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(12) **United States Patent**  
**Elko**

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(54) **REDUCING NOISE IN AUDIO SYSTEMS**

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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 852 days.

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**Related U.S. Application Data**

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(51) **Int. Cl.**  
**H04R 3/00** (2006.01)  
**H04R 1/02** (2006.01)

(52) **U.S. Cl.** ..... **381/92; 381/91; 381/122**

(58) **Field of Classification Search** ..... 381/97,  
381/91, 92, 122, 95, 317-318, 313, 320-321,  
381/94.1-3, 13

See application file for complete search history.

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(57) **ABSTRACT**

Two or more microphones receive acoustic signals and generate audio signals that are processed to determine what portion of the audio signals result from (i) incoherence between the audio signals and/or (ii) audio-signal sources having propagation speeds different from the acoustic signals. The audio signals are filtered to reduce that portion of one or more of the audio signals. The present invention can be used to reduce turbulent wind-noise resulting from wind or other airjets blowing across the microphones. Time-dependent phase and amplitude differences between the microphones can be compensated for based on measurements made in parallel with routine audio system processing.

**55 Claims, 13 Drawing Sheets**

1200

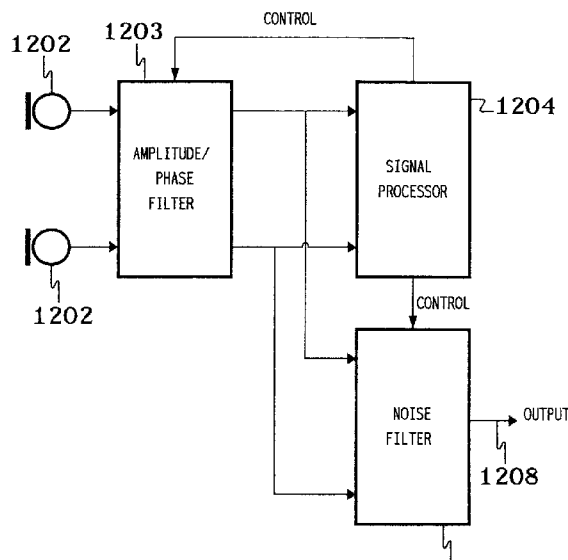


Fig. 1

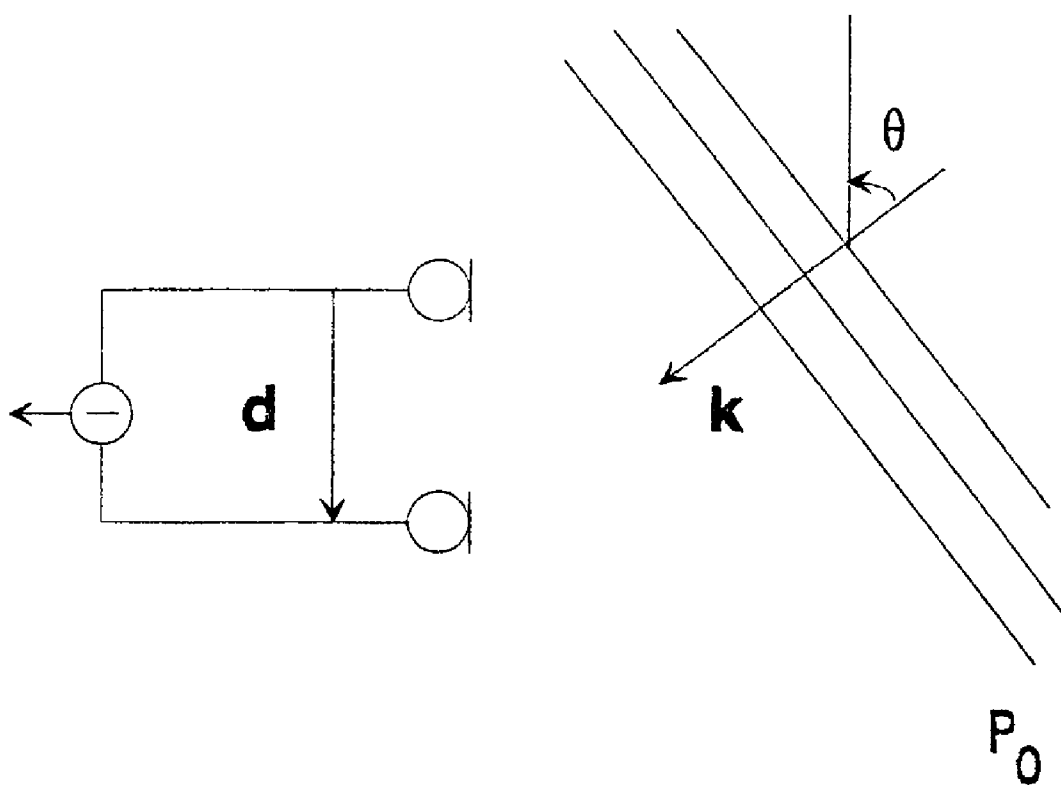


Fig. 2

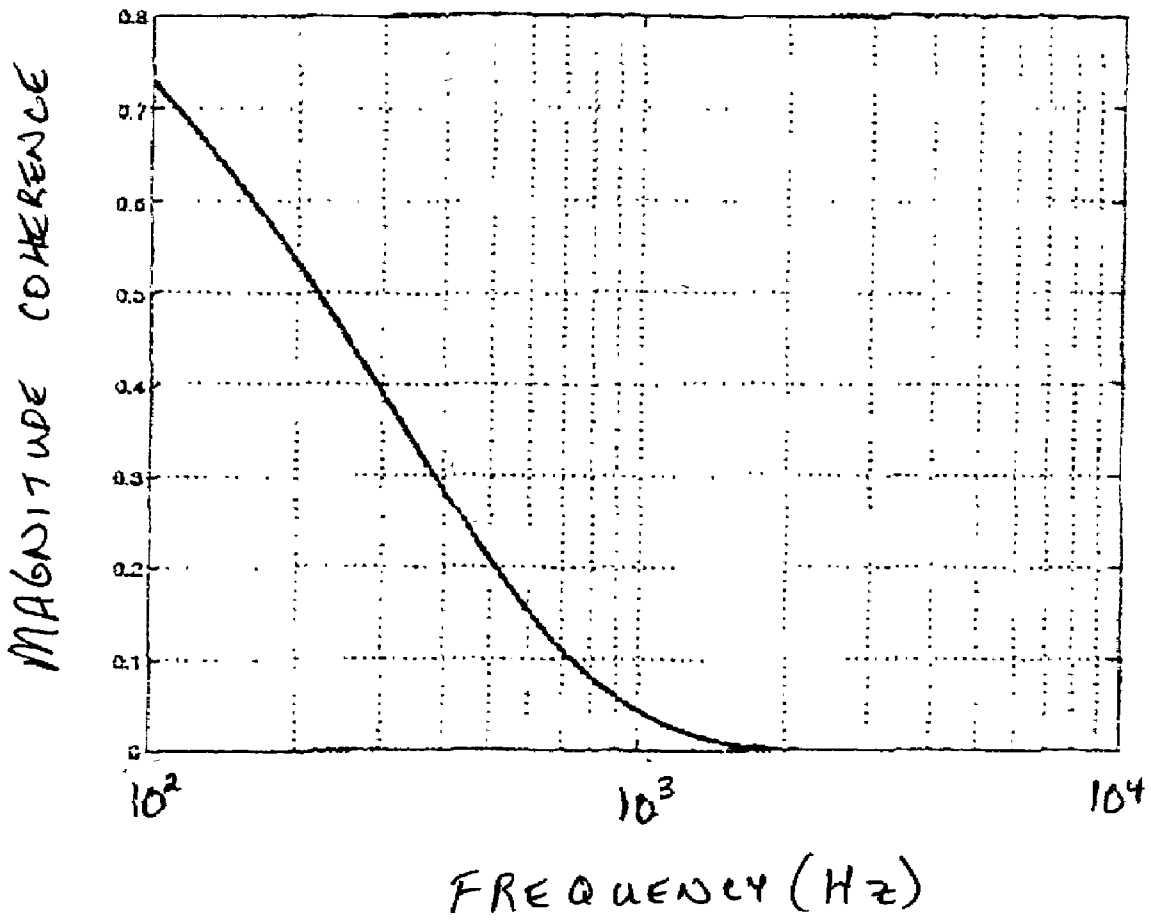


Fig. 3

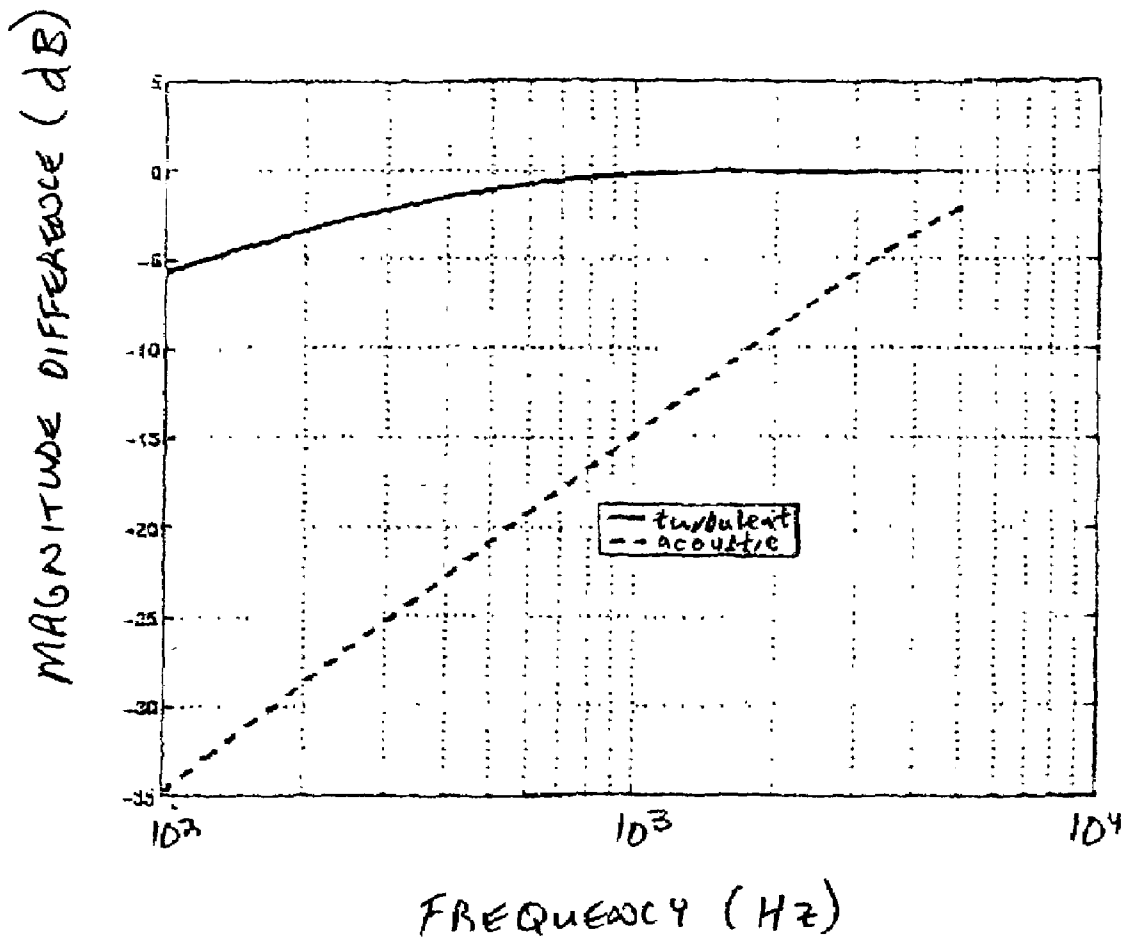
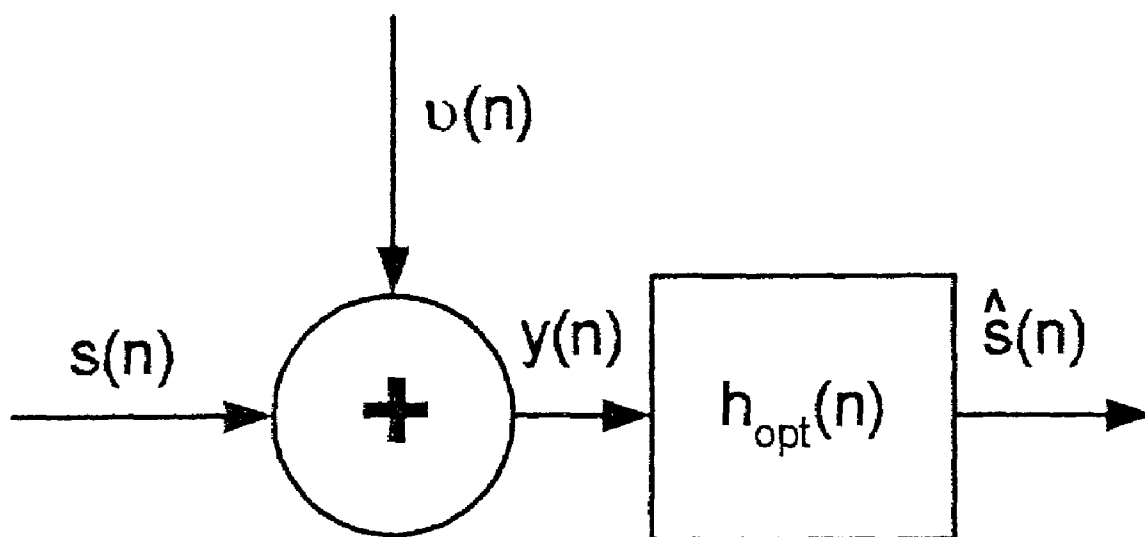


Fig. 4



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