Kinetic Energy Recovery System in Four Wheelers

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Abstract— The main motive of our project is to recover the kinetic energy lost during braking. While driving an automobile, a great amount of kinetic energy is wasted when the brakes are applied, which then makes the start up fairly energy consuming. We have altered the rear axle for generating the power during the braking process through a generator.

Key words: Kinetic Energy, Modified Rearaxle, Energy Harnessing Method, Generating Power for Future use

I. INTRODUCTION

Regenerative braking systems (RBSs) are a type of kinetic energy recovery system that transfers the kinetic energy of an object in motion into potential or stored energy to slow the vehicle down, and increase fuel efficiency. These systems are also called kinetic energy recovery systems. There are multiple existing methods of energy conversion in RBSs including spring, flywheel, electromagnetic and hydraulic. More recently, an electromagnetic-flywheel hybrid RBS has emerged as well. Each type of RBS utilizes a different energy conversion or storage method, giving varying efficiency and applications for each type.

RBSs are installed along the drive train or fitted to the drive wheels of a vehicle where they inhibit the motion of the wheels using magnetic fields or mechanical torque. These methods of motion inhibition allow energy to be generated under braking, as opposed to friction brakes which simply waste away energy to slow the vehicle by turning the kinetic energy into thermal energy. Due to the maximum charging rate of the energy storage mechanisms, the braking force from a RBS is limited. Therefore, a traditional friction brake system is required to maintain the safe operation of a vehicle when heavy braking is necessary. RBS can improve fuel consumption and reduce the overall braking load taken on by the vehicles friction brakes, reducing the wear on the brake pads.

II. EXISTING SYSTEM

The existing automobile generates the power by using internal combustion engine and the power is transferred to the gear box by means of torque converter. Thus the speed of the vehicle depends on the transmission system. Hence during braking the energy generated during the power stroke gets wasted by means of heat and friction through tyres. Again to start up the vehicle the energy is generated from the engine, thereby lot of kinetic energy is wasted.

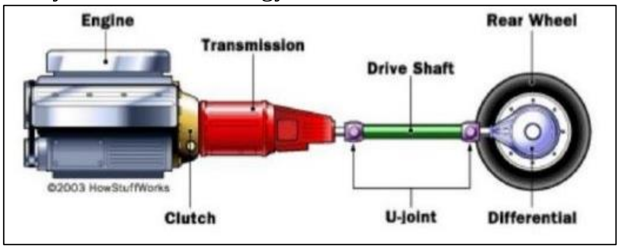

Fig. 1: Existing Transmission system

III. PROPOSED KINETIC ENERGY RECOVERY SYSTEM

A kinetic energy recovery system abbreviated as KERS is an automotive system which recovers the kinetic energy of a moving vehicle under braking. The energy recovered is stored in terms of potential energy a reservoir for later use for acceleration. Examples of reservoir are high voltage batteries, flywheels, hydraulic coupling, etc. The selection of reservoir largely depends on the purpose. In recent days recovering Kinetic energy has become an interesting area of research for many. Let us first find out why? The total energy in this universe can be broadly divided into two parts Potential Energy and Kinetic Energy.

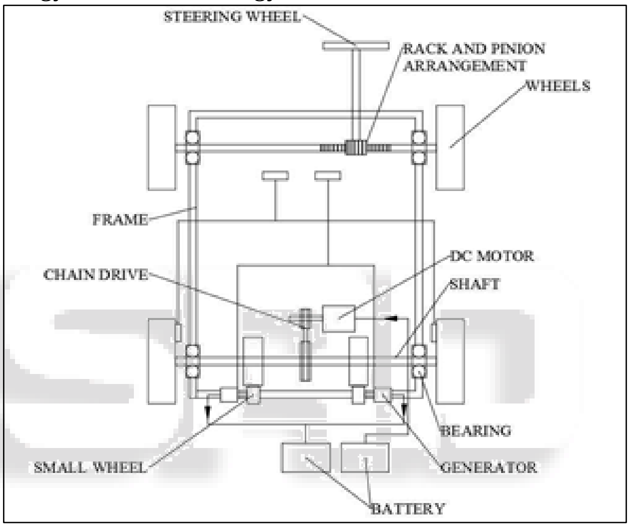

Fig. 2: Proposed Layout

When the dc motor is turned on, it activate the shaft by crank wheel motion which is coupled with help of chain drive. The obtained rotation activates the vehicle to move from its rest to motion. These rotation is also transmitted to the driven wheel attached to the shaft. When the foot lever is pressed against the driven wheel, the friction wheel arrangement is forced on the rotating driven wheel. This creates rotational force on the friction wheel and simultaneously it stops the rotation experienced by the driven wheel. Thus the wheel rotation is controlled and at the same time power is generated with the help of dynamo which is coupled with the friction wheel. The generated power is stored in the battery for future use.

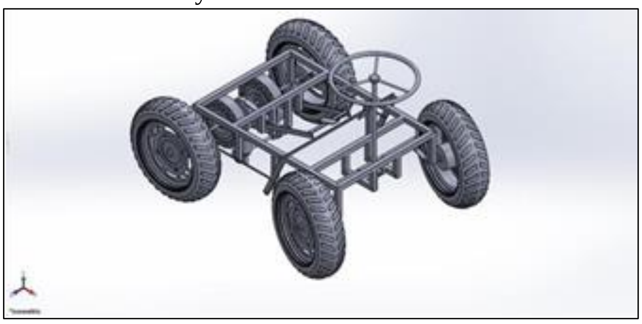

Fig. 3: Three Dimensional Layout

IV. COMPUTATION OF VEHICLE TOTAL KINETIC ENERGY

The vehicle total kinetic energy is calculated as follows

$$E = (1/2)\, mv_1^2 + (1/2) \sum I_\omega * \omega^2$$

Where,
E = Total kinetic energy
V_1= Velocity at the time of braking
I_ω= Rotational Inertia
ω = Angular velocity
r = wheel radius
$\delta = 1 + ((\sum I\omega)/(mr^2))$
δ – vehicle rotation quality conversion coefficient.(based on dynamic performance of wheel usually δ=1.04)
$E_1 = 0.52mv_1^2$
E_1 – Total kinetic energy at braking initially
E_2- $0.52mv_2^2$ (total kinetic energy at the end of braking)

$$E = 0.52*m*(v_1^2 - v_2^2)$$

Total kinetic energy produced during braking from 25 km/hr to 0 km.hr.
V_1=6.944 m/s
$E = 0.52*25*(6.944^2-0)$
E = 626.85 kgm/s
E = 63.92 watts
Thus the total kinetic energy produced during braking is 63.92 watts.
Torque required to move the vechile
Calculating force required

$$F = m*a$$

Retarding from 25 Km/Hr to 0 Km/Hr in 0.5 m
T= S/D
= 6.944/0.5
T= 13.88 Seconds
Acceleration is given by
a=change in velocitiy/ change in time
$= (V_f - V_i)/(T_f - T_i)$
= (0-6.944)/13.88
$a = -0.5002\ m/s^2$
Force is given by
F= m*a
= 25* 0.5022
F= 12.05N
Therefore Torque is given by
T=f*r
= 12.505*0.1651
T= 2.0657 N-M

V. STRUCTURAL ANALYSIS

Structural analysis is carried out by ANSYS to find out the stress distribution on our modified frame and the frictional contact of the friction wheel.

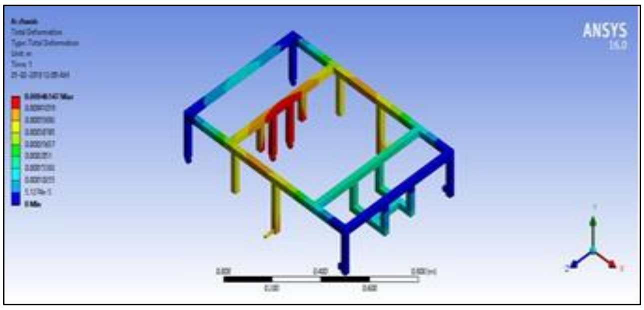

Fig. 4: Frame analysis

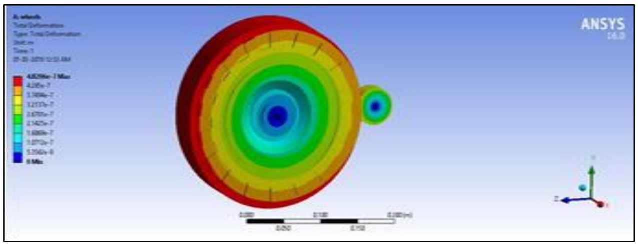

Fig. 5: Friction whee

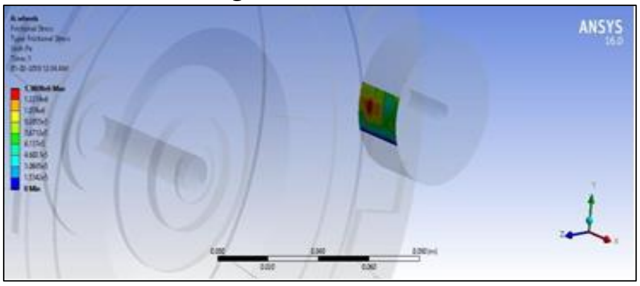

Fig. 6: Frictional contact

VI. EXPERIMENTAL MODEL

Fig. 7: Energy harnessing setup in the rear axle

VII. CONCLUSION

The present invention provides a light, compact and an inexpensive system. In a Regenerative Braking system, the regenerative brake captures about half of the energy wasted and is utilized by the engine whereas in conventional brakes, 80% of the total energy is wasted. Fuel consumption is reduced by 10 to 25 percent in a regenerative braking system. At higher speeds too, a regenerative braking has shown to contribute to improved fuel economy – by as much as 20%.

The energy harnessed for various velocities are tabulated in the below table.

Velocity (Km/hr)	Volt generated (Volts)
15	18
25	36
60	70

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