International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Crankshaft and Coil Spring Mechanism for Footstep Power Generator

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Abstract - Electricity is a vital human necessity. We have a national power shortage as well as a dearth of environmentally friendly renewable energy. As our reliance on non-renewable energy sources grows, the consequences of climate change and energy use intensify. Although it is unlikely to have a significant effect on the transition away from carbon-based fuels, this approach is nevertheless crucial. By completing this project, more electricity would be generated to meet basic needs. The energy that is extracted from the floor is non-traditional energy. Most of the energy in this system is produced using conventional energy sources. Now this mechanism generates energy by the placement of extra weights on the ground because of human activity. It's an electromechanical system. This system is made up of the dc generator, coil spring, chromium rod, Battery, crankshaft. The power is produced using a crankshaft and coil-spring for the footstep power generation.

***Key Words*:** Crankshaft, Coil Spring, Footstep power generator, Non-Renewable Energy

1.INTRODUCTION

The primary component for generating power is the crankshaft, which transforms the vertical movement caused by each footstep into rotational energy. This essential part facilitates the electricity generation process by converting the linear action of stepping down into circular motion. The crankshaft successfully captures the mechanical energy generated by human movement, offering an effective method to produce electricity in various scenarios. The coil spring mechanism is an important element that improves the efficiency and performance of the footstep power generator, functioning in harmony with the crankshaft. Positioned strategically within the system, the coil spring plays a crucial role in storing kinetic energy during each step. As a person steps down, the coil spring compresses, storing potential energy that is subsequently released when the spring returns to its original form. The collaboration between the crankshaft and the coil spring mechanism highlights the synergy between engineering advancements and sustainable energy production. These components empower individuals to actively participate in generating clean, renewable electricity in their everyday lives by harnessing the power of human motion. This crankshaft and coil-spring mechanism captures energy during compression and produces energy upon release. Such a design minimizes energy loss, thereby boosting the overall power generation and efficiency of the device.

2.LIERATURE REVIEW

Mrs. Krupal Dhimar, Miss. Krishna Patel, Miss. Zeel Patel, and Miss. Nisha Pindiwala [1] talked about a 5-level three-phase cascaded hybrid multilevel inverter that operates with different DC voltage sources of 24V and 48V. An example of a linear actuator is a rack and pinion system, which includes two gears that convert rotational motion into linear motion; the pinion engages with the teeth of the rack. There is no need for external energy sources since the footstep power generator obtains its energy from non-renewable sources. Furthermore, the pinion shaft is connected to a chain sprocket, and the RPM of the small sprocket shaft is enhanced by employing a flywheel in conjunction with a stepper motor.

Ajinkya V. Gothane, Akshay R. Gosavi, and Prof. P. V [2] explored how individuals can produce electricity by utilizing a rack and ratchet system while traversing a speed bump. There exists some kinetic energy in moving vehicles, which is typically wasted. By employing an innovative design referred to as a power hump, this kinetic energy can be harnessed to generate electricity. This device operates through both mechanical and electrical processes for the generation and storage of power. The study also incorporates a rack and pinion mechanism.

R. Selvendran, K. Prabhu Deva, and C. K. Ramkumar Dev [3] examined the use of metal rollers that rotate due to the weight of passing vehicles, which then drives a generator to produce electricity. These rollers turn continuously, and one of them is linked to a free wheel, allowing it to rotate independently as cars move across the surface. A mechanical link has been established to connect an AC motor to the spinning roller for power generation. As a vehicle travels over a speed bump, the speed bump rotates in response to the vehicle's weight and speed. A 12-volt lead battery is utilized to store the generated D.C. voltage. Currently, the output from the motor is connected to street and traffic lights.

Tanzila Younas, Muhammad Saadat, Imran Hussain [4] discussed on the mechanism of two horizontally positioned shafts that are connected by a sprocket arrangement at the upper and lower shafts. On the bottom shaft, we have a flywheel, a gear assembly, two gears with different sizes, and a 4:1 gear ratio. The magnetic flux surrounding the rotor is reduced as it rotates within a static magnetic stator, producing the electric motive force (emf). To control 10 the electromotive force generated and provide the necessary output value of 12V, a voltage regulator is used. A battery charging circuit receives this 12V voltage and stores it in a battery bank. An inverter that is attached to this battery bank produces AC voltage for our use. The generated energy can be used for civic development initiatives like road signals.

3.METHODOLOGY

The footstep power generator operates by transforming the mechanical energy produced by a person's footsteps into electrical energy. When an individual steps onto the footstep platform, the resulting pressure is transmitted to the crankshaft mechanism. This platform incorporates a spring system that engages the crankshaft, leading to its rotation. The rotational movement is connected to a coil spring, which accumulates energy through compression as the pressure from the footstep is exerted. When the person lifts their foot, the energy stored in the coil spring is unleashed, assisting the crankshaft in continuing to turn. The crankshaft activates a generator rotor, which is usually linked to a magnet. As the crankshaft rotates, the magnet passes through a coil, generating alternating current (AC) via electromagnetic induction. This electrical energy is then routed through a rectifier circuit, which converts AC into direct current (DC). A voltage regulator ensures the voltage remains at a safe level for energy storage and usage. The overall system is engineered to effectively convert the mechanical energy from footsteps into usable electrical energy, providing a sustainable and renewable power source for low-energy tasks such as lighting or charging small electronic devices.

DESIGNED MODEL

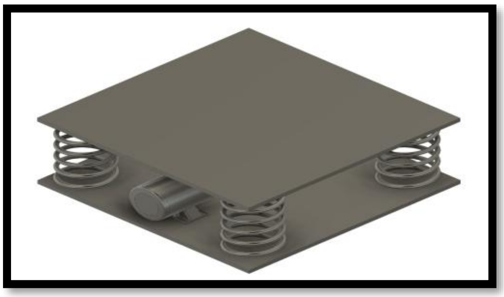

FIGURE 3.(A) *3D MODEL OF CRANK SHAFT MECHANISM*

We designed the 3d model of footstep power generator in fusion 360 software and analyzed it in Ansys for stress and total deformation.

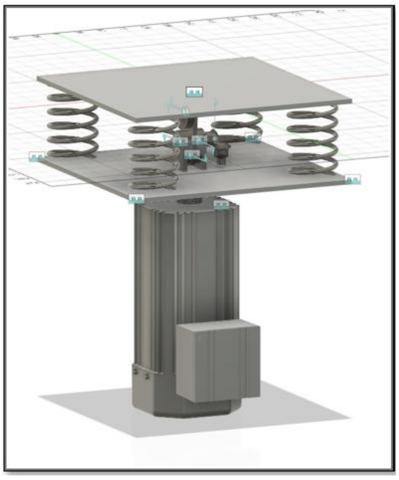

FIGURE 3.(B) *3D MODEL OF THE FOOTSTEP POWER GENERATOR*

4. CALCULATION

Power required from electric footstep power generator for railway station basic electrical needs,

Power Calculation:

Let 1 computer = 30-70 watt

So let us take an average of 50 watt

8hrs per day = 50*8

= 400wh

So, for 10 computers - 4000wh per day

Yearly usage = 1440 kwh per year

Each tiles produces around 25-50 watts, so the required no of units are,

Assuming 8hrs per usage,

= 25*8 hrs = 200 wh day

So, for 10 tiles,

= 0.2*10

= 2 kwh a day

Yearly usage = 2*365 days

= 730 kwh per year

In India 1 kwh = 8.57 rupees

So, 8.57*730 = 6256 rupees

Therefore, a sum total of 6200 Rupees can be saved every year.

5. DESIGN AND DRAFT OF THE CRANK WEB

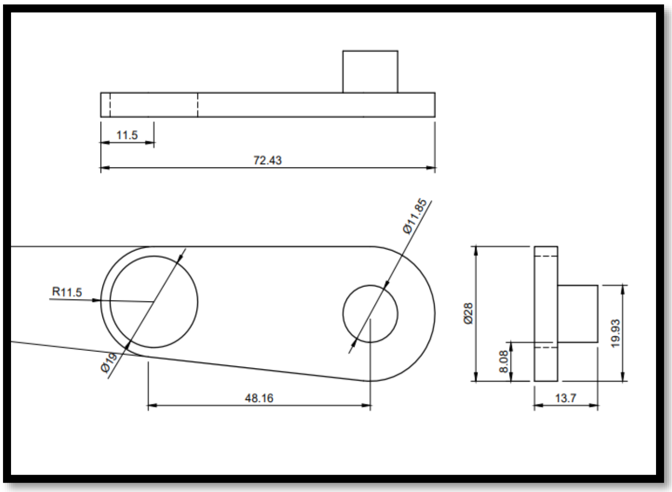

FIGURE 5.(A) DRAFT OF CRANK WEB

The crankshaft is generally constructed from a durable aluminium alloy to endure repeated mechanical strain. It incorporates an eccentric cam, which effectively transforms the linear movement from the footstep into rotational movement. When the footstep platform is activated, the spring mechanism causes the crankshaft to begin rotating. The Chromium rod facilitates a smooth vertical motion of the base plate, ensuring there is no tilting. The crankshaft is equipped with bearings and supports to minimize friction and promote smooth rotation. It is connected to the coil spring mechanism, which captures energy during compression and releases it to continuously power the generator rotor.

6. DESIGN VALIDATION:

In the finite element analysis (FEA) the boundary conditions, Total deformation and Stress are analyzed on how the structure or system will behave. They outline the ways in which the model responds to its surroundings and limitations, affecting the analysis's result.

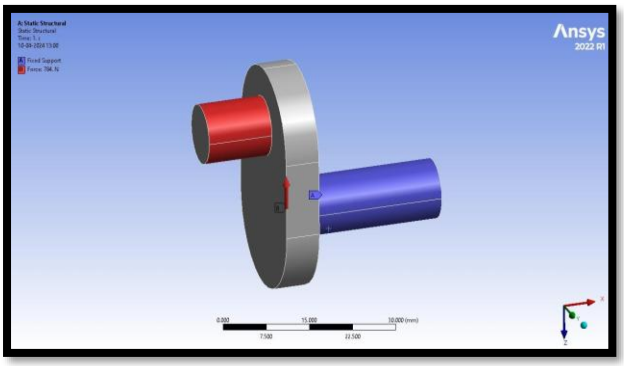

FIGURE 6.(A) *BOUNDARY CONDITION*

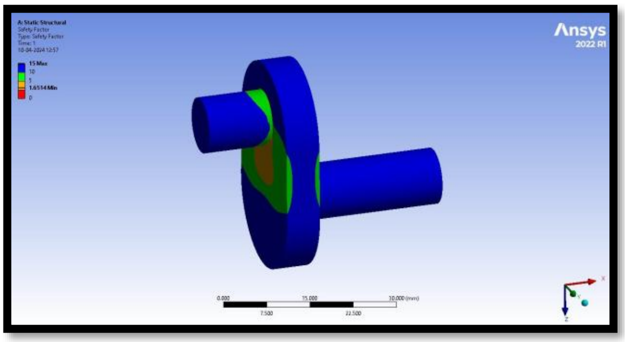

FIGURE6.(B) *FACTOR OF SAFETY*

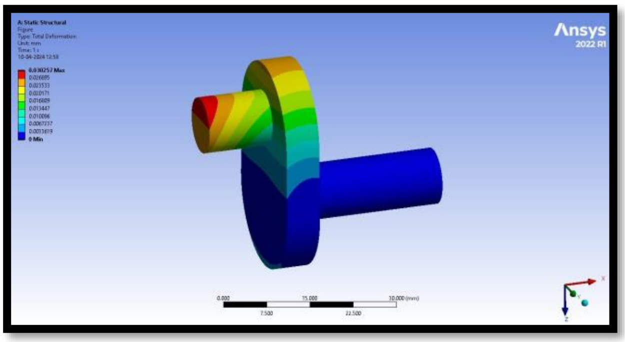

FIGURE 6.(C) *TOTAL DEFORMATION*

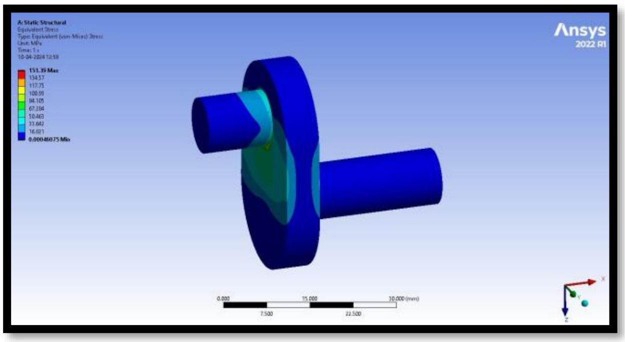

FIGURE 6.(D) *STRESS*

The figure above shows the von mises stress in different regions of the crank web when a load of 80 kg is applied on the base plate.

Analysis	Result
Max Deformation	0.0302mm
Max Stress	151.39 Mpa
Min factor of safety	1.6514

These conditions are applied to simulate the force that will be acting on the crankshaft during its operation

7. WORKING MODEL:

FIGURE 7.(A) *SIDE VIEW OF THE MODEL*

The model was manufactured in incubation cell at Sri Sairam engineering college, 3D printed coupling were used to support the chromium rod which is attached to the base plate. MIG welding was used to seal the frame and coil spring is attached to store the compressed energy. The crank webs were manufactured using laser cutting for accurate and precise rotation of the crankshaft.

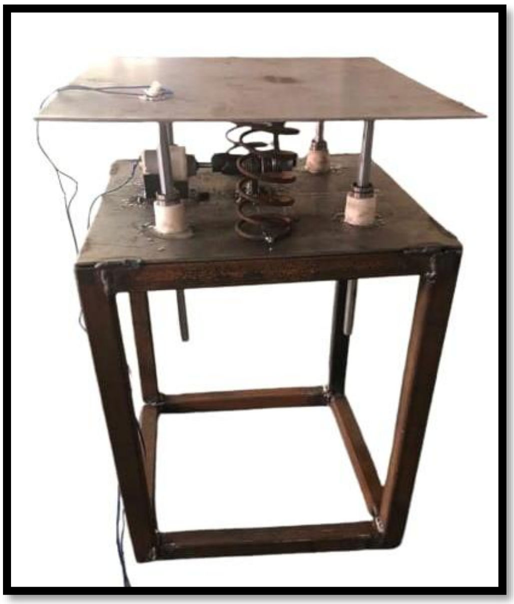

FIGURE 7.(B) *FRONT VIEW OF THE MODEL*

9. RESULT AND DISSCUSION

The field trial of the crankshaft and coil spring mechanism for footstep power generator was conducted at Sri Sairam Engineering College West Tambaram, Chennai, Tamil Nadu, India in mechanical department. The experiment was successful we achieved the desired results we were also able to power up the led bulbs of 10 watts in the building.
Finally we were able to bring the desired dimensions for our project, for every single components to work efficiently and thoroughly, which are listed below.

Components	**Dimension**
Steel plate	**250.4 * 91.82mm**
Connecting rod	**L = 42.5mm** **Dia = 25mm**
Spring	**Dia = 55mm**
Crank	**L= 72mm** **D = 19mm** **d = 11.5mm**

10.CONCLUSION

In conclusion, the footstep power generator project's crankshaft and coil spring system uses human kinetic energy to produce electricity. This creative approach provides an environmentally beneficial source of energy that can be used for a variety of purposes, including off-grid power solutions and the powering of low-energy equipment. It is also sustainable and renewable. The mechanism's efficiency and usefulness could be further optimized and refined, opening the door to greater adoption in both urban and rural settings.

FUTURE SCOPE:

- Implementation of any mechanism like rack and pinion for the front and back movement of the plate along the shaft.
- We Can use some sensors for the prevention of injury while the walking on the platform.
- It can be used in sport shoes for small power generation.

11. REFERENCES

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