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Zhu et al.

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(54) **MICROPHONE ARRAY SYSTEM**

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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 794 days.

(21) Appl. No.: **13/049,877**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**

H04R 25/00	(2006.01)
H03G 3/20	(2006.01)
H04R 3/00	(2006.01)
G01S 5/22	(2006.01)
G01S 3/801	(2006.01)
G01S 3/805	(2006.01)
H04R 1/40	(2006.01)
H04M 3/56	(2006.01)

(52) **U.S. Cl.**

CPC ***G01S 3/8055*** (2013.01); *H04M 3/568* (2013.01); ***H04R 3/005*** (2013.01); ***G01S 5/22*** (2013.01); *H04R 2201/403* (2013.01); ***G01S 3/801*** (2013.01); *H04R 2201/401* (2013.01); ***H04R 1/406*** (2013.01)

USPC **381/300**; 381/57

(58) **Field of Classification Search**

CPC G01S 3/80; G01S 3/801; G01S 3/8055; G01S 5/22; H04R 1/406; H04R 3/005; H04R 2201/401; H04R 2201/403

USPC 381/92, 94.1, 93

See application file for complete search history.

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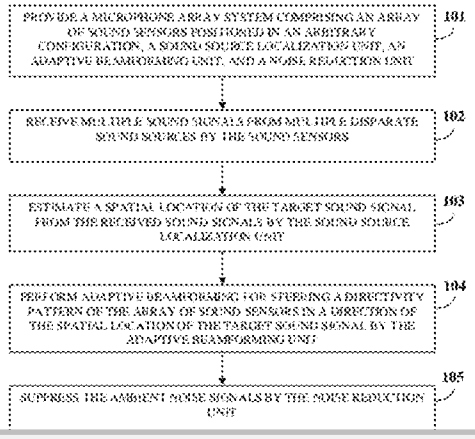
(57) **ABSTRACT**

A method and system for enhancing a target sound signal from multiple sound signals is provided. An array of an arbitrary number of sound sensors positioned in an arbitrary configuration receives the sound signals from multiple disparate sources. The sound signals comprise the target sound signal from a target sound source, and ambient noise signals. A sound source localization unit, an adaptive beamforming unit, and a noise reduction unit are in operative communication with the array of sound sensors. The sound source localization unit estimates a spatial location of the target sound signal from the received sound signals. The adaptive beamforming unit performs adaptive beamforming by steering a directivity pattern of the array of sound sensors in a direction of the spatial location of the target sound signal, thereby enhancing the target sound signal and partially suppressing the ambient noise signals, which are further suppressed by the noise reduction unit.

21 Claims, 34 Drawing Sheets



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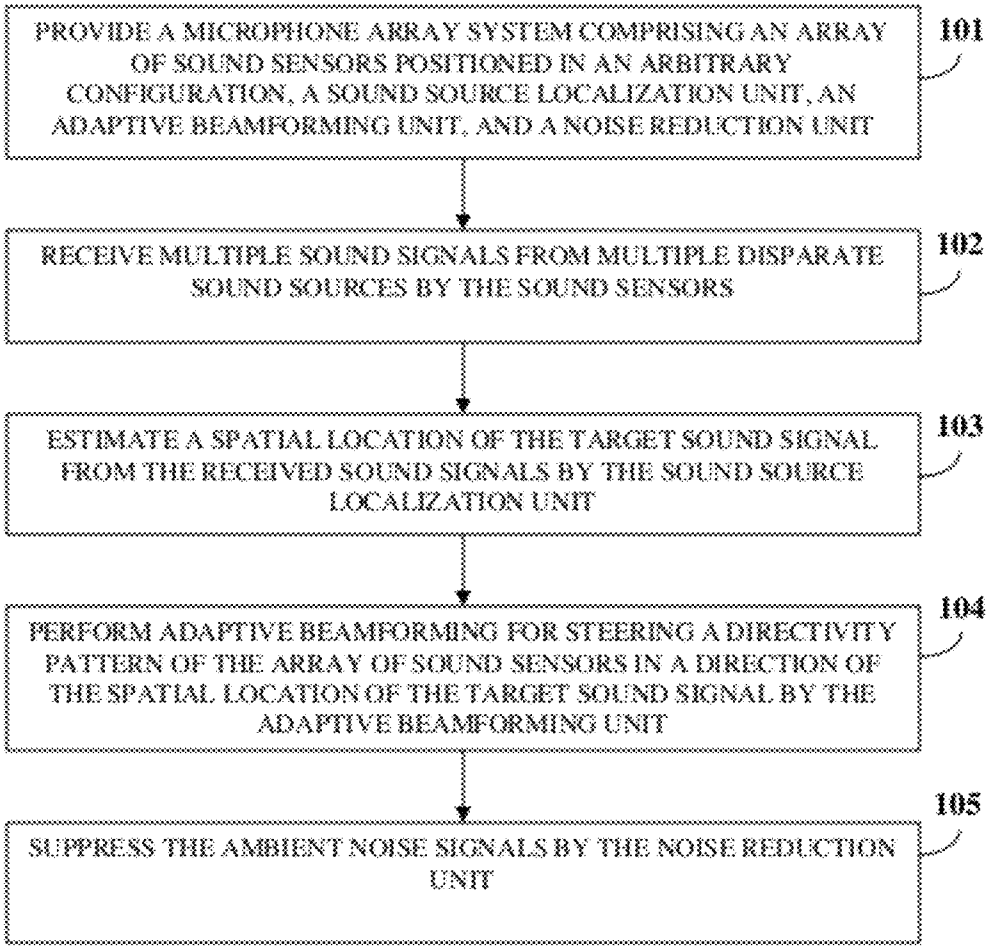

FIG. 1

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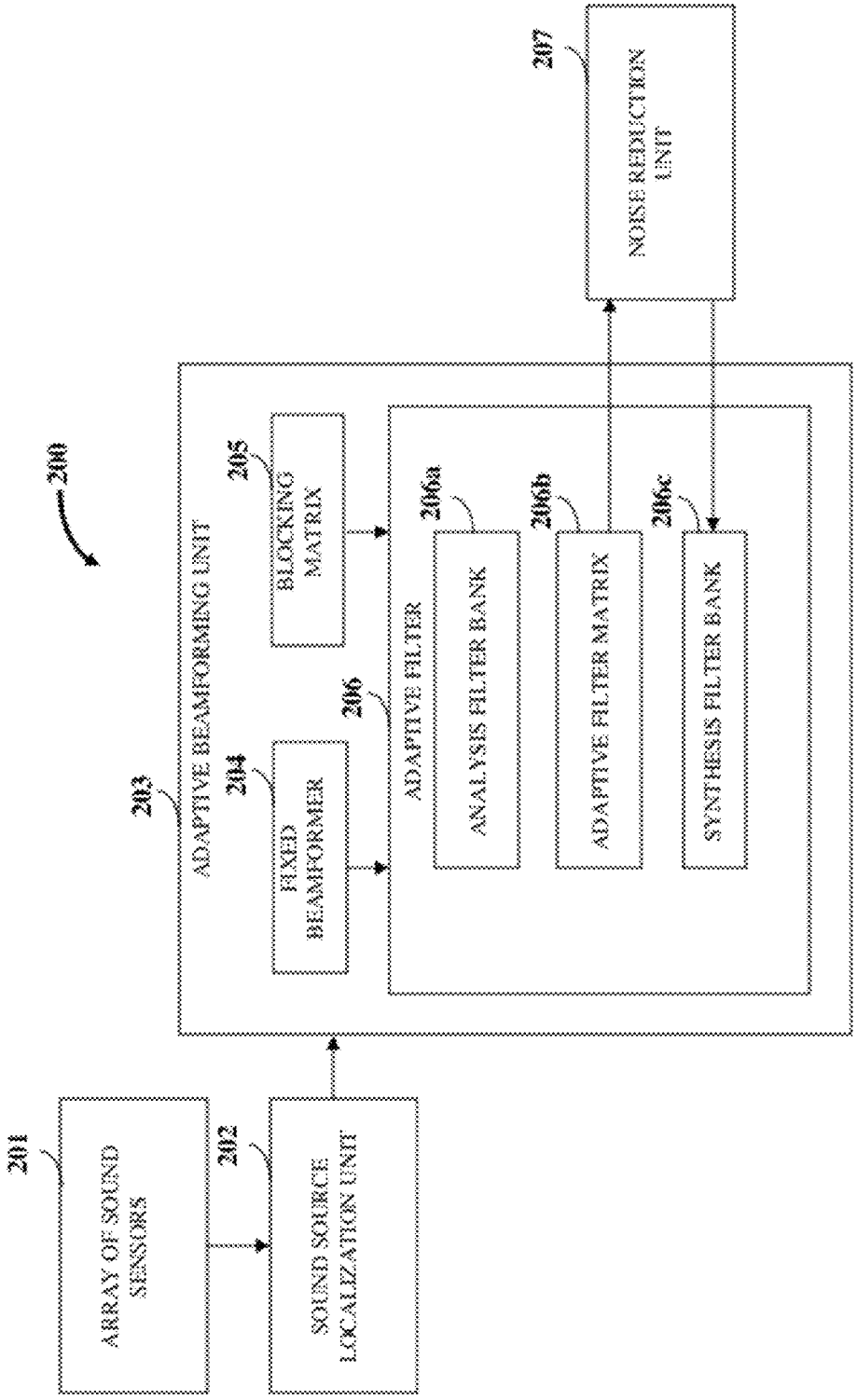

FIG. 2

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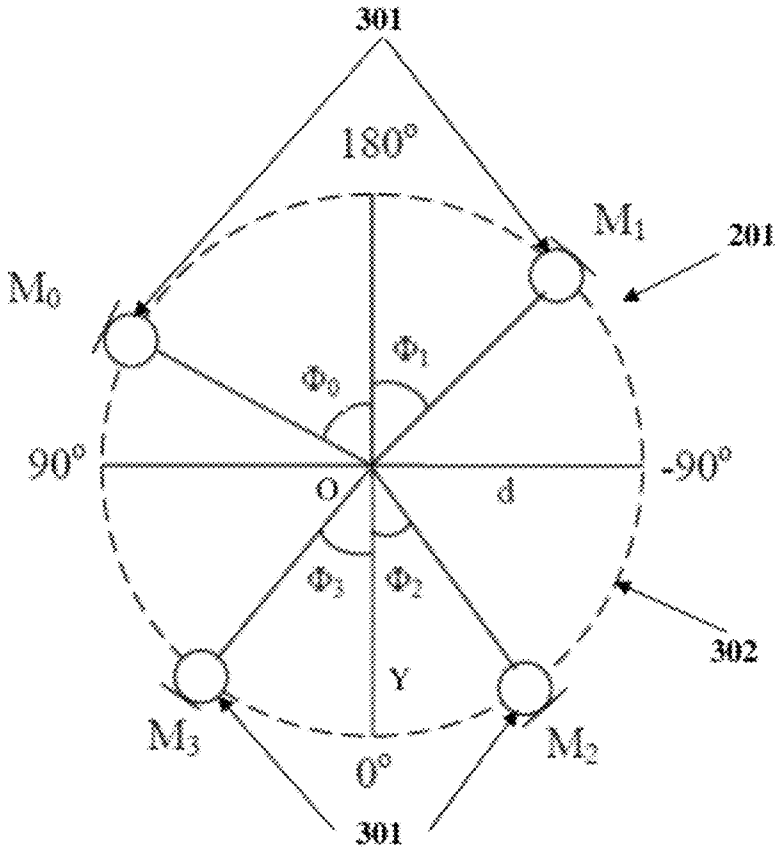

FIG. 3

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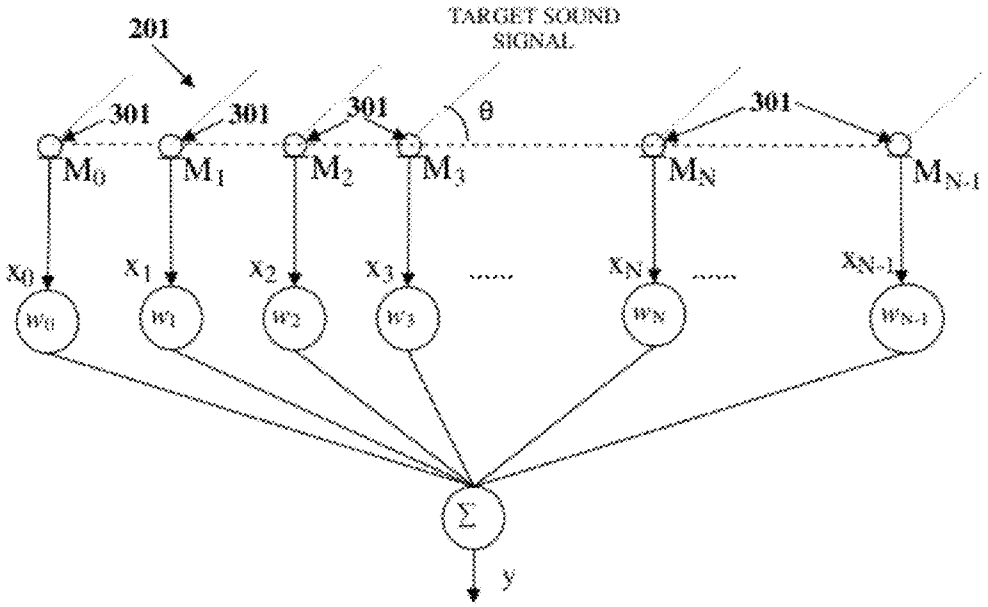

FIG. 4

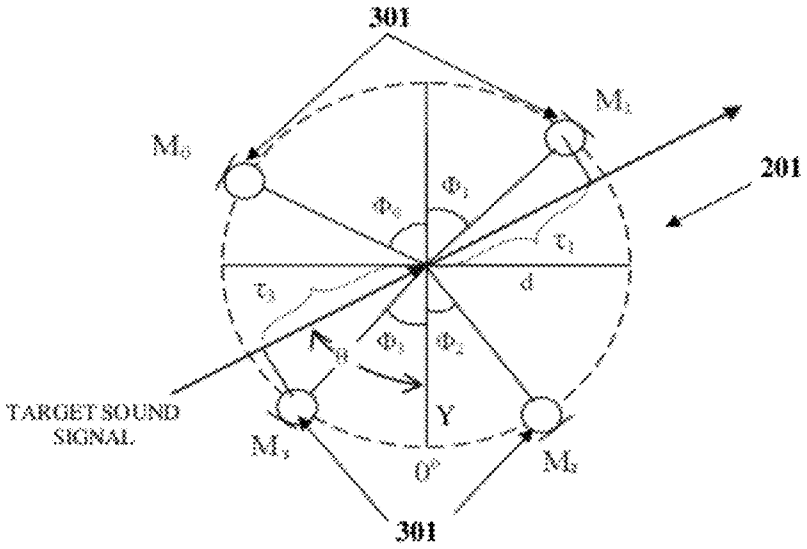

FIG. 5

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