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United States Patent [19]

Hanawa

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[54] **AUTOMATIC FREQUENCY TUNING OF AN RF POWER SOURCE OF AN INDUCTIVELY COUPLED PLASMA REACTOR**

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[51] Int. Cl.⁶ **C23F 1/02**

[52] U.S. Cl. **156/345; 156/643.1**

[58] Field of Search 118/723 I, 723 IR,
118/723 E, 723 ER, 723 MP, 671; 156/345,
643.1, 626.1, 627.1; 216/68; 204/298.08,
298.32, 298.03

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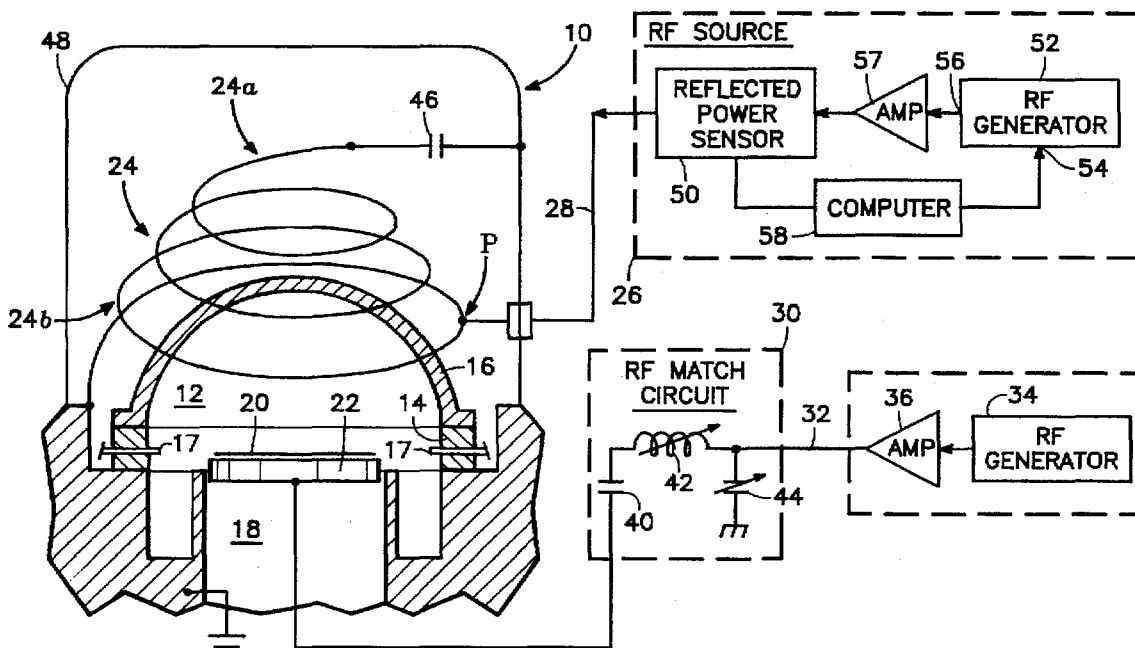
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Primary Examiner—John Niebling
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Attorney, Agent, or Firm—Michaelson & Wallace

[57] ABSTRACT

A plasma reactor has a reactor chamber for containing a semiconductor wafer to be processed and gas inlet apparatus for introducing an ionizable gas into the chamber, a variable frequency RF power source, an RF antenna near the chamber, the antenna connected to the RF power source for coupling RF power to the ionizable gas to produce a plasma therefrom, a power sensor connected to the antenna for sensing either (or both) transmitted power to the plasma or reflected power to said source, and a control circuit connected to a control input of the variable frequency RF power source and responsive to the power sensor for changing the frequency of the variable frequency RF power source so as to either increase the transmitted power or decrease the reflected power, so as to provide an accurate RF match instantly responsive to changes in plasma impedance.

30 Claims, 13 Drawing Sheets



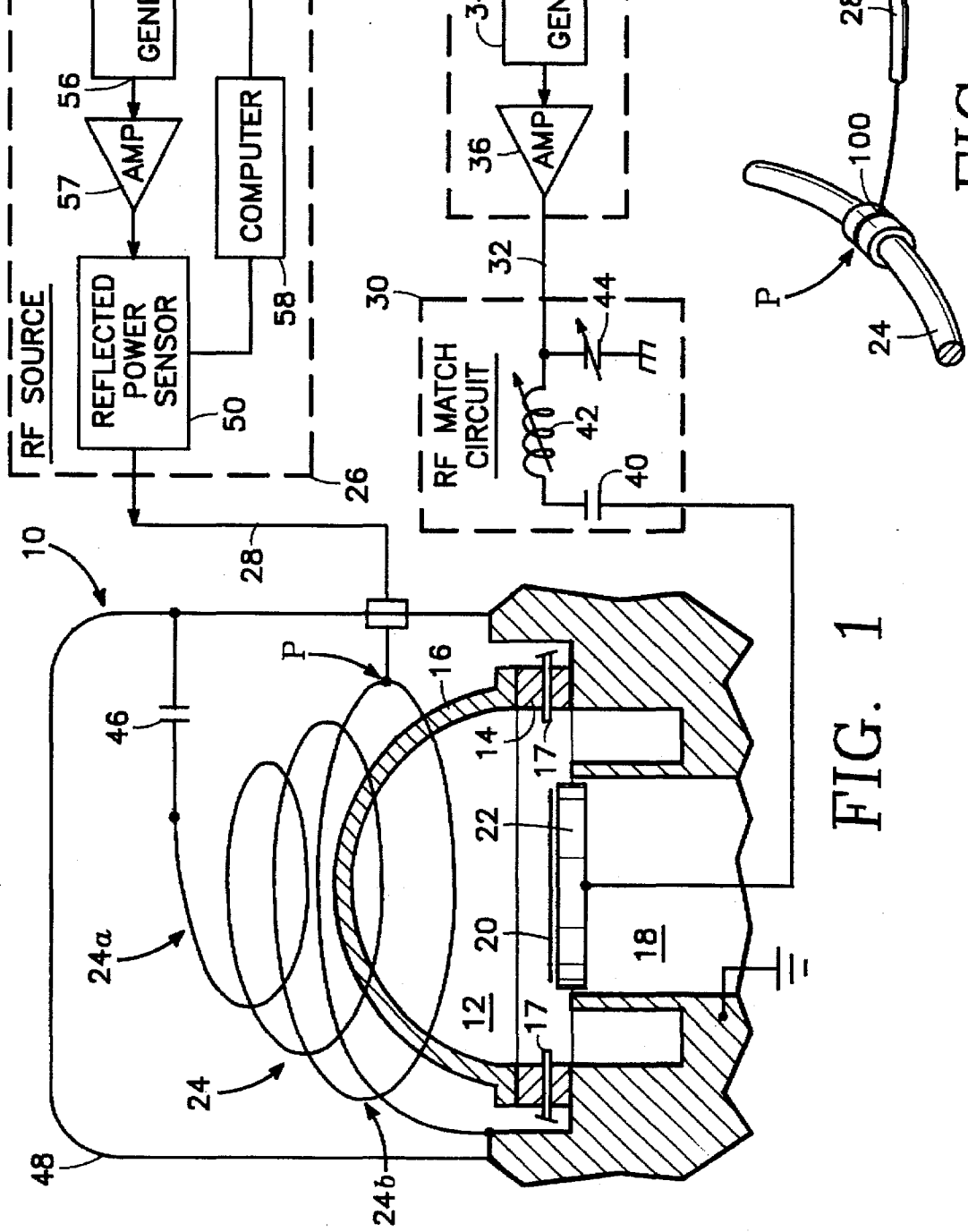


FIG. 1

FIG. 2

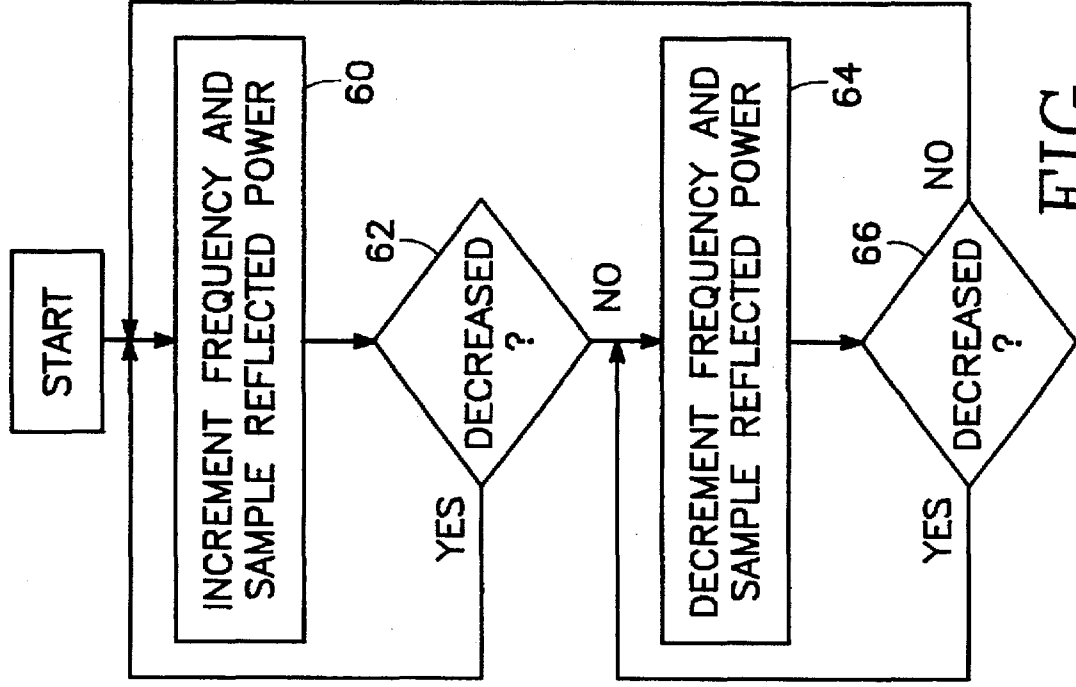


FIG. 2

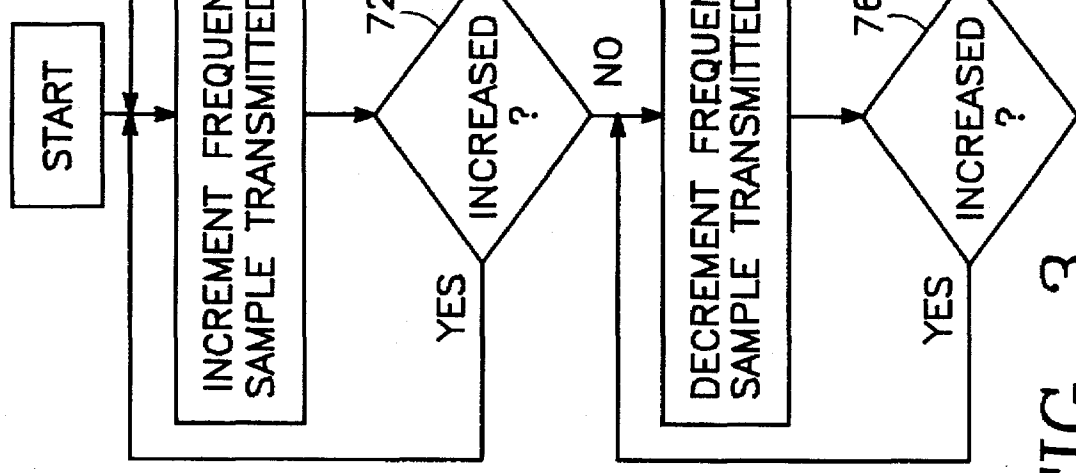


FIG. 3

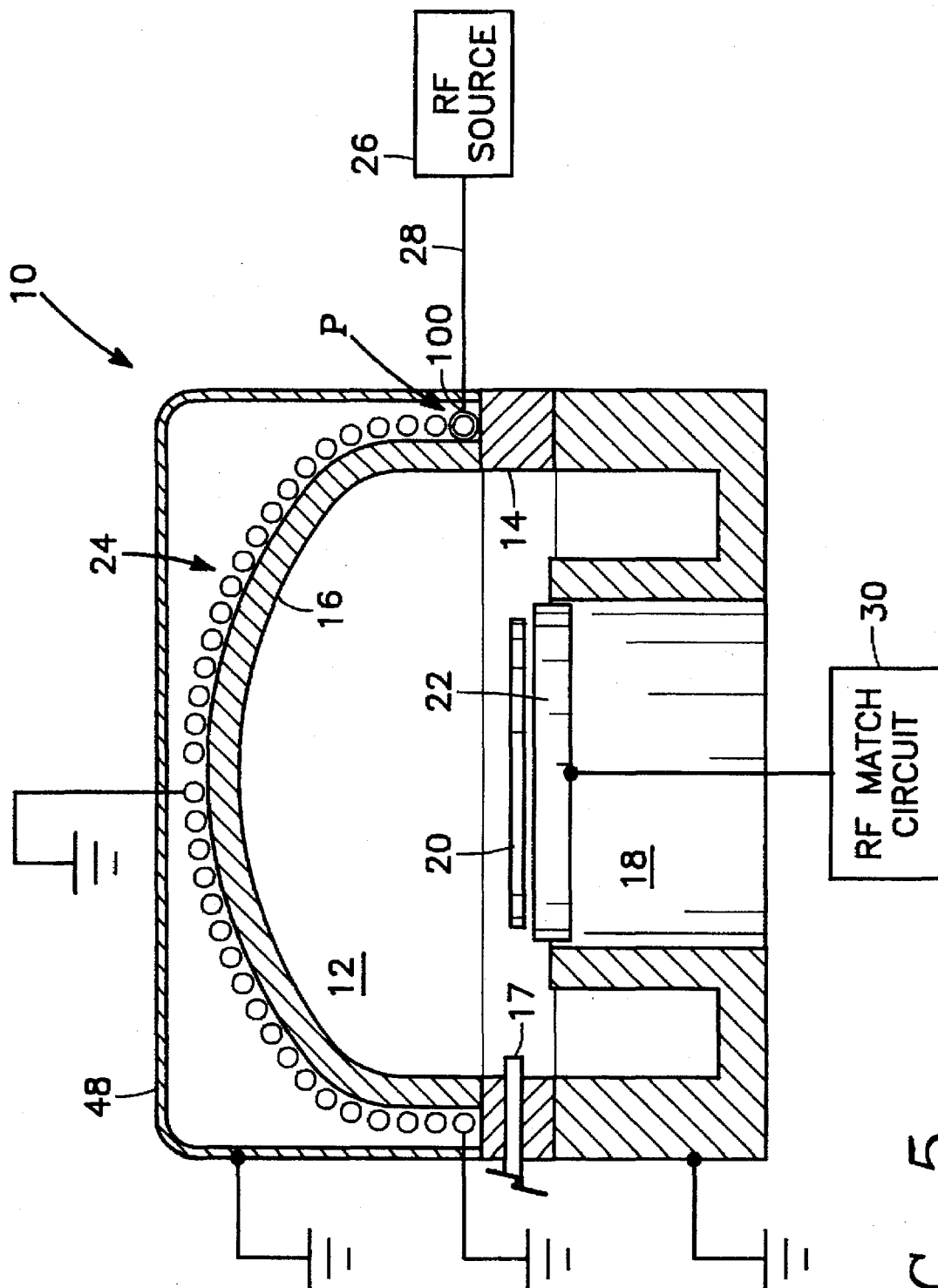


FIG. 5

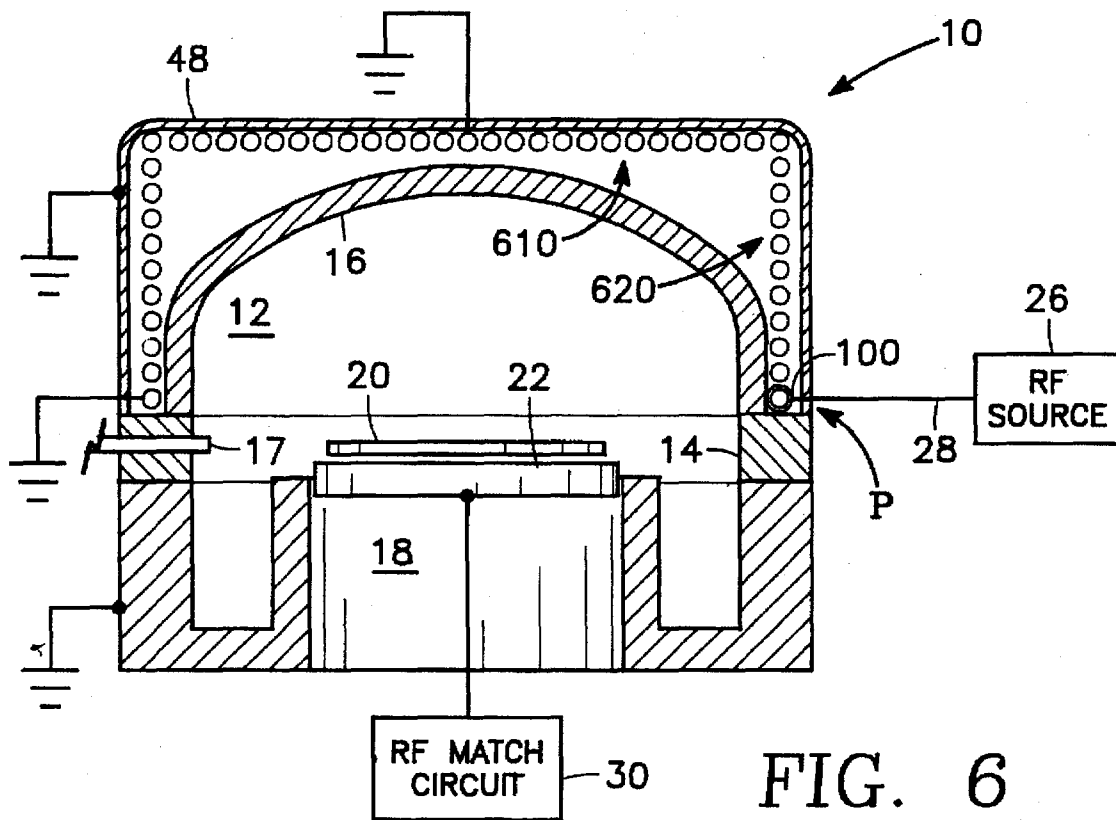


FIG. 6

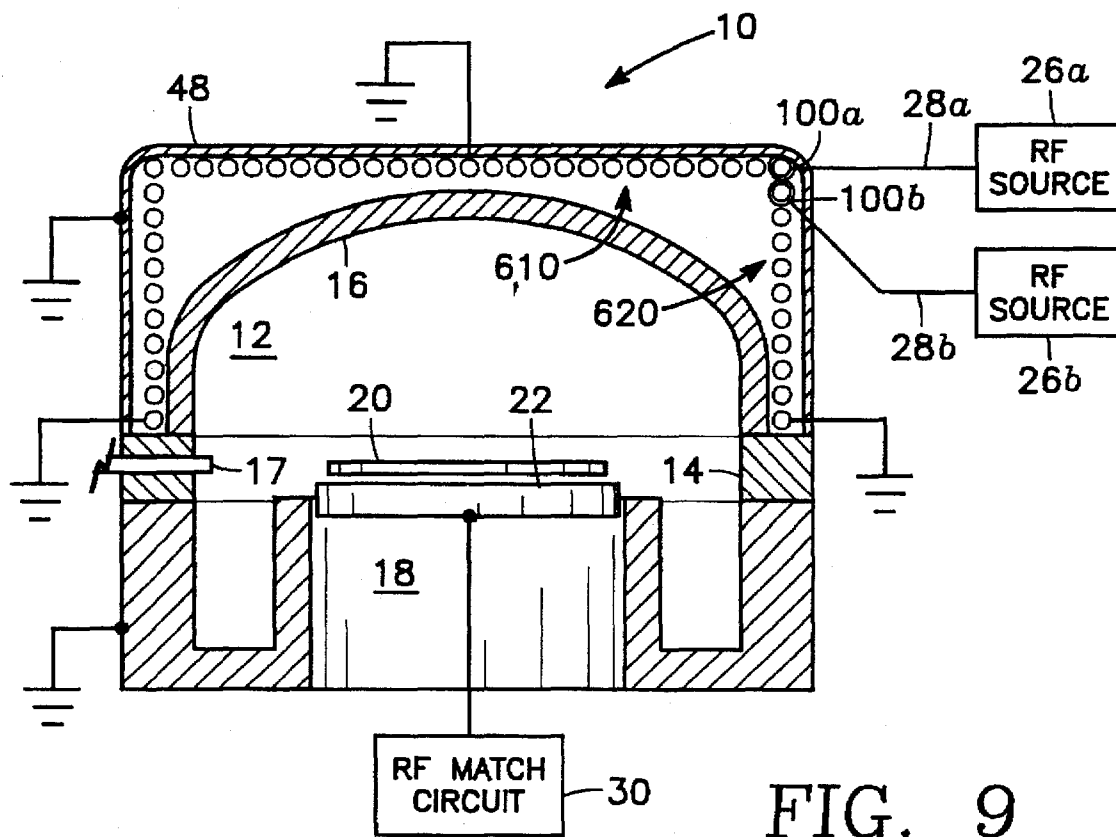


FIG. 9

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