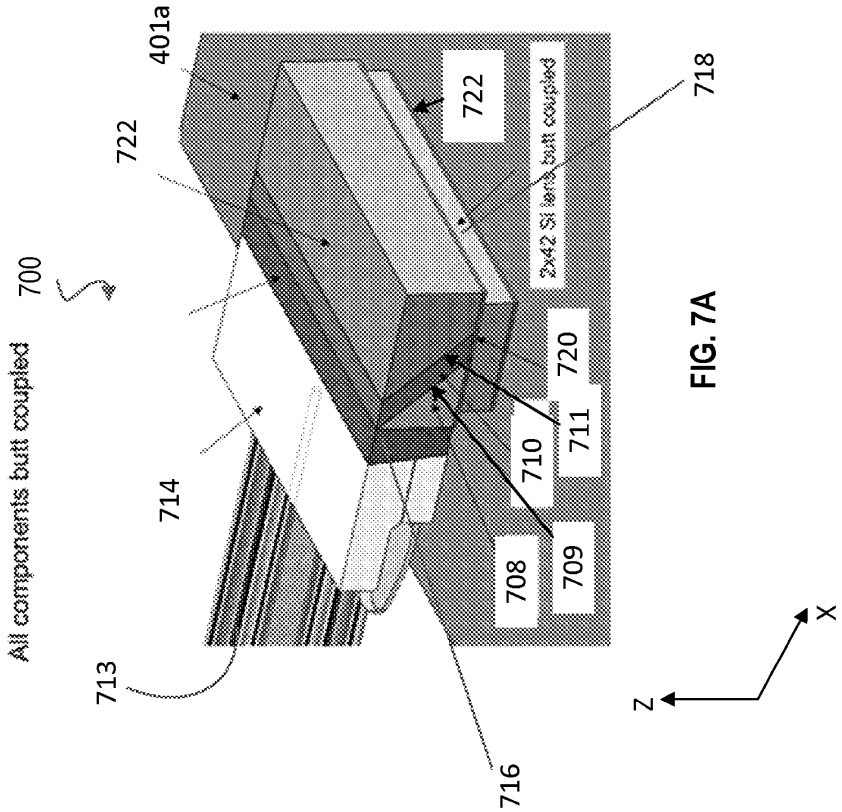
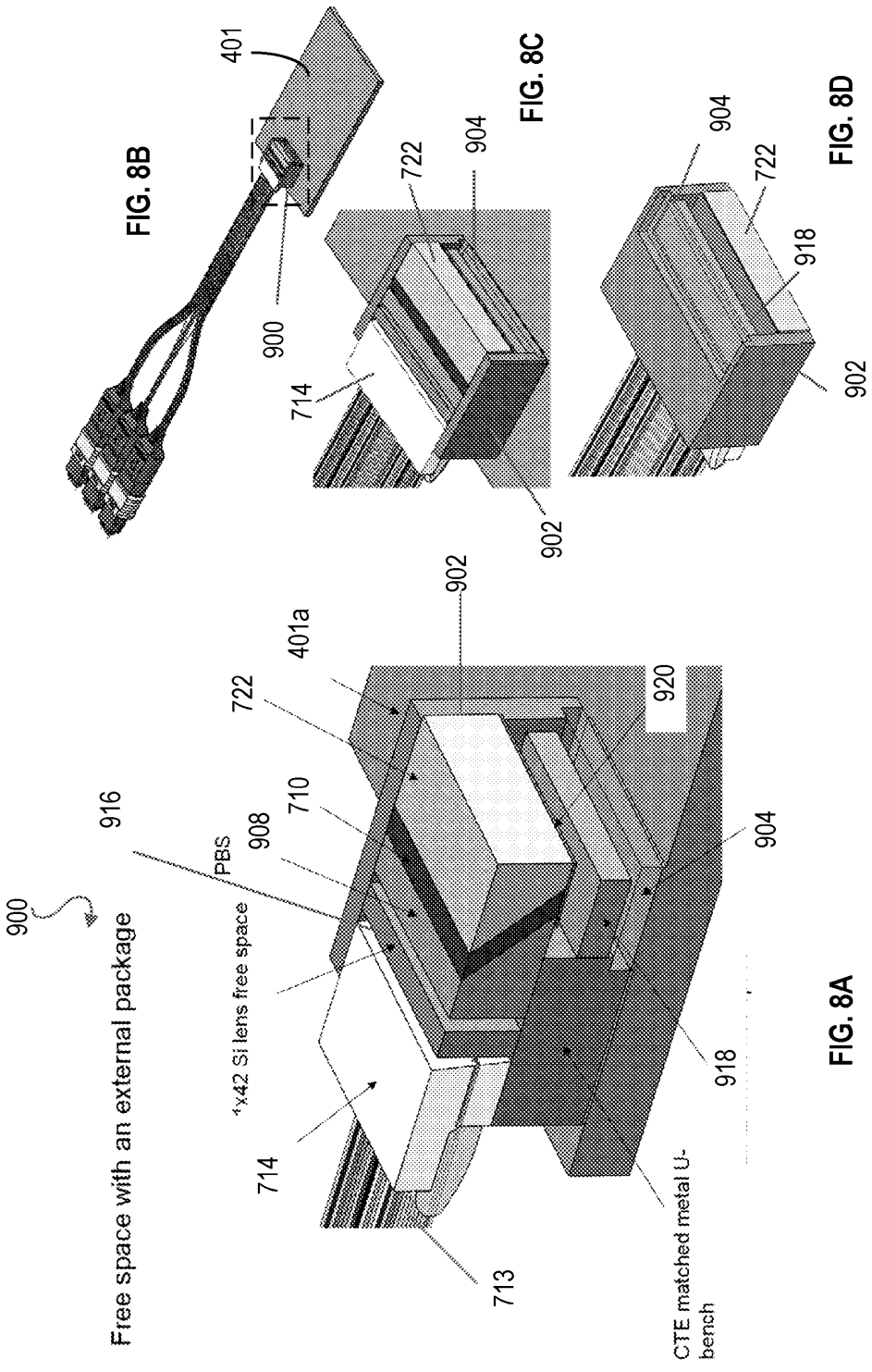

All components butt coupled
700
401a
722
714
713
716
718
722
2x42 Si lens butt coupled
720
711
710
709
708
Z
X

FIG. 7A


900
Free space with an external package
916
PBS
908
1x42 Si lens free space
710
722
401a
902
920
904
714
713
918
CTE matched metal U-bench
FIG. 8A
401
900
FIG. 8B
722
904
714
902
FIG. 8C
904
722
918
902
FIG. 8D

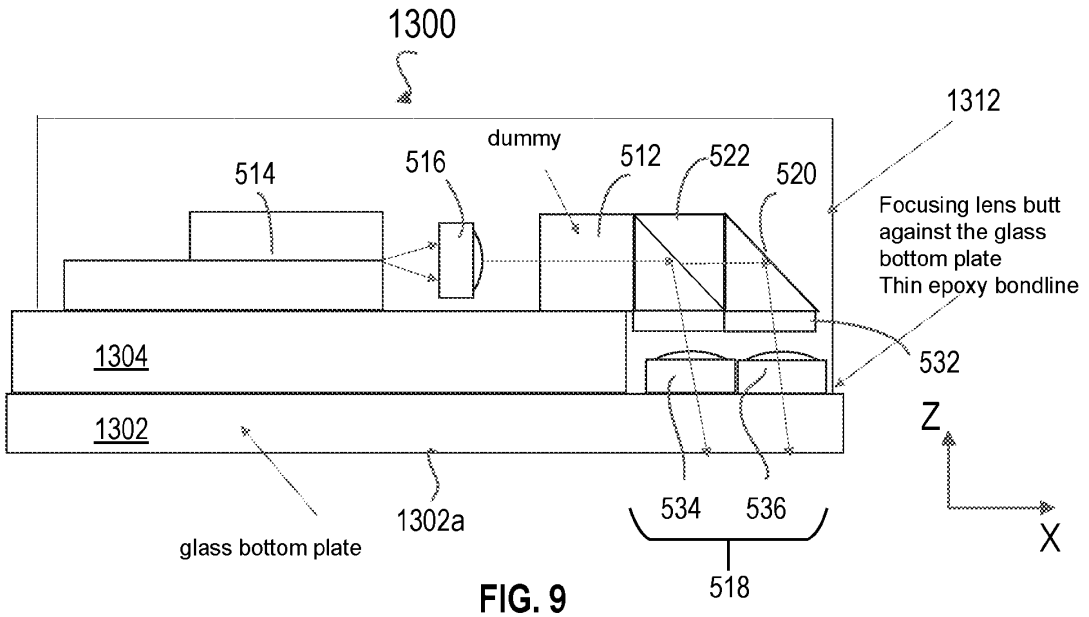

1300
1312
dummy
514
516
512
522
520
Focusing lens butt against the glass bottom plate
Thin epoxy bondline
1304
532
1302
Z
X
glass bottom plate
1302a
534
536
518

FIG. 9

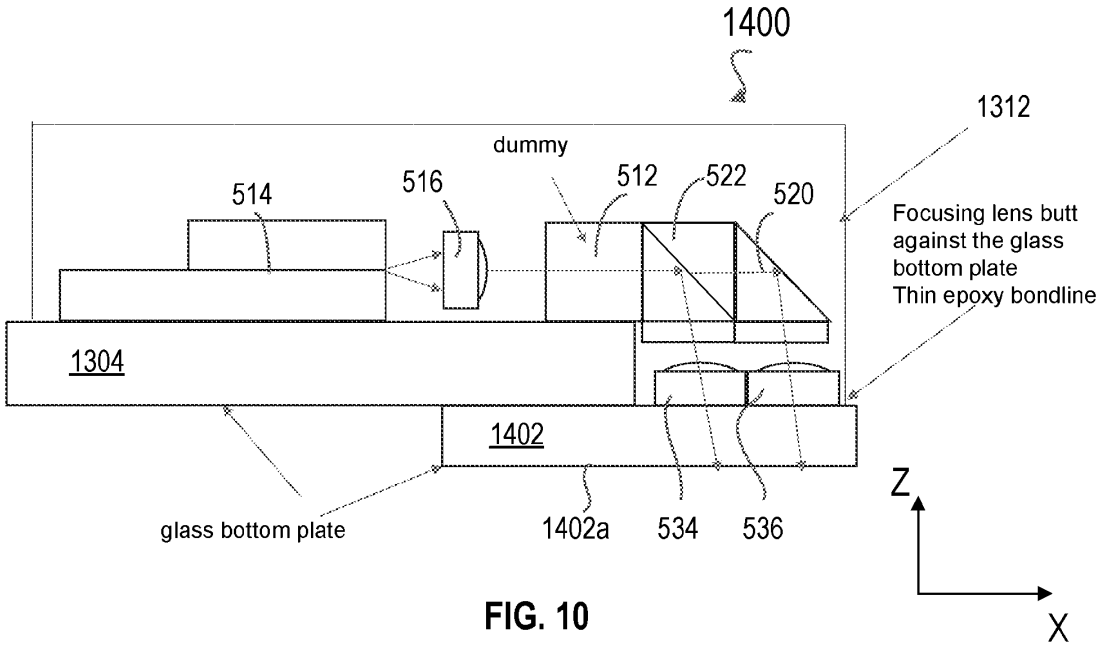

1400
1312
dummy
514
516
512
522
520
Focusing lens butt against the glass bottom plate
Thin epoxy bondline
1304
1402
Z
X
glass bottom plate
1402a
534
536

FIG. 10

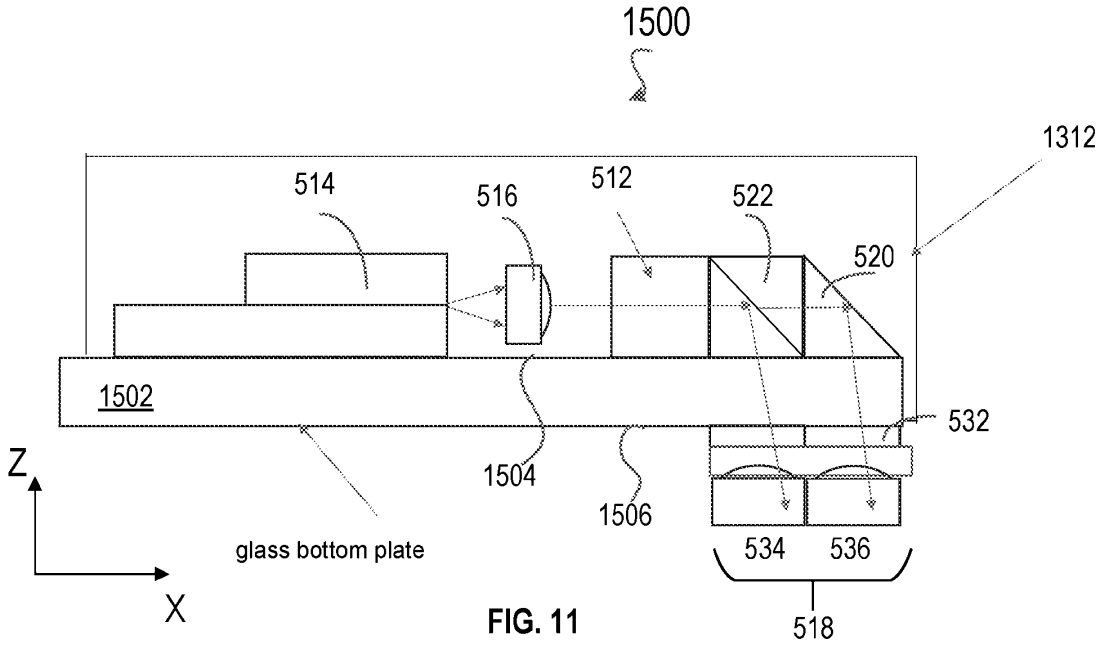

1500
1312
514
516
512
522
520
1502
532
1504
1506
glass bottom plate
534
536
518
Z
X

FIG. 11

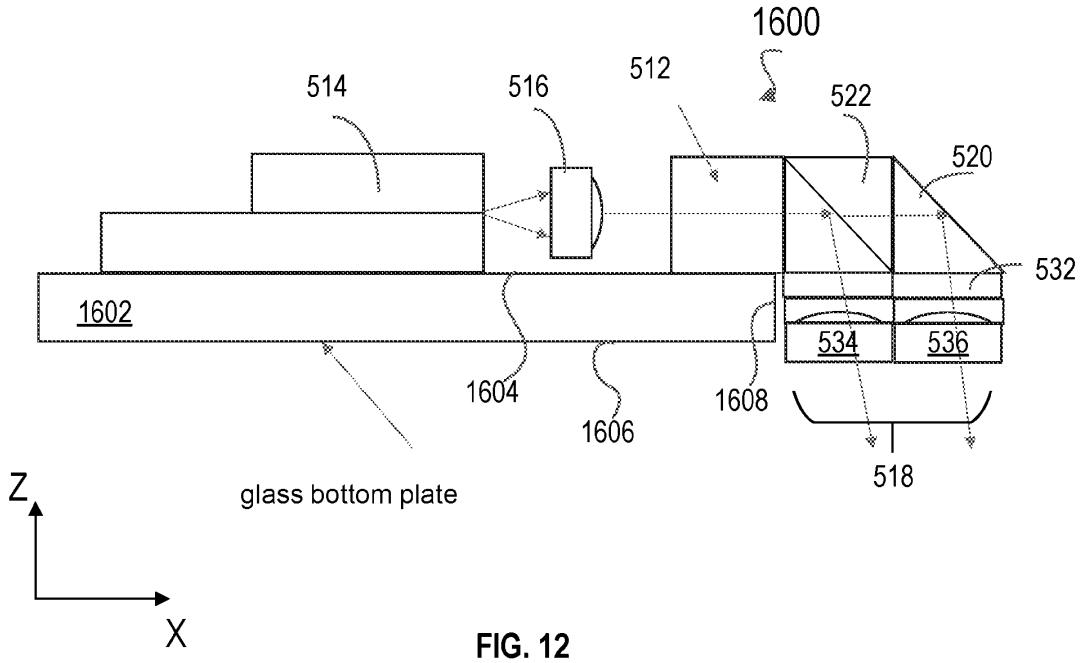

1600
514
516
512
522
520
532
1602
534
536
1604
1606
1608
518
glass bottom plate
Z
X

FIG. 12

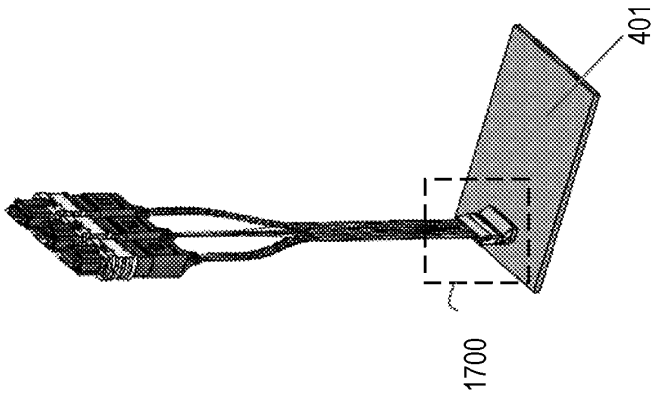


FIG. 13B

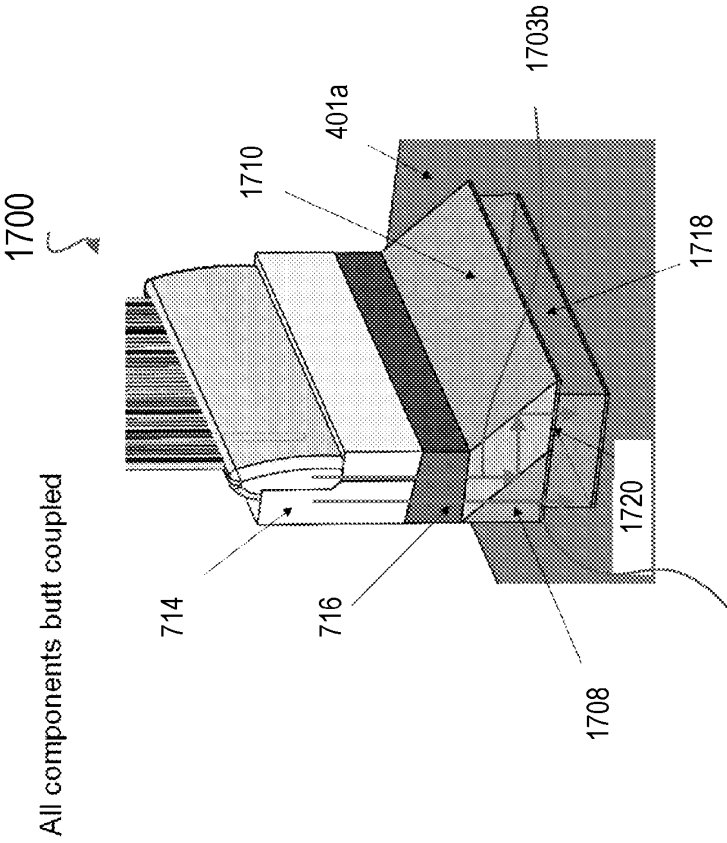


FIG. 13A

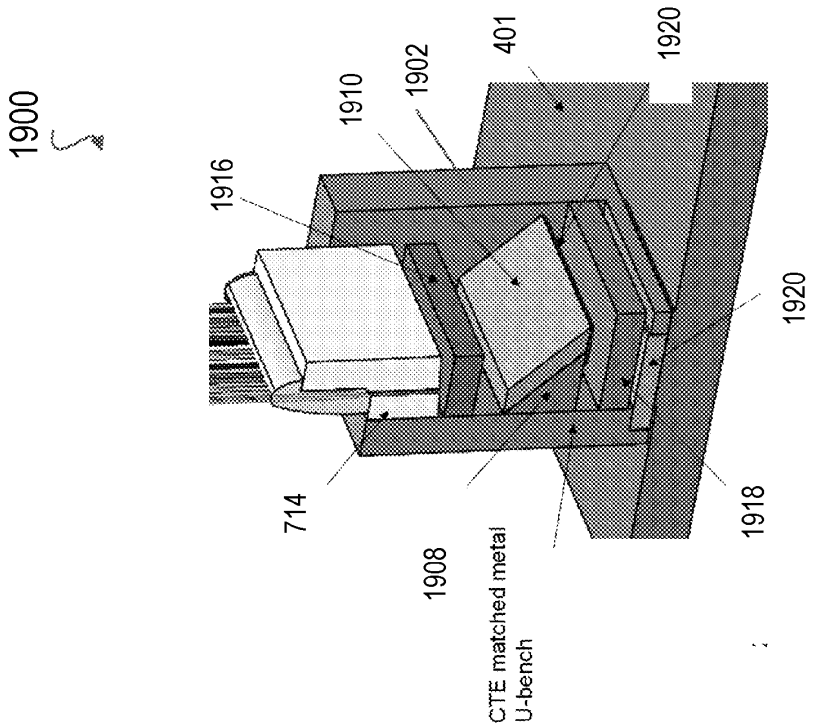

1900
1916
1910
1902
401
1920
1920
714
1908
CTE matched metal
U-bench
1918

FIG. 14

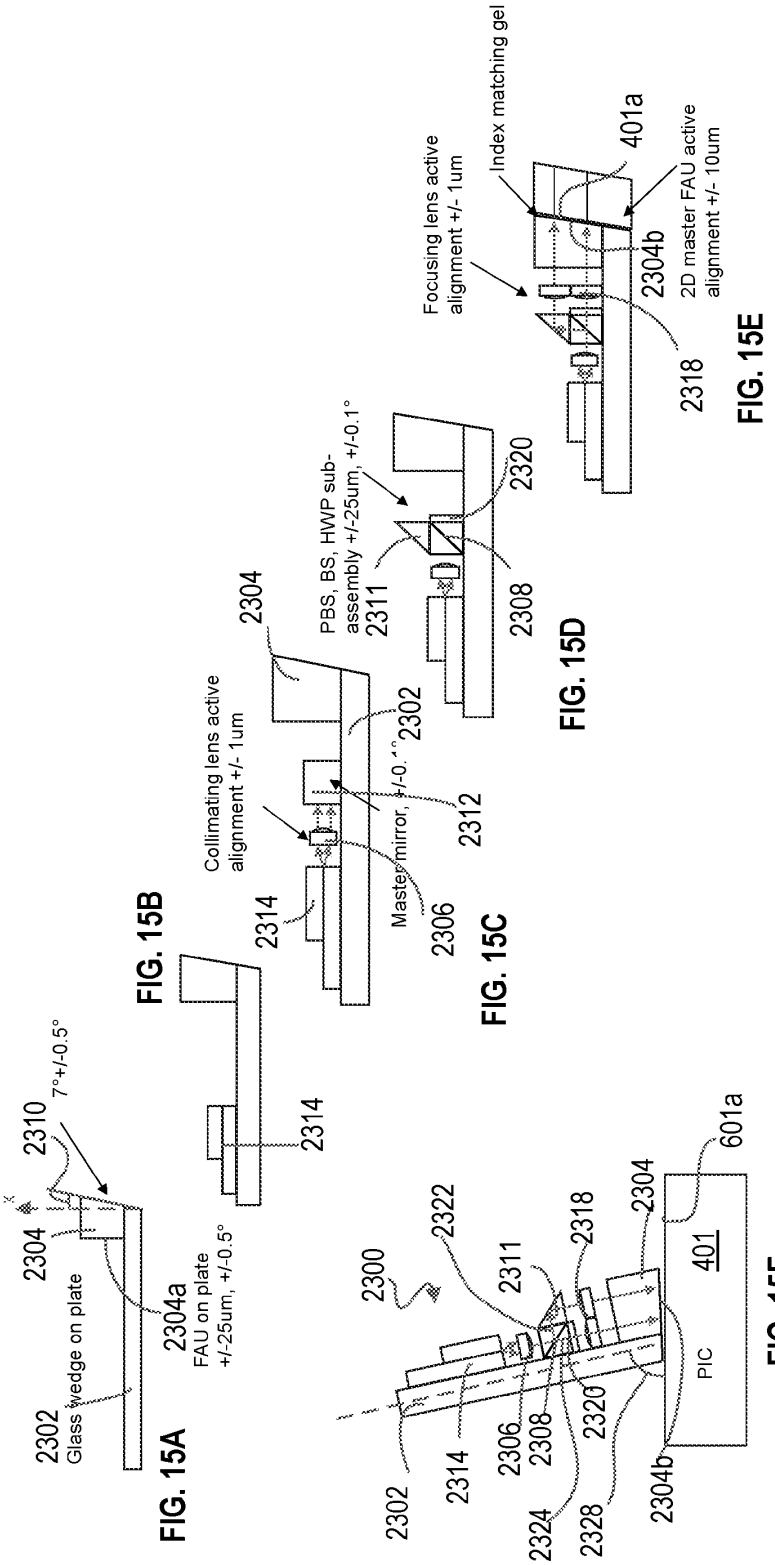


FIG. 15A

FIG. 15B

FIG. 15C

FIG. 15D

FIG. 15E

FIG. 15F

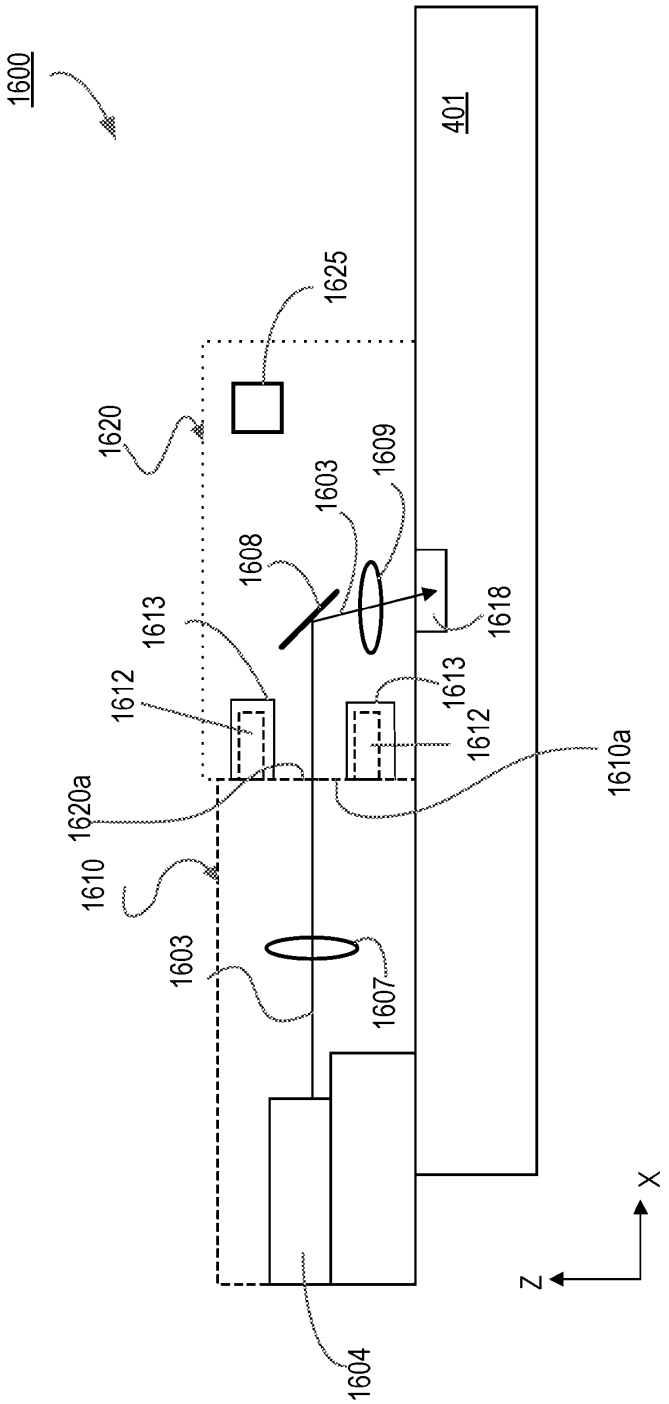

1600
401
1625
1620
1609
1603
1608
1613
1618
1612
1613
1612
1610a
1620a
1610
1603
1607
1604
X
Z

FIG. 16

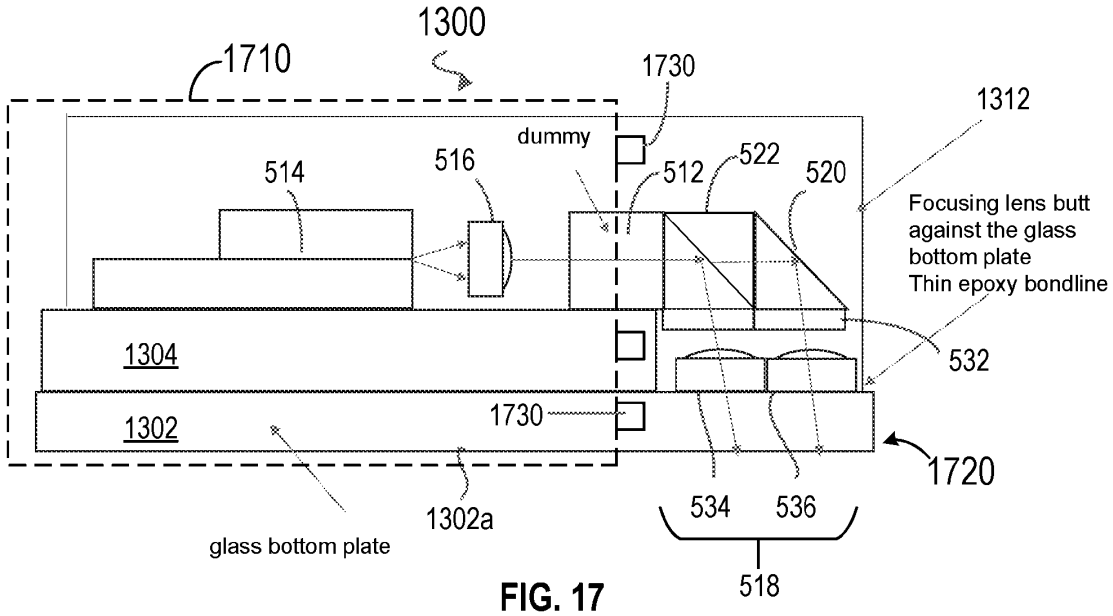

1300
1710
1730
1312
dummy
514
516
512
522
520
Focusing lens butt against the glass bottom plate
Thin epoxy bondline
1304
532
1302
1730
1720
1302a
534
536
glass bottom plate
518

FIG. 17

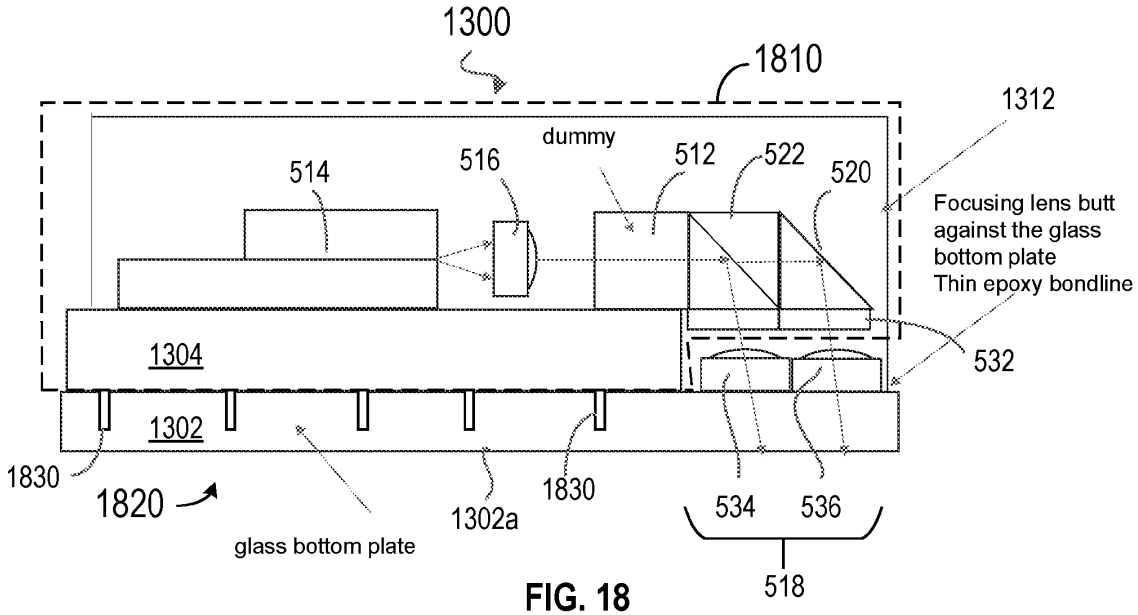

1300
1810
1312
dummy
514
516
512
522
520
Focusing lens butt against the glass bottom plate
Thin epoxy bondline
1304
532
1302
1830
1820
1830
1302a
534
536
glass bottom plate
518

FIG. 18