DESIGN AND FABRICATION OF TREADMILL CYCLE

Prof. P. R. Gajbhiye[1], Prof. Dhananjay G. Dange[2], Shubham. C. Hingnekar[3], Raunak. V. Kondalwar[4], Nazeefuddin Jamal[5], Mohit. G. Sonwane[6], Mohit. G. Shete[7]

[1] *Assistant Prof. P R. Gajbhiye, Department of Mechanical Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

[2]*Assistant Prof. D. G. Dange, Department of Mechanical Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

[3]*Shubham. C. Hingnekar, Department of Mechanical Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

[4]*Raunak. V. Kondalwar , Department of Mechanical Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

[5]*Nazeefuddin Jamal, Department of Mechanical Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

[6]*Mohit. G. Sonwane, Department of Mechanical, Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

[7]*Mohit. G. Shete, Department of Mechanical Engineering, K.D.K. college of engineering, Nagpur, Maharashtra, India*

ABSTRACT

Exercise is inevitable to keep health in good status. In this project we study the treadmill exercise outdoor and their effect on health. Also we enlisted the advantages and disadvantages of treadmill cycle exercise. One of the most popular types of home as well as outdoor exercise equipment is the treadmill cycle, which provides a straightforward, efficient aerobic workout. For many, treadmills are a good choice to begin a new exercise routine because walking is well tolerated by most individuals regardless of fitness level and for most back conditions. As strength and endurance are developed, the treadmill bicycle can be used for jogging or for interval training. The modern challenge faced with the global energy situation is the growing energy demand and the strong dependence on unsustainable fossil fuels. Another concurrent issue is the adverse health and socio-economic implications of adult obesity. 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 this thesis project was to design and develop a human powered treadmill generator and determine its power generation potential. A heavy duty rechargeable battery pack was used to store the generated energy and additional components to measure the generated power were included. The power generating potential of the generator was determined for varying belt speeds and angles of inclination, and compared with the American College of Sports Medicine (ACSM) metabolic walking and running prediction equations to determine efficiency. The generator was able to deliver 140W peak power for a short period of time. Regression equations related the power generated to the belt speed, covering values ranging from an average 10.8±0.36W at 1.83±0.045m/s to 90.3±3.04W at 2.38±0.054m/s. The angle of inclination did not have a significant impact on energy generation. The max average efficiency obtained for the

system in this study was 37.9±2.63%, assuming 25% gait efficiency. Possible applications for this concept include energy saving equipment in a gym, low-cost, simple to operate, and low maintenance solutions for developing nations, and as a tool to educate energy conservation. Also, the need for exercise in space with low gravity makes the treadmill generator a possible source for secondary power in future extraterrestrial environments.

Keyword: - *Exercise, Treadmill, Battery, Belt, Gait efficiency, Treadmill cycle and Generator.*

1. INTRODUCTION

This project work modifying a treadmill to better fit the needs of users. Treadmill bike is design for those persons who love to run outside. Treadmill fitted on bicycle frame and constructs a big innovation named 'TREADMILL CYCLE'. This bicycle has electronic part and runs entirely on human momentum. As the rider walks on the treadmill, the belt butts up against the rear wheel propelling the bike forward.

A treadmill is a device generally for walking or running while staying in the same place. Treadmills 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 treadwheel to grind grain. In later times, treadmills were used as punishment devices for people sentenced to hard labor in prisons. The terms *treadmill* and *treadwheel* were used interchangeably for the power and punishment mechanisms.

More recently, treadmills are not used to harness power, but as exercise machines for running or walking in one place. Rather than the user powering the mill, the machine provides a moving platform with a wide conveyor belt driven by an electric motor or a flywheel. The belt moves to the rear, 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 (usually by an electric motor). The simpler, lighter, and less expensive versions passively resist the motion, moving only when walkers push the belt with their feet. The latter are known as manual treadmills.

Components Used:

1. Rectangular pipe 1”/2”
2. Small round pipe for roller 5 pcs
3. Big round pipe for roller 2 pcs
4. Bearings for pipe 14 pcs
5. Pedestal bearing 4 pcs
6. Shafts for small roller 5 pcs
7. Shaft for big roller 2 pcs
8. Back tyre
9. Front tyre with cycle
10. Wheels
11. Fly wheel 1 pc
12. Shaft for fly wheel 1 pcs
13. Clamping accessories

14. Battery

15. Walking belt

2. DESIGN AND CALCULATIONS

Fig -1: Creo model of Treadmill base

CALCULATION FOR CHAIN DRIVE:

Parameters taken from standard specification of sprocket:

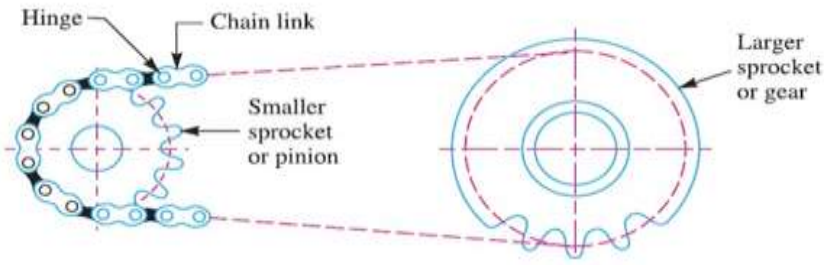
No. of teeth on the sprocket = **18**

Speed of sprocket = **24.8 RPM**

Outside diameter of the sprocket $\mathbf{D_o = 76\ mm}$

Pitch circle diameter of the sprocket $\mathbf{D_p = 70\ mm}$

Centre to centre distance = **540mm**



Considering Pitch length AB of the chain subtending at an angle at the centre of the sprocket

= 360 / 18

= 20

Pitch of the chain

p = 72 sin (180/18)

p = 12.5 mm

Diameter of the chain roller d_1

$D_O = D_P + 0.8d_1$

d_1 = 7.5 mm

Tooth flank radius r_e

r_e = 0.008 d_1 (T^2 + 180)

r_e = 30.24 mm

Roll seating radius r_i

r_i = 0.505 d_1 + 0.069

r_i = 3.92 mm

Roll seating angle α

Maximum roll seating angle = $140^0 - 90^0 / T$

= 2.77^0

Minimum roll seating angle = $120^0 - 90^0 / T$

= **1.66^0**

Tooth Height of the above pitch polygon (h_a)

$h_a = 0.5 (p - d_1)$

h_a = 2.5 mm

Root diameter (D_f)

$D_f = D - 2r_1$

D_f = 64.16 mm

Velocity ratio of the chain drives

Here two sprockets are same diameters and same no of teeth

Speed of the sprocket 1 is same as speed of the sprocket 2

So, Speed of the chain driven $\mathbf{N_2 = 24.8\ RPM}$

Average velocity of the chain

$$V = \pi D N / 60$$

V = 93.44 mm /sec

V = 0.0933 m/s

Length of the chain:

Let us assume

Centre distance between the chain sprocket and chain Driven X = 762 mm

The length of the chain must be equal to product of the number of chain links and pitch of the chain

$$L = k \times p$$

Number of chain links

$$K = (T_1 + T_2)/2 + (2X/p) + ((T_2 - T_1)/2\pi)^2 (p/x)$$

K = 139.92

Length of the chain L = k x p

L = 1749.5 mm

L = 1.75 m

3. WORKING

The human effort is a basic fundamental being the driving source of the cycle. When the person or driver will walk over the treadmill belt he/she will rotate the gear attached to the rear end roller hub of the belt support. The belt will rotate the gear and then the gear will turn the rear wheel with a chain drive and sprocket involved to maintain speed ratio.

The D.C motor is for the support in walking as some people won't be able to manually drive the weight of the frame. In this way the motor will assist he walking of treadmill and the rear wheel will be driven.

The treadmill driven cycle is constructed by the above mentioned components over the base frame. There are five rollers fitted next to next by certain distance and the belt is connected over the rollers which cover the rollers. The spur gear arrangement is connected to the rear roller for achieving forward motion of the vehicle. Then the chain drive is connected between spur gear shaft and rear wheel. When we walk over the belt, the roller will be rotated and it will rotate the spur gear shaft. Then the power will be transmitted to the wheel shaft through chain drive. Then the hub motor is fitted to the front wheel as an alternate drive for automatic running of vehicle. The

power from the battery is used for hub motor operation which will completely reduce human effort. This vehicle can be helpful for many people for easy transportation in future.

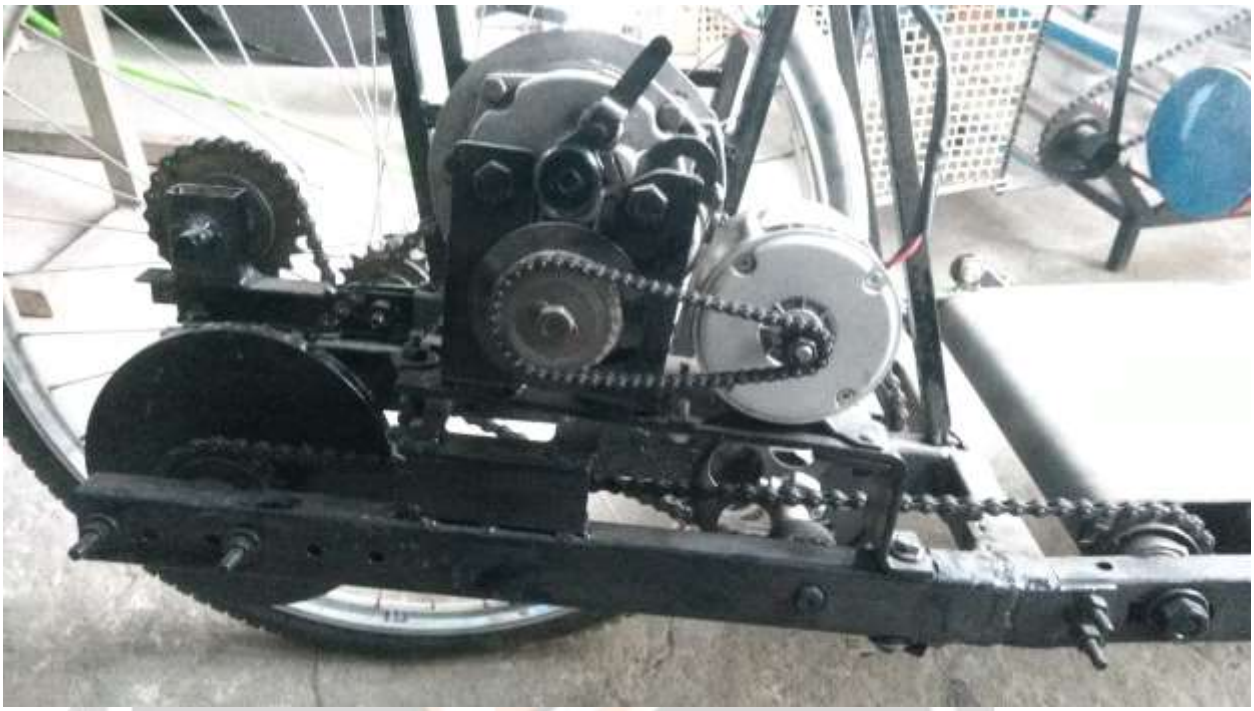


Fig: Driving mechanism of Treadmill cycle

4. ADVANTAGES

1. Outdoor walking
2. Treadmill runner
3. The treadmill bicycle is a relatively easy piece of exercise equipment to use.
4. The treadmill bicycle has a predictable surface that is much easier to negotiate than sidewalks, curbs or trails and the risk of tripping is reduced.
5. Multiple users can use the same equipment without adjusting the structure.
6. Running on a treadmill generally burns calories faster than most other forms of exercise.

5. FUTURE SCOPE

1. It can be used as an indoor locomotive device infrastructure with large roof span i.e. malls, warehouse, open markets, large office spaces, etc.
2. By using such product pedestrian cops can save themselves from getting exhausted.
3. Pedestrians in large campuses can benefits from this product the same way.
4. Can replace cycle as an energy efficient vehicle for those who cannot drive a cycle.

6. CONCLUSION

In conclusion, a 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 time. Regression equations were obtained to relate the

power generated to the belt speed, covering values ranging from an average 10.8±0.36W at 1.83±0.045m/s to 90.3±3.04W at 2.38±0.054m/s. The variation of angle of inclination was not determined to have a significant impact on energy generation. These results were compared to energy expenditure values predicted by the American College of Sports Medicine (ACSM) metabolic relations at various speeds and angles of inclinations. The maximum average system efficiency obtained through this study for the system was 37.9±2.63 % by finding the ratio between the obtained and predicted power output, and assuming a 25% gait efficiency. Furthermore, analyses were done on the possible applications for the treadmill generation concept. 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. However, the need for exercise to inhibit bone and muscle atrophy in low gravity makes the treadmill generator a possible concept for future extraterrestrial environments as a secondary source of power. In this day where the world is challenged to be more responsible in its sourcing of electrical power, the method of human power generation could be a solution that also helps mitigate the issue of obesity and overweight. If additional design and study of this concept proves it effective in energy use reduction, localized energy delivery and sustainability education, it could efficiently answer the two great challenges.

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