Technical Description of BARP

Preliminary

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Team Zero Project has evolved out of the concepts presented by inventor Michael Hargett and his efforts to further his ideas. Modeling and testing of the *Battery Alternating Recharging Process (BARP),* developed by Michael Hargett, as presented in Patent Application 20100001686, has been the recent goal of the Team Zero Project. The Albany, Oregon based Team has converted a ZAP![1] Xebra sedan into a proof of concept vehicle to demonstrate the efficiencies inherent in electrical power drives and the unique approach to maintaining perpetually charged batteries for continuous operation, over extended periods of time using, the BARP.

The process requires more than one battery pack; two battery packs are in the proof of concept vehicle. Each battery pack is stand-alone, designed to drive the electric motor transaxle system and operate the vehicle completely. The essential principal behind the BARP system is that the charging time for a battery pack is less than the discharge time under load. While one battery pack is operating the vehicle the other is off-line fully charged or being recharged by the BARP system.

When the battery pack in use reaches a state of discharge, the BARP system takes it off-line and switches to the freshly charged battery pack to continue to power the electric motor drive without interruption. The BARP vehicle management system then initiates charging of the off-line, discharged battery. Battery technology currently in commercial distribution meets the requirements of the BARP system for substantial gain in efficiency from hydrocarbon based drive systems. Batteries for electric vehicles (EV) are currently being marketed with charge times as fast as five minutes demonstrating the ability to accept high current inputs during the quick recharge process in BARP.

The proof of concept vehicle has a mass of approximately 1100 kg (2400 lb) and is driven by a high efficiency (93%) Azure Dynamics[2] 24 hp (18 kW) electric motor and transaxle module. Electric power to operate the Azure Dynamics transaxle is provided by Li-ion batteries that are designed to operate in a high discharge rate/quick recharge rate environment. During normal vehicle operation and recharging, the battery control system communicates with the vehicle operating system to initiate battery cooling and report battery temperature, report state of charge/ discharge rate, and signal battery faults for both batteries.

The proof of concept vehicle initially used two Li ion–iron phosphate battery packs with a capacity of approximately 30 MJ each. Each fully charged battery pack provides enough energy to drive at a constant speed of 60 mph (27 m/s) for approximately 60 minutes with a range of 60 miles. The battery packs are currently being upgraded to given even better performance.

The BARP system will work with any energy source to do the recharging. Initially the proof of concept vehicle used a 25 kW generator set which could fully charge one of the battery packs in about 24 minutes using about 0.64 gallons of gasoline. This gives a fuel efficiency of 94 mpg per charging cycle, about double that of the best hybrid vehicles on the market.

The generator set has been upgraded to a Kinetic Art and Technology[3] 338-4-34.3 high efficiency (97%) 30 kW generator driven by a 40 hp (30 kW) Kohler[4] Command Pro CH1000 gasoline engine, which should reduce the charging time to 20 minutes or less.

The vehicle has a five gallon gas tank. With each recharge cycle requiring 0.64 gallons to complete this allows 7.8 charge cycles. Starting with both battery packs fully charged and 60 miles traveled per charge results in a range of 540 miles before refueling and resulting in a fuel efficiency of 120 mpg for the test vehicle, a substantial improvement in efficiency over current hydrocarbon energy systems. At refueling the second battery pack would be 80% recharged. Because the battery packs would not start out fully charged the range is reduced to about 400 miles for each subsequent refueling.

Results from road tests of the proof of concept vehicle demonstrate the functionality of the BARP system and clearly show the efficiency gains to the power consumer that the BARP system provides.

The fact that the EV tested by Team Zero Project would not require plugging in to a nationwide established wired electrical grid provides for a vehicle solution that would not require the establishment of a supporting refueling network for EV. This improvement offered by BARP to the current state of establishing an efficient replacement of hydrocarbon fueled vehicles by EV is greatly enhanced. The BARP system requires no separate electrical distribution system for battery recharging, removing the need for large capital expenditures required to establish recharge centers nationwide to offer recharge service for plug-in EVs. On the other hand, the vehicle could be plugged-in overnight to take advantage of off-peak electrical power and start the next day with both battery packs fully charged.

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[1] Santa Rosa, CA
[2] Oak Park, MI
[3] Greenville, IN
[4] Kohler, WI