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Power Generation by Shock Absorber

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Abstract: ***In a country like India, two-wheeler vehicles are predominant over four wheelers. According to data taken from internet, around 20 million two wheelers were sold in 2017/18, as compared to 4 million four wheelers. And this demand keeps on increasing in India. Keeping this mind, a huge potential of energy is being wasted every day. This project is one of the methods to harvest those wasted energy. That's why this project is under energy recovery. All the major advancements and break through has been done mostly on four wheelers. To name some energy recovery mechanisms, regenerative brakes, regenerative shocks, MGU-H, MGU-K. Even the companies like AUDI and BMW have started launching commercial vehicles which come with energy recovery systems. The main purpose of the dampers is to keep the tires in contact with the ground all the time. Other functions include to absorb the vibrations produced due to irregularities of the surface. This prototype aims to convert these vibrational energies into electricity which otherwise would have been wasted. In a way it can be called Regenerative dampers, which is completely mechanical in nature. This prototype uses a rack and pinion arrangement to convert the reciprocating motion of the bike front fork into a linear motion. The motor is coupled to a DC generator which produces electricity. Our main focus is on two wheelers so, the energy stored can be used to increase the engine efficiency as extra load on alternator is reduced. The aim for this prototype is to produce a current of 0.3A and 12 V (DC), which would be sufficient to charge the batteries and run other auxiliary system of a motorcycle.***

Keywords: Power generation, Shock absorber, Dampers, Rack and pinion

I. INTRODUCTION

It was described to develop electricity using the real-time motion of parts in a form of wheeler. After careful analysis of a various such parts it was decided to generated electricity using relational motion available in a suspension system of a two-wheeler. In the new age of the electric bikes, almost everything has to be modified. In one hundred years, people will launch at today's hybrid and pure electric vehicles rather in the way we launch at motor vehicles from 1880 that looked like something dragged along by a horse because that was the starting point. Inside and out, today's electric vehicles look almost the same as what went before. We have batteries and electrical and electronic controls in big lumps because that is what they had to look like in the past, together with masses of wiring. We have a big lump of noisy, dirty, shaking internal combustion engine in a hybrid because that is what an engine has looked like in the past. Bring in smart electronic surfaces, wireless links, laminar conformal batteries and mini turbine range extenders. Then we really will have moved on in cost, performance and passenger safety, comfort and space available. However, until we figure out how to make comfortable vehicle bodies we shall need shock absorbers, so they might as well generate electricity. In 2005, David Oxen reider of Boiling Springs, PA, presented a design for an electricity generating shock absorber. Experimental Bosch suspension systems have generated electricity. Problems have included the devices being too large, too expensive, and too inefficient in converting electricity or just poor shock absorbers because they dispensed with the spring or had the wrong damping characteristics. During our project on off road vehicles, we noticed that the wheel travel of those vehicles was significantly very high. Along with the wheel travel the shock absorbers also had a simultaneous effect. These incidents left us to ponder, why can't we harvest this wasted energy and produce something useful. The challenge was to come up with something robust and efficient which can sustain the harsh road conditions of the Indian roads. We had to convert the reciprocating motion of the dampers into something usable form of energy. So, the direction was clear for us to use a generator to produce electricity. When a vehicle is travelling on a surface, it experiences various forces. Some of the predominant conditions arise while braking, accelerating, bumpy surfaces. To preserve the conventional sources of energy Fossil fuels are being depleted rapidly. Also, the price of fuel is increasing. So, the work needs to be done on reducing the fuel consumption. Dampers are the most important parts to ensure the comfort of the rider. They endure forces due to bumps, acceleration or braking. Shock absorbers have reciprocating motion in it. This motion is converted into rotational motion with the use of rack and pinion gear system attached to motor so that the EMF is produced. The main purpose of the energy conversion system is to convert the dissipating energy on the vehicle dampers to a functional current for the vehicle usage.

Mohamed A.A. et al. [1] talks about the potentiality of energy harvesting systems in four-wheeler vehicles. They have covered the various types of energy harvesting mechanisms in a very detailed manner. The paper studies the use of dampers to generate electrical energy. There are various configurations in which the power can be harvested. Liner type harvesters consists of electromagnets which when the flux is changed, EMF is induced. All the survey and research in this paper is related to light and heavy four-wheeler commercial vehicles. Towards the end of the paper, it talks about the scope of this field of technology. Ravindra Bhoite et. Al [2] proposed a prototype to harvest the energy from coil overs used in cars. They used rack and pinion gears to convert the rotary motion into reciprocating motion. Pei Sheng Zhang et.al. [3] talked about the different type of suspension system. They have used rack and pinion arrangements for energy conversions. Himanshu Rewatkar et. Al [4] designed the controller for a vehicle suspension system is to reduce the discomfort sensed by passengers which arises from road roughness and to increase the ride handling associated with the pitching and rolling movements. This necessitates a very fast and accurate controller to meet as much control objectives, as possible. Therefore, this paper deals with an artificial intelligence Neuro-Fuzzy (NF) technique to design a robust controller to meet the control objectives. The advantage of this controller is that it can handle the nonlinearities faster than other conventional controllers. The approach of the proposed controller is to minimize the vibrations on each corner of vehicle by supplying control forces to suspension system when travelling on rough road. The other purpose for using the NF controller for vehicle model is to reduce the body inclinations that are made during intensive manoeuvres including braking and cornering. A full vehicle nonlinear active suspension system is introduced and tested. The results show that the intelligent NF controller has improved the dynamic response measured by decreasing the cost function. S. Mathivanan et.al. [5] propsed an electromagnetic linear generator and regenerative electromagnetic shock absorber is disclosed which converts variable frequency, repetitive intermittent linear displacement motion to useful electrical power. The innovative device provides for superposition of radial components of the magnetic flux density within a coil winding array. Due to the vector superposition of the magnetic field and magnetic flux from a plurality of magnets, a nearly four-fold increase in magnetic flux density is achieved over conventional electromagnetic generator designs with a potential sixteen-fold increase in power generating capacity. Suchit Moon et. al. [6] propsed regenerative shock absorber is a type of suspension system that converts parasitic intermittent linear motion & vibration into use full energy, such as electricity. Conventional shock absorber simply dissipates this energy as heat. In our project, we use shock absorber, rack & pinion arrangement and dynamo. As shock absorber effect formed, spring is compressed. Linear movement of crank is converted into the rotary motion due to pinion moves as the rack is meshed with pinion and the pinion is mounted on the shaft which is connected to shaft of dynamo due to this arrangement, rotary motion of pinion is used to rotate dynamo. As dynamo rotation led to generation of energy. And this energy is used to charge the battery and this store energy is use for different vehicle accessories like power window, lights & air conditioners etc. this energy applicable in most of the military vehicles, race automobiles & maximum suspension system.

II. SCOPE OF THE PROJECT

We the group of young engineers found that, there is an impending need to make much more forays to make non-Conventional energy attain popular acclaim. This is also very essential to preserve the conventional sources of energy and explore viable alternatives like sustainable energy (the energy which we are already utilizing but for some safety of other uses we are suddenly wasting it, that can be reutilized), solar, wind and biomass that can enhance sustainable growth. What is more, such alternatives are environment friendly and easily replenish able. Therefore, they need to be thoroughly exploited with a functionally expedient, energy matrix mix. Growing economies, especially of Asia are gifted with sufficient resource base and non-conventional energy technologies are consistent both for grid linked energy generation and transmission in out of the way locales that are islanded from the grid. Adaptation of technology and employing them should be pursued right from this moment to have a head start, be informed of the barriers in technology applications of the renewable variety and synergizing them with the existing, traditional power production technology. It is known that in coming times, wind energy will be the most cost-effective renewable resource. Yet, it is doubtful if any individual technology would hold centre-stage. Thus, we selected kinetic motors means the “Energy in motion when it is suddenly applied with a sort of obstacle, then according to Newton’s law for every action there is an equal and opposite reaction. Utilization of this reaction is the basic reason behind the selection of this project work.”

III. DESIGN DETAILS

A. Working Principal

Power is to be produced from Vehicle suspension set up. The load acted upon the damper setup is transmitted to rack and pinion. Rack is mounted on the sliders which are fixed with the damper.

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This slider provides a smooth reciprocating motion. Damper's reciprocating motion is transformed into rotary motion using the Rack & Pinion. DC generator gets the input from the pinion gear. An EMF is generated when the rotor cuts the flux due to magnetic stators. The generated EMF can be converted to DC current with the help of voltage regulators. The emf generated can be used to charge the battery where it is stored. This power can also be used for supporting auxiliary systems like lights and other accessories.

B. Component

TABLE I
COMPONENTS DETAILS

Sr. No.	Components	Details	Specification	Quantity
1	DC Motor	6 Volts	-	04
2	Pulleys	5mm Diameter	Plastics	08
3	Battery	6 volts 4.5 Ah	-	01
4	Spring	-	-	01
5	Shock absorber	76101298 assembled	-	01
6	Rectifier	-	Full wave	01
7	Horizontal plate	$95 \times 95\ mm$	10 mm thick iron plate	02
8	Vertical Plate	$95 \times 95\ mm$	10 mm Thick wooden plate	02

C. Design Procedure

1) *Definition of the problem:* Before proceeding to design, the problem should be well defined i.e. The design engineer should make it clear, what exactly is the requirement i.e., for example Design and Fabrication of Power Generation by Shock absorber.
2) *Selection of Mechanism:* The selection of a proper mechanism for the machine part is usually decided by the purpose for which the part is to be designed. Considerations are given to strength wear, accuracy of relation efficiency and cost speed reduction.
3) *Selection of Materials:* Strength, Rigidity, Cost, Corrosion resistance, Machinability & Surface finish are the primary consideration in the selection of materials for the machine member.
4) *Preliminary design:* After selecting suitable materials and mechanism, the working stress and design stress can be determined. The dimensions of machine members are fixed by strength consideration, keeping the stress below the Design stress. The dimensions are rounded to the nearest to the standard values.
5) *Revising the Design*: After making the preliminary design, the design should be revised to suit the requirements.

D. Processes

Arc welding is a welding process that is used to join metal to metal by using electricity to create enough heat to melt metal, and the melted metals, when cool, result in a binding of the metals. It is a type of welding that uses a welding power supply to create an electric

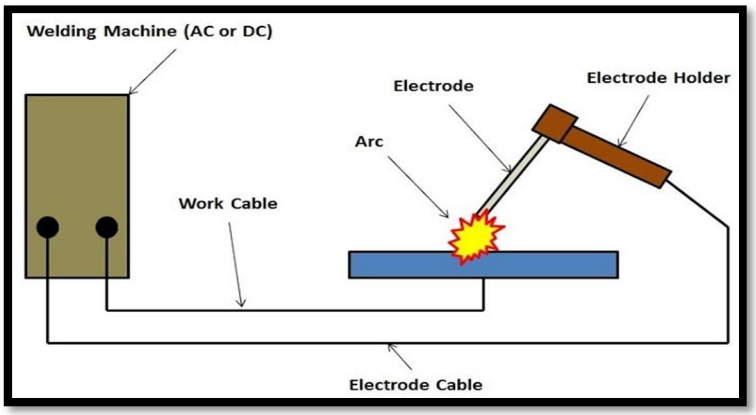

Fig. 1 Arc Welding

arc between a metal stick ("electrode") and the base material to melt the metals at the point of contact. Arc welders can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding area is usually protected by some type of shielding gas, vapor, or slag. Arc welding processes may be manual, semi-automatic, or fully automated. First developed in the late part of the 19th century, arc welding became commercially important in shipbuilding during the Second World War. Today it remains an important process for the fabrication of steel structures and vehicles.

Grinding is an abrasive machining process that uses a grinding wheel or grinder as the cutting tool. Grinding is a subset of cutting, as grinding is a true metal-cutting process. Grinding is used to finish workpieces that must show high surface quality and high accuracy of shape and dimension. It has some roughing applications in which grinding removes high volumes of metal very rapidly Grinding is a method of reducing the size of hard materials or sharpening tools, generally accomplished in several stages. To produce desired fineness of end products, grinding is done after machining operation.

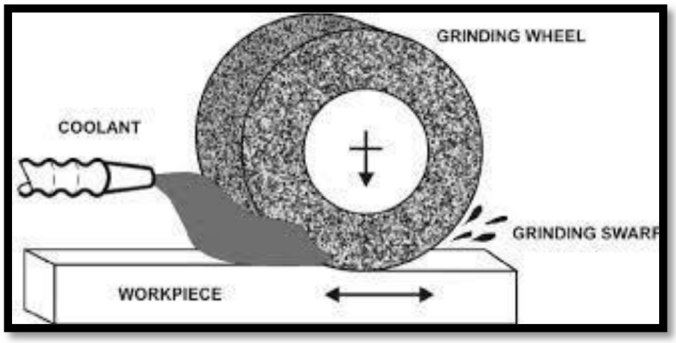

Fig. 2 Grinding

IV. RESULTS AND DISCUSSION

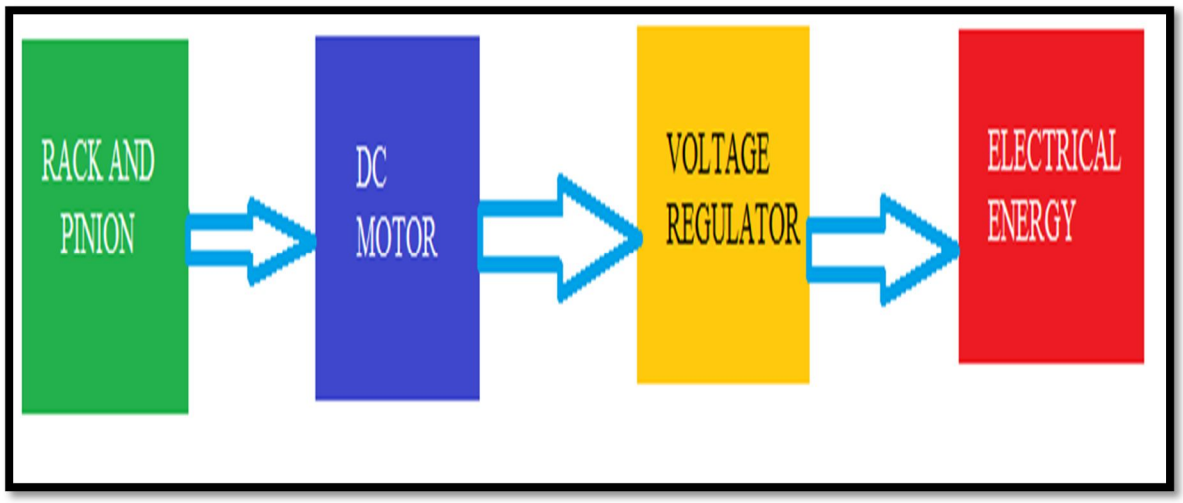

Fig. 3 Experimental testing block diagram

The experimental setup was fixed on the bike and the bikes front wheel was placed on the weighing machine.

A. Testing

1) First test without Voltage regulator and rectifier -

Load was given on the front suspension and the voltmeter was connected to motors in series. Only the voltage output was measured from voltmeter, since the rectifier was not used only positive values were taken. Load was measured from the weighing machine. Current was calculated from the formula I=E/R,

Where E = induced EMF

R = Total resistance in the circuit

Power was calculated from = VI

2) Second test with voltage regulator and rectifier -

Two mustimeters were connected, one to measure Voltage and the second one to measure Current. Load was measured from the weighing machine.

B. Model Calculation

1) Electrical Calculation

When a vehicle is running at a speed of 30 to 40 km/hr we observe 7 to 10 volts with the help of multi meter. Voltage Generated (V) = 10volt Current Generated (I) = 4amp

As Electrical Power (P) = V x I = 10 x 4= 40 Watts

2) TO CALCULATE CHARGING TIME FOR 6 VOLT BATTERY

Charging time =battery current (Ah) / current generated (A)

=4.5 (Ah) /3.2(A)

= 1.40 hr

But it was noted that during charging 40% get loss

=4.5 x 40 /100

=1.8 Ah

Charging time = 4.5 +1.8 /3.2

=1.9 hr

3) TO CALCULATE CHARGING TIME FOR 12 VOLT BATTERY

Consider that the suspension system is mounted on both side of the front suspension.

Total voltage produced by this suspension system in 18 volts, 64A

Therefore, time required to charge a 12-volt, 33 Ah battery is,

Charging Time =Battery current (Ah) / current generated (A)

=33 (Ah)/ 6.4 (A)

=5.15 hr

But it was noted that 40% loss during battery charging

=33 x 40/100

=13.2 (Ah)

Charging time = 33 + 13.2 /6.4

=7.21 hr

V. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries. We are proud that we have completed the work with the limited time successfully. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities. Thus, we have developed an "POWER GENERATING FROM SHOCK ABSORBER" which helps to achieve the motion rectification of the shock with the production of the electric energy. By using more techniques, they can be modified and developed according to the applications

VI. AKNOWLEDMENT

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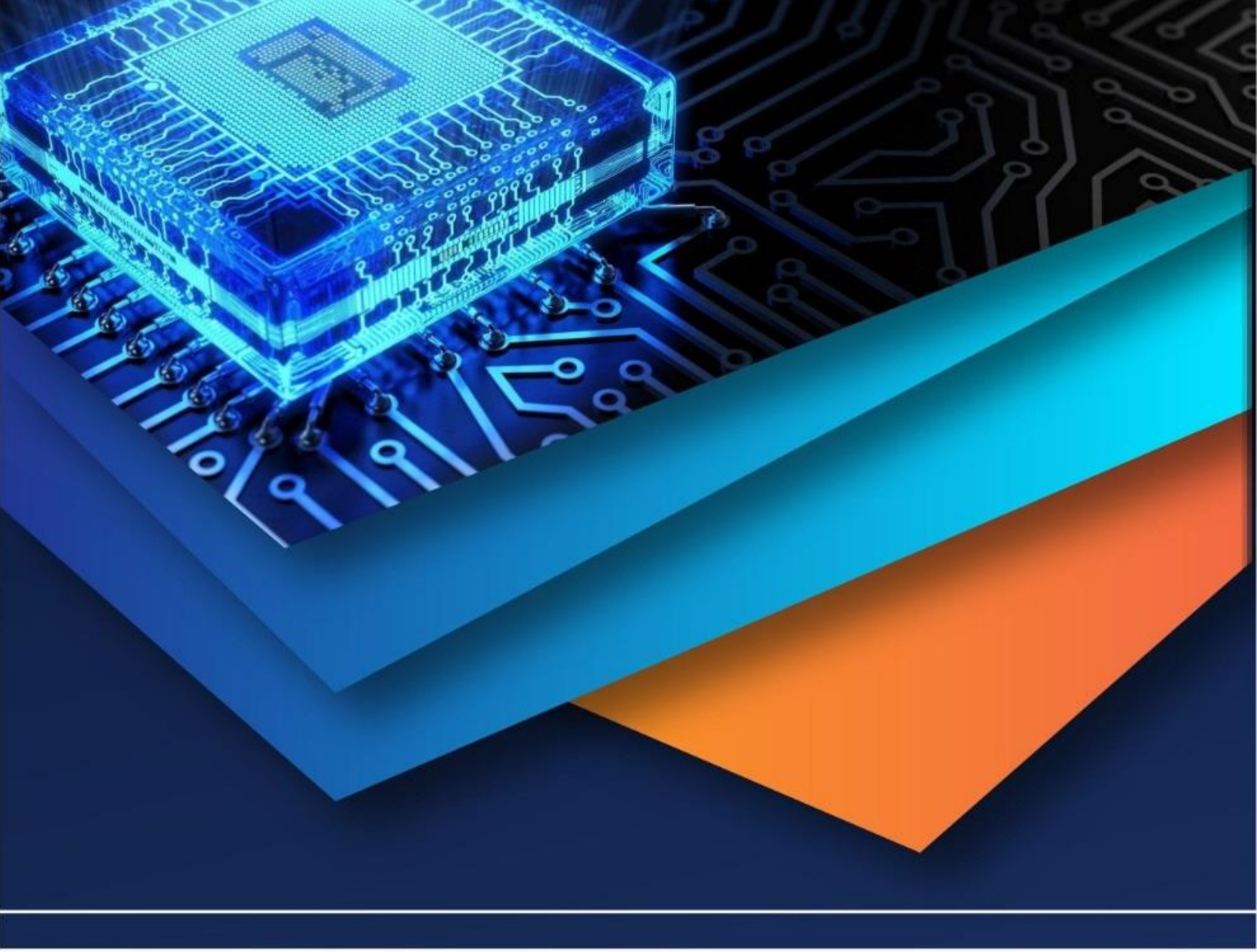

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