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Kinetic Energy Recovery System (KERS).

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***Abstract*— Kinetic Energy Recovery System (KERS) is a system for recovering the moving vehicle's kinetic energy under braking and also to convert the usual loss in kinetic energy into gain in kinetic energy. When riding a bicycle, a great amount of kinetic energy is lost while braking, making start up fairly strenuous. Here we used mechanical kinetic energy recovery system by means of a flywheel to store the energy which is normally lost during braking, and reuse it to help propel the rider when starting. The rider can charge the flywheel when slowing or descending a hill and boost the bike when accelerating or climbing a hill. The flywheel increases maximum acceleration and nets 10% pedal energy savings during a ride where speeds are between 12.5 and 15 mph.**

***Index Terms*— KERS, Regenerative braking, Flywheel energy storage, Flywheel bicycle, Mechanical KERS, Smart braking.**

I. INTRODUCTION

In a world where almost all its fuel is being depleted, conservation of natural resources has become a necessity in today's world, especially in the field of renewable technology. In an automobile, maximum energy is lost during deceleration or braking. This problem has been resolved with the introduction of regenerative braking. It is an approach to recover or restore the energy lost while braking. The Kinetic Energy Recovery System (KERS) is a type of regenerative braking system which has the capability to store and reuse the lost energy. In recent years, hybrid electric vehicles were developed in order to meet the demand of reducing energy consumption, the increasing fuel prices and the damage caused by fossil fuel emissions to our environment. Currently, the market for hybrid vehicles is largely comprised of hybrid electric vehicles. These vehicles are partially or fully powered by electric motors that are supplied electricity from rechargeable batteries.

Unfortunately the poor conversion efficiencies cancel out most of the advantages these battery powered hybrid vehicles bring with them. The flywheel-based kinetic energy recovery system is a possible solution which could potentially replace the electric hybrids. In principle, a flywheel is nothing more than a wheel on an axle which stores and regulates energy by spinning continuously. The amount of energy that flywheels are able to store is dependent upon the weight of the flywheel and how fast it is rotating. This kinetic energy recovery system stores energy as a vehicle brakes and recycles it as the vehicle accelerates again. The KERS was first designed for formula one racing cars. In this paper, we will examine the flywheel based kinetic energy recovery system and explain why it is the fuel efficiency technology of the future.

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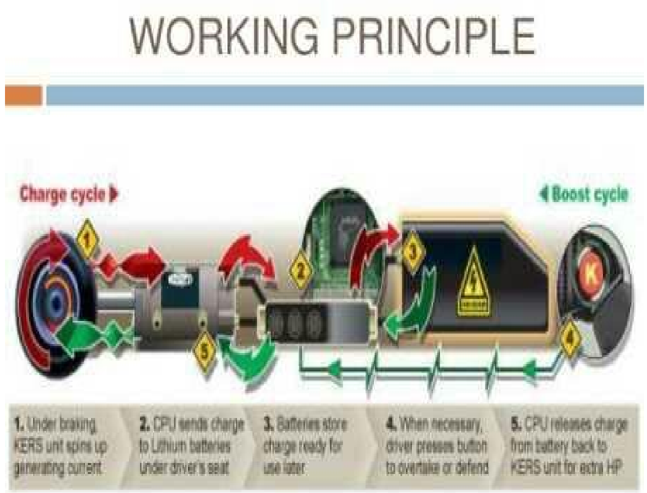
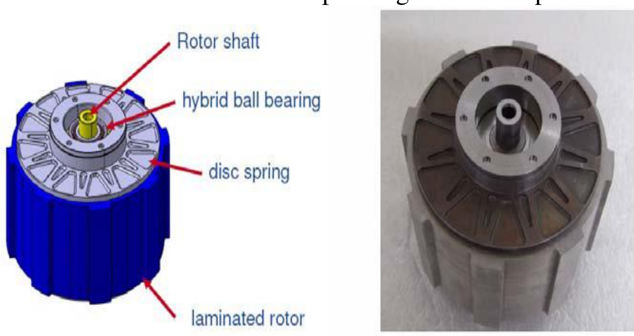


FIG-1.

II. FLYWHEEL ENERGY STORAGE

Kinetic storages, also known as Flywheel Energy Storages (FES), are used in many technical fields. While using this technical approach, inertial mass is accelerating to a very high rotational speed and maintaining the energy in the system as rotational energy. The energy is converted back by slowing down the flywheel. Available performance comes from moment of inertia effect and operating rotational speed.

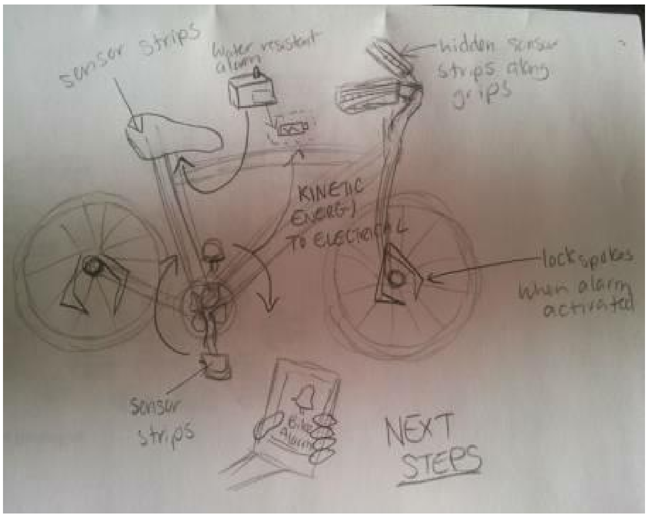


III. FLYWHEEL ROTOR OF STORAGE SUBUNIT

The flywheel has to be bored centrally in order to place a ball bearing so that flywheel can rotate over the axle. Also flywheel has to be selected so that the selected weight does not affect the bicycle physics and riding performance of the rider. The performance of KERS system mainly depends upon the flywheel selection. For clutch accessories there should be provisions in the flywheel which is used to deliver and release energy from flywheel.

IV. KERS BICYCLE WORKING.

A crank wheel connected to the rear wheels always rotates the clutch plate, connected in the flywheel axle. This is being achieved by using chain transmission at a specified gear ratio, crank to clutch sprocket helps us to increase the overall speed of flywheel. Now at a time when a speed reduction is required, clutch is applied which makes the contact between the clutch and flywheel. Then the flywheel starts rotating, also the speed of bicycle is decreased. Thus a regenerative braking system is achieved. On course energy is stored in flywheel. In case the brake has to be applied fully then after flywheel rotations clutch is disengaged and the brake is applied. Now when we again rides the bicycle during which we would apply clutches at this time as rear wheel rotation is lesser compared to flywheel the energy gets transmitted from the flywheel to the wheels. Now also we can reduce the overall pedaling power required in course of overrides by having clutch fully engaged. We can reduce overall pedaling power by 10 per cent. Also situation arises such as traffic jam, down climbing a hill where we do not intend to apply brake fully. For such cases we can apply our smart braking system which would allow us to decelerate and allow us to boost acceleration after this during normal riding and distance that can be covered by pedaling can also improve. During normal rides situations may arise we need to reduce the speed without braking fully such as traffic jams taking turns etc. we can store the energy that would normally be wasted due to speed reduction by the application of clutch. When the clutch is engaged that time due to initial engage the flywheel rotation consumes energy which would result in speed reduction thus a braking effect. After some instances the energy is being stored in the flywheel this can be reused by the engage of clutch plate and energy transfer from the flywheel occurs whenever the rotation is high enough to rotate rear wheel. Thus if sudden braking then applied we can disengage the flywheel connections so that flywheel energy is not wasted and going to take ride the speed of rear wheel is null and hence engage would help in returning the energy from the flywheel to rear wheel. While riding downhill we always use braking for allowing slowdown. This is the best case where we can store maximum amount of energy in our flywheel. The flywheel can be engaged for full downhill ride and after all for some distance we need not ride the bicycle which would be done by the flywheel. This is the main advantage area of KERS bic



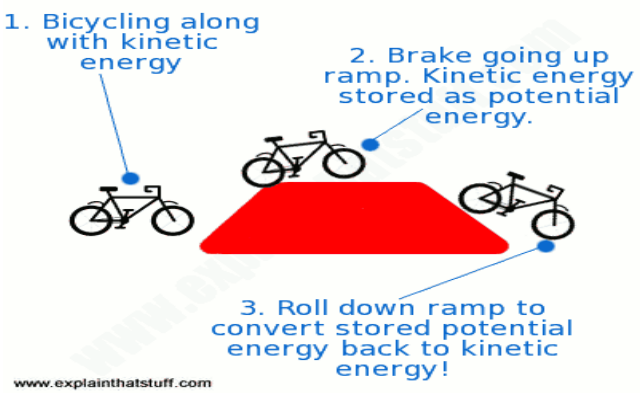


FIG-3.

During long drive the engage can be made full time. This will help in reducing the overall pedaling effort. It has been found that the pedaling power can be reduced by 10 per cent during long drives. Also this would help in avoiding pedaling effort at some points of ride.

V. SYSTEM COMPONENTS.

[Fig.] refers to KERS components, respectively: Electric Propulsion Motor /
Generator, Power Electronics – Inverter, and the Quad Flywheel Storage.

FIG-4.

2.1 Electric Propulsion Motor/Generator

Electric Propulsion Motor and Generator in one, also known as a MGU - Motor
Generator Unit [Fig. 7.].

2.2 System Control

System communication is provided via CAN interface (Controller–Area Network).

2.2.2 Control Electronics

[Fig.] Refers to flywheel storage subunits equipped with bonding pad for control electronics

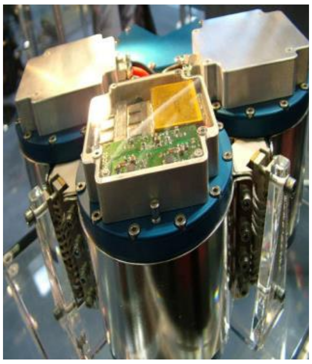


Fig-5 Control electronics – ECU

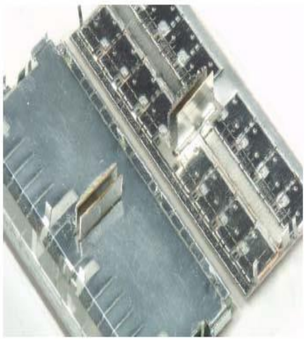


Fig6- Microprocessor of Control unit

VI. KERS IN F1

.F1 must "respond in a responsible way to the world's environmental challenges".

.Max Mosley, F1 President 60 kW (80 Hp) for 2009 season.

.All electric systems – except Williams flywheel system – CF rotor ~90,000 rpm ~ 50kg.

FIG-7

FIG-8

VII. FUTURE SCOPE OF KERS.

The simplicity of energy transfer in this mechanical KERS system makes it superior to the electrical KERS system. Mechanical hybrids are more powerful, more efficient, and cheaper than electrical hybrids. In the future, automobiles will be much more fuel efficient than the cars of today. Flywheel kinetic energy recovery system technology is definitely practical because many car companies are looking into using the system in average everyday cars. Volvo in partnership with Flybrid, officially announced that they intend to develop and produce a vehicle that uses the flywheel based kinetic energy recovery system. With improvement in technology, KERS will definitely become even more efficient and affordable. The main driving force which will launch flywheel-based kinetic energy recovery systems into the automotive industry is the low cost in comparison with fully hybrid vehicles. Any vehicle could be designed and fitted with a flywheel-based kinetic energy recovery
system, but the area most affected by this technology would be any vehicle with a start-stop cycle of driving. This technology has already been tested in FLYBUS (a flywheel hybrid system developed for buses).

The Flywheel KERS is a technology of great importance and potential. With more advancements and refinements, this system would increase the efficiency of hybrid vehicles. It can reduce fuel consumption and at the same time increase power. Its lower CO2 emissions reduce air pollution. Probably the biggest advantage of this system is its ability to be retrofitted. The flywheel KERS does not come without flaws, however, developments still need to be made in reducing the forces that act upon the flywheel. With these forces minimized, the system would have much higher efficiency and would be able to store energy longer. It would rival hybrid electric vehicles in efficiency and range.

VIII. CONCLUSION.

The flywheel KERS system promises to be a technology of the future. It makes every car more powerful and at the same time improves fuel efficiency. Better fuel efficiency directly translates to a cleaner, greener environment. It reduces the negative impact on the environment by decreasing harmful CO2 emissions. It has been found that the amount of CO2 emitted during the manufacturing of one flywheel KERS is made up for within the first 12,000 km of driving. In addition, as opposed to a hybrid electric vehicle, a flywheel-based mechanical hybrid does not have the harmful chemicals to dispose of that are found in batteries.

Flywheel storage technology provides boost acceleration and braking force.
FES supports starting and guarantees light, silent and emissionfree starts of
Combustion engine. KERS also supplies all electric appliances, stabilizes on-board power supply and offers stable air-condition.
Kinetic recuperation based on braking energy stored in flywheel is without cycle
loading, unlike braking energy repeatedly stored in battery.

REFFERENCE.

[1] https://www.google.co.in/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwiNtsXPv_nRAhUKQ48KHSN8CEEQjhwIBQ&url=http%3A%2F%2Fwww.azom.com%2Farticle.aspx%3FArticleID%3D9503&psig=AFQjCNEcx4jBVof5DjbFiL_73A_nYe4Rxw&ust=1486402636586786
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[3] ENGINEERING BOOKS BASED ON KINETIC ENERGY.
[4] https://www.google.co.in/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwiHqdrawPnRAhURT48KHV3gAYkQjhwIBQ&url=https%3A%2F%2Fgr8autotech.wordpress.com%2Fkinetic-energy-recovery-system-kers%2F&psig=AFQjCNE-eAVcpJSKsSLdK3aSTIa04We2Dw&ust=1486402956718655.