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Askeland et al.

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(54) **CONTROLLING THERMAL, ACOUSTIC, AND/OR ELECTROMAGNETIC PROPERTIES OF A COMPUTING DEVICE**

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(52) **U.S. Cl.** ..... **361/687**; 361/695; 361/724; 454/184; 700/304

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(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,568,243 A *	2/1986	Schubert et al. ....	415/213.1
4,971,520 A *	11/1990	Van Houten .....	416/169 A
5,000,079 A *	3/1991	Mardis .....	454/184
5,440,450 A *	8/1995	Lau et al. ....	361/695
5,530,202 A *	6/1996	Dais et al. ....	174/35 R
5,566,749 A *	10/1996	Jordan et al. ....	165/80.3
5,838,551 A *	11/1998	Chan .....	361/818
5,867,365 A *	2/1999	Chiou .....	361/690
6,037,732 A *	3/2000	Alfano et al. ....	318/471
6,064,571 A *	5/2000	Noble .....	361/695
6,122,169 A *	9/2000	Liu et al. ....	361/700

6,141,213 A *	10/2000	Antonuccio et al. ....	361/687
6,163,454 A *	12/2000	Strickler .....	361/695
6,172,872 B1 *	1/2001	Katsui .....	361/695
6,219,236 B1 *	4/2001	Hirano et al. ....	361/695
6,247,898 B1 *	6/2001	Henderson et al. ....	417/3
6,351,380 B1 *	2/2002	Curlee et al. ....	361/695
6,362,977 B1 *	3/2002	Tucker et al. ....	361/818
6,400,049 B1 *	6/2002	Lai .....	310/67 R

(Continued)

**OTHER PUBLICATIONS**

Chang JY et al., *Identification of Minimum Air Flow Design for a Desktop Computer Using CFD Modeling*, 2000 *Inter Society Conference on Thermal Phenomena*, pp. 330-338, 2000.\*

Lundquist and Carey, *Microprocessor-Based Adaptive Thermal Control for an Air-Cooled Computer CPU Module*, *Seventeenth IEEE Semi-Therm Symposium*, pp. 168-173, 2001.\*

Yu and Webb, *Thermal Design of a Desktop Computer System Using CFD Analysis*, *Seventeenth IEEE Semi-Therm Symposium*, pp. 18-26, 2001.\*

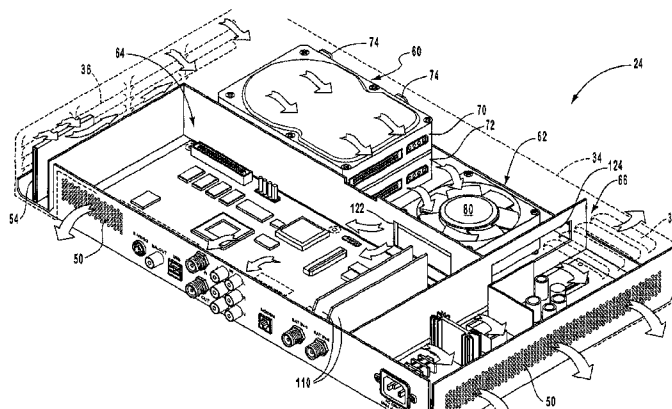
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(57) **ABSTRACT**

A computing device includes a housing with various electrical and/or mechanical components included therein. Disposed within the housing is a processor assembly that includes a fan. The fan is configured to draw air into the interior of the housing and force air heated by the internal components of the computing device from the interior of the housing. The fan has a diameter that is larger than the smallest dimension of the three orthogonal dimensions of the housing of the computing device and generates low levels of acoustic noise having a low frequency. Additionally, the processor assembly includes a support structure that supports the fan and reduces the effects of electromagnetic emissions generated by a processor of the processor assembly upon electrical devices adjacent to the computing device.

**21 Claims, 6 Drawing Sheets**



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## U.S. PATENT DOCUMENTS

6,462,670 B1	*	10/2002	Bologna et al. ....	340/815.45	6,597,972 B2	*	7/2003	Emberty et al. ....	700/304
6,526,333 B1	*	2/2003	Henderson et al. ....	700/300	6,659,292 B2	*	12/2003	Gough et al. ....	211/26
6,587,337 B2	*	7/2003	Sasaki .....	361/687					

\* cited by examiner

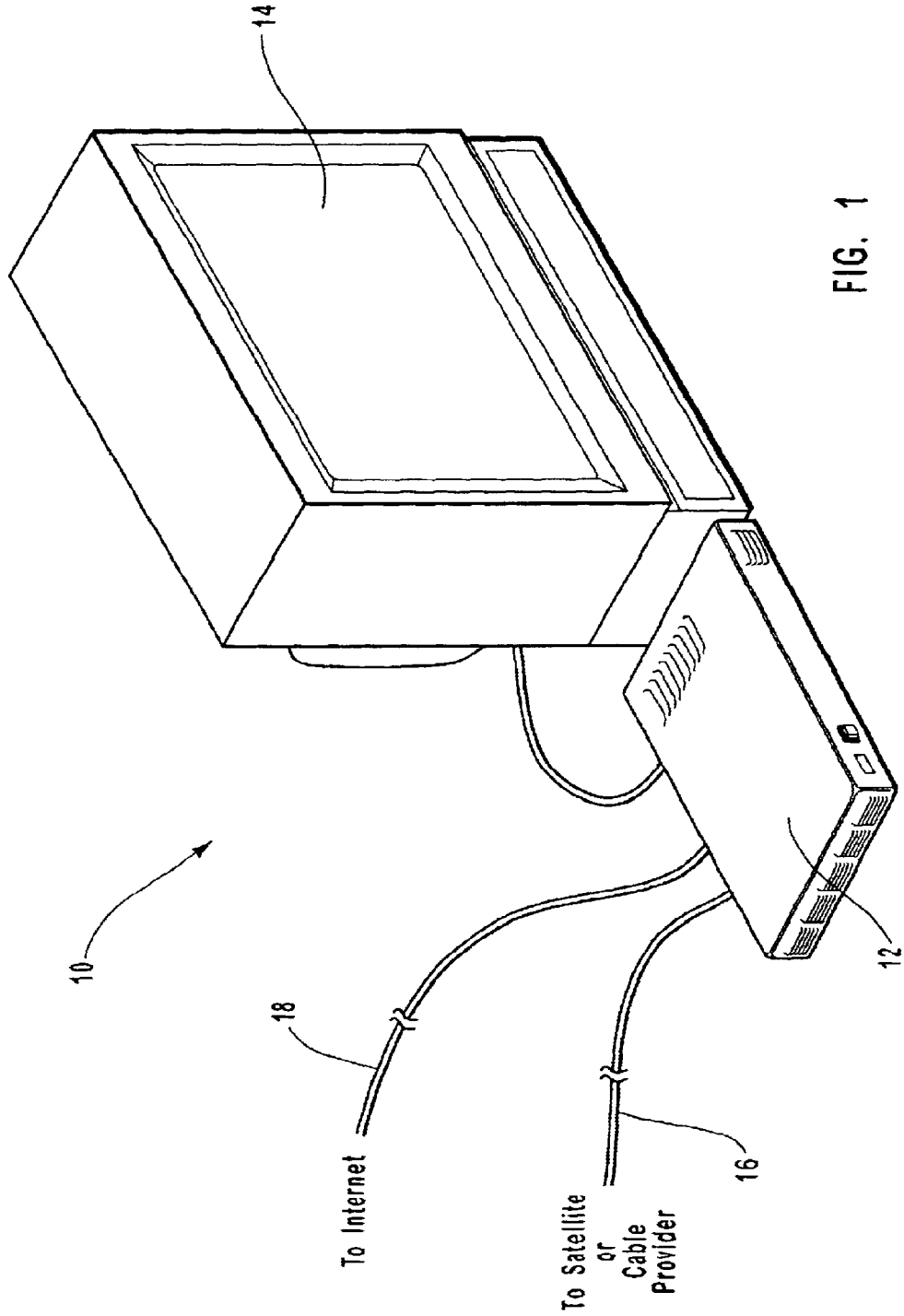


FIG. 1

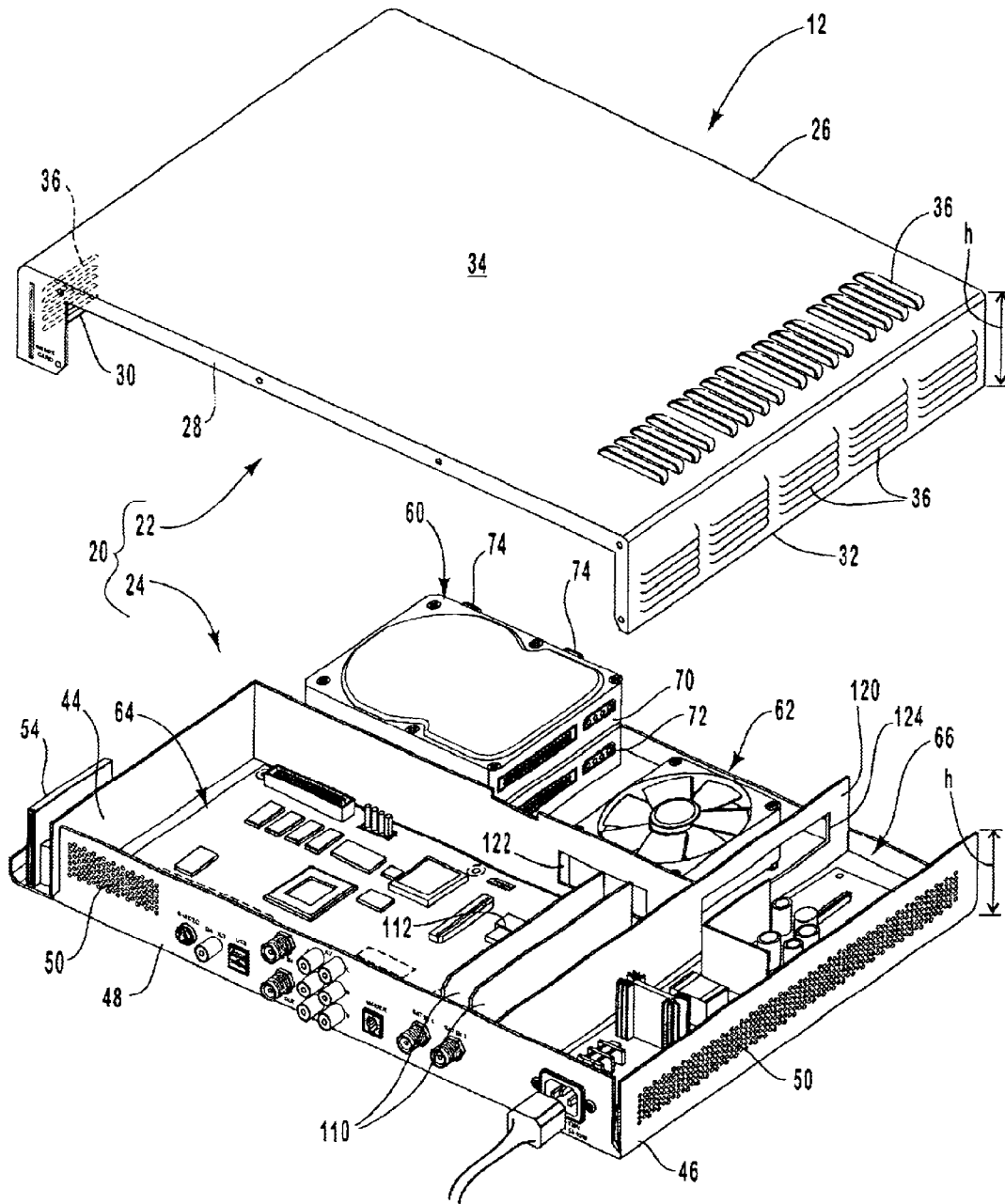


Fig. 2

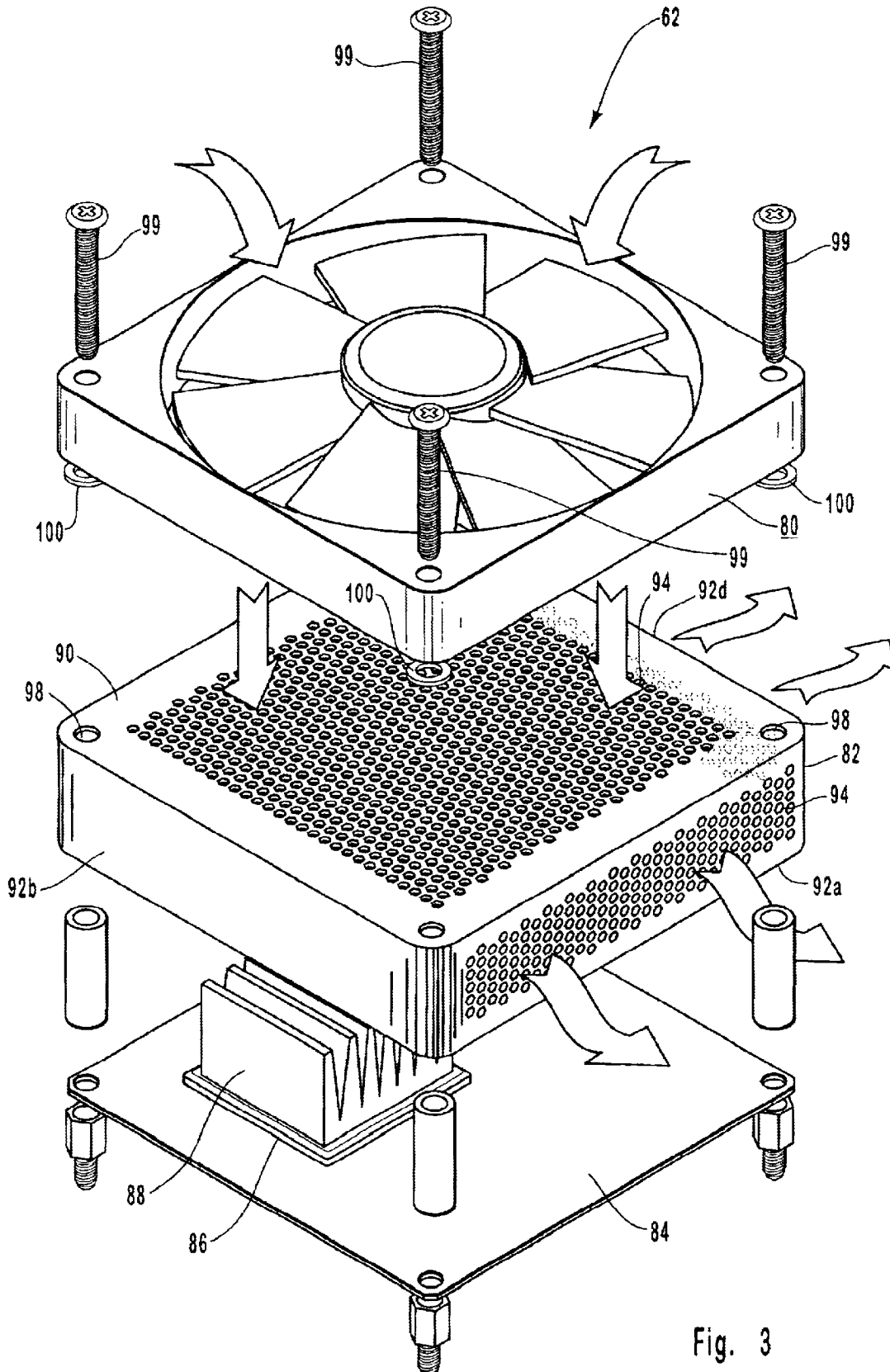


Fig. 3

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