
100
Transmitting unit 110
Optical element
Receiving unit 120
Optical element
Scanning apparatus 130
Detection beam 101
Return light 102
Target

FIG. 1

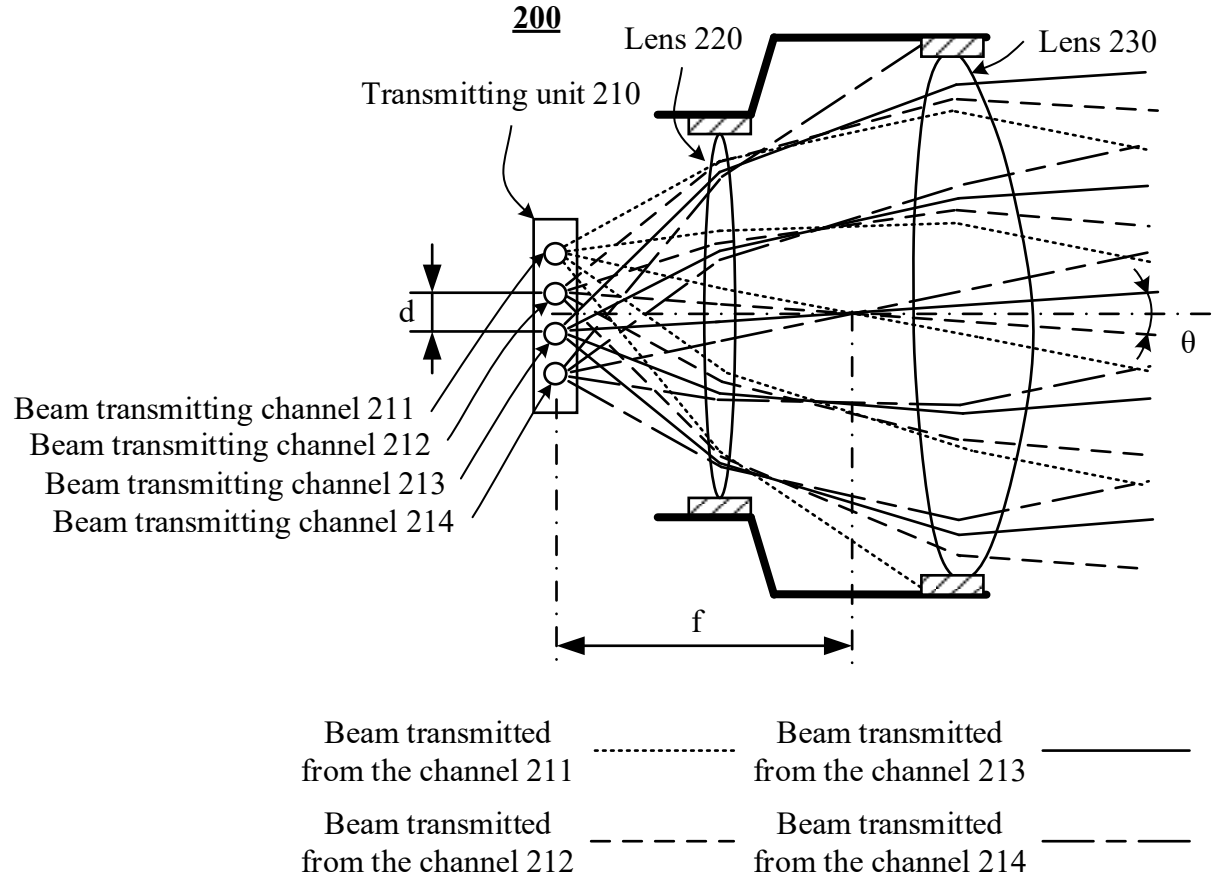

200
Lens 220
Lens 230
Transmitting unit 210
d
θ
Beam transmitting channel 211
Beam transmitting channel 212
Beam transmitting channel 213
Beam transmitting channel 214
f
Beam transmitted from the channel 211
Beam transmitted from the channel 213
Beam transmitted from the channel 212
Beam transmitted from the channel 214

FIG. 2

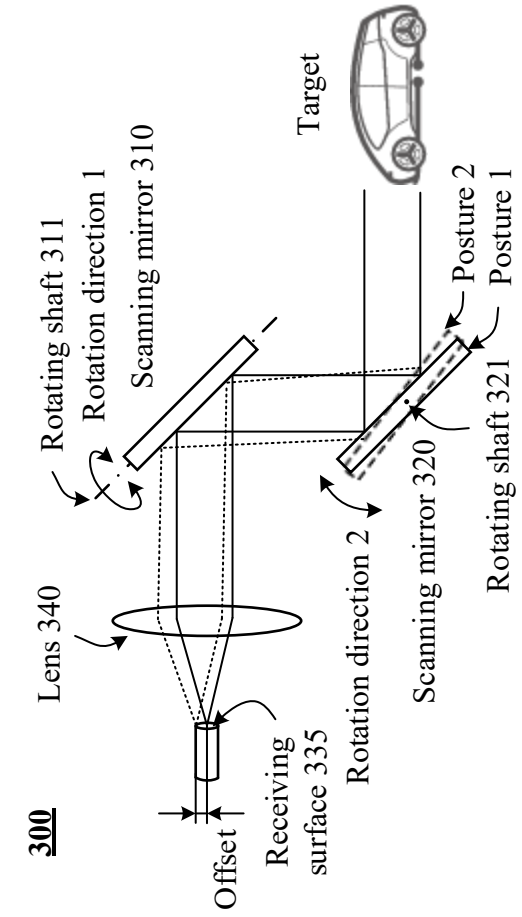

300
Lens 330
Transmitting unit 301
Rotating shaft 311
Rotation direction 1
Scanning mirror 310
Rotation direction 2
Scanning mirror 320
Rotating shaft 321
Posture 1
Target

FIG. 3A

300
Lens 340
Offset
Receiving surface 335
Rotating shaft 311
Rotation direction 1
Scanning mirror 310
Rotation direction 2
Scanning mirror 320
Rotating shaft 321
Posture 2
Posture 1
Target

FIG. 3B

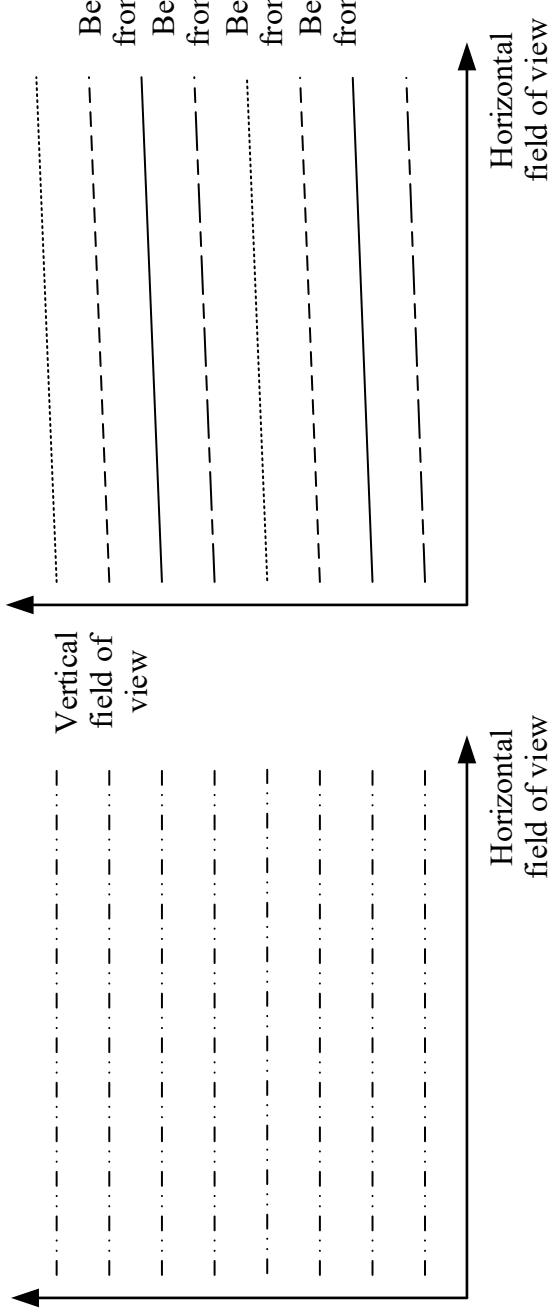

Vertical field of view
Horizontal field of view
Vertical field of view
Horizontal field of view
Beam transmitted from a channel 211
Beam transmitted from a channel 212
Beam transmitted from a channel 213
Beam transmitted from a channel 214

FIG. 4A

FIG. 4B

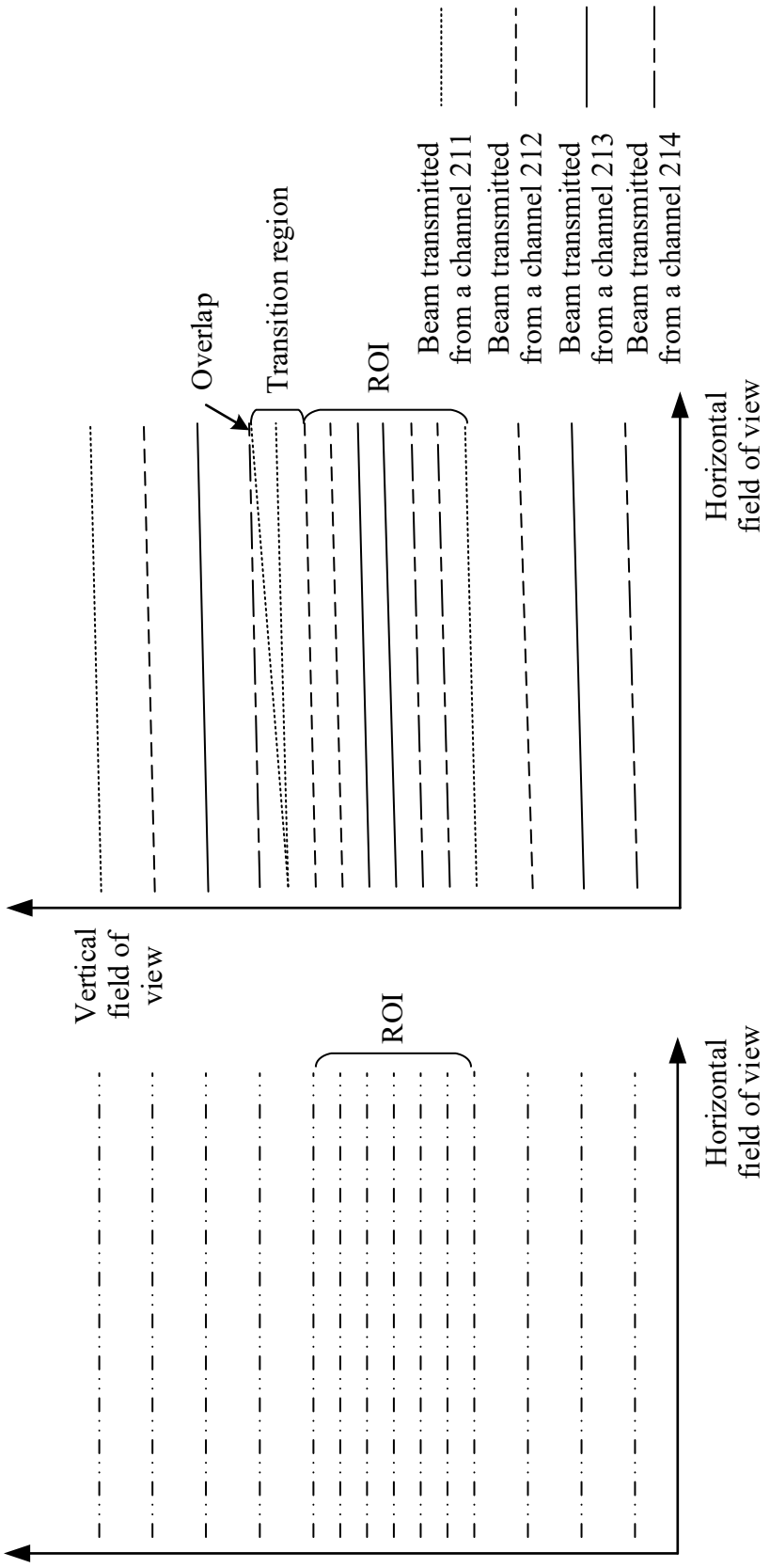

Vertical field of view
Horizontal field of view
ROI
Vertical field of view
Horizontal field of view
Overlap
Transition region
ROI
Beam transmitted from a channel 211
Beam transmitted from a channel 212
Beam transmitted from a channel 213
Beam transmitted from a channel 214

FIG. 5A

FIG. 5B

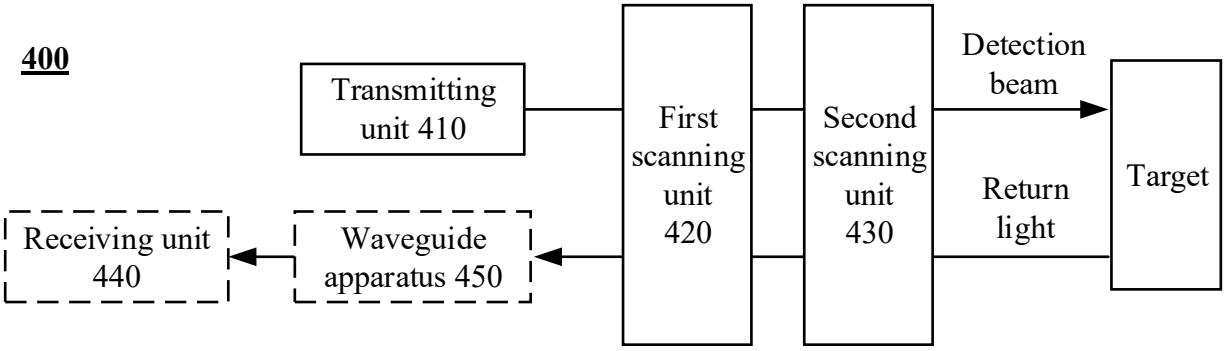

400
Transmitting unit 410
First scanning unit 420
Second scanning unit 430
Detection beam
Return light
Target
Receiving unit 440
Waveguide apparatus 450

FIG. 6

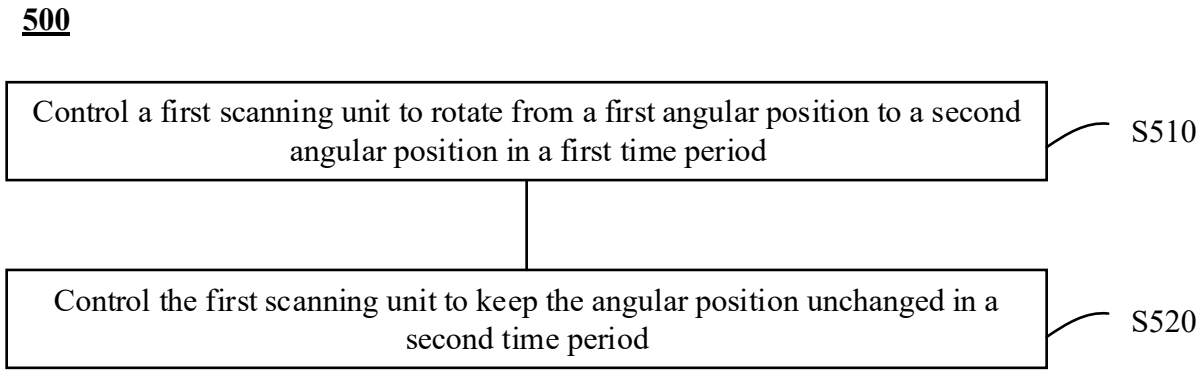

500
Control a first scanning unit to rotate from a first angular position to a second angular position in a first time period
S510
Control the first scanning unit to keep the angular position unchanged in a second time period
S520

FIG. 7

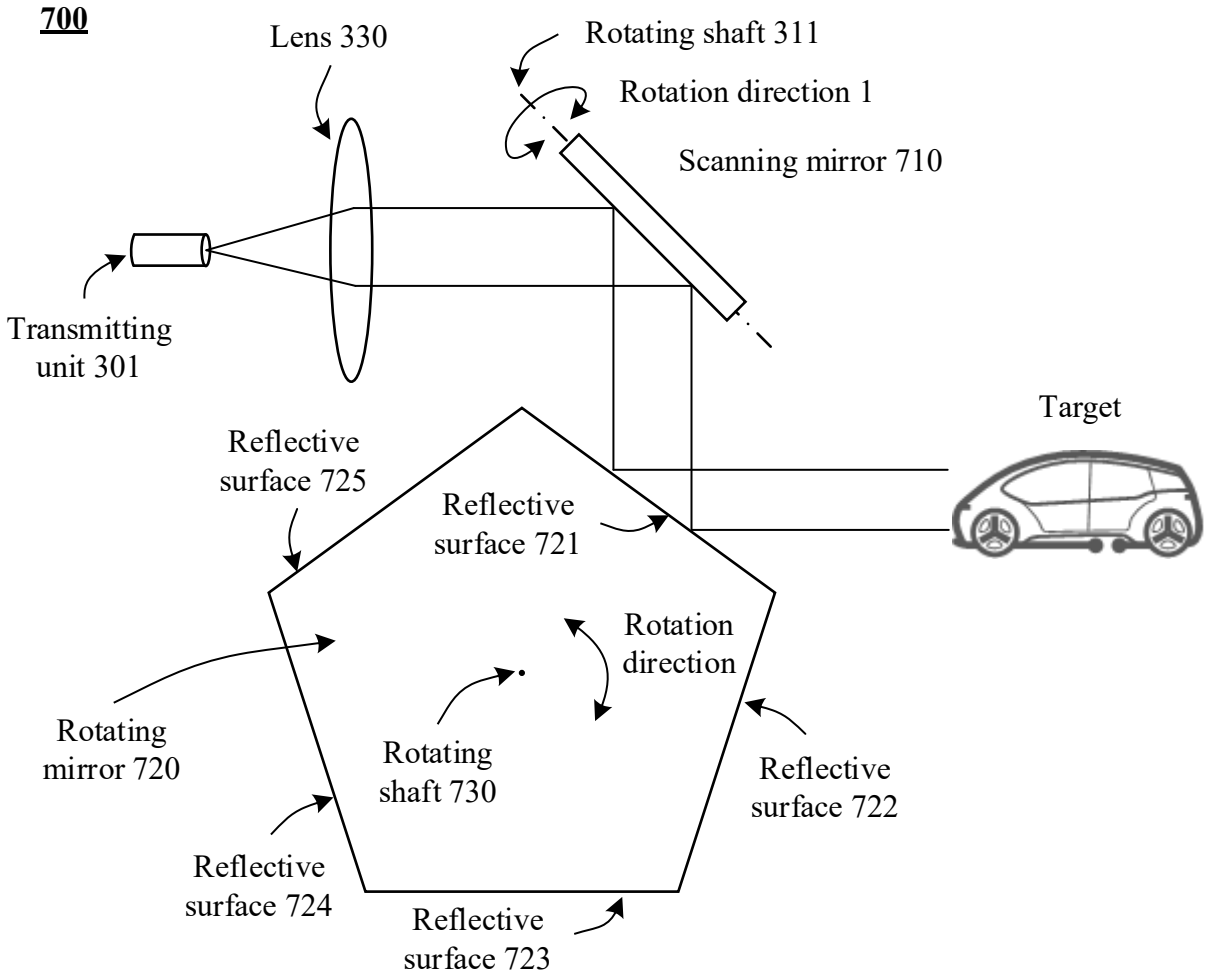

700
Lens 330
Rotating shaft 311
Rotation direction 1
Scanning mirror 710
Transmitting unit 301
Target
Reflective surface 725
Reflective surface 721
Rotation direction
Rotating mirror 720
Rotating shaft 730
Reflective surface 722
Reflective surface 724
Reflective surface 723

FIG. 8

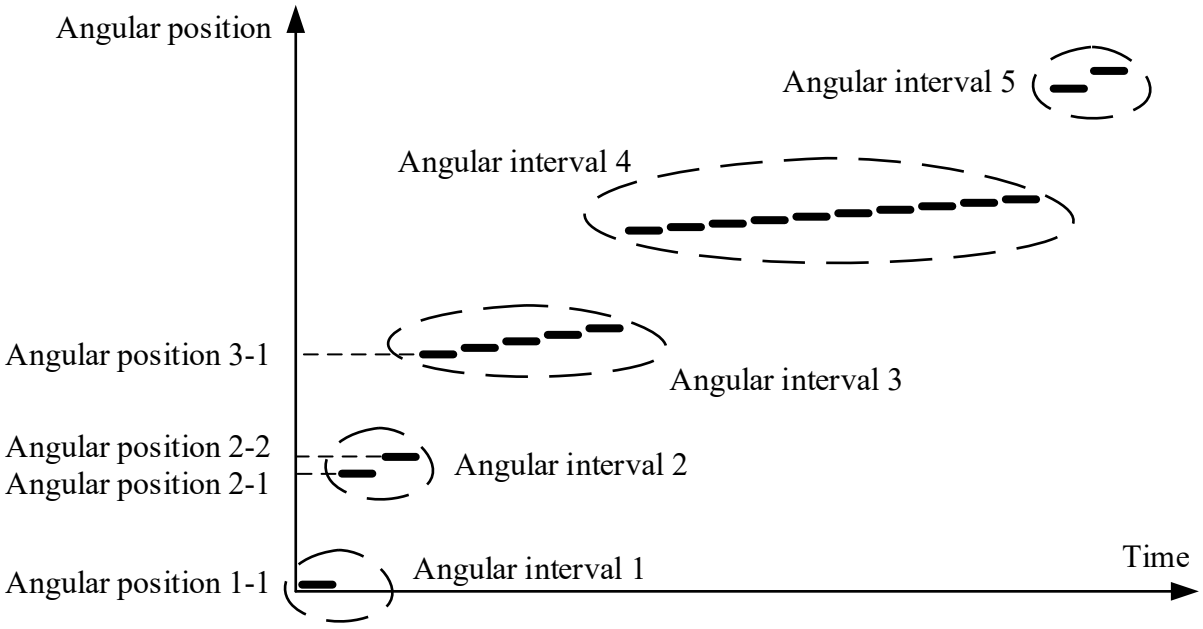

Angular position
Angular interval 5
Angular interval 4
Angular position 3-1
Angular interval 3
Angular position 2-2
Angular position 2-1
Angular interval 2
Angular position 1-1
Angular interval 1
Time

FIG. 9

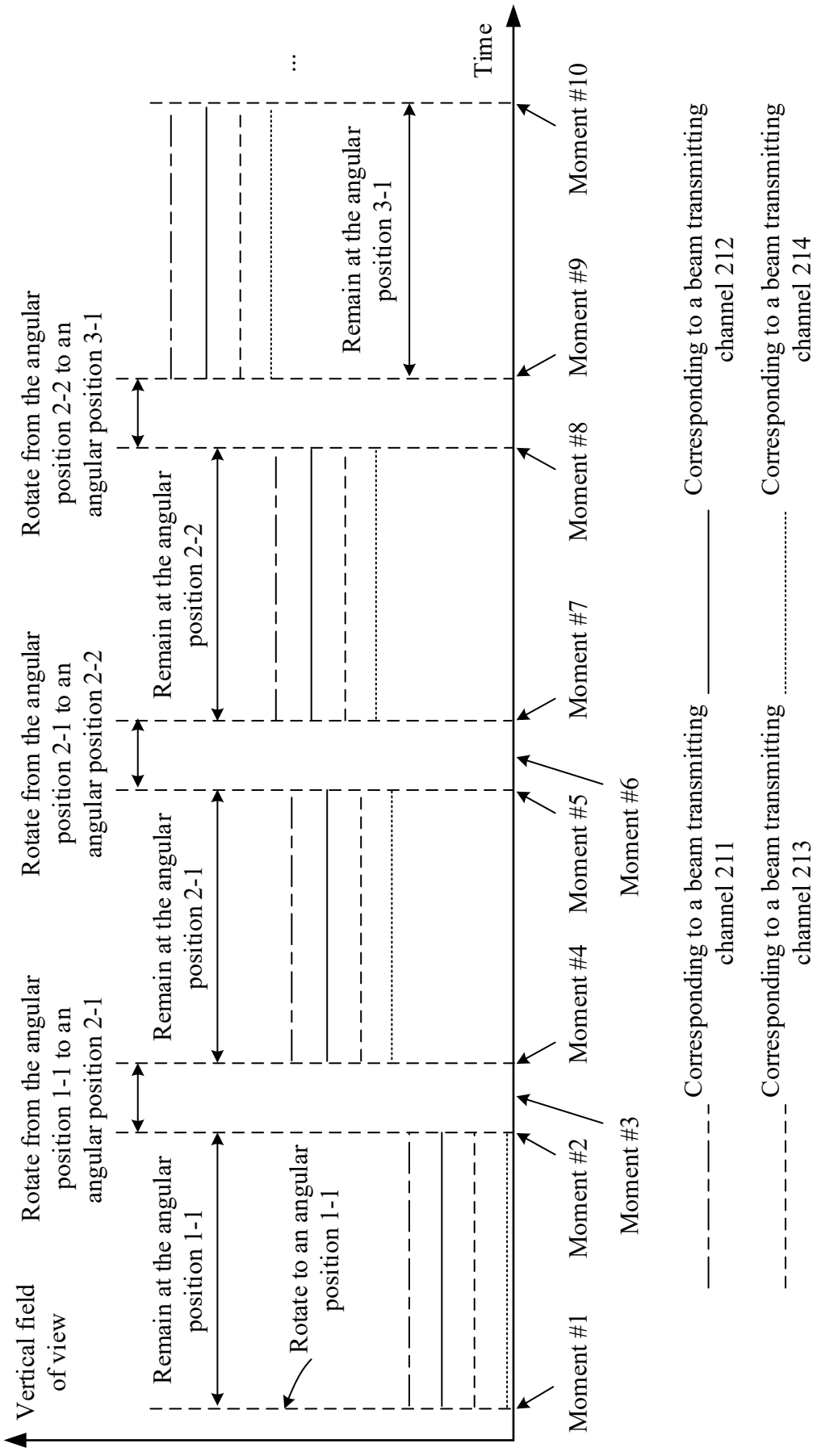

Vertical field of view
Time
Rotate from the angular position 1-1 to an angular position 2-1
Rotate from the angular position 2-1 to an angular position 2-2
Rotate from the angular position 2-2 to an angular position 3-1
Remain at the angular position 1-1
Rotate to an angular position 1-1
Remain at the angular position 2-1
Remain at the angular position 2-2
Remain at the angular position 3-1
...
Moment #1
Moment #2
Moment #3
Moment #4
Moment #5
Moment #6
Moment #7
Moment #8
Moment #9
Moment #10
Corresponding to a beam transmitting channel 211
Corresponding to a beam transmitting channel 212
Corresponding to a beam transmitting channel 213
Corresponding to a beam transmitting channel 214

FIG. 10

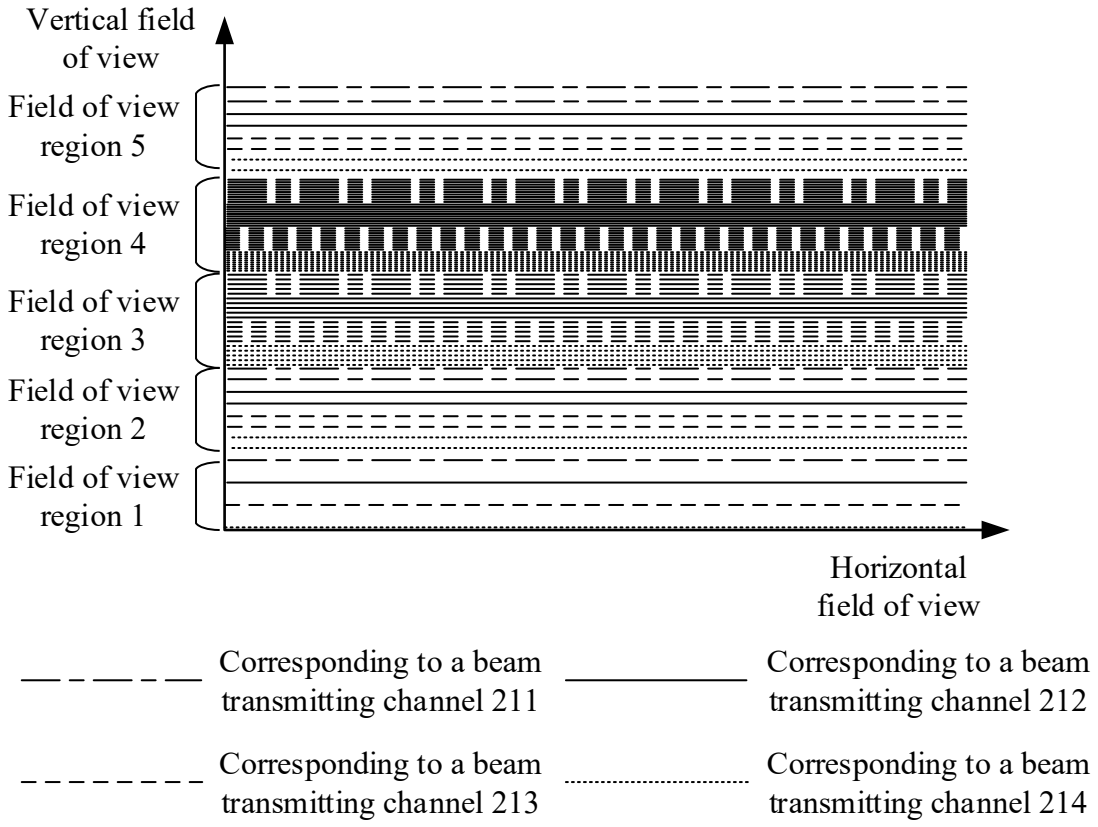


FIG. 11



FIG. 12A FIG. 12B FIG. 12C FIG. 12D

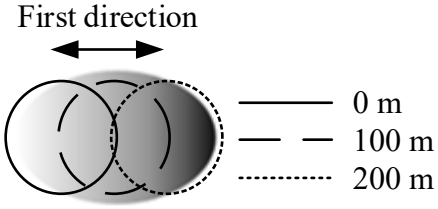


FIG. 13

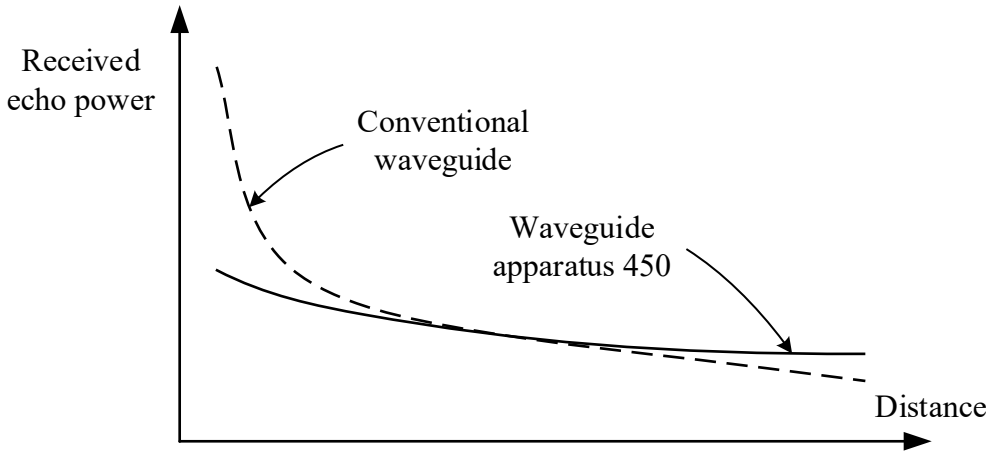

Received
echo power
Conventional
waveguide
Waveguide
apparatus 450
Distance

FIG. 14

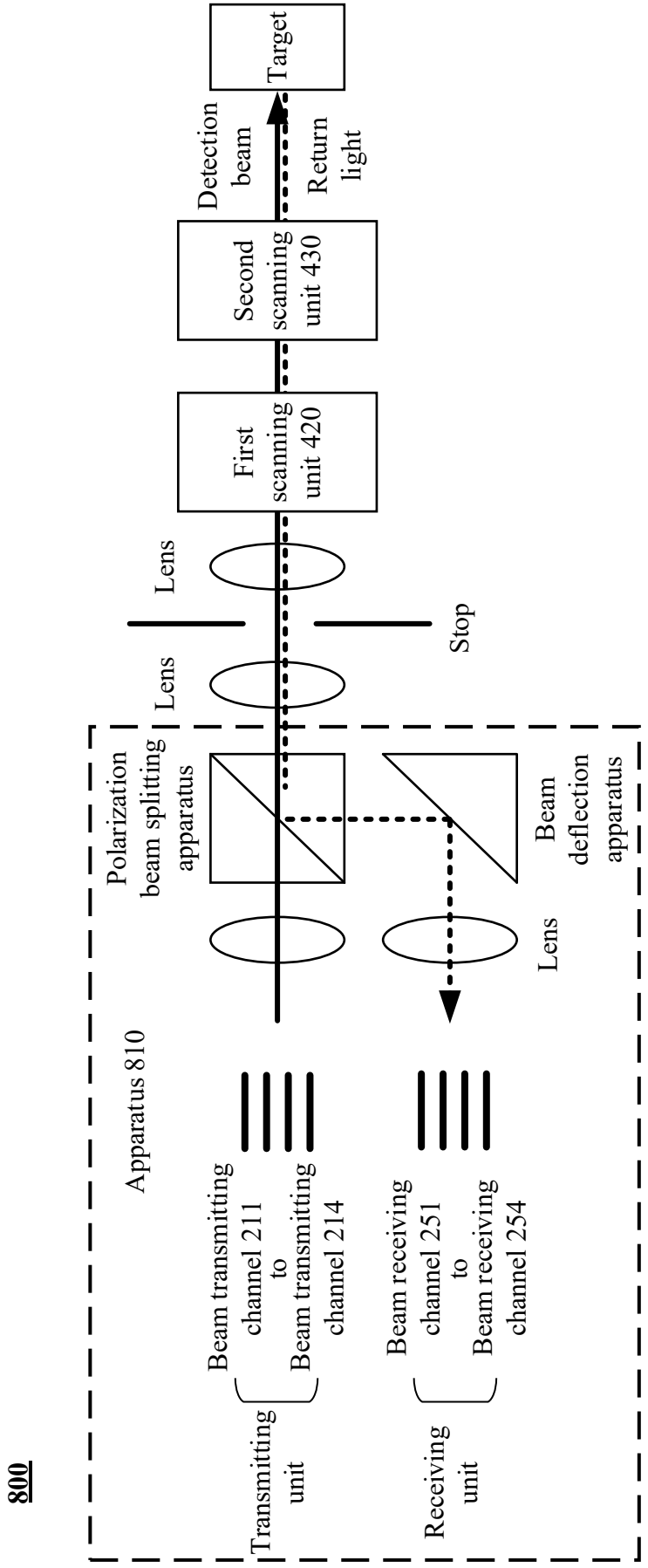

800
Apparatus 810
Transmitting unit
Beam transmitting channel 211 to Beam transmitting channel 214
Receiving unit
Beam receiving channel 251 to Beam receiving channel 254
Polarization beam splitting apparatus
Beam deflection apparatus
Lens
Lens
Lens
Stop
First scanning unit 420
Second scanning unit 430
Detection beam
Return light
Target

FIG. 15

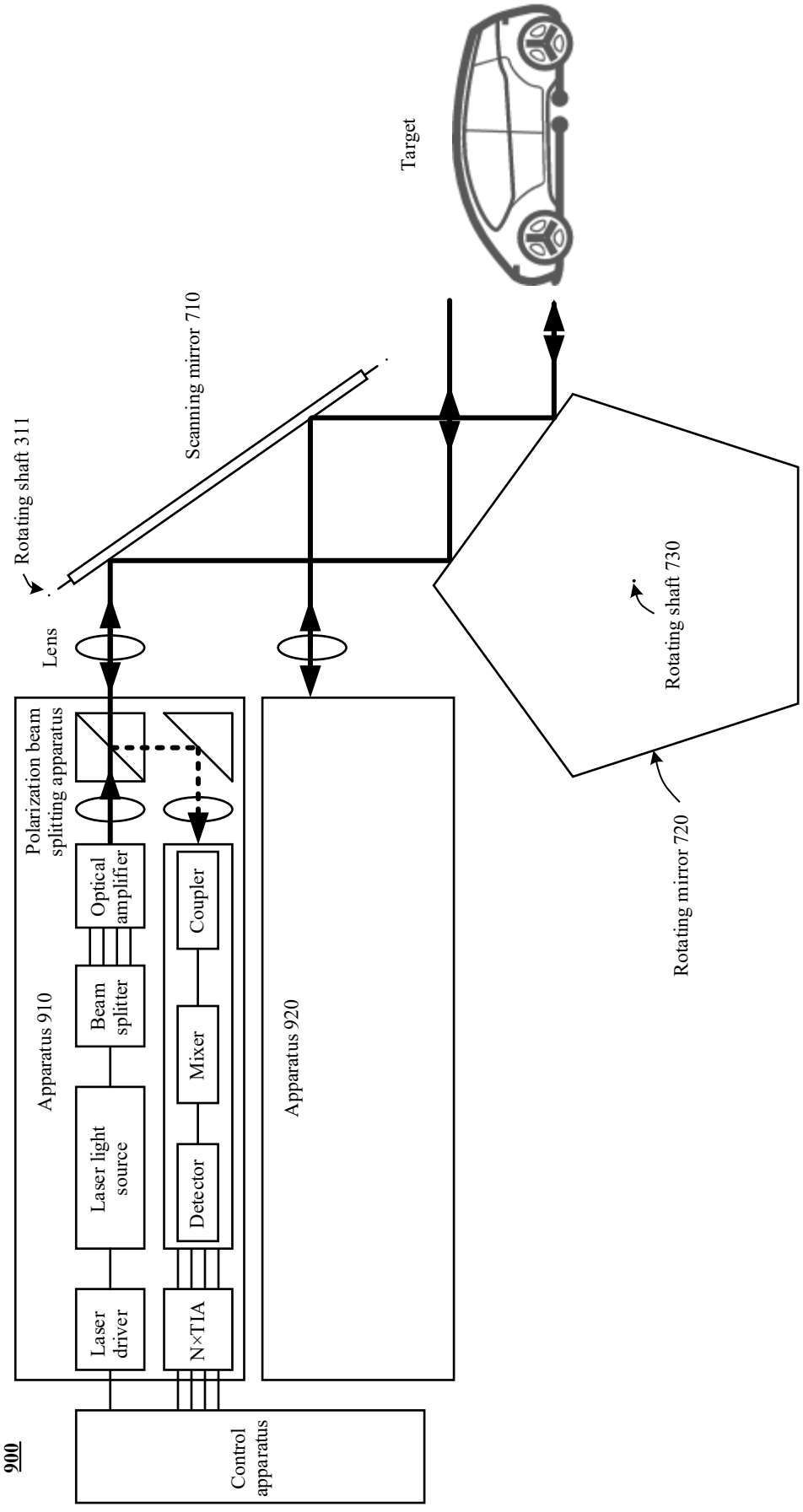

900
Control apparatus
Apparatus 910
Laser driver
N×TIA
Laser light source
Detector
Beam splitter
Mixer
Optical amplifier
Coupler
Polarization beam splitting apparatus
Apparatus 920
Lens
Rotating shaft 311
Scanning mirror 710
Rotating mirror 720
Rotating shaft 730
Target

FIG. 16

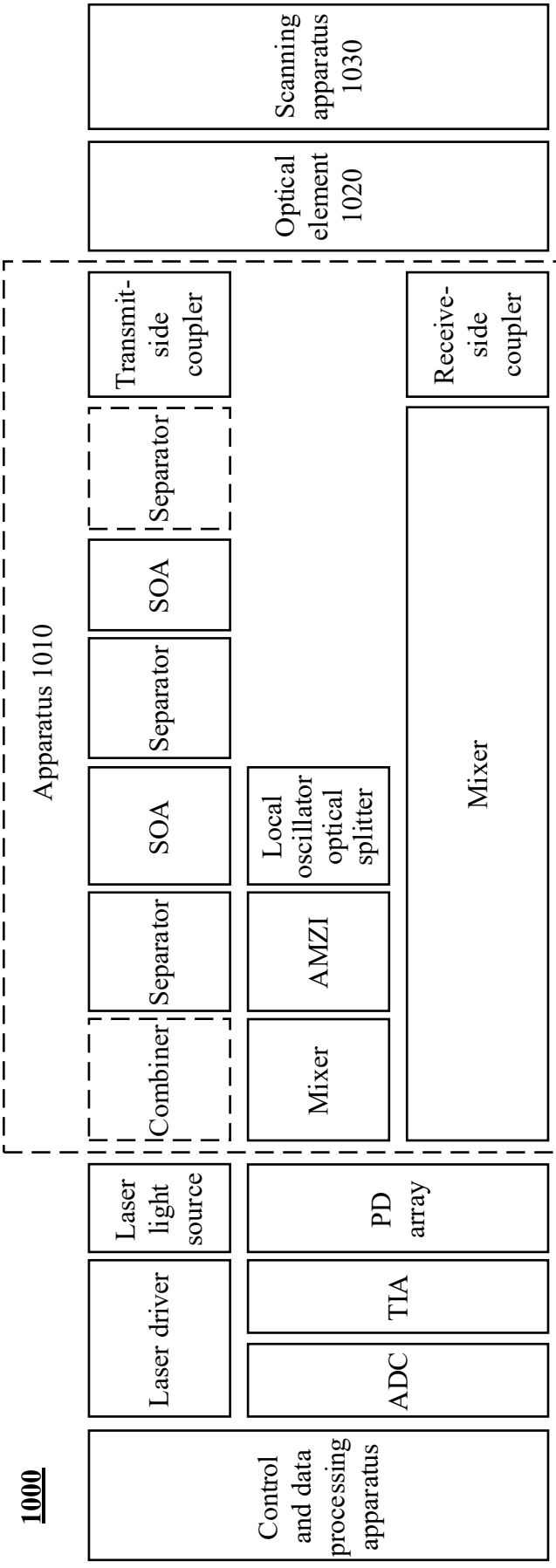

1000
Control and data processing apparatus
Laser driver
ADC
TIA
Laser light source
PD array
Apparatus 1010
Combiner
Separator
SOA
Separator
SOA
Separator
Transmit-side coupler
Mixer
AMZI
Local oscillator optical splitter
Mixer
Receive-side coupler
Optical element 1020
Scanning apparatus 1030

FIG. 17

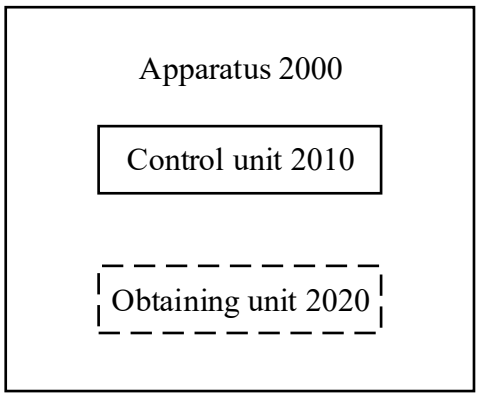

Apparatus 2000
Control unit 2010
Obtaining unit 2020

FIG. 18

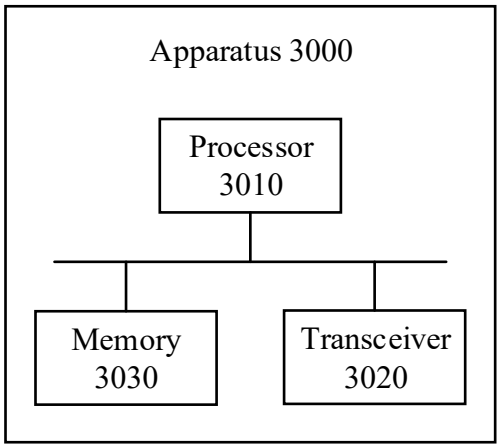

Apparatus 3000
Processor 3010
Memory 3030
Transceiver 3020

FIG. 19