International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Design & Fabrication of Electric Treadmill Bicycle

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ABSTRACT:The treadmill and bicycle are two commonplace machines that will be combined in this project. Running on it and turning on the motor as necessary makes it feasible to operate this combination machine both physically and electrically. It is a brand-new method of moving. In the gym, people use the treadmill to run while exercising. The main disadvantage of utilizing a treadmill is that it is stationary, which might make people periodically become bored while jogging in the same place without being outside. For short trips, people frequently use commercial vehicles, which increase pollution and waste fuel. This concept concurrently tackles both of these problems in this manner.
A mechanical link moves the car ahead. The alternator's shaft rotates as a result, charging the battery. This walking bicycle can also be occasionally powered by the battery's reserve of electricity. The sprocket and chain system is used to transfer mechanical power from one area to another. Utilizing the proper gear ratio reduces the amount of effort necessary, increasing efficiency.
As part of the project, a device that combines a treadmill and an electric bicycle must also be created. The machine will be powered by electricity and offer several levels of resistance to accommodate users of different fitness levels.

While the treadmill allows users to walk, jog, or run at various speeds, the bicycle pedals will provide the resistance needed for an effective workout. The device will also have a control panel that displays speed, distance, and other crucial information so users can keep track of their progress and adjust their training as needed. Instead of just walking on a treadmill, we want to develop a speedier and more healthy mode of transportation.

Key Words: treadmill, bicycle, sprocket

1. INTRODUCTION

The concept of indoor cycling has grown in popularity as more people look for easy ways to exercise and maintain a healthy lifestyle without leaving their homes. On stationary bikes or other fitness equipment, indoor cycling has traditionally been practised, but these workouts lack the excitement and variety of outdoor cycling. The best of both worlds will be merged in this effort to produce an electric treadmill bicycle. The gadget will allow users to simulate outdoor cycling while staying still, providing a unique and effective workout.

It will be necessary to design and build a device that combines a treadmill and an electric bicycle. The machine will be powered by electricity and offer several levels of resistance to accommodate users of different fitness levels. While the treadmill allows users to walk, jog, or run at various speeds, the bicycle pedals will provide the resistance needed for an effective workout. The device will also have a control panel that displays speed, distance, and other crucial information so users can keep track of their progress and adjust their training as needed.

The electric treadmill bicycle will need to be completely designed and constructed. The device will be built using a mix of metal, plastic, and electronic components. Stability, safety, and usability will all be carefully examined during the design process. The fabrication procedure will involve cutting, welding, and assembling the various elements to create a sturdy and practical device.

2. LITERATURE REVIEW

This chapter examines the literature on issue definition with a focus on defining the goal, parameters, and anticipated results of the project. The following topics are covered in the literature:
a. Treadmill Bicycle Analysis
b. Transportation electric bicycle design
For a high temperature differential, the chassis, gear belt, and other components should be made of the best material.
d. Performance evaluation

Previous work conducted related to the topic is mentioned here.

1. In today's world, there are two key problems that are troubling humanity: global warming, which is brought on by heavy use of combustibles, and automobile use, even for short trips. This has a significant impact on the environment and contributes to the depletion of fuel resources. The second issue is that many people are currently experiencing serious health problems. This is a result of inadequate exercise. I therefore developed a brand-new, ground-breaking idea for modern transportation that I called a solar-powered health bicycle that can force riders to walk while they ride.

2. The terms "physical activity," "exercise," and "physical fitness" refer to many ideas. However, the names are sometimes used interchangeably and are frequently confused with one another. This essay suggests definitions to set them apart. Every skeletal muscle-driven movement that uses energy is considered to be physical activity. Kilocalories are the unit used to measure energy expenditure. Everyday physical activity can be divided into occupational, sporting, conditioning, domestic, and other activities. Exercise is a category of physical activity with the enhancement or maintenance of physical fitness as its ultimate or intermediate goal. It is planned, systematic, and repetitive. A group of qualities referred to as physical fitness might be either skill- or health-related. Specific tests can be used to gauge how much a person possesses these qualities. These concepts are provided as a foundation for interpreting research that link exercise, physical activity, and fitness to health. Using a constant treadmill speed (3.3 miles per hour) and frequent equal increments in treadmill grade (5 percent/3 min), a new continuous treadmill protocol (USAFSAM) has been developed. In comparison to procedures using various or higher treadmill speeds, or even both, the constant treadmill speed requires only a brief period of initial stride adaptation from the patient, requires fewer technician modifications, and results in less electrocardiographic motion artifact. Compared to procedures that are discontinuous or call for more drastic changes in labor load, regular, equal increments in treadmill grade are simple to apply and offer a greater variety of workloads.
3. Dr. Chandrakala SP MD, Dr. Anitha OR MD, and Dr. Swapnali Ravikiran Kisan, One kind of bicycle is a treadmill bicycle, in which a guy walks on the treadmill before the treadmill reverses direction. The electric motor is activated by the treadmill's motion, and the motor uses a chain drive and batteries to rotate the rare wheel's shaft. The treadmill bicycle is sometimes known as a walking bicycle since its motion is dependent on human effort. We're going to attach a reciprocating pump to the multipurpose treadmill bike to pump water. Pumps that rotate pressurize water. The components of a multipurpose treadmill bicycle include wheels, a treadmill, a battery, a dc motor, a chain drive, and a reciprocating pump

3. PROBLEM DEFINITION

We notice in daily life that many people use cars and bicycles as forms of transportation. The environment is polluted and fuel is consumed.

Using a motor to rotate the rotors on a manual treadmill eliminates its unpleasant motion.

Most automobile sector batteries are not rechargeable, thus when they are disposed of, pollution is created.

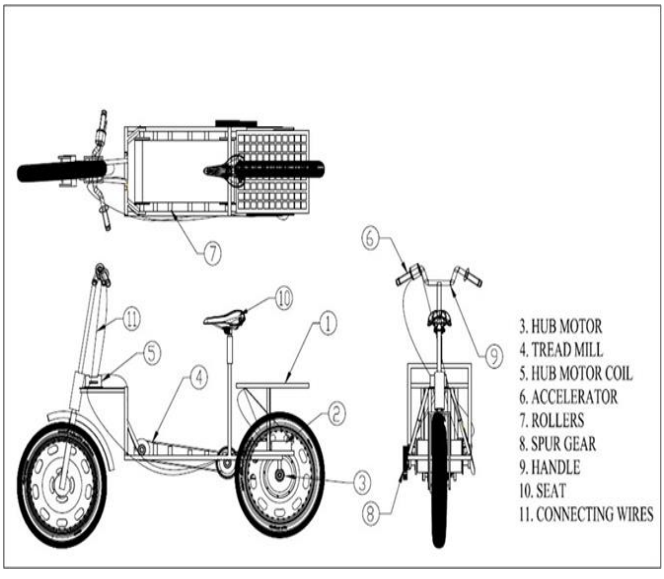
In an effort to make them better, we decide to construct something that would aid in taming all of the aforementioned undesirable events.

4. OBJECTIVES

The electric treadmill cycle represents an entirely new mobility frontier.
Compared to "a stroll in the park" to ride a bicycle, an electric-powered bicycle requires far less effort.
This would encourage individuals to exercise while travelling to various areas while maybe reducing the growth in pollution. It is totally devoted to alternative energy sources. It has aided in the reduction of greenhouse gas emissions and the advancement of fuel-efficient transportation systems.

5. CONSTRUCTIONAL DIAGRAM

6. WORKING OPERATIONS



7. DESIGN CALCULATION

Mathematical Calculations for Load

Load Calculation

Assumption : Wt= 120 kg = 1177.2 N

Tyre (D)= 460mm

Rolling Resistance = Fr*w

= 0.05 x 1177.2

= 58.86 N

Gradient resistance = W * sin θ

= 1177.2 * sin 0

= 0

Total resistance = Rolling resistance + Gradient resistance

= 117.2 + 0

= 58.86 N

Resistance Torque = Force x radius of tyre

= 58.86 x 0.23

= 13.53 N.m

Assuming the speed of Tyre as 50 RPM

Power = 2*πNT/60

= 2* π * 50 *58.86/60

= 141.73 Watt

Assuming Factor of safety as 1.5

∴ Power = 141.23 * 1.5

= 212.6 watt

Mathematical Calculations for Shaft design

Assuming the weight of a person to be 100 KG

100 x 9.81 = 981 N

Hence weight on each shaft = (Person Weight / Number of shaft)

= (981 / 2)

= 490.5 N

Wt = Ft = 490.5 N

Fr = Ft*Cosα= 490.5 * Cos (20)

= 460.44 N

Ra + Rb = 490.5 N

Ra = 245.25 N

33cm

33cm

Bending Moment = 245.25 * 660 / 2

= 56652 N.mm

Assuming the material as C45

σ =360 N/mm^2

[σ] = 360/ FOS

[σ] = 90 n/mm^2

[τ] = 90/ 2

= 45 N/mm^2

Bending Equation

M/I = σ/y

80933/ (πd^4/64) = 90/ (d/2)

d = 20.92 mm

Torque = 460.44 * 21

= 5064.84 N*mm

Equivalent torque

Te = √(Mb^2 + T^2)

= √[(566520)^2 + (5064.84)

= 56877 N/mm^2

T_e / I_p = τ/r

566877.68/ (πd^4/32) = 45/ (d/2)

d = 18.60 mm

Since the value of bending is higher

∴ d = 21 mm

But the availability of Bearing of Inner dia 21 is not possible

Hence taking the next higher value

Dia of shaft = d = 25mm

GEAR DESIGN

Let us assume,

$Z_p = 69$

$Z_g = 100$

$i = 1.45$

Material consideration and stress concentration

Let both gear and material made of C-45

∴ For m<6,

$\sigma_b = 1400$ Kgf/cm^2

$= 140$ N/mm^2

$\sigma_c = 500$ N/mm^2

Now, F_s calculation

$F_{s1} = \sigma_b * Y_{v1}$

$F_{s1} = \sigma_b * \pi * y_{v1}$

$= 1400 \times \pi \times (0.154 - 0.912/69)$

$= 619.9$

$F_{s2} = \sigma_b * Y_{v2}$

$= \sigma_b * \pi * y_{v1}$

$= 1400 \times \pi \times (0.154 - 0.912/100)$

$= 637.22$

Since, $F_{s1} < F_{s2}$

So pinion is weaker and needs to be design

$m = 1.26 \times \sqrt[3]{[M_t]/(y * [\sigma_b] * \Psi * z_1}$

$M_t = 97420 \times 0.25 / 1875$

$= 13$ Kgf.cm

As the overall reduction of torque is 3.53

∴ $[M_t] = 13/3.53$ Kgf.cm

$= 3.68$ Kgf.cm

$y_{v1} = 0.1327$

$\Psi_m = 10$

$m = 1.26 \times \sqrt[3]{2.33 \times 10/(0.14 * 1400 * 10 * 69}$

$= 0.8$ mm

Considering safety factor

$m = 1$ mm

$m = d/t$

8. ADVANTAGES

1. Convenient: Cycling on a treadmill provides a useful indoor riding option that enables riders to exercise in any weather or at any time of day. This makes it a great option for people who have busy schedules or like to exercise at home.
2. Low impact: Cycling on a treadmill is a low-impact exercise that is easier on the joints than regular cycling. As a result, it's a fantastic solution for people who want to exercise their hearts but have joint issues or other health issues.
3. The majority of treadmills have resistance levels that can be changed, allowing users to tailor their workouts to their fitness level and goals. This makes it a great option for both beginning and experienced athletes. Variety: You can do endurance rides, hill climbs, and interval training
4. Metrics tracking: Users of treadmill cycling can keep track of data such as speed, distance, and calories burned, making it simple to monitor progress and set new fitness goals. Another feature that may be useful to those looking to improve their cardiovascular health is the heart rate monitor that is included into some treadmills.
5. Variety: While riding on a treadmill, you can perform interval training, hill climbs, and endurance rides. This variant keeps exercises challenging and exciting, reducing boredom and improving fitness results all around.

9. DISADVANTAGES

1. Limited Muscle Engagement: When cycling on a treadmill, some muscles may not be as fully stimulated as they would be when cycling outside. As a result, the rider won't need to use their leg muscles as much to keep their balance or make little adjustments like they would on a regular bike. This is due to the rider's pedalling motion, which is essentially stationary, and the treadmill belt, which is continually moving.
2. Limited Terrain Simulation: While some expensive treadmills may offer inclination and decline

functions to simulate outdoor terrain, it's conceivable that these features aren't as precise or effective as running on actual hills and slopes.

3. Boredom: Cycling on a treadmill can get monotonous and boring, particularly if the cyclist is stationary and not navigating a dynamic environment like they would outside. As a result, it could be more difficult to stay motivated and stick to a regular fitness plan.
4. Cost: Treadmill cycling machines can be expensive and not accessible to everyone. Additionally, they might require routine maintenance and repair, which could increase the total cost of ownership.

10. CONCLUSION

We created a branch and bound method together with swift, efficient bounds to optimize the "Treadmill Electric Bicycle," which can be used for transportation and exercise while using less non-renewable energy. Through this project, we are building a framework for the conversion of mechanical energy into linear motion. By adapting our natural walking pace to a decent running pace, we can save energy while simultaneously re-creating the principle of a little initial expenditure yielding a large return on investment. By utilizing this prototype, we can both conserve energy and develop a fresh concept for the distribution of energy in the electrical field, a necessity that will affect everyone in the future. Rechargeable battery power will continually move the bike in small increments.

ACKNOWLEDGEMENT

We are extremely grateful and sincerely grateful to our mentor Prof. A. J. Ghude for giving us the chance to work with him and do research on a novel issue.
Additionally, we are grateful to our Head of Department (Dr.) Usha C. Pawar whose suggestions and assistance have

This project was successfully finished as a result of debate that was carried out. We extend our sincere gratitude to our esteemed Principal Dr. S.D. Sawarkar, whose assistance was vital in the project's success. Additionally, we would like to express our sincere gratitude to the college staff for their tolerance, cooperation, and support. We would not have been able to finish the project on time without their assistance.

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