IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Treadmill To Generate Electricity By Human Power: A Review

V.B. Vaidya[1], Harsh Rangari[2], Kantesh Thakare[3], Harsh Gotmare[4]

[1]Assistant Professor, Department of Mechanical Engineering, KDK College of Engineering, Nagpur, Maharashtra, India.

[2,3,4,]UG Student, Mechanical Engineering, KDK College of Engineering, Nagpur

Abstract:

The rising cost of electricity is attributed to inadequate power generation and increasing energy demands. Traditional power generation methods, particularly those relying on non-renewable sources, have detrimental environmental impacts. Therefore, there is a pressing need for alternative, eco-friendly power generation techniques. This study explores a novel approach to power generation utilizing manual treadmills. A treadmill's rotating shaft can be connected to a generator, enabling the conversion of human motion into electrical energy. This method is entirely pollution-free and can generate approximately 50-60 watts of power per hour. As an individual walks on the manual treadmill, they exert force on its surface, which causes the treadmill's shaft to rotate. This rotational energy is mechanically coupled to a small DC generator, which produces variable output due to the intermittent nature of the force exerted. To stabilize the output, a charge controller is employed, ensuring a constant supply of power. The generated electricity is stored in a battery for later use. This approach offers a sustainable and innovative solution for small-scale power generation.

Keywords: Treadmill, Power generation, Free energy generator, Sustainable energy, DC generator, Smart generation.

Introduction

Power hacksaws are specialized machines designed for cutting large metal or plastic shafts and rods, particularly those with diameters exceeding 15 millimetres. Cutting such materials manually with a standard handheld hacksaw is a labor-intensive and time-consuming task. To address these challenges, the power hacksaw machine was developed in the 1920s in the United States. This machine is classified as an automatic tool, as it eliminates the need for the operator to manually provide the reciprocating motion or apply downward force to the workpiece during the cutting process. Once the workpiece is fed to the desired length and the machine is activated, the power hacksaw automatically performs the cutting operation until the workpiece is completely divided into two parts.

Design

Load analysis of the selected material: -

Maximum applied load = 150kg = 1471.5 N.

Design of Shaft: - Maximum allowable load = 150 kg = 1471.5 N

Length of Shaft= 600 mm.

Uniform distributed load= 2.45 N/mm.

Consider simply supported load.

Material: -

Designation - C45.

Condition - Tubes, cold drawn and tempered.

Yield strength (syt) - 600 N/mm2.

Ultimate tensile strength (Sut) - 700 N/mm2.

Tp = 0.3 Syt = 0.3*600 = 180 N/mm2.

Tp = 0.18 Sut = 0.18*700 = 126 N/mm2.

Select whichever is smaller value – Tp = 126 N/mm2.

Assume kb =1.5 and kt =1.

P(KW) = 2πNT 60$*$1061.5=2πT$*$1500 60$*$106.

T = 9549.29 N-mm.

Mmax = (2.45*600) *300 = 441450 N-mm.

As per ASME code,

πd3Tp16= √ $(kb * M)2 + (kt * T)2$.

πd3 $*$ 126 16= √ (1.5 $*$ 441450)2 + (1 $*$ 9549.29)2.

πd3 $*$ 126 16= 662243.852. d3= 26768.097.

d = 29.91. d ≃ 30 mm.

Step 6: - Bearing selection and design

P = X*V*Fr + Y*Fa

Where,

P = equivalent dynamic load (N),

Fr = Radial load (N),

Fa = Axial or thrust load (N),

V = Race rotation factor

Fr =200 ∗ 9.81 4 = 490.5 N

Hence, the bearing is subjected to Pure bearing load. The value of V is 1.2 when the outer race rotates w.r.t.

Load while the inner race remains stationary.

P = V*Fr = 1.2* 490.5 = 588.6 N.

Bearing life (L10)

We take L10h = 16000 L10 =60n$L10h$ 106

Where,

n = Speed of rotation (rpm)

$L10h$ = rated bearing life (hours)

L10= bearing life (mill. revln)

=60∗1500∗16000 106

= 1440 milli revln

Then, we find Dynamic load capacity (C)

C = P (L10h)1/3= 588.6 (1440)1/3

C = 6645.725 N.

We select bearing 16006.

Belt selection and design

P=1.5 KW

Load correction factor= 1.2

Maximum power= 1.2*1.5= 1.8 KW

αs = 180 −2sin−1($D - d$) 2C

αs = 180 −2sin−1(67 − 50) 2 ∗ 1520

αs = 179.359

$\alpha s \simeq$ 180.

Hence, arc of contact factor Fd =1

Power corrected= (KW)max * Fd =1.8*1= 1.8 KW

Power corrected= 1.8 KW.

Assume n = 120 rpm not 1500 rpm as human being run

on the belt to measure velocity.

Belt velocity is given by,

v =$\pi * d * n$ 60 ∗ 103

v =π ∗ 67 ∗ 120 60 ∗ 103

v = 0.4209 m/s.

Corrected KW rating =0.118 ∗ v 5.08

Corrected KW rating =0.118 ∗ 0.4209 5.08

Corrected KW rating = 9.778 ∗ 10−4 KW.

width ∗ plies =$corrected\ power\ corrected\ belt\ rating$

width ∗ plies =1.8 9.778 ∗ 10−4

width ∗ plies = 1840

for 4 plies,

width =18404

width = 460 mm

width = 46 cm.

For standardization we assume width = 50 cm.

Length of Belt is given by,

L = 2C +$\pi(D + d)$ 2+$(D - d)$2 4C

L = 2 ∗ 1520 +π(67 + 50) 2+(67 − 50)2 4 ∗ 1520

L = 3223.83 mm L ≃ 325 cm.

Problem Identification

In recent years, the increasing pollution caused by the growing demand for energy has become a critical global issue. This surge in energy consumption has exacerbated environmental degradation, making it imperative to seek alternative sources of clean energy. The production of clean energy is essential not only to mitigate environmental pollution but also to enhance the efficiency of energy usage by reducing the depletion of finite resources. This paper addresses the need for clean energy generation through the conversion of kinetic energy generated by human activity, specifically walking and running.

The proposed system aims to harness the kinetic energy produced by individuals using a treadmill and convert it into electrical power. This is achieved by incorporating a new treadmill design that utilizes gears to multiply the rotational speed, which is then connected to a generator to produce electricity. The study involves experimental investigations of clean energy production using a treadmill system with gears, and compares the amount of electricity generated through walking and running on both a traditional treadmill and the proposed system.

By implementing this innovative treadmill design with gears in sports and health centers, it is estimated that a facility with ten machines could generate up to 500 kW annually. This contribution would significantly increase energy production while simultaneously reducing pollution levels, presenting a sustainable and efficient approach to energy generation.

Literature Review

Vikas Pansare et al. [1] proposed a project aimed at meeting the basic daily household power requirements, such as inverter battery charging for auxiliary power supply and charging mobile phones and other electronic devices. Their system focused on harnessing renewable energy for everyday applications.

Gopinath et al. [2] introduced a technique for generating electricity using components that capture the energy of human footsteps. Their system employs a converter to store the energy for future use. The study emphasized the importance of increasing power generation capacity by implementing such systems in high-traffic areas, addressing the energy crisis while simultaneously promoting a healthier environment.

Ravindra Burkul et al. [3] developed a branch-and-bound approach to optimize the "Treadmill Electric Bicycle," which serves both as an exercise tool and a means to reduce reliance on non-renewable energy sources. Their platform converts mechanical energy into linear motion, offering a potential solution for harnessing the energy wasted on treadmills in fitness centers. This concept introduces a novel way of energy distribution, providing a sustainable approach for the future.

Kunal Titare et al. [4] observed the current generation during test runs of their project, finding that current output was achieved at specific speeds. They calculated the current drawn from the motor to the battery and confirmed that the treadmill assembly remained free from failure or deformation, providing a reliable energy generation system.

Harsha et al. [5] developed a treadmill-based human power generator, using an electromagnetic dynamo generator coupled with the manual treadmill's flywheel. Their study demonstrated that a human-powered treadmill could significantly reduce energy consumption in gym environments. They highlighted the treadmill generator as a low-cost, quick-to-implement, simple-to-operate solution, especially beneficial for isolated areas such as rural regions or developing countries.

Gandhewar et al. [6] proposed a platform that converts mechanical energy into linear motion. Their fuel-saving technology was designed to harness the energy wasted on treadmills in fitness centers. They explored the application of this system in large indoor environments with significant foot traffic, such as malls, warehouses, open markets, and large office spaces, to optimize energy use.

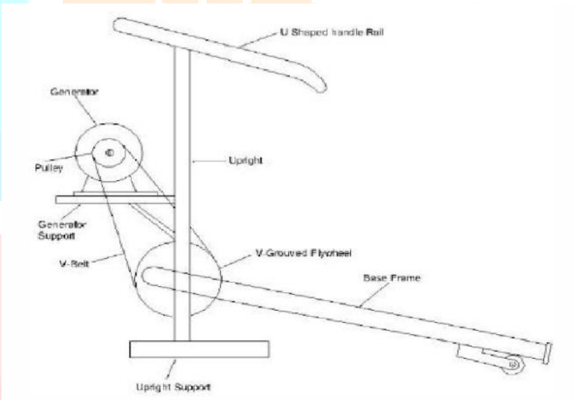
Masuma Akter et al. [7] explored the idea of capturing wasted energy from human locomotion. By installing feasible energy-harvesting devices at high-traffic locations such as railway stations, shopping malls, and roadways, they demonstrated that significant amounts of electricity could be generated. Their piezoelectric system, designed to capture footstep energy, was identified as a practical solution for harnessing kinetic energy in urban spaces.

Abhiram et al. [8] proposed a novel model combining a treadmill with a tricycle. This "treadmill tricycle" could serve as an eco-friendly alternative to regular bicycles, offering reduced initial and running costs. Their model is a step forward in promoting sustainable, pollutant-free transportation.

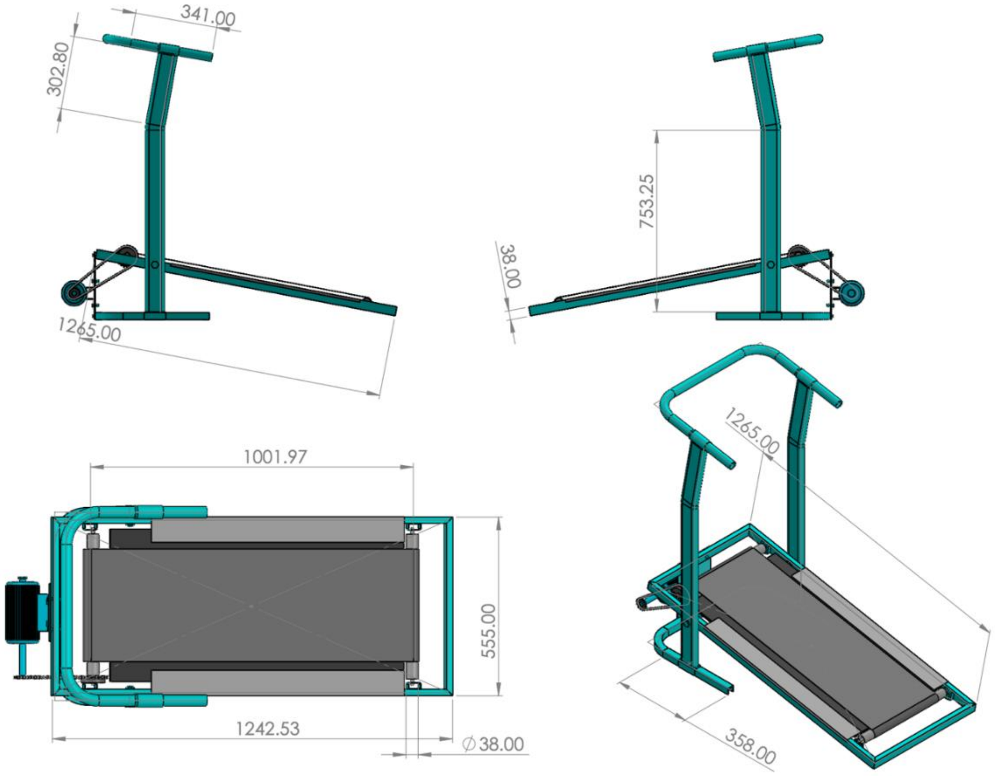
Manish Debnath et al. [9] explored an eco-friendly electricity generation method using manual treadmills equipped with small DC generators. Their system, which requires minimal torque to operate, is particularly feasible for remote areas where access to electricity is limited. This method provides a significant opportunity to reduce fossil fuel consumption and promote sustainable energy production.

Shamshad Ali et al. [10] designed a simple, sustainable manual treadmill integrated with an electricity generator. Their system not only addresses various health benefits, such as muscle strengthening, but also contributes to environmental sustainability by reducing greenhouse gas emissions. They emphasized the potential of this innovation to play a role in mitigating climate change

Proposed Concept



CAD Modeling



Objectives

1. To design and develop a treadmill integrated with an electricity generator to facilitate the saving of electrical energy.
2. To create a treadmill with an electricity generator that can serve as a practical solution for battery charging in areas with limited or no access to electricity.
3. To provide a treadmill with an electricity generator featuring a simple and efficient design.
4. To offer a treadmill with an electricity generator at a low production cost, making it accessible for widespread adoption.
5. To design a treadmill with an electricity generator that can be easily manufactured, ensuring scalability and ease of implementation.
6. To contribute to environmental sustainability by using the treadmill electricity generator to reduce energy consumption and, consequently, mitigate pollution.
7. To provide a treadmill with an electricity generator that maintains simplicity in design while offering effective energy generation.

Methodology

The methodology provides a structured framework for acquiring, validating, and applying knowledge in the context of this research. It ensures that the study is conducted systematically, rigorously, and reliably.

1. **Design**: The first step involves designing the shape and size of the model for the project, considering the functional and structural requirements.
2. **Selection of Materials and Components**: The materials and components for the fabrication of the innovative project are carefully selected based on their suitability, durability, and efficiency for the intended purpose.

3. **Equipment Requirements**: The necessary equipment for measuring various parameters related to the performance of the system are identified and acquired.
4. **Fabrication of Components**: The individual components of the experimental setup are fabricated according to the final design specifications, ensuring proper assembly and functionality.
5. **Performance Testing**: The experimental setup is tested to evaluate its performance, collecting data on key parameters to assess the effectiveness and efficiency of the system.

Advantages

The proposed treadmill with an electricity generator offers several benefits, which enhance its utility and effectiveness:

1. **Health and Fitness Benefits**: The exercise treadmill bicycle promotes physical fitness, which is essential for maintaining good health in daily life. Traditional gym workouts can become monotonous, especially in enclosed spaces. This portable treadmill allows users to exercise outdoors, enjoying fresh air and a more engaging workout experience.
2. **Energy Saving**: The use of the treadmill generates electricity, contributing to energy conservation. By harnessing kinetic energy from the user's movement, a certain amount of electricity is produced, which can be used for domestic applications or stored for later use. This system helps reduce energy wastage and provides a sustainable source of power.
3. **Eco-Friendly**: The treadmill operates without the need for any fuel, making it an environmentally friendly device. It does not produce any harmful emissions, contributing to reduced pollution and supporting eco-friendly practices.

Conclusion

The innovative treadmill-based electricity generation system discussed in this research presents a promising and sustainable solution for addressing the growing demand for energy while simultaneously reducing environmental pollution. By harnessing kinetic energy produced during human activity, such as walking or running, the proposed system converts mechanical motion into electrical power through a simple, eco-friendly process. The integration of a small DC generator, coupled with a charge controller, enables the production of up to 50-60 watts per hour, providing a potential source of clean energy, particularly in areas with limited access to conventional power sources.

This research emphasizes the feasibility of using manual treadmills as a viable means for small-scale power generation, making it an attractive solution for both individual and community-level applications. The system is especially valuable for regions where electricity infrastructure is insufficient or where environmental sustainability is a priority. The treadmill generator's simple design, low production cost, and ease of implementation ensure its scalability, making it suitable for widespread adoption.

Furthermore, the integration of fitness and energy generation promotes dual benefits—enhancing public health while contributing to energy conservation. This project paves the way for further development in clean, human-powered energy systems, offering a unique approach to mitigating the negative impacts of energy production from non-renewable sources. Overall, the research underscores the potential of this innovative treadmill system to support sustainable energy practices, reduce reliance on fossil fuels, and promote a greener, healthier future