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Marash et al.

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[54] INTERFERENCE CANCELING METHOD AND APPARATUS

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[51] Int. Cl.⁷ **H04M 9/08**; H03R 3/00

[52] U.S. Cl. **379/410**; 379/407; 381/92; 381/94.1; 367/121

[58] Field of Search 379/407, 406, 379/408, 409, 410, 411, 416; 381/92, 94.1, 91.2, 94.7, 155; 367/116, 117, 118, 119-127; 708/322

[56] References Cited

U.S. PATENT DOCUMENTS

4,965,834	10/1990	Miller	381/94.1
5,226,016	7/1993	Christman	367/135
5,627,799	5/1997	Hoshuyama	367/121
5,825,898	10/1998	Marash	381/92

Primary Examiner—Forester W. Isen

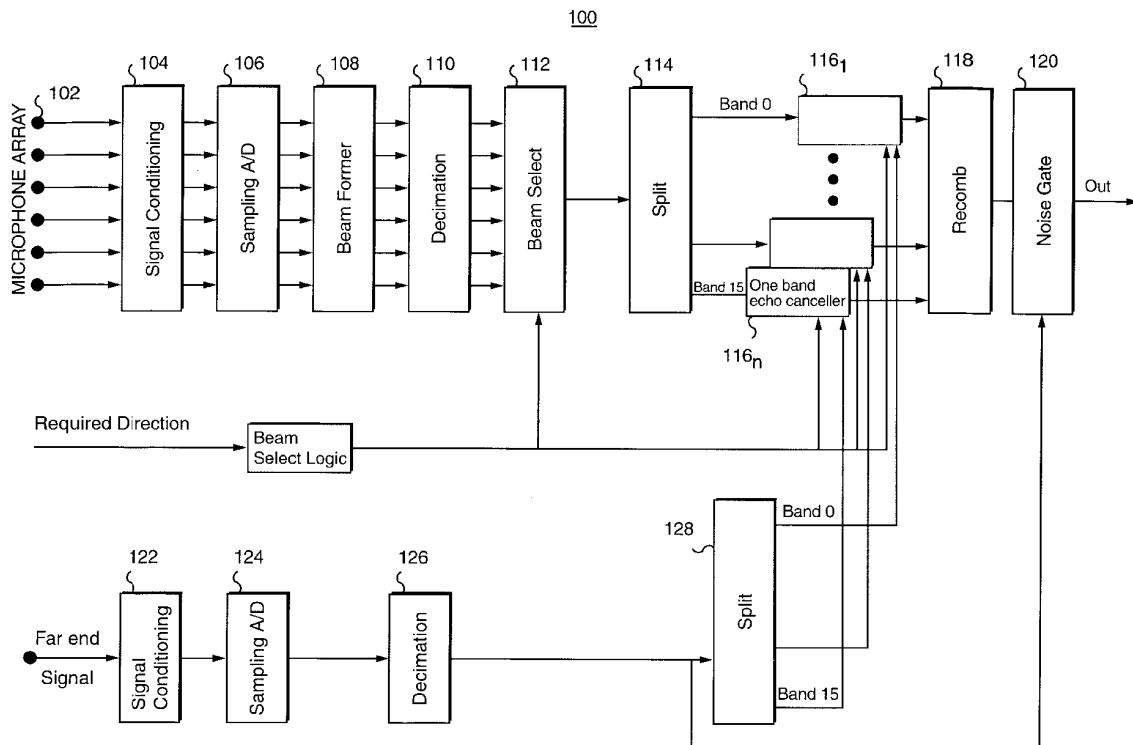
Assistant Examiner—Jacques Saint-Surin

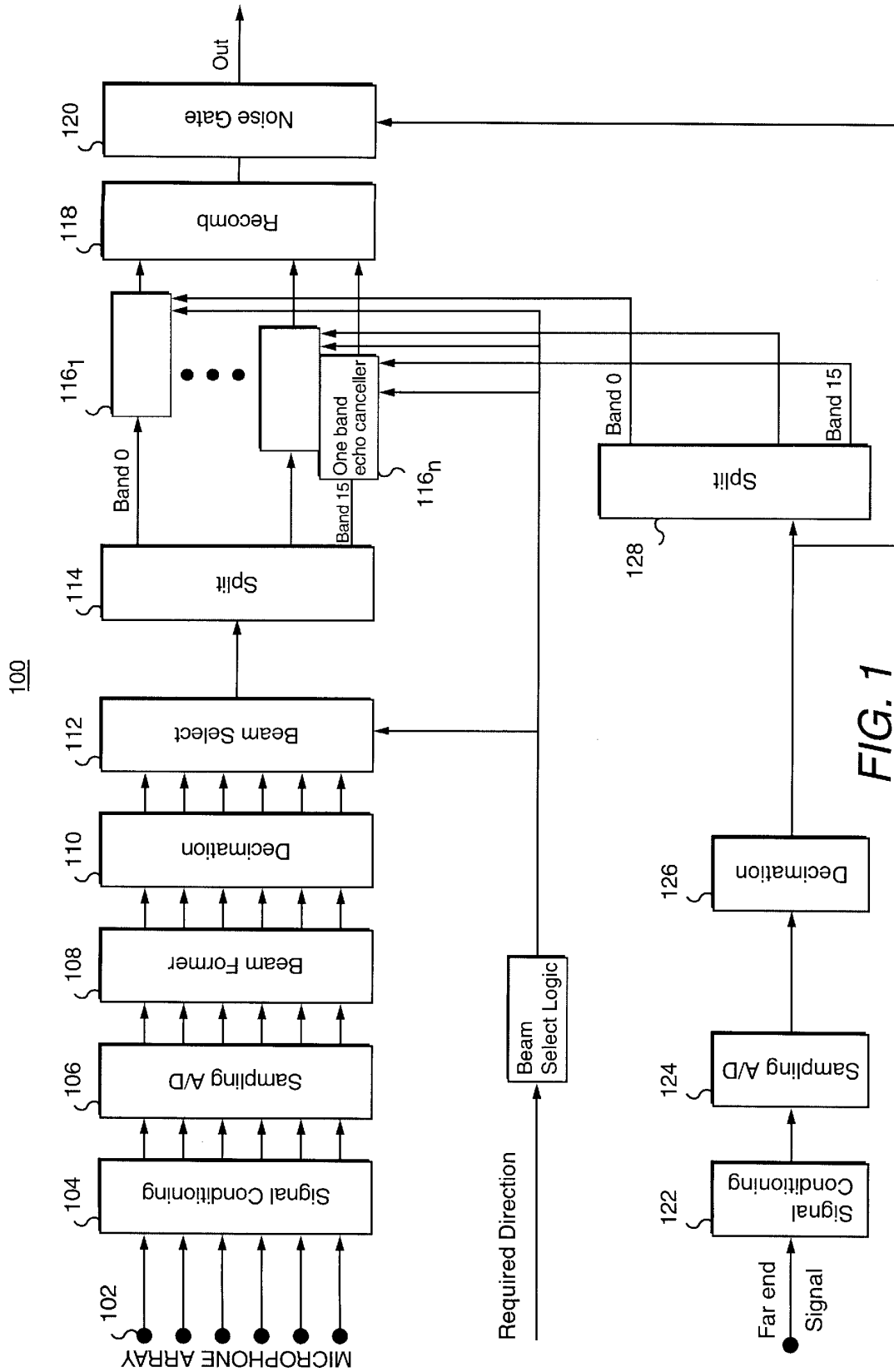
Attorney, Agent, or Firm—Frommer Lawrence & Haug LLP; Thomas J. Kowalski

[57] ABSTRACT

Interference canceling is provided for canceling, from a target signal generated from a target source, an interference signal generated by an interference source. The beam splitter beam-splits the target signal into a plurality of band-limited target signals band-limited frequency bands and beam-splits the interference signal into corresponding band-limited frequency bands. The adaptive filter adaptively filters each band-limited interference signal from each corresponding band-limited target signal. The inhibitor can permit the adaptive filter to adapt or change coefficients when a signal-to-noise ratio of the reference signal exceeds a predetermined threshold, to be determined periodically, over a signal-to-noise ratio of the main signal. The beam selector selects at least one of a plurality of beams for adaptive filtering by the adaptive filter representing a direction from which the main signal is received. The beam selector selects beams simultaneously to improve accuracy and, in particular, selects a beam having a fixed direction and a beam which rotates in direction. The noise gate gates the main signal adaptively filtered by the adaptive filter by opening the noise gate when a signal-to-noise ratio at the near end is above a predetermined threshold and closing the noise gate when the signal-to-noise ratio at the near end is below the predetermined threshold. When the target signal represents speech generated at a near end of a teleconference, the adaptive filter cancels an echo present in the reference signal broadcast to a far end of the teleconference.

37 Claims, 7 Drawing Sheets





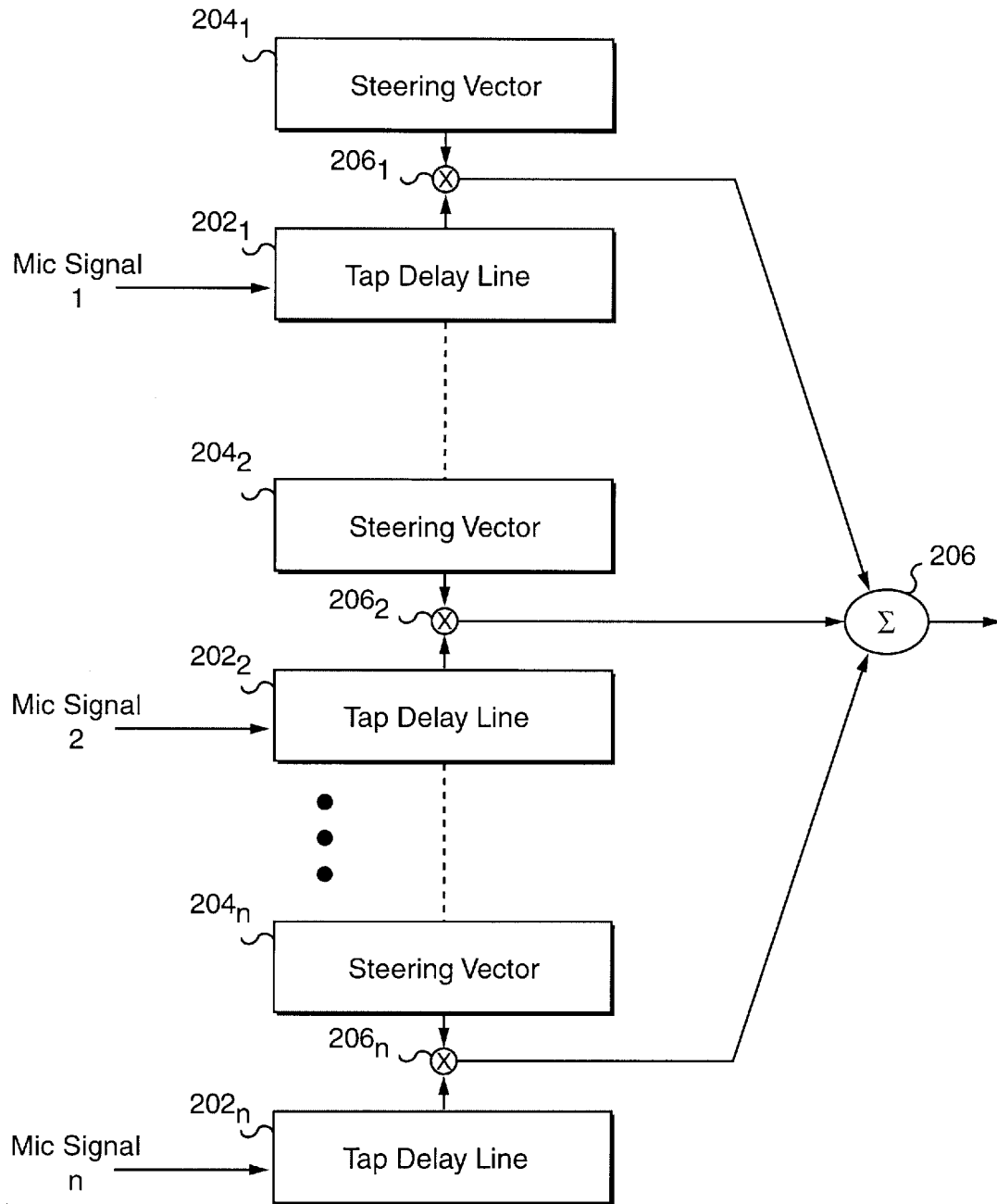


FIG. 2

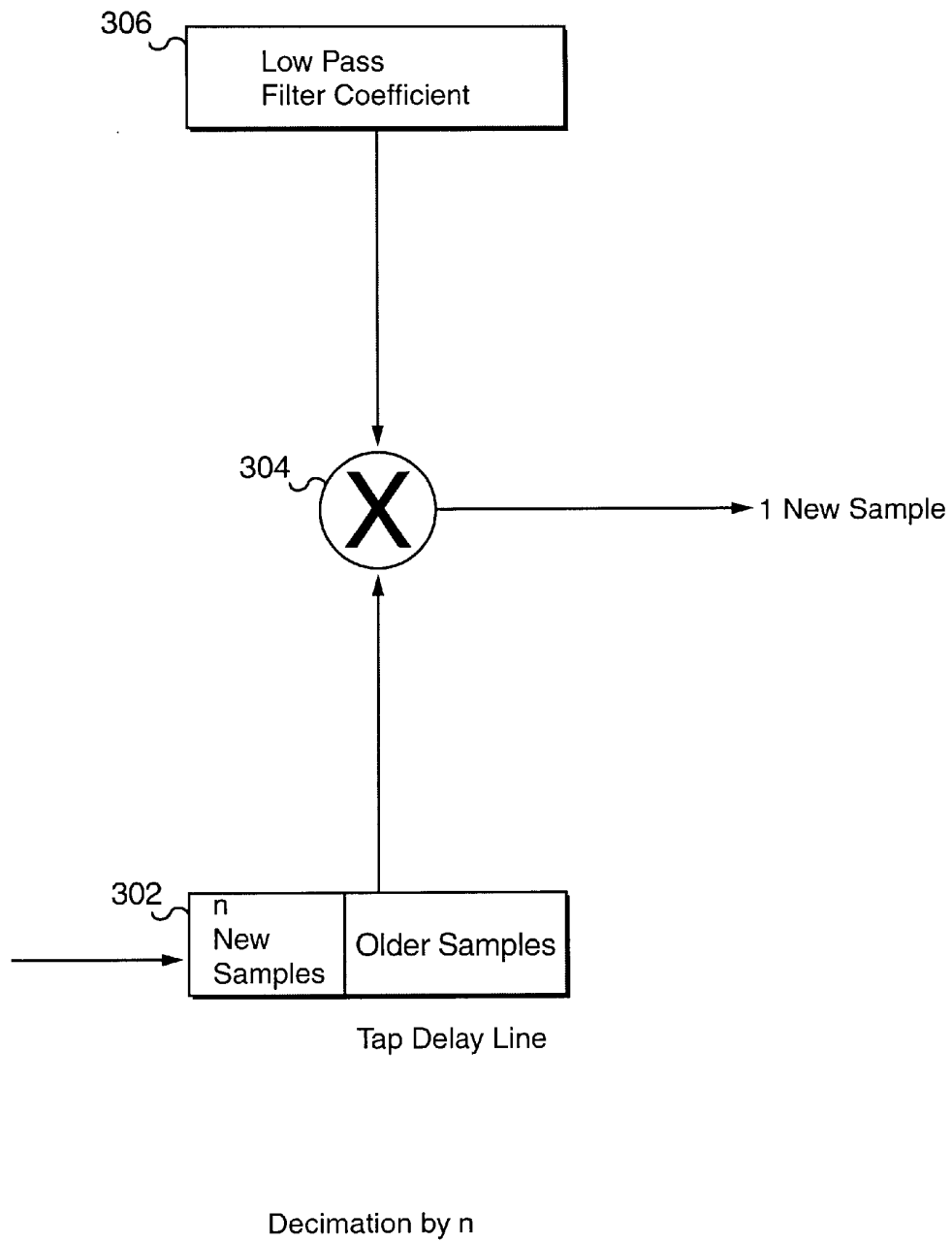


FIG. 3

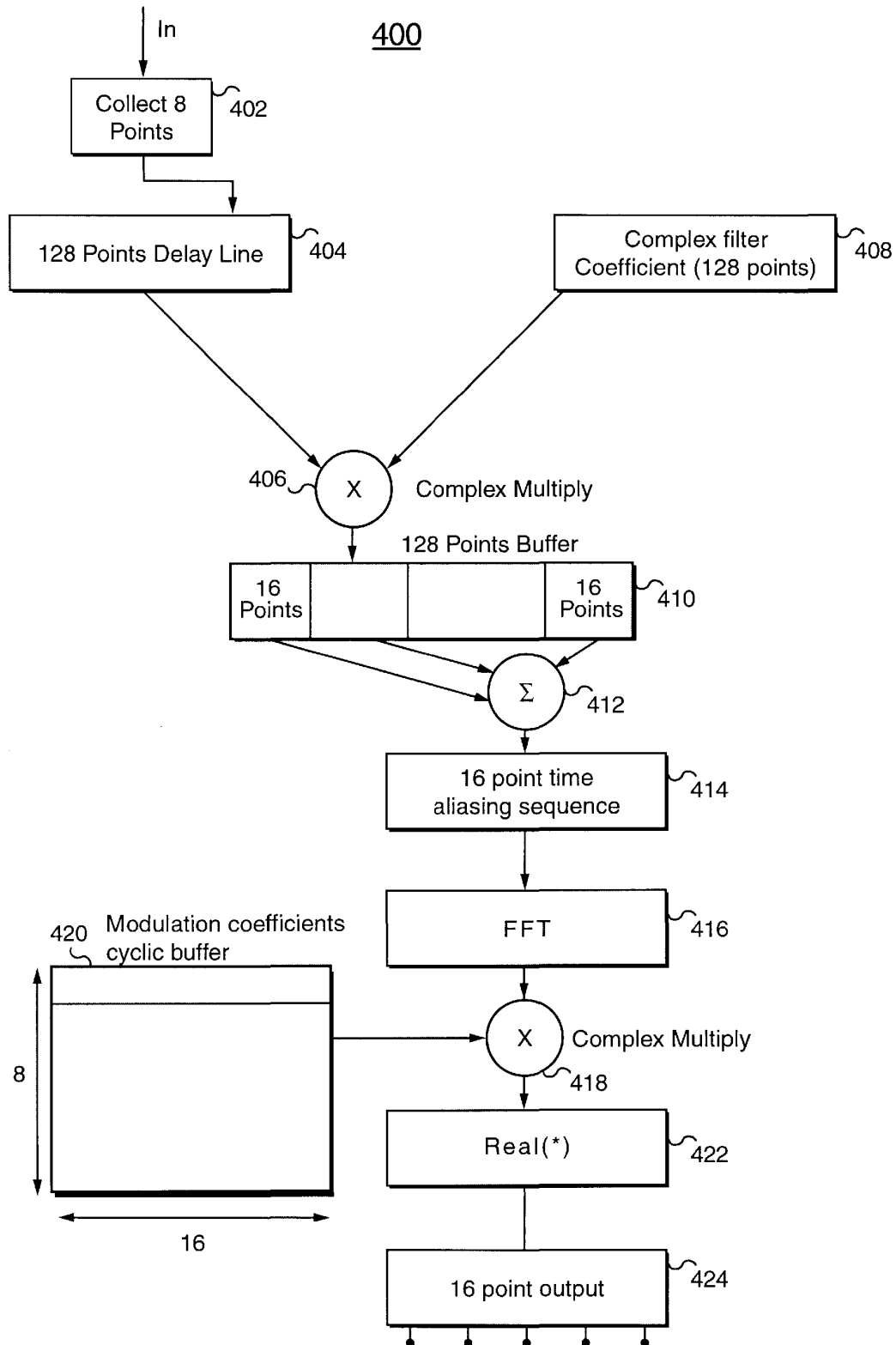


FIG. 4

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