

Treadmill E – Bicycle

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Abstract: *Walking a bicycle is a totally new way of moving. The combination of gear mechanisms boosts your walking pace up to the moderate speed of a regular bike. When we are walking on the treadmill, the rollers are pushed back, which creates some mechanical energy. The movement of the belt on the rollers will drive the gear fitted on the treadmill's last roller, which will further drive the vehicle with a chain mechanism. And the same shaft is coupled with the machine, which converts mechanical energy into electrical energy. As we are using a DC generator, the amount of power generated completely depends on the input rpm that we provide. This energy can be stored in the battery and used for lateral application. When the vehicle is at a standstill, as there is no load, the input speed will be high, and therefore we can generate more power. But in the case of a running engine, the amount of power generation will be moderate because the load applied will increase and the speed will decrease, resulting in a lower amount of power being generated.*

Keywords: Bicycle.

I. INTRODUCTION

The increasing reduction of fossil fuels and non-renewable energy has created a critical need for another alternative source of energy to replace the depletion and continuously supply the increasing energy demand. Energy is the ability to do work. Electricity is a widely used energy that is growing in popularity as the population grows. The objective of this project is to use the human effort while they are walking, during which a lot of energy is released and wasted. If we make an arrangement to save this energy and convert it into electrical energy, which can be used for many applications, in order to generate the electricity, the wasted energy needs to be utilised. The energy wasted from walking activities done by a human can be used to generate electricity. The walking energy is wasted in different ways. The average human footstep can take about 3000–5000 steps a day. This step can generate more electricity to meet the demand. Generally, there are different techniques for generating electrical energy that are received from people or vehicles moving on roads.

From the preceding discussion, we came up with the idea of introducing a treadmill called the E-Bicycle, on which a normal person can easily walk and develop mechanical energy. The mechanical energy developed by walking on this treadmill will be converted into electrical energy by a DC generator. The generated electrical energy can be stored in the battery and used for lateral applications like lightning, horning, and small charging applications.

There are different forms of energy on earth. The sun is considered the elemental form of energy on earth. In physics, energy is considered a quantitative property that can be transferred from an object to perform work. Hence, we can define energy as the strength to do any kind of physical activity. Thus, in simple words, we can define energy as, Energy is the ability to do work, according to the laws of conservation of energy, “energy can neither be created nor destroyed but can only be converted from one form to another”. The SI unit of energy is Joule.

II. POWER GENERATION

In this electric power is generated as non-conventional method. Thus, the generation of power is by walking or running on treadmill. At this time non-conventional energy is very important. This system introduces power generation using non-conventional energy which does not need any input to generate electrical output. In this conversion of rotational energy into electrical energy takes place.

Many people used to do exercise like walking and running on treadmills in their homes and gyms etc., There we burn lot energy by rotating the rollers. But the mechanical developed there is wasted completely since no other external devices attached to utilize that power. And also, just simply walking or running in indoor is also not much effective to human beings that they couldn't avail fresh oxygen and less interaction with environment. There we got an idea called treadmill bicycle which can be used to travel some distance and also used to generate power. Instead of walking on that regular treadmill if we walk on treadmill bicycle by involving gear mechanism, we can increase our walking pace and drive the vehicle and also power can be generated by using some small dc generators. A battery is connected to the output terminals of the generator and the generated energy can be stored in the battery which can be used for lateral applications.

2.1 Generation of Power by Bicycle

As per the design the bicycle generator is constructed. In this manual load applied on the bicycle pedal due to the manual force the largest sprocket starts to rotated.

The largest sprocket is connected with the small sprocket in the back end by simplex chain. There by the small sprocket also starts to rotate. The small sprocket is placed in the centre shaft of the back wheel.

So that the rotating motion of the centre shaft transmitted to the back wheel there by the back wheel also rotate. The back wheel is coupled with the D.C generator through flat belt.

Now the motion is transmitted to the generator. the generator converts this mechanical motion into electrical energy. The current produced is in the form of D.C so it can be directly stored in the battery. The inverter board is used to convert the D.C current into A.C current and then it sent to the supply port.



Power generation by bicycle

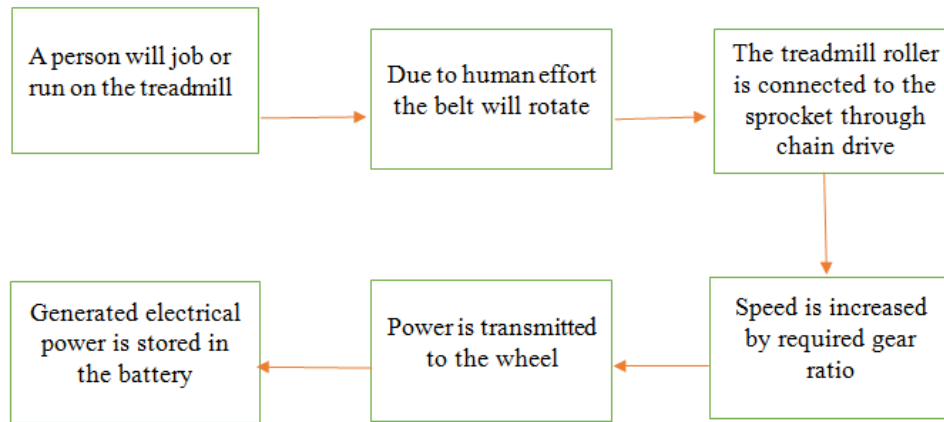


Treadmill frame



Conveyor Belt

2.2 Block Diagram:



Block diagram

2.3 Components of the Vehicle

1. Treadmill
2. Rollers
3. Gear Wheels
4. DC Generator
5. Handlebars and Stem
6. Frame
7. Brakes
8. Battery
9. Wheels
10. Lighting

2.4 DC Generator

A DC generator is a device which converts mechanical energy into electrical energy based on the principle of electro magnetic induction. Whenever a moving conductor placed in a uniform magnetic field an emf is generated according to Faraday’s law. As this is the DC generator the amount of power generated is majorly depends on the input speed. It is directly proportional to rpm of the generator. Corresponding to the given input an emf is generated. When external circuit is closed, then it starts the flow of current through the circuit.



2.5 Battery

An electric battery is a source of electric power consisting of one or more electrochemical cells with external connections for powering electrical devices. When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode. [2] The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox

reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. [3] Historically the term "battery" specifically referred to a device composed of multiple cells; however, the usage has evolved to include devices composed of a single cell. Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to, at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers. Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in converting electrical energy to mechanical work, compared to combustion engines.

III. WORKING

Its simply works on the human effort. When we walk on the treadmill, the rollers are pushed back and creates a uniform mechanical energy from all the rollers with support of conveyor belt. The speed and direction of the vehicle is increased by gear mechanism which based on the different gear ratio. The last roller is connected to the rear wheel by chain system hence it drives the vehicle. Therefore the vehicle moves forward when we walk on treadmill. The speed of the vehicle is somehow depends on the walking speed of the person. A dynamo is coupled with the shaft of the back wheel which converts the mechanical energy into electrical energy. A battery is provided which used to store the generated power or directly we can use this power to DC appliances.



IV. CALCULATIONS

4.1 How much distance can we walk on Treadmill:

A healthy person can walk 45 – 50 steps on a manual treadmill for one minute. On average a person can able to walk 2800 – 3000 steps for one hour on a manual treadmill. We can complete one mile of distance in one hour. Hardly it takes 1700 – 1900 steps required to complete 1 kilo meter walking in 34 – 38 minutes.



The walking speed depends upon the person weight, height and his healthy condition. A person with good health condition can walk around 60 – 65 steps per minute on a manual treadmill. So he\she can cover 1.5 – 2.5 miles distance for one hour that he\she can able to walk at a speed of 3kmph – 5kmph.

4.2 Output speed of the Treadmill

A normal person can walk 45 – 50 steps on a manual treadmill. One step can complete 2-3 rotation of the roller. So as we complete 50 steps in one minute we can produce 120 – 140 rotations of the roller for one minute. Therefore we can produce 120 – 150 rpm of the roller for one minute.

4.3 Speed development of the vehicle

Let, Z_1 = No. of teeth of pinion

Z_2 = No. of teeth of gear wheel

N_1 = Speed of the pinion in rpm

N_2 = Speed of the gear wheel in rpm

The relation between the number of teeth and speed is given by

$$N_1 Z_1 = N_2 Z_2$$

Therefore, $N_2 = Z_1 / Z_2 * N_1$

If the number of teeth and speed of any one vehicle is determined, then the speed of the other wheel can be calculated.[7]

Let us say on average a 120 rpm can be developed from the treadmill. This can be calculated from the last roller of the treadmill.

Here we are using two different size gear wheels of $Z_1 = 60$, $Z_2 = 50$ and the speed of the pinion is $N_1 = 120$.

$$N_2 = Z_1 / Z_2 * N_1$$

$$N_2 = 60 / 50 * 120$$

$$N_2 = 144 \text{ rpm}$$

The speed of gear wheel is 144 rpm.

Like this by using different size (different numbered teeth) gear wheels, different speeds can be obtained which depends on the gear ratio.

- By using of number of gear wheels the direction of the speed is changes.
- Let us say here two gear wheels are using
- First wheel is rotating in anti-clock wise direction (back ward direction) as the rollers are pushed back.
- The second gear wheel will rotate in clock wise direction (forward direction)
- Final direction is same as initial direction if we use odd number of gear wheels
- Final direction will change (opposite to initial direction) if we place even number of gear wheels.

Here we are using flywheel and sprocket which further increases the speed of the vehicle. In this alignment we are producing around 150 rpm from the treadmill and which will be given to the back wheel by chain system. There by the overall speed of the vehicle will be further increased to 3 times to the treadmill output. So here finally we are getting 350 – 400 rpm from the vehicle.

The input to the generator will be given as 350 – 400 rpm which converts this mechanical energy to electrical energy which proportional to its input speed.

We can produce around 20 v to its maximum value if we give maximum speed, that completely depends on the walking pace of the person. If we use some high rated generator, we can generate some high amount of voltage.

V. RESULT AND CONCLUSION

When we are walking on the treadmill, the rollers are pushed back which creates some mechanical energy. The movement of the belt on rollers will drive the gear fitted on the treadmill last roller which will further drive the vehicle with chain mechanism. And the same shaft is coupled with the machine which convert the mechanical energy into electrical energy. As we are using DC Generator, the amount of power generation is completely depends on input RPM which we provide. This energy can be stored in the battery and can be used for lateral applications.

At the final, if we walk 50 steps for one minute, we can produce 120 – 150 rpm for the first wheel, due to different gear ratio this speed can be increased up to 180 - 220 rpm. As we are using sprocket and chain system, the speed of the back wheel will be further increased to maximum speed. Therefore, we can drive the vehicle at 400 – 500 rpm.

As if we walk at a speed of 1.6 – 2.0 kilo meter per hour on a treadmill, we can drive the vehicle at a speed of 12 – 15 kilo meter per hour.

By using this treadmill bicycle, we can increase the speed up to 5 – 6 times more than our walking pace and we can travel some more distance.

VI. FUTURE SCOPE

The treadmill bike will proof to be a future vehicle as no fuel is used for travelling through this and it is pollution free. It can be driven by any person of different edges. We can erect solar panels to get additional power to charge the battery and run the vehicle. It also helps in exercising which is required for a person to be fit and healthy. These vehicles will be introduced at everywhere in the world in the future, since these are ecofriendly and no fuel using.

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