EXHIBIT I

(12) **United States Patent** (10) **Patent No.:** **US 8,503,691 B2**

Burnett (45) **Date of Patent:** *Aug. 6, 2013

(54) **VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)**

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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 1050 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

(60) Provisional application No. 60/934,551, filed on Jun. 13, 2007, provisional application No. 60/953,444, filed on Aug. 1, 2007, provisional application No. 60/954,712, filed on Aug. 8, 2007, provisional application No. 61/045,377, filed on Apr. 16, 2008.

(51) **Int. Cl.**
H04R 3/00 (2006.01)

(52) **U.S. Cl.**
USPC **381/92**; 381/94.7; 704/233; 704/E21.004

(58) **Field of Classification Search**
USPC 381/92, 94.7; 704/233, E21.004
See application file for complete search history.

(56) **References Cited**

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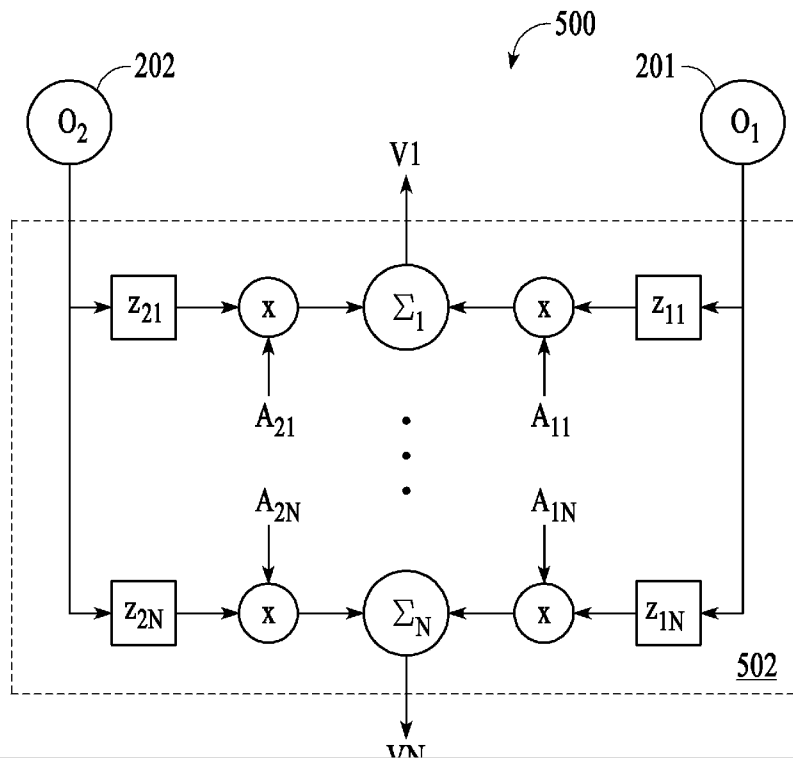|					
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(57) **ABSTRACT**

A dual omnidirectional microphone array noise suppression is described. Compared to conventional arrays and algorithms, which seek to reduce noise by nulling out noise sources, the array of an embodiment is used to form two distinct virtual directional microphones which are configured to have very similar noise responses and very dissimilar speech responses. The only null formed is one used to remove the speech of the user from V_2. The two virtual microphones may be paired with an adaptive filter algorithm and VAD algorithm to significantly reduce the noise without distorting the speech, significantly improving the SNR of the desired speech over conventional noise suppression systems.
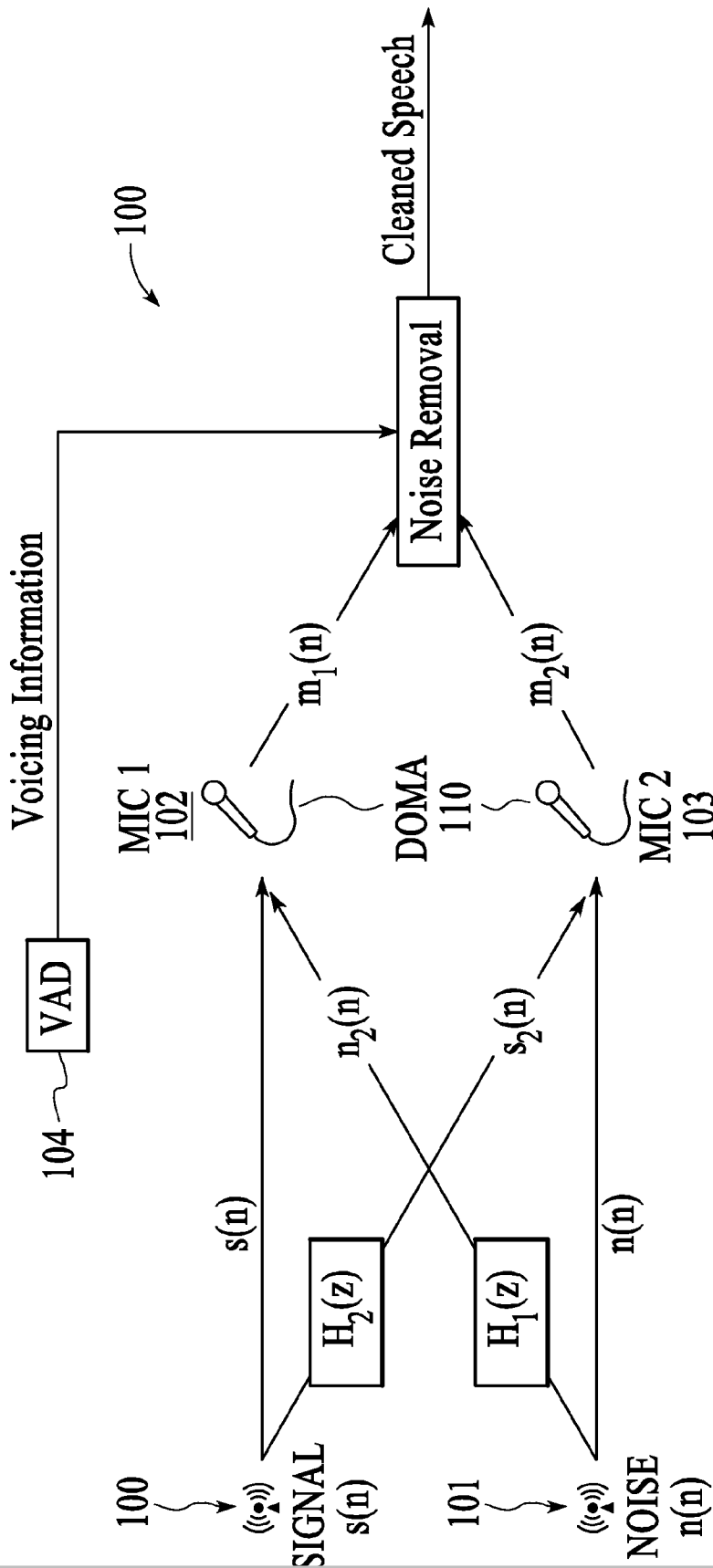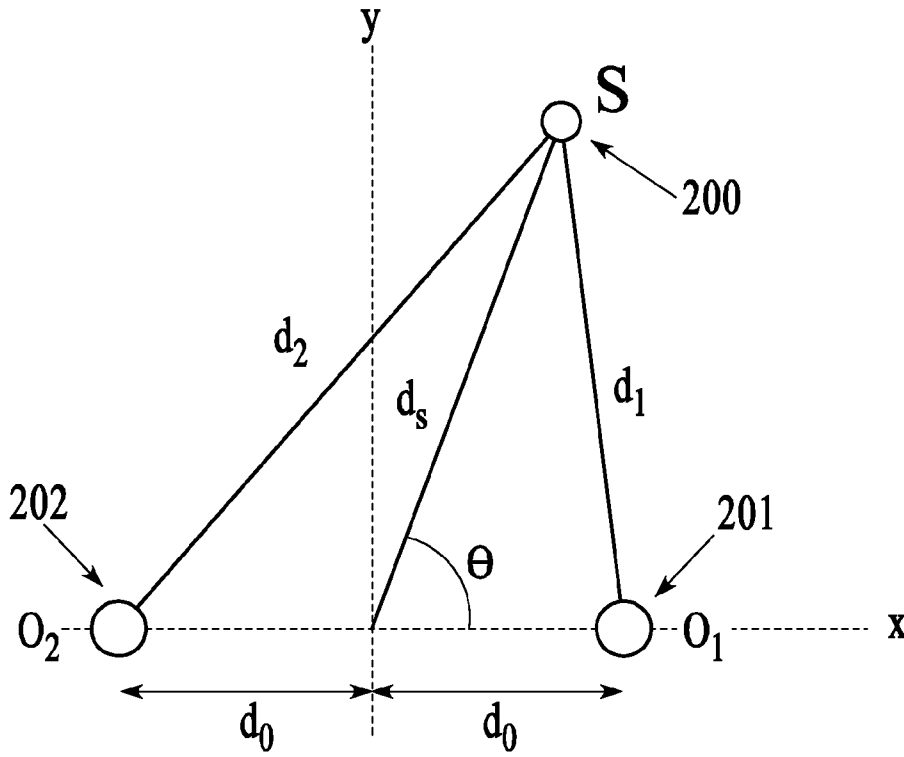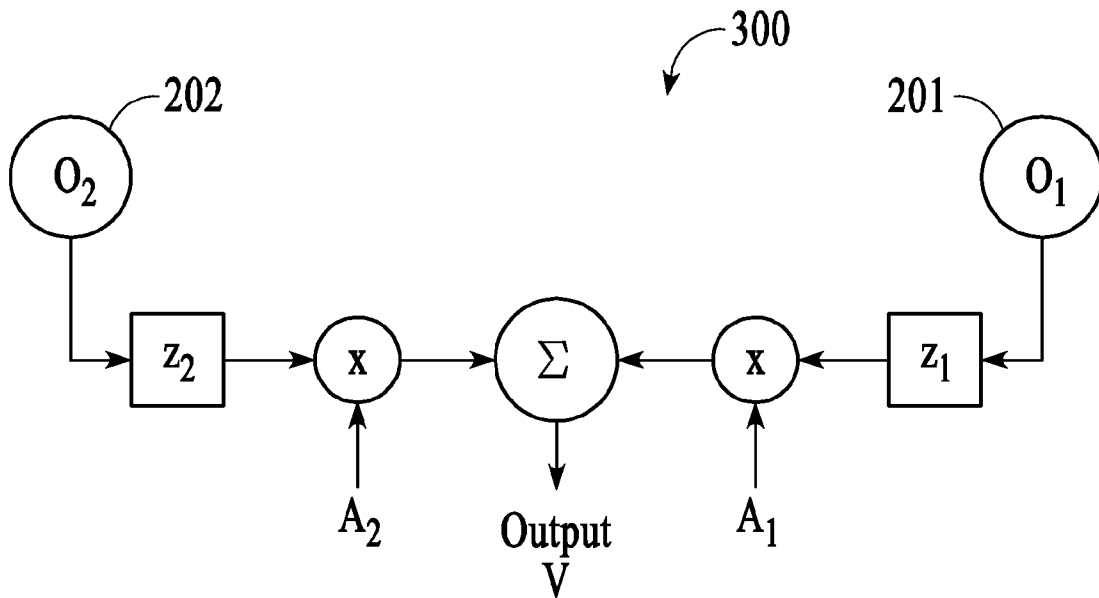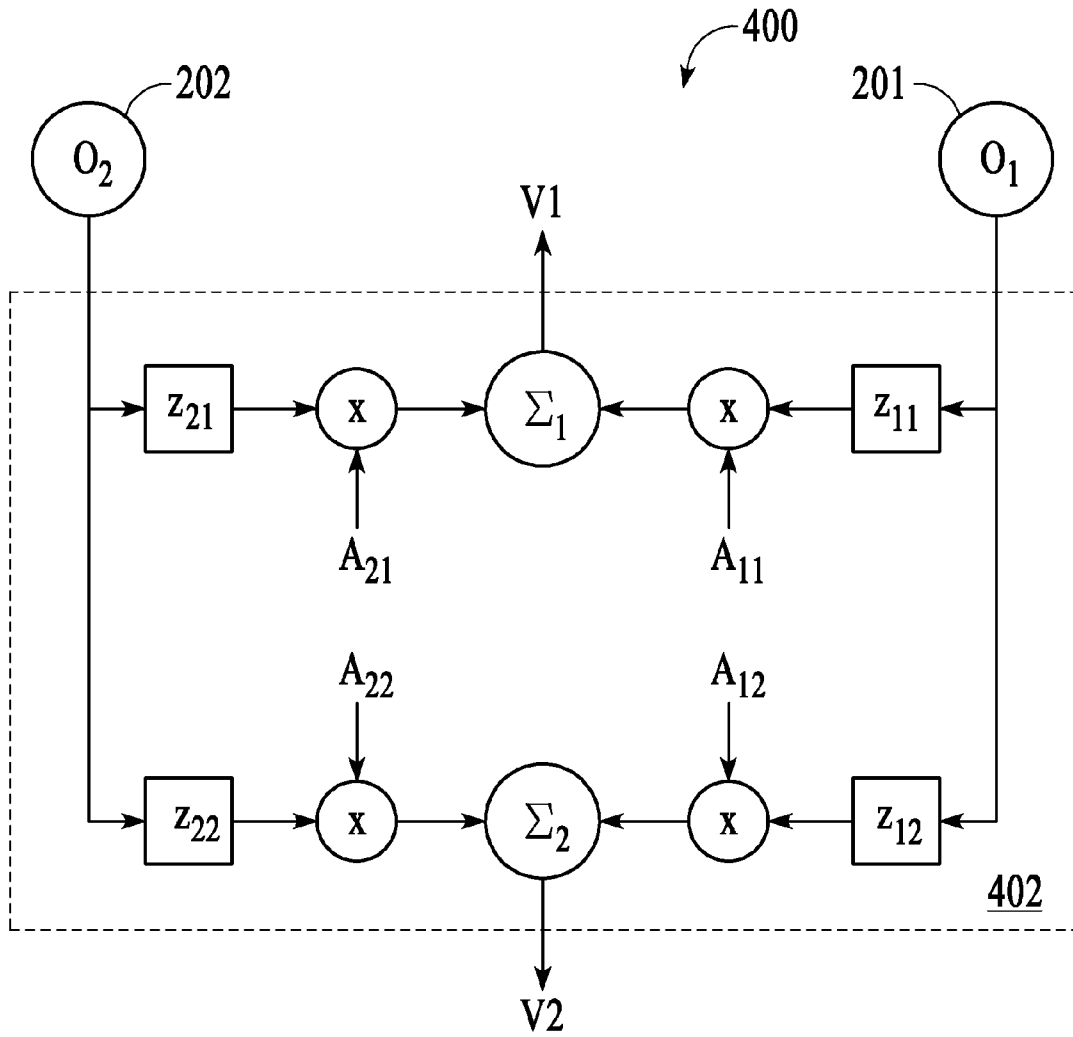
46 Claims, 17 Drawing Sheets

FIG.1

FIG.2

FIG.3

FIG.4

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