



(12) **United States Patent**  
**Howe et al.**

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- (54) **HIGH SPECTRAL PURITY MICROWAVE OSCILLATOR USING AIR-DIELECTRIC CAVITY**
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- (52) **U.S. Cl.** ..... **331/96; 331/117 D; 331/107 DP; 331/175; 331/107 G; 331/68**
- (58) **Field of Classification Search** ..... **331/96, 331/117 D, 99, 175, 107 DP, 107 G, 68**  
See application file for complete search history.

- (56) **References Cited**  
**U.S. PATENT DOCUMENTS**
- |               |         |                       |           |
|---------------|---------|-----------------------|-----------|
| 4,555,678 A   | 11/1985 | Galani et al. ....    | 331/1 A   |
| 5,032,800 A   | 7/1991  | Galani et al. ....    | 331/1 R   |
| 5,036,299 A   | 7/1991  | Dick et al. ....      | 331/25    |
| 5,150,080 A * | 9/1992  | Bianchini et al. .... | 331/99    |
| 5,233,319 A * | 8/1993  | Mizan et al. ....     | 333/219.1 |
| 5,841,322 A   | 11/1998 | Ivanov et al. ....    | 331/1 R   |

- OTHER PUBLICATIONS**
- “High Spectral Purity X-Band Source”; F.L. Walls, C.M. Felton, T.D. Martin; Proc. 1990 IEEE Freq. Cont. Symp. pp. 542-548, May 23, 1990.
- “Future Trends in the Development of Ultra-Low Noise Microwave Oscillators with Interferometric Signal Processing”; E.N. Ivanov and M.E. Tobar; Proc. 1999 Joint Meeting EFTF-IEEE IFCS, Besancon, France, pp. 552-556.

\* cited by examiner

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(57) **ABSTRACT**

A high spectral purity microwave oscillator is provided. The Oscillator uses an air-dielectric cavity and employs the known carrier-suppression technique. In one embodiment, the oscillator employs a high-Q cavity to self-sustain an oscillating signal formed by feeding back into its input a power-amplified output signal of the cavity in which residual phase noise in the amplifier stages is suppressed. A bandpass filter selects the cavity mode. FIG. 1 illustrates this embodiment. Another embodiment suppresses the noise of a voltage-controlled oscillator whose frequency and power-amplified output interrogates the cavity mode. FIG. 2 illustrates this embodiment.

**23 Claims, 3 Drawing Sheets**

