Kinetic Energy Recovery System

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Abstract: The introduction of Kinetic Energy Recovery Systems (KERS) is one of the most significant technical introductions for the Formula One Race. Formula One have always lived with an environmentally unfriendly image and have lost its relevance to road vehicle technology. This eventually led to the introduction of KERS.KERS is an energy saving device fitted to the engines to convert some of the waste energy produced during braking into more useful form of energy. The system stores the energy produced under braking in a reservoir and then releases the stored energy under acceleration. The key purpose of the introduction was to significantly improve lap time and help overtaking. KERS is not introduced to improve fuel efficiency or reduce weight of the engine. It is mainly introduced to improve racing performance.

1 Introduction

The acronym KERS stands for Kinetic Energy Recovery System. The device recovers the kinetic energy that is present in the waste heat created by the car's braking process. It stores that energy and converts it into power that can be called upon to boost acceleration.

Basically, it's working principle involves storing the energy involved with deceleration and using it for acceleration. That is, when a car breaks, it dissipates a lot of kinetic energy as heat. The KERS stores this energy and converts this into power, Up to 80 BHP for 6.67 sec or 400 kj of energy can be stored.

2 History

1. In development since 90's **.** It was first introduced to the general public through the 2009 series of Formula one motor sport.
2. KERS builders, Flybrid Systems demonstrated a working Formula One-spec device at the Autosport International show. (24kg , 400kj energy capacity, power boost-60kw
3. FIA introduced KERS in 2009 GP series to Increase Overtaking and also as defensive tool to block faster car
4. But many F1 teams Opposed it , as it was an Expensive system, so it was banned in 2010 season
5. But with improvements and increase in manufacturers for KERS it was reintroduced in 2011.
6. At the 2011North American International Auto Show, Porsche unveiled a RSR variant of their Porsche 918 concept car which uses a flywheel-based KERS
7. A motorcycle racing company called KTM Racing, secretly tested this kinetic energy system in their vehicle, but they were banned as that system was illegal and unstable for motorcycles

3 Components of KERS

The three main components of the KERS are as follows

1 An electric motor positioned between the fuel tank and the engine is connected directly to the engine crankshaft to produce additional power.

2 High voltage lithium-ion batteries used to store and deliver quick energy.

3 A KERS control box monitors the working of the electric motor when charging and releasing energy.

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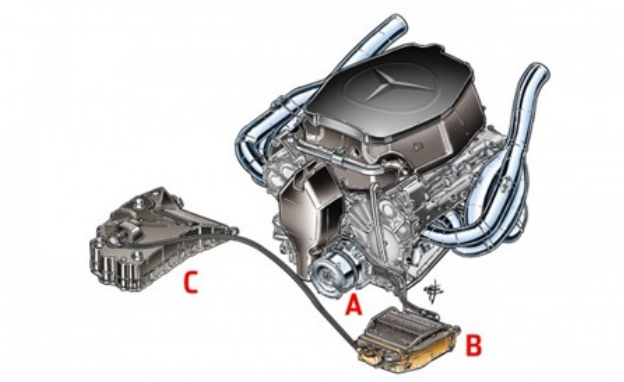


A – Electric motor
B – Electronic Control Unit
C – Battery Pack

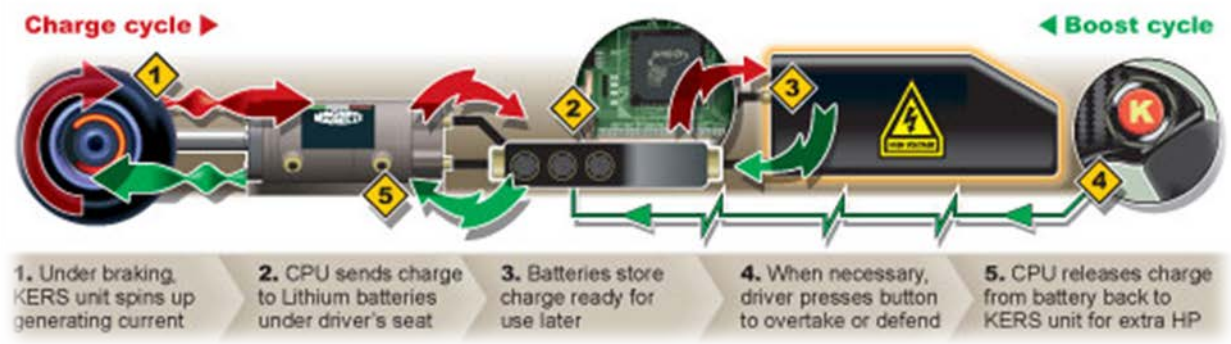
4 Working Principles of KERS

Kinetic Energy Recovery Systems or KERS works on the basic principle of physics that states, "Energy cannot be created or destroyed, but it can be endlessly converted."

When a car is being driven it has kinetic energy and the same energy is converted into heat energy on braking. It is the rotational force of the car that comes to stop in case of braking and at that time some portion of the energy is also wasted. With the introduction of KERS system the same unused energy is stored in the car and when the driver presses the accelerator the stored energy again gets converted to kinetic energy. According to the F1 regulations, the KERS system gives an extra 85 bhp to the F1 cars in less than seven seconds.

This systems take waste energy from the car's braking process, store it and then reuse it to temporarily boost engine power. This and the following diagram show the typical placement of the main components at the base of the fuel tank, and illustrate the system's basic functionality – a charging phase and a boost phase. In the charging phase, kinetic energy from the rear brakes is captured by an electric alternator/motor controlled by a central processing unit (CPU),which then charges the batteries

In the boost phase, the electric alternator/motor gives the stored energy back to the engine in a continuous stream when the driver presses a boost button on the steering wheel. This energy equates to around 80 horsepower and may be used for up to 6.6 seconds per lap. The location of the main KERS components at the base of the fuel tank reduces fuel capacity (typically 90-100kg in 2008) by around 15kg, enough to influence race strategy, particularly at circuits where it was previously possible to run just one stop. The system also requires additional radiators to cool the batteries. Mechanical KERS, as opposed to the electrical KERS illustrated here, work on the same principle, but use a flywheel to store and re-use the waste energy.



5 Types of KERS

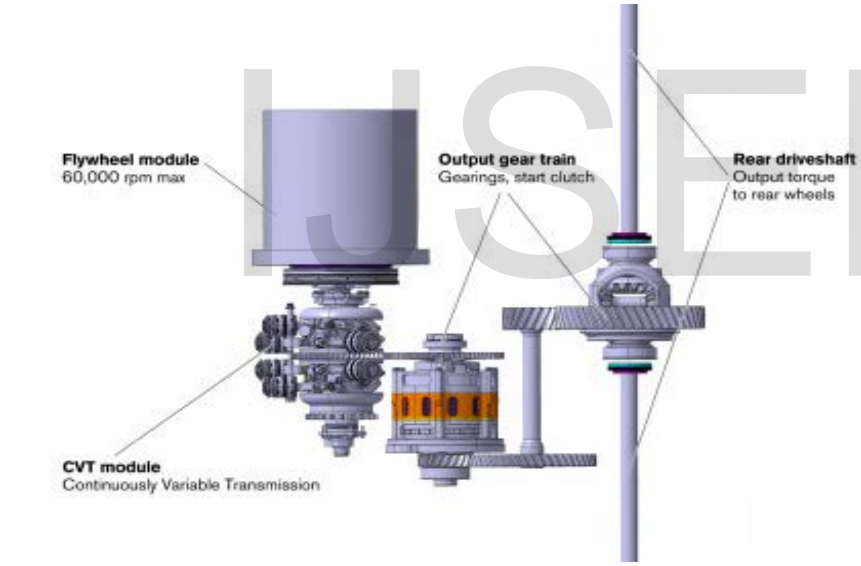
5.1 Electronic KERS

Electronic KERS supplied by Italian firm Magneti Marelli is a common system used in F1 by Red Bull, Toro Rosso, Ferrari, Renault, and Toyota.

The key challenge faced by this type of KERS system is that the lithium ion battery gets hot and therefore an additional ducting is required in the car. BMW has used super-capacitors instead of batteries to keep the system cool. With this system when brake is applied to the car a small portion of the rotational force or the kinetic energy is captured by the electric motor mounted at one end of the engine crankshaft. The key function of the electric motor is to charge the batteries under barking and releasing the same energy on acceleration. This electric motor then converts the kinetic energy into electrical energy that is further stored in the high voltage batteries. When the driver presses the accelerator electric energy stored in the batteries is used to drive the car.

5.2 Mechanical KERS

The Electro-Mechanical KERS is invented by Ian Foley. The system is completely based on a carbon flywheel in a vacuum that is linked through a CVT transmission to the differential. With this a huge storage reservoir is able to store the mechanical energy and the system holds the advantage of being independent of the gearbox. The braking energy is used to turn the flywheel and when more energy is required the wheels of the car are coupled up to the spinning flywheel. This gives a boost in power and improves racing performance.



6 Limitations of KERS

1 Only one KERS for car which has only one braking system.
2 60 kw is the maximum input and output power of the KERS system.
3 The energy recovery system is functional only when the car is moving.
4 The recovery system must be controlled by the same electronic control unit.
5 If in case the KERS is connected between the differential and the wheel the torque applied to each wheel must be same.
6 It is very costly. Engineers are trying hard to make it more cost effective.

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