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Kinetic Energy Recovery System in Bicycle

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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.

INTRODUCTION:

KERS is a collection of parts which takes some of the kinetic energy of a vehicle under deceleration, stores this energy and then releases this stored energy back into the drive train of the vehicle, providing a power boost to that vehicle. For the driver, it is like having two power sources at his disposal, one of the power sources is the engine while the other is the stored kinetic energy. Kinetic energy recovery systems (KERS) store energy when the vehicle is braking and return it when accelerating. During braking, energy is wasted because kinetic energy is mostly converted into heat energy or sometimes sound energy that is dissipated into the environment. A flywheel can temporarily store the kinetic energy from the bicycle when the rider needs to slow down.

The energy stored in the flywheel can be used to bring the cyclist back up to cruising speed. In this way the cyclist recovers the energy normally lost during braking. In addition to increased energy efficiency, the flywheel-equipped bicycle is more fun to ride since the rider has the ability to boost speed.

HARDWARE DESCRIPTION:

Introduction:

In this chapter the block diagram of the project and design aspect of independent modules are considered. Block diagram is shown in fig: 3.1:

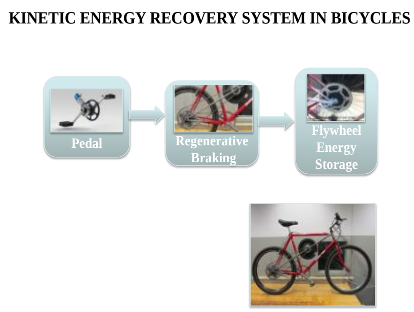

FIG 3.1: Block diagram of kinetic energy recovery system

The main blocks of this project are:

1 pedal
2. RBS

Basic Terms to be known before the actual concept:

Acceleration & Deceleration:

Acceleration, in physics, is the rate of change of velocity of an object.

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An object's acceleration is the net result of any and all forces acting on the object, as described by Newton's Second Law. The SI unit for acceleration is metre per second squared (m/s2). Accelerations are vector quantities (they have magnitude and direction) and add according to the parallelogram law. As a vector, the calculated net force is equal to the product of the object's mass (a scalar quantity) and the acceleration. For example, when a car starts from a standstill (zero relative velocity) and travels in a straight line at increasing speeds, it is accelerating in the direction of travel. If the car turns there is acceleration toward the new direction. For this example, we can call the accelerating of the car forward a "linear acceleration", which passengers in the car might experience as force pushing them back into their seats. When changing directions, we might call this "non-linear acceleration", which passengers might experience as a sideways force. If the speed of the car decreases, this is an acceleration in the opposite direction of the direction of the vehicle, sometimes called deceleration. Passengers may experience deceleration as a force lifting them away from their seats. Mathematically, there is no separate formula for deceleration, as both are changes in velocity. Each of these accelerations (linear, non-linear, deceleration) might be felt by passengers until their velocity (speed and direction) match that of the car.

Brake Boost:

Most modern vehicles use a vacuum assisted brake system that greatly increases the force applied to the vehicle's brakes by its operator. This additional force is supplied by the manifold vacuum generated by air flow being obstructed by the throttle on a running engine. This force is greatly reduced when the engine is running at fully open throttle, as the difference between ambient air pressure and manifold (absolute) air pressure is reduced, and therefore available vacuum is diminished. However, brakes are rarely applied at full throttle; the driver takes the right foot off the gas pedal and moves it to the brake pedal - unless left-foot braking is used.

Because of low vacuum at high RPM, reports of unintended acceleration are often accompanied by complaints of failed or weakened brakes, as the high-revving engine, having an open throttle, is unable to provide enough vacuum to power the brake booster. This problem is exacerbated in vehicles equipped with automatic transmissions as the vehicle will automatically downshift upon application of the brakes, thereby increasing the torque delivered to the driven-wheels in contact with the road surface.

Noise: Although ideally a brake would convert all the kinetic energy into heat, in practice a significant amount may be converted into acoustic energy instead, contributing to noise pollution. For road vehicles, the noise produced varies significantly with tire construction, road surface, and the magnitude of the deceleration.[2] Noise can be caused by different things. These are signs that there may be issues with brakes wearing out over time.

Inefficiency:

A significant amount of energy is always lost while braking, even with regenerative braking which is not perfectly efficient. Therefore a good metric of efficient energy use while driving is to note how much one is braking. If the majority of deceleration is from unavoidable friction instead of braking, one is squeezing out most of the service from the vehicle. Minimizing brake use is one of the fuel economy-maximizing behaviors. While energy is always lost during a brake event, a secondary factor that influences efficiency is "off-brake drag", or drag that occurs when the brake is not intentionally actuated. After a braking event, hydraulic pressure drops in the system, allowing the brake caliper pistons to retract. However, this retraction must accommodate all compliance in the system (under pressure) as well as thermal distortion of components like the brake disc or the brake system will drag until the contact with the disc, for example, knocks the pads and pistons back from the rubbing surface. During this time, there can be significant brake drag.

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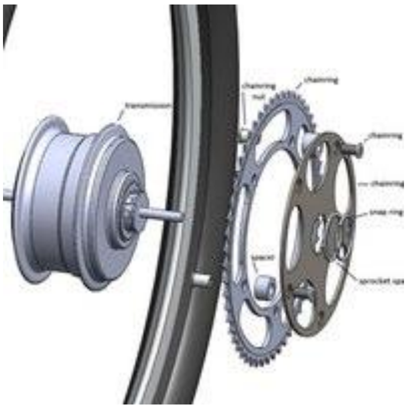
This brake drag can lead to significant parasitic power loss, thus impact fuel economy and vehicle performance.

Flywheel:

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by the application of a torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing the flywheel's rotational speed. Flywheels are typically made of steel and rotate on conventional bearings; these are generally limited to a revolution rate of a few thousand RPM. Some modern flywheels are made of carbon fiber materials and employ magnetic bearings, enabling them to revolve at speeds up to 60,000 RPM. Carbon-composite flywheel batteries have recently been manufactured and are proving to be viable in real-world tests on mainstream cars.

Additionally, their disposal is more eco-friendly. Flywheel Bicycle: KERS for pedal-pushers In order to help boost their range, many electric and hybrid cars employ regenerative technology where braking energy is stored in the battery instead of simply being wasted. This idea can also be applied to electric-assist bikes, but what about bicycles of the plain old human-powered variety? Isn't it a shame that after having built up some good momentum, you just have to write it all off once you stop? Maxwell von Stein, a student at New York City's Cooper Union for the Advancement of Science and Art, thought so. As his senior project, he recently rigged up a flywheel to an existing bicycle, in order to harness the energy that's lost during braking. That energy can then be used to boost the bike when needed.



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The Flywheel Bicycle has a continuously variable transmission in the rear hub. This is linked to a 6.8 kilogram (15 lb) flywheel from a car engine mounted in the middle of the frame. When the cyclist wishes to slow down, such as when they're going down a hill or coming to a stop, they shift the transmission to maximize the flywheel-speed-to-bike-speed ratio. This "charges" the flywheel with kinetic energy - effectively a mechanical version of what happens in an EV where a battery stores the scavenged energy. Once they want to accelerate or climb a hill, they do the opposite - they shift the transmission to *minimize* the ratio. This lets the energy stored in the flywheel drive the transmission, giving the bike and its rider a boost. In a ride where speeds vary between 20 and 24 kph (12.4 to 14.9 mph), the system is claimed to not only increase acceleration, but to also produce 10 percent in energy savings.

Although the added weight of the flywheel would certainly need to be taken into account, the concept behind the Flywheel Bicycle is still definitely intriguing ... enough so that it won von Stein the Nicholas Stefano Prize, which Cooper Unionawards to outstanding mechanical engineering senior projects.

Cruising Speed:

A speed for a particular vehicle, ship, or aircraft, usually somewhat below maximum, that is comfortable and economical

Moment of Inertia:

The moment of inertia, otherwise known as the angular mass or rotational inertia, of a rigid body determines the torque needed for a desired angular acceleration about a rotational axis. It depends on the body's mass distribution and the axis chosen, with larger moments requiring more torque to change the body's rotation. It is an extensive (additive) property: the moment of inertia of a composite system is the sum of the moments of inertia of its component subsystems (all taken about the same axis).

KERS Bicycle:

KERS is a collection of parts which takes some of the kinetic energy of a vehicle under deceleration, stores this energy and then releases this stored energy back into the drive train of the vehicle, providing a power boost to that vehicle. For the driver, it is like having two power sources at his disposal, one of the power sources is the engine while the other is the stored kinetic energy. Kinetic energy recovery systems (KERS) store energy when the vehicle is braking and return it when accelerating. During braking, energy is wasted because kinetic energy is mostly converted into heat energy or sometimes sound energy that is dissipated into the environment. Vehicles with KERS are able to harness some of this kinetic energy and in doing so will assist in braking. By a proper mechanism, this stored energy is converted back into kinetic energy giving the vehicle extra boost of power.

There are two basic types of KERS systems i.e. Electrical and Mechanical. The main difference between them is in the way they convert the energy and how that energy is stored within the vehicle. Battery-based electric KERS systems require a number of energy conversions each with corresponding efficiency losses. On reapplication of the energy to the driveline, the global energy conversion efficiency is 31–34%. The mechanical KERS system storing energy mechanically in a rotating fly wheel eliminates the various energy conversions and provides a global energy conversion efficiency exceeding 70%, more than twice the efficiency of an electric system This design of KERS bicycle was motivated by a desire to build a flywheel energy storage unit as a proof of concept.

On a flat road, the cyclist can maintain a fixed cruising speed to get from point to point. Globally all roads are flat with impediments such as intersections, cars, and turns that force the cyclist to reduce speed, then accelerate. A flywheel can temporarily store the kinetic energy from the bicycle when the rider needs to slow down. The energy stored in the flywheel can be used to bring the cyclist back up to cruising speed. In this way the cyclist recovers the energy normally lost during braking. In addition to increased energy efficiency, the flywheel-equipped bicycle is more fun to ride since the rider has the ability to boost speed. The flywheel bicycle model is shown in figure 1.

Fig.1 Flywheel KERS Bicycle

I. 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 bicycle. During long drive the engage can be made full time. This will help in reducing the overall pedalling effort. It has been found that the pedalling power can be reduced by 10 per cent during long drives. Also this would help in avoiding pedalling effort at some points of ride. The complete KERS bicycle is shown in figure 2 below

Fig. 2 KERS Bicycle

OF KERS:

Advanced transmissions that incorporate hi-tech flywheels are now being used as regenerative systems in such things as formula-1 cars, where they're typically referred to as kinetic energy recovery systems (KERS).

The types of KERS that have been developed are:

- 4.1. Mechanical KERS
- 4.2. Electro-mechanical KERS
- 4.3. Hydraulic KERS
- 4.4. Electronic KERS

Of the three types of KERS units – mechanical, electrical and hydraulic – Formula 1 teams have decided to go for the mechanic one. The reasons behind this choice are quite logical: less weight, better weight distribution, increased power boost and improved fuel economy.

4.1. Mechanical KERS:

The mechanical KERS system has a flywheel as the energy storage device but it does away with MGUs by replacing them with a transmission to control and transfer the energy to and from the driveline. The kinetic energy of the vehicle end up as kinetic energy of a rotating flywheel through the use of shafts and gears. Unlike electronic KERS, this method of storage prevents the need to transform energy from one type to another. Each energy conversion in electronic KERS brings its own losses and the overall efficiency is poor compared to mechanical storage. To cope with the continuous change in speed ratio between the flywheel and road-wheels, a continuously variable transmission (CVT) is used, which is managed by an electro-hydraulic control system. A clutch allows disengagement of the device when not in use. As Li-ion batteries are still an expensive emerging technology, plus they have associated risks, recycling and transport problems. The attraction of flywheel KERS is obvious, however no team have raced such a system in F1. Flywheels can effectively replace the Li-ion batteries with in a typical KERS system, the flywheel being mated to a second MGU to convert the power generated by the primary MGU on the engine into the kinetic to be stored in the flywheel. Williams are believed to have just such a system. However the simper flywheel solution is connect the flywheel system via a clutched and geared mechanism.

4.2. Electro-mechanical KERS:

In electro-mechanical KERS energy is not stored in batteries or super-capacitors, instead it spins a flywheel to store the energy kinetically. This system is effectively an electro-mechanical battery. There is limited space in a racecar so the unit is small and light. Therefore, the flywheel spins very fast to speeds of 50,000 - 160,000 rpm to achieve sufficient energy density. Aerodynamic losses and heat buildup are minimized by containing the spinning flywheel in a vacuum environment. The flywheel in this system is a magnetically loaded composite (MLC). The flywheel remains one piece at these high speeds because it is wound with high strength fibers. The fibers have metal particles embedded in them that allows the flywheel to be magnetized as a permanent magnet. The flywheel will perform similarly to an MGU. As the flywheel spins, it can induce a current in the stator releasing electricity or it can spin like a motor when current flows from the stator. This flywheel is used in conjunction with an MGU attached to the gearbox which supplies electrical energy to the flywheel from the road and returns it to the gearbox for acceleration at the touch of a button. Not all flywheels used in the electro-mechanical KERS are permanent magnets. Instead, these systems use two MGUs, one near the flywheel and another at the gearbox. Some systems use flywheels and batteries together to store energy.

Fig 4.1.Carbon Fibre Hydraulic Accumulator

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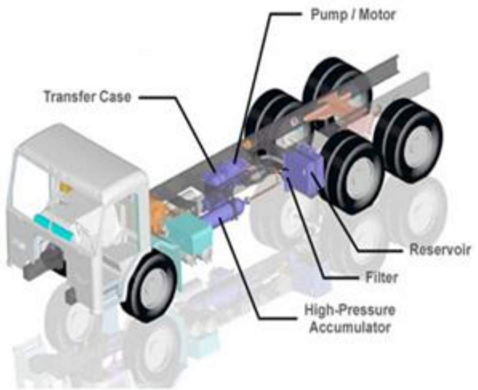

Fig 4.2. HLA (Hydraulic Launch Assist)

KERS & REGENERATIVE BRAKING:

Since kinetic energy is the energy of motion, you could probably guess that cars create lots of it. Capturing some of that kinetic energy for the sake of fuel efficiency in a hybrid car is a little tricky, but regenerative braking is one common method employed by many automakers. On a non-hybrid car during a routine stop, mechanical braking slows and then stops the vehicle. For instance, if your vehicle has disc brakes, the brake pads clamp down on a rotor to stop the car. If your car has drum brakes, the brake shoe pushes the brake lining material outward toward the brake drum surface to slow or stop the car. In both cases, most of the kinetic energy in the spinning wheels is absorbed by the pads or the drums, which creates heat.

On a hybrid car that uses regenerative braking, the electric motor is used to slow the car. When the motor is operating in this mode, it acts as a generator to recover the rotational kinetic energy at the wheels, convert it into energy and store it in the car's batteries. When the driver of the hybrid car takes his or her foot off of the accelerator pedal, the resistance provided by the generator slows the car first and then the mechanical brake pads can be applied to finish the job. Of course, the mechanical brake pads can also be engaged immediately in an emergency braking scenario. The car uses the energy stored in the battery to power the electric motor which drives the car at low speeds.

Depending on the type of hybrid, the electric motor can either work alone to move the car or it can work in concert with the car's gasoline-powered engine. So regenerative braking, coupled with eco-friendly driving techniques like slow starts and slower overall vehicle speeds, is an important feature on some of some of the most fuel-efficient vehicles on the road today. Regenerative brakes may seem very hi-tech, but the idea of having "energy-saving reservoirs" in machines is nothing new. Engines have been using energy-storing devices called flywheels virtually since they were invented.

CARMAKERS – APPLICATION OF KERS TECHNOLOGY

6.1. Porsche

At 2011 North American International Auto Show Porsche unveiled a RSR variant of their Porsche 918 concept car which uses a flywheel-based KERS system that sits beside the driver in the passenger compartment and boosts the dual electric motors driving the front wheels and the 565 BHP V8 gasoline engine driving the rear to a combined power output of 767 BHP. The electric motors are not powered by a set of batteries, as in a traditional hybrid, rather they take their power from an inertial flywheel mounted where the passenger seat would be on a road car and spinning at up to 36,000rpm. That's spun up by momentum when the car brakes and, when the driver hits a button, that momentum is converted to give an acceleratory boost.

Fig 5.1. Porsche 918 RSR Concept Car

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Fig 5.2. Ferrari Vettura Laboratorio HY-KERS

CONCLUSION:

By adopting the cheaper and lighter flywheel system (the ideal solution if it could be made to fit into the no-refueling era cars), a more powerful boost, and limiting the number of activations in a race it would cover all the bases it needs to. It would be affordable for the all the teams, deliver performances as well as being a more interesting race variable. The sidepod solution is quite unique, and has given us a new envelope to try to drive performance to the rear of the car. We need to keep thinking out-of-the-box. Compared to ten or 20 years ago, it's really quite staggering what can be delivered given the restrictions we have now – it's a tribute to imaginative thinking

Thus we are coming to the end of the elaborate study of KERS going through their advantaged limitation relevance and finally to the modification. To sum up this seminar we have gone through sophisticated concept which will surely be much raved in coming days. Also it would be a great showcase of technology which could have a major impact on the car industry in years to come. In the future the technology could also be used on buses, trains, and wind power generation.

FABRICATION PROCESS:

A. Frame Modification:

The frame modification is the first part of the fabrication that has to be done. The frame has to be modified by adding steel tube. One end has to be welded at the handle end and the other at the rear wheel centre. The frame should have enough strength so as to carry the flywheel and the additional forces that comes to play.

The modification should not hinder normal riding. Also the modified frame should have enough space in order to accommodate flywheel and clutch assemblies. This is shown in figure 3 below.

Fig. 3 Frame Modified

B. Flywheel:

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. The works done on flywheel is shown in figure 4 below.

Fig. 4 Works on Flywheel

Flow Chart of the Fabrication Process:

The flowchart of the fabrication process is shown in the figure 5 below.

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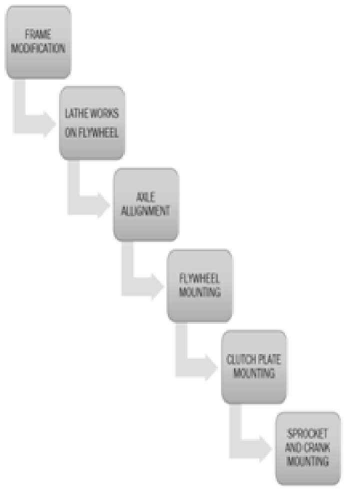

Fig. 5 Fabrication flowchart

RESULT AND ANALYSIS:

The flywheel bicycle increases efficiency on rides where the rider slows often. The additional weight is outweighed by the ability to recover energy normally lost during braking. Thus the addition of extra weight does not make it difficult for the rider. Also clutch provided helps in deciding the time period of activity. The overall result is that KERS system is efficient in storing the energy normally lost in braking and returns it for boosting.

A. Weight and Performance:

Normally energy stored in the flywheel is directly proportional to the weight and radius. Hence increase in weight proves to improve the performance. But as we know that the maximum safe weight that can be used is limited due to frame properties and rider compatibility. And also after some extent the radius can"t be increased and the energy storage thus seems to be limited to some particular extend. This is also because of the fact that the total running speed is being reduced due to weight. Energy storage capacity increases with increase in weight but limitation seems to be the speed driving the flywheel. And performance of system is directly linked with the energy stored. Thus a graph can be plotted between performance and weight. Optimum value lies between 5 and 8 kg.

Energy stored in flywheel, $E_k = \frac{1}{2} I\omega^2$

Where, 'I' is the moment of inertia

'ω' is the rotational velocity (rpm)

Moment of inertia, $I = kmr^2$

Where, 'k' is inertial constant (depends on shape)

'm' is mass of the disc

'r' is the radius

Thus E_k is directly proportional to the mass of the disc

The flywheel and transmission add weight to the bicycle. The increased weight will add to the energy required to accelerate the bicycle and to ride it uphill. However, once the rider has provided the energy to reach a cruising speed, the flywheel reduces the energy cost of slowing down from this speed since it aids in subsequent acceleration. Roads are optimal environment for the flywheel bicycle because its flat and there are lots of reasons for the cyclist to slow down. The performance versus weight graph is shown in figure 6 and the comparison of weight of ordinary and flywheel bicycle is shown in figure 7 below.

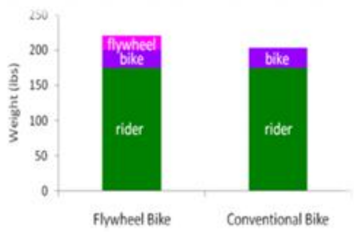

Fig.6 Performance Versus Weightfig. 7 Weight Comparison Between Flywheel Bicycle And Conventional Bicycle

Comparison Analysis:

Comparison is made between conventional bicycle and the KERS bicycle. The major things looked up was velocity, kinetic energy and pedal power input. The velocities of both seemed to be similar but the distance covered by flywheel is somewhat greater. A graph velocity versus time between both bicycles can be plotted. Next is the kinetic energy taken in to account. The flywheel has an extra kinetic energy that is being stored and hence from conventional bicycle flywheel bicycle is having an additional kinetic energy of

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flywheel. Graph connecting kinetic energy and time can be plotted. Now pedal power is taken to account. The flywheel bicycle has additional acceleration that is being boosted up by the flywheel acceleration. Hence conventional bicycle pedaling power can be achieved by less effort in case of flywheel bicycle. A graph can be plotted for pedal power input versus time. A side-by-side comparison, shown in figure, of the flywheel bicycle and a conventional bicycle during a ride cycle illustrates how the flywheel bicycle saves energy. Once at cruising speed the riders of both bikes reduce speed temporarily and return to the cruising speed three times before coming to a stop.

This frequent deceleration and acceleration is typical of a rider riding through red lights where he/she must slow for crossing traffic. During deceleration, the rider on the conventional bicycle applies the brakes to reduce speed, while the rider on the flywheel bicycle shifts the transmission to charge the flywheel. In both deceleration stages, the kinetic energy of the bike is reduced, but on the flywheel bike, the energy is transferred to the flywheel. The pedal power input is plotted for both riders.

Both input pedal power to overcome the same drag force, shown in blue. In order to return to cruising speed, the rider on the conventional bike needs to input pedal power to accelerate, shown in green. However the rider on the flywheel bike can transfer energy from the flywheel back to the bike by shifting the transmission to boost the bike. The rider of the flywheel bike doesn't need pedal power to accelerate! The sum of the drag and acceleration power is shown in grey. The area of this sum of pedal power input is the total pedal energy input since energy is the integral of power over time. Hence, the rider on the flywheel bicycle uses less energy than the rider on the conventional bike. This is depicted in figure 8 below.

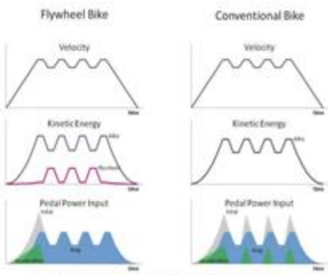

Fig. 8 Ride Cycle comparison between flywheel bicycle and conventional bicycle

ADVANTAGES AND DISADVANTAGES

Advantages

1. No chance of exploding batteries or electric shocks
2. High Power capability
3. Low weight and small size
4. Long system life of upto 250,000 kms
5. High efficiency storage and recovery
6. Low embedded carbon content
7. Low cost and efficient design

Disadvantages:

Developing this type of KERS, have reported that it is extremely difficult to develop, and will not be highly beneficial unless it is placed in the optimum position.

Applications:

We can implement the system for bicycle models, exercising equipments, pedaling unit etc.

RESULTS:

The flywheel bicycle increases efficiency on rides where the rider slows often. The additional weight is outweighed by the ability to recover energy normally lost during braking. Thus the addition of extra weight does not make it difficult for the rider. Also clutch provided helps in deciding the time period of activity. The overall result is that KERS system is efficient in storing the energy normally lost in braking and returns it for boosting.

Conclusion:

KERS 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.

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The results from some of the test conducted show that around 30% of the energy delivered can be recovered by the system. KERS 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. Here we are concluding that the topic KERS got a wide scope in engineering field to minimize the energy loss. As now a day, 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. Continuously variable transmission can be implemented to this system which would prove in drastic improvement in energy transmissions.

6.3 Future Scope:

We can add more features like pedaling with flywheel for generating power with dynamo interfacing. We can extend the project by designing even with Electric bicycle model also

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