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Marcinkiewicz et al.

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(54) **CONTROL SYSTEMS AND METHODS FOR PERMANENT MAGNET ROTATING MACHINES**

(56) **References Cited**

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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 0 days.

(21) Appl. No.: **11/293,743**

(57) **ABSTRACT**

(22) Filed: **Dec. 2, 2005**

(65) **Prior Publication Data**

US 2006/0290304 A1 Dec. 28, 2006

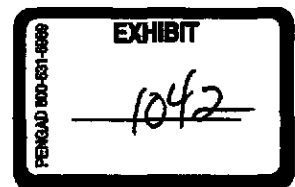
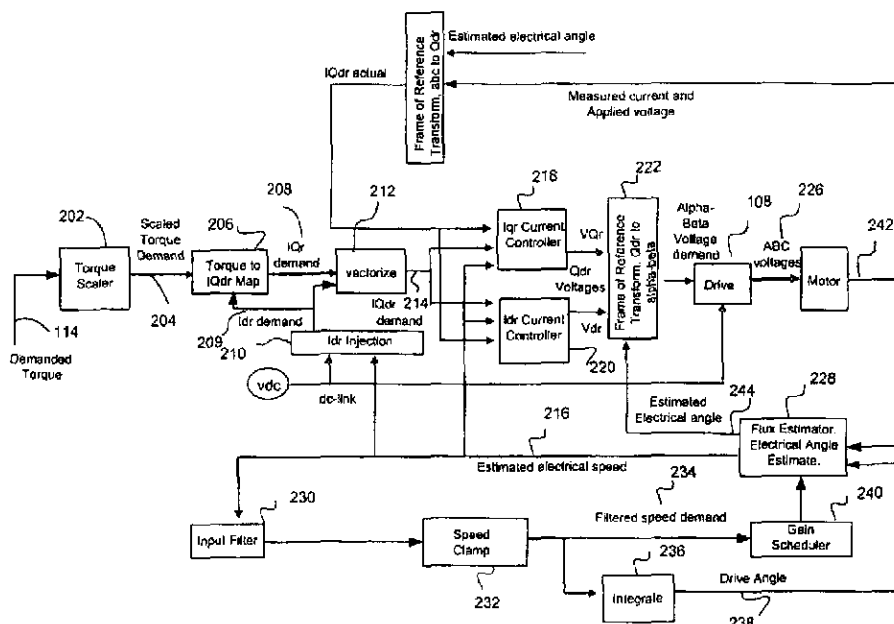
Related U.S. Application Data

(60) Provisional application No. 60/694,077, filed on Jun. 24, 2005, provisional application No. 60/694,066, filed on Jun. 24, 2005.

Systems and methods for controlling a rotating electromagnetic machine. The rotating machine, such as a permanent magnet motor or hybrid switched reluctance motor, includes a stator having a plurality of phase windings and a rotor that rotates relative to the stator. A drive is connected to the phase windings for energizing the windings. A controller outputs a control signal to the drive in response to inputs of demanded torque, rotor position and/or speed. Control methods include calculating a scaled torque demand from the received torque demand to obtain substantially constant torque over a range of motor speeds, calculating an optimal d-axis injection current using a cost function and a starting method that switches from speed control mode to torque control mode at a predetermined rotor speed or at predetermined start-up timing intervals.

(51) **Int. Cl.**
H02K 21/00 (2006.01)
(52) **U.S. Cl.** **318/254; 318/138; 318/439; 318/701**
(58) **Field of Classification Search** **318/754, 318/138, 439, 701, 717, 723, 798, 815, 432, 318/433; 388/907.5, 902, 815**
See application file for complete search history.

23 Claims, 8 Drawing Sheets



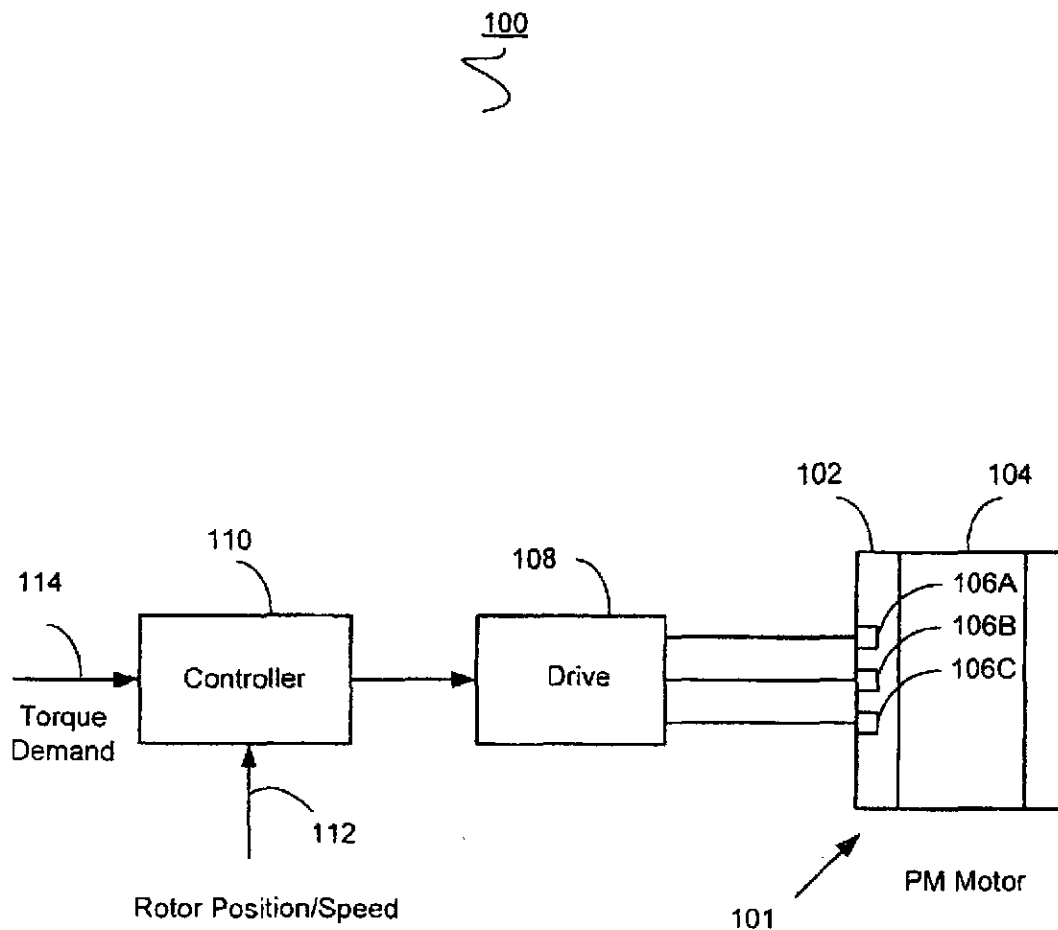


FIG. 1

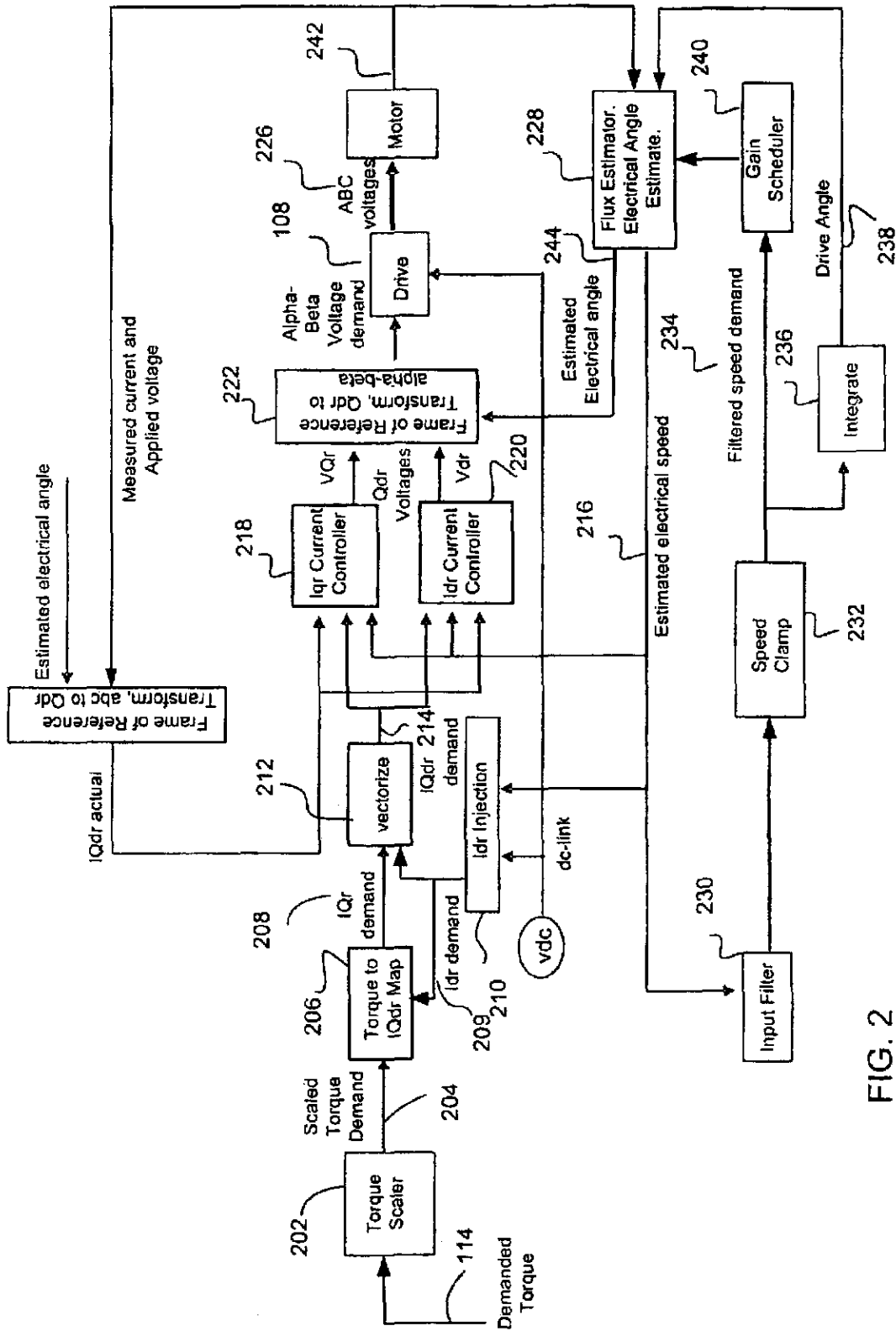


FIG. 2

300

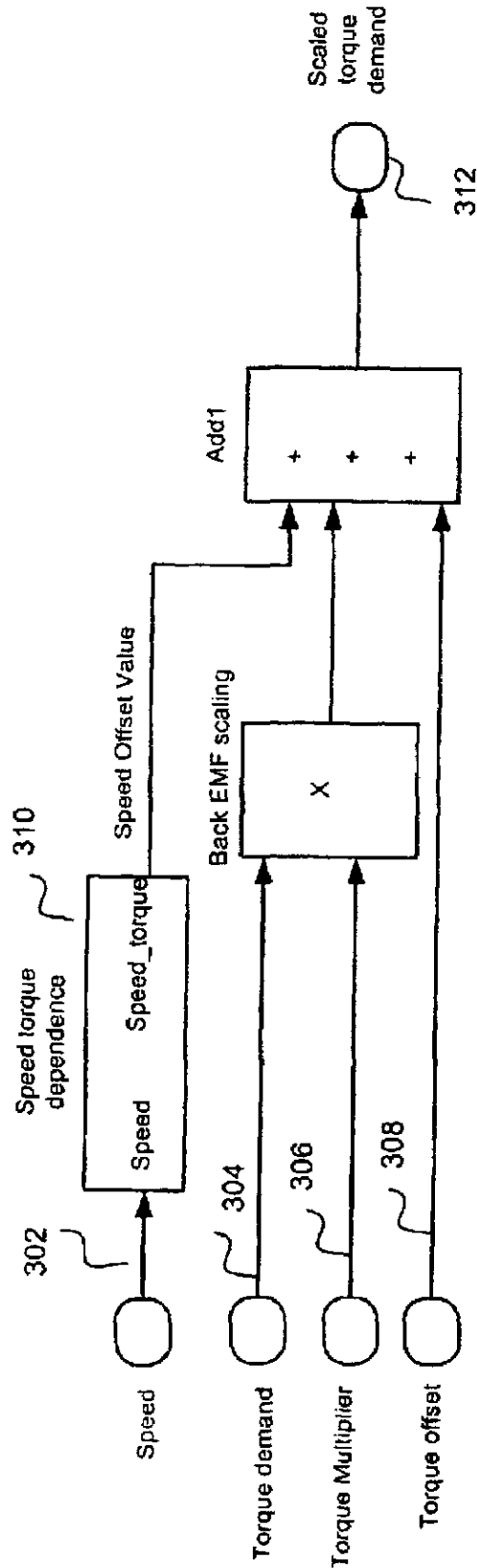


FIG. 3

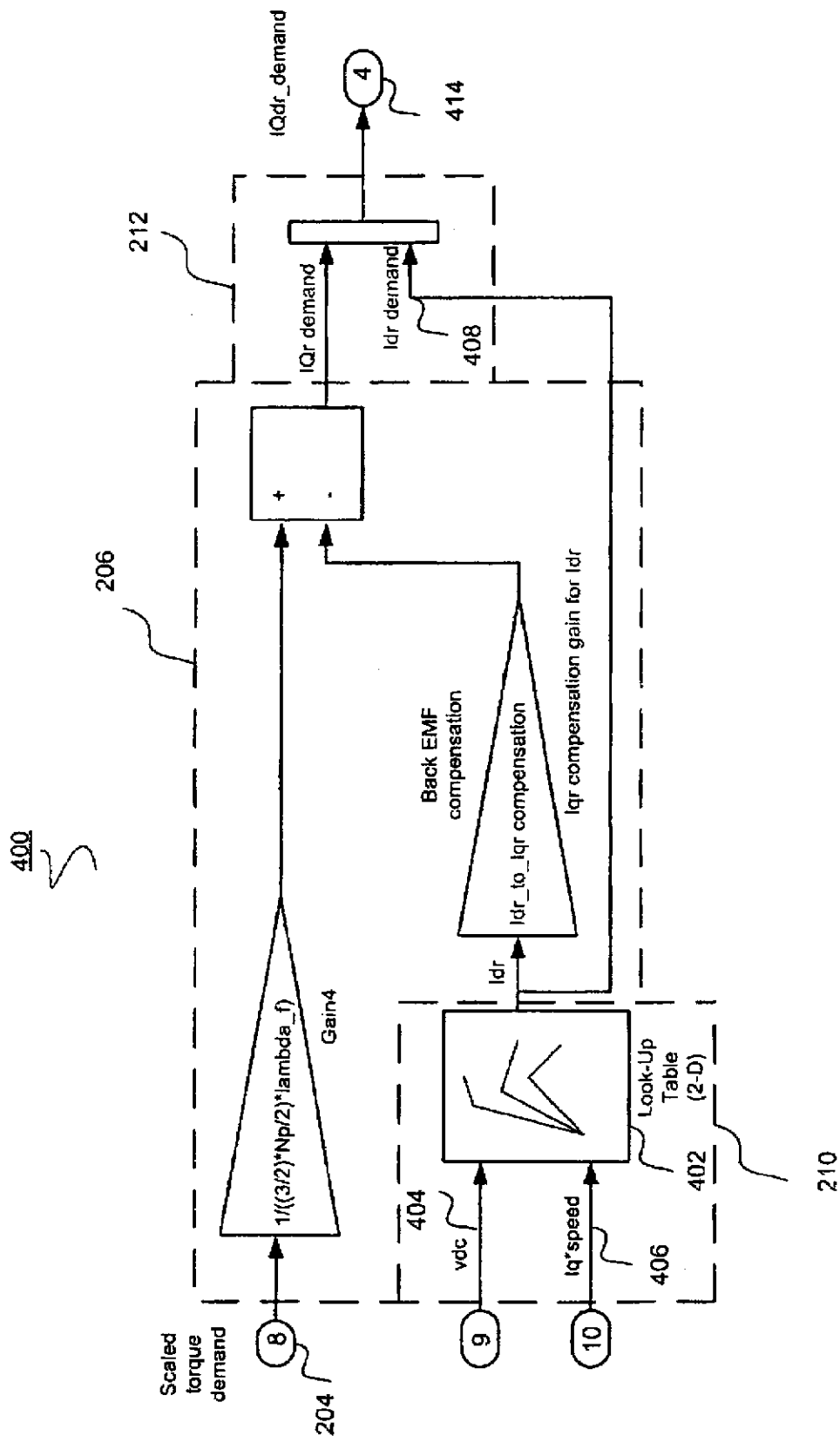


FIG. 4

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