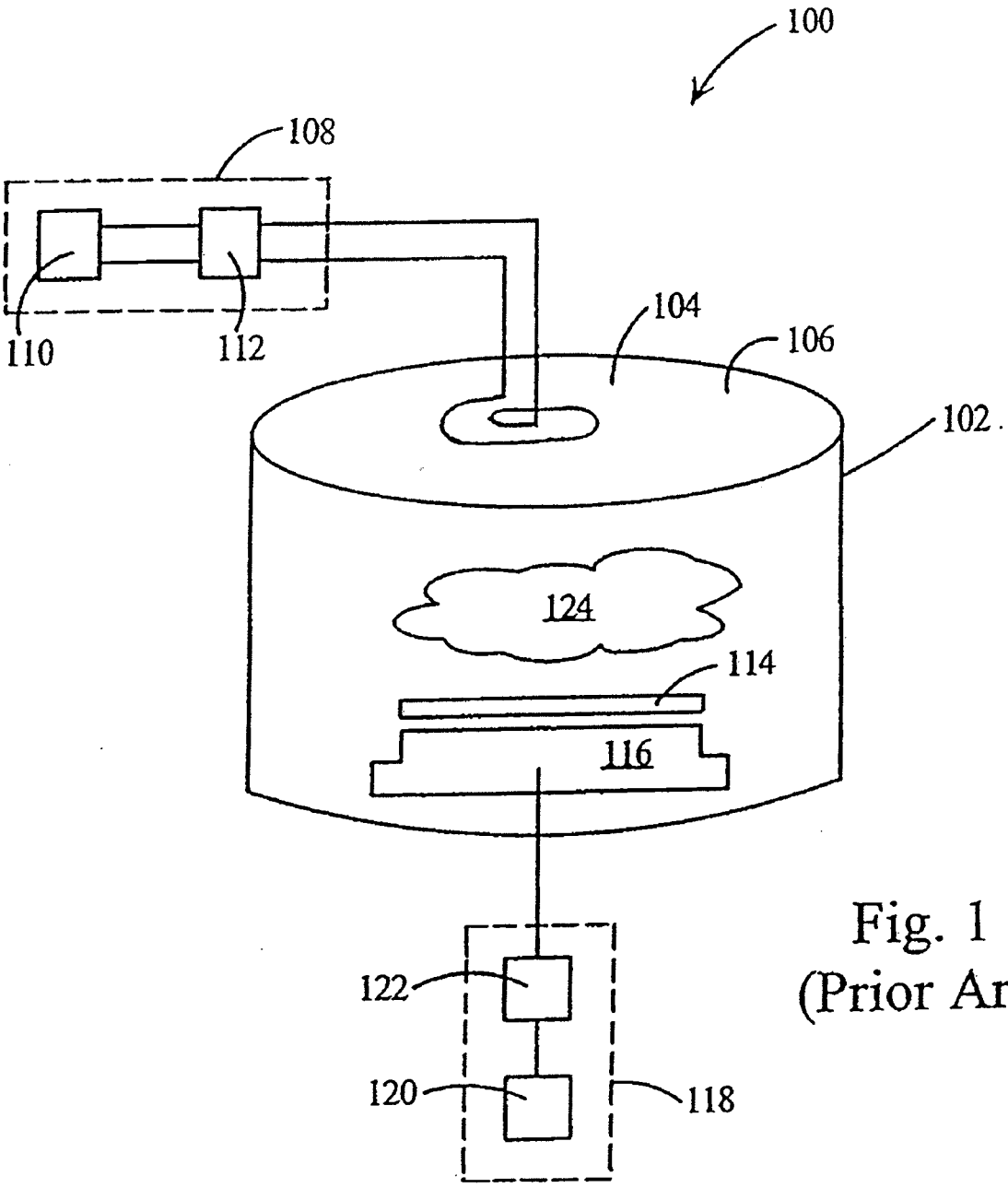


Fig. 1
(Prior Art)

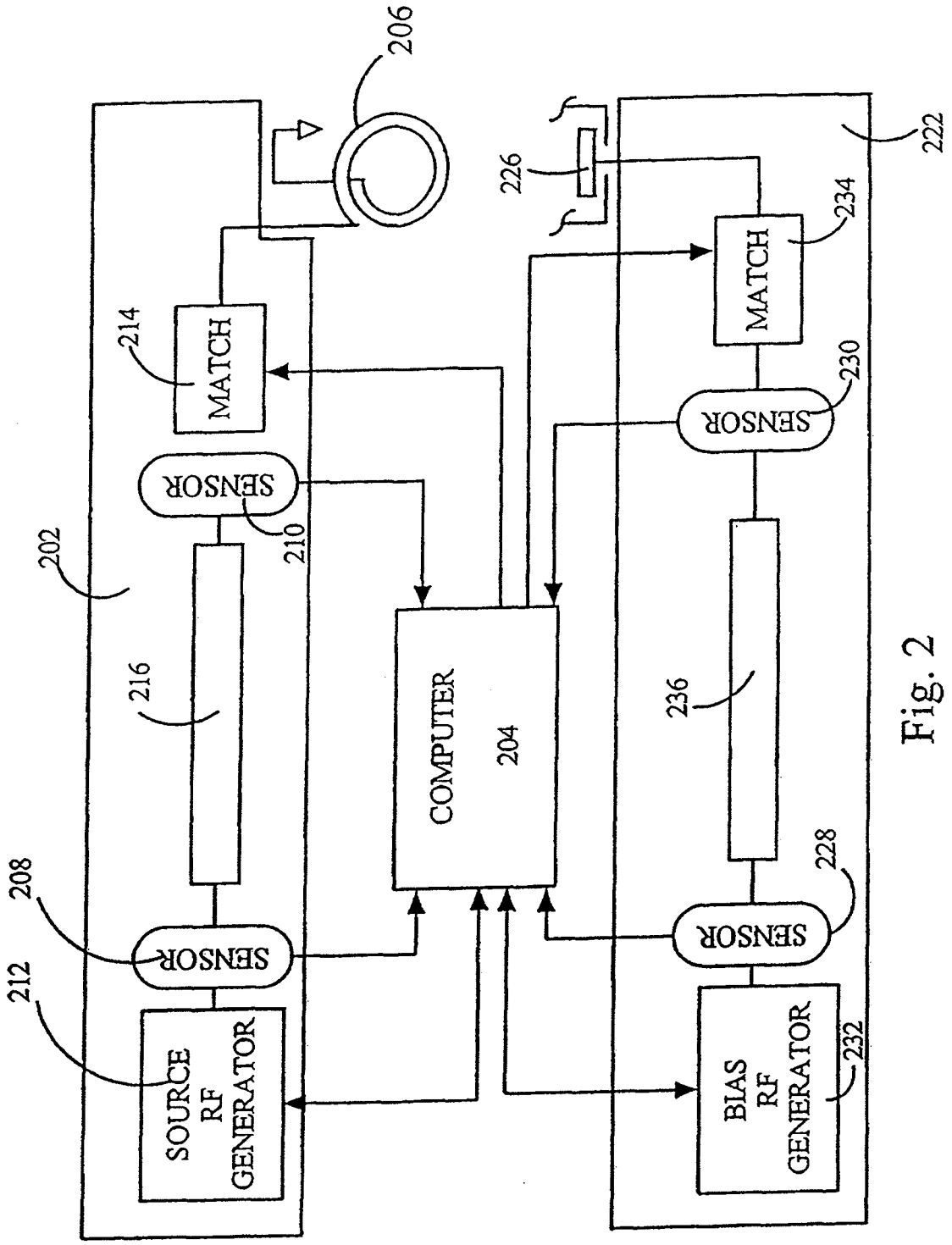

206
222
226
234
MATCH
214
MATCH
230
SENSOR
SENSOR
210
202
216
COMPUTER
204
236
208
228
SENSOR
SENSOR
212
SOURCE RF GENERATOR
BIAS RF GENERATOR
232

Fig. 2

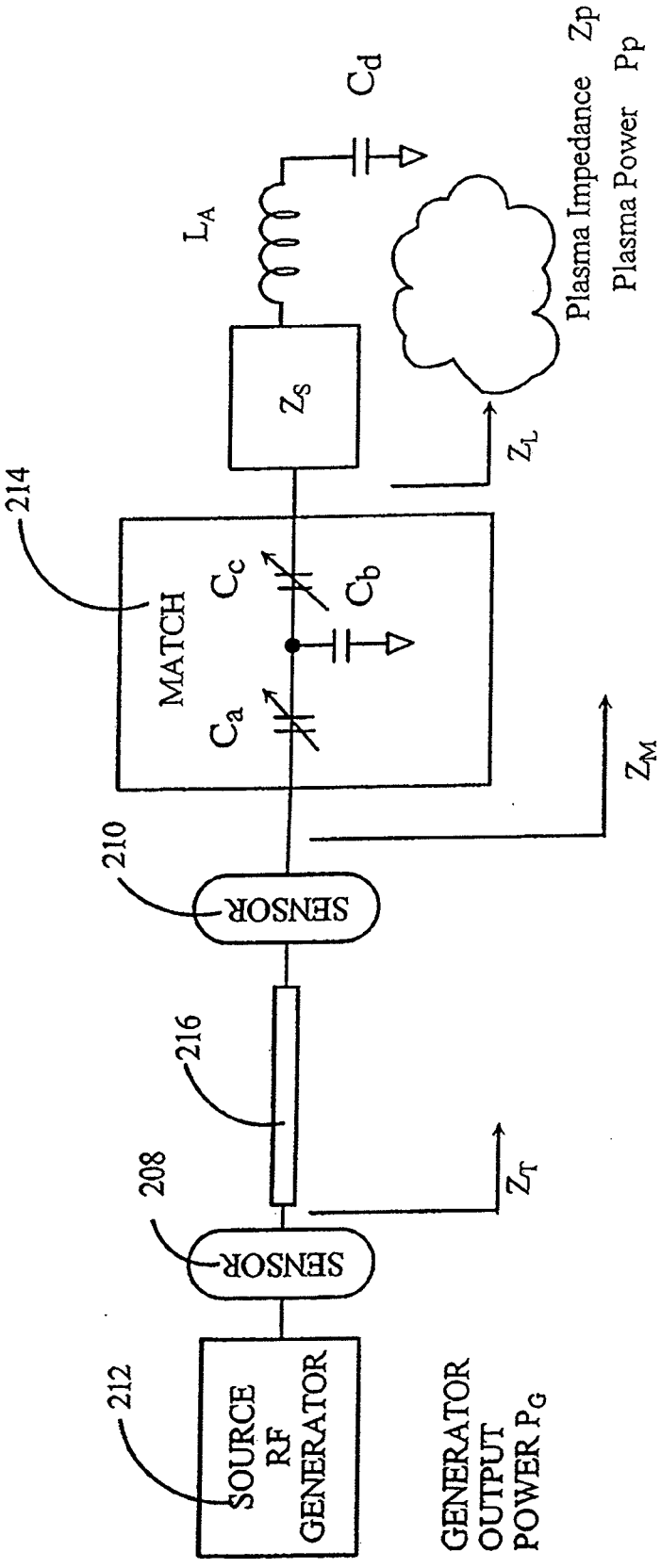
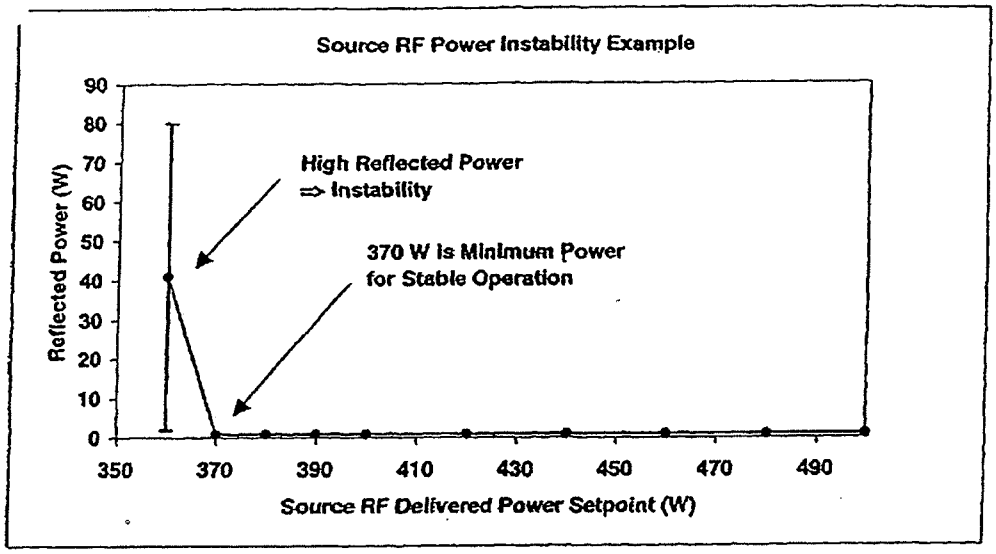

212
SOURCE RF GENERATOR
GENERATOR OUTPUT POWER P_G
208
SENSOR
216
210
SENSOR
214
MATCH
C_a
C_c
C_b
Z_T
Z_M
Z_S
L_A
C_d
Z_L
Plasma Impedance Z_p
Plasma Power P_p

Fig. 3

Fig. 4A


Source RF Power Instability Example
Reflected Power (W)
90
80
70
60
50
40
30
20
10
0
High Reflected Power
⇒ Instability
370 W is Minimum Power
for Stable Operation
350
370
390
410
430
450
470
490
Source RF Delivered Power Setpoint (W)

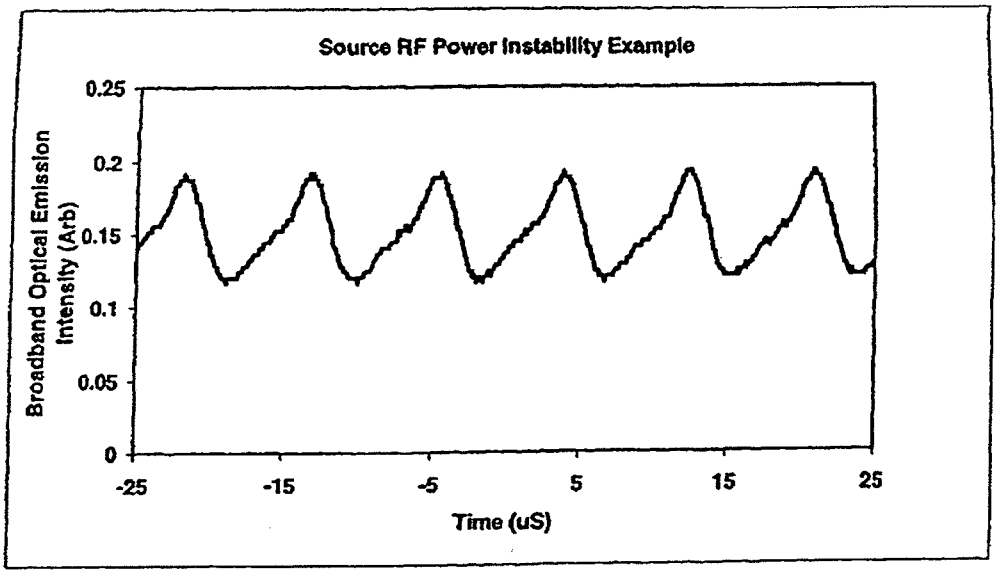

Source RF Power Instability Example
Broadband Optical Emission Intensity (Arb)
0.25
0.2
0.15
0.1
0.05
0
-25
-15
-5
5
15
25
Time (uS)

Fig. 4B

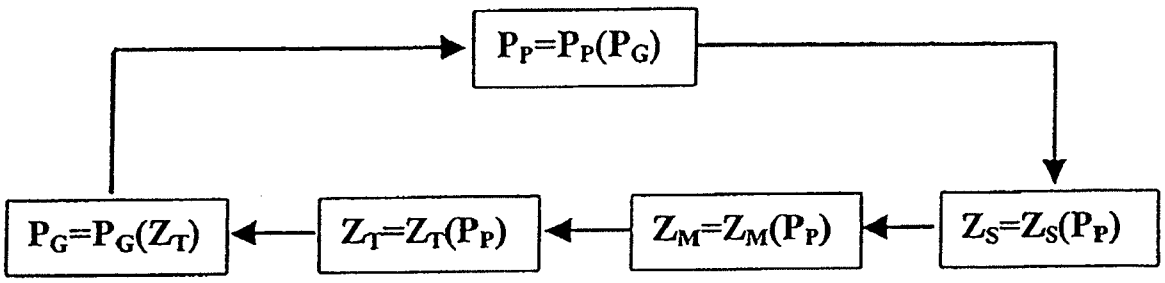


Fig. 5

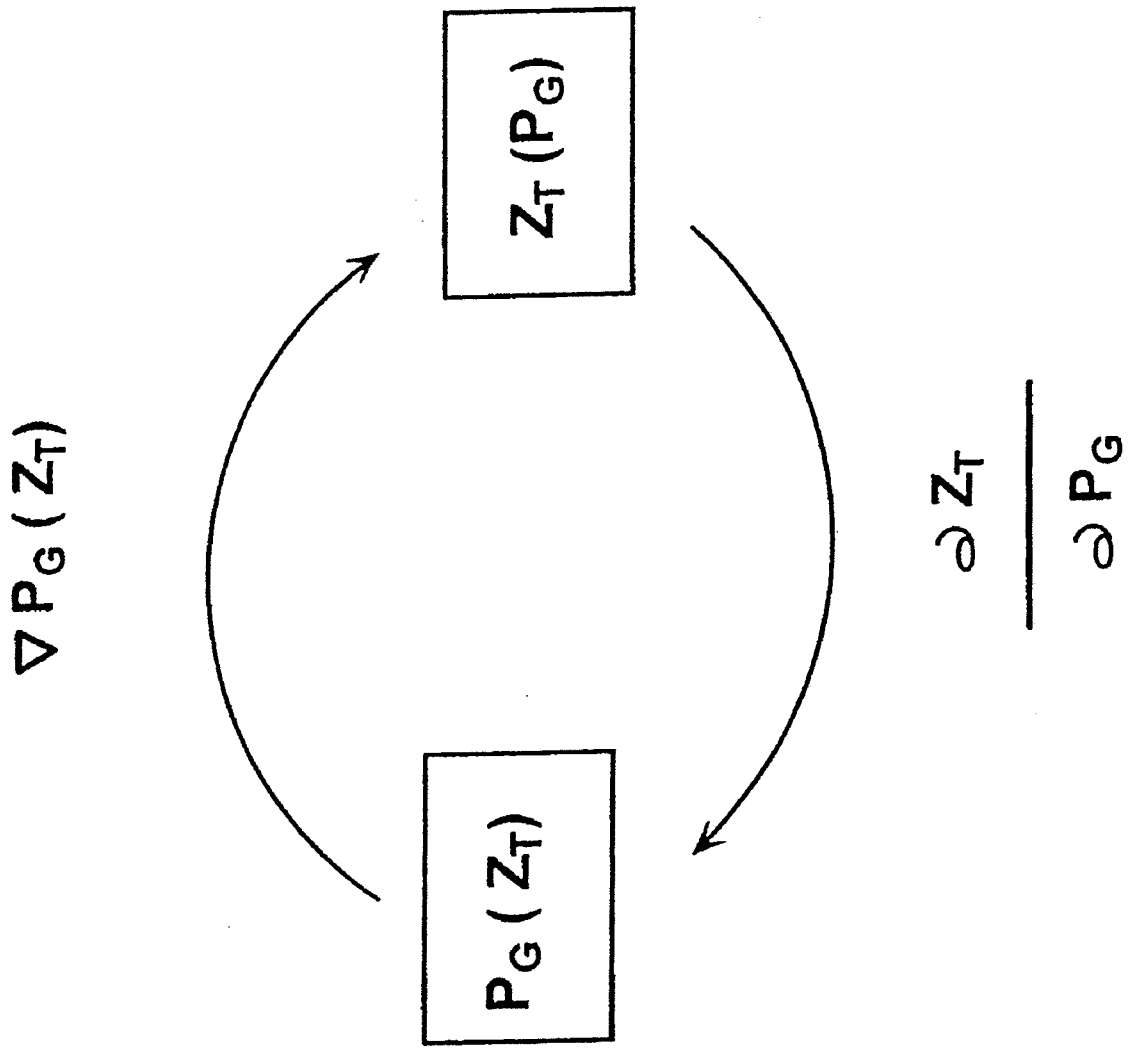


FIG. 6

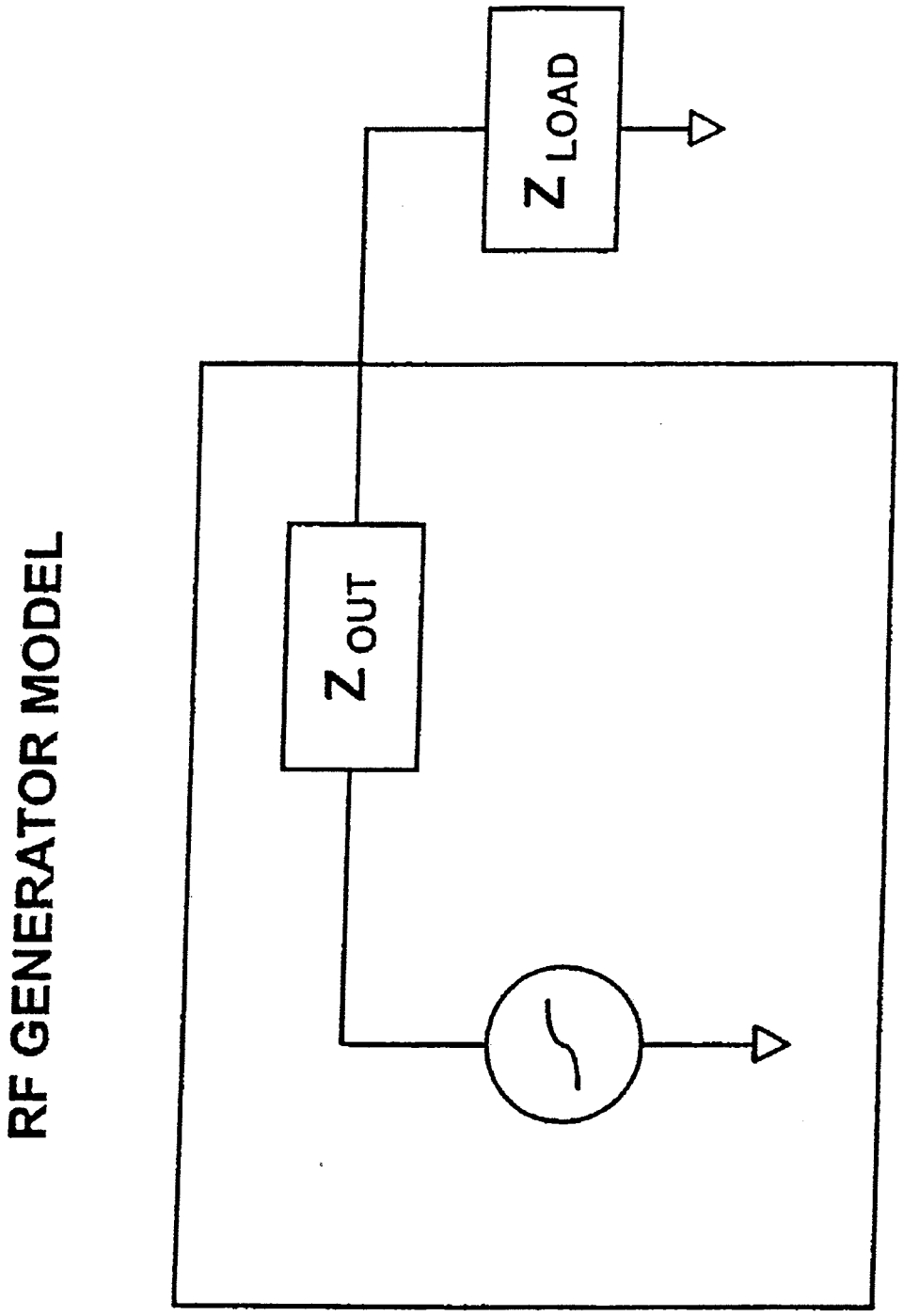


FIG. 7A

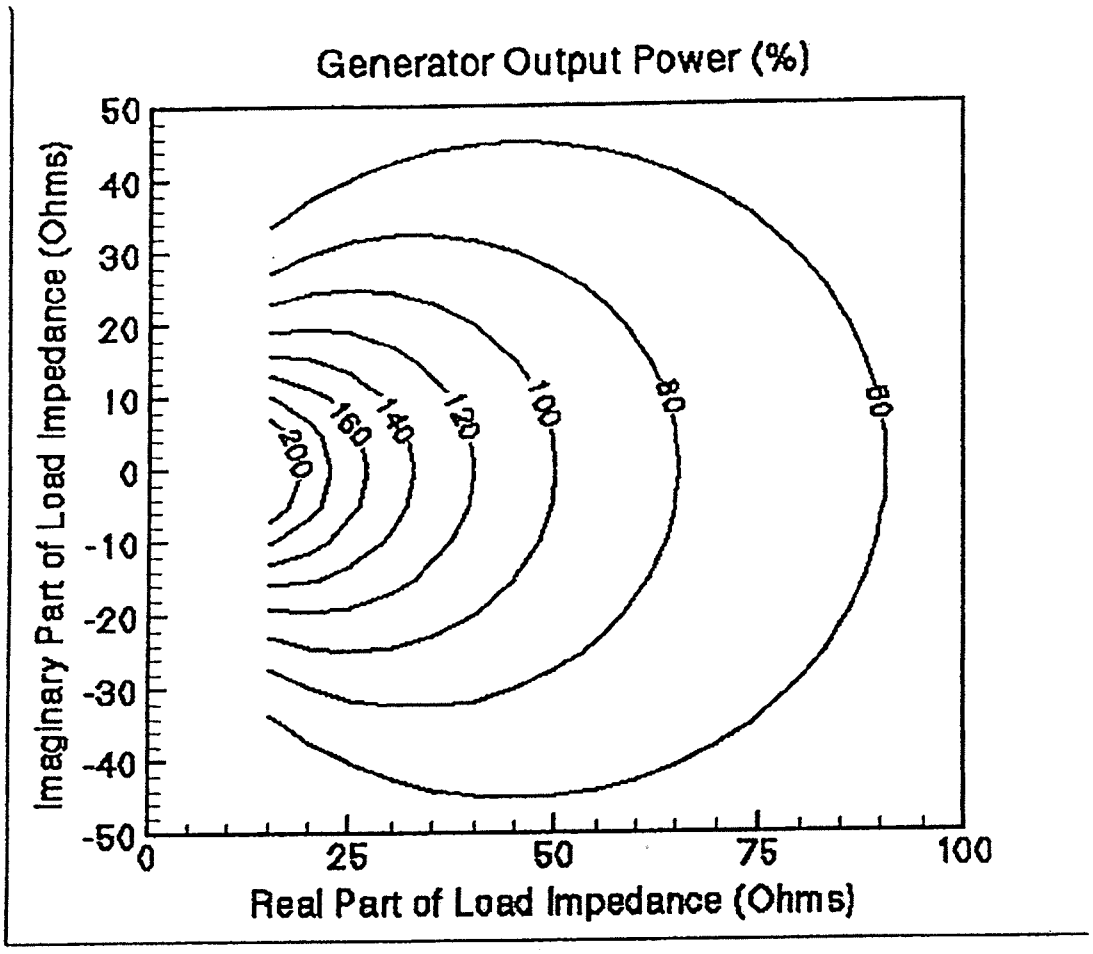

Generator Output Power (%)
Imaginary Part of Load Impedance (Ohms)
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
25
50
75
100
Real Part of Load Impedance (Ohms)
200
160
140
120
100
80
60

Fig. 7B

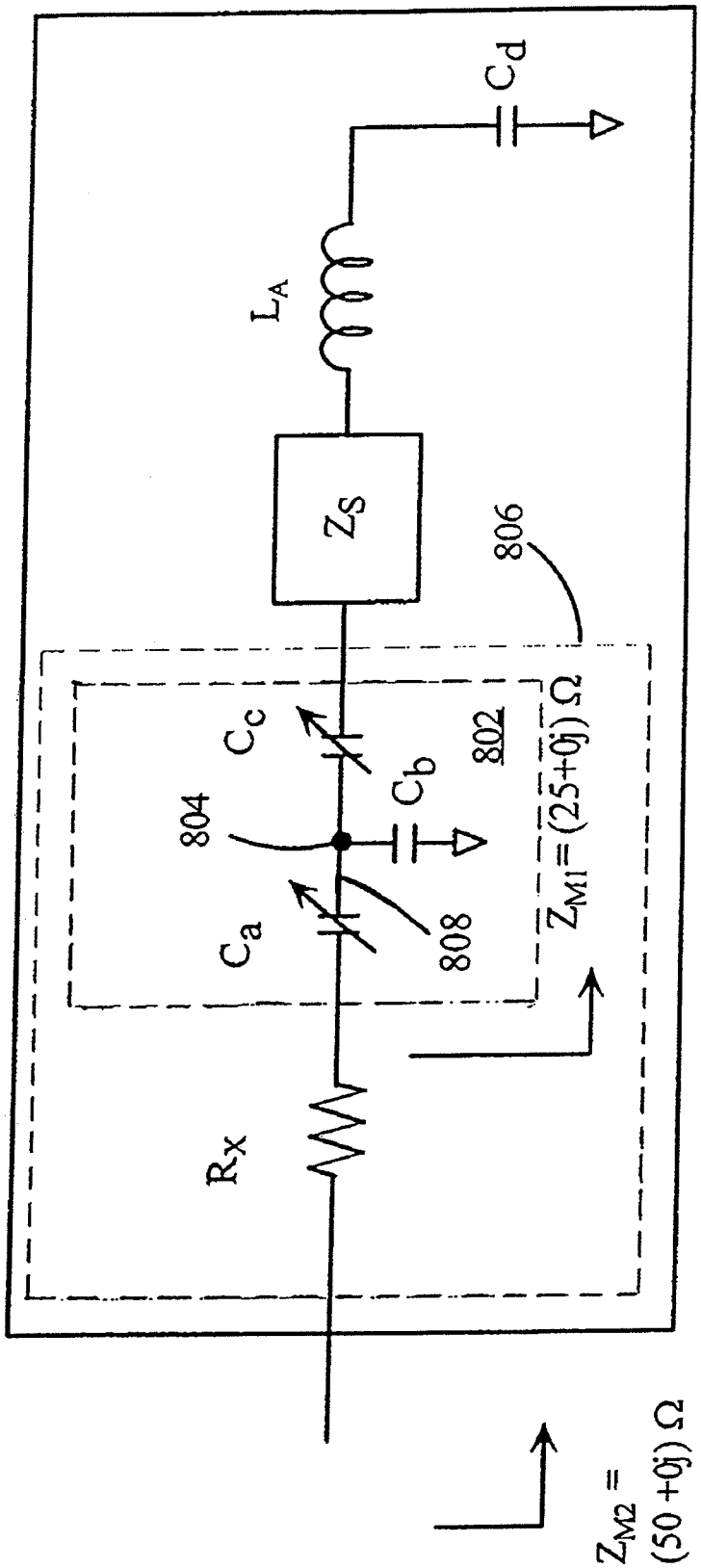

C_d
L_A
Z_S
806
C_c
C_b
802
804
C_a
808
$Z_{M1} = (25+0j)\ \Omega$
R_X
$Z_{M2} = (50+0j)\ \Omega$

Fig. 8A

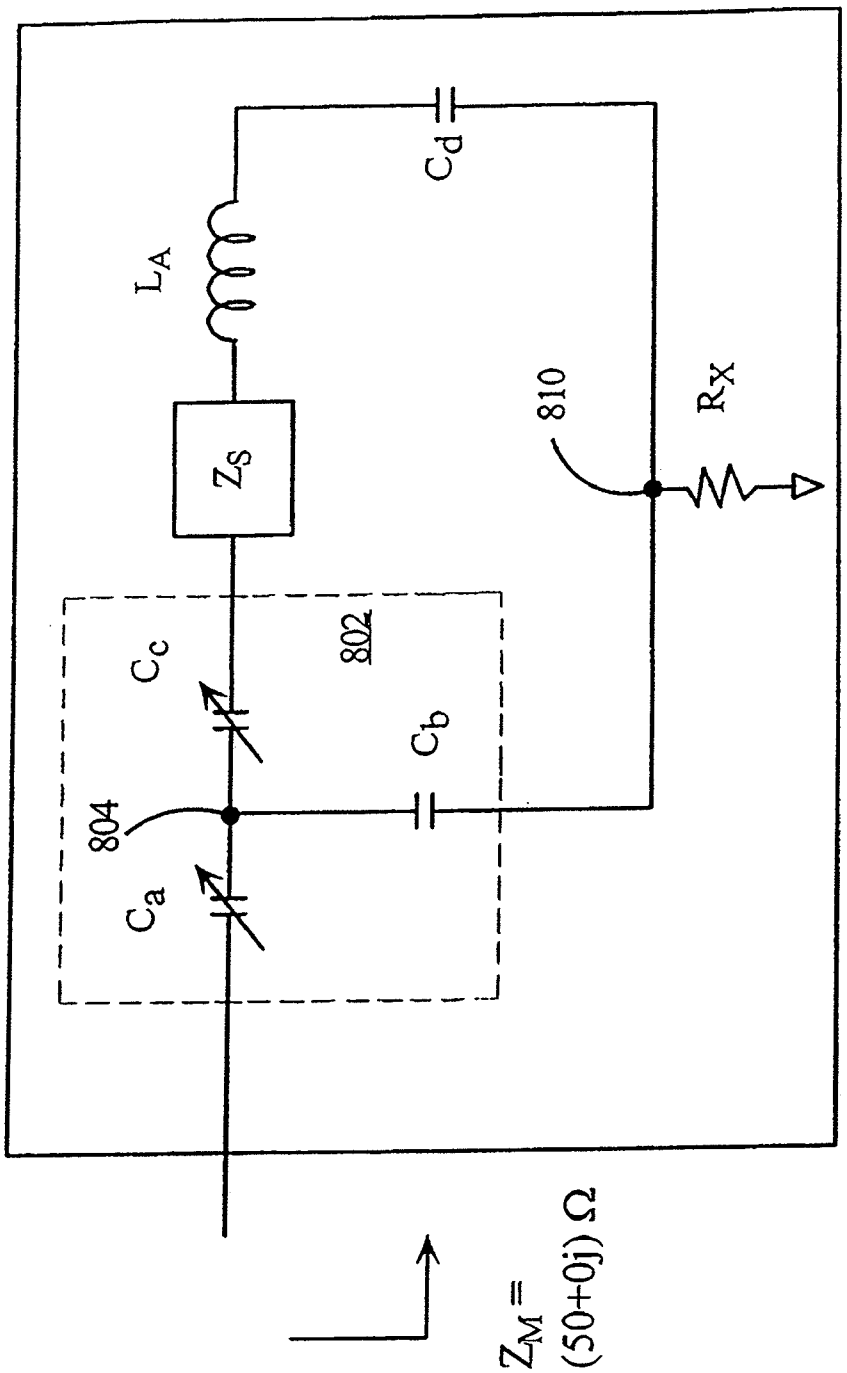


Fig. 8B

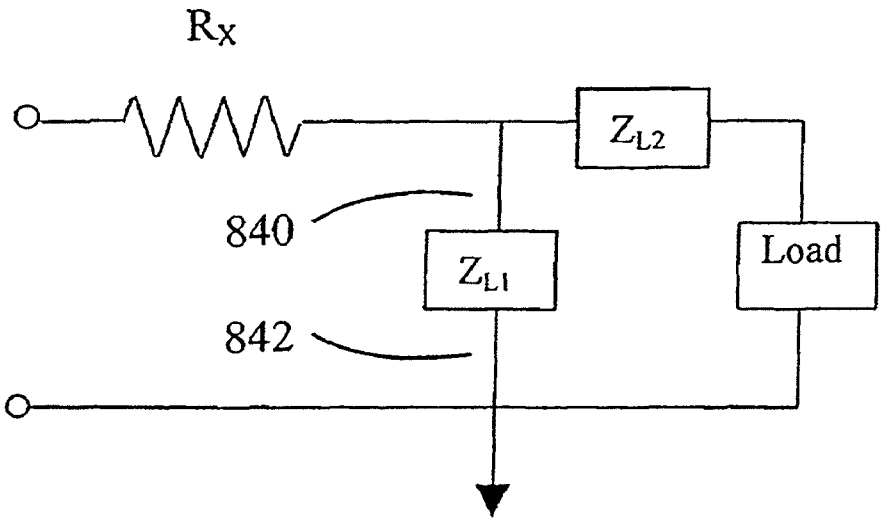


Fig. 8C

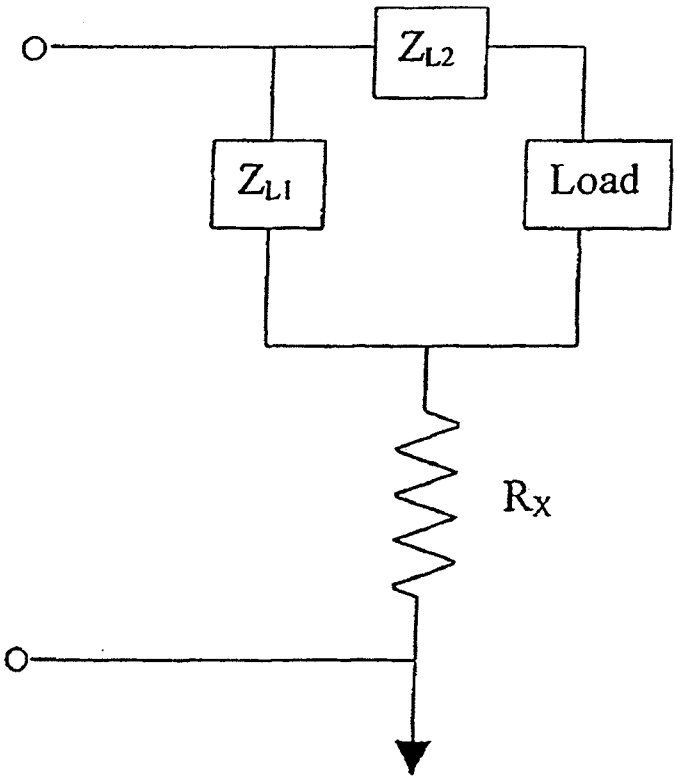


Fig. 8D

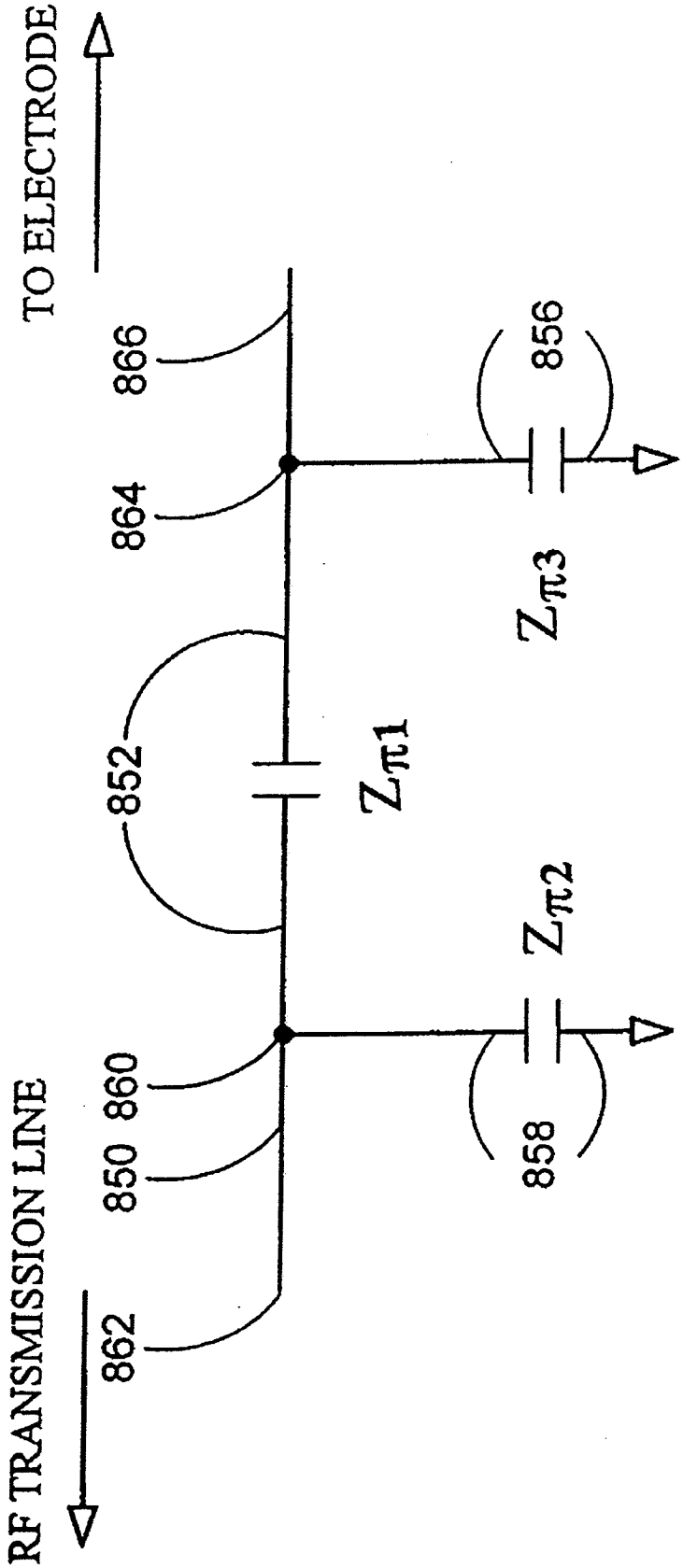

TO ELECTRODE
866
864
852
850
860
862
TO RF TRANSMISSION LINE
$Z_{\pi 1}$
$Z_{\pi 2}$
$Z_{\pi 3}$
856
858

FIG. 8E

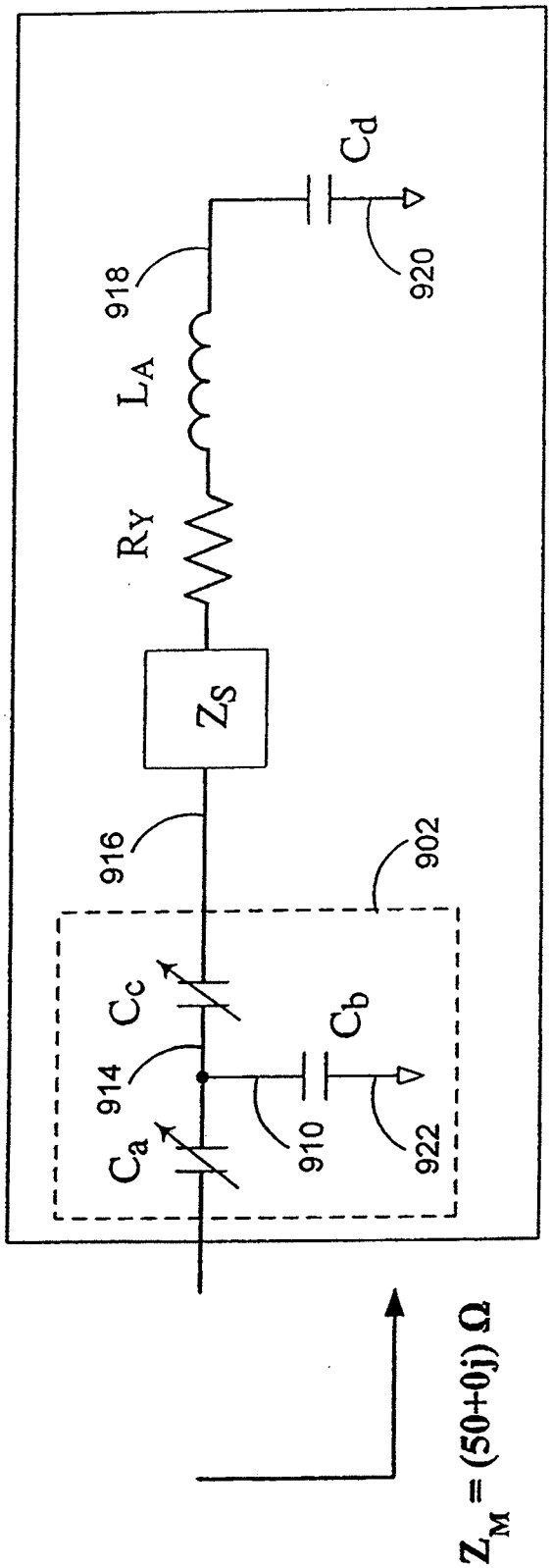


FIG. 9

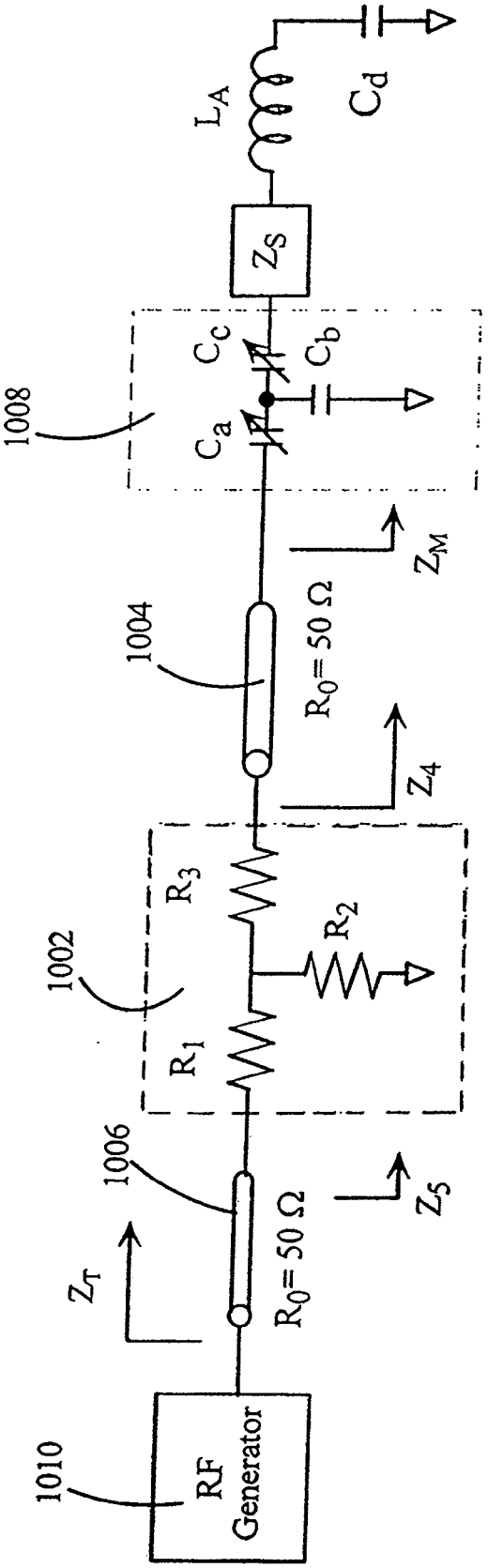


Fig. 10A

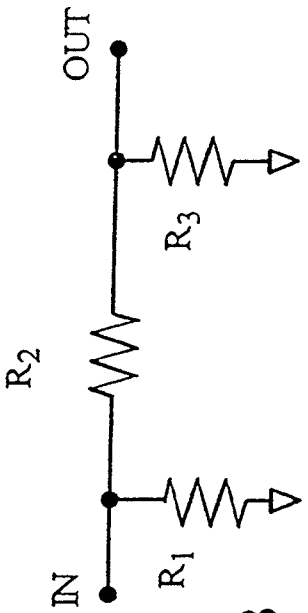


Fig. 10B

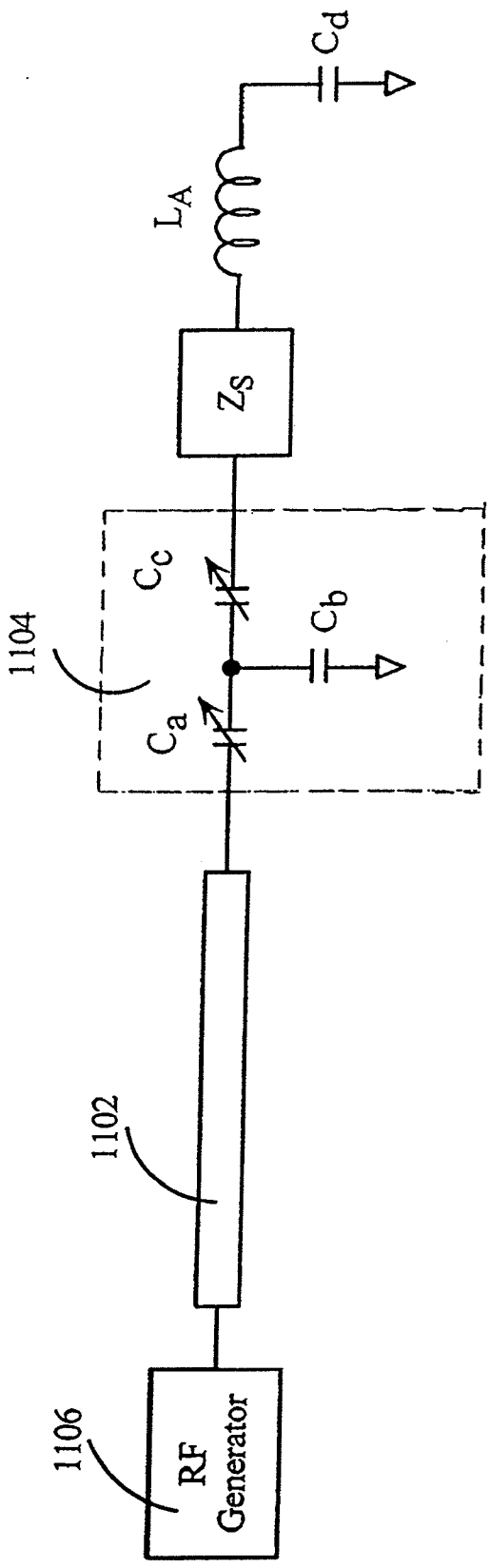


Fig. 11

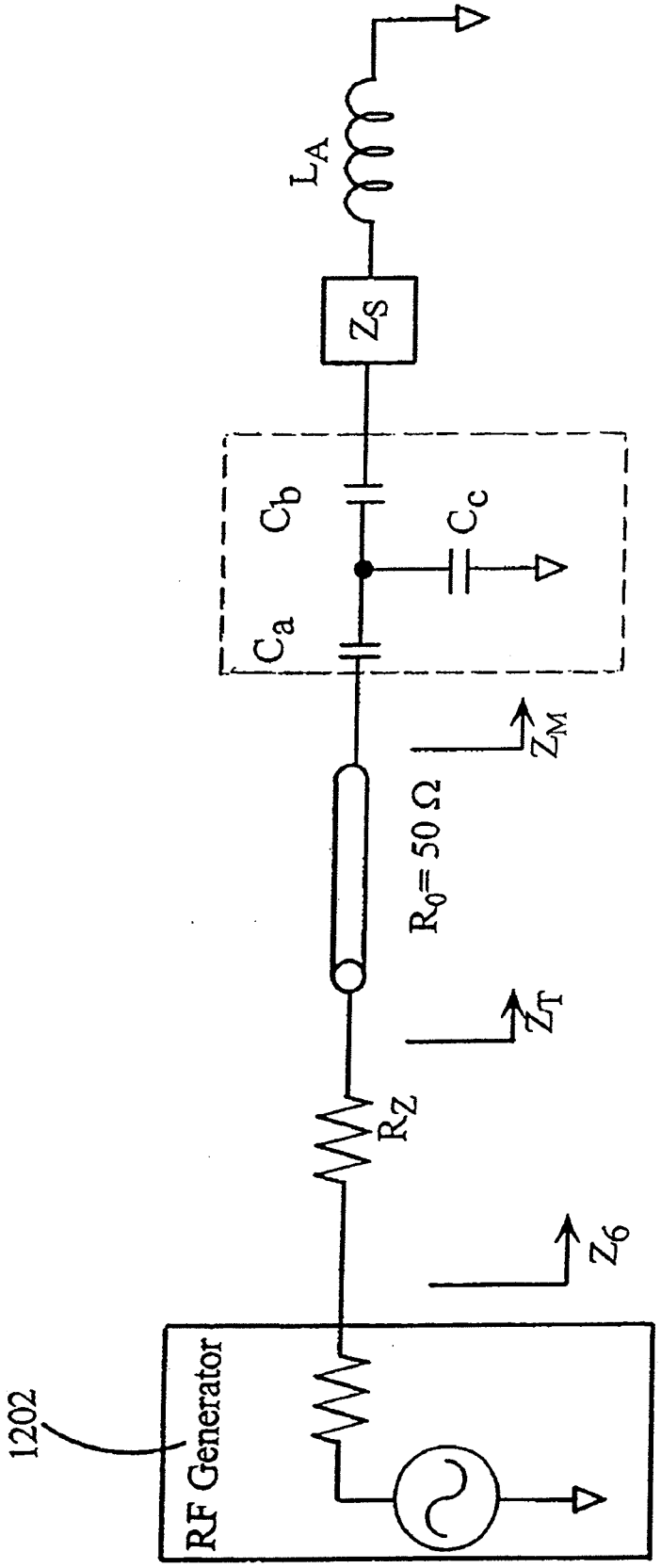
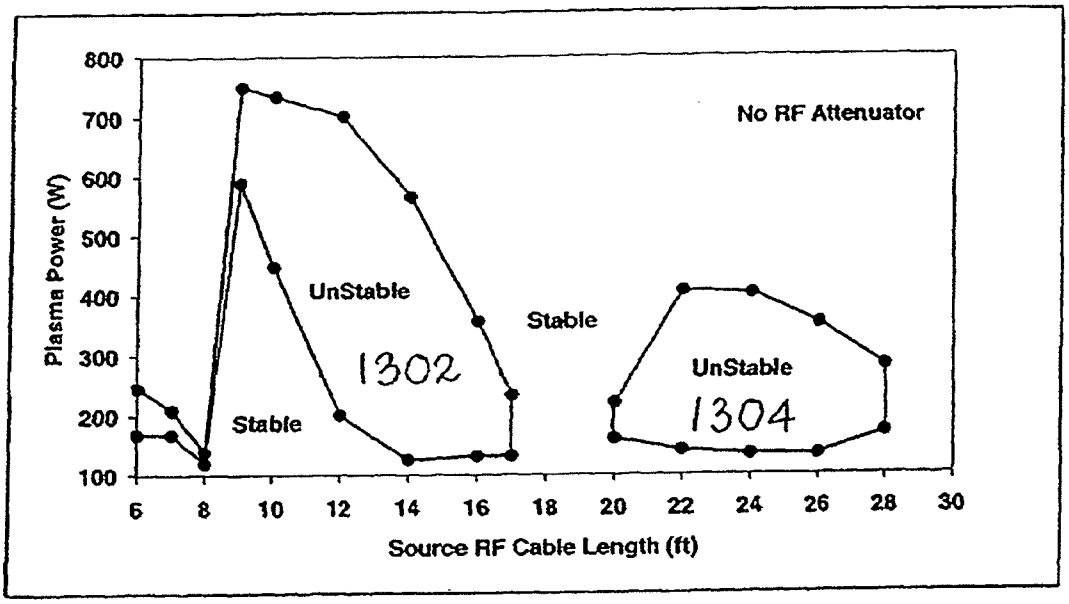


Fig. 12

Fig. 13A



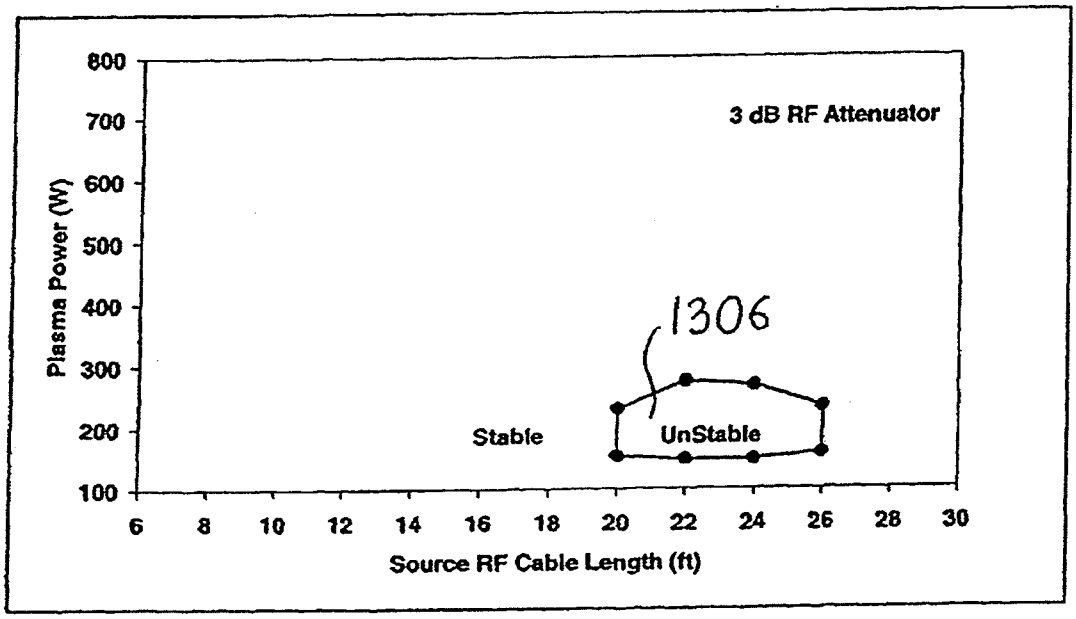


Fig. 13B

Fig 14

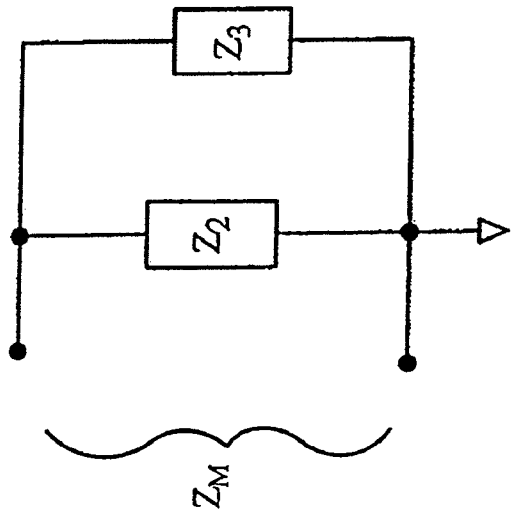
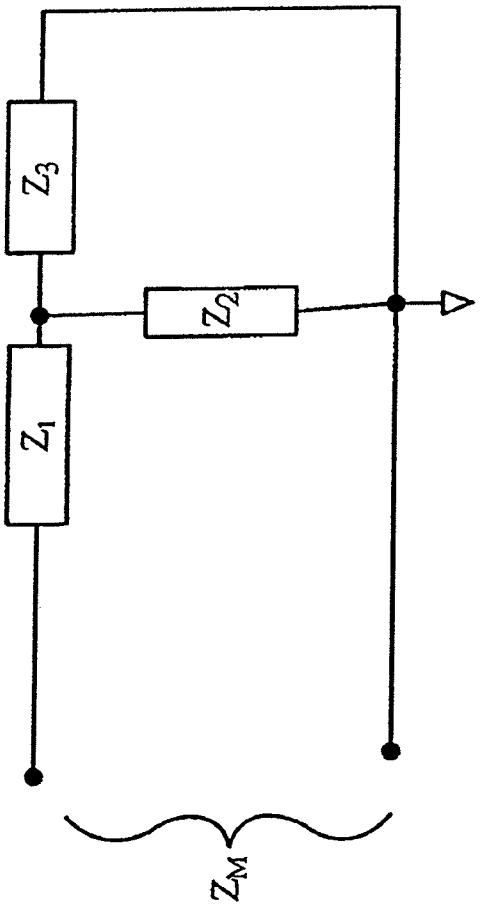


Fig 15



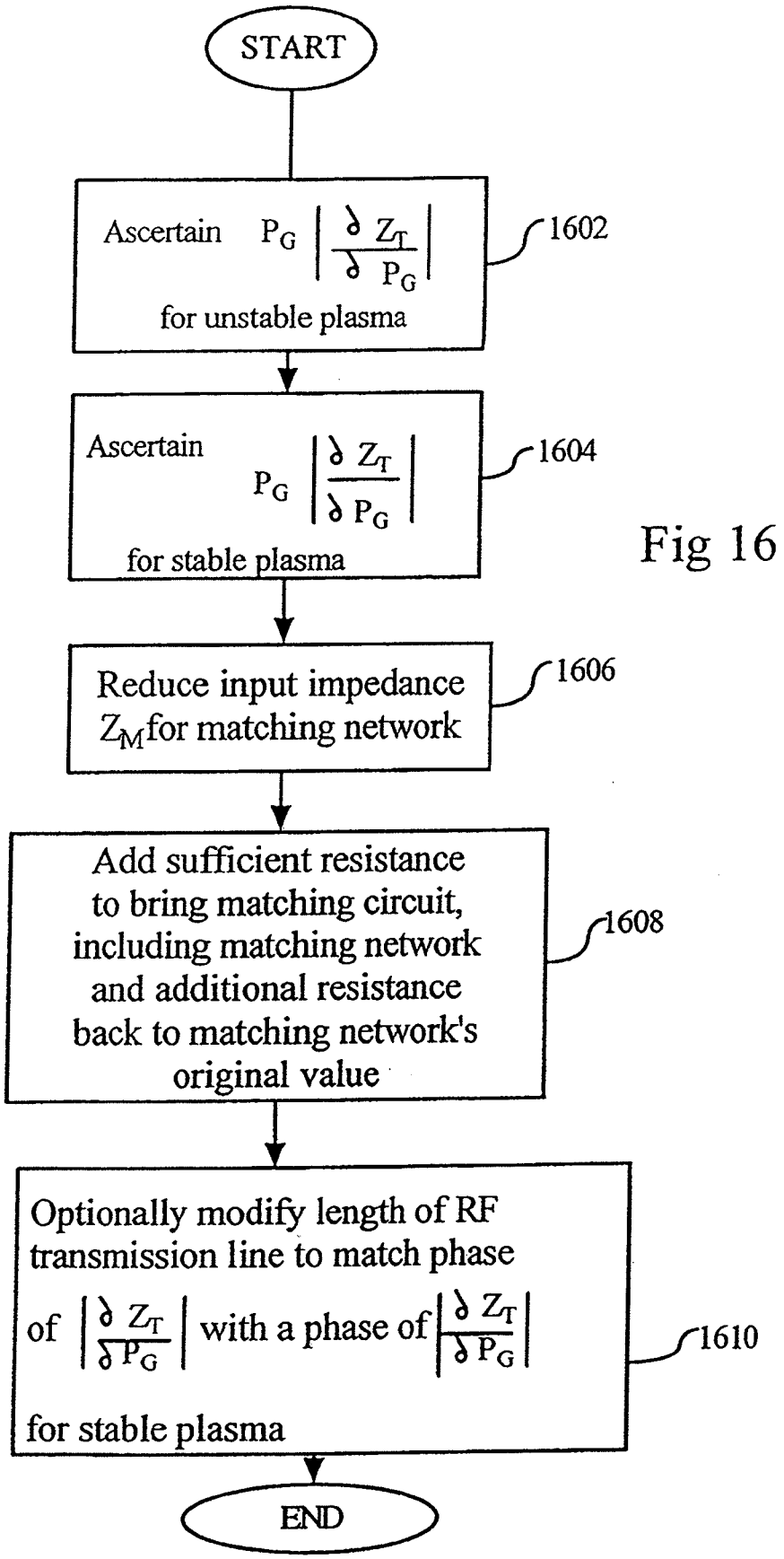

START
Ascertain $P_G \left| \frac{\partial Z_T}{\partial P_G} \right|$ for unstable plasma
1602
Ascertain $P_G \left| \frac{\partial Z_T}{\partial P_G} \right|$ for stable plasma
1604
Reduce input impedance Z_M for matching network
1606
Add sufficient resistance to bring matching circuit, including matching network and additional resistance back to matching network's original value
1608
Optionally modify length of RF transmission line to match phase of $\left| \frac{\partial Z_T}{\partial P_G} \right|$ with a phase of $\left| \frac{\partial Z_T}{\partial P_G} \right|$ for stable plasma
1610
END

Fig 16

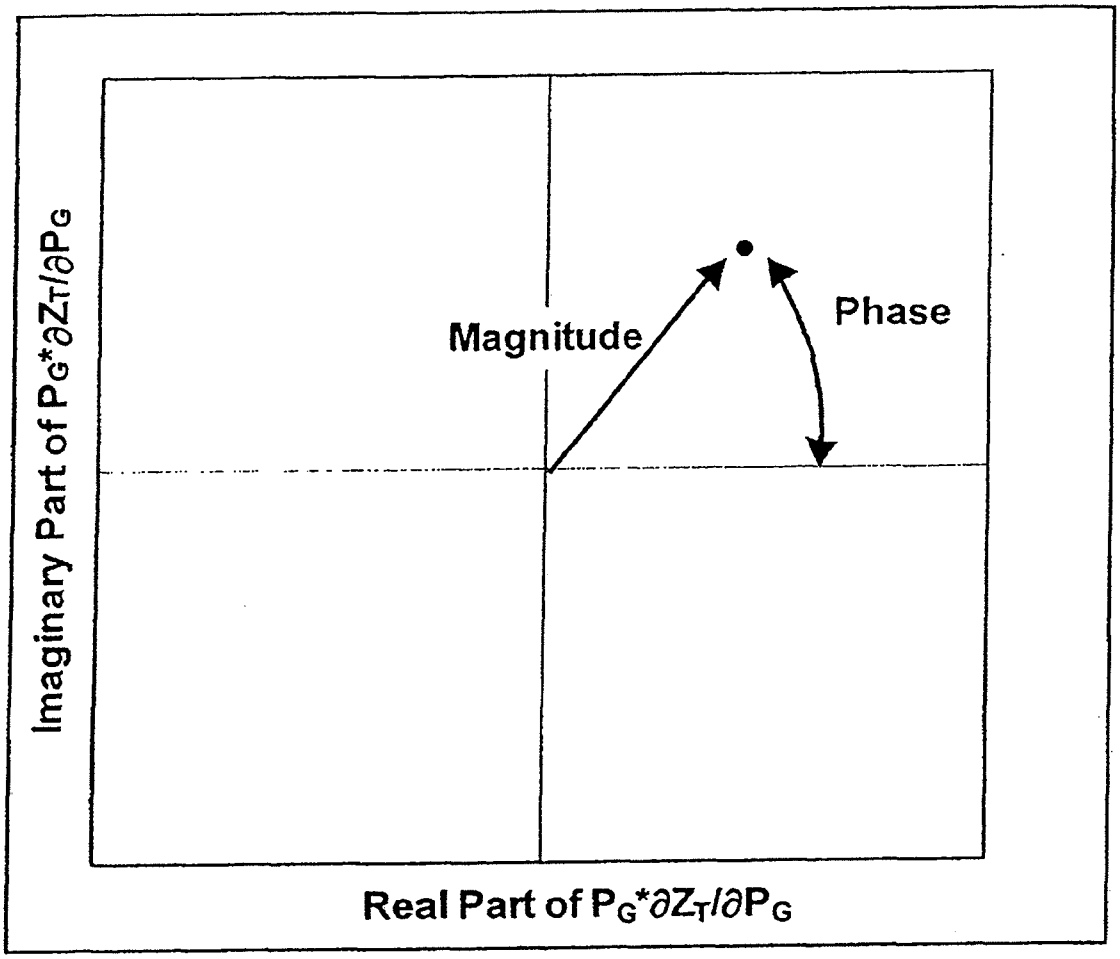

Imaginary Part of $P_G*\partial Z_T/\partial P_G$
Magnitude
Phase
Real Part of $P_G*\partial Z_T/\partial P_G$

Fig. 17A

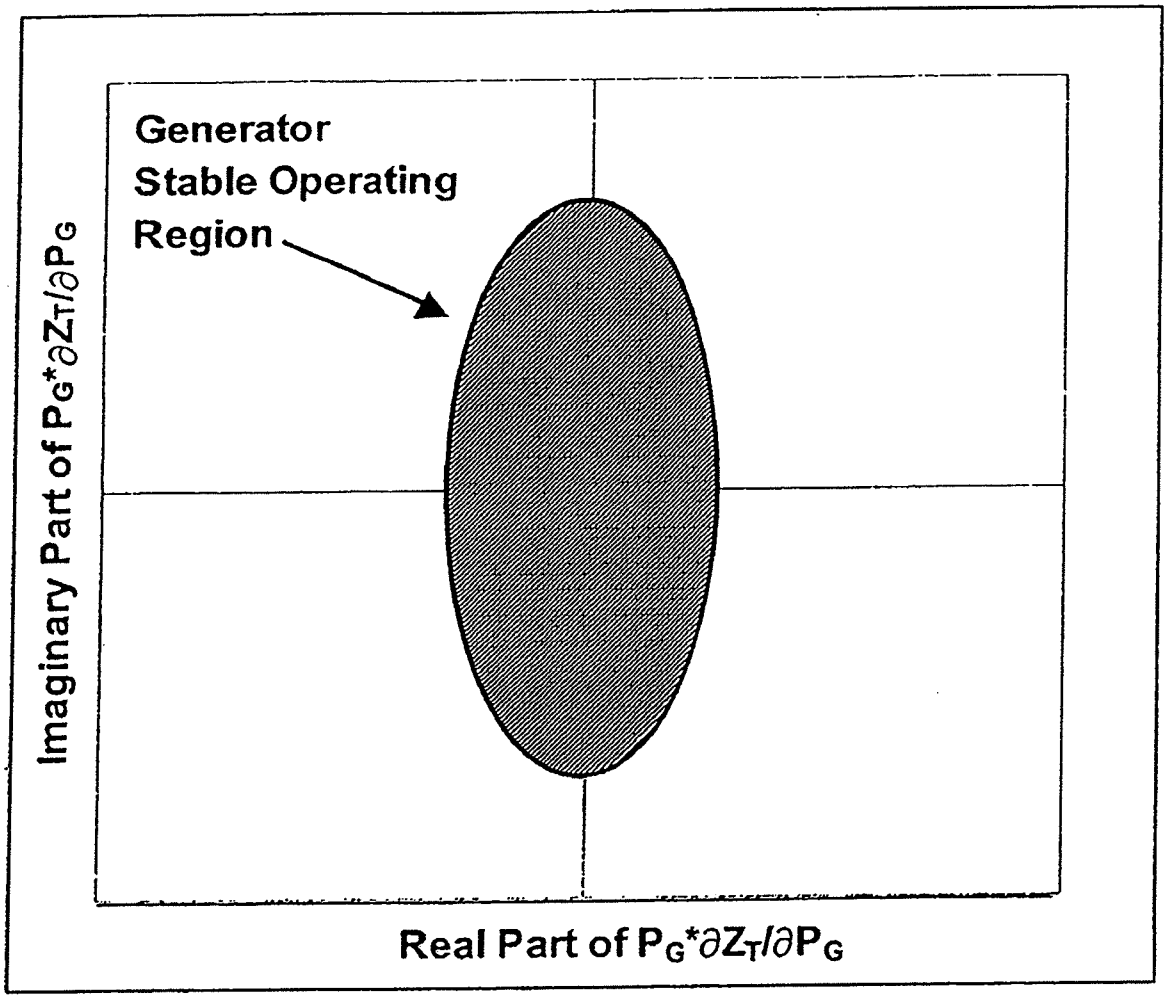

Generator
Stable Operating
Region
Imaginary Part of $P_G^*\partial Z_T/\partial P_G$
Real Part of $P_G^*\partial Z_T/\partial P_G$

Fig. 17B

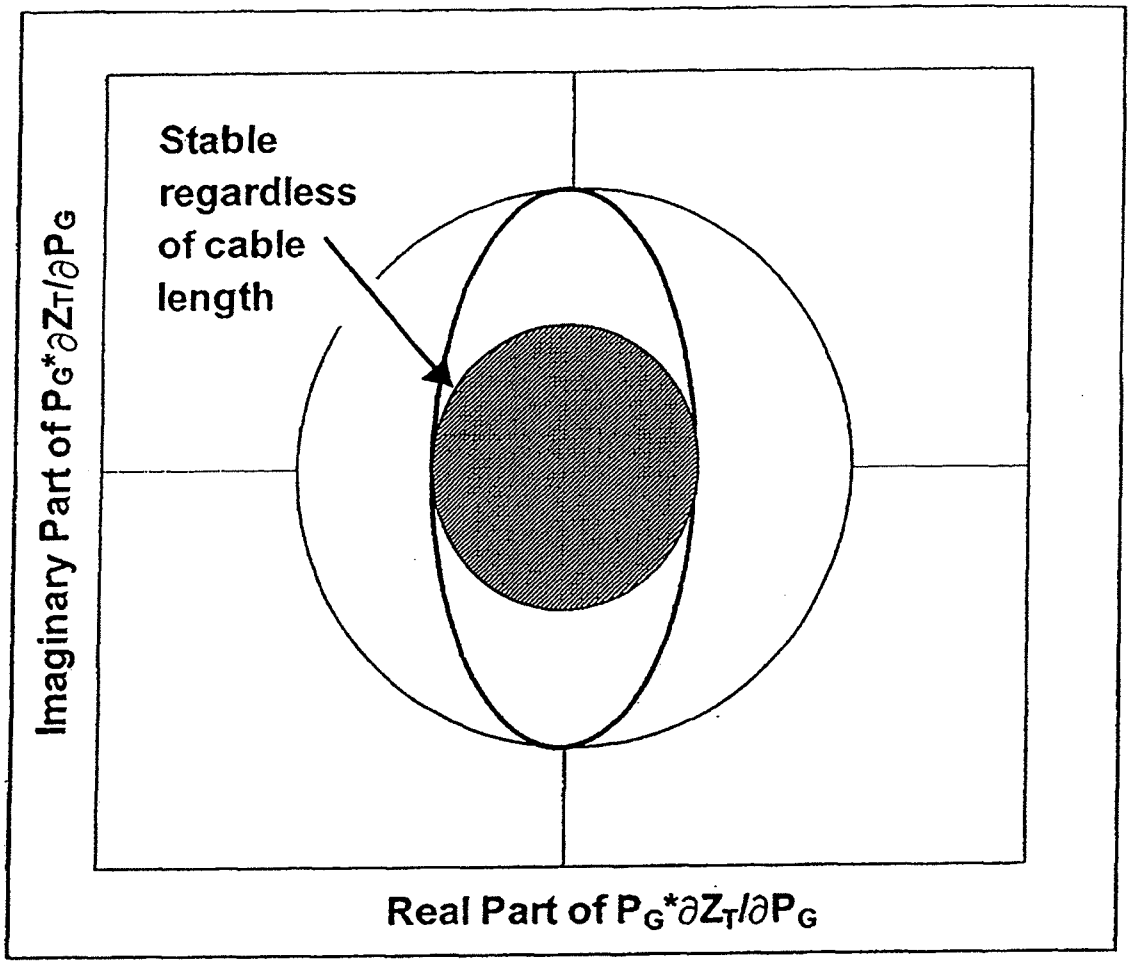

Stable
regardless
of cable
length
Imaginary Part of $P_G^* \partial Z_T / \partial P_G$
Real Part of $P_G^* \partial Z_T / \partial P_G$

Fig. 17C

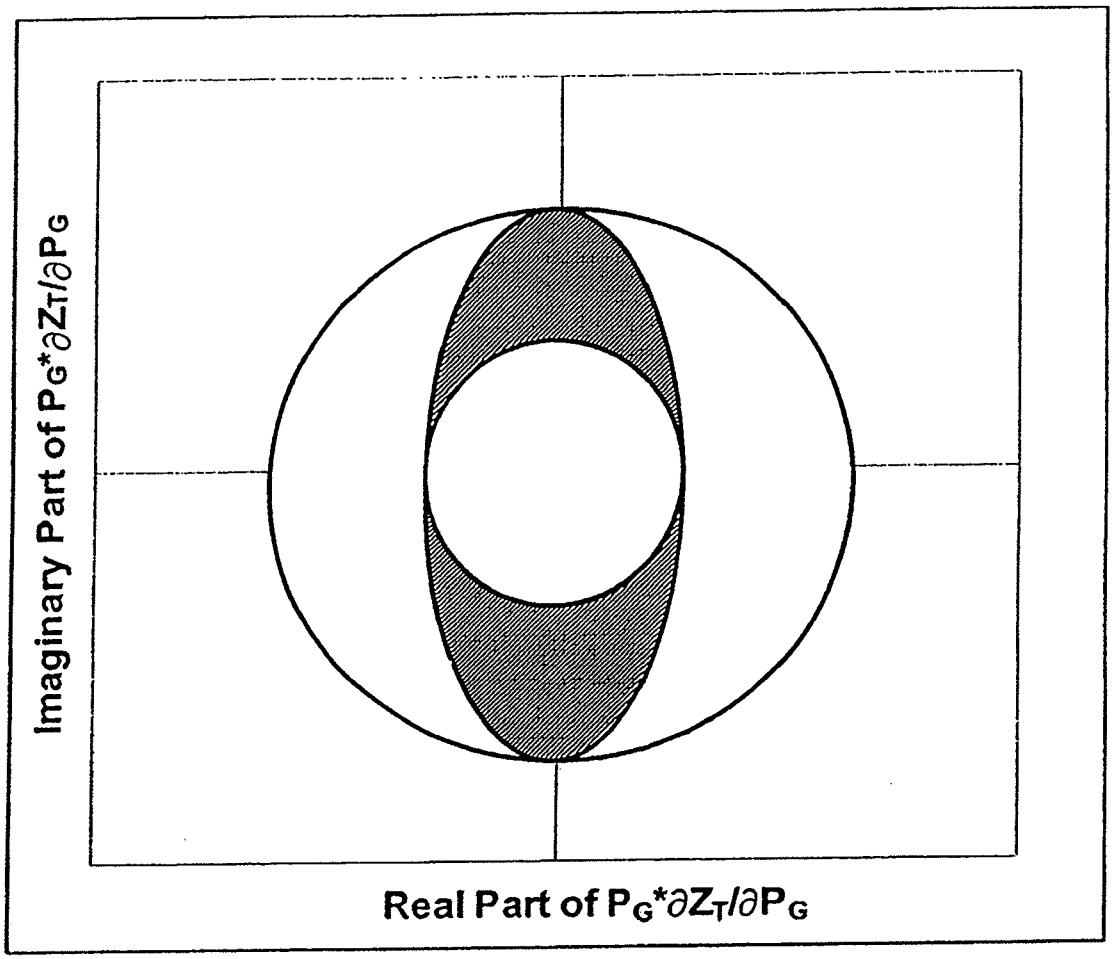

Imaginary Part of $P_G^* \partial Z_T / \partial P_G$
Real Part of $P_G^* \partial Z_T / \partial P_G$

Fig. 17D

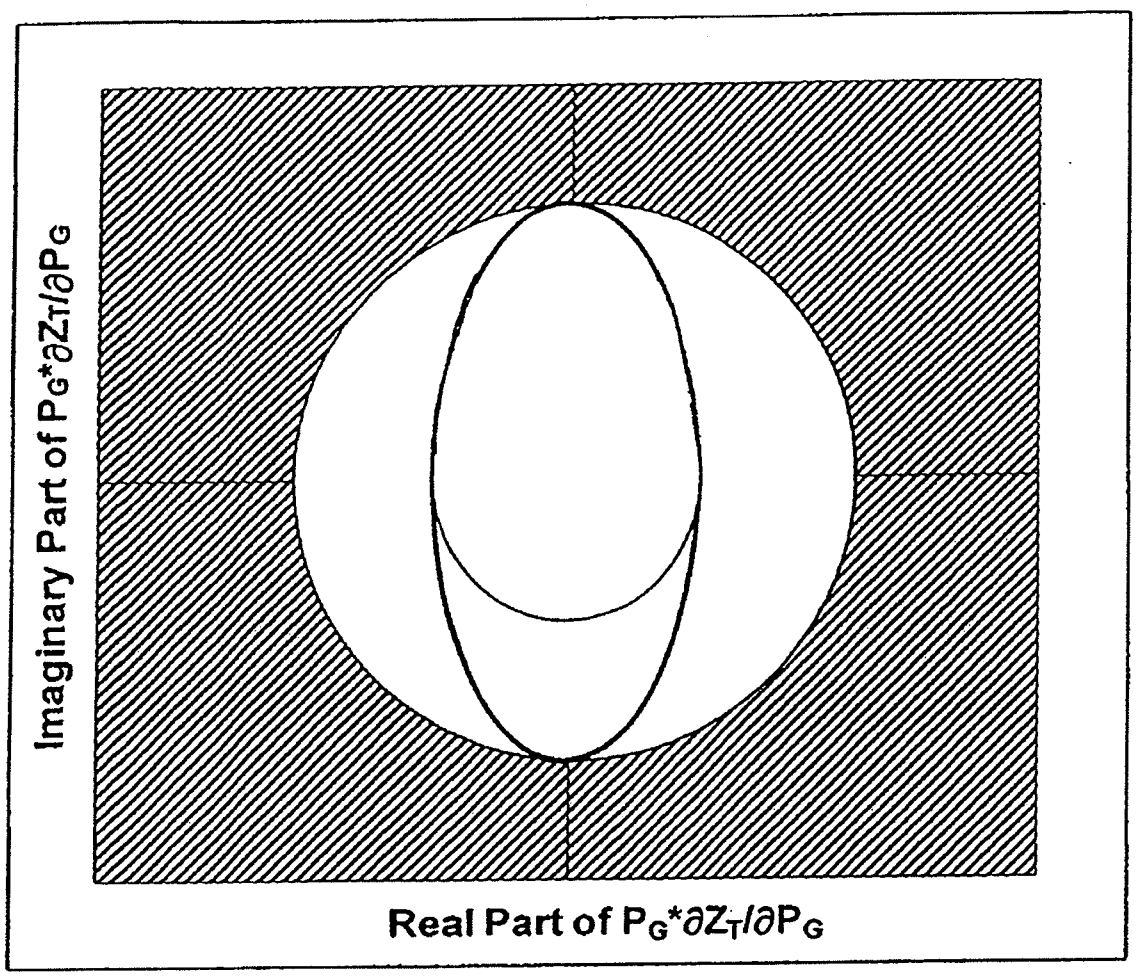

Imaginary Part of $P_G * \partial Z_T / \partial P_G$
Real Part of $P_G * \partial Z_T / \partial P_G$

Fig. 17E