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DESIGN AND MANUFACTURING OF HYBRID TRIKE

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ABSTRACT

The search for alternatives to petroleum economy, in automotive field, must satisfy the energy requirements and to offer, at least, the same performance than conventional vehicles. This work proposes a vehicle configuration that satisfies its real energy requirements and also obtains a reduced level of noxious emissions.Hybrid electric vehicles (HEVs) combine the internal combustion engine of a conventional vehicle with the battery and electric motor of an electric vehicle, resulting increased fuel economy than conventional vehicles. Hybrid cars serve the same purpose to get mileage and saves money on fuel. This project work proposes a trike i.e vehicle with three wheels eliminating the use of differential thus reducing weight considerably. This vehicle will serve as a viable replacement for bikes as well as for cars with a low initial cost and comparatively low running costs.

INTRODUCTION

Hybrid vehicle

A **hybrid vehicle** is a vehicle that uses two or more distinct power sources to move the vehicle. The term most commonly refers to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors. However, other mechanisms to capture and utilize energy are included.Hybrid Cars use a rechargeable energy storage system to supplement fossil fuel energy for vehicle propulsion. Hybrid engines are smaller and more efficient than traditional fuel engines. Some hybrid vehicles use regenerative braking to generate electricity while travelling. The term "Hybrid Vehicle" can also refer to a vehicle engine that uses a combination of different fuels such as petroleum and ethanol. The articles on this page

are on the topic of Hybrid vehicles and related technologies.

Hybrid vehicle power train configurations

PHEVs are based on the same three basic powertrain architectures as conventional electric hybrids:

Series hybrids

They use an internal combustion engine (ICE) to turn a generator, which in turn supplies current to an electric motor, which then rotates the vehicle's drive wheels

Parallel hybrids:

They can simultaneously transmit power to their drive wheels from two distinct sources—for example, an internal combustion engine and a battery-powered electric drive.

Power split hybrids:

Series parallel or power split have the flexibility to operate in either series or parallel mode. Hybrid powertrains currently used by Ford, Lexus,Nissan, and Toyota, which some refer to as "series-parallel with power-split," can operate in both series and parallel mode at the same time.

Plug-in hybrid electric vehicle (PHEV)

Another subtype of hybrid vehicles is the plug-in hybrid electric vehicle (PHEV). The plug-in hybrid is usually a general fuel-electric (parallel or serial) hybrid with increased energy storage capacity, usually through a li-ion battery, which allows the vehicle to drive on all-electric mode a distance that depends on the battery size and its mechanical layout (series or parallel).

Fuel cell, electric hybrid

The fuel cell hybrid is generally an electric vehicle equipped with a fuel cell. The fuel cell as well as the electric battery are both power sources, making the vehicle a hybrid. Fuel cells use hydrogen as a fuel and power the electric battery when it is depleted.

Terminology

A plug-in hybrid's all-electric range is designated by PHEV-[miles] or PHEV[kilometers]km in which the number represents the distance the vehicle can travel on battery power alone. For example, a PHEV-20 can travel twenty miles (32 km) without using its combustion engine, so it may also be designated as a PHEV32km.

The Energy Independence and Security Act of 2007 defines a plug-in electric drive vehicle as a vehicle that:

- draws motive power from a battery with a capacity of at least 4 kilowatt hours;
- can be recharged from an external source of electricity for motive power; and
- is a light-, medium-, or heavy-duty motor vehicle or nonroad vehicle.

This distinguishes PHEVs from regular hybrid cars mass marketed today, which do not use any electricity from the grid.

The Institute of Electrical and Electronics Engineers (IEEE) defines PHEVs similarly, but also requires that the hybrid electric vehicle be able to drive at least ten

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miles (16 km) in all-electric mode (PHEV-10; PHEV16km), while consuming no gasoline or diesel fuel.

The California Air Resources Board uses the term "off-vehicle charge capable" (OVCC) to mean having the capability to charge a battery from an off-vehicle electric energy source that cannot be connected or coupled to the vehicle in any manner while the vehicle is being driven.

Other popular terms sometimes used for plug-in hybrids are "grid-connected hybrids", "Gas-Optional Hybrid Electric Vehicle" (GO-HEV) or simply "gas-optional hybrids"General Motors is calling its Chevrolet Volt series plug-in hybrid an "Extended-Range Electric Vehicle".

Charging systems:

Batteries are DC devices while grid power is AC. In order to charge the batteries, a DC charger must be utilized. The charger can be located in several locations:

- **On-board chargers**
- **Off-board chargers**
- **Using electric motor's inverter**

Modes of operation

Regardless of its architecture, a plug-in hybrid may be capable of charge-depleting and charge-sustaining modes. Combinations of these two modes are termed blended mode or mixed-mode. These vehicles can be designed to drive for an extended range in all-electric mode, either at low speeds only or at all speeds.

Electric power storage

PHEVs typically require deeper battery charging and discharging cycles than conventional hybrids. Because the number of full cycles influences battery life, this may be less than in traditional HEVs which do not deplete their batteries as fully. However, some authors argue that PHEVs will soon become standard in the automobile industry. Design issues and trade-offs against battery life, capacity, heat dissipation, weight, costs, and safety need to be solved. Advanced battery technology is under development, promising greater energy densities by both mass and volume, and battery life expectancy is expected to increase.

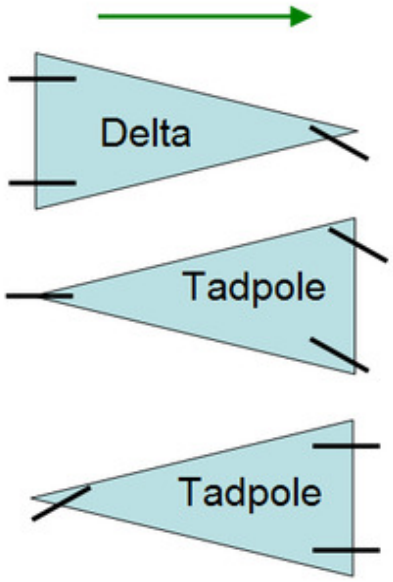
TRIKE

Introduction:

A **trike** is a vehicle with three wheels, either "human or people-powered vehicles" (HPV or PPV) or motorizedvehicles in the form of a motorcycle, all-terrain vehicle (ATV) or automobile. Other names for three-wheelers include trikes, tri-cars and cycle-cars. The term tricycle is used somewhat interchangeably, but the term three-wheeler is more often applied to motor vehicles. They can be legally classed as either automobiles or motorcycles.

Design layouts

Tricycles generally are uprights, recumbent delta or tadpole. Conversion sets can alter the design of the tricycle.



DC MOTOR

Introduction

A **DC motor** relies on the fact that like magnet poles repel and unlike magnetic poles attract each other. A coil of wire with a current running through it generates a electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnet field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°.

Type	**Permanent Magnet**
Voltage	**48 volts**
Power	**800 watt**
No load current	**1 Amps**
Rated current	**20 Amps**
Output Speed	**1500 rpm**

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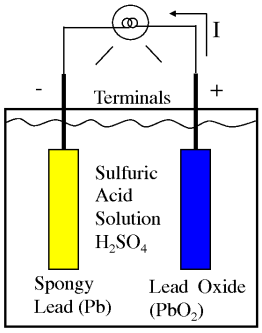
LEAD–ACID BATTERY



Cell: 2 V
Battery: Multiple cells

Sulfuric Acid Electrolyte:

$$H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{-2}$$

Oxidation at the Negative Plate (Electrode:Anode):

$$Pb + SO_4^{-2} \rightarrow PbSO_4 + \boxed{2e^-}$$

Reduction at the Positive Plate (Electrode:Cathode):

$$PbO_2 + 4H_3O^+ + SO_4^{-2} + \boxed{2e^-} \rightarrow PbSO_4 + 6H_2O$$

The **lead–acid battery** was invented in 1859 by French physicist Gaston Plante and is the oldest type of rechargeable battery. Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, its ability to supply high surge currents means that the cells have a relatively large power-to-weight ratio. These features, along with their low cost, makes it attractive for use in motor vehicles to provide the high current required by automobile starter motors.

Negative plate reaction:

$$PbSO4(s) + H+(aq) + 2e^- \rightarrow Pb(s) + HSO{-}4(aq)$$

Positive plate reaction:

$$PbSO4(s) + 2H2O(l) \rightarrow PbO2(s) + HSO{-}4(aq) + 3H+(aq) + 2e^-$$

Type	Lead acid
Voltage	12 V
Current	26 Amps
Nos	4
Total Voltage	48 V

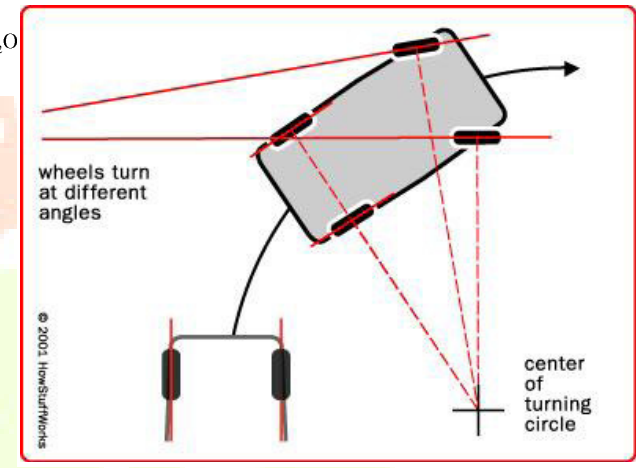
STEERING SYSTEM

Introduction

Steering is the collection of components, linkages, etc. which allow a vessel (ship, boat)or vehicle (car, motorcycle, bicycle) to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches (and also known as 'points' in British English) provide the steering function. The most conventional steering arrangement is to turn the front wheels using a hand–operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints (which may also be part of the collapsible steering column design), to allow it to deviate somewhat from a straight line.

1) Basic geometry

The basic aim of steering is to ensure that the wheels are pointing in the desired directions. This is typically achieved by a series of linkages, rods, pivots and gears. One of the fundamental concepts is that of *caster angle* – each wheel is steered with a pivot point ahead of the wheel; this makes the steering tend to be self-centering towards the direction of travel.



ADVANTAGES

Energy resilience and petroleum displacement

Each kilowatt hour of battery capacity in use will displace up to 50 U.S. gallons (190 l; 42 imp gal) of petroleum fuels per year (gasoline or diesel fuels). Also, electricity is multi-sourced and, as a result, it gives the greatest degree of energy resilience.

Fuel efficiency

The actual fuel economy for PHEVs depends on their powertrain operating modes, their all-electric range, and the amount of driving between charges. If no gasoline is used the miles per gallon gasoline equivalent (MPG-e) depends only on the efficiency of the electric system.

Range anxiety elimination

One of the main barriers for the general adoption of all-electric cars is the range anxiety factor, the driver's fear of being stranded by adepleted battery before reaching the final destination. Plug-in hybrids, as opposed to pure electric cars, eliminate the range anxiety concerns because the gasoline engine serves as a back-up to recharge the battery to provide electric power to the electric motor, or to provide propulsion directly. Access to a regular fuel station

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guarantees that a PHEV has similar driving ranges as conventional gasoline-powered automobile.

Smog

The Ontario Medical Association announced that smog is responsible for an estimated 9,500 premature deaths in its province every year. Plug-in hybrids in emission-free electric mode may contribute to the reduction of smog.

Vehicle-to-grid electricity

PHEVs and fully electric cars may allow for more efficient use of existing electric production capacity, much of which sits idle as operating reserve most of the time. This assumes that vehicles are charged primarily during off peak periods (i.e., at night), or equipped with technology to shut off charging during periods of peak demand. Another advantage of a plug-in vehicle is their potential ability to load balance or help the grid during peak loads.

DISADVANTAGES

Cost of batteries

Disadvantages of plug-in hybrids include the additional cost, weight, and size of a larger battery pack. According to a 2010 study by the National Research Council, the cost of alithium-ion battery pack is about US$1,700/kW·h of usable energy, and considering that a PHEV-10 requires about 2.0 kW·h and a PHEV-40 about 8 kW·h, the manufacturer cost of the battery pack for a PHEV-10 is around US$3,000 and it goes up to US$14,000 for a PHEV-40.

Risk of explosion

Excessive charging electrolyzes some of the water, emitting hydrogen and oxygen. This process is known as "gassing". Wet cells have open vents to release any gas produced, and VRLA batteries rely on valves fitted to each cell. Wet cells come with catalytic caps to recombine any emitted hydrogen. A VRLA cell normally recombines any hydrogen and oxygen produced inside the cell, but malfunction or overheating may cause gas to build up.

CALCULATION

Description	Right Front Wheel Load (N)	Left Front Wheel Load (N)	Back Wheel Load (N)
Seat driver and frame	763.11	763.11	779.12
Engine /clutch and support battery	57.54	49.32	104.56
DC Motor	33.99	72.79	130.83
Batteries	181.66	181.66	185.47
Total	1036.3	1066.88	1199.98

WEIGHT OF THE VEHICLE = 335 KG

Selection of Chain

Power = 800W

Speed of driver N_1= 300 rpm

Approx. center distance = 450 mm

Transmission ratio i=3.7

No. of teeth on driver Z_1 =10

No. of teeth on driven Z_2 =37

Standard pitch (P)

a=(30 to 50)p

P_{max} = a/30 = 450/30 = 15

P_{min} = a/50 =450/50 = 9

Min std pitch is 15.875 mm (PSGDB 7.74)

10A-1 is selected

CONCLUSION

A tadpole trike was fabricated, with two power sources an engine and an electric motor of suitable power enough to pull the vehicle comfortably. The required components were machined perfectly and properly assembled for perfect balance and easy mobility.

The vehicle has given proven results with cost per kilometre as low as 84 paise which is much less than existing two wheelers and cars. The vehicles contribution to pollution is also reduced to half since it covers the additional distance on an electric motor.

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