

Treadmill Based Electricity Generator for Domestic Purpose

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Abstract - The modern challenge faced with the global energy situation is the growing energy demand and the strong dependence on unsustainable fossil fuels. Human power generation, which uses metabolized human energy to generate electrical power, could potentially address both these challenges. The treadmill, one of the most popular exercise machines, presently consumes large amounts of energy while dissipating a majority as heat. The purpose of design and develop a human powered treadmill generator and determine its power generation potential. The developed treadmill was based on a manual flatbed treadmill using an electromagnetic dynamo generator coupled to a front axle flywheel. A heavy duty rechargeable battery pack was used to store the generated energy and additional components to measure the generated power were included. The scope of this system focuses upon a method of generating electrical energy from the application of specially designed treadmill with the provision of specially designed washing machine, which will work when a human runs over a treadmill for exercise which is an integral part of modern society life.

Key Words: Alternative, Conventional Energy, Generator, Greenhouse, Power, Treadmill.

1. INTRODUCTION

In sport training, medical diagnosis, rehabilitation and analysis of cardio respiratory kinetics, automated exercise testing systems have revealed their growing importance. These systems can fully implement programmed exercise and training protocols to achieve desired exercising and testing results. The major aim of this treadmill based electricity generation is to develop a computer controlled treadmill system, which can control the heart rate of the subject according to a preset heart rate profile. Some commercial treadmills are already available which offer heart rate control. However, these normally use very simple control strategies, their control performance is poor and they have no mechanism for setting a desired heart rate profile. In this seminar we describe a treadmill exercise system which can automatically control the treadmill speed and elevation to accurately track a desired preset heart rate profile. Conventional Proportional Integral Derivation (PID) control is the most popular control algorithms in industry due to its simplicity in structure and ease of tuning.

However, an acceptable control performance may be difficult to achieve when the controlled systems are highly nonlinear.

A treadmill is a device generally used for walking or running while staying in the same place. Treadmill were introduced before the development of powered machines, to harness the power of animals or humans to do work, often a type of mill that was operated by a person or animal treading steps of a tread-wheel to grind grain. More recently, treadmills are not used to harness power, but used as an exercise machines for running or walking while staying in one place. Rather than the user powering the mill, the machine provides a moving platform with a wide conveyor belt (track), driven by an electric motor. The belt moves to the roller, requiring the user to walk or run at a speed matching that of the belt. The rate at which the belt moves is the rate of walking or running. Thus, the speed of running may be controlled and measured. The more expensive, heavy duty versions are motor driven the simpler, lighter, and less expensive versions passively resist the motion, moving only when walkers push the belt with their feet. The latter types are known as manual treadmills.

2. BLOCK DIAGRAM OF ELECTRICITY GENERATION

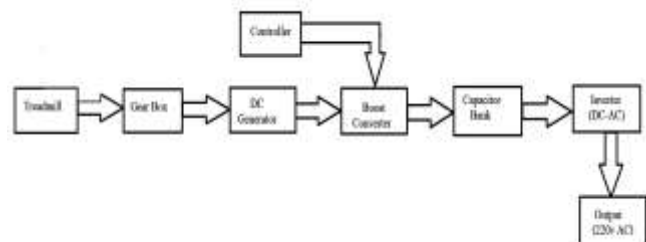


Fig. 2.1: Block Diagram of Electricity Generation Mechanism Through Treadmill

Human power generation has multiple applications in modern society. This treadmill with Electricity Generator is useful for such areas where electricity is not available. Electrical energy can be saved by using this manual treadmill with Electricity Generator. Green House Gases can be reduced up to some extent by this manual treadmill with Electricity Generator. Strength of muscles can be improved by using this manual treadmill with Electricity Generator. Treadmill provides a moving platform with a wide conveyor

belt (track), driven by an electric motor. The belt moves to the roller, requiring the user to walk or run at a speed matching that of the belt. The rate at which the belt moves is the rate of walking or running. The stored energy can be used for various purpose and we not only save the energy required for treadmill but also generates the energy from using treadmill.

2.2: Working

In the treadmill for this proposed model, axis of moving belt rotation is orthogonal to movement of the belt. The rotational force generated on the treadmill rotating belt axis due to the application of pressure force on moving belt by user causes the rotation of moving belt about its belt axis. The moving belt axis is directly coupled to gearbox through shaft which is connected with DC generator which rotates due to the rotation of belt about its axis. The generator is coupled with boost converter which is used to increase its DC voltage up to 220V. The voltage produced at the output of boost Converter is governed by controlled which is used to maintain constant voltage irrespective of change in speed of moving belt.

Converter is governed by controlled which is used to maintain constant voltage irrespective of change in speed of moving belt. Capacitor bank is used DC voltage to increase stored energy and improve the ripple current capacity of the voltage or smoothing the DC voltage before operation of inverter which will convert the input DC voltage in to AC voltage. The AC voltage generated after inverter operation in filtered, smoothed and transfer it for the use of home appliances when required. When a person starts running over the walking belt, this rotates the wheel of the treadmill, which in turn provides a torque to the shaft of the gearbox. Being connected with the gearbox shaft on the other side, the washing tub starts rotating. Gear box works on the principal of conservation of energy used in speed variation, force variation, change indirection. In propose model gear box system is used to increase the speed with the assist of spiral bevel gear, having low ratio with pin out bearing structure. In OUT project we have used 32 mm gear part diameter coupled across the generator.

2.3: Prototype Development

The laboratory prototype of the treadmill generator was based around a manual treadmill donated is as show in fig. 2.3 (a). This let the prototype require no power consumption to operate all power going into the system would be from the human work. The power coming out of the system was to becollected in a 12V rechargeable battery. The battery chosen for the prototype was a Duracell Powerpack 600 which contained a sealed lead acid battery

(28Ah, 12Vdc nominal) and AC power output components for easy draining of collected energy to electronics such as laptops, etc. The cigarette-lighter DC charging port was used to interface with the internal battery of the device. other end of the provided cigarette lighter plug cable was stripped to expose positive and negative poles to be connected to the electrical circuit. The internal circuit breaker was specified to be at 12A which the experiment trials did not exceedThe mechanical energy produced by the treadmill belt motion was translated to electrical with the use of a DC electromagnetic generator dynamo of 300W peak capacity, obtained from Millinewton Second (MNS) Power. This choice was made due to the relatively high power output expected from human leg motion cheaper. Hand-held cranks were deemed inadequate due to their peak power output capacity of around 10W. Further, the dynamo came with a 3L size v-belt pulley attached to the shaft. This was used to mount an adjustable v-belt to be coupled with the left flywheel of the treadmill's front axle. V-belt links were removed until the displacement was about 1inch when pressed with a fig. 2.3 (a).



Fig. 2.3 (a): phototype Development

2.4: Electricity Generation

To harness the power of animals or humans for doing work, treadmills were introduced, which are a type of mill operated by a person or animal treading steps of a tread-wheel to grind grain. Treadmills are not used to harness power nowadays, but used as an exercise machines for running or walking. The machine provides a moving

platform with a wide conveyor belt (track) rather than the user powering the mill and was driven by an electric motor. This simple, light and low budget treadmills passively resist the motion, moves only when walkers push the belt with their feet. But an addition of small DC generators were done, whose moving parts are mechanically coupled with the moving rollers of machine that moves when belt of the treadmill is moving. When the rotor of the DC generator starts moving, an emf will be produced across its output terminals. This generated emf can be used for charging of Battery or other purposes.

3. CIRCUIT DESCRIPTION

In order to make measurements, a few components were added to the basic schematic shown in fig. 3.1 (a) illustrates the final schematic implemented for the power generating circuit the voltage measurement limit for this device was $\pm 10V$, below the approximate 12V levels of the generator and battery. Hence, voltage dividers with high resistance values were used to halve these to measureable values. These values were deemed acceptable for the current study purposes as they are many orders of magnitude smaller than expected power generation values of $>10W$.

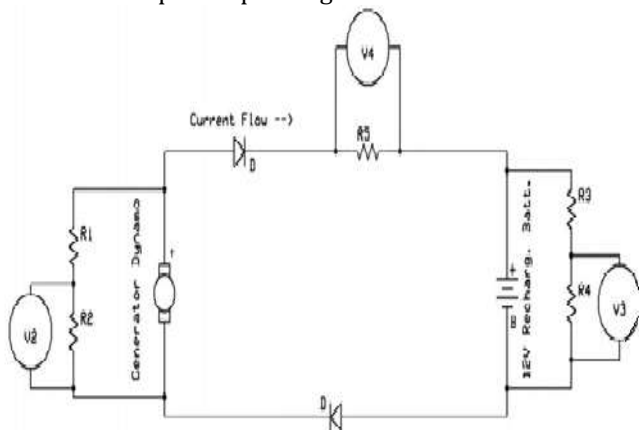


Fig. 3.1 (a): Circuit Schematic for Voltage Measurements

The speed of the treadmill belt was measured using a proximity sensor built into the right side flywheel on the treadmill front axle. The sensor consisted of a magnet and a reed switch which closed the circuit when the magnet was nearby. A circuit as shown in fig. 3.1 (b) was created, incorporating a constant 9V battery DC source connected with a 200 resistor with the proximity switch in series. Therefore, whenever the magnet mounted on the right flywheel came close to the reed switch, the switch was closed and a pulse voltage measurement was produced across the resistor. The frequency of these was determined by measuring the period between the front edges of these peaks.

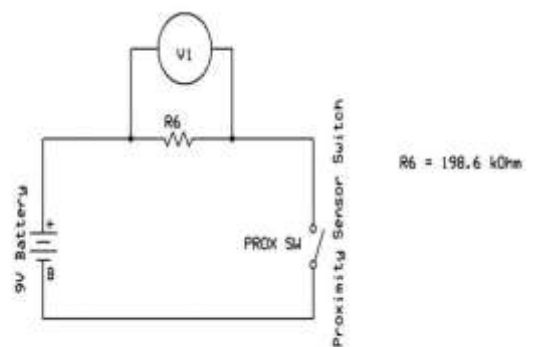


Fig. 3.1 (b): Frequency and Walking Belt Speed Measuring Circuit

Alligator clip cables were used to construct the main power circuit due to their flexibility, ease of connection and capability of carrying the current expected to be encountered in the tests. For the walking belt speed measuring circuit, solid wires were used in conjunction with a breadboard. Shunt resistor voltage, frequency circuit resistor voltage, divided voltage across generator, and divided voltage across battery.

4. CONCLUSION

The treadmill based human power generator was developed using an electromagnetic dynamo generator coupled to a manual treadmill's flywheel. The final circuit delivering power to a heavy duty battery was found to be able to deliver 140W peak for a short period of times the variation of angle of inclination was not determined to have a significant impact on energy generation. In the gym environment, it was found that a human power treadmill generator could help reduce energy consumption significantly. In isolated areas such as rural countryside or developing countries, the treadmill generator can provide for a low-cost, quick to implement, simple to operate, and low maintenance solution. In any application, the treadmill can be used as an educational tool to give people a physical perspective on quantities in energy, helping realize the importance of energy conservation. In space, the treadmill generator is not as feasible as current establishments such as the International Space Station do not face a scarcity of energy and the process would entail high costs of implementation.

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