PCT
WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B60K 6/02 — A1

(11) International Publication Number: WO 93/23263

(43) International Publication Date: 25 November 1993 (25.11.93)

(21) International Application Number: PCT/US93/04378

(22) International Filing Date: 7 May 1993 (07.05.93)

(30) Priority data:
07/880,967 8 May 1992 (08.05.92) US
07/948,288 21 September 1992 (21.09.92) US

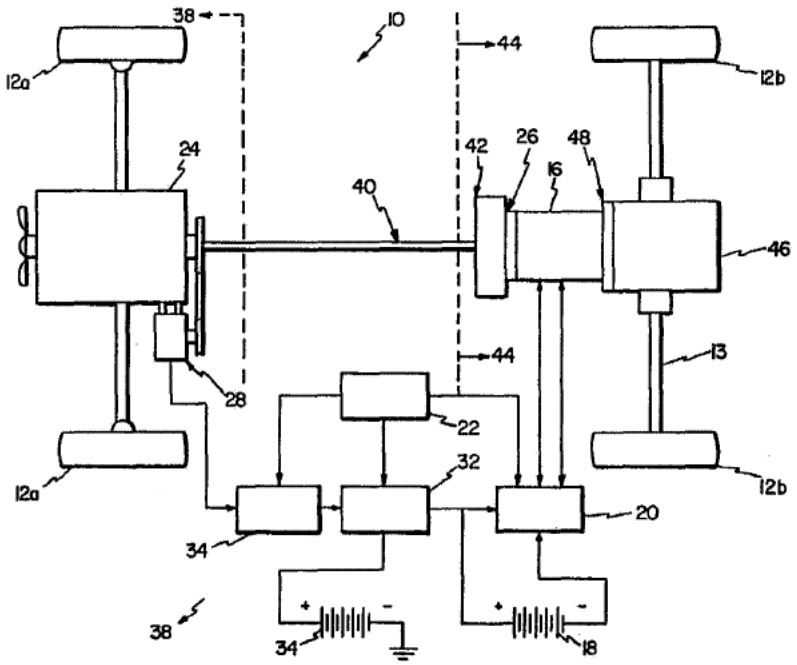
(71)(72) Applicant and Inventor: FIELD, Bruce, F. [US/US]; 501 Theodore Wirth Parkway, Golden Valley, MN 55422 (US).

(74) Agents: FRIEDERICHS, Norman, P. et al.; Kinney & Lange, 625 4th Avenue South, Suite 1500, Minneapolis, MN 55415-1659 (US).

(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: ELECTRIC HYBRID VEHICLE



(57) Abstract

A vehicle having an electric hybrid power system (10) is provided. The vehicle (10) includes an electric motor (16) drivably connected to one or more ground engaging wheels. A battery pack (18) stores electricity to power the electric motor (16). An engine (24) is drivably connected to the wheels (12) with an alternator (28) connected to the engine (24) for recharging an accessory battery. The engine is located near the end of the vehicle (10) opposite the end where the electric motor (16) is located and the two motors (16) are joined with a light-weight small-diameter drive shaft (40). The alternator (28) has at least a voltage output range of between approximately the standard output voltage of the accessory battery (30) and the standard output voltage of the battery pack (18). In accordance with the present invention, a mechanism for electrically connecting the alternator (28) to the battery pack (18) is provided such that the alternator (28) alternatively recharges both the battery pack (18) and the accessory battery (30)

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**FR**	France	**MR**	Mauritania
AU	Australia	**GA**	Gabon	**MW**	Malawi
BB	Barbados	**GB**	United Kingdom	**NL**	Netherlands
BE	Belgium	**GN**	Guinea	**NO**	Norway
BF	Burkina Faso	**GR**	Greece	**NZ**	New Zealand
BG	Bulgaria	**HU**	Hungary	**PL**	Poland
BJ	Benin	**IE**	Ireland	**PT**	Portugal
BR	Brazil	**IT**	Italy	**RO**	Romania
CA	Canada	**JP**	Japan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SK**	Slovak Republic
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SN**	Senegal
CM	Cameroon	**LI**	Liechtenstein	**SU**	Soviet Union
CS	Czechoslovakia	**LK**	Sri Lanka	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**MC**	Monaco	**UA**	Ukraine
DK	Denmark	**MG**	Madagascar	**US**	United States of America
ES	Spain	**ML**	Mali	**VN**	Viet Nam
FI	Finland	**MN**	Mongolia		

ELECTRIC HYBRID VEHICLE

BACKGROUND OF THE INVENTION

This application is a continuation-in-part of the U.S. application having a Serial Number 07/880,967 and a filing date of May 8, 1992. This invention relates to parallel electric hybrid vehicles and combined series-parallel electric hybrid vehicles, and in particular to the location of the component parts.

There are basically four types of electric propulsion systems known for vehicles. First, there is a pure electric drive vehicle. The pure electric drive vehicle has an electric motor which receives power from a main battery pack via a controller. The controller controls the speed of the electric motor. The major disadvantage of a pure electric drive vehicle is that the range is very limited and the vehicle must be stopped and connected to an energy source such as an electrical outlet in order to be recharged.

The second type of electric propulsion system for vehicles is a series hybrid system. There are three major components in a series system: (1) a generator; (2) an electric motor arranged in series; and (3) an engine powering the generator. Mechanical energy generated by the engine is converted to electrical energy by the generator and is then converted back to mechanical energy by the electric motor. Each process of conversion is afflicted with losses and subsequent reductions of efficiency which is a significant disadvantage of this type of system.

The main advantage of the series hybrid is that it is possible to operate the engine at a fixed operating point within its engine speed/torque map. This point can be selected so that the engine functions with the greatest efficiency or produces particularly low emissions. Nevertheless, the efficiency of the entire series hybrid drive system is less than satisfactory.

The third type of electric propulsion systems is the parallel hybrid system, as described, for example, in U.S. Patent 5,081,365. Parallel hybrid propulsion systems generally have three component areas: (1) electrical storage mechanism, such as storage batteries, ultracapacitors, or a combination thereof; (2) an electric drive motor, typically powered by the electrical storage mechanism and used to propel the wheels at least some of the time; and (3) an engine, such as a liquid fueled engine (e.g. internal combustion, stirling engine, or turbine engine) typically used to propel the vehicle directly and/or to recharge the electrical storage mechanism.

In parallel hybrid systems, the electric drive motor is alternatively driven by mechanically coupling it to the engine. When coupled, the engine propels the vehicle directly and the electric motor acts as a generator to maintain a desired charge level in the batteries or the ultracapacitor. While a parallel hybrid system achieves good fuel economy and performance, it must operate in an on and off engine parallel mode. In this mode, the stop-and-go urban driving uses electric power and the engine is used to supplement existing electric system capacity. For long trips, when the battery for the electric motor could be depleted, the vehicle cruises on the small engine and the electric system will provide the peaking power.

The primary advantage of the parallel hybrid drive over the series drive previously described is improved efficiency (lower fuel consumption) in the engine, since the engine's mechanical energy is passed directly on to the drive axle. The bulky generator is no longer required, thereby lowering both the cost and weight of the vehicle.

However, with extended stop and go urban driving, the battery pack will be often depleted and will need a charge in addition to the charge received from the electric motor. Or, the engine will be required to power the vehicle during the stop and go driving period thereby eliminating most

beneficial effects of such an electric system. Therefore, the vehicle with a parallel system has limited inner city driving capabilities and range.

The fourth type of electric propulsion systems is the combined series-parallel hybrid system, as shown and described in application Serial Number 07/880,967, the parent to the present application. The combined series-parallel system includes the advantages of both the series hybrid vehicle and the parallel hybrid vehicle. The combined series-parallel system also minimizes the disadvantages of both the series and parallel systems when taken separately. The series-parallel system is described more fully below.

The second, third and fourth systems described above have encountered space problems. The component parts were difficult to fit into a single vehicle, while allowing room for manufacture and subsequent maintenance work. For example, a typical parallel type of hybrid usually has a drive line, a drive clutch, a primary transmission, a mechanical clutch, an electric drive motor, a linkage to the secondary energy transfer clutch and from there a linkage to the internal combustion engine. The internal combustion engine and the electric motor have been squeezed into one end of the vehicle. Thus, hardware configurations have been fairly complex and bulky in the past. To provide additional space in some vehicles, manufacturers have reduced the size of the engines. This size reduction often accompanies a lower amount of power that the engine has to offer. The loss of power is counter productive to the industry's goal of increasing power in electric vehicles.

SUMMARY OF THE INVENTION

Due to the innate, but separate, advantages of both the series and the parallel drives, a method of combining series and parallel systems has been invented. The engine has an alternator or generator connected directly to the engine's drive shaft by some mechanism, for example, a fan

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.