



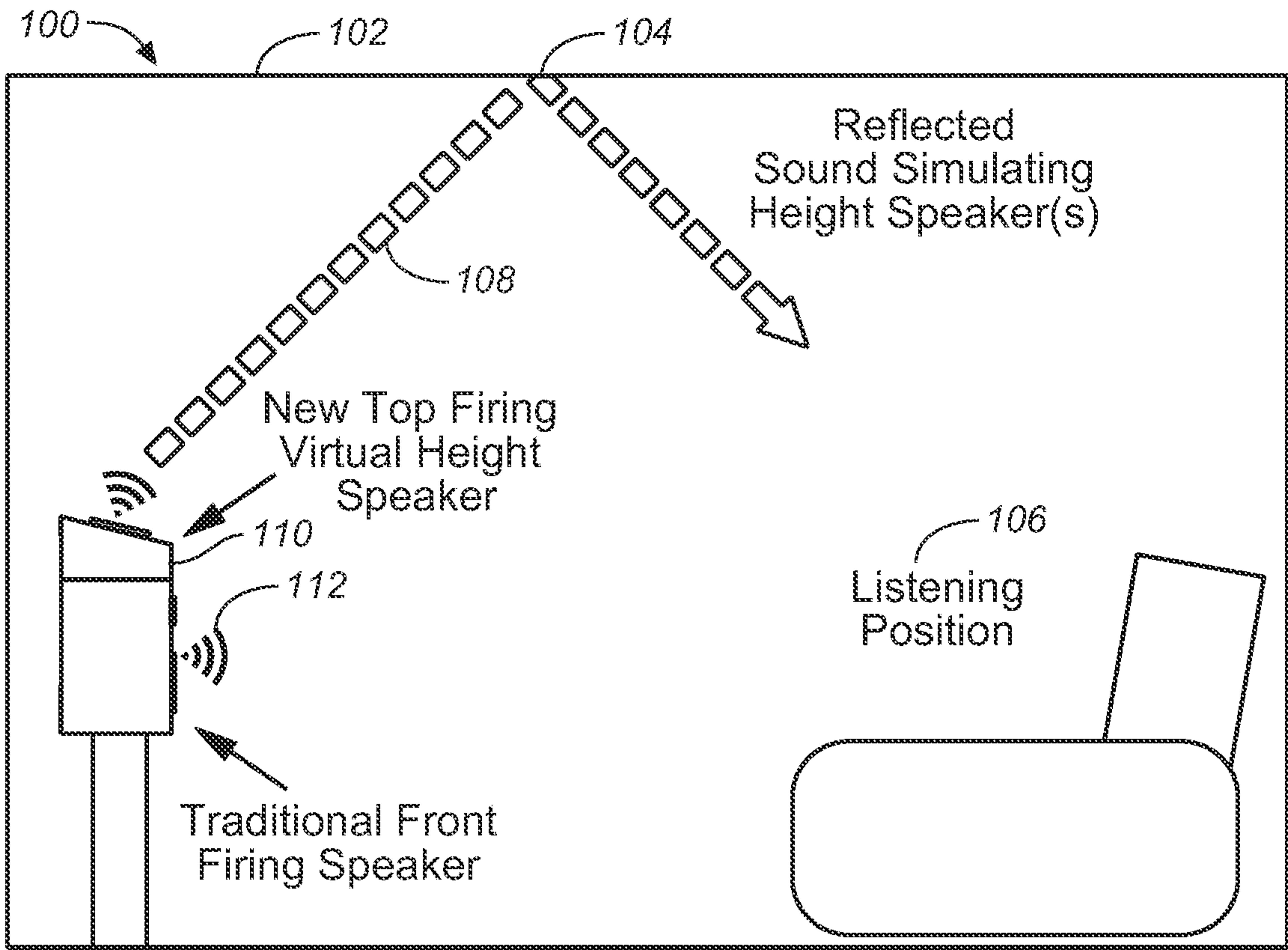
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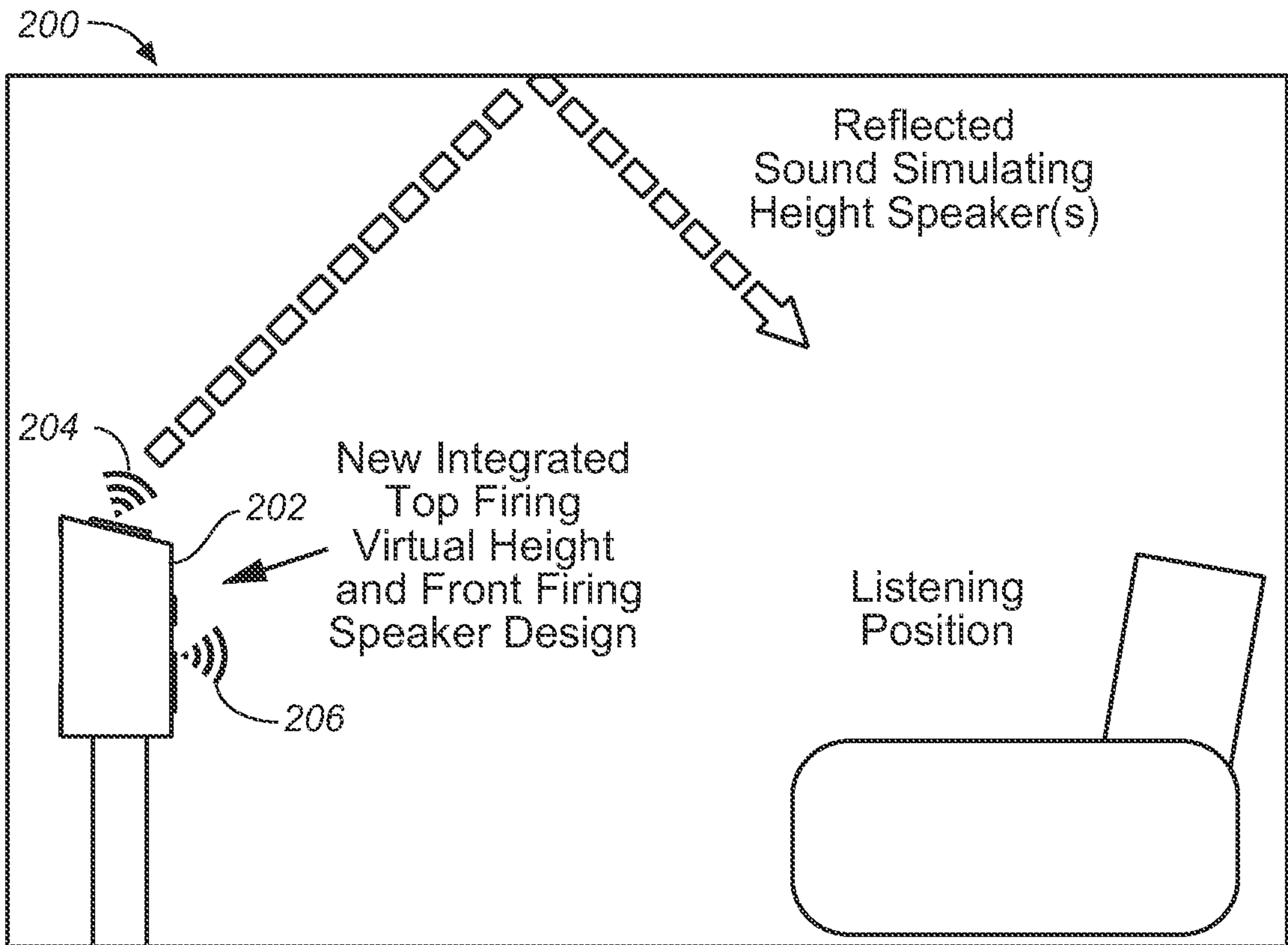
(54) Titre : FILTRE PAR HAUTEUR VIRTUELLE POUR RENDU DE SON REFLECHI UTILISANT DES CIRCUITS  
 D'ATTAQUE D'AMORCAGE ASCENDANT  
 (54) Title: VIRTUAL HEIGHT FILTER FOR REFLECTED SOUND RENDERING USING UPWARD FIRING DRIVERS

(57) **Abrégé/Abstract:**

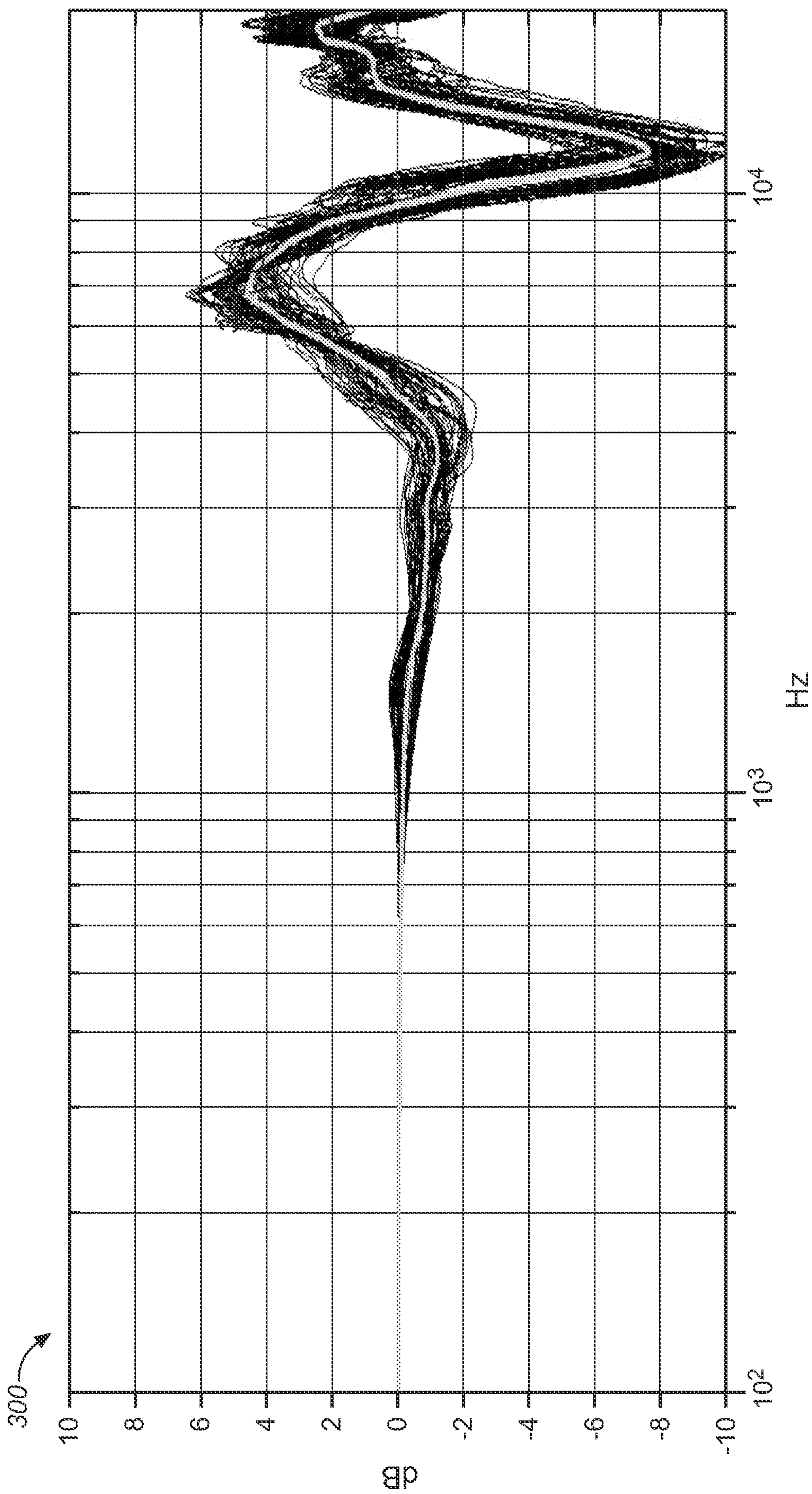
Embodiments are directed to speakers and circuits that reflect sound off a ceiling to a listening location at a distance from a speaker. The reflected sound provides height cues to reproduce audio objects that have overhead audio components. The speaker comprises upward firing drivers to reflect sound off of the upper surface and represents a virtual height speaker. A virtual height filter based on a directional hearing model is applied to the upward-firing driver signal to improve the perception of height for audio signals transmitted by the virtual height speaker to provide optimum reproduction of the overhead reflected sound. The virtual height filter may be incorporated as part of a crossover circuit that separates the full band and sends high frequency sound to the upward-firing driver.



**FIG. 1**



**FIG. 2**



**FIG. 3**

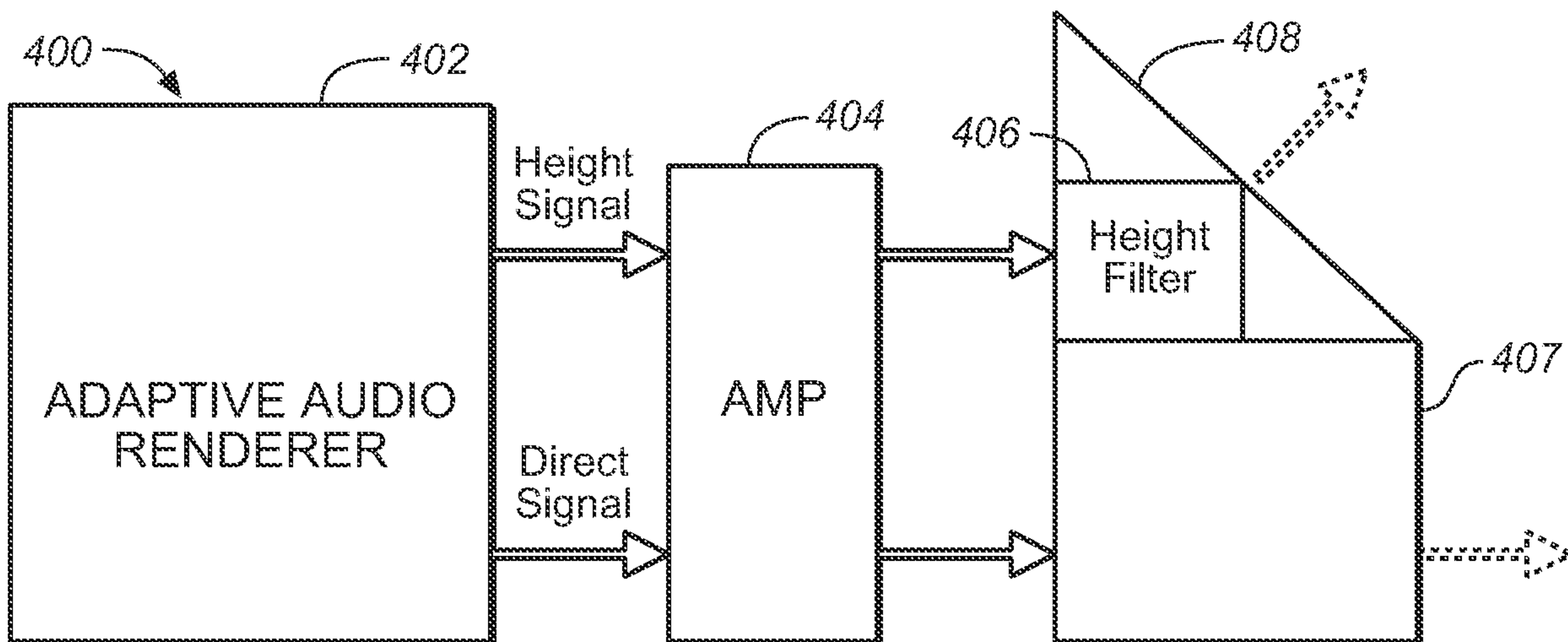


FIG. 4A

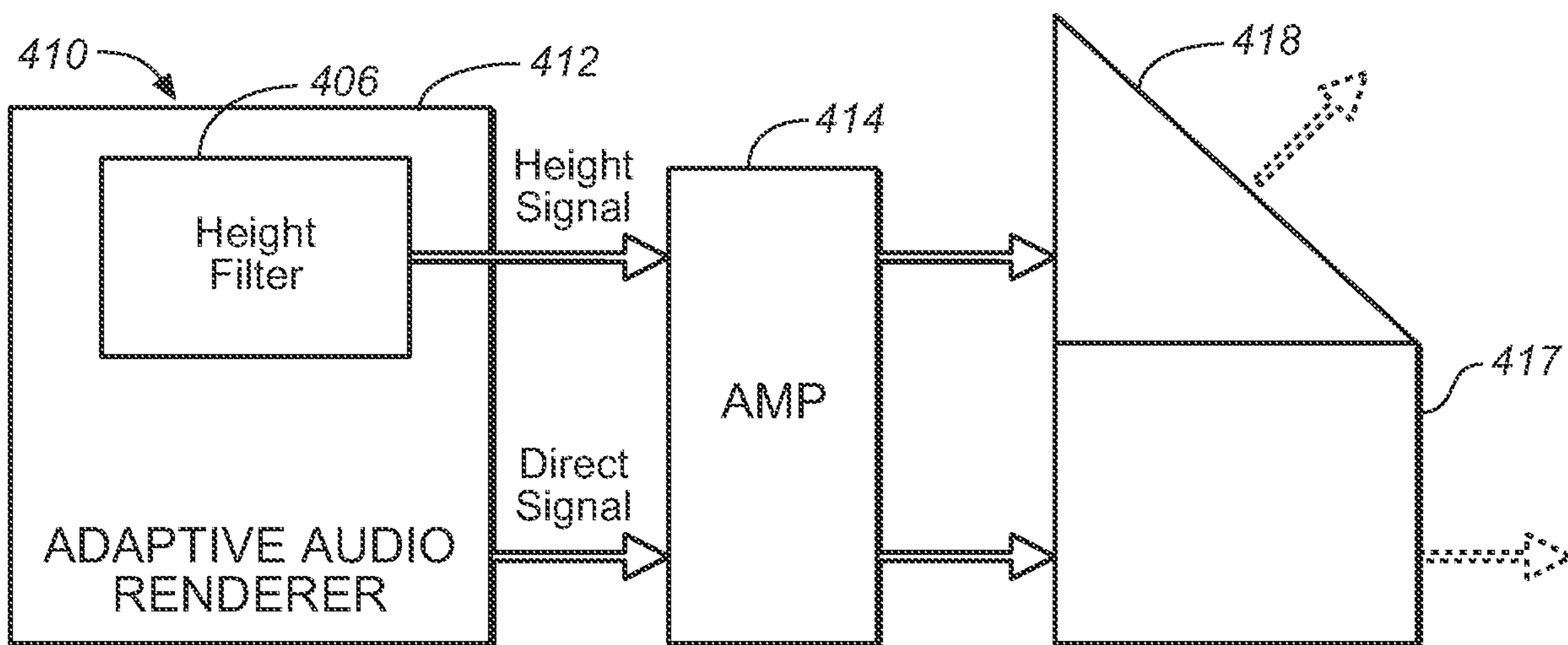


FIG. 4B

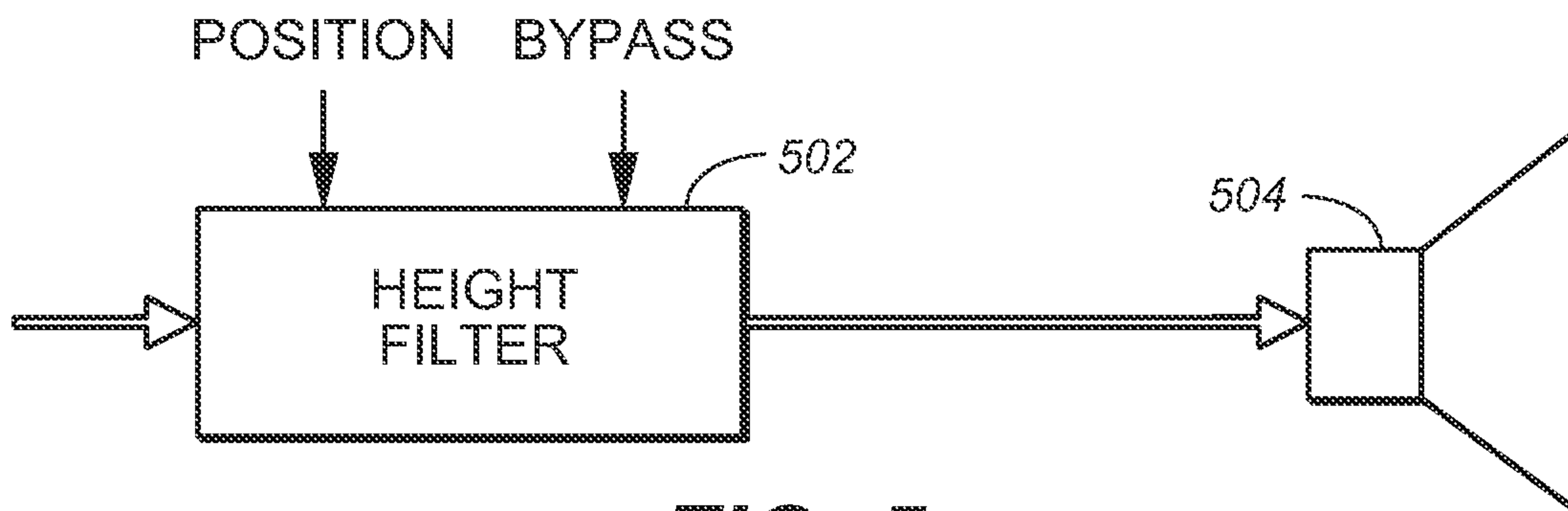
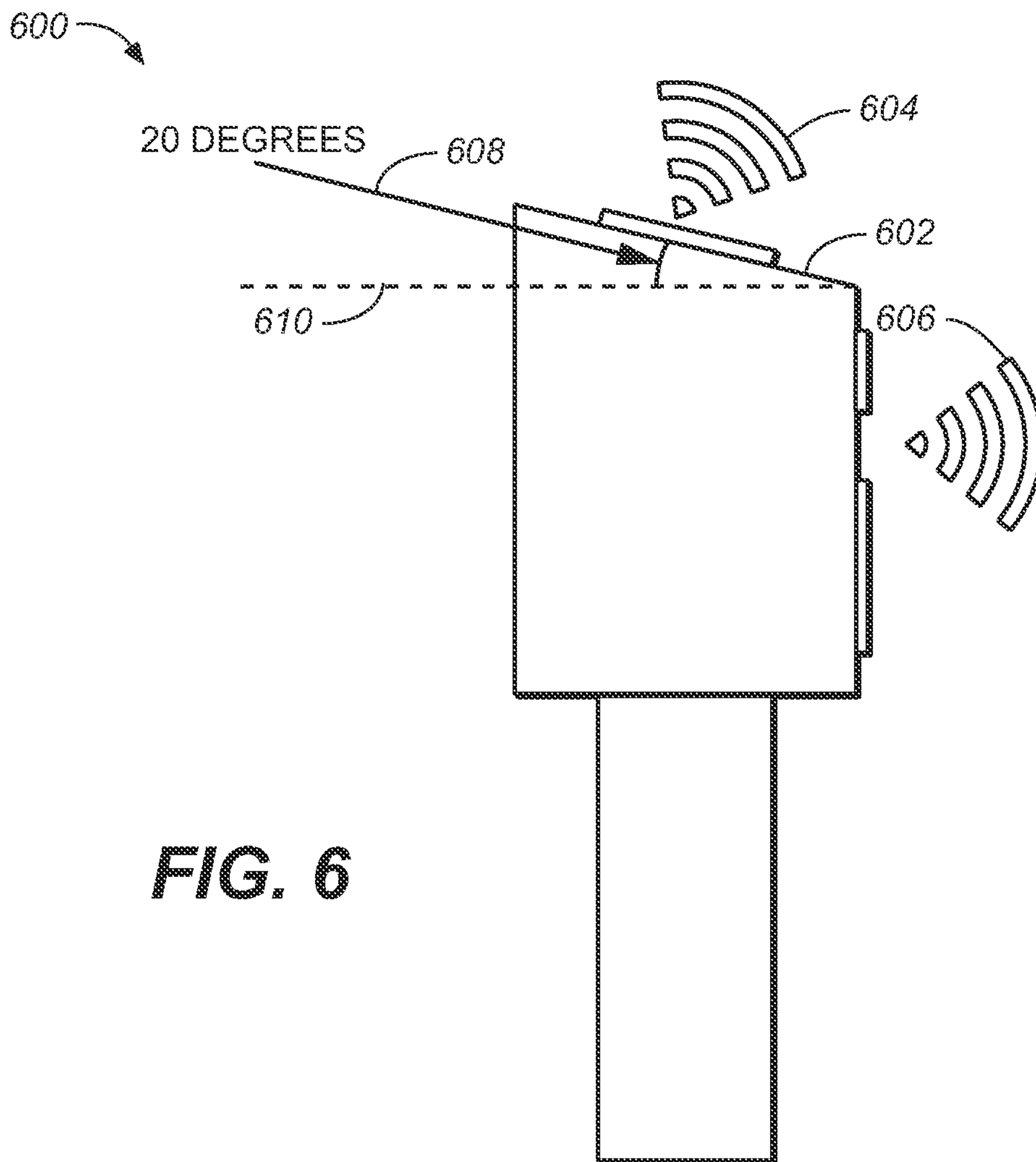
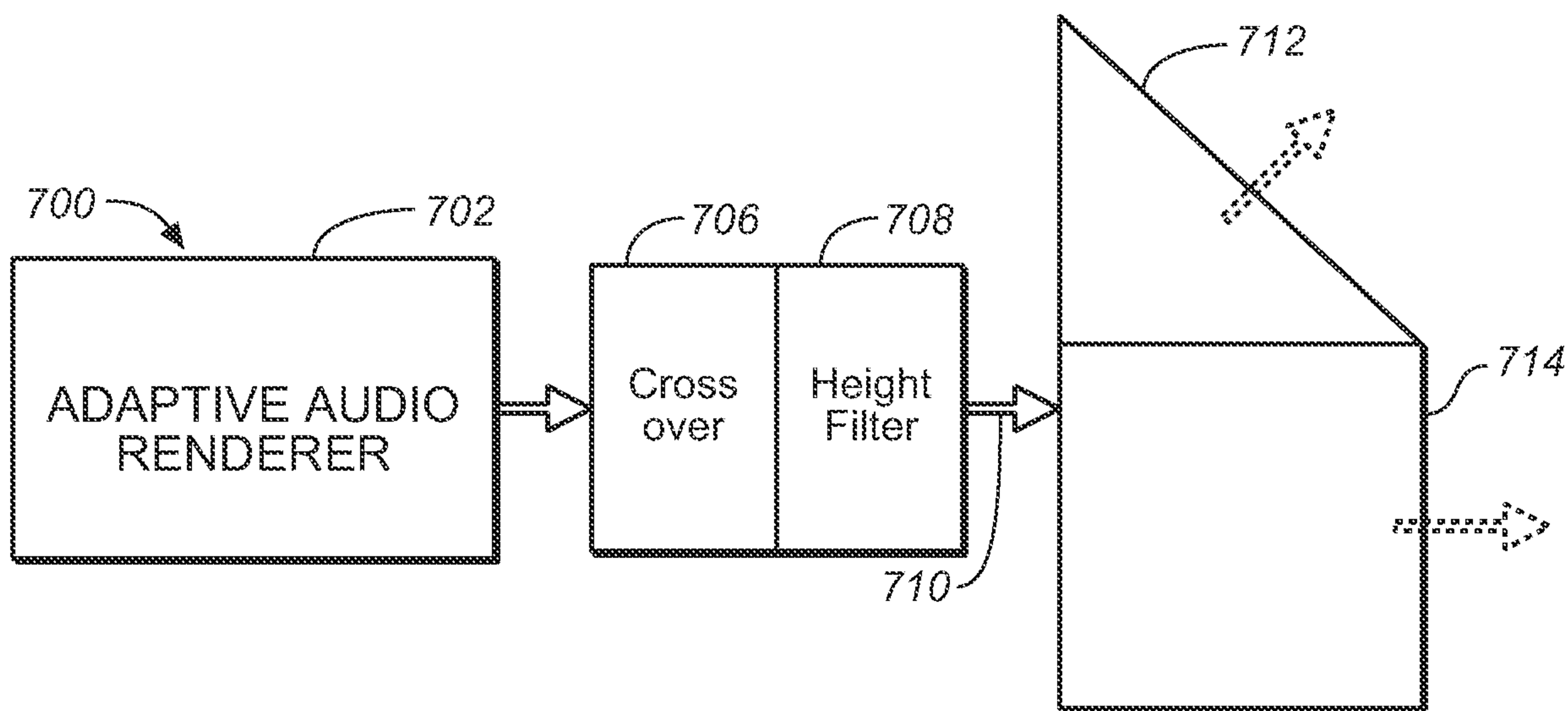


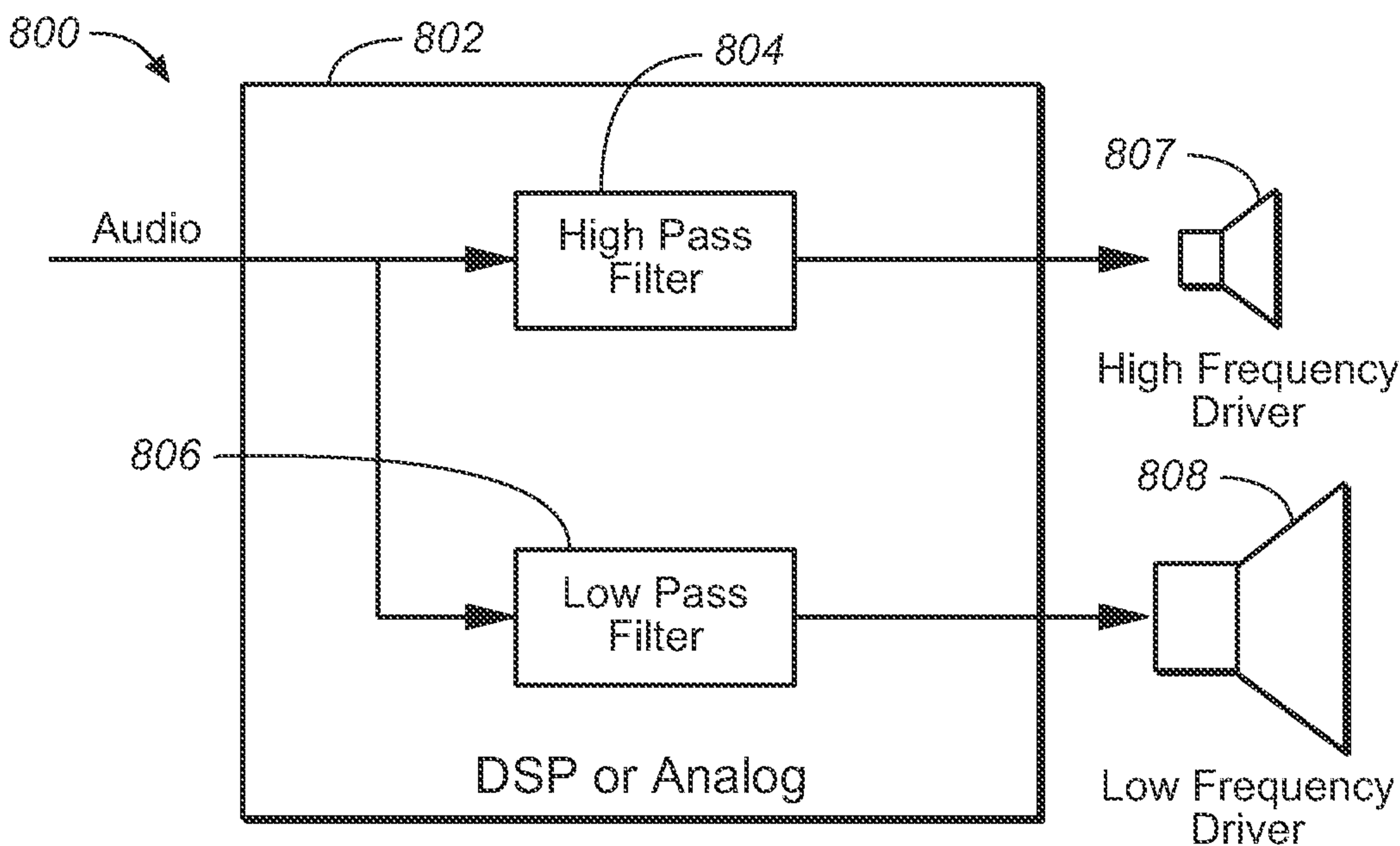
FIG. 5



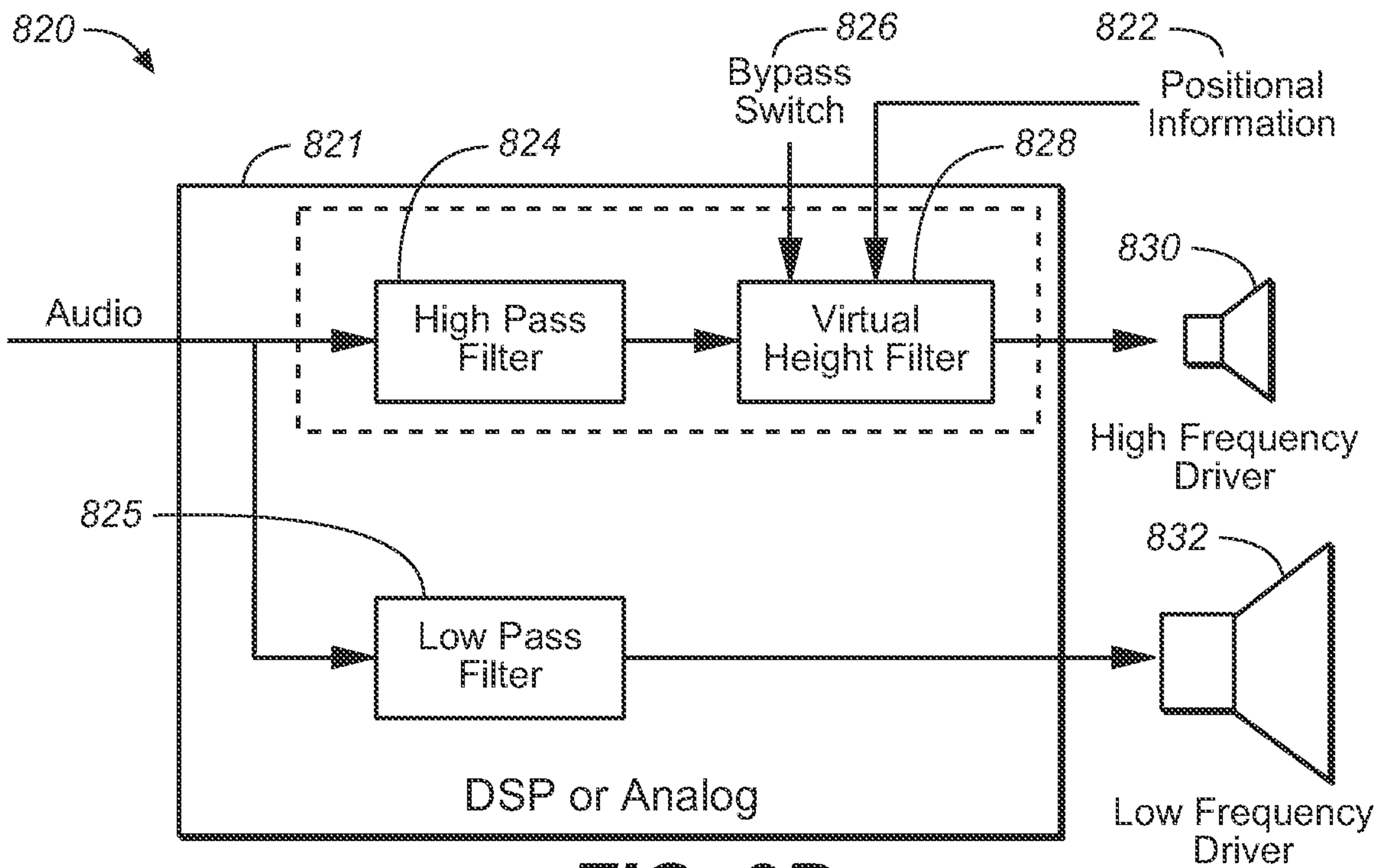
**FIG. 6**



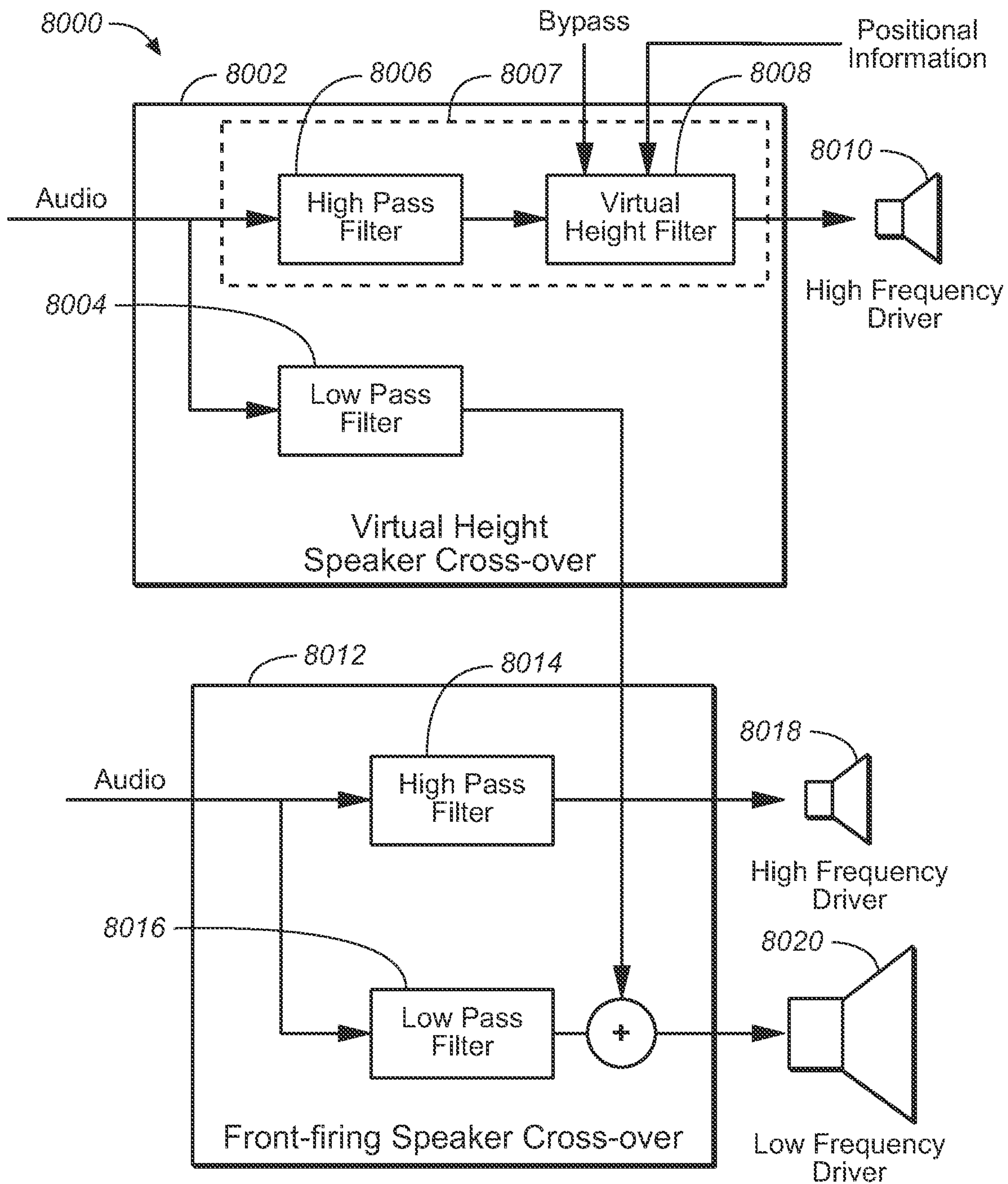
**FIG. 7**



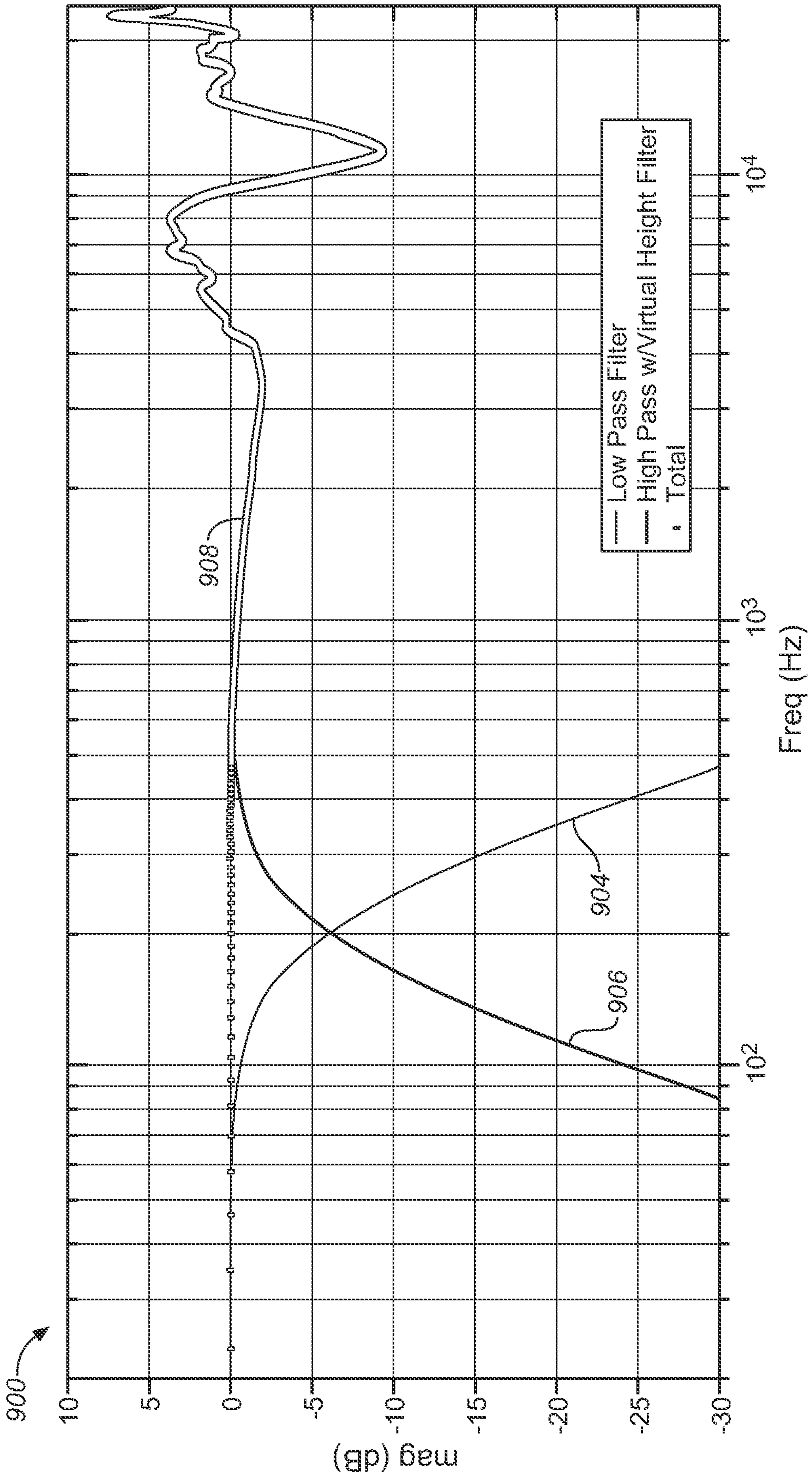
**FIG. 8A**



**FIG. 8B**



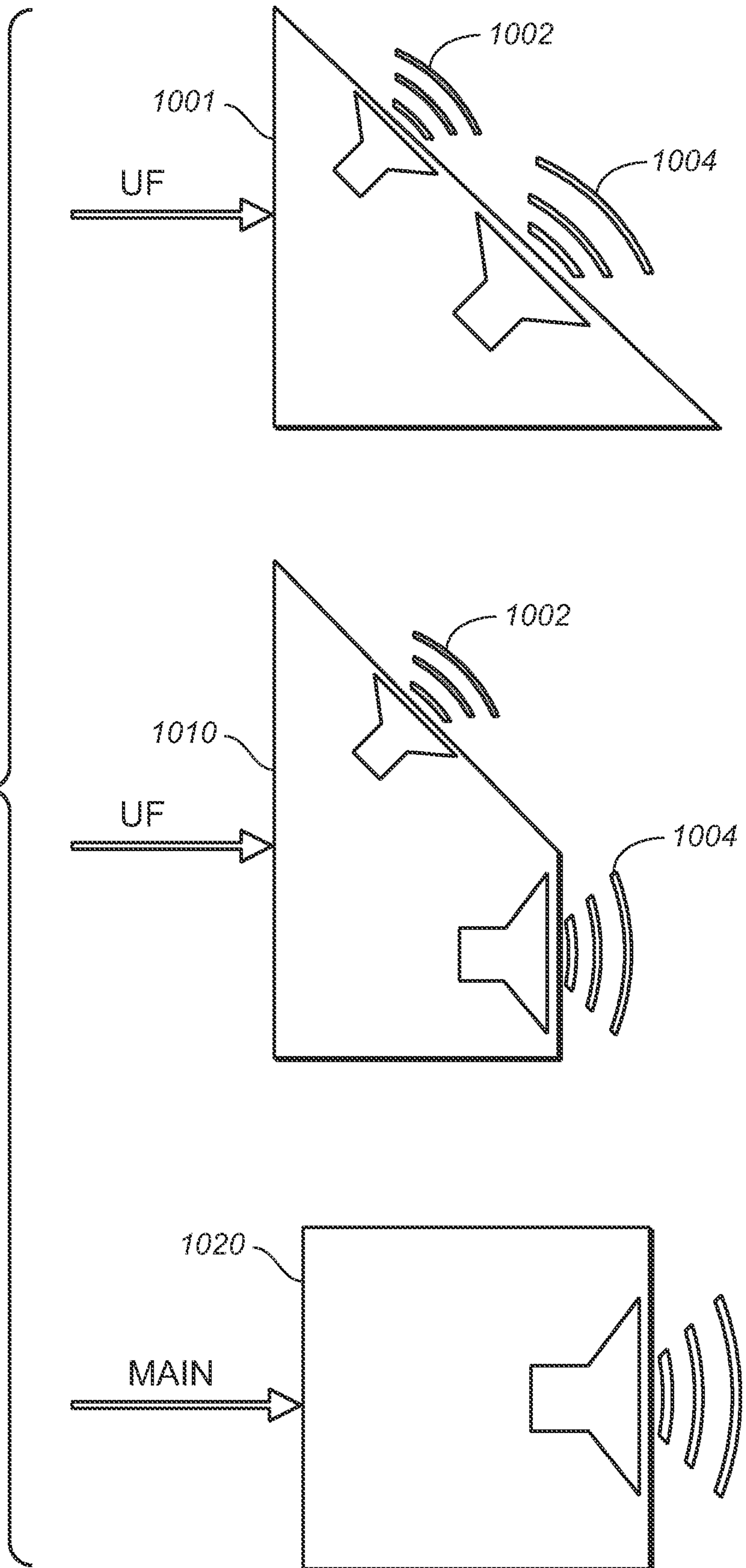
**FIG. 8C**

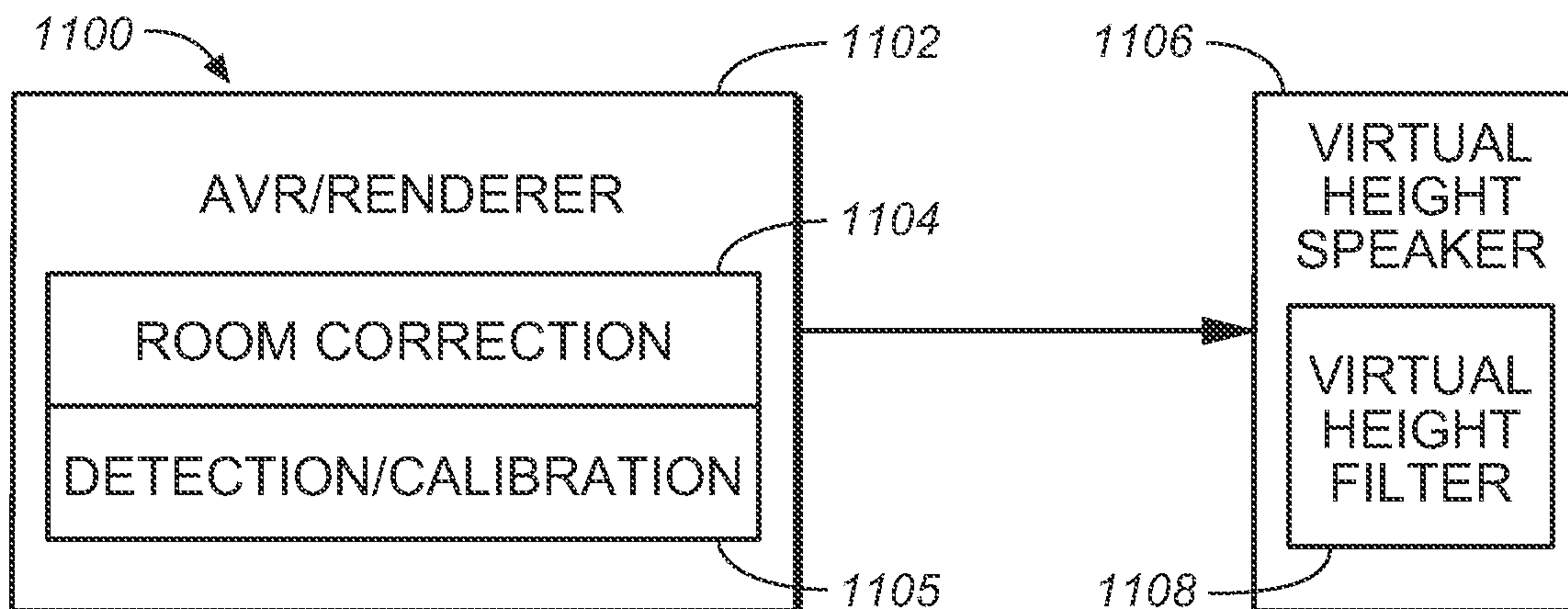


**FIG. 9**

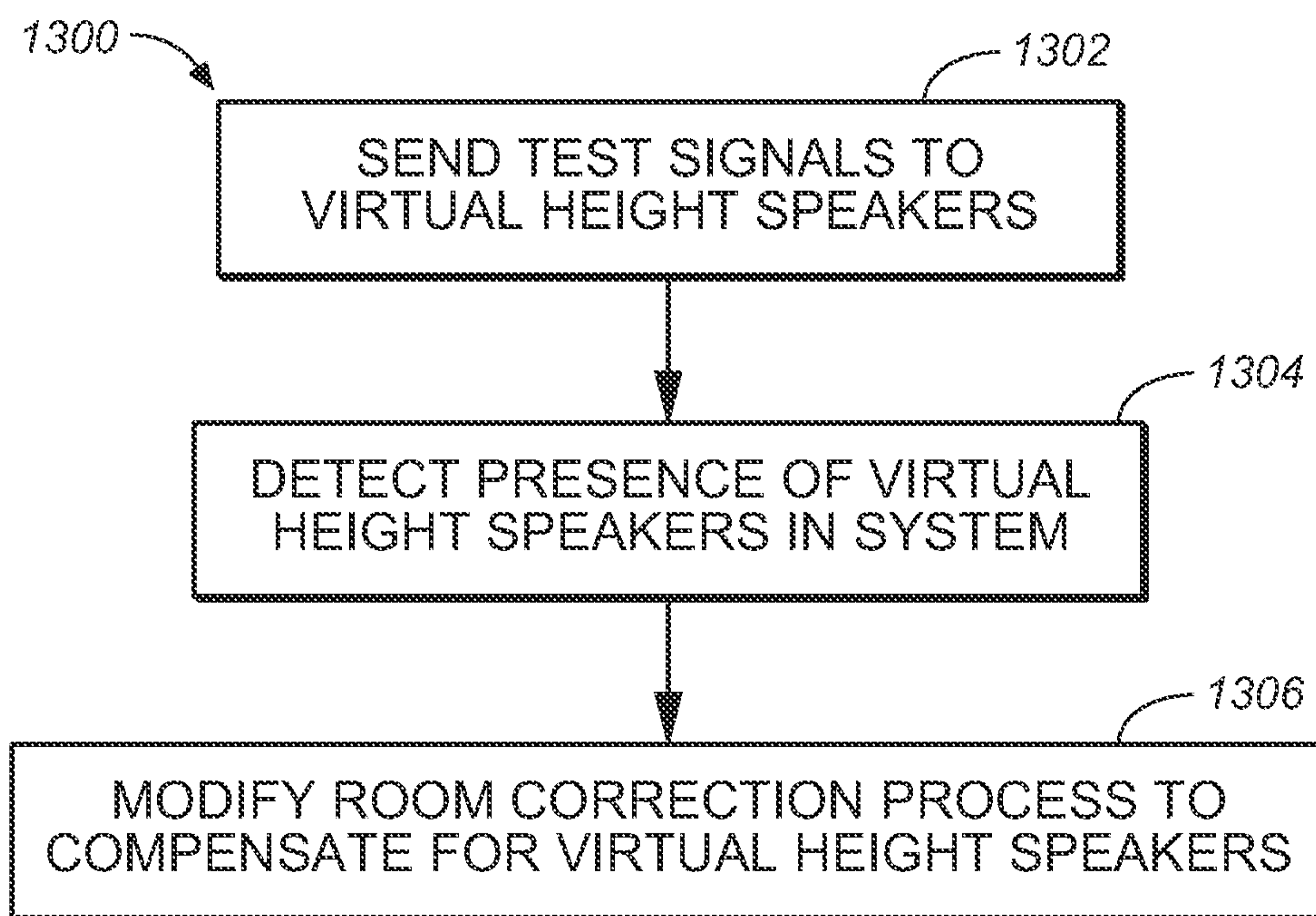


**FIG. 10**

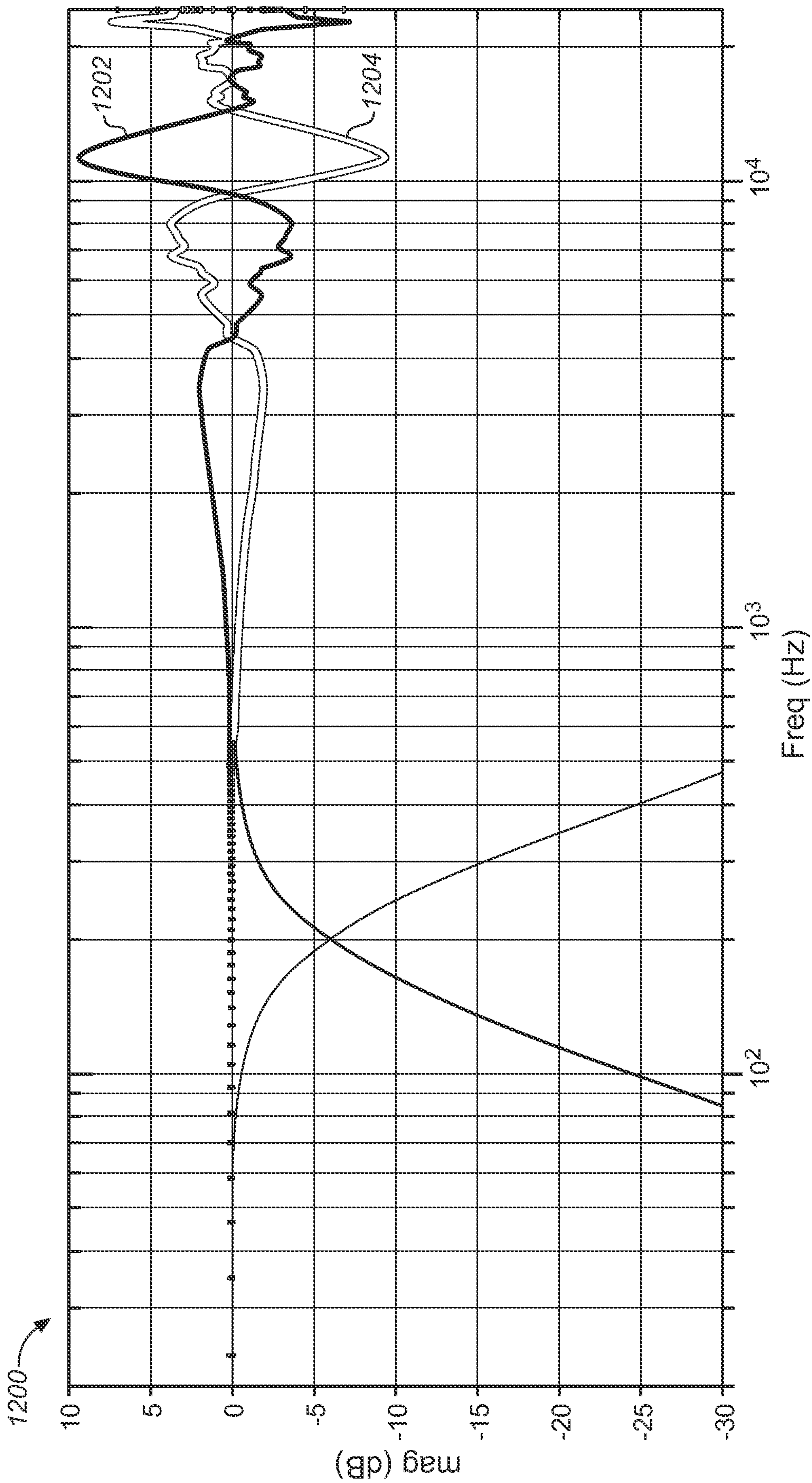




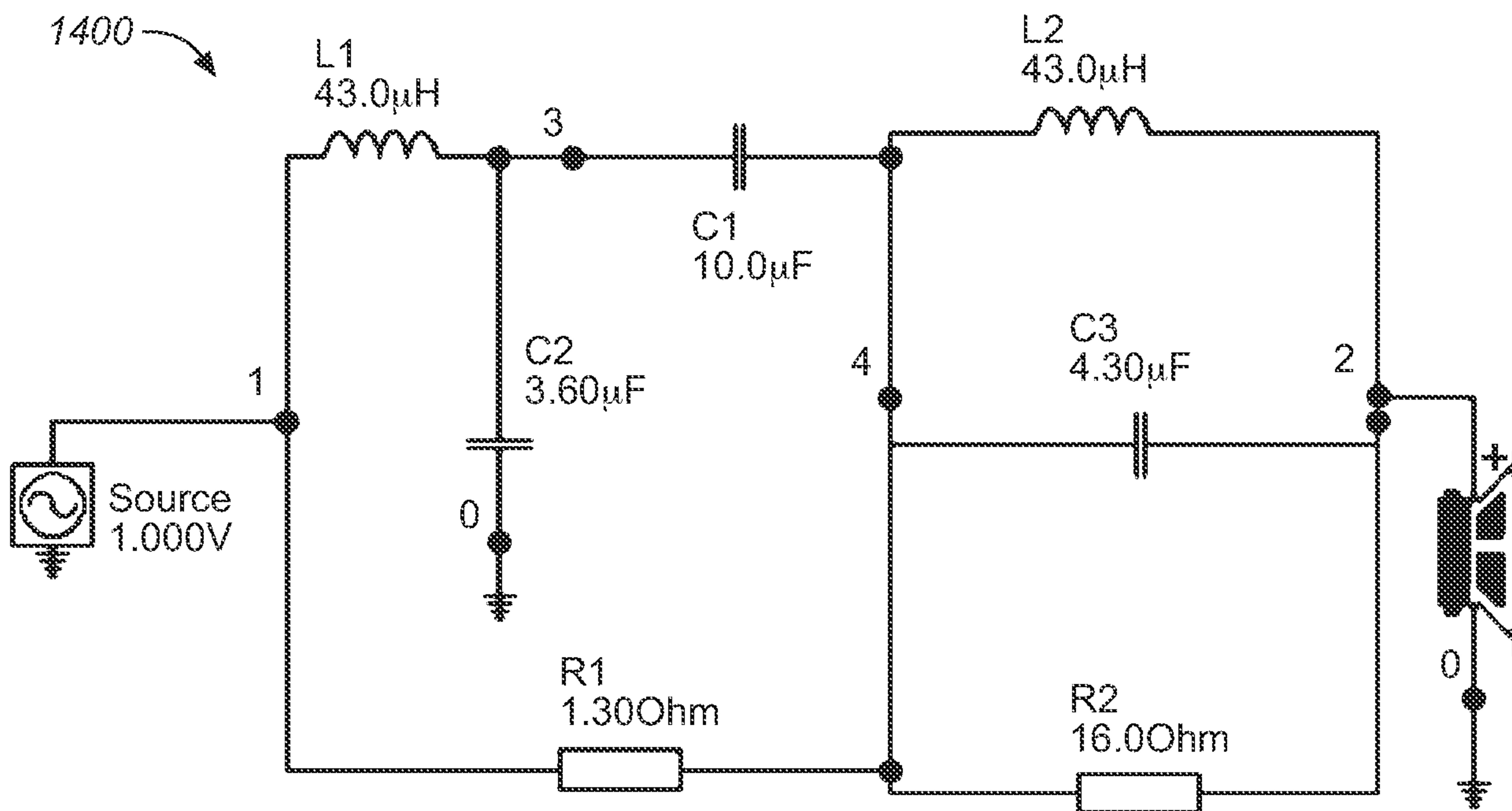
**FIG. 11**



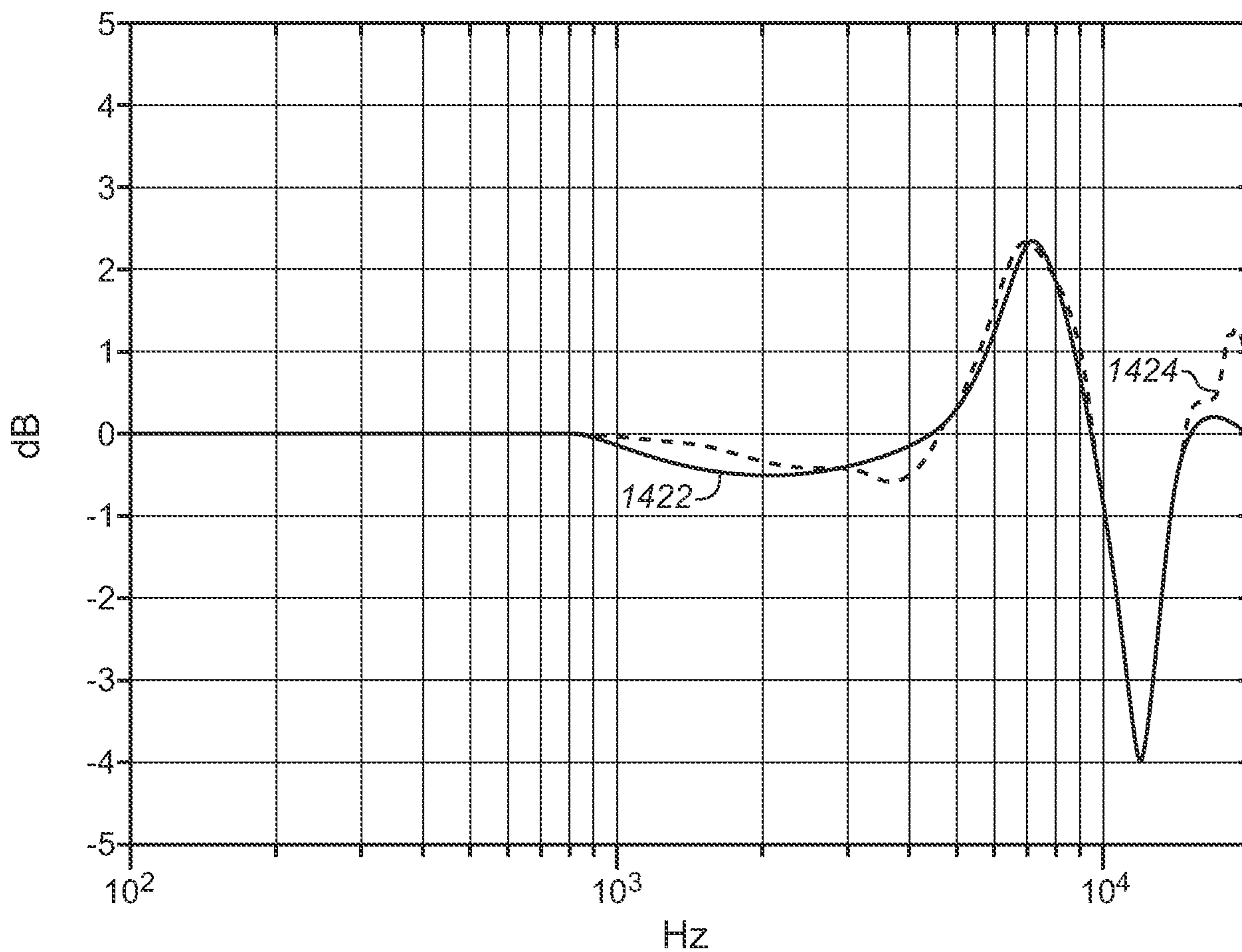
**FIG. 13**



**FIG. 12**

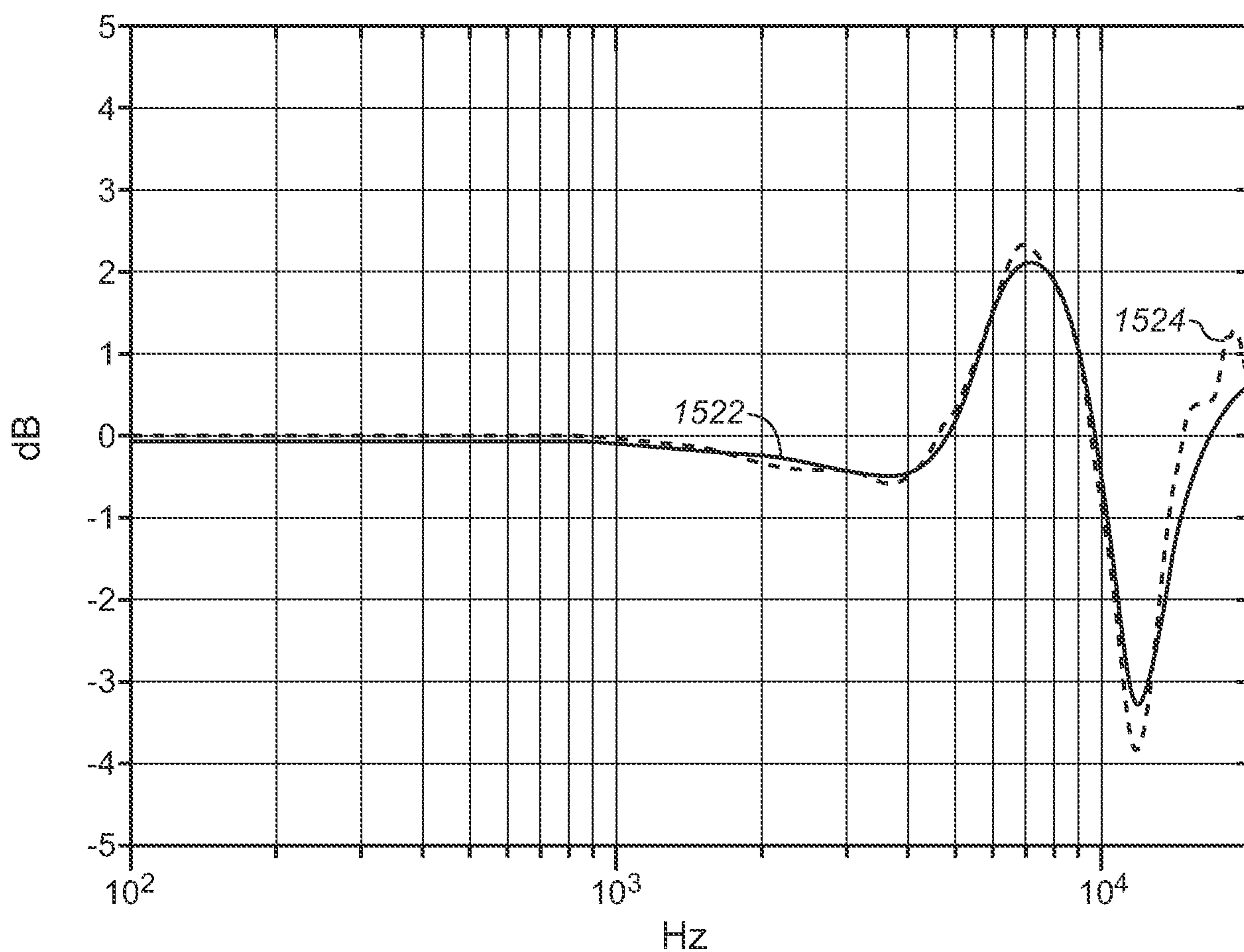


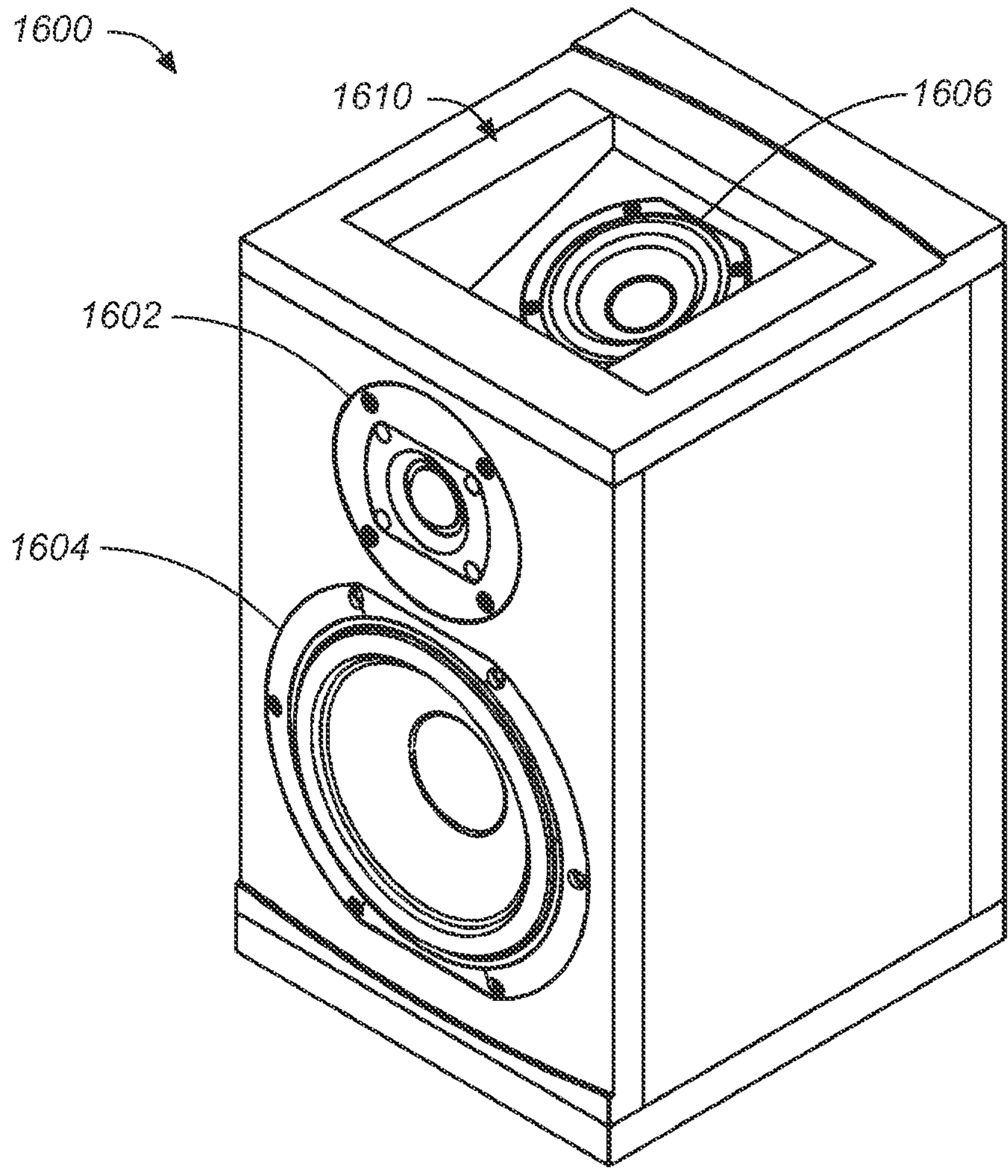
**FIG. 14A**



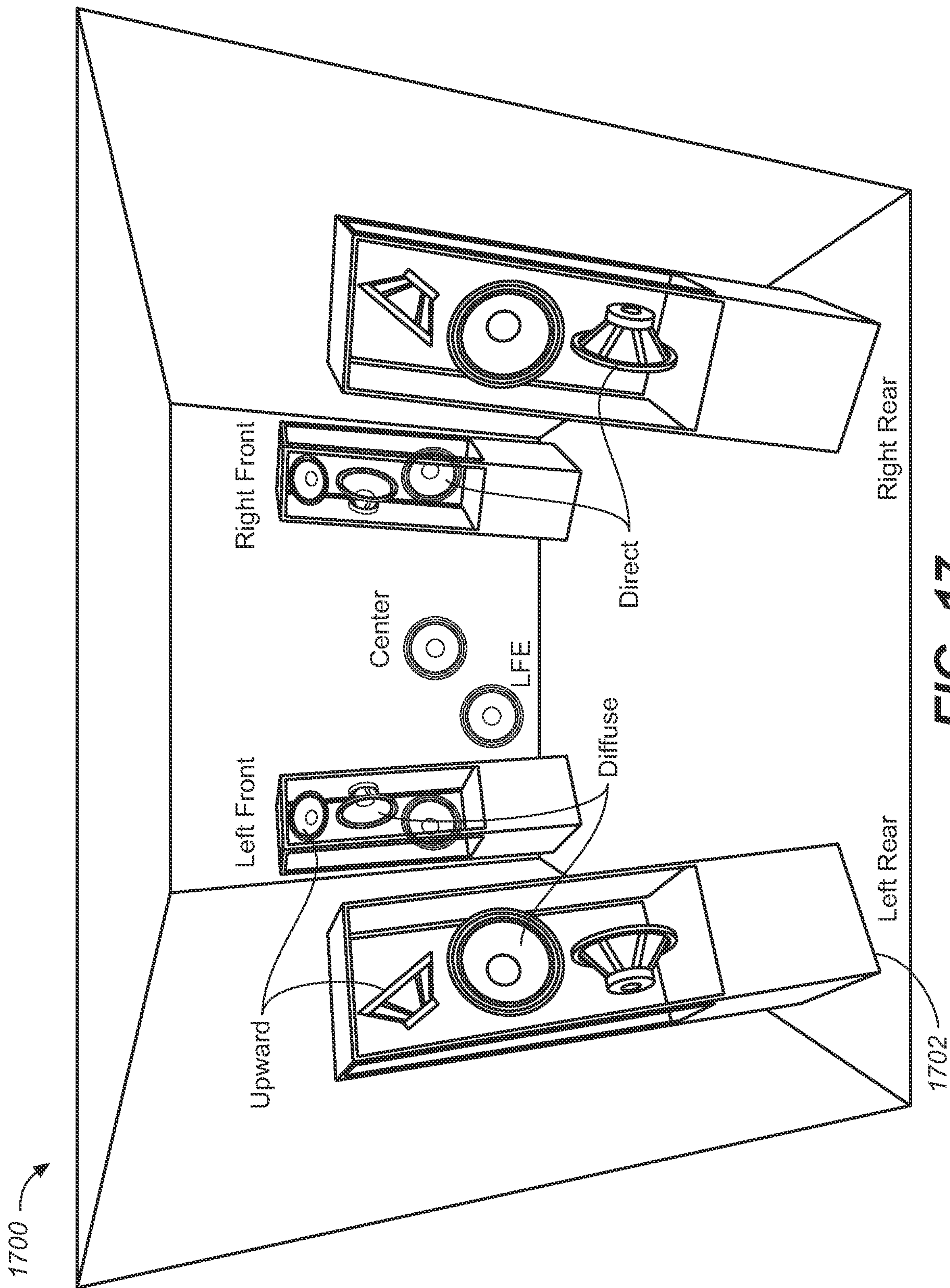
**FIG. 14B**

$$H(z) = \frac{0.9911 - 1.3044z^{-1} + 1.3382z^{-2} - 0.8314z^{-3} + 0.3840z^{-4}}{1.000 - 1.3143z^{-1} + 1.2533z^{-2} - 0.6224z^{-3} + 0.2656z^{-4}}$$

**FIG. 15A****FIG. 15B**



**FIG. 16**



**FIG. 17**





**FIG. 1**

