FIG. 1

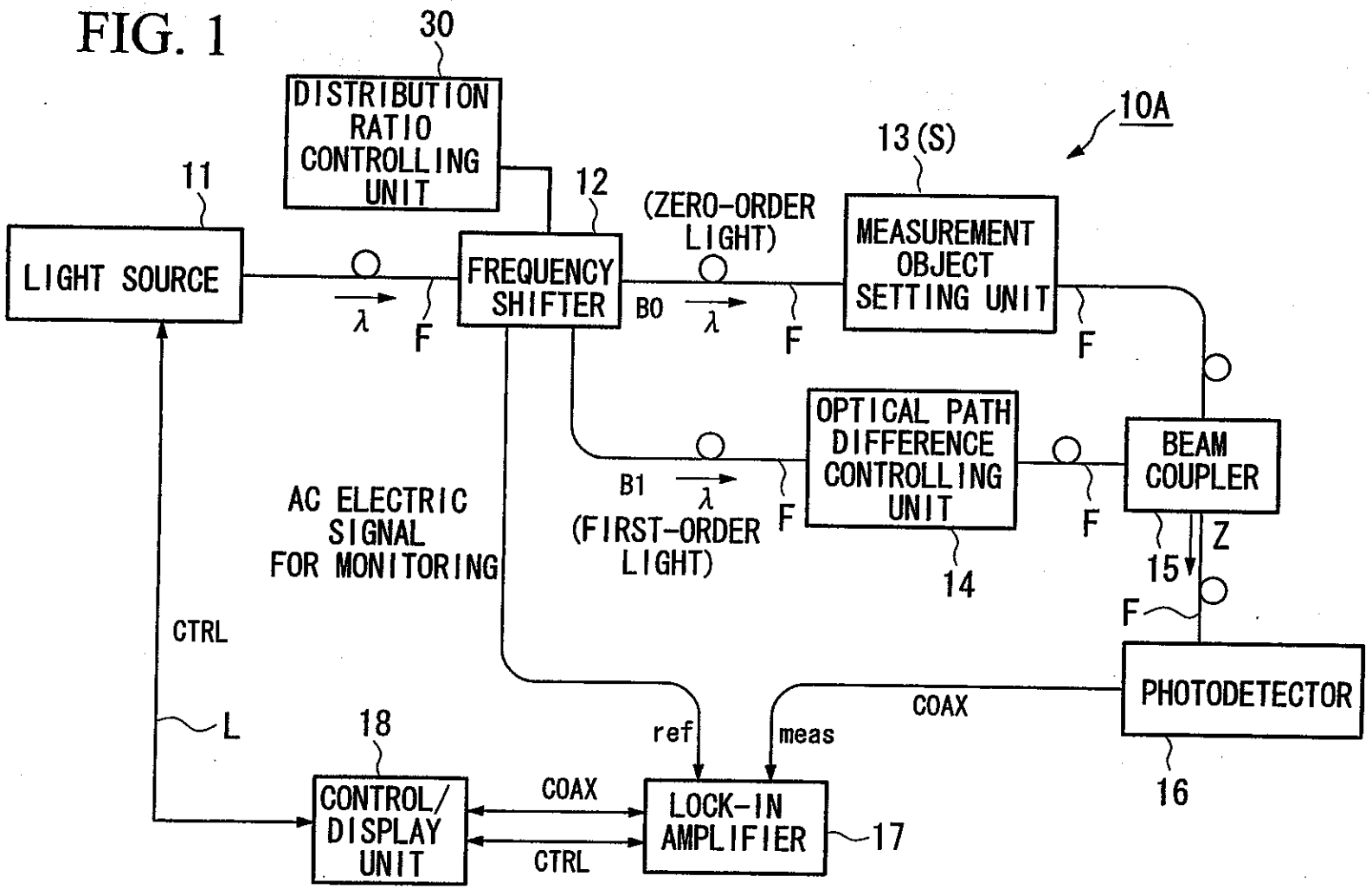

30
DISTRIBUTION RATIO CONTROLLING UNIT
10A
13(S)
11
12
(ZERO-ORDER LIGHT)
MEASUREMENT OBJECT SETTING UNIT
LIGHT SOURCE
FREQUENCY SHIFTER
λ
F
B0
λ
F
F
OPTICAL PATH DIFFERENCE CONTROLLING UNIT
BEAM COUPLER
B1
λ
F
F
AC ELECTRIC SIGNAL FOR MONITORING
(FIRST-ORDER LIGHT)
14
15
Z
F
CTRL
PHOTODETECTOR
COAX
L
18
ref
meas
16
CONTROL/ DISPLAY UNIT
COAX
CTRL
LOCK-IN AMPLIFIER
17

FIG. 2

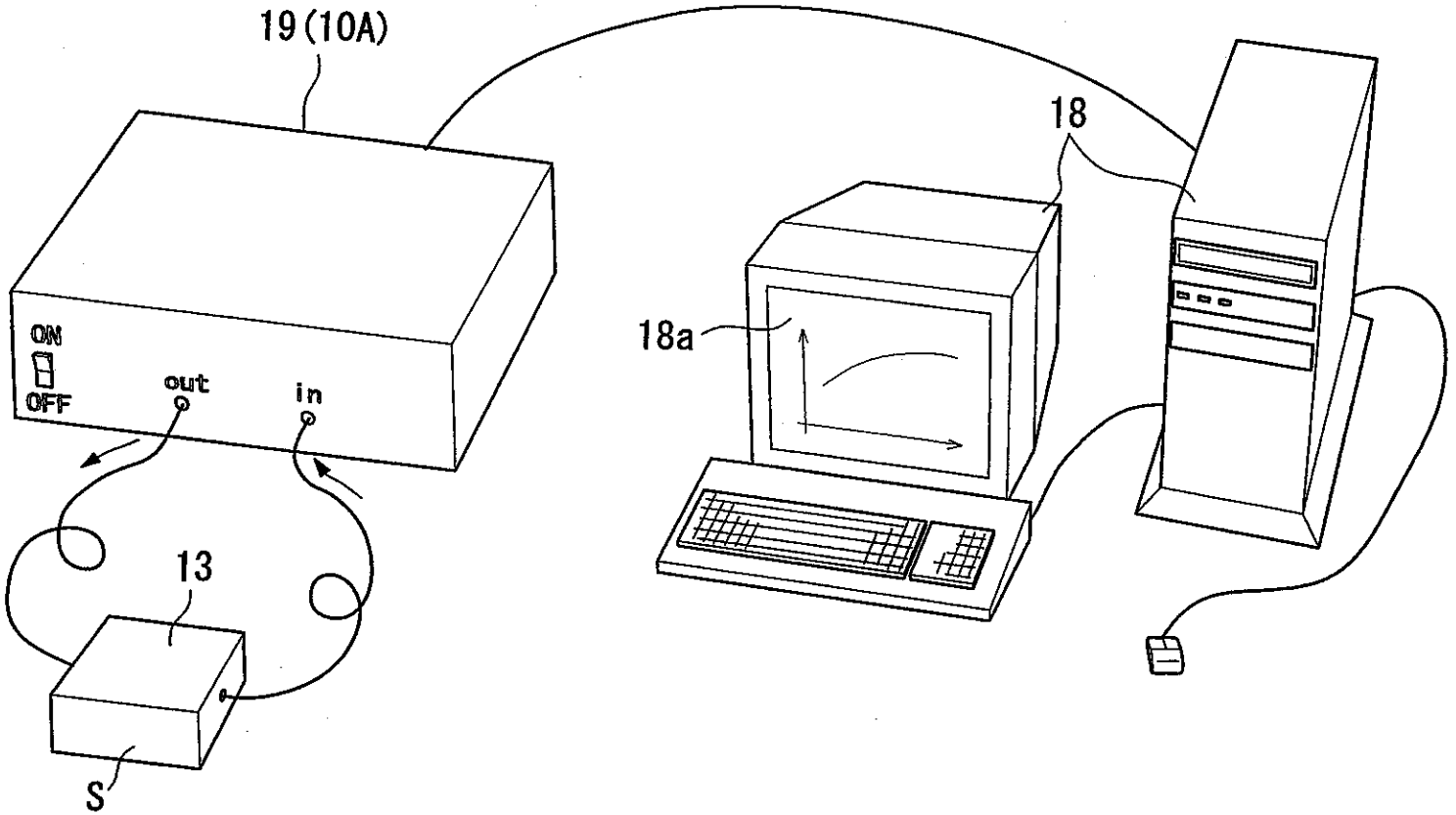


FIG. 3

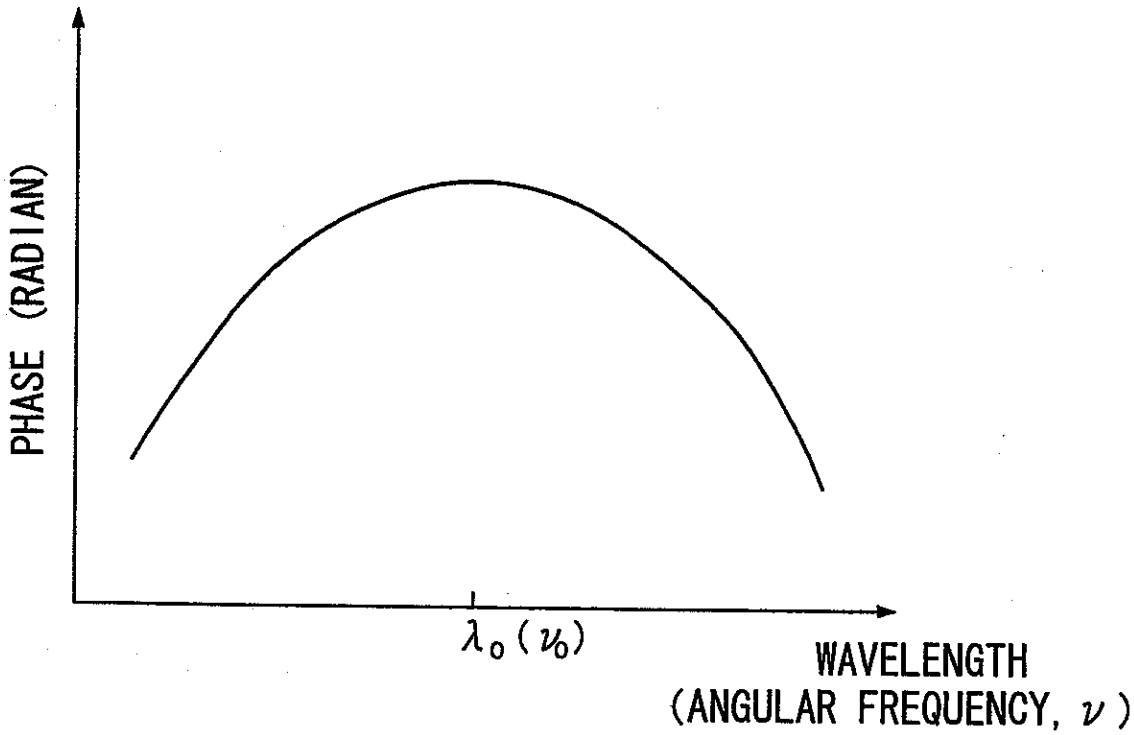


FIG. 4A

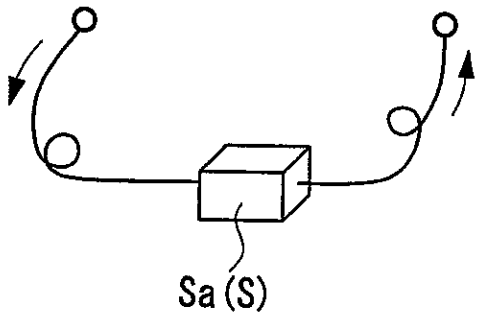


FIG. 4B

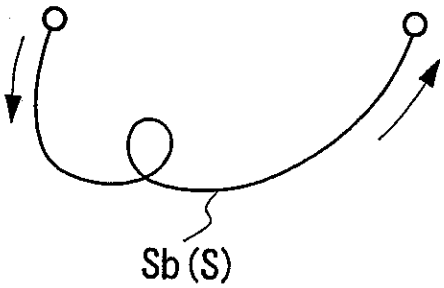


FIG. 4C

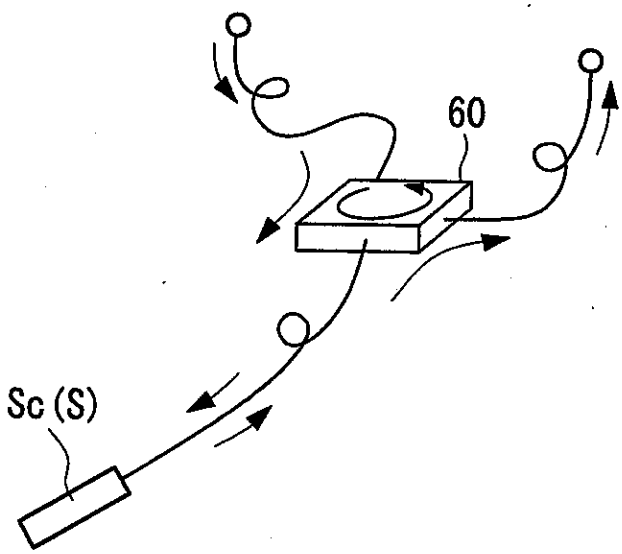


FIG. 5

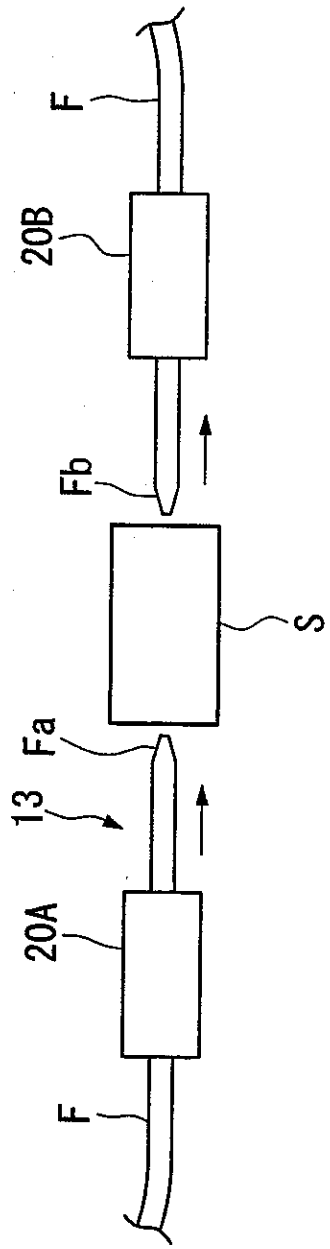


FIG. 6A

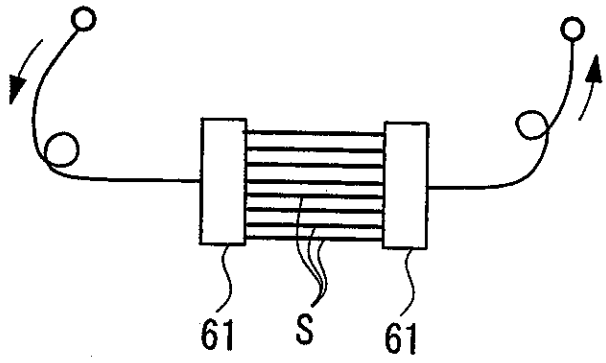


FIG. 6B

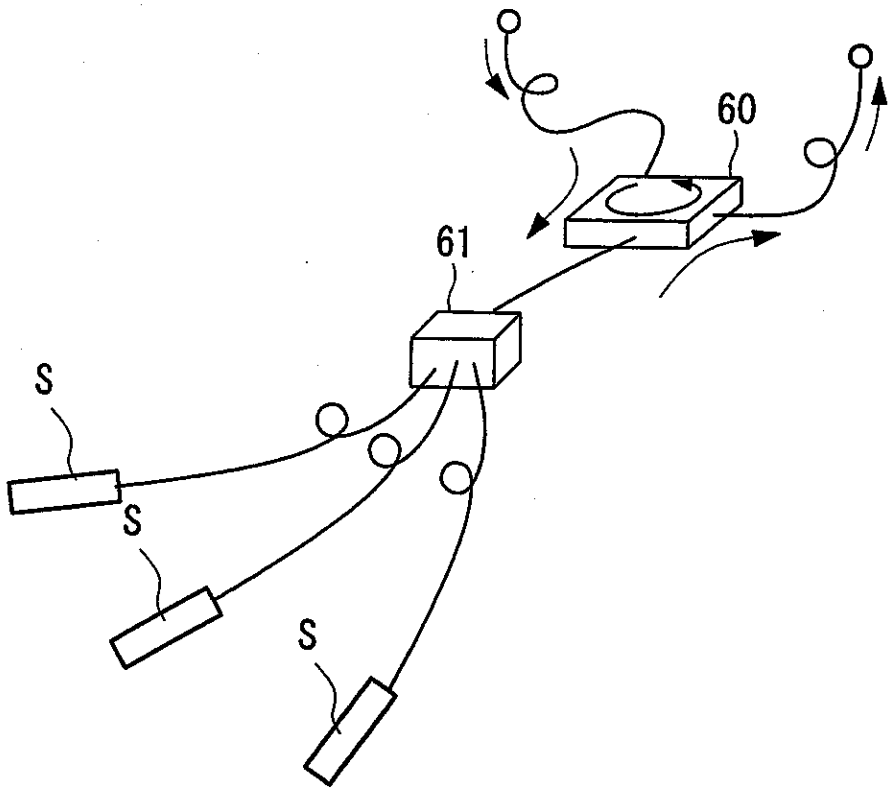


FIG. 7A

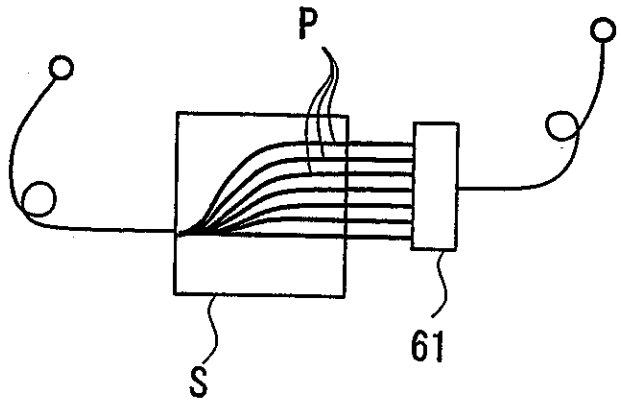


FIG. 7B

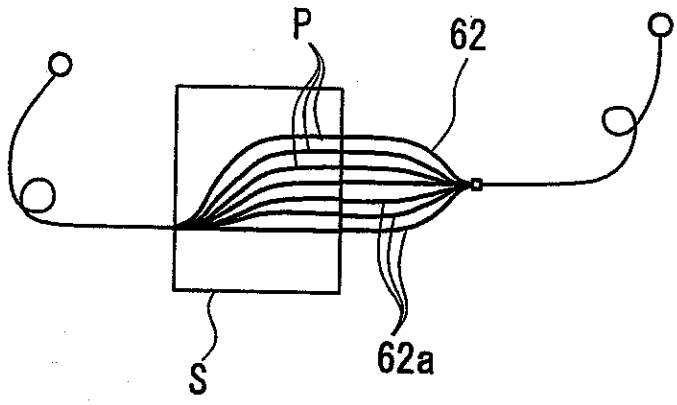


FIG. 8

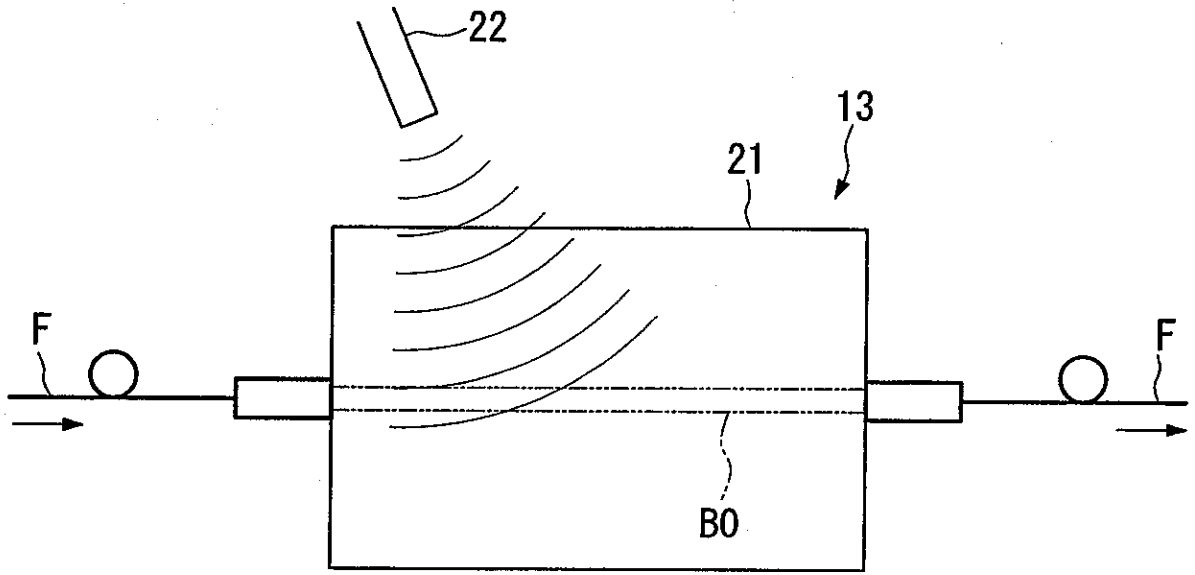


FIG. 9

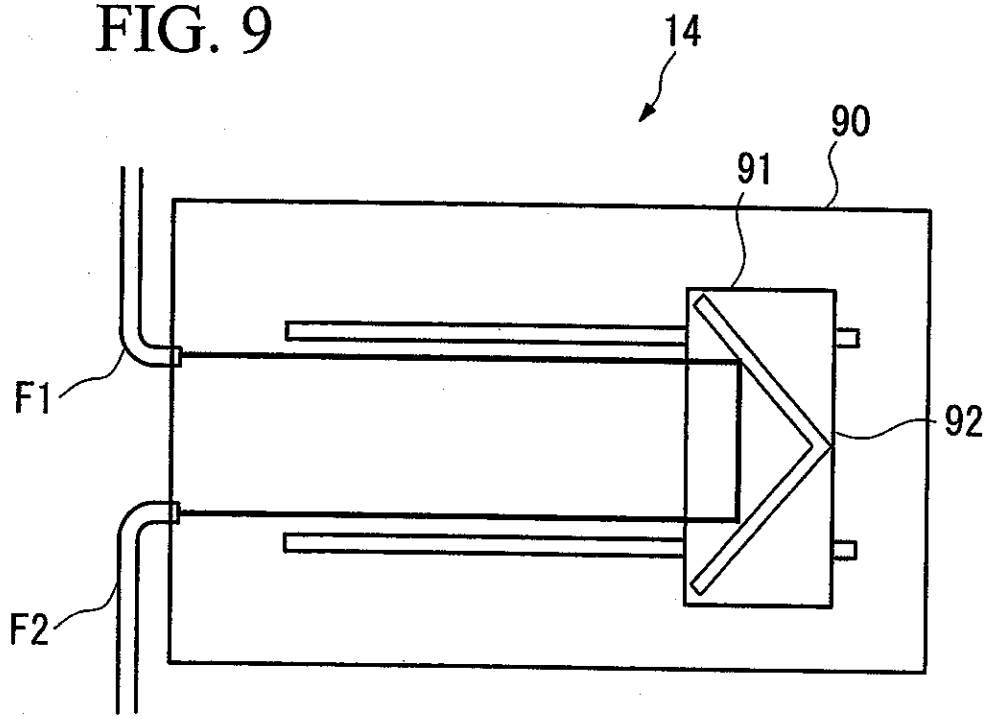


FIG. 10

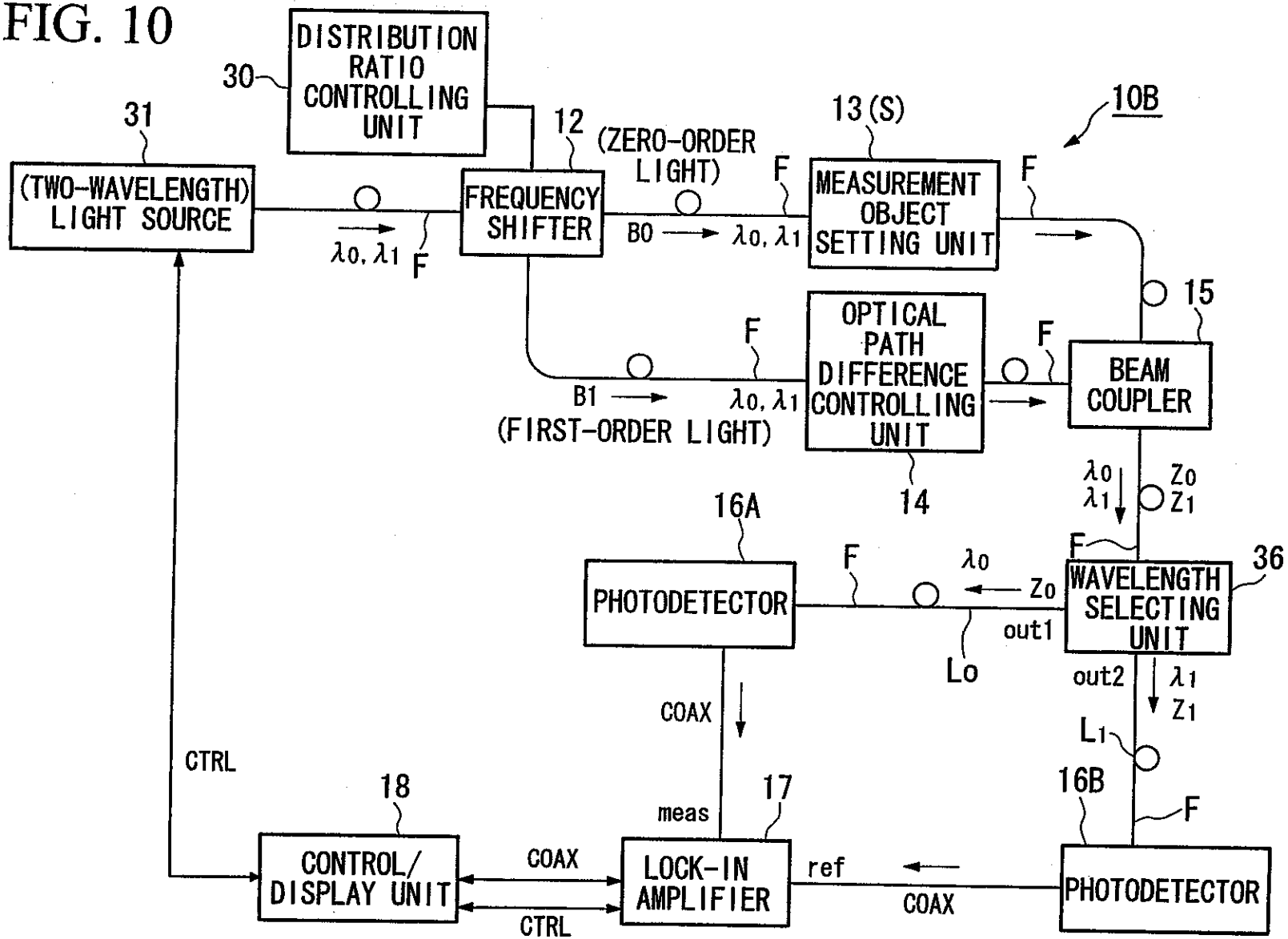

DISTRIBUTION RATIO CONTROLLING UNIT
30
31
(TWO-WAVELENGTH) LIGHT SOURCE
12
FREQUENCY SHIFTER
(ZERO-ORDER LIGHT)
B0
λ0, λ1
F
13(S)
MEASUREMENT OBJECT SETTING UNIT
10B
B1
(FIRST-ORDER LIGHT)
OPTICAL PATH DIFFERENCE CONTROLLING UNIT
14
15
BEAM COUPLER
λ0
λ1
Z0
Z1
16A
PHOTODETECTOR
WAVELENGTH SELECTING UNIT
36
out1
out2
Lo
L1
COAX
CTRL
meas
17
18
16B
CONTROL/ DISPLAY UNIT
LOCK-IN AMPLIFIER
ref
PHOTODETECTOR

FIG. 11

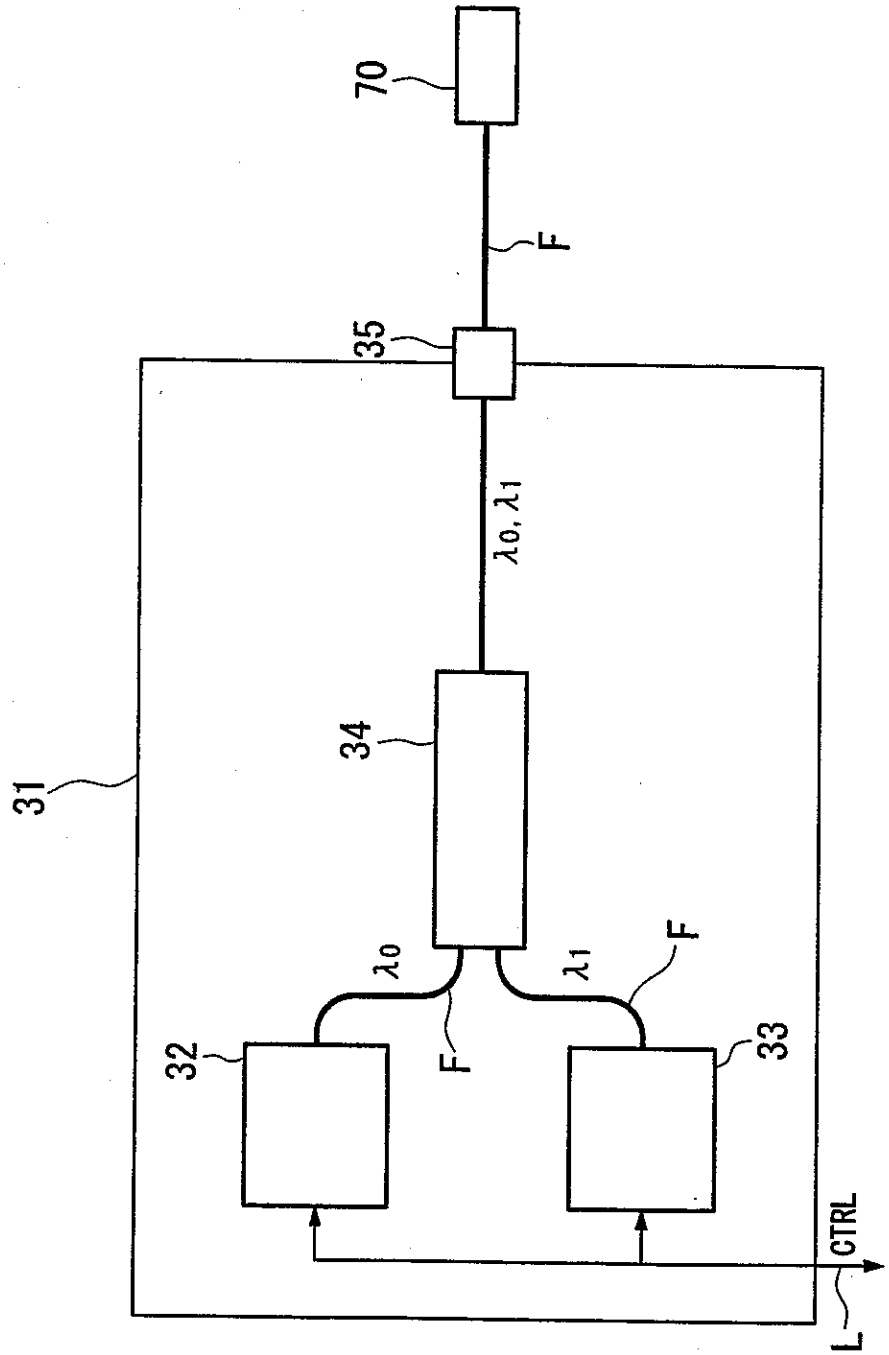


FIG. 12

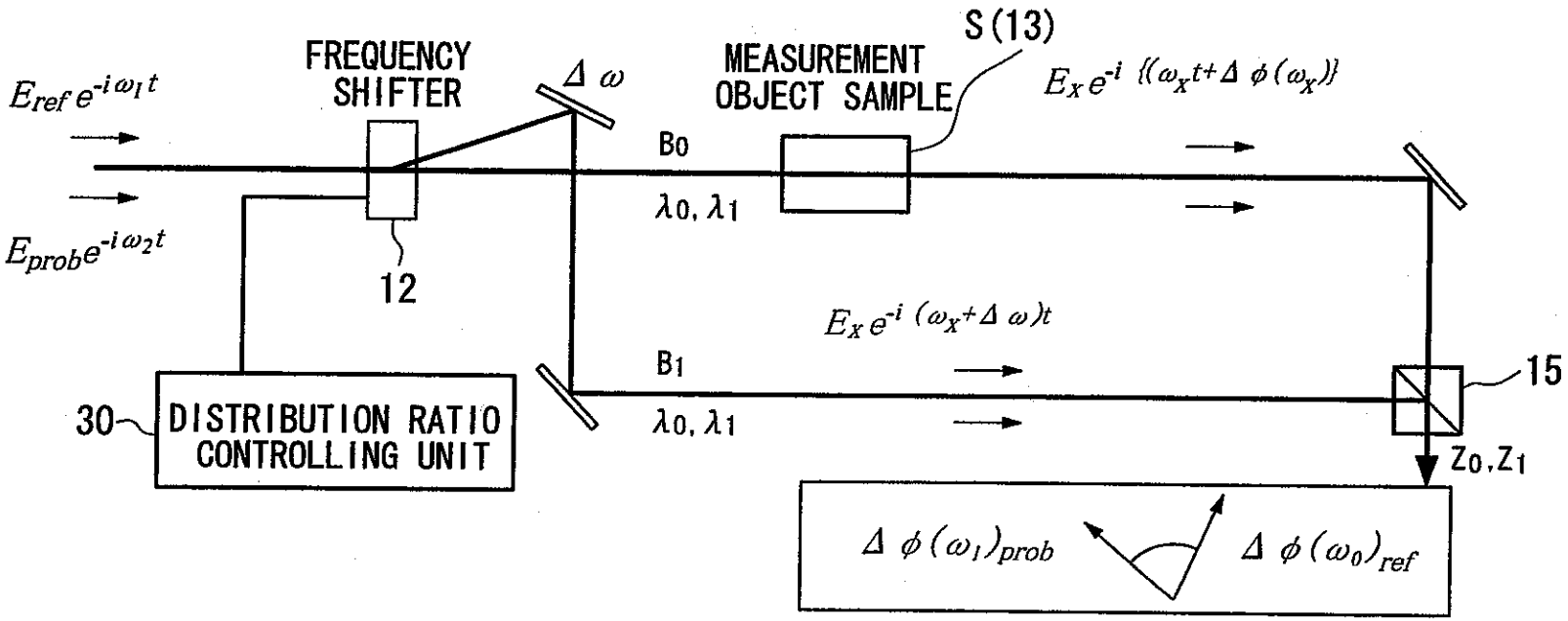

$E_{ref}e^{-i\omega_1 t}$
FREQUENCY SHIFTER
$\Delta\omega$
MEASUREMENT OBJECT SAMPLE
S(13)
$E_X e^{-i\{(\omega_X t+\Delta\phi(\omega_X)\}}$
B0
λ_0, λ_1
$E_{prob}e^{-i\omega_2 t}$
12
$E_X e^{-i(\omega_X+\Delta\omega)t}$
B1
λ_0, λ_1
15
30
DISTRIBUTION RATIO CONTROLLING UNIT
Z_0, Z_1
$\Delta\phi(\omega_1)_{prob}$
$\Delta\phi(\omega_0)_{ref}$

FIG. 13

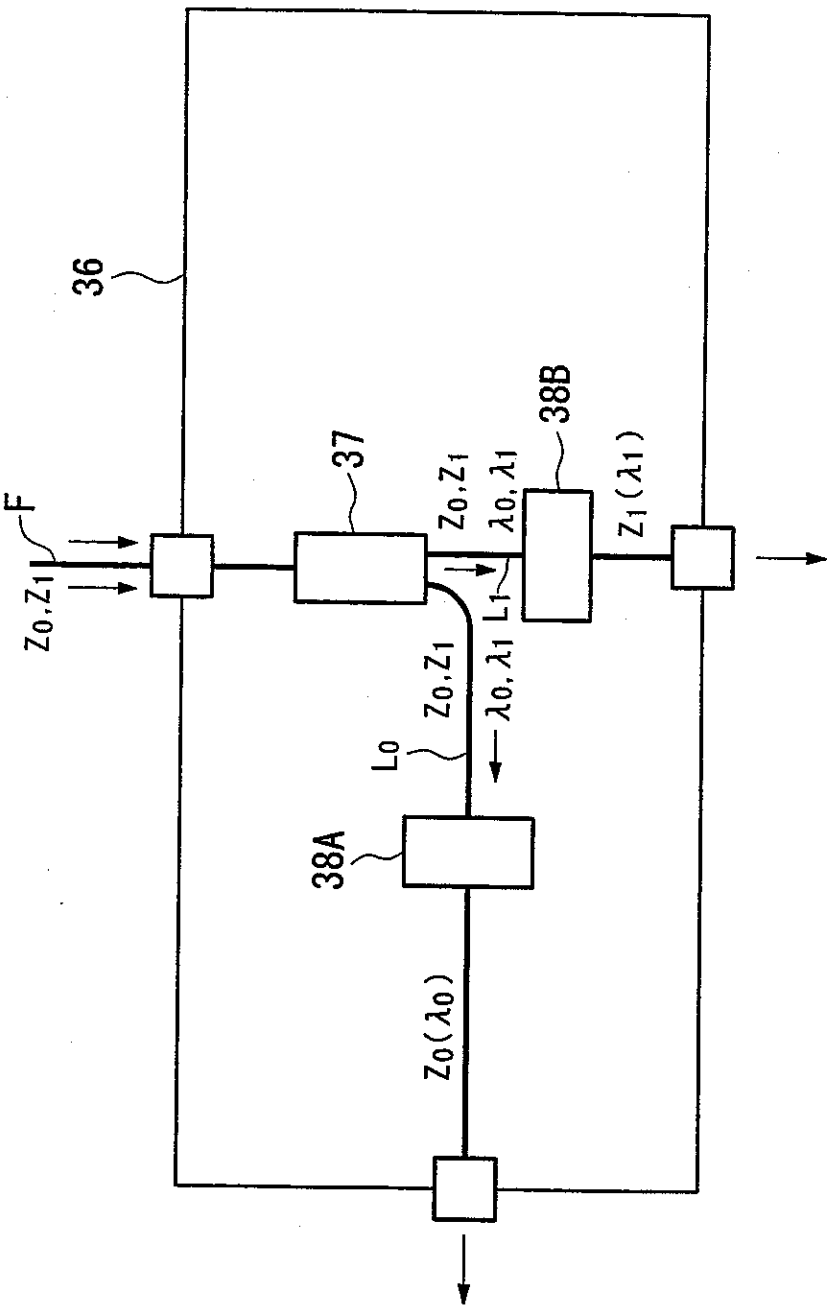


FIG. 14

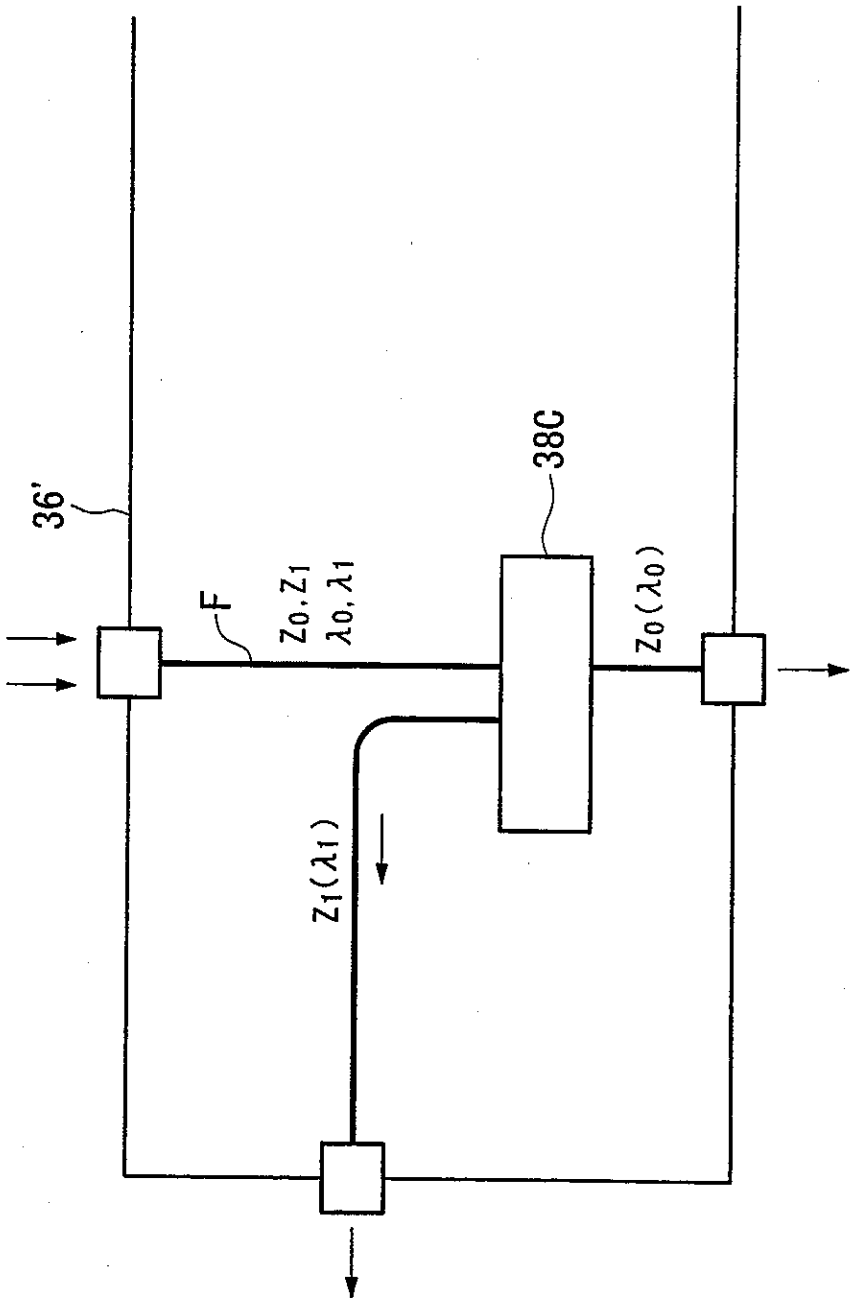


FIG. 15A

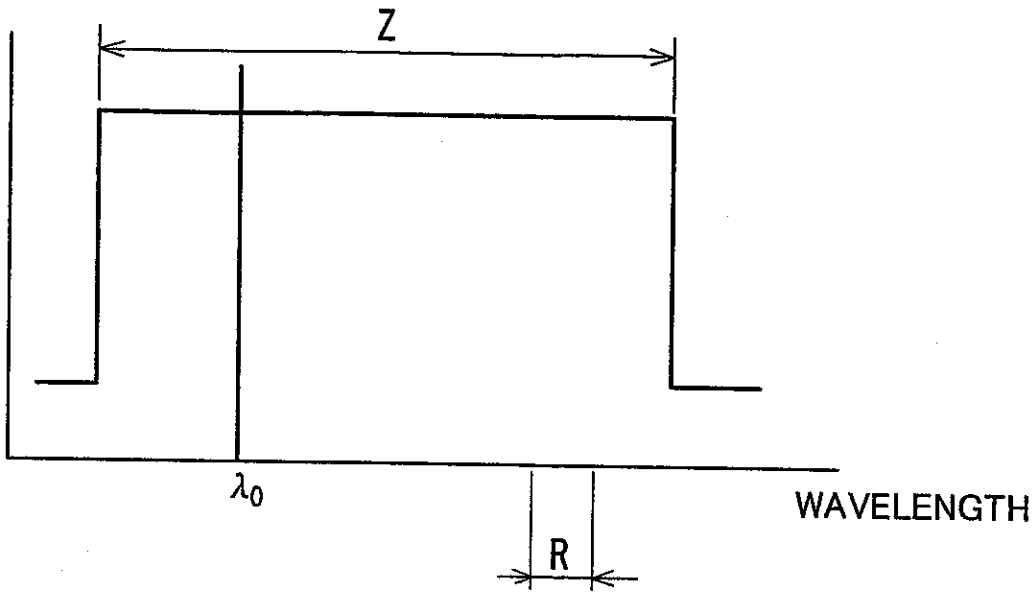


FIG. 15B

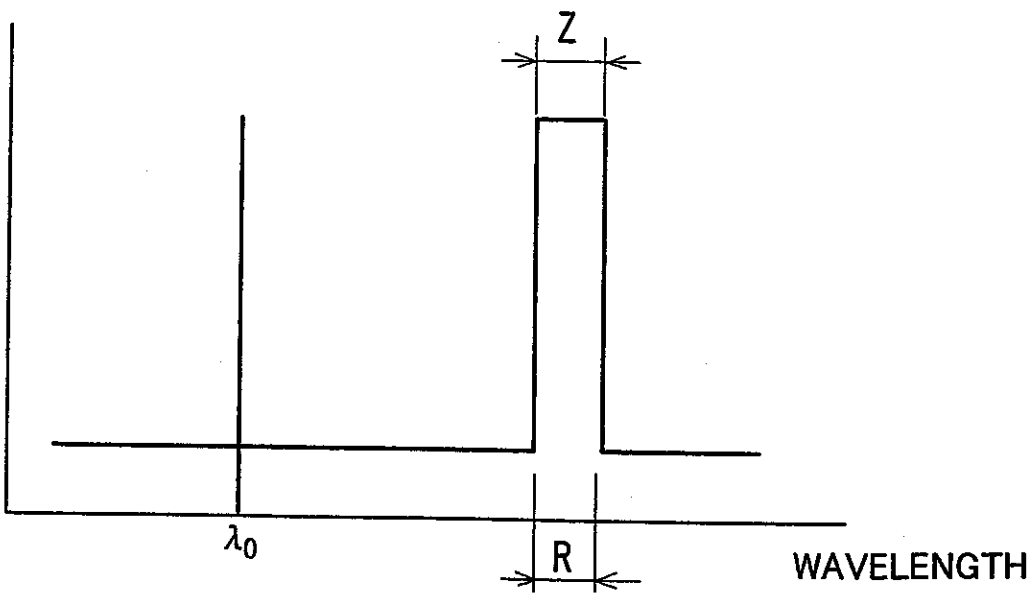


FIG. 16

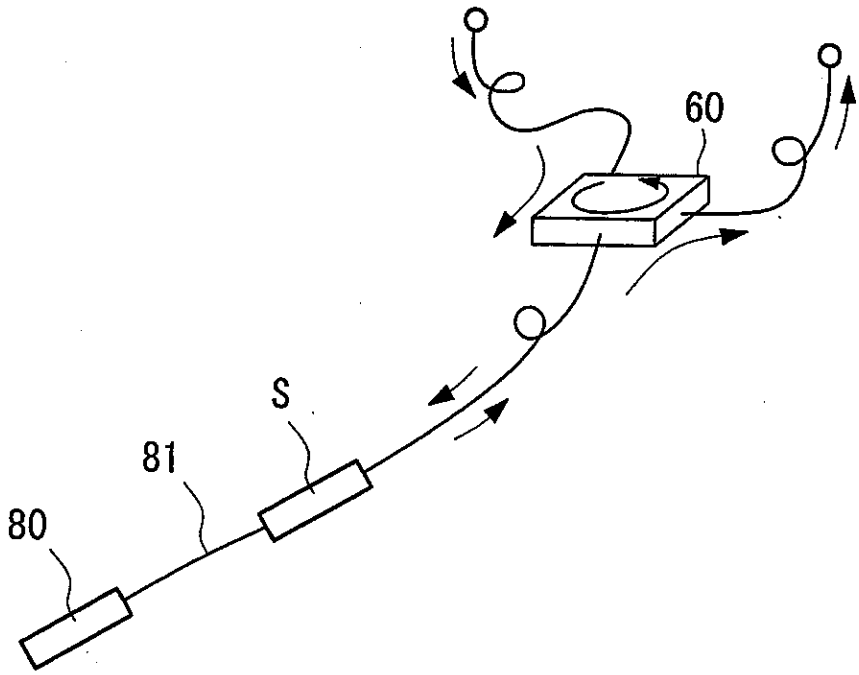


FIG. 17

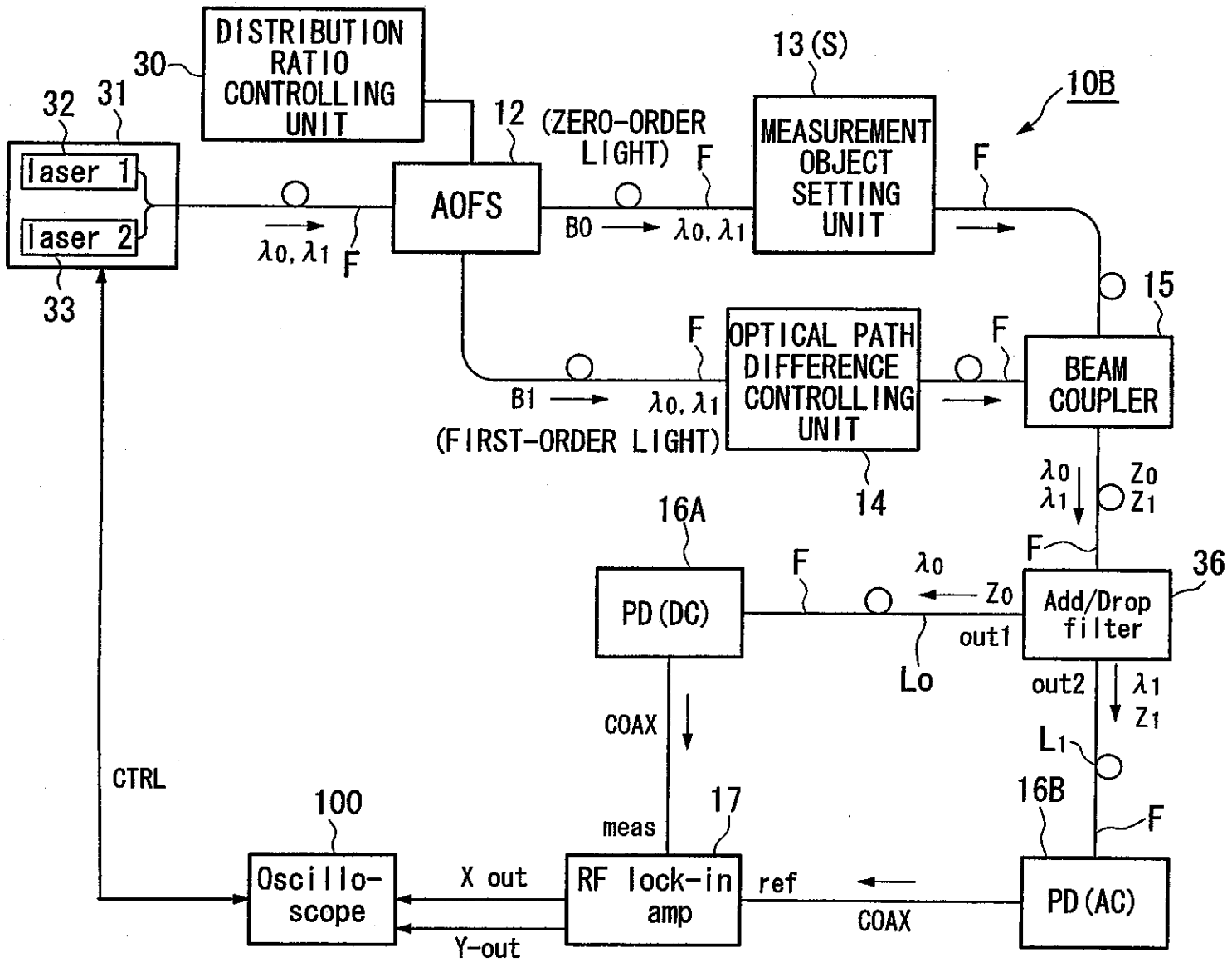

DISTRIBUTION RATIO CONTROLLING UNIT
30
32
31
laser 1
laser 2
33
λ0, λ1
F
12
AOFS
(ZERO-ORDER LIGHT)
B0
λ0, λ1
F
13(S)
MEASUREMENT OBJECT SETTING UNIT
10B
F
15
BEAM COUPLER
F
B1
λ0, λ1
(FIRST-ORDER LIGHT)
OPTICAL PATH DIFFERENCE CONTROLLING UNIT
F
14
λ0
λ1
Z0
Z1
16A
F
PD(DC)
F
λ0
Z0
Lo
out1
Add/Drop filter
36
out2
λ1
Z1
L1
16B
F
PD(AC)
COAX
meas
17
RF lock-in amp
ref
COAX
CTRL
100
Oscillo-scope
X out
Y-out

FIG. 18

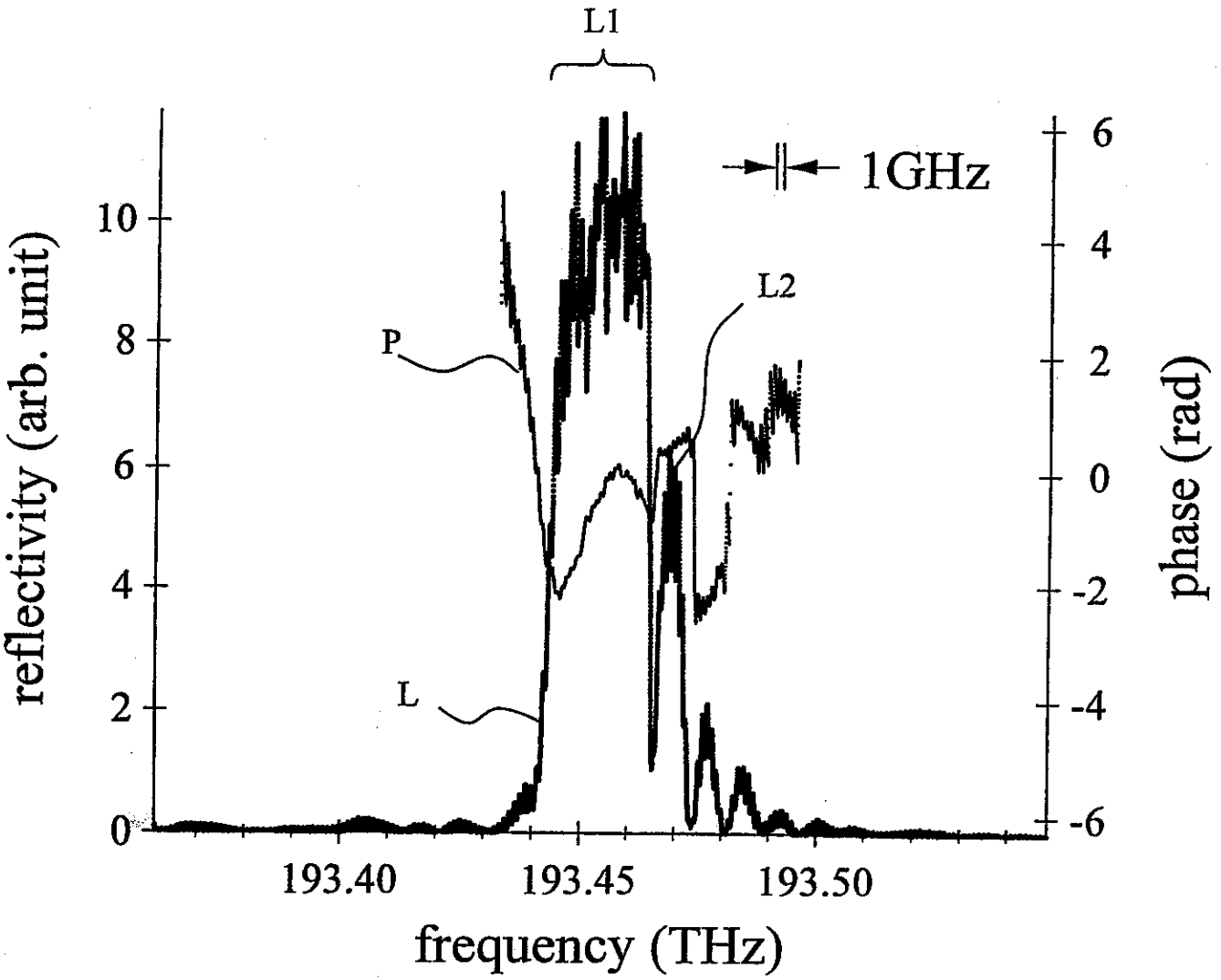

L1
1GHz
L2
P
L
reflectivity (arb. unit)
phase (rad)
10
8
6
4
2
0
6
4
2
0
-2
-4
-6
193.40
193.45
193.50
frequency (THz)

FIG. 19

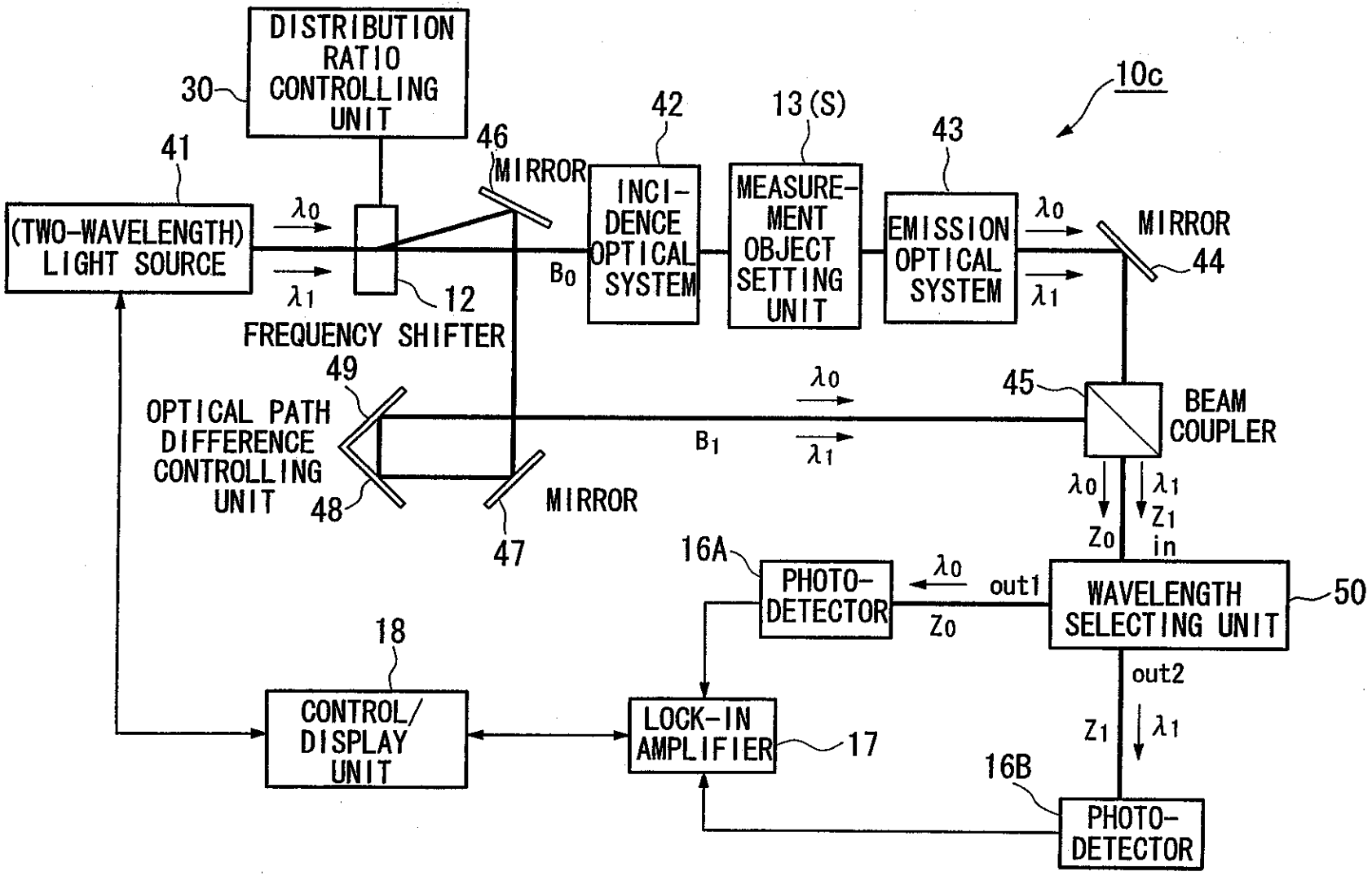

DISTRIBUTION RATIO CONTROLLING UNIT
30
10c
42
13(S)
43
41
46
MIRROR
INCI-DENCE OPTICAL SYSTEM
MEASURE-MENT OBJECT SETTING UNIT
EMISSION OPTICAL SYSTEM
(TWO-WAVELENGTH) LIGHT SOURCE
λ0
λ1
12
FREQUENCY SHIFTER
B0
MIRROR
44
49
45
BEAM COUPLER
OPTICAL PATH DIFFERENCE CONTROLLING UNIT
48
47
MIRROR
B1
Z0
Z1 in
16A
PHOTO-DETECTOR
out1
WAVELENGTH SELECTING UNIT
50
18
CONTROL/ DISPLAY UNIT
LOCK-IN AMPLIFIER
17
out2
Z1
16B
PHOTO-DETECTOR

FIG. 20

