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**Bhutta et al.**

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(54) **RF IMPEDANCE MATCHING CIRCUIT AND SYSTEMS AND METHODS INCORPORATING SAME**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.  
  
This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

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**Related U.S. Application Data**

(63) Continuation of application No. 16/111,776, filed on Aug. 24, 2018, now Pat. No. 10,460,912, which is a (Continued)

(57) **ABSTRACT**

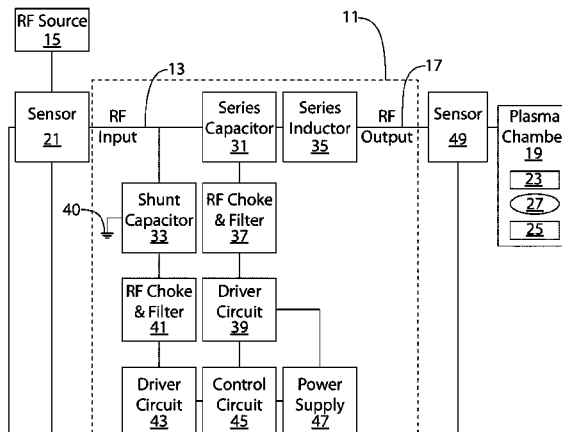
In one embodiment, an RF impedance matching circuit is disclosed. The matching circuit is coupled between a plasma chamber and an RF source providing an RF signal having a frequency. The matching circuit includes a first electronically variable capacitor having a first variable capacitance and a second electronically variable capacitor having a second variable capacitance. A control circuit determines a first parameter related to the plasma chamber, and then determines, based on the first parameter, a first capacitance value for the first electronically variable capacitor and a second capacitance value for the second electronically variable capacitor. The control circuit then generates a control signal to alter the first variable capacitance and the second variable capacitance accordingly, causing the RF power reflected back to the RF source to decrease while the frequency of the RF source is not altered.

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(58) **Field of Classification Search**  
CPC ..... H01J 37/32183; H01J 37/32935; H01J 2237/334; H01J 2237/327;  
(Continued)

**17 Claims, 31 Drawing Sheets**



**Related U.S. Application Data**

continuation of application No. 15/637,271, filed on Jun. 29, 2017, now Pat. No. 10,431,428, which is a continuation-in-part of application No. 15/467,667, filed on Mar. 23, 2017, now Pat. No. 10,455,729, which is a continuation-in-part of application No. 14/982,244, filed on Dec. 29, 2015, now Pat. No. 10,454,453, which is a continuation-in-part of application No. 14/935,859, filed on Nov. 9, 2015, now abandoned, which is a continuation-in-part of application No. 14/622,879, filed on Feb. 15, 2015, now abandoned, which is a continuation-in-part of application No. 14/616,884, filed on Feb. 9, 2015, now Pat. No. 9,865,432, which is a continuation-in-part of application No. 14/594,262, filed on Jan. 12, 2015, now Pat. No. 9,496,122, said application No. 15/637,271 is a continuation-in-part of application No. 15/223,984, filed on Jul. 29, 2016, now Pat. No. 9,728,378, which is a continuation-in-part of application No. 15/061,020, filed on Mar. 4, 2016, now Pat. No. 9,543,122, which is a continuation-in-part of application No. 14/700,209, filed on Apr. 30, 2015, now Pat. No. 9,345,122, said application No. 15/637,271 is a continuation-in-part of application No. 14/702,900, filed on May 4, 2015, now Pat. No. 9,745,660, and a continuation-in-part of application No. 14/788,888, filed on Jul. 1, 2015, now Pat. No. 9,697,991, which is a continuation-in-part of application No. 14/622,879, filed on Feb. 15, 2015, now abandoned, said application No. 15/637,271 is a continuation-in-part of application No. 14/936,978, filed on Nov. 10, 2015, now Pat. No. 9,844,127, which is a continuation-in-part of application No. 14/935,859, filed on Nov. 9, 2015, now abandoned, said application No. 15/637,271 is a continuation-in-part of application No. 15/450,495, filed on Mar. 6, 2017, which is a continuation-in-part of application No. 15/196,821, filed on Jun. 29, 2016.

- (60) Provisional application No. 61/925,974, filed on Jan. 10, 2014, provisional application No. 61/940,139, filed on Feb. 14, 2014, provisional application No. 61/940,165, filed on Feb. 14, 2014, provisional application No. 62/077,753, filed on Nov. 10, 2014, provisional application No. 62/097,498, filed on Dec. 29, 2014, provisional application No. 62/312,070, filed on Mar. 23, 2016, provisional application No. 61/987,718, filed on May 2, 2014, provisional application No. 61/987,725, filed on May 2, 2014, provisional application No. 62/019,591, filed on Jul. 1, 2014, provisional application No. 62/077,750, filed on Nov. 10, 2014, provisional application No. 62/185,998, filed on Jun. 29, 2015, provisional application No. 62/303,625, filed on Mar. 4, 2016.

- (51) **Int. Cl.**  
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*H01L 21/311* (2006.01)  
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*H01L 23/473* (2006.01)

- (52) **U.S. Cl.**  
 CPC .. *H01L 21/02274* (2013.01); *H01L 21/31116*

2237/327 (2013.01); *H01J 2237/332* (2013.01); *H01J 2237/334* (2013.01); *H01L 23/473* (2013.01)

- (58) **Field of Classification Search**  
 CPC . H01J 2237/332; H05K 7/20609; H03H 7/38; H03H 11/28; H01L 21/31116; H01L 21/02274; H01L 23/473; H01G 7/00  
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 See application file for complete search history.

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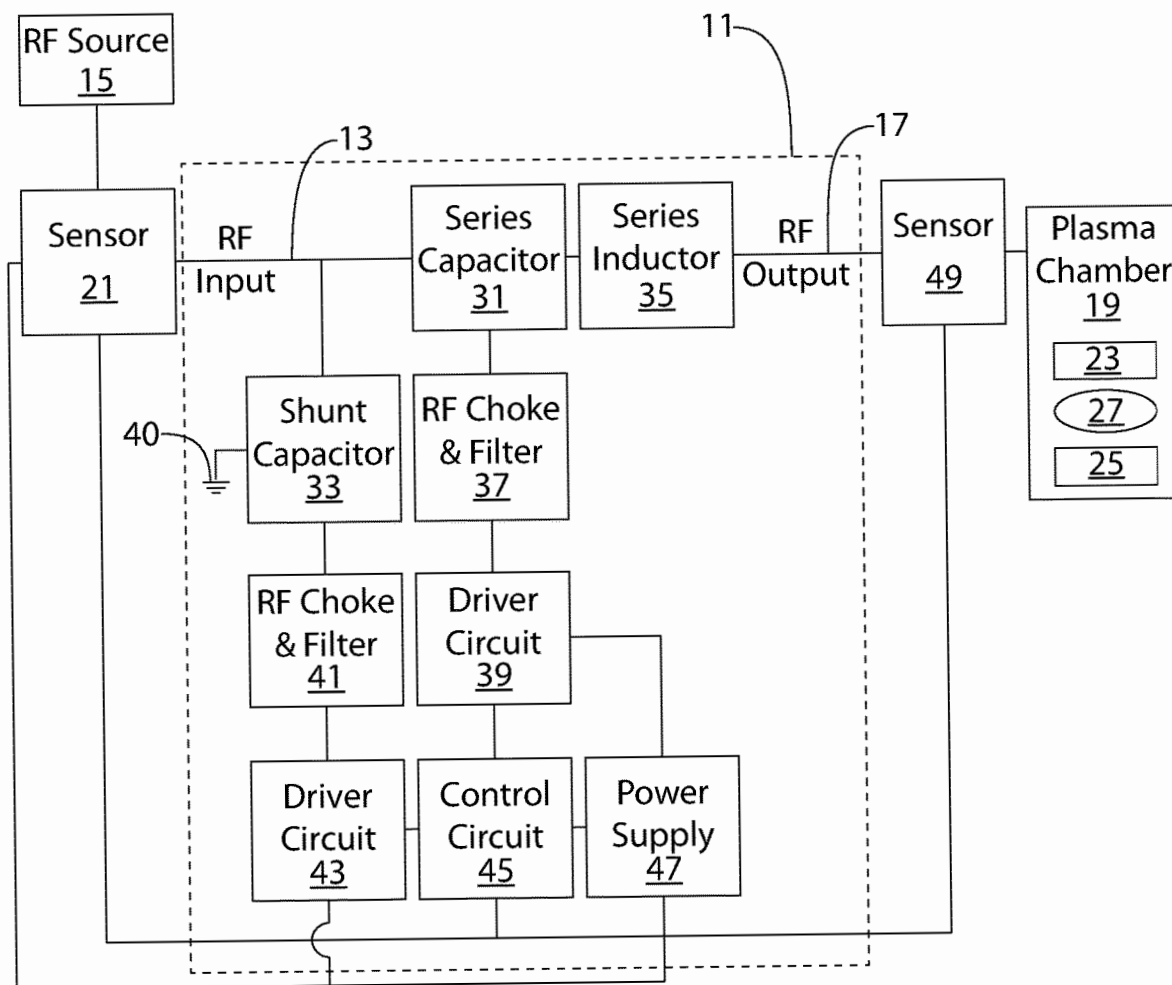


FIG. 1

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