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[54] **HYBRID ELECTRIC VEHICLE**

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[52] **U.S. Cl.** **180/65.2**; 180/65.6; 180/165; 60/718; 475/2; 475/5

[58] **Field of Search** 180/65.2, 65.3, 65.4, 180/65.6, 165; 60/716, 718; 475/2, 5, 8, 9

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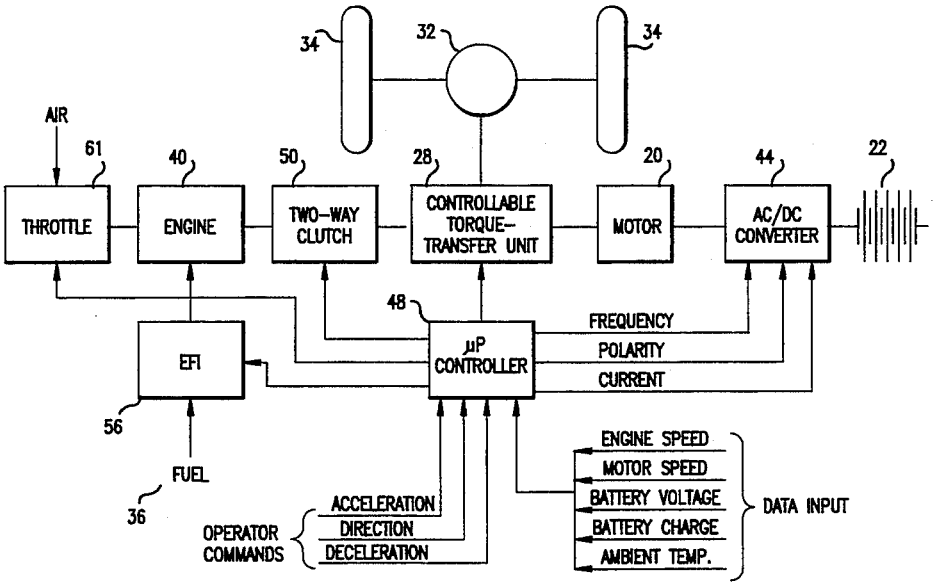
[57] **ABSTRACT**

An improved hybrid electric vehicle includes an internal combustion engine and an electric motor. Both the motor and the engine provide torque to drive the vehicle directly through a controllable torque transfer unit. Typically at low speeds or in traffic, the electric motor alone drives the vehicle, using power stored in batteries; under acceleration and during hill climbing both the engine and the motor provide torque to drive the vehicle; and in steady state highway cruising, the internal combustion engine alone drives the vehicle. The internal combustion engine is sized to operate at or near its maximum fuel efficiency during highway cruising. The motor is operable as a generator to charge the batteries as needed and also for regenerative braking. No transmission is employed. The motor operates at significantly lower currents and higher voltages than conventionally and has a rated power at least equal to that of the internal combustion engine. In this manner a cost efficient vehicle is provided, suffering no performance disadvantage compared to conventional vehicles.

40 Claims, 12 Drawing Sheets