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Electrical Power Generation through Speed Breaker

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Abstract: ***In the present situation power becomes basic need for human life. Energy is responsible for major developments of any country's economy. Conventional energy sources generate most of the energy of today's world. But the population is increasing day by day and the conventional energy sources are diminishing. Moreover, these conventional energy sources are polluting and responsible for global warming. So, nonconventional sources are needed to be developed for power generation which are clean, environment friendly and sustainable. In this research we propose a renewable non-conventional energy source based on speed breaker mechanism. Our project is to enlighten the streets utilizing the jerking pressure which is wasted during the vehicles passes over speed breaker in roadside. We can tap the energy generated by moving vehicles and produce power by using the speed breaker as power generating unit. The kinetic energy of the moving vehicles can be converted into mechanical energy through rack and pinion mechanism and this mechanical energy will be converted to electrical energy using generator which will be used for lighting the street lights. Therefore, by using this mechanism we can save lot of energy which can fulfill our future demands.***

Keywords: kinetic energy, speed breaker, rack & pinion, generator, non-conventional energy, street light.

I. INTRODUCTION

Now a day's power has become the major need for human life. Energy is an important input in all the sectors of any countries economy. The availability of regular conventional fossil fuels will be the main sources for power generation, but there is a fear that they will get exhausted eventually by the next few decades. Therefore, we have to investigate other types of renewable sources .The day-to-day increasing population and decreasing conventional sources for power generation, provides a need to think on non-conventional energy resources [1] [2].Another major problem, which is becoming the exiting topic for today is the pollution. Power stations and automobiles are the major pollution producing places. So non-conventional power source is needed to reduce this problem. We proposed a nonconventional power generating system based on speed breaker mechanism which generate electricity without using any commercial fossil fuels, which is not producing any polluting products [3]. In this paper, our aim is to conserve the kinetic energy which convert into electricity that gone wasted, while vehicles move.

II. METHODOLOGY

Power can be produced from conventional and nonconventional energy sources. In this paper we show energy conversion from kinetic energy to rotational energy and rotational energy to electrical energy respectively [4]. This project explains the mechanism of electricity generation from speed breakers. It is a simple but optimum process to generate energy from speed breaker arrangements. There are a large number of vehicles running on the road. These vehicles are going over a number of speed breakers present on the road. We want to replace this traditional speed breakers with our proposed speed breaker. It is an Electro-Mechanical unit. This system utilizes both mechanical technologies and electrical techniques for the power generation and its storage. The generation will be proportional to the traffic density [5].

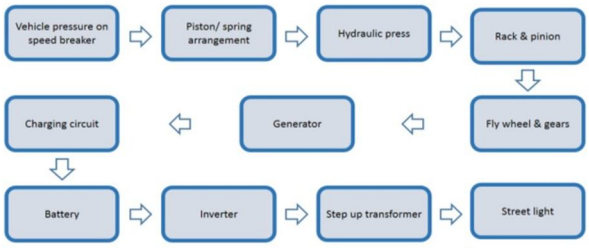

Fig. 1. Block diagram of

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III. SYSTEM DESIGN & FUNCTION

In this research, vehicle pressure on the speed breaker which is converted into rotary energy through rack and pinion using hydraulic press. Consequently, this rotary energy rotates generator that generates electrical power which is being stored through battery using charging circuit [6]. The whole system is represented on Fig. 2 and Fig. 3.

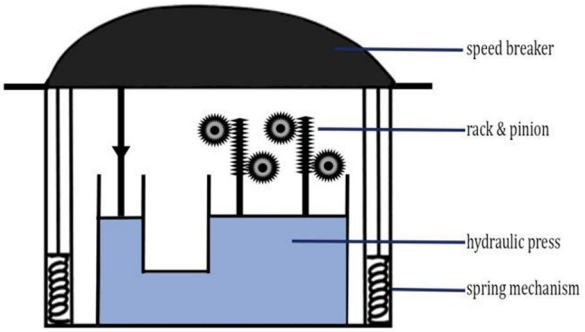

Fig. 2. Speed breaker mechanism

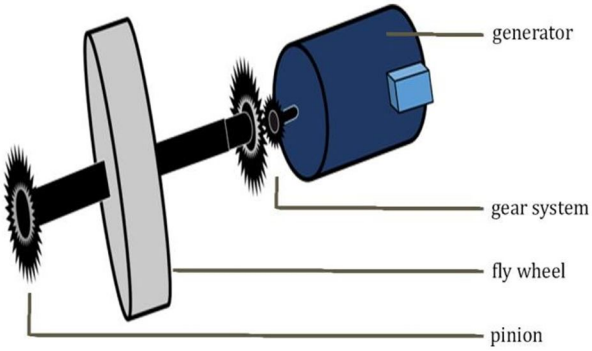

Fig. 3. Fly wheel and generator mechanism

When the vehicle load acted upon the speed breaker system is transmitted to rack and pinion arrangements. Because of the weight of vehicle the top portion of the speed breaker moves downwards [7]. The pressure rod which one side is attached to the bottom of the speed breaker and other side to small piston of hydraulic press. The hydraulic press convert the force into 4times from small piston to large piston. 3 rakes attached to large piston.

Every rack connected with 2 one way pinion. Pinions are getting rotation from the movement of rack backward and forward. Every pinion connect to a fly wheel which absorbs the energy when demand is less and releases the same when it is required. Fly wheel connected to a large gear and large gear connected to a small gear which attached to a generator. Generator convert rotational energy into electrical energy [8]. When the vehicle passes the speed breaker, the expansion of springs takes the speed breaker at previous state which done the system reverse.

The charging circuit charges a battery. The Inverter circuit converts this DC voltage into AC voltage and a step up transformer stepped up the AC voltage. A dark sensing circuit is used to sense the night so that the street light lit on.

IV. SYSTEM CONSTRUCTION

Speed breaker, spring arrangement, hydraulic press, rack and pinion combination, freewheeling and gear combination, generator, charging circuit, battery, dark sensing & switching circuit, inverter circuit and step up transformer used to the system in this research work.

A. Speed Breaker

It's the top portion of the system which is made of iron in curved shape. The main function of this speed breaker is to sustain the pressure of vehicle and squeezes it when vehicle passes through it.

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B. Spring arrangement

A spring is an elastic body whose function is to distort when loaded and to recover its original shape when the load is removed. It cushions, absorbs or controls energy either due to shocks or due to vibrations [9]. There are four helical springs below the speed breaker which are squeezed when vehicle pressurizes upon it and it bring the speed breaker at previous state.

C. Hydraulic Press

In a hydraulic press a small force applied on a column of liquid is converted into a much greater force available to another column of liquid. It is an application of Pascale law. In our proposed system it convert the force into 4times from small piston to large piston when the pressure created on speed breaker using this equation,

$$F_2 = \frac{F_1}{a} \times A$$

F_1= created force on small piston by speed breaker
F_2= converted force by hydraulic press
a = area of small piston
A = area of large piston

D. Rack & Pinion

Rack and pinion can convert rotary to linear of from linear to rotary motion [10]. Rack is a linear gear and pinion is a circular gear. Applied force on rack is converted to rotation by pinion. The mechanical force is converted into rotational force.

E. Fly wheel

The primary function of flywheel is to act as an energy accumulator. It reduces the fluctuations in speed [11]. It absorbs the energy when demand is less and releases the same when it is required.

F. Generator

The device which converts mechanical energy into electrical energy is called generator. An AC generator is used for producing alternating current which contains an assembly of stationary (stator) and moving parts (rotor). The rotor is connected with the gear. The torque which generated by gear rotates the rotor of the generator. The rotor creates a moving magnetic field around the stator, which induces a voltage difference between windings of stator and produce the alternating current (AC) output of the generator [12].

G. Charging Circuit

Charging circuit is used to charge the battery. Fig. 4. shows the charging circuit.

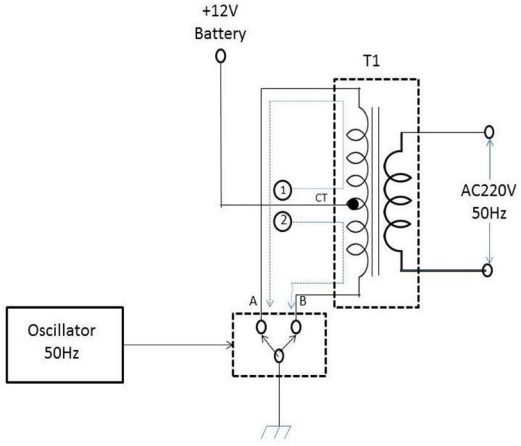

Fig. 4. Charging circuit

H. Dark Sensing and Switching Circuit

Dark sensing circuit sense the dark and switch the light on. Fig. 5. shows the dark sensing & switching circuit.

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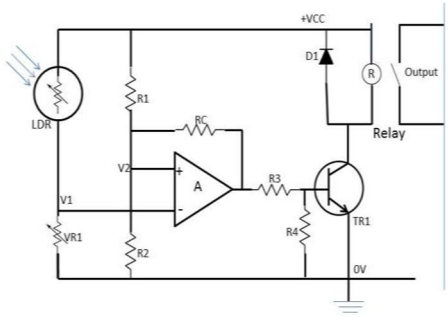

Fig. 5. Dark sensing & switching circuit.

I. Inverter Circuit & Step-up Transformer

Inverter convert DC voltage to AC voltage and step up transformer is a type of transformer which stepped up the AC voltage. In this system inverter circuit converts 12V DC to 15V AC. Step up Transformer makes the voltage to 250 V AC from 15 V AC.

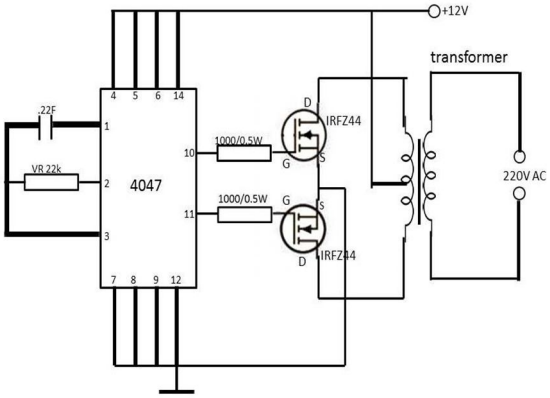

Fig. 6. Inverter circuit & step-up transformer.

V. COST ANALYSIS

The different essential equipment and its cost with quantities are given to Table I.

Table I. COST ANALYSIS

Equipment	No. of set	Price (BDT)
Rack	2	200
Pinion	4	400
Gear	2	200
Spring	4	400
Body frame	1	1000
Hydraulic press	1	3000
Battery	4	8000
Fly wheel	1	500
Wiring		200
Maintenance cost		1000
Installation cost		1000
Generator		3000
Total cost		18900

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VI. POWER CALCULATION & RESULT ANALYSIS

Let's consider,
The mass of vehicle moving over the speed breaker = 350Kg (Approximately)
Height of speed breaker = 15 cm
Weight of the Body = 350 Kg × 9.8 = 3430 N
Distance traveled = Height of the speed breaker = 15cm
Work done = weight of the body × distance travelled by the pressure of vehicle
Power = Work done/Second = (3430×0.15)/60 = 8.58 Watts
Output Power developed for 1 vehicle passing over the speed
Power developed for 60 minutes (1 hr.) = 514.5 watts
Power developed for 24 hours = 12.35 Kw
Our proposed system can provide 250 v and 24 amp.
We are using CFL bulb (100 watt) In one km 60 bulbs are needed.
Total watt = 60×100 = 6000 watt = 6 Kw
This power generated by vehicles is more than sufficient to run four street lights in the night time**.**

VII. ADVANTAGES

Using this proposed technology we can get the following advantages:

A. Nonpolluting power generating source Power generation with low cost.
B. Simple construction, mature technology.
C. Less floor area required and no obstruction to traffic.
D. No need of manual work during power generation.
E. Low installation and maintenance cost
F. Power generation using non-conventional energy sources.
G. Easy for maintenance and no fuel transportation problem.
H. Simple construction, mature technology, and easy maintenance.

VIII. CONCLUSION

The listed system is non-conventional and the way of power generation technique is also echo friendly. It has advantage that it does not utilize any external source [13]. By using this system we will able to reduce power crisis and load shedding. The stored electricity could satisfy the daily requirement for street lighting. We can also use it for signal system on road, tollbooth or any other useful work. So from the every angle we can see this system is very much effective to reducing the power crisis in Bangladesh.

IX. ACKNOWLEDGMENT

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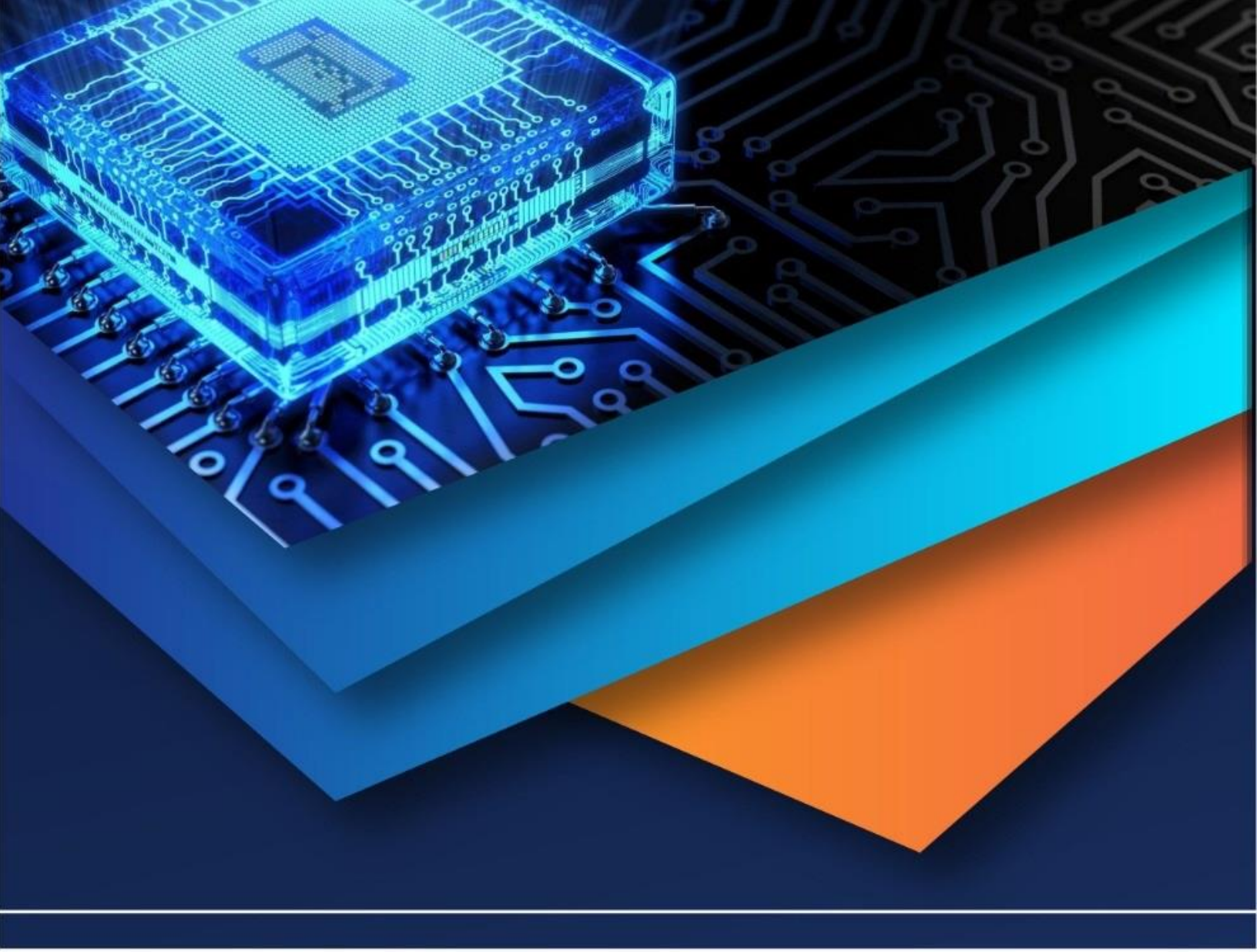

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