DESIGN AND FABRICATION OF KINETIC ENERGY RECOVERY SYSTEM THROUGH MECHANICAL BRAKES

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Abstract: As the basic law of Physics says 'energy can neither be created nor be destroyed it can only be converted from one form to another'. During huge amount of energy is lost to atmosphere as heat. It will be good if we could store this energy somehow which is otherwise getting wasted out and reuse it next time we started to accelerate. Regenerative braking system through mechanical brakes refers to a system in which the kinetic energy of the vehicle is stored temporarily, as an accumulative energy, during deceleration, and is reused as kinetic energy during acceleration or running. Kinetic energy recovery braking is a small, yet very important, step toward our eventual independence from fossil fuels. These kinds of brakes allow batteries to be used for longer periods of time without the need to be plugged into an external charger. These types of brakes also extend the driving range of fully electric vehicles. This system is completely designed and kinematic analysis in 3D EXPERIENCE.

1. INTRODUCTION:

When a conventional vehicle applies its brakes, kinetic energy is converted to heat as friction between the brake pads and wheels. This heat is carries away in the airstream and the energy is effectively wasted The total amount of energy lost in this way depends on how often, how hard and for how long the brakes are applied.regenerative braking system refers to a process in which a portion of the kinetic energy of the vehicle is stored by a short term storage system. Energy normally dissipated in the brakes is directed by a power transmission system to the energy store during deceleration.

That energy is held until required again by the vehicle, whereby it is converted back into kinetic energy and used to accelerate the vehicle. The magnitude of the portion available for energy storage varies according to the type of storage, drive train efficiency, drive cycle and inertia weight. A lorry on the monoway could travel 100 miles between stops. This represents little saving even if the efficiency of the system is 100%. City centre driving involves many more braking events representing a much higher energy loss with greater potential savings. With buses, taxis, delivery vans and so on there is even more potential for economy. Since regenerative braking system results in an increase in energy output for a given energy input to a vehicle, the efficiency is improved. The amount of work done by the engine of the vehicle is reduced, in turn reducing the amount of prime energy required to propel the vehicle. In order for a regenerative braking system system to be cost effective the prime energy saved over a specified lifetime must offset the initial cost, size and weight penalties of the system.

The energy storage unit must be compact, durable and capable of handling high power levels efficiently, and any auxiliary energy transfer or energy conversion equipment must be efficient, compact and of reasonable cost. In this chapter discussed about the project background such as problem statement, objectives and scope of the project. All this information is crucial to give a starting point for the progress in this project. This project is focused on design and fabrication of regenerative braking system through mechanical brakes assembly by using CATIA design software.

In society day by day the automobile sector is developing very huge. In India present economy is depend on the automobile sector. While manufacturing the automobile components consider the following parameters

- Design parameters
- Safety parameters
- Cost of reduction
- Weight reduction
- Power generation after applying brakes
- Fuel consumption
- Easy fitment
- Time factor

2. LITERATURE SURVEY:

Pulkit Gupta ,Anchal Kumar ,Sandeepan Deb ,Shayan , (2014) " Regenerative Braking Systems (RBS) (Future Of Braking Systems) " , *International Journal of Mechanical and Production Engineering (IJMPE)* , pp. 75-78, Volume-2,Issue-5

mr.shete Prasad bapusaheb(2016) and his team members said about importance of regenerative braking system and also they concluded that how mechanical systems designs are done as well as how to build them from theoretical flywheel and spring and the difference between the real world systems and theoretical once.

Santhosh Bawage[2017] studied about the motor based regenerative system used in electric or hybrid electrical vehicle to motor use of electric motors. He connects the drive shaft to vehicle to motor, when current is supplied to motor it starts rotating and in turn rotate the drive shaft of vehicle. When brake pedal is pressed which cuts the current supply to motor.

Deepak vishwakarma And suyuja chaudary[2016] studied about the regenerative braking using electric motor and regenerated braking using flywheel. The amount of energy stored by flywheel s depends upon its mass, radius and rotational velocity thus the maximum energy can stored by flywheel can be increased momentum must be varied. They conclude that the effort should be made to layout o appropriate design of flywheel which can be a large amount of stress developed in flywheel.

3. Need of kinetic energy recovery brakes:

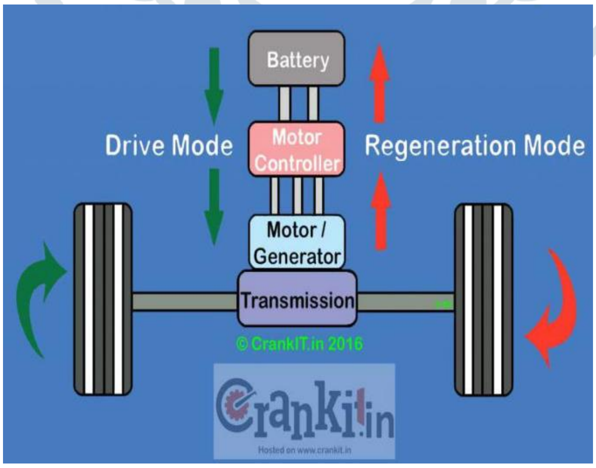
- It improved the fuel consumption by 33%.
- It reduces the emission of the vehicles.
- The price increase of petroleum based fuel also given rise to various research and development efforts in energy conservation.
- Regenerative braking system have the potential to improve the fuel economy of vehicles.

4. Working:

During this time, the wheels transfer the kinetic energy or momentum; back to the generator. While rotating, the generator converts this kinetic energy into electrical energy. Later, it transfers the electricity generated back to the batteries, thereby; charging the During this time, the wheels transfer the kinetic energy or momentum; back to the generator. While rotating, the generator converts this kinetic energy into electrical energy. Later, it transfers the electricity generated back to the batteries, thereby; charging them.

The regenerative braking system uses complex electronic circuits, to choose between; the forward / reverse direction of rotation of the motor. In some cases, the capacitors are used to store the electrical energy for later use. Keeping the battery fully charged; especially in electric vehicles, is

very helpful; which extends their driving range. It also helps to improve the mileage and reduce emissions to some extent in case of hybrid vehicles.

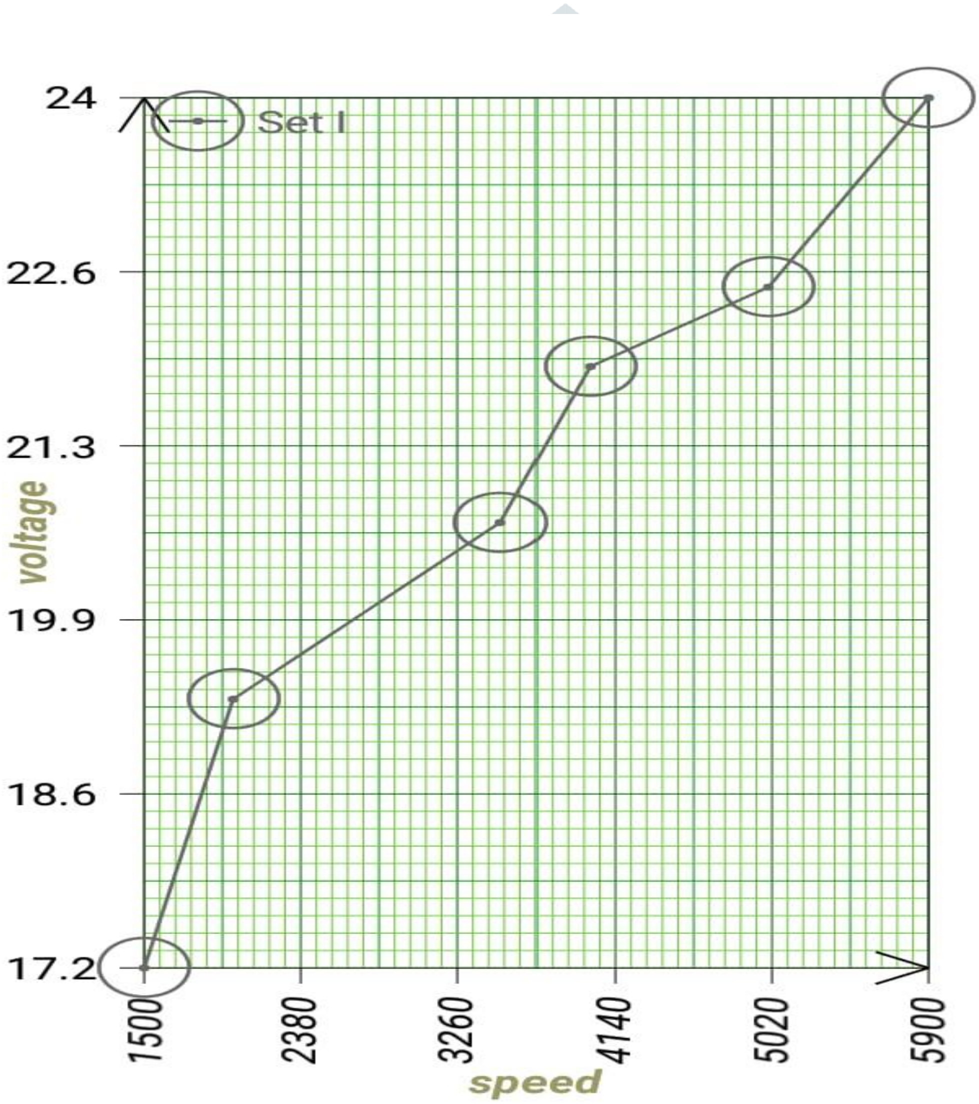


Working of kinetic energy recovery system through brakes

5. RESULTS:

S.NO	RPM at which brake pedal pressed	Voltage output
1	1500	17.20
2	2000	19.30
3	3500	20.68
4	4000	21.90
5	5000	22.52
6	5900	24

❖ **GRAPHICAL REPRESENTAION OF RESULTS:**



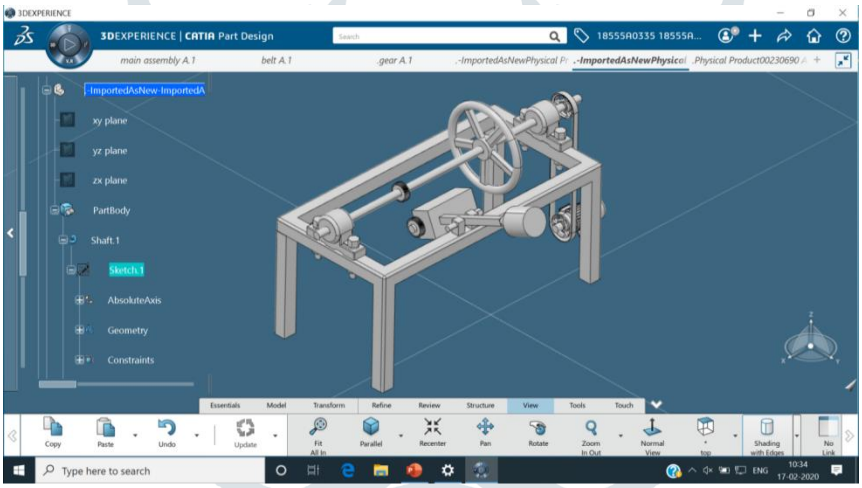
6. Design and kinematic analysis in 3D EXPERIENCE:

CATIA is an acronym for Computer **A**ided **T**hree-dimensional **I**nteractive **A**pplication. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.

CATIA is a multi platform 3D software suite developed by Dassault Systèmes, encompassing CAD, CAM as well as CAE. Dassault is a French engineering giant active in the field of aviation, 3D design, 3D digital mock-ups, and product lifecycle management (PLM) software. CATIA is a solid modelling tool that unites the 3D parametric features with 2D tools and also addresses every design-to-manufacturing process. In addition to creating solid models and assemblies, CATIA also provides generating orthographic, section, auxiliary, isometric or detailed 2D drawing views. It is also possible to generate model dimensions and create reference dimensions in the drawing views. The bi-directionally associative property of CATIA ensures that the modifications made in the model are reflected in the drawing views and vice-versa.

Catia in 3d experience

Final assembly of project in 3d experience:



Final assembly

Figure 6.9 shows the complete assembly of kinetic energy recovery system through mechanical brakes in 3D experience. By starting the prime mover motor, the rotational energy from the motor is transformed to shaft through the open belt. The shaft in which a spur gear is mounted exactly at the center of shaft. A lever with a handle is hinged opposite to the spur gear at any one side of the length frame. The lever in which a dynamo or generator is inserted and at the end a spur gear is also inserted, during operation whenever the lever is pressed against the gear on the shaft the kinetic energy from the shaft is absorbed by the gear which is mounted on the lever. By the direct coupling of gear shaft and the generator, generator starts rotating and then produce electricity which is proportional to the speed of the wheel and the pressure we act on lever.

6.1 KINEMATIC ANALYSIS IN 3D EXPERIENCE:

Logo of mechanical system design in 3d experience

DMU Kinematics Simulator 2 (KIN) defines mechanisms for digital mock-ups of all sizes using a wide variety of joint types, or by generating them automatically from mechanical assembly constraints. DMU Kinematics Simulator 2 (KIN) also simulates mechanism motion easily with mouse-based manipulation in order to validate mechanisms. DMU Kinematics Simulator 2 (KIN) analyzes mechanism motion by checking interferences and computing minimal distances. It generates the trace or the swept volume of a moving part to drive further design. Finally, it allows combined simulations through the integration with other DMU products.

Addressing people involved in activities ranging from the design of mechanisms to the functional verification of mechanisms, DMU Kinematics Simulator 2 (KIN) is targeted for all types of industries.

3D Mechanism based on...

16 types of joints are available: Revolute, Prismatic, Cylindrical/Actuator, Planar, Rigid, Spherical, Universal, Point-Surface, Point-Curve, Roll-Curve, Slide-Curve, Screw, Gear, Rack, Cable and Constant Velocity joints. Associativity is supported between the created mechanism and the used geometry for most of joint types. Full V4 set of joints is supported for V5 creation and V4 to V5 upgrade. The user can define and verify joint limits (travel limits or joint stops) allowing to guide the design of the assembly and the design inside the mechanism.

- **Automatically generates mechanism:** Constraints defined in CATIA Assembly Design (ASD) product can be automatically interpreted as joints.

- **Simulates mechanism motion:** The user can easily simulate motion using the mouse, and is guided in his possible actions thanks to a copilot, which pops up icons under the mouse. The user can also create a wide range of kinematics laws allowing time-based simulation. The laws can be graphically visualized.

- **Analyzes mechanism motion dynamically:** During mock-up design review, users do not only need to view simulated kinematics motion but also analyze the mechanism's consistency with the functional specifications. DMU Kinematics Simulator 2 performs interference and clearance checking as well as computing the minimum distance. A 'stop on collision' option freezes the motion for detailed analysis.

- **Records motion analysis' results:** The user can replay a motion simulation, or save it as a video file.

- **Generates useful information:** DMU Kinematics Simulator 2 provides users the ability to define a point in a moving part and generate its trace in order to design cams. The user can also generate the swept volume of a moving part that is defined by a part moving through its entire range of motion. The swept volume can be reused in the clash analysis to check, during the digital mockup evolution, that the mechanism can still be operated. During a simulation with laws, it is possible to plot sensors according to Time but this functionality also offers the possibility to plot a sensor according to another sensor. This ability enhances the study of a mechanism offering a better way to qualify its behavior, or to improve its design. A user can run for instance the simulation of an engine and plot the position of an inlet valve according to the rotation of the crankshaft.

Allows automation of mechanism creation and simulation through Visual Basic macro programming

- **Allows combined simulations:** Multiple combined simulations are possible for advanced digital product synthesis when using this product in conjunction with other DMU products. For example, users can simulate and synchronize un-mounting procedures with a kinematics motion when both the DMU Kinematics Simulator 2 and DMU Fitting Simulator 2 products are installed.

- **Simulates mechanisms involving:** The data used to create the full digital mock-up may come from any number of supported data formats, including: CATIA, STL, IGES, OBJ (from Wave front) or other multi-CAD environments. The kinematics simulation and associated kinematics analysis functions are identical whatever data format is used.

Preserves V4 customers' investment: Users can browse and simulate V4 mechanisms involving multiple parts. All information related to the mechanism definition can be displayed (degrees of freedom, types of joints, etc.). The user has also the possibility to upgrade V4 mechanisms into V5 mechanisms

7. Conclusion:

Driving is an extremely wasteful process. Large amounts of kinetic energy is turned into heat and gone from the car. Thankfully, a regenerative braking system system makes use of this heat to regenerate the batteries of the electric vehicle. Despite the amount of research and development that has gone into regenerative braking system, there is still significant room for improvement.regenerative braking system is still very limited and dependent on uncontrollable variables. Also, danger can arise if regenerative braking system is applied to two-wheel-drive brake systems. However, regenerative braking system does have various benefits. A proper implementation of regenerative braking system system extends driving range, improves braking efficiency, reduces brake wear, and improves energy conservation.

8. Scope of study:

Kinetic energy recovery braking system systems require further research to develop a better system that captures more energy and stops faster. As the time passes, designers and engineers will perfect regenerative braking system systems, so these systems will become more and more common. All vehicles in motion can benefit from these systems by recapturing energy that would have been lost during braking process. Future technologies in kinetic energy recovery brakes will include new types of motors which will be more efficient as generators, new drive train designs which will be built with kinetic energy recovery braking system in mind, and electric systems which will be less prone to energy losses. Future technologies in these brakes will include new types of motors which will be more efficient as generators, new drive train designs which will be built with regenerative braking system in mind, and electric systems which will be less prone to energy losses.

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