Kinetic Energy Recovery System

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Abstract: The term KERS alludes to an innovation that is utilized to recoup the motor vitality of any protest that is lost while impediment or deceleration. Dynamic Energy Recovery System (KERS) is a framework for recuperating the moving vehicle's motor vitality under braking and furthermore to change over the standard misfortune in active vitality into pick up in active vitality. Dynamic Energy Recovery Systems (KERS) is a kind of regenerative stopping mechanism which has diverse ways to deal with store and reuse the lost vitality. If there should be an occurrence of vehicles, vitality preservation should be possible by utilizing regenerative slowing mechanisms (RBS). When driving a vehicle, an incredible measure of motor vitality is squandered when brakes are connected, which at that point influences the begin to up reasonably vitality devouring. If there should arise an occurrence of cars, vitality protection should be possible by utilizing regenerative slowing mechanisms (RBS) by dynamic vitality recuperation framework. So the objective of recouping the vitality lost in braking is finished under the different kinds of Kinetic Energy Recovery System (KERS).The vehicle might be assembled utilizing different KERS plans, in view of sort of KERS utilized. This paper demonstrates a nitty gritty portrayal about KERS.

1.INTRODUCTION

In the present occupied world it has been important to investigate the vitality emergencies on the planet. Greatest vitality is lost in a rolling application is while hindering the movement it is either revolving or direct. In this time of vitality emergencies this misfortune isn't unimportant particularly when it can be used. The idea of recouping the active vitality of vehicle was first actualized in Formula - 1 autos. In such rivalries there is more significance of the jolt of energy then the vitality at a consistent supply. Which is the unique nature of the KERS; it gives back the vitality to the primary framework and gives a high get up at arrival of brakes.

KERS is an accumulation of parts which takes a portion of the active vitality of a vehicle under deceleration, stores this vitality and after that discharges this put away vitality once again into the drive prepare of the vehicle, giving a power lift to vehicle. KERS has an extensive variety of uses in this day and age of cutting edge innovations. As it is pertinent in bikes, bicycles, autos and additionally whatever other moving application that has a variety in speed as a result of deceleration, as these all are it is business and down to earth application.

KERS framework utilized as a part of the vehicles fulfills the reason for sparing a piece of the vitality lost amid braking and it can be worked at high temperature run and are effective when contrasted with customary stopping mechanism. The outcomes from a portion of the test that he directed demonstrate that around 30% of the vitality conveyed can be recuperated by the framework. The utilization of more productive frameworks could prompt gigantic reserve funds in the economy of any nation. Here we are reasoning that the subject KERS got a wide degree in designing field to limit the vitality misfortune.

Sreevalsan Menon[1] implemented KERS system in a bicycle with an engaging and disengaging clutch mechanism for gaining much more efficiency.

Flywheel technology is on the rise across many kinds of technology. It is a pollution free method of storing energy that has many current and potential applications. In the case of road vehicles there is much to be desired in terms of energy efficiency, especially when considering pollution per unit of energy. Any system of brake regeneration can help that, but flywheels have the potential to increase the efficiency of road vehicles without direct or indirect negative effects on the environment. The batteries used in hybrids do not last the cars lifetime and can have costly environmental effects. [2]

The engines have few cylinders, and are turbocharged and directly injected, gasoline or Diesel depending on the target use. KERS is preferably mechanical, but electric and electro-mechanical solutions are also options. The best mobility solution in the short term is the use of simple, lightweight vehicles equipped with front small, high power density, internal combustion engines and rear kinetic energy recovery system brakes.

Alberto. Boretti also named the mechanical KERS as M-KERS and electrical KERS as E-KERS and in his research they he found that M-KERS on the rear non-motored wheels, the thermal engine powering the front wheels has to supply 0.31 MJ/km or 30.82 MJ/100 km for a 1000 kg vehicle of standard rolling and aerodynamic resistances covering a modified version of the new European driving cycle. [3]

Kevin Ludlum [4] displayed a fairly simple design with implementation of a kinetic energy recovery system with a non-negligible increase in the efficiency of a bicycle. Also reasoned to use a flywheel that, flywheel has environmental impact only at its time of production, and has the potential to heavily outweigh those costs through its use. Bikes do not have the pollution problems, cars and other modes of transportation have, but they can serve as a good analogy for how a kinetic energy recovery system can increase the efficiency of a vehicle. [4]

A comparison of other battery energy storage and regenerative braking with KERS and observed by **Cibulka, J.** [5] that in comparison with other battery storage technologies, KERS offers:

Cycle durability- 90% efficiency of flywheel (including power electronics) in both directions during KERS reference duty cycle.Extensive operating temperature range.

Steady voltage and power level, which is independent of load, temperature and state of charge.

High efficiency at whole working speed range.

No chemistry included thus, no environmental pollution and great recycling capability.

Using KERS with the use of more efficient systems could lead to huge savings in the economy of any country. It is concluding that the topic KERS got a wide scope in engineering field to minimize the energy loss. As now a day's energy conservation is very necessary thing. Here we implemented KERS system in a bicycle with an engaging and disengaging clutch mechanism for gaining much more efficiency. As many mating parts are present large amount of friction loss is found in this system which can be improved. Boost is reduced because of friction. [6]

U. Mugunthan, U. Nijanthan have been performed an overdrive test to observe the efficiency of bicycle. It has been found out that the flywheel supplies an energy with which the cycle could move forward by 10% of the given input. Depending upon the input given, the efficiency varies. But only 10% can be obtained by this principle. This system when installed in vehicles would save a greater amount of energy lost during the braking of the vehicle. This energy can be stored and can be reused when needed. It is more efficient when compared to the conventional braking system. We would conclude that, this recovery system has to be developed further and has a wide range of research which can be conducted in the future. [7]

The regenerative braking system used in the vehicles satisfies the purpose of saving a part of the energy lost during braking. Also it can be operated at high temperature range and are efficient as compared to conventional braking system. The results from some of the test conducted show that around 30% of the energy delivered can be recovered by the system. Regenerative braking system has a wide scope for further development and the energy savings. The use of more efficient systems could lead to huge savings in the economy of any country [8].

2. Literature Review

The first of these systems to be revealed was the Flybrid. This system weighs 24 kg (53 lbs) and has an energy capacity of 400 kJ after allowing for internal losses. A maximum power boost of 60 kW (81.6 PS, 80.4 HP) for 6.67 seconds is available. The 240 mm (9.4") diameter flywheel weighs 5.0 kg (11 lbs) and revolves at up to 64,500 rpm. The maximum torque generated at the flywheel is 18 Nm (13.3 ft-lbs), and the torque at the gearbox connection is correspondingly higher for the change in speed. The system occupies 13 litres of volume. Two small accidents were reported during testing of various KERS systems in the year 2008. The first incident happened with Red Bull Racing when the team tested their KERS battery for the first time in July, the battery malfunctioned and accidentally caused a fire, to avoid any causality evacuated the building. The second incident happened within a week. A BMW Sauber mechanic got an electric shock when he touched Christian Klien's KERS-equipped car during a test at the Jerez circuit. Formula one has stated that they support environment friendly technology and thy have allowed use of KERS in 2009 F1 championship. Due to the previous accidents with KERS system many teams did not use it in their cars. Only four teams opted for KERS in 2009 session that to in few races only. Ferrari, BMW, Renault and McLaren were the fore teams using the KERS in their cars. Due to some malfunctioning BMW and Renault stopped using this system during the season. Vodafone McLaren Mercedes was the first team to win a F1 GP using a KERS equipped car on July 26, 2009 at the Hungarian Grand Prix. Lewis Hamilton was driving that car to become the first driver to win a pole position with a car equipped with KERS. In that race only their car which was also equipped with KERS finished fifth. Kimi Räikkönen won Belgian Grand Prix with KERS equipped Ferrari on 30th August 2009. This time the KERS contributed directly to race victory. Giancarlo Fisichella who came out second in that race claimed that he was faster than Kimi Räikkönen and Kimi only beat him because of KERS equipped car. KERS helped Kimi win the race substantially and get the lead.

ABOUT KERS SYSTEM:

TYPES OF KINETIC ENERGY RECOVERY SYSTEM

1.Mechanical KERS

In this system the energy is stored by means of either flywheel or spring. Here the braking energy is used to turn a flywheel or spring and when extra power is needed the wheels are coupled up to the spinning flywheel to give a boost in power or springs are released to restore the energy into the main

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Fig.1 KERS Bicycle

Some advantages of using this system are as mentioned below:-

- The energy stored is permanent. Therefore the energy can be released whenever required.
- Use of planetary gear system allows energy to be transmitted in the same sense of rotation as that of the axle.
- The system is robust, compact and can be mounted easily inside wheel rim.
- Unlike flywheel based KERS, this system is inexpensive.
- Compared to Regenerative Braking System this mechanical KERS is more efficient due to fewer conversions.

2. Electric KERS

With this system when brake is applied to the vehicle 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. KERS components for battery storage systems are:

Electric Propulsion Motor /Generator.

Power Electronics – Inverter, and the Quad Flywheel Storage.

Electric Propulsion Motor and Generator in one are also known as a MGU – Motor Generator Unit.

Capacitors are fundamental electrical circuit elements that store electrical energy in the order of microfarads and assist in filtering

2.1 PRINCIPLE OF WORKING

If you use mechanical energy to rotate the coil at uniform angular velocity ω in the magnetic field it will produce a sinusoidal *emf* in the coil.

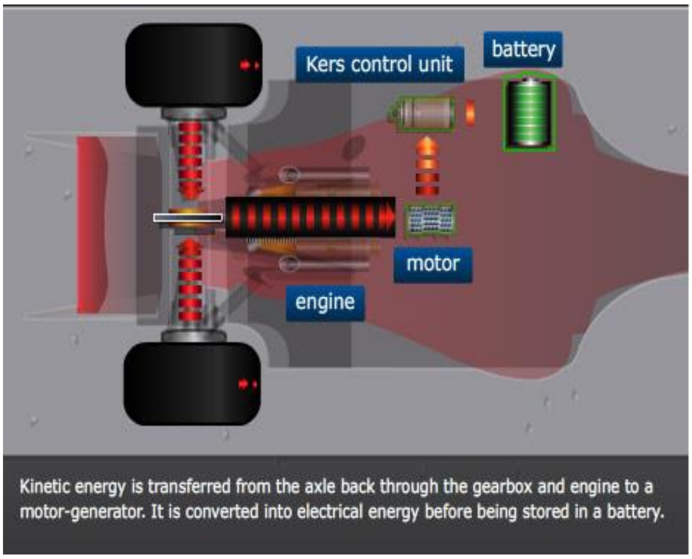

Fig.3 Principal of KERS

Electrical KERS brake consists of:-

A driving wheel linked with a rotary shaft

A motor

A battery charging circuit

A set of batteries or other storing device.

3.Hydraulic KERS

In a hydraulic accumulator the potential energy is stored in the form of a compressed gas or spring, which is used to exert a force against an incompressible fluid. Accumulators store energy when the hydraulic system pressure is greater than the accumulator pressure and releases hydraulic energy in the opposite case. Regenerative braking in vehicles using a variable displacement hydraulic pump/motor together with a hydro-pneumatic accumulator has attracted considerable interest during the last 20–25 years. Such a system is particularly suitable for application in city buses

Despite the significant gains in the efficient use of energy that can be brought about by hydro-pneumatic regenerative braking, its use has not attained great popularity. The added cost, which may represent 10–15% of the total for the vehicle, is undoubtedly a deterrent.

4. Hydro-electrical KERS

In this system the combination of electric and hydraulic system is used to store the energy.

Hydraulic accumulator has the characteristics of higher power density and is well suited for frequent acceleration and deceleration under city traffic conditions. It can provide high power for accelerations and can recover more efficiently power during regenerative braking in comparison with electric counterparts However; the relatively lower energy density brings the packaging limit for the increasing accumulator size.

The regenerative component consists of,

1.A fixed displacement hydraulic pump/ motor.

2.A hydro-pneumatic accumulator.

A hydraulic-accumulator/battery hybrid energy system, called hydraulic/electric synergy system (HESS), is designed to overcome the drawbacks of existing single energy storage sources used in heavy hybrid vehicles.

4.1 ADVANTAGES: -

1. High power capability.
2. High speeds attained in lesser time.
3. Overtaking and defense improved in F1.
4. Fuel Consumption to be reduced.
5. Light weight and small size.
6. Long system life.
7. A truly green solution.
8. High efficiency storage and recovery.
9. Low embedded carbon content.
10. Low cost in volume manufacture.

4.2 LIMITATIONS: -

1. Storage capability.
2. Weight increment, particularly important in F1 cars.
3. Explosion in batteries.
4. Electric shocks.
5. Incidents regarding gearbox locking.
6. Teams not ready to spend millions for developing the technology.

Objectives:

1. System design and theoretical derivation of kinetic energy recovery system on various speed parameters for desired output power and braking distance.
2. Design, Development and analysis of kinetic energy recovery system components under derived system of forces as per specifications.
3. Manufacturing and Testing of drive to derive the performance.
4. Plot Performance Characteristic Curves ;
5. Energy audit of the system at various speed conditions.

CONCLUSION:

Cars with a flywheel based energy recovery system, though significantly more expensive than cars without this system, have more power and better fuel efficiency. According to www.thegreencarwebsite.co, "the system could reduce fuel consumption by as much as 20% and give a four-cylinder engine acceleration like a six-cylinder unit [7]." This effectively means that cars with the Flywheel KERS system have better fuel efficiency and more power than the cars without the KERS system.

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