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Energy Generation Using Piezoelectric Materials in The Sides of Railway Track

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Abstract: The aim of this paper to offer a total appraisal at the rail line sound and vibration power reaping, from the beginning to the greatest best in class. This street numbers restrictive power reaping resources for the rail route environmental elements, various procedures of force collecting and their advantages and downsides, and on the end, power gathering bundles with inside the rail route venture. Various designs and models of force reapers are conveyed and analyzed. At last, the capacity bundles of rail line power gathering are tended to ,and future difficulties and patterns are talked about .The plan of the current work is planned in a way to offer perusers the greatest tremendous norms that need to be thought about with inside the format of railroad power collectors.

Keywords: Energy Generation, Electro Magnetic, Railway Track, Piezoelectric,

1. Introduction:

Rail transport, including passenger trains and metros, assumes a vital part in the economy and individuals' personal satisfaction. Around 66% of all U.S. traveler train clients and 33% of U.S. public travel clients ride inside the New York metropolitan region. Assisting policymakers and transport specialists with settling on informed choices about the activity and the executives of the area's transportation framework, consistent checking of the rail line's underlying condition, and appropriate support power line foundation. Correspondences train and track observing, dynamic train control, and so on) are fundamental. Tragically, the persistent checking of the underlying state of the rails and the solid and financially savvy power supplies expected for the electrical framework stays a test. This prompts untimely disappointment identification which happens one time per year. A huge part of the track is situated in underground passages, on spans or in somewhat far off regions, as displayed in Figure 1, where the energy expected to control the electrical foundation isn't modest to introduce and maintain.As an outcome, the failure to ceaselessly screen the primary condition and cost-effective power supply of the railroad electrical framework prompts administration disturbances, wasteful vehicle the executives, genuine rail mishaps and that's just the beginning.

2. Related Work:

Piezoelectricity (from the Greek piezo "strain" or "crush") can empower a "cycle of removing, changing over and putting away energy from the climate" [3] and was found by Curie in 1880 [4].

Figure 1. (a)No warning lights and gates in remote area, (b) subway tunnels requires significant expenditure for power wiring and (c) improper track structure monitoring and positive train control.

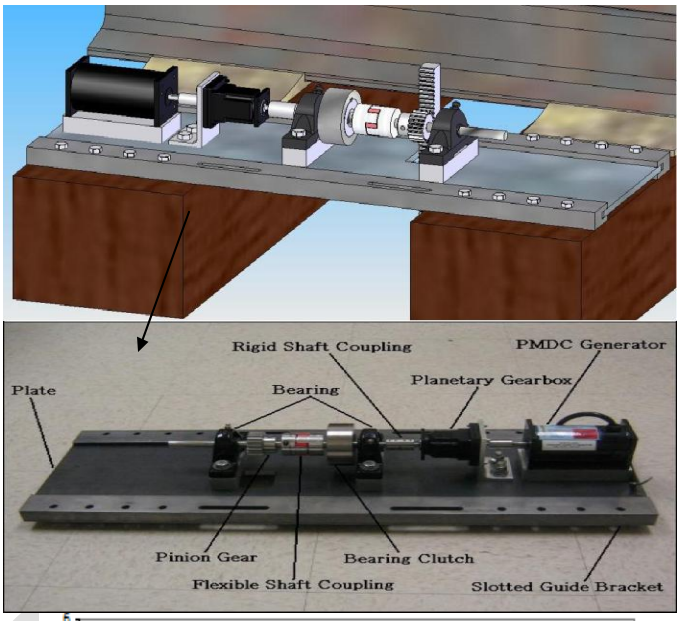
actuators in MEMS innovation and piezoelectric energy are not broadly used to catch dynamic energy.[1] predicts dramatic development in interests in piezoelectric energy gathering and an increment in piezoelectric units delivered somewhere in the range of 2012 and 2022, which is driving push the subject of this article to draw in the consideration of innovation producers and financial backers. The quantity of as of late distributed logical papers in the field of piezoelectric energy recuperation has expanded drastically throughout the most recent ten years. Hence, this paper investigates the full scholarly revenue in the energy recuperation of piezoelectricity. Outfitted with this obtained information, the creators propose a mechanical premonition in the field. Innovation Foresight [5] is tied in with distinguishing and assessing arising advancements that could acquire immense monetary and social advantages what's to come. Piezoelectric Energy Collector Because maintainable clean energy produces a usable measure of power contingent upon the tension of human strides, this valuable energy is squandered regardless of the accessible wellspring of clean power (human development). Electrical gadgets like lighting and screens, notwithstanding, private workplaces or private spaces utilize this innovation on the grounds that the gathered energy can't be utilized. The principle factors influencing the utilization of piezoelectric innovation are the power conveyed per step, the

amassing of the battery, the expense, the utilization base, the quantity of clients, the recurrence of dispersion of the strolling zone and the strategy for involving this innovation for ideal outcomes in energy saving, they expect energy to be utilized as the fundamental source or as a trigger sensor to deal with the electrical establishment vital for the area of clients and give sufficient ability to address their issues. This paper intends to work with the utilization of piezoelectric innovation by introducing the principle sorts of this innovation, particularly utilized in energy recuperation soils, some of which are introduced organizations whose items and different classifications are introduced as examination upheld by tests. The assortment of energy accessible in the climate like mechanical vibrations, heat, liquid streams, electromagnetic radiation as light and radio waves (RF) and in vivo energy can give clean energy to work different electronic gadgets, for example, remote sensor organizations, portable hardware, versatile biomedical gadgets and inserts. These gadgets are typically controlled by electrochemical batteries.

3. Methodology:

Since rail piezoelectric energy recovery can only recover energy on the order of milliwatts, enough to power sensors that monitor structural health, but not simultaneously with electrical infrastructure sol, Nelson [12] then used a rotating electromagnetic generator to capture energy from the rail as shown in Figure 2(a). It is an adaptation of the traditional rack and pinion vibration energy collector to railway oscillations. In this case, the rack and pinion will convert the non-uniform linear oscillation into non-uniform rotation and the generator is driven by this rotary oscillation. Therefore, the power generated is also erratic as shown in Figure 2 (c). This prototype conventional rotary vibratory energy collector for railway applications is shown in Figure 2 (b). The rack is grounded to a certain depth. The entire system is mounted on a mounting plate and the plate is bolted to two cross members as shown in Figure 2 (a) when a loaded train crosses the track, it swings vertically and drives a harvester to generate power.

Since piezoelectric energy harvesting from rails can only recover energy on the order of milliwatt, it is sufficient to power sensors that monitor structural health, but not simultaneously with solar energy infrastructure. Nelson [12] then used a rotating electromagnetic generator to capture energy from the rail, as shown in Figure 2 (a). It is an adaptation of the rack and pinion oscillating energy recovery system with rail oscillation. In this case, the rack and pinion will convert the non-uniform linear oscillation to uneven rotation and the generator is driven by this rotary oscillation. Therefore, the output power generated is also irregular, as shown in Figure 2(c). A prototype of a conventional rotary vibration energy collector for railway applications is shown in Figure 2(b). The rack is grounded to a certain depth. The entire system is mounted on a mounting plate and the plate is bolted to two crossbeams as shown in Figure 2 (a) when a loaded train crosses the track, it wobbles vertically and drives a combine to generate power.



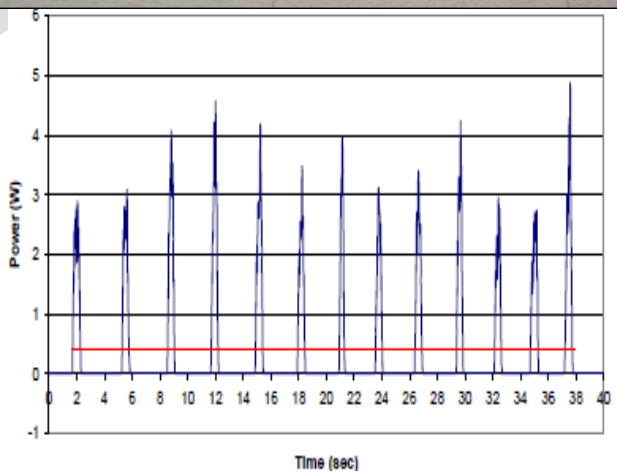


Figure 2 a) Electro-magnetic based railroad energy harvesting b) Prototype of the rotational harvester c) Power harvested by the harvester (avg-0.5Watts)

3.1 Other types of railroad energy harvesting:-

In addition to piezoelectric and rotary electromagnetic energy harvesting methods, very few other rail energy harvesting methods have also been invented. Zahid.Mian generates energy by placing an electromagnetic coil near the track as shown in figure 3. passing, the coil will generate electricity only because the moving wheel will change the magnetic flux around the coil.The high permeability of the steel wheel will allow the flow to pass and the rate of change of the flow depends on the speed of the wheel. This method can only generate on the order of a few milliwatts.

Nelson et al also use an induction coil device to collect energy from the rail. The induction coil device is positioned on the side of the rail as shown in figure 4 is produced. As shown in figure 4, the induction coil magnet is displaced due to the vertical displacement of the rail caused by the moving train.

Inductive coil magnets are driven directly by the vertical movement of the rail caused by the passage of a loaded train.

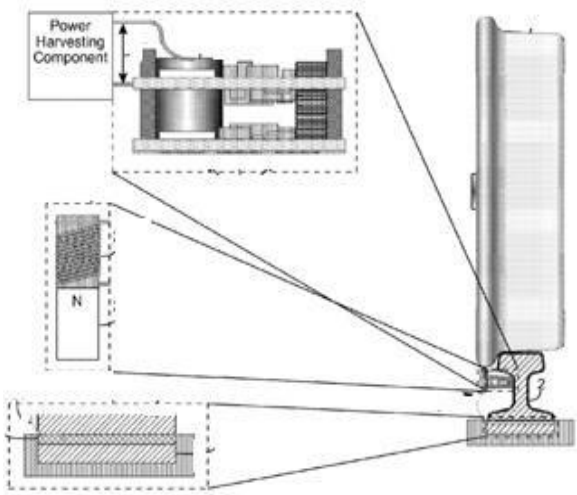


Figure 3. Magnetic coil based railroad energy harvesting

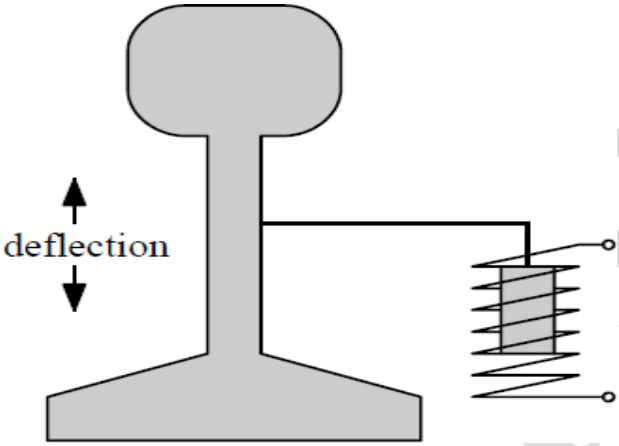


Figure 4. Induction coil device

4. Result and Discussion:

This project explains the mechanism of electricity generation from train track. The load acted upon the beam in train track by train wheel is transmitted to rack and pinion arrangement. Then, reciprocating motion of the beam track arrangement is converted into rotary motion using the rack and pinion arrangement where the axis of the pinion is coupled with the sprocket arrangement. This project explains the mechanism of electricity generation from train track. The load acted upon the beam in train track by train wheel is transmitted to rack and pinion arrangement. Then, reciprocating motion of the beam track arrangement is converted into rotary motion using the rack and pinion arrangement where the axis of the pinion is coupled with the sprocket arrangement.

Power Calculation:

While implementing, Load applied by one wheel of the train is 8.250 tons on a load train.

Finally the load on the beam is 16.500 tons.

Height of the beam track fitted 16cm.

Weight of the body = 16500 × 9.81 = 1, 61,865 N

Distance = 16cm. Power = work done/second = (1, 61,865 × 0.16)/60 = 431.64

Figure 5. Working model

While implementing our project approximately we get 431.64v of power. Since our project is just a model, we get very less power.

Our project, Load is applied manually 5-20 kg.

Height of the beam fitted 3cm.

Since manual load weight is same as applied load 1 kg (approx.) Weight of the body = 20×9.81 = 196.2N Distance = 3cm.

Power = (196.2×.03)/60 = 0.0981 W.

However power generation from the project is very less but it will not create any pollution and environmental hazards. Our project is a purely eco-friendly one and with the help of our project it is possible to green energy.

Table 1 Power generation by different loading

Experiment No.	Weight of the body(kg)	Height of beam(cm)	Power (watt)
1	5	3	(5x9.81x0.03)/60=0.024525
2	10	3	(10x9.81x0.03)/60=0.04905
3	15	3	(15x9.81x0.03)/60=0.073575
4	20	3	(20x9.81x0.03)/60=0.0981

From above experiment we find that when load increase 5 kg to 20 kg and height of the beam 3cm then power generation also be increase with respect of load on spring. At 20 kg we get 0.0981 watt power.

Table 2: Power generation by different loading

Experiment No.	Weight of the body(kg)	Height of beam(cm)	Power (watt)
1	5	2	(5x9.81x0.02)/60=0.01635
2	10	2	(10x9.81x0.02)/60=0.0327
3	15	2	(15x9.81x0.02)/60=0.04905
4	20	2	(20x9.81x0.02)/60=0.0654

From above experiment we find that when load increase 5 kg to 20 kg and height of the beam 2 cm then power generation also be increase with respect of load on spring. At 20 kg we get 0.0654 watt power.

5. Conclusion:

This project explains the mechanism of electricity generation from train track. The load acted upon the beam in train track by train wheel is transmitted to rack and pinion arrangement. In this experiment we apply different loading on spring and take different beam height and generate power. It will not create any pollution and environmental hazards. Our project is a purely eco-friendly one and with the help of our project it is possible to green energy. From above experiment we find that when load increase 5 kg to 20 kg and height of the beam 3cm then power generation also be increase with respect of load on spring. At 20 kg we get 0.0981 watt power.

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