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ENERGY HARVESTING BY FATS REDUCING CARDIO STEPS.

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ABSTRACT Energy issues are seen throughout the world. Mankind uses both renewable and non-renewable sources of energy to overcome energy crisis. Non-renewable energy sources such as petroleum, coal are used widely along with renewable energy sources such as solar, wind, tidal energies. Apart from these traditional ways we can even generate energy through our everyday chores. We spend a lot of energy everyday which often goes futile. Henceforth the rational method of utilization of waste energy of human foot power through specially designed footstep is propounded in this paper. A special mechanical arrangement using rack and pinion is employed on a footstep. This arrangement converts the power applied by the foot on the steps into a rotational motion which will be used to generate electricity efficiently. It is an ecofriendly, non-conventional power generation system when compared to extant systems in use. Walking or going through these footsteps will help us to generate and harvest the energy simultaneously.

KEYWORDS : energy, rational, rack, pinion, footstep, ecofriendly

INTRODUCTION

Energy harvesting is an operation in which energy is deduced from various extrinsic sources, i.e. captured and stored for tiny, wireless autonomous devices, such as wearable electronics and wireless sensor networks. We harvest solar power, thermal energy, wind energy. Mankind have been using energy at an increasing rate for his sustenance and wellbeing ever since he came on the earth. With further demand of energy man began to use the wind for sailing ships and for driving windmills, the force of falling water to turn water wheels. Semiconductor era led to energy harvesting through solar energy. Energy harvesting devices proselytize ambient energy into electrical energy. Such energy generated is stored in a capacitor or a battery.

Physical exercise is any bodily activity that enriches or conserves the physical fitness and generic health of an individual. Aerobic exercise is a type of exercise which causes one's body to use more oxygen than it would while resting. It increases cardiovascular endurance. Examples of aerobic exercises are cycling, walking, jumping, skipping, etc. On an average an adult of good fitness or health can produce power between 50 – 150 watts for an hour of vigorous exercise.

In our everyday life we often do the things which can act as source for power generation such as walking. This utilization of waste energy of foot power with human locomotion is relevant and important. The propounded system involves simple setup that is installed under the footstep. When people walk on this footstep their body weight compresses the helical spring which rotates the dynamo and voltage produced can be stored in a dry battery. Larger movement of a person on a footstep will generate more energy. This whole human energy being wasted can be made possible for utilization by using energy harvesting by fat reducing cardio steps It will be the prominent energy source in future.

PROPOUNDED METHODOLOGY

The primitive mechanism used is rack and pinion mechanism with pinion attached to the shaft of the dynamo. Stepping and pushing on the footstep on application of human load produces linear motion of rack, which is converted into rotational motion by pinion arrangement and rotates the shaft of the dynamo. Thus the mechanical energy (human weight or load) is converted into electrical energy.

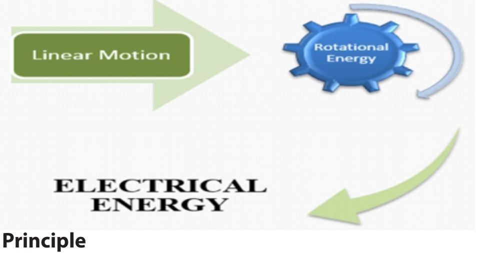


Fig 1. Principle

When an individual stands on the footstep, the slider of the footstep goes down on application of individuals weight (human load/force/pressure). As a result spring of known constant gets compressed to finite length. Simultaneously rack moves downward along with spring compression and attached pinion i.e. small gear completes finite rotations accordingly. The shaft of DC generator i.e. dynamo rotates correspondingly with pinion. When an individual leaves the footstep the slider comes upward by returning to its initial position. As a result spring expands and returns to its initial or normal position. This motion moves rack upwards and downwards and pinion rotates in clockwise and counterclockwise sense respectively. This in turn rotates shaft of the dynamo. Thus we get output in terms of few Volts. This respective generated voltage can be given to charging circuit.[1]

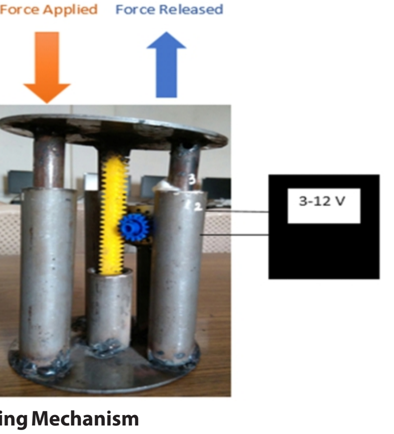


Fig 2. Working Mechanism

DESIGN AND MECHCHANISM

1.SPRING

A push force is required for compression of the spring, hence we have designed a helical compression spring. Following are the design and main parameters of any spring.

1. d = wire diameter of the spring (mm).
2. ID = inner diameter of the spring (mm).
3. OD = outer diameter of the spring (mm).
4. D = mean coil diameter (mm).
5. C = spring index (Ratio of mean coil diameter to the wire diameter)
6. N_t = Total no. of coils.
7. p= pitch of the coil.
8. L_t = Total length/ Free length.
9. L_c = Compressed length.
10. L_s = Solid length. [3]

Through thorough analysis and designs following specifications are considered.

Let the valued parameters be- d = 1.8 mm, ID = 25 mm, OD = 27 mm,

N_t = 8, L_t = 67 mm,

D = ID + OD/2
= 25 +27/2 = 26 mm.

C = D/d
= 26/1.8 = 14.44 mm.

L_s = N_t * d
= 8 * 1.8 = 14.4 mm

L_c = (N_t – 1)* Gap between adjacent coils.
= 7* 4.25
= 30 mm.

p = (L_t/ N_t) – 1
= 67/ 7
= 9.5 mm.

ð = L_t – L_c
= 37 mm

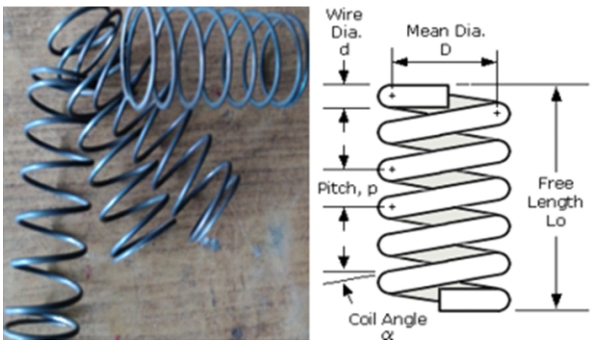


Fig 3. Designed spring

2. RACK AND PINION :

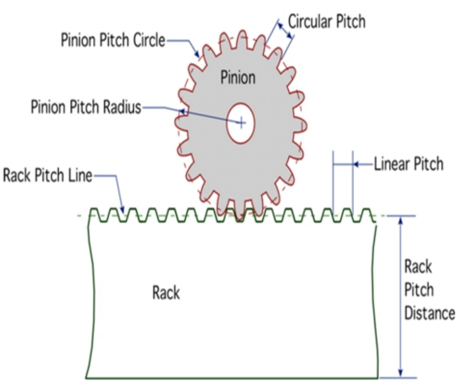


Fig 4. Rack and Pinion Mechansim

Now,

Z_p = No. of teeth of pinion.

Z_r = No. of teeth of rack.

i = Gear Ratio.

We have,

Z_p = 15, Z_r = 25,

i = No. of teeth of driven gear / No. of teeth of driving gear
= Z_p / Z_r
= 3/5 = 0.6

Hence, 5 rotations of pinion is equal to 3 times linear motion of the rack.

POWER CALCULATIONS:

As we know,

Force = mass * acceleration (N)

Work = force * displacement (J)

1 Joule = 0.2389 calories

Power = Work/time (W)

CALCULATIONS

Given

m = 5 kg, d = 30 mm, t = 30 sec

Now,

F = 5 * 9.81 = 49.05 N

W = f * s = 49.05 * 0.03 = 1.4715 J

P = W/t = 1.4715/30 = 49.05 mW

Power developed for 1 hour = 49.05 * 60
= 2.943 W

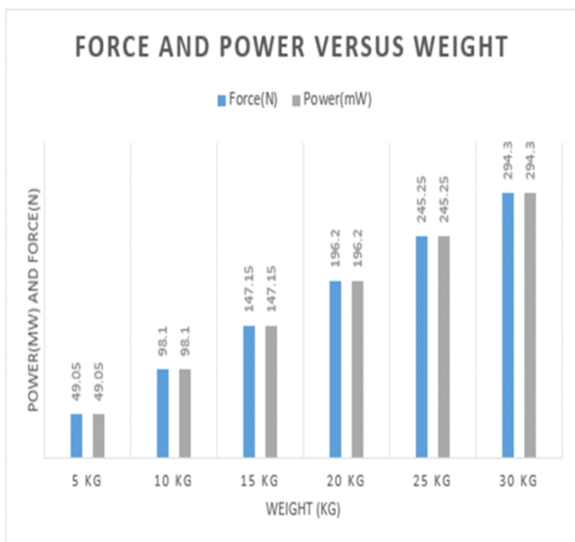
Power developed for 1 day = 2.943 * 24
= 70.632 W

If effective steps are 5,

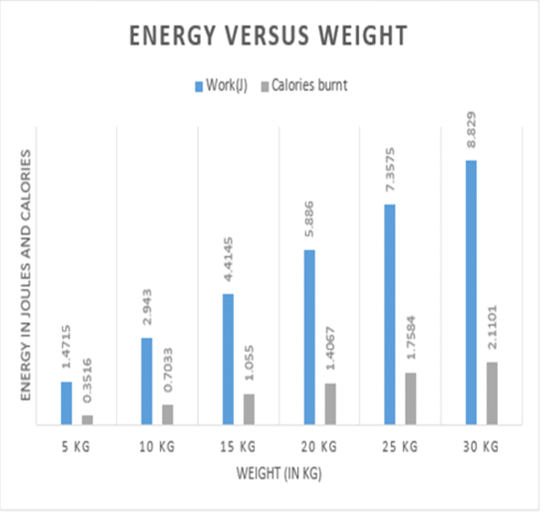
Total Power = 70.632 * 5
= 0.353 kW

Table 1. Calculated power for 30 sec

Sr. No.	Weight (Kg)	Force (N)	Work (J)	Power (mW)	Calories burnt
1.	5	49.05	1.4715	49.05	0.3516
2.	10	98.1	2.9430	98.10	0.7033
3.	15	147.15	4.4145	147.15	1.0550
4.	20	196.2	5.8860	196.2	1.4067
5.	25	245.25	7.3575	245.2	1.7584
6.	30	294.3	8.8290	294.3	2.1101



Graph 1. Force and Power versus weight



Graph 2. Energy versus weight

EXPERIMENTAL RESULTS

Fig 4. Practical realization of the setup

In this propounded methodology, a hobby DC motor and a red LED was used to test the output. We get an AC output. This was verified through the clockwise and anticlockwise motion of the fan and blinking of a LED.

CONCLUSIONS

1. Unutilized human energy can be harvested and converted into various forms of energy.
2. Rack and Pinion arrangement converts the linear motion into rotational motion.
3. This mechanical arrangement (mechanism) contributes to the fitness of an individual.
4. It is renewable source of energy.
5. Output is AC (Alternate Current).
6. Graphical representation of the data strictly implies overall good efficiency of the system.

ADVANTAGES

1. This setup is easy to construct.
2. Easy energy harvesting
3. It is a protean setup which can be used and installed everywhere.

LIABILITY

1. Being a mechanical system, there is wear and tear of the parts being used.
2. Frictional loss.
3. Variable output.

APPLICATIONS

1. In gyms, dancing floors, zumba.
2. In college, school, universities.
3. Footpaths, shopping malls, airports.

Thus, it has wide applications in all pedestrian places and areas.

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