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**Marcinkiewicz et al.**

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(54) **LOW NOISE HEATING, VENTILATING AND/OR AIR CONDITIONING (HVAC) 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 300 days.

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(51) **Int. Cl.**  
**H02P 21/00** (2006.01)

(52) **U.S. Cl.** ..... **318/400.02**; 318/400.32; 318/599

(58) **Field of Classification Search** ..... 318/400.02, 318/400.32, 400.34, 459, 500, 432, 599  
See application file for complete search history.

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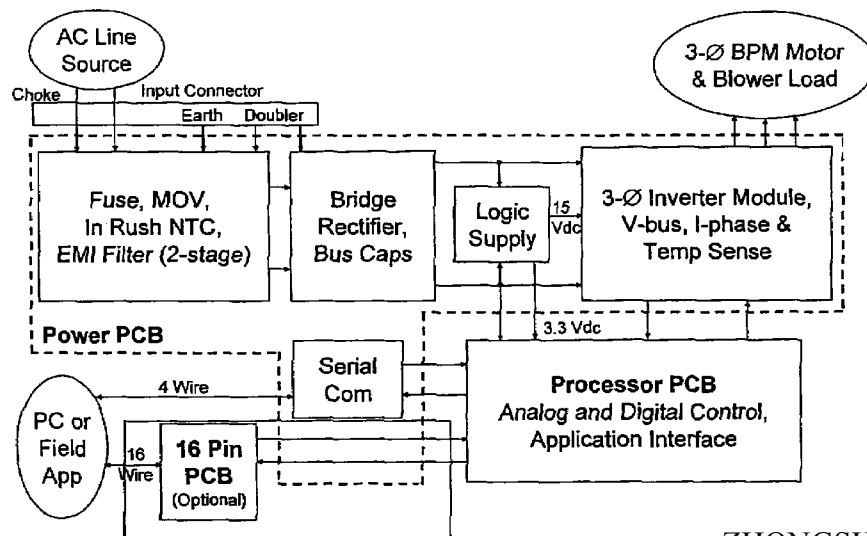
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(57) **ABSTRACT**

A heating, ventilating and/or air conditioning (HVAC) system includes a system controller, a motor controller, an air-moving component, and a permanent magnet motor having a stationary assembly, a rotatable assembly in magnetic coupling relation to the stationary assembly, and a shaft coupled to the air-moving component. The motor controller is configured for performing sinewave commutation in response to one or more control signals received from the system controller to produce continuous phase currents in the permanent magnet motor for driving the air-moving component. By using sinewave commutation (in contrast to square wave commutation), the noise and vibration produced by the HVAC system is markedly reduced.

**20 Claims, 4 Drawing Sheets**



ZHONGSHAN BROAD OCEAN  
MOTOR CO., LTD.  
Exhibit 1001

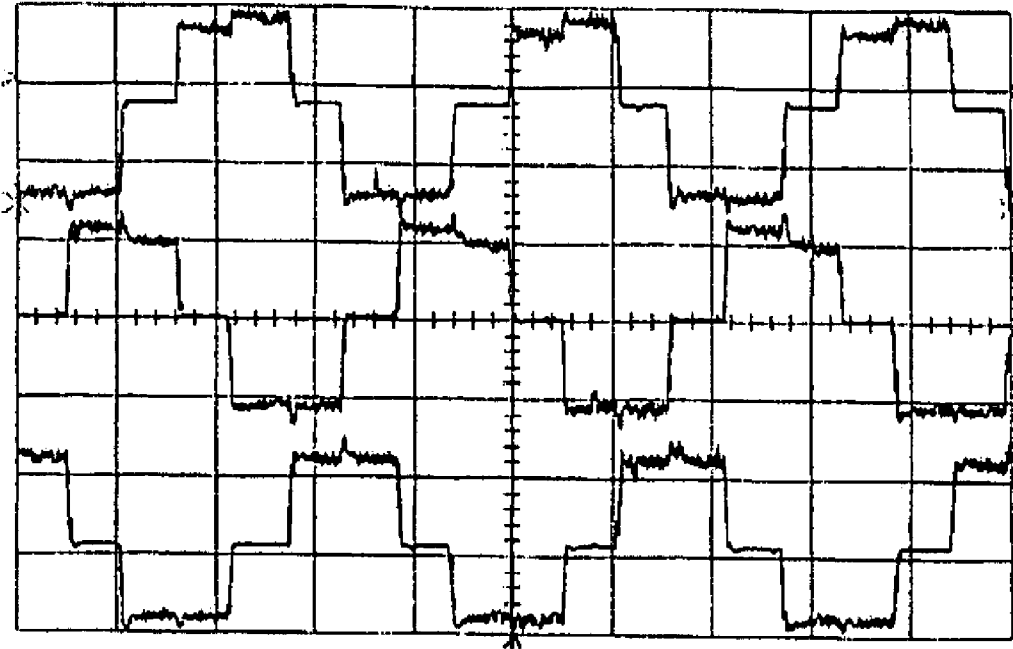


Figure 1  
(Prior Art)

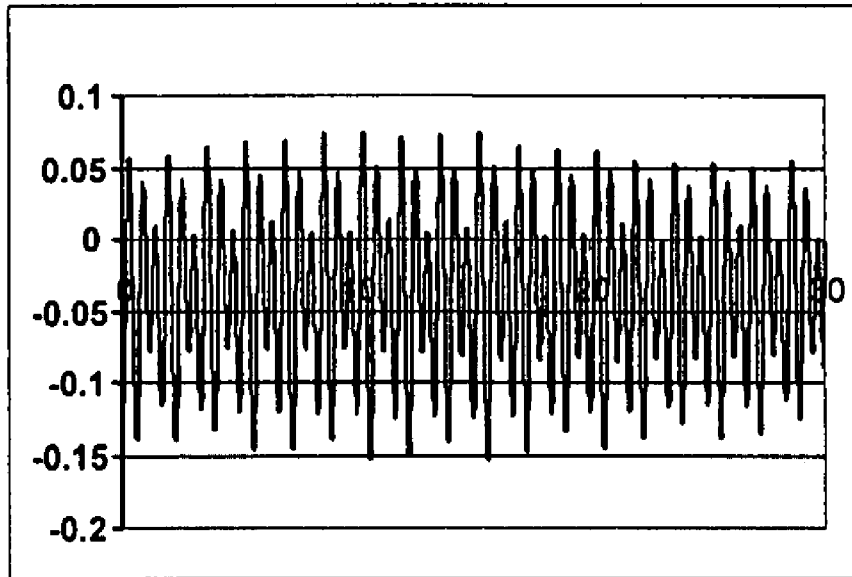


Figure 2  
(Prior Art)

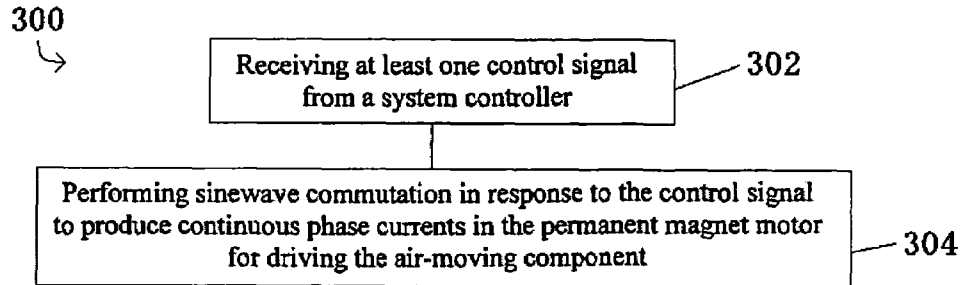


Figure 3

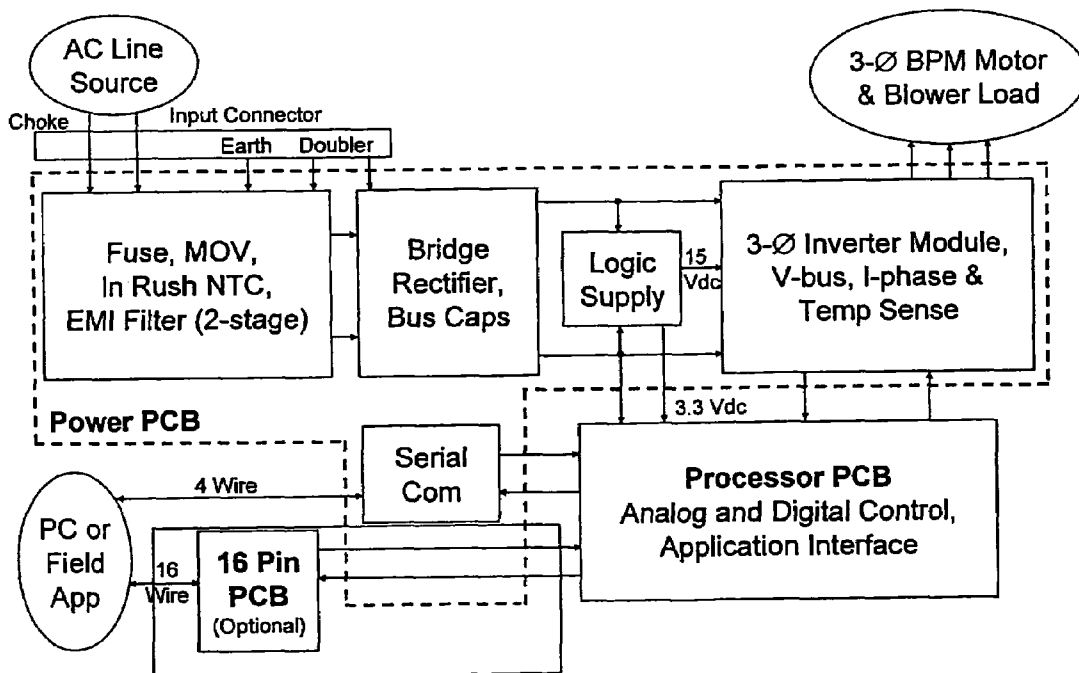


Figure 7

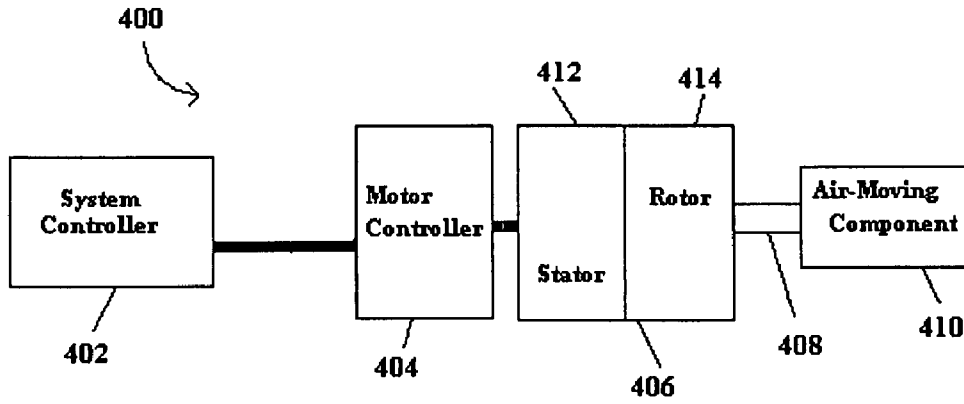


Figure 4

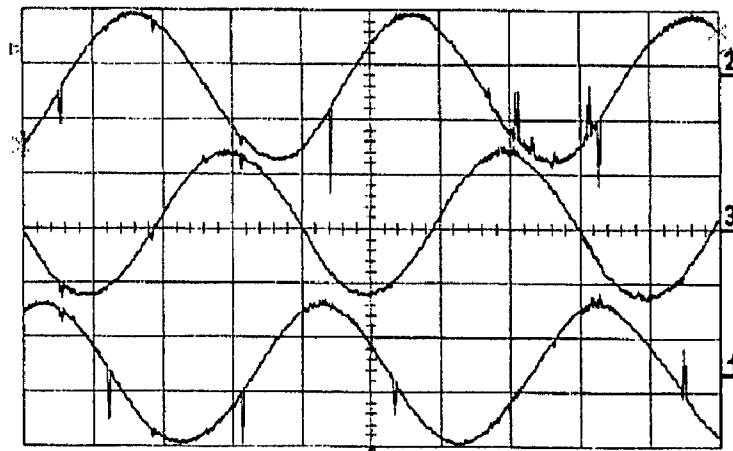


Figure 5

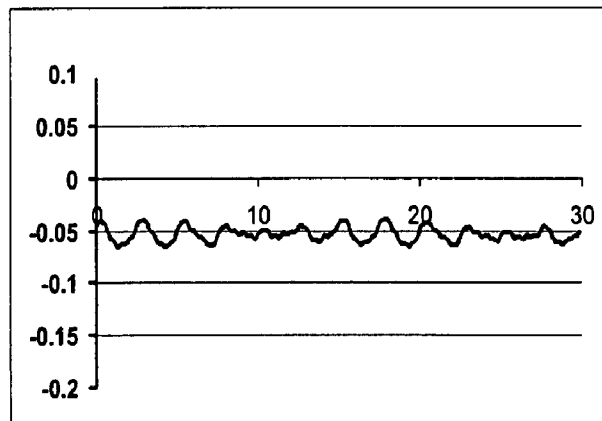


Figure 6

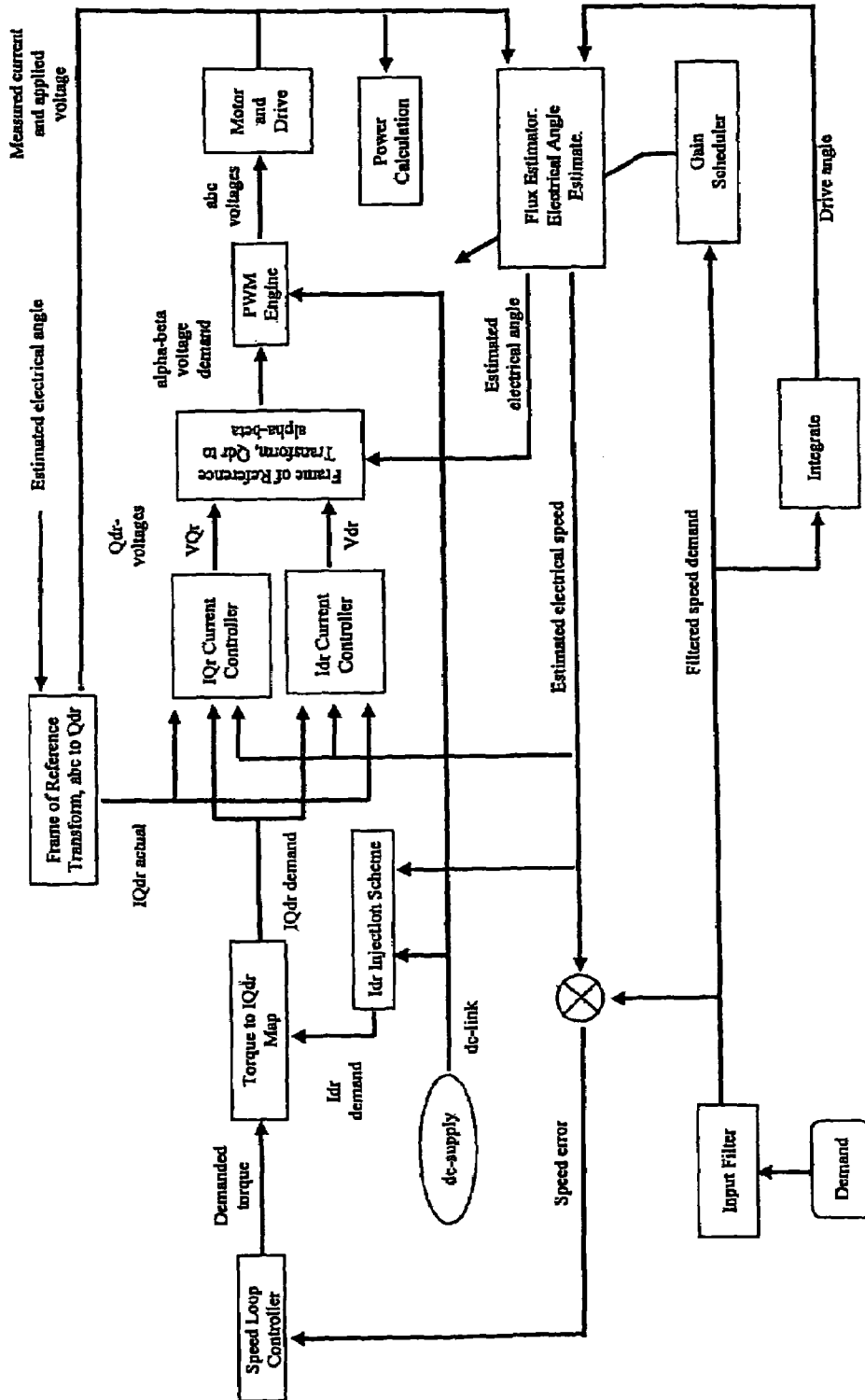


Figure 8

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