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Chen et al.

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(54) **LOW RIPPLE TORQUE CONTROL OF A PERMANENT MAGNET MOTOR WITHOUT USING CURRENT SENSORS**

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Related U.S. Application Data

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(51) **Int. Cl.**⁷ **H02K 17/32; H02K 23/68; H02K 27/30; H02P 7/00**

(52) **U.S. Cl.** **318/434; 318/805; 318/799; 318/806**

(58) **Field of Search** 318/434, 798-801, 318/805, 806, 808-812, 599

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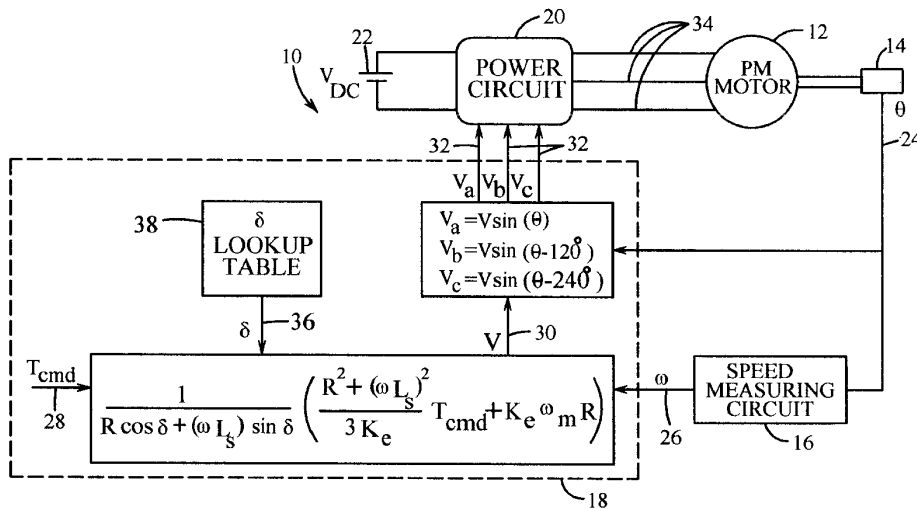
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(57) **ABSTRACT**

A method and apparatus for controlling the torque of and reducing torque ripple in a permanent magnet motor without using current sensors. By eliminating the need for current sensors, low frequency torque ripple is reduced. A voltage mode control method is implemented to control the motor. In response to the position and speed of the rotor and a torque command signal, a controller develops motor voltage command signals indicative of the voltage required to produce the desired motor torque. A rotor position encoder determines the angular positions of the rotor. From the angular positions of the rotor, a speed measuring circuit determines the speed of the rotor. The position and speed signals are applied to the controller. The controller uses this information and develops the motor voltage command signals indicative of the voltage needed to produce the desired motor torque. An inverter is coupled between a power source and the controller. The circuit applies phase voltages to the motor, in response to the motor voltage command signals, to produce the desired motor torque.

18 Claims, 3 Drawing Sheets



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FIG. 1

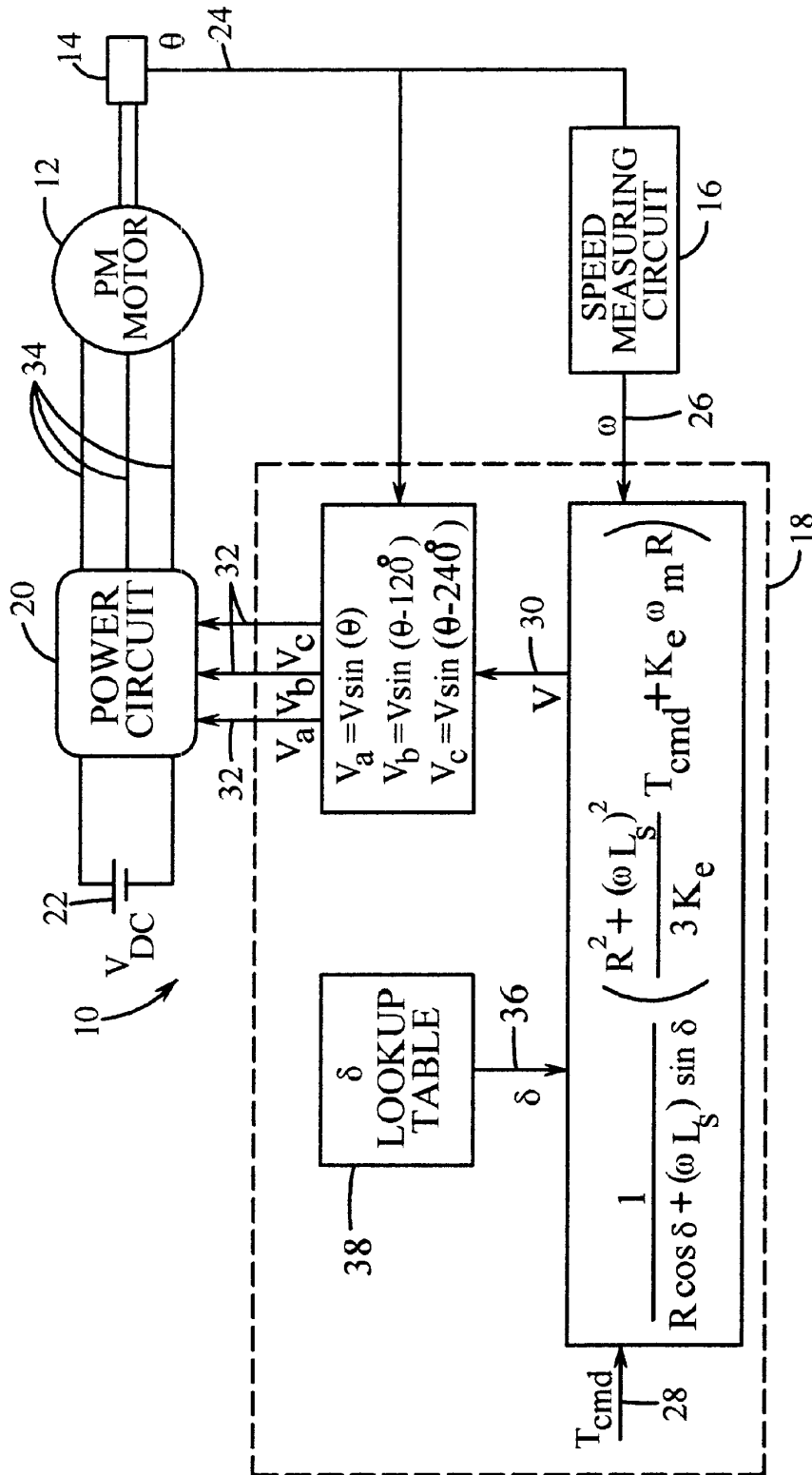


FIG. 2

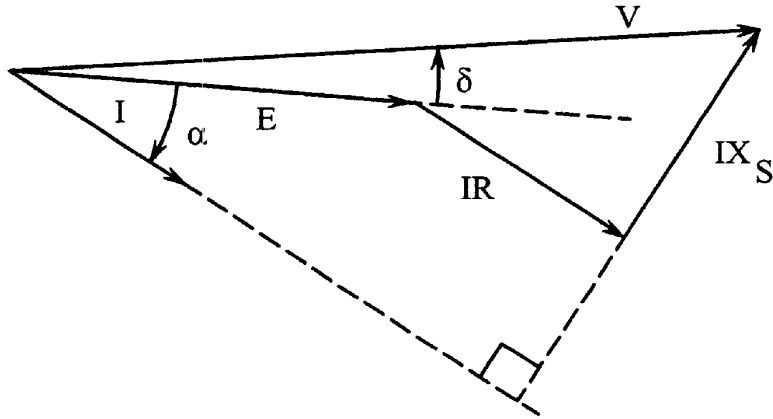


FIG. 3

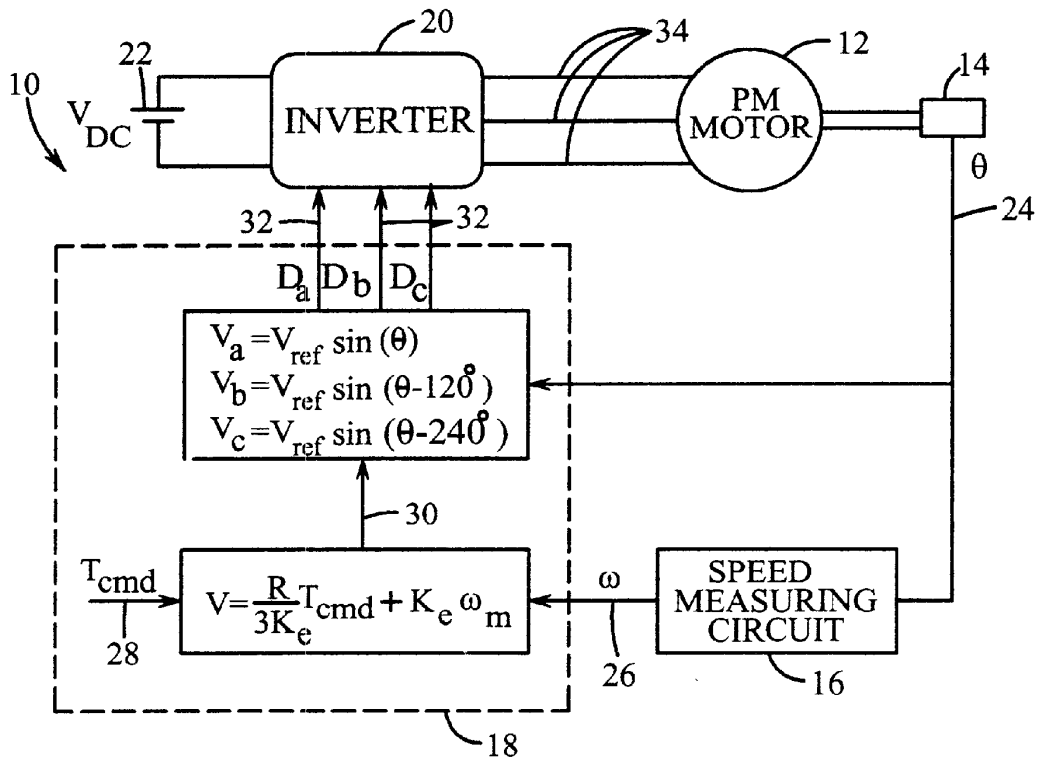


FIG. 4

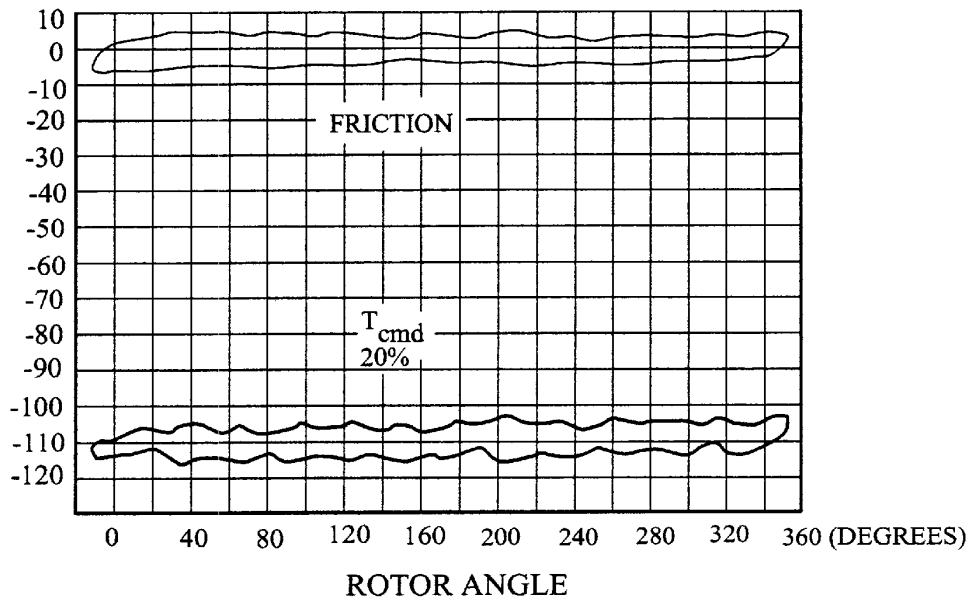
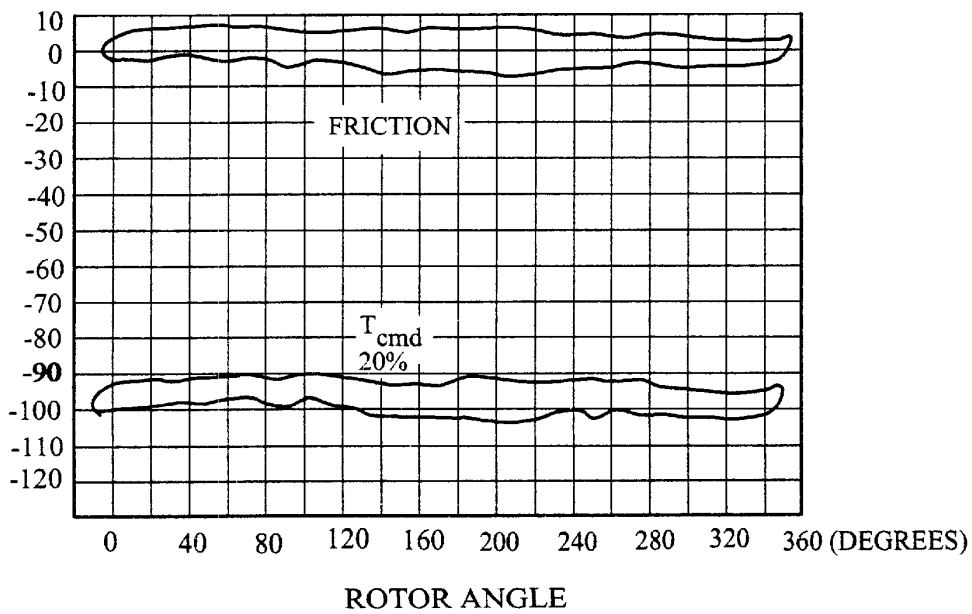


FIG. 5



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